Victorian Gas Program

Risks, Benefits and Impacts Assessment

Final Report

26 March 2020

DJPR NOTE: This report was reissued on 26 March 2020 with errors corrected - percentage change in Gross State Product, Gross Regional Product and Gross Regional Income.
This report supersedes the 2 March 2020 report.

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Ernst & Young was engaged on the instructions of the Department of Jobs, Precincts and Regions ("the department" or "Client") to provide a comprehensive assessment and Report on the risks, benefits and impacts of any potential new onshore conventional gas exploration and development in Victoria. This work has been undertaken in accordance with our contract with you dated 12 November 2019.

The results of Ernst & Young's work, including the assumptions and qualifications made in preparing the Report, are set out in this Report dated 26 March 2020 ("Report"). The Report should be read in its entirety including this notice, the applicable scope of the work and any limitations. A reference to the Report includes any part of the Report. No further work has been undertaken by Ernst & Young since the date of the Report to update it.

Our work commenced on 12 November 2019 and was completed on 2 March 2020. Therefore, our Report does not take account of events or circumstances arising after 2 March 2020 and we have no responsibility to update the Report for such events or circumstances.

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Our conclusions are based, in part, on the assumptions stated and on information provided by the Department of Jobs, Precincts and Regions (the department) and other information sources used during the course of the engagement. The modelled outcomes are contingent on the collection of assumptions as agreed with the department and no consideration of other market events, announcements or other changing circumstances are reflected in this Report. Neither Ernst & Young nor any member or employee thereof undertakes responsibility in any way whatsoever to any person in respect of errors in this Report arising from incorrect information provided by the department or other information sources used.

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Acronyms

Acronym	Definition
2P	Proven and probable reserves
ACCC	Australian Consumer and Competition Commission
ADGSM	Australian Domestic Gas Security Mechanism
AEMO	Australian Energy Market Operator
ALARP	As low as reasonably practicable
APG0041	Australian Pipelines and Gas Association Ltd
APPEA	Australian Petroleum Production Exploration Association
ASIC	Australian Securities and Investments Commission
Bcf	Billion cubic feet
BPEM	Best Practice Environmental Management
CES	Constant elasticity of substitution
CHMP	Cultural heritage management plan
CRESH	Constant Ratios of Elasticities Substitution, Homothetic
CRG	Community Reference Group
CSG	Coal seam gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DJPR	Department of Jobs, Precincts and Regions
DTS	Declared Transmission System
EBA	Enterprise Bargaining Agreement
EES	Environmental Effects Statement
EMP	Environment Management Plan
EPA	Environment Protection Authority Victoria
EP Act	Environmental Protection Act
EPBC	Environmental Protection and Biodiversity Conservation
EPIK	Energy Projects and Infrastructure Korea
ERP	Emergency Response Plan
ERR	Earth Resources Regulation
EY	Ernst & Young
EYGR	EY's in-house Computable General Equilibrium Model
FFG	Flora and Fauna Guarantee
FTE	Full time equivalent

Acronym	Definition
GISERA	Gas Industry Social & Environmental Research Alliance
GPG	Gas-powered generation
GHG	Greenhouse gas emissions
GJ	Gigajoule
GRI	Gross Regional Income
GRP	Gross Regional Product
GTAP	Global Trade Analysis Project
GSP	Gross State Product
GSV	Geological Survey of Victoria
IAGC	International Association of Geophysical Contractors
IEA	International Energy Agency
ILUA	Indigenous Land Use Agreement
IOGP	International Association of Oil & Gas Producers
IAP2	International Association for Public Participation
ISO	International Organisation for Standardisation
LGA	Local Government Area
LNG	Liquefied natural gas
ML	Megalitres
MLUF	Multiple Land Use Framework
MWh	Megawatt hour
NGA	National Greenhouse Account
NGER	National Greenhouse and Energy Reporting
NEM	National Electricity Market
OPGGS	Offshore Petroleum and Greenhouse Gas Storage Act 1998
PJ	Petajoule
PEP	Petroleum exploration permit
POE	Probability of exceedance
PRMS	Petroleum Resource Management System
RBI	Risks, benefits and impacts
RoW	Right of Ways
RP	Recommended Practices
tCO2e	Tonnes of carbon dioxide equivalent
TJ	Terajoule

Acronym	Definition
UGS	Underground gas storage
UNEP	United Nations Environment Programme
VEEC	Victorian Energy Efficiency Certificate
VGP	Victorian Gas Program
WRA	Water Resource Aquifer
WTS	Western Transmission System

Glossary

Term	Definition
1-in-2	The 1-in-2 maximum demand projection has a 50% probability of exceedance. This projected level of demand is expected, on average, to be exceeded once in two years.
1-in-20	The 1-in-20 maximum demand projection has a 5% probability of exceedance. This is expected, on average, to be exceeded once every 20 years.
Basin	A geological depression filled with sediments.
Coal seam gas	Gas found in coal seams that cannot be economically produced using conventional oil and gas industry techniques
Contingent resources	Gas resources that are known but currently considered uncommercial based on one or more uncertainties (contingencies) such as commercial viability, quantities of gas, technical issues, or environmental approvals.
Conventional resources	Petroleum resources within discrete accumulations that are recoverable through wells (boreholes) under normal hydrostatic pressures and does not require dewatering or hydraulic fracturing to extract.
Declared Transmission System	The Victorian gas Declared Transmission System (DTS) refers to the principal gas transmission pipeline system identified under the National Gas (Victoria) Act, including augmentations to that system.
Development	Phase in which a proven oil or gas field is brought into production by drilling and completing production wells.
Discovery	The first well (borehole) in a new field from which any measurable amount of oil or gas has been recovered. A well that makes a discovery is classified as a new field discovery (NFD)
East Coast gas market	The interconnected gas market covering Queensland, South Australia, New South Wales, the Australian Capital Territory, Victoria and Tasmania.
Exploration	Phase in which a company or organisation searches for petroleum or mineral resources by carrying out detailed geological and geophysical surveys, followed up where appropriate by drilling and other evaluation of the most prospective sites.
Fault	A break or planar surface in a brittle rock across which there is an observable displacement
Field	An area consisting of a single reservoir or multiple reservoirs grouped on, or related to, the same individual geological structural feature and/or stratigraphic condition.
Gas-powered generation	The generation of electricity using gas as a fuel for turbines, boilers or engines.
Gigajoule	A billion joules
Hydraulic fracturing	Hydraulic fracturing (fraccing or fracking), is a method of increasing the extraction of oil and gas from reservoirs, and more recently coal seam gas, by injecting fluid under high pressure to fracture wells or coal seams.
Hydrocarbons	Organic compounds consisting entirely of hydrogen and carbon. Hydrocarbons are the principal components of oil and natural gas.
Joule	A unit of energy in the International System of Units.
Liquefied natural gas	Natural gas that has been converted to liquid form for ease of storage or transport.
LNG netback price	A pricing concept based on an effective price to the producer or seller at a specific location or defined point, calculated by taking the delivered price paid for gas and subtracting or 'netting back' costs incurred between the specific location and the delivery point of the gas.
National Electricity Market	The wholesale market for electricity supply in Queensland, New South Wales, the Australian Capital Territory, Victoria, Tasmania, and South Australia.

Term	Definition
Permeability	The degree to which gas or fluids can move through a rock
Petajoule	A quadrillion joules
Petroleum	Liquid, gaseous and solid hydrocarbons; includes oil, natural gas, gas condensate, ethane, propane, butane and pentane.
Play	An area in which hydrocarbon accumulations or prospects of a given type occur.
Porosity	The amount of pore space in between the grains in a rock that are available for air, water, other fluids or gas to be stored.
Production	The phase of bringing well fluids to the surface and separating them, and storing, gauging and otherwise preparing the product for transportation.
Probability of exceedance	The probability that a forecast maximum demand figure will be exceeded. For example, a forecast 5% probability of exceedance maximum demand will, on average, be exceeded only one year in every 20, and is equivalent to 1-in-20 terminology.
Prospective resources	Estimated quantities associated with undiscovered gas. These represent quantities of gas which are estimated, as of a given date, to be potentially recoverable from gas deposits identified on the basis of indirect evidence but which have not yet been drilled.
Prospectivity	An assessment, whether qualitative or quantitative, of the potential for prospective resources.
Proven reserves	Quantities of petroleum that can be estimated with reasonable certainty (at least 90 per cent) to be commercially recoverable. Also known as 1P or P90 reserves.
Proven and probable reserves	Proven reserves plus reserves that are deemed probable (at least 50 per cent likely) to be commercially recoverable. Also known as 2P or P50 reserves.
Reserves	Reserves are quantities of gas which are anticipated to be commercially recovered from known accumulations.
Reservoir	A rock or geological formation that may hold petroleum within the pore spaces in the rock.
Seal	An impermeable rock that forms a barrier or cap above reservoir rocks such that fluids cannot migrate beyond the reservoir
Shows	A surface observation of hydrocarbons, usually observed as florescent liquid on cuttings when viewed with an ultraviolet or black light (oil show) or increased gas readings from the mud logger's gas-detection equipment (gas show).
Source rock	A rock rich in organic matter, which, if heated sufficiently and placed under sufficient pressure, will generate oil or gas.
Terajoule	A trillion joules.
Trap	Any barrier to the upward movement of oil or gas, allowing either or both to accumulate.
Unconventional resources	Resources within petroleum accumulations that are pervasive throughout a large area and that are not significantly affected by hydrodynamic influences. Typically, such accumulations require specialised extraction technology. Examples include coal seam gas (CSG), tight gas, shale gas, gas hydrates, natural bitumen and shale oil.

Source: ACCC, 2019, Gas inquiry 2017-2020 Interim Report; AEMO, 2019, Gas Statement of Opportunities; AEMO, 2019, Victorian Gas Planning Report; APPEA, 2019, Australian oil and gas glossary. https://www.appea.com.au/industry-in-depth/australian-oil-and-gas-glossary/, accessed 2 February 2020; Geoscience Australia, 2019; Australian Energy Resources Assessment, Appendices -glossary. https://aera.ga.gov.au/#!/glossary, Accessed 2 February 2020; Schlumberger, 2019, Oilfield Glossary. https://www.glossary.oilfield.slb.com, accessed 2 February 2020; SPE international, 2019, Petrowiki. petrowiki.org/PetroWiki Accessed 2 February 2020.

Executive Summary

Background

The Victorian Gas Program is a comprehensive science-led program established in 2017 to assess the potential for further discoveries of onshore conventional gas in Victoria and to assess the risks, benefits and impacts of the industry.[1]

Ernst & Young (EY) was engaged by the Department of Jobs, Precincts and Regions (the department) to provide an assessment and Report on the risks, benefits and impacts of potential new onshore conventional gas exploration and development scenarios in Victoria. This Report does not consider any unconventional gas or fracking activities as they are banned in Victoria. The analysis considers the likely resource impacts of the scenarios and, while cognisant of the Victorian Government's commitment to achieving net-zero emissions, is not constrained by this requirement.

The scope of the Report covers the following petroleum activities:

- **Exploration** – Includes seismic surveys, geotechnical surveys and exploration/appraisal drilling
- **Development** – Includes wellhead installation, pipeline construction and gas plant expansion/construction
- **Operations** – Includes production from the well via a pipeline and gas plant, and trucking of condensate to refineries (which may also be required)
- **Rehabilitation (or transitional rehabilitation)** – Includes returning some of the land to its former use (e.g. reducing a drilling lease to an operating well lease)
- **Complete rehabilitation** – Includes removing infrastructure and returning the land to its former use.[2]

The Victorian Gas Program's geoscientific, technical and environmental studies are providing an evidence-based estimate of prospective gas resources at a regional level. The studies are also looking closely at the risks, benefits and impacts associated with onshore conventional gas exploration and development. The studies focus on Victoria's two most prospective regions for gas: the Otway Basin and the Gippsland Basin. The Victorian Gas Program's work is informing government decisions during the onshore conventional gas moratorium, which is currently in place until 30 June 2020.[3]

This Report represents the culmination of the Victorian Gas Program's reviews and studies, which have been supplemented by EY economic and greenhouse gas analysis and publicly available information.

Scenarios

Hypothetical scenarios were constructed (in consultation with and approval provided by the department) to assess the potential impact of gas exploration and development in Western Victoria (the Otway Basin), and in South-Eastern Victoria (the Gippsland Basin).[4]

For each basin, low, medium and high hypothetical levels of gas exploration and development were considered with the inclusion of a minimum scenario for the Otway Basin. The hypothetical scenarios are based on a prospectivity assessment and resource estimate conducted by the Victorian Gas Program. For the Otway Basin hypothetical scenarios (minimum, low, medium, high),

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[1] VGP Progress Report No. 1, January 2018, p. 6
[2] Petroleum Act 1998. s170(2)
[3] VGP Progress Report No. 3, October 2019, p. 3
[4] Scenario data provided by the department.

the number of exploration wells drilled, resultant discoveries and resource size increases through the scenarios (Table 1). For the Gippsland Basin, the resource size increases from low, medium to high (Table 2). The Otway Basin has an additional 'minimum scenario' scenario that reflects the quantity of gas that was discovered and produced in the Port Campbell area in the past. A 'minimum scenario' scenario has not been prepared for the Gippsland Basin because there has never been any commercial onshore gas production and the level of knowledge of resources is much less.

These hypothetical exploration and development volumes form the foundation of the economic and greenhouse gas emissions modelling performed in this report, and guide the assessment of the risks, benefits and impacts of onshore conventional gas exploration and development in Victoria.

Table 1: Otway Basin summary of hypothetical gas exploration and development scenarios

#	Scenario	Description
1	Otway Basin (Minimum scenario)	► Total estimated discovered resources of 81 Bcf (90 PJ) ► Discoveries in the following reservoir rock units: upper Waarre Formation, Pretty Hill Formation and the Sawpit Sandstone ► Exploration and development in the Eastern Region (Port Campbell Embayment) and Western Region (Penola Trough) ► Eighteen (18) exploration wells resulting in six discoveries; 14 development wells are required, inclusive of the six discovery wells ► Gas discovered in the Port Campbell Embayment is processed using existing facilities and gas discovered in the Penola Trough requires one new processing plant (either full-scale or modular).[5]
2	Otway Basin (Low)	► Total estimated discovered resources of 294 Bcf (317 PJ) ► Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ► Exploration and development in the Eastern Region (Port Campbell Embayment), Western Region (Penola Trough) and Central Region ► Fifty-four (54) exploration wells resulting in 18 discoveries; 52 development wells are required, inclusive of the 18 discovery wells ► Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant.
3	Otway Basin (Medium)	► Total estimated discovered resources of 434 Bcf (470 PJ) ► Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ► Exploration and development in the Eastern Region (Port Campbell Embayment), Western Region (Penola Trough) and Central Region ► Eighty-one (81) exploration wells resulting in 27 discoveries; 81 development wells are required, inclusive of the 27 discovery wells ► Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant.
4	Otway Basin (High)	► Total estimated discovered resources of 660 Bcf (715 PJ) ► Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ► Exploration and development across the Victorian Otway Basin from the Eastern Region (Port Campbell Embayment) to the Western Region (Penola Trough) including the Central Region ► One hundred and thirty-eight (138) exploration wells resulting in 46 discoveries; 125 development wells are required, inclusive of the 46 discovery wells ► Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant, with potential for an additional modular plant.

[5] For modelling purposes, it is assumed that a modular plant will be constructed as it is likely that operators will already have established infrastructure in the region.

Table 2: Gippsland Basin summary of hypothetical gas exploration and development scenarios

#	Scenario	Description
1	Gippsland Basin (Low)	► Total estimated discovered resources of 35 Bcf (38 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy (70) exploration wells resulting in seven discoveries ► Nine development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.[6]
2	Gippsland Basin (Medium)	► Total estimated discovered resources of 70 Bcf (77 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy (70) exploration wells resulting in seven discoveries ► Eighteen (18) development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.
3	Gippsland Basin (High)	► Total estimated discovered resources of 105 Bcf (115 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy (70) exploration wells resulting in seven discoveries ► Twenty-seven (27) development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.

[6] Advice provided by the department

Approach

The key steps in developing this Report are summarised in Figure 1.

Figure 1: Summary approach

1 **Complete literature review**

A review of the Victorian Gas Program studies (geoscience and environmental studies, community and stakeholder engagement, and resource and land use planning), and publicly available literature was completed.

2 **Develop scenarios and risks, benefits and impacts assessment framework**

Seven hypothetical conventional gas exploration and development scenarios were developed by the department (four in the Otway Basin and three in the Gippsland Basin). In addition, the risks, benefits and impacts assessment framework, including the economic, social and environmental receptors was clearly defined.

3 **Conduct economic and emissions modelling**

Economic impact analysis was conducted (via Computable General Equilibrium modelling) to measure the net impact of changes on an economy from the hypothetical scenarios. Similarly, emission modelling was conducted to measure the absolute GHG emissions and greenhouse gas emissions intensity from the hypothetical scenarios.

4 **Complete risks, benefits and impacts assessment**

The risks, benefits and impacts were identified for each economic, social and environmental receptor from the hypothetical scenarios by applying the risks, benefits and impacts assessment framework and drawing upon the Victorian Gas Program scientific study outputs, the literature review, and economic and environmental modelling.

5 **Reporting**

A Report was designed and drafted to provide an assessment of the risks, benefits and impacts of potential new onshore conventional gas exploration and development in Victoria.

Throughout each stage of the assessment, engagement and feedback was sought from the department, Victoria's Lead Scientist and the Victorian Gas Program's independent Stakeholder Advisory Panel for Onshore Conventional Gas (Stakeholder Advisory Panel). To ensure the Report's technical rigour, the assessment was also supported by peer review by:

- the Geological Survey of Victoria
- the Victorian Gas Program's Scientific Reference Group (which includes members with experience and expertise in geoscience, environmental studies and the gas industry)
- Aventus Consulting who provided expertise in health, safety, security and environmental impacts.

Assessment framework

A multi-faceted assessment framework was used to evaluate the risks, benefits and impacts of seven hypothetical gas exploration and development scenarios (four in the Otway Basin and three in the Gippsland Basin).

Social, environmental and economic receptors were identified by the department in consultation with the Stakeholder Advisory Panel, the Scientific Reference Group, and other government agencies such as the Department of Environment, Land, Water and Planning and the Department of Premier and Cabinet. A workshop was conducted on 19 November 2019 with the department, Victoria's Lead Scientist and the Stakeholder Advisory Panel to confirm the 17 social, environmental and economic receptors for use in the assessment (see Table 6).

For each hypothetical scenario and its time horizon (short, medium or long term), the assessment considered the potential risks, benefits, and impacts associated with each of the social, environmental and economic receptors.

The assessment framework consists of:

- **Benefits and impacts assessment:** Analyses the positive or negative effect that a hypothetical gas exploration and development scenario could have on the receptor, assuming the industry complies with the current legislative framework. The overall assessment of the impact is calculated by the net effect of the hypothetical gas exploration and development scenario on the receptor.
- **Risks assessment**: Considers the likelihood and consequence that the receptor will be exposed to harm because of a hypothetical gas exploration and development scenario, assuming the industry complies with the current legislative framework (based on the ISO 31000:2009 Risk Management – Principles and Guidelines).

A scoring model[7] was employed to rank the benefit and impact assessment for each hypothetical scenario on a receptor, and a risk matrix was applied to assess the risk to a receptor. Combining the benefit and impact scoring provides a net-effect summary assessment for each receptor and each scenario.

Table 3: Benefit and impact assessment scoring model

Scoring	Description	Further guidance
	Hypothetical scenario has an extremely positive impact on the receptor	Extent of benefit: benefit to environment reaches a large geographical area, social benefit impacts large community (e.g. numerous towns) Likely duration of benefit: long term
	Hypothetical scenario has a positive impact on the receptor	Extent of benefit: environmental benefits are moderately localised, social impacts are felt by small communities (e.g. individual town, large section of community) Likely duration of benefit: medium term
	Hypothetical scenario has a slightly positive impact on the receptor	Extent of benefit: environmental benefits are localised, social benefits impact several individuals (e.g. multiple landholders) Likely duration of benefit: short to medium term
–	Hypothetical scenario has no material impact on the receptor	Extent of impact: impact is negligible, environmental impact is highly localised, social impacts are felt at an individual level Likely duration of cost: short term, temporary
×	Hypothetical scenario has a slightly negative impact on the receptor	Extent of impact: environmental impact is localised, social impacts are felt by several individuals (e.g. multiple landholders) Likely duration of cost: short term to medium term
××	Hypothetical scenario has a negative impact on the receptor	Extent of impact: environmental impacts are moderately localised, social impact are felt by small communities (e.g. individual town, large section of community) Likely duration of cost: medium term

[7] Developed in consultation with and approval provided by the department.

Scoring	Description	Further guidance
×××	Hypothetical scenario has an extremely negative impact on the receptor	Extent of impact: impact on environment reach a large geographical area, social impact felt by large communities (e.g. numerous towns) Likely duration of cost: long term

The risk assessment considered the consequence, cause of the risk, likelihood, control measures and residual impact of the risk on the receptors. A description of the consequences and likelihood is available in Chapter 3.

The risk matrix shown in Table 4, is used to determine an overall risk rating to be applied to potential benefits/impacts and is based on multiplying the consequence and likelihood of a risk. Table 5 defines the categorisations of risk rankings based on the scores in the risk matrix (Table 4: Risk matrix.

Table 4: Risk matrix[8]

		Likelihood				
						1. Highly unlikely
Consequence	5.Severe	25	20	15	10	5
	4. Serious	20	16	12	8	4
	3. Moderate	15	12	9	6	3
	2. Minor	10	8	6	4	2
	1. Negligible	5	4	3	2	1

Table 5: Risk ranking

Risk ranking	Score
Severe	20-25
High	10-19
Moderate	5-9
Low	1-4

Victorian Gas Program studies and quantitative and qualitative public information was used, along with economic and greenhouse gas emissions modelling to inform this assessment and assess how each hypothetical scenario might potentially impact the 17 receptors (see Table 6).

Table 6: Receptors for risks, benefits and impacts assessment

Focus area	Receptors
Economic receptors	► Employment ► Gross state product ► Gross regional product and gross regional income ► Domestic gas supply ► Gas prices ► Government revenue

[8] Scoring developed in consultation with and approval provided by the department.

Focus area	Receptors
Social receptors	► Community, health, safety and security ► Community wellbeing and social cohesion ► Land access and use issues ► The Aboriginal community and people Schools, ► education and vocational capacity Aboriginal ► and other Victorian cultural heritage Existing ► farm industries, food and biosecurity Labour ► and working conditions
Environmental receptors	► Greenhouse gas emissions ► Groundwater and surface water quality and quantity ► Affected native flora and fauna

Otway RBI assessment summary

Economic impact

The assessment found that all the Otway Basin hypothetical exploration and development scenarios are expected to result in employment growth in the Otway region, increased economic value to the Otway region (and Victoria), and increased government revenue (e.g. royalties and company taxation). Otway Basin exploration and development scenarios are expected to slightly improve gas supply available to Victorian gas users however no material impact is expected on Victorian gas prices regardless of the timeframe or level of development.

The economic impact was assessed using a computable general equilibrium model, which measured the net change to the economy in response to the hypothetical exploration and development scenarios. The economic modelling was informed by gas production and price forecasts published by the Australian Energy Market Operator,[9] historical average development rates and Australian benchmark cost estimates of similar gas developments and asset types.

[9] AEMO (2019). *Victorian Gas Planning Report*. AEMO (2019). *Gas Statement of Opportunities*. and Core Energy (2019) *Wholesale gas price outlook databook.*

Table 7: Otway scenarios: Risk, benefit and impact assessment summary – Economic receptors

Receptor	Score	Finding
Economic receptors[10]		
ER1 Employment	Benefit /impact · Risk Minimum scenario – N/A Low scenario N/A Medium scenario N/A High scenario N/A	The assessment found all scenarios are projected to result in employment growth primarily in the Otway region. This ranged from average annual additional 57 full-time equivalents under the minimum scenario (or total of 569 full-time equivalents – 387 direct and 182 indirect) over the lifetime of production to an average annual additional 204 full-time equivalents under the high scenario (or total of 5506[11] full-time equivalents – 3816 direct and 1689 indirect) over the lifetime of production. The analysis suggests that there will be some redistribution of labour as a result of the project, with employment being drawn from the rest of Victoria in order to satisfy demand. The ratings for each scenario have been assessed based on their relative overall impact on employment across Victoria with high scenario expected to have the largest impact on employment across the state, however, still minor in comparison to total state employment. No further mitigations or risks were identified for this receptor.
ER2 Gross state product	Benefit /impact · Risk Minimum scenario N/A Low scenario N/A Medium scenario N/A High scenario N/A	The assessment found all scenarios are projected to result in a positive impact to Victoria's gross state product, ranging from an average annual additional $76.50 million under the minimum scenario (a total of $764.97 million over the lifetime of production) to an average annual additional $282.10 million under the high scenario (a total of $7,616.63 million over the lifetime of production). The ratings for each scenario have been assessed based on their relative overall impact on gross state product for Victoria. As a share of total gross state product, the minimum scenario equates to 0.02 per cent and the high scenario 0.04 per cent. No further mitigations or risks were identified for this receptor.
ER3 Gross regional product and gross regional income	Benefit /impact · Risk Minimum scenario N/A Low scenario N/A Medium scenario N/A High scenario N/A	The assessment found all scenarios are projected to result in a positive impact to the Otway region's gross regional product, ranging from an average annual additional $65.55 million under the minimum scenario (a total of $655.53 million over the lifetime of production) to an average annual additional $248.54 million under the high scenario (a total of $6,710.66 million over the lifetime of production). As a share of total GRP, the minimum scenario equates to 0.69 per cent and high scenario 1.98 per cent. Similar to the estimated GRP impact, the GRI figures increase from the minimum to high scenarios (additional annual average GRI from $81.06 million to $336.01 million respectively) due to the underlying gas production and investment inputs. The ratings for each scenario have been assessed based on their relative overall impact on gross regional product and GRI for the Otway region. No further mitigations or risks were identified for this receptor.

[10] Assessment of economic receptors are based on the outputs of EY's economic modelling, the figures of which are estimates.

[11] Note direct and indirect jobs may not add due to rounding.

<table>
<tr><th>Receptor</th><th>Score</th><th>Finding</th></tr>
<tr>
<td>ER4 Domestic gas supply</td>
<td>
<table>
<tr><th></th><th>Benefit /impact</th><th>Risk</th></tr>
<tr><td>Minimum scenario</td><td>–</td><td>N/A</td></tr>
<tr><td>Low scenario</td><td></td><td>N/A</td></tr>
<tr><td>Medium scenario</td><td></td><td>N/A</td></tr>
<tr><td>High scenario</td><td></td><td>N/A</td></tr>
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The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect gas supply.

Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas. However, due to falling production forecasts from the offshore Gippsland and Otway basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023. Current forecasts by AEMO suggest that shortfalls are expected from 2024 onwards.

Unless currently uncommitted gas supply projects proceed, Victoria is expected to become a net-importer of gas (e.g. more reliant on gas sources from outside the state in particular from Queensland).

The assessment identified that all four hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production under the high and medium scenarios would be much higher than in the low and minimum scenario.

The assessment found that the low, medium and high scenarios could:
► reduce the tightening gas supply situation in Victoria, with the potential to add up to an estimated 20 PJ of gas supply in 2024 and 33 PJ in 2025 (~9.0 per cent and ~14.8 per cent of forecast Victorian consumption in 2023 respectively)
► increase gas available to industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs and a retailer margin)
► improve the availability of gas supply for gas-powered generation on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of gas powered generation may be necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day)
► improve the amount of gas available for uses such as a transition fuel.

Overall, the assessment found that the level of benefit obtained is limited by the scale and timing of development, which over the lifetime of production is relatively small as a proportion of Victoria’s total gas supply and consumption (and energy supply and consumption).

Therefore, only the low, medium and high scenarios are expected to have a slightly positive impact on Victoria’s energy supply.

The minimum scenario is not expected to have a material impact on Victoria’s supply. This is because annual gas production is a small proportion of total forecast Victorian supply (e.g. 5.8 per cent of Victoria’s forecast consumption, and 5.3 per cent of Victoria’s forecast production in 2025) and is only expected to produce gas for a limited period (e.g. eight years ending in 2032).

The introduction of domestic prioritisation mechanism (e.g. right of first offer) was identified as a further mitigation. Such a mechanism could require gas produced from Otway Basin scenarios to be offered to Victorian gas users first.

No risks were identified to this receptor.
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Receptor	Score	Finding
ER5 Gas prices	Benefit /impact / Risk Minimum scenario: – / N/A Low scenario: – / N/A Medium scenario: – / N/A High scenario: – / N/A	The qualitative assessment considered the extent to which the hypothetical Otway Basin exploration and development scenarios could improve gas and electricity price outcomes for Victorians. In the case of gas prices, the assessment found that the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for gas users. As a result, it was unlikely to reduce the price of gas for Victorians and prices will continue to be set largely by the liquefied natural gas netback price. While the development scenarios are unlikely to influence overall prices, they may help reduce costs for some Victorian industrial users, particularly those located closest to the development. Victorian industrial users may be able to purchase gas directly from producers reducing transportation costs that would be incurred from buying gas from the east-coast gas market. A similar conclusion was reached with respect to wholesale electricity prices. The assessment found that the hypothetical gas development scenarios were unlikely to reduce wholesale gas prices because the level of gas development is not expected to change gas supply or prices, which are primary input cost for gas powered generation and impacts the price at which gas powered generation bids in the market. Therefore, based on the analysis, all four Otway Basin hypothetical exploration and development scenarios are expected to have no material impact on the gas price receptor regardless of the timeframe or level of development. No further mitigation measures or risks were identified for this receptor.
ER6 Government revenue	Benefit /impact / Risk Minimum scenario: N/A Low scenario: N/A Medium scenario: N/A High scenario: N/A	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect government revenue. The petroleum regulatory framework requires gas producers to pay royalties to government for the use of state-owned resources. The Otway Basin hypothetical scenarios would increase royalties obtained from onshore conventional gas production by the Victorian Government. The level of benefit from royalties is directly linked to the level and timing of production. For example, the minimum scenario is expected to provide ~$9.4 million in annual average royalties over the lifetime of production, which is only eight years (2024 to 2031). By contrast, the high development scenario is expected to provide the greatest level of benefit with annual average royalties expected to reach ~$31.1 million per year over the lifetime of production which is spread over 26 years (from 2024 to 2049). The assessment also identified the exploration and development scenarios are expected to provide a slightly positive benefit on government revenue through company taxation from Victorian onshore gas producers. It was acknowledged that the applicability of various tax forms, and the amount of company taxation payable is dependent on many factors and therefore difficult to quantify. Based on this analysis, the impact of each scenario on government revenue is linked to the to the level and timing of production – as both these factors materially influence revenue from royalties and company taxation. No further mitigation measures or risks were identified for this receptor.

Social impact

The assessment found that the Otway Basin exploration and development scenarios are expected to deliver benefits (e.g. increases in employment, wage and salary income), impacts (e.g. noise, dust generation) and risks (e.g. cultural heritage) across the suite of social receptors. Identified risks are largely expected to be mitigated through various measures (e.g. risks to cultural heritage managed through various measures as required under the *Aboriginal Heritage Act 2006* and *Heritage Act 1995*).

Table 8: Otway scenarios: Risk, benefit and impact assessment summary – Social receptors

Receptor	Score			Finding
Social receptors				
SR1 Community health, safety and security		Benefit /impact	Risk	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect community health, and safety and security within the region. While there are potential negative impacts and risks within the region due to fire and spill risks, visible flaring, noise and vibrations, and dust generation, these will be mitigated through requirements under the current regulatory framework to be as low as reasonably practicable. In the case of noise and dust generation from operations/exploration, the impact is expected to be comparable with other land use activities such as farming. The impacts and residual risks are not considered to differ between scenarios, as the mitigating actions will manage the impact or risk to be as low as reasonably practicable and to an acceptable level, regardless of the footprint of the petroleum activities. Mitigating actions will also reduce the likelihood of the risk occurring. Therefore, the scenarios are expected to have a slightly negative impact on the community's health, safety and security and are assessed as having a low risk, based on the average ratings for each impact and risk. Proposed mitigation measures to improve the regulatory framework will also reduce the severity of the impacts and the likelihood of the identified risk occurring.
	Minimum scenario	x	L	
	Low scenario	x	L	
	Medium scenario	x	L	
	High scenario	x	L	

Receptor	Score	Finding
SR2 Community wellbeing and social cohesion	Benefit /impact · Risk Minimum scenario: – · N/A Low scenario: – · N/A Medium scenario: – · N/A High scenario: – · N/A	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect community wellbeing and social cohesion within the region. Community attitudes to the proximity of development and exploration are important to consider, however the impact of this measure on each of the exploration and development scenarios is neutral based on the results of surveys conducted with residents of the Otway local government areas. The extent of contribution could vary between the Otway Basin hypothetical exploration and development scenarios as the number of locations where gas is developed changes. As the number of locations increase where gas is developed, contributions to community projects could increase, however this would be dependent on a number of factors, including the locations of operation, size of the operations and commercial return obtained by producers. Community engagement, although non prescript, is required under legislation, providing benefits but there is room for improvement. Further mitigation is suggested through stronger community engagement required in legislation. On the other hand, access and affordability of housing and essential services and with the impact on local roads and traffic are expected to have neutral impacts on the community. Therefore, based on the high-level analysis and average scoring, all scenarios are expected to have a neutral impact overall. No risks were identified for this receptor.
SR3 Land access and use issues	Benefit /impact · Risk Minimum scenario: – · L Low scenario: – · L Medium scenario: – · L High scenario: x · L	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect land access and use. Landholder consultation (that informs landowner consent and compensation agreements and lease agreements) is dictated by the nature and scale of the petroleum activity. However, the legislation is clear that gas developers must enter into a land agreement prior to commencing exploration which is expected to have a neutral impact for landowners. With respect to the adequacy of community consultation, it was found that the process would be assumed to be consistent for each of the projects, and therefore the impact would increase in line with the exploration and development levels across the scenarios. The size of land impacted by gas exploration and development activities are expected to increase directly within an increase in production as there is a correlation with the number of wells and infrastructure built under each scenario. However, the absolute size of land required for conventional gas exploration and production is relatively small, and with underground pipelines, there is no evidence to suggest that there is significantly reduced land available to other users. It is anticipated that increases in land value will be negligible and devaluation of land being mitigated through compensation to directly impacted land owners, resulting in a negligible residual impact. Based on the ratings in the analysis, the minimum scenario, low scenario and medium scenario are expected to have neutral impacts. The hypothetical high scenario is expected to have a slightly negative impact. The risk of inadequate rehabilitation is expected to be low across all scenarios as the regulatory framework requires operators to restore land that was developed and that landowners will be appropriately compensated for any land that can no longer be returned to its original state.

Receptor	Score	Finding
		Further mitigation measures of increased land owner engagement requirements and stronger involvement of land holders in decision making particularly around rehabilitation would further address risks and impacts.
SR4 The Aboriginal community and people	Benefit /impact – Risk Minimum scenario: L Low scenario: L Medium scenario: L High scenario: L	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect the Aboriginal community and its people within the region. While there is potential for drilling and development to encroach on land under Native Title, or impact on Aboriginal people, existing mitigation measures limit these potential impacts and risks. Engagement activities undertaken by operators and the implementation of Reconciliation Action Plans are likely to result in slightly positive outcomes for the Aboriginal community and its people within the region as they increase transparency of gas development with the Aboriginal community and provide practical actions to drive reconciliation, both internally and within the community. The creation of ongoing employment within the Otway region also provides employment and business opportunities for Aboriginal community members and businesses. These are expected to increase in line with production across the Otway gas exploration and development scenarios. Overall, this results in all hypothetical scenarios having slightly positive impacts on the Aboriginal community and its people based on the average rating across all benefits and impacts. There is a low risk that gas exploration and development activities could impact land that is under Native Title. Potential serious consequences are mitigated through several measures, including the *Native Title Act 1993*, and the implementation of an Indigenous Land Use Agreement. Further, the Petroleum Act requires that a compensation agreement be made where Native Title exists. Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.
SR5 Schools, education and vocational capacity	Benefit /impact – Risk Minimum scenario: N/A Low scenario: N/A Medium scenario: N/A High scenario: N/A	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect schools, education and vocational capacity. With respect to projected increase in apprenticeships, and population growth, the assessment found that increases in the extent of gas production results in increases in employment, wage and salary income, and median household income. This is consistent with the perceived local perceptions of benefits from onshore conventional gas development in the Otway region. As production increases, so too does the demand for labour in the region. As such, increase in benefits is correlated with an increase in gas production. Similarly, contributions to school funding from industry are expected to result in increasing levels of benefits dependent on several factors, including the number of locations where gas is developed, and size of gas development and exploration. Therefore, the minimum scenario is expected to have a slightly positive impact, the low, medium and high scenarios are expected to have a positive impact on schools, education and vocational capacity, based on the average rating for each impact. No further mitigation measures or risks were identified for this receptor.

Receptor	Score	Finding
SR6 Protection of cultural heritage	Benefit /impact | Risk Minimum scenario: N/A | M Low scenario: N/A | M Medium scenario: N/A | M High scenario: N/A | M	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect non-Aboriginal and Aboriginal cultural heritage sites. Areas of non-Aboriginal and Aboriginal cultural heritage within the region are unlikely to be impacted by the Otway Basin hypothetical exploration and development scenarios. This is because the risks to cultural and indigenous heritage sites are mitigated through the regulatory framework (including the *Heritage Act 1995* and the *Aboriginal Heritage Act 2006*) once it is recognised that the land is of cultural, religious/spiritual and/or Aboriginal significance through cultural heritage surveying. However, if development occurred on sites of significance, this could result in irreparable damage to the place of significance, resulting in the hypothetical scenarios having a moderate risk on the protection of cultural heritage receptor. No benefits or impacts were identified for this receptor.
SR7 Existing farm industries, food and biosecurity	Benefit /impact | Risk Minimum scenario: – | M Low scenario: – | M Medium scenario: – | M High scenario: x | M	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect existing farm industries, food and biosecurity. It identified the Otway scenarios could slightly negatively impact on coexisting with existing agriculture industries, livestock near petroleum activities, gross size of farming land used for exploration and development, and the management of potential and actual incursion of pests and diseases. The consequences of these impacts increase with the level of production, as the number of well sites required increases, thereby potentially affecting more land used currently for farming. However, the land size required for petroleum activities is relatively small in comparison to the area required for farming, and the regulatory framework mitigates the impacts through arrangements to compensate for temporary losses of farming income for having production wells on their property. Industry practice is often to go above the minimum compensation requirement for providing a source of off farm income. Overall, the minimum scenario, low and medium scenarios were assessed as having no material impact, and the high scenario was assessed as having a slightly negative impact. The potential and actual incursion of pests and diseases was assessed as a key risk to farming industries. These risks are managed on a project by project basis, with each project required to have an adequate Environment Management Plan (EMP) in place, identifying measures that comply with all relevant regulations and legislation. Proposed reforms to the Petroleum Regulatory Framework would further mitigate this risk. Therefore, the risk has been assessed as moderate for all scenarios, as projects would not proceed unless the impacts are assessed by the regulator to be as low as reasonably practicable. Improvements in community and landholder engagement requirements, particularly around rehabilitation would benefit the operator's ability to coexist with existing agricultural industries. Stronger consideration of farming as a land-use in government decision making when granting acreage and permits would also be of benefit.
SR8 Labour and working conditions	Benefit /impact | Risk Minimum scenario: | N/A Low scenario: | N/A	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect labour and working conditions. The assessment found that Enterprise Bargaining Agreements are common within the oil and gas industry. The existence of, and conditions within an Enterprise Bargaining Agreement result in positive outcomes for labour and working conditions. These are independent of the level of gas exploration and

Receptor	Score			Finding
	Medium scenario		N/A	development, so benefits are not expected to vary between scenarios. Diversity policies are also common in the industry, resulting in positive impacts on worker representation for all exploration and development scenarios. The assessment also found that the extent of organisational policies and procedures is up to the discretion of the employer. However, at a minimum, the employer has a legal responsibility to provide a safe and healthy workplace. Increases in gas production have little impact on the working conditions of employees, as organisations are required to have policies and procedures governing working conditions regardless of the size of a development. The frameworks and policies would provide benefits to employees irrespective of the size of production. However, these are expected to be comparable to other employers in the region. Therefore, the minimum scenario, low, medium and high scenarios are expected to have a slightly positive impact on the labour and working conditions overall. No further mitigation measures or risks were identified for this receptor.
	High scenario		N/A	

Environmental impact

The assessment found that the Otway Basin exploration and development scenarios are expected to result in a slight increase in absolute greenhouse gas emissions as a proportion of Victoria's net 2017 greenhouse gas emissions. The scenarios also have a low risk of negatively impacting on ground and surface water quality and quantity and native flora and fauna.

Table 9: Otway scenarios: Risk, benefit and impact assessment summary – Environmental receptors

Receptor	Score			Finding
Environmental receptors[12]				
ENR1 Greenhouse gas emissions		Benefit /impact	Risk	The assessment identified the Otway Basin exploration and development scenarios would result in an increase in absolute annualised GHG emissions as a proportion of Victoria's net 2017 GHG emissions ranging from 0.1 per cent (~101,891 t CO_2e) under the minimum scenario to 0.2 per cent (~249,067 t CO_2e) under the high scenario. Therefore, all scenarios are expected to deliver a minor negative impact on absolute greenhouse gas emissions. While the Otway Basin exploration and development scenarios are not expected to significantly change or alter the State's composition of its greenhouse gas emissions, the assessment found that greenhouse gas emissions from the Otway Basin hypothetical scenarios are expected to represent an increased proportion of Victoria's net greenhouse gas emissions portfolio into the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050. However, the Otway Basin hypothetical exploration and development scenarios are not expected to significantly alter the trajectory to achieving Victoria's 2050 net-zero target, as the additional supply is not expected to change market dynamic and impact consumption of gas. The findings from the assessment have indicated that all Otway Basin hypothetical exploration and development scenarios are expected to have a minor negative impact on greenhouse gas emissions.
	Minimum scenario	×	N/A	
	Low scenario	×	N/A	
	Medium scenario	×	N/A	
	High scenario	×	N/A	

[12] Assessment of greenhouse gas emissions is based on the outputs of EY's environmental modelling, the figures of which are estimates.

Receptor	Score	Finding
		As part of the VGP, the department has measured a baseline of atmospheric measurements in the Otway region so any future changes in air quality resulting from future petroleum exploration and development could be identified appropriately. No risks were identified for this receptor.
ENR2 Groundwater and surface water quality and quantity	Benefit /impact | Risk Minimum scenario: – | L Low scenario: – | L Medium scenario: – | L High scenario: – | L	The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect ground and surface water within the region. The only measure shown to have an impact on ground and surface water is the volume of water removed from the nearest aquifer resource. The groundwater impact modelling showed that impacts on groundwater quantity and quality would be negligible due to the large geological separation between conventional gas reservoirs and aquifers. Under the current regulatory framework, the removal of water resources must be at an acceptable level to receive development approval. All scenarios are expected to have no material impact on ground and surface water based on the average rating. The risk of groundwater and surface water contamination was rated as low, as that the Environmental Management Plan must address the risk of potential contamination. A further mitigation measure was identified for this receptor to improve the regulatory requirements around groundwater monitoring and Reporting. This regulatory activity could be supported by the Victorian Gas Program regional baseline data of groundwater chemistry, dissolved methane and hydrocarbon occurrence so that any future changes in groundwater condition can be identified.
ENR3 Affected native flora and fauna	Benefit /impact | Risk Minimum scenario: N/A | L Low scenario: N/A | L Medium scenario: N/A | L High scenario: N/A | L	The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect native flora and fauna within the region. Key risks have been identified that could affect native flora and fauna. Greater numbers of wells will have a greater impact however the impact of each well will vary depending on its location. The small size of well leases during drilling (typically 1 ha, with a much smaller footprint for operating wells), in addition to the use of existing infrastructure (e.g. aligning pipelines alongside existing pipeline easements) further reduces the overall impact, particularly for the minimum and low development scenarios. It is also important to note once the gas has been extracted from the well, the area will be rehabilitated, reducing the long-term impact on flora to nil. As such impacts are only expected to occur in the short to medium term. As environmental risks are managed on a project-by-project basis, each project will need to have an approved Environmental Management Plan and will need to comply with a number of local, state and federal regulations and legislation. Therefore, the risk has been assessed as low for all scenarios, as projects would not proceed unless the impacts are determined by Earth Resources Regulation to be as low as reasonably practicable and meeting the requirements of other environmental legislation. No benefits or impacts were identified for this receptor. As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making (refer to Figure 41 for the summary of areas identified as constrained in the Otway Basin). No benefits or impacts were identified for this receptor.

Gippsland RBI assessment

Economic impact

The assessment found that all the Gippsland Basin exploration and development scenarios are expected to result in employment growth in the Gippsland region, increased economic value to the Gippsland region (and Victoria), and increased government revenue (e.g. royalties and company taxation). Gippsland Basin exploration and development scenarios are expected to have no material impact on Victorian gas supply or gas prices regardless of the timeframe or level of development.

Table 10: Gippsland scenarios: Risk, benefit and impact assessment summary – Economic receptors

Receptor	Score			Finding
Economic receptors				
ER1 Employment		Benefit /impact	Risk	The assessment found all scenarios are projected to result in employment growth primarily in the Gippsland region. This ranged from average annual additional 21 full-time equivalents under the low scenario (or total of 355 full-time equivalents - 145 direct and 210 indirect over the lifetime of production) to an average annual additional 68 full-time equivalents under the high scenario (or total of 890 full-time equivalents – 520 direct and 370 indirect over the lifetime of production). The analysis suggests that there will be some redistribution of labour as a result of the project, with employment being drawn from the rest of Victoria in order to satisfy demand. The ratings for each scenario have been assessed based on their relative overall impact on employment across Victoria with high scenario expected to have the largest impact on employment across the state, however, still assessed as a marginal impact as a proportion of total employment. No further mitigation measures or risks were identified for this receptor.
	Low scenario	–	N/A	
	Medium scenario	–	N/A	
	High scenario	–	N/A	
ER2 Gross state product		Benefit /impact	Risk	The assessment found all scenarios are projected to result in a positive impact to Victoria's gross state product, ranging from an average annual additional $18.26 million under the low scenario (a total of $310.4 million over the lifetime of production) to an average annual additional $76.39 million under the high scenario (a total of $993 million over the lifetime of production). The ratings for each scenario have been assessed based on their relative overall impact on gross state product for Victoria. As a share of total gross state product, the low scenario equates to 0.00 per cent and the high scenario 0.01 per cent. No further mitigations or risks were identified for this receptor.
	Low scenario	–	N/A	
	Medium scenario	N/A		
	High scenario	N/A		

Receptor	Score	Finding
ER3 Gross regional product and gross regional income	Benefit /impact — Risk Low scenario: – — N/A Medium scenario: N/A High scenario: N/A	The assessment found all scenarios are projected to result in a positive impact to the Gippsland region's gross regional product, ranging from an average annual additional \$14.76 million under the low scenario (a total of \$250.9 million over the lifetime of production) to an average annual additional \$63.37 million under the high scenario (a total of \$823.9 million over the lifetime of production). Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios (additional annual average GRI of \$16.01 million to \$1,085.78 million respectively) due to the underlying gas production and investment inputs. The ratings for each scenario have been assessed as having a neutral or slightly positive benefit based on their relative overall impact on gross regional product and GRI for the Gippsland region. No further mitigations or risks were identified for this receptor.
ER4 Domestic gas supply	Benefit /impact — Risk Low scenario: – — N/A Medium scenario: – — N/A High scenario: – — N/A	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect gas supply. Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas. However, due to falling production forecasts from the offshore Gippsland and Otway basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023. Current forecasts by AEMO suggest that shortfalls are expected from 2024 onwards. Unless currently uncommitted gas supply projects proceed, Victoria is expected to become a net-importer of gas (e.g. more reliant on gas sources from outside the state, in particular from Queensland). The assessment identified that all three hypothetical exploration and development scenarios are expected to begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production under the high and medium scenarios would be higher than in the low scenario. The Gippsland hypothetical scenarios could add up to an estimated 12 PJ of gas supply in 2024 and 13 PJ in 2025 (~5.4 per cent and ~5.8 per cent of forecast Victorian consumption in 2023 respectively). However, this amount of gas produced is not expected to have a material impact on Victoria's gas supply. This is because annual gas production is a small proportion of total forecast Victorian supply (e.g. a maximum of less than 6 per cent of Victoria's forecast consumption, less than 6 per cent of Victoria's production supply and only active for a limited period (12 years of production). As such, the estimated amount of gas that could be produced under all scenarios would be insufficient to materially: ► reduce the tightening gas supply situation in Victoria, with the potential to add ► improve energy security by increasing the diversity of Victoria's gas supply (which is largely sourced from Longford gas facility via the offshore gas fields) ► improve the availability of gas supply for gas-powered generation on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of gas-powered generation may be

Receptor	Score	Finding
		necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day) ► improve the amount of gas available for uses such as a transition fuel. However, the assessment found that the amount of gas could: ► increase gas available and the terms of negotiation for industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs and a retailer margin). Overall, the assessment found that the level of benefit obtained is limited by the scale and timing of development, which over the lifetime of production is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption). The introduction of domestic prioritisation mechanism (e.g. right of first offer) was identified as a further mitigation. Such a mechanism could require gas produced from Gippsland Basin scenarios to be offered to Victorian gas users first. This type of mechanism would be expected to improve the terms of negotiation for local gas users. No further risks were identified for this receptor.
ER5 Gas prices	Benefit /impact — Risk Low scenario: – / N/A Medium scenario: – / N/A High scenario: – / N/A	The qualitative assessment considered the extent to which the hypothetical Gippsland Basin exploration and development scenarios could improve gas and electricity price outcomes for Victorians. In the case of gas prices, the assessment found that the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for gas users. As a result, it was unlikely to reduce the price of gas for Victorians and prices will continue to be set largely by the liquefied natural gas netback price. While the development scenarios are unlikely to influence overall prices, the assessment found they may help reduce costs for some Victorian industrial users, particularly those located closest to the development. Victorian industrial users may be able to purchase gas directly from producers reducing transportation costs that would be incurred from buying gas from the east-coast gas market. A similar conclusion was reached with respect to wholesale electricity prices. The assessment found that the hypothetical gas development scenarios were unlikely to reduce wholesale gas prices because the level of gas development is not expected to change gas supply or prices, which are primary input cost for gas powered generation and impacts the price at which gas powered generation bids in the market. Therefore, based on the analysis, all three Gippsland Basin hypothetical exploration and development scenarios are expected to have no material impact on the gas price regardless of the timeframe or level of development No further mitigation measures or risks were identified for this receptor.

Receptor	Score	Finding
ER6 Government revenue	| | Benefit /impact | Risk | | Low scenario | | N/A | | Medium scenario | | N/A | | High scenario | | N/A |	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect government revenue. The petroleum regulatory framework requires gas producers to pay royalties to government for the use of state-owned resources. The Gippsland scenarios would increase royalties obtained from onshore conventional gas production by the Victorian Government. The level of benefit from royalties is directly linked to the level and timing of production. For example, the low scenario is expected to provide ~$6.1 million in annual average royalties over the lifetime of production which is only six years (2024 to 2029). By contrast, the high development scenario is expected to provide the greatest level of benefit with annual average royalties are expected to reach ~$11.9 million per year over the lifetime of production which is spread over 10 years (from 2024 to 2033). The assessment also identified the exploration and development scenarios are expected to provide a slightly positive benefit on government revenue through company taxation from Victorian onshore gas producers. It was acknowledged that the applicability of various tax forms, and the amount of company taxation payable is dependent on many factors and therefore difficult to quantify. Based on this analysis, the impact of each scenario on government revenue is linked to the to the level and timing of production – as both these factors materially influence revenue from royalties and company taxation, however overall benefits are expected to still be only slightly positive due to low production levels in all development scenarios. No further mitigation measures or risks were identified for this receptor.

Social impact

The assessment found that the Gippsland Basin exploration and development scenarios are expected to deliver benefits (e.g. increases in employment, wage and salary income), impacts (e.g. noise, dust generation) and risks (e.g. cultural heritage) across the suite of social receptors. Identified risks are largely expected to be mitigated through the existing regulatory framework (e.g. risks to cultural heritage managed through various measures as required under the *Aboriginal Heritage Act 2006* and the *Heritage Act 1995*).

Receptor	Score	Finding
Social receptors		
SR1 Community health, safety and security	Benefit /impact — Risk Low scenario: – / L Medium scenario: – / L High scenario: – / L	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect health and safety within the region. While there are potential negative impacts and risks within the region due to fire and spill risks, visible flaring, noise and vibrations, and dust generation, these will be mitigated through requirements under the current regulatory framework to be as low as reasonably practicable. In the case of noise and dust generation from operations/exploration, the impact is expected to be comparable with other land use activities such as farming. The impacts and residual risks are not considered to differ between scenarios, as the mitigating actions will manage the impact or risk to be as low as reasonably practicable and to an acceptable level, regardless of the size of exploration or development. Mitigating actions will also reduce the likelihood of the risk occurring. Therefore, the scenarios are expected to have a neutral impact on the community's health and safety and are assessed as having a low risk, based on the average ratings for each impact. Proposed mitigation measures to improve the regulatory framework will also reduce the severity of the impacts and the likelihood of the identified risks occurring.
SR2 Community wellbeing and social cohesion	Benefit /impact — Risk Low scenario: – / N/A Medium scenario: – / N/A High scenario: – / N/A	The qualitative assessment considered the extent to which the Gippsland exploration and development scenarios could affect community wellbeing and social cohesion within the region. Community attitudes to the proximity of development and exploration are important to consider, however the impact of this measure on each of the exploration and development scenarios is neutral based on the results of surveys conducted with residents of Gippsland local government areas. The extent of contribution is unlikely to vary between the Gippsland Basin hypothetical exploration and development scenarios as the locations where gas is developed is consistent. Community engagement, although non-prescript, is required under legislation, providing benefits but there is room for improvement. Further mitigation is suggested through stronger community engagement requirements in the legislation. On the other hand, access and affordability of housing and essential services and the impact on local roads are expected to have negative and neutral impacts respectively. Therefore, based on the high-level analysis and average scoring, all scenarios are expected to have a neutral impact overall. No risks were identified for this receptor.

Receptor	Score	Finding
SR3 Land access and use issues	Benefit /impact · Risk Low scenario: – · L Medium scenario: – · L High scenario: – · L	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect land access and use. Landholder consultation (that informs landowner consent and compensation agreements and lease agreements) is dictated by the nature and scale of the petroleum activity. However, the legislation is clear that gas developers must enter into a land agreement prior to commencing exploration which is expected to have a neutral impact for landowners. With respect to the adequacy of community consultation, it was found that the process would be assumed to be consistent for each of the projects, and therefore the impact would increase in line with the exploration and development levels across the scenarios. The size of land impacted by gas exploration and development activities are expected to increase directly within an increase in production as there is a correlation with the number of wells and infrastructure built under each scenario. However, the absolute size of land required for conventional gas exploration and production is relatively small, and with underground pipelines, there is no evidence to suggest that there is significantly reduced land available to other users. It is anticipated that increases in land value will be negligible and devaluation of land being mitigated to directly impacted land owners, resulting in a negligible residual impact. Based on the ratings in the analysis the low, medium and high scenarios are expected to have neutral impacts. The risk of inadequate rehabilitation is expected to be low across all scenarios as the regulatory framework requires operators to restore land that was developed and that land owners will be appropriately compensated for any land that can no longer be returned to its original state. Further mitigation measures of increased land owner engagement requirements and stronger involvement of landholders in decision making particularly around rehabilitation would further address risks and impacts.
SR4 The Aboriginal community and people	Benefit /impact · Risk Low scenario: L Medium scenario: L High scenario: L	The qualitative assessment considered the extent to which the Gippsland exploration and development scenarios could affect the Aboriginal community and its people within the region. While there is potential for drilling and development to encroach on land under Native Title, or impact on Aboriginal people, existing mitigation measures are strong, limiting these potential impacts and risks. Engagement activities undertaken by operators and the implementation of Reconciliation Action Plans are likely to result in slightly positive outcomes for the Aboriginal community and its people within the region as they increase transparency of gas development with the Aboriginal community and provide practical actions to drive reconciliation, both internally and within the community. The creation of ongoing employment within the Gippsland region also provides employment and business opportunities for Aboriginal community members and businesses. These are expected to increase in line with production across the Gippsland gas exploration and development scenarios. Overall, this results in all hypothetical scenarios having slightly positive impacts on the Aboriginal community and its people based on the average rating across all benefits and impacts. There is a low risk that gas exploration and development activities could impact land that is under Native Title. Potential serious consequences are mitigated through several measures, including the *Native Title Act 1993*, and the implementation of an Indigenous Land Use Agreement. Further, the Petroleum Act requires that a compensation

<table>
<tr><th>Receptor</th><th>Score</th><th>Finding</th></tr>
<tr><td></td><td></td><td>agreement be made where Native Title exists. Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.</td></tr>
<tr><td>SR5 Schools, education and vocational capacity</td><td><table><tr><th></th><th>Benefit /impact</th><th>Risk</th></tr><tr><td>Low scenario</td><td></td><td>N/A</td></tr><tr><td>Medium scenario</td><td></td><td>N/A</td></tr><tr><td>High scenario</td><td></td><td>N/A</td></tr></table></td><td>The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect schools, education and vocational capacity.

With respect to projected increase in apprenticeships, and population growth, the assessment found that increases in the extent of gas production results in increases in employment, wage and salary income, and median household income. This is consistent with the perceived local perceptions of benefits from onshore conventional gas development in the Gippsland region. As production increases, so too does the demand for labour in the region. As such, increase in benefits is correlated with an increase in gas production.

Similarly, contributions to school funding from industry are expected to result in increasing levels of benefits dependent on several factors, including the number of locations where gas is developed, and size of gas development and exploration. The low, medium and high scenarios are expected to have slightly positive benefits.

Therefore, the low, medium and high scenarios are expected to have a slightly positive benefit to the schools, education and vocational capacity, based on the average rating for each impact.

No further mitigation measures or risks were identified for this receptor.</td></tr>
<tr><td>SR6 Protection of cultural heritage</td><td><table><tr><th></th><th>Benefit /impact</th><th>Risk</th></tr><tr><td>Low scenario</td><td>N/A</td><td>M</td></tr><tr><td>Medium scenario</td><td>N/A</td><td>M</td></tr><tr><td>High scenario</td><td>N/A</td><td>M</td></tr></table></td><td>The qualitative assessment considered the extent to which the Gippsland hypothetical exploration and development scenarios could affect non-Aboriginal and Aboriginal cultural heritage sites.

Areas of non-Aboriginal and Aboriginal cultural heritage within the region are unlikely to be impacted by the Gippsland hypothetical exploration and development scenarios. This is because the risks to cultural and indigenous heritage sites are mitigated through the regulatory framework (including the Heritage Act 1995 and the Aboriginal Heritage Act 2006) once it is recognised that the land is of cultural, religious and/or Indigenous significance through cultural heritage surveying. However, if development occurred on sites of cultural heritage, it could result in irreparable damage to the place of significance. Therefore, the scenarios are expected to have a moderate risk on the protection of cultural heritage receptor.

No benefits or impacts were identified for this receptor.</td></tr>
</table>

Receptor	Score	Finding
SR7 Existing farm industries, food and biosecurity	 Benefit /impact · Risk Low scenario: – · M Medium scenario: – · M High scenario: – · M	The qualitative assessment considered the extent to which the Gippsland exploration and development scenarios could affect existing farm industries, food and biosecurity. It identified the Gippsland scenarios could slightly negatively impact on coexisting with existing agriculture industries, livestock near petroleum activities, and the gross size of farming land used for exploration and development. The consequences of these impacts increase with the level of production, as the number of well sites required increases, thereby potentially affecting more land used currently for farming. However, the land size required for petroleum activities is relatively small in comparison to the area required for farming, and the regulatory framework mitigates the impacts through compensation arrangements to compensate for temporary losses of farming income for having production wells on their property. Further proposed regulatory reforms would require enhanced community consultation and consideration which would benefit the operator's ability to coexist with existing agricultural industries. Industry practice is often to go above the minimum compensation requirement, providing a source of off-farm income. Overall, the low, medium and high scenarios were assessed as having no material impact. The potential and actual incursion of pests and diseases was assessed as a key risk to farming industries. These risks are managed on a project by project basis, with each project required to have an adequate Environmental Management Plan in place, identifying measures that comply with all relevant regulations and legislation. Proposed reforms to the Petroleum regulatory Framework would further mitigate the risk. Therefore, the risk has been assessed as moderate for all scenarios, as projects would not proceed unless the impacts are assessed by regulators to be as low as reasonably practicable. Improvements in community and landholder engagement requirements, particularly around rehabilitation, would benefit the operator's ability to coexist with existing agricultural activities. Stronger consideration of farming as a land-use in government decision making when granting acreage and permits would also be of benefit.

Receptor	Score			Finding
SR8 Labour and working conditions		Benefit /impact	Risk	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect labour and working conditions. The assessment found that Enterprise Bargaining Agreements are common within the oil and gas industry. The existence of, and conditions within an Enterprise Bargaining Agreements result in positive outcomes for labour and working conditions. These are independent of the level of gas exploration and development, so benefits are not expected to vary between scenarios. Diversity policies are also common in the industry, resulting in positive impacts on worker representation for all exploration and development scenarios. The assessment also found that the extent of organisational policies and procedures is up to the discretion of the employer. However, at a minimum, the employer has a legal responsibility to provide a safe and healthy workplace. Increases in gas production have little impact on the working conditions of employees, as organisations are required to have policies and procedures governing working conditions regardless of the size of development. However, these are expected to be comparable to other employers in the region. Therefore, the low, medium and high scenarios are expected to have a slightly positive impact on the labour and working conditions overall. No further mitigation measures or risks were identified for this receptor.
	Low scenario		N/A	
	Medium scenario		N/A	
	High scenario		N/A	

Environmental impact

The assessment found that all scenarios in the Gippsland Basin exploration and development scenarios are expected to result in a slight increase in absolute greenhouse gas emissions as a proportion of Victoria's net 2017 greenhouse gas emissions, however this is not expected to materially impact the receptor. The scenarios also have a low risk of negatively impacting on ground and surface water quality and quantity and native flora and fauna.

Table 11: Gippsland scenarios: Risk, benefit and impact assessment summary – Environmental receptors

Receptor	Score			Finding
Environmental receptors				
ENR1 Greenhouse gas emissions		Benefit /impact	Risk	The assessment identified the Gippsland Basin exploration and development scenarios would result in an increase in absolute annualised greenhouse gas emissions as a proportion of Victoria's net 2017 greenhouse gas emissions between 0.02 per cent (20,245 t CO2e) under the low scenario and 0.07 per cent (80,120 t CO2e) under the high scenario. While the Gippsland Basin exploration and development scenarios are not expected to significantly change or alter the state's composition of its greenhouse gas emissions, the assessment found that greenhouse gas emissions from the Gippsland Basin scenarios are expected to represent an increased proportion of Victoria's net greenhouse gas emissions portfolio into the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050. However, the Gippsland Basin exploration and development scenarios are not expected to significantly alter the trajectory to achieving Victoria's 2050 net-zero target, as the additional supply is not expected to change market dynamic and impact consumption of gas. The findings from the assessment have indicated that none of the Gippsland Basin hypothetical exploration and
	Low scenario	–	N/A	
	Medium scenario	–	N/A	
	High scenario	–	N/A	

Receptor	Score	Finding
		development scenarios are expected to have a material impact on greenhouse gas emissions (as they only represent 0.02-0.07 per cent of Victoria's net 2017 greenhouse gas emissions). As part of the Victorian Gas Program, the department has measured a baseline of atmospheric measurements in the Gippsland region so any future changes in air quality resulting from future petroleum exploration and development could be identified appropriately. No further risks were identified for this receptor.
ENR2 Groundwater and surface water quality and quantity	| | Benefit /impact | Risk | | Low scenario | – | L | | Medium scenario | – | L | | High scenario | – | L |	The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could affect ground and surface water within the region. The measures shown to have an impact on ground and surface water are the volume of water removed from the nearest aquifer resource and the groundwater level draw down. The groundwater impact modelling showed that impacts on groundwater quantity and quality would be negligible due to the large geological separation between conventional gas reservoirs and aquifers. Under the current regulatory framework the removal of water resources must be at an acceptable level to receive development approval. All scenarios are expected to have no material impact on ground and surface water based on the average rating. The risk of groundwater and surface water contamination was rated as low, given that a project specific Environmental Management Plan must address the risk of potential contamination. A further mitigation was identified for this receptor to improve the regulatory requirements around groundwater monitoring and Reporting. This regulatory activity could be supported by the Victorian Gas Program regional baseline data of groundwater chemistry, environmental isotopes, dissolved methane and hydrocarbon occurrence so that any future changes in groundwater condition can be identified.

Receptor	Score	Finding
ENR3 Affected native flora and fauna	Benefit /impact | Risk Low scenario: N/A | L Medium scenario: N/A | L High scenario: N/A | L	The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect native flora and fauna within the region. Key risks have been identified that could affect native flora and fauna. Given the low number of wells in all scenarios the impact is expected to minimal for all scenarios. The small size of well leases during drilling (typically 1 ha, with a much smaller footprint for operating wells), in addition to the use of existing infrastructure (e.g. aligning pipelines alongside existing pipeline easements) and the addition of a single modular plant in the high development scenario further reduces the overall impact. It is also important to note once developed, the wells will only be there for a certain timeframe, and once the gas has been extracted from the well and the area will be rehabilitated, reducing the long-term impact on flora to nil. As such impacts are only expected to occur in the short to medium term. As environmental risks are managed on a project-by-project basis, each project will need to have an approved Environmental Management Plan and will need to comply with all relevant regulations and legislation. Therefore, the risk has been assessed as low for all scenarios, as projects would not proceed unless the impacts are as low as reasonably practicable and meet the requirements of environmental legislation. As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making (refer to Figure 63 for the summary of areas identified as constrained in the Gippsland Basin. No benefits or impacts were identified for this receptor.

1. Introduction

1.1 Scope and purpose

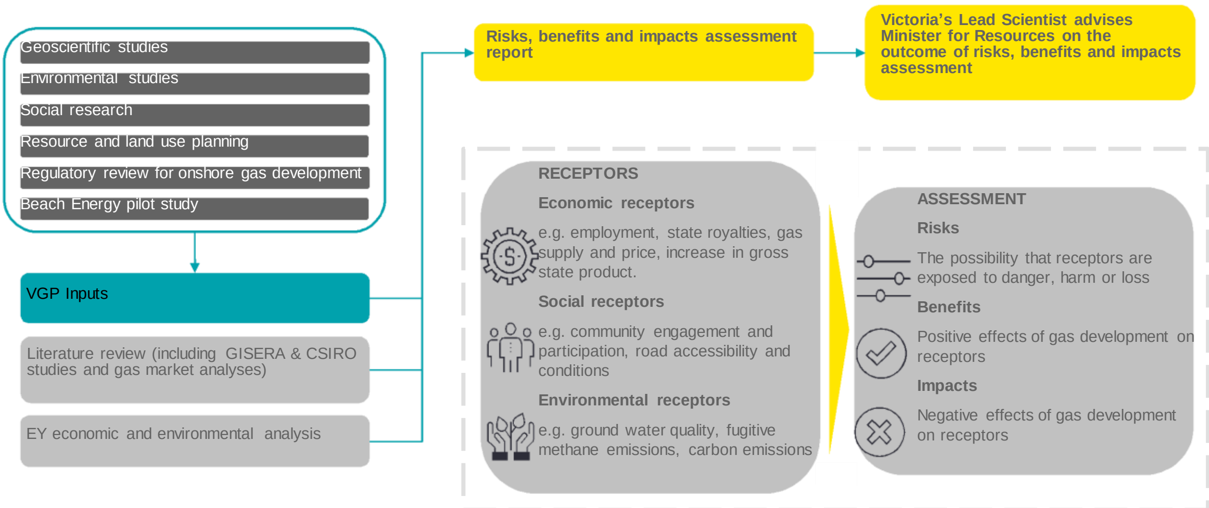
Ernst & Young (EY) was engaged by the Department of Jobs, Precincts and Regions (the department) to provide an assessment and Report on the risks, benefits and impacts of potential new onshore conventional gas exploration and development scenarios in Victoria. This Report does not consider any unconventional gas or fracking as they are banned in Victoria. The analysis considers the likely resource impacts of the scenarios and, while cognisant of the Victorian Government's commitment to achieving net-zero emissions, is not constrained by this requirement. The scope of this engagement does not include a review of the State Government's energy policy.

The scope covers the following petroleum activities:

- **Exploration** – includes seismic surveys, geotechnical surveys and exploration/appraisal drilling
- **Development** – includes wellhead installation, pipeline construction and gas plant expansion/construction
- **Operations** – includes production from the well via a pipeline and gas plant, and trucking of condensate to refineries (which may also be required)
- **Rehabilitation (or transitional rehabilitation)** – includes returning some of the land to its former use (e.g. reducing a drilling lease to an operating well lease)
- **Complete rehabilitation** – includes removing infrastructure and returning the land to its former use.

This Report represents the culmination of the Victorian Gas Program's (VGPs) reviews and studies, undertaken over the last three years, which have been supplemented by EY economic and greenhouse gas (GHG) analysis based on these studies and publicly available information. Figure 2 outlines these inputs and provides an overview of the assessment approach.

Figure 2: Inputs to the Report



Source: EY, adapted from information supplied by the department

1.2 The Victorian Gas Program

The VGP is a comprehensive science-led program established in 2017 to assess the potential for further discoveries of onshore conventional gas in Victoria and to assess the risks, benefits and impacts of the industry.[13]

The VGP's geoscientific, technical and environmental studies are providing an evidence-based estimate of prospective gas resources at a regional level. The studies are also looking closely at the risks, benefits and impacts associated with onshore conventional gas exploration and development. The studies focus on Victoria's two most prospective regions for gas: the Otway Basin and the Gippsland Basin. This work is informing government decisions during the onshore conventional gas moratorium, which is in place until 30 June 2020.[14]

1.2.1 Onshore conventional gas studies

The onshore conventional gas studies are being overseen by Victoria's Lead Scientist in consultation with the Stakeholder Advisory Panel for Onshore Conventional Gas (Stakeholder Advisory Panel), which includes representatives from key sectors such as farming, industry, local government, environment and the community. The panel was established in 2017 to provide the Minister for Resources with advice on the risks, benefits and impacts pertaining to onshore conventional gas if the industry was allowed to resume, with particular focus on social, environmental and economic factors.

The responsibilities and obligations of the Stakeholder Advisory Panel are governed by their Terms of Reference, which include providing advice to the Minister of Resources on the risks, benefits and impacts of onshore conventional gas resources including:

- geoscience investigations to identify the prospectivity for new gas discoveries
- environmental benchmarking to identify and monitor potential impacts on the environment
- socio-economic analysis to identify key benefits and impacts at a regional and State level.

The VGP has assessed five components for the onshore conventional gas studies including:

- geoscientific studies
- environmental studies
- community engagement
- resource and land use planning
- risks, benefits and impacts assessment.

Each of these components are summarised in Table 12.

Table 12: Victorian Gas Program – component projects

Stream	Description	Key outputs	Detail on outputs
Geoscientific studies	The purpose of the geoscientific studies was to assess the prospectivity of the Victorian Otway and Gippsland basins and to estimate Victoria's undiscovered	► 7,172 new analyses from rock samples (Otway Basin) ► New 3D geological framework models for	All projects within the Geoscience studies enabled mapping of seal, reservoir and source rock units (presence, absence and quality) to assess

[13] DJPR (2018). *VGP Progress Report No. 1.* p.6.
[14] DJPR (2019). *VGP Progress Report No. 3.* p.3.

Stream	Description	Key outputs	Detail on outputs
	conventional gas resource potential. The evidence for the assessments was gathered and built by undertaking rock characterisation and 3D geological framework model projects. ► Rock characterisation studies achieved an enhanced understanding of rock properties through the analysis of rock samples (drill cores) from seal, reservoir and source rocks ► 3D geological framework models used previously collected geological data (seismic and well data) to map rock layers and structures to map the location of seal, reservoir and source rock units.	the onshore Otway and Gippsland basins ► Petroleum systems modelling for the Otway and Gippsland basins.	prospectivity and estimate undiscovered resource potential.
Environmental studies	The environmental studies improved the understanding of the current environmental conditions and potential impacts should onshore conventional gas development occur. Regional baseline studies included groundwater sampling and air quality measurements. In addition, regional groundwater and local scale assessment models were developed to assess hypothetical groundwater impacts associated with gas development.	► Gippsland and Otway Basins – over 100 groundwater samples were collected ► Two regional air quality surveys (methane and carbon dioxide) were completed in April and November 2018 ► Regional and point scale groundwater models were developed for each region to assess used for hypothetical groundwater impacts assessment ► VGP Environmental Risk Assessment Report – onshore geophysical exploration 2018 ► VGP Environmental Risk Assessment Report- onshore conventional gas drilling and operations 2017.	► Groundwater sampling provided one of the most comprehensive assessments of groundwater conditions and improves understanding of the groundwater processes ► Air quality surveys defined the methane and carbon dioxide variability across the two regions ► Groundwater models identified the potential impact that gas development scenarios could have on groundwater in the basins.
Community engagement	The stakeholder and community engagement program supported all the scientific components of the VGP. The broad objectives of the stakeholder and community engagement program were to: ► inform and educate stakeholders, local communities and the public about the VGP and its scientific findings ► build the capacity of stakeholders and communities to offer input and have a community voice to inform decisions through the VGP	► Over 710 engagements as of 2019 ► Over 625 events held ► CSIRO Reports on community wellbeing and local attitudes on onshore conventional gas development in both the Otway and Gippsland basins.	Engagements included briefings, meetings, forums, email and telephone calls to explain the work of the program and share the science that underpinned these activities.

Stream	Description	Key outputs	Detail on outputs
	► build trust and nurture relationships.		
Resource and land use planning	Resource and land use planning activities undertaken by the VGP were designed to help ensure that future onshore conventional gas exploration takes place where it is appropriate in the local context. This involved assessing key natural resources and cultural, environmental, existing and future land uses, with cognisance of community views to ensure that the best land use options are adopted.	► Development of a resource and land-use inventory ► Development of a resource and land use framework and model ► Stakeholder and community workshops ► Final resource and land-use planning recommendations for the Otway and Gippsland Basins.	► The resource and land use planning model provides a visualisation of areas of significance, sensitivity to identify existing and future land uses and landscape value sensitivities ► Consultation enabled the final land use model to be considerate of community views.
Risks, benefits and impacts assessment	► The VGP is supporting the Lead Scientist and the Stakeholder Advisory Panel in their analysis of the broader risks, benefits and impacts of potential onshore conventional gas activity. The assessment will be based on hypothetical gas exploration and development scenarios across the Gippsland and Otway regions and will be informed by the VGP studies.[15]	► Initial case study on Beach Energy's Otway gas plant ► This Report, which is a broader risk, benefits and impacts assessment for onshore conventional gas.	The Beach Energy case study, through a triple-bottom-line approach, examined the economic, social and environmental effects of the operation at a local and state level to inform future gas production.

The findings from all VGP projects were key inputs into this assessment, including the development of the assessment framework (including the economic, social and environmental receptors), scenarios and the summary assessment.

1.3 Limitations of the Report

The assessments provided in this Report have been developed based on information sources which introduce inherent limitations as follows:

- This report relies on information and data provided by the department as part of the VGP, as well as publicly available information. EY does not imply, and it should not be construed that we have verified any of the information provided to us, or that our enquiries could have identified any matter that a more extensive examination might disclose.
- Information from a range of sources believed after due enquiry to be reliable and accurate has been considered and relied upon in preparing the Report. Nothing was brought to our attention by anyone that suggests that any information supplied to us, or obtained from public sources, was false or that any material information has been withheld from us. The assessment documented in the Report does not constitute an audit or review in accordance with Australian Auditing Standards.
- A risks, benefits and impacts (RBI) assessment has been conducted on the hypothetical development scenarios in the Otway Basin and Gippsland Basin as mutually exclusive overall hypothetical development scenarios. This is in contrast to a comparative analysis which would assess the risks, benefits and impacts of hypothetical development in the Otway Basin against the risks, benefits and impacts of hypothetical development in the Gippsland Basin. This report has also considered likelihood and consequence that the receptor may be exposed to harm

[15] DJPR (2019). *VGP Progress Report No. 3*. p.33.

because of a hypothetical gas development scenario assuming industry complies with the current legislative framework.

- This Report has also relied on comprehensive stakeholder engagement work undertaken by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) on behalf of the VGP in parallel with this evaluation rather than separately undertaking primary stakeholder consultation. However, consultation, feedback and advice has been sought from members of the Stakeholder Advisory Panel.

1.4 Structure of the Report

The Report is structured as follows:

- Chapter 2 provides essential background on the Victorian gas market and its legislative and regulatory framework.
- Chapter 3 describes the approach and framework for this assessment, which includes discussion of the economic, social and environmental receptors and measures.
- Chapter 4 describes the hypothetical onshore conventional gas exploration and development scenarios in the Otway Basin and provides an assessment that summarises the risks, benefits and impacts to each economic, social and environmental receptor from these scenarios.
- Chapter 5 describes the hypothetical onshore conventional gas exploration and development scenarios in the Gippsland Basin and provides an assessment that summarises the risks, benefits and impacts to each economic, social and environmental receptor from these scenarios.
- Appendix A provides an industry profile.
- Appendix B provides an overview of the economic modelling calculation methodology and assumptions.
- Appendix C provides an overview of the GHG emissions modelling calculation methodologies, emissions factors and assumptions.
- Appendix D provides a summary of other regulatory controls authority holders must comply with.

2. Background

Assessments in this Report have been made based on an understanding of the conventional gas industry, and the legislative and regulatory frameworks within which the industry operates.

The industry's history within Victoria has led to the current production and consumption patterns which also provide important context to the analysis. This section provides a summary of background information relevant to the RBI assessment, including:

- fundamentals of onshore conventional gas development
- history of gas exploration, development, production and use in Victoria
- gas production and use in Victoria
- the legislative framework for gas exploration, development, production and use in Victoria.

2.1 Fundamentals of onshore conventional gas development

Formations where conventional gas may be found

Natural gas is found in reservoir rock units that are porous and permeable. The pore spaces in a reservoir allow the rock to contain liquids or gases. If the unit is also permeable, liquids and gases are able to flow through the rock. For gas to accumulate in the reservoir, the unit must be capped by impervious rock, known as a seal or caprock, that prevents the gas from migrating upward or laterally. The natural gas migrates into reservoir rock units from organic-rich source rocks. Hydrocarbons are generated from source rocks when they are buried and subjected to high temperatures and pressures. The gas migrates and accumulates in geological structures known as traps.

Seismic surveys and drilling are used to identify and test rock layers in the subsurface that may be prospective for hydrocarbons. Suitable reservoir and seal units need to be present within a geological structure to trap hydrocarbons. Previous hydrocarbon discoveries or 'shows' in a geographic location indicate that source rocks have generated oil or gas and it has migrated into overlying rock units.

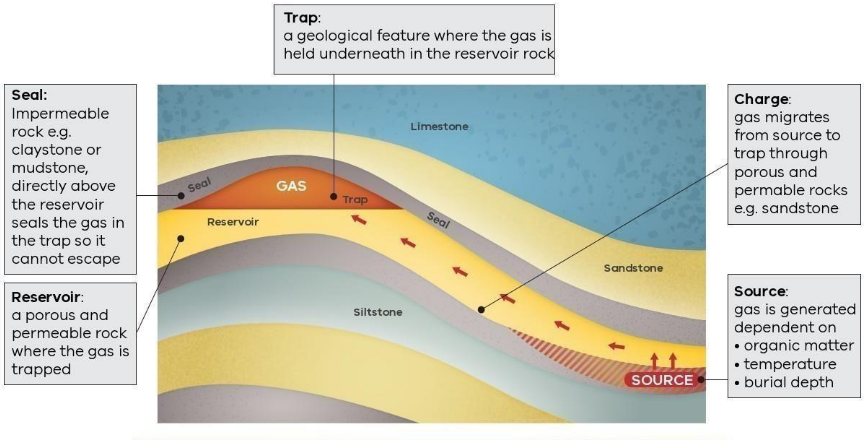
All of the following must be present for hydrocarbons (gas) to accumulate:

- reservoir[16]: a rock unit, such as a sandstone, with sufficient porosity and permeability to store and transmit fluids
- trap: a geological structure in which hydrocarbons can accumulate if reservoir and seal rocks are present
- seal: a relatively impermeable rock (commonly shale) that forms a barrier or cap above and around reservoir rock such that fluids cannot migrate beyond the reservoir
- source: the layer of rock where organic matter has been compressed over geological time to produce hydrocarbons which migrate into reservoir units.

Figure 3 provides a visual schematic of the key structures found in and around a typical gas reservoir.

[16] Oilfield glossary, Accessed via: https://www.glossary.oilfield.slb.com/en/Terms/r/reservoir.aspx

Figure 3: The structures found in and around a typical gas reservoir



Source: DJPR (2017). VGP Progress Report No. 2. p.7.

Plays

When geoscientists are exploring for hydrocarbons, they use the term 'play' to refer collectively to the specific components that together make up a petroleum system: source, reservoir and seal rocks that have been identified previously through exploration and studies and are unique to the geographic location. While there are several interpretations as to what constitutes a play, for the purposes of this Report a play is defined as a family of undrilled prospects and discovered pools of petroleum that are considered to share a common gross reservoir, top-seal and petroleum charge system.[17]

Seven plays have been identified in both the Otway and Gippsland scenarios that are most likely to contain gas. Further information on these plays are provided in Section 4.1 and Section 5.1 respectively.

Discoveries

Onshore gas discoveries have been made at 17 gas fields in Victoria and with five in production: Wallaby Creek (19.8 billion cubic feet – Bcf), Skull Creek (2.2 Bcf), North Paaratte (18.2 Bcf) and Mylor (11.8 Bcf) and Fenton Creek (4.8 Bcf). An exploration well is drilled to determine if gas is present in a prospective location. A discovery is made when an exploration well is successful in locating gas. Further investigations, such as desk top studies or drilling are usually required to determine the commercial status of the discovery. If the gas accumulation is considered commercially viable, applications are made to use the exploration well to produce the gas or further development wells may be drilled. A hydrocarbon show may be recorded even if a well does not discover oil or gas. A show indicates a presence of hydrocarbons in the area.

Subsidence and seismicity

Seismicity refers to the occurrence of earthquakes, and only seismicity induced by human activities is considered in this risk investigation. The seismicity risk assessment found that Victoria had a low risk of seismicity. This conclusion was based upon the type of geological conditions in Victoria, plus no historic seismic events which have been associated with the existing conventional gas industry.

Subsidence refers to the geological process of where the land surface elevation lowers as a result of either natural or induced activities. As part of the VGP, the Geological Survey of Victoria (GSV) has reviewed subsidence occurrence in the Otway and Gippsland Basins. In the Otway Basin, long-term groundwater trends in the Dilwyn aquifer are generally stable,[18] and thereby it was inferred that it is

[17] Allen, P. and Allen, J. (2013). *Basin Analysis*. Somerset: Wiley.
[18] Hocking, M., Torkzaban, S. & Gaal, A. 2020. Groundwater impact assessment – Numerical model development, Onshore Otway Basin, Victoria. Victorian Gas Program Technical Report X. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. (in prep)

highly unlikely that human induced subsidence is or would occur. In the Gippsland Basin, groundwater levels have been falling in the Latrobe aquifer at the coast for the past 40 years.[19] The CSIRO subsidence Reports[20,21,22] predicted subsidence to range between 0.45 and 1.2 metres (m) by 2056 in the Golden Beach area, which equates to 9 to 24 millimetres per year (mm/year). Surveying of elevation reference points along the Gippsland Coast[23] suggests since 2004 a maximum land surface decline of 89 mm, which equates to 2-3 mm/year since 2004. The primary cause of this subsidence is however unclear. There has been no onshore gas production in the Gippsland Basin.

2.2 History of gas exploration, development, production and use in Victoria

The two geological basins in Victoria that are the most prospective for gas are the Otway and Gippsland basins. Hydrocarbons have been discovered and produced in commercial quantities from both basins in the past, although in the Gippsland Basin, production has been restricted to the offshore area.[24]

2.2.1 Exploration and production in the Otway Basin

The eastern extent of the Otway Basin is about 100 kilometres (km) to the southwest of Melbourne, whilst the Port Campbell Embayment (an area of past gas production) is a further 100 km away. The basin covers approximately 155,000 km^2, with about 80 per cent of the basin being located offshore.

In the onshore Otway Basin, petroleum (oil and gas) exploration extends back to the early 1920s with 155 wells drilled since that time. Gas was first discovered in the onshore Victorian Otway Basin in 1959 in the Port Campbell area, but it was not until 1978 that a commercial gas discovery in the same area revived interest in the commodity and a number of discoveries followed. From the early 1990s into the 2000s, gas discoveries both onshore and offshore around the Port Campbell area established the region as a relatively risk free, active gas producing province. Gas was produced from the onshore part of the basin between 1986 and 2006, with production continuing from fields in the offshore basin safely and in line with regulatory requirements.

In the offshore Otway Basin as at 2014, 23 petajoules (PJ) of liquid hydrocarbons (crude oil, condensate and naturally occurring liquified petroleum gas resources) and 850 PJ have been produced.[25] In 2002, the initial recoverable reserves from the small Port Campbell Embayment gas fields were 59 Bcf with 47.3 Bcf remaining in mid-2001. The only remaining production since the closure of the Heytesbury gas processing plant in 2006 is a small volume of carbon dioxide gas that is produced from Boggy Creek. The nearby Iona gas field is used as a storage facility for gas piped from offshore. Both activities are carried out under current production licences, a cluster of which are still 'active' in the Port Campbell area.

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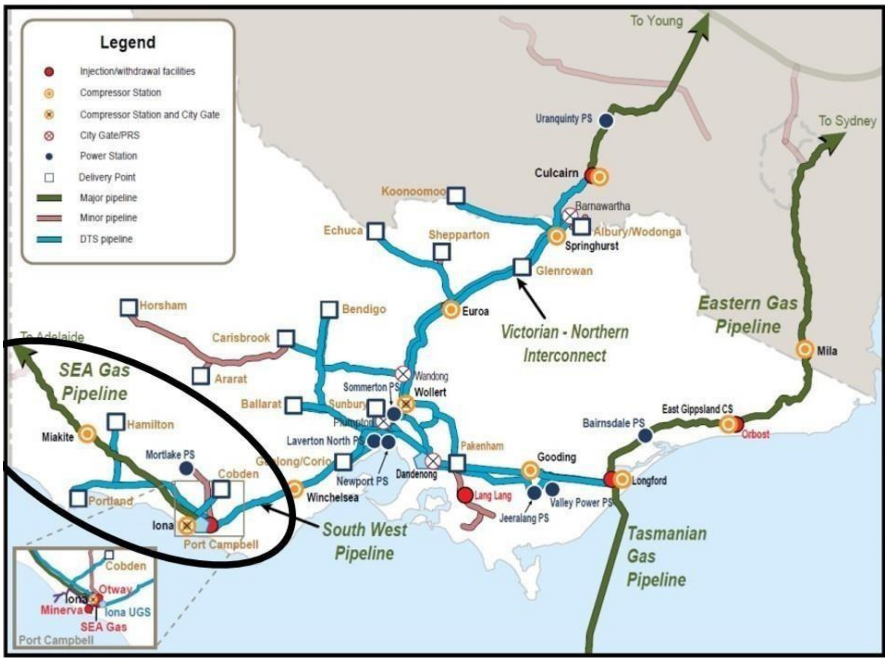
[19] Hocking, M. & Beverly, C., 2020. Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report X. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p (in prep).
[20] Hatton, T., Otto, C. and Underschultz, J. (2004). *Falling water levels in the Latrobe Aquifer, Gippsland Basis: Determination of cause and recommendations for future work.* Perth: CSIRO.
[21] Underschultz, J., Bailey, W., Freij-Ayoub, R. and Otto, C. (2006). *Falling water levels in the Latrobe Aquifer, Gippsland Basin: offshore aquifer update, onshore fault seal analysis, and preliminary numerical simulation of coastal subsidence risk.* Perth: CSIRO.
[22] Freij-Ayoub, R., Underschultz, J., Li, F., Trefry, C., Hennig, A., Otto, C. & Mcinnes, K., 2007. Simulation of coastal subsidence and storm wave inundation risk in the Gippsland Basin, CSIRO, Petroleum Report 07-003. Commonwealth Scientific and Industrial Research Organisation.
[23] McKinley, H., Holden, L. and Woods, A. (2019) Considerations for on-going localised subsidence and modelling deformations. Surveyor – General Victoria (SGV) in association with RMIT University. Unpublished poster.
[24] Information provided by the department.
[25] Geoscience Australia & BREE, 2014

Natural gas from the offshore Otway Basin services Melbourne, regional centres across Victoria as well as the wider east-coast gas market. Gas from the offshore Otway Basin is delivered via pipeline infrastructure as illustrated in Figure 4.

There are currently nine Petroleum Exploration Permits (PEPs) across the Otway Basin. The licensees for these permits include:

- Bridgeport (Eromanga) Pty Ltd
- Mirboo Ridge Pty Ltd
- Beach Energy ltd
- Somerton Energy Pty Ltd
- Lochard Energy (Iona Operations) Pty Ltd
- CO2CRC Ltd
- Boggy Creek Pty Ltd
- Lattice Energy Ltd.

Figure 4: The existing pipeline infrastructure, with the area of focus for the Otway Basin scenarios



Source: DJPR (2019). Victorian Gas Planning Report.

2.2.2 Exploration and production in the Gippsland Basin

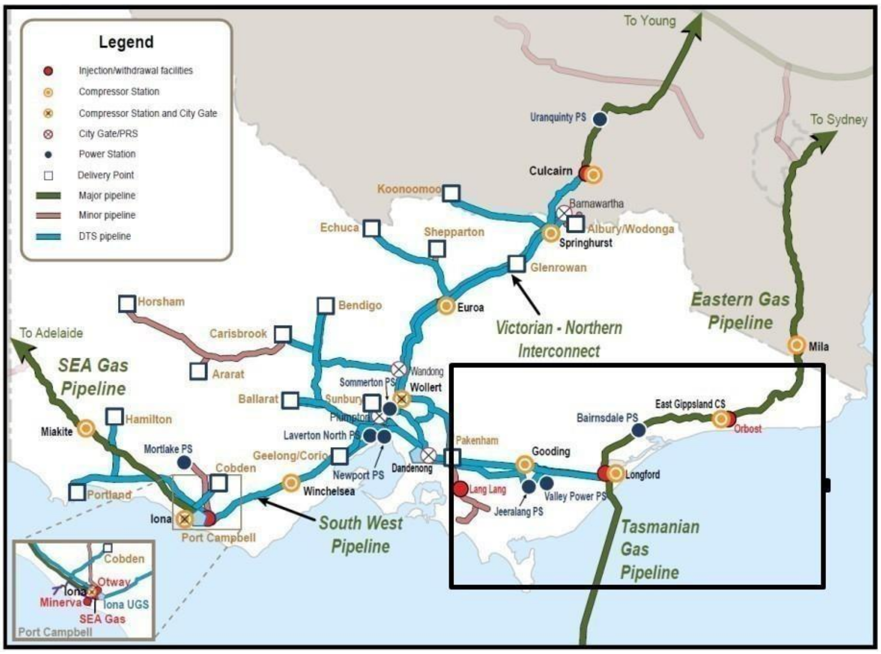
The Gippsland Basin is located approximately 200 km east of the city of Melbourne. The basin covers an area of 46,000 km^2, with two-thirds located offshore. The onshore component stretches from Western Port Bay to Orbost. The Gippsland Basin is Victoria's most productive petroleum basin. Exploration since the 1960s has yielded several world class oil and gas fields as well as numerous small and medium sized fields. In the offshore part of the basin as at 2014, 9,120 PJ of gas and 26,089 of liquid hydrocarbons had been produced.

The onshore Gippsland Basin has had a long history of exploration, with 197 wells drilled since 1886. Exploration of the Gippsland Basin was carried out safely and in line with requirements of the regulatory framework. While the onshore geological units found are similar to those offshore, no commercial discoveries have been made. There are currently only two PEPs across the onshore Gippsland Basin. The licensees for these permits are:

- Petro Tech Pty Ltd
- Icon Energy Limited.

The Gippsland region hosts a wide array of processing facilities and gas pipelines (Figure 5). Gas produced from the Gippsland Basin services Melbourne, regional centres across Victoria as well as the wider east-coast gas market.[26]

Figure 5: The existing pipeline infrastructure, with the area of focus for the Gippsland Basin scenarios in this assessment



Source: DJPR (2019). Victorian Gas Planning Report.

2.3 Gas production and use in Victoria

Victoria consumes a large volume of gas relative to other states (see Figure 6 and Table 13). Victoria's colder climate, nearby offshore reserves and historically large levels of gas supply led to the establishment of gas as a cheap, reliable energy source since the 1970s.

Currently, natural gas provides residential consumers in Victoria with 65 per cent of their annual energy use (compared to the Australian average of 32 per cent of residential energy use from gas).

Annual Victorian gas consumption[27] has been relatively consistent over the last six years approximately 200 PJ/year (see Table 13) – with industrial gas usage being offset by increased residential consumption particularly during the winter peaks.

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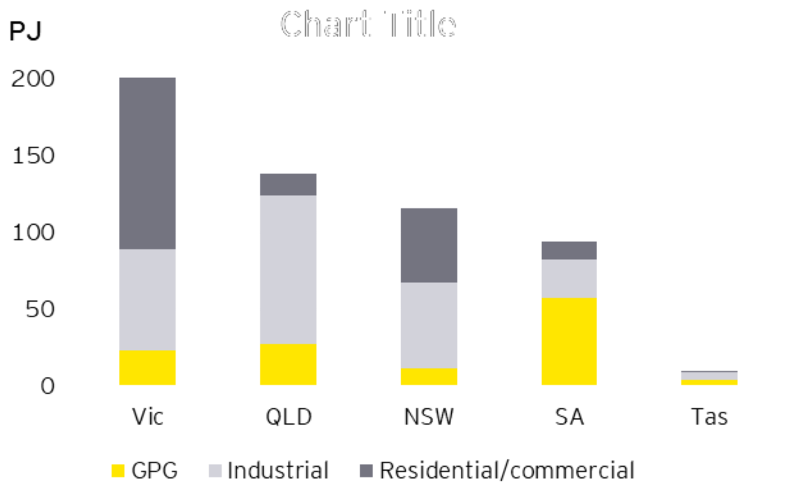
[26] Earth Resources. (2020). *Oil and gas in Victoria*. [online] Available at: https://earthresources.vic.gov.au/geology-exploration/oil-gas/oil-and-gas-in-victoria [Accessed 18 Dec. 2019].

[27] For modelling purposes, it is assumed that existing facilities would be connected as it is likely that operators will already have established infrastructure in the region.

Figure 6: Gas consumption in eastern Australia, 2018



Source: AEMO (2019). Gas Statement of Opportunities.
Note: GPG is gas-powered generation.

Table 13: Annual gas consumption and peak daily demand, Victoria

	2013	2014	2015	2016	2017	2018
Total Victorian Consumption (PJ)	217	217	218	211	241	220
Actual DTS peak total demand (TJ/day)	1,165	1,214	1,179	1,187	1,279	1,132

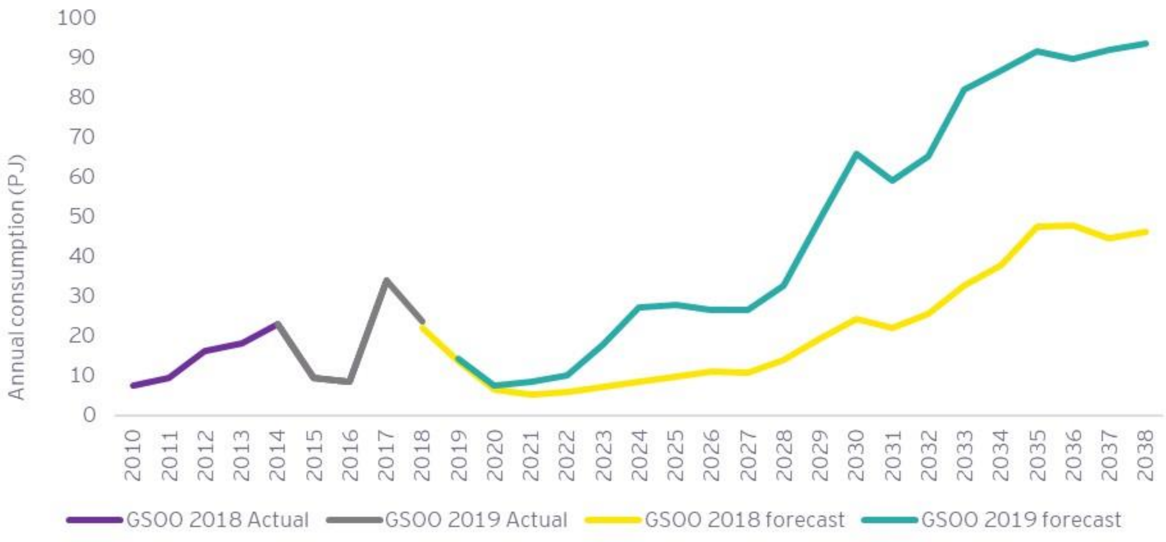
Source: AEMO (2019). Gas Statement of Opportunities.

Average annual Victorian gas consumption is forecast to increase slightly during the outlook period[28], from 200 PJ in 2019 to 203 PJ in 2023. This is due to an increase in residential consumption (driven by population growth relative to energy efficiency improvements) and gas-powered generation (GPG) consumption as a result of the expected closure of the Liddell coal-fired power station in NSW in 2022.[29] [30] Actual and forecast GPG consumption in Victoria is presented in Figure 7.

[28] Outlook period refers to the time period between 2019 – 2023.
[29] Victorian forecast GPG consumption is forecast to rise primarily due to the announced closure of the Liddell coal-fired power station.

[30] Victorian Gas Planning Report. (2019). Australian Energy Market Operator, p.28.

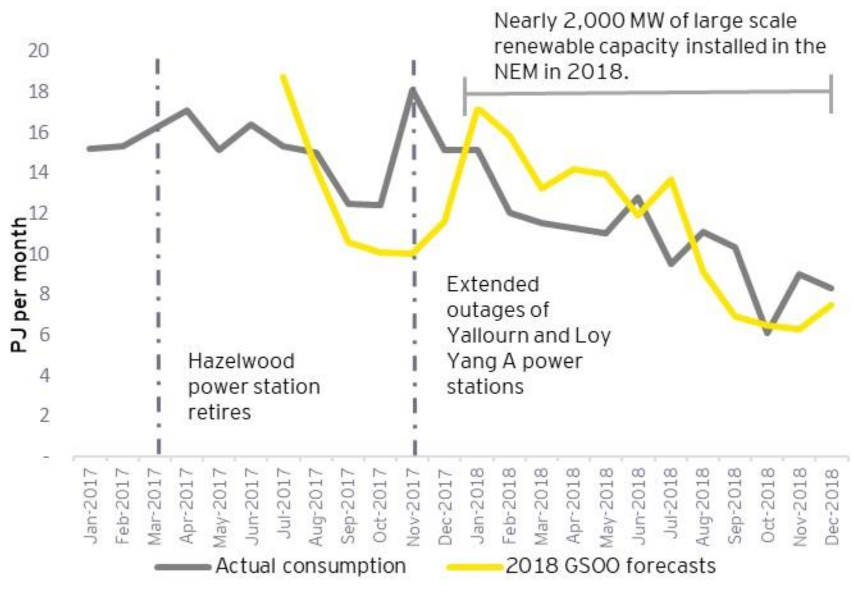
Figure 7: Actual and forecast annual Victorian GPG consumption, 2010-2038



Source: Forecasting.aemo.com.au. (2020). NATIONAL ELECTRICITY FORECASTING. *[online] Available at: http://forecasting.aemo.com.au/Gas/AnnualConsumption/Total [Accessed 4 Feb. 2020].*

Prior to 2017, annual gas consumption for GPG was relatively low compared to other uses (around 3-4 PJ/year). However, the closure of Hazelwood Power Station in March 2017 has led to increased GPG consumption during 2017 and 2018 (Figure 8). Since then an increase in black coal-fired (in New South Wales), hydro, and renewable generation has reduced annual gas consumption for GPG close to pre-2017 levels.

Figure 8: Gas monthly consumption forecast comparison, GPG, 2017-18 (PJ per month)

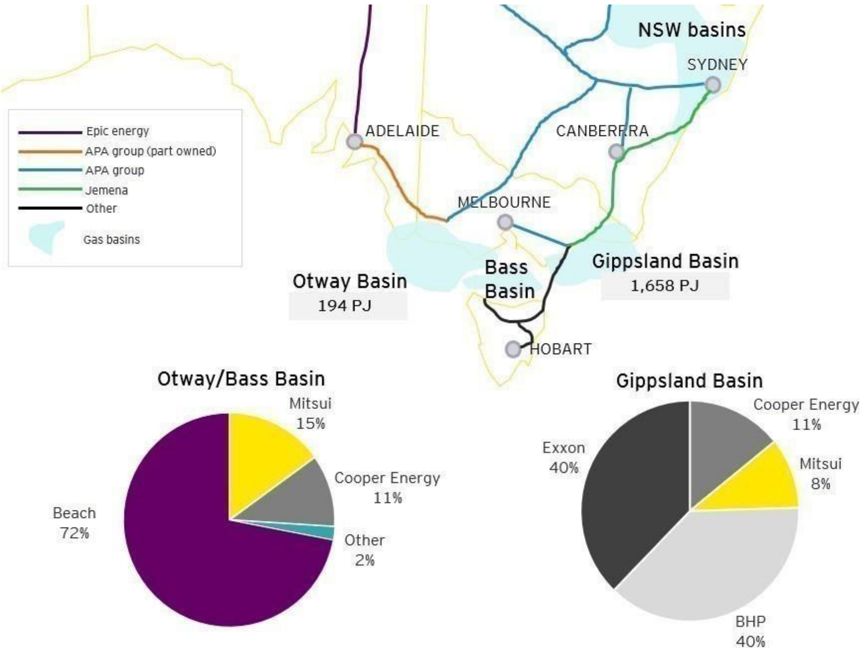


Source: AEMO (2019). Gas Statement of Opportunities.

Victoria has historically relied on gas production from the Gippsland, Otway and Bass basins. Gas reserves of approximately 194 PJ of 2C[31] remain in the offshore Otway Basin, with 1,658 PJ in the offshore Gippsland Basin (Figure 9).

[31] 2C refers to 'contingent, not proven or probable' reserves.

Figure 9: Victorian gas production shares by basin, and gas transmission ownership

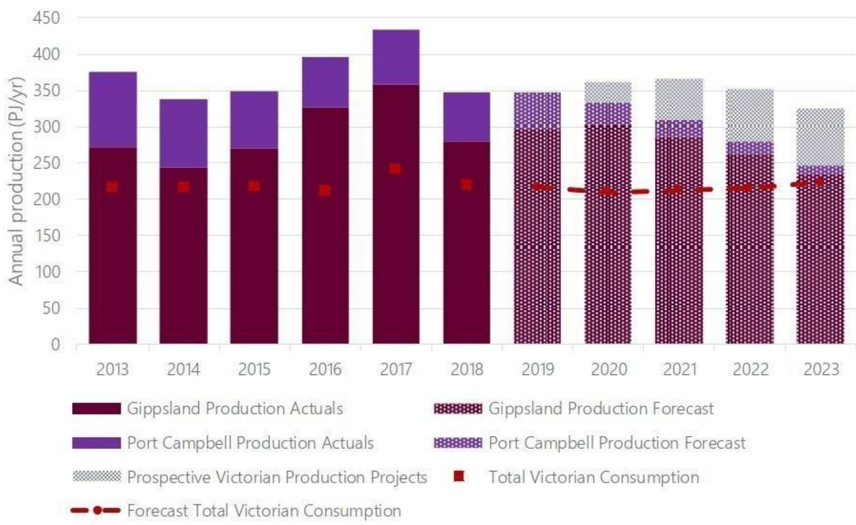


Source: AER (2018). State of the Energy Market.

Gas production forecasts show that offshore Victorian gas production is expected to decline by 29 per cent during the five-year outlook period, from 347 PJ in 2019 to 246 PJ in 2023 (Figure 10).

Victoria has supplied, on average, 150 PJ/year to South Australia, New South Wales and Tasmania from production surplus to Victorian consumption. This annual production surplus is also forecast to decline to 130 PJ/year in 2019 through to 23 PJ in 2023.[32]

Figure 10: Victorian annual gas production and consumption by location (actual and forecast), 2013-2023



Source: AEMO (2019). Gas Statement of Opportunities.

There are several new uncommitted projects being considered by market participants that could increase exploration, development and annual gas supply in Victoria. This includes:

[32] Note, the maximum physical capacity of gas flow from Queensland to the southern states through existing pipeline infrastructure is 145 PJ/y.

- additional offshore gas production projects (e.g. Kipper Stage 1B)
- liquified natural gas (LNG) import terminal projects (e.g. AGL's Crib Point LNG import facility)
- additional gas storage capacity (e.g. series of committed and proposed expansions of the Iona underground gas storage (UGS) reservoir facility).

For further information on the industry profile, see Appendix A.

2.4 Legislative framework for exploration, development, production and use in Victoria

2.4.1 Moratorium

The Victorian Government introduced a moratorium to regulate and restrict onshore gas exploration and production in the State, with a view to managing the risks and impacts associated with the conventional gas industry.

In August 2012, the previous Victorian government introduced a moratorium on new coal seam gas ('unconventional') exploration licences granted under the *Mineral Resources (Sustainable Development) Act 1990* (the Minerals Act) and approvals to undertake hydraulic fracturing as part of onshore gas exploration. This was extended in November 2013 to cover all new onshore gas exploration licenses in order to undertake water science and community engagement programs to inform the government's policy direction for onshore unconventional gas.

In May 2014, this moratorium was further extended to include conventional gas exploration drilling, thereby deferring regulatory decisions on applications to undertake work and operations while the water science and community engagement programs were underway.

In 2017, the Victorian Government passed the *Resources Legislation Amendment (Fracking Ban) Act 2017* (Vic) (The Fracking Ban Act) to:

- amend the *Petroleum Act 1998* ('the Petroleum Act') to permanently ban the exploration of all onshore unconventional gas, which includes hydraulic fracturing and coal seam gas exploration
- extend the moratorium on all petroleum exploration and on onshore conventional gas production in Victoria until 30 June 2020
- exempt certain activities.

In the absence of any legislative change, the onshore conventional gas exploration and development moratorium sunsets at 30 June 2020, and the industry will be able to restart at this time. The work performed by the VGP on the prospectivity of future gas development in the region has been conducted to inform government decision-making on future gas regulation in Victoria.

2.4.2 Petroleum regulation in Australia

Upstream petroleum regulatory frameworks around the world, including the Victorian framework, may be characterised as risk based, and are generally non-prescriptive. Most frameworks require an explicit description of the operating environment, identification of risks, and measures to mitigate identified risks to the specific environment as far as practicable.

Petroleum regulation in Australia features four basic tenets: exploration and production as the main phases of a petroleum project; exclusive rights to explore for or produce petroleum in the authority area; Crown ownership of all petroleum; and royalties payable on production. Accordingly, any petroleum found onshore, or up to three nautical miles offshore from the seashore, is owned and regulated by the relevant state. Any petroleum that exists offshore from the three nautical mile limit and to the extent of Australian territorial waters is owned and regulated by the Commonwealth.

Petroleum frameworks deal with two main functions: the allocation of rights to facilitate the discovery of petroleum for the benefit of constituents in a jurisdiction, and to minimise risk. This is done through the granting of licences that give the holder the exclusive right to undertake exploration and production activities in the licenced area. Licences set conditions that dictate the extent of the authority areas, the tenure of the authority, and authorised activities.

Secondary authorisations, in the form of plans that apply to a specific authority and activity, manage risk. Throughout the life of an authority, a number of plans must be submitted to the relevant regulator for approval. These plans identify the operating environment within an authority area, and mitigation measures implemented to minimise risk. These plans become more detailed as a project develops, with specific plans required for exploration, drilling and management of wells, petroleum production or storage.

2.4.3 Current legislative framework for onshore conventional gas

Onshore conventional gas is regulated by the Petroleum Act and its regulations ('The Petroleum Regulation Framework').[33] The Petroleum Act defines 'petroleum' in a broad sense to include natural gas, and covers the issues of licensing, approvals, compensation, community consultation, royalties and rehabilitation.

The objectives of the legislation are to balance the economic benefits of a competitive and efficient gas industry while ensuring that any negative impacts on the community and environment are minimised or compensated.[34]

Objectives of the Petroleum Act 1998

The objectives of the Petroleum Act are set out in section 3 and include two parts. First, to encourage the exploration for petroleum in Victoria and to promote petroleum production for the benefit of all Victorians by providing:

- an orderly, fair and competitive system for granting authorities enabling petroleum exploration and production
- clear and effective administrative frameworks for organising petroleum development activities
- fiscal regimes that offer petroleum explorers a fair return while benefiting all Victorians
- easy and effective access to information on Victoria's petroleum geology.

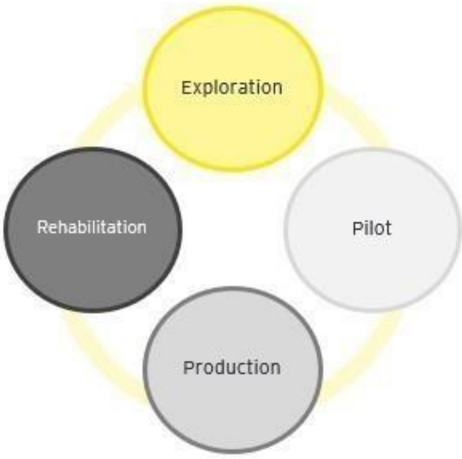
Second, in 'encouraging petroleum exploration and production' the Petroleum Act seeks to have regard to economic, social and environmental interests by ensuring:

- the safe and efficient exploration for, and production of, petroleum
- that the impacts on individuals, public amenity and the environment as a result of petroleum activities will be minimised as far as is practicable
- that land affected by petroleum activities is rehabilitated
- that there will be just compensation for access to, and the use of, land
- that petroleum explorers and producers will comply with all authority conditions that apply to them.

The Petroleum Act provides the main legislative framework for the development and regulation of conventional gas across the gas operation lifecycle, as shown in Figure 11.

[33] *Petroleum Act 1988*.
[34] *Petroleum Act 1988*. s1.

Figure 11: Typical gas operation lifecycle



The Petroleum Act establishes and regulates the following streams and activities within the gas operation lifecycle:

- allocating petroleum rights
- authorising exploration activities
- authorising production activities
- land access arrangements
- rehabilitation and closure
- managing environmental impacts
- managing social impacts
- penalties and enforcement
- ensuring fit and proper authority holders
- promoting economic impacts.

Table 14 summarises each of these governance and regulatory requirements introduced through the Petroleum Act. Each of these are outlined in further detail below.

Table 14: Activities regulated by the Petroleum Act

Activities regulated by the Petroleum Act	Summary of how the Petroleum Act regulates these activities
Allocating petroleum rights	The Petroleum Act allows for the grant of the following authorities: ► PEP – which enable the holder to explore for petroleum within the permitted area ► petroleum retention lease – which enable the holder of an exploration permit to retain certain rights to a petroleum discovery that is not currently commercially viable, but might become viable to develop within 15 years ► petroleum production license – which allow for the production and exploration of petroleum ► petroleum special access authorisation ► petroleum special drilling authorisation. These authorities all serve to manage gas exploration and production activities.

Activities regulated by the Petroleum Act	Summary of how the Petroleum Act regulates these activities
Authorising exploration activities	► The Petroleum Act requires that once a PEP has been granted, that plans must be prepared and approved by the Minister prior to any work commencing. The following plans must, among other things, describe the proposed activities and outline how impacts and risks will be avoided, minimised and mitigated: ► risk assessments and management commitments ► Well Operations Management Plans (WOMPs)[35] ► Environmental Management Plans (EMPs) ► rehabilitation commitments ► Development Plan. The PEP may also include a cultural heritage management plan for any ground disturbing works in areas of cultural heritage sensitivity.
Authorising production activities	Similar to the process described above for exploration, gas production also requires an approved operation plan and a production development plan, which must include a reservoir management plan. These plans must address all the issues relating to the proposed operation and must cover all the aspects prescribed in the Petroleum Regulatory Framework.
Land access arrangements	The Petroleum Act requires that consent or a compensation agreement is needed prior to starting a gas operation on private property. This means that a person must obtain the consent of both the owner and occupier of land where an operation is proposed and enter into a compensation agreement with the owner and occupier of the relevant land. Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of gas operation on land.
Rehabilitation and closure	The Petroleum Act sets out the framework for rehabilitation and closure. The holder of an authority[36] must rehabilitate land affected by exploration or resource development and must rehabilitate the land before the authority expires or ends. The authority holder is required to obtain a rehabilitation bond for an amount specified by the Minister.
Managing environmental impacts	The regulatory framework under the Petroleum Act specifies that the industry is required to protect the environment when carrying out petroleum activities. Operations Plans serve as important requirements in overseeing and assessing environmental impacts.
Penalties and enforcement	Penalties in the Petroleum Regulatory Framework are related specifically to offences the Act, meaning that penalties are designed to punish the act of breaching the legislation as opposed to punishing the outcome or consequence from the breach.
Promoting economic impacts	The Petroleum Regulatory Framework and non-regulatory measures also work to attract new exploration investment in Victoria and to encourage discovery and production if environmental and social risks can be managed.

2.4.3.1 Allocating petroleum rights

The Petroleum Act allows for the grant of the following authorities (Table 15):

Table 15: Authorities established by the Petroleum Act

Authority name	
PEP	► allows the holder to explore for petroleum within the defined area ► five-year initial tenure with one renewal possible for another five-year term ► generally, a fairly large licence area where area is reduced on renewal.

[35] If a well is to be drilled.
[36] Authority refers to possession of an approved permit, retention lease, production license, special authorisation or special drilling authorisation.

Authority name	Purpose
Petroleum retention lease	▶ allows the holder to undertake exploration activities within the lease area ▶ applicant must hold an exploration permit and have discovered a petroleum resource that is not currently economic to produce, but will be within 15 years ▶ Fifteen--year term with no possibility of renewal ▶ licence area is normally the minimum area necessary to cover the maximum extent of the petroleum resource.
Petroleum production licence	▶ allows the licensee to produce petroleum or store gas underground ▶ applicant must hold petroleum exploration permit or retention lease ▶ no defined term –, operates until the holder surrenders the licence. However, holder must continue to undertake some form of activity to retain licence ▶ licence area is normally the minimum area necessary to cover the maximum extent of the petroleum resource ▶ any petroleum produced is property of the licensee once it has passed through the well-head.
Petroleum special access authorisation	▶ allows the applicant to undertake petroleum exploration operations within the authorisation area ▶ does not allow for the making of a well or grant any rights to petroleum within the authority area ▶ applicant is not required to hold any other type of authority under the Petroleum Act ▶ maximum term of one year, with one renewal of a further year.
Petroleum special drilling authorisation	▶ applicant must have an exploration, retention, or production authority under the Petroleum Act, or *Offshore Petroleum and Greenhouse Gas Storage Act 1998* (OPGGS Act) ▶ allows the holder of an exploration, retention, or production authority under the Petroleum Act or OPGGS Act to carry out petroleum exploration operations within the authorisation area ▶ allows the holder of a production authority under the Petroleum Act or OPGGS Act to carry out petroleum production in the authorisation area ▶ does not give the holder any rights in respect to resources within the authorisation area ▶ must hold an authority under the Petroleum Act or OPGGS Act ▶ terms are the same as that of the authority pursuant to which it is granted (I.e. If primary authority is a production licence under the Petroleum Act, the related petroleum special drilling authorisation will also remain in force indefinitely).

Applications for petroleum authorities are invited by government. The only way to apply for a PEP is when the state decides to undertake an acreage release that specifies particular areas that are available. The state sets criteria as to how tenders will be assessed, and authorities subsequently granted. It is not possible for an application to be submitted unsolicited as in the model for mineral and stone exploration.

An application for a petroleum production licence or retention lease must be accompanied by evidence of the discovery of a petroleum resource or reservoir. If it is economic to produce at the time of discovery, a retention lease will not be granted. A retention lease is granted only when a resource or reservoir is deemed to be uneconomic at the time of discovery, but likely to become economic within 15 years. To apply for either of these authorities, one must hold a PEP.

In the event that a petroleum resource or reservoir is discovered, with the current authority holder unable to produce or retain it, or in the event of a production licence or retention lease being surrendered, the Minister may invite tenders for the relevant authority.

2.4.3.2 Authorising exploration activities

Petroleum exploration requires a PEP. Petroleum tenements[37] are released by the Minister under acreage releases and companies are invited to tender.

Once the Minister has granted a PEP, the holder must prepare and have approved an operation plan prior to any exploration work commencing. This plan describes the proposed activities, risk assessments and management commitments, includes both a WOMP and EMP, and consultation plans. These are explained further below.

The PEP may also include a Cultural Heritage Management Plan (CHMP) for any ground disturbing works in areas of cultural heritage sensitivity.

Exploration cannot be carried out on private land without:

- obtaining consent of the owner and occupier
- a compensation agreement being entered with the owner and occupier of the land
- the Victorian Civil and Administrative Tribunal determining the compensation payable to the owners and occupiers of the land
- written consent of the Minister.

Petroleum exploration does not require a planning permit. A licensee must hold insurance and provide a rehabilitation bond. A licensee must provide the landowner or occupier with 21 days written notice of any operations taking place.

2.4.3.3 Authorising production activities

Similar to the process described for exploration, petroleum production also requires an approved operation plan and a production development plan, which must include a reservoir management plan. These plans must address all the issues relating to the proposed operation and must cover all the aspects prescribed in the Petroleum Regulations.

An applicant must obtain planning approval for petroleum production and development. The same requirements for exploration relating to consent, compensation, insurance and rehabilitation also apply to production.

The Crown owns all petroleum "on or below the surface of any land in Victoria that came to be on or below that surface without human assistance". Therefore, no compensation is payable to landowners for petroleum that is extracted from their land. Compensation is payable for any loss or damage that has been, or will be, sustained in relation to the land as a direct, natural and reasonable consequence of the approval of any petroleum operation or the carrying out of any petroleum operation under the authority.

2.4.3.4 Land access arrangements

The Petroleum Act gives the State Government ownership over all petroleum, including natural gas, in Victoria.[38] There is no compensation to owners or occupiers of the land for the value of any natural gas extracted on the land.[39]

Before any operation on private land begins, the authority-holder must have the consent of, or a compensation agreement with the owners and occupiers of the land for access to the land. The

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[37] Defines petroleum permit boundaries including exploration permits, retention leases and production licences.
[38] *Petroleum Act 1998*. s13.
[39] Petroleum Act 1998 (Vic), s131

Victorian Civil and Administrative Tribunal also has the power to determine the compensation payable to landowners and occupiers.[40]

Owners and occupiers of private land and Native Title land are entitled to compensation from the authority holder for the following:[41]

- deprivation of possession of the whole, or any part of the surface, of the land
- damage to the surface of the land
- damage to any improvements on the land
- severance of the land from other land of the owner or occupier
- loss of amenity, including recreation and conservation values
- loss of opportunity to make any planned improvement on the land
- any decrease in the market value of the owner or occupier's interest in the land.

In the event a satisfactory compensation agreement is not entered into, the owner or occupier of land, or the holder of an authority, may apply to the Victorian Civil and Administrative Tribunal for the determination of the amount payable to the owners and occupiers of the land subject to a petroleum operation.

2.4.3.5 Rehabilitation and closure

The Petroleum Act outlines the framework for rehabilitation once a gas well is depleted. The authority holder must rehabilitate land affected by any operation under the authority, including exploration and production, and they are required to complete this before the authority ends.[42] To rehabilitate the land, the authority holder must fulfil the rehabilitation measures included in their Operation Plan, which was approved by the Minister.[43]

The authority holder is required to have a rehabilitation bond for an amount that has been determined by the Minister.[44] This financial security that ensures there is money to for Earth Resources Regulation (ERR) to undertake rehabilitation if the authority holder is unable to do so.

Victorian government records[45] indicate that the rehabilitation bond for retention leases are approximately $25,500 and range from $4,000 to $25,500 for exploration permits.[46] If the rehabilitation undertaken is insufficient, the Minister can carry out rehabilitation and recover those costs from the license holder via the courts if they are not fully covered by the rehabilitation bond.

Landowners can request that the Minister carry out further rehabilitation.[47] If the Minister refuses, they must inform the landowner of the reasons for that refusal.[48]

The rehabilitation process is specified in greater detail in the Minerals Act and which was amended in 2019. ERR in the department is responsible for administering the act and overseeing the rehabilitation process.

[40] *Petroleum Act 1998*. s128.
[41] *Petroleum Act 1998*. s129.
[42] *Petroleum Act 1998*. s170(1).
[43] *Petroleum Act 1998*. s170(2).
[44] *Petroleum Act 1998*. s173.
[45] Information provided by the department.
[46] Information provided by the department.
[47] Petroleum Act 1998. s175(1)(c)
[48] Petroleum Act 1998. s175(4)

2.4.3.6 Managing environmental impacts

The Petroleum Regulatory Framework has evolved with the onshore petroleum industry in Victoria. It sets out how industry is required to protect the environment when carrying out petroleum activities.

Prior to carrying out any petroleum operation an authority holder is required to submit an Operation Plan to the Minister. The Petroleum Regulations require an Operation Plan to include an EMP that outlines how the authority holder will manage environmental risks. The plan must be reviewed and accepted by the Minister before an authority holder can carry out any petroleum operations. Additionally, the authority holder must observe the plan, and ensure that operations are carried out in accordance with it, with penalties in place for non-compliance.

A WOMP must, to the satisfaction of the Minister:

- detail the design of the operation
- identify the risks associated with the well activity and state how the holder of the authority proposes to eliminate or minimise those risks
- outline how well integrity hazards will be dealt with
- outline how aquifers will be protected.

An EMP must, to the satisfaction of the Minister:

- describe the environment including any relevant values and sensitivities
- describe any relevant cultural, historical, aesthetic, social, recreational, ecological, biological, landscape, and economic aspects of the environment that may be affected by the petroleum operation
- describe environmental risks and effects
- describe how environmental risks will be managed
- describe how interested parties will be consulted about environmental performance.

The description of the environment forms the basis of identifying and evaluating the environmental effects and risks of the petroleum operation that are directly and indirectly caused by the normal activities of the petroleum operation. Furthermore, an assessment of the risks of potential effects on the environment resulting from reasonably proximate and possible activities relating to the petroleum operation, or incidents or events that are not normal activities, incidents, or events arising from the operation.

An EMP must define standards and objectives that the authority holder will be bound to in assessing whether they have protected the environment from their petroleum operation. Measurement methods that determine whether the objectives and standards have been met must also be included.

An important element of the EMP is the implementation strategy. The implementation strategy sets out how the authority holder will:

- ensure environmental performance objectives and standards are met
- identify the systems, practices, and procedures that:
  - eliminate or minimise potential adverse environmental effects and risks from the petroleum operation so far as is practical

- meet environmental performance objectives and standards.

- establish a clear chain of command (outlining roles and responsibilities) in relation to the implementation, management and review of the plan
- include measures to ensure each employee or contractor meets their responsibilities in relation to the environment and ensure they have the appropriate skills and training to fulfil them
- provide for monitoring, audit, and review of environmental performance and the implementation strategy
- maintain quantitative records of emissions and discharges into the air, land, or subsurface that can be monitored and audited against environmental performance standards
- include arrangements to record, monitor, and Report information about the petroleum operation that will allow the Minister to determine if the plan is complied with
- provide appropriate consultation for the life of the operation about the authority holder's environmental performance with relevant State and Commonwealth agencies, and other relevant interested parties and organisations
- provide an up to date emergency response manual with detailed arrangements for dealing with any threat to the environment near the petroleum operation and ensuring that a threat does not harm the environment.

While the Minister provides the final approval for an EMP, the Minister relies on ERR to make assessments on behalf of the Minister. The Petroleum Regulatory Framework also requires authority holders to consult the relevant agencies, interested people and organisations and provide a Report on the outcome of this consultation as part of the EMP. ERR ensures compliance with the plan by conducting physical site inspections, examining the records required by the Petroleum Act, and the Operation Plan.

Finally, an EMP must include a statement of the corporate environmental policy of the authority holder, a Report on any consultations between the holder of the authority and relevant agencies, interested people and organisations while developing the plan, and a list of all Victorian or Commonwealth environmental legislation that may be applicable to the petroleum operation.

Environmental risks arising from petroleum activities are also governed through a comprehensive legislative framework that goes beyond the Petroleum Regulatory Framework. In addition to this framework, authority holders must comply with several other acts and regulatory mechanisms including:

- *Aboriginal Heritage Act 2006* ('Aboriginal Heritage Act')
- *Catchment and Land Protection Act 1994* ('CALP Act')
- *Environment Protection Act 1970* ('EP Act')
- *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act')
- *Flora and Fauna Guarantee Act 1988* ('FFG Act')
- *Planning and Environment Act 1987* ('P&E Act')
- *Water Act 1989* ('Water Act')
- *Wildlife Act 1975* ('Wildlife Act').

2.4.3.7 Managing social impacts

The Petroleum Regulatory Framework is not prescriptive to how social impacts need to be addressed, and this is an area where the community has, and continues to demand greater action and consideration from government.

Engagement with the community can take place at various stages of the exploration process:

- determining an acreage area stage
- acreage release stage
- rights allocation stage
- preparation of environmental approvals (EMP, EPBC Act referral, Environmental Effects Statement (EES), Emergency Response Plan (ERP), etc).[49]

Unlike environmental and operational risks, the level of scrutiny and expectation in managing social impacts is low. In order to satisfy the current requirements relating to social impacts, a proponent must submit a Report of their consultation undertaken in the development of the operation plan with relevant agencies and interested people and organisations. There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community. While this has been acceptable in the past, communities are becoming more informed and demand meaningful and ongoing consultation throughout the life of a project, not just at the point where an authority has been granted and a proponent is required to prepare an operation plan.

2.4.3.8 Penalties and enforcement

Penalties in the petroleum regulatory framework are related specifically to offences against the Petroleum Act. This means that penalties are not designed to punish the outcome of a breach of the act, but to punish the action of breaching the legislation. For example, if the holder of a petroleum production licence were to cause an oil spill to occur, the penalties under the Petroleum Act relate to the authority holder not following plans approved under the Act, if this has indeed occurred. Environmental and occupational health and safety impacts are penalised under the relevant acts and would incur penalties commensurate to the nature of the breach under their relevant act. In terms of the penalty units attached to breaches under the Petroleum Act, these are commensurate to those in the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (‘OPGGS Act’) and are generally in line with those found in other resources legislation in Australia.

For example, the EP Act provides for the management of air, land, water, and noise pollution, setting out acceptable limits for discharges via the subordinate state environment protection policies. The process under the Petroleum Act ensures that any discharges approved under an operation plan complies with these limits. Compliance with the operations plan is managed by ERR, however if a discharge occurs that exceeds the allowable limits then enforcement actions are undertaken by the Environment Protection Authority under the EP Act.

Under the Petroleum Act, the maximum penalties are 240 penalty units for an individual and 1,200 penalty units for a corporation for the breach of an operation plan. However, the maximum penalty for recklessly endangering persons at workplaces is 20,000 penalty units under the *Occupational Health and Safety Act 2004* (‘OH&S Act’) and the maximum penalty for aggravated pollution in the EP Act is 10,000 penalty units.

2.4.3.9 Ensuring fit and proper authority holders

The Petroleum Act does not have explicit provisions to test whether authority applicants are ‘fit and proper’. This is typically undertaken in mining regulation to ensure that authorities are not issued to

[49] Information provided by the department.

applicants that have a poor compliance history, a criminal history or those that are unlikely to have sufficient financial capacity to meet the obligations placed on them under the act.

Petroleum legislation typically does not include 'fit and proper' provisions because the nature of companies that are active in the industry are large, well-resourced entities that are subject to other regulatory schemes (e.g. *Corporations Act 2001* and/or ASIC listing rules) that serve to achieve the same outcome of a fit and proper test. Further, petroleum authorities may only be applied for when government decides to release acreage and invite tenders. Government is able to determine assessment criteria as part of these tender specifications that, amongst other things, can include fit and proper criteria.

2.4.3.10 Promoting economic impacts

In addition to the risk management measures outlined above, the Petroleum Regulatory Framework and non-regulatory measures also work to attract new exploration investment into Victoria and to encourage discovery and production.

Victoria allocates the right to explore for petroleum on a competitive basis. The Minister invites tenders over a specified area, with the applicant that demonstrates the best proposed work program and ability to achieve that work program granted a PEP. Regardless of the number of applicants an invitation attracts, the Minister must consider the relevant merits of, and likelihood of a work program being carried out. The potential return of a petroleum resource necessitates a significant investment in finding, developing and producing it to the maximum benefit of the Victorian public.

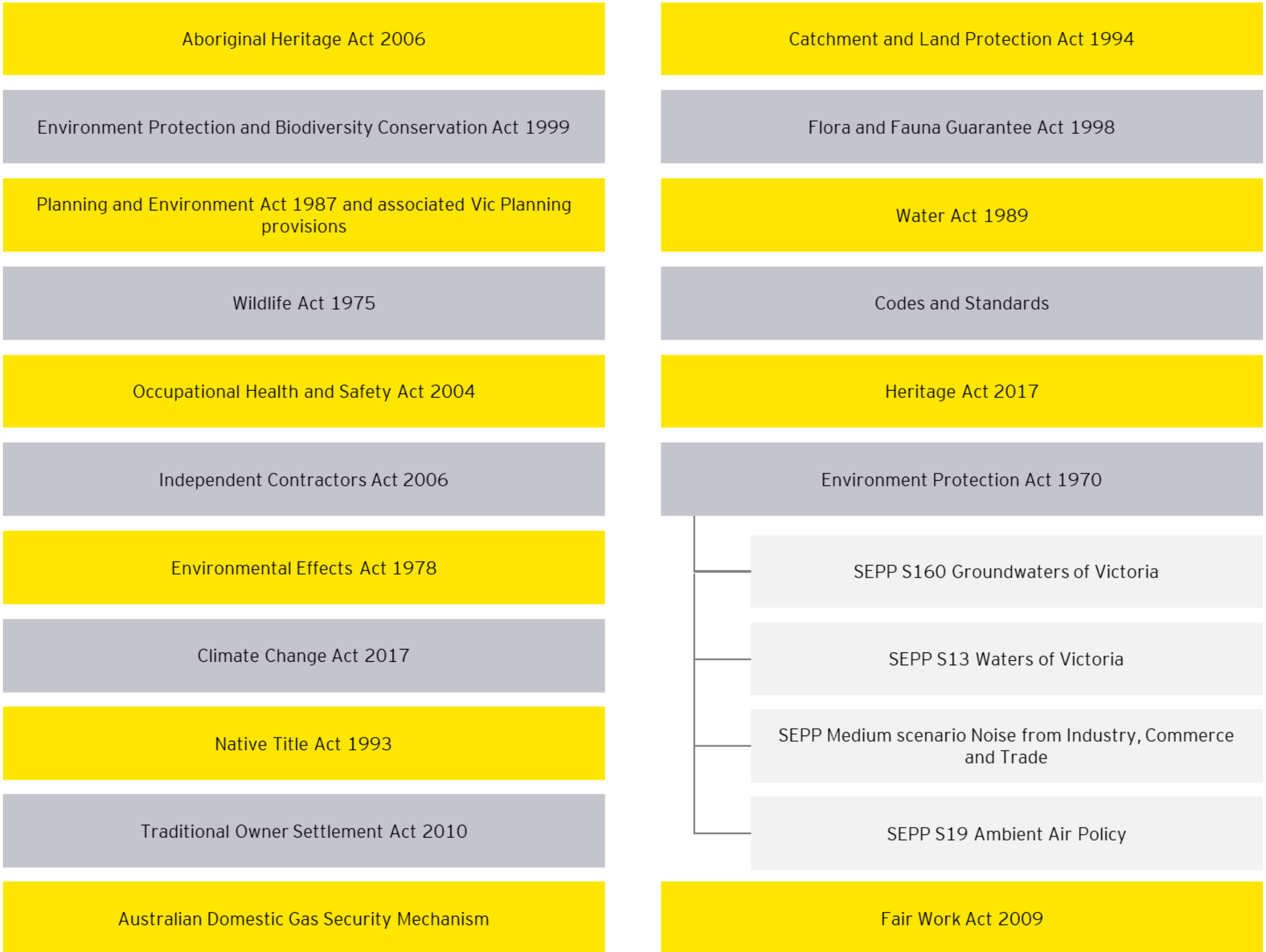
As the Minister determines when and where land will be available for exploration, it is necessary to provide pre-competitive data to drive and create interest in areas that are prospective. This is achieved through the GSV. The GSV undertakes a thorough investigation of prospective areas, incorporating water science studies, geological surveys and modelling of this data to create a model of specific basins that informs the Minister as to the prospectivity of an area as well as associated risks. If the Minister determines that an area is sufficiently prospective, an acreage release can occur, and this data is released publicly. Applicants must then use this data in developing an appropriate work program.

This serves to reduce risk and increase interest on the part of petroleum explorers in Victorian resources.

2.4.3.11 Other Legislation

In addition to this framework, authority holders must comply with several other Acts and regulatory mechanisms, including those shown in Figure 12.

Figure 12: Legislation authority holders must comply with in addition to the Petroleum Regulatory Framework[50]



Other regulatory controls are discussed in further detail in Appendix D.

2.4.3.12 International and national standards and self-regulation

Standards and self-regulation are designed to set industry best practice and impose requirements on current and prospective license holders that are a higher standard than expected under the legislative framework. The Petroleum Regulatory Framework and other legislation is therefore designed to set the minimum operating standards required by all parties with the sector.

Key international and national standards that the gas industry operates to include:

- Environmental Manual for Worldwide Geophysical Operations International Association of Geophysical Contractors 2013
- Environmental Management in Oil and Gas Exploration and Production Industry and Environment office of the United Nations Environment Programme 1997
- Exploration and Production Waste Management Guidelines E&P Forum 1993
- Code of Environmental Practice Australian Petroleum Production Exploration Association (APPEA) 2008

50 Information provided by the department.

► Code of Environmental Practice (APGA) 2017.

The gas industry also possesses its own standards of best practice and implements standards under the International Organisation for Standardisation (ISO), with a technical committee existing for the sole purpose of creating standards for materials, equipment and offshore structures for industries including natural gas.

There is also a vast array of guidance material produced by the International Association of Oil & Gas Producers that the industry regularly refers to when determining what best practice is.

A good example of the application of industry standards is for the management of well integrity. Well integrity is defined by NORSOK D-010 as the "application of technical, operational and organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well." Strong well integrity is important to operators both from a commercial perspective (to minimise loss of gas) and an environmental perspective (to minimise environmental contamination. Managing well integrity is relatively a standard process in the industry that can be easily codified. The government regulatory framework relies on application of these standards by industry during the life of an operation and for the closure of a well. License holders generally detail the industry standards and frameworks that they abide by on their company websites. There are currently 10 parties holding PEPs in Victoria (noting these parties are unable to conduct exploration or development activities under the moratorium). These parties are outlined in Figure 13.

Figure 13: Current parties who hold exploration permits in Victoria[51]

Bridgeport (Eromanga) Pty Ltd
Mirboo Ridge Pty Ltd
Petro Tech Pty Ltd
Beach Energy Ltd
Icon Energy Ltd
Somerton Energy Pty Ltd
Lochard Energy (Iona Operations) Pty Ltd
Boggy Creek Pty Ltd
CO2CRC Ltd
Beach Energy (Operations) Ltd

2.4.3.13 Regulatory and legislative gap analysis

The VGP has undertaken a desktop assessment of earth resources and onshore gas-related inquiries and Reports to identify key regulatory areas of importance to communities and other stakeholders. The assessment extended to the identification of key regulatory gaps and inadequacies in these areas of the Petroleum Regulatory Framework, including jurisdictional review to identify current regulatory trends and leading practice. The gap analysis showed that while the onshore Petroleum Regulatory Framework is relatively robust for managing environmental and safety risks, it could be improved in areas relating to:

► consideration and management of broader industry impacts on the economy, environment and communities in regulatory decision making

51 Information provided by the department.

- community engagement obligations
- transparency of regulatory decisions and industry activities
- information asymmetries between industry and land holders.

2.4.3.14 Compliance and enforcement

ERR sits within the department with the Minister for Resources responsible for its oversight. ERR is responsible for regulating the resources industry to effectively manage risks to the environment and community and is responsible for administering the Petroleum Act in Victoria. It is the regulator of exploration, mining, quarrying, petroleum, recreational prospecting and other earth resource activities. If the moratorium is lifted, ERR will likely be responsible for ensuring compliance with the new regulatory regime.[52]

ERR's core responsibilities are to:

- authorise earth resources exploration, production and other activities that provide jobs and support the Victorian economy
- regulate these activities to protect local communities and the environment.

Table 16 summarises the key compliance and regulatory activity undertaken by ERR in the January to March 2019 quarter.

Table 16: Compliance activities undertaken by Earth Resources Regulation

Compliance	FY19 Q1	FY18 Q4	Description
Compliance Activities	206	149	Earth Resources Regulation undertakes proactive compliance activities, which include audits, inspections, meetings with duty holders and site closures.
Compliance Audits	21	69	The number of audits undertaken in FY19 Q1 is lower than previous quarters, which can be explained by the audit program being refined for 2019-20.
Action requirements of Audits	10	58	The audit program is risk-based with a focus on more significant sites. Compliance improvements or enhanced risk controls where recommended at 48% of audited sites in FY19 Q1, compared to 84% of sites in FY18 Q4.
Enforcement activities	6	4	Earth Resources Regulation undertook a number of investigations into alleged illegal quarrying activities. Outcomes ranged from official warnings, infringements, and some matters were referred to prosecution.

Source: ERR Quarterly Report, 2019-20

More detail on compliance can be found in the 'ERR Compliance Strategy 2018 – 2020.'

[52] Department of Economic Development, Jobs, Transport and Resources (2018). *Earth Resources Regulation Compliance Strategy 2018 - 2020*.

3. Approach and assessment framework

3.1 Approach

The key steps in developing this Report are summarised in Figure 14. Throughout each stage of the assessment, engagement and feedback was sought from the department, Victoria's Lead Scientist and the Stakeholder Advisory Panel for Onshore Conventional Gas ('Stakeholder Advisory Panel'). To ensure the Report's technical rigour, the assessment was also supported by peer review by:

- the GSV
- the VGP Scientific Reference Group, which includes members with experience and expertise in geoscience, environmental studies and the gas industry
- Aventus Consulting who provided expertise in health, safety, security and environmental impacts.

Figure 14: Summary approach

1 Complete literature review

A review of the VGP studies (geoscience and environmental studies, community and stakeholder engagement, and resource and land use planning), and publicly available literature was completed.

2 Develop scenarios and RBI assessment framework

Seven hypothetical conventional gas exploration and development scenarios were developed by the department (four in the Otway Basin and three in the Gippsland Basin). In addition, the RBI assessment framework, including the economic, social and environmental receptors was clearly defined.

3 Conduct economic and emissions modelling

Economic impact analysis was conducted (via Computable General Equilibrium (CGE) modelling) to measure the net impact of changes on an economy from the hypothetical scenarios. Similarly, emission modelling was conducted to measure the absolute GHG emissions and GHG emissions intensity from the hypothetical scenarios.

4 Complete RBI assessment

The risks, benefits and impacts were identified for each economic, social and environmental receptor from the hypothetical scenarios by applying the RBI assessment framework and drawing upon the VGP scientific study outputs, the literature review, and economic and environmental modelling.

5 Reporting

A Report was designed and drafted to provide an assessment of the risks, benefits and impacts of potential new onshore conventional gas exploration and development in Victoria.

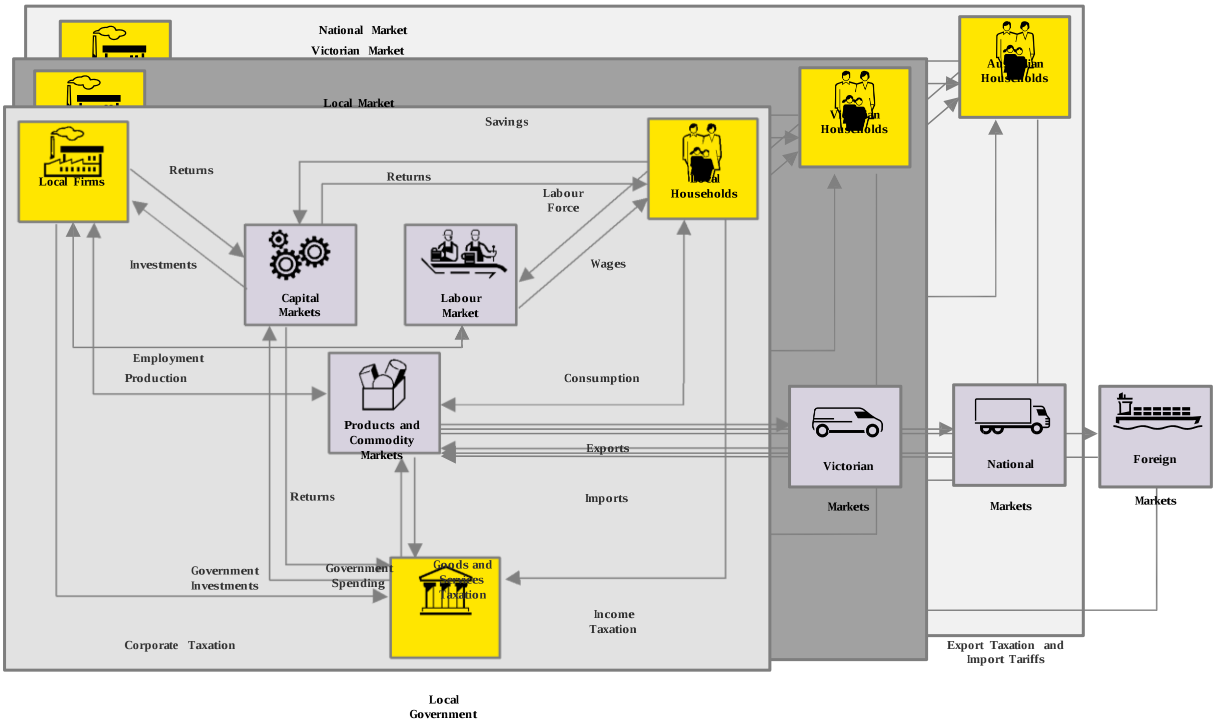
3.2 Economic modelling

Economic impact analysis measures the net impact of changes on an economy. It is used to measure the net change in response to a given event (e.g. such as the loss of an activity, or increased expenditure in a particular sector). The key economic metrics are expressed in terms of changes to gross domestic product and employment.

CGE models are the modelling framework of choice for analysing the economic impacts of major project investments, including gas production. The analysis is based on EYGEM, EY's in-house CGE model.

The EYGEM model is a large scale, dynamic, multi-region, multi-commodity CGE model of the world economy. The framework of the EYGEM model traces the various transaction flows in an economy and is summarised in Figure 15. The EYGEM model enjoys significant flexibility both at the regional and sectoral level, including the capability to individually identify subregions of Australia, in this case the Otway and Gippsland regions, the rest of Victoria and the rest of Australia.

Figure 15. EYGEM model framework



The inputs into the model are related to the extraction and processing of natural gas and were derived from the seven hypothetical gas exploration and development scenarios, and included:

- gas production profile and time horizon
- capital investment
- price of gas[53]
- increases in investment
- returns to capital.

The inputs into the model were informed by gas production and price forecasts published by the Australian Energy Market Operator,[54] historical average development rates and Australian benchmark cost estimates of similar gas developments and asset types. A detailed description of the model, inputs and assumptions is presented in Appendix B.

[53] Economic modelling assume a fixed gas price in all of the scenarios considered. This is based on the assessment of price impacts in the RBI assessment (see 4.2.1.5 ER5: Gas prices) which relies on publicly available information. Energy market modelling has not been conducted.

[54] AEMO (2019). *Victorian Gas Planning Report*. AEMO (2019). *Gas Statement of Opportunities*. and Core Energy (2019) *Wholesale gas price outlook databook.*

3.3 Emissions modelling

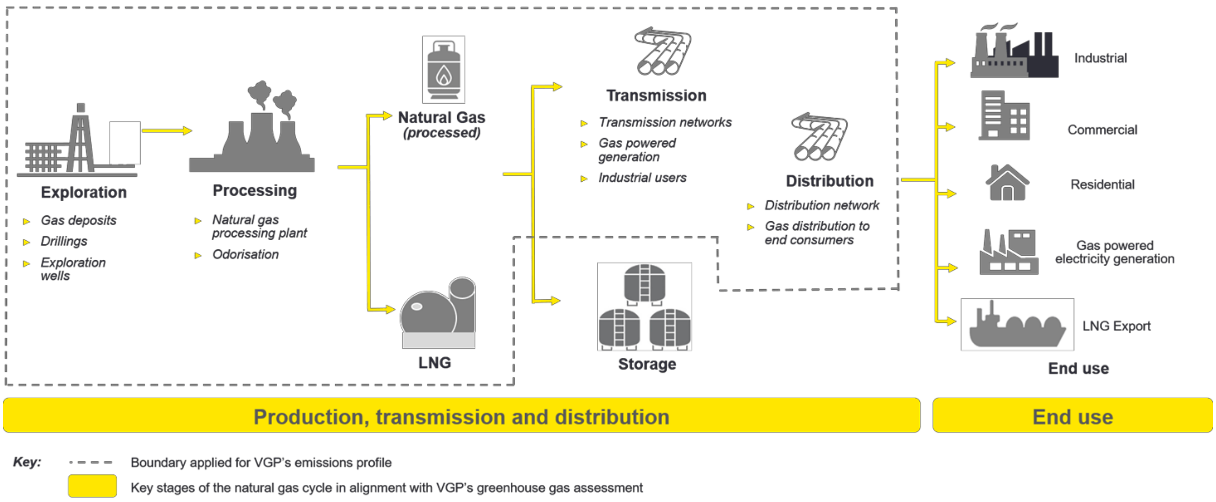
An emissions inventory was created based on seven hypothetical gas exploration and development scenarios. This inventory modelled the total GHG emissions over the life of the proposed onshore developments as part of the VGP for the selected scenarios.

The GHG emissions profile was developed based on the following stages:

- Current state analysis - a review was undertaken of scientific research and environmental studies conducted as part of the VGP, including outputs of regional atmospheric surveys, to determine a baseline profile of the greenhouse gas emission sources that are relevant.

- Identify GHG calculation boundary - the key stages of a natural gas processing cycle were mapped based on end-to-end activities that are typically applicable from exploration of potential natural gas resources to the provision of gas for consumers for end use (summarised in Figure 16). The National Greenhouse and Energy Reporting (NGER) legislation includes requirements to Report for scope 1 and scope 2 emissions. Emissions associated with natural gas consumption by the end user have not been included as they would have occurred irrespective of the proposed developments.

Figure 16: Natural gas production cycle



The economic modelling and emission modelling were conducted separately. This means the economic growth assumed in the economics modelling is not incorporated into the emissions modelling, which is more static in nature, and only considers the production, transmission and distribution of the gas produced under the hypothetical scenarios. A detailed description of the emissions model, inputs and assumptions is presented in Appendix C.

3.4 Risks, benefits and impacts assessment framework

A multi-faceted assessment framework was used to evaluate the risks, benefits and impacts of seven hypothetical gas exploration and development scenarios (four in the Otway Basin and three in the Gippsland Basin). For all seven scenarios, the assessment considered the following aspects over the scenario's time horizon (i.e. short, medium and long term):[55]

- **benefits:** the positive effect a hypothetical gas development scenario has on the receptor assuming industry complies with the current legislative framework

[55] Short term – benefit, impact or risk occurs within several months to five years
Medium term – benefit, impact or risk occurs within five to 20 years
Long term – benefit, impact or risk occurs between 20 to 50 years.

- **impacts**: the negative effect a hypothetical gas development scenario has on the receptor assuming industry complies with the current legislative framework

- **risks**: the likelihood and consequence that the receptor may be exposed to harm because of a hypothetical gas development scenario assuming industry complies with the current legislative framework.

3.4.1.1 Benefit and impact assessment

The benefit and impact assessment identified and described the following for each receptor:

- **the benefit and/or impact:** benefits and impacts are things that will happen, and typically relate to events that occur frequently (e.g. noise emissions from a plant)

- **the cause of the benefit and/or impact**: the activities or events that cause the benefit and/or impact

- **the consequence of the benefit and/or impact occurring:** the changes to the receptor, whether adverse or beneficial, wholly or partly resulting from the activity or event that caused the benefit and/or impact[56]

- **the control measures** (e.g. measures imposed by the regulatory framework, or common industry practice) used to minimise the consequence associated with each benefit and/or impact. It is important to note that these controls are generic in nature, and need to be tailored to be site-specific and account for local environmental conditions

- **the impact rating (residual)**: the consequence of the benefit and/or impact occurring to a receptor is assessed consistent with the scoring model presented in Table 17. The rating is assigned in the context of the successful implementation of the identified control measures.

For receptors where a negative or extremely negative impact on the receptor was identified, further consideration was given as to whether the impact could be mitigated further.

The benefit and impact assessment was undertaken based on the VGP studies, information provided by the department, and publicly available information. The benefits and impacts have been considered together (i.e. the net-effect on the receptor) as they refer to potential effects, one being positive and the other negative. The scoring model applied in this assessment is outlined in Table 17.

Table 17: Benefit and impact assessment scoring model

Scoring	Description	Further guidance
	Hypothetical scenario has an extremely positive impact on the receptor	Extent of benefit: Benefit to environment reaches a large geographical area, social benefit impacts large community (e.g. numerous towns) Duration of benefit: Long term
	Hypothetical scenario has a positive impact on the receptor	Extent of benefit: Environmental benefits are moderately localised, social impacts are felt by small communities (e.g. individual town, large section of community) Duration of benefit: Medium term
	Hypothetical scenario has a slightly positive impact on the receptor	Extent of benefit: Environmental benefits are localised, social benefits impact several individuals (e.g. multiple landholders) Duration of benefit: Short to medium term

[56] Assessment of impacts does not take into account industry practice.

Scoring	Description	Further guidance
–	Hypothetical scenario has no material impact on the receptor	Extent of impact: Impact is negligible, environmental impact is highly localised, social impacts are felt at an individual level Duration of impact: Short term, temporary
×	Hypothetical scenario has a slightly negative impact on the receptor	Extent of impact: Environmental impact is localised, social impacts are felt by several individuals (e.g. multiple landholders) Duration of impact: Short term to medium term
××	Hypothetical scenario has a negative impact on the receptor	Extent of impact: Environmental impacts are moderately localised, social impact are felt by small communities (e.g. individual town, large section of community) Duration of impact: Medium term
×××	Hypothetical scenario has an extremely negative impact on the receptor	Extent of impact: Impact on environment reach a large geographical area, social impact felt by large communities (e.g. numerous towns) Duration of impact: Long term

3.4.1.2 Risk assessment

The risk assessment approach followed the ISO 31000:2009 *Risk Management – Principles and Guidelines*. It identified and described the following for each receptor:

- **the risk:** things that may happen, typically low probability events (e.g. a gas leak)
- **the cause of the risk:** the activities or events that cause the risk
- **the consequence of the risk occurring:** the changes to the receptor, whether adverse or beneficial, wholly or partly resulting from the activity or event that caused the risk
- the control measures (e.g. measures imposed by the regulatory framework, or common industry practice) used to minimise the likelihood or consequence associated with each risk. It is important to note that these controls are generic in nature, and need to be tailored to be site-specific and account for local environmental conditions
- **the consequence, likelihood and risk rating (residual):** the consequence and likelihood of the consequence occurring are identified, adopting the ratings outlined below. The risk rating is a result of combining the consequence and likelihood ratings using the risk matrix outlined below. The consequence and likelihood ratings are assigned in the context of the successful implementation of the identified control measures.[57]

For receptors where a high or severe residual risk to the receptor was identified, further consideration was given as to whether the risk could be mitigated further.

The risk assessment was undertaken based on the VGP studies, information provided by the department, and publicly available information. Where VGP studies have previously considered the likelihood or consequence of a risk, this has been adopted for the purposes of this assessment.

[57] The inherent risk was not rated, as the existence of the regulatory framework meant that the inherent risk would not be a feasible outcome.

Determining consequence

The following definitions of consequence ratings were adopted for the risk assessment, consistent with previous risk assessments undertaken for the VGP (Table 18).

Table 18: Description of consequences

	Environmental	Social	Cultural heritage
5. Severe	Spatial extent: Extensive (hundreds of square kilometres or hectares). Population: Large group of plants or animals. Nearly an entire habitat type or species population. Duration of impact: Long-term (e.g. up to 50 years), wholly or partially reversible damage. Active rehabilitation required over many years. Habitat or species is unlikely to recolonise. Impacts on: Threatened species, unique/iconic species, habitats or ecosystems.	Population: Very large community (e.g. multiple suburbs/towns or city, entire fishery) or state-wide. Impact: Large increased cost of living or business operations (e.g. hundreds of thousands of dollars), high-level/long-term nuisance. Business or residency unlikely to remain viable. Long-term (e.g. months to years) exclusion from operations. Community outrage, conflict between neighbours/towns. Duration of impact: Long-term (year/s).	Impact: Irreparable damage to item/place of international or national cultural heritage significance. Duration of impact: Permanent.
4. Serious	Spatial extent: Localised to extensive (tens of square kilometres or hectares). Population: Large group of plants or animals. Partial habitat type or population. Duration of impact: Long-term (e.g. 20-50 years), reversible damage. Active rehabilitation required over years. Habitat or species is likely to recolonise. Impacts on: Threatened species, unique/iconic species, habitats or ecosystems.	Population: Large community (e.g. town/s of several thousand people, tens to hundreds of fisheries licensees). Impact: Moderate increased cost of living or business operations (e.g. tens of thousands of dollars), high-level nuisance. Business or residency may not remain viable. Long-term (e.g. weeks to one month) exclusion from operations. Noticeable community unrest/tension, conflict between neighbours. Duration of impact: Medium-term (weeks).	Impact: Serious (e.g. extensive) but repairable damage to item/place of international or national cultural heritage significance. Duration of impact: Long-term (repair/restoration may take months or years).
3. Moderate	Spatial extent: Moderately localised (<10 square kilometres or hectares). Population: Small to large group of plants or animals. Duration of impact: Medium-term (e.g. 5-20 years), reversible damage. Active rehabilitation required over months/years. Habitat or species is highly likely to recolonise. Impacts on: Threatened species, unique/iconic species, habitats or ecosystems.	Population: Small community (e.g. town of several hundred people, tens of fisheries licensees). Impact: Minor increased cost of living or business operations (e.g. thousands of dollars), medium-level nuisance. Short-term (up to several days) exclusion from normal operations. Some community unrest/tension, unease between neighbours. Duration of impact: Short-term (days to weeks).	Impact: Repairable damage to item/place of national cultural heritage significance. Duration of impact: Medium-term (repair/restoration may take weeks or months).

	Environmental	Social	Cultural heritage
2. Minor	Spatial extent: Localised (<1 square kilometre or hectare). Population: Small group of plants or animals. Duration of impact: Short-term (e.g. several months to 5 years), reversible damage. Active rehabilitation may be required over weeks. Habitat or species will recolonise. Impacts on: Non-threatened or threatened species, habitats or ecosystems.	Population: Several individuals (e.g. multiple landholders, < 10 fishing licensees). Impact: Minor increased cost of living or business operations (e.g. hundreds of dollars), low-level nuisance, no exclusion from normal operations. Duration of impact: Temporary (several hours up to several days)	Impact: Low level of repairable or irreparable damage to item/place of state or national cultural heritage significance. Duration of impact: Short-term (repair/restoration may take days or weeks).
1. Negligible	Spatial extent: Highly localised (up to tens of square metres). Population: Individual plant or animal. Duration of impact: Immediate (e.g. up to several months), reversible damage. No active rehabilitation required. Habitat or species is known to recolonise. Impacts on: Non-threatened common species, not affecting habitats or ecosystems.	Population: Individual (e.g. landholder, fisher). Impact: No increased cost of living or business operations, low-level nuisance. Duration of impact: Immediate/temporary (minutes to several hours)	Impact: No visible damage to item/place of local, state, national or international cultural heritage significance. Duration of impact: No lasting effect.

Source: Adapted from information provided by the department.

Determining likelihood

The following definitions of likelihood were adopted for the risk assessment, consistent with previous risk assessments undertaken for the VGP (Table 19).

Table 19: Description of likelihood

	Industry experience	Frequency	Probability of occurrence
5.Very likely	Occurs frequently in the industry	A daily event	100%
4. Likely	Has occurred several times in the industry	Could occur within the next few weeks	70-99%
3. Possible	Commonly occurs in the industry	Could occur within weeks to months.	40-69%
2. Unlikely	Occurs infrequently in the industry	Could occur within months to years	11-39%
1. Highly unlikely	Has occurred once or twice in the industry	A one in 10-year event	1-10%

Source: Adapted from information provided by the department

While the assessment of likelihood is guided by the definitions in Table 19, it is still a somewhat subjective exercise.

Risk matrix

The risk matrix shown in Table 20 is based on multiplying the consequence and likelihood of a risk. Table 21 defines the rankings based on the scores in the risk matrix.

Table 20: Risk matrix

		Likelihood				
						1. Highly unlikely
Consequence	5.Severe	25	20	15	10	5
	4. Serious	20	16	12	8	4
	3. Moderate	15	12	9	6	3
	2. Minor	10	8	6	4	2
	1. Negligible	5	4	3	2	1

Table 21: Risk ranking

Risk ranking	Score
Severe	20-25
High	10-19
Moderate	5-9
Low	1-4

3.4.1.3 Assumptions

The following assumptions were applied for the analysis:

- the analysis was conducted using the best available information at the time of the assessment (i.e. VGP analysis, publicly available information and EY modelling based on these sources)
- the receptor scoring model and rating model for each hypothetical gas exploration and development scenario reflects how that receptor would be impacted after the current legislative framework has been applied. Scoring therefore assumes that:
  - future updates to the Petroleum Regulatory Framework that may occur are not considered
  - industry practice over and above the current legislative framework is not reflected in the receptor scoring but rather considered in a qualitative analysis, where there is evidence[58]
  - ERR has the capacity and capability to apply the regulatory controls that have been identified in the analysis.

3.4.2 Description of receptors

A set of economic, social and environmental receptors were developed based on the scope of the VGP and drawing on issues important to stakeholders as derived from VGP community engagement, previous studies and inquiries and in consultation with the Stakeholder Advisory Panel, the Scientific Reference Group and other government agencies including the Department of Environment, Land, Water and Planning and the Department of Premier and Cabinet. The receptors were assessed in a case study on Beach Energy's Otway gas plant also informed the selection of receptors for this Report. [59] The receptors were socialised with For each receptor, several measures were defined, based on the scope of analysis undertaken by the VGP publicly available information, and EY economic and emissions modelling based on these sources. A workshop was conducted on

[58] This is because it is unclear whether industry practices are consistent across all market participants.

[59] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.

19 November 2019 with the department, Victoria's Lead Scientist and members of the Stakeholder Advisory Panel to confirm the final receptors and measures.

This analysis has focused on the direct risks, benefits and impacts of the hypothetical onshore conventional gas exploration and development scenarios. Potential indirect benefits, impacts and risks that have not been explicitly measured, but are identified, where relevant, in the analysis.

The economic, social and environmental receptors are summarised in Table 22, Table 23 and Table 24, including receptor descriptions and measures.

Table 22: Economic receptors

#	Receptor	Description	Measures
ER1	Employment	What direct and indirect regional employment numbers and type that will be added?	▸ Direct employment (full-time equivalents -FTE) in three regions (i.e. Otway region, Gippsland region and rest of Victoria) ▸ Indirect employment (FTE) in three regions (i.e. Otway region, Gippsland region and rest of Victoria).
ER2	Gross state product (GSP)	How much value will be added to Victoria?	▸ GSP of Victoria.
ER3	Gross regional product (GRP) and gross regional income (GRI)	How much value will be added to regional areas, including changes in regional income?	▸ GRP in three regions (i.e. Otway region, Gippsland region, rest of Victoria) ▸ GRI in three regions (i.e. Otway region, Gippsland region, rest of Victoria).
ER4	Domestic gas supply (Export, household use, electricity generation)	What are the flow on economic benefits to users of gas in Victoria?	▸ Gas supply for direct use in Victoria ▸ Gas peaking generation supply in Victoria ▸ Energy security in Victoria.
ER5	Gas prices	What are the price impacts of increased gas supply (i.e. will gas or electricity prices decrease)?	▸ Price of gas in Victoria ▸ Wholesale electricity market prices in Victoria.
ER6	Government revenue	What are the flow on economic benefits to government through taxation and royalties?	▸ Royalties ▸ Company taxation (including income tax, land tax, payroll tax and rates).

Table 23: Social receptors

#	Receptor	Description	Measures
SR1	Community health, safety and security	What level of impact on the community's health, safety and security will gas development have?	▸ Spill risk on site ▸ Visible flaring from the site ▸ Fire risk ▸ Noise from operations/exploration ▸ Dust generation ▸ Public safety.

#	Receptor	Description	Measures
SR2	Community wellbeing and social cohesion	What level of impact will occur with respect to the community's wellbeing?	▶ Community attitudes to proximity of development and exploration ▶ Community projects funded by gas development ▶ Community engagement in decision making process ▶ Access and affordability of housing and essential services ▶ Impact on local roads.
SR3	Land access and use issues	What are the current uses of land, how will land access impact on this land use as well impact the surrounding areas?	▶ Landowner consultation to inform landowner consent and compensation agreements and lease agreement ▶ Adequacy of process for disseminating community updates about land use as well as consultation periods ▶ Size of land impacted by gas exploration/development activities ▶ Impact on land value ▶ Adequacy of rehabilitation after gas production and exploration.
SR4	The Aboriginal Community and people	What impacts are there on the Aboriginal community?	▶ Awareness of gas development by the Aboriginal community ▶ Reconciliation action plan for potential operators ▶ Number of Aboriginal community members employed (direct) ▶ Number of Aboriginal businesses impacted (indirect). ▶ Risk of impact to Native Title.
SR5	Schools, education and vocational capacity	What educational opportunities are created?	▶ Projected increase in apprenticeships, and population growth ▶ Contributions to school funding.
SR6	Protection of cultural heritage	How (if any) will areas of cultural heritage be affected?	▶ Risk to non-Aboriginal cultural heritage sites ▶ Risk to Aboriginal cultural heritage.
SR7	Existing farm industries, food and biosecurity	How will surrounding farm and food production, and biosecurity be impacted?	▶ Ability to co-exist with existing agriculture industries ▶ Impact on livestock located near drill sites ▶ Gross size of farming land used for exploration/development ▶ Compensation provided to farmers for well sites located on farmland ▶ Management of potential and actual incursion of pests and diseases.
SR8	Labour and working conditions	What working conditions will be in place for the development and operation of gas production? What mechanisms are there to support a diverse workforce?	▶ Existence and assessment of an Enterprise Bargaining Agreement (EBA) improving employment conditions for workers ▶ Workforce representation ▶ Organisational policies and procedures governing working conditions

Table 24: Environmental receptors

#	Receptor	Description	Measures
ENR1	GHG emissions	What are the total GHG emissions as a result of the hypothetical scenarios?	► Absolute GHG emissions (quantitative EY analysis) ► GHG emissions intensity of proposed developments (emissions per quantity of gas processed) ► Alignment with 2050 net zero target (qualitative assessment).
ENR2	Groundwater and surface water quality and quantity	What are the measurable impacts on groundwater and surface water near the proposed development sites?	► The volume removed from the nearest groundwater resource aquifer (Megalitres - ML) ► Groundwater level draw down (area of greater than 5 m - hectares) ► Volume impact on surface water receptors (ML/year) ► Area of water table drawdown greater than 0.1 m (hectares) ► Groundwater and surface water contamination ► Time to impact - maximum impact and time to recover.
ENR3	Affected native flora and fauna	What is the impact on flora and fauna in areas included in the hypothetical scenarios and surrounding areas?	► Impact of noise/light on flora/fauna ► Destruction of native flora and fauna ► Intrusion of invasive weeds, pests or pathogens.

4. Otway scenarios and summary assessment

This section provides a description of the Otway Basin hypothetical onshore conventional gas exploration and development scenarios, and a summary of their performance against the assessment framework outlined in Chapter 3.

4.1 Otway Basin hypothetical exploration and development scenarios

4.1.1 Overview of Otway Basin scenarios

Four hypothetical scenarios have been developed to assess the risks, benefits and impacts of potential onshore conventional gas exploration and development in the Otway Basin in South-West Victoria, if the moratorium were lifted. The scenarios include four hypothetical levels of development – minimum scenario, low, medium and high.[60]

The Otway Basin hypothetical scenarios are based on a prospectivity assessment and resource estimate conducted as part of the VGP. Legacy data and new information acquired during the VGP were used to compile maps of source, seal and reservoir rock units that need to be present if gas is to be found. For the Otway Basin hypothetical scenarios, these datasets were synthesised and refined to create maps of prospective areas. The preliminary prospectivity maps indicate areas where there is a minimum, low, moderate or high probability that gas might be found. This mapping, together with the results of past exploration, were used to estimate how much gas might be found and form the basis of the hypothetical scenarios.

As the scenarios transition from minimum to high levels of exploration and development, there is an increase in:

- on-ground activity (exploration, drilling, trucks and other processing activities)
- the number of exploration and discovery wells
- resource size in Bcf
- the number and/or size of processing facilities
- the total area required for developments.

A full summary of the scenarios based on the descriptions detailed in this section is listed in Table 25.

Table 25: Summary of Otway Basin hypothetical exploration and development scenarios

#	Scenario	Description
1	Otway Basin (Minimum scenario)	► Total estimated discovered resources of 81 Bcf (90 PJ) ► Discoveries in the following reservoir rock units: upper Waarre Formation, Pretty Hill Formation and the Sawpit Sandstone ► Exploration and development in the Eastern Region (Port Campbell Embayment) and Western Region (Penola Trough) ► Eighteen (18) exploration wells resulting in six discoveries; 14 development wells are required, inclusive of the six discovery wells ► Gas discovered in the Port Campbell Embayment is processed using existing facilities and gas discovered in the Penola Trough requires one new processing plant (either full-scale or modular).[61]

[60] Scenario data provided by the department
[61] For modelling purposes, it is assumed that a modular plant will be constructed as it is likely that operators will already have established infrastructure in the region.

#	Scenario	Description
2	Otway Basin (Low)	▶ Total estimated discovered resources of 294 Bcf (317 PJ) ▶ Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ▶ Exploration and development in the Eastern Region (Port Campbell Embayment), Western Region (Penola Trough) and Central Region ▶ Fifty-four (54) exploration wells resulting in 18 discoveries; 52 development wells are required, inclusive of the 18 discovery wells ▶ Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant.
3	Otway Basin (Medium)	▶ Total estimated discovered resources of 434 Bcf (470 PJ) ▶ Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ▶ Exploration and development in the Eastern Region (Port Campbell Embayment), Western Region (Penola Trough) and Central Region ▶ Eighty-one (81) exploration wells resulting in 27 discoveries; 81 development wells are required, inclusive of the 27 discovery wells ▶ Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant.
4	Otway Basin (High)	▶ Total estimated discovered resources of 660 Bcf (715 PJ) ▶ Discoveries in all seven reservoir rock units: Flaxman Formation, lower and upper Waarre Formation, Heathfield Sandstone, Windermere Sandstone, Pretty Hill Formation and Sawpit Sandstone ▶ Exploration and development across the Victorian Otway Basin from the Eastern Region (Port Campbell Embayment) to the Western Region (Penola Trough) including the Central Region ▶ One hundred and thirty-eight (138) exploration wells resulting in 46 discoveries; 125 development wells are required, inclusive of the 46 discovery wells ▶ Gas discovered in the Port Campbell Embayment is processed using existing facilities and/or a new modular plant; a new modular plant is required for the Central Region; gas discovered in the Penola Trough requires one new full-scale processing plant, with potential for an additional modular plant.

The hypothetical scenarios were developed from modelling conducted by the GSV. The expected number of discoveries were derived for each reservoir rock unit that gas might be found (Table 26). The geological units listed in Table 26 increase in geological age and generally, the depth they are found at within the Otway Basin (i.e. the Flaxman Formation is the youngest unit). The number of discoveries increases in each reservoir rock unit for each scenario from the minimum scenario to the high scenario.

Table 26: Otway Basin hypothetical development scenarios – expected number of discoveries

Reservoir rock unit	Expected number of discoveries			
	Minimum scenario	Low	Medium	High
Flaxman Formation	1	2	3	6
Upper Waarre Formation	1	2	3	6
Lower Waarre Formation	0	2	3	6
Heathfield Sandstone	0	2	3	5
Windermere Sandstone	0	1	2	4
Pretty Hill Formation	3	7	10	14
Sawpit Sandstone	1	2	3	5

Reservoir rock unit	Expected number of discoveries			
	Minimum scenario	Low	Medium	High
TOTAL	6	18	27	46

The number of discoveries for each scenario and reservoir rock unit was then used to determine the discovered volumes and the number of wells that might be required to develop the resources across geographic areas in the Otway Basin (Table 27). As the number of discoveries increase for each hypothetical scenario, the level of development across each geographic area increases. The number of development wells required in each geographic area for each scenario (Table 27) includes the successful exploration wells in each scenario. The number of development wells were calculated based on approximately one well per 5 Bcf of production. This results in a maximum number of wells for each scenario.[62]

Table 27: Otway Basin hypothetical development scenarios – discovered resources and number of development wells

Geographic area	Number of discoveries				Discovered resources (Bcf)				Number of development wells			
	Min	Low	Med	High	Min	Low	Med	High	Min	Low	Med	High
Port Campbell Embayment (Eastern Region)	2	6	9	17	13.5	49	80	151	2	7	13	26
Penola Trough (Western Region)	4	9	13	20	67.5	182.5	250.5	363	12	32	48	71
Central Region	0	3	5	9	0	62.5	103.5	146	0	13	20	28
TOTAL	**6**	**18**	**27**	**46**	**81.0**	**294.0**	**434.0**	**660.0**	**14**	**52**	**81**	**125**

The estimates calculated by GSV were classified as an estimate of prospective/undiscovered resources as defined by the Petroleum Resource Management System.[63] This estimate is also known as a yet-to-find and is an estimate of the remaining potential in a petroleum basin. The yet-to-find estimate is the product of the number of features (fields) and their size and the probability of success. The method adopted by GSV was the same used by the United States Geological Survey to assess hydrocarbon provinces world-wide in 2000. The minimum, low, medium and high estimates of prospective resources cover a range of uncertainty from most chance of success (low hypothetical scenario) to least chance of success (high hypothetical scenario).

The Otway Basin has an additional 'minimum scenario' scenario that reflects the quantity of gas that was discovered and produced in the Port Campbell area in the past. A discovered resource of 81 Bcf is used as the minimum scenario and represents a more constrained and conservative estimate to allow the modelling to test as full a range of options as possible.

EY has adopted a series of assumptions for the purposes of economic modelling. In particular, gas production is assumed to occur over a 27-year period with operations beginning in 2023. In

[62] For some fields, this will be an overestimate and for others, an underestimate. In reality, there is a large variation in the number of development wells required. For example, four wells were used to produce gas from the Minerva field offshore. This field had around 500 Bcf original gas in place. Whereas the onshore Iona field had around 40 Bcf original gas in place and also used four development wells.
[63] Spe.org. (2020). [online] Available at: https://www.spe.org/en/industry/reserves/ [Accessed 15 Dec. 2019].

addition, gas developments are assumed to be relatively consistent across the life of each project and ceases in 2050 as 100 per cent of resources have been extracted.

Appendix B provides further detail on the assumptions made across the Otway Basin hypothetical scenarios and includes a visual representation of when capital expenditure (on new development wells, tie-backs and gas plants) occurs over the lifetime of each development scenario.

4.1.2 Minimum scenario hypothetical scenario

The minimum scenario represents a scenario generated from GSV estimates with the least possible uncertainty. It can be thought of as the scenario with resource most likely to sustain gas development. Although this is the lowest resource size, there is a higher likelihood that there will be successful discoveries. In the minimum scenario, the rock layers that have the highest prospectivity are those where gas has been found before – these are the Flaxman Formation and upper Waarre Formation, and the Pretty Hill Formation and the Sawpit Sandstone.

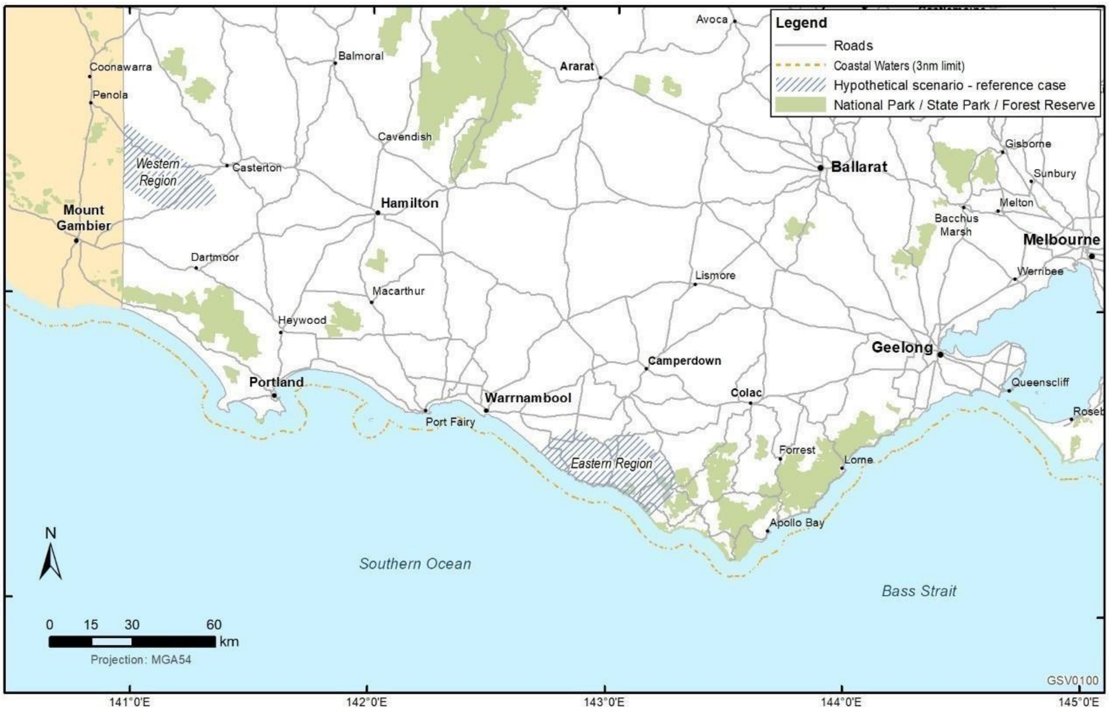
The Flaxman Formation and upper Waarre Formation are largely restricted in the onshore Otway Basin to an area known as the Port Campbell Embayment, between Warrnambool and the Otway Ranges (the Eastern Region in Figure 17). Gas has been discovered and produced from this area in the past (between 1986 and 2006). The Pretty Hill Formation and the Sawpit Sandstone are most prospective in a geological area known as the Penola Trough, located to the east of Casterton, extending into South Australia (the Western Region in Figure 17). Gas has also been discovered and produced here in the past in South Australia.

In the South Australian Penola Trough, new gas discoveries have been made recently including Dombey-1 in October 2019 and Haselgrove-3 in December 2017.[64] [65] Adjacent to the Port Campbell Embayment, offshore in Commonwealth waters, gas was discovered in Annie-1.[66] These new discoveries demonstrate that there is gas still to find in these rock units (plays) and in these geographic areas.

The minimum scenario therefore incorporates potential discoveries in the most prospective areas – the Port Campbell Embayment and the Penola Trough (Figure 17). In this scenario, there are six new discoveries – two in the Port Campbell Embayment and four in the Penola Trough. The historical success rate in the Otway Basin has been around 30 per cent, so it is estimated that 18 exploration wells would be required to make the six discoveries. The success rate in the Port Campbell Embayment is higher at around 50 per cent, so the number of exploration wells required in the area may be lower. Sometimes further exploration wells may be required to define the full extent of the gas accumulation.

[64] Cooper Energy. (2020). *New gas discovery at Dombey-1DW1*. [online] Available at: https://www.cooperenergy.com.au/Upload/Dombey-Pretty-Hill.pdf [Accessed 20 Dec. 2019].
[65] Member.afraccess.com. (2020). *New gas discovery in the Otway Basin, South Australia*. [online] Available at: http://member.afraccess.com/media?id=CMN://2A1059772&filename=20180111/BPT_01940745.pdf [Accessed 20 Dec. 2019].
[66] Cooper Energy. (2020). *New gas field at Annie*. [online] Available at: https://www.cooperenergy.com.au/Upload/New%20gas%20field%20discovery%20at%20Annie.pdf [Accessed 20 Dec. 2019].

Figure 17: Otway Basin hypothetical minimum scenario exploration and development scenario – gas to be found in the Port Campbell Embayment (Eastern Region) and the Penola Trough (Western Region).



Source: Provided by the department

For smaller gas fields (i.e. a field size of around or under 5 Bcf), the exploration well is generally converted into a production well. For larger accumulations, additional development wells may be required. For this 'minimum scenario' scenario, a maximum of 14 development wells would be required in both areas inclusive of the six exploration wells.

An estimated total discovered resource of 81 Bcf (13.5 Bcf in the Port Campbell Embayment and 67.5 Bcf in the Penola Trough) could be processed using existing infrastructure in the case of the former and a new processing facility required in the case of the later. In the Port Campbell Embayment, existing facilities include the Otway Gas Plant and the Minerva Plant. The Minerva Gas Plant has a processing capacity of 150 TJ per day.[67]

4.1.3 Low hypothetical scenario

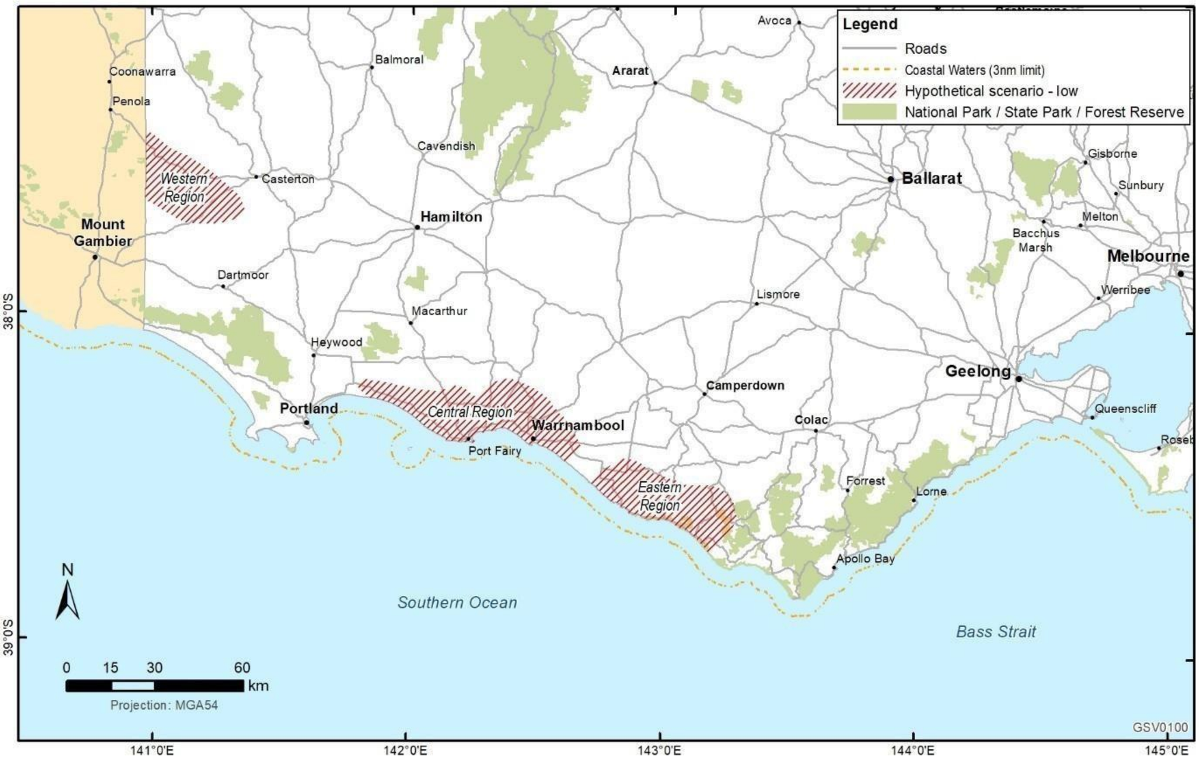
The hypothetical scenario for a low level of exploration and development corresponds to a low prospective resource estimate. Although this is a low resource size, there is a higher likelihood that there will be success of a discovery.

In the 'low' scenario, there is a greater level of exploration and development in the Port Campbell Embayment (the Eastern Region in Figure 18) and Penola Trough (inclusive of an area to the southeast – the Western Region in Figure 18) and exploration and development in the geographic area between these two (e.g. the Tyrendarra Embayment, Windermere and Warrong troughs). These are labelled Central Region in Figure 18.

In this scenario, exploration and development is undertaken in all rock layers that have been identified by the GSV as prospective plays in Figure 18. This includes areas and plays that are considered highly prospective and areas where the prospectivity is less certain. Reduced prospectivity, as assessed by GSV, is due to either a lack of data or historical data that demonstrated an absence of accumulations or indications of hydrocarbons (known as shows).

[67] Note excess capacity in these plants would be used to accommodate processing of gas from new discoveries in the area before any additional infrastructure investment is made.

Figure 18: Otway Basin hypothetical low exploration and development scenario – gas to be found in the Port Campbell Embayment (Eastern Region), Penola Trough (Western Region) and in the Central Region.



Source: Provided by the department

In the 'low' scenario, there are 18 discoveries– six in the Flaxman and Waarre formations (in the Port Campbell Embayment), nine in the Pretty Hill Formation and Sawpit Sandstone (in the Penola Trough, including the area to the south east) and three in the Heathfield and Windermere sandstones. Using the historical success rate in the Otway Basin of around 30 per cent, it is estimated that 54 exploration wells would be required to make 18 discoveries.

In the 'low' hypothetical scenario, 52 development wells would be required to produce the resources, inclusive of the exploration wells that were drilled to make the discoveries (34 additional wells). In the Port Campbell Embayment (Eastern Region), seven development wells are used for production. In the Central Region area, 13 development wells are used. In the Penola Trough (Western Region), 32 development wells are required for production.

An estimated total discovered resource of 294 Bcf (49 Bcf in the Port Campbell Embayment, 182.5 Bcf in the Penola Trough and 62.5 Bcf in the Central Region) are processed using existing infrastructure and new processing facilities.

In the Port Campbell Embayment, existing facilities and/or a new modular plant could be used to process around 49 Bcf. A new modular plant would be required to process gas in the Central Region, and a new full-scale plant would be required for the Penola Trough and surrounds.

Processing capacity will affect the speed at which volumes are produced. If a processing plant such as Minerva processes 150 TJ per day (54,750 TJ per annum), that is 54.75 PJ or around 50 Bcf per year (a maximum that is unlikely to be reached).[68]

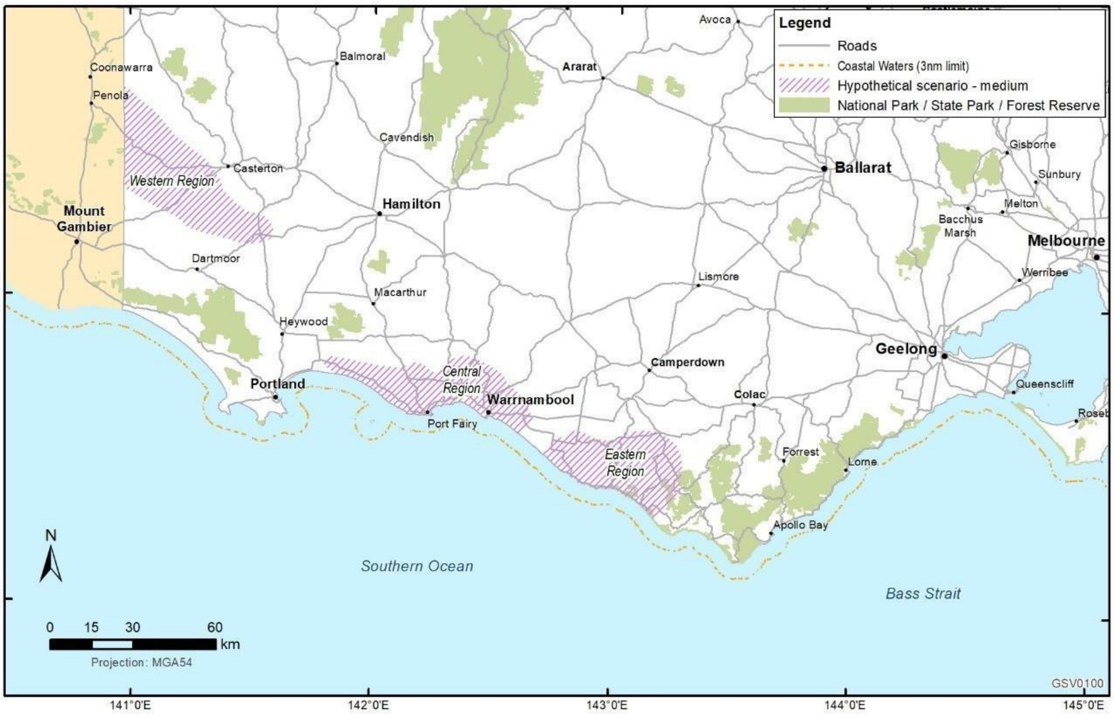
[68] Even if capacity was optimal, production from rock formations must not damage the formation and hinder further production.

4.1.4 Medium hypothetical scenario

The hypothetical scenario for a medium level of exploration and development corresponds to a medium prospective resource estimate. The ‘medium’ scenario is the mid case where there is a 50 per cent chance of success or likelihood that there will be a discovery.

In the ‘medium’ hypothetical scenario, there is a greater level of exploration and development in the Port Campbell Embayment (the Eastern Region in Figure 19) and Penola Trough (inclusive of an area to the southeast – the Western Region in Figure 19) and exploration and development in the geographic area between these two (e.g. the Tyrendarra Embayment, Windermere and Warrong troughs). These are labelled Central Region in Figure 19. In this scenario, exploration and development is undertaken in all rock layers that have been identified by GSV as prospective plays in Figure 19. This includes areas and plays that are considered highly prospective and areas where the prospectivity is less certain. Reduced prospectivity, as assessed by GSV, is due to either a lack of data or historical data that demonstrated an absence of accumulations or indications of hydrocarbons (known as shows).

Figure 19: Otway Basin hypothetical medium exploration and development scenario – gas to be found in the Port Campbell Embayment (Eastern Region), Penola Trough (Western Region) and in the Central Region.



Source: Provided by the department

In the ‘medium’ scenario, there are 27 discoveries – nine in the Flaxman and Waarre formations (in the Port Campbell Embayment – Eastern Region), 13 in the Pretty Hill Formation and Sawpit Sandstone (in the Penola Trough, including the area to the south east; the Western Region) and five in the Heathfield and Windermere sandstones in the Central Region. Using the historical success rate in the Otway Basin of around 30 per cent, it is estimated that 81 exploration wells would be required to make 27 discoveries.

In the ‘medium’ hypothetical scenario, a total of 81 development wells is required for production of the resources inclusive of the exploration wells that were drilled to make the discoveries (54 additional wells). In the Port Campbell Embayment, 13 development wells are used for production. In the Central Region, 20 development wells are used. In the Penola Trough and to the southeast (Western Region), 48 development wells are required to produce the gas resource.

An estimated total discovered resource of 434 Bcf (80 Bcf in the Port Campbell Embayment, 250.5 Bcf in the Penola Trough and 103.5 Bcf in the Central Region) are processed using existing infrastructure and new processing facilities.

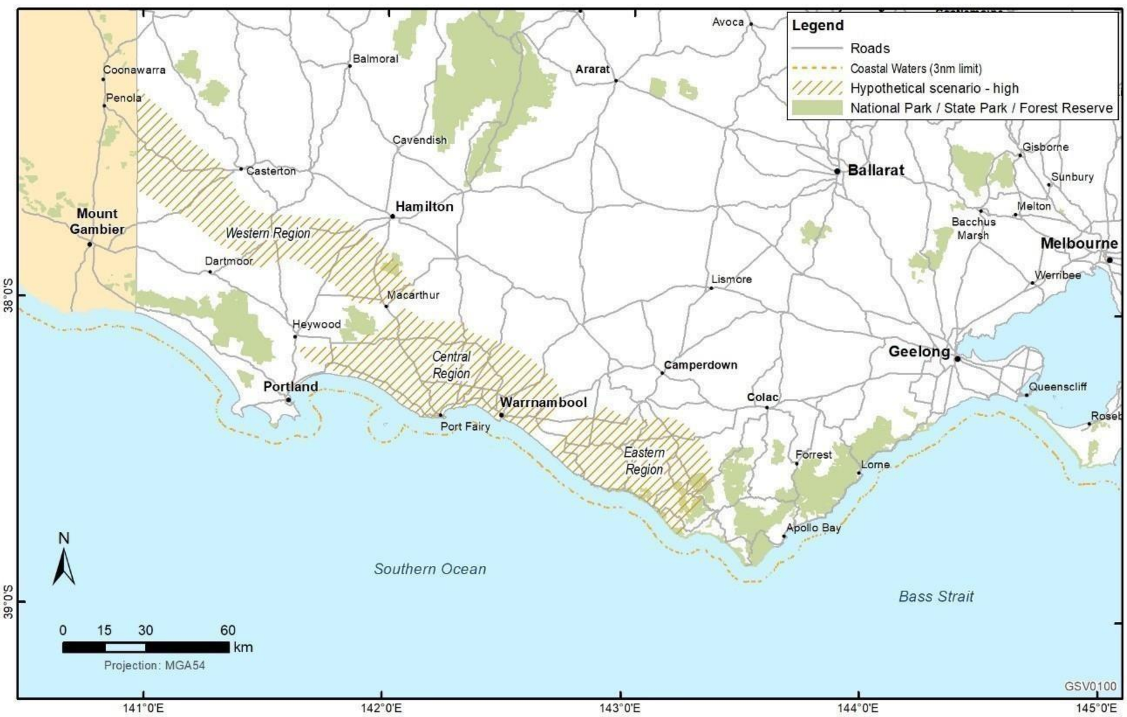
In the Port Campbell Embayment, the discovery of around 80 Bcf is about the same volume of gas that was discovered and produced from the area between 1986 and 2006.[69] Existing facilities could be used to process this volume, or alternately an additional modular plant may be constructed. A new modular plant would be required to process gas in the Central Region, and a new full-scale plant would be required for the Penola Trough and surrounds.

4.1.5 High hypothetical scenario

The hypothetical scenario for a high level of exploration and development corresponds to a high prospective resource estimate. Although this is the highest resource size, there is a less likelihood that there will be success. In the 'high' hypothetical scenario, the rock layers that have the highest prospectivity - the Flaxman Formation and upper Waarre Formation, and the Pretty Hill Formation and the Sawpit Sandstone are wholly developed. A high number of discoveries are made in less prospective areas of the basin – inclusive of plays in the lower Waarre Formation and the Heathfield and Windermere sandstones.

In the 'high' scenario, there is a greater level of exploration and development in the Port Campbell Embayment (Eastern Region), Penola Trough and the area to the southeast (Western Region), and Central Region (e.g. the Tyrendarra Embayment, Windermere and Warrong troughs – see Figure 20).

Figure 20: Otway Basin hypothetical high exploration and development scenario – gas to be found in the Port Campbell Embayment (Eastern Region), Penola Trough (Western Region) and in the Central Region.



Source: Provided by the department

In the 'high' scenario, there are 46 discoveries – 18 in the Flaxman and Waarre Formations, 19 in the Pretty Hill Formation and Sawpit Sandstone, five in the Heathfield Sandstone and four in the Windermere Sandstone. With a historic success rate of around 30 per cent, it is estimated that 138 exploration wells would be required to make the 46 discoveries.

[69] DJPR, 2015, A review of gas prospectivity: Otway region

In the ‘high’ hypothetical scenario, a total of 125 development wells inclusive of the exploration wells that were drilled to make the discoveries (79 additional wells). A higher number of additional wells are required to produce/develop gas resources in the ‘high’ scenario than for the other scenarios. In the Port Campbell Embayment (Eastern Region), 26 development wells are used for production. In the Central Region, 28 development wells are used. In the Western Region, 71 wells are required for production.

An estimated total discovered resource of 660 Bcf (151 Bcf in the Eastern Region, 363 Bcf in the Western Region and 146 Bcf in the Central Region) could be processed using a mix of existing infrastructure and new processing facilities.

In the Port Campbell Embayment, existing facilities include the Otway Gas Plant and the Minerva Plant could be accessed for processing. At these volumes a new modular plant would be required in the area. Given that additional volumes have been discovered and that there is more gas yet-to-find offshore in Commonwealth Waters and State waters (that is, within the three nautical mile zone from the shoreline), the existing infrastructure may be used to process that gas.

One or two modular processing facilities would be required in the Central Region and in the Western Region (Penola Trough and surrounds), a full-scale plant would be required with additional capacity from a modular plant if there was a need for increased production.

4.2 Assessment of Otway Basin hypothetical scenarios

4.2.1 Economic impact assessment[70]

4.2.1.1 ER1: Employment

What direct and indirect regional employment numbers and type that will be added?

Benefits and impacts

The analysis has identified benefits to employment with respect to the Otway Basin hypothetical exploration and development scenarios. Economic impact analysis was used to assess the extent to which the Otway Basin hypothetical exploration and development scenarios could impact employment outcomes both within the region, and more broadly across Victoria.

In Table 28, the minimum scenario and the low, medium and high scenarios are projected to result in employment growth primarily in the Otway region. The analysis suggests that there will be some redistribution of labour as a result of the project, with employment being drawn from the rest of Victoria in order to satisfy demand. The high scenario is expected to provide to most significant employment impact, with just over 5,500 total FTE projected to be created between 2020/21 and 2049/50, which equates to approximately 204 FTEs a year.

Table 28: Employment impact for the Otway Basin hypothetical scenarios

#	Scenario	Region	employment	employment	FTE*	employment	FTE*	year	End year
1	Otway Basin (Minimum scenario)	Otway region	387	182	569	0.06%	57	2021/22	2030/31
		Rest of Victoria			-132		-9		
2	Otway Basin (Low)	Otway region	1532	661	2194	0.14%	122	2021/22	2041/42
		Rest of Victoria			-409		-13		
3	Otway Basin (Medium)	Otway region	2416	1059	3475	0.18%	151	2021/22	2043/44
		Rest of Victoria			-589		-13		
4	Otway Basin (High)	Otway region	3816	1689	5506	0.24%	204	2021/22	2048/49
		Rest of Victoria			-810		-14		

[70] Assessment of economic receptors are based on the outputs of EY's economic modelling, the figures of which are estimates.

*Note: * The total and average FTE figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document.*

The project's impact on employment will vary depending on the scope and level of required expenditure under each scenario (se e appendix B for assumptions). In addition to the direct employment impacts relating to the additional workers that will be directly employment to deliver and implement the proposed program, the project will also lead to indirect employment growth across adjacent industries which will be required to help satisfy the demand created by the project.

The assessment of the impact to employment is summarised in Table 29.

Table 29: Key benefits and impacts to employment

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Projected employment growth	The implementation of gas exploration and development in the Otway region will increase demand and created additional employment opportunities	Growth in employment can be categorised as: ► direct employment growth relating to the workers required to undertake the gas exploration and development in the Otway region ► indirect employment growth as a result of the demand created by the project, including expenditure from direct employees. As the number of exploration and development sites increases across the hypothetical scenarios, the ongoing expenditure will help to create additional jobs across the Otway region, both in terms of employment directly related to projects as well as indirect employment related to suppliers and induced employment in other industries. As outlined in Table 28, employment ranges from 387 direct and 182 indirect FTEs in the minimum scenario to 3816 direct and 1689 indirect FTEs in the high development scenario. Average annual FTEs as a percentage of local employment ranges from 0.06% in the minimum scenario to 0.24% in the high development scenario. As such impact on projected employment is expected to be no impact in the minimum	N/A	Minimum scenario: – Low: Medium: High:	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		scenario and slightly positive for the remaining scenarios.			

Risk assessment

No risks were identified for this receptor.

Overall assessment

The assessment found all scenarios are projected to result in employment growth primarily in the Otway region, ranging from an average annual additional 57 FTE under the minimum scenario (or total of 569 FTE – 387 direct and 182 indirect) over the lifetime of production to an average annual additional 204 FTE under the high scenario (or total of 5,506 FTE – 3,816 direct and 1,689 indirect) over the lifetime of production.

The analysis suggests that there will be some redistribution of labour as a result of the project, with employment being drawn from the rest of Victoria in order to satisfy demand. The ratings for each scenario have been assessed based on their relative overall impact on employment across Victoria with high scenario expected to have the largest impact on employment across in the Otway region, however, still minor in comparison to total State employment (see Table 30). As such impact on projected employment is expected to be no impact in the minimum scenario and slightly positive for the remaining scenarios.

No risks were identified for this receptor.

Table 30: ER1: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.1.2 ER2: Gross state product

How much value will be added to Victoria?

Benefits and impacts

Economic impact analysis was used to assess the extent to which the Otway Basin hypothetical exploration and development scenarios could impact Victoria's overall GSP. In Table 31, the minimum scenario and the low, medium and high scenarios are projected to result in a positive uplift to GSP, with the high scenario expected to provide to most significant impact, contributing an additional $282.10 million annually to Victorian GSP.

Table 31: Otway scenario GSP impacts

#	Scenario	Total GSP ($m) *^	Average Annual GSP ($m) *^	GSP (% change from base)	Start year	End year
1	Otway Basin (Minimum scenario)	764.97	76.50	0.02%	2021/22	2030/31
2	Otway Basin (Low)	3018.62	167.70	0.03%	2021/22	2041/42
3	Otway Basin (Medium)	4819.59	209.55	0.04%	2021/22	2043/44
4	Otway Basin (High)	7616.63	282.10	0.04%	2021/22	2048/49

The assessment of the impact to Victoria's GSP is summarised in the Table 32.

Table 32 Key benefits and impacts to employment

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Uplift to Victoria's GSP	The increased expenditure related to the implementation of gas exploration and development in the Otway region will provide additional value to Victoria's economy, above the cost of inputs required to produce related goods and services. This increase in net output across the State's economy will result in an increase to Victoria's overall GSP.	Benefits as a result of the hypothetical development scenarios are: ► economic growth for Victoria ► increased GSP. As the number of exploration and development sites increases, the corresponding increases in expenditure relating to gas production and other investments, will provide a boost to Victoria's economy, and help to stimulate economic growth across the state. The hypothetical scenarios' impact on GSP is largely proportional to the scale	N/A	Minimum scenario: Low: Medium: High:	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		of expenditure and investment required in each scenario. As a share of total GSP, the minimum scenario equates to 0.02 per cent and the high scenario 0.04 per cent. Therefore, the minimum scenario is expected to have a slightly positive impact, while the low, medium and high scenarios are expected to have a positive impact.			

Overall assessment

The assessment found that the minimum scenario is expected to have a slightly positive impact, while the low, medium and high scenarios are expected to have a positive impact. The impact to Victoria's GSP ranges from an average annual additional $76.50 m under the minimum scenario to an average annual additional $282.10 m under the high scenario. The ratings for each scenario have been assessed based on their relative overall impact on GSP for Victoria (Table 33).

No risks were identified for this receptor.

Table 33: ER2: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.1.3 ER3: Gross regional product and gross regional income

How much value will be added to regional areas, including changes to regional income?

Benefits and impacts

Economic impact analysis was used to assess the extent to which the Otway Basin hypothetical exploration and development scenarios could impact GRP and GRI within the Otway and the rest of Victoria. GRP measures the value of production in each region and is the equivalent to GDP but at the regional level. GRI is a superior indicator of economic welfare and considers the level of income in a region, rather than the level of production.

While the impact on GRP is largely a reflection of the expenditure spent within the region, there are also resultant flow-on impacts for the rest of the economy (Table 34 and Table 35). Therefore, while the majority of expenditure related to each of the scenarios will be spent within the Otway region, the indirect impacts are also expected to result in increases in GRP across the rest of Victoria. The analysis suggests the high scenario will provide the most significant impact to Otway's regional economy, contributing an additional $248.54 million each year to the region's GRP, with an additional $33.55 million to the rest of Victoria. Similarly the high scenario delivers the largest impact on GRI (total of $9,072.22 million or $336.01 million average annual GRI) with an additional $1,850.79 million to the rest of Victoria. Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs (see Table 35).

Table 34 Otway scenarios impact on GRP

#	Scenario	Region	Total GRP ($m) *^	Average Annual GRP ($m) *^	GRP (% change from base)	Start year	End year
1	Otway Basin (Minimum scenario)	Otway region	655.53	65.55	0.69%	2021/22	2030/31
		Rest of Victoria	109.44	10.94	0.00%		
2	Otway Basin (Low)	Otway region	2605.13	144.73	1.18%	2021/22	2041/42
		Rest of Victoria	413.49	22.97	0.00%		
3	Otway Basin (Medium)	Otway region	4191.38	182.23	1.61%	2021/22	2043/44
		Rest of Victoria	628.20	27.31	0.01%		
4	Otway Basin (High)	Otway region	6710.66	248.54	1.98%	2021/22	2048/49
		Rest of Victoria	905.98	33.55	0.01%		

*Note: * The total and average GRP figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

Table 35: Otway scenarios impact on GRI

#	Scenario	Region	Total GRI ($m) *^	Average Annual GRI ($m) *^	GRI (% change from base	Start year	End year
1	Otway Basin (Minimum scenario)	Otway region	810.63	81.06	0.66%	2021/22	2030/31
		Rest of Victoria	151.69	15.17	0.00%		
2	Otway Basin (Low)	Otway region	3229.06	179.39	1.06%	2021/22	2041/42
		Rest of Victoria	677.65	37.65	0.01%		
3	Otway Basin (Medium)	Otway region	5392.08	234.44	1.46%	2021/22	2043/44
		Rest of Victoria	1173.60	51.03	0.01%		
4	Otway Basin (High)	Otway region	9072.22	336.01	1.84%	2021/22	2048/49
		Rest of Victoria	1850.79	68.55	0.01%		

*Note: * The total and average GRI figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

The assessment of the impact to Victoria's GRP and GRI is summarised in Table 36.

Table 36: Key benefits and impacts to GRP

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Uplift to the GRP of the Otway region	The increased expenditure related to the implementation of gas exploration and development in the Otway region will provide additional value to the region's economy, above the cost of inputs required to produce related goods and services. This increase in net output within the region's economy will result in an increase to overall GRP.	Uplift to GRP and GRI as a result of the hypothetical development scenarios is achieved through: ► increased expenditure within the Otway region directly related to the implementation of gas exploration and development ► flow-on impacts throughout the rest of Victoria as a result of the increased expenditure. As the number of exploration and development sites increases, the economic growth that is generated will help to create	N/A	Minimum scenario: Low: Medium: High:	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		additional jobs and provide new employment opportunities across the state, both in terms of employment directly related to the project, as well as the indirect (i.e. flow-on) employment required to service the increased demand across the economy. While the impact on GRP is largely a reflection of the expenditure spent within the region, there are also flow-on impacts that will result throughout the rest of the economy. Therefore, while the majority of expenditure related to each of the scenarios will be spent within the Otway region, the indirect impacts are also expected to result in increases in GRP across the rest of Victoria. The analysis suggests low, medium and high scenarios will provide a greater level of benefit than the minimum scenario. The high case is expected to contribute an additional $248.54 m each year to the Otway's regional economy, with an addition $33.55 m to the rest of Victoria. As a share of total GRP, the minimum scenario equates to 0.69 per cent and high scenario 1.98 per cent. Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs.			

Risk assessment

No risks were identified for this receptor.

Overall assessment

The ratings for each scenario has been assessed as having a slightly positive impact in the case of the minimum scenario and a positive impact in the case of the low, medium and high scenarios. The impact to the Otway region's GRP ranges from an average annual additional $65.55 million under the minimum scenario to an average annual additional $282.54 million under the high scenario. Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs, with average additional GRI ranging from $81.06 million to $336.01 million. The ratings for each scenario have been assessed based on their relative overall impact on GRP and GRI for the Otway region, with the high scenario expected to have the largest impact (Table 37).

Table 37: ER3: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.1.4 ER4: Domestic gas supply

What are the flow on economic benefits to users of gas in Victoria?

Benefits and impacts

The analysis has identified the following key benefits and impacts to the domestic gas supply with respect to the Otway Basin hypothetical exploration and development scenarios:

- gas supply for direct use in Victoria
- GPG supply in Victoria
- energy security in Victoria.

These impacts are described further below.

Gas supply for direct use in Victoria

Onshore conventional gas exploration and development in the Otway region is expected to increase gas supply available for direct use in Victoria. This would lead to an:

- increase in Victoria's overall gas supply by reducing tightening supply situation and reliance on imports
- increase in diversity of gas supply
- increase gas available to industrial users, particularly those located closest to the development.

Increase in Victoria's overall gas supply by reducing tightening supply situation and reliance on imports

Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas.[71] However, due to falling production forecasts from the offshore Gippsland and Otway

[71] Additional Victorian supply is currently used to provide gas to other neighbouring jurisdictions (i.e. New South Wales, South Australia and Tasmania).

basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023.[72] Current forecasts by AEMO suggest that shortfalls are expected from 2024 onwards.[73]

Unless currently uncommitted gas supply projects proceed,[74] Victoria is expected to become a net-importer of gas (e.g. more reliant on gas sources from outside the state, in particular from Queensland). Victoria is also expected to be increasingly reliant on the Iona gas storage facility.[75]

In addition, it is expected that new infrastructure will be required to ensure that gas demand in southern states can be met in 2024 and beyond, particularly as Victorian production continues to decline. At present, maximum physical capacity of gas flow from Queensland to the southern states through existing pipeline infrastructure is 145 PJ/year.[76]

As a result, exploration and development of onshore conventional gas in the Otway Basin may provide a positive impact by reducing the tightening gas supply situation in Victoria and reliance on imports from other states, particularly Queensland.

The scale and timing of development are important factors in determining the level of benefit exploration and development cou ld deliver in reducing the tightening gas supply. Figure 21 and Figure 22 highlights the gas production profile and total gas produced over the lifetime of production respectively. The assessment identified that all four hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production under the high and medium scenarios would be much higher than in the low and minimum scenario. Production under the minimum scenario is expected to end much sooner than in the other three scenarios.

[72] Next five years are from 2019-23 (also referred to by AEMO as the outlook period). For more information see: AEMO, 2019, Victorian Gas Planning Report
[73] AEMO (2019) *Gas Statement of Opportunities*
[74] Further information on potential sources of new supply (excluding new offshore gas developments) is provided in Appendix A (Industry Profile).
[75] AEMO (2019). *Gas Statement of Opportunities*. p. 3.
[76] AEMO (2019). *Victorian Gas Planning Report*. p. 38.

Figure 21: Gas production profiles – Otway minimum scenario, low, medium and high scenarios

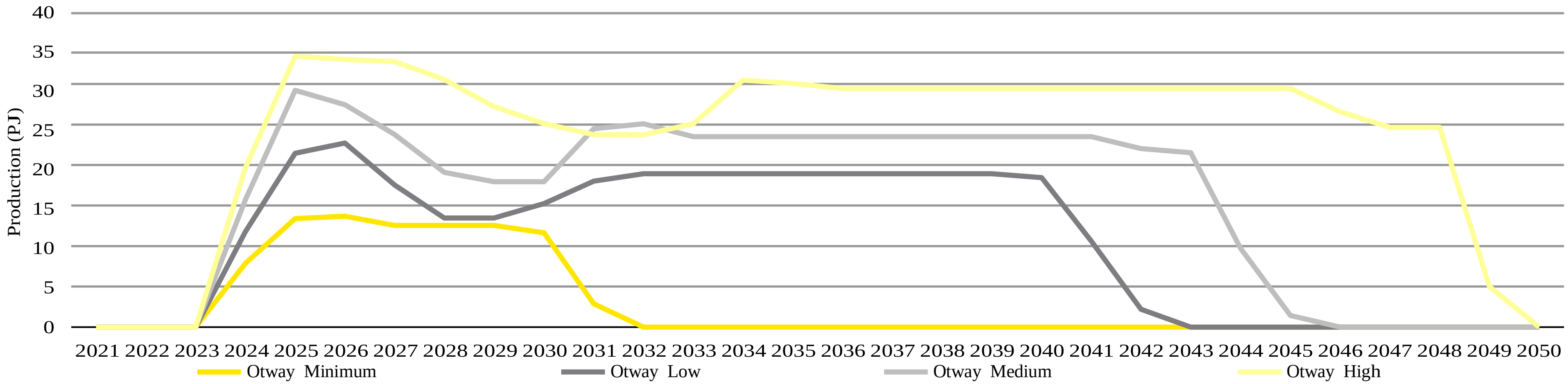


Figure 22: Total gas production - Otway minimum scenario, low, medium and high scenarios

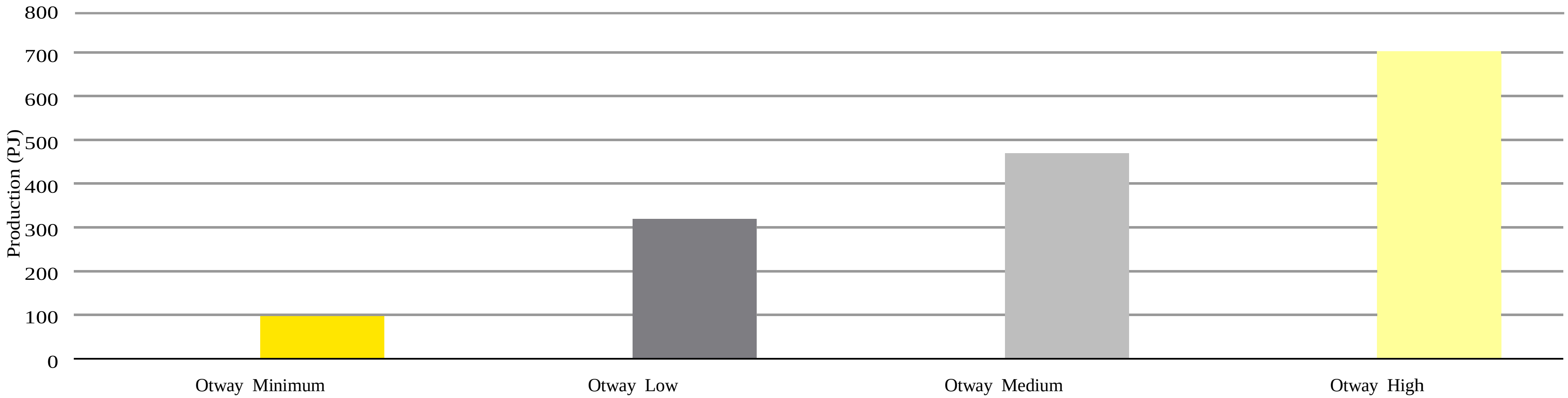


Table 38 compares AEMO's total forecast consumption in 2023 (223 PJ) to assumed annual gas production from the four hypothetical Otway exploration and development scenarios in 2024 and 2025.[77] This analysis indicates that the high development scenario could add an additional 20 PJ of gas supply in 2024 and 33 PJ in 2025 (~9.0% and ~14.8% of forecast Victorian consumption in 2023 respectively).

Table 38: Annual gas production in 2024 and 2025 under the four hypothetical Otway scenarios, compared to total forecast Victorian consumption in 2023 (AEMO)

Scenario / Plant	2024		2025	
	Annual gas production (PJ/year)	Annual gas production in 2024 as a per centage of forecast Victorian consumption in 2023	Annual gas production (PJ/year)	Annual gas production as a per centage of forecast Victorian consumption in 2023
Otway Basin (Minimum scenario)	8	3.6%	13	5.8%
Otway Basin (Low)	12	5.4%	21	9.4%
Otway Basin (Medium)	16	7.2%	29	13.0%
Otway Basin (High)	20	9.0%	33	14.8%

Table 39 compares AEMO's total forecast Victorian production supply in 2023 (246 PJ) to assumed annual gas production from the four hypothetical Otway exploration and development scenarios in 2024 and 2025.[78] This analysis indicates that the high development scenario represents ~13.4% of forecast available production supply in 2023 (based on annual gas production in 2025).

Table 39: Annual gas production in 2024 and 2025 under the four hypothetical Otway scenarios, compared to total forecast Victorian production supply in 2023

Scenario / Plant	2024		2025	
	Annual gas production (PJ/year)	Annual gas production in 2024 as a per centage of forecast available production supply in 2023	Annual gas production (PJ/year)	Annual gas production in 2025 as a per centage of forecast available production supply in 2023
Otway Basin (Minimum scenario)	8	3.3%	13	5.3%
Otway Basin (Low)	12	4.9%	21	8.5%
Otway Basin (Medium)	16	6.5%	29	11.8%
Otway Basin (High)	20	8.1%	33	13.4%

[77] AEMO. (2019). *Victorian Gas Planning Report*. p. 5.
[78] AEMO. (2019). *Victorian Gas Planning Report*. p. 5.

It is difficult to assess the impact of the scenarios on Victoria's overall gas supply in the medium to long term as Victorian production and supply adequacy is only forecasted by AEMO over the next five years. However, gas supply is expected to remain tight into the future as forecast supply (including committed gas projects) is projected to be insufficient to meet forecast demand if no further sources of gas or alternative infrastructure are developed.[79]

Based on the high-level analysis above, all scenarios except the minimum scenario are expected to provide a minor positive effect in reducing the tightening gas supply situation in Victoria and reliance on imports from other states in the near term[80]. This is because annual gas production for these scenarios represents a material amount of gas (e.g. more than or close to 10 per cent of Victoria's forecast consumption and production in 2025). In addition, all scenarios except the minimum scenario are expected to continue producing gas over a longer time period and therefore depending on supply adequacy, could play a role into the 2040s.

The minimum scenario is not expected to have a material impact on Victoria's gas supply. This is because annual gas production is a small proportion of total forecast Victorian supply (e.g. 5.8 per cent of Victoria's forecast consumption, and 5.3 per cent of Victoria's forecast production in 2025) and is only expected to produce gas for a limited period (e.g. eight years ending in 2032).

Increase in diversity of gas supply

Major supply disruptions can impact gas supply to gas users across the supply chain, disrupting economic and social activity until gas supply can be safely restored. Diversifying gas supply can reduce the likelihood and severity of disruption events, including the costs incurred to industrial, business and residential customers.

Table 40 highlights the nameplate capacity of Victoria's gas processing plans and production, and capacity utilisation in the September quarter of 2019. It indicates that while there are other additional sources, Victoria's gas supply is largely reliant on Longford gas facility in Gippsland which has a nameplate capacity 900 TJ/day more than the next largest Victorian processing plant.

Table 40: Victorian gas processing plants and capacity utilisation, September quarter 2019

Gas processing plant	Nameplate capacity (TJ/day)	Capacity utilisation
Longford	1,115	82%
Otway Gas Project	205	52%
Orbost	80	0%
Minerva	21	235%

[79] AEMO. (2019). *Gas Statement of Opportunities*. p.40-41.
[80] Analysis of other states' access to gas sources and availability of gas supply is beyond the scope of this report.

Gas processing plant	Nameplate capacity (TJ/day)	Capacity utilisation
Bass Gas	67	32%
Casino	165	23%

Source: AEMO. (2019). Victorian Gas Planning Report. p. 4.

Drawing on the information above, it is expected that Victoria will benefit from increased diversity of gas supply in Victoria as additional gas production and processing plants would exist in the Otway Basin (rather than Gippsland where the Longford gas facility is located). The level of benefit is considered dependent on multiple factors including the capacity and utilisation of existing gas processing plants, size and timing of annual gas production as a proportion of annual consumption, and availability and location of alternative supply sources.

The annual gas production of the four development scenarios is relatively small compared to capacity of existing gas processing plant and annual consumption. It is also noted that several additional supply sources are also being considered by various parties (e.g. LNG import terminals and additional gas storage capacity).[81]

Based on this analysis, only the low, medium and high scenarios are expected to provide a slightly positive effect with respect to increasing the diversity of supply over their timeframe of production. The minimum scenario is not expected to make a material impact.

Increase gas available to industrial users, particularly those located closest to the development

Gas is an essential input for many industrial businesses, and commonly used to manufacture pulp and paper, metals, chemicals, stone, clay glass and processed foods.[82] In Victoria, industrial users represent 31 per cent of demand and are often located close to gas developments and related processing plants enabling them to purchase gas directly from producers (rather than through retail contracts, which often include higher transportation costs and a retailer margin). However, gas prices offered to all users (including industrial users) have risen from around $3-4 GJ in 2013 to around $9-10 GJ in 2019 (see analysis of ER4: Gas prices in Section 4.2.1.4 for more information).[83] As a result, industrial businesses reliant on gas, including some Victorian businesses such as Dow Chemicals, have been forced to close.[84]

Exploration and development of conventional gas in the Otway Basin may increase the gas available to industrial users, particularly those located closest to development. As noted above, the level of benefit will be dependent on the size and timing of annual gas production, and ability of the industrial user to negotiate a contract with the producer and arrange their own transportation.

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[81] See Industry Profile in Appendix A for more detail.

[82] AER (2018). *State of the Energy Market*. p.183.

[83] AER (2019). *State of the Energy Market*.

[84] Toscano, N. and Sakkal, P. (2019). *Altona site to shut: Union sounds jobs alarm on gas crisis*. [online] Available at: https://www.smh.com.au/business/companies/altona-site-to-shut-union-sounds-jobs-alarm-on-gas-crisis- 20190528-p51s2s.html [Accessed 3 Nov. 2019].

As a result, only the low, medium and high scenarios are expected to provide a slightly positive effect with respect to increasing gas available to industrial users over their timeframe of production.

Gas peaking generation supply in Victoria

Onshore conventional gas exploration and development in the Otway region is expected to increase gas supply available for peaking generation in Victoria. This will lead to an increase in Victoria's gas supply available for GPG on peak system demand days for the gas system.

Increase in Victoria's gas supply available for GPG on peak system demand day for the gas system

With gas production falling within its five-year outlook period, AEMO has forecast that the available peak day capacity will decrease by 21 per cent between 2019 and 2023. As a result, Victorian gas production available to meet Victorian GPG demand (and supply gas to other states) on a 1-in-20 peak demand day[85] is projected to fall from 596 TJ/day in 2019 to 190 TJ/day. AEMO has stated that "without additional gas supply capacity, restrictions and curtailment[86] of GPG may be necessary in 2023 on a 1-in-20 year peak system demand day."[87]

Table 41 provides a summary of plant production capacity, pipeline capacity and the remaining supply capacity for GPG demand in 2023 in TJ/day. The DTS potential supply represents the total gas supply available based on total plant capacity and total pipeline capacity. The expected supply is based on forecast 1-in-20 peak demand day and informs the remaining supply capacity gas available for GPG demand.

Table 41: Victorian capacities and expected supply on a 1-in-20 peak demand day, 2023 (TJ/day)

		Total plant capacity	Pipeline capacity	DTS potential supply	Expected supply	Remaining supply capacity
Gippsland		805	1,030	805	740	65
Port Campbell	To Melbourne	562	429	449	449	113
	To WTS[88]		20			
Melbourne	LNS storage	87		87	75	12
Total supply		**1,454**	**1,479**	**1,341**	**1,264**	

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[85] A 1-in 2 year peak demand day refers to a maximum demand projection where there is a 5 per cent probability that a forecast gas maximum demand figure will be exceeded. It considers that this projected level of demand is expected, on average, to be exceeded only once in twenty years.
[86] The interruption of a customer's supply of gas at the customer's delivery point, which occurs when a system operator intervenes, or an emergency direction is issued.
[87] AEMO. (2019). *Victorian Gas Planning Report*.
[88] The Western Transmission System (WTS) transmission pipelines serving the area from Port Campbell to Portland, and the Western District from Iona. Now integrated into the gas market and the gas Declared Transmission System (DTS).

1-in-20-year system demand	1,264	1,264	1,264	1,264	
DTS surplus/shortfall quantity (TJ/day)	**190**	**215**	**77**		**190**

Source: AEMO. (2019). Victorian Gas Planning Report. p. 41.

It is worth noting that the location, timing and size of gas production, transmission constraints and Victorian non-DTS consumption all impact the peak day supply capacity available for GPG. For example, AEMO has identified that Port Campbell's maximum daily supply capacity (including the Iona UGS facility)[89] is forecast to remain higher than pipeline capacity in 2023.

When considering the effect of onshore conventional gas exploration and development in the Otway region:

- ► The level of production under all scenarios is not expected to significantly improve the forecast available production supply for GPG on peak system demand days, particularly if current gas production falls quicker than anticipated.
- ► Existing pipeline capacity constraints may mean that all the estimated ~168 PJ discovered in the Port Campbell Embayment under the high development scenario does not provide a positive impact on the availability of gas supply for GPG on peak system demand day for the gas system in the short term (or until additional pipeline infrastructure is built).

Considering the above, only the low, medium and high scenarios are expected to provide a slightly positive impact on the availability of gas supply for GPG on peak system demand for the gas system in the medium to long term. The minimum scenario is not expected to have a material impact.

Energy security in Victoria

Onshore conventional gas exploration and development in the Otway region is expected to increase gas supply available for direct use and peaking generation in Victoria. This may support the energy transition and energy security in Victoria.

Supporting the energy transition and energy security in Victoria

The energy transition has raised challenges around energy security. There has been an increasing interdependency between gas and electricity markets. The NEM is expected to require more flexible sources of generation (such as GPG) to:

- ► balance against intermittent renewables and maintain security and reliability

[89] AEMO expects the Iona USG to be essential for supporting Victorian peak day demand including GPG, which can exceed 1,200 TJ/d.

- support increased electrification and decarbonisation. This includes opportunities for electrification in the transportation sector (with zero emissions vehicles), space heating and hot water, and the production and export of hydrogen.[90]

Gas continues to be an essential feedstock or heat source into industrial processes (such as the manufacture of plastics, fertilizers, pape r, pharmaceuticals and chemicals).[91]

In the short-term gas may enable the Victorian energy sector to transition away from ageing coal-fired generation, and which can be replaced with more sustainable, lower-emissions generation such as GPG and renewable generation such as wind and solar.[92]

The ability of GPG to respond quickly to changes in electricity market supply or demand means it is a particularly flexible source of generation that can:

- manage weather events (e.g. drought conditions) and the intermittency of renewable generation
- reduce reliance on ageing coal-fired generators.

In the medium term, exploration and development of conventional gas in the Otway Basin may help diversify Victoria's energy mix and provide a positive impact on the availability of gas supply to manage changes in electricity market demand and supply and reduce reliance on coal-fired generators and alternative supply sources in the short term. The ability to achieve this is highly dependent on market developments and the level of gas development.

As noted above, the additional production from the Otway scenarios is a small proportion of total gas supply (see Table 39), and even smaller proportion of Australia's electricity mix and total energy mix. As a result, only the low, high and medium scenarios are expected to provide a slight positive impact in supporting the energy transition and energy security in Victoria. The minimum scenario is not expected to have a material impact.

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[90] IRENA (2019). *Electrification with renewables: Driving the transformation of energy services.*
[91] At present, the ability for renewable technologies to provide the same heat quality as gas is quite limited.
[92] Department of the Environment and Energy (2017). *Independent review into the future security of the national electricity market: Blueprint for the future*.

Summary of benefits and impacts

The assessment of impacts to the domestic gas supply is summarised in Table 42.

Table 42: Key benefits and impacts to domestic gas supply

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Gas supply for direct use in Victoria	Victoria primarily uses gas directly for residential and commercial applications (typically as a heat source), but also industrial and manufacturing applications (typically as an energy source and feedstock). In this assessment, individual well production profiles were developed based on a typical well production profile and timelines for development. The assessment identified that all four hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production would range from 90 PJ in the minimum scenario to 715 PJ in the high scenario (over the lifetime of production).	The consequence of an increase in gas supply available for direct use in Victoria is an: ► reduce the tightening gas supply situation in Victoria and reliance on imports[93] ► Improve energy security by increasing the diversity of Victoria's gas supply ► increase gas available to industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs). Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas. However, due to falling production forecasts from the offshore Gippsland and Otway basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023. Current	In 2017, the Australian Government introduced the Australian Domestic Gas Security Mechanism (ADGSM) in response to a forecast gas supply shortfall in the eastern domestic gas market. The ADGSM provides the government with the ability to restrict LNG exports to secure domestic supply.[94] [95] If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used locally and reduce the tightening supply situation expected over the five-year outlook period if gas were to be produced under the Otway Basin hypothetical scenarios.	Minimum scenario: – Low: Medium: High:	The introduction of domestic prioritisation mechanism (e.g. right of first offer) could require any gas produced from Otway Basin scenarios to be offered to Victorian gas users first.[96]

93 AEMO (2019). *Victorian Gas Planning Report*. p. 3.
94 Department of Industry, Innovation and Science (2020). *Review of the Australian Domestic Gas Security Mechanism*. p. 3.
95 A recent review of the ADGSM found that ADGSM has been working effectively to safeguard domestic gas supplies and recommended the ADGSM be retained until its scheduled repeal in 2023. It also recommended amending the ADGSM's guidelines to include referencing the ACCC's LNG netback price series in estimating a potential shortfall.
96 DJPR has advised that the Victorian Government is seeking advice on the implementation of its policy commitment for gas produced from newly released offshore acreage in Victoria to be first made available to domestic residential and business customers. A similar policy could apply to any new onshore gas development.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		forecasts by AEMO suggest that shortfalls are expected from 2024 onwards. The analysis indicates that all scenarios except the minimum scenario are expected to provide a slightly positive effect in reducing the tightening gas supply situation in Victoria and reliance on imports from other states in the near term. This is because annual gas production for these scenarios represents a material amount of gas. For example, as highlighted in Table 38, the high development scenario is expected to add an additional 20 PJ of gas supply in 2024 and 33 PJ in 2025 (~9.0 per cent and ~14.8 per cent of forecast Victorian consumption in 2023 respectively). In addition, the low, medium and high scenarios are expected to continue producing gas over a longer time period and therefore depending on supply adequacy, could play a role in reducing the tightening supply situation until the 2040s. The low, medium and high scenarios are also expected improve energy security by increasing the diversity of Victoria's supply (which is largely sourced from Longford gas facility). Industrial users are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers (rather than through retail contracts which can often include higher transportation costs and a retailer margin). The minimum scenario is not expected to have a material impact in reducing the tightening gas supply situation in Victoria. For example, the minimum scenario is expected to add 5.8 per cent of Victoria's forecast consumption, and			

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		5.3 per cent of Victoria's forecast production in 2025) and is only expected to produce gas for a limited period (e.g. eight years ending in 2032).			
Gas peaking generation supply in Victoria	GPG units are typically operated as peaking stations during times of high electricity demand (e.g. in Victoria across the summer and winter peaks) or during generator outages.	The consequence of an increase in gas supply for GPG in Victoria is an: ► improve availability of GPG on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of GPG may be necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day Victorian gas supply has typically been sufficient to meet GPG demand, however this has been tested in the past particularly on a 1-in-2 year peak system demand day for the gas system where there is both system demand and winter GPG demand.[97] With gas production falling over the five-year outlook period, AEMO has forecast that without additional gas supply capacity restrictions and curtailment of GPG may be necessary in 2023 on a 1-in-20 year peak system demand day for the gas system. This could result in an interruption of supply for electricity users. The low, medium and high development are scenarios expected to provide a slightly positive impact on the availability of gas supply for GPG on peak system demand for the gas system in the medium to long term, although this is dependent on pipeline capacity constraints during	Similar to the above, the ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used locally and increase Victoria's gas supply available for GPG on peak system demand if gas were to be produced under the Otway Basin hypothetical scenarios	Minimum scenario: – Low: Medium: High:	Mitigation measures are the same those described for Gas supply for direct use in Victoria.

[97] A 1-in 2 year peak demand day refers to a maximum demand projection where there is a 50 per cent probability that a forecast gas maximum demand figure will be exceeded. It considers that this projected level of demand is expected, on average, to be exceeded only once in two years.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		peak system demand days and the scale and timing of development. The minimum scenario is not expected to have a material impact on the availability of gas supply for GPG on peak system demand.			
Energy security in Victoria	Gas has an essential role as both a fuel source itself, and as an input into electricity generation. In particular, gas is expected to be an important bridging fuel to support the energy transition currently underway across Australia. The NEM is expected to require more flexible sources of generation (such as GPG) to balance intermittent renewables, manage weather events, maintain security and reliability, and support increased electrification and decarbonisation.	The consequence of additional supply for both direct use and GPG is an: ► improvement in the amount of gas available for uses such as a transition fuel. Onshore conventional gas development in the Otway Basin may help diversify Victoria's energy mix and provide a positive impact on the availability of gas supply to manage changes in electricity market demand and supply. It may also reduce reliance on coal-fired generators and alternative supply sources in the short term. We note this is highly dependent on market developments and the level of gas development. Production from the Otway scenarios is expected to be a small proportion of total gas supply (see Table 39) and an even smaller proportion of Australia's electricity mix and total energy mix. As a result, only the low, medium and high scenarios are expected to provide a slight positive impact in supporting Victoria's energy transition and energy security in Victoria. The minimum scenario is not expected to have a material impact.	Similar to the above, the ADGSM provides the government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used for both direct use and GPG locally if gas were to be produced under the Otway Basin hypothetical scenarios, thus supporting the energy transition and energy security in Victoria.	Minimum scenario: – Low: Medium: High:	Mitigation measures are the same those described for Gas supply for direct use in Victoria.

Risk

The analysis did not identify any risks to domestic gas supply with respect to the Otway Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect gas supply. The scale and timing of development were considered important factors in determining the level of benefit exploration and development could deliver with respect to Victoria's gas supply, as were supply and demand dynamics. The assessment identified that all four hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained.

The assessment identified that the low, medium and high scenarios could:

- reduce the tightening gas supply situation in Victoria, with the potential to add up to an estimated 20 PJ of gas supply in 2024 and 33 PJ in 2025 (~9.0 per cent and ~14.8 per cent of forecast Victorian consumption in 2023 respectively)
- improve energy security by increasing the diversity of Victoria's supply (which is largely sourced from the Longford gas facility)
- increase gas available to industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs and a retailer margin)
- improve the availability of gas supply for GPG on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of GPG may be necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day).
- improve the amount of gas available for uses such as transition fuel.

Overall, the assessment finds that the level of benefit obtained is limited by the scale and timing of development, which over the lifetime of production is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption).

Therefore, the low, medium and high scenarios are expected to have a slightly positive impact on Victoria's energy supply (Table 43).

The minimum scenario is not expected to have a material impact. This is because annual gas production is a small proportion of total forecast Victorian supply (e.g. 5.8 per cent of Victoria's forecast consumption, and 5.3 per cent of Victoria's forecast production in 2025) and is only expected to produce gas for a limited period (e.g. eight years ending in 2032).

Table 43: ER4: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.1.5 ER5: Gas prices

What are the price impacts of increased gas supply (i.e. will gas or electricity prices decrease)?

Benefits and impacts

The analysis identified the following key benefits and impacts to gas prices with respect to the Otway Basin hypothetical exploration and development scenarios:

- price of gas in Victoria
- wholesale electricity market prices in Victoria.

These impacts are described further below.

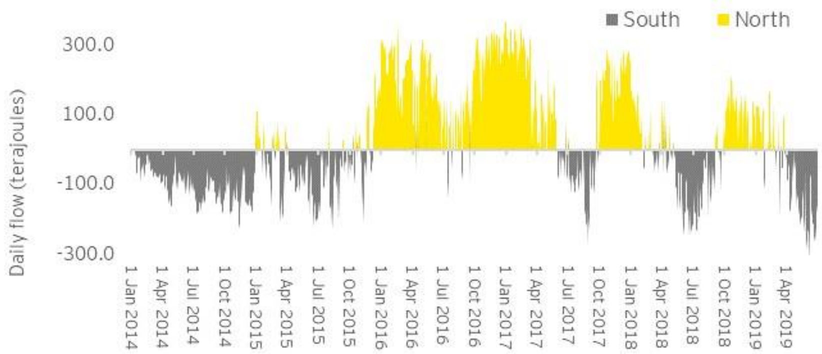
Price of gas in Victoria

Reduction in the price of gas for Victorians

In 2014, the commencement of LNG exports from Gladstone materially changed the demand and supply dynamic of the domestic gas market in eastern Australia by significantly reducing the amount of gas available for domestic use, tying the domestic market to the international market and increasing reliance on interregional gas trades to manage supply-demand balance.[98]

Figure 23 provides evidence of the latter, illustrating how demand during the winter peak drives southbound gas flow from Queensland to the Southern States (i.e. Victoria, NSW and South Australia), while shortfalls reserves to meet LNG exports drivers northbound gas flow from Victoria and South Australia drives northbound gas flow to Queensland.

Figure 23: North-south gas flows in eastern Australia



Source: AER (2019). State of the Energy Market.

As a result of LNG exports, wholesale gas prices across the domestic market have more than doubled. In Victoria, the average prices rose from around $3-4 GJ in 2013 to around $9-10 GJ in 2019.[99] Wholesale gas prices have been closely aligned to the LNG netback price, which estimates the export parity price a domestic gas producer would expect to receive from exporting its gas rather than selling it domestically.[100]

These wholesale price increases have also resulted in increased retail gas prices for small consumers. Since 2012 retail gas prices have increased much quicker than the Consumer Price Index, leading to significant cost increase for consumers and industrial gas users.[101]

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[98] Australia's largest basin, with almost 90 per cent of all gas reserves, was converted from supplying direct use gas for the domestic market to LNG exports for the international market. In the 12 months to June 2019, LNG exports consumption was 1302 PJ compared to 833 PJ for domestic gas consumption across the east coast market (i.e. 61 per cent of total consumption).

[99] AER (2019). *State of the Energy Market*.

[100] Further information on price trends in the east coast gas market is provided in Appendix A (Industry Profile).

[101] ACCC (2019). *Gas inquiry 2017-2020 Interim Report.*

The assessment of this receptor considers the extent to which exploration and development of conventional gas in the Otway Basin could improve gas price outcomes for Victorians. In order to consider this benefit, the assessment draws on the Australian Consumer and Competition Commission's (ACCC) bargaining framework to analyse pricing outcomes in the Southern States. A summary of this framework is provided below.

ACCC's bargaining framework

Due to the cost of transportation between the Southern States and Queensland, the ACCC has identified that while there is a range of possible pricing outcomes in gas supply negotiation, it would usually be expected fall between:

- **The buyer alternative (ceiling price):** in a well-functioning market this represents the highest price that Queensland producers would be offered by Southern States when users are unable to reach agreement for gas supply with a southern supplier. It is expected that this price would reflect the LNG netback price plus transportation costs (with a higher price for the further away the gas user is from Queensland).
- **The seller alternative (floor price):** in a well-functioning market this presents the lowest price that a producer would be offered by Southern States, and is dependent on sufficient supply and diversity of suppliers in the Southern States increasing competition. It is expected that this price would reflect the LNG netback price less transportation costs or the cost of production (whichever is higher).

By considering pricing dynamics of the Southern States in the ACCC's bargaining framework, the assessment found that while new gas resources developed in Victoria are likely to be supplied to domestic customers (due to reduced transportation costs), the hypothetical Otway Basin exploration and development scenarios are unlikely to reduce the price of gas for Victorians.

This is because the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for Victorian gas users. Victoria is expected to remain reliant on Queensland suppliers during the winter peak (noting this is when the gas price ceiling would be set) and therefore prices will continue to be set largely by the LNG netback price (i.e. international gas markets).

This conclusion is consistent with AEMO's wholesale gas price forecasts which anticipate wholesale gas prices to remain around their current levels in the short term and potentially increase in the medium to long term.[102]

It is worth noting that while the hypothetical scenarios may not be able to influence overall prices, they may help reduce costs for some Victorian industrial users, particularly those located closest to the development. As noted in Section 4.2.1.4: ER4 Domestic gas supply, Victorian industrial users may be able to purchase gas directly from producers reducing transportation costs that would be incurred from buying gas from the east-coast gas market.

Overall, none of the Otway Basin development scenarios are expected to have a material impact on gas prices in Victoria.

Wholesale electricity market prices in Victoria

Reduction in average wholesale electricity prices in Victoria.

There has been an increasing interdependency between gas and electricity markets. GPG has increasingly taken on a price setting role across the National Electricity Market (NEM). For example, in Q3 2019 GPG was the price setter 32.9 per cent of the time in Victoria at an average price of $90 MWh.[103]

Changing market conditions (notably the closure of coal-fired generation) have resulted in an increase in wholesale electricity prices across the NEM. In Victoria, between 2014-15 and 2018-19 volume weighted average spot prices rose from less than $40 MWh to more than $120 MWh.[104]

[102] AEMO (2019). *Gas Statement of Opportunities.*
[103] AER (2019). *Quarterly price setter and average price set by fuel source – Victoria.*
[104] AER (2019). *State of the Energy Market.*

There is therefore a question around the extent to which the Otway Basin scenarios could reduce the average price that GPG bids into the wholesale electricity market and therefore reduce average wholesale electricity prices in Victoria (when GPG is the price setter).

The assessment found that the hypothetical Otway Basin exploration and development scenarios are unlikely to reduce the wholesale price of electricity for Victorians. This is because:

- the level of gas development is not expected to change gas supply or prices, which are primary input cost for GPG and impacts the price at which GPG bids in the market

- average wholesale electricity prices in Victoria are being driven by much larger market developments such as changes in overall generation reserves (i.e. speed at which existing generation is replaced by increased investment in renewable generation and interconnection) and changes in demand patterns such as increases in distributed energy resources (e.g. rooftop solar and batteries).[105]

As a result, none of the Otway Basin hypothetical exploration and development scenarios are expected to have a material impact on average wholesale electricity prices in Victoria regardless of the timeframe or level of development.

[105] Nelson, T. (2017). Electricity market design in a decarbonised energy system. *IAEE Energy Forum,* pp.29-32.

Summary of benefits and impacts

The assessment of impacts to gas prices is summarised in the Table 44.

Table 44: Key benefits and impacts to gas prices

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Price of gas in Victoria	Increased supply of gas has the potential to change supply and demand dynamics and improve gas price outcomes for Victorians. For example, an increase in gas supply or diversity of suppliers in Victoria has the potential to increase competition for residential, commercial and industrial gas users.	A potential consequence of an increase in gas supply is a: ► reduction in the price of gas for Victorians. Since the commencement of LNG exports in 2014, wholesale gas prices across the domestic market have more than doubled. In Victoria, average gas prices rose from around $3-4 GJ in 2013 to around $9-10 GJ in 2019.[106] This analysis applied the ACCC's bargaining framework to analyse potential pricing outcomes from the Otway Basin development scenarios. It found that the development scenarios are unlikely to have a material impact on the gas price receptor regardless of the timeframe or level of development. This is because the level of gas development under the scenarios is unlikely to materially change diversity of suppliers (or level of supply) in Victoria to the extent that it increases competition for Victorian gas users. Acknowledging that there are uncertainties around how the market would react and develop gas under the Otway scenarios, Victoria is expected to remain reliant on Queensland suppliers and prices will continue to be set largely by the LNG netback price. As a result, none of the scenarios are expected to have a material impact on gas prices in Victoria.	The ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood of gas being used locally if gas were to be produced under the Otway Basin scenarios. However, given the development scenarios are not expected to materially change the level of supply or diversity of suppliers in Victoria, the ADGSM is unlikely to alter residual impact ratings. The Victorian government has no regulatory levers to influence price of gas.	Minimum scenario: – Low: – Medium: – High: –	N/A

[106] AER (2019). *State of the Energy Market*.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Wholesale electricity market prices in Victoria	There has been an increasing interdependency between gas and electricity markets. GPG has increasingly taken on a price setting role across the NEM. There is therefore a question around the extent to which the Otway hypothetical scenarios could reduce the average price which GPG bids into the wholesale electricity market and therefore reduce average wholesale electricity prices in Victoria (when GPG is the price setter).	A potential consequence of an increase in gas supply is a: ► reduction in average wholesale electricity prices in Victoria. The assessment found that the level of gas development is not expected to change gas supply or prices, which are a primary input cost for GPG (and impacts the price at which GPG bids into the market). In addition, average wholesale electricity prices are driven by much larger market developments such as changes in overall generation and demand patterns. As a result, none of the Otway Basin development scenarios are expected to have a material impact on average wholesale electricity prices in Victoria.	The ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria’s gas supply tightens), it is expected to increase the likelihood of gas being used locally and increasing Victoria’s gas supply available for GPG on peak system demand if gas were to be produced under the Otway Basin scenarios. The Victorian government has no regulatory levers to influence price of GPG.	Minimum scenario: – Low: – Medium: – High: –	N/A

Risk

The analysis did not identify any risks to gas prices with respect to the Otway Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could improve gas and electricity price outcomes for Victorians.

In the case of gas prices, the assessment found that the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for gas users. As a result, it was unlikely to reduce the price of gas for Victorians and prices will continue to be set largely by the LNG netback price.

While the development scenarios may not be able to influence overall prices, the assessment found they may help reduce costs for some Victorian industrial users, particularly those located closest to the development. Victorian industrial users may be able to purchase gas directly from producers reducing transportation costs that would be incurred from buying gas from the east-coast gas market.

A similar conclusion was reached with respect to wholesale electricity prices. The assessment found that the hypothetical gas development scenarios were unlikely to reduce wholesale gas prices because the level of gas development is not expected to change gas supply or prices, which are primary input cost for GPG and impacts the price at which GPG bids in the market.

Therefore, based on the analysis, all four Otway Basin hypothetical exploration and development scenarios are expected to have no material impact on the gas price receptor regardless of the timeframe or level of development (see Table 45).[107]

Table 45: ER5: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

[107] Similar to the gas supply receptor, given the impact of the hypothetical scenarios on the gas prices receptor is expected to be minimal, EY and DJPR decided not to conduct an energy market modelling exercise as part of the assessment. Nonetheless, EY acknowledges that energy market modelling would be necessary to validate its assessment of this receptor.

4.2.1.6 ER6: Government revenue

What are the flow on economic benefits to government through taxation and royalties?

Benefits and impacts

This analysis has identified the following key benefits and impacts to government revenue with respect to the Otway Basin hypothetical exploration and development scenarios:

- royalties
- company taxation (including income tax, land tax, payroll tax and rates).

These benefits are described further below.

Royalties

Onshore conventional gas exploration and development in the Otway Basin is expected to increase royalties from production. This will lead to an increase in Victoria's royalties obtained from onshore conventional gas production.

Increase in Victoria's royalties obtained from onshore conventional gas production.

The Petroleum Regulation Framework sets out the requirement for holders of a production licence to pay royalties on onshore petroleum production. Royalties are paid to government as a resource rent for the exploitation of a State-owned resource. The rate of royalty is normally set at 10 per cent of the net wellhead value of the petroleum produced by holders of a production licence and paid every six months.[108]

The total value of royalties over the lifetime of each Otway Basin hypothetical exploration and development scenario was estimated as part of this assessment. Figure 24 shows the total royalties for each scenario over the lifetime of its production as a proportion of the year on year net-value of the petroleum at the well-head. The net-value of petroleum at the well-head is the value of petroleum produced less all expenses incurred (e.g. recovery and extraction, transportation and tax expenses).

[108] It is noted that the rate of royalty and time of payment of royalties may also be specified in a production licence provided all requirements outlined in the Petroleum Act and regulations have been met. This includes requirements for the relevant Minister to consult the Treasurer before varying the royalty rate or providing a different method of collecting revenue.

Figure 24: Total value of royalties for each scenario as a proportion of net value of petroleum at the well-head

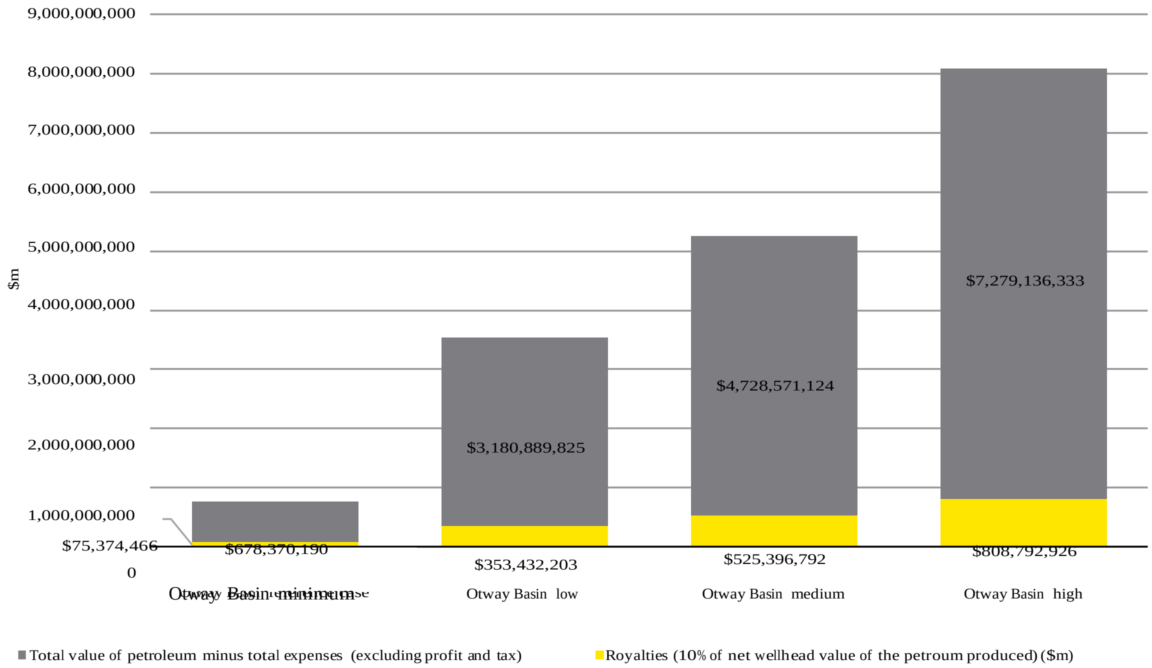


Table 46 illustrates annual average royalties over the lifetime of production from the Otway hypothetical exploration and development scenarios as a percentage of the current royalties payable to the Victorian Government from extractive, minerals, petroleum and coal industries.

Table 46: Annual average royalties as a percentage of current royalties payable to the Victorian Government[109]

Scenario	Annual average royalties ($m)	Annual average royalties from the Otway scenarios as a percentage of annual royalties payable to the Victorian Government from extractive, minerals, petroleum and coal industries
Otway Basin Minimum scenario	9.4	9.8%
Otway Basin (Low)	18.6	19.3%
Otway Basin (Medium)	23.9	24.8%
Otway Basin (High)	31.1	32.3%

This analysis indicates that the level of benefit from royalties is directly linked to the level and timing of production. For example, the minimum scenario is expected to provide ~$9.4m in annual average royalties over the lifetime of production, which is only eight years (2024 to 2031) and represents 9.8 per cent of annual royalties. It is therefore expected to provide a slightly positive impact. By contrast, the high development scenario is expected to provide the greatest level of benefit with annual average royalties expected to reach ~$31.1m per year over the lifetime of production which is spread over 26 years (from 2024 to 2049) and represents 32.3 per cent of annual royalties. It is therefore expected to provide an extremely positive impact.

The value of royalties collected in the low and medium development scenarios are closer together and sit between these two extremes. Production is expected to end in 2042 and 2045 respectively. Both scenarios are therefore expected to provide a positive impact; increasing Victoria's royalties obtained from onshore gas production.

[109] Earth Resources Regulation. (2020). 2018-19 Annual Statistical Report. [online] Available at: [Accessed 12 Feb. 2020].

https://earthresources.vic.gov.au/legislation-and-regulations/regulator-performance-Reporting/annual-statistical-Reports

[Accessed 12 Feb. 2020].

Company taxation (including income tax, land tax, payroll tax and rates)

Onshore conventional gas exploration and development in the Otway region is expected to increase company taxation. This will lead to an increase company taxation from Victorian onshore gas producers.

Increase in company taxation from Victorian onshore gas producers

Businesses conducting economic activity in Australia results in direct taxable income and indirect taxation streams such as land tax, payroll tax and council rates. These requirements are established under a variety of legislation set at the federal, state and local level.

The applicability of various tax forms, and the amount of company taxation payable is dependent on many factors including, but not limited to:

- the size of production (and therefore revenue)
- the characteristics of the business (e.g. corporate structure, location of parent firm)
- use of allowable deductions (e.g. exploration and prospecting expenditure and capital expenditure).[110]

For these reasons it is difficult to accurately estimate the level of tax payable by onshore gas producers under the hypothetical Otway Basin exploration and development scenarios.

Having said this, it is expected that most of the company taxation streams would be applicable, with annual taxes increasing consistent with the level of capital expenditure and production over the exploration and development period of each scenario. As a result, oil and gas producers are expected to begin paying company taxation related to all scenarios in 2022. Company taxation is expected to provide less government revenue than royalties and has not been calculated due to a multitude of factors influencing the amount of tax paid by companies. Taxation revenue is expected to cease soon after the end of each scenario's development period (i.e. 2031 under the minimum scenario, 2042 in the low scenario, 2045 in the medium scenario and 2049 in the high scenario).

Based on this analysis, all four scenarios are only expected to provide a slightly positive impact in increasing company taxation.

Table 47: Annual average royalties expected under the Otway Basin development scenarios

Scenario / Plant	Annual average production (PJ/annum)	Annual average royalties ($m)	Average annual company taxation ($m)
Otway Basin (Minimum scenario)	4.3	9.4	Unknown
Otway Basin (Low)	15.5	18.6	Unknown
Otway Basin (Medium)	22.8	23.9	Unknown
Otway Basin (High)	34.7	31.1	Unknown

[110] Earth Resources. (2020). *Tariffs and customs*. [online] Available at: https://earthresources.vic.gov.au/licensing-approvals/oil-and-gas-permits-leases-and-licences/tariffs-and-customs [Accessed 2 Feb. 2020].

Summary of benefits and impacts

The assessment of impacts to government revenue is summarised in Table 48.

Table 48: Key benefits and impacts to government revenue

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Royalties	The government allocates petroleum rights to private companies to derive benefits from State-owned resources. This ensures Victoria receives an adequate return on the use of the State's natural resources. Benefits are captured through royalties levied on onshore gas production and collected by the State (via ERR). The royalty is normally set at 10 per cent of the net wellhead value of the petroleum produced by holders of a production licence and paid every six months.[111]	The consequence of obtaining royalties from gas production is an: ► increase in Victoria's royalties obtained from onshore gas production. The level of benefit is directly linked to the level and timing of production and current royalties payable from extractive, minerals, petroleum and coal industries. The total value of royalties over the lifetime of each Otway Basin exploration and development scenario has been estimated as part of this assessment.[112] This analysis indicates that the minimum scenario is expected to provide ~$9.4 m in annual average royalties over the lifetime of production, which is only eight years (2024 to 2031) and represents 9.8 per cent of annual royalties. Consistent with the factors identified above, the high development scenario is expected to provide the greatest level of benefit with annual average royalties expected to reach ~$31.1m per year over the lifetime of production which is spread over 26 years (from 2024 to 2049) and represents 32.3 per cent of annual royalties.	The Petroleum Regulation Framework sets out the requirement for holders of a production licence to pay royalties on onshore petroleum production. As a result, the benefits provided by royalties are dependent on the legislative control being in place, and adequate capacity and capability from ERR to enforce royalty requirements.	Minimum scenario: Low: Medium: High:	N/A

[111] The rate of royalty and time of payment of royalties may also be specified in a production licence provided all requirements outlined in the Petroleum Act and regulations have been met. This includes requirements for the relevant Minister to consult the Treasurer before varying the royalty rate or providing a different method of collecting revenue.

[112] Note, it has been assumed the Otway Basin hypothetical scenarios do not include any circumstances in which a royalty is not payable, no penalties for late payment, and that the regulator has the capacity and capability to collect all due royalties.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		It is worth noting that royalties are only payable during each scenario's production period. As a result, royalties would only be paid from 2024 and the high scenario is the only scenario expected to provide royalties to 2050.			
Company taxation (including income tax, land tax, payroll tax and rates)	Businesses conducting economic activity in Australia results in direct taxable income and indirect taxation streams such as land tax, payroll tax and council rates. Company taxation is generally paid on an annual basis to either federal, state or local government's depending on the specific tax applicable.	The consequence of company taxation is an: ► increase in company taxation from Victorian onshore gas producers. The applicability of various tax forms, and the amount of company taxation payable is dependent on many factors including, but not limited to the size of the production, business characteristics, and deductions. As a result, it is difficult to accurately estimate the level of tax payable by onshore gas producers under the Otway Basin development scenarios. Having said this, it is expected that most of the company taxation streams would be applicable, with annual taxes increasing consistent with the level of capital expenditure and production over the exploration and development period of each scenario. As a result, government is expected to begin receiving company taxation in 2022, with tax payments ending as early as 2031 under the minimum scenario, and as late as 2049 in the high scenario. Company taxation is expected to provide less government revenue than royalties.	Company taxation is based on a variety of legislation set at the federal, state and local level. For example, income tax is set by the Australian Government, while land tax and payroll tax are a State tax. Rates are set by local councils. Similar to royalties, the benefits provided by company taxation are dependent on this legislation and adequate capacity and capability from responsible bodies to enforce company tax requirements.	Minimum scenario: Low: Medium: High:	N/A

Risk

The analysis has not identified any risks to government revenue with respect to the Otway Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect government revenue. It identified the Otway scenarios could increase royalties obtained from onshore gas production by the Victorian Government. This analysis indicates that the level of benefit from royalties is directly linked to the level and timing of production. For example, the high scenario was expected to provide the greatest level of benefit with total royalties expected to reach ~$809 million over the lifetime of production.

The assessment also identified the hypothetical scenarios are expected to provide a slightly positive benefit on government revenue through company taxation from Victorian onshore gas producers. The applicability of various tax forms, and the amount of company taxation payable is dependent on many factors and is therefore difficult to quantify.

Based on this analysis, the impact of each scenario on government revenue is linked to the to the level and timing of production – as both these factors materially influence revenue from royalties and company taxation (see Table 49).

Table 49: ER6: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.2 Social impact assessment

4.2.2.1 SR1: Community health, safety and security

What level of impact on the community's health, safety and security will gas development have?

Benefits and impacts

The analysis has identified the following key benefits and impacts to community health, safety and security with respect to the Otway Basin hypothetical exploration and development scenarios:

- visible flaring from site
- noise and vibration from operations / exploration
- dust generation.

Summary of benefits and impacts

The assessment of impacts to community health, safety and security are summarised in (Table 50):

Table 50: Key benefits and impacts to community health, safety and security

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Visible flaring from site	As part of the well appraisal process, gas flaring is used to determine the volume, pressure, flow rate and composition of the gas from the well prior to it coming into production.[113] Flaring at the well site can last for several days, until the flow of liquids and gas from the well are stabilised. At gas plants, flaring is usually intermittent and only undertaken during process upsets (to safely purge the plant	Visible flaring from site may reduce visual amenity in the immediate area of the well site.	Flaring is within scope of an EMP and must be reduced to a level that is as low as reasonably practicable. Industry practice is to consult with nearby communities and landholders where planned flaring is to take place (so that timing and duration considers local amenity concerns).[114] Flaring is an activity that is within scope of both planning permit and EES assessments where these are required.	Minimum scenario: x Low: x Medium: x High: x	Possible legislative improvements derived from the VGP gap analysis': ► requirement for enhanced community consultation and consideration of community input during authority

[113] Gas Fields Commission Queensland. (2020). *Gas Flaring*. [online] Available at: https://gasfieldscommissionqld.org.au/gas-industry/technical-information/gas-flaring. [Accessed 28 Jan. 2020].
[114] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	of gas), to burn the components of gas that can't be transported in a pipeline or to maintain pressures for safe and efficient operations.		Both assessments will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. [115]		grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. These may increase the level of consultation around visible flaring events, so that the timing and duration takes into account local amenity concerns.
Noise from operations/ exploration	Noise and vibrations are created during the site preparation (well site, pipeline Right of Ways (RoW), gas plant), drilling and testing phases and occur throughout the life of the project.[116] They can be caused by: ► clearing and/or mulching of vegetation ► engine and road noise from the seismic survey vehicles and other survey vehicles	The consequences of increased noise and vibration can include: ► inconvenience and annoyance to landholders ► vibration disturbance to buildings. These noise and vibration impacts are generally sporadic and not ongoing. They occur only while the specific activity is being undertaken, for example, during. drilling activities on site, which only occur over short timeframes. Therefore, noise/vibration is a temporary hazard in	Impacts of noise and vibration and measures for control are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Noise must be reduced to a level that is as low as reasonably practicable. The EP Act s46 requires that the emission of noise shall be in accordance with the State Environment Protection Policy specifying acceptable conditions for emitting noise. The Environmental Protection Authority (EPA) Guideline:	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as visible flaring from site.

[115] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[116] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	► vibrations generated by the activation of the base plate on the seismic survey vehicles ► the drill rig and associated generators and temporary camp site (if workers are not accommodated in a nearby town) ► pipeline RoW clearing and construction ► rock hammering for pipeline construction ► engine and road noise from the tractors used for rehabilitation ► wellsite and gas plant flaring ► gas plant equipment. Development may create or exacerbate noise pollution in the immediate area of exploration and development.[117] Noise and vibrations occur during the site preparation, drilling and testing phases and occur throughout the life of the project.[118] They can be caused by: ► engine and road noise from seismic surveying [119] and other survey vehicles ► mulching of vegetation ► vibrations generated by the activation of the base plate on seismic survey vehicles engine and road noise from vehicles used for rehabilitation.	any given location and is not dissimilar to farming activities in terms of noise outputs. In the Otway Basin exploration and development scenarios, the noise impacts can vary depending on the progression of the development. If a hypothetical development undertook only a seismic survey and did not proceed to drilling, then impacts would be limited to a few minutes to days depending on the layout of the survey. If drilling did occur, then the timeframe for impacts would be days and if production was to occur low levels of noise would occur for a period of two to three years. A recent noise study carried out at the Halladale and Speculant production well sites confirmed that operation noise did not exceed guidance noise levels near the well site.[120]	*Noise from industry in regional Victoria* sets out the recommended maximum noise levels which can be applied to manage the impacts of noise on the community.[121] The EPA has the power to serve a pollution abatement notice if a process or activity which is being carried on is causing unreasonable noise. This notice can include orders to cease carrying on the activity, or to modify the activity in the manner specified in the notice. Noise from operations is within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. [122]		

[117] Information supplied by the department.
[118] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.
[119] Buggy with an attached seismic vibrator that injects low frequency vibrations into the earth to perform seismic surveys.
[120] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.
[121] Environment Protection Agency Victoria (2011). 'Noise from Industry in Regional Victoria', *EPA Publication 1411*.
[122] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Dust generation	Repeated vehicle (including heavy vehicle) travel over natural landforms, unsealed roads, farm tracks or fallow farmland can generate dust. The creation of new tracks and roads, or clearing of pipeline RoW, well leases or gas plant sites will also result in dust.[123]	Consequences of increased dust can include: ► nuisance to landholders and the public ► nuisance to native fauna and livestock ► localised and temporary decrease in air quality ► smothering of pastures. Similar to noise and vibration impacts, dust generation is sporadic, and only occurs when specific activities are undertaken (e.g. vehicles being driven to and from site on unsealed surfaces). Areas impacted by dust already experience dust created as a part of business as usual farm activities, such as cropping or harvesting. Dust generated from gas exploration or development activities is likely to be similar to other land use activities such as farming.[124] Further the dust generated from activities is affected by the soil type. As an example, operational activities carried out on Bulldust (a fine red aeolian dust common in outback Australia) will produce more dust than clay. As such impacts will vary based on well site location. However, petroleum development by its nature does not involve large scale soil disturbance as such overall dust generation is expected to be low at all levels of development.[125] Dust generation is an impact that will occur during the lifetime of exploration	Impacts of dust and measures to control it are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Dust must be reduced to a level that is as low as reasonably practicable. The EMP takes into account the State Environment Protection Policy (Ambient Air Quality) which outlines the processes to measure and Report on the concentration of environmental indicators in the air to determine whether the environmental quality objectives of the Policy are being met.[126] The EPA has the power to serve a pollution abatement notice if a process or activity which is being carried on is causing unreasonable dust. This notice can include orders to cease carrying on the activity, or to modify the activity in the manner specified in the notice. Dust from operations is within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. [127]	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as visible flaring from site.

[123] Information supplied by the department
[124] Information supplied by the department
[125] Advice provided by the department.
[126] State Environment Protection Policy (Ambient Air Quality) No S19, Gazette 9/2/1999.
[127] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		and development and will cease upon completion. In the Otway Basin hypothetical exploration and development scenarios, production at an individual well site is between two and three years. Further, building of capex infrastructure, including plants and pipelines has a duration of between 0-3 years. Therefore, the local impact of an individual well would only occur over this timeframe.			

The impact is likely to vary with the types of activities performed as well as the level of exploration and development however overall impacts at all levels of development are expected to be low. This is because the legislative requirements require impacts to be mitigated and managed to an acceptable level. While the total number of development wells increases from 14 under the minimum scenario to 125 under the high scenario, the number of wells being developed in an individual year only varies from two under the minimum scenario to eight under the high scenario. Therefore, the impact in a given year is unlikely to vary between the scenarios.

Risk

The analysis has identified the following key risks to community health, safety and security with respect to the Otway Basin hypothetical exploration and development scenarios (Table 51).

Table 51: Key risks to community health, safety and security

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Hydrocarbon or chemical spill that Reports offsite	There are several causes within the exploration and development of gas that can create a spill risk both on site.[128] These include: ► poor storage of hazardous materials ► poor housekeeping	Spills may: ► create safety hazards for employees, landowners and the local community ► increase the risk of damage and destruction of third-party property,	Risks of hydrocarbon and chemical spills are addressed in an EMP (and if relevant, a separate Oil Spill Contingency Plan, OSCP) and where relevant, an EPBC Act Referral and/or EES. An ERP is a document prepared by operators to describe its emergency response	Unlikely[131]	Minor[132]	Low	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input

[128] Information supplied by the department.
[131] Information supplied by the department
[132] Information supplied by the department

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	► inadequate waste management procedures ► ignition of vegetation during vegetation slashing/mulching/ clearing ► ignition of flammable materials mechanical, electrical or operational failure of equipment on site ► well blowout during drilling ► external fire reaching site ► loading/unloading of product (e.g. condensate) or chemicals ► refuelling. Spill risk can occur throughout the exploration, development and operations phases of the gas operation lifecycle. Once the production phase of development is complete, spill risk will cease. In the Otway Basin exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe.	farmland, crops and stock ► create excessive atmospheric emissions (gas). ► possible contamination of air, soil, water and/or groundwater. ► injury to fauna/livestock through ingestion. ► visual pollution. ► fire.	preparedness and response measures. Spill risk must be reduced to a level that is as low as reasonably practicable. The EMP would include a spill management plan and emergency response manual, with detailed arrangements for dealing with any threat to the environment near the petroleum operation and ensuring that the treatment does not harm the environment. The OH&S *Act*, the OH&S Regulations and the Dangerous Goods (Storages and Handling) Regulations 2012 outline specific duties and obligations for the storage and handling of dangerous goods, including flammable materials. The Code of Practice for the Storage and Handling of Dangerous Goods includes guidance on how to comply with these obligations, including how to control risks associated with the storage and handling of dangerous goods, as well as planning emergency responses.[129] The obligations contained in these Acts require operators to ensure any risk associated with the storage and handling of dangerous goods is eliminated or reduced. The Code of Practice is administered by WorkSafe Victoria as such gas operators will be subject to WorkSafe audits,				during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. The Petroleum Regulations 2011 could be updated with stronger provisions for well management and rehabilitation and closure.

[129] WorkSafe (2013). *Code of practice for the storage and handling of dangerous goods.*

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			reducing the chance that non-compliance with the code would occur. Spill risks is within the scope of EES assessments where these are required. An EES will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[130]				
Fire risk	Exploration phase: ► ignition of vegetation during vegetation clearing/ mulching/slashing ► ignition of flammable materials mechanical, electrical or operational failure of equipment on site ► external fire reaching site ► refuelling ► inadequate cigarette disposal. Construction phase: ► drop out from flaring ► well blowout ► ignition of flammable materials ► mechanical, electrical or operational failure of equipment on site	Fires may lead to: ► injury or death to project personnel or the public ► bushfire ► damage to or destruction of third-party property ► loss of farmland or pasture and/or crops, stock ► excessive atmospheric emissions (gas, smoke etc.).	Fire risk is within scope of an EMP and must be reduced to a level that is as low as reasonably practicable. The EMP needs to include an emergency response manual, with detailed arrangements for dealing with any threat to the environment near the petroleum operation and ensuring that the treat does not harm the environment. The EMP needs to include a Fire Management Plan that ensure risks are reduced to an acceptable level.[133][134] Local CFA brigades are expected to be consulted and updated on safety plans to manage risk. Fire risk is within the scope of EES assessments where these are required. An EES will expect that any negative impacts are reduced	Unlikely	Minor[136]	Low	Mitigation measures are the same as hydrocarbon or chemical spill that Reports offsite.

[130] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[133] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.
[134] Mineral Resources (Health and Safety) Regulations 1991.
[136] Information supplied by the department

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	► external fire reaching site ► refuelling. Production phase: ► pipeline rupture ► gas plant explosion ► ignition of flammable materials ► mechanical, electrical or operational failure of equipment on site ► external fire reaching site ► refuelling.		to the lowest level possible. Members of the public can provide written comments as a part of this. [135]				

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect community health, safety and security within the region. While there are potential negative impacts and risks within the region due to fire and spill risks, visible flaring, noise and vibrations, and dust generation, these will be mitigated through requirements under the current regulatory framework to ALARP. In the case of noise and dust generation from operations/exploration, the impact is expected to be comparable with other land use activities such as farming[137]. The impacts and residual risks are not considered to differ between scenarios, as the mitigating actions will manage the impact or risk to ALARP and an acceptable level, regardless of the footprint of the petroleum activities. Mitigating actions will also reduce the likelihood of the risk occurring.

Therefore, the scenarios are expected to have a slightly negative impact on the community's health, safety and security (Table 52) and are assessed as having a risk, based on the average ratings for each impact and risk (Table 53).

Table 52: SR1: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

[135] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[137] Advice provided by the department.

Table 53: SR1: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

4.2.2.2 SR2: Community wellbeing and social cohesion

What level of impact will occur with respect to the community's wellbeing?

Benefits and impacts

The analysis has identified the following key benefits and impacts to community wellbeing and social cohesion with respect to the Otway Basin hypothetical exploration and development scenarios:

- community attitudes to proximity of development and exploration
- community projects funded by gas development
- community engagement in decision making process
- access and affordability of housing and essential services
- impact on local roads.

These benefits and impacts are described further below.

Community attitudes to proximity of developments/exploration

There are mixed perceptions in the local community about gas extraction and production.[138] If gas development were to occur, community concerns should be considered and proactively managed in the context of the Otway region.

In 2019, CSIRO conducted a study, commissioned by the VGP, to investigate local attitudes and perceptions of onshore conventional gas development in the region (the CSIRO study).[139] The survey had a representative sample across five Otway local government areas (LGAs), of which 100 participants per LGA (total of 500 participants from the region), including landowners, were surveyed.

The survey found that:

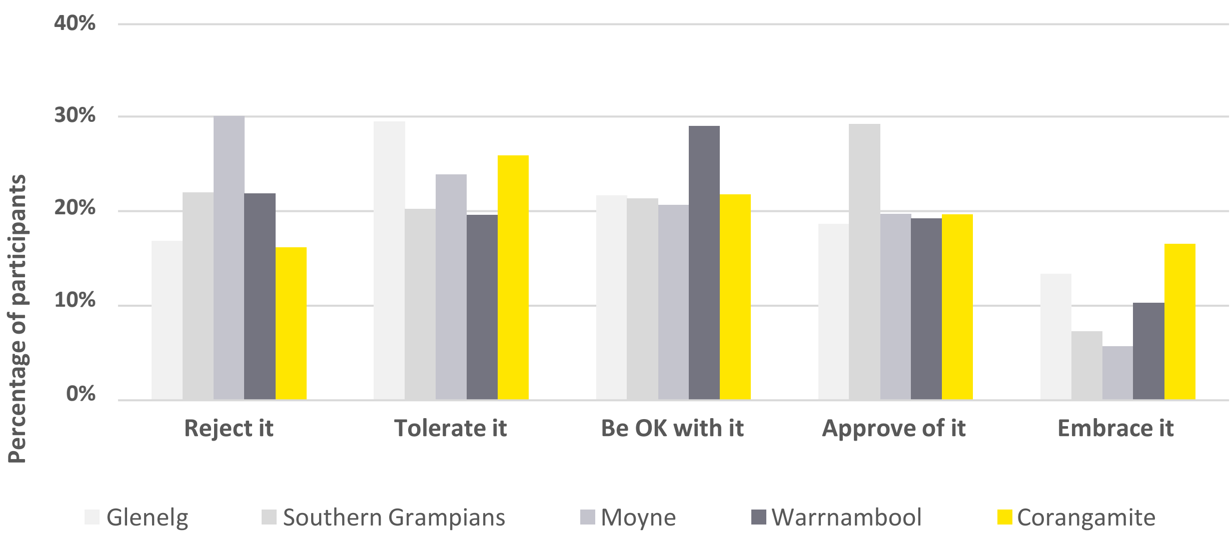
- 21 per cent of participants rejected onshore conventional gas development

[138] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results*
[139] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results*

- 11 per cent of participants embraced onshore conventional gas development
- 68 per cent of people tolerated, would be ok with, or approved of onshore conventional gas development:
    - 23 per cent would tolerate it
    - 24 per cent would be ok with it
- 21 per cent would approve it. These

attitudes are presented in Figure 25.

Figure 25: Attitudes towards onshore conventional gas development: Otway LGAs

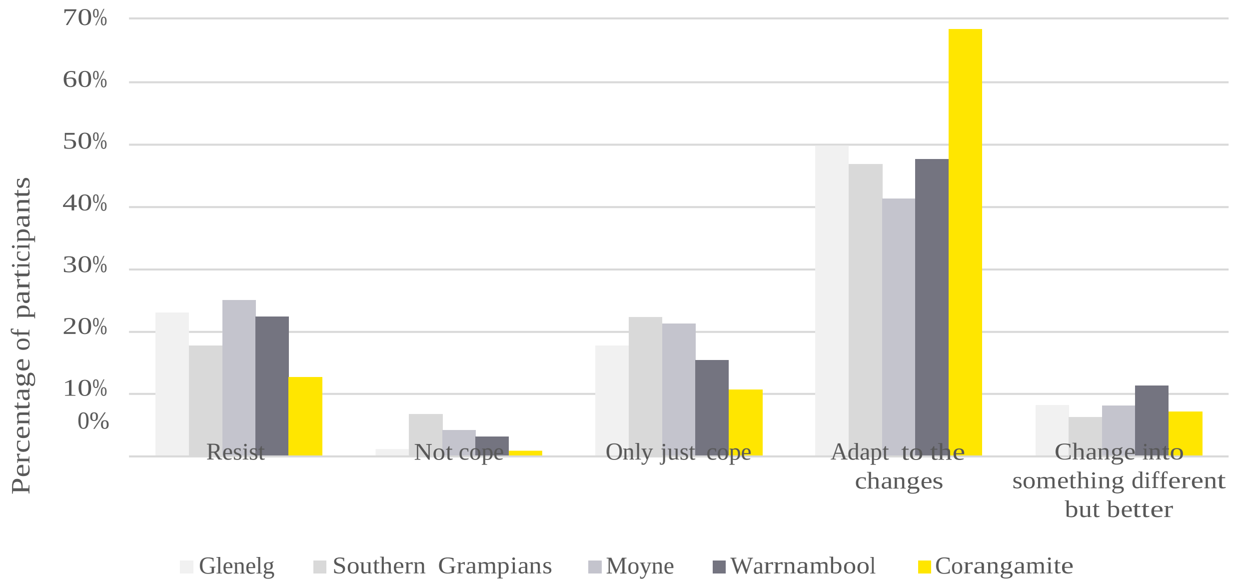


Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results

The CSIRO study also investigated the perceived community adaption to onshore conventional gas development within the Otway region (see Figure 26). The results found that:

- 50 per cent would 'adapt to the changes' (up to 70 per cent of individuals in the Corangamite LGA)
- approximately 25 per cent would 'resist' or 'not cope'
- 18 per cent would 'only just cope'.

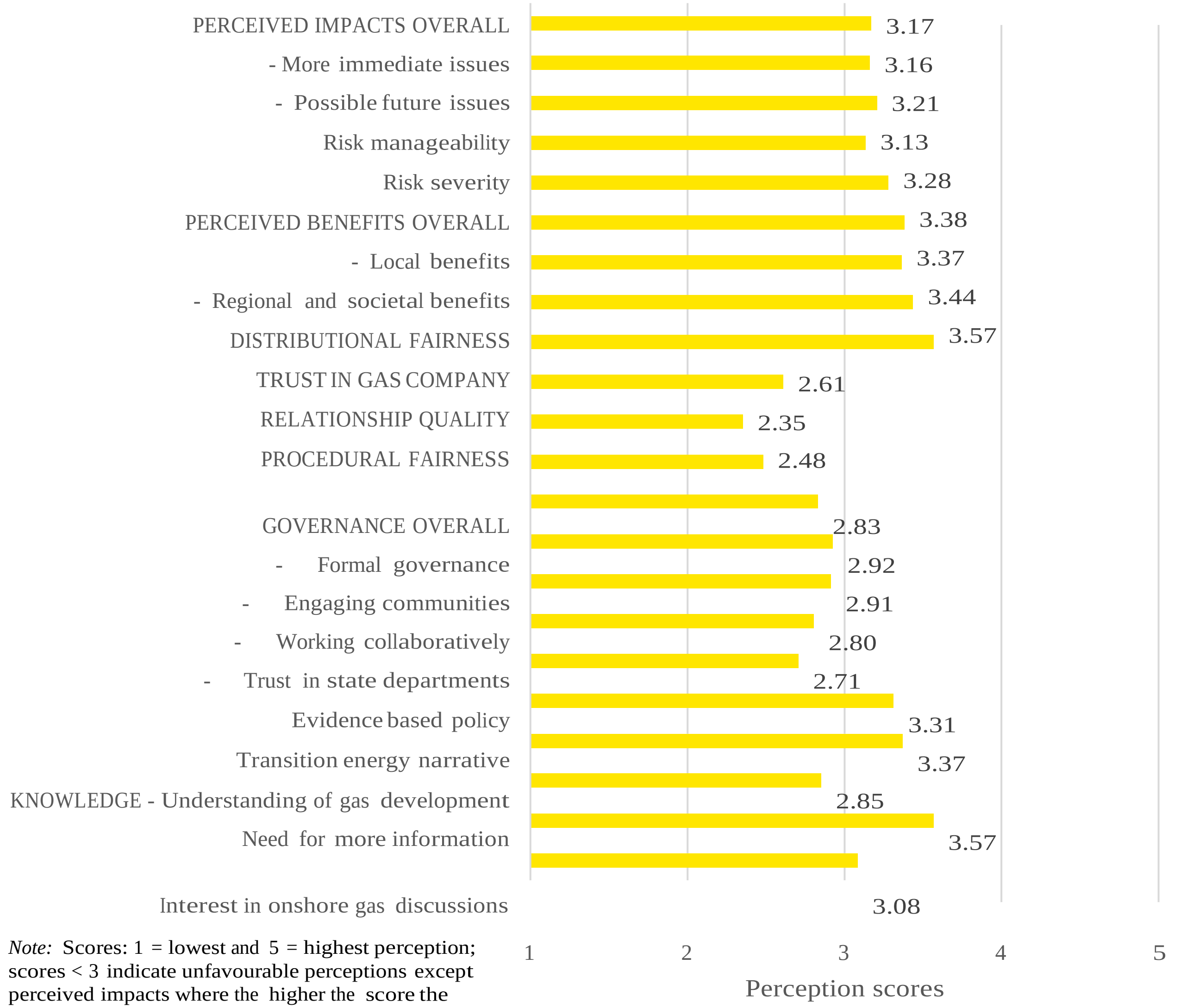
Figure 26: Perceived community adaption to onshore conventional gas development: Otway LGAs



Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).

The research also identifies the issues that underpin the community's attitudes towards onshore conventional gas exploration and development (see Figure 27).

Figure 27: Perceptions about onshore conventional gas exploration and development: Summary underlying drivers in the Otway region



Note: Scores: 1 = lowest and 5 = highest perception; scores < 3 indicate unfavourable perceptions except perceived impacts where the higher the score the greater the concern;

Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).

The results found that:

- there were moderate concerns about impacts of gas development overall (M[140] = 3.17)
- potential benefits were perceived to be moderate and slightly higher than impacts (M = 3.38)
- there was a perception of limited trust in gas companies (M = 2.61)
- community members indicated a need for more information about conventional gas development (M = 3.57) as current understanding is limited (M = 2.85)
- there was a favourable view of the role of gas in transitioning to renewable energies (M = 3.37).

This indicates that overall, community attitudes to exploration and development of gas in the Otway Basin is relatively neutral.

Community engagement in the decision-making process

Community engagement enables community members to discuss and have input in the project. Gas companies can incorporate this feedback in operations to meet the needs of the region and accommodate concerns.

In Victoria, social impacts have not been adequately addressed, which has led to communities demanding greater action from the government.[141] Proper community engagement may reduce potential social and environmental costs by pre-identifying sensitive receptors and companies can appropriately incorporate mitigations to these when responding to the regulations.[142] Community engagement tends to be focused on the perceived quality of relationships with industry, whereas industry engagement tends to be market-focused.

Engagement with the community can take place at various stages of the exploration process:

- determining an acreage area stage
- acreage release stage
- rights allocation stage

[140] M refers to the mean (i.e. average) score. This is calculated by determining the sum of total divided by count of total.
[141] Information provided by the department.
[142] Information provided by the department.

- preparation of environmental approvals (EMP, EPBC Act referral, EES, ERP, etc).[143]

Communities are becoming more informed and demand meaningful and ongoing consultation throughout the life of a project, not just at the point where an authority has been granted and a proponent is required to prepare an operation plan as required by the petroleum legislation.

Social licence and community engagement benefits are largely intangible and difficult to measure. Primary intangible benefits include:

- strong local trust
- contribution to community cohesion and spirit
- achievement of broader social aspirations of communities
- improved social responsibility for industry.[144]

A study of Coal Seam Gas (CSG) extraction in the Surat Basin, Queensland, examining coexistence between farmers and CSG developers found that clear communication was necessary to promote coexistence between farmers and the developers. The absence of which led to farmers struggling to explain some concerns because of the different way they interpreted their landscape. This among other factors caused frustration and farmers felt that this has led to severe impacts on mental health and wellbeing. The workshops also identified a range of issues perceived by farmers arising from increased traffic volumes, impacts to mental health and wellbeing, place identity and loss of water resources for farmers.[145]

In a separate study on preconditions for social licence, it was found that proactively providing people with information about regulation and compliance, and industry's commitment to ensuring local community involvement produced more favourable views of trust and fairness about a new mining proposal.[146]

Access and affordability of housing and essential services

As gas production increases within the Otway region, it is expected that employees will relocate to the area, putting pressure on access to and affordability of housing and essential services for the local community. It is expected that housing and essential service prices increase as the scale of production increases. The housing price impact is expected to be low given excess capacity of housing within the Otway Basin relative to the inflow of workers related to hypothetical gas development scenarios. Furthermore, development of the industry would be gradual and staggered and spread out over a region over time and not in one hit at one location, minimising abrupt price changes. The increase in scale of production would result in increased

[143] Information provided by the department.
[144] Information provided by the department.
[145] Huth, N., Cocks, B., Dalgliesh, N., Poulton, P., Marinoni, O. and Garcia, J. (2017). Farmers' perceptions of coexistence between agriculture and a large scale coal seam gas development. Agriculture and Human Values, 35(1), pp.99-115.
[146] Zhang, A., Measham, T. and Moffat, K. (2018). Preconditions for social licence: The importance of information in initial engagement. *Journal of Cleaner Production*, 172, pp.1559-1566.

number of workers and employees to undertake petroleum activities, some of whom would need to relocate to South-West Victoria, resulting in potential increased demand for local housing and essential services. Due to the nature of the petroleum industry, this impact is expected to be low as it does not create a large workforce at a single site in the way that mining does.[147] Rather the workforce is expected to be spread-out over the region where development is occurring.

There is evidence to suggest that gas companies have put mitigations in place to reduce these social burdens. As an example, Beach Energy established temporary accommodation to support drilling crew working in shifts to help offset local housing pressures.[148] Other employees and contractors could arrange local accommodation if required. In an alternative example, in Queensland, a CSG operator has directed staff and contractors not requiring accommodation longer than three nights must use accommodation in local towns (rather than an accommodation camp) to ensure that small towns reap the economic benefits of industry workers.[149] This policy was developed in consultation with accommodation and service providers.

While these mitigations do support the local community, they are not required under the current legislative framework. As such, overall gas development may create a burden on the community that worsens in severity as production increases.

[147] Advice provided by the department.
[148] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.
[149] Advice provided by the department.

Summary of benefits and impacts

The assessment of benefits and impacts to community wellbeing and social cohesion is summarised in Table 54.

Table 54: Key benefits and impacts to community wellbeing and social cohesion

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Community attitudes to proximity of developments and exploration	There are mixed perceptions in the local community about the gas industry, as outlined above.[150] If gas development were to occur, community concerns should be considered and proactively managed in the context of the Otway region. Community attitudes can be influenced by several ways including: ► media ► community consultation ► company Reports ► whether the company has social licence ► word of mouth. Community attitudes to proximity of developments/exploration will be important to consider for the life of the project.	The consequence of community attitudes to proximity of developments and exploration is dependent on the attitude of the individual/community. The results of the CSIRO stakeholder analysis show that general attitudes within the Otway region towards gas production are slightly favourable.	The petroleum rights allocation regime provides for petroleum acreage to be selectively released over areas deemed appropriate for development.[151] The rights allocation regime recommends the following in relation to areas of gas development and production: ► actions should be taken to reduce the potential of conflict between gas producers and existing users of land ► companies should avoid sensitive areas or clearly define areas of exploration and development ► companies need to understand the social risk of producing gas in the given area.[152] The utilisation of directional drilling provides for flexibility as to where petroleum wells are located, and standard industry is to locate wells where they cause least disturbance.[153] Proximity of community to developments is within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that community impacts are reduced to the	Minimum: Low: Medium: High:	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to community that industry will provide them with information about onshore conventional gas activities. The reforms will also ensure that community is genuinely engaged over the entire industry lifecycle. This may

[150] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results*
[151] Advice provided by the department.
[152] Tordo, S., Johnston, D. and Johnston, D. (2020). *Petroleum exploration and production rights: allocation strategies and design issues*. [online] Documents.worldbank.org. Available at: http://documents.worldbank.org/curated/en/785881468336848695/Petroleum-exploration-and-production-rights-allocation-strategies-and-design-issues [Accessed 3 Feb. 2020].
[153] Advice provided by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
			lowest level possible. Members of the public can provide written comments as a part of this.[154]		influence their attitudes towards development and exploration in the region. The VGP community engagement function will provide information to local communities about the risks benefits and impacts of developments in their locality.
Community projects funded by gas development	As part of developments some industry participants fund community projects. Current industry practice is that the developers will undertake community specific support initiatives as part of their exploration activities.	Primary impacts of community projects funded by gas development include: ► support the local community ► may provide additional jobs ► may strengthen social licence ► may increase trust in the gas company. The retention of value from gas production is an important consideration for people considering the net effects on local communities. Whilst many of the perceived negative impacts of gas development are local, significant perceived benefits, such as the provision of energy, are realised both in the community and elsewhere. There is an expectation that developers will provide additional local benefits through community support programs to work against this perception. Community projects funded by gas development may occur throughout all phases of the gas operation lifecycle. The extent of contribution could vary between the Otway Basin exploration and development scenarios as the	While there are no control measures in place, it is noted that it is industry practice to fund community projects.	Minimum: - Low: - Medium: - High: -	N/A

[154] Planning. (2020). *What is the EES process in Victoria?* [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		number of locations where gas is developed changes. As the number of locations increase where gas is developed, contributions to community projects could increase, however this would be dependent on a number of factors, including the locations of operation, size of the operations and commercial return obtained by producers increases in line with development. Gas producers also pay a significant amount in rates each year. For example, in 2019 Beach Energy paid rates in excess of $860,000 (approximately 4 per cent of Corangamite Shire Council rates income) to the Corangamite Shire Council, which were used to support community assets and services. Industry practice suggests that operators would fund local projects to build social license. Each scenario is expected to have a neutral impact on the receptor as while it is industry practice to do so, there is no associated regulatory requirement mandating this.			
Community engagement in decision making process	Engagement with the community can take place at various stages of the exploration process: ► determining an acreage area stage ► acreage release stage ► rights allocation stage ► preparation of environmental approvals (EMP, EPBC Act referral, EES, ERP, etc).[155]	Primary intangible benefits of community engagement include: ► strong local trust ► contribution to community cohesion and spirit ► achievement of broader social aspirations of communities ► improved social responsibility for industry.[156]	The Petroleum Act requires that companies consult with interested people and parties during the development of an operations plan. The Petroleum Regulations require operators to provide appropriate consultation for the life of the operation with interested people and organisations about its the environmental performance. General	Minimum scenario: Low: Medium: High:	Mitigation measures are the same as community projects funded by gas development.

[155] Information provided by the department.
[156] Information provided by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		The benefit of adequately providing this information to the public is consistent for each of the scenarios as it would be expected that all scenarios would need to have similar systems and process in place to enable community engagement.	operations and social issues are also common discussion topics. There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community. ERR generally expects titleholders to adhere to IAP2 consultation principles. There is also a low level of government scrutiny around the extent of consultation that must be undertaken. Despite the legal requirement for consultation and engagement not be prescript, it is standard petroleum industry practice to engage with community during operations and particularly during well construction and disturbance events such as flaring.[157]		
Access and affordability of housing and essential services	As gas production increases within the Otway region, it is expected that employees will relocate to the area which could create potential pressure on the housing supply and therefore rental/property prices and access to and essential services for the local community.	Further exploration and development will increase demand for housing and essential services. It is expected that rental and property prices are unlikely to increase due to the relatively low number of workers moving from the rest of Victoria (810 FTE in the high development scenario) coupled with the dispersed nature of the development scenarios. Similarly, the impact on essential services will likely not increase This impact is also expected to be lower in Victoria relative to other States and territories due to the higher population density and inherent	There is evidence to suggest that gas companies have put mitigations in place to reduce potential impacts. As an example, Beach Energy established temporary accommodation to support drilling crew working in shifts to help offset local housing pressures.[159] Other employees and contractors could arrange local accommodation if required. While these mitigations do support the local community, they are not required under the current legislative framework.	Minimum scenario: – Low: - Medium: - High: -	N/A

[157] Advice provided by the department.
[159] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		level of residential development in regional Victoria than that which exists in the rest of Australia. [158]			
Damage to local roads and traffic disruptions	Gas exploration and development has potential impacts on the surrounding areas. It results in increased traffic on local roads (particularly unsealed roads), many of which may not be of a standard capable of withstanding frequent, large and heavy loads.[160] There may also be vegetation clearing along road verges (with speed restrictions or diversions in place to ensure the safety of project personnel and the travelling public).[161] Deployment and retrieval of nodes and cables along road verges during seismic surveys, and long heavy loads (e.g., drill rigs, gas plant equipment) will create temporary traffic disruptions.	Onshore conventional gas exploration and development may result in: ► damage to local roads ► increased traffic ► increased travel times in local areas. The disturbances to roads and disruption to traffic can be a nuisance to residents and travelling public. It can also increase the travel time due to associated traffic controls and slow-moving low-loaders and equipment. Seismic surveys, drilling, pipeline construction and gas plan construction and operations are generally located in areas of low population density, where there are also low volumes of traffic. As such, disturbance is experienced by few people. Residents and landholders who are impacted are also habituated to movements of large, slow vehicles of narrow roads (such as cattle trucks, milk trucks and farm machinery).[162] Disruption would be concentrated around the construction and development phases. Over the long term, frequently used wells may be developed.	The risks regarding road damage and traffic interruptions and measures to control these are addressed in an EMP and where relevant, an EES. Operators also work with LGAs to upgrade roads (generally at their own cost) that are not otherwise suitable to support their exploration, development and operations activities, which in turn provides a wider community benefit (e.g. sealed roads remove the risks created by pot holes, remove issues regarding dust and improve travel times).[163] Impacts on local roads are managed as part of an Operations Plan. The Operations Plan would identify the risks that operations may pose on local roads and the operators' actions to mitigate these impacts. Proximity of community to developments is within scope of both planning permit and EES assessments where these are required. Both assessments will expect that impacts on local roads are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. It is standard industry practice to upgrade and maintain roads and access	Minimum scenario: – Low: - Medium: - High: x	N/A

[158] Advice provided by the department.
[160] Information provided by the department.
[161] Advice provided by the department.
[162] Information provided by the department.
[163] Advice provided by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		These impact on local roads is sporadic and not ongoing - i.e. they occur only while the specific activity is being undertaken (e.g. drilling activities on site, which only occur over short timeframes). Local roads would assume previous state once exploration, and rehabilitation are complete. Therefore, this is a temporary hazard in any given location, and is not dissimilar to farming activities in terms of impacts on roads. It has been rated as having no material impact across the minimum, low and medium scenarios. The hypothetical high scenario has been allocated a slightly negative impact rating.	tracks where additional vehicle movements are expected to have impacts.[164]		

Risk

No risks to this receptor were identified.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect community wellbeing and social cohesion within the region.

Community attitudes to the proximity of development and exploration are important to consider, however the impact of this mea sure on each of the exploration and development scenarios is neutral based on the results of surveys with residents of the Otway LGAs. The extent of contribution could vary between the Otway Basin exploration and development scenarios as the number of locations where gas is developed changes. As the number of locations increase where gas is developed, contributions to community projects could increase, however this would be dependent on a number of factors, including the locations of operation, size of the operations and commercial return obtained by producers. Community engagement, as required under legislation, will provide benefits, however the legislative framework is non-prescript as to the level of engagement required. The proposed legislative changes will improve this area. On the other hand, access and affordability of housing and essential services and with the impact on local roads and traffic are expected to have neutral impacts on the community.

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[164] Advice provided by the department.

Therefore, based on the high-level analysis and average scoring, all scenarios are expected to have a neutral impact overall (Table 55).

Table 55: SR2: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.2.3 SR3: Land access and use issues

What are the current uses of land, how will land access impact on this land use as well as impact on the surrounding areas?

Benefits and impacts

The analysis has identified the following key benefits and impacts to land access and use issues with respect to the Otway Basin hypothetical exploration and development scenarios:

- landowner consultation to inform landowner consent and compensation agreements and lease agreements
- insufficient or inadequate community understanding of gas projects in the region
- size of land impacted by gas exploration/ development activities
- impact on land value.

These benefits and impacts are described further below.

Landowner consultation to inform landowner consent and compensation agreements and lease agreements

The Petroleum Regulatory Framework requires landowner and lessee consent to be attained as well as adequate compensation be agreed prior to gas companies undertaking any gas-related exploration or development operations. Further, regulator consent for area and location specific operations for petroleum title holders must also to be obtained.

Landowner consent and consultation is a mandatory component of the Operation Plan[165] that is required to be submitted to the Minister prior to any gas operation commencing, and the Minister has discretion to reject any Operation Plan where this has not been appropriately undertaken.

Table 56 summarises the key aspects of the legislation and how it has been formulated to ensure landowner consent is attained prior to any gas-related exploration or development activity.

Table 56: Sections of Petroleum Act that ensure landowner consent and consultation

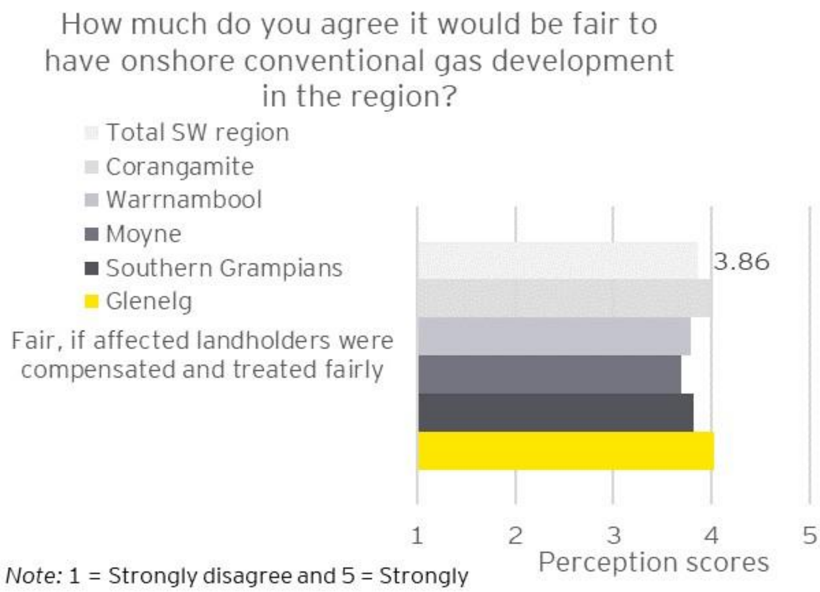
Section of the Petroleum Act	Description and how it safeguards landowner rights
Section 128	A person must not carry out any petroleum operation on private land unless: ► it has obtained the consent of the owners and occupiers of the land to the operation; or ► it has entered into a compensation agreement with the owners and occupiers of the land in relation to the operation; or ► the Tribunal has determined the amount of compensation that is payable to the owners and occupiers of the land under this Act in relation to the operation.
Section 141	A person must not carry out petroleum operation on land without written consent of the person or body responsible for the land on which there is a public highway, road or street.
Section 161	Before carrying out any petroleum operation, the holder of the authority under which the operation is to be carried out must give the Minister an Operation Plan: ► that identifies the risks of injury or damage that the operation may pose to the environment, to any community, person, land user, land or property in the vicinity of the operation and to any petroleum, source of petroleum or reservoir that the operation might affect; and ► that specifies what the holder of the authority will do to eliminate or minimise those risks; and

[165] *Petroleum Act 1998 (Vic)*, s161

Section of the Petroleum Act	Description and how it safeguards landowner rights
	► that specifies what the holder of the authority will do to rehabilitate the land that will be affected by the operation; and ► that sets out any other matters required by the regulations. The holder of the authority must not carry out the petroleum operation unless the Minister has accepted the Operation Plan for the operation in writing. The Minister must not accept an Operation Plan unless she or he is satisfied that the holder of the authority has, in preparing the plan, consulted the person who owns, occupies or manages the land on which the operation is to be carried out.

Perceptions in the Otway community show that it would be fair to have onshore conventional gas development in the region if landholders were compensated and treated fairly (Figure 28).

Figure 28: Perceptions of distributional fairness to have onshore gas development in the region, by subregion, 2019



Source: Walton, A., and McCrea, R. (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report: CSIRO, Australia (in prep).

Compensation

While landowners are not entitled to royalties in Australia because petroleum resources are owned by the Crown,[166] the Petroleum Act requires that a compensation agreement is in place prior to starting a petroleum operation on private property.[167] The consent of both the owner and occupier of land is required where an operation is proposed, and parties must enter into a compensation agreement with the owner and occupier of the relevant land. Compensation agreements can also include payments for changes in any wage or earning potential as a result of gas exploration and development. Compensation (both financial and non-financial) may reimburse landholders and lessees for legal, accounting and valuation costs incurred in preparing and negotiating a compensation agreement.

Information provided by the Stakeholder Advisory Panel has noted that industry practice is for operators to go over and above compensation set out by regulatory requirements.[168] It was

[166] COAG, 2018, 'Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia'
[167] Information supplied by the department.
[168] Advice from the Stakeholder Advisory Panel.

suggested that some industry participants ensure a net benefit to the landowner. This includes ensuring:

- rent paid is at the industry value, which is greater than the farm value
- a contracted income over the land use period providing certainty of income to landowners over less certain traditional farm income
- rent income provided by operators also offers landowners a diversified income stream
- landowners are compensated for their meetings with the operators.

Fair treatment

Landowner consultation is required throughout the process from exploration and discovery to development as new land is acquired or used for gas development and exploration. Commercial negotiation provides power to the landowner. Further, consultation is required after the project is in the rehabilitation phase to bring the land back to its previous state.

As summarised in Table 56, legislation is clear that gas operators must enter into a land agreement prior to commencing exploration there is unlikely to be any material impacts around consent and compensation. As such, all scenarios are assumed to have a neutral impact, assuming compensation adequately covers off the inconvenience.

Insufficient or inadequate community understanding of gas projects in the region

Companies voluntarily engage in consultation as a means to inform the public on the gas development activities occurring in the area and provide an opportunity to dispel any negative perceptions about potential gas exploration and development activities. Techniques used to consult may include suggestion boxes, telephone, written or electronic surveys, hotline or phone-in opportunities, media advertising, inviting submissions, public exhibitions or interviews.[169]

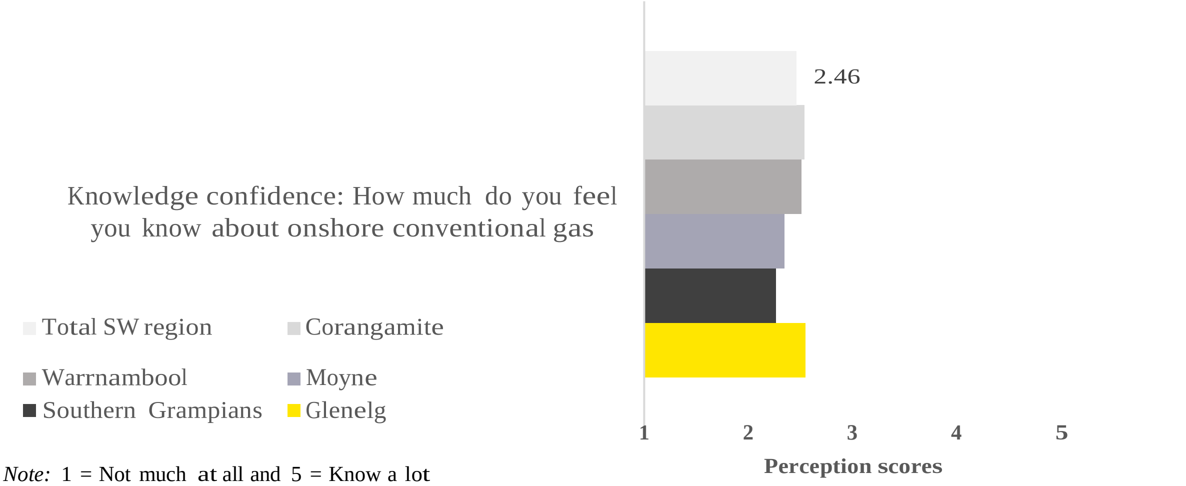
One method that companies utilise to disseminate information concerning operations to the local community is Community Reference Groups (CRG).[170] Exploration and development companies also often have dedicated systems in place for locals or interested parties to provide feedback, complaints, claims or grievances.

Membership of the CRG is to be reflective of stakeholder interests that may arise from operations, as well as provide communication channels to further disseminate information about the project to the community. The significant role of disseminating information to the community begins prior to development and exploration and extends into the rehabilitation phases of the project.

Figure 29 illustrates that residents across the Otway region had low levels of confidence in their knowledge of onshore conventional gas development. CRG meetings therefore serve as an important way for companies to provide information specific to their gas development project and the impacts on the community, while concurrently providing an opportunity for companies to influence and develop community views about onshore gas development.

[169] Earth Resources. *Community Engagement Guidelines for Mining and Mineral Exploration*. Accessed via: https://earthresources.vic.gov.au/legislation-and-regulations/guidelines-and-codes-of-practice/community-engagement-guidelines-for-mining-and-mineral-exploration
[170] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.

Figure 29: Knowledge levels of onshore conventional gas, by subregion, 2019



Note: 1 = Not much at all and 5 = Know a lot

Source: Walton, A., and McCrea, R. (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report: CSIRO, Australia.

Size of land impacted by gas exploration/development activities

Once production starts, the area used for development decreases considerably and is typically fenced off. The average operational conventional gas drill site is approximately 25 square metres once established.

Overall, the size of the onshore conventional gas development is relatively small in comparison to the area required for other primary industries such as mining, quarrying and farming.[171] Regulation also states that only the minimum area necessary for maximum extent of the petroleum field will be approved, thereby reducing the extent of land size that is potentially impacted.[172] It is also noted that the impact will cease once land has been appropriately rehabilitated after use.

Table 57 summaries the projected effects on the size of land required and duration of use for each hypothetical development scenario.

Table 57: Number of wells and production duration under each hypothetical scenario

Scenario	Discovery and development wells drilled per year	Total years of production	Number of years that each well is operational
Minimum scenario	4-5	8 years	2-3 years
Low scenario	4-6	19 years	2-3 years
Medium scenario	5-9	22 years	2-3 years
High scenario	5-10	26 years	2 years

The size of the land required for gas exploration and development infrastructure is dependent on the size of production, and number of wells.

[171] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.
[172] Petroleum Act 1998. s41 - s58.

Impact on land value

One study has found that wells and gas-related activity is associated with a fluctuation in land value of both directly affected property as well as neighbouring land.[173]

Landowners with gas developments on their property would expect development to be short term, for the life of the well/pipeline on the property.[174] The Petroleum Regulatory Framework requires that land used for gas-related activity must be rehabilitated to its original state where possible.[175] Therefore, it is expected that the impact on land values are temporary in nature. Land values are projected to assume previous levels (ignoring exogenous housing market fluctuations) once exploration, development and rehabilitation are complete. Relative to other resource industries such as mining and quarrying, the nature of the petroleum industry is such that rehabilitation of land used for gas related activities is quite straight-forward.[176]

Landowners that do not receive compensation but are located in the nearby gas development therefore may suffer a loss if they sell their property during the gas development and operations phase to parties other than the gas operators.

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[173] Boxall, P., Chan, W. and McMillan, M. (2005). The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis. *Resource and Energy Economics*, 27(3), pp.248-269.
[174] Modelling assuming each well only produces for 2-3 years
[175] *Petroleum Act 1998*. s128.
[176] Advice provided by the department.

Summary of benefits and impacts

The assessment of impacts to land access and use is summarised in Table 58

Table 58: Key benefits and impacts to land access and use issues

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Landowner consultation to inform landowner consent and compensation agreements and lease agreements	Prior to commencing exploration or development activities, companies must consult with landowners to gain agreement to use the land for gas development and exploration activities.[177] This includes consultation on the appropriate compensation for any impacts or inconveniences of the gas activity on their property.	► Landowners and related parties have the opportunity to provide input on the project to align exploration and development projects with the needs and perceptions of the community. ► Landowners receive appropriate compensation for any impacts and inconveniences of the gas activity on their property. Landowner consultation is expected to be consistent across each of the scenarios, as this is a requirement regardless of the size and level of gas activities. Industry practice is also to provide additional compensation beyond that required by regulations.[178]	Written consent and compensation agreements must be provided as per s128 of the Petroleum Act. Landholders and lessees are required to be notified of proposed activities and with a reasonable amount of time to assess proposed operations. In addition, landholder and lessees must engage in consultation throughout the duration of the project and must also agree on a compensation amount. The regulation further states that compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.[179] This minimises the level of impact to landowners to the lowest level.	Minimum scenario: x Low: x Medium: x High: x	The department has developed a standard land access proforma template for the minerals sector that assists landholders in easily negotiating compensation agreements. The proforma template could be relatively easily adapted to petroleum industries.
Insufficient or inadequate community understanding of gas projects in the region	Processes for disseminating community updates about land use and consultation on gas development is inadequate. Community consultation and disseminating information relating to gas development is not mandated per	Community updates and information regarding gas development may not be extensive or to an acceptable standard and the residents may be unaware of the impacts of the project on their community. The need for community consultation is anticipated to increase with the increase	While regulation requires that proponent must submit a Report of their consultation undertaken in developing their Operations Plan, the regulatory framework currently does not mandate that community updates and consultations occur alongside	Minimum scenario: x Low: xx Medium: xx High: xx	Possible legislative improvements derived from the VGP gap analysis includes a requirement for enhanced community consultation and

[177] Coagenergycouncil.gov.au. (2019). *Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia*. [online] Available at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/FYI2019037%20-%20GSS%20FAQs_0.pdf [Accessed 31 Jan. 2020].
[178] Advice from the SAP.
[179] *Petroleum Act 1998 (Vic),* s128

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	the petroleum regulatory framework, and this is done on a voluntary basis by gas companies.	in exploration and development levels across the scenarios. From the minimum scenario to the high scenario, the number of development wells and associated production activity increases, as do the number of locations impacted. Further, it is estimated that the total duration of the production timeframe progressively increases from 8 years of gas production under the minimum scenario to 26 years under the high scenario (noting that each well will be producing for 2-3 years). Therefore, it becomes increasingly important for the community to understand the nature of the project, how they may be impacted and to provide a forum for gas companies to discuss any concerns or negative perceptions regarding the project. While industry takes or can take accountability for informing communities about their operations, there is also a need to keep communities informed at a regional and industry wide scale. This is inherently shared responsibility between government and industry organisations.[180]	gas development. However, gas companies often voluntarily engage with the community in some form in order to inform the community about the nature of their project and its impacts on the community.[181] Therefore, while regulation does not explicitly mandate community updates regarding gas-related activity, gas companies make efforts to engage with the community in relation to gas projects and how they may be impacted.		consideration of community input during authority grants and during the life of operations. The VGP community engagement function will provide information to local communities about the risks benefits and impacts of developments in their locality and at a regional scale.
Size of land impacted by gas exploration/ development activities	In the short to medium term, sites for drilling would be leased for exploration and development wells. A typical drill site requires an area of 100 x 100 m (1 ha) (and additional land may be impacted by access track/s). A typical operating well requires an area to be cleared of 25 m^2, with the well-head and associated	There is a risk that the size of area used for petroleum development is larger than necessary, enhancing the risks observed in other social and environmental receptors. There is a risk that the land utilised for petroleum development reduces the amount land available for other uses (e.g. farming). The nature of the conventional petroleum industry is such that vast resources can be	The Petroleum Act contains general provisions that minimise the land size that is affected by gas development, such as the license area covers the minimum area necessary to cover the maximum extent of the petroleum field.[185] Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies.	Minimum: - Low: - Medium: - High: x	The VGP community engagement function will provide information to local communities about the risks benefits and impacts of developments in their locality and at a regional scale.

[180] Advice provided by the department.
[181] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report.
[185] *Petroleum Act 1998 (Vic),* s41, s58.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	infrastructure generally smaller than an average water tank.[182] A pipeline construction RoW is typically up to 25 m wide, which is then reduced to a 12 m wide easement during operations. Gas plants typically require many hectares of land.	extracted from a very low physical footprint relative to other resource industries such as mining and quarrying.[183] Multiple wells can be developed from a single drill pad using directional drilling. With each increase in scenario level from the minimum scenario to the high scenario, the number of exploration and development wells progressively increases from 4-5 wells per year and no new plants in the minimum scenario, to 5-10 wells in the high scenario with one new modular plant and full-scale plant, as well as the pipelines required to connect the wells. As the number of wells, pipelines and plants increase, so too does the land required and therefore the impact of the gas exploration and development. However, as part of these projections, it has been estimated that each well will only be in operation for 2-3 years, leading to the duration of impact for each well site being relatively short-term. Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies.[184]	The compensation provisions of the Petroleum Act create a commercial incentive that ensure that industry minimizes the size of its disturbance footprint as much as possible.[186]		
Impact on land value	Gas development facilities and infrastructure, as well as drilling for exploration, can have adverse impacts on land value for landowners who are directly affected, as well as for neighbouring properties.	Reduction in land value negatively affects landowners in the community, particularly upon resale. One research paper indicated study indicates that proximity to gas facilities also reduces property prices,	Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including depression of land value.[188]	Minimum: - Low: - Medium: - High: -	Nil

[182] Coagenergycouncil.gov.au. (2019). *Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia*. [online] Available at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/FYI2019037%20-%20GSS%20FAQs_0.pdf [Accessed 31 Jan. 2020].
[183] Advice provided by the department.
[184] *Petroleum Act 1998 (Vic),* s41, s58
[186] Advice provided by the department.
[188] *Petroleum Act 1998 (Vic),* s128

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		therefore impacting neighbouring properties. [187] It is anticipated that the impact on land value will increase in line with production, as the number of development wells needed increases in the progression from the minimum scenario to high scenario. In the minimum scenario, a total of 26 well sites (exploration, discovery and development wells) will be developed during the exploration and production phase, compared with a total of 217 well sites (exploration, discovery and development wells) will be developed during the exploration and production phase. However, potential buyers may be attracted to properties with wells and infrastructure on site due to the certainty of income provided by the operators.	Rehabilitation that is required per the Petroleum regulatory framework minimises the duration and/or magnitude of the reduction of land value.[189] Compensation agreements often include ongoing rent type payments for the use of the land, and this remains during any sale of property ensuring that it does not diminish land sale price.[190]		

Risk

The analysis has identified the following key risks to land access and use with respect to the Otway Basin hypothetical exploration and development scenarios (Table 59):

Table 59: Key risks to land access and use

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Inadequate rehabilitation	The risk exists of well leases, pipelines, and gas plants not being completely rehabilitated once	► economic loss to landowners ► reduced area for farming activities (e.g.	Rehabilitation of the drill sites is required under the Petroleum Act legislation,[191] which requires that states that drill sites would be rehabilitated and could be and returned to their original state where possible brought back to their previous state. The Petroleum Act also sets out a framework for rehabilitation. The holder of	Highly unlikely	Moderate	Low	Possible legislative improvements derived from the VGP gap analysis provides for enhanced landholder consultation during site rehabilitation.

[187] Boxall et al, 2005, 'The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis'
[189] *Petroleum Act 1998 (Vic),* s170
[190] Advice provided by the department.
[191] *Petroleum Act 1998 (Vic),* s170

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	these activities cease, or that there are permanent or long-lasting effects on the land.	grazing or cropping).	an authority must rehabilitate land affected by exploration or resource development and must rehabilitate the land before the authority expires or ends. This is done in consultation with the landowner such that the land is returned to its former land use (e.g. liaison is required to determine the depth of soil ripping, contouring, pasture seed mixes and so on). The authority holder is required to obtain a rehabilitation bond for an amount specified by the Minister. Information on planned rehabilitation processes is required to be detailed in the Operation Plan. The Minister must be satisfied that rehabilitation has occurred, is likely to be successful and any other work which the bond related to has been satisfactorily completed[192] Opportunities exist to increase consultation with landowner/holder in relation to adequacy of rehabilitation. The Petroleum Act states that compensation must be provided to any land that cannot be rehabilitated.[193] This compensation would need to be agreed upon by both the company and the landowner, which is likely to ensure that the compensation levels are fair and appropriate to the size of land unable to be rehabilitated and the associated long-term costs (financial or opportunity-costs).				The reforms will see that the Minister does not return rehabilitation bonds until satisfied that consultation has been undertaken with the landowner and local council.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin exploration and development scenarios could affect land access and use. Landholder consultation (that informs landowner consent and compensation agreements and lease agreements) is dictated by the nature and scale of the petroleum activity. However, the legislation is clear that explorers must enter into a land agreement prior to commencing exploration which is expected to have a neutral impact for landowners.

With respect to the adequacy of community consultation, assuming landowner consultation consistent for each of the projects, the impact would increase in line with the exploration and development levels across the scenarios. The size of land impacted by gas exploration and development activities is

[192] *Petroleum Act 1998. s170.*
[193] *Petroleum Act 1998.* s132.

expected to increase directly within an increase in production as there is a correlation with the number of wells and infrastructure built under each scenario. However, the absolute size of land required for conventional gas exploration and production is relatively small, and with underground pipelines, there is no evidence to suggest that there is significantly reduced land available to other users.[194]

It is anticipated that increases in land value will be negligible and devaluation of land will be mitigated through compensation to directly impacted landowners resulting in negligible residual impact.

Therefore, based on the ratings in the analysis, the minimum scenario, low scenario and medium scenario are expected to have neutral impacts. The hypothetical high scenario is expected to have a slightly negative impact (Table 60).

The risk of inadequate rehabilitation is expected to be low across all scenarios as the Petroleum Regulatory Framework requires operators to restore land that was developed and for any land that can no longer be returned to its original state, landowners will be appropriately compensated (Table 61).

Table 60: SR3: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 61: SR3: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

[194] Advice provided by the department.

4.2.2.4 SR4: The Aboriginal community and people

What impacts are there on the Aboriginal community?

Benefits and impacts

The analysis has identified the following key benefits and impacts to the Aboriginal community and people with respect to the Otway Basin hypothetical exploration and development scenarios:

- awareness of gas development by the Aboriginal community
- reconciliation action plan for potential operators
- number of Aboriginal community members employed (direct)
- number of Aboriginal businesses impacted (indirect).

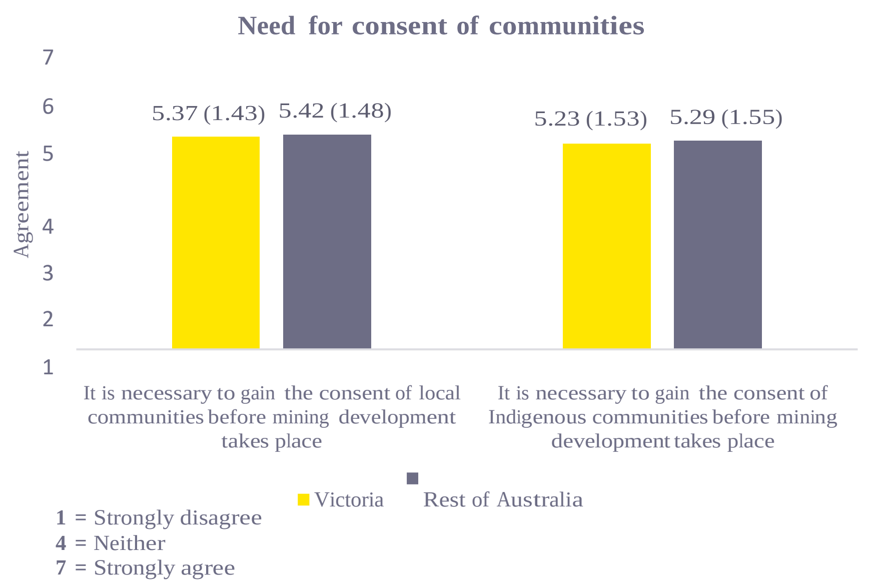
These can be impacted by the existence of an ILUA and CHMP, which are discussed below.

Existence of an Indigenous Land Use Agreement

Within Australia, there is a consensus that Indigenous communities should provide consent before gas development takes place on Aboriginal land. Results of the commissioned CSIRO Report into attitudes into onshore conventional gas production show that Victorians surveyed agree that it is necessary for gas companies to gain consent of Aboriginal communities before gas development takes place (M = 5.23) (as shown in Figure 30).[195] This is reinforced by the Victorian Government commitment to set up treaty agreements with First Nations.[196] This provides the Aboriginal community and people with a voice and further mitigates any negative impacts to the Aboriginal community if they are heard.

[195] CSIRO (2017). *Victorian attitudes towards mining Citizen Survey*.
[196] Aboriginalvictoria.vic.gov.au. (2020). *Treaty in Victoria*. [online] Available at: https://www.aboriginalvictoria.vic.gov.au/treaty [Accessed 3 Feb. 2020].

Figure 30: Mean ratings for need for consent from communities before mining takes place



Source: CSIRO (2017). Victorian attitudes towards mining Citizen Survey.

As such, an ILUA may be negotiated between Native Title groups and others about the use of land.[197]

Cultural Heritage Plan

The land potentially used in the Otway Basin for conventional gas exploration and development may encroach on land under Native Title[198] See Figure 31 for regional registered Native Titles in South-West Victoria. The area of the Eastern Maar overlay a significant extent of the Otway Basin. Native Title negotiations are currently underway between the State Government and the Eastern Maar traditional owner group.[199]

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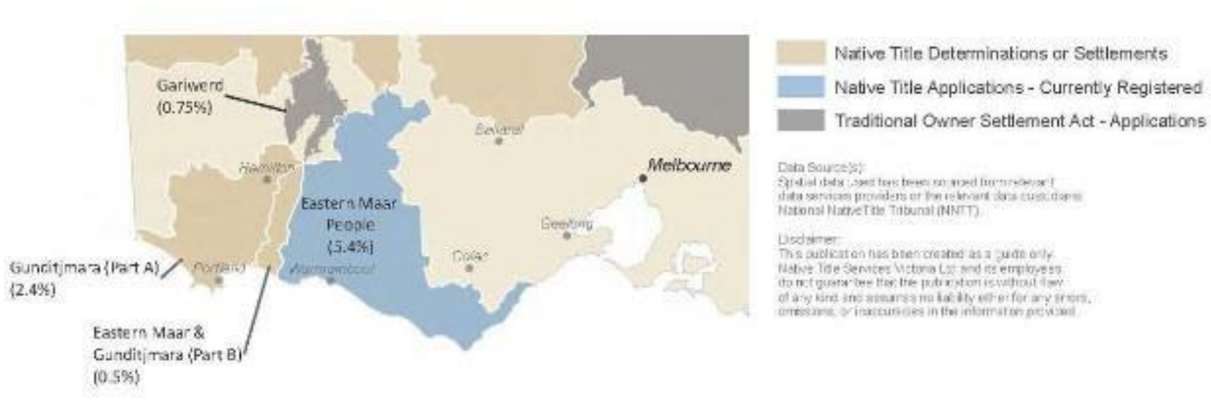
[197] Nativetitle.org.au. (2020). *Native title, rights and interests | Prescribed Bodies Corporate*. [online] Available at: https://www.nativetitle.org.au/learn/native-title-and-pbcs/native-title-rights-and-interests [Accessed 3 Feb. 2020].

[198] Information provided by the department.

[199] Justice VIC. (2020). *Proposed Eastern Maar recognition and settlement agreement*. [online] Available at: https://www.justice.vic.gov.au/your-rights/native-title/proposed-eastern-maar-recognition-and-settlement-agreement [Accessed 24 Jan. 2020].

Figure 31: Native Title Act Applications and Determinations, and Traditional Owner Settlement Act - Applications and Settlements in Victoria as of 30 June 2016



Source: ANTaR Victoria. (2020). Local Nations – ANTaR Victoria. *[online] Available at: https://antarvictoria.org.au/local-nations [Accessed 14 Jan. 2020].*

These regions could have significant Aboriginal cultural heritage (i.e. isolated archaeological artefacts including stone tools or surface scatters), which could be impacted by gas exploration and development activities. Natural water features (i.e. rivers, creeks, wetlands) and landmarks (i.e. scar trees, rock formations, etc) may have cultural significance to Aboriginal communities. These may be difficult to identify and avoid as they are a part of the natural landscape and not man-made. The impacts on Aboriginal cultural heritage is discussed under SR6 (see Section 4.2.2.6).

Summary of benefits and impacts

The assessment of impacts to the Aboriginal community and people is summarised in Table 62.

Table 62: Key benefits and impacts to the Aboriginal community and people

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Awareness of gas development by the Aboriginal community	Disseminating information about the gas exploration and development activities to the Aboriginal community and people is voluntary and can begin prior to development and exploration and extend into the rehabilitation phases of the project.	Transparency with the Aboriginal community and people Awareness of gas development within Aboriginal community and people The benefits of adequately providing information about gas exploration and development activities to the Aboriginal community is consistent for each of the scenarios, as it would be expected that all would need to have similar systems and process in place. As such, each scenario has been allocated a slightly positive benefit.	The Petroleum Act requires that companies consult with interested people and parties during the development of an operations plan. The Petroleum Regulations require operators to provide appropriate consultation for the life of the operation about the environmental performance of the development with interested people and organisations. There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community. There is also a low level of government scrutiny around the extent of consultation that must be undertaken. Despite the legal requirement for consultation and engagement not be prescript, it is standard petroleum industry practice to engage with the aboriginal community when industry activities occur on are nearby Aboriginal land. The existence of an ILUA, CHMP and RAP allow for operators to further their communication with the Aboriginal communities. Both are discussed in subsequent measures.	Minimum scenario: Low: Medium: High:	Possible legislative improvements derived from the VGP gap analysis would provide additional regulatory framework, requiring enhanced community consultation. There would also be a requirement that certain information relating to government decisions and industry activity is publicised. The VGP community engagement function will provide information to Aboriginal communities about the risks benefits and impacts of developments in their area and at a regional scale.
RAP for potential operators	RAPs can be implemented to provide a framework for organisations to support the national reconciliation movement.	Provides practical actions to drive reconciliation both internally and within the community	N/A	Minimum scenario: - Low: - Medium: -	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		While not required, industry practice is to develop a RAP. As an example, Origin implemented a RAP in 2015, with aspirations identified in the following areas: ► building a culture of respect ► providing education, skills, jobs and careers ► commerce and community development ► developing and maintaining relationships and partnerships ► governance and disclosure.[200] The benefits of having a RAP will be consistent for each scenario. ► However, as this is not within the regulatory framework, it is assumed to provide a neutral impact under each case.		High: -	
Number of Aboriginal community members employed (direct)	Ongoing operation under the proposed hypothetical scenarios will create ongoing employment opportunities for residents in the region, including the Aboriginal community and people.	Employment opportunities for the Aboriginal community and people may: ► increase apprenticeship opportunities for the Aboriginal community and people ► encourage higher education and skill levels of the Aboriginal community and people. Australian Bureau of Statistics 2016 data shows that 1.4 per cent of the catchment region within the Otway Basin identifies as Aboriginal or Torres Strait Islander.[201] Within Victoria, 2016 Census data also shows that 52 per cent of the Aboriginal	The *Traditional Owner Settlement Act 2010* enables the Aboriginal community and people to be employed as a part of the Natural Resource Agreements framework, which allows for strategies to be implemented to enable traditional owner group members to participate in or obtain employment. Petroleum companies often have policies in place that support the employment of Aboriginal people.	Minimum scenario: - Low: - Medium: - High: -	N/A

[200] Origin (2019). *Stretch Reconciliation Action Plan July 2019-June 2022*.
[201] EY independently accessed the indigenous population data from the 2016 ABS Census, extracted the relevant LGA data and averaged the percentage related to Indigenous and Torres Straight Islanders in the region. 1.4 per cent is the average population of Aboriginal and Torres Straight Islanders in the catchment. Accessed via: https://itt.abs.gov.au/itt/r.jsp?databyregion

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		community and people are in the labour force.[202] [203] The economic contribution analysis indicates that the proposed hypothetical scenarios has the potential to deliver 56.88 ongoing full-time jobs to the region under the minimum scenario, 115.46 under the low scenario, 144.79 under the medium scenario and 196.63 under the high scenario. While it is not possible to estimate the number of the Aboriginal community and people that may be employed under the exploration and development scenarios, these additional jobs provide opportunities for employment for the Aboriginal community and people. As such, the minimum scenario is expected to have a slightly positive impact, the low and medium scenarios are expected to have a slightly positive impact, and the high scenario is expected to have an extremely positive impact. Future capacity building projects with Aboriginal communities may result in increased workforce participation among Aboriginal residents within the region.			
Number of Aboriginal businesses impacted (indirect)	Aboriginal businesses could be hired directly or indirectly to assist with either the construction/drilling phases or the operational phases of gas exploration and development. For example, Urban Colours Arts, located in Lara provides land use planning, Flora & Fauna surveys and environmental impact assessments,	Information is not available to draw conclusions on whether there are any benefits for the Aboriginal community and people from a business perspective.	The *Traditional Owner Settlement Act 2010* enables the Aboriginal community and people to be employed as a part of the Natural Resource Agreements framework, which allows for strategies to be implemented to enable traditional owner group	N/A	N/A

[202] Labour force refers to individuals who are employed or unemployed and looking for work.
[203] Abs.gov.au. (2020). *2076.0 - Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians, 2016*. [online] Available at: https://www.abs.gov.au/AUSSTATS/Abs@.Nsf/7d12b0f6763c78caca257061001cc588/5f17e6c26744e1d1ca25823800728282!OpenDocument [Accessed 3 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	which could be utilised in the hypothetical development scenarios.[204]		members to participate in or obtain employment.		

Risk

The analysis has identified the following key risk to the Aboriginal community and people with respect to the Otway Basin hypothetical exploration and development scenarios (Table 63):

Table 63: Key risks to the Aboriginal community and its people

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Impact to Native Title	Native Title refers to the recognition of the rights and interest of land and waters of the Aboriginal community according to their traditional law. This provides Native Title holders a number of rights. Depending on the location of wells, pipelines and gas plants, development can encroach on Native Title land. This can include: ► vacant (or unallocated) Crown land ► parks and public reserves ► beaches ► leases ► land held by government agencies or Aboriginal and Torres Strait Islander communities	If drilling was to occur in potential Aboriginal cultural heritage sights, this could result in: ► damage to Native Title land during the development process ► loss of access to cultural Aboriginal heritage places/sites ► loss of identify to Aboriginal community members ► loss of legal rights. Damage to Native Title land could occur	The Native Title Act recognises the rights and interests Of Aboriginal and Torres Strait Islander communities in land and waters. The Act would also regulate any potential commercial operations over this land. Therefore, gas production would have to be complaint. Under the Native Title Act, an ILUA may be negotiated between Native Title groups and others about the use of land.[206] According to the National Native Title Tribunal, an ILUA can be: ► over areas where Native Title has, or has not yet, been determined ► entered regardless of whether there is a Native Title claim over the area or not	Highly unlikely	Serious	Low	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to

[204] Ibd.supplynation.org.au. (2020). [online] Available at: https://ibd.supplynation.org.au/public/s/supplierprofile?accid=a1G7F000000SlfgUAC [Accessed 10 Feb. 2020].
[206] National Native Title Tribunal, Indigenous Land Use Agreements. Accessed via: http://www.nntt.gov.au/ILUAs/Pages/default.aspx

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	► oceans, seas, reefs, lakes, rivers creeks and other waters that are not privately owned.[205] Native title cannot be claimed in relation to gas under Australian Law.	during the exploration and construction phase as this is when land would be accessed and used to produce gas. For Otway scenarios: ► Reference: 2022-2030 ► Low: 2022-2041 ► Medium: 2022-2044 ► High: 2022-2049	► part of a Native Title determination or settled separately from a Native Title claim.[207] ILUAs can cover topics a range of topics including: ► Native Title holders agreeing to future development ► access to an area ► compensation ► employment and economic opportunities for Native Title groups ► cultural heritage mining.[208] Entering an ILUA is voluntary for organisations and operators can enter into an agreement prior to commencing development. While the existence of an ILUA isn't mandatory for developers, it is industry practice to do so. An example of this is Beach Energy, which entered an ILUA with the Kirrae Whurrong, now Eastern Maar Native Title Group. If implemented, the ILUA would be in place for the duration of the project. If implemented, an ILUA would bind all parties and Native Title holders to the terms of the agreement Where Native Title exists, the Petroleum Act provides the same land access provisions for Native Title holders as that afforded to landowners on free hold land. The Petroleum Act requires that a				Native Title holders that industry will provide them with information about onshore conventional gas activities. The reforms will also ensure that Native Title holders are genuinely engaged over the entire industry lifecycle. This may influence their attitudes towards development and exploration in the region. The VGP community engagement function will provide information to aboriginal groups about the risks benefits and impacts of developments in their locality.

[205] Nativetitle.org.au. (2020). *Native title, rights and interests | Prescribed Bodies Corporate*. [online] Available at: https://www.nativetitle.org.au/learn/native-title-and-pbcs/native-title-rights-and-interests [Accessed 3 Feb. 2020].
[207] Nntt.gov.au. (2020). *About Indigenous Land Use Agreements (ILUAs)*. [online] Available at: http://www.nntt.gov.au/ILUAs/Pages/default.aspx [Accessed 1 Feb. 2020].
[208] Nntt.gov.au. (2020). *About Indigenous Land Use Agreements (ILUAs)*. [online] Available at: http://www.nntt.gov.au/ILUAs/Pages/default.aspx [Accessed 1 Feb. 2020].

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			compensation agreement be made where Native Title exists. While damage to Native Title land is highly unlikely, the severity of the drilling and developing pipelines on site would cause serious damage. As such, the residual risk rating is low.				

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect the Aboriginal community and its people within the region. While there is potential for drilling and development to encroach on land under Native Title, or impact on Aboriginal people, mitigations measures limit these potential impacts and risks.

Engagement activities undertaken by operators and the implementation of RAPs can result in slightly positive outcomes for the Aboriginal community and its people within the region as they increase transparency of gas exploration and development with the Aboriginal community and provide practical actions to drive reconciliation bother internally and within the community. The creation of ongoing employment within the Otway region also provides employment and business opportunities for Aboriginal community members and businesses. These are expected to increase in line with production across the Otway gas exploration and development scenarios.

Overall, this results all scenarios having slightly positive impacts on the Aboriginal community and its people based on the average rating across all benefits and impacts (Table 64).

The risk of gas exploration and development activities occurring in areas covered by Native Title have been assessed as serious in consequence with a highly unlikely likelihood which results in the hypothetical scenarios having a low risk (Table 65). This is mitigated through a number of measures, including the Native Title Act, and the implementation of an ILUA. Further, the Petroleum Act requires that a compensation agreement be made where Native Title exists. Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.

Table 64: SR4: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 65: SR4: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

4.2.2.5 SR5: Schools, education and vocational capacity

What educational opportunities are created?

Benefits and impacts

The analysis has identified the following key benefits and impacts to schools, education and vocational capacity with respect to the Otway Basin exploration and development scenarios:

- projected increase in apprenticeships and population growth
- contributions to school funding.

These benefits and impacts are described further below.

Projected increase in apprenticeships, and population growth

The implementation of gas exploration and development in the Otway region increases the demand for skilled labourers in the area for the life of the project. This may lead to:

- increased demand for workers, creating employment opportunities
- increased apprenticeship opportunities
- higher educational attainment
- an indirect impact on income.

Increase in demand for workers, creating employment opportunities

The economic impact analysis found that the Otway Basin exploration and development scenarios would result in employment growth primarily in the Otway region, ranging from an average annual additional 56.9 FTE under the minimum scenario to an average annual additional 196.6 FTE under the high scenario (as set out in section 4.2.1.1).

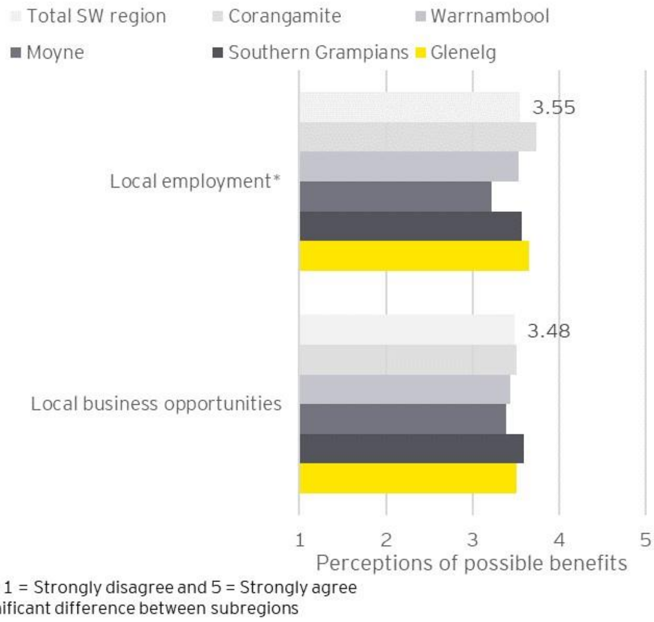
These findings are consistent with a study conducted in the Northern Territory that found that gas development generated an increase in FTEs within the region from 2,154 in the low scenario to 13,611 in the high scenario over the forecast period of 25 years.[209]

Drawing on the evidence above, it is expected that the job market will benefit from development and gas exploration in the Otway region and that as production increases, so too will the regional demand for labour.

This correlates with the community's expectations of local benefits. Recent community engagement undertaken by CSIRO found that the community overall perceived that onshore conventional gas development would lead to local employment opportunities and local business opportunities (see Figure 32).

[209] ACIL Allen Consulting (2017). The economic impacts of a potential shale gas development in the Northern Territory". Access via: https://frackinginquiry.nt.gov.au/inquiry-Reports?a=465934

Figure 32: Perceived significant local benefits from onshore conventional gas development in Otway Basin: By subregion, 2019 – Local employment and local business opportunities



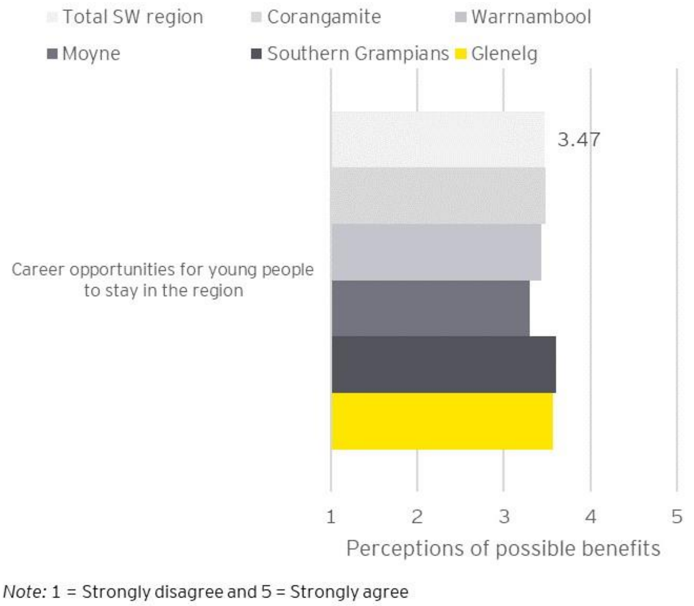
Source: CSIRO (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report (in prep).

Increased apprenticeship opportunities

Increased demand for workers may occur across all levels of employment, including new career opportunities for young people (e.g. apprenticeships). Skilled labour in the region will therefore increase, resulting in diversified skill sets and increasing overall incomes. Diversified employment opportunities may encourage community members to stay within the region for work or can result in more people relocating the region for employment.

The CSIRO community research also found that the community overall perceived that onshore conventional gas development would lead to career opportunities for young people to stay in the region (see Figure 33).

Figure 33: Perceived local benefits from onshore conventional gas development in Otway Basin: By subregion, 2019 – Career opportunities for young people to stay in the region



Source: CSIRO (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report (in prep).

Higher educational attainment

The overall educational attainment in the region is low compared to state averages.[210] 2016 ABS census data shows that in the Otway Region, 36.5 per cent of persons aged 15 years and over have a have completed year 12 or equivalent, while only 12 per cent have completed a bachelor's degree or higher. This is considerably lower than the state average whereby 54.4 per cent of per cent of persons aged 15 years and over have a have completed year 12 or equivalent, and 24.4 per cent have completed a bachelor's degree or higher. Increased production and skilled labour in the area could encourage higher educational attainment and skill levels in the region, due to the increase in higher skilled local career opportunities.

Indirect impact on income

The economic impact analysis found that the Otway Basin exploration and development scenarios may result in growth in gross regional product growth primarily in the Otway region, ranging from an estimated average annual increase of $39.28 million in GRP under the minimum scenario to an estimated average annual increase of $93.72 million in GRP under the high scenario.

This is consistent with findings of other studies into the economic impact of gas development. in 2019, an analysis of development scenarios for South East South Australia was completed. Results suggest a net increase of $32 million in gross regional product and increase in employment of 16 FTE over 10 years for the scenario deemed most likely by stakeholders.[211]

A study into the economic impacts of early unconventional gas development in New South Wales found a 7 per cent increase in family income in regions with CSG development compared to those

[210] EY independently accessed the educational attainment data from the 2016 ABS Census, extracted the relevant LGA data and averaged the percentage related to the region. Accessed via: https://itt.abs.gov.au/itt/r.jsp?databyregion.
[211] Porushci et al, 2019, 'The value of local gas resources: A scenarios based analysis of the gas industry futures in South East South Australia'.

without, for a gas industry including approximately 430 gas wells.[212] This compared to a 15 per cent increase in family income for gas development in Queensland including over 4,000 wells.[213]

The increase in demand for skilled labourers and employment opportunities will occur throughout all phases of the gas operation lifecycle. The scale of production and time over which production occurs varies across the Otway Basin exploration and development scenarios:

► minimum scenario: total production of 87 PJ, with production occurring over an 8-year timeframe.

► low scenario: total production of 315 PJ, with production occurring over a 19-year timeframe.

► medium scenario: total production of 467 PJ, with production occurring over a 22-year timeframe.

► high scenario: total production of 710 PJ, with production occurring over a 26-year timeframe.

The level of employment and apprenticeship opportunities will increase across the Otway Basin exploration and development scenarios as greater number of people will be required to develop and operate more exploration and development wells and produce higher volumes of gas. As such:

► the minimum case has a minimal level of production and low employment and apprenticeship opportunities. As such, it is expected to have slightly positive impact

► the low and medium scenario have low to moderate levels of production, employment and apprenticeship opportunities, and will have positive impacts

► the high scenario has the highest level of production, employment and apprenticeship opportunities, and is expected to have an extremely positive impact.

Contributions to school funding:

Gas production companies generally contribute to the education and schools in the regions where they operate. Aside from rates paid to local governments, producers also can contribute to educational institutions directly and fund projects that have positive educational benefits. For example, gas producer Beach Energy funded a Let's Read program through the Corangamite Shire Council.[214] Producers are also known to undertake school visits to create aspiration and employment opportunities for knowledge workers in the region.

This contribution to education will occur throughout all phases of the gas operation lifecycle. The extent of contribution could vary between the Otway Basin exploration and development scenarios as the number of locations where gas is developed changes:

► minimum scenario: exploration and development occurs in the Port Campbell Embayment and the Penola Trough

► low, medium and high scenarios: exploration and development occurs in the Port Campbell Embayment (Eastern Region), the Penola Trough (Western Region) and the Central Region.

As the number of locations increase where gas is developed, contributions to school funding or education programs could increase, however this would be dependent on a number of factors,

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[212] Marcos-Martinez, 2019, 'Economic impacts of early unconventional gas mining: Lessons from the coal seam gas industry in New South Wales, Australia'.
[213] Fleming & Measham, 2015, 'Local economic impacts of an unconventional energy boom: the coal seam gas industry in Australia'.
[214] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.

including the locations of operation, size of the operations and commercial return obtained by producers increases in line with development. As such:

- minimum scenario: slightly positive impact on the receptor, as exploration and development is relatively small, and occurs in the Eastern Region (Port Campbell Embayment) and Western Region (Penola Trough)
- low, medium and high scenario: positive impact, as the exploration and development is greater, and occurs in the Eastern Region (Port Campbell Embayment), Western Region (Penola Trough) and the Central Region.

Summary of benefits and impacts

The assessment of impacts to the schools, education and vocational capacity is summarised in Table 66.

Table 66: Key benefits and impacts to schools, education and vocational capacity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Projected increase in apprenticeships and population growth	Onshore conventional gas exploration and development in the Otway region increases the demand for skilled labourers in the area for the life of the project. This creates employment opportunities in the catchment area as it presents employment in the gas industry as viable, without having to relocate considerably to obtain work.	Gas exploration and development in the Otway region may result in: ► increase in demand for workers ► employment opportunities ► increased apprenticeship opportunities ► increased production and skilled labour in the area could encourage higher educational attainment and skill levels in the region ► indirect impact on income. As the number of sites increases, so too does the demand for workers in the region, enabling an increase in apprenticeships offered to the local community. The increase in demand for skilled labourers and employment opportunities will occur throughout all phases of the gas project lifecycle. The level of employment and apprenticeship opportunities will increase across the scenarios as greater number of people will be required to develop and operate more exploration and development wells and produce higher volumes of gas.	N/A	Minimum: Low: Medium: High:	N/A
Contributions to school funding	Gas production companies generally contribute to the education and schools in the regions where they operate. Aside from rates paid to local governments, producers also can contribute to educational institutions directly and fund projects that have positive educational benefits.	Funding to schools: ► would result in direct financial contribution to educational institutions ► may result in contribution to careers programs in schools.	N/A	Minimum: - Low: - Medium: - High: -	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		This contribution to education will occur throughout all phases of the gas operation lifecycle. The extent of contribution could vary between the Otway Basin exploration and development scenarios as the number of locations where gas is developed changes. As the number of locations increase where gas is developed, contributions to school funding or education programs could increase, however this would be dependent on a number of factors, including the locations of operation, size of the operations and commercial return obtained by producers increases in line with development. However, as this contribution is not required by the regulatory framework, the impact has been assessed as neutral.			

Risk

The analysis has not identified any risks to schools, education and vocational capacity with respect to the Otway Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect schools, education and vocational capacity.

With respect to projected increase in apprenticeships, and population growth, the assessment found that increases in the extent of gas production results in increases in employment, wage and salary income, and median household income. This is consistent with the perceived local perceptions of benefits from onshore conventional gas development in the Otway region. As production increases, so too does the demand for labour in the region. As such, increase in benefits is correlated with an increase in gas production.

Similarly, contributions from industry to school funding are expected to result in increasing levels of benefits dependent on several factors, including the number of locations where gas is developed, and size of gas development and exploration. However, as this contribution is not required by the regulatory framework, the impact from this measure has been assessed as neutral.

Overall the minimum scenario is expected to have a slightly positive impact, the low, medium and scenarios would have positive impacts, based on the average rating for each impact (Table 67).

No risks were identified for this receptor.

Table 67: SR5: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.2.6 SR6: Protection of cultural heritage

How (if any) will areas of cultural heritage be affected?

Benefits and impacts

The analysis has not identified any benefits or impacts to cultural heritage with respect to the Otway Basin hypothetical exploration and development scenarios.

Risk

The analysis has identified the following key risks to the protection of cultural heritage with respect to the Otway Basin hypothetical exploration and development scenarios:

- risk to non-Aboriginal cultural heritage sites
- risk to Aboriginal cultural heritage.

These risks have been described further below.

Identification and protection of sites of cultural heritage

As a part of the planning stages for the VGP, the department has prepared a resource and land use planning model to assess a region's landscape, features and values.[215]

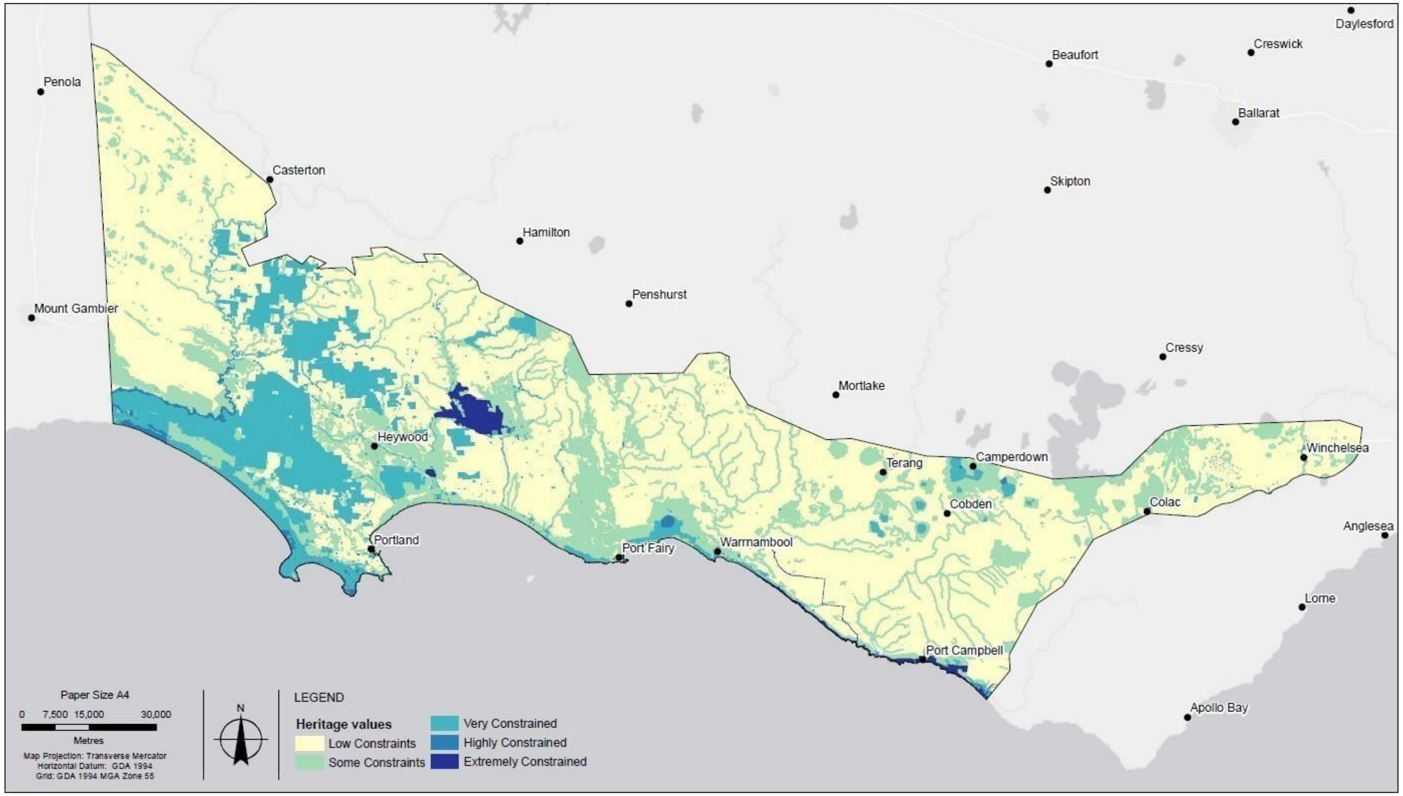
The land use and planning analysis included the identification of areas of significant Aboriginal, cultural, European and natural heritage values. Figure 34 shows the results of this assessment.

While only a small area has been identified as being extremely or highly constrained in the Otway Basin area (less than 2% of the total area),[216] datasets containing locations and sites of aboriginal cultural sensitivity are not currently publicly available and therefore the model is not reflective of what is on the ground.[217] This information is held by the local Traditional Owners and would be assessed on a site by site basis as part of any individual development's CHMP. Budj Bim National Park, which features some of the world's earliest and most expansive settlement and aquaculture system is highlighted as being 'extremely constrained' for any exploration or developments. In 2019, the site was entered into the United National Educational,

[215] Victorian Gas Program (2020). Victorian Gas Program – Resource and land use planning Findings Report, Otway Basin, Victoria (in prep).
[216] Victorian Gas Program (2020). Victorian Gas Program – Resource and land use planning Findings Report, Otway Basin, Victoria (in prep).
[217] Advice provided by the department.

Scientific and Cultural Organisation's (UNESCO) World Heritage List as it represents one of the world's most extensive and oldest aquaculture systems.[218] The local Gunditjmara aboriginal people have had a continuous cultural association with Budj Bim for over 6,600 years.

Figure 34: Victorian Gas Program Land Use Planning Model – Otway Basin: Heritage Values Assessment



Source: Victorian Gas Program (2020). Victorian Gas Program –Resource and land use planning Findings Report, Otway Basin, Victoria (in prep).

While constraints have been identified across the basin, the specific location of gas exploration and development under each scenario is not known. As such, it is difficult to assess how likely it is areas of non-Aboriginal and Aboriginal cultural heritage could be affected. However, the following considerations have been applied:[219]

[218] UNESCO (2020). *Budj Bim Cultural Landscape*. [online] Whc.unesco.org. Available at: https://whc.unesco.org/en/list/1577/ [Accessed 10 Feb. 2020].
[219] Information provided by the department.

- in open farmland areas, the likelihood of encountering previously unrecorded heritage artefacts is low.
- in vegetated areas, the likelihood is higher, especially near watercourses.

Most Indigenous cultural heritage sites are protected and will be assessed as part of any individual development proposal and subsequent CHMP developed as part of the legislated EMP, as outlined in Table 68. In practice, operators would seek to avoid cultural heritage areas where possible. Where this is not possible, the measures identified in the Cultural Heritage Plan would mitigate the impact on cultural heritage, as well as the additional control measures, as outlined in the table above.

The residual risk is unlikely to vary across different levels of exploration and development. The likelihood of the risk occurring, and consequence of the risk is independent of the level of development being undertaken. This is because the legislative requirements require these impacts to be mitigated and managed to an acceptable level.

Summary of risks

The assessment of risks to the protection of cultural heritage is summarised in Table 68.

Table 68: Key risks to the protection of cultural heritage

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Damage or loss of non-Aboriginal cultural heritage sites and places	The land in the Otway Basin identified in the hypothetical scenarios may encroach on areas of Aboriginal and non-Aboriginal cultural heritage. In the Otway Basin catchment region, there are 3,097[220] heritage sites registered with Heritage Council Victoria.[221]	If activity was to occur in cultural heritage sites or places, this could result in: ► irreparable damage to or permanent loss of sites or places of non-Aboriginal cultural heritage ► irreparable damage to or permanent loss of sites of religious	The potential impacts to cultural heritage sites and places and measures to control these are addressed in an EMP and where relevant, a CHMP and EES.[222] An EMP requires the management of cultural heritage impacts. A CHMP is developed during the initial stages of the project and be implemented throughout the development and exploration phases. A specialist cultural heritage consultant who is qualified and experienced may be engaged to undertake the necessary cultural heritage research and field surveys to assess possible disturbances. These areas must be avoided during exploration and development where	Highly unlikely	Severe	Moderate	Possible legislative improvements derived from the VGP gap analysis would include new Requirements for the publication of certain information relating to government decisions and industry activity. This would include the publication of cultural heritage management plans and any compliance actions against these plans which will improve community confidence

[220] This amount was calculated by adding all heritage sites from each of the LGAs within the Otway Basin catchment region. Note, many of these heritage sites will not be within areas where drilling is expected.
[221] Vhd.heritagecouncil.vic.gov.au. (2020). *VHD*. [online] Available at: https://vhd.heritagecouncil.vic.gov.au/ [Accessed 29 Jan. 2020].
[222] Advice provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		or spiritual significance	possible. Where not possible, removal and relocation of the material is undertaken in accordance with Heritage Victoria and/or local council. Non-Indigenous heritage (such as ruins) is managed under the Heritage Act 2017. This Act establishes the Victorian Heritage Register that provide legal protection for heritage places and objects. Impacts on these sites must be managed as part of an EMP. These sites are often more easily identified than those of Indigenous heritage as often use western building materials (such as bricks) which are easily recognisable. Impacts on cultural heritage is within scope of EES assessments where these are required.[223] This assessment will expect that impacts on local cultural heritage is reduced to the lowest level possible. Members of the public can provide written comments as a part of this. The Environment Protection and Biodiversity Conservation Act 1994 also provides a legal framework to heritage places as defined as matters of national environmental significance. Drilling in environmental heritage sights must comply with the regulations set out in this Act. The nature of the conventional petroleum industry is such that there is flexibility to locate drill sites. To save on costs associated with cultural heritage disturbance, industry will routinely locate drill sites to where they cause least disturbance.[224] In addition, the physical footprint and earth disturbance associated with the petroleum industry is low relative to other resource industries. As such the disturbance of cultural heritage is expected to be low.				around the regulation of this area.

[223] Advice provided by the department.
[224] Advice provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Damage to or loss of Aboriginal cultural heritage sites or places	The land identified in the hypothetical scenarios may encroach on areas of Aboriginal cultural heritage, land sacred to Aboriginals and/or Native Title land.[225]	If activity was to occur in potential Indigenous heritage sites or places, this would result in: ► irreparable damage to or permanent loss of sites or places of Aboriginal heritage ► damage to or permanent loss of artefacts of Indigenous heritage.	As per the previous row. The Aboriginal Heritage Act requires that a CHMP be in place if the petroleum activity is within an area of cultural significance. Additionally, a CHMP may be developed. A CHMP involves: ► assessing the area to determine the nature of any Indigenous cultural heritage sites or objects in the area ► writing a Report stating the results of the assessment and recommendations for measures to be undertaken before, during and after gas production and exploration to manage and protect the cultural heritage identified. The plan must then be approved by the required registered Aboriginal party.	Highly unlikely	Severe	Moderate	N/A

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect non-Aboriginal and Aboriginal cultural heritage sites.

No benefits or impacts to cultural heritage with respect to the Otway Basin hypothetical exploration and development scenarios were identified.

Areas of Aboriginal and non-Aboriginal cultural heritage within the region are unlikely to be impacted by the Otway Basin hypothetical exploration and development scenarios. This is because the risks to cultural and indigenous heritage sites are mitigated through the regulatory framework (including the Heritage Act and the Aboriginal Heritage Act) once it is recognised that the land is of cultural, religious/spiritual and/or Aboriginal significance through cultural heritage surveying. However, if development occurred on sites of significance, this could result in irreparable damage to the place of significance, resulting in the hypothetical scenarios having a moderate risk on the protection of cultural heritage receptor (Table 69).

[225] Information provided by the department.

Table 69: SR6: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

4.2.2.7 SR7: Existing farm industries, food and biosecurity

How will surrounding farm and food production, and biosecurity be impacted?

Benefits and impacts

The analysis has identified the following key benefits and impacts to existing farm industries, food and biosecurity with respect to the Otway Basin hypothetical exploration and development scenarios:

- ability to co-exist with existing agriculture industries
- disturbance to livestock located near petroleum activities
- gross size of farming land used for exploration/development
- stress and financial burden to farmers to negotiate compensation agreements.

Ability to coexist with existing agriculture industries

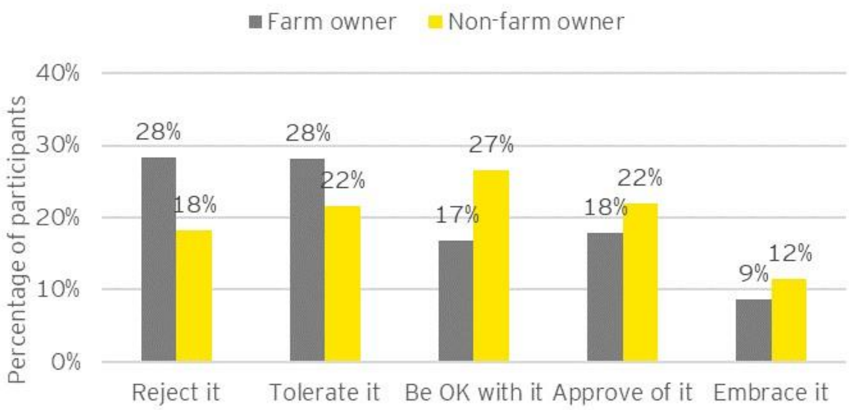
There are both planned and unplanned disturbances that would occur due to onshore conventional gas development and exploration.[226] Planned disturbances are activities that result from land access as discussed in Figure 35. Unplanned disturbances to farming activities are activities that do not have pre-negotiated compensation agreements. These disturbances may include:

- the loss of crops or pasture outside of agreed seismic survey lines, well lease pads or pipeline RPs
- the potential for a vehicle strikes with livestock
- interference with optimal crop sowing or harvesting patterns
- damage to paddocks or infrastructure.

The ability to coexist with existing agriculture industries may also be impacted by farmers perceptions of onshore gas development and subsequently the farmers and community's willingness to allow onshore conventional gas development on their property and region. The CSIRO study[227] found that attitudes of farmers towards onshore gas development in the Otway Basin are more negative when compared to the attitudes of non-farm owners, as displayed in Figure 35. This is reflective of the perceived disturbances (both planned and unplanned) to farming activities caused by onshore conventional gas development.

[226] Information supplied by the department.
[227] *CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results*

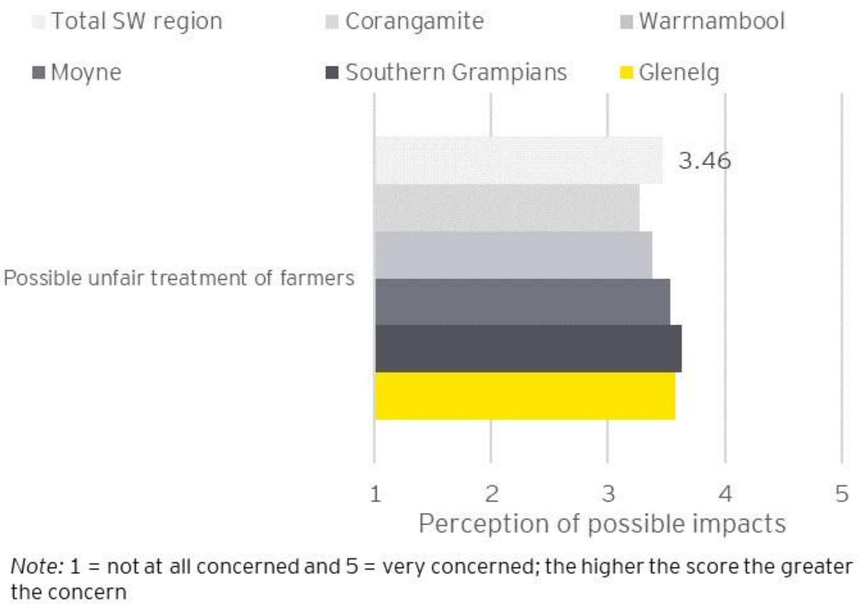
Figure 35: Attitudes towards onshore conventional gas development in the Otway Basin: By farm ownership, 2019



Source: CSIRO, 2019, Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report (in prep).

The CSIRO study also found that the general community in the Otway Basin region has concerns about the possible unfair treatment of farmers, as shown in Figure 36.

Figure 36: Perceived impacts about onshore conventional gas development in the Otway Basin: By subregion, 2019



Source: CSIRO, 2019, Community wellbeing and local attitudes to onshore conventional gas development in the Otway Basin: Interim Report (in prep).

Similar studies that have taken place in South Australia show that farmers attitudes towards gas production on their premises have changed since wells and pipelines were developed in the region.[228] Participants Reported they appreciate the more developed roads in the region and noted that the land used for development was minimal, pipelines were buried and there was little impact on their business as usual activities.

The Multiple Land Use Framework (MLUF) can be used where land access and land use conflict has the potential, real or perceived, to arise. The framework supports the ability of local and regional communities and governments to maximise land use in a flexible, environmentally sustainable

[228] CSIRO, 2019, Understanding natural gas impacts and opportunities on agriculture in the South East of South Australia

manner over time. The MLUF is designed to operate within established regulatory and policy frameworks relating to land ownership, usage and access.[229]

The MLUF guiding principles underpin key areas of activity and include:

- best use of resources
- coexistence
- strategic planning
- tailored participation of communities and landholders
- engagement and information
- decision making and accountability
- efficient processes
- accessible relevant information.[230]

The VGP's resource and land use planning assessed land use and features in line with the MLUF. The methodology for the resource and land use planning project supports flexible land use and management options that increase productivity, support key industry and food systems, promote governance over land and water resources, meet community needs and safeguard natural resources, ecosystems and economies for current and future generations.[231]

The resource and land use planning developed a model that provides a high-level regional assessment of the land within the Otway Basin in relation to suitability of onshore conventional gas development which demonstrates constraints and opportunities for the potential for multi and sequential land use. The resource and land use planning model identifies:

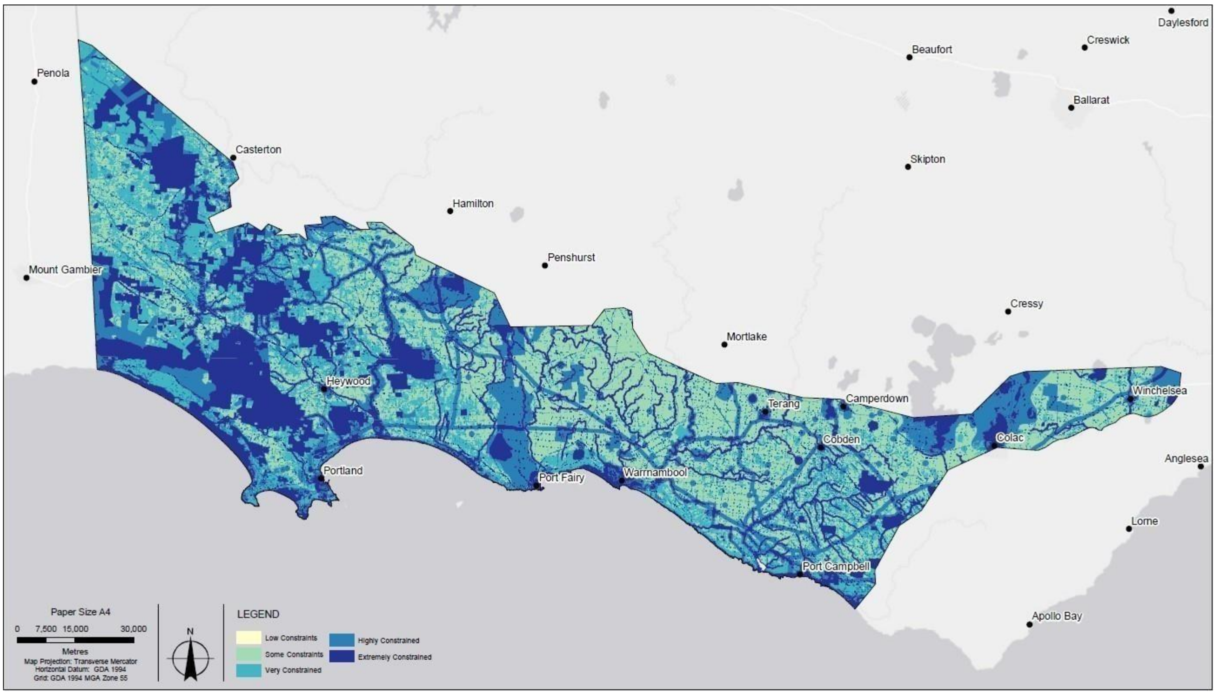
- land that may not appropriate for coexistence with development
- features of sensitivity or significance that would need to be considered and addressed prior to any exploration or development proceeding (through the provisions of the Petroleum Regulatory Framework in relation to the preparation and implementation of EMPs for petroleum operations).

The model indicates that there are no areas with no constraints in the Otway Basin, therefore all areas require appropriate planning and management if development was to occur. Figure 37 shows that:

- thirty-eight (38) per cent of land is scored as having 'some constraints' and therefore may be more suitable for future onshore conventional gas development
- twenty five (25) per cent of land is scored as being 'extremely constrained' due to key land features or values that would need to be addressed prior to any development and appropriately managed throughout development.

[229] COAG, 2013, Multiple Land Use Framework.
[230] COAG, 2013, Multiple Land Use Framework.
[231] Advice provided by the department.

Figure 37: Otway Basin resource and land use planning model



Source: Victorian Gas Program (2020). Victorian Gas Program -- Resource and land use planning - Findings Report, Otway Basin, Victoria (in prep).

As noted in ER4: Domestic Gas Supply, exploration and development of conventional gas in the Otway Basin may increase the gas available to industrial users, particularly those located closest to development, however as noted previously gas consumption is not expected to change as a result of the development scenarios. As noted above, the level of benefit will be dependent on the size and timing of annual gas production, and ability of the industrial user to negotiate a contract with the producer and arrange their own transportation. Negotiation of contracts may result in cheaper prices and better terms for the customer.

Impacts on existing uses of land occur during the exploration, development, and rehabilitation phases. In the Otway Basin hypothetical exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe. Planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income under the regulatory framework.[232] Further, the Petroleum Regulations require an EMP for all seismic survey activities including rehabilitation, resulting in phase, survey lines are cleared meaning no lasting disturbance to farming activities, is likely reducing the risk of both planned and unplanned disturbances.

The extent of these impacts increases across the scenarios, as the number of wells, and therefore land sites impacted, increase. The minimum scenario has the least amount of production and well sites, and therefore has a slightly negative impact. The low and medium scenarios have a small to medium level of production (and well sites) and would also have a slightly negative impact as long term impacts are still expected to be minimal. The high scenario has a high level of production and therefore would have a negative impact.

Gross size of farming land used for exploration and development.

In the short- to medium-term, sites for drilling would be leased for exploration and development wells. A typical operational well site requires a cleared area of 75 m^2, or less than half the size of a tennis court.[233] Once production starts, the area used decreases considerably and is typically

[232] *Petroleum Act 1998 (Vic),* s128
[233] COAG, 2018, 'Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia'

fenced off. The average operational drill site is approximately 25 m^2, or 1/8 of a tennis court. Overall, the size of operating well leases is relatively small in comparison to the area required for farming.[234] As such, the impact on farming and its profitability will be minimal. Pipelines are buried and therefore have minimal impact on livestock farming and cropping.

As noted above, planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income under the Petroleum Regulatory Framework, therefore, farmers receive supplementary income as compensation for having production wells on their property.

Longer term, drill sites would be rehabilitated and could be brought back to their initial function, as required under the framework for rehabilitation set out in the Petroleum Act. This impact will cease once land has been appropriately rehabilitated after use.

The size of the land required for the scenarios is dependent on the size of production. As the number of wells required increases, so too does the land required for wells and other infrastructure.

The minimum scenario involves 33 wells drilled, which will have an immaterial effect on the gross size of farming land. The low and medium scenarios will have 91 and 137 wells drilled respectively and will also have a neutral impact. The high scenario will involve 217 wells being drilled and will also have a slightly negative impact given the minimal impact of well drilling on gross size of farmland.

Disturbance to livestock located near petroleum activities

Onshore conventional gas development and exploration occurring may cause disturbances to nearby livestock. Increased traffic in farming regions due to gas exploration and development activities, including seismic surveys and pipeline construction activity may exacerbate the impact on livestock.

Disturbances have the potential to cause injury or death of livestock (and consequential income losses for farmers). These disturbances could occur during the exploration, development and rehabilitation phases of production.

The level of this impact is dependent on the prevalence of surrounding livestock and the timeline of exploration, development and production which will increase from the minimum scenario to the highest scenario given the landmass and time of production increases. In general, drill sites are fenced off to minimise interaction with livestock, which contributes to the rare incidence of disturbances to livestock near drill sites. As such, the impact of disturbances to livestock is immaterial given its rare nature.

These impacts on livestock near drill sites are sporadic and not ongoing - i.e. they occur only while the specific activity is being undertaken (e.g. drilling activities on site, pipeline construction activities or travelling vehicles which only occur over short timeframes). Therefore, impact on livestock is a temporary hazard in any given location and is not dissimilar to farming activities in terms of machinery and vehicle traffic.

In the Otway Basin exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe.

[234] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.

Summary of benefits and impacts

The assessment of impacts to existing farm industries, food and biosecurity is summarised in Table 70.

Table 70: Key benefits and impacts to existing farm industries, food and biosecurity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Ability to co-exist with existing agriculture industries	Onshore gas conventional development and exploration that occurs on and/or near existing agricultural land may cause disturbances to landholders.	Planned and unplanned disturbances resulting from onshore conventional gas development and exploration on and/or near agricultural land include: ► the loss of crops or pasture outside of agreed survey lines ► the potential for a vehicle strikes with livestock ► interference with optimal cropping patterns ► damage to paddocks or infrastructure. [235] [236] The impacts of these disturbances increase with the level of production, as the number of well sites required increases. The minimum scenario has the lowest number of wells, and therefore has a slightly negative impact. The low and medium scenarios have a small to medium number of wells and would also have a slightly negative impact as disturbances are still expected to be minimal. The high scenario has a high number of wells and therefore would have a negative impact.	► Impacts on agricultural industries must be managed as part of an EMP and EES, if applicable). ► Compensation agreements, which are required must be provided as per s128 of the Petroleum Act. Compensation must be paid under the Petroleum Act for any impacts on agricultural productivity agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and as well as for inconveniences caused.[237] Rehabilitation of the drill sites is required under legislation,[238] which states that drill sites would be rehabilitated and could be brought back to their previous state. The Petroleum Act also sets out a framework for rehabilitation. The holder of an authority must rehabilitate land affected by exploration or resource development and must rehabilitate the land before the authority expires or ends. The authority holder is required to obtain a rehabilitation bond for an amount specified by the minister.	Reference: x Low: x Medium: x High: xx	Possible legislative improvements derived from the VGP gap analysis would include the following: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations; ► provision for improved consideration of social, economic and environmental factors in decision-making; ► requirement for the publication of certain information relating to government decisions and industry activity.

[235] Information supplied by the department.
[236] Planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income. Unplanned disturbances to farming activities are activities that do not have pre-negotiated compensation agreements.
[237] *Petroleum Act 1998 (Vic),* s128
[238] *Petroleum Act 1998 (Vic),* s170

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
			Information on planned rehabilitation processes is required to be detailed in the Operation Plan. Impacts to agriculture is within scope of both planning permit and EES assessments where these are required.[239] Both of these assessments will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. The MLUF is intended to be used where land access and land use conflict has the potential, real or perceived, to arise. The MLUF is designed to operate within established regulatory and policy frameworks relating to land ownership, usage and access.		These reforms would provide confidence to farmers that petroleum industry impacts on agriculture are being thoroughly considered and managed. The reforms will also ensure that farmers are genuinely engaged over the entire industry lifecycle. This may influence farmer attitudes towards development and exploration in the region. The VGP community engagement function will provide information to farmers about the risks benefits and impacts of developments in their locality.
Gross size of farming land used for exploration/ development	In the short-medium term, sites for drilling would be acquired or leased for exploration and development wells.	The level of this impact is relative to the aggregate number of wells drilled for each scenario however noting the impact per well is minimal. A typical drill site requires an area to be cleared of 75 m^2, or under half the size of a tennis court. Once production starts, the area used decreases considerably and is typically fenced off. Longer term, drill sites would be rehabilitated and could be brought back to their initial condition. This impact will	► Compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on land and livestock.[240] ► The Petroleum Act contains general provisions that minimise the land size that is affected by gas	Reference: – Low: – Medium: – High: x	N/A

[239] Advice provided by the department.
[240] *Petroleum Act 1998 (Vic),* s128

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		cease once land has been appropriately rehabilitated after use. Overall, the size of wells is relatively small in comparison to the area required for farming. As such, the impact on farming and its profitability will be minimal. Pipelines can be buried and therefore would not have a significant impact on livestock farming. The minimum scenario involves 33 wells drilled which will have an immaterial effect. The low and medium scenarios will have 91 and 137 wells drilled respectively and will also have a neutral impact. The high scenario will involve 217 wells being drilled and will also have a slightly negative impact given the minimal impact of well drilling on gross size of farmland. Farmland that is used for well sites also provides a source of supplementary farm income so while the land used for production decreases slightly, the net impact on farm income may be positive.	development, such as the license area covers the minimum area necessary to cover the maximum extent of the petroleum field. ► Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies.		
Disturbance to livestock located near petroleum activities	Increased traffic in farming regions may exacerbate the impact on livestock if they are required to be moved across main roads. As traffic increases, so too does the negative impact.	Disturbances have the potential to cause injury or death of livestock (and consequential income losses for farmers). These disturbances could occur during the development, exploration and rehabilitation phases of production. These impacts on livestock near petroleum activities are sporadic and not ongoing - i.e. they occur only while the specific activity is being undertaken (e.g. drilling activities on site or travelling vehicles which only occur over short timeframes). Therefore, impact on livestock is a temporary	► impacts on livestock are managed as part of an EMP (and ESS, if applicable). ► compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on livestock.[241]	Minimum scenario: – Low: – Medium: – High: –	N/A

241 *Petroleum Act 1998 (Vic),* s128

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		hazard in any given location and is not dissimilar to farming activities in terms of machinery and vehicle traffic. As such the impact for each scenario is not material.			
Stress and financial burden to farmers to negotiate compensation agreements	The Petroleum Act requirements for a compensation agreement covering causes the stress and financial burden to farmers. The compensation agreement must be negotiated prior to commencing operations on a private property. This means that a person must obtain the consent of both the owner and occupier of land where an operation is proposed and enter into a compensation agreement with the owner and occupier of the relevant land.	Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land. The process of organising compensation arrangements begins prior to development and exploration and extends into the rehabilitation phases of the project. This process can cause stress and financial burden as farmers may need to seek legal assistance to negotiate the agreement and to define the loss or damage that will be sustained Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land. The impact on farmers is expected to be minor and offset by the benefits of providing receiving compensation under the agreement. This will be consistent for each scenario. It is assumed to have a neutral impact under each case as the compensation is provided to replace lost or damage property.	Compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on livestock.[242] Industry practice if often to go above the minimum compensation requirement for providing a source of off farm income.[243]	Minimum scenario: – Low: – Medium: – High: –	The department has developed a standard land access proforma template for the minerals sector that assists landholders in easily negotiating compensation agreements. The proforma template could be relatively easily adapted to petroleum industries.

[242] *Petroleum Act 1998 (Vic),* s128
[243] Advice provided by the department.

Summary of risks

The analysis has identified the following key risks to existing farm industries, food and biosecurity with respect to the Otway Basin hypothetical exploration and development scenarios (Table 71):

Table 71: Key risks to existing farm industries, food and biosecurity

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Introduction of pests and diseases	Vehicles and equipment used as a part of the exploration and development process have the potential to introduce or spread local or foreign soil or other organic material (such as seeds) through farmland or areas of native vegetation. Clearing of native vegetation also has the potential to open the soil to weed infestation.	Introduced weeds, pests and pathogens can adversely impact the local ecology. In relation to farming opportunities, disease and/or death of livestock and pasture can reduce productivity and result in consequential financial losses. The risk of introducing weeds, pests or pathogens is they would likely remain in the region after rehabilitation and development is complete as they can be difficult to remove or eradicate. The consequence of potential and actual incursion of pests and disease is expected to be larger during development phases as more vehicles are travelling in and out of the sites. However, the risk is still prevalent during production phases albeit marginally lower. As such, number of developments are used as a comparator to assess the severity of this risk with	The risks of introducing pest and disease are managed as part of an EMP (and ESS, if required). The CALP Act is the primary legislation governing noxious weed and pest animal management in Victoria. The Petroleum Act has several provisions intended on minimising biosecurity risks. s113 of the Petroleum Act states the Minister may cancel an authority if any petroleum operation carried out under the authority has caused an unexpected significant adverse impact on biosecurity.[244] The Petroleum Act also specifies the need for an EES which assesses biosecurity effects of a proposed project. s161 of the Petroleum Act states before carrying out any petroleum operation, an operation plan must be given to the minister that identifies	Unlikely[248]	Serious[249]	Moderate	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make biosecurity management transparent. Any compliance actions will also be published which will give confidence to communities and farmers that this risk is being robustly managed.

[244] *Petroleum Act 1998 (Vic),* s113

[248] Information supplied by the department.

[249] Information supplied by the department.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		consideration of total production time.	the risks of injury or damage that the operation may pose to biosecurity. [245] Victorian plant biosecurity is governed by the *Plant Biosecurity Act 2010* and subordinate legislation. The objectives of Victorian plant biosecurity legislation are to: ► minimise disruptions to plant production and market access from biosecurity incidents ► facilitate trade of plant products to local, interstate and overseas markets. The main purposes of this Act are to: ► provide for the prevention, monitoring, controlling and eradication of plant pests and diseases ► outline the required packaging, labelling and description of plants and plant products ► facilitate the movement of plants, plant products, used packages, used equipment and earth material within, into and out of Victoria. This Act, and subordinate legislation, includes inspector powers to conduct compliance activities relating				

[245] *Petroleum Act 1998 (Vic),* s161

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			to plant biosecurity regulation. This equips the department to manage declared pests and diseases, including exotic pests and diseases within Victoria and to control border and post border plant biosecurity threats.[246] Impacts of pest and disease incursions are within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[247]				

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect existing farm industries, food and biosecurity. It identified the Otway hypothetical scenarios could slightly negatively impact on coexisting with existing agriculture industries, livestock near petroleum activities, gross size of farming land used for exploration and development, and the man agement of potential and actual incursion of pests and diseases. The consequences of these impacts increase with the level of production, as the number of well sites required increases, thereby potentially affecting more land used currently for farming. However, the land size required for petroleum activities is relatively small in comparison to the area required for farming,[250] and the Petroleum Regulatory Framework mitigates the impacts through compensation arrangements to compensate for temporary losses of farming income for having production wells on their property. Industry practice is often to go above the minimum compensation requirement for providing a source of off farm income.[251]

246 *Plant Biosecurity Act* 2010

250 SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished Report.
251 Advice provided by e

As such, the impact on existing farm industries will be minimal. Overall, the minimum scenario, low and medium scenarios were assessed as having a no material impact, and the high scenario was assessed as having a slightly negative impact (Table 72).

The potential and actual incursion of pests and diseases was assessed as a key risk to farming industries. These risks are managed on a project-by-project basis, with each project required to have an adequate EMP in place identifying measures that comply with all relevant regulations and legislation. Therefore, the risk has been assessed as moderate for all scenarios (Table 73), as projects would not proceed unless the impacts are assessed by the regulator to be are ALARP.

Table 72: SR7: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 73 SR7: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

4.2.2.8 SR8: Labour and working conditions

What working conditions will being place for the development and operation of gas production? What mechanisms are there to support a diverse workforce?

Benefits and impacts

The analysis has identified the following key benefits and impacts to labour and working conditions with respect to the Otway Bas in hypothetical exploration and development scenarios (Table 74):

Table 74: Key benefits and impacts to labour and working conditions

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Existence of an EBA improving employment conditions for workers	The existence of an EBA is up to the discretion of the employer.[252] An EBA is a formal agreement where the employer and employee negotiate for an enterprise agreement that may change the terms and conditions of employment. Employee representatives, such as unions[253], may also be included in the negotiation process. The agreement negotiated is intended to not only improve business productivity and efficiency, but also improve and vary the working conditions to benefit employees.	An EBA must result in employees being better off than if they were paid according to their relevant award. If an EBA is developed, the award will not apply unless it is incorporated into the agreement. Depending on the negotiation held, consequences of an EBA may include: ► more flexible hours and rosters ► increased training and career opportunities ► broader job classifications ► profit sharing or performance related pay ► agreement to achieve efficiency gains ► family friendly arrangements ► improved service delivery ► improved workplace issues procedures ► long term benefits for both the business and employees.	There are no current control measures in place for this measure under the Petroleum Regulatory Framework. The Fair Work Act 2009 requires: ► awards or EBAs in include all sections of the National Employment Standards ► only one enterprise agreement can apply to an employee. Compliance for existence and assessment of EBAs is predominately enforced by the Fair Work Commission.	Minimum scenario: - Low: - Medium: - High: -	N/A

[252] Fair Work Ombudsman. (2020). *Improving workplace productivity through bargaining*. [online] Available at: https://www.fairwork.gov.au/how-we-will-help/templates-and-guides/best-practice-guides/improving-workplace-productivity-through-bargaining#bargaining [Accessed 20 Dec. 2019].

[253] The gas sector is currently unionised by the Construction, Forestry, Maritime Mining and Energy union.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		EBAs are common within the oil and gas industry. According to the Fair Work Commission, there were 24 separate EBA applications from the oil and gas industry within the period from 01 July 2019 to 20 January 2020.[254] This highlights the industry practice to implement an EBA. Assuming existing businesses would be employed to manage production, organisations may already have existing EBAs in place, and would therefore may choose to negotiate an EBA for the proposed development region. The existence of, and conditions within an EBA result in positive outcomes for labour and working conditions. However, it is not required under the regulatory framework and is expected to have a neutral impact. These are independent of the level of gas exploration and development, so is not expected to vary between scenarios.			
Workforce representation	Diversity within the workplace ensures that different social groups are adequately represented. There should be no barriers in place that might discourage individuals from different backgrounds from employment.	Workplace representation can result in: ► diverse workforce ► feelings of inclusivity in the workplace ► improved social licence for operators Workplace representation measures would be in place for the duration of employment in the region. Workforce representation and diversity are often required for organisations to	There are no current control measures in place for this measure under the Petroleum Regulatory Framework or under current legislation. However, under Victorian and federal anti-discrimination laws, a person should be hired based on whether they are best person for the job, regardless of their background and personal characteristics.[256] *Fair Work Act 2009* requires:	Minimum scenario: - Low: - Medium: - High: -	N/A

[254] Fair Work Commission. (2020). *Document search for: Agreements*. [online] Available at: https://www.fwc.gov.au/search/document/agreement?search_api_views_fulltext=&display_switcher=%2Fsearch%2Fdocument%2Fagreement&created%5Bdate%5D=&created_1%5Bdate%5D=&matter_number=&field_fwc_doc_agreement_print_members=All&reference=&field_fwc_doc_agreement_AGR_AGMT_ID=&title=&old_pub_code=&state=All&industry=Oil+and+gas+industry&abn=&search_api_aggregation_1=&sort_bef_combine=search_api_relevance+DESC&=Update+Search# [Accessed 3 Feb. 2020].

[256] Humanrightscommission.vic.gov.au. (2020). *The Workplace*. [online] Available at: https://www.humanrightscommission.vic.gov.au/the-workplace [Accessed 20 Dec. 2019].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		maintain social license. Many large organisations operating within Australia have therefore adopted diversity policies, and this extends to the gas industry. For example, Beach Energy has adopted a diversity policy to achieve its gender diversity goals.[255] Key objectives include: ► gender composition at board and senior levels ► talent pipeline ► ensuring adequate female representation on company wise leadership development programs ► flexibility practices. The assessment found that increases in gas production has little impact on the labour and working conditions of employees, as organisations either have internal policies, or they do not. The frameworks and policies, if implemented, would provide significant benefits to employees irrespective of the size of production. While it is current industry practice is to have diversity policies in place, it is not required under the existing regulatory framework. It is therefore expected the gas exploration and development scenarios would result in a neutral impact on workforce representation and benefits will be consistent for each scenario.	► employers to not take adverse action again an employee or prospective employee based on their race, colour, sex, sexual orientate, age, physical or mental disability, marital status, family or carer's responsibilities, pregnancy, religion, political opinion, natural extraction or social origin. ► Employers in Victoria must also abide by the following anti-discrimination law: ► *Age Discrimination Act 2004* ► *Disability Discrimination Act 1992* ► *Racial Discrimination Act 1975* ► *Sex Discrimination Act 1984* ► *Equal Opportunity Act 2010* (Victoria) ► Equal remuneration is required for work of equal or comparable value.		
Organisational policies and procedures	Gas exploration and development may impact on the working conditions (e.g. safety) of employees. Organisational	Organisational policies governing working conditions may lead to:	An approved EMP including a WOMP is required prior to any exploration and development activities taking place. This	Minimum: Low:	N/A

[255] Beachenergy.com.au. (2020). *2019 Corporate Governance Statement*. [online] Available at: https://www.beachenergy.com.au/wp-content/uploads/2019/08/GD19-0084-Beach-Corporate-Governance-Statement_FA.pdf [Accessed 24 Jan. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
governing working conditions	policies and procedures outline the arrangements to manage working conditions. These policies can include, but are not limited to: ► Workplace Health and Safety Policy ► Drug and Alcohol Policy ► safety management procedures ► risk assessment procedure ► risk control procedures ► Workplace Bullying Policy ► Smoke-free Workplace Policy ► hazard identification procedure ► performance monitoring and review procedures ► governance policies.	► improved health safety of workforce ► improved productivity and performance of workforce ► clear decision making and governance arrangements The extent of organisational policies and procedures is up to the discretion of the employer. At a minimum, the employer has a legal responsibility to provide a safe and healthy workplace.[257] The assessment found that increases in gas production has little impact on the working conditions of employees, as organisations are required to have policies and procedures governing working conditions regardless of the size of a development. The frameworks and policies would provide benefits to employees irrespective of the size of production. Therefore, it is expected the gas exploration and development scenarios would have a positive material impact on workforce conditions and benefits will be consistent for each scenario.	will include a mitigation and management plan to ensure safety risks are reduced to an acceptable level. *Fair Work Act 2009* sets the standards and regulations for employment. Employees working conditions are governed under this framework. The OH&S Act contains a power for WorkSafe Victoria to appoint inspectors for the purposes of the Petroleum Act. Additionally, gas processing facilities are defined as major hazard facilitates that must be licensed and follow an extensive, strict legal framework.	Medium: High:	

Risk

No risks to this receptor were identified.

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect labour and working conditions. The assessment found that EBAs are common within the oil and gas industry. The existence of, and conditions within an EBA result in positive outcomes for labour and working conditions. These are independent of the level of gas exploration and development, so benefits are not expected

257 www1.worksafe.vic.gov.au. (2020). *1.1.4 Employer obligations*. [online] Available at: http://www1.worksafe.vic.gov.au/vwa/claimsmanual/Claims_Manual/1-the-scheme/1-1-4-employer-obligations.htm [Accessed 4 Feb. 2020].

to vary between scenarios. Diversity policies are also common in the industry, resulting in positive impacts on worker representation for all exploration and development scenarios. As none of these measures are required under legislation, both are expected to have a neutral impact

The assessment also found that the extent of organisational policies and procedures is up to the discretion of the employer. However, at a minimum, the employer has a legal responsibility to provide a safe and healthy workplace.[258] Increases in gas production has little impact on the working conditions of employees, as organisations are required to have a minimum level of policies and procedures governing working conditions. The frameworks and policies would provide benefits to employees irrespective of the size of production. This is expected to have a slightly positive impact under all scenarios.

Therefore, all scenarios are expected to have a slightly positive impact on the labour and working conditions (Table 75).

No risks to labour and working conditions with respect to the Otway hypothetical exploration and development scenarios were identified.

Table 75: SR8: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

258 www1.worksafe.vic.gov.au. (2020). *1.1.4 Employer obligations*. [online] Available at: http://www1.worksafe.vic.gov.au/vwa/claimsmanual/Claims_Manual/1-the-scheme/1-1-4-employer-obligations.htm [Accessed 4 Feb. 2020].

4.2.3 Environmental impact assessment

4.2.3.1 ENR1: Greenhouse gas emissions[259]

What are the total GHG emissions as a result of the proposed development?

Benefits and impacts

The analysis has identified the following benefits and impacts on GHG emissions with respect to the Otway Basin hypothetical exploration and development scenarios:

- absolute GHG emissions
- GHG emissions intensity of proposed developments
- alignment with 2050 net zero target

These impacts are described further below.

Absolute GHG emissions

Gas exploration and development in the Otway region is expected to result in GHG emissions from activities associated with exploration, processing, transmission and distribution.[260]

GHG emissions include Nitrous Oxide (NO_2), Carbon Dioxide (CO_2), Methane (CH_4) and fluorinated gases. Methane emissions, which make up the bulk of the fugitive emissions[261] from gas production cycle , have a global warming potential (how much heat is trapped relative to CO_2) 28 times higher than CO_2 over a 100-year time horizon[262] while the carbon dioxide emissions can stay in the atmosphere for thousands of years.[263] These emissions will contribute

[259] Assessment of greenhouse gas emissions is based on the outputs of EY's environmental modelling, the figures of which are estimates.

[260] As noted in section 3.3, the GHG modelling only included the production, transmission and distribution of gas. End use was not considered, because the analysis in sections 4.2.1.4 and 4.2.1.5 found that the scenarios do not result in significant additional supply so as to change market dynamics, and Victoria is forecast to become a net importer of gas in the medium term to meet existing consumption.

[261] Fugitive emissions are losses, releases and leaks of methane and carbon dioxide into the atmosphere as a result of industrial processing, transmission and distribution of natural gas, oil and coal.

[262] Greenhouse Gas Protocols, 2013, Global Warming Potential Values

[263] IPCC, 2007, Couplings Between Changes in the Climate System and Biogeochemistry. In relative terms, the global warming potential of methane is 84 times greater than CO_2 in the atmosphere over a 20-year timeframe.

to Victoria's overall GHG emissions profile, thus contributing to physical impacts such as rising temperatures, decreased rainfall, more extreme fire weather and heatwaves and rising sea levels.[264]

The impact of the Otway Basin exploration and development scenarios over the life of the proposed development on absolute GHG emissions has been determined through GHG emissions modelling.[265] In determining whether there has been an absolute increase in emissions, the assessment considered:

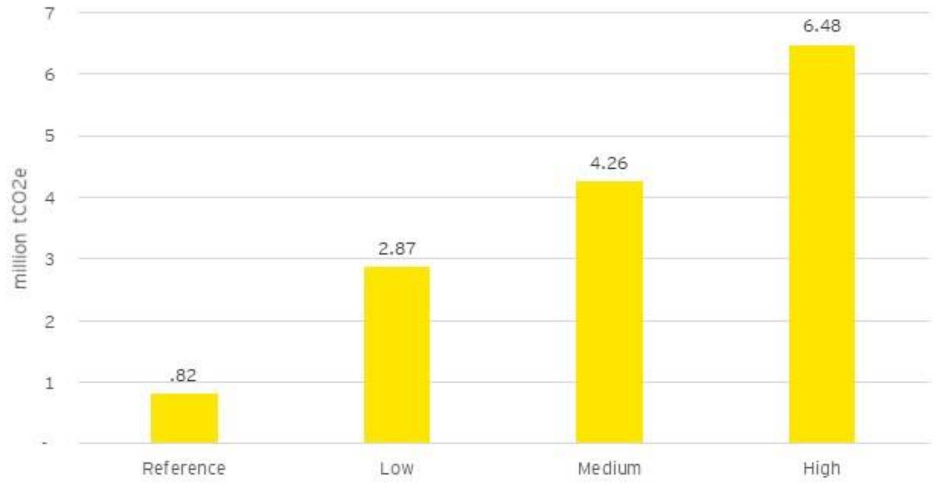
- the quantity and quality of natural gas within the well; with increases in the volume of the gas extracted increasing the associated emissions
- whether emissions associated with natural gas consumption by the end user would occur irrespective of the proposed developments.

In the case of the Otway Basin hypothetical exploration and development scenarios, the assessment found that emissions associated with combustion of natural gas would occur irrespective of the proposed developments. This is because the Otway Basin scenarios are not expected to significantly change Victoria's natural gas supply or consumption patterns (see Section 4.2.1.3). Therefore, the resulting end use emissions are likely to occur regardless of whether Victorian consumers source gas from the Otway Basin exploration and development scenarios or from existing interstate gas supply. Correspondingly, the GHG modelling and associated results presented in this Report excludes GHG emissions produced from end-use of these proposed gas developments.

As a result, Figure 38 only includes emissions from activities associated with natural gas infrastructure, exploration, processing, distribution, transmission (and excludes end-use).[266] It shows that total emissions over the lifetime of production (over the exploration and development period) range from ~0.8 million tonnes of carbon dioxide equivalent (m tCO2e) in the minimum scenario to ~6.5m tCO2e in the high scenario.

[264] Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)
[265] A detailed discussion of the methodology, emissions boundary, and calculation approach applied is provided in Appendix C - Overview of GHG analysis.
[266] Emissions associated with natural gas consumption by the end user have not been included as they would have occur irrespective of the proposed developments.

Figure 38: Total emissions from exploration, production, distribution, and transmission over the Otway Basin hypothetical exploration and development period (30 years) (mtCO2-e)



Source: EY GHG emissions modelling analysis

Table 76 compares the annual average emissions per scenario for the hypothetical developments to Victoria's net 2017 GHG emissions of 110.3 million tCO2e.[267] The overall impact of these hypothetical developments on Victoria's net 2017 emissions range from an additional 0.1 per cent (minimum scenario) to an additional 0.2 per cent (high scenario). This compares to an additional 5,610 one way flights from Melbourne to Sydney per year, or 519 additional one way flights from Melbourne to Los Angeles for the minimum scenario and an additional 13,713 one way flights from Melbourne to Sydney per year, or 1,269 additional one way flights from Melbourne to Los Angeles for the high scenario.

[267] Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)

Table 76: Annual emissions per scenario (Otway)

Scenario	Annualised emissions				
	Lifetime of production (years)	Annual emissions (tCO2e)	Percentage of Victoria's net 2017 GHG emissions	Equivalent emissions no. of flights from MEL -> SYD[268]	Equivalent emissions no. of flights from MEL -> LAX[269]
Otway Basin (Minimum scenario)	8	101,891	0.09%	5,610	519
Otway Basin (Low)	19	151,109	0.14%	8,320	770
Otway Basin (Medium)	22	193,490	0.18%	10,653	986
Otway Basin (High)	26	249,067	0.23%	13,713	1,269

Source: EY GHG emissions modelling analysis

While the scenarios do not currently represent a significant portion of Victoria's annual emissions, this is expected to increase as a proportion in the future, as Victoria introduces emission reduction initiatives in line with the net-zero 2050 target, and total emissions reduce.

The Independent Expert Panel on Interim Emissions Reduction Targets for Victoria estimate that Victoria has an emissions budget of 1.25 GtCO2-e over the period 2017 to 2050 to be consistent with a 1.5°C trajectory.[270] At 2016 emissions levels, the panel estimate the 1.5°C budget will be exhausted by 2026. The total emissions over the life of the developments are estimated to contribute to 0.1 per cent to 0.2 per cent of Victoria 's remaining carbon budget depending on the scenario. This is a small net-impact of the Otway Basin exploration and development scenarios and their timeframe for development.

There may be opportunities for gas explorers and producers to use carbon offsets to offset emissions elsewhere in the economy and compensate the emissions associated with the proposed developments. However, given that carbon offsetting is voluntary and there is no mechanism to enable this (such as a formal carbon pricing scheme) in Australia, this has not been factored into this assessment.

[268] Determined based on a one-way flight (A330-200 aircraft or similar) with 230 economy class passengers and 28 business class passengers. Data sourced from Icao.int. (2020). ICAO Carbon Emissions Calculator. [online] Available at: https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx [Accessed 14 Feb. 2020].
[269]Determined based on a one-way flight (A330-200 aircraft or similar) with 230 economy class passengers and 28 business class passengers. Data sourced from Icao.int. (2020). ICAO Carbon Emissions Calculator. [online] Available at: https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx [Accessed 14 Feb. 2020].
[270] Independent Expert Panel on Interim Emissions Reduction Targets for Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)

Overall, the annual average GHG emissions from the Otway Basin exploration and development scenarios are small as a percentage of net-2017 emissions (0.1 to 0.2 per cent). Therefore, all scenarios are expected to deliver a minor negative impact on absolute GHG emissions.

Greenhouse gas emissions intensity of proposed developments

The GHG emissions intensity[271] of natural gas developments is an important factor in determining absolute and relative GHG emissions. The intensity metric is based on the total energy (PJ) that reaches the end consumer, which considers losses associated with the processing, transmission and distribution of the natural gas.

No information was available at the time of analysis of the gas composition in the Otway Scenarios. Therefore, the emissions intensity of natural gas was assumed to be (a constant) 9,057 tCO2e/PJ for all proposed developments. As a result, no comparisons were made between the development scenarios for this analysis.

It is important to note that this differs from the intensity metrics based on the natural gas that reaches the end consumer (which was excluded from this analysis), which also considers the emissions associated with combustion.[272]

Alignment with 2050 net zero target

The hypothetical gas exploration and development scenarios in the Otway region increase in GHG emissions from activities associated with natural gas exploration, processing, transmission and distribution. This may impact the energy sector's alignment with Victoria's 2050 net-zero target.

Victoria's 2050 net-zero target

The Victorian Government has set a target of net zero emissions by the year 2050, which is enshrined in the Victorian Government's *Climate Change Act 2017* (the Climate Change Act). The Climate Change Act sets a policy framework and a pathway to 2050 that is consistent with the Paris Agreement and is guided by long and interim targets, five-year strategies, adaptation planning, reduction pledges, and other mechanisms.[273] The Climate Change Act includes a requirement to determine interim targets for 2025 and 2030 by 31 March 2020.[145] As a precursor to setting these targets, an independent panel was appointed to advise the government on these interim targets for 2021-2025 and 2026-2030 and to identify opportunities for achieving these targets. Figure 39 displays both the projected emissions reduction by 2020 and the current recommended interim target ranges for Victoria for 2025 and 2030.

Based on Figure 39 reduction in emissions between 2016 to 2020 is mostly attributed to emissions reduction policies and the closure of Hazelwood Power Station which occurred in early 2017. Direct combustion emissions and fugitive emissions are projected to decrease by 0.9 per cent and 15.6 per cent

[271] Emissions intensity is determined as a ratio of tonnes of carbon dioxide equivalent GHG emissions produced (excluding end use) per petajoule of energy of discovered resources for the hypothetical gas development scenarios.
[272] Appendix C provides further information on the natural gas production cycle.
[273] Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)

respectively between 2016 and 2020 due to reduced natural gas consumption resulting from fuel switching, improvements in energy efficiency, and reductions in industry loads with population growth expected to only partially offset these reductions.

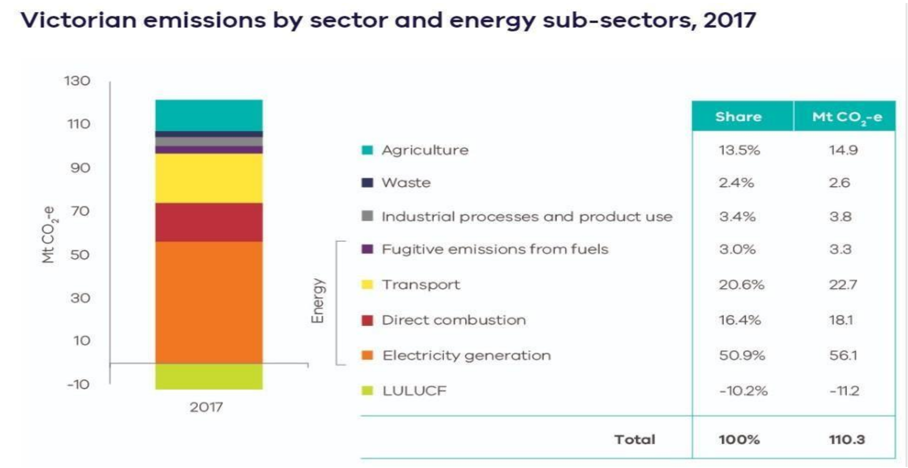
It is important to note that projected emissions pathways are modelled based on present conditions; therefore if the development of natural gas in Victoria was to change these conditions (e.g. through changes in natural gas demand in Victoria), this could result in a steeper and more difficult trajectory to achieve this net-zero commitment given the cumulative nature of carbon budgets.

Figure 39: Victoria's proposed emissions reduction targets for 2021-25 and 2026-30

Source: Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)

A general breakdown of Victoria's emissions by sector is outlined in Figure 40. The emissions relating to activities associated with natural gas exploration, processing, transmission and distribution fall under industrial, direct combustion, electricity generation, transport, and fugitive emission categories.

Figure 40: Greenhouse gas emissions in Victoria



Source: Department of Environment, Land, Water and Planning (DELWP), 2019, 'Victorian Greenhouse Gas Emissions Report'

Alignment to Victoria's 2050 net-zero target

Natural gas production does not form a significant part of Victoria's emissions profile,[274] however, the increase in production of gas in Victoria under the Otway Basin exploration and development scenarios could impact on the alignment with the 2050 net-zero target, due to the increase in absolute GHG emissions. Further, natural gas is considered by many experts to be a key transition fuel which can contribute towards reducing the emission profiles/portfolios dominated by other emissions-intensive fossil fuels. The International Energy Agency (IEA) found that, on average, switching from coal to natural gas reduces emissions by 50 per cent when producing electricity and by 33 per cent when providing heat.[275] As such, changes in demand for gas and other fuels as a result of the additional supply of gas could offset the increase in emissions from electricity production in Victoria, improving alignment to Victoria's 2050 net-zero target.

However, as noted in sections 4.2.1.4 and 4.2.1.5, the additional supply under the Otway Basin exploration and development sc enarios is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption) and, as such, is not expected to impact gas pricing, or market dynamics, including consumption. Therefore, the Otway Basin exploration and development scenarios are not expected to significantly alter the trajectory to achieving Victoria's 2050 net-zero target.

[274] ClimateWorks Australia, 'Gas-Electricity substitution projections to 2050'
[275] IEA, 2019, The Role of Gas in Today's Energy Transitions

Summary of benefits and impacts

The assessment of impacts to greenhouse gas emissions is summarised in Table 77.

Table 77: Key benefits and impacts to GHG emissions

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Absolute GHG emissions	GHG emissions occur from gas exploration, processing, distribution and transmission, and consumption by the consumer.	The consequence of an increase in GHG emissions from activities associated with natural gas is an: ► increase in Victoria's absolute GHG emissions. The assessment conducted GHG emissions modelling by scenario and stage. In determining whether there has been an absolute increase in emissions the assessment considered: ► the quantity and quality of natural gas within the well; with increases in the volume of the gas extracted increasing the associated emissions ► whether emissions associated with natural gas consumption by the end user would occur irrespective of the proposed developments. In the case of the Otway Basin exploration and development scenarios, the assessment concluded that emissions associated with consumption of gas would occur irrespective of the proposed developments. This is because the Otway Basin scenarios are not expected to significantly change Victoria's natural gas supply or consumption patterns (see sections 4.2.1.5 and 4.2.1.6). As a result, the end use of this gas has been excluded from the GHG analysis.	As part of achieving its emissions reduction target under the Climate Change Act, the Victorian Government has committed to set interim emissions targets. It also intends to pledge contributions[276] to emission reduction in key emissions producing sectors via the TAKE2 campaign.[277] The impact of the emissions targets and pledges is uncertain, as the government has yet to set interim targets for 2025 and 2030.[278] However the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply.	Minimum: × Low: × Med: × High: ×	As part of the VGP, the department has measured a baseline of atmospheric measurements in the Otway region so any future changes in air quality resulting from future petroleum exploration and development could be identified appropriately.

[276] Other levels of government, businesses and communities are also able to pledge contributions.
[277] Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)
[278] By 31 March 2020, the Victorian Government will set interim targets for 2025 and 2030.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		The assessment found total emissions over the lifetime of production range from ~0.8m tCO2e in the minimum scenario to ~6.5m tCO2e in the high scenario. The assessment compared the annual average emissions per scenario for the Otway Basin hypothetical exploration and development scenarios to Victoria's net 2017 GHG emissions of 110.3 million tCO2e. The overall impact of these hypothetical exploration and development scenarios on Victoria's net 2017 emissions range from 0.1 per cent (minimum scenario) to 0.2 per cent (high scenario). Although the proportions do not currently depict a significant portion of Victoria's annual emissions, this is expected to increase in proportion in the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050 target. The Independent Expert Panel on Interim Emissions Reduction Targets for Victoria estimate that Victoria has an emissions budget of 1.25 GtCO2-e over the period 2017 to 2050 to be consistent with a 1.5°C trajectory. The total emissions over the life of the developments are estimated to contribute to 0.1 per cent to 0.2 per cent of Victoria's remaining carbon budget depending on the scenario. This is a small net-impact of the Otway Basin exploration and development scenarios and their timeframe for development. Overall, the annual average GHG emissions from the Otway Basin exploration and development scenarios are small as a percentage of net-2017 emissions (0.1% to 0.2% equivalent to 519 and 1,269 flights from Melbourne to			

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		LAX respectively). Therefore, all scenarios are expected to deliver a minor negative impact on absolute GHG emissions.			
GHG emissions intensity of proposed developments	The GHG emissions intensity of natural gas developments is an important factor in determining absolute and relative GHG emissions of the production, transmission and distribution of gas. The intensity metric is based on the total energy (PJ) that reaches the end consumer, which considers losses associated with the processing, transmission and distribution of the natural gas.	No information was available at the time of analysis of the gas composition in the Otway Scenarios. Therefore, the emissions intensity of natural gas was assumed to be (a constant) 9,057 tCO_2e/PJ for all proposed developments.[279] As a result, no comparisons were made between the development scenarios for this analysis. It is important to note that this differs from the intensity metrics based on the natural gas that reaches the end consumer, which considers losses associated with the processing, transmission, and distribution of the natural gas and also considers the emissions associated with combustion.	Similar to above, the Victorian Government has committed to set interim emissions targets. The impact of the emissions targets and pledges is uncertain, as the Government has yet to set interim targets for 2025 and 2030. However, the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply.	N/A	Mitigation measures are the same as those described in Absolute GHG emissions.
Alignment with 2050 net zero target	The Victorian Government has set a target of net zero emissions by the year 2050, which is enshrined in the Victorian Government's Climate Change Act The Climate Change Act includes a requirement to determine interim targets for 2025 and 2030 by 31 March 2020. As a precursor to setting these targets, an independent panel was appointed to advise the government on these interim targets for 2021-2025 and 2026-2030 and to identify opportunities for achieving these targets.	The consequence of additional supply of natural gas may: ► increase or decrease the energy sector's alignment with Victoria's 2050 net-zero target. Natural gas production does not form a significant part of Victoria's emissions profile,[280] however, the increase in production of gas in Victoria under the Otway Basin exploration and development scenarios could impact on the alignment with the 2050 net-zero target, due to the increase in absolute GHG emissions. Further, natural gas is considered by many experts to be a key transition fuel	Similar to above, the Victorian Government has committed to set interim emissions targets. The impact of the emissions targets and pledges is uncertain, as the Government has yet to set interim targets for 2025 and 2030. However, the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply. It is noted that petroleum industry will need to meet the requirements of the Climate Change Act as will all carbon emitters. Gas producers will need to consider how they meet the net zero	Minimum: – Low: – Med: – High: –	N/A

[279] Appendix C describes the approach and assumptions for the GHG modelling.
[280] ClimateWorks Australia, 'Gas-Electricity substitution projections to 2050'

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		which can contribute towards reducing the emission profiles/portfolios dominated by other emissions-intensive fossil fuels. As such, changes in demand for gas and other fuels as a result of the additional supply of gas could offset the increase in emissions from the production in Victoria, improving alignment to Victoria's 2050 net-zero target. However, as noted in sections 4.2.1.4 and 4.2.1.5, the additional supply under the Otway Basin exploration and development scenarios is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption) and, as such, is not expected to impact gas pricing, or market dynamics, including consumption. Therefore, the Otway Basin exploration and development scenarios are not expected to change the trajectory to achieving Victoria's 2050 net-zero target. Based on the above analysis, the Otway Basin exploration and development scenarios are expected to have no material impact on the energy sector's alignment with Victoria's 2050 net-zero target.	targets in their commercial decision making.		

Risk

The analysis has not identified any risks to GHG emissions with respect to the Otway Basin exploration and development scenarios.

Overall assessment

The assessment identified the Otway Basin exploration and development scenarios would result in an increase in absolute annualised GHG emissions as a proportion of Victoria's net 2017 GHG emissions ranging from 0.1 per cent (~101,891 t CO_2e, equivalent to 519 flights from Melbourne to LAX) under the minimum scenario to 0.2 per cent (~249,067 t CO_2e, equivalent to 1269 flights from Melbourne to LAX) under the high scenario. Therefore, all scenarios are expected to deliver a minor negative impact on absolute GHG emissions.

While the Otway Basin exploration and development scenarios are not expected to significantly change or alter the State's composition of its GHG emissions, the assessment found that GHG emissions from the Otway Basin scenarios are expected to represent an increased proportion of Victoria's net GHG emissions portfolio into the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050.

However, the Otway Basin hypothetical exploration and development scenarios are not expected to change the trajectory to achieving Victoria's 2050 net-zero target, as the additional supply is not expected to change market dynamic and impact consumption of gas.

Based on the findings, the Otway Basin hypothetical exploration and development scenarios are expected to have a minor negative impact on GHG emissions (Table 78).

Table 78: ENR1: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

4.2.3.2 ENR2: Groundwater and surface water quality and quantity

What are the measurable impacts on ground water and surface water near the proposed development sites?

Benefits and impacts

The analysis has identified the following key benefits and impacts to groundwater and surface water quality and quantity with respect to the Otway Basin hypothetical exploration and development scenarios:

- the volume removed from the nearest water resource aquifer (WRA)
- volume impact on surface water receptors
- groundwater level drawdown greater than 5 m from the nearest WRA
- area of water table drawdown greater than 0.1 m
- time to impact, maximum impact and time to recover.

The Department of Environment, Land, Water and Planning and the GSV conducted water science studies on onshore natural gas in 2015[281] to provide an initial screening analysis of the potential impacts of possible onshore gas exploration and development on water users and ecosystems. The VGP environmental studies assessed the potential impacts of aquifer depressurisation (i.e. groundwater level decline) in more detail[282]. The studies applied a biophysical approach, identifying where natural gas might be, where water resources are, the physical connection between the gas and water resources, and utilising modelling to infer impacts on water users and ecosystems. The result of the studies showed low impacts related to aquifer depressurisation on groundwater, surface water users and ecosystems. The results of these studies have been used to inform the assessment of benefits and impacts to groundwater and surface water quality and quantity.

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[281] Jacobs (Australia) Pty Ltd (2015). Otway region synthesis Report. [online] State Government Victoria. Available at: https://earthresources.vic.gov.au/__data/assets/pdf_file/0004/456745/O1-Water-science-studies-Otway-synthesis-Report-June-2015.pdf [Accessed 14 Dec. 2019].

[282] Hocking, M., Torkzaban, S., Gaal, A., Bold, T., Iverach, C. and Beverly, C. (2020a) Otway groundwater impact assessment – conventional gas development scenarios. Victorian Gas Program Report (in prep).

Table 79: Estimated impact on ground and surface water under each Otway Basin hypothetical scenario.[283]

Metric	Minimum scenario	Low	Medium	High
Volume removed from the nearest WRA (ML)	81	294	433	660
Groundwater level drawdown greater than 5 m from the nearest WRA (hectares)	0	0	0	0
Volume impact on surface water receptors (ML/year)	0	0	0	0
Area of water table drawdown > 0.1 metres (hectares)	0	0	0	0
Time to initial impact (years)	0	0	6	4
Time to maximum impact from initial (years)	0	0	9	13
Time to recover (years)	0	0	15	29

Summary of benefits and impacts

The assessment of impacts to groundwater and surface water quality and quantity is summarised in Table 80.

Table 80: Key benefits and impacts to groundwater and surface water quality and quantity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
The volume removed from the nearest WRA (ML)	Onshore conventional gas development in the Otway Basin necessitates the depressurisation of gas fields. In some instances, this includes the extraction of condensate. The depressurisation effect of withdrawing gas can have a similar impact as groundwater extraction. The equivalent volume of water extracted is related to the amount of gas extracted and	Depletion of groundwater and surface water can impact the viability of ecosystems. The ecological impact of groundwater depletion of the ecosystems listed above will depend on:[284] ▸ the ecosystem's total environmental value (including biodiversity) ▸ the ecosystem's level of dependence on groundwater	The current Petroleum Regulatory Framework pertaining to the management of water extraction and water impacts, includes the need for EMPs and compliance with the EP Act, and in some instances the EES process where water impacts are deemed an issue by the Minister for Planning. Impacts on water aquifers are managed as part of EMP's. Negative impacts on ground and surface water must be reduced as low as reasonably practicable.	Minimum scenario: – Low: – Medium: – High: –	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make groundwater management transparent. Any compliance actions will

[283] Hocking, M., Torkzaban, S., Gaal, A., Bold, T., Iverach, C. and Beverly, C. (2020a) Otway groundwater impact assessment – conventional gas development scenarios. Victorian Gas Program Report (in prep).

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	subsequently the level of development. Ground and surface water systems are interrelated and removal from one of the systems can impact on the other. Groundwater is water found underground where it saturates soil and fills spaces in rock. It has an important function in supporting: ► Intermittent stream ecosystems: groundwater helps to sustain intermittent streams which alternate between flowing and non-flowing periods. ► Biodiversity and ecological processes under the streambed: groundwater catchments support their own ecosystems diverse aquatic invertebrates, such as crustaceans, insects, molluscs, water mites and worms. ► Wetlands: groundwater is a key source of water for wetlands which contain a high proportion of endemic species (species which can only survive in a wetland environment). ► Agricultural irrigation and water supplies: There are existing demands on groundwater for irrigation use which is regulated under licensing. Likewise, groundwater is used, and licensed, for stock and domestic supplies.	► the ecosystem's susceptibility to changes in the groundwater regime The rate and magnitude of the change in groundwater availability (higher rates and magnitudes produce more severe impacts on average). Other consequences of reduced access to groundwater include: ► loss of access to groundwater ► reductions in surface water flows ► changes in groundwater quality, due to poorer quality groundwater being drawn into good quality aquifers. In the Otway Basin exploration and development scenarios, volume removed from the nearest aquifer ranges from 81 in the minimum scenario to 660 ML in the high development scenario over the life of the development. To provide context the average ground water irrigation license in South-West Victoria is 100 ML/year and current groundwater extraction for agriculture and town supply within the Otway Basin is 177,000 ML/annum (based on aggregated entitlement and registered bores for domestic use).[285] Given the above, the incremental impact on groundwater removed from aquifers is negligible compared to existing consumption, as such no impact has been assessed for each of the scenarios.	Impacts on groundwater are within scope of both EES assessments where these are required. This assessment will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.		also be published which will give confidence to community that this risk is being robustly managed. There is an opportunity to amend the Petroleum Regulations updated with local groundwater assessment, monitoring and Reporting provisions that would further improve community confidence in this area.

[285] Jacobs (Australia) Pty Ltd (2015). Otway region synthesis Report. [online] State Government Victoria. Available at: https://earthresources.vic.gov.au/__data/assets/pdf_file/0004/456745/O1-Water-science-studies-Otway-synthesis-Report-June-2015.pdf [Accessed 14 Dec. 2019].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		The groundwater impact modelling also showed that impacts on groundwater quantity and quality would be negligible due to the large geological superstation between conventional gas aquifers.[286]			
Volume impact on surface water receptors (ML/year)	Onshore conventional gas development in the Otway Basin necessitates the extraction of ground water from aquifers. The volume of water extracted is related to the amount of gas extracted and subsequently the size of development. Ground and surface water systems are interrelated and removal from one of the systems may impact on the other.	VGP analysis has shown no impact on this measure for all development scenarios. Refer to Table 79.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable) Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as those described in control measures for the volume removed from the nearest WRA (ML)
Groundwater level drawdown greater than 5 m from the nearest WRA (hectares)	Groundwater level drawdown refers to a reduction in the height of the free surface of water above a given point beneath the surface, within the aquifer. As gas developments depressurise gas bearing formations, they can lower pressure in aquifers. As such, there can be a causal relationship between the amount of gas production and the level of drawdown.	VGP analysis has shown no impact on this measure for all development scenarios. Refer to Table 79.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable) Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as those described in control measures for the volume removed from the nearest WRA (ML)
Area of water table drawdown greater than 0.1 m (hectares)	The water table is an underground boundary between the soil surface and the area where groundwater saturates spaces between sediments and cracks in rock[287]. Consideration is given to the	VGP analysis has shown no impact on this measure for all development scenarios. Refer to Table 79.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable)	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as those described in control measures for the volume removed from the nearest WRA (ML)

[286] Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).
[287] Society, N. (2020). *Water Table*. [online] National Geographic Society. Available at: https://www.nationalgeographic.org/encyclopedia/water-table/ [Accessed 11 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	volume impact on the water table as it represents a much wider impact than the localised impact around the wells.		Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.		
Time to initial impact (years) Time to maximum impact (years) Time to recover (years)	The three areas described in this section relate to the timing of the above impacts.	These three measures dictate the timing for which the negative impacts of groundwater extraction will be felt. Table 79 highlights that the impacts associated with all hypothetical scenarios are insignificant.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable) Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Minimum scenario: – Low: – Medium: – High: –	Mitigation measures are the same as those described in control measures for the volume removed from the nearest WRA (ML)

Risk

The analysis has identified the following key risks to ground and surface water with respect to the Otway Basin hypothetical exploration and development scenarios (Table 81):

Table 81: Key risks to ground and surface water

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Groundwater and surface water contamination	Incorrect disposal of waste water could lead to contamination of surface and potentially ground water surrounding a development site.	Contamination of surrounding ground and surface water can negatively impact other users of aquifers which in the case of the Otway development scenarios would predominantly affect the agricultural industry. The GSV found that the potential for impacts on groundwater quality from aquifer depressurisation for gas development was low, based on the predicted changes to groundwater	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable) Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Possible	Minor, given that the EMP provides the regulator the opportunity to make an informed decision which considers all relevant risk areas.	Low	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make groundwater management transparent. Any compliance actions will also be published which will give confidence to community that this risk is being robustly managed.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		pressure gradients being within historical ranges[288]. The potential for impacts on surface water users and ecosystems as a result of reduced stream flow or changes in surface water quality caused by aquifer depressurisation is inferred as low, because the predicted changes to groundwater levels are within historical ranges[289].					There is an opportunity to amend the Petroleum Regulations updated with local groundwater assessment, monitoring and Reporting provisions that would further improve community confidence in this area. This regulatory activity could be supported by the VGP's regional baseline data of groundwater chemistry, dissolved methane and hydrocarbon occurrence so that any future changes in groundwater condition can be identified.
Loss of groundwater supply to users	Aquifer depressurisation may cause reduced aquifer storage volume.	Licenced groundwater users of the Dillwyn aquifer could be impacted by reduced water availability. Loss of groundwater supply for users The GSV found that the potential for impacts on groundwater volume from aquifer depressurisation for gas development was low, based on modelling scenarios[290].	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable) Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Unlikely	Minor, given that the EMP provides the regulator the opportunity to make an informed decision which considers all relevant risk areas.	Low	Mitigation measures are the same as those described in Groundwater and surface contamination

[288] Hocking, M., Torkzaban, S., Gaal, A., Bold, T., Iverach, C. and Beverly, C. (2020a) Otway groundwater impact assessment – conventional gas development scenarios. Victorian Gas Program Report (in prep).
[289] Jacobs (Australia) Pty Ltd (2015). Otway region synthesis Report. [online] State Government Victoria. Available at: https://earthresources.vic.gov.au/__data/assets/pdf_file/0004/456745/O1-Water-science-studies-Otway-synthesis-Report-June-2015.pdf [Accessed 14 Dec. 2019].
[290] Hocking, M., Torkzaban, S., Gaal, A., Bold, T., Iverach, C. and Beverly, C. (2020a) Otway groundwater impact assessment – conventional gas development scenarios. Victorian Gas Program Report (in prep).

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios may affect ground and surface water within the region.

The only measure shown to have an impact on ground and surface water is the volume of water removed from the nearest aquifer resource. The groundwater impact modelling showed that impacts on groundwater quantity and quality would be negligible due to the large geological separation between conventional gas reservoirs and aquifers. Under the current regulatory framework, the removal of water resources must be at an acceptable level to receive development approval.

All scenarios are expected to have no material impact on ground and surface water based on the average rating (Table 82).

The risk of groundwater and surface water contamination was rated as low, as that the EMP must address the risk of potential contamination (Table 83).

Table 82: ENR2: Benefits and impact assessment

Minimum scenario	×××	××	×	–			
Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 83: ENR2: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

4.2.3.3 ENR3: Affected native flora and fauna

What is the impact on flora and fauna at hypothetical exploration and development location and surrounding areas?

Benefits and impacts

No benefits or impacts to native flora and fauna were identified.

Risk

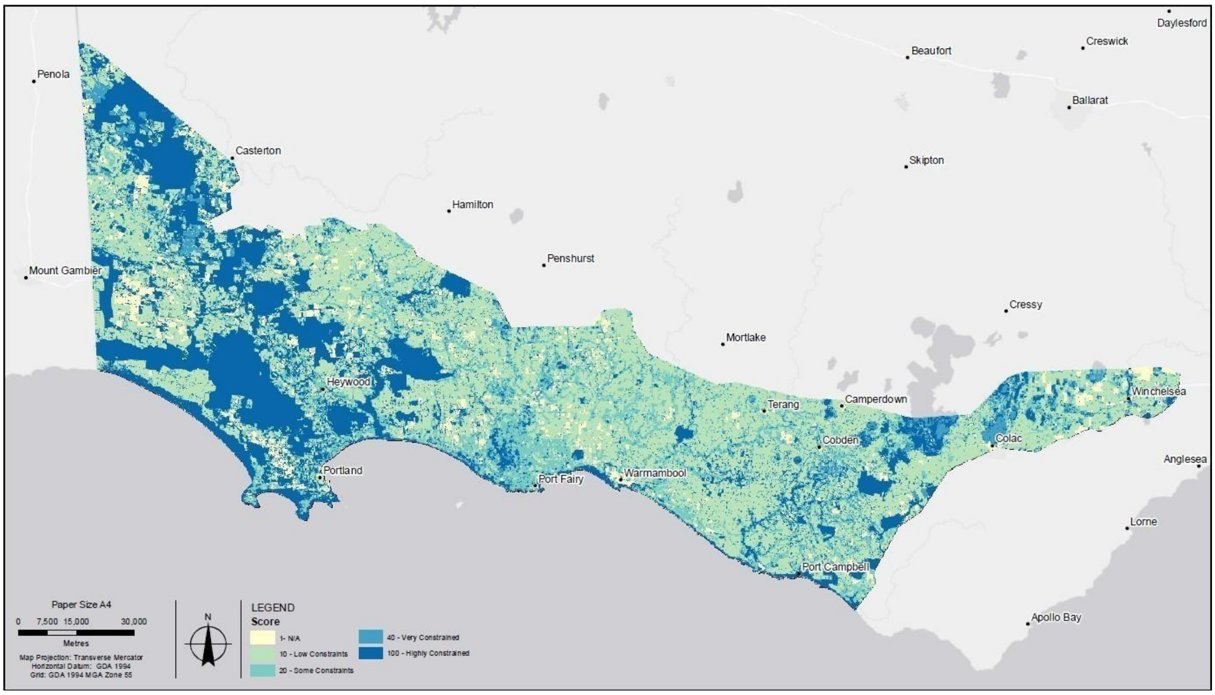
The analysis has identified the following key risks to native flora and fauna with respect to the Otway Basin exploration and development scenarios:

- impact of noise/light on flora and fauna
- removal or destruction of native flora and fauna
- intrusion of invasive weeds, pests or pathogens to the Otway Basin.

The VGP have undertaken resource and land use planning to assess key natural resources, cultural, environmental and existing land use values. The resource and land use planning produced a land use model which identified areas that may be constrained in relation to onshore conventional gas development. If an area was identified as being constrained, this could mean that resource development may not be appropriate in the context of local land values and /or features; or this is an area where features of sensitivity or significance exist that would need to be considered and addressed through the licencing process prior to any development proceeding.

Significant flora and fauna (i.e. areas and species listed as threatened under the EPBC Act and/or the FFG Act was one of four criteria used to assess environmental value constraints within the Otway Basin. Figure 41 highlights areas identified as being constrained in relation to onshore conventional gas development in the Otway Basin in relation to significant flora and fauna. A summary of the resource and land use planning model classifications is listed in Table 84.

Figure 41: Significant Flora and Fauna - Resource and land use planning assessment of values, constraints and opportunities in Otway Basin



Source: Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Otway Basin, Victoria (in prep).

Table 84: Summary of resource and land use planning constraint by land classification in the Otway Basin

Classification	Land Cover (%)
Low Constraints	30
Some Constraints	9
Very Constrained	33
Highly Constrained	8
Extremely Constrained	19

Over a quarter of the land in the Otway Basin has been identified as being extremely or highly constrained in relation to significant flora and fauna. Identification of these areas home to significant flora and fauna can be utilised to minimise impact by avoiding development in extremely constrained areas. Most impacts in areas with other levels of constraint can be mitigated through appropriate siting and design of development. The control measures outlined in Table 85 will mitigate negative impacts by outlining risk management requirements and rehabilitation requirements to bring the land back to its pre-development state. This analysis has been used to inform the risk assessment of affected native flora and fauna in Table 85.

Summary of risks

The assessment of risks to native flora and fauna is summarised in the Table 85.

Table 85: Key risks to native flora and fauna

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Impact of noise/light on flora/ fauna	Native fauna is at risk of being adversely impacted by the light and noise associated with gas exploration, development and operations. During exploration and development, noise comes primarily from transport,	Increased noise and light have the potential to alter the normal behavioural patterns of fauna near well sites and other operational facilities. Noise from drilling and construction are likely to be greater than operations.[291]	The Otway Basin exploration and development hypothetical scenarios are required to comply with a regulatory framework consisting of EMPs, the FFG Act, the EPBC Act, EES process (if relevant), native vegetation clearance regulations and rehabilitation requirements.	Possible[297]	Minor[298]	Low	Possible legislative improvements derived from the VGP gap analysis would include the following: ▶ requirement for enhanced community consultation and

[291] US National Library of Medicine (2018). *Residential noise from nearby oil and gas well construction and drilling.* Available at: https://www.ncbi.nlm.nih.gov/pubmed/29749380 [Accessed 1 Feb. 2020].
[297] Information provided by the department.
[298] Information provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	drilling rigs and vibroseis trucks. This is temporary impact. During operations, there is little to no noise from wells, but there is some low level noise generated from gas plants. This includes the trucks supporting operations.	As such, impacts would be expected to be greater in the short term. This also indicates that greater levels of development will have a greater negative impact as more wells needs to be drilled in the four Otway development scenarios, increasing levels of development will require the creation of new processing facilities, the location of these effect the impact they have. However, it is likely that full-scale plants will be located at industrial centres, which will result in minimal impact on flora and fauna.	EMPs are required for all gas projects. All relevant risks to a project (including those to Flora and Fauna) will be identified in the EMP as well as the control measures that we will be in place, using best practice risk management procedures. [292] The control measures identified will need to be sufficient in their response to the identified risks to ensure risks are mitigated to the point where they are ALARP. EMPs must consider: ► *DELWPs Guidelines for the removal, destruction or lopping of native vegetation* which requires the authority holder to avoid, minimise and offset any destruction of native vegetation[293] (which includes all onshore exploration and development).[294] ► ecological surveys determine the presence of threatened communities or species. This will allow them to be avoided when locating the well lease, which will minimise the impact on them. [295] ► the regulatory framework - currently, there is no identified gap in the planning approvals, regulatory or legislative framework relating to environmental issues.[296] Identification of areas of key natural resources, cultural, environmental and				consideration of community input during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to community that petroleum industry impacts on native flora and fauna are being thoroughly considered and managed. This may influence farmer attitudes towards development and exploration in the region.

[292] This assumes that all legislative and regulatory requirements are adhered to, industry best practice is used in developing the EMPs and that it is updated at each stage of exploration, development and operations. It also assumes environmental risk assessments are conducted at each stage of exploration, development and operations.
[293] DELWP (2017). *Guidelines for the removal, destruction or lopping of native vegetation*
[294] The offset must be calculated to be of equivalent biodiversity value.
[295] For example, selecting farmland instead of remnant native vegetation for well lease and access roads wherever practicable. The surveys will also serve as a baseline to measure any impact on the native flora and fauna, before, during and after exploration and development are complete.
[296] The broad range of legislation and regulatory requirements that natural gas producers are required to comply is considered in section 2.4.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			existing land use values would be utilised to minimise impact by avoiding development in extremely constrained regions. Figure 41 highlights the constraints in Table 84 overlaid over the region map. Projects must also give consideration to native flora and fauna that are threatened (note that gas exploration and development is not specifically listed as a threatening process under the FFG Act or EPBC Act). Offset provisions under the Victorian planning system may be implemented to ensure that any vegetation cleared for a gas development is offset through the protection of currently unprotected native vegetation of equivalent or higher environmental value. A final consideration is that developers are required to rehabilitate areas, such that in the long-term development sites will have no impact on native flora. The extensive legislative requirements pertain to developments of any size and are effective at minimising negative impacts.				The VGP community engagement function will provide information to farmers about the risks benefits and impacts of developments in their locality. Noise and light are typically mitigated using devices such as noise enclosures, light shields, silencers on truck mufflers and reversing beepers, and so forth. Best available technology is generally applied when designing a new gas plant. As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making
Loss of very small areas of native vegetation (and associated fauna habitat)	The Otway and Victorian volcanic plains encompass the proposed development scenario areas for the Port Campbell embayment whilst the Millicent Coast covers the majority of the Penola Trough. These plains have had most of	One risk identified by the VGP was loss of native vegetation and habitat due to clearing for lease pad and/or access road/s.[301] The exact location of the well sites will determine how much native flora is lost due to clearing land for the lease	Impacts to vegetation area and measures to avoid, minimise or mitigate for vegetation losses are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Refer to control measures in the Impact of noise/light on flora/fauna section for more information.	Possible[303]	Minor[304]	Low	As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making

[301] Aventus Consulting, Environmental Risk Assessment 2017 – onshore conventional gas drilling and operations. Unpublished Report.
[303] Information provided by the department.
[304] Information provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	their native vegetation cleared for agricultural purposes.[299] A consequence of the clearing of vegetation is that the land has limited value for native fauna.[300]	pad and or access roads. Any flora cleared is likely to be isolated trees or shrubs in paddocks or within roadside reserves. It is important to note that the actual footprint of a well is small (generally 100 x 100 m, or 1 ha), with the production well drill site being approximately 25 m^2.[302] As such, significant disruption will not occur from the wells themselves but possibly from the construction of pipelines and gas plants. Therefore, greater levels of development that necessitate higher levels of supporting infrastructure will have a greater impact on native flora and fauna. However, these are not expected to be on land with high conservation value.	In addition to the controls described above the EPBC Act establishes a strong framework for protection of the environment and the conservation of biodiversity. It includes a broad range of enforcement mechanisms for managing suspected or identified instances of non-compliance and for reviewing the compliance of referred projects. Under the EPBC Act, gas exploration and development within the Otway Basin may be required to seek approval to proceed if a significant impact is possible to a Matter of National Environmental Significance. A significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. A proponent must consider all of these factors when determining whether an action is likely to have a significant impact on the environment. If a significant impact on flora and fauna was found, then this would be managed and enforced through the EPBC Act.				

299 Vicflora.rbg.vic.gov.au. (2020). Flora of Victoria. [online] Available at: https://vicflora.rbg.vic.gov.au/flora/bioregions/otway-plain [Accessed 1 Feb. 2020].
Vicflora.rbg.vic.gov.au. (2020). Flora of Victoria. [online] Available at: https://vicflora.rbg.vic.gov.au/flora/bioregions/wimmera [Accessed 1 Feb. 2020].
Vicflora.rbg.vic.gov.au. (2020). Flora of Victoria. [online] Available at: https://vicflora.rbg.vic.gov.au/flora/bioregions/victorian-volcanic-plain [Accessed 1 Feb. 2020].

300 SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished Report. p.48.

302 COAG (2018). *Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia*

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Introduction of invasive weeds, pests or pathogens to the Otway Basin	Increased usage and access to gas exploration and development sites during all phases of operation may increase the likelihood of the spread or introduction of weeds, pests or pathogens. This is because the drilling rig, machinery, vehicles and any materials brought onto the drilling site may be carrying weeds.	The introduction of invasive weeds, pests or pathogens may negatively impact both native flora and fauna by resulting in the death of vegetation (and associated fauna habitat) and possible predation on stock. It may also affect agricultural operations (e.g. a reduction in the area of pasture, poisoning from weeds, increased cost of herbicide use) As agriculture is one of the larger industries in the area, this would also have a negative impact on social cohesion.	Impacts of weeds, pests and pathogens and measures to control their introduction and spread are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Refer to control measures in the Impact of noise/light on flora/fauna section for more information.	Possible[305]	Minor[306]	Low	As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making

Overall assessment

The qualitative assessment considered the extent to which the Otway Basin hypothetical exploration and development scenarios could affect native flora and fauna within the region. Key risks have been identified that could affect native flora and fauna. Key risks have been identified that could affect native flora and fauna. Given the low number of wells in all scenarios the impact is expected to minimal for all scenarios. The smal l size of well leases during drilling (typically 1 ha, with a much smaller footprint for operating wells), in addition to the use of existing infrastructure (e.g. aligning pipelines alongside existing pipeline easements) and the addition of a single modular plant in the high development scenario further reduces the overall impact. It is also important to note once developed, the wells will only be there for a certain timeframe, and once the gas has been extracted from the well and the area will be rehabilitated, reducing the long-term impact on flora to nil. As such impacts are only expected to occur in the short to medium term.

As environmental risks are managed on a project-by-project basis, each project will need to have an EMP approved and will need to comply with all relevant regulations and legislation. Therefore, the risk has been assessed as low for all scenarios, as projects would not proceed unless the impacts are determined by ERR to be ALARP (Table 86).

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[305] Information provided by the department.
[306] Information provided by the department.

Table 86: ENR3: Risk assessment

Minimum scenario	Severe	High	Moderate	Low
Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

5. Gippsland scenarios and summary assessment

This section provides a description of the Gippsland Basin hypothetical onshore conventional gas exploration and development scenarios, and a summary of their performance against the assessment framework outlined in Chapter 3.

5.1 Gippsland Basin hypothetical exploration and development scenarios

5.1.1 Overview of Gippsland Basin scenarios

Three hypothetical scenarios have been developed to assess the risks, benefits and impacts of potential onshore gas exploration and development in the Gippsland Basin in Eastern Victoria, if the moratorium were lifted.[1] Three hypothetical levels of development - low, medium and high, have been defined (Table 87). The hypothetical scenarios are based on geological mapping conducted as part of the VGP and have been devised to capture a conservative resource range on the basis that there has been no commercial onshore conventional gas production in the Gippsland Basin.[2] A 'minimum' case scenario has not been prepared for the Gippsland Basin as there has never been any commercial onshore gas production in the region and therefore there is less knowledge of local resources.

In the transition from 'low' to 'high' scenarios, the number of exploration wells and expected discoveries remains unchanged, while the expected total resource discovered size increases. The number of development wells required progressively increases from the low to high scenarios.

A full summary of each hypothetical scenario, based on the descriptions detailed in this section, are provided in Table 87.

Table 87: Summary of Gippsland Basin hypothetical exploration and development scenarios

#	Scenario	Description
1	Gippsland Basin (Low)	► Total estimated discovered resources of 35 Bcf (38 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy exploration wells resulting in seven discoveries ► Nine development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.
2	Gippsland Basin (Medium)	► Total estimated discovered resources of 70 Bcf (77 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy exploration wells resulting in seven discoveries ► Eighteen development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.

[1] Scenario data provided by the department
[2] Earth Resources (2015). *A review of gas prospectivity: Gippsland region*.

#	Scenario	Description
3	Gippsland Basin (High)	► Total estimated discovered resources of 105 Bcf (115 PJ) ► Discoveries in all seven reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, including the Tyers Subgroup ► Exploration and development in the Central onshore region ► Seventy exploration wells resulting in seven discoveries ► Twenty-seven development wells are required, inclusive of the seven discovery wells ► Gas discovered in the Central onshore region is processed using existing facilities and/or a new modular plant.

While there have been no commercial discoveries of conventional gas accumulations in the onshore Gippsland Basin to date, previous studies and VGP modelling indicate that there is some level of prospectivity. Three-dimensional framework modelling commissioned by the GSV for the VGP has confirmed and mapped the presence of seal, reservoir and source rocks across the onshore Gippsland Basin. Preliminary petroleum systems modelling indicates that there are pathways for hydrocarbon migration in the onshore Gippsland Basin.

Discovered resources and the number of development wells for each hypothetical scenario are listed in Table 88. In each scenario, there is projected to be a discovery in each reservoir rock unit. One development well is required per 5 Bcf for the Seaspray Group, and Cobia, Halibut, Golden Beach and Emperor subgroups. For the Strzelecki Group and Tyers Subgroup, extra development wells are required due to the low permeability nature of the formations (1 per 2.5 Bcf).

The geological units listed in Table 88 increase in geological age and, in general, the depth they are found at within the Gippsland Basin. For the Gippsland Basin hypothetical scenarios (low, medium and high), the number of exploration wells[3] and discoveries is static with the difference between the scenarios due to the increasing resource size.

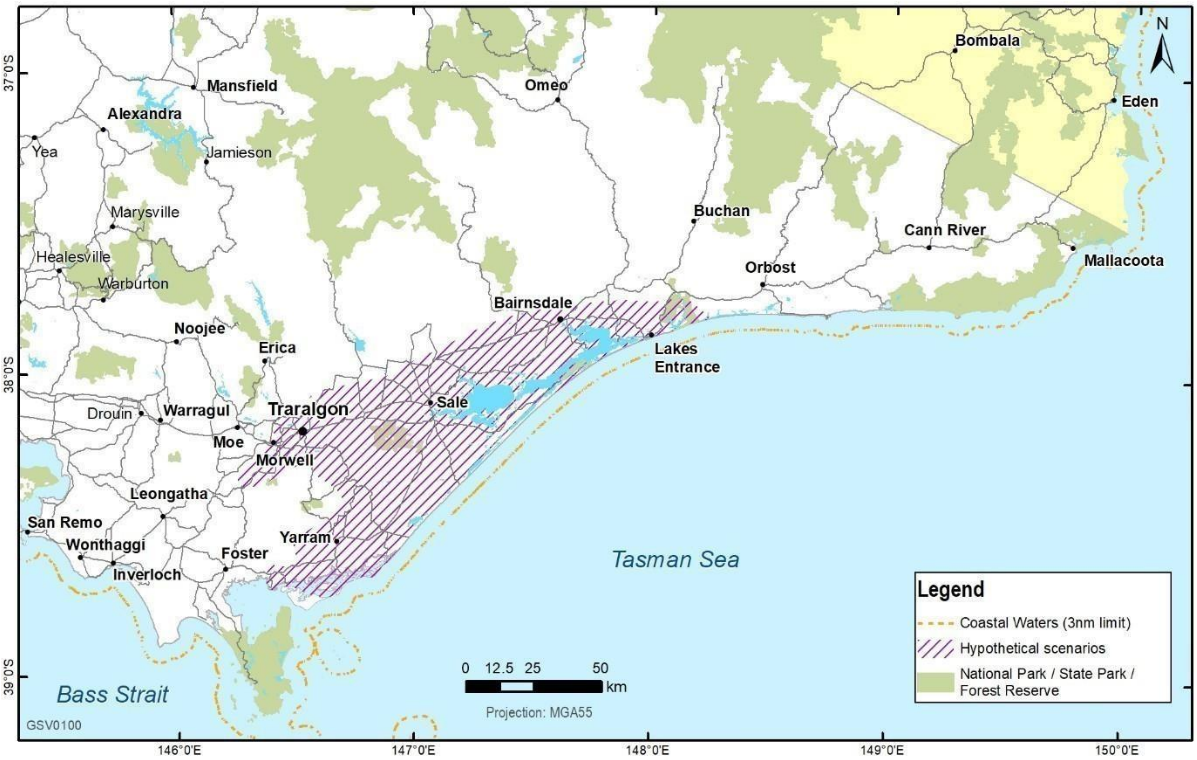
Table 88: Gippsland Basin hypothetical development scenarios – discovered resources and development wells

Reservoir rock unit	Discovered resources (Bcf)			Number of development wells		
	Low	Mid	High	Low	Mid	High
Seaspray Group	5	10	15	1	2	3
Cobia Subgroup	5	10	15	1	2	3
Halibut Subgroup	5	10	15	1	2	3
Golden Beach Subgroup	5	10	15	1	2	3
Emperor Subgroup	5	10	15	1	2	3
Strzelecki Group	5	10	15	2	4	6
Tyers Subgroup	5	10	15	2	4	6
TOTAL	**35**	**70**	**105**	**9**	**18**	**27**

All discovered resources for all reservoir rock units are located within the Central onshore region (Figure 42).

[3] The calculation of exploration wells are as follows: Exploration wells = discovery x 10. This calculation was based on there being no success rate yet from GSV work or wells drilled prior to 1950s/60s.

Figure 42: Gippsland Central onshore region – geographic area for hypothetical low, medium and high exploration and development scenarios



Source: Provided by the department

EY has adopted a series of assumptions for the purposes of economic modelling. In particular, gas production is assumed to occur over a 10-year period with operations commencing in 2023. In addition, gas development is assumed to be relatively consistent across the life of each project and ceases in 2033 as 100 per cent of resources is assumed to have been extracted. Appendix B provides further detail on the assumptions made across the Gippsland hypothetical scenarios and includes a visual representation of when capital expenditure (on new development wells, tie-backs and gas plants) occurs over the lifetime of each development scenario.

5.1.2 Low hypothetical scenario

For the 'low' hypothetical scenario for gas exploration and development, the total discovered resource is defined as 38 PJ (35 Bcf).

In the 'low' scenario, there are projected to be seven discoveries (Table 88), one in each of the reservoir rock units: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, and the Tyers Subgroup. There are expected to be 5 Bcf of discovered resources in each of the above reservoir rock units.

Gas exploration and development is expected to occur in the Central onshore region, and gas discovered in these reservoirs will be processed through a tie-back to existing facilities.

Under a 'low' exploration and development scenario, 70 exploration wells and nine development wells would be required to produce the resources, inclusive of the exploration wells that were drilled to make the discoveries (seven discovery wells). One development well is needed for all of the above-mentioned reservoir units except for Strzelecki Group and Tyers Subgroup, for which two development wells each are needed.

Note, it is anticipated under the hypothetical low scenario that resources would be discovered in the ~~early stages of exploration cons~~istent with other scenarios. Exploration wells would be drilled across a longer timeframe than the medium and high hypothetical scenarios due to the per year drill assumptions associated with a ‘low scenario’ (and consistent with the Otway hypothetical scenarios). Refer to Appendix B for production and drill timelines.

5.1.3 Medium hypothetical scenario

A medium level of hypothetical exploration and development corresponds to a medium level of discovered resource of 77PJ (70 Bcf).

There are estimated to be a total of seven discoveries under this scenario, with discoveries in all seven reservoir rock units identified in Table 88, which are: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, and the Tyers Subgroup. Ten Bcf of discovered resources are projected for each of these reservoir rock units.

As with the ‘low’ scenario, gas discovered in these reservoirs under the ‘medium’ scenario will be processed using existing facilities.

The ‘medium’ scenario requires 18 development wells inclusive of the seven discovery wells, as well as 70 exploration wells in order to produce the estimated discovered resources. This exploration and development will be in the Central onshore region. For each of the above-mentioned reservoir rock units except for Strzelecki Group and Tyers Subgroup, two development wells are needed. For Strzelecki Group and Tyers Subgroup, discoveries have been estimated based on there being four development wells each.

5.1.4 High hypothetical scenario

Exploration and development under the ‘high’ scenario will occur in the Central onshore region. Under this scenario, 70 exploration wells are required, which are expected to result in seven discoveries. These will be in all the aforementioned seven reservoir rock units – see Table 88), namely: the Seaspray Group, Cobia, Halibut Golden Beach and Emperor subgroups (of the Latrobe Group), the Strzelecki Group, and the Tyers Subgroup. Gas produced and developed is expected to be processed in both the existing facilities and through a new modular plant. Analysis has projected additional infrastructure would be required under this scenario, namely one tie-back to the existing plant, one new modular gas plant and one tie-back to the new modular gas plant.

The ‘high’ scenario requires a total of 27 development wells including the seven discovery wells to achieve its total estimated discovered resources of 115 PJ (105 Bcf). 15 Bcf of discovered resources are estimated for each of the seven reservoir rock units. To achieve this, three development wells are required for all of the reservoir rock units other than Strzelecki Group and Tyers Subgroup, for which six development wells are needed.

5.2 Assessment of Gippsland scenarios

5.2.1 Economic impact assessment

5.2.1.1 ER1: Employment

What direct and indirect regional employment numbers and type that will be added?

Benefits and impacts

The analysis has identified potential benefits to employment with respect to the Gippsland Basin exploration and development scenarios. Economic impact analysis was used to assess the extent to which the Gippsland Basin exploration and development scenarios could impact upon employment outcomes both within the region, and more broadly across Victoria.

Table 89 shows that the low, medium and high scenarios are projected to result in employment growth primarily in the Gippsland region. The analysis suggests that there will be some redistribution of labour as a result of the project, with employment expected to be drawn from the rest of Victoria in order to satisfy demand. The high scenario is expected to provide the most significant impact on employment, with just over 890 FTEs projected to be created between 2021/22 and 2034/35, which equates to approximately 68 FTEs a year during this period.

Table 89: Employment impact for the Gippsland Basin hypothetical scenarios

#	Scenario	Region	Direct employment	Indirect employment	Total FTE*	% of local employment	Average Annual FTE*	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	145	210	355	0.02%	21	2021/22	2038/39
		Rest of Victoria			-96		-5		
2	Gippsland Basin (Medium)	Gippsland region	319	300	619	0.05%	48	2021/22	2034/35
		Rest of Victoria			-167		-12		
3	Gippsland Basin (High)	Gippsland region	520	370	890	0.07%	68	2021/22	2034/35
		Rest of Victoria			-231		-16		

*Note: * The total and average FTE figures are measured from the start year to the end year stated for each scenario. The start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. Direct and indirect employment may not add to total FTE may not add due to rounding.*

The project’s impact on employment will vary depending on the scope and level of required expenditure under each scenario (se e Appendix B for assumptions). In addition to the direct employment impacts, which relate to the additional workers that will be directly employed to deliver and implement the proposed program, the project will also result in indirect employment growth across adjacent industries which will be required to help satisfy the demand created by the project.

The assessment of the impact to employment is summarised in Table 90.

Table 90: Key benefits and impacts to employment

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Projected employment growth	The implementation of gas exploration and development in the Gippsland region is expected to increase demand and create additional employment opportunities.	Development and exploration of gas may result in: ► direct employment growth relating to the workers required to undertake the gas exploration and development in the Gippsland region ► indirect employment growth as a result of the demand created by the project, including expenditure from direct employees. As the number of exploration and development sites increases across the hypothetical scenarios, the ongoing expenditure will help to create additional jobs within Gippsland, both in terms of employment directly related to the project as well as indirect employment related to suppliers and induced employment in other industries. As shown in Table 89, direct employment ranges from 145 direct and 210 indirect FTEs in the low case to 520 direct and 370 indirect FTEs in the high development scenario. Average annual FTEs as a percentage of local employment ranges from 0.02 per cent in the low case to 0.07 per cent in the high development scenario. As such no material impact on projected employment is expected in all scenarios.	N/A	Low: - Medium: - High: -	N/A

Risk assessment

No risks were identified for this receptor.

Overall assessment

The assessment found all scenarios are projected to result in employment growth primarily in the Gippsland region, ranging from an estimated annual additional 21 (direct and indirect) FTE under the low scenario to an estimated average annual additional 68 FTE (direct and indirect) under the high scenario. As a share of total employment in the region, the additional employment equates to 0.02 per cent in the low scenario and 0.07 per cent in the high scenario. The analysis also shows that there will be some redistribution of labour as a result of the project, with employment being drawn from the rest of Victoria in order to satisfy demand. The ratings for each scenario have been assessed based on their relative overall impact on employment across Victoria (Table 91).

No risks were identified for this receptor.

Table 91: ER1: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.1.2 ER2: Gross state product

How much value will be added to Victoria?

Benefits and impacts

Economic impact analysis was used to assess the extent to which the Gippsland Basin hypothetical exploration and development scenarios could impact Victoria's overall GSP. Table 92 shows that the low, medium and high scenarios are projected to result in a positive uplift to GSP, with the high scenario is expected to provide to most significant impact, contributing an estimated additional $76.39m annually to Victorian GSP.

Table 92: Gippsland scenario GSP impacts

#	Scenario	Total GSP ($m) *	Average Annual GSP ($m) *	% of GSP	Start year	End year
1	Gippsland Basin (Low)	310.4	18.26	0.00%	2021/22	2038/39
2	Gippsland Basin (Medium)	636.0	48.92	0.01%	2021/22	2034/35
3	Gippsland Basin (High)	993.0	76.39	0.01%	2021/22	2034/35

*Note: * The total and average GSP figures are measured from the start year to the end year stated for each scenario. The start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

The assessment of the impact to Victoria's GSP is summarised in Table 93.

Table 93: Key benefits and impacts to GSP

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Potential uplift to Victoria's GSP	The estimated increased expenditure related to the implementation of gas exploration and development in the Gippsland region is expected to provide additional value to Victoria's economy, above the cost of inputs required to produce related goods and services. This potential increase in net output across the State's economy is expected result in an increase to Victoria's overall GSP.	Expenditure will result in: ► economic growth for Victoria ► increased GSP. As the number of exploration and development sites are assumed to increase, the corresponding increases in expenditure relating to gas production and other investments is expected to provide a boost to Victoria's economy and help to stimulate economic growth across the state.	N/A	Low: – Medium: High:	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		The hypothetical scenarios' impact on GSP is largely proportional to the scale of expected expenditure and investment required in each scenario. Victoria's GSP in 2019 was estimated at $399,009 m, as such incremental GSP ranges from 0.00 per cent to 0.01 per cent (low to high scenario).[4] Given the minor incremental GSP, a neutral or slightly positive impact is expected under all scenarios.			

Overall assessment

The assessment found that the low scenario is expected to have a neutral impact and the medium and high scenarios are projected to result in a potential positive impact. The impact to Victoria's GSP ranges from an average annual additional $18.26 m under the low scenario (an estimated total of $310.4 m over the lifetime of production) to an estimated average annual additional $76.39 m under the high scenario (an estimated total of 0.00 per cent in the low scenario and 0.01 per cent in the high scenario). The ratings for each scenario have been assessed based on their relative overall impact on GSP for Victoria (Table 94).

No risks were identified for this receptor.

Table 94: ER2: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

[4] Parliament.vic.gov.au. (2020). Parliament of Victoria - Victorian Economic Snapshot. [online] Available at: https://www.parliament.vic.gov.au/publications/research-papers/download/36-research-papers/13853-victorian-economic-snapshot [Accessed 11 Feb. 2020].

5.2.1.3 ER3: Gross regional product and gross regional income

How much value will be added to regional areas, including changes to regional income?

Benefits and impacts

Economic impact analysis was used to assess the extent to which the Gippsland Basin exploration and development scenarios could impact upon GRP and GRI within Gippsland and the rest of Victorian regions. GRP measures the value of production in each region and is the equivalent to GDP but at the regional level. GRI is a superior indicator of economic welfare and considers the level of income in a region, rather than the level of production.

While the impact on GRP is largely a reflection of the expenditure spent within the region, there are also flow-on impacts that will result throughout the rest of the economy (Table 95). Therefore, while the majority of expenditure related to each of the scenarios is expected to be spent within the Gippsland region, the indirect impacts are also expected to result in increases in GRP across the rest of Victoria. The analysis suggests high scenario is expected to provide the most significant impact to Gippsland's regional economy, contributing an expected additional $63.37 million each year to the region's GRP, with an expected additional $13.01 million to the rest of Victoria. Similarly, the high scenario is expected to deliver the largest impact on GRI (expected total of $677.30 million or $48.38 million average annual GRI) with an expected additional $108.90 million to the rest of Victoria. Similar to the estimated GRP impact, the GRI figures are expected to increase from the low to high scenarios due to the underlying gas production and investment inputs (see Table 96).

Table 95: Gippsland scenario impact on the GRP

#	Scenario	Region	Total GRP ($m) *^	Average Annual GRP ($m) *^	GRP (% change from base)	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	250.9	14.76	0.07%	2021/22	2038/39
		Rest of Victoria	59.5	3.50	0.00%		
2	Gippsland Basin (Medium)	Gippsland region	522.8	40.21	0.21%	2021/22	2034/35
		Rest of Victoria	113.2	8.71	0.00%		
3	Gippsland Basin (High)	Gippsland region	823.9	63.37	0.33%	2021/22	2034/35
		Rest of Victoria	169.2	13.01	0.00%		

*Note: * The total and average GRP figures are measured from the start year to the end year stated for each scenario. The start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

Table 96: Gippsland scenario impact on GRI

#	Scenario	Region	Total GRI ($m) *^	Average Annual GRI ($m) *^	GRI (% change from base)	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	272.22	16.01	0.06%	2021/22	2038/39
		Rest of Victoria	50.26	2.96	0.00%		
2	Gippsland Basin (Medium)	Gippsland region	680.91	52.38	0.20%	2021/22	2034/35
		Rest of Victoria	117.39	9.03	0.00%		
3	Gippsland Basin (High)	Gippsland region	1085.78	1085.78	0.31%	2021/22	2034/35
		Rest of Victoria	183.20	183.20	0.00%		

*Note: * The total and average GRI figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

The assessment of the impact to Victoria's GRP and GRI is summarised in Table 97.

Table 97: Key benefits and impacts to GRP

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?

Potential uplift to the GRP of the Gippsland region	The estimated increased expenditure related to the implementation of gas exploration and development in the Gippsland region is expected to provide additional value to region's economy, above the cost of inputs required to produce related goods and services. This expected increase in net output within the region's economy is expected to result in an increase to overall GRP.	The potential uplift to GRP and GRI as a result of the hypothetical development scenarios is achieved through: ► increased expenditure within the Gippsland region directly related to the implementation of gas exploration and development ► flow-on impacts throughout the rest of Victoria as a result of the increased expenditure. As the number of exploration and development sites increases, the economic growth that is generated will help to create additional jobs and provide new employment opportunities across the state, both in terms of employment directly related to the project, as well as	N/A	Low:– Medium: High:	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		the indirect (i.e. flow-on) employment required to the increased demand across the economy. As can be seen in the table above, while the impact on GRP is largely a reflection of the expenditure spent within the region, there are also flow-on impacts for the rest of the economy. Therefore, while the majority of expenditure related to each of the scenarios will be spent within the Gippsland region, the indirect impacts are also expected to result in increases in GRP across the rest of Victoria. The analysis suggests that high scenario will provide the most significant impact to Gippsland's regional economy, contributing an estimated additional $63.37 m each year to the region's GRP, with an estimated addition $13.01 m to the rest of Victoria. The nominal GRP in 2018 for the Gippsland region was reported at $16.79B and $16.45B (Real).[5] As such the high case represents an increment to GRP of 0.33 per cent (nominal). Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs. As such the residual benefit is considered to be slightly positive for the medium and high scenarios given that the remaining scenarios have a lesser economic impact. The low scenario is assumed to have a neutral impact.			

[5] App.remplan.com.au. (2020). REMPLAN Online. [online] Available at: https://app.remplan.com.au/southgippsland/economy/trends/gross-regional-product?state=EdLlf8!Xy8jcARoS47M2mHBA0ZwiMFrhAvXsmhmSaSLSjfnEk [Accessed 6 Feb. 2020].

Risk assessment

No risks were identified for this receptor.

Overall assessment

The ratings for each scenario have been assessed as having a neutral impact in the case of the low scenario or a slightly positive impact in the case of the medium and high scenarios. The impact to the Gippsland region's GRP ranges from an estimated average annual additional $14.76 m under the low scenario (a total of $250.9 m over the lifetime of production) to an estimated average annual additional $63.37m under the high scenario (a total of $823.9m over the lifetime of production). Similar to the estimated GRP impact, the GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs, with additional average annual GRI ranging from $12.37 million to $48.38 million. The ratings for each scenario have been assessed based on their relative overall impact on GRP and GRI for the Gippsland region (Table 98).

Table 98: ER3: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.1.4 ER4: Domestic gas supply

What are the flow on economic benefits to users of gas in Victoria?

Benefits and impacts

The analysis has identified the following key benefits and impacts to the domestic gas supply with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- gas supply for direct use in Victoria
- GPG supply in Victoria
- energy security in Victoria.

These impacts are described further below.

Gas supply for direct use in Victoria

Onshore conventional gas exploration and development in the Gippsland region is expected to increase gas supply available for direct use in Victori a. This may lead to an:

- increase in Victoria's overall gas supply by reducing tightening supply situation and reliance on imports
- increase in diversity of gas supply
- increase gas available to industrial users, particularly those located closest to the development.

Increase in Victoria's overall gas supply by reducing tightening supply situation and reliance on imports

Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas.[6] However, due to falling production forecasts from the offshore Gippsland and Otway

[6] Additional Victorian supply is currently used to provide gas to other neighbouring jurisdictions (i.e. New South Wales, South Australia and Tasmania).

basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023. Current forecasts by AEMO suggest that shortfalls are expected from 2024 onwards.[7]

Unless currently uncommitted gas supply projects proceed,[8] Victoria is expected to become a net-importer of gas (e.g. more reliant on gas sources from outside the state, in particular from Queensland). Victoria is also expected to be increasingly reliant on the Iona gas storage facility.[9]

In addition, it is expected that new infrastructure will be required to ensure that gas demand in southern states can be met in 2024 and beyond, particularly as Victorian production continues to decline. At present, maximum physical capacity of gas flow from Queensland to the southern states through existing pipeline infrastructure is 145 PJ/year.[10]

As a result, exploration and development of onshore conventional gas in the Gippsland Basin may provide a positive impact by reducing the tightening gas supply situation in Victoria and reliance on imports from other states, particularly Queensland.

The scale and timing of development are important factors in determining the level of benefit exploration and development could deliver in reducing the tightening gas supply. Figure 43 and Figure 44 highlight the gas production profile and total gas produced over the lifetime of production respectively. The assessment identified that all three hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production under the high and medium scenarios would be higher than in the low scenario.

[7] AEMO (2019). *Gas Statement of Opportunities*.
[8] Further information on potential sources of new supply (excluding new offshore gas developments) is provided in Appendix A (Industry Profile).
[9] AEMO (2019). *Gas Statement of Opportunities*. p.3.
[10] AEMO (2019). *Victorian Gas Planning Report*. p.38.

Figure 43: Gas production profiles – Gippsland low, medium and high scenarios

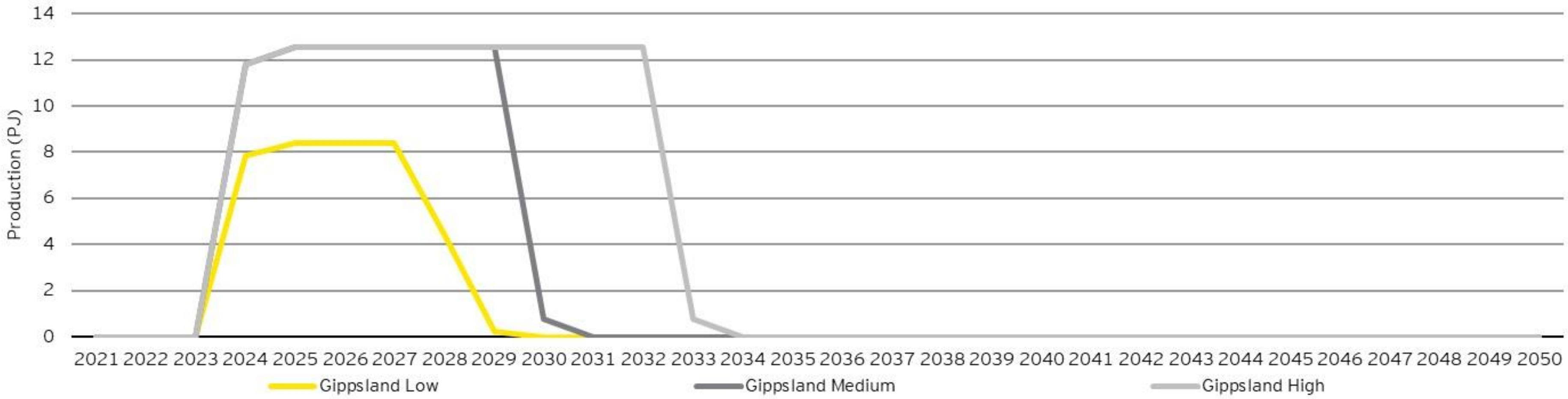


Figure 44: Total gas production – Gippsland low, medium and high scenarios

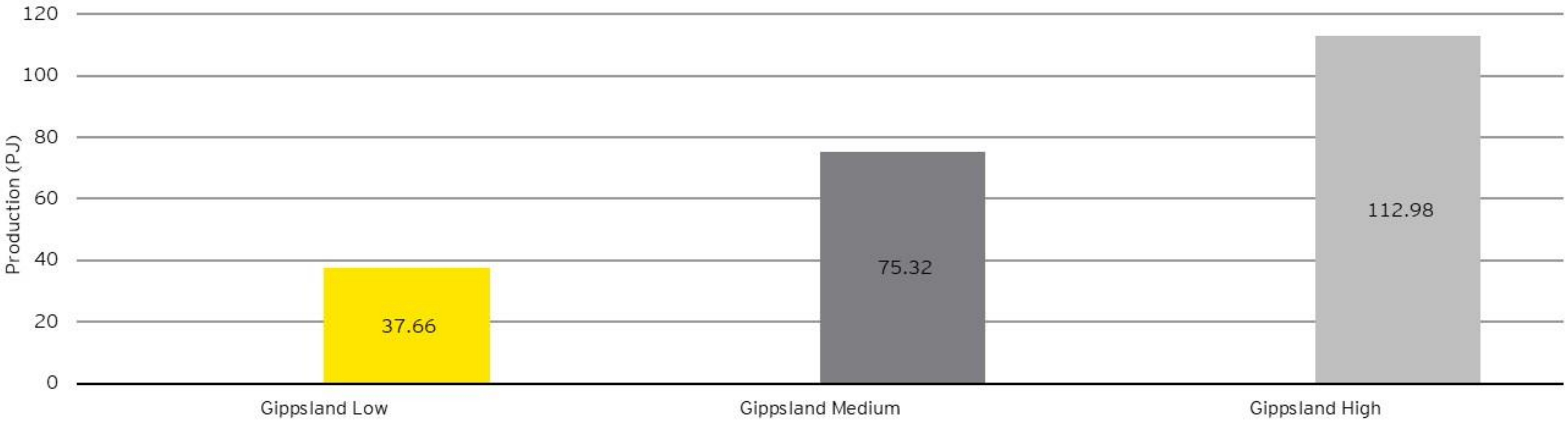


Table 99 compares AEMO's total forecast consumption in 2023 (223 PJ) to assumed annual gas production from the three hypothetical Gippsland exploration and development scenarios in 2024 and 2025.[11] This analysis indicates that the medium and high development scenarios could add an additional 12 PJ of gas supply in 2024 and 13 PJ in 2025 (~5.4 per cent and ~5.8 per cent of forecast Victorian consumption in 2023 respectively).

Table 99: Annual gas production in 2024 and 2025 under the three hypothetical Gippsland scenarios, compared to total forecast Victorian consumption in 2023 (AEMO)

Scenario / Plant	2024		2025	
	Annual gas production (PJ/year)	Annual gas production in 2024 as a percentage of forecast Victorian consumption in 2023	Annual gas production (PJ/year)	Annual gas production as a percentage of forecast Victorian consumption in 2023
Gippsland Basin (Low)	8	3.6%	8	3.6%
Gippsland Basin (Medium)	12	5.4%	13	5.8%
Gippsland Basin (High)	12	5.4%	13	5.8%

Table 100 compare's AEMO's total forecast Victorian production supply in 2023 (246 PJ) to assumed annual gas production from the three hypothetical Gippsland exploration and development scenarios in 2024 and 2025.[12] This analysis indicates that the medium and high development scenario represents ~5.3 per cent of forecast available production supply in 2023 (based on annual gas production in 2025).

Table 100: Annual gas production in 2024 and 2025 under the three hypothetical Gippsland scenarios, compared to total forecast Victorian production supply in 2023

Scenario / Plant	2024		2025	
	Annual gas production (PJ/year)	Annual gas production in 2024 as a percentage of forecast available production supply in 2023	Annual gas production (PJ/year)	Annual gas production in 2025 as a percentage of forecast available production supply in 2023
Gippsland Basin (Low)	8	3.3%	8	3.3%
Gippsland Basin (Medium)	12	4.9%	13	5.3%
Gippsland Basin (High)	12	4.9%	13	5.3%

[11] AEMO (2019). *Victorian Gas Planning Report*. p. 5.
[12] AEMO (2019). *Victorian Gas Planning Report*. p. 5.

It is difficult to assess the impact of the scenarios on Victoria's overall gas supply in the medium to long term as Victorian production and supply adequacy is only forecasted by AEMO over the next five years. However, gas supply is expected to remain tight into the future as forecast supply (including committed gas projects) is projected to be insufficient to meet forecast demand if no further sources of gas or alternative infrastructure are developed.[13]

Based on the high-level analysis, none of the Gippsland scenarios are expected to have a material impact in reducing the tightening gas supply situation in Victoria and reliance on imports from other states in the near term. This is because the maximum annual gas production is less than 6 per cent of Victoria's forecast consumption (Table 99), less than 6 per cent of Victoria's production supply and only active for a limited period (maximum 12 years of production).

Increase in diversity of gas supply

Major supply disruptions can impact gas supply to gas users across the supply chain, disrupting economic and social activity until gas supply can be safely restored. Diversifying gas supply can reduce the likelihood and severity of disruption events, including the costs incurred to industrial, business and residential customers.

Table 101 highlights the nameplate capacity of Victoria's gas processing plans and production, and capacity utilisation in the September quarter of 2019. It indicates that while there are other additional sources, Victoria's gas supply is largely reliant on Longford processing plant in Gippsland which has a nameplate capacity 900 TJ/day more than the next largest Victorian processing plant.

Table 101: Victorian gas processing plants and capacity utilisation, September quarter 2019

Gas processing plant	Nameplate capacity (TJ/day)	Capacity utilisation
Longford	1,115	82%
Otway Gas Project	205	52%
Orbost	80	0%
Minerva	21	235%
Bass Gas	67	32%
Casino	165	23%

Source: AEMO, 2019, Victorian Gas Planning Report p. 4

[13] AEMO (2019). *Gas Statement of Opportunities.* pp.40-41.

Drawing on the information above, Victoria is unlikely to benefit from increased diversity of gas supply as additional gas production and processing plants would also be located in the Gippsland Basin (potentially at Longford processing plant). As a result, none of the scenarios are expected to materially increase the diversity of supply over their timeframe of production.

Increase gas available to industrial users, particularly those located closest to the development

Gas is an essential input for many industrial businesses, and is commonly used to manufacture pulp and paper, metals, chemicals, stone, clay glass and processed foods.[14] In Victoria, industrial users represent 31 per cent of demand and are often located close to gas developments an d related processing plants, enabling them to purchase gas directly from producers (rather than through retail contracts which often include higher transportation costs and a retailer margin). However, gas prices offered to all users (including industrial users) have risen from around $3-4 GJ in 2013 to around $9-10 GJ in 2019 (see analysis of ER4: Gas prices in Section 5.2.1.4 for more information).[15] As a result, industrial business reliant on gas, including some Victorian businesses such as Dow Chemicals, have been forced to close.[16]

Similar to above, the level of level of benefit will be dependent on the size and timing of annual gas production, and abilit y of the industrial user to negotiate a contract with the producer and arrange their own transportation.

As a result, none of the Gippsland scenarios are expected to materially increase gas available to industrial users over their timeframe of production.

Gas peaking generation supply in Victoria

Onshore Conventional gas exploration and development in the Gippsland region is expected to increase gas supply available for peaking generation in Victoria. This may lead to an increase in Victoria's gas supply available for GPG on peak system demand day for the gas system.

Increase in Victoria's gas supply available for GPG on peak system demand day for the gas system

With gas production falling within its five-year outlook period, AEMO has forecast that the available peak day capacity will decrease by 21 per cent between 2019 and 2023. As a result, Victorian gas production available to meet Victorian GPG demand (and supply gas to other states) on a 1-in-20 peak demand day[17] is projected to fall from 596 TJ/day in 2019 to 190 TJ/day. AEMO has stated that:

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[14] AER (2018). *State of the Energy Market.* p. 183.
[15] AER (2019). *State of the Energy Market*.
[16] Toscano, N. and Sakkal, P. (2019). *Altona site to shut: Union sounds jobs alarm on gas crisis.* [online] Available at: https://www.smh.com.au/business/companies/altona-site-to-shut-union-sounds-jobs-alarm-on-gas-crisis- 20190528-p51s2s.html [Accessed 3 Nov. 2019].
[17] A 1-in 2 year peak demand day refers to a maximum demand projection where there is a 5 per cent probability that a forecast gas maximum demand figure will be exceeded. It considers that this projected level of demand is expected, on average, to be exceeded only once in twenty years.

"without additional gas supply capacity, restrictions and curtailment[18] of GPG may be necessary in 2023 on a 1-in-20 year peak system demand day."[19]

Table 102 provides a summary of plant production capacity, pipeline capacity and the remaining supply capacity for GPG demand in 2023 in TJ/day. The DTS potential supply represents the total gas supply available based on total plant capacity and total pipeline capacity. The expected supply is based on forecast 1-in-20 peak demand day and informs the remaining supply capacity gas available for GPG demand.

Table 102: Victorian capacities and expected supply on a 1-in-20 peak demand day, 2023 (TJ/day)

		Total plant capacity	Pipeline capacity	DTS potential supply	Expected supply	Remaining supply capacity
Gippsland		805	1,030	805	740	65
Port Campbell	To Melbourne	562	429	449	449	113
	To WTS		20			
Melbourne	LNS storage	87		87	75	12
Total supply		**1,454**	**1,479**	**1,341**	**1,264**	
1-in-20-year system demand		1,264	1,264	1,264	1,264	
DTS surplus/shortfall quantity (TJ/day)		**190**	**215**	**77**		**190**

Source: AEMO (2019). Victorian Gas Planning Report. p. 41

It is worth noting that the location, timing and size of gas production, transmission constraints and Victorian non-DTS consumption all impact the peak day supply capacity available for GPG.

Onshore conventional gas exploration and development in the Gippsland region is not expected to materially improve forecast available production supply and therefore not expected to materially improve gas supply available for GPG on peak system demand days. As a result, none of the scenarios are expected to materially impact on the availability of gas supply for GPG on peak system demand for the gas system.

Energy security in Victoria

Onshore conventional gas exploration and development in the Gippsland region is expected to increase gas supply available for direct use and peaking generation in Victoria. This may support the energy transition and energy security in Victoria.

[18] The interruption of a customer's supply of gas at the customer's delivery point, which occurs when a system operator intervenes, or an emergency direction is issued.
[19] AEMO (2019). *Victorian Gas Planning Report.*

Supporting the energy transition and energy security in Victoria

The energy transition has raised challenges around energy security. In particular, there has been an increasing interdependency between gas and electricity markets. The NEM is expected to require more flexible sources of generation (such as GPG) to:

- balance against intermittent renewables and maintain security and reliability
- support increased electrification and decarbonisation. This includes opportunities for electrification in the transportation sector (with zero emissions vehicles), space heating and hot water, and the production and export of hydrogen.[20]

Gas continues to be an essential feedstock or heat source into industrial processes (such as the manufacture of plastics, fertilizers, paper, pharmaceuticals and chemicals).[21]

In the short-term gas is enabling the Victorian energy sector to transition away from ageing coal-fired generations, which can be replaced with more sustainable, lower-emissions generation such as GPG and renewable generation such as wind and solar.[22]

The ability of GPG to respond quickly to changes in electricity market supply or demand means it is a particularly flexible source of generation that is able to:

- manage weather events (e.g. drought conditions) and the intermittency of renewable generation
- reduce reliance on ageing coal-fired generators.

In the medium term, gas may help diversify Victoria's energy mix and provide a positive impact on the availability of gas supply to manage changes in electricity market demand and supply and reduce reliance on coal-fired generators and alternative supply sources in the short term. The ability to achieve this is highly dependent on market developments and the level of gas development.

As noted above, the additional production from the Gippsland scenarios is a very small proportion of total gas supply (see Table 100), and even smaller proportion of Australia's electricity and total energy mix. As a result, none of the Gippsland scenarios are expected to have a material impact in supporting the energy transition and energy security in Victoria.

[20] IRENA (2019). *Electrification with renewables: Driving the transformation of energy services.*
[21] At present, the ability for renewable technologies to provide the same heat quality as gas is quite limited.
[22] Department of the Environment and Energy (2017). *Independent review into the future security of the national electricity market: Blueprint for the future.*

Summary of benefits and impacts

The assessment of impacts to the domestic gas supply is summarised in Table 103.

Table 103: Key benefits and impacts to domestic gas supply

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Gas supply for direct use in Victoria	Victoria primarily uses gas directly for residential and commercial applications (typically as a heat source), but also industrial and manufacturing applications (typically as an energy source and feedstock). In this assessment, individual well production profiles were developed based on a typical well production profile and timelines for development. The assessment identified that all four hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained. The level of production would range from 38 PJ in the low scenario to 115 PJ in the high scenario (over the lifetime of production).	An increase in gas supply available for direct use in Victoria may: ► reduce the tightening gas supply situation in Victoria and reliance on imports[23] ► Improve energy security by increasing the diversity of Victoria's gas supply ► increase gas available and the terms of negotiation for industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs and a retailer margin. Gas production from offshore Victoria has typically been more than sufficient to meet direct use demand. In 2018, gas processed in Victoria was 348 PJ and consumption was 220 PJ, resulting in a 128 PJ surplus of gas. However, due to falling production forecasts from the offshore Gippsland and Otway basins, annual supply adequacy is expected to tighten over the next five-years reducing the surplus to 23 PJ in 2023. Current	In 2017 the Australian Government introduced the Australian Domestic Gas Security Mechanism (ADGSM) in response to a forecast gas supply shortfall in the eastern domestic gas market. The ADGSM provides the Government with the ability to restrict LNG exports to secure domestic supply.[24] [25] If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used locally and reduce the tightening supply situation if gas were to be produced under the Gippsland Basin hypothetical scenarios.	Low: – Medium: – High: –	The introduction of domestic prioritisation mechanism (e.g. right of first offer) could require any gas produced from Gippsland Basin scenarios to be offered to Victorian gas users first.[26]

[23] AEMO (2019). *Victorian Gas Planning Report*. p. 3.
[24] Department of Industry, Innovation and Science (2020). *Review of the Australian Domestic Gas Security Mechanism*. p. 3.
[25] A recent review of the ADGSM found that ADGSM has been working effectively to safeguard domestic gas supplies and recommended the ADGSM be retained until its scheduled repeal in 2023. It also recommended amending the ADGSM's guidelines to include referencing the ACCC's LNG netback price series in estimating a potential shortfall.
[26] DJPR has advised that the Victorian Government is seeking advice on the implementation of its policy commitment for gas produced from newly released offshore acreage in Victoria to be first made available to domestic residential and business customers. A similar policy could apply to any new onshore gas development.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		forecasts by AEMO suggest that shortfalls are expected from 2024 onwards. The analysis indicates that none of the Gippsland scenarios are expected to have a material impact in reducing the tightening gas supply situation in Victoria and reliance on imports from other states in the near term. This is because the maximum annual gas production is less than 6 per cent of Victoria's forecast consumption, less than 6 per cent of Victoria's production supply and only active for a limited period (maximum 12 years of production). For example, as highlighted in Table 99, the high development scenario is expected to add an additional 12 PJ of gas supply in 2024 and 13 PJ in 2025 (~5.4% and ~5.8% of forecast Victorian consumption in 2023 respectively). In addition, Victoria is unlikely to benefit from increased diversity of gas supply as additional gas production and processing plants would also be located in the Gippsland Basin (potentially at the Longford processing plant).			
GPG supply in Victoria	GPG units are typically operated as peaking stations during times of high electricity demand (e.g. in Victoria across the summer and winter peaks) or during generator outages.	An increase in gas supply for GPG in Victoria may: ► improve availability of GPG on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of GPG may be necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day Victorian gas supply has typically been sufficient to meet GPG demand, however this has been tested in the past particularly on a 1-in-2 year peak system demand day for the gas system where	Similar to the above, the ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used locally if gas were to be produced under the Gippsland Basin hypothetical scenarios.	Low: – Medium: – High: –	Mitigation measures are the same as described in Gas supply for direct use in Victoria.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		there is both system demand and winter GPG demand.[27] With gas production falling over the five year outlook period, AEMO has forecast that without additional gas supply, capacity restrictions and curtailment of GPG may be necessary in 2023 on a 1-in-20 year peak system demand day for the gas system. This could result in an interruption of supply for electricity users. Onshore conventional gas exploration and development in the Gippsland region is not expected to materially improve forecast available production supply and therefore not expected to materially improve the gas supply available for GPG on peak system demand days. As a result, none of the scenarios are expected to materially impact on the availability of gas supply for GPG on peak system demand for the gas system.			
Energy security in Victoria	Gas has an essential role as both a fuel source itself, and as an input into electricity generation. In particular, gas is expected to be an important bridging fuel to support the energy transition currently underway across Australia. The NEM is expected to require more flexible sources of generation (such as GPG) to balance intermittent renewables, manage weather events, maintain security and reliability, and support increased electrification and decarbonisation.	Additional supply for both direct use and GPG may provide an: ► improvement in the amount of gas available for uses such as a transition fuel. As noted above, the additional production from the hypothetical Gippsland scenarios is a very small proportion of total gas supply (see Table 99), and even smaller proportion of Australia's electricity mix and total energy mix. As a result, none of the Gippsland scenarios are expected to have a material impact in supporting the energy transition and energy security in Victoria.	Similar to the above, the ADGSM provides the Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood that gas will be used for both direct use and GPG locally if gas were to be produced under the Gippsland Basin hypothetical scenarios.	Low: – Medium: – High: –	Mitigation measures are the same as described in Gas supply for direct use in Victoria.

[27] A 1-in 2-year peak demand day refers to a maximum demand projection where there is a 50 per cent probability that a forecast gas maximum demand figure will be exceeded. It considers that this projected level of demand is expected, on average, to be exceeded only once in two years.

Risk

The analysis did not identify any risks to domestic gas supply with respect to the Gippsland Basin exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect gas supply. The scale and timing of development were considered important factors in determining the level of benefit exploration and development could deliver with respect to Victoria's gas supply, as were supply and demand dynamics. The assessment identified that all three hypothetical scenarios could begin producing in the 2023-24 financial year if discoveries were made that were considered commercially viable and the necessary regulatory approvals were gained.

The Gippsland hypothetical scenarios could add up to an estimated 12 PJ of gas supply in 2024 and 13 PJ in 2025 (~5.4 per cen t and ~5.8 per cent of forecast Victorian consumption in 2023 respectively). However, this amount of gas produced is not expected to have a material impact on Victoria's gas supply. This is because annual gas production is a small proportion of total forecast Victorian supply (e.g. a maximum of les s than 6 per cent of Victoria's forecast consumption, less than 6 per cent of Victoria's production supply and only active for a limited period (12 years of production).

As such, the estimated amount of gas that could be produced under all Gippsland hypothetical scenarios would be insufficient to materially:

- reduce the tightening gas supply situation in Victoria, as annual gas production represents a maximum of less than 6 per cent of Victoria's forecast consumption, less than 6 per cent of Victoria's production supply and only active for a limited period (maximum ten years of production)

- improve energy security by increasing the diversity of Victoria's supply (which is largely sourced from Longford processing plant), as additional gas production and processing plants would also be located in the Gippsland Basin (potentially at the Longford processing plant)

- improve the availability of gas supply for GPG on peak system demand days (as without additional gas supply capacity, restrictions and curtailment of GPG may be necessary in 2023 (and beyond) on a 1-in-20 year peak system demand day).

- improve the amount of gas available for uses such as a transition fuel.

However, the Gippsland scenarios could:

- increase gas available and the terms of negotiation for industrial users (who are expected to see the greatest benefit as they would likely have opportunities to purchase gas directly from producers rather than through retail contracts which often include higher transportation costs and a retailer margin).

Table 104: ER4: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.1.5 ER5: Gas prices

What are the price impacts of increased gas supply (i.e. will gas or electricity prices decrease)?

Benefits and impacts

The analysis assessed the following key benefits and impacts to gas prices with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- price of gas in Victoria
- wholesale electricity market prices in Victoria.

These impacts are described further below.

Price of gas in Victoria

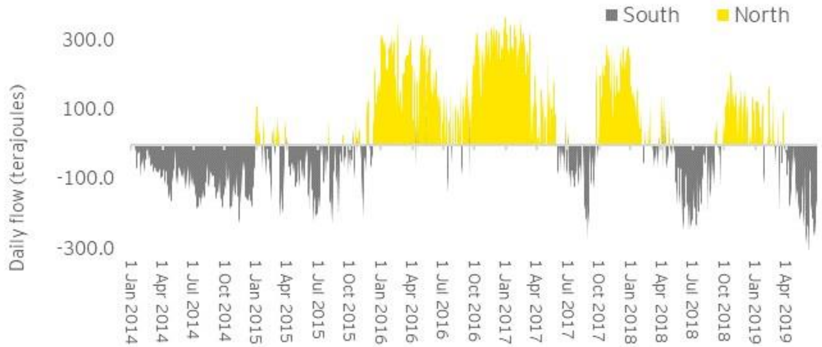
Reduction in the price of gas for Victorians

In 2014, the commencement of LNG exports from Gladstone materially changed the demand and supply dynamic of the domestic gas market in eastern Australia by significantly reducing the amount of gas available for domestic use, tying the domestic market to the international market and increasing reliance on interregional gas trades to manage supply-demand balance.[28]

Figure 45 provides evidence of the latter, illustrating how demand during the winter peak drives southbound gas flow from Queensland to the Southern States (i.e. Victoria, NSW and South Australia), while shortfalls reserves to meet LNG exports drivers northbound gas flow fr om Victoria and South Australia drives northbound gas flow to Queensland.

[28] Australia's largest basin, with almost 90 per cent of all gas reserves, was converted from supplying direct use gas for the domestic market to LNG exports for the international market. In the 12 months to June 2019, LNG exports consumption was 1302 PJ compared to 833 PJ for domestic gas consumption across the east coast market (i.e. 61 per cent of total consumption).

Figure 45: North-south gas flows in eastern Australia[29]



Source: AER (2019). State of the Energy Market.

As a result of LNG exports, wholesale gas prices across the domestic market have more than doubled. In Victoria, the average prices rose from around $3-4 GJ in 2013 to around $9-10 GJ in 2019.[30] Wholesale gas prices have been closely aligned to the LNG netback price, which estimates the export parity price a domestic gas producer would expect to receive from exporting its gas rather than selling it domestically.[31]

These wholesale price increases have also resulted in increased retail gas prices for small consumers. Since 2012, retail gas prices have increased quicker the Consumer Price Index, leading to significant cost increase for consumers and industrial gas users.[32]

The assessment of this receptor considers the extent to which exploration and development of conventional gas in the Gippsland Basin could improve gas price outcomes for Victorians. In order to consider this benefit, the assessment draws on the ACCC's bargaining framework to analyse pricing outcomes in the southern states. A summary of this framework is provided below.

[29] Flows are from the QSN Link section of South West Queensland Pipeline.
[30] AER (2019). *State of the Energy Market*.
[31] Further information on price trends in the east coast gas market is provided in Appendix A (Industry Profile).
[32] ACCC (2019). *Gas inquiry 2017-2020 Interim Report*.

ACCC's bargaining framework

Due to the cost of transportation between the southern states and Queensland, the ACCC has identified that while there is a range of possible pricing outcomes in gas supply negotiation, it would usually be expected fall between:

- **The buyer alternative (ceiling price):** in a well-functioning market, this represents the highest price that Queensland producers would be offered by southern states when users are unable to reach agreement for gas supply with a southern supplier. It is expected that this price would reflect the LNG netback price plus transportation costs (with a higher price for the further away the gas user is from Queensland).
- **The seller alternative (floor price)**: in a well-functioning market this presents the lowest price that a producer would be offered by southern states and is dependent on sufficient supply and diversity of suppliers in the southern states increasing competition. It is expected that this price would reflect the LNG netback price less transportation costs or the cost of production (whichever is higher).

By taking into account pricing dynamics of the southern states in the ACCC's bargaining framework, the assessment found that while new gas resources developed in Victoria are likely to be supplied to domestic customers (due to reduced transportation costs), the hypothetical Gippsland Basin exploration and development scenarios are unlikely to reduce the price of gas for Victorians.

This is because the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for Victorian gas users. Victoria is expected to remain reliant on Queensland suppliers during the winter peak (noting this is when the gas price ceiling would be set), and therefore prices will continue to be set largely by the LNG netback price.

This conclusion is consistent with AEMO's wholesale gas price forecasts which anticipate wholesale gas prices to remain around their current levels in the short term and potentially increase in the medium to long term.[33]

As a result, none of the Gippsland Basin hypothetical exploration and development scenarios are expected to have a material impact on gas prices in Victoria.

Wholesale electricity market prices in Victoria

Reduction in average wholesale electricity prices in Victoria.

There has been an increasing interdependency between gas and electricity markets. GPG has increasingly taken on a price setting role across the NEM. For example, in Q3 2019 GPG was the price setter 32.9 per cent of the time in Victoria at an estimated average price of $90 MWh.[34]

Changing market conditions (notably the closure of coal-fired generation) have resulted in an increase in wholesale electricity prices across the NEM. In Victoria, between 2014-15 and 2018-19, volume weighted average spot prices rose from less than $40 MWh to more than $120 MWh.[35]

[33] AEMO (2019). *Gas Statement of Opportunities*.
[34] AER (2019). *Quarterly price setter and average price set by fuel source – Victoria*.
[35] AER (2019). *State of the Energy Market*.

There is therefore a question around whether the Gippsland Basin scenarios could reduce the average price that GPG bids into the wholesale electricity market and therefore reduce average wholesale electricity prices in Victoria (when GPG is the price setter).

The assessment found that the hypothetical Gippsland Basin exploration and development scenarios are unlikely to reduce the wholesale price of electricity for Victorians. This is because:

- the level of gas development is not expected to change gas supply or prices, which are primary input cost for GPG and impacts the price at which GPG bids in the market
- average wholesale electricity prices in Victoria are being driven by much larger market developments such changes in overall generation reserves (i.e. speed at which existing generation is replaced by increased investment in renewable generation and interconnection) and changes in demand patterns such as increases in distributed energy resources (e.g. rooftop solar and batteries).[36]

As a result, none of the Gippsland Basin hypothetical exploration and development scenarios are expected to have a material impact on average wholesale electricity prices in Victoria regardless of the timeframe or level of development.

Summary of benefits and impacts

The assessment of impacts to gas prices is summarised in Table 105.

Table 105: Key benefits and impacts to gas prices

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Price of gas in Victoria	Increased supply of gas has the potential to change supply and demand dynamics and improve gas price outcomes for Victorians. For example, an increase in gas supply or diversity of suppliers in Victoria has the potential to increase competition for residential, commercial and industrial gas users.	A potential consequence of an increase in gas supply is a: ► reduction in the price of gas for Victorians. Since the commencement of LNG exports in 2014, wholesale gas prices across the domestic market have more than doubled. In Victoria, average gas prices rose from around $3-4 GJ in 2013 to around $9-10 GJ in 2019.[37] This analysis applies the ACCC's bargaining framework to analyse	The ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria's gas supply tightens), it is expected to increase the likelihood of gas being used locally if gas were to be produced under the Gippsland Basin scenarios. However, given the development scenarios are not expected to materially change the level of supply or diversity of suppliers in Victoria, the	Low: – Medium: – High: –	N/A

[36] Nelson, T. (2017). Electricity market design in a decarbonised energy system. *IAEE Energy Forum,* pp.29-32.

[37] AER (2019). *State of the Energy Market*.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		potential pricing outcomes from the Gippsland Basin development scenarios. It found that the development scenarios are unlikely to have a material impact on the gas price receptor regardless of the timeframe or level of development. This is because the level of gas development under the scenarios is unlikely to materially change diversity of suppliers (or level of supply) in Victoria to the extent that it increases competition for Victorian gas users. Acknowledging that there are uncertainties around how the market would react and develop gas under the Gippsland scenarios, Victoria is expected to remain reliant on Queensland suppliers and prices will continue to be set largely by the LNG netback price. As a result, none of the scenarios are expected to have a material impact on gas prices in Victoria.	ADGSM is unlikely to alter residual impact ratings. The Victorian government has no regulatory levers to influence price of gas.		
Wholesale electricity market prices in Victoria	There has been an increasing interdependency between gas and electricity markets. GPG has increasingly taken on a price setting role across the NEM. There is therefore a question around the extent to which the Gippsland scenarios could reduce the average price which GPG bids into the wholesale electricity market and therefore reduce average wholesale electricity prices in Victoria (when GPG is the price setter).	A potential consequence of an increase in gas supply is a: ► reduction in average wholesale electricity prices in Victoria. The assessment found that the level of gas development is not expected to change gas supply or prices, which are a primary input cost for GPG (and impacts the price at which GPG bids into the market). In addition, average wholesale electricity prices are driven by much larger market developments such as changes in overall generation and demand patterns. As a result, none of the Gippsland Basin development scenarios are expected to have a material impact on average wholesale electricity prices in Victoria.	The ADGSM provides the Australian Government with the ability to restrict LNG exports to secure domestic supply. If the ADGSM was enacted (as may be the case as Victoria’s gas supply tightens), it is expected to increase the likelihood of gas being used locally and increasing Victoria’s gas supply available for GPG on peak system demand if gas were to be produced under the Gippsland Basin scenarios. The Victorian government has no regulatory levers to influence price of GPG.	Low: – Medium: – High: –	N/A

Risk

The analysis did not identify any risks to gas prices with respect to the Gippsland Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could improve gas and electricity price outcomes for Victorians.

In the case of gas prices, the assessment found that the level of gas development under the scenarios is unlikely to materially change the level or diversity of suppliers in Victoria to the extent that it increases competition for gas users. As a result, it was unlikely to reduce the price of gas for Victorians and prices will continue to be set largely by the LNG netback price.

A similar conclusion was reached with respect to wholesale electricity prices. The assessment found that the hypothetical gas development scenarios were unlikely to reduce wholesale gas prices because the level of gas development is not expected to change gas supply or prices, which are primary input cost for GPG and impacts the price at which GPG bids in the market.

Therefore, based on the analysis, all three Gippsland Basin hypothetical exploration and development scenarios are expected to have no material impact on the gas price receptor regardless of the timeframe or level of development (see Table 106).[38]

Table 106: ER5: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

[38] Similar to the gas supply receptor, given the impact of the hypothetical scenarios on the gas prices receptor is expected to be minimal, it was decided not to conduct an energy market modelling exercise as part of the assessment. Nonetheless, it is acknowledged that energy market modelling would be necessary to validate its assessment of this receptor.

5.2.1.6 ER6: Government revenue

What are the flow on economic benefits to government through taxation and royalties?

Benefits and impacts

This analysis has identified the following key benefits and impacts to government revenue with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- royalties
- company taxation (including income tax, land tax, payroll tax and rates).

These benefits are described further below.

Royalties

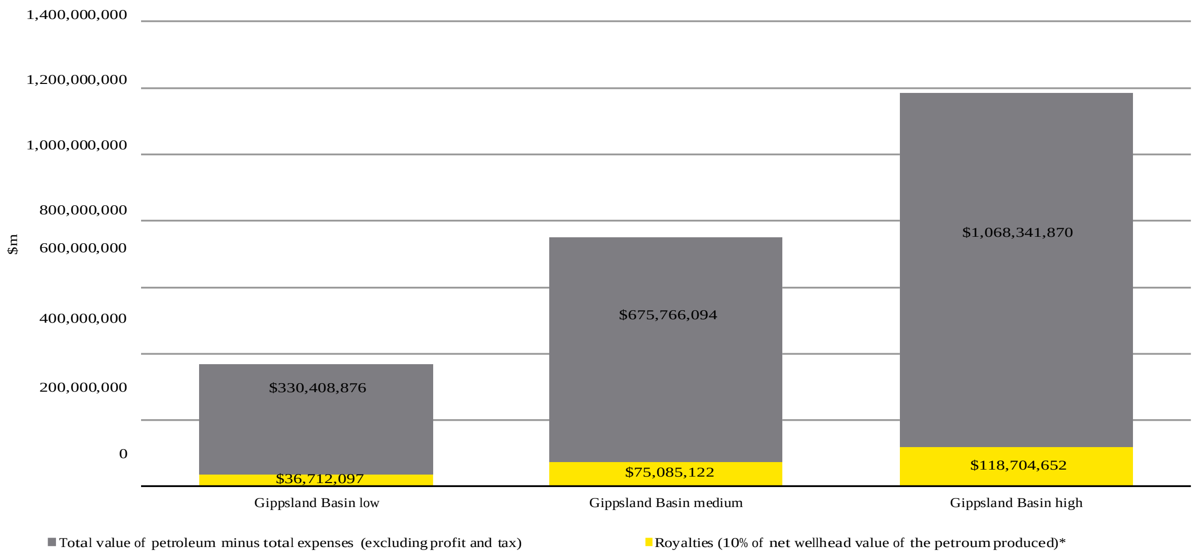
Onshore conventional gas exploration and development in the Gippsland Basin is expected to increase royalties from production. This will lead to an increase in Victoria's royalties obtained from onshore conventional gas production.

Increase in Victoria's royalties obtained from onshore conventional gas production.

The Petroleum Regulation Framework sets out the requirement for holders of a production licence to pay royalties on onshore petroleum production. Royalties are paid to government as a resource rent for the exploitation of a state-owned resource. The rate of royalty is normally set at 10 per cent of the net wellhead value of the petroleum produced by holders of a production licence and paid every six months.[39]

The total value of royalties over the lifetime of each Gippsland Basin hypothetical exploration and development scenario was estimated as part of this assessment. Figure 46 shows the total royalties for each scenario over the lifetime of its production as a proportion of the year on year net-value of the petroleum at the well-head. The net-value of petroleum at the well-head is the value of petroleum produced less all expenses incurred (e.g. recovery and extraction, transportation and tax expenses).

Figure 46: Total value of royalties for each scenario as a proportion of net value of petroleum at the well-head



[39] It is noted that the rate of royalty and time of payment of royalties may also be specified in a production licence provided all requirements outlined in the Petroleum Act and regulations have been met. This includes requirements for the relevant Minister to consult the Treasurer before varying the royalty rate or providing a different method of collecting revenue.

Table 107 illustrates annual average royalties over the lifetime of production from the Gippsland exploration and development scenarios as a percentage of the current royalties payable to the Victorian Government from extractive, minerals, petroleum and coal industries.

Table 107: Annual average royalties as a percentage of current royalties payable to the Victorian Government

Scenario	Annual average royalties ($m)	Annual average roya percentage of annua Government from ex industries
Gippsland Basin (Low)	6.1	6.3%
Gippsland Basin (Medium)	10.7	11.1%
Gippsland Basin (High)	11.9	12.3%

Source: Earth Resources Regulation. (2020. 2018-19 Annual Statistical Report. [online] Available at: https://earthresources.vic.gov.au/legislation-and-regulations/regulator-performance-reporting/annual-statistical-reports {Accessed 12 February 2020]

This analysis indicates that the level of potential benefit from royalties is directly linked to the level and timing of production, and current royalties payable to the Victorian Government. In the case of the Gippsland scenarios, the level and timing of production, and percentage of annual royalties payable are considered reasonably similar. For example, the low scenario is expected to provide ~$6.1m in annual average royalties over the lifetime of production which is only six years (2024 to 2029) and represents 6.3 per cent of annual royalties. While in the high development scenario annual average royalties are expected to reach ~$11.9m per year over the lifetime of production which is spread over 10 years (from 2024 to 2033) and represents 11.9 per cent of annual royalties. Therefore, all three Gippsland scenarios are expected to provide a slightly positive impact with respect to royalties obtained from onshore gas production.

Company taxation (including income tax, land tax, payroll tax and rates)

Onshore conventional gas exploration and development in the Gippsland region is expected to increase company taxation. This will lead to an increase company taxation from Victorian onshore gas producers.

Increase in company taxation from Victorian onshore gas producers

Businesses conducting economic activity in Australia results in direct taxable income and indirect taxation streams such as land tax, payroll tax and council rates. These requirements are established under a variety of legislation set at the federal, state and local level.

The applicability of various tax forms, and the amount of company taxation payable is dependent on many factors including, but not limited to:

- the size of production (and therefore revenue)
- the characteristics of the business (e.g. corporate structure, location of parent firm)
- use of allowable deductions (e.g. exploration and prospecting expenditure and capital expenditure).[40]

For these reasons it is difficult to accurately estimate the level of tax payable by onshore gas producers under the Gippsland Basin hypothetical exploration and development scenarios.

[40] Earth Resources. (2020). *Tariffs and customs*. [online] Available at: https://earthresources.vic.gov.au/licensing-approvals/oil-and-gas-permits-leases-and-licences/tariffs-and-customs [Accessed 2 Feb. 2020].

Having said this, it is expected that most of the company taxation streams would be applicable, with annual taxes increasing consistent with the level of capital expenditure and production over the exploration and development period of each scenario. As a result, oil and gas producers are expected to begin paying company taxation related to all scenarios in 2022. Tax revenue is dependent on the various tax regime that may be applicable in the future. Taxation revenue is expected to cease soon after the end of each scenario's development period (i.e. 2029 in the low scenario, 2030 2031 in the medium scenario and 2033 in the high scenario).
Company taxation is expected to provide less government revenue than royalties.

Based on this analysis, all three scenarios are only expected to provide a slightly positive impact in increasing company taxation.

Summary of benefits and impacts

The assessment of impacts to government revenue is summarised in Table 108.

Table 108: Key benefits and impacts to government revenue

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Royalties	The government allocates petroleum rights to private companies to derive benefits from State-owned resources. This ensures Victoria receives an adequate return on the use of the State's natural resources. Benefits are captured through royalties levied on onshore gas production and collected by the State (via ERR). The royalty is normally set at 10 per cent of the net wellhead value of the petroleum produced by holders of a production licence and paid every six months.[41]	The consequence of obtaining royalties from gas production is an: ► increase in Victoria's royalties obtained from onshore gas production. The level of benefit is directly linked to the level and timing of production. The total value of royalties over the lifetime of each Gippsland Basin exploration and development scenario was estimated as part of this assessment.[42] This analysis indicates that the level of benefit from royalties is directly linked to the level and timing of production, and current royalties payable to the Victorian Government. In the case of the Gippsland scenarios, the level and timing of production, and percentage of annual royalties payable are considered reasonably similar. For example, the low scenario is expected to provide ~$6.1m in annual average royalties over the lifetime of production which is only six years (2024 to 2029) and represents 6.3 per cent of annual royalties. While in the high development scenario annual average royalties are expected to reach ~$11.9m per year over the lifetime of production which is spread over 10 years	The Petroleum Regulation Framework sets out the requirement for holders of a production licence to pay royalties on onshore petroleum production. As a result, the benefits provided by royalties are dependent on the legislative control being in place, and adequate capacity and capability from ERR to enforce royalty requirements.	Low: Medium: High:	N/A

[41] The rate of royalty and time of payment of royalties may also be specified in a production licence provided all requirements outlined in the Petroleum Act and regulations have been met. This includes requirements for the relevant Minister to consult the Treasurer before varying the royalty rate or providing a different method of collecting revenue.
[42] Note, it has been assumed the Gippsland Basin hypothetical scenarios do not include any circumstances in which a royalty is not payable, no penalties for late payment, and that the regulator has the capacity and capability to collect all due royalties.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		(from 2024 to 2033) and represents 11.9 per cent of annual royalties. Therefore, all three Gippsland scenarios are expected to provide a slightly positive impact with respect to royalties obtained from onshore gas production. It is worth noting that royalties are only payable during each scenario's production period.			
Company taxation (including income tax, land tax, payroll tax and rates)	Businesses conducting economic activity in Australia results in direct taxable income and indirect taxation streams such as land tax, payroll tax and council rates. Company taxation is generally paid on an annual basis to either Federal, State or Local Government's depending on the specific tax applicable.	The consequence of company taxation is an: ► increase in company taxation from Victorian onshore gas producers. The applicability of various tax forms, and the amount of company taxation payable is dependent on many factors including, but not limited to the size of the production, business characteristics, and deductions. As a result, it is difficult to accurately estimate the level of tax payable by onshore gas producers under the Gippsland Basin development scenarios. Having said this, it is expected that most of the company taxation streams would be applicable, with annual taxes increasing consistent with the level of capital expenditure and production over the exploration and development period of each scenario. As a result, government is expected to begin receiving company taxation in 2024, with tax payments ending as early as 2029 in the low scenario, 2030 in the medium scenario and 2033 in the high scenario. Company taxation is expected to provide less government revenue than royalties.	Company taxation is based on a variety of legislation set at the federal, state and local level. For example, income tax is set by the Australian Government, while land tax and payroll tax are a State tax. Rates are set by local councils. Similar to royalties, the benefits provided by company taxation are dependent on this legislation and adequate capacity and capability from responsible bodies to enforce company tax requirements.	Low: Medium: High:	N/A

Risk

The analysis has not identified any risks to government revenue with respect to the Gippsland Basin exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could affect government revenue. It identified that the Gippsland scenarios could increase royalties obtained from onshore gas production by the Victorian Government. The level of benefit from royalties is directly linked to the level and timing of production, and current royalties payable from extractive, minerals, petroleum and coal industries. For example, the low scenario is estimated to provide ~$6.1 million in annual average royalties over the lifetime of production which is only six years (2024 to 2029) and represents 6.3 per cent of annual royalties. By contrast, the high development scenario is estimated to provide the greatest level of potential benefit with annual average royalties are estimated to reach ~$11.9 million per year over the lifetime of production which is spread over 10 years (from 2024 to 2033) and represents 11.9 per cent of annual royalties.

The assessment also identified the hypothetical scenarios are expected to provide a slightly positive benefit on government revenue through company taxation from Victorian onshore gas producers. It was acknowledged that the applicability of various tax forms, and the amount of company taxation payable is dependent on many factors and therefore difficult to quantify.

Based on this analysis, the impact of each scenario on government revenue is linked to the to the level and timing of production, as both these factors materially influence revenue from royalties and company taxation.

Table 109: ER6: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.2 Social impact assessment

5.2.2.1 SR1: Community health, safety and security

What level of impact on the community's health, safety and security will gas development have?

Benefits and impacts

The analysis has identified the following key benefits and impacts to community health, safety and security with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- visible flaring from site
- noise and vibration from operations / exploration
- dust generation.

Summary of benefits and impacts

The assessment of impacts to the community health, safety and security is summarised in Table 110.

Table 110: Key benefits and impacts to community health, safety and security

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Visible flaring from site	As part of the well appraisal process, gas flaring is used to determine the volume, pressure, flow rate and composition of the gas from the well prior to it coming into production.[43] Flaring at the well site can last for several days, until the flow of liquids and gas from the well are stabilised. At gas plants, flaring is usually intermittent and only undertaken during process upsets (to safely purge the plant of gas), to burn the components of gas	Visible flaring from site may reduce visual amenity in the immediate area of the well site.	Flaring is within scope of an EMP and must be reduced to a level that is as low as reasonably practicable. Industry practice is to consult with nearby communities and landholders where planned flaring is to take place (so that timing and duration considers local amenity concerns).[44] Flaring is an activity that is within scope of both planning permit and EES assessments where these are required. Both assessments will expect that any	Low: **x** Medium: **x** High: **x**	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority

[43] GasFields Commission Queensland. (2020). *Gas Flaring.* [online] Available at: https://gasfieldscommissionqld.org.au/gas-industry/technical-information/gas-flaring. [Accessed 28 Jan. 2020].
[44] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	that can't be transported in a pipeline or to maintain pressures for safe and efficient operations.		negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[45]		grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. These may increase the level of consultation around visible flaring events, so that the timing and duration takes into account local amenity concerns.
Noise and vibration from operations/ exploration	Noise and vibrations occur during the site preparation, drilling and testing phases and occur throughout the life of the project.[46] They can be caused by: ► engine and road noise from seismic surveying[47] and other survey vehicles ► mulching of vegetation ► vibrations generated by the activation of the base plate on seismic survey vehicles engine and road noise from vehicles used for rehabilitation.	The consequences of increased noise and vibration can include: ► inconvenience and annoyance to landholders ► vibration disturbance to buildings. These noise and vibration impacts are sporadic and not ongoing, that is they occur only while the specific activity is being undertaken (e.g. drilling activities on site, which only occur over short timeframes). Therefore, noise/vibration is	Impacts of noise and vibration and measures to control it are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Noise must be reduced to a level that is as low as reasonably practicable. The EP Act s46 requires that the emission of noise shall be in accordance with the State Environment Protection Policy specifying acceptable conditions for	Low: – Medium: – High: –	Mitigation measures are the same as described in Visible flaring from site.

[45] Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[46] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[47] Buggy with an attached seismic vibrator injects low frequency vibrations into the earth to perform seismic surveys.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		a temporary hazard in any given location and is not dissimilar to farming activities in terms of noise outputs. In the Gippsland Basin exploration and development scenarios, the noise impacts can vary depending on the progression of the development. If a hypothetical development undertook only a seismic survey and did not proceed to drilling, then impacts would be limited to a few hours to days depending on the survey's proximity to sensitive receptors. If drilling did occur, then the timeframe for impacts would be weeks (depending on proximity to sensitive receptors) and if production was to occur, low levels of noise would occur for a period of two to three years. A recent noise study carried out at the Halladale and Speculant production well sites confirmed that operation noise did not exceed guidance noise levels near the well site.[48]	emitting noise. EPA Guideline: *Noise from industry in regional Victoria* sets out the recommended maximum noise levels which can be applied to manage the impacts of noise on the community.[49] The EPA has the power to serve a pollution abatement notice if a process or activity which is being carried on is causing unreasonable noise. This notice can include orders to cease carrying on the activity, or to modify the activity in the manner specified in the notice. Noise from operations is within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[50]		
Dust generation	Repeated vehicle (including heavy vehicle) travel over natural landforms, unsealed roads, farm tracks or fallow farmland can generate dust. The creation of new tracks and roads, or clearing of pipeline RoW, well leases or gas plant sites will also result in dust.[51]	Consequences of increased dust can include: ► nuisance to landholders and the public ► nuisance to native fauna and livestock ► localised and temporary decrease in air quality ► smothering of pastures. Similar to noise and vibration impacts, dust generation is sporadic, and only	Impacts of dust and measures to control it are addressed in an EMP and, where relevant, an EPBC Act Referral and/or EES. Dust must be reduced to a level that is as low as reasonably possible. The EMP takes into account the State Environment Protection Policy (Ambient Air Quality) which outlines the processes to measure and report	Low: – Medium: – High: –	Mitigation measures are the same as described in Visible flaring from site.

48 SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
49 Environment Protection Agency Victoria (2011). 'Noise from Industry in Regional Victoria', *EPA Publication 1411*.
50 Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
51 Information supplied by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		occurs when specific activities are undertaken (e.g. vehicles being driven to and from site on unsealed surfaces). Areas impacted by dust already experience dust created as a part of business as usual farm activities, such as cropping or harvesting. Dust generated from gas exploration or development activities is likely to be similar to other land use activities such as farming.[52] The volume of dust generated from activities varies by the soil type. As an example, operational activities carried out on dry loams can result in bulldust, producing more dust than some other soil types such as clay. As such impacts will vary based on well site location. However, petroleum development by its nature does not involve large scale soil disturbance. As such overall dust generation is expected to be low at all levels of development.[53] Dust generation is an impact that will occur during the lifetime of exploration and development and will cease upon completion. In the Gippsland Basin hypothetical exploration and development scenarios, production at an individual well site is between two and three years. Further, building of capex infrastructure, including plants and pipelines, has a duration of between 0-3 years. Therefore, the local impact of an individual well would only occur over this timeframe.	on the concentration of environmental indicators in the air to determine whether the environmental quality objectives of the Policy are being met.[54] The EPA has the power to serve a pollution abatement notice if a process or activity which is being carried on is generating unreasonable dust. This notice can include orders to cease carrying on the activity, or to modify the activity in the manner specified in the notice. Dust from operations is within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[55]		

[52] Information supplied by the department.
[53] Advice provided by the department.
[54] State Environment Protection Policy (Ambient Air Quality) No S19, Gazette 9/2/1999.
[55] Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].

The impact is unlikely to vary across different levels of exploration and development. This is because the legislative requirements require these impacts to be mitigated and managed to an acceptable level. While the total number of development wells increases from 9 under the low scenario to 27 under the high scenario, the number of wells being developed in an individual year only varies from two under the low scenario to eight under the high scenario. Therefore, the impact in a given year is unlikely to vary between the scenarios.

Summary of risks

The assessment of risks to community health, safety and security is summarised in Table 111.

Table 111: Key risks to community health, safety and security

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Hydrocarbon or chemical spill that reports offsite	There are several processes within the exploration and development of gas that can cause a spill risk both onsite and offsite.[56] These include: ► poor storage of hazardous materials ► poor housekeeping ► inadequate waste management procedures ► ignition of vegetation during vegetation slashing/mulching/ clearing ► ignition of flammable materials ► mechanical, electrical or operational failure of equipment on site ► well blowout during drilling ► external fire reaching site	Spills may: ► create safety hazards for employees, landowners and the local community ► increase the risk of damage and destruction of third-party property, farmland, crops and stock ► create excessive atmospheric emissions (gas). ► cause possible contamination of air, soil, water and/or groundwater. ► cause injury to fauna/livestock through ingestion. ► cause visual pollution. ► cause fires.	Risks of hydrocarbon and chemical spills are addressed in an EMP (and if relevant, a separate Oil Spill Contingency Plan, OSCP) and where relevant, an EPBC Act Referral and/or EES. An ERP is a document prepared by operators to describe its emergency response preparedness and response measures. Spill risk must be reduced to a level that is as low as reasonably practicable. The EMP would include a spill management plan and emergency response manual, with detailed arrangements for dealing with any threat to the environment near the petroleum operation and ensuring that the treatment does not harm the environment.	Unlikely[59]	Minor[60]	Low	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making ► requirement for the publication of certain information relating to government decisions and industry activity. The Petroleum Regulations 2011 could be updated with stronger provisions

[56] Information supplied by the department.
[59] Information supplied by the department.
[60] Information supplied by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	► loading/unloading of product (e.g., condensate) or chemicals ► refuelling. Spill risk can occur throughout the exploration, development and operations phases of the gas operation lifecycle. Once the production phase of development is complete, spill risk will cease. In the Gippsland Basin exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe.		The OH&S *Act*, the OH&S Regulations and the Dangerous Goods (Storages and Handling) Regulations 2012 outline specific duties and obligations for the storage and handling of dangerous goods, including flammable materials. The Code of Practice for the Storage and Handling of Dangerous Goods includes guidance on how to comply with these obligations, including how to control risks associated with the storage and handling of dangerous goods, as well as planning emergency responses.[57] The obligations contained in these Acts require operators to ensure any risk associated with the storage and handling of dangerous goods is eliminated or reduced. The code of Practice is administered by WorkSafe Victoria as such gas operators will be subject to WorkSafe audits, reducing the chance that non-compliance with the code would occur. Spill risks is within the scope of EES assessments where these are required. An EES will expect that any negative impacts are reduced to the lowest level possible.				for well management and rehabilitation and closure.

[57] WorkSafe (2013). *Code of practice for the storage and handling of dangerous goods.*

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			Members of the public can provide written comments as a part of this.[58]				
Fire risk	Exploration phase: ► ignition of vegetation during vegetation clearing/ mulching/slashing ► ignition of flammable materials ► mechanical, electrical or operational failure of equipment on site ► external fire reaching site ► refuelling ► inadequate cigarette disposal Construction phase: ► drop out from flaring ► well blowout ► ignition of flammable materials ► mechanical, electrical or operational failure of equipment on site ► external fire reaching site ► refuelling. Production phase ► pipeline rupture	Fires may lead to: ► injury or death to project personnel or the public ► bushfire ► damage to or destruction of third-party property ► loss of farmland or pasture and/or crops, stock ► excessive atmospheric emissions (gas, smoke etc.).	Fire risk is within scope of an EMP and must be reduced to a level that is as low as reasonably practicable. The EMP needs to include an emergency response manual, with detailed arrangements for dealing with any threat to the environment near the petroleum operation and ensuring that the treat does not harm the environment. The EMP needs to include a Fire Management Plan that ensure risks are reduced to an acceptable level.[61 62] Local CFA brigades are expected to be consulted and updated on safety plans to manage risk. Fire risk is within the scope of EES assessments where these are required. An EES will expect that any negative impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.[63]	Unlikely[64]	Minor[65]	Low	Mitigation measures are the same as described in Hydrocarbon or chemical spill that reports offsite.

[58] Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[61] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[62] Mineral Resources (Health and Safety) Regulations 1991.
[63] Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].
[64] Information supplied by the department.
[65] Information supplied by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	▸ gas plant explosion ▸ ignition of flammable materials ▸ mechanical, electrical or operational failure of equipment on site ▸ external fire reaching site ▸ refuelling.						

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could affect community health, safety and security within the region. While there are potential negative impacts and risks within the region due to fire and spill risks, visible flaring, noise and vibrations, and dust generation, these will be mitigated through requirements under the current regulatory framework to an acceptable level. In the case of noise and dust generation from operations/exploration, the impact is expected to be comparable with other land use activities such as farming. The impacts and residual risks are not considered to differ between scenarios, as the mitigating actions will manage the impact or risk to ALARP, regardless of the size of exploration or development. Mitigating actions will also reduce the likelihood of the risk occurring.

Therefore, the scenarios are expected to have a neutral impact on the community's health and safety (Table 112) and are assessed as having a low risk, based on the average ratings for each impact (Table 113).

Table 112: SR1: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 113: SR1: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

5.2.2.2 SR2: Community wellbeing and social cohesion

What level of impact on the community's health, safety and security will gas development have?

Benefits and impacts

The analysis has identified the following key benefits and impacts to community wellbeing and social cohesion with respect to the Gippsland Basin exploration and development scenarios:

- community attitudes to proximity of development and exploration
- community projects funded by gas development
- community engagement in decision making process
- access and affordability of housing and essential services
- impact on local roads.

These benefits and impacts are described further below.

Community attitudes to proximity of developments/exploration

There are mixed perceptions in the local community surrounding the petroleum industry.[66] If gas development were to occur, community concerns should be considered and proactively managed in the context of the Gippsland region.

In 2019, CSIRO conducted a study, commissioned by the VGP, to investigate local attitudes and perceptions of onshore conventional gas development in the region (the CSIRO study).[67] The survey had a representative sample across three Gippsland region LGAs, of which 100 participants from each LGA (a total of 300 participants), including landowners were surveyed.

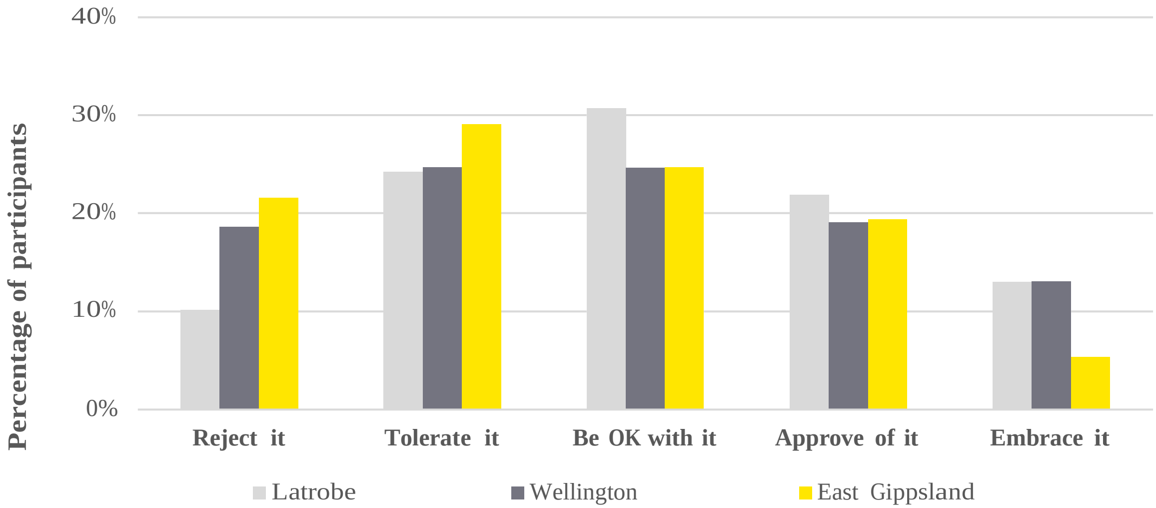
The survey found that:

- 16 per cent of participants rejected onshore conventional gas development
- 11 per cent of participants embraced onshore conventional gas development

[66] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).*
[67] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).*

- 73 per cent of people tolerated, would be ok with, or approved of onshore conventional gas development:
    - 26 per cent would tolerate it
    - 27 per cent would be ok with it
    - 20 per cent would approve it.

Figure 47: Attitudes towards onshore conventional gas development: Gippsland LGAs

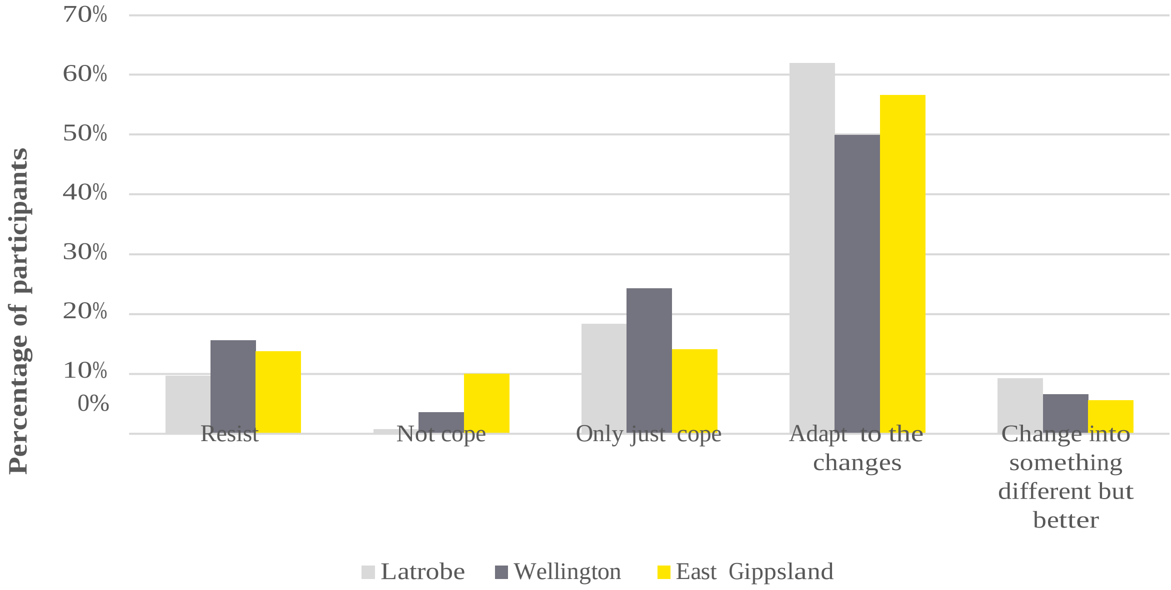


Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).

The CSIRO study also investigated the perceived community adaption to onshore conventional gas exploration and development within the Gippsland Basin region. The results found that:

- 65 per cent would ‘adapt to the changes’ or ‘change it into something better’
- approximately 16 per cent would ‘resist’ or ‘not cope’
- 19 per cent would ‘only just cope’.

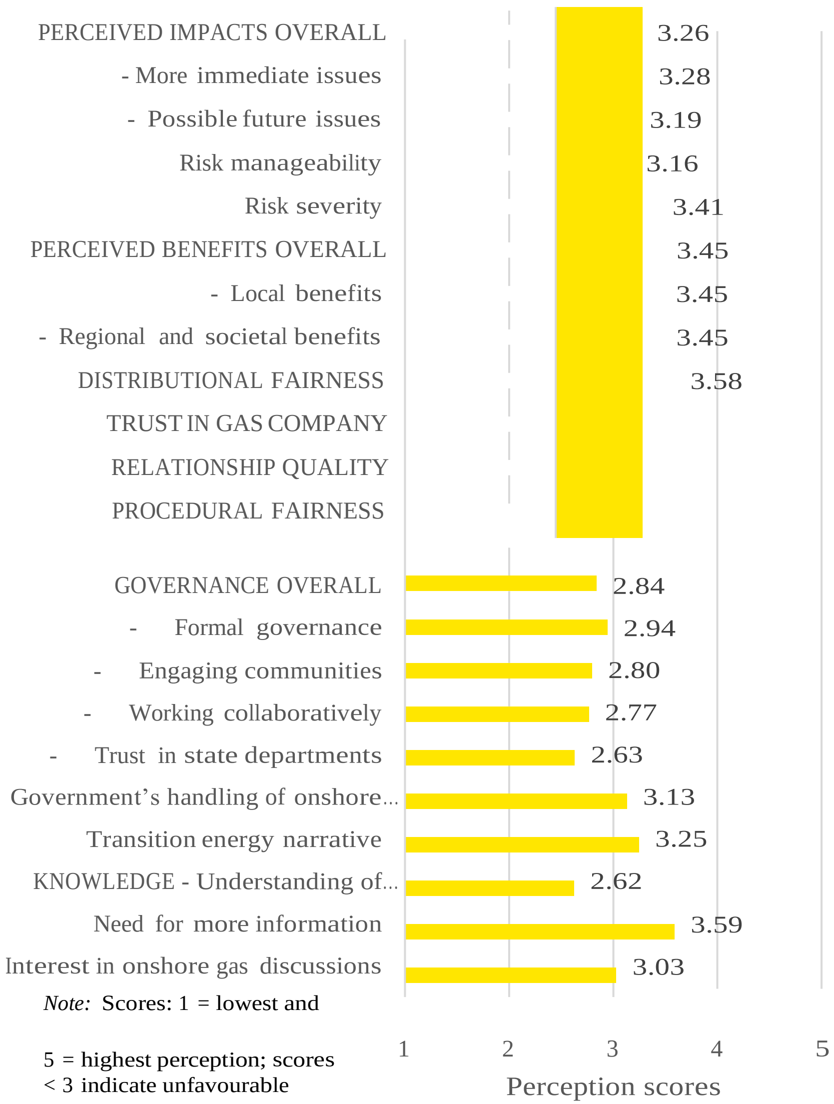
Figure 48: Perceived community adaption to onshore conventional gas development: Gippsland LGAs



Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).

The research commissioned also identifies the issues that underpin the community's attitudes towards onshore conventional gas exploration and development (see Figure 49).

Figure 49: Perceptions about onshore conventional gas exploration and development: Summary underlying drivers in the Gippsland region



Note: Scores: 1 = lowest and 5 = highest perception; scores < 3 indicate unfavourable

Source: CSIRO (2019). Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results (in prep).

The results found that:

- there were moderate concerns about impacts of gas development overall (M[68] = 3.26)
- potential benefits were perceived to be moderate and slightly higher than impacts (M = 3.45)
- there was a perception of limited trust in gas companies (M = 2.56)
- community members indicated a need for more information about conventional gas development (M = 3.59) as current understanding is limited (M = 2.62)
- there was a favourable view of the role of gas in transitioning to renewable energies (M = 3. 25).

This indicates that overall, community attitudes to exploration and development of gas in the Gippsland Basin are relatively neutral.

Community engagement in the decision-making process

Community engagement enables community members to discuss and have input in the project. Gas companies can incorporate this feedback to meet the needs of the region and accommodate for concerns.

In Victoria, social impacts have not been adequately addressed, which has led to communities demanding greater action from the government.[69] Proper community engagement may reduce potential social and environmental costs by pre-identifying sensitive receptors, and companies can appropriately incorporate them in responding to the regulations.[70] Community engagement tends to be focused on the perceived quality of relationships with industry, whereas industry engagement tends to be market-focused.

Engagement with the community can take place at various stages of the exploration process:

- determining an acreage area stage
- acreage release stage
- rights allocation stage

[68] M refers to the mean (i.e. average) score. This is calculated by determining the sum of total divided by count of total.
[69] Information provided by the department.
[70] Information provided by the department.

- preparation of environmental approvals (EMP, EPBC Act referral, EES, ERP, etc).[71]

There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community.[72] Communities are becoming more informed and demand meaningful and ongoing consultation throughout the life of a project, not just at the point where an authority has been granted and a proponent is required to prepare an operation plan as required by the Petroleum legislation.

Social licence and community engagement benefits are largely intangible and difficult to measure. Primary intangible benefits include:

- strong local trust
- contribution to community cohesion and spirit
- achievement of broader social aspirations of communities
- improved social responsibility for industry.[73]

A study of CSG extraction in the Surat Basin, Queensland, examining coexistence between farmers and CSG developers found that clear communication was necessary to promote coexistence between farmers and the developers. The absence of which led to farmers struggling to explain some concerns because of the different way they interpreted their landscape. This among other factors caused frustration and farmers felt that this has led to severe impacts on mental health and wellbeing. The workshops also identified a range of issues perceived by farmers arising from increased traffic volumes, impacts to mental health and wellbeing, place identity and loss of water resources for farmers.[74]

In a separate study on preconditions for social licence, it was found that proactively providing people with information about regulation and compliance, and industry's commitment to ensuring local community involvement produced more favourable views of trust and fairness about a new mining proposal.[75]

Access and affordability of housing and essential services

As gas production increases within the Gippsland region, it is expected that employees may relocate to the area, putting pressure on access to and affordability of housing and essential services for the local community. It is expected that housing and essential service prices may increase as the scale of production increases. The housing price impact is expected to be low given excess capacity of housing within the Gippsland Basin relative to the inflow of

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[71] Information provided by the department.
[72] Information provided by the department.
[73] Information provided by the department.
[74] Huth, N., Cocks, B., Dalgliesh, N., Poulton, P., Marinoni, O. and Garcia, J. (2017). Farmers' perceptions of coexistence between agriculture and a large scale coal seam gas development. Agriculture and Human Values, 35(1), pp.99-115.
[75] Zhang, A., Measham, T. and Moffat, K. (2018). Preconditions for social licence: The importance of information in initial engagement. Journal of Cleaner Production, 172, pp.1559-1566.

workers related to hypothetical gas development scenarios.[76] Furthermore, development of the industry would be gradual and staggered and spread out over a region over time and not in one hit at one location, minimising abrupt price changes. The increase in scale of production would result in increased number of workers and employees to undertake petroleum activities, some of whom would need to relocate to the Gippsland regio n, resulting in potential increased demand for local housing and essential services. Due to the nature of the petroleum industry, this impact is expected to be low as it does not create a large workforce at a single site in the way that mining does.[77] Rather the workforce is expected to be spread-out over the region where development is occurring.

There is evidence to suggest that gas companies have put mitigations in place to reduce these social burdens. As an example, Beach Energy established temporary accommodation to support drilling crew working in shifts to help offset local housing pressures.[78] Other employees and contractors could arrange local accommodation if required. In an alternative example, in Queensland, a CSG operator has directed staff and contractors not requiring accommodation longer than three nights to use accommodation in local towns (rather than an accommodation camp) to ensure that small towns reap the economic benefits of industry workers.[79] This policy was developed in consultation with accommodation and service providers.

While these mitigations do support the local community, they are not required under the current legislative framework. As such, overall gas development may create a burden on the community that worsens in severity as production increases.

Summary of benefits and impacts

The assessment of benefits and impacts to community wellbeing and social cohesion is summarised in Table 114.

Table 114: Key benefits and impacts to community wellbeing and social cohesion

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Community attitudes to proximity of developments and exploration	There are mixed perceptions in the local community about the petroleum industry.[80] If gas development were to occur, community concerns should be considered and proactively managed in the context of the Gippsland region. Community attitudes can be influenced by several ways including:	The consequence of community attitudes to proximity of developments and exploration is dependent on the attitude of the individual/community. The results of the CSIRO stakeholder analysis show that general attitudes within the Gippsland region towards gas production are slightly favourable.	The petroleum rights allocation regime recommends the following in relation to areas of gas development and production: ► actions should be taken to reduce the potential of conflict between gas producers and existing users of land	Low: – Medium: – High: –	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of

[76] Information provided by the department.
[77] Advice provided by the department.
[78] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[79] Advice provided by the department.
[80] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results.*

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	► media ► community consultation ► company reports ► whether the company has social licence ► word of mouth. Community attitudes to proximity of developments/exploration will be important to consider for the life of the project.		► companies should avoid sensitive areas or clearly define areas of exploration and development ► companies need to understand the social risks of producing gas in the given area.[81] Planning permits and EMPs (and possibly an ESS) would be required as a part of the development process. Members of the public can provide written comments as a part of this process.[82]		community input during authority grants and operations; ► provision for improved consideration of social, economic and environmental factors in decision-making; ► requirement for the publication of certain information relating to government decisions and industry activity. This framework would provide additional information to the community that would allow them to be more informed about onshore conventional gas production. This may influence their attitudes towards development and exploration in the region.
Community projects funded by gas development	As part of gas developments some industry participants fund community projects. Current industry practice is that the developers will undertake community specific support initiatives as part of their exploration activities.	Funding for community projects: ► support the local community ► may provide additional jobs ► may strengthen social licence	While there are no control measures in place, it is noted that it is industry practice to fund community projects.	Low: – Medium: – High: –	N/A

[81] Tordo, S., Johnston, D. and Johnston, D. (2020). *Petroleum exploration and production rights: allocation strategies and design issues*. [online] Documents.worldbank.org. Available at: http://documents.worldbank.org/curated/en/785881468336848695/Petroleum-exploration-and-production-rights-allocation-strategies-and-design-issues [Accessed 3 Feb. 2020].
[82] Planning. (2020). *What is the EES process in Victoria?*. [online] Available at: https://www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria [Accessed 3 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		► may increase trust in the gas company. The retention of value from gas production is an important consideration for people considering the net effect on local communities. Whilst many of the perceived negative impacts of gas development are local, significant perceived benefits, such as the provision of energy, are realised both in the community and elsewhere. There is an expectation that developers will provide additional local benefits through community support programs to work against this perception. Community projects funded by gas development will occur throughout all phases of the gas operation lifecycle. The extent of contribution is unlikely to vary between the Gippsland Basin exploration and development scenarios as the number of locations where gas is consistent. Gas producers also pay a significant amount in rates each year. For example, in 2019 Beach Energy paid rates in excess of $860,000 (approximately 4 per cent of Corangamite Shire Council rates income) to the Corangamite Shire Council, which were used to support community assets and services. Industry practice suggests that operators would fund local projects to build social license. Each scenario is expected to have a neutral impact on the receptor as while it is industry practice to do so, there is no associated regulatory requirement mandating this.			
Community engagement in	Engagement with the community can take place at various stages of the exploration process:	Primary intangible benefits of community engagement include:	The Petroleum Act requires that companies consult with interested people and parties during the	Low: –	Mitigation measures are the same as described in Community attitudes

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
decision making process	► determining an acreage area stage ► acreage release stage ► rights allocation stage ► preparation of environmental approvals (EMP, EPBC Act referral, EES, ERP, etc).[83]	► strong local trust ► contribution to community cohesion and spirit ► achievement of broader social aspirations of communities ► improved social responsibility for industry.[84] The benefit of properly undertaking community engagement is consistent for each of the scenarios as it would be expected that all scenarios would need to have similar systems and process in place to enable community engagement.	development of an operations plan. The Petroleum Regulations require operators to provide appropriate consultation for the life of the operation with interested people and organisations about its the environmental performance. General operations and social issues are also common discussion topics. There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community. ERR generally expects titleholders to adhere to IAP2 consultation principles. There is also a low level of government scrutiny around the extent of consultation that must be undertaken. Despite the legal requirement for consultation and engagement not be prescript, it is standard petroleum industry practice to engage with community during operations and particularly during well construction and disturbance events such as flaring.[85]	Medium: – High: –	to proximity of developments and exploration.
Access and affordability of housing and essential services	As gas production increases within the Gippsland region, it is expected that employees will relocate to the area which could create potential pressure on the housing supply and therefore rental/property prices and access to and essential services for the local community.	Further exploration and development will increase demand for housing and essential services. It is expected that rental and property prices are unlikely to increase due to the relatively low number of workers moving from the rest of Victoria (890 total FTE employed in the high development scenario) coupled with the dispersed nature of the development scenarios.	There is evidence to suggest that gas companies have put mitigations in place to reduce potential impacts. As an example, Beach Energy established temporary accommodation to support drilling crew working in shifts to help offset local housing pressures.[86] Other employees and contractors could arrange local accommodation if required.	Low: – Medium: – High: –	N/A

[83] Information provided by the department.
[84] Information provided by the department.
[85] Advice provided by the department.
[86] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		Similarly, the impact on essential services will likely not increase. This impact is also expected to be lower in Victoria relative to other states and territories due to the higher population density and inherent level of residential development in regional Victoria than that which exists in the rest of Australia.	While these mitigations do support the local community, they are not required under the current legislative framework.		
Damage to local roads and traffic disruptions	Gas exploration and development has potential impacts on the surrounding areas. It results in increased traffic on local roads (particularly unsealed roads), many of which may not be of a standard capable of withstanding frequent, large and heavy loads.[87] There may also be vegetation clearing along road verges (with speed restrictions or diversions in place to ensure the safety of project personnel and the travelling public).[88] Deployment and retrieval of nodes and cables along road verges during seismic surveys, and long heavy loads (e.g., drill rigs, gas plant equipment) will create temporary traffic disruptions.	Gas exploration and development may result in: ► damage to local roads ► increased traffic ► increased travel times in local areas. The disturbances to roads and disruption to traffic can be a nuisance to residents and travelling public. It can also increase the travel time due to associated traffic controls and slow-moving low-loaders and equipment. Seismic surveys, drilling, pipeline construction and gas plan construction and operations are generally located in areas of low population density, where there are also low volumes of traffic. As such, disturbance is experienced by few people. Residents and landholders who are impacted are also generally habituated to movements of large, slow vehicles of narrow roads (such as cattle trucks, milk trucks and farm machinery).[89]	The risks regarding road damage and traffic interruptions and measures to control these are addressed in an EMP and where relevant, an EES. Operators also work with LGAs to upgrade roads (generally at their own cost) that are not otherwise suitable to support their exploration, development and operations activities, which in turn provides a wider community benefit (e.g. sealed roads remove the risks created by pot holes, remove issues regarding dust and improve travel times).[90] Impacts on local roads are managed as part of an Operations Plan. The Operations Plan would identify the risks that operations may pose on local roads and the operators' actions to mitigate these impacts.	Low: – Medium: – High: –	N/A

[87] Information provided by the department.
[88] Advice provided by the department.
[89] Information provided by the department.
[90] Advice provided by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		Disruption would be concentrated around the construction and development phases. Over the long term, frequently used wells may be developed.			

Risk

No risks to this receptor were identified.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland hypothetical exploration and development scenarios could affect community wellbeing and social cohesion within the region.

Community attitudes to the proximity of development and exploration are important to consider, however the impact of this mea sure on each of the exploration and development scenarios is neutral based on the results of surveys with residents of Gippsland LGAs. The extent of contribution is unlikely to vary between the Gippsland Basin exploration and development scenarios as the locations where gas is developed is consistent. Community engagement, as required under legislation, will also provide benefits. On the other hand, access and affordability of housing and essential services and with the impact on local roads are expected to have neutral impacts.

Therefore, based on the high-level analysis and average scoring, all scenarios are expected to have a neutral impact overall (Table 115).

Table 115: SR2: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.2.3 SR3: Land access and use issues

What are the current uses of land, and how will land access impact on this land use as well impact the surrounding areas?

Benefits and Impacts

The analysis has identified the following key benefits and impacts to land access and use issues with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- landowner consultation to inform landowner consent and compensation agreements and lease agreements
- insufficient or inadequate community understanding of gas projects in the region
- size of land impacted by gas exploration/ development activities
- impact on land value.

These benefits and impacts are described further below.

Landowner consultation to inform landowner consent and compensation agreements and lease agreements

The Petroleum Regulatory Framework requires landowner and lessee consent to be attained and that appropriate compensation be agreed upon prior to gas companies undertaking any gas-related exploration or development operations. Further, regulator consent for area and location specific operations for petroleum title holders must also be obtained.

Landowner consent and consultation is an important component of the Operation Plan that is required to be submitted to the Minister prior to any gas operation commencing, and the Minister has discretion to reject any Operation Plan where this has not been appropriately undertaken.[91]

Table 116 summarises the key aspects of the legislation and how it has been formulated to ensure landowner consent is attained prior to any gas-related exploration or development activity.

Table 116: Sections of Petroleum Act that ensure landowner consent and consultation

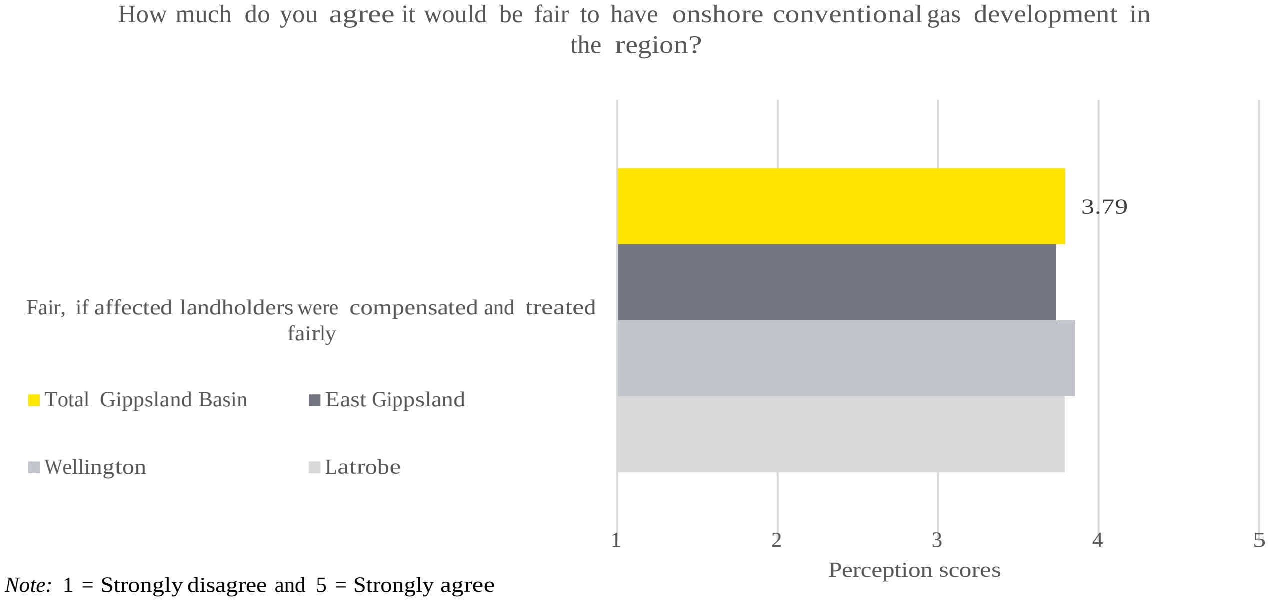
Section of the Petroleum Act	Description and how it safeguards landowner rights
Section 128	A person must not carry out any petroleum operation on private land unless– ► it has obtained the consent of the owners and occupiers of the land to the operation; or

[91] *Petroleum Act 1998 (Vic).* s161

Section of the Petroleum Act	Description and how it safeguards landowner rights
	► it has entered into a compensation agreement with the owners and occupiers of the land in relation to the operation; or ► the Tribunal has determined the amount of compensation that is payable to the owners and occupiers of the land under this Act in relation to the operation.
Section 141	A person must not carry out petroleum operation on land without written consent of the person or body responsible for the land on which there is a public highway, road or street.
Section 161	Before carrying out any petroleum operation, the holder of the authority under which the operation is to be carried out must give the Minister an Operation Plan– ► that identifies the risks of injury or damage that the operation may pose to the environment, to any community, person, land user, land or property near the operation and to any petroleum, source of petroleum or reservoir that the operation might affect; and ► that specifies what the holder of the authority will do to eliminate or minimise those risks; and ► that specifies what the holder of the authority will do to rehabilitate the land that will be affected by the operation; and ► that sets out any other matters required by the regulations. The holder of the authority must not carry out the petroleum operation unless the Minister has accepted the Operation Plan for the operation in writing. The Minister must not accept an Operation Plan unless she or he is satisfied that the holder of the authority has, in preparing the plan, consulted the person who owns, occupies or manages the land on which the operation is to be carried out.

Perceptions in the Gippsland community show that it would be fair to have onshore conventional gas development in the region if landholders were compensated and treated fairly (Figure 50).

Figure 50: Perceptions of distributional fairness to have onshore gas development in the region, by subregion, 2019



Note: 1 = Strongly disagree and 5 = Strongly agree

Source: Walton, A., and McCrea, R. (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Gippsland Basin: Interim report: CSIRO, Australia (in prep).

Compensation

Landowners are not entitled to royalties from petroleum in Australia as these resources are owned by the Crown,[92] however the Petroleum Act requires that a compensation agreement is in place prior to starting a petroleum operation on private property.[93] The consent of both the owner and occupier of land is required where an operation is proposed, and parties must enter into a compensation agreement with the owner and occu pier of the relevant land. Compensation agreements can also include payments for changes in any wage or earning potential as a result of gas exploration and development. Compensation (both financial and non-financial) may reimburse landholders and lessees for legal, accounting and valuation costs incurred in preparing and negotiating a compensation agreement.

[92] COAG (2018). *Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia.*
[93] Information provided by the department.

Information provided by the Stakeholder Advisory Panel has noted that industry practice is for operators to go over and above compensation set out by regulatory requirements.[94] It was suggested that some industry participants ensure a net benefit to the landowner. This includes ensuring:

- rent paid is at the industry value, which is greater than the farm value
- a contracted income over the land use period providing certainty of income to landowners over less certain traditional farm income
- rent income provided by operators also offers landowners a diversified income stream
- landowners are compensated for their meetings with the operators.

Fair treatment

Landowner consultation is required throughout the process from exploration and discovery to development as new land is acquired or used for gas development and exploration. Commercial negotiation provides power to the landowner. Further, consultation is required after the project is in the rehabilitation phase to bring the land back to its previous state.

As summarised in Table 116, legislation is clear that gas developers must enter into a land agreement prior to commencing exploration there is unlikely to be any material impacts around consent and compensation. As such, all scenarios are assumed to have a neutral impact, assuming compensation adequately covers off the inconvenience.

Insufficient or inadequate community understanding of gas projects in the region

Companies voluntarily engage in consultation as a means to inform the public on the gas development activities occurring in the area and provide an opportunity to dispel any negative perceptions about potential gas exploration and development activities. Techniques used to consult may include suggestion boxes, telephone, written or electronic surveys, hotline or phone-in opportunities, media advertising, inviting submissions, public exhibitions or interviews.[95]

One method that companies use to disseminate information concerning operations to the local community is CRG.[96] Exploration and development companies also often have dedicated systems in place for locals or interested parties to provide feedback, complaints, claims or grievances.

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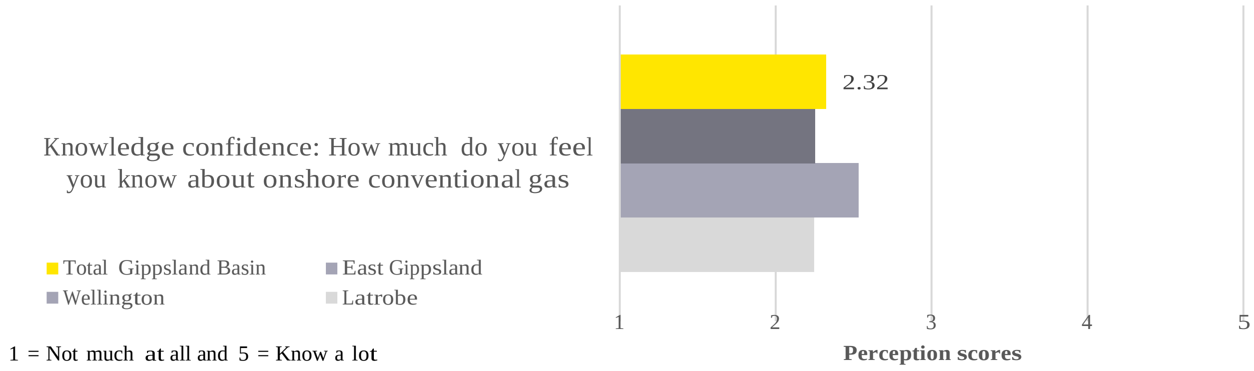
[94] Advice from the Stakeholder Advisory Panel.
[95] Earth Resources. *Community Engagement Guidelines for Mining and Mineral Exploration*. Accessed via: https://earthresources.vic.gov.au/legislation-and-regulations/guidelines-and-codes-of-practice/community-engagement-guidelines-for-mining-and-mineral-exploration
[96] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.

Membership of the CRG is to be reflective of stakeholder interests that may arise from operations, as well as provide communication channels to further disseminate information about the project to the community. The significant role of disseminating information to the community begins prior to development and exploration and extends into the rehabilitation phases of the project.

Figure 51 illustrates that residents across the Gippsland region had low levels of confidence in their knowledge of onshore conventional gas development. CRG meetings therefore serve as an important way for companies to provide information specific to their gas development project and the impacts on the community, while concurrently providing an opportunity for companies to influence and develop community views about onshore gas development.

Figure 51: Knowledge levels of onshore conventional gas, by subregion, 2019



Source: Walton, A., and McCrea, R. (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Gippsland Basin: Interim report: CSIRO, Australia (in prep).

Size of land impacted by gas exploration/development activities

Once production starts, the area used for development decreases considerably and is typically fenced off. In Queensland, the average operational drill site is approximately 25 square metres.

Overall, the size of the onshore conventional gas development is relatively small in comparison to the area required for farming.[97] Regulation also states that only the minimum area necessary for maximum extent of the petroleum field will be approved, thereby reducing the land size that is potentially impacted.[98] We also note that impact will cease once land has been appropriately rehabilitated after use.

[97] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[98] Petroleum Act 1998 (Vic). s41, s58.

Table 117 summaries the projected effects on the size of land required and duration of use for each hypothetical development scenario.

Table 117: Number of wells and production duration under each hypothetical scenario

Scenario	Discovery and development wells drilled per year	Total years of production	Number of years that each well is operational
Low scenario	4-5	6 years	2-3 years
Medium scenario	5-8	7 years	2-3 years
High scenario	5-8	10 years	2 years

The size of the land required for gas exploration and development infrastructure is dependent on the size of production, and number of wells. It is also dependent on whether the producer seeks to minimise inconvenience to land holders, noting it is usually in their best interest to do so to reduce project cost and delays.

Impact on land value

One study has found wells and gas-related activity is associated with a fluctuation in land value of both directly affected property as well as neighbouring land.[99]

Landowners with gas developments on their property would therefore expect development to be short term, for the life of the well/pipeline on the property.[100] The Petroleum Regulatory Framework requires that land used for gas-related activity must be rehabilitated to its original state where possible.[101] Therefore, it is expected that the impact on land values are temporary in nature. Land values are projected to assume previous levels (ignoring exogenous housing market fluctuations) once exploration, development and rehabilitation are complete. Relative to other resource industries such as mining and quarrying, the nature of the petroleum industry is such that rehabilitation of land used for gas related activities is quite straight-forward.[102] (Table 118).

[99] Boxall, P., Chan, W. and McMillan, M. (2005). The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis. *Resource and Energy Economics*, 27(3), pp.248-269.
[100] Modelling assuming each well only produces for 2-3 years.
[101] *Petroleum Act 1998*. s128.
[102] Advice provided by the department.

Summary of benefits and impacts

The assessment of impacts to land access and use issues is summarised in Table 118.

Table 118: Key benefits and impacts to land access and use issues

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Landowner consultation to inform landowner consent and compensation agreements and lease agreements	Prior to commencing exploration or development activities, companies must consult with landowners to gain agreement to use the land for gas development and exploration activities.[103] This includes consultation on the appropriate compensation for any impacts or inconveniences of the gas activity on their property.	Landowners and related parties may have the opportunity to provide input on the project to align exploration and development projects with the needs and perceptions of the community. Landowners would receive appropriate compensation for any impacts and inconveniences of the gas development activity on their property. Landowner consultation is expected to be consistent across each of the scenarios, as this is a requirement regardless of the size and level of gas activity. Industry practice is also to provide additional compensation beyond that required by regulations.[104]	Written consent and compensation agreements must be provided as per s128 of the Petroleum Act. Landholders and lessees are required to be notified of proposed activities and a reasonable amount of time to assess proposed operations. In addition, landholders and lessees must engage in consultation throughout the duration of the project and must also agree on a compensation amount. The regulation further states that compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.[105] This minimises the level of impact to landowners to the lowest level.	Low: – Medium: – High: –	The department has developed a standard land access proforma template for the minerals sector that assists landholders in easily negotiating compensation agreements. The proforma template could be relatively easily adapted to petroleum industries.
Insufficient or inadequate community understanding of gas projects in the region	Process for disseminating community updates about land use and consultation on gas development is inadequate. Community consultation and disseminating information relating to gas development is not mandated per the regulatory framework, and this is	Community updates and information regarding gas development may not be extensive or to an acceptable standard and the residents may be unaware of the impacts of the project on their community. The need for community consultation is anticipated to increase with the scenario levels. From the low to high	While regulation requires that proponent must submit a report of their consultation undertaken in developing their Operations Plan, The regulatory framework currently does not mandate that community updates and consultations occur alongside gas development. However, gas companies often voluntarily	Low: – Medium: – High: –	Possible legislative improvements derived from the VGP gap analysis include: ► enhanced community consultation and

[103] Coagenergycouncil.gov.au. (2019). *Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia*. [online] Available at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/FYI2019037%20-%20GSS%20FAQs_0.pdf [Accessed 31 Jan. 2020].
[104] Advice from the SAP.
[105] *Petroleum Act 1998*. s128.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	done on a voluntary basis by gas companies.	scenarios, the number of development wells and associated production activity increases. Further, it is estimated that the total duration of the project progressively increases from 6 years of gas production under the low scenario to 11 years under the high scenario (noting that each well will be producing for 2-3 years). Therefore, it becomes increasingly important for the community to understand the nature of the project, how they may be impacted and to provide a forum for gas companies to dispel any concerns or negative perceptions regarding the project.	engage with the community in some form in order to inform the community about the nature of their project and its impacts on the community.[106] Therefore, while regulation does not explicitly mandate community updates regarding gas-related activity, gas companies make efforts to engage with the community in relation to gas projects and how they may be impacted.		consideration of community input during authority grants and operations ► publication of certain information relating to government decisions and industry activity.
Size of land impacted by gas exploration/ development activities	In the short to medium term, sites for drilling would be leased for exploration and development wells. A typical drill site requires an area of 100 x 100 m (1 ha) (and additional land may be impacted by access track/s). A typical operating well requires an area to be cleared of 25 m^2, with the well-head and associated infrastructure generally smaller than an average water tank.[107] A pipeline construction RoW is typically up to 25 m wide, which is then reduced to a 12 m wide easement during operations.	There is a risk that the size of area used for petroleum activity is larger than necessary, enhancing the risks observed in other social and environmental receptors. There is a risk that the land utilised for petroleum development reduces the amount land available for other uses (e.g. farming). The nature of the conventional petroleum industry is such that gas can be extracted from a very small physical footprint relative to other resource industries such as mining and quarrying.[108] Multiple wells can be developed from a single drill pad using directional drilling.	The Petroleum Act contains general provisions that minimise the land size that is affected by gas development, such as the license area covers the minimum area necessary to cover the maximum extent of the petroleum field.[110] Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies. The compensation provisions of the Petroleum Act create a commercial incentive that ensure that industry minimizes the size of its disturbance footprint as much as possible.[111]	Low: – Medium: – High: –	Use of the VGP land-use and planning model to support regulation of the sector.

[106] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished report.
[107] Coagenergycouncil.gov.au. (2019). *Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia*. [online] Available at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/FYI2019037%20-%20GSS%20FAQs_0.pdf [Accessed 31 Jan. 2020].
[108] Advice provided by the department.
[110] *Petroleum Act 1998 (Vic).* s41, s58.
[111] Advice provided by the department.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	Gas plants typically require many hectares of land.	With each increase in scenario level from the low scenario to the high scenario, the number of discovery and development wells progressively increase, from 4-5 wells per year and no new plants in the low scenario to 5-10 wells in the high scenario with one new modular plant, as well as the pipelines required to connect the wells. As the number of wells, pipelines and plants increase, so too does the land required and therefore the impact of the gas exploration and development. However, as part of these projections, it has been estimated that each well will only be in operation for 2-3 years, leading to the duration of impact for each well site being relatively short-term. Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies.[109]			
Impact on land value	Gas development facilities and infrastructure, as well as drilling for exploration, can have adverse impacts on land value for landowners who are directly affected, as well as for neighbouring properties.	Reduction in land value negatively affects landowners in the community, particularly upon resale. One study indicates that proximity to gas facilities also reduces property prices, therefore impacting neighbouring properties. [112] It is anticipated that the impact on land value will increase in line with production, as the number of development wells needed increases in	Compensation agreements in place for owners directly impacted by the gas development project intend to provide restitution for associated costs and inconveniences, including depression of land value.[113] Rehabilitation that is required per the regulatory framework minimises the duration and/or magnitude of the reduction of land value.[114]	Low: – Medium: – High: –	N/A

[109] *Petroleum Act 1998 (Vic).* s41, s58
[112] Boxall, P., Chan, W. and McMillan, M. (2005). The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis. *Resource and Energy Economics*, 27(3), pp.248-269.
[113] *Petroleum Act 1998 (Vic).* s128
[114] *Petroleum Act 1998 (Vic).* s170.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		the progression from the low scenario to high scenario. In the low scenario, a total of 72 well sites (exploration, discovery and development wells) will be developed during the exploration and production phase, compared with a total of 90 well sites (exploration, discovery and development wells) will be developed during the exploration and production phase. However, potential buyers may be attracted to properties with wells and infrastructure on site due to the certainty of income provided by the operators.	Compensation agreements often include ongoing rent type payments for the use of the land, and this remains during any sale of property ensuring that it does not diminish land sale price.[115]		

Summary of risks

The assessment of risks to land access and use is summarised in Table 119.

Table 119: Key risks to land access and use

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Inadequate rehabilitation	The risk exists that well leases, pipelines, and gas plants are not being completely rehabilitated once these activities cease, or that there are permanent or long-lasting effects on the land.	Inadequate rehabilitation may result in: ► economic loss to landowners ► reduced area for farming activities (e.g. grazing or cropping).	Rehabilitation of the drill sites is required under the Petroleum Act legislation, which states that drill sites would be rehabilitated and could be and returned to their original state where possible brought back to their previous state.[116] The Petroleum Act also sets out a framework for rehabilitation. The holder of an authority must rehabilitate land affected by exploration or resource development and must rehabilitate the land before the authority expires or ends. This is done in consultation with the landowner such that the land is returned to its former land use (e.g. liaison is required to determine the	Highly unlikely	Moderate	Low	Possible legislative improvements derived from the VGP gap analysis provides for enhanced landholder consultation during site rehabilitation. The reforms will see that the Minister does not return rehabilitation bonds until satisfied that consultation has been undertaken with the

[115] Advice provided by the department.
[116] *Petroleum Act 1998 (Vic).* s170.

			depth of soil ripping, contouring, pasture seed mixes and so on). The authority holder is required to obtain a rehabilitation bond for an amount specified by the Minister. Information on planned rehabilitation processes are required to be detailed in the Operation Plan. The Minister must be satisfied that rehabilitation has occurred, is likely to be successful and any other work which the bond related to has been satisfactorily completed.[117] Opportunities exist to increase consultation with landowner/holder in relation to adequacy of rehabilitation. The Petroleum Act states that compensation must be provided to any land that cannot be rehabilitated.[118] This compensation would need to be agreed upon by both the company and the landowner, which is likely to ensure that the compensation levels are fair and appropriate to the size of land unable to be rehabilitated and the associated long-term costs (financial or opportunity-costs).				landowner and local council.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could affect land access and use. Landholder consultation (that informs landowner consent and compensation agreements and lease agreements) is dictated by the nature and scale of the petroleum activity. However, the legislation is clear that gas developers must enter into a land agreement prior to commencing exploration which is expected to have a neutral impact for landowners.

With respect to the adequacy of community consultation, it was found that the process would be assumed to be consistent for each of the projects, and therefore the impact would increase in line with the exploration and development levels across the scenarios. The size of land impacted by gas exploration and development activities are expected to increase directly within an increase in production as there is a correlation with the number of wells and infrastructure built under each scenario. However, the absolute size of land required for conventional gas exploration and production is relatively small, and with underground pipelines, there is no evidence to suggest that there is significantly reduced land available to other users.[119]

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[117] *Petroleum Act 1998 (Vic). s170.*
[118] *Petroleum Act 1998 (Vic).* s132.
[119] Advice provided by the department.

It is anticipated that increases in land value will be negligible and devaluation of land will be mitigated through compensation to directly impacted land owners resulting in negligible residual impact.

Therefore, based on the ratings in the analysis the scenarios are expected to have neutral impacts (Table 120).

The risk of inadequate rehabilitation is expected to be low across all scenarios as the Petroleum Regulatory Framework requires operators to restore land that was developed and for any land that can no longer be returned to its original state, landowners will be appropriately compensated (Table 121).

Table 120: SR3: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 121: SR3: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

5.2.2.4 SR4: The Aboriginal community and people

What impacts are there on the Aboriginal community?

Benefits and impacts

The analysis has identified the following key benefits and impacts to the Aboriginal community and people with respect to the Gippsland hypothetical exploration and development scenarios:

- awareness of gas development by the Aboriginal community
- reconciliation action plan for potential operators
- number of Aboriginal community members employed (direct)
- number of Aboriginal businesses impacted (indirect).

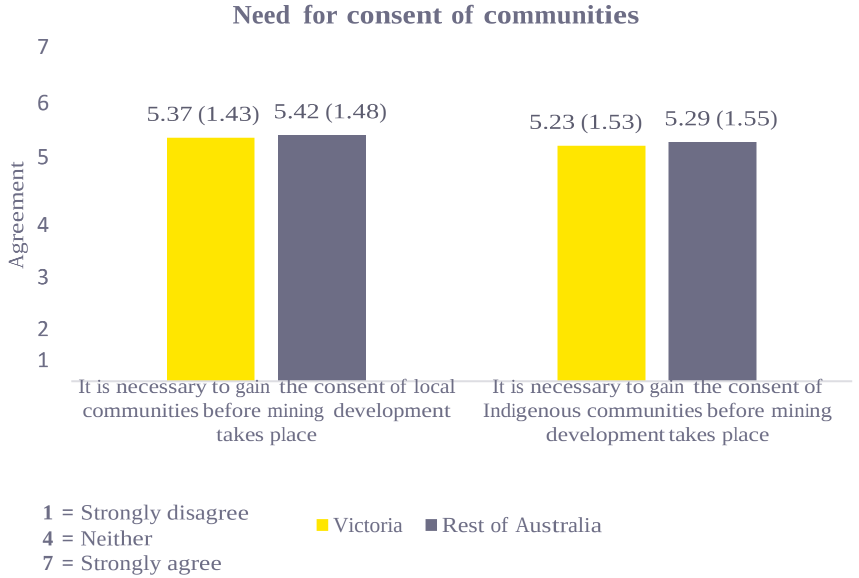
These can be impacted by the existence of an ILUA and CHMP, which are discussed below.

Existence of an Indigenous Land Use Agreement

Within Australia, there is a consensus that Indigenous communities should provide consent before gas development takes place. Results of the commissioned CSIRO report into attitudes into onshore conventional gas production show that Victorians surveyed agree that it is necessary for gas companies to gain consent of Aboriginal communities before gas development takes place (M = 5.23) (as shown in Figure 52).[120] This is reinforced by the Victorian Government commitment to set up treaty agreements with First Nations.[121] This provides the Aboriginal community and people with a voice and further mitigates any negative impacts to the Aboriginal community if they are heard.

[120] CSIRO (2017). *Victorian attitudes towards mining Citizen Survey*.
[121] Aboriginalvictoria.vic.gov.au. (2020). *Treaty in Victoria*. [online] Available at: https://www.Aboriginalvictoria.vic.gov.au/treaty [Accessed 3 Feb. 2020].

Figure 52: Mean ratings for need for consent from communities before mining takes place



Source: CSIRO (2017). Victorian attitudes towards mining Citizen Survey.

As such, an ILUA may be negotiated between Native Title groups and others about the use of land.[122]

Cultural Heritage Plan

The land potentially used in Gippsland for conventional gas exploration and development may encroach land under Native Title.[123] See Figure 53 for regional registered Native Titles.

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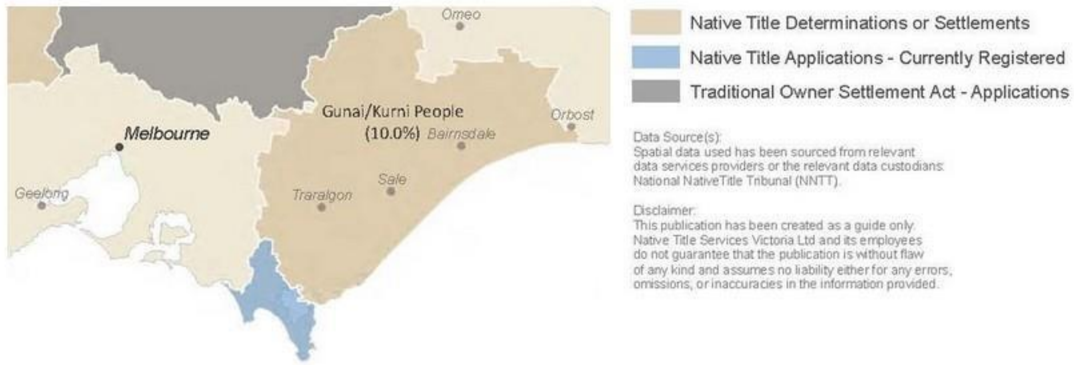
[122] Nativetitle.org.au. (2020). *Native title, rights and interests | Prescribed Bodies Corporate*. [online] Available at: https://www.nativetitle.org.au/learn/native-title-and-pbcs/native-title-rights-and-interests [Accessed 3 Feb. 2020].
[123] Information provided by the department.

Figure 53: Native Title Act Applications and Determinations, and Traditional Owner Settlement Act - Applications and Settlements in Victoria as of 30 June 2016



Source: ANTaR Victoria. (2020). Local Nations – ANTaR Victoria. *[online] Available at: https://antarvictoria.org.au/local-nations [Accessed 14 Jan. 2020].*

These regions could have significant Aboriginal cultural heritage (i.e. isolated archaeological artefacts including stone tools or surface scatters), which could be impacted by gas exploration and development activities. Natural water features (i.e. rivers, creeks, wetlands) and landmarks (i.e. scar trees, rock formations, etc) may have cultural significance to Aboriginal communities. These may be difficult to identify and avoid as they are a part of the natural landscape and not man-made. The impacts on Aboriginal cultural heritage is discussed under SR6 in Section 5.2.2.6.

Summary of benefits and impacts

The assessment of impacts to the Aboriginal community and people is summarised in Table 122.

Table 122: Key benefits and impacts to the Aboriginal community and people

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Awareness of gas development by the Aboriginal community	Disseminating information about the gas exploration and development activities to the Aboriginal community and people is voluntary and can begin prior to development and exploration and extend into the rehabilitation phases of the project.	Appropriate dissemination of information may result in: ► transparency with the Aboriginal community and people ► awareness of gas development within Aboriginal community and people. The benefits of adequately providing information about gas exploration and development activities to the Aboriginal community is consistent for each of the scenarios, as it would be expected that all scenarios would need to have similar systems and process in place. As such, each scenario has been allocated a slightly positive benefit.	The Petroleum Act requires that companies consult with interested people and parties during the development of an operations plan. The Petroleum Regulations require operators to provide appropriate consultation for the life of the operation about the environmental performance of the development with interested people and organisations. There is no explicit requirement to consult to a standard and it is not incumbent on an authority holder to continually engage with the local community. There is also a low level of government scrutiny around the extent of consultation that must be undertaken. Despite the legal requirement for consultation and engagement not being prescribed, it is standard petroleum industry practice to engage with the Aboriginal community when industry activities occur on are nearby Aboriginal land. The existence of an ILUA, CHMP and RAP allow for operators to further their communication with the Aboriginal communities. Both are discussed in subsequent measures.	Low: Med: High:	Possible legislative improvements derived from the VGP gap analysis would provide additional regulatory framework, requiring enhanced community consultation. There would also be a requirement that certain information relating to government decisions and industry activity is publicised. The VGP community engagement function will provide information to Aboriginal communities about the risks benefits and impacts of developments in their area and at a regional scale.
RAP for potential operators	RAPs can be implemented to provide a framework for organisations to support the national reconciliation movement.	Provides practical actions to drive reconciliation both internally and within the community. While not required, industry practice is to develop a RAP.	N/A	Low: - Med: - High: -	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		As an example, Origin implemented a RAP in 2015, with aspirations identified in the following areas: ► building a culture of respect ► providing education, skills, jobs and careers ► commerce and community development ► developing and maintaining relationships and partnerships ► governance and disclosure.[124] The benefits of having a RAP will be consistent for each scenario. However, as this is not within the regulatory framework, it is assumed to provide a neutral impact under each case.			
Number of Aboriginal community members employed (direct)	Ongoing operation under the proposed hypothetical scenarios will create ongoing employment opportunities for residents in the region, including the Aboriginal community and people.	Employment opportunities for the Aboriginal community and people may: ► increase apprenticeship opportunities for the Aboriginal community and people ► encourage higher education and skill levels of the Aboriginal community and people. Australian Bureau of Statistics 2016 data shows that 1.8 per cent of the catchment region within the Gippsland catchment region identifies as Aboriginal or Torres Strait Islander.[125] Within Victoria, 2016 Census data also shows that 52 per cent	The *Traditional Owner Settlement Act 2010* enables the Aboriginal community and people to be employed as a part of the Natural Resource Agreements framework, which allows for strategies to be implemented to enable traditional owner group members to participate in or obtain employment.	Low: - Medium: - High: -	N/A

[124] Origin (2019). *Stretch Reconciliation Action Plan July 2019-June 2022*.
[125] EY independently accessed the indigenous population data from the 2016 ABS Census, extracted the relevant LGA data and averaged the percentage related to Indigenous and Torres Straight Islanders in the region. 1.8 per cent is the average population of Aboriginal and Torres Straight Islanders in the catchment. Accessed via: https://itt.abs.gov.au/itt/r.jsp?databyregion

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		of the Aboriginal community and people are in the labour force.[126] [127] The economic impact analysis indicates that the proposed hypothetical scenarios have the potential to deliver an annual average additional 19.7 FTE to the region under the low scenario, 44.2 FTE under the medium scenario and 63.6 FTE under the high scenario. While it is not possible to estimate the number of the Aboriginal community and people that may be employed under the exploration and development scenarios, these additional jobs provide opportunities for employment for the Aboriginal community and people. Without regulation enforcing this, all three Gippsland scenarios are expected to have a neutral impact in creating ongoing employment opportunities for the Aboriginal community and people. Its noted that future capacity building projects with Aboriginal communities may result in increased workforce participation among Aboriginal residents within the region.			
Number of Aboriginal businesses impacted (indirect)	Aboriginal businesses could be hired directly or indirectly to assist with either the construction/drilling phases or the operational phases of gas exploration and development.	Information has not been provided to draw conclusions on whether there are any benefits for the Aboriginal community and people from a business perspective.	The *Traditional Owner Settlement Act 2010* enables the Aboriginal community and people to be employed as a part of the Natural Resource Agreements framework, which allows for strategies to be implemented to enable traditional owner group members to participate in or obtain employment.	Low: N/A Medium: N/A High: N/A	N/A

[126] Labour force refers to individuals who are employed or unemployed and looking for work.

[127] *Abs.gov.au. (2020).* 2076.0 - Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians, 2016. *[online] Available at: https://www.abs.gov.au/AUSSTATS/Abs@.Nsf/7d12b0f6763c78caca257061001cc588/5f17e6c26744e1d1ca25823800728282!OpenDocument [Accessed 3 Feb. 2020].*

Summary of risks

The assessment of risks to the Aboriginal community and its people is summarised in Table 123.

Table 123: Key risks to the Aboriginal community and its people

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Impact to Native Title	Native Title refers to the recognition of the rights and interest of land and waters of the Aboriginal community according to their traditional law. This provides Native Title holders a number of rights. Depending on the location of wells, pipelines and gas plants, development can encroach on Native Title land. This can include: ► vacant (or unallocated) Crown land ► parks and public reserves ► beaches ► leases ► land held by government agencies or Aboriginal and Torres Strait Islander communities ► oceans, seas, reefs, lakes, rivers creeks and other waters that are not privately owned.[128]	If drilling was to occur in potential cultural heritage sights, this could result in: ► damage to Native Title land during the development process. Damage to Native Title land could occur during the exploration and construction phase as this is when land would be accessed and used to produce gas. For Gippsland scenarios: ► low: 2022-2039 ► medium: 2022-2035 ► high: 2022-2035.	The Native Title Act recognises the rights and interests of Aboriginal and Torres Strait Islander communities in land and waters. The Act also regulates any potential commercial operations over this land. Therefore, gas production would have to be complaint with Native Title Requirements. An ILUA may be negotiated between Native Title groups and others about the use of land.[129] According to the National Native Title Tribunal, an ILUA can be: ► over areas where Native Title has, or has not yet, been determined ► entered regardless of whether there is a Native Title claim over the area or not ► part of a Native Title determination or settled separately from a Native Title claim.[130] ILUAs can cover topics a range of topics including: ► Native Title holders agreeing to future development	Highly unlikely	Serious	Low	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations; ► provision for improved consideration of social, economic and environmental factors in decision-making; ► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to Native Title holders that industry will provide them with information about onshore conventional gas activities. The reforms will also ensure that Native Title holders are genuinely

[128] Nativetitle.org.au. (2020). *Native title, rights and interests | Prescribed Bodies Corporate*. [online] Available at: https://www.nativetitle.org.au/learn/native-title-and-pbcs/native-title-rights-and-interests [Accessed 3 Feb. 2020].
[129] Nntt.gov.au. (2020). *About Indigenous Land Use Agreements (ILUAs)*. [online] Available at: http://www.nntt.gov.au/ILUAs/Pages/default.aspx [Accessed 1 Feb. 2020].
[130] Nntt.gov.au. (2020). *About Indigenous Land Use Agreements (ILUAs)*. [online] Available at: http://www.nntt.gov.au/ILUAs/Pages/default.aspx [Accessed 1 Feb. 2020].

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	Native title cannot be claimed in relation to gas under Australian Law.		► access to an area ► compensation ► employment and economic opportunities for Native Title groups ► cultural heritage mining.[131] Entering an ILUA is voluntary for organisations, and operators can enter into an agreement prior to commencing development. While the existence of an ILUA isn't mandatory for developers, it is industry practice to have one in place. An example of this is Beach Energy, who entered an ILUA with the Kirrae Whurrong, now Eastern Maar Native Title Group. If implemented, the ILUA would be in place for the duration of the project. If implemented, an ILUA would bind all parties and Native Title holders to the terms of the agreement The Petroleum Act requires that a compensation agreement be made where Native Title exists. Compensation is payable for any loss or damage that has or will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land. Compensation will be payable during the exploration and development stages once land is acquired. Additional compensation may also be payable during rehabilitation stages if land or assets are damaged or lost.				engaged over the entire industry lifecycle. This may influence their attitudes towards development and exploration in the region. The proposed VGP community engagement function will provide information to Aboriginal groups about the risks benefits and impacts of developments in their locality.

[131] Nntt.gov.au. (2020). *About Indigenous Land Use Agreements (ILUAs)*. [online] Available at: http://www.nntt.gov.au/ILUAs/Pages/default.aspx [Accessed 1 Feb. 2020].

Overall assessment

The qualitative assessment considered the extent to which Gippsland hypothetical exploration and development scenarios could affect the Aboriginal community and its people within the region. While there is potential for drilling and development to encroach on land under Native Title, or impact on Aboriginal people, mitigations measures limit these potential impacts and risks.

Engagement activities undertaken by operators can result in slightly positive outcomes for the Aboriginal community and its people within the region as they increase transparency of gas exploration and development with the Aboriginal community. The implementation of RAPs of operators and creation of ongoing employment within the Gippsland catchment region also provides employment and business opportunities for Aboriginal community members and businesses and provide practical actions to drive reconciliation both internally and within the community. However, this is not enforced under existing legislation, it is expected to have a neutral impact.

Overall, this results all scenarios having slightly positive impacts on the Aboriginal community and its people based on the average rating across all benefits and impacts (Table 124).

The risk of gas exploration and development activities occurring in areas covered by Native Title have been assessed as serious in consequence with a highly unlikely likelihood which results in the hypothetical scenarios having a low risk (Table 124). This is mitigated through several measures, including the Native Title Act, and the implementation of an ILUA.

Table 124: SR4: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 125: SR4: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

5.2.2.5 SR5: Schools, education and vocational capacity

What educational opportunities are created?

Benefits and impacts

The analysis has identified the following key benefits and impacts to schools, education and vocational capacity with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- projected increase in apprenticeships and population growth
- contributions to school funding.

These benefits and impacts are described further below.

Projected increase in apprenticeships, and population growth

The implementation of gas exploration and development in the Gippsland region increases the demand for skilled labourers in the area for the life of the project. This may lead to:

- increased demand for workers, creating employment opportunities
- increased apprenticeship opportunities
- higher educational attainment
- an indirect impact on income.

Increase in demand for workers, creating employment opportunities

The economic impact analysis found that the Gippsland Basin exploration and development scenarios would result in employment growth primarily in the Gippsland region, ranging from an average annual additional 19.7 FTE under the low scenario to an average annual additional 63.6 FTE under the high scenario (as set out in Section 5.2.1.1).

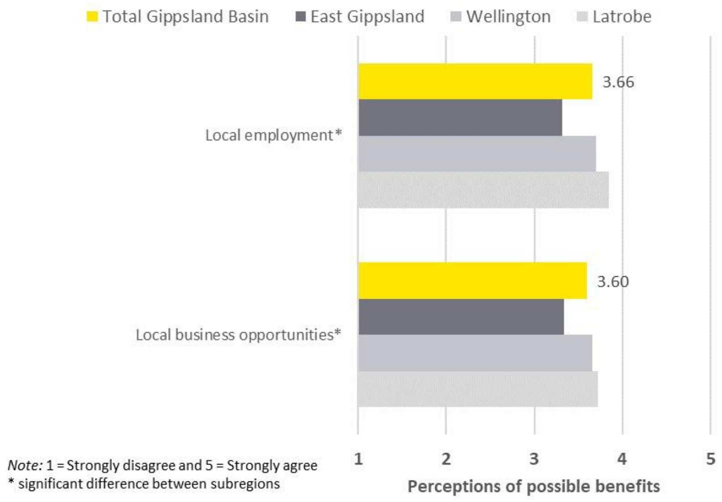
These findings are consistent with a study conducted in the Northern Territory that found that gas development generated an increase in FTEs within the region from 2,154 in the low scenario to 13,611 in the high scenario over the forecast period of 25 years.[132]

Drawing on the evidence above, it is expected that the job market may benefit from development and gas exploration in the Gippsland region and that as production increases, so too will the potential regional demand for labour.

This correlates with the community's expectations of local benefits. Recent community engagement undertaken by CSIRO found that the community overall perceived that onshore conventional gas development would lead to local employment opportunities and local business opportunities (see Figure 54).

[132] ACIL Allen Consulting (2017). The economic impacts of a potential shale gas development in the Northern Territory". Access via: https://frackinginquiry.nt.gov.au/inquiry-reports?a=465934

Figure 54: Perceived significant local benefits from onshore conventional gas development in Gippsland Basin: By subregion, 2019 – Local employment and local business opportunities



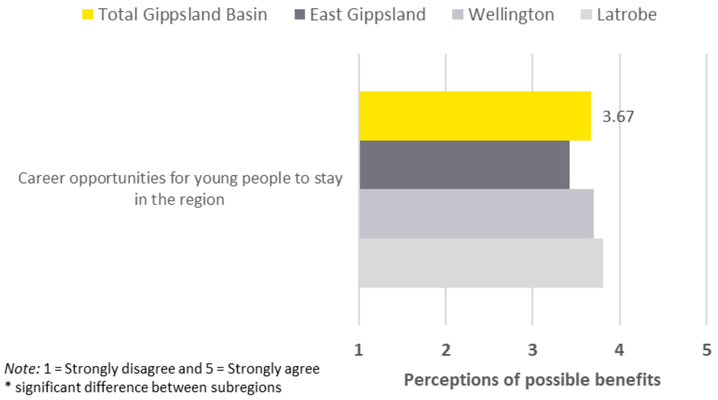
Source: CSIRO, 2019, Community wellbeing and local attitudes to onshore conventional gas development in Gippsland: Interim report (in prep).

Increased apprenticeship opportunities

Increased demand for workers may occur across all levels of employment, including new career opportunities for young people (e.g. apprenticeships). Skilled labour in the region may therefore increase, resulting in diversified skill sets and increasing overall incomes. Diversified employment opportunities may encourage community members to stay within the region for work or can result in more people relocating the region for employment.

The CSIRO community research also found that the community overall perceived that onshore conventional gas development would lead to career opportunities for young people to stay in the region (see Figure 55).

Figure 55: Perceived local benefits from onshore conventional gas development in Gippsland: By subregion, 2019 – Career opportunities for young people to stay in the region



Source: CSIRO (2019). Community wellbeing and local attitudes to onshore conventional gas development in Gippsland: Interim report (in prep).

Higher educational attainment

The overall educational attainment in the region is low compared to state averages. ABS 2016 census data shows that in the Gippsland Region, 35.1 per cent of persons aged 15 years and over have a have completed year 12 or equivalent, while only 11.8 per cent have completed a bachelors degree or higher. This is considerably lower than the state average whereby 54.4 per cent of per cent of persons aged 15 years and over have a have completed year 12 or equivalent, and 24.4 per cent have completed a bachelor's degree or higher. Increased production and skilled labour in the area could encourage higher educational attainment and skill levels in the region, due to the increase in local higher skilled career opportunities.

Indirect impact on income

The economic impact analysis found that the Gippsland Basin exploration and development scenarios would result in growth in GRP growth primarily in the Gippsland region, ranging from an average annual increase of $12.37 million in GRP under the low scenario to an average annual increase of $48.38 million in GRP under the high scenario (as set out in section 5.2.1.3).

This is consistent with findings of other studies into the economic impact of gas development. In 2019, an analysis of development scenarios for South East South Australia was completed. Results suggest a net increase of $32 million in gross regional product and increase in employment of 16 FTE over 10 years for the scenario deemed most likely by stakeholders.[133]

A study into the economic impacts of early unconventional gas development in New South Wales found a 7 per cent increase in family income in regions with CSG development compared to those without for a gas industry including approximately 430 gas wells.[134] This compared to a 15 per cent increase in family income for gas development in Queensland including over 4,000 wells.[135]

The increase in demand for skilled labourers and employment opportunities may occur throughout all phases of the gas operation lifecycle. The scale of production and time over which production occurs varies across the Gippsland Basin exploration and development scenarios:

- low scenario: total production of 35 PJ, with production occurring over a six-year timeframe
- medium scenario: total production of 70 PJ, with production occurring over a seven-year timeframe
- high scenario: total production of 105 PJ, with production occurring over a ten-year timeframe.

The level of employment and apprenticeship opportunities is expected to increase across the Gippsland Basin exploration and development scenarios as greater number of people will be required to develop and operate more exploration and development wells and produce higher volumes of gas. The scenarios will all provide employment and apprenticeship opportunities and will have slightly positive impacts for the region.

Contributions to school funding:

Gas production companies generally contribute to the education and schools in the regions where they operate. Aside from rates paid to local governments, producers also can contribute to educational institutions directly and fund projects that have positive educational benefits. For example, gas producer Beach Energy funded a Let's Read program through the Corangamite Shire Council.[136] Producers are also known to undertake school visits to create aspiration and employment opportunities for knowledge workers in the region.

This contribution to education may occur throughout all phases of the gas operation lifecycle. The extent of contribution could vary based on a number of factors, including the locations of operations, size of operations and commercial return obtained by producers. As the Gippsland Basin

[133] Poruschi, L. and Measham, T. (2020). *Assessing the value of locally produced conventional gas in South Eastern South Australia*. [online] Gisera.csiro.au. Available at: https://gisera.csiro.au/wp-content/uploads/2018/07/Social-12-Project-Order.pdf [Accessed 18 Jan. 2020].
[134] Marcos-Martinez, R., Measham, T. and Fleming-Muñoz, D. (2019). Economic impacts of early unconventional gas mining: Lessons from the coal seam gas industry in New South Wales, Australia. *Energy Policy*, 125, pp.338-346.
[135] Fleming, D. and Measham, T. (2014). Local economic impacts of an unconventional energy boom: the coal seam gas industry in Australia. *Australian Journal of Agricultural and Resource Economics*, 59(1), pp.78-94.
[136] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished report.

exploration and development scenarios only produce gas in one geographical region, and the level of production is small across all scenarios, the contribution to education is not expected to vary between scenarios.

Summary of benefits and impacts

The assessment of impacts to the schools, education and vocational capacity is summarised in Table 126.

Table 126: Key benefits and impacts to schools, education and vocational capacity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Projected increase in apprenticeships and population growth	Onshore conventional gas exploration and development in the Gippsland region increases the demand for skilled labourers in the area for the life of the project. This creates employment opportunities in the catchment area as it presents employment in the gas industry as viable, without having to relocate considerably to obtain work.	Gas exploration and development in the Gippsland region may result in: ► increase in demand for workers ► employment opportunities ► increased apprenticeship opportunities ► increased production and skilled labour in the area could encourage higher educational attainment and skill levels in the region ► indirect impact on income As the number of sites increases, so too does the demand for workers in the region, enabling an increase in apprenticeships offered to the local community. The increase in demand for skilled labourers and employment opportunities will occur throughout all phases of the gas project lifecycle. The level of employment and apprenticeship opportunities will increase across the scenarios as greater number of people will be required to develop and operate more exploration and development wells and produce higher volumes of gas.	N/A	Low: Med: High:	N/A
Contributions to school funding	Gas production companies generally contribute to the education and schools in the regions where they operate. Aside from rates paid to local governments, producers also can contribute to educational institutions directly and fund projects that have positive educational benefits.	Funding to schools: ► would result in direct financial contribution to educational institutions ► may result in contribution to careers programs in schools.	N/A	Low: - Med: - High: -	N/A

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		This contribution to education will occur throughout all phases of the gas operation lifecycle. The extent of contribution could vary between the Gippsland Basin exploration and development scenarios as the number of locations where gas is developed changes. As the number of locations increase where gas is developed, contributions to school funding or education programs could increase, however this would be dependent on a number of factors, including the locations of operation, size of the operations and commercial return obtained by producers increases in line with development. However, as this contribution is not required by the regulatory framework, the impact has been assessed as neutral.			

Risk

The analysis has not identified any risks to schools, education and vocational capacity with respect to the Gippsland Basin hypothetical exploration and development scenarios.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin hypothetical exploration and development scenarios could affect schools, education and vocational capacity.

With respect to projected increase in apprenticeships, and population growth, the assessment found that increases in the extent of gas production results in increases in employment, wage and salary income, and median household income. This is consistent with the perceived local perceptions of benefits from onshore conventional gas development in the Gippsland region. As production increases, so too does the demand for labour in the region. As such, increase in benefits is correlated with an increase in gas production.

Similarly, contributions from industry to school funding are expected to result in increasing levels of benefits dependent on several factors, including the number of locations where gas is developed, and size of gas development and exploration. However, as this contribution is not required by the regulatory framework, the impact has been assessed as neutral.

Therefore, the low, medium and high scenarios are expected to have a positive impact on the schools, education and vocational capacity, based on the average rating for each impact.

No risks were identified for this receptor.

Table 127: SR5: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.2.6 SR6: Protection of cultural heritage

How (if any) will areas of cultural heritage be affected?

Benefits and impacts

The analysis has not identified any benefits or impacts to cultural heritage with respect to the Gippsland hypothetical exploration and development scenarios.

Risk

The analysis has identified the following key risks to the protection of cultural heritage with respect to the Gippsland hypothetical exploration and development scenarios:

- risk to non-Aboriginal cultural heritage sites
- risk to Aboriginal cultural heritage.

These risks have been described further below.

Identification and protection of sites of cultural heritage

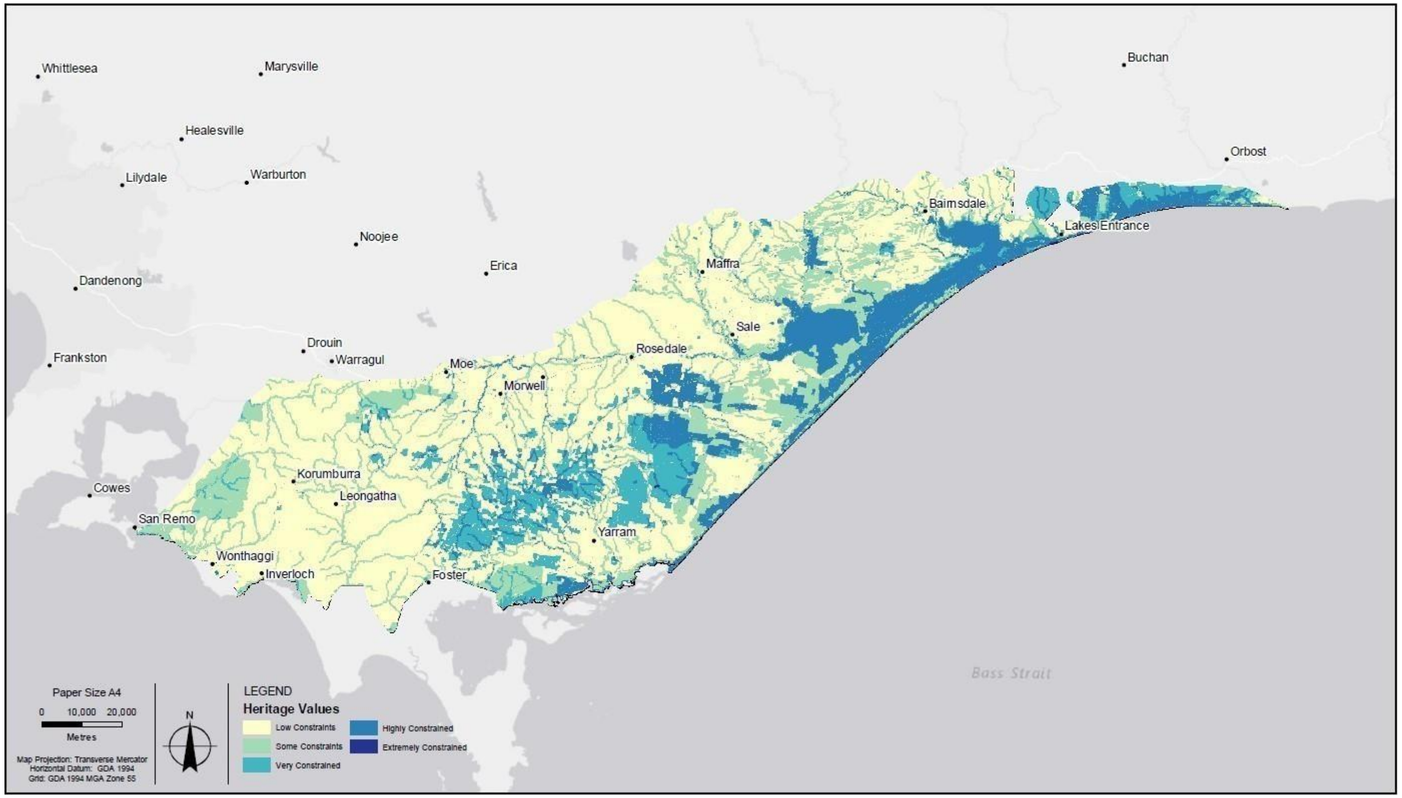
As a part of the planning stages for the VGP, the department has prepared a resource and land use planning model to assess a region's landscape, features and values.[137]

The land use and planning analysis included the identification of areas of significant Aboriginal, cultural, European and natural heritage values. Figure 56 shows the results of the assessment.

While only a small area has been identified as being extremely or highly constrained in relation to cultural heritage, in the Gippsland Basin area (less than 13 per cent of the total area), datasets containing locations and databases identifying sites of aboriginal cultural sensitivity are not currently publicly available and therefore the model is not reflective of what exists on the ground.[138] This information is held by the local Traditional Owners and would be assessed on a site by site basis as part of any individual development's CHMP.

[137] Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Gippsland Basin, Victoria (in prep).
[138] Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Gippsland Basin, Victoria (in prep).

Figure 56: Victorian Gas Program Gippsland Land Use Planning Model: Heritage Values (preliminary)



Source: Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Gippsland Basin, Victoria (preliminary) (in prep).

While constraints have been identified in areas across the entire basin, the specific location of gas exploration and development under each scenario is not known. As such, it is difficult to assess how likely it is areas of cultural, religious or Indigenous significance could be affected. However, the following considerations have been applied:

- in open farmland areas, the likelihood of encountering previously unrecorded heritage artefacts is low
- in vegetated areas, the likelihood is higher, especially near watercourses.[139]

[139] Information provided by the department.

Most Indigenous cultural heritage sites are protected and will be assessed as part of any individual development proposal and subsequent Cultural Heritage Plan developed as part of the legislated EMP, as outlined in Table 128. In practice, operators would seek to avoid cultural heritage areas where possible. Where this is not possible, the measures identified in the Cultural Heritage Plan would mitigate the impact on cultural heritage, as well as the additional control measures, as outlined in the table above.

The residual risk is unlikely to vary across different levels of exploration and development. The likelihood of the risk occurring, and consequence of the risk is independent of the level of development being undertaken. This is because the legislative requirements require these impacts to be mitigated and managed to an acceptable level.

Summary of risks

The assessment of risks to protection of cultural heritage is summarised in Table 128.

Table 128: Key risks to the protection of cultural heritage

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Damage or loss of non-Aboriginal cultural heritage sites and places	The land in Gippsland identified in the hypothetical scenarios may encroach on areas of non-Aboriginal cultural heritage. In the Gippsland catchment region, there are 1,359[140] heritage sites registered with Heritage Council Victoria.[141]	If activity was to occur in potential cultural heritage sites or places, this could result in: ► irreparable damage to or permanent loss of sites of non-Aboriginal heritage ► irreparable damage to or permanent loss of sites of religious significance.	The potential impacts to cultural heritage sites and places and measures to control these are addressed in an EMP and where relevant, a CHMP and EES.[142] An EMP requires the management of cultural heritage impacts. A CHMP is developed during the initial stages of the project and be implemented throughout the development and exploration phases. A specialist cultural heritage consultant who is qualified and experienced may be engaged to undertake the necessary cultural heritage research and field surveys to assess possible disturbances. These areas must be avoided during exploration and development where possible. Where not possible, removal and relocation of the material is undertaken in accordance with Heritage Victoria and/or local council.	Highly unlikely	Severe	Moderate	N/A

[140] This amount was calculated by adding all heritage sites from each of the LGAs within the Gippsland catchment region. Note, many of these heritage sites will not be within areas where drilling is expected.
[141] Vhd.heritagecouncil.vic.gov.au. (2020). *VHD.* [online] Available at: https://vhd.heritagecouncil.vic.gov.au/ [Accessed 29 Jan. 2020].
[142] Advice provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			Non-Indigenous heritage (such as ruins) is managed under the Heritage Act. This Act establishes the Victorian Heritage Register that provide legal protection for heritage places and objects. Impacts on these sites must be managed as part of an EMP. These sites are often more easily identified than those of Indigenous heritage as often use western building materials (such as bricks) which are easily recognisable. Impacts on cultural heritage is within scope of EES assessments where these are required.[143] This assessment will expect that impacts on local cultural heritage is reduced to the lowest level possible. Members of the public can provide written comments as a part of this. The EPBC Act also provides a legal framework to heritage places as defined as matters of national environmental significance. Drilling in environmental heritage sights must comply with the regulations set out in this Act. The nature of the conventional petroleum industry is such that there is flexibility to locate drill sites. To save on costs associated with cultural heritage disturbance, industry will routinely locate drill sites to where they cause least disturbance.[144] In addition, the physical footprint and earth disturbance associated with the petroleum industry is low relative to other resource industries.				
Damage to or loss of Aboriginal cultural heritage sites or places	The land in Gippsland identified in the hypothetical scenarios may encroach on areas of Aboriginal cultural heritage, land sacred	If activity was to occur in potential Indigenous heritage sites or places, this would result in: ► irreparable damage to or	Control measures are consistent with those set out in Damage or loss of non-Aboriginal cultural heritage sites and places. The Aboriginal Heritage Act requires that a CHMP be in place if the petroleum activity is within an area of cultural significance.	Highly unlikely	Severe	Moderate	N/A

[143] Advice provided by the department.
[144] Advice provided by the department.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	to Aboriginals and/or Native Title land.[145]	permanent loss of sites of Indigenous heritage ► damage to or permanent loss of artefacts of Indigenous heritage.	A CHMP involves: ► assessing the area to determine the nature of any Indigenous cultural heritage sites or objects in the area ► writing a report stating the results of the assessment and recommendations for measures to be undertaken before, during and after gas production and exploration to manage and protect the cultural heritage identified. The plan must then be approved by the required registered Aboriginal party.				

Overall assessment

The qualitative assessment considered the extent to which the Gippsland hypothetical exploration and development scenarios could affect cultural, religious or Indigenous heritage sites.

No benefits or impacts to cultural heritage with respect to the Gippsland hypothetical exploration and development scenarios were identified.

Areas of Aboriginal and non-Aboriginal cultural heritage within the region are unlikely to be impacted by the Gippsland hypothetical exploration and development scenarios. This is because the risks to cultural and indigenous heritage sites are mitigated through the regulatory framework (including the Heritage Act and the *Aboriginal* Heritage Act) once it is recognised that the land is of cultural, religious/spiritual and/or Indigenous significance through cultural heritage surveying. However, if development occurred on sites of significance, this could result in irreparable damage to the place of significance. Therefore, the scenarios are expected to have a moderate risk on the protection of cultural heritage receptor (Table 129).

Table 129: SR6: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

[145] Information provided by the department.

5.2.2.7 SR7: Existing farm industries, food and biosecurity

How will surrounding farm and food production, and biosecurity be impacted?

Benefits and impacts

The analysis has identified the following key benefits and impacts to existing farm industries, food and biosecurity with respect to the Gippsland hypothetical exploration and development scenarios:

- ability to co-exist with existing agriculture industries
- disturbance to livestock located near petroleum activities
- gross size of farming land used for exploration/development
- stress and financial burden to farmers to negotiate compensation agreements.

These impacts are described further below.

Ability to coexist with existing agriculture industries:

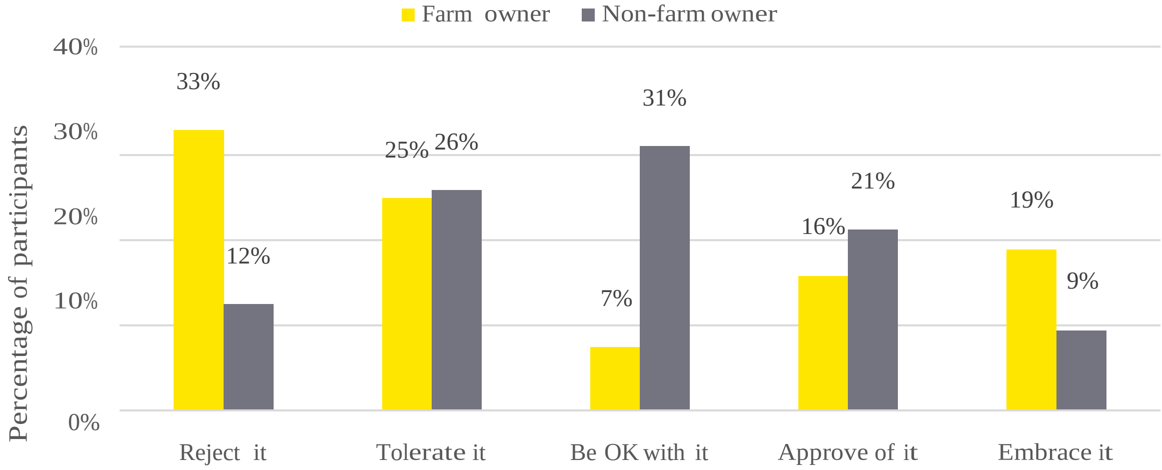
There are both planned and unplanned disturbances that would occur due to onshore conventional gas development and exploration.[146] Planned disturbances are activities that result from land acquisition as discussed in Figure 57. Unplanned disturbances to farming activities are activities that do not have pre-negotiated compensation agreements. These disturbances may include:

- the loss of crops or pasture outside of agreed seismic survey lines, well lease pads or pipeline RPs
- the potential for a vehicle strikes with livestock
- interference with optimal crop sowing or harvesting patterns
- damage to paddocks or infrastructure.

The ability to coexist with existing agriculture industries may also be impacted by farmers perceptions of onshore gas development and subsequently the farmers and community's willingness to allow onshore gas development on their property and region. The CSIRO study found that attitudes of farmers towards onshore gas development in the Gippsland basin are more negative when compared to the attitudes of non-farm owners, as displayed in Figure 57.[147] This is reflective of the perceived disturbances (both planned and unplanned) to farming activities caused by onshore conventional gas development.

[146] Information supplied by the department.
[147] CSIRO (2019). *Local attitudes and perceptions of onshore conventional gas development: Otway and Gippsland Basins Initial Results*.

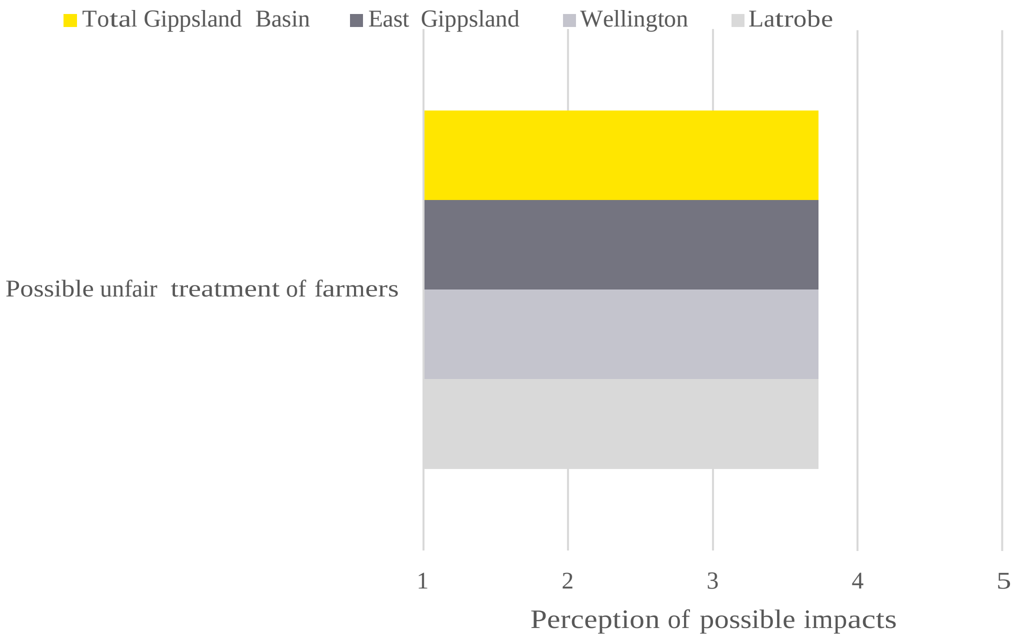
Figure 57: Attitudes towards onshore conventional gas development in Gippsland: By farm ownership, 2019



Source: CSIRO (2019). Community wellbeing and local attitudes to onshore conventional gas development in the Gippsland Basin: Interim report.

The CSIRO study also found that the general community in the Gippsland Basin region has concerns about the possible unfair treatment of farmers, as shown in Figure 58.

Figure 58: Perceived impacts about onshore conventional gas development in Gippsland: By subregion, 2019



Note: 1 = not at all concerned and 5 = very concerned; the higher the score the greater

Source: CSIRO (2019). Community wellbeing and local attitudes to onshore conventional gas development in Gippsland: Interim report (in prep).

Similar studies that have taken place in South Australia show that farmers attitudes towards gas production on their premises have changed since wells and pipelines were developed in the region.[148] Participants reported they appreciate the more developed roads in the region and noted that the land used for development was minimal, pipelines were buried and there was little impact on their business as usual activities.

[148] CSIRO (2019). *Understanding natural gas impacts and opportunities on agriculture in the South East of South Australia.*

The MLUF can be used where land access and land use conflict has the potential, real or perceived, to arise. The framework supports the ability of local and regional communities and governments to maximise land use in a flexible, environmentally sustainable manner over time. The MLUF is designed to operate within established regulatory and policy frameworks relating to land ownership, usage and access.[149]

The MLUF guiding principles underpin key areas of activity and include:

- best use of resources
- coexistence
- strategic planning
- tailored participation of communities and landholders
- engagement and information
- decision making and accountability
- efficient processes
- accessible relevant information.[150]

The VGP's resource and land use planning assessed land use and features in line with the MLUF. The methodology for the resource and land use planning project supports flexible land use and management options that increase productivity, support key industry and food systems, promote governance over land and water resources, meet community needs and safeguard natural resources, ecosystems and economies for current and future generations.[151]

The resource and land use planning developed a model that provides a high-level regional assessment of the land within the Gippsland Basin in relation to suitability of onshore conventional gas development which demonstrates constraints and opportunities for the potential for multi and sequential land use. The resource and land use planning model identifies:

- land that may not appropriate for coexistence with development, or
- there are features of sensitivity or significance that would need to be considered and addressed prior to any exploration or development proceeding (through the provisions of the Petroleum Regulatory Framework in relation to the preparation and implementation of EMPs for petroleum operations).

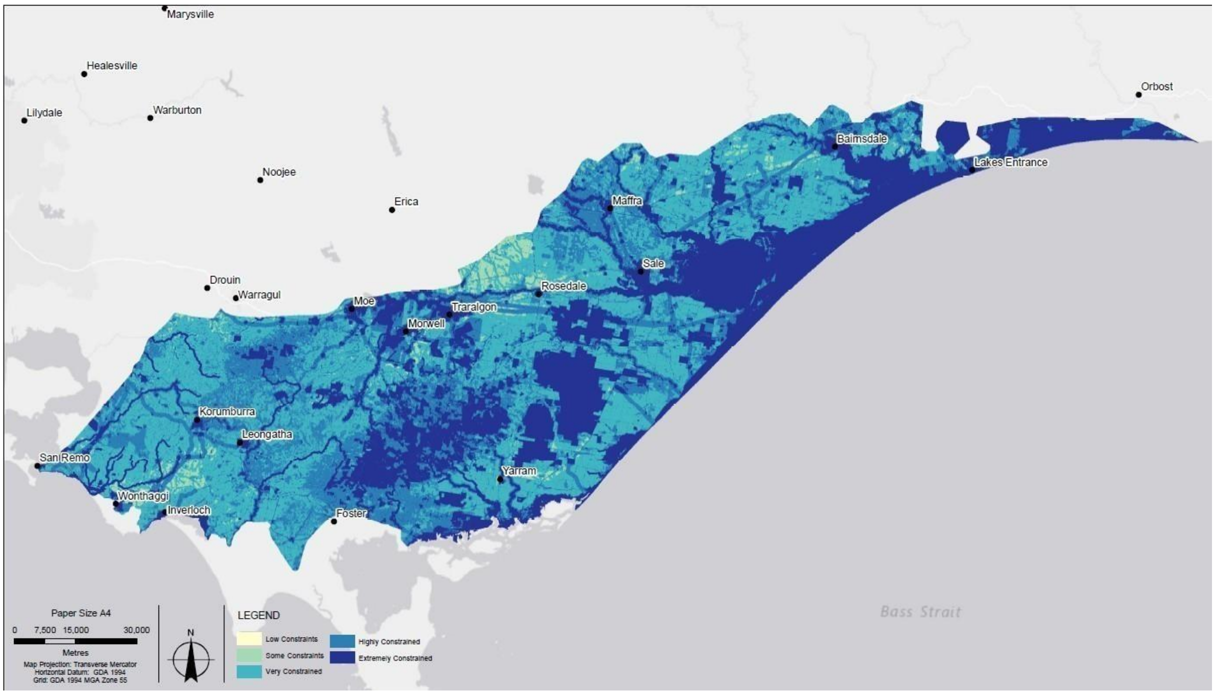
Figure 59 shows the social value constraints of the proposed regions which is comprised mostly by grazing and cropping land with residential and forest areas. This shows that there are a number of areas throughout the Gippsland region that are highly and extremely constrained. In particular areas identified in the model as highly constrained include:

- areas already prohibited and restricted through existing legislation
- areas within and surrounding townships and residential zones
- areas along rivers and near water bodies

[149] COAG (2013). *Multiple Land Use Framework*.
[150] COAG (2013). *Multiple Land Use Framework*.
[151] Advice provided by the department.

- areas identified through the resource and land use planning scoring framework as having significant cultural, economic, and / or social values.

Figure 59: Gippsland Basin resource and land use planning model (preliminary)



Source: Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Gippsland Basin, Victoria (in prep).

As noted in ER4: Domestic Gas Supply, exploration and development of conventional gas in the Gippsland Basin may provide gas at a closer proximity to industrial users, particularly those located closest to development. As noted above, the level of benefit will be dependent on the size and timing of annual gas production, and ability of the industrial user to negotiate a contract with the producer and arrange their own transportation. Negotiation of contracts may result in cheaper prices and better terms for the customer, if transportation costs are appropriate within the contract.

Impacts on existing uses of land occur during the development, exploration and rehabilitation phases. In Gippsland exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe. Planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income under the regulatory framework.[152] Further, the Petroleum Regulations require an EMP for all seismic survey activities and during the rehabilitation phase, survey lines are cleared meaning no lasting disturbance to farming activities is likely reducing the risk of both planned and unplanned disturbances.

The extent of these impacts increases as the number of wells, and therefore land sites impacted, increase. However, there is no significant difference between the number of wells in the low, medium and high scenarios, and the total number of wells is comparable to the Gippsland medium scenario. Therefore, all scenarios would also have a slightly negative impact.

Gross size of farming land used for exploration and development.

In the short- to medium-term, sites for drilling would be leased for exploration and development wells. A typical operational well site requires a cleared area of 75 m^2, or less than half the size of a

[152] *Petroleum Act 1998 (Vic).* s128

tennis court.[153] Once production starts, the area used decreases considerably and is typically fenced off. The average operational drill site is approximately 25 m^2, or 1/8 of a tennis court. Overall, the size of operating well leases is relatively small in comparison to the area required for farming.[154] As such, the impact on farming and its profitability will be minimal. Pipelines are buried and therefore have minimal impact on livestock farming and cropping.

As noted above, planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income under the Petroleum Regulatory Framework, therefore, farmers receive supplementary income as compensation for having production wells on their property.

Longer term, drill sites would be rehabilitated and could be brought back to their initial function, as required under the framework for rehabilitation set out in the Petroleum Act. This impact will cease once land has been appropriate rehabilitated after use.

The size of the land required for the scenarios is dependent on the size of production. As the number of wells required increases, so too does the land required for wells and other infrastructure.

The low scenario involves 72 wells drilled, the medium scenario will have 81 wells drilled and the high scenario 90 wells drilled. These are expected to have an immaterial effect on the gross size of farming land. Given that farmland that is used for well sites also provides a source of supplementary farm income while the land is used for production, the net impact on farm income may be positive.

Disturbance to livestock located near petroleum activities

Onshore conventional gas development and exploration occurring on land near livestock may cause disturbances to nearby livestock. Increased traffic in farming regions due to gas exploration and development activities, including seismic surveys and pipeline construction activity may exacerbate the impact on livestock.

Disturbances have the potential to cause injury or death of livestock (and consequential income losses for farmers). These disturbances could occur during the exploration, development and rehabilitation phases of production.

The level of this impact is dependent on the prevalence of surrounding livestock and the timeline of exploration, development and production which will increase from the low scenario to the highest scenario given the time of production increases. In general, drill sites are fenced off to minimise interaction with livestock, which contributes to the rare incidence of disturbances to livestock near drill sites. As such, the impact of disturbances to livestock is somewhat immaterial given its rare nature.

These impacts on livestock near drill sites are sporadic and not ongoing, that is, they occur only while the specific activity is being undertaken (e.g. drilling activities on site, pipeline construction activities or travelling vehicles which only occur over short timeframes). Therefore, impact on livestock is a temporary hazard in any given location and is not dissimilar to farming activities in terms of machinery and vehicle traffic.

In the Gippsland Basin exploration and development scenarios, production at an individual well site is between two and three years, therefore the local impact of an individual well would only occur over this timeframe.

[153] COAG (2018). *Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia.*
[154] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.

Summary of benefits and impacts

The assessment of impacts to existing farm industries, food and biosecurity is summarised in Table 130.

Table 130: Key benefits and impacts to existing farm industries, food and biosecurity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Ability to co-exist with existing agriculture industries	Onshore conventional gas development and exploration that occurs on and/or in close proximity to existing agricultural land may cause disturbances to landholders.	Planned and unplanned disturbances resulting from onshore conventional gas development and exploration on and/or near agricultural land include: ► the loss of crops or pasture outside of agreed survey lines ► the potential for a vehicle strikes with livestock ► interference with optimal cropping patterns ► damage to paddocks or infrastructure.[155] [156] The impacts of these disturbances increase with the level of production, as the number of well sites required increases. However, there is no significant difference between the number of wells in the low, medium and high scenarios, and the total number of wells is comparable to the Gippsland medium scenario. However, the mitigating factors result in all scenarios having a neutral impact.	► Impacts on agricultural industries must be managed as part of an EMP and EES, if applicable). ► Compensation agreements are required must be provided as per s128 of the Petroleum Act. Compensation must be paid under the Petroleum Act for any impacts on agricultural productivity agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and as well as for inconveniences caused.[157] Rehabilitation of the drill sites is required under legislation, which states that drill sites would be rehabilitated and could be brought back to their previous state.[158] The Petroleum Act also sets out a framework for rehabilitation. The holder of an authority must rehabilitate land affected by exploration or resource development and must rehabilitate the land before the authority expires or ends. The authority	Low: - Medium: - High: -	Possible legislative improvements derived from the VGP gap analysis include: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations; ► provision for improved consideration of social, economic and environmental factors in decision-making; ► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to

[155] Information supplied by the department.
[156] Planned disturbances have associated compensation arrangements to compensate for temporary losses of farming income. Unplanned disturbances to farming activities are activities that do not have pre-negotiated compensation agreements.
[157] *Petroleum Act 1998 (Vic).* s128.
[158] *Petroleum Act 1998 (Vic).* s170.

			holder is required to obtain a rehabilitation bond for an amount specified by the minister. Information on planned rehabilitation processes is required to be detailed in the Operation Plan. Impacts to agriculture is within scope of both planning permit and EES assessments where these are required.[159] Both of these assessments will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this. The Multiple Land Use Framework is intended to be used where land access and land use conflict has the potential, real or perceived, to arise. The MLUF is designed to operate within established regulatory and policy frameworks relating to land ownership, usage and access.		farmers that petroleum industry impacts on agriculture are being thoroughly considered and managed. The reforms will also ensure that farmers are genuinely engaged over the entire industry lifecycle. This may influence farmer attitudes towards development and exploration in the region. The proposed VGP community engagement function will provide information to farmers about the risks benefits and impacts of developments in their locality.
Gross size of farming land used for exploration/ development	In the short-medium term, sites for drilling would be acquired or leased for exploration and development wells.	The level of this impact is relative to the aggregate number of wells drilled for each scenario however noting the impact per well is minimal. In the short- to medium-term, sites for drilling would be leased for exploration and development wells. A typical operational well site requires a cleared area of 75 square metres, or less than half the size of a tennis court. Once production starts, the area used decreases considerably and is typically fenced off. The average operational drill site is approximately 25 square metres, or 1/8 of a tennis court. Overall, the size of operating well leases is relatively small in comparison to the area required for farming. As such, the impact on	Compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on land and livestock.[160] The Petroleum Act contains general provisions that minimise the land size that is affected by gas development, such as the license area covers the minimum area necessary to cover the maximum extent of the petroleum field.	Low: - Medium: - High: -	N/A

[159] Advice provided by the department.
[160] *Petroleum Act 1998 (Vic).* s128.

		farming and its profitability will be minimal. Pipelines are buried and therefore have minimal impact on livestock farming and cropping. The low, medium and high scenarios will have 72, 81 and 90 wells drilled respectively and will have a slightly negative impact given the minimal impact of well drilling on gross size of farmland. Farmland that is used for well sites also provides a source of supplementary farm income, While the land used for production decreases slightly, the net impact on farm income may be positive.	Impacts on land are likely to be short- to medium-term in duration, due to the requirement for land rehabilitation for gas companies.		
Disturbance to livestock located near petroleum activities	Increased traffic in farming regions may exacerbate the impact on livestock if they are required to be moved across main roads. As traffic increases, so too does the negative impact.	Disturbances have the potential to cause injury or death of livestock (and consequential income losses for farmers). These disturbances could occur during the development, exploration and rehabilitation phases of production. These impacts on livestock near petroleum activities are sporadic and not ongoing - i.e. they occur only while the specific activity is being undertaken (e.g. drilling activities on site or travelling vehicles which only occur over short timeframes). Therefore, impact on livestock is a temporary hazard in any given location and is not dissimilar to farming activities in terms of machinery and vehicle traffic. As such the impact for each scenario is not expected to be material.	Impacts on livestock are managed as part of an EMP (and ESS, if applicable). Compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on livestock.[161]	Low: – Medium: – High: –	N/A
Stress and financial burden to farmers to negotiate compensation agreements	The requirement for a compensation agreement causes stress and financial burden to farmers. The compensation agreement must be negotiated prior to commencing operations on a private property. This means that a person must obtain the consent of both the owner and occupier of land where an operation is proposed and enter	The process of organising compensation arrangements begins prior to development and exploration and extends into the rehabilitation phases of the project. This process can cause stress and financial burden as farmers may need to seek legal assistance to negotiate the agreement and to define the loss or damage that will be sustained in relation to the land as a direct, natural and reasonable consequence of the approval of, or carrying out of petroleum operation on land.	Compensation agreements must be provided as per s128 of the Petroleum Act. Compensation agreements in place for owners directly impacted by the gas development project intend to provide retribution for associated costs and inconveniences, including impact on livestock.[162] Industry practice if often to go above the minimum compensation	Low: – Medium: – High: –	The department has developed a standard land access proforma template for the minerals sector that assists landholders in easily negotiating compensation agreements. The proforma template could be relatively easily

[161] *Petroleum Act 1998 (Vic).* s128
[162] *Petroleum Act 1998 (Vic).* s128.

[160] *Petroleum Act 1998 (Vic).* s128.

	into a compensation agreement with the owner and occupier of the relevant land.	The impact on farmers is expected to be minor and offset by the benefits of receiving compensation under the agreement. This will be consistent for each scenario and consistent with the measure Landowner consultation to inform landowner consent and compensation agreements and lease agreements in SR3.	requirement for providing a source of off farm income.[163]		adapted to petroleum industries.

Summary of risks

The assessment of risks to existing farm industries, food and biosecurity is summarised in Table 131.

Table 131: Risks to existing farm industries, food and biosecurity

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Introduction of pests and diseases	Vehicles and equipment used as a part of the exploration and development process have the potential to introduce or spread local or foreign soil or other organic material (such as seeds) through farmland or areas of native vegetation. Clearing of native vegetation also has the potential to open the soil to weed infestation.	Introduced weeds, pests and pathogens can adversely impact the local ecology. In relation to farming opportunities, disease and/or death of livestock and pasture can reduce productivity and result in consequential financial losses. The risk of introducing weeds, pests or pathogens is they would likely remain in the region after rehabilitation and development is complete as they can be difficult to remove or eradicate. The consequence of potential and actual incursion of pests and disease is expected to be larger during development phases as more vehicles are	Management of pest and disease incursions is managed as part of an EMP (and ESS, if required). The CALP Act is the primary legislation governing noxious weed and pest animal management in Victoria. The Petroleum Act has several provisions intended on minimising biosecurity risks. s113 of the Petroleum Act states the Minister may cancel an authority if any petroleum operation carried out under the authority has caused an unexpected significant adverse impact on biosecurity.[164] The Petroleum Act also specifies the need for an ESS which assesses biosecurity	Unlikely[167]	Serious[168]	Moderate	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make biosecurity management transparent. Any compliance actions will also be published which will give confidence to communities and farmers that this risk is being robustly managed.

[163] Information supplied by the department.
[164] *Petroleum Act 1998 (Vic).* s113.
[167] Information supplied by the department.
[168] Information supplied by the department.
[160] *Petroleum Act 1998 (Vic).* s128.

		travelling in and out of the sites. However, the risk is still prevalent during production phases albeit marginally lower. As such, number of developments are used as a comparator to assess the severity of this risk with consideration of total production time.	effects of a proposed project. s161 of the Petroleum Act states before carrying out any petroleum operation, an operation plan must be given to the minister that identifies the risks of injury or damage that the operation may pose to biosecurity.[165] Victorian plant biosecurity is governed by the *Plant Biosecurity Act 2010* and subordinate legislation. The objectives of Victorian plant biosecurity legislation are to: ► minimise disruptions to plant production and market access from biosecurity incidents, and ► facilitate trade of plant products to local, interstate and overseas markets. The main purposes of this Act are to: ► provide for the prevention, monitoring, controlling and eradication of plant pests and diseases ► outline the required packaging, labelling and description of plants and plant products ► facilitate the movement of plants, plant products, used packages, used equipment and earth material within, into and out of Victoria. This Act, and subordinate legislation, includes inspector powers to conduct compliance activities relating to plant biosecurity regulation. This				

[165] *Petroleum Act 1998 (Vic).* s161.

			equips the department to manage declared pests and diseases, including exotic pests and diseases within Victoria and to control border and post border plant biosecurity threats.[166] Impacts of pest and disease incursions are within scope of both planning permit and EES assessments where these are required. Both of these assessments will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.				

Overall assessment

The qualitative assessment considered the extent to which the Gippsland hypothetical exploration and development scenarios could affect existing farm industries, food and biosecurity. It identified the Gippsland hypothetical scenarios could neutral impact on coexisting with existing agriculture industries, livestock near petroleum activities, and the gross size of farming land used for exploration and development. The consequences of these impacts increase with the level of production, as the number of well sites required increases, thereby potentially affecting more land used currently for farming. However, the land size required for petroleum activities is relatively small in comparison to the area required for farming,[169] and the Petroleum Regulatory Framework mitigates the impacts through compensation arrangements to compensate for temporary losses of farming income for having production wells on their property. Industry practice is often to go above the minimum compensation requirement for providing a source of off farm income.[170]

As such, the impact on existing farm industries will be minimal. Overall, the low, medium and high scenarios were assessed as having no material impact (Table 132).

The potential and actual incursion of pests and diseases was assessed as a key risk to farming industries. These risks are managed on a project-by-project basis, with each project required to have an adequate EMP in place with measures that enable compliance with all relevant regulations and legislation. Therefore, the risk has been assessed as moderate for all scenarios (Table 133), as projects would not proceed unless the impacts are assessed by the regulator to be are ALARP.

[166] *Plant Biosecurity Act* 2010
[169] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[170] Information supplied by the department.

Table 132: SR7: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 133 SR7: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

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Victorian Gas Program: Risks, benefits and impacts assessment
EY 321

5.2.2.8 SR8: Labour and working conditions

What working conditions will being place for the development and operation of gas production? What mechanisms are there to support a diverse workforce?

Benefits and impacts

The analysis has identified the following key benefits and impacts to labour and working conditions with respect to the Gippsland hypothetical exploration and development scenarios (Table 134).

Table 134: Key benefits and impacts to labour and working conditions

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Existence of an EBA improving employment conditions for workers	The existence of an EBA is up to the discretion of the employer.[171] An EBA is a formal agreement where the employer and employee negotiate for an enterprise agreement that may change the terms and conditions of employment. Employee representatives, such as unions[172], may also be included in the negotiation process. The agreement negotiated is intended to not only improve business productivity and efficiency, but also improve and vary the working conditions to benefit employees.	An EBA must result in employees being better off than if they were paid according to their relevant award. If an EBA is developed, the award will not apply unless it is incorporated into the agreement. Depending on the negotiation held, consequences of an EBA may include: ► more flexible hours and rosters ► increased training and career opportunities ► broader job classifications ► profit sharing or performance related pay ► agreement to achieve efficiency gains ► family friendly arrangements ► improved service delivery ► improved workplace issues procedures ► long term benefits for both the business and employees. EBAs are common within the oil and gas industry. According to the Fair Work	There are no current control measures in place for this measure under the Petroleum Regulatory Framework. The Fair Work Act 2009 requires: ► awards or EBAs in include all sections of the National Employment Standards ► only one enterprise agreement can apply to an employee. Compliance for existence and assessment of EBAs is predominately enforced by the Fair Work Commission.	Low: - Medium: - High: -	N/A

171 Fair Work Ombudsman. (2020). *Improving workplace productivity through bargaining*. [online] Available at: https://www.fairwork.gov.au/how-we-will-help/templates-and-guides/best-practice-guides/improving-workplace-productivity-through-bargaining#bargaining [Accessed 20 Dec. 2019].
172 The gas sector is currently unionised by the Construction, Forestry, Maritime Mining and Energy union.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		Commission, there were 24 separate EBA applications from the oil and gas industry within the period from 01 July 2019 to 20 January 2020.[173] This highlights the industry practice to implement an EBA. Assuming existing businesses would be employed to manage production, organisations may already have existing EBAs in place, and would therefore may choose to negotiate an EBA for the proposed development region. The existence of, and conditions within an EBA result in positive outcomes for labour and working conditions. However, it is not required under the regulatory framework and is expected to have a neutral impact. These are independent of the level of gas exploration and development, so is not expected to vary between scenarios.			
Workforce representation	Diversity within the workplace ensures that different social groups are adequately represented. There should be no barriers in place that might discourage individuals from different backgrounds from employment.	Workplace representation can result in: ► diverse workforce ► feelings of inclusivity in the workplace ► improved social licence for operators Workplace representation measures would be in place for the duration of employment in the region. Workforce representation and diversity are often required for organisations to maintain social license. Many large organisations operating within Australia have therefore adopted diversity policies, and this extends to the gas industry.	There are no current control measures in place for this measure under the Petroleum Regulatory Framework or under current legislation. However, under Victorian and federal anti-discrimination laws, a person should be hired based on whether they are best person for the job, regardless of their background and personal characteristics.[175] *Fair Work Act 2009* requires: ► employers to not take adverse action again an employee or prospective employee based on their race, colour, sex, sexual orientate, age, physical or	Low: - Medium: - High: -	N/A

[173] Fair Work Commission. (2020). *Document search for: Agreements*. [online] Available at: https://www.fwc.gov.au/search/document/agreement?search_api_views_fulltext=&display_switcher=%2Fsearch%2Fdocument%2Fagreement&created%5Bdate%5D=&created_1%5Bdate%5D=&matter_number=&field_fwc_doc_agreement_print_members=All&reference=&field_fwc_doc_agreement_AGR_AGMT_ID=&title=&old_pub_code=&state=All&industry=Oil+and+gas+industry&abn=&search_api_aggregation_1=&sort_bef_combine=search_api_relevance+DESC&=Update+Search# [Accessed 3 Feb. 2020].
[175] Humanrightscommission.vic.gov.au. (2020). *The Workplace*. [online] Available at: https://www.humanrightscommission.vic.gov.au/the-workplace [Accessed 20 Dec. 2019].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		For example, Beach Energy has adopted a diversity policy to achieve its gender diversity goals.[174] Key objectives include: ► gender composition at board and senior levels ► talent pipeline ► ensuring adequate female representation on company wise leadership development programs ► flexibility practices. The assessment found that increases in gas production has little impact on the labour and working conditions of employees, as organisations either have internal policies, or they do not. The frameworks and policies, if implemented, would provide significant benefits to employees irrespective of the size of production. While it is current industry practice is to have diversity policies in place, it is not required under the existing regulatory framework. It is therefore expected the gas exploration and development scenarios would result in a neutral impact on workforce representation and benefits will be consistent for each scenario.	mental disability, marital status, family or carer's responsibilities, pregnancy, religion, political opinion, natural extraction or social origin. ► Employers in Victoria must also abide by the following anti-discrimination law: ► *Age Discrimination Act 2004* ► *Disability Discrimination Act 1992* ► *Racial Discrimination Act 1975* ► *Sex Discrimination Act 1984* ► *Equal Opportunity Act 2010* (Victoria) ► Equal remuneration is required for work of equal or comparable value.		
Organisational policies and procedures governing working conditions	Gas exploration and development may impact on the working conditions (e.g. safety) of employees. Organisational policies and procedures outline the arrangements to manage working conditions. These policies can include, but are not limited to: ► Workplace Health and Safety Policy	Organisational policies governing working conditions may lead to: ► improved health safety of workforce ► improved productivity and performance of workforce ► clear decision making and governance arrangements	An approved EMP including a WOMP is required prior to any exploration and development activities taking place. This will include a mitigation and management plan to ensure safety risks are reduced to an acceptable level. *Fair Work Act 2009* sets the standards and regulations for employment.	Low: Medium: High:	N/A

[174] Beachenergy.com.au. (2020). *2019 Corporate Governance Statement*. [online] Available at: https://www.beachenergy.com.au/wp-content/uploads/2019/08/GD19-0084-Beach-Corporate-Governance-Statement_FA.pdf [Accessed 24 Jan. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	► Drug and Alcohol Policy ► safety management procedures ► risk assessment procedure ► risk control procedures ► Workplace Bullying Policy ► Smoke-free Workplace Policy ► hazard identification procedure ► performance monitoring and review procedures ► governance policies.	The extent of organisational policies and procedures is up to the discretion of the employer. At a minimum, the employer has a legal responsibility to provide a safe and healthy workplace.[176] The assessment found that increases in gas production has little impact on the working conditions of employees, as organisations are required to have a policies and procedures governing working conditions regardless of the size of a development. The frameworks and policies would provide benefits to employees irrespective of the size of production. Therefore, it is expected the gas exploration and development scenarios would have a positive material impact on workforce conditions and benefits will be consistent for each scenario.	Employees working conditions are governed under this framework. The OH&S Act contains a power for WorkSafe Victoria to appoint inspectors for the purposes of the Petroleum Act. Additionally, gas processing facilities are defined as major hazard facilitates that must be licensed and follow an extensive, strict legal framework.		

Risk

No risks to this receptor were identified.

Overall assessment

The qualitative assessment considered the extent to which the Gippsland hypothetical exploration and development scenarios could affect labour and working conditions. The assessment found that EBAs are common within the oil and gas industry. The existence of, and conditions within an EBA result in positive outcomes for labour and working conditions. These are independent of the level of gas exploration and development, so benefits are not expected to vary between scenarios. Diversity policies are also common in the industry, resulting in positive impacts on worker representation for all exploration and development scenarios. As none of these measures are required under legislation, both are expected to have a neutral impact

The assessment also found that the extent of organisational policies and procedures is up to the discretion of the employer. However, at a minimum, the employer has a legal responsibility to provide a safe and healthy workplace.[177] Increases in gas production has little impact on the working conditions of

[176] www1.worksafe.vic.gov.au. (2020). *1.1.4 Employer obligations*. [online] Available at: http://www1.worksafe.vic.gov.au/vwa/claimsmanual/Claims_Manual/1-the-scheme/1-1-4-employer-obligations.htm [Accessed 4 Feb. 2020].
[177] www1.worksafe.vic.gov.au. (2020). *1.1.4 Employer obligations*. [online] Available at: http://www1.worksafe.vic.gov.au/vwa/claimsmanual/Claims_Manual/1-the-scheme/1-1-4-employer-obligations.htm [Accessed 4 Feb. 2020].

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employees, as organisations are required to have a minimum level of policies and procedures governing working conditions. The frameworks and policies would provide benefits to employees irrespective of the size of production. This is expected to have a slightly positive impact under all scenarios.

Therefore, the low, medium and high scenarios are expected to have a slightly positive impact on the labour and working conditions (Table 135).

No risks to labour and working conditions with respect to the Gippsland hypothetical exploration and development scenarios were identified.

Table 135: SR8: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

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5.2.3 Environmental impact assessment

5.2.3.1 ENR1: GHG emissions

What are the total GHG emissions as a result of the proposed development?

Benefits and impacts

The analysis has identified the following benefits and impacts on GHG emissions with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- absolute GHG emissions
- GHG emissions intensity of proposed developments
- alignment with 2050 net zero target

These impacts are described further below.

Absolute GHG emissions

Onshore conventional gas exploration and development in the Gippsland region is expected to result in GHG emissions from activities associated with exploration, processing, transmission and distribution.[178]

GHG emissions include Nitrous Oxide (NO_2), Carbon Dioxide (CO_2), Methane (CH_4) and fluorinated gases. Methane emissions, which make up the bulk of the fugitive emissions[179] from gas exploration and development, have a global warming potential (how much heat is trapped relative to CO_2) 28 times higher than CO_2 over a 100-year time horizon,[180] while the carbon dioxide emissions can stay in the atmosphere for thousands of years.[181] These emissions will

[178] As noted in section 3.3, the GHG modelling only included the production, transmission and distribution of gas. End use was not considered, because the analysis in sections 5.2.1.4 and 5.2.1.5 found that the scenarios do not result in significant additional supply so as to change market dynamics, and Victoria is forecast to become a net importer of gas in the medium term to meet existing consumption.

[179] Fugitive emissions are losses, releases and leaks of methane and carbon dioxide into the atmosphere as a result of industrial processing, transmission and distribution of natural gas, oil and coal.

[180] GHG Protocols (2013). *Global Warming Potential Values.*

[181] IPCC (2007). *Couplings Between Changes in the Climate System and Biogeochemistry. In relative terms, the global warming potential of methane is 84 times greater than CO_2 in the atmosphere over a 20-year timeframe.*

contribute to Victoria's overall GHG emissions profile, thus contributing to physical impacts such as rising temperatures, decreased rainfall, more extreme fire weather and heatwaves and rising sea levels.[182]

The Gippsland Basin hypothetical exploration and development scenarios would result in GHG emissions from activities associated with natural gas infrastructure, exploration, processing, distribution and transmission. GHG emissions have been quantified for each of the Gippsland Basin exploration and development scenarios over the life of the proposed development.[183] In determining whether there has been an absolute increase in emissions the assessment considered:

- the quantity and quality of natural gas within the well; with increases in the volume of the gas extracted increasing the associated emissions
- whether emissions associated with natural gas consumption by the end user would occur irrespective of the proposed developments.

In the case of the Gippsland Basin exploration and development scenarios, our assessment found that emissions associated with combustion of natural gas would occur irrespective of the proposed developments. This is because the Gippsland Basin scenarios are not expected to significantly change Victoria's natural gas supply or consumption patterns (see Section 5.2.1.3). Therefore, the resulting end use emissions are likely to occur regardless of whether Victorian consumers source gas from the Gippsland Basin exploration and development scenarios or from existing interstate gas supply. Correspondingly, the GHG modelling and associated results presented in this report excludes GHG emissions produced from end-use of these proposed gas developments.

As a result, Figure 60 only includes emissions from activities associated with natural gas infrastructure, exploration, processing, distribution, transmission (and excludes end-use).[184] It shows that total emissions over the lifetime of production range from ~0.3m tCO_2e in the low scenario to ~1.0m tCO_2e in the high scenario.

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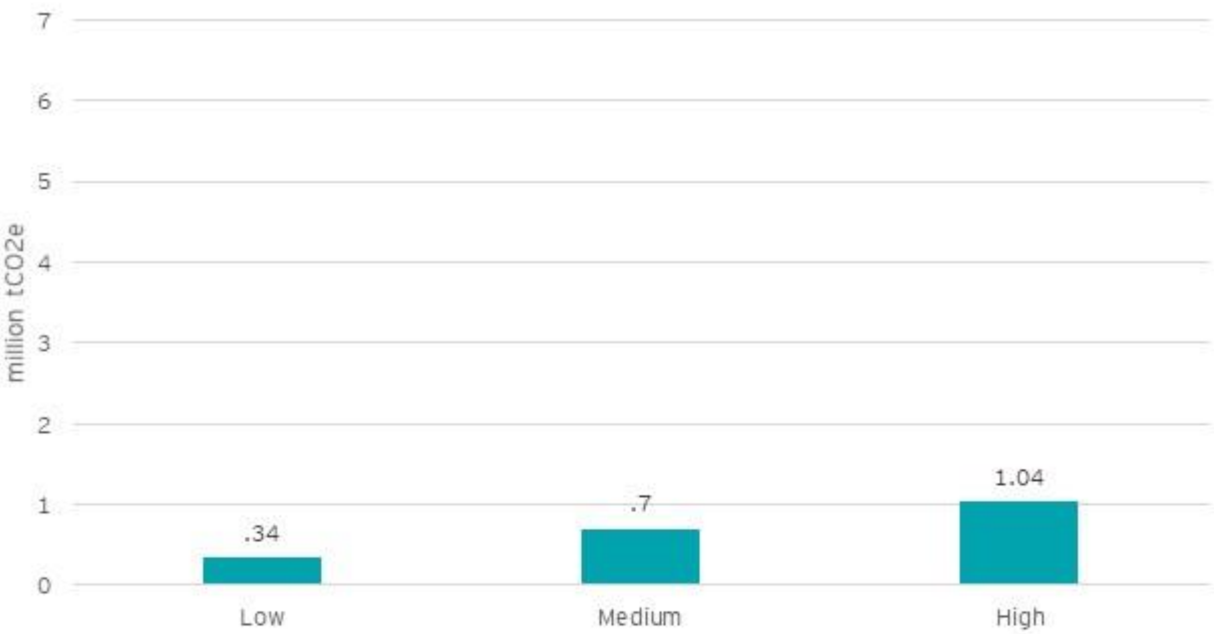
[182] Climate Change Victoria (2019). *Interim Emissions Reduction Targets for Victoria (2021-2030).*
[183] A detailed discussion of the methodology, emissions boundary, and calculation approach applied is provided in Appendix C - Overview of GHG analysis.
[184] Emissions associated with natural gas consumption by the end user have not been included as they would have occur irrespective of the proposed developments. However total emissions from end use have been calculated for each scenario and are available in Appendix C.

Figure 60: Total emissions from exploration, production, distribution, and transmission over the Gippsland Basin hypothetical exploration and development period (10 years) (m tCO2-e)



Source: EY GHG emissions modelling analysis

Table 136 compares the annual average emissions per scenario for the proposed VGP developments to Victoria's net 2017 GHG emissions of 110.3 million tCO_2e.[185] The annual impact of these proposed developments is between 0.02 and 0.07 per cent of Victoria's net 2017 emissions (or the equivalent emissions of between 1,115 and 4,411 one-way flights from Melbourne to Sydney). Although the proportions do not currently depict a significant portion of Victoria's annual emissions, this is expected to increase in proportion in the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050 target, and total emissions reduce.

[185] Climate Change Victoria (2019). *Interim Emissions Reduction Targets for Victoria (2021-2030).*

Table 136: Annual emissions per scenario (Gippsland)

Scenario	Annualised emissions				
	Lifetime of production (years)	Annual emissions (m tCO2e)	Percentage of Victoria's net 2017 GHG emissions	Equivalent emissions no. of flights from MEL -> SYD[186]	Equivalent emissions no. of flights from MEL -> LAX[187]
Gippsland Basin (Low)	6	20,245	0.02%	1,115	103
Gippsland Basin (Medium)	7	53,645	0.05%	2,953	273
Gippsland Basin (High)	10	80,120	0.07%	4,411	408

Source: EY GHG emissions modelling analysis

The Independent Expert Panel on Interim Emissions Reduction Targets for Victoria estimate that Victoria has an emissions budget of 1.25 GtCO2-e over the period 2017 to 2050 to be consistent with a 1.5°C trajectory.[188] At 2016 emissions levels, the panel estimate the 1.5°C budget will be exhausted by 2026. The total emissions over the life of the developments are estimated to contribute to 0.1 per cent of Victoria's remaining carbon budget. Acknowledging this small net-impact of the Gippsland Basin exploration and development scenarios and their timeframe for development.

Some gas explorers and producers may choose to use carbon offsets to offset emissions elsewhere in the economy and compensate the emissions associated with the proposed developments. However, given that carbon offsetting is voluntary and there is no mechanism to enable this (such as a formal carbon pricing scheme) in Australia we have not factored this into our assessment.

Overall, the annual average GHG emissions from the Gippsland Basin hypothetical exploration and development scenarios are very small as a percentage of net-2017 emissions. Therefore, none of the Gippsland Basin exploration and development scenarios are expected to have a material impact on absolute GHG emissions.

GHG emissions intensity of proposed developments

There may be opportunities for gas explorers and producers to use carbon offsets to offset emissions elsewhere in the economy and compensate the emissions associated with the proposed developments. However, given that carbon offsetting is voluntary and there is no mechanism to enable this (such as a formal carbon pricing scheme) in Australia we have not factored this into our assessment.

[186] Icao.int. (2020). ICAO Carbon Emissions Calculator. [online] Available at: https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx [Accessed 14 Feb. 2020].
[187] Icao.int. (2020). ICAO Carbon Emissions Calculator. [online] Available at: https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx [Accessed 14 Feb. 2020].
[188] Independent Expert Panel on Interim Emissions Reduction Targets for Victoria (2019). *Interim Emissions Reduction Targets for Victoria (2021-2030).*

Overall, the annual average GHG emissions from the Gippsland Basin exploration and development scenarios are very small as a percentage of net-2017 emissions. Therefore, none of the Gippsland Basin exploration and development scenarios are expected to have a material impact on absolute GHG emissions.

GHG emissions intensity of proposed developments

The GHG emissions intensity[189] of natural gas developments is an important factor in determining absolute and relative GHG emissions. The intensity metric is based on the total energy (PJ) that reaches the end consumer, which considers losses associated with the processing, transmission and distribution of the natural gas.

No information was available at the time of analysis of the gas composition in the Gippsland scenarios. Therefore, the emissions intensity of natural gas was assumed to be (a constant) of 9.1 kgCO2e/GJ for all scenarios. As a result, no comparisons were made between the development scenarios for this analysis.

It is important to note that this differs from the intensity metrics based on the natural gas that reaches the end consumer (which was excluded from this analysis), which also considers the emissions associated with combustion.[190]

Alignment with 2050 net zero target

The hypothetical gas exploration and development scenarios in the Gippsland region increase in GHG emissions from activities associated with natural gas exploration, processing, transmission and distribution. This may impact the energy sector's alignment with Victoria's 2050 net-zero target.

Victoria's 2050 net-zero target

The Victorian Government has set a target of net zero emissions by the year 2050, which is enshrined in the Victorian Government's Climate Change Act. The Climate Change Act sets a policy framework and a pathway to 2050 that is consistent with the Paris Agreement and is guided by long and interim targets, five-year strategies, adaptation planning, reduction pledges, and other mechanisms.[191] The Climate Change Act includes a requirement to determine interim targets for 2025 and 2030 by 31 March 2020.[145] As a precursor to setting these targets, an independent panel was appointed to advise the government on these interim targets for 2021-2025 and 2026-2030 and to identify opportunities for achieving these targets. Figure 61 displays both the projected emissions reduction by 2020 and the current recommended interim target ranges for Victoria for 2025 and 2030.

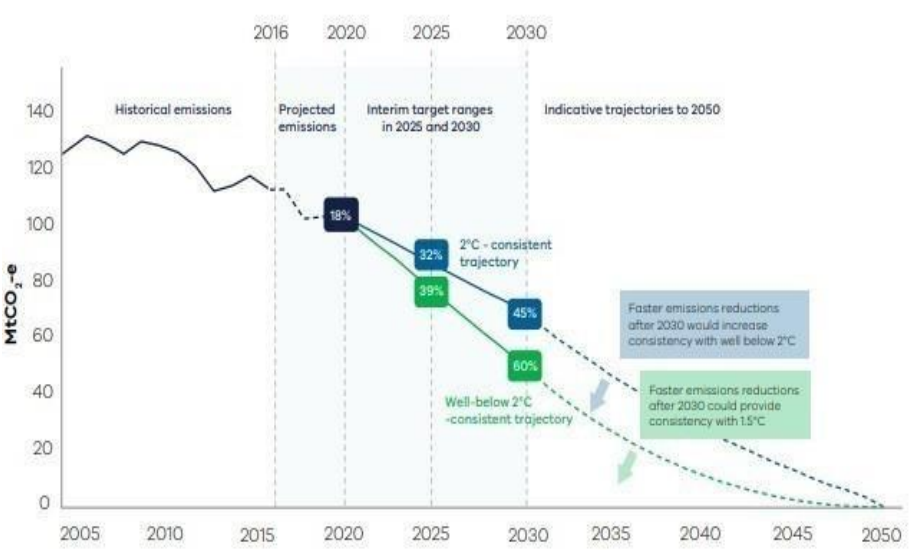
Based on Figure 61 reduction in emissions between 2016 to 2020 is mostly attributed to emissions reduction policies and the closure of Hazelwood Power Station which occurred in early 2017. Direct combustion emissions and fugitive emissions are projected to decrease by 0.9 per cent and 15.6 per cent

[189] Emissions intensity is determined as a ratio of tonnes of carbon dioxide equivalent GHG emissions produced (excluding end use) per petajoule of energy of discovered resources for the hypothetical gas development scenarios.
[190] Appendix C provides further information on the natural gas production cycle.
[191] Climate Change Victoria (2019). *Interim Emissions Reduction Targets for Victoria (2021-2030).*

respectively between 2016 and 2020 due to reduced natural gas consumption resulting from fuel switching, improvements in energy efficiency, and reductions in industry loads with population growth expected to only partially offset these reductions.

It is important to note that projected emissions pathways are modelled based on present conditions. Therefore, if the development of natural gas in Victoria was to change these conditions (e.g. through changes in natural gas demand in Victoria), this could result in a steeper and more difficult trajectory to achieve this net-zero commitment given the cumulative nature of carbon budgets.

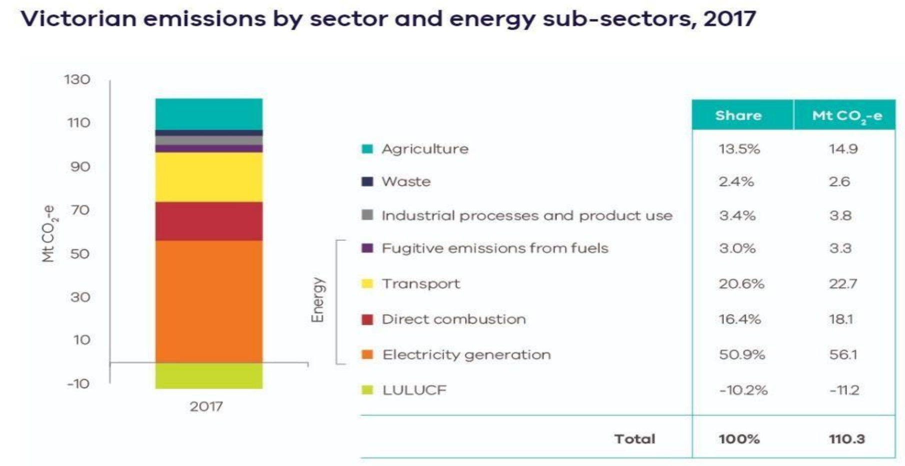
Figure 61: Victoria's proposed emissions reduction targets for 2021-25 and 2026-30



Source: Climate Change Victoria, 2019, Interim Emissions Reduction Targets for Victoria (2021-2030)

A general breakdown of Victoria's emissions by sector is outlined in Figure 62. The emissions relating to activities associated with natural gas exploration, processing, transmission and distribution fall under industrial, direct combustion, electricity generation, transport, and fugitive emission categories.

Figure 62: Greenhouse gas emissions in Victoria



Source: Department of Environment, Land, Water and Planning (DELWP), 2019, 'Victorian Greenhouse Gas Emissions Report'

Alignment to Victoria's 2050 net-zero target

Natural gas production does not form a significant part of Victoria's emissions profile,[192] however, the increase in production of gas in Victoria under the Otway Basin exploration and development scenarios could impact on the alignment with the 2050 net-zero target, due to the increase in absolute GHG emissions. Further, natural gas is considered by many experts to be a key transition fuel which can contribute towards reducing the emission profiles/portfolios dominated by other emissions-intensive fossil fuels. The IEA found that, on average, switching from coal to natural gas reduces emissions by 50 per cent when producing electricity and by 33 per cent when providing heat.[193] As such, changes in demand for gas and other fuels as a result of the additional supply of gas could offset the increase in emissions from the production in Victoria, improving alignment to Victoria's 2050 net-zero target.

However, as noted in sections 5.2.1.4 and 5.2.1.5, the additional supply under the Gippsland Basin exploration and development scenarios is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption) and, as such, is not expected to impact gas pricing, or market dynamics, including consumption. Therefore, the Gippsland Basin exploration and development scenarios are not expected to significantly alter the trajectory to achieving Victoria's 2050 net-zero target. Based on the above analysis, the Gippsland Basin exploration and development scenarios are expected to have no material impact on the energy sector's alignment with Victoria's 2050 net-zero target.

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[192] ClimateWorks Australia (2016). *Gas-Electricity substitution projections to 2050*.
[193] IEA (2019). *The Role of Gas in Today's Energy Transitions*.

Summary of benefits and impacts

The assessment of impacts to the GHG emissions is summarised in Table 137.

Table 137: Key benefits and impacts to GHG emissions

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
Absolute GHG emissions	GHG emissions occur from gas exploration, processing, distribution and transmission, and consumption by the consumer.	The consequence of an increase in GHG emissions from activities associated with natural gas is an: ► increase in Victoria's absolute GHG emissions. The assessment conducted GHG emissions modelling analysis under the absolute GHG emissions by scenario and stage. In determining whether there has been an absolute increase in emissions the assessment considered: ► the quantity and quality of natural gas within the well; with increases in the volume of the gas extracted increasing the associated emissions ► whether emissions associated with natural gas consumption by the end user would occur irrespective of the proposed developments. In the case of the Gippsland Basin exploration and development scenarios, our assessment found that emissions would occur irrespective of the proposed developments. This is because the Gippsland Basin scenarios are not expected to significantly change Victoria's natural gas supply or consumption patterns (see section 5.2.1.5 and 5.2.1.6). As a result, the end	As part of achieving its emissions reduction target under the Climate Change Act, the Victorian Government has committed to set interim emissions targets. It also intends to pledge contributions[194] to emission reduction in key emissions producing sectors via the TAKE2 campaign.[195] The impact of the emissions targets and pledges is uncertain, as the Government has yet to set interim targets for 2025 and 2030.[196] However the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply.	Low: – Med: – High: –	As part of the VGP, the department has measured a baseline of atmospheric measurements in the Gippsland region so any future changes in air quality resulting from future petroleum exploration and development could be identified appropriately.

[194] Other levels of government, businesses and communities are also able to pledge contributions.
[195] Climate Change Victoria (2019). *Interim Emissions Reduction Targets for Victoria (2021-2030).*
[196] By 31 March 2020, the Victorian Government will set interim targets for 2025 and 2030.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		use of this gas has been excluded from the GHG analysis. The assessment found total emissions over the lifetime of production range from ~0.3m tCO_2e in the low scenario to ~1.0m tCO_2e in the high scenario. The assessment compared the annual average emissions per scenario for the proposed VGP developments to Victoria's net 2017 GHG emissions of 110.3 million tCO_2e. The annual impact of these proposed developments is between 0.02 and 0.07 per cent of Victoria's net 2017 emissions (or the equivalent emissions of between 1,115 and 4,411 flights from Melbourne to Sydney). Although the proportions do not currently depict a significant portion of Victoria's annual emissions, this is expected to increase in proportion in the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050 target. The Independent Expert Panel on Interim Emissions Reduction Targets for Victoria estimate that Victoria has an emissions budget of 1.25 $GtCO_2$-e over the period 2017 to 2050 to be consistent with a 1.5°C trajectory. The total emissions over the life of the developments are estimated to contribute to 0.1 per cent of Victoria's remaining carbon budget. Acknowledging this small net-impact of the Gippsland Basin exploration and development scenarios and their timeframe for development. Overall, the annual average GHG emissions from the Gippsland Basin exploration and development scenarios are very small as a percentage of net-2017 emissions. Therefore, none of the Gippsland Basin exploration and development scenarios are expected to			

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
		have a material impact on absolute GHG emissions.			
GHG emissions intensity of proposed developments	The GHG emissions intensity of natural gas developments is an important factor in determining absolute and relative GHG emissions of the production, transmission and distribution of gas. The intensity metric is based on the total energy (PJ) that reaches the end consumer, which considers losses associated with the processing, transmission and distribution of the natural gas.	Emissions intensity is determined as a ratio of tonnes of carbon dioxide equivalent GHG emissions produced (excluding end use) per petajoule of energy of discovered resources for the hypothetical gas development scenarios. No information was available at the time of analysis of the gas composition in the Otway Scenarios. Therefore, the emissions intensity of natural gas was assumed to be (a constant) 9,057 tCO2e/PJ for all proposed developments.[197] As a result, no comparisons were made between the development scenarios for this analysis. It is important to note that this differs from the intensity metrics based on the natural gas that reaches the end consumer, which considers losses associated with the processing, transmission, and distribution of the natural gas and also considers the emissions associated with combustion.	Similar to above, the Victorian Government has committed to set interim emissions targets. The impact of the emissions targets and pledges is uncertain, as the Government has yet to set interim targets for 2025 and 2030. However, the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply.	N/A	Mitigation measures are the same as described in Absolute GHG emissions.
Alignment with 2050 net zero target	The Victorian Government has set a target of net zero emissions by the year 2050, which is enshrined in the Victorian Government's Climate Change Act. The Climate Change Act includes a requirement to determine interim targets for 2025 and 2030 by 31 March 2020. As a precursor to setting these targets, an independent panel was appointed to advise the government on these interim targets for 2021-2025 and 2026-2030	The consequence of additional supply of natural gas may: ► increase or decrease the energy sector's alignment with Victoria's 2050 net-zero target. Natural gas production does not form a significant part of Victoria's emissions profile,[198] however, the increase in production of gas in Victoria under the Gippsland Basin exploration and development scenarios could impact on the alignment with the 2050 net-zero	Similar to above, the Victorian Government has committed to set interim emissions targets. The impact of the emissions targets and pledges is uncertain, as the Government has yet to set interim targets for 2025 and 2030. However, the interim emissions targets may encourage investment in zero carbon alternatives ahead of additional gas supply. It is noted that petroleum industry will need to meet the requirements of the	Low: – Med: – High: –	N/A

[197] Appendix C describes the approach and assumptions for the GHG modelling.
[198] ClimateWorks Australia (2016). *Gas-Electricity substitution projections to 2050*.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	and to identify opportunities for achieving these targets.	target, due to the increase in absolute GHG emissions. Further, natural gas is considered by many experts to be a key transition fuel which can contribute towards reducing the emission profiles/portfolios dominated by other emissions-intensive fossil fuels. As such, changes in demand for gas and other fuels as a result of the additional supply of gas could offset the increase in emissions from the production in Victoria, improving alignment to Victoria's 2050 net-zero target. As discussed in section 5.2.1.4 and 5.2.1.5, the additional supply under the Gippsland Basin exploration and development scenarios is relatively small as a proportion of Victoria's total gas supply and consumption (and energy supply and consumption) and, as such, is not expected to impact gas pricing, or market dynamics, including consumption. Therefore, the Gippsland Basin exploration and development scenarios are not expected to change the trajectory to achieving Victoria's 2050 net-zero target. Based on the above analysis, the Gippsland Basin exploration and development scenarios are expected to have no material impact on the energy sector's alignment with Victoria's 2050 net-zero target.	Climate Change Act as will all carbon emitters. Gas producers will need to consider how they meet the net zero targets in their commercial decision making.		

Risk

The analysis has not identified any risks to GHG emissions with respect to the Gippsland Basin exploration and development scenarios.

Overall assessment

The assessment identified the Gippsland Basin exploration and development scenarios would result in an increase in absolute annualised GHG emissions as a proportion of Victoria's net 2017 GHG emissions between 0.02 per cent (~20,245 t CO_2e, equivalent to 103 one-way flights from Melbourne to Los

Angeles) under the low scenario and 0.07 per cent (~80,120 t CO2e, equivalent to 408 one-way flights from Melbourne to Los Angeles) under the high scenario.

While the Gippsland Basin hypothetical exploration and development scenarios are not expected to significantly change or alter the State's composition of its GHG emissions, the assessment found that GHG emissions from the Gippsland Basin scenarios are expected to represent an increased proportion of Victoria's net GHG emissions portfolio into the future as Victoria introduces emission reduction initiatives in line with the net-zero 2050.

However, the Gippsland Basin hypothetical exploration and development scenarios are not expected to significantly alter the trajectory to achieving Victoria's 2050 net-zero target, as the additional supply is not expected to change market dynamic and impact consumption of gas.

Based on the findings above, the Gippsland Basin exploration and development scenarios are expected to have no material impact on GHG emissions (Table 138).

Table 138: ENR1: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

5.2.3.2 ENR2: Groundwater and surface water quality and quantity

What are the measurable impacts on ground water and surface water near the proposed development sites?

Benefits and impacts

The analysis has identified the following key benefits and impacts to groundwater and surface water quality and quantity with respect to the Gippsland Basin exploration and development scenarios:

- the volume removed from the nearest WRA
- volume impact on surface water receptors
- groundwater level drawdown greater than 5 m from the nearest WRA
- area of water table drawdown greater than 0.1 m
- time to impact, maximum impact and time to recover.

The Department of Environment, Land, Water and Planning and the GSV conducted water science studies on onshore natural gas in 2015[199] to provide an initial screening analysis of the potential impacts of possible onshore gas exploration and development on water users and ecosystems. The VGP environmental studies assessed the potential impacts of aquifer depressurisation (i.e. groundwater level decline) in more detail.[200] The studies applied a biophysical approach, identifying where natural gas might be, where water resources are, the physical connection between the gas and water resources, and utilising modelling to infer impacts on water users and ecosystems. The result of the studies showed low impacts related to aquifer depressurisation on groundwater, surface water users and ecosystems. The results of these studies have been used to inform the assessment of benefits and impacts to groundwater and surface water quality and quantity.

Table 139: Estimated impact on ground and surface water under each Gippsland Basin hypothetical scenario

Metric	Low	Med	High
Total approx. volume removed from the nearest WRA (ML)	450	600	800
Groundwater level drawdown greater than 5 m from the nearest WRA (hectares)	7	7	7
Volume impact on surface water receptors (ML/year)	0	0	0

[199] Jacobs (Australia) Pty Ltd (2015). Otway region synthesis report. [online] State Government Victoria. Available at: https://earthresources.vic.gov.au/__data/assets/pdf_file/0004/456745/O1-Water-science-studies-Otway-synthesis-report-June-2015.pdf [Accessed 14 Dec. 2019].
[200] Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).

Metric	Low	Med	High
Area of watertable drawdown > 0.1 m (hectares)	0	0	0
Time to initial impact (years)	2.5	3	3
Time to maximum impact from initial (years)	2.5	3.5	3.5
Time to recover (years)	9	14	18

Source: Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).

Summary of benefits and impacts

The assessment of impacts to groundwater and surface water quality and quantity is summarised in Table 140.

Table 140: Key benefits and impacts to groundwater and surface water quality and quantity

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
The volume removed from the nearest WRA (ML)	Onshore conventional gas development in the Gippsland basin necessitates the extraction of ground water from aquifers. The level of water extracted is related to the amount of gas extracted and subsequently the level of development. Ground and surface water systems are interrelated and removal from one of the systems can impact on the other. Groundwater is water found underground where it saturates soil and fills spaces in rock. It has an important function in supporting: ► intermittent stream ecosystems: groundwater helps to sustain intermittent streams which alternate between flowing and non-flowing periods. ► biodiversity and ecological processes under the streambed: groundwater catchments	Depletion of groundwater and surface water can impact the viability of the ecosystems. The ecological impact of groundwater depletion of the ecosystems listed above will depend on: ► the ecosystem's total environmental value (including biodiversity) ► the ecosystem's level of dependence on groundwater ► the ecosystem's susceptibility to changes in the groundwater regime. The rate and magnitude of the change in groundwater availability (higher rates and magnitudes produce more severe impacts on average). Other consequences of reduced access to groundwater include: ► loss of access to groundwater ► reductions in surface water flows	The current Petroleum Regulatory Framework pertaining to the management of water extraction and water impacts, includes the need for EMPs and compliance with the EP Act and in some instances the EES process where water impacts are deemed an issue by the Minister for Planning. Impacts on water aquifers are managed as part of EMPs. Negative impacts on ground and surface water must be reduced as low as reasonably practicable. Impacts on groundwater are within scope of both EES assessments where these are required. This assessment will expect that impacts are reduced to the lowest level possible. Members of the public can provide written comments as a part of this.	Low: – Medium: – High: –	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make groundwater management transparent. Any compliance actions will also be published which will give confidence to community that this risk is being robustly managed. The VGP community engagement function will provide information to community about the potential the risks, benefits and impacts of developments in their locality.

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	support their own ecosystems diverse aquatic invertebrates, such as crustaceans, insects, molluscs, water mites and worms. ► wetlands: groundwater is a key source of water for wetlands that contain a high proportion of endemic species (species that can only survive in a wetland environment) ► agricultural irrigation and water supplies: There are existing demands on groundwater for irrigation use which is regulated under licensing. Likewise, groundwater is used, and licensed, for stock and domestic supplies.	► changes in groundwater quality, due to poorer quality groundwater being drawn into good quality aquifers. In the Gippsland Basin exploration and development scenarios, total volume removed over 20 years from the nearest aquifer ranges from 450 ML in the low development scenario to 800 ML in the high development scenario over the life of the development. To provide context for these figures, the total annual entitlements from the upper, middle and lower aquifers in the Gippsland Basin equate to 82,000 ML per year.[201] Given the above, the incremental impact on groundwater removed from aquifers is negligible compared to existing consumption, as such no impact has been assessed for each of the scenarios. The groundwater impact modelling also showed that impacts on groundwater quantity and quality would be negligible due to the large geological superstation between conventional gas aquifers.[202]			There is an opportunity to amend the Petroleum Regulations updated with local groundwater assessment, monitoring and reporting provisions that would further improve community confidence in this area. This regulatory activity could be supported by the VGP's regional baseline data of groundwater chemistry, dissolved methane and hydrocarbon occurrence so that any future changes in groundwater condition can be identified.
Volume impact on surface water receptors (ML/year)	Onshore conventional gas development in the Gippsland basin necessitates the extraction of ground water from aquifers. The volume of water extracted is related to the amount of gas extracted and subsequently the size of development.	VGP analysis has shown no impact on this measure. Refer to Table 139.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable). Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Low: – Medium: – High: –	Mitigation measures are the same as those described in the volume removed from the nearest WRA (ML).

[201] Jacobs (Australia) Pty Ltd (2015). Gippsland region synthesis report. [online] State Government Victoria. p16. Available at: https://earthresources.vic.gov.au/__data/assets/pdf_file/0006/456729/G1-Water-science-studies-Gippsland-synthesis-report-June-2015.pdf [Accessed 14 Dec. 2019].
[202] Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	Ground and surface water systems are interrelated and removal from one of the systems may impact on the other.				
Groundwater level drawdown greater than 5 m from the nearest WRA (hectares)	Groundwater level drawdown refers to a reduction in groundwater head elevation relative to a nominated baseline condition. As gas developments depressurise gas bearing formations, they can lower pressure in aquifers. As such, there can be a causal relationship between the amount of gas production and the level of drawdown.	Negative impacts associated with groundwater level drawdown reduced access to groundwater include: ► loss of access to groundwater ► reductions in surface water flows ► changes in groundwater quality, due to poorer quality groundwater being drawn into good quality aquifers. In all Gippsland development scenarios, groundwater level drawdown for 7 hectares from the nearest WRA. This can potentially impact other users of groundwater as outlined above. However, the groundwater impact modelling also showed that impacts on groundwater quantity and quality would be negligible due to the large geological superstation between conventional gas aquifers. Therefore, impact of this drawdown is expected to be minimal when compared to the total area being considered for development.[203]	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable). Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Low: – Medium: – High: –	Mitigation measures are the same as those described in the volume removed from the nearest WRA (ML).
Area of water table drawdown greater than 0.1 m (hectares)	The water table is an underground boundary between the soil surface and the area where groundwater saturates spaces between sediments and cracks in rock.[204] Consideration is given to the volume impact on the water table as it represents a much	VGP analysis has shown no impact on this measure for all development scenarios. Refer to Table 139.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable).	Low: – Medium: – High: –	Mitigation measures are the same as those described in the volume removed from the nearest WRA (ML).

[203] Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).
[204] Society, N. (2020). *Water Table*. [online] National Geographic Society. Available at: https://www.nationalgeographic.org/encyclopedia/water-table/ [Accessed 11 Feb. 2020].

Description of benefit or impact	Description of cause	Description of consequence	Description of current control measures	Residual impact rating	Can this impact be mitigated further?
	wider impact than the localised impact around the wells.		Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.		
Time to initial impact (years) Time to maximum impact (years) Time to recover (years)	The three areas described in this section relate to the timing of the above impacts.	These three measures dictate the timing for which the negative impacts of groundwater extraction will be felt. Table 139 highlights that the impacts associated with the three development scenarios will be incurred within three years, with maximum impact being reached half a year later and increasing time to recover as more water is removed from the aquifers. Table 139 highlights that that the system will recover within the development window with most impacts being felt in the short term.	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable). Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Low: – Medium: – High: –	Mitigation measures are the same as those described in the volume removed from the nearest WRA (ML).

Summary of risks

The assessment of risks to ground and surface water is summarised in Table 141.

Table 141: Key risks to ground and surface water

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Groundwater and surface water contamination	Incorrect disposal of waste water could lead to contamination of surface and potentially ground water surrounding a development site.	Contamination of surrounding ground and surface water can negatively impact other users of aquifers which in the case of the Gippsland development scenarios would predominantly affect the agricultural industry. Any risk of contamination, at any level of development	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable). Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Unlikely	Minor, given that the EMP provides the regulator the opportunity to make an informed decision which considers all relevant risk areas.	Low	Possible legislative improvements derived from the VGP gap analysis would include reforms that will require the publication of environment management plans which will make groundwater management transparent. Any compliance actions will also be published which will give confidence to community that this risk is being robustly managed.

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		is mitigated through the environmental management plan, discussed at right. The Gippsland water studies concluded that, based on present information, there is no significant onshore conventional gas potential in the Gippsland region. As such no impact is expected for any development scenarios as only conventional gas development is being considered.					The VGP community engagement function will provide information to community about the potential the risks, benefits and impacts of developments in their locality. There is an opportunity to amend the Petroleum Regulations updated with local groundwater assessment, monitoring and reporting provisions that would further improve community confidence in this area. This regulatory activity could be supported by the VGP's regional baseline data of groundwater chemistry, dissolved methane and hydrocarbon occurrence so that any future changes in groundwater condition can be identified.
Loss of groundwater supply to users	Aquifer depressurisation may cause reduced aquifer storage volume.	Licenced groundwater users of the local aquifers could be impacted by reduced water availability. Loss of groundwater supply for users. The GSV found that the potential for impacts on groundwater volume from aquifer depressurisation for gas development was	Applicable regulatory framework includes compliance with: ► EMPs ► EP Act ► EES (where applicable). Refer to the control measures for the volume removed from the nearest WRA (ML) for further information.	Unlikely	Minor, given that the EMP provides the regulator the opportunity to make an informed decision which considers all relevant risk areas.	Low	Mitigation measures are the same as those described in Groundwater and surface water contamination

Description of risks	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		low, based on modelling scenarios.[205]					

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios may affect ground and surface water within the region. The measures shown to have an impact on ground and surface water are the volume of water removed from the nearest aquifer resource and the groundwater level draw down. The groundwater impact modelling showed that impacts on groundwater quantity an d quality would be negligible due to the large geological separation between conventional gas reservoirs and aquifers. Under the current regulatory framework, the removal of water resources must be at an acceptable level to receive development approval. All scenarios are expected to have no material impact on ground and surface water based on the average rating (Table 142).

The risk of groundwater and surface water contamination was rated as low, as that the EMP must address the risk of potential contamination (Table 143).

Table 142: ENR2: Benefits and impact assessment

Low scenario	×××	××	×	–			
Medium scenario	×××	××	×	–			
High scenario	×××	××	×	–			

Table 143: ENR2: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

[205] Hocking, M. & Beverly, C. and Bold, T. (2020) Gippsland Groundwater Model (GGM v1.1), Gippsland Basin, Victoria. Victorian Gas Program Technical Report. Geological Survey of Victoria. Department of Jobs, Precincts and Regions. Melbourne, Victoria. 266p. (in prep).

5.2.3.3 ENR3: Affected native flora and fauna

What is the impact on flora and fauna at hypothetical exploration and development location and surrounding areas?

Benefits and impacts

No benefits or impacts to native flora and fauna were identified.

Risk

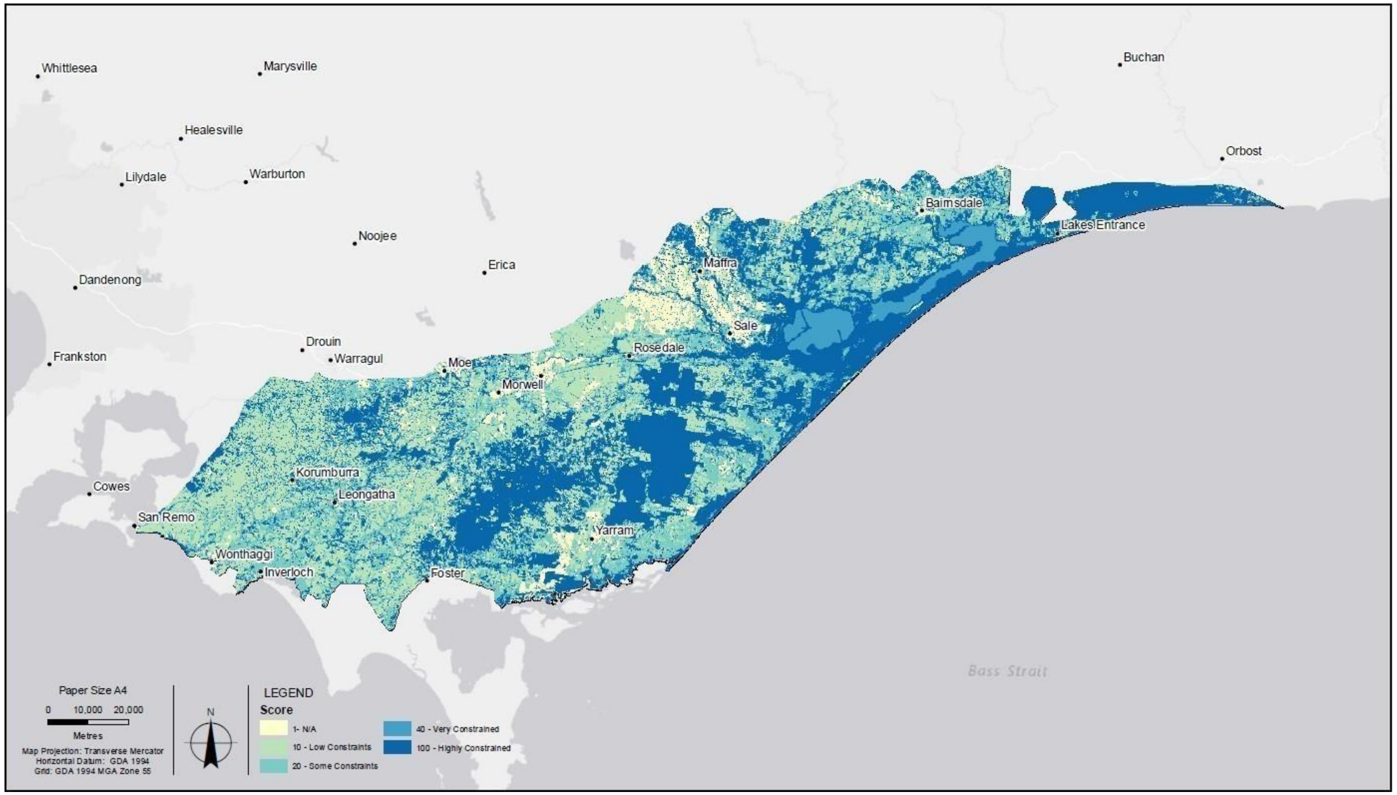
The analysis has identified the following key risks to native flora and fauna with respect to the Gippsland Basin hypothetical exploration and development scenarios:

- impact of noise/light on flora and fauna
- removal or destruction of native flora and fauna
- intrusion of invasive weeds, pests or pathogens to the Gippsland Basin.

The VGP have undertaken resource and land use planning to assess key natural resources, cultural, environmental and existing land use values. The resource and land use planning produced a land use model which identified areas that may be constrained in relation to onshore conventional gas development. If an area was identified as being constrained, this could mean that resource development may not be appropriate in the context of local land values and /or features; or this is an area where features of sensitivity or significance exist that would need to be considered and addressed through the licencing process prior to any development proceeding.

Significant flora and fauna (i.e. areas and species listed as threatened under the EPBC Act and/or the FFG Act) was one of four criteria used to assess environmental value constraints within the Gippsland Basin. Figure 63 highlights areas identified as being constrained in relation to onshore conventional gas development in the Gippsland Basin in relation to significant flora and fauna. A summary of the resource and land use planning model classifications is listed in Table 144.

Figure 63: Significant Flora and Fauna - Resource and land use planning assessment of values, constraints and opportunities in the Gippsland Basin



Source: Victorian Gas Program (2020). Victorian Gas Program Resource and land use planning Findings Report, Gippsland Basin, Victoria (in prep).

Table 144: Summary of resource and land use planning constraints by land classification in the Gippsland Basin

Classification	Land Cover (%)
Low Constraints	42
Some Constraints	22
Very Constrained	12
Highly Constrained	24
Extremely Constrained	0

Over a quarter of the land in the Gippsland Basin has been identified as being extremely or highly constrained by key natural resources, cultural, environmental and existing land uses. Identification of areas of key natural resources, cultural, environmental and existing land use values would be utilised to minimise impact by avoiding development in extremely constrained regions. The control measures outlined in Table 145 may mitigate negative impacts by outlining risk management requirements, and rehabilitation requirements to bring the land back to its pre-development state. This analysis has been used to inform the risk assessment of affected native flora and fauna in Table 145.

Summary of risks

The assessment of risks to native flora and fauna and use is summarised in Table 145.

Table 145: Key risks to native flora and fauna

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
Impact of noise/light on flora/fauna	Native fauna is at risk of being adversely impacted by the light and noise associated with gas exploration, development and operations.	Increased noise and light have the potential to alter the normal behavioural patterns of fauna near well sites and other operational facilities. Noise from drilling and construction are likely to be greater than	The Gippsland development hypothetical scenarios are required to comply with a regulatory Framework consisting of EMPs, the FFG Act, the EPBC Act, EES process (if relevant), native vegetation	Possible[212]	Minor[213]	Low	Possible legislative improvements derived from the VGP gap analysis: ► requirement for enhanced community consultation and consideration of community input during authority grants and operations ► provision for improved consideration of social, economic and environmental factors in decision-making

[212] Information provided by the department.
[213] Information provided by the department.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	During exploration and development, noise comes primarily from transport, drilling rigs and vibroseis trucks. This is temporary impact. During operations, there is little to no noise from wells, but there is some low-level noise generated from gas plants. This includes the trucks supporting operations.	operations.[206] As such, impacts would be expected to be greater in the short term. This also indicates that greater levels of development will have a greater negative impact as more wells needs to be drilled. In the three Gippsland development scenarios all three scenarios require tying wells back to an existing plant with the high development scenario requiring an additional new modular gas plant and tying back to a new modular plant. As such during the development phase in the low and medium scenarios, noise from operations will be primarily limited to the well sites. Which range from 1 development well in the low scenario to 3 wells in the high scenario, given that each well site is approximately 25 square metres[207] and the number of development wells, potential impacts across	clearance regulations and rehabilitation requirements. EMPs are required for all gas projects. All relevant risks to a project (including those to flora and fauna) will be identified in the EMP as well as the control measures that we will be in place, using best practice risk management procedures.[208] The control measures identified will need to be sufficient in their response to the identified risks to ensure risks are mitigated to the point where they are ALARP. EMPs must consider: ► DELWPs "Guidelines for the removal, destruction or lopping of native vegetation" which requires the authority holder to avoid, minimise and offset any destruction of native vegetation				► requirement for the publication of certain information relating to government decisions and industry activity. These reforms would provide confidence to community that petroleum industry impacts on native flora and fauna are being thoroughly considered and managed. This may influence farmer attitudes towards development and exploration in the region. The VGP community engagement function will provide information to farmers about the risks benefits and impacts of developments in their locality. Noise and light are typically mitigated using devices such as noise enclosures, light shields, silencers on truck mufflers and reversing beepers, and so forth. Best available technology is generally applied when designing a new gas plant. As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making

[206] Ncbi.nlm.nih.gov. (2020). *Residential noise from nearby oil and gas well construction and drilling. - PubMed - NCBI*. [online] Available at: https://www.ncbi.nlm.nih.gov/pubmed/29749380 [Accessed 14 Jan. 2020].
[207] COAG (2018). *Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia.*
[208] This assumes that all legislative and regulatory requirements are adhered to, industry best practice is used in developing the EMPs and that it is updated at each stage of exploration, development and operations. It also assumes environmental risk assessments are conducted at each stage of exploration, development and operations.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
		all scenarios are expected to be low. Noise impacts would be higher during the exploration phase (18 years for the low case and 14 years for the medium and high case) due to more wells being drilled (4 wells per year for the low scenario and 5 for the medium and high scenarios) during this period compared to the development phase, discussed above. However overall impact is still expected to be low due to the number of wells.	(which includes all onshore exploration and development)[209] ► ecological surveys: determine the presence of threatened communities or species. This will allow them to be avoided when locating the well lease, which will minimise the impact on them[210] ► the regulatory framework: currently, there is no identified gap in the planning approvals, regulatory or legislative framework relating to environmental issues.[211] Identification of areas of key natural resources, cultural, environmental and existing land use values would be utilised to minimise impact by avoiding development in extremely constrained				

[209] DELWP (2017). *Guidelines for the removal, destruction or lopping of native vegetation*.
[210] For example, selecting farmland instead of remnant native vegetation for well lease and access roads wherever practicable. The surveys will also serve as a baseline to measure any impact on the native flora and fauna, before, during and after exploration and development are complete.
[211] The broad range of legislation and regulatory requirements that natural gas producers are required to comply is considered in Section 2.4.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			regions. Figure 63: Significant Flora and Fauna - Resource and land use planning assessment of values, constraints and opportunities in the Gippsland Basin highlights the below constraints overlaid over the region map. The development scenarios must also give consideration to native flora and fauna that are threatened (note that gas exploration and development is not specifically listed as a threatening process under the FFG Act or EPBC Act). A final consideration is that developers are required to rehabilitate areas, such that in the long-term development sites will have no impact on native flora. The extensive legislative requirements pertain to developments of any size and are effective at minimising negative impacts.				
Loss of very small areas of native	The vegetation in the Gippsland	One risk identified by the VGP was loss of native	Impacts to vegetation area and measures to	Possible[218]	Minor[219]	Low	Offset provisions under the Victorian planning system may be implemented to

[218] Information provided by the department.
[219] Information provided by the department.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
vegetation (and associated fauna habitat)	Basin has been significantly disturbed, or totally removed over large areas, for agricultural purposes. A consequence of the clearing of vegetation is that the land has limited value for native fauna.[214]	vegetation and habitat due to clearing for lease pad and/or access road/s.[215] The exact location of the well sites will determine how much native flora is lost due to clearing land for the lease pad and or access roads. Any flora cleared is likely to be isolated trees or shrubs in paddocks or within roadside reserves. It is important to note that the actual footprint of a well is small (generally 100 x 100 m, or 1 ha), with the production well drill site being approximately 25 square metres.[216] As such, significant disruption will not occur from the wells themselves but possibly from the construction of pipelines and gas plants. Therefore, greater levels of development that necessitate higher levels of supporting infrastructure will have a greater impact on native flora and fauna however due to the low conservation value of the land impacts are expected to remain low.[217]	avoid, minimise or mitigate for vegetation losses are addressed in an EMP and where relevant, an EPBC Act Referral and/or EES. Refer to control for the measure Impact of noise/light on flora/fauna for further details. In addition to the controls described above the EPBC Act establishes a strong framework for protection of the environment and the conservation of biodiversity. It includes a broad range of enforcement mechanisms for managing suspected or identified instances of non-compliance and for reviewing the compliance of referred projects. Under the EPBC Act, gas exploration and development within the Gippsland Basin may be required to seek approval to proceed if a significant impact is possible to a Matter of				ensure that any vegetation cleared for a gas development is offset through the protection of currently unprotected native vegetation of equivalent or higher environmental value. As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making

[214] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis*. Department of Jobs, Precincts and Regions. Unpublished report.
[215] Information provided by the department.
[216] COAG (2018). *Energy Council Gas Supply Strategy Frequently Asked Questions about onshore gas, offshore gas and underground gas storage activities in Australia.*
[217] Advice provided by the department.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
			National Environmental Significance. A significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. A proponent must consider all of these factors when determining whether an action is likely to have a significant impact on the environment. If a significant impact on flora and fauna was found, then this would be managed and enforced through the EPBC Act.				
Introduction of invasive weeds, pests or pathogens to the Gippsland Basin	Increased usage and access to gas exploration and development sites during all phases of	The introduction of invasive weeds, pests or pathogens may negatively impact both native flora and fauna by resulting in the death of vegetation (and associated fauna	Impacts of weeds, pests and pathogens and measures to control their introduction and spread are addressed in an EMP and where	Unlikely[220]	Minor[221]	Low	As an additional mitigation measure, the Victorian Gas Program's resource and land use planning model can be used to inform regulatory decision making

[220] Information provided by the department.
[221] Information provided by the department.

Description of risk	Description of cause	Description of consequence	Description of current control measures	Likelihood	Consequence	Residual Risk Rating	Can this impact be mitigated further?
	operation may increase the likelihood of the spread or introduction of weeds, pests or pathogens. This is because the drilling rig, machinery, vehicles and any materials brought onto the drilling site may be carrying weeds.	habitat) and possible predation on stock. It may also affect agricultural operations (e.g. a reduction in the area of pasture, poisoning from weeds, increased cost of herbicide use). As agriculture is one of the larger industries in the area, this would also have a negative impact on social cohesion.	relevant, an EPBC Act Referral and/or EES.				

Overall assessment

The qualitative assessment considered the extent to which the Gippsland Basin exploration and development scenarios could affect native flora and fauna within the region. Key risks have been identified that could affect native flora and fauna. Given the low number of wells in all scenarios the impact is expected to minimal for all scenarios. The small size of well leases during drilling (typically 1 ha, with a much smaller footprint for operating wells), in addition to the use of existing infrastructure (e.g. aligning pipelines alongside existing pipeline easements) and the additi on of a single modular plant in the high development scenario further reduces the overall impact. It is also important to note once developed, the wells will only be there for a certain timeframe, and once the gas has been extracted from the well and the area will be rehabilitated, reducing the long-term impact on flora to nil. As such impacts are only expected to occur in the short to medium term.

As environmental risks are managed on a project by project basis, each project will need to have an approved EMP and will need to comply with all relevant regulations and legislation. Therefore, the risk has been assessed as low for all scenarios, as projects would not proceed unless the impacts are ALARP.

Table 146: ENR3: Risk assessment

Low scenario	Severe	High	Moderate	Low
Medium scenario	Severe	High	Moderate	Low
High scenario	Severe	High	Moderate	Low

Appendix A Industry Profile: Victorian Gas Market

Current state of the east coast gas market

In Victoria, gas is employed in two key activities:

- direct gas use for residential, commercial and industrial uses
- GPG, to power electricity.

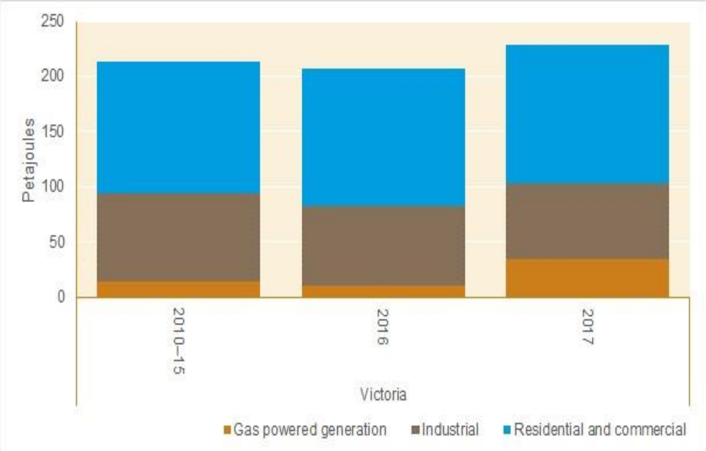
As illustrated in Figure 64, while residential, commercial and industrial direct gas use is the most common form of gas-consumption, the use of gas as a mechanism for electricity generation is becoming increasingly popular.

Gas is employed in the domestic market for a myriad of purposes, from facilitating heating and cooking in residential properties to within commercial industries as an input to manufacture a range of metals, pulp and paper, chemicals, stone, clay, glass and processed foods. Gas is also a major feedstock in ammonia production for fertilisers and explosives.

It is important to note that barriers exist that mean many gas users, particularly industrial users, cannot easily adjust their inputs. This includes cost competitiveness and awareness of renewable energy options.[222]

In Victoria, over 80 per cent of Victorian households are connected to a gas network, with heating and cooling for residential and small commercial customers constituting the majority of gas demand in the State.[223]

Figure 64: Victorian gas consumption by user type



Source: Australian Energy Regulator (2018). AER State of the energy market.

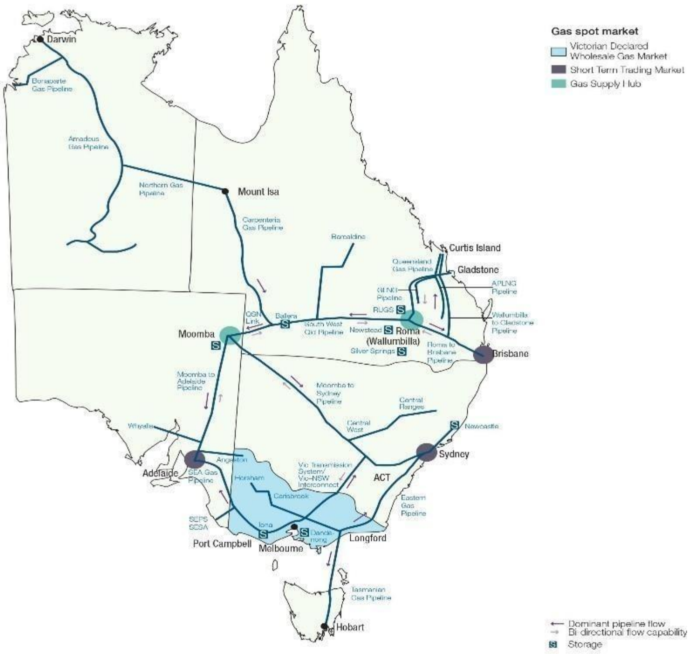
Direct gas use

Eastern Australia has an integrated gas pipeline network which extends from Victoria to the Northern Territory. This allows wholesale gas purchasers, including gas retailers and industrial customers, to purchase gas from any source in this network. The interconnected nature of the market means that the whole market is affected by any changes in market conditions across the east coast.

[222] ARENA (2015). *Renewable energy options for Australian industrial gas users.*
[223] AER (2018). *State of the Market.*

Figure 65 demonstrates how gas pipelines connect the whole of the east coast of Australia. These interconnections create a single market where gas can be bought and sold, less the cost of transportation using the pipelines.

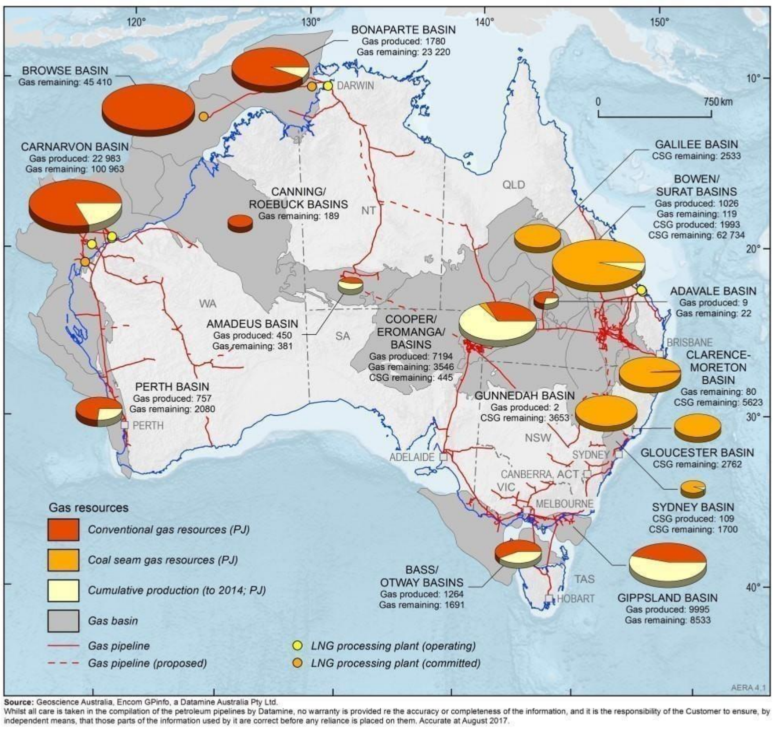
Figure 65: Map of east coast gas pipelines



Source: Australian Energy Regulator (2018). AER State of the energy market.

Figure 66 shows that east coast gas reserves are largely located in Queensland. Given the LNG export terminal in QLD, most of this supply is exported. The Victorian conventional gas reserves, which currently supply the Victorian market are being depleted, with AEMO forecasting significant drops in production by 2023.

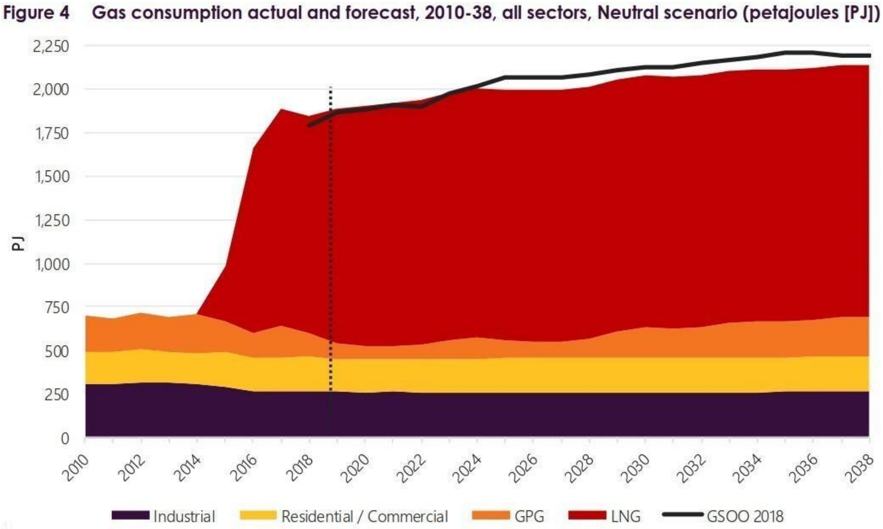
Figure 66: Australian gas reserves



Source: Geoscience Australia (2017).

In 2014, the Australian domestic gas market was connected to the international gas market through LNG export facilities Queensland. The connection with the international market changed the demand and supply dynamic of the whole east coast market. LNG exports now account for most of the demand in the market, as shown in Figure 67.

Figure 67: Eastern Australia Gas Demand



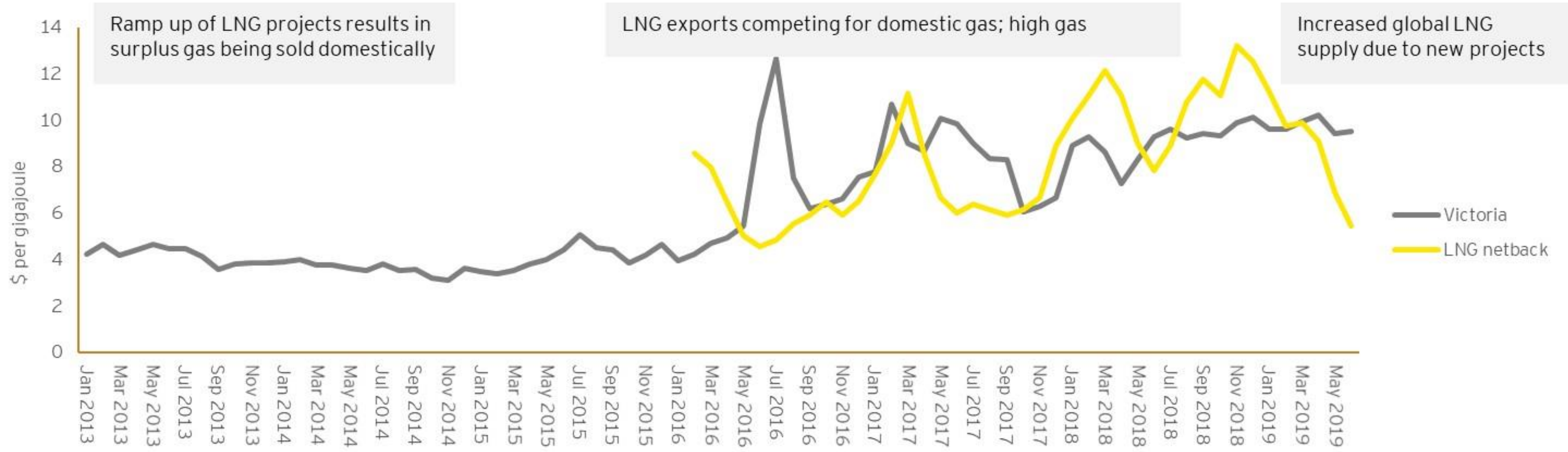
Source: AEMO (2019). Gas Statement of Opportunities. p4.

The connection of the east coast gas market to the international gas market has caused the price of domestic gas to rise to the "netback" price as demonstrated in Figure 68. The netback price is the international price less the cost of transportation. If the netback price is higher than the domestic price, then domestic prices will need to rise to match it otherwise gas will be exported to take advantage of the higher price.

The substantial increase in gas prices has outstripped increases to the Consumer Price Index: this has led to significant cost increased for consumers and industrial gas users. The ACCC is currently investigating gas prices and their drivers in more detail.[224]

[224] ACCC (2019). *Gas inquiry 2017-2020 interim report*.

Figure 68: Spot gas and LNG netback prices



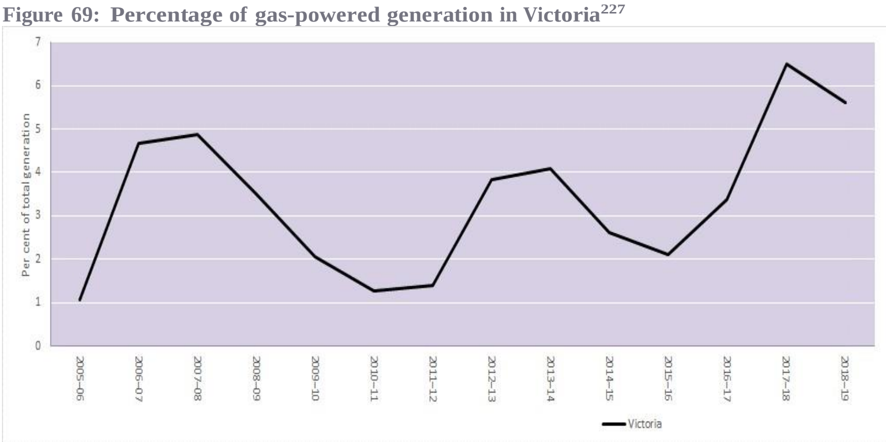
Infographic showing price increase- Source: AER (2019). State of the Energy Market.

Gas powered generation

GPG needs as little as five minutes to ramp up to full operating capacity, allowing them to respond quickly to changes in the electricity market. This makes it a useful complement to solar and wind generation, which are affected by sudden changes in the weather. GPG emits significantly less carbon than coal generation at approximately 50 per cent less when comparing the most efficient gas and coal generators.[225]

GPG often work to meet the seasonal demand in summer (and sometimes winter) when electricity demand and prices are highest.[226] The retirement of coal generators in Victoria has made gas generation critical to meeting electricity demand when coal-fired power stations are offline or when renewable energy is low. This led to gas generation in 2018–19 being 266 per cent higher in Victoria than it was three years ago in 2015-16. Figure 69 and Figure 70 highlight how GPG fluctuates significantly depending on Victoria's energy needs.

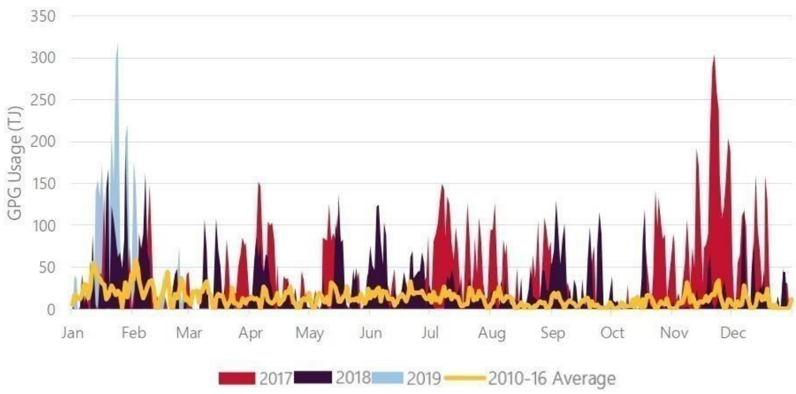
Figure 69: Percentage of gas-powered generation in Victoria[227]



Source: Australian Energy Regulator (2018). AER State of the energy market.

Overall, the percentage of GPG generation as a share of total generation has risen from 2.6 per cent in 2014-15 to 5.6 per cent in 2018-19.

Figure 70: GPG demand for 2017, 2018 and 2019 (YTD) vs 2010-2016 average



Source: AEMO (2019). Victorian Gas Planning Report.

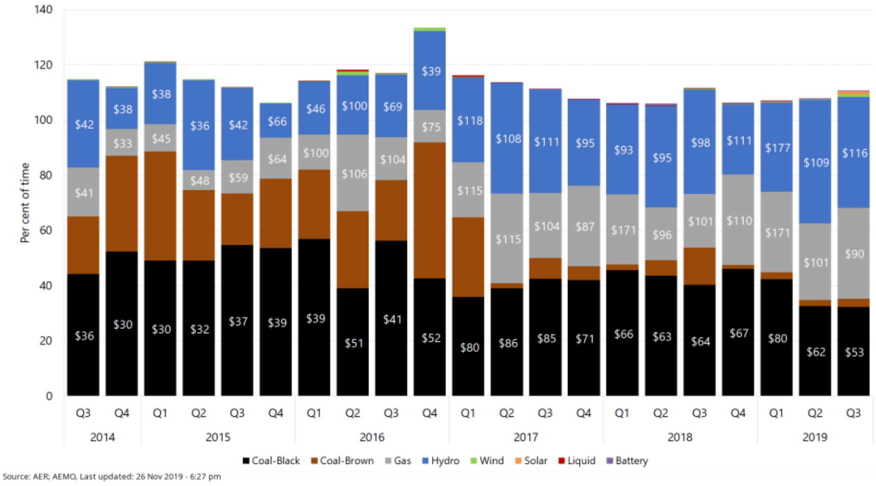
GPG price-setting dynamics

While previously wholesale electricity prices were dominated by hydro and coal, GPG is increasingly playing a more prominent role. In the second quarter of 2019, GPG was the marginal fuel type on the wholesale electricity market 23 per cent of the time.[228]

[225] AER (2019). *State of the energy market*.
[226] AER (2019). *State of the energy market*.
[227] AER (2019). *State of the energy market*.
[228] AEMO (2019). *Insights, Quarterly Energy Dynamics Q3 2019*. p15.

Figure 71: Quarterly price setter and average price set by fuel source – Victoria displays the percentage of time that generators of each fuel type set the wholesale electricity price in Victoria in a given quarter. While there has been a decline in the period of time that both black and brown coal influence and set price, GPG and hydro are rapidly increasing as key determinants of electricity prices, particularly from 2016.

Figure 71: Quarterly price setter and average price set by fuel source – Victoria



Source: AER (2019). Wholesale statistics.

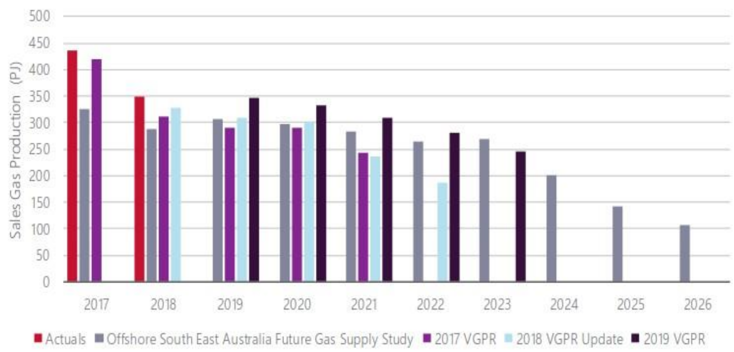
Forecast Gas Supply and Demand

The ACCC has projected enough supply to meet forecast domestic and export demand for 2020.[229] Gas supply forecasts provided to AEMO by gas producers forecast sufficient fall in gas supply through the five-year period to 2023. For example:

- in Gippsland, producers have advised that annual production will reduce by 22 per cent from 2019 to 2023
- in Port Campbell producers have advised that annual production will reduce by 74 per cent from 2019 to 2023.[230]

Figure 72 forecasts total Victorian production to reduce from 347 PJ in 2019 to 246 PJ in 2023 unless additional reserves are found and developed.

Figure 72: Victorian production forecasts by year (PJ/year)



Source: AEMO (2019). Victorian Gas Planning Report.

[229] ACCC (2019). *Gas inquiry 2017-2020 interim report*.
[230] AEMO (2019). *Victorian Gas Planning Report*. p6.

From 2024 onwards, supply will be reliant on upon much less certain 2C estimates, which are defined as the best estimate of contingent, not probable or proven resources.

Peak Day Supply Adequacy

Due to its use in heating, gas experiences peak demand in winter, especially on cold days. Winter peak day supply adequacy is forecast to continue to tighten during the outlook period. Without additional gas supply capacity, gas supply restrictions and curtailment of gas-powered generation (GPG) for electricity may be necessary on a peak winter day from 2023.

Producers have advised that total Victorian winter production will reduce from 1,275 terajoules per day (TJ/d) in 2019 to 847 TJ/d in 2023, which is a 34 per cent decrease. Prospective production projects, currently uncommitted, could increase production up to 1,030 TJ/d in 2023 (still a 19 per cent decrease).[231]

At the same time, Victorian GPG consumption is forecast to increase by 25 per cent over AEMO's five-year outlook (from 7.2 PJ in 2019 to 9.0 PJ in 2023). This is primary due to the closure of Liddell coal-fired power station in 2022 and assumes generation and transmission developments in line with the neutral scenario in AEMO's 2018 Integrated System Plan.[232]

As shown below in Table 147, forecasted total Victorian consumption (and therefore demand) is projected to be less than the expected supply of gas. Therefore, while Victoria is forecast to have sufficient supply to service projected demand for gas, winter monthly gas consumption is up to three times the summer monthly gas consumption. This is expected to place strain on winter gas supply-demand balance in Victoria.

Table 147: Annual actual and forecast gas consumption and peak gas total demand

	2018 (actual)	2019	2020	2021	2022	2023
DTS system consumption (PJ)	194	200	200	201	202	203
DTS GPG consumption (PJ)	10	7	4	5	6	9
Victorian non-DTS consumption (PJ)	16	9	5	6	6	11
Total Victorian consumption (PJ)	220	217	209	212	215	223
Total available production supply (PJ)	348	347	333	310	280	246
Surplus/shortfall quantity (PJ)	128	130	124	97	65	23

Source: AEMO (2019). Victorian Gas Planning Report.

Potential sources of new supply and changes to gas demand

Given the forecast shortfall in gas supply in south eastern Australia, AEMO has considered the impact of a number of new sources of supply including an LNG import terminal or new pipeline infrastructure, offshore gas opportunities and new Queensland and Northern Territory supply sources.

[231] Information provided by the department.
[232] AEMO (2019). *Victorian Gas Planning Report.*

Import terminal

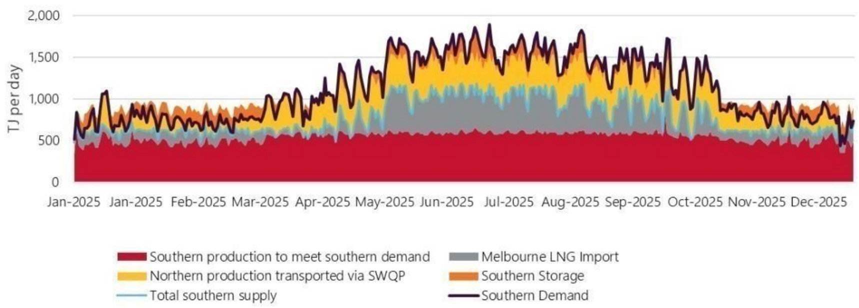
An LNG import terminal located at Melbourne would have the greatest impact to reduce projected shortfalls, as it is able to utilise the existing pipeline infrastructure. The key development of LNG import facilities in Victoria is AGL's Crib Point LNG import facility. AGL is currently working through the Victorian government's EES process and expects the outcome to occur no earlier than late FY 2020, and first gas in expected in the second half of FY 2022. It is expected that the initial production amounts will be 100 PJ/a.

Along with providing an additional unconstrained source of gas for Victoria, this terminal is projected to reduce pipeline and storage infrastructure congestion, enabling greater access to supply from northern fields. This development is projected to reduce total system shortfalls by up to 265 PJ a year by 2030 and delay the timing of the first shortfalls by five years (to 2029). After 2030, the shortfalls are reduced by up to 290 PJ per year.[233]

These benefits have resulted in growing interest for constructing LNG terminals in southern Australia, with several projects also being considered in Sydney (Port Kembla import terminal),[234] Newcastle (Energy Projects and Infrastructure Korea (or EPIK) LNG project),[235] and Adelaide (Outer Harbor LNG project).[236]

The imported LNG storage is projected to be utilised most heavily during winter when gas demand peaks, although small amounts of LNG imports would also add support during low demand periods. This would allow southern storages to get filled and be available during high demand periods in the winter.

Figure 73: Forecast daily supply and demand balance in southern states in 2025 with additional supply from Melbourne LNG terminal



Source: AEMO (2019). Gas Statement of Opportunities (GS00). p55.

Alternative LNG import terminal locations in Sydney or Adelaide, would not be effective at increasing supply, as shown in Figure 74. The Melbourne terminal would prevent a shortfall until 2029 due to its access to existing gas pipeline infrastructure.

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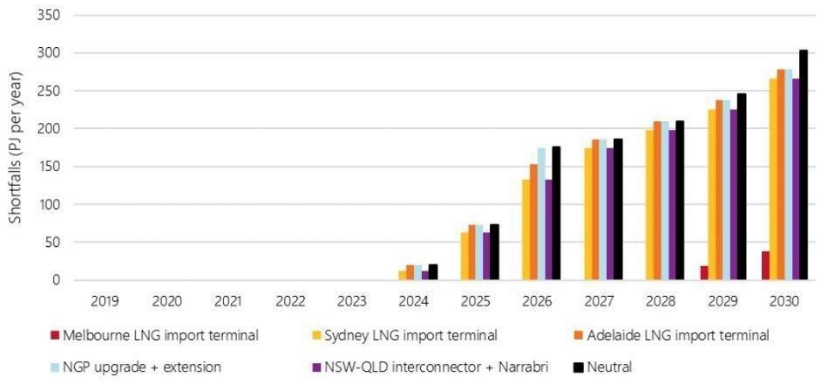
[233] AEMO (2019). *Gas Statement of Opportunities (GSOO).* p55.

[234] Australian Industrial Energy. (2020). *Need for the Project - Australian Industrial Energy*. [online] Available at: https://ausindenergy.com/need-for-the-project [Accessed 14 Jan. 2020].

[235] EPIK. (2020). *Newcastle GasDock*. [online] Available at: https://www.epiklng.com/nlng-471710.html [Accessed 14 Jan. 2020].

[236] Veniceenergy.com. (2020). *Venice Energy*. [online] Available at: https://veniceenergy.com/outer-harbor-LNG-project [Accessed 14 Jan. 2020].

Figure 74: Forecast shortfalls of the new supply options, compared to the Neutral existing and committed projects only shortfalls, 2019-30



Source: AEMO (2019). Gas Statement of Opportunities (GS00). p59.

Underground gas storage

UGS makes use of depleted gas fields to store gas when there is an over-supply and then to release it back into the market when there is an under supply. It fulfils a similar role to a battery; storing excess capacity in the summer months when demand is low and then supplying gas during the peak demand of the winter months.

The Iona UGS facility works to balance daily and monthly supply and demand while the Dandenong LNG storage facility is used to supply peak shaving gas during periods of very high demand or during disruptions to gas supply.[237]

The Iona reservoir is planned to increase in its withdrawal capacity to increase the facility's supply capacity to 520 TJ/d by 2021. This increase supply capacity is expected to continue to be limited by the transportation capacity of the SWP towards Melbourne. Furthermore, Lochard Energy has agreed to purchase a number of depleted gas fields near the Iona UGS facility, with the intention of converting some of these fields to gas storage reservoirs.[238] These additional storage reservoirs are not expected to be available prior to 2023. They have received ACCC approval to complete this acquisition.[239]

The VGP has also investigated the viability of increase gas storage options, however this falls beyond the scope of this report.

Offshore gas opportunities

A number of offshore gas supply projects are presently being evaluated across the Gippsland and Otway Basins, which could materially improve annual production quantities.

Prospective and potential projects[240] to increase supply and reduce the risk of peak demand day shortfall include:

- **Beach Energy:** Beach Energy has announced its intentions to develop the Blackwatch gas field in Port Campbell, along with undertaking exploratory drilling, with a target on the Enterprise and Artisan prospects. If these explorations are found to be successful, this gas is expected to

[237] AEMO (2019). *Victorian Gas Winter Operations Plan.* p3.
[238] Australian Financial Review. (2020). *Origin Energy, QIC's Lochard sign storage assets deal.* [online] Available at: https://www.afr.com/street-talk/origin-energy-qicbacked-lochard-sign-heytesbury-deal-20190201-h1aqkg [Accessed 14 Jan. 2020].
[239] Australian Competition and Consumer Commission. (2020). *Lochard's acquisition of Heytesbury gas reservoirs not opposed.* [online] Available at: https://www.accc.gov.au/media-release/lochard%E2%80%99s-acquisition-of-heytesbury-gas-reservoirs-not-opposed [Accessed 14 Jan. 2020].
[240] 'Prospective supply' includes projects or development which have not reached Final Investment Decision but are anticipated to proceed during the outlook period. 'Potential projects' are uncommitted gas supply projects that have not reached Final Investment Decision, which are considered less likely but could potentially proceed during the outlook period.

be processed through the Otway Gas Plant. Beach have additionally proposed further development of the Thylacine and Geographe fields.[241]

- **Cooper Energy:** Cooper Energy is proposing a redevelopment of the Henry-2 well in 2020, specifically targeting an additional 20 TJ/d of production.[242] They are also conducting studies on two exploration projects: Annie and Elanora, which are both located in the Otway Basin.[243]

Victorian Energy Upgrades

The Victorian Energy Upgrades scheme, and its legislative basis *The Victorian Energy Efficiency Target Act 2007*, is a market-based incentive mechanism hosting a suite of improvements to promote energy efficiency and reduce energy consumption within residential and non-residential properties. These improvements and legislative changes are expected to significantly impact future gas demand and thereby the size and composition of the gas supply market.

Through the *Victorian Energy Efficiency Target Act 2007*, the following priorities in the electricity and gas market are established:

- to reduce GHG emissions
- to encourage efficient use of electricity and gas
- to encourage investment, employment and technology development in industries that supply goods and services which reduce the use of electricity and gas by consumers.

Through the introduction of schemes such as the Victorian Energy Efficiency Certificate (VEEC's), as well as through supporting innovation and competition in energy markets, overall demand for energy from consumers is projected to reduce, thereby placing downward pressure on wholesale gas and electricity prices. This is designed to have two effects: one being that electricity generation and transmission capacity expansions can be deferred, and that the industry transforms to invest more heavily in more efficient activities and further reduce the use of gas and electricity within the energy market.[244]

[241] SED Regional Advisory (2019). *Beach Energy – Economic, social and environmental impacts analysis.* Department of Jobs, Precincts and Regions. Unpublished report.
[242] Cooper Energy (2019). *FY18 Results & FY19 Outlook*.
[243] Cooper Energy (2018). *Presentation to Goldman Sachs Emerging Energy Companies Conference*. Available at: http://member.afraccess.com/media?id=CMN://2A1120361&filename=20181128/COE_02053102.pdf [Accessed 14 Jan. 2020].
[244] Department of Environment, Land, Water and Planning (2018). *Regulatory Impact Statement, Victorian Energy Efficiency Target Regulations*.

Appendix B Overview of the economic analysis

Approach

Economic impact analysis measures the net impact of changes on an economy. It is used to measure the net change in response to a given event (e.g. such as the loss of an activity, or increased expenditure in a particular sector). The key economic metrics are expressed in terms of changes to gross domestic product and employment.

Computable General Equilibrium models are the modelling framework of choice for analysing the economic impacts of major project investments, including gas production. Our analysis is based on EYGEM, EY's own in-house CGE model.

The EYGEM model is a large scale, dynamic, multi-region, multi-commodity CGE model of the world economy. The EYGEM model enjoys significant flexibility both at the regional and sectoral level, including the capability to individually identify subregions of Australia, in this case Otway, Gippsland, rest of Victoria and rest of Australia.

Overview of the modelling framework

EYGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).

- The model does not consider end use of gas.

- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas utility function.

- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.

- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a Cobb-Douglas utility function.

- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.

- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a constant elasticity of substitution (CES) production function.

- Producers are cost minimisers, and in doing so choose between domestic, imported and interstate intermediate inputs via a CRESH production function.

- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply. For this modelling exercise, we have adopted 0.3 for Otway and Gippsland, and 0.15 for the rest of Victoria and the rest of Australia.

- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return.

- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).

- For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But in relative terms imported goods from different regions are treated as closer substitutes than domestically-produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.

Dynamics of EYGEM

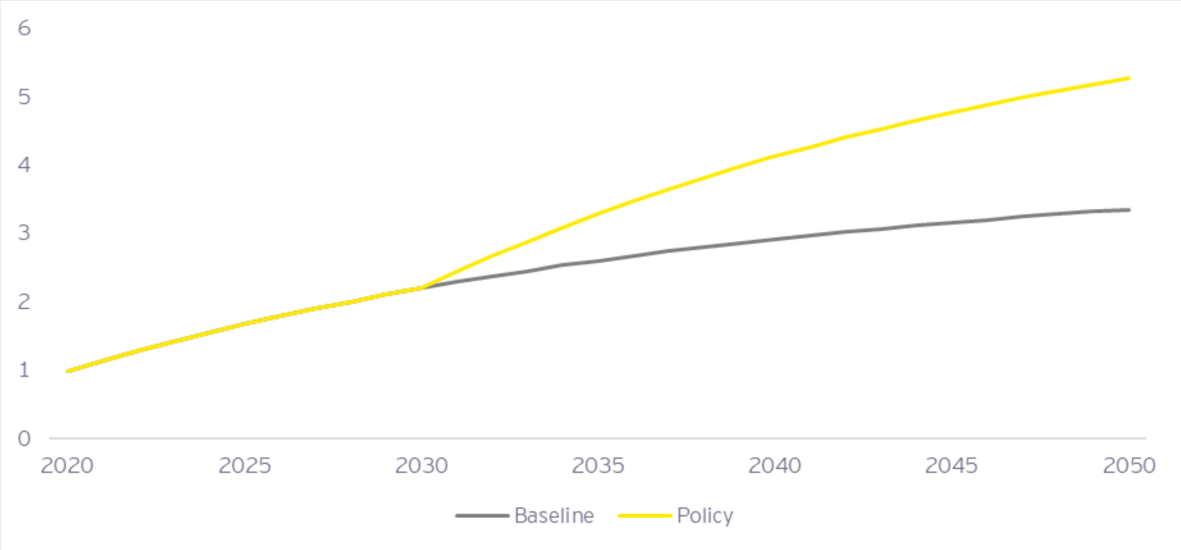
EYGEM is a recursive dynamic model that solves year-on-year over a specified timeframe. This has two main advantages. First, dynamics allows a richer specification of the model in that issues such as debt accumulation (which facilitates the ability to model international capital flows) and labour market dynamics are able to be modelled in a more sophisticated manner. Second, scenario analysis using a model such as EYGEM can be greatly enhanced by the ability to alter the baseline, or minimum case, to account for key developments or uncertainties.

The model is then used to project the relationship between variables under different scenarios, or states, over a pre-defined period. This is illustrated in Figure 75, where a minimum case or 'baseline' forms the basis of the analysis undertaken using EYGEM. The model is solved year-by-year from time 0 which reflects the base year of the model (2020) to a predetermined end year (in this case 2050).

The 'Variable' represented in the figure could be one of the hundreds or thousands represented in the model ranging from macroeconomic indicators such as real GDP to sectoral variables such as the exports of iron and steel from Australia. In the figure, the percentage changed in the variables have been converted to an index (= 1.0 in 2020) and is projected to increase by 2050.

Set against this baseline is, in Figure 75, a 'Policy' scenario. This scenario represents the impacts of a policy change or different assumptions about economic development that results in a new projection of the path of the variable over the simulation time period. The impacts of the policy/assumption change are reflected in the differences in the variable at time T. It is important to note that the differences between the baseline and policy scenario are tracked over the entire timeframe of the simulation.

Figure 75: Example dynamic simulation using EYGEM



Detailed interdependencies

The model is underpinned by a detailed, global database. The model's database is 'benchmarked' or 'calibrated' so that initial equilibrium solution exists that replicates actual sectoral production, consumption, trade and factor usage. It contains 141 regions and 65 sectors for a base year of 2014, and is the benchmark dataset for applied, global general equilibrium modelling. This database produced by the Global Trade Analysis Project (GTAP) at Purdue University is the most detailed and comprehensive database of its type in the world. Used by over 700 researchers globally, the database is a truly international, collaborative research effort that is fully documented and transparent.

The EYGEM model is primarily based on input-output or social accounting matrices, as a means of describing how economies are linked through production, consumption, trade and investment flows. For example, the model considers:

- direct linkages between industries and countries through purchases and sales of each other's goods and services; and
- indirect linkages through mechanisms such as the collective competition for available resources, such as labour, that operates in an economy-wide or global context.

The remainder of this Appendix describes the economic receptors estimated by the EYGEM model and outlines the key assumptions, values and timings used to generate these outputs.

Impacts and benefits assessed

The CGE model is used to support the impacts and benefits assessment of the economic receptors shown in Table 148.

Table 148: Economic receptors analysed using CGE modelling

#	Receptor	Description	Measures
ER1	Employment	What direct and indirect regional employment numbers and type that will be added?	► Direct employment (FTE) in three regions (i.e. Otway region, Gippsland region and rest of Victoria) ► Indirect employment (FTE) in three regions (i.e. Otway region, Gippsland region and rest of Victoria)

#	Receptor	Description	Measures
ER2	GSP	How much value will be added to Victoria?	► GSP of Victoria
ER3	GRP and GRI	How much value will be added to regional areas, including changes in regional income?	► GRP in three regions (i.e. Otway region, Gippsland region, rest of Victoria) ► GRI in three regions (i.e. Otway region, Gippsland region, rest of Victoria)

Model inputs

The economic impacts in this section are generated through a bespoke implementation of EY's in-house Computable General Equilibrium Model, the EYGEM model. A detailed description of the model is presented above.

The inputs to the model can be broken into two broad categories: the market data used to generate the economic 'shocks', and specific assumptions that guide our choice of the economic environment used in the model. Each of these elements are described in further detail below.

Economic shocks

- *Gas production and investment:* for each scenario and in each region of interest (i.e. the Otway region for Otway scenarios and the Gippsland region for the Gippsland scenarios), non-zero inputs for gas production indicate an increase in gas supply due to production becoming operational. Non-zero inputs for investment indicate an increase in capital investment in a given site.

- *The price of gas:* our modelling scenarios assume a fixed gas price in all of the scenarios considered. This is based on the assessment of price impacts in the RBI assessment (see Section 4.2.1.5 ER5: Gas prices)

Economic environment

- *Increases in investment:* each scenario represents combinations of gas production and investment. The levels of investment are measured in millions of dollars and represent deviations from the baseline.

- *Returns to capital:* the investment and production profiles for each scenario suggest that capital investment occurs for two years prior to first gas production, and in selected scenarios that capital investment continues beyond the cessation of production. Our choice of economic environment dictates that despite the economic stimulus associated with construction (for example) activities, the newly installed capital is only productive once, and during the period, gas production is operational.
Once gas production commences, capital assets now generate the standard economic returns that are expected. In the Gippsland scenarios, it is assumed that investment occurs for several years after gas production is completed. In the model, this investment is also considered non-productive for this period of time.

Economic impact assessment results

ER1 Economic impact assessment results

ER1: Employment

Employment is presented in full time equivalent (FTE) terms. A single FTE position represents a single person working a 37.5 hour week at the economy-wide average wage rate. In each scenario, the development of gas production causes a net increase in employment in the state of Victoria, with the majority of the impact explained by an increase in employment in the region of interest, partnered with second order crowding in or crowding out in other regions depending on the scenario. That is, employment outcomes are strong in the Otway region for the Otway scenarios, and in the Gippsland region for the Gippsland scenarios, mainly due to an expansion of industries in each region. Employment is estimated to decrease by a small amount, however, in the rest of Victoria for all scenarios, due to the redistribution of labour-intensive sectors between regions.

Otway scenario results

#	Scenario	Region	Direct employment	Indirect employment	Total FTE*	% of local employment	Average Annual FTE*	Start year	End year
1	Otway Basin (Reference case)	Otway region	387	182	569	0.06%	57	2021/22	2030/31
		Rest of Victoria			-132		-9		
2	Otway Basin (Low)	Otway region	1532	661	2194	0.14%	122	2021/22	2039/40
		Rest of Victoria			-409		-13		
3	Otway Basin (Medium)	Otway region	2416	1059	3475	0.18%	151	2021/22	2044/45
		Rest of Victoria			-589		-13		
4	Otway Basin (High)	Otway region	3816	1689	5506	0.24%	204	2021/22	2048/49
		Rest of Victoria			-810		-14		

*Note: * The total and average FTE figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. Direct and indirect employment may not add to total FTE may not add due to rounding.*

Gippsland scenario results

#	Scenario	Region	Direct employment	Indirect employment	Total FTE*	% of local employment	Average Annual FTE*	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	145	210	355	0.02%	21	2021/22	2038/39
		Rest of Victoria			-96		-5		
2	Gippsland Basin (Medium)	Gippsland region	319	300	619	0.05%	48	2021/22	2034/35
		Rest of Victoria			-167		-12		
3	Gippsland Basin (High)	Gippsland region	520	370	890	0.07%	68	2021/22	2034/35
		Rest of Victoria			-231		-16		

*Note: * The total and average FTE figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by* *the CGE Model Inputs described in this document. Direct and indirect employment may not add to total FTE may not add due to rounding.*

ER2: Gross state product

GSP is a measure of the value of net production in the Victorian economy. It is the equivalent of GDP but at the state level. The estimated GSP impacts increase from the low to high scenarios, driven both by the increased annual gas production and the increased time over which gas production occurs.

Otway scenario results

#	Scenario	Total GSP ($m) *^	Average Annual GSP ($m) *^	GSP (% change from base)	Start year	End year
1	Otway Basin (Reference case)	764.97	76.50	0.02%	2021/22	2030/31
2	Otway Basin (Low)	3018.62	167.70	0.03%	2021/22	2039/40
3	Otway Basin (Medium)	4819.59	209.55	0.04%	2021/22	2044/45
4	Otway Basin (High)	7616.63	282.10	0.04%	2021/22	2048/49

*Note: * The total and average GSP figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

Gippsland scenario results

#	Scenario	Total GSP ($m) *	Average Annual GSP ($m) *	GSP (% change from base)	Start year	End year
1	Gippsland Basin (Low)	310.37	18.26	0.00%	2021/22	2038/39
2	Gippsland Basin (Medium)	635.95	48.92	0.01%	2021/22	2034/35
3	Gippsland Basin (High)	993.04	76.39	0.01%	2021/22	2034/35

*Note: * The total and average GSP figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

ER3: Gross regional product and gross regional income

GRP measures the value of production in each region and is the equivalent to GDP but at the regional level. GRI is a superior indicator of economic welfare and considers the level of income in a region, rather than the level of production. Similar to the results presented for GSP, the estimated GRP and GRI figures increase from the low to high scenarios due to the underlying gas production and investment inputs.

Otway scenario results

#	Scenario	Region	Total GRP ($m) *^	Average Annual GRP ($m) *^	GRP (% change from base)	Start year	End year
1	Otway Basin (Reference case)	Otway region	655.53	65.55	0.69%	2021/22	2030/31
		Rest of Victoria	109.44	10.94	0.00%		
2		Otway region	2605.13	144.73	1.18%	2021/22	2039/40

#	Scenario	Region	Total GRP ($m) *^	Average Annual GRP ($m) *^	GRP (% change from base)	Start year	End year
	Otway Basin (Low)	Rest of Victoria	413.49	22.97	0.00%		
3	Otway Basin (Medium)	Otway region	4191.38	182.23	1.61%	2021/22	2044/45
		Rest of Victoria	628.20	27.31	0.01%		
4	Otway Basin (High)	Otway region	6710.66	248.54	1.98%	2021/22	2048/49
		Rest of Victoria	905.98	33.55	0.01%		

*Note: * The total and average GRP figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

#	Scenario	Region	Total GRI ($m) *^	Average Annual GRI ($m) *^	GRI (% change from base)	Start year	End year
1	Otway Basin (Reference case)	Otway region	810.63	81.06	0.66%	2021/22	2030/31
		Rest of Victoria	151.69	15.17	0.00%		
2	Otway Basin (Low)	Otway region	3229.06	179.39	1.06%	2021/22	2039/40
		Rest of Victoria	677.65	37.65	0.01%		
3	Otway Basin (Medium)	Otway region	5392.08	234.44	1.46%	2021/22	2044/45
		Rest of Victoria	1173.60	51.03	0.01%		
4	Otway Basin (High)	Otway region	9072.22	336.01	1.84%	2021/22	2048/49
		Rest of Victoria	1850.79	68.55	0.01%		

*Note: * The total and average GRI figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7 per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

Gippsland scenario results

#	Scenario	Region	Total GRP ($m) *^	Average Annual GRP ($m) *^	GRP (% change from base)	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	250.91	14.76	0.07%	2021/22	2038/39
		Rest of Victoria	59.46	3.50	0.00%		
2	Gippsland Basin (Medium)	Gippsland region	522.77	40.21	0.21%	2021/22	2034/35
		Rest of Victoria	113.18	8.71	0.00%		
3	Gippsland Basin (High)	Gippsland region	823.86	63.37	0.33%	2021/22	2034/35
		Rest of Victoria	169.17	13.01	0.00%		

*Note: * The total and average GRP figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

#	Scenario	Region	Total GRI ($m) *^	Average Annual GRI ($m) *^	GRI (% change from base)	Start year	End year
1	Gippsland Basin (Low)	Gippsland region	272.22	16.01	0.06%	2021/22	2038/39
		Rest of Victoria	50.26	2.96	0.00%		
2	Gippsland Basin (Medium)	Gippsland region	680.91	52.38	0.20%	2021/22	2034/35
		Rest of Victoria	117.39	9.03	0.00%		
3	Gippsland Basin (High)	Gippsland region	1085.78	1085.78	0.31%	2021/22	2034/35
		Rest of Victoria	183.20	183.20	0.00%		

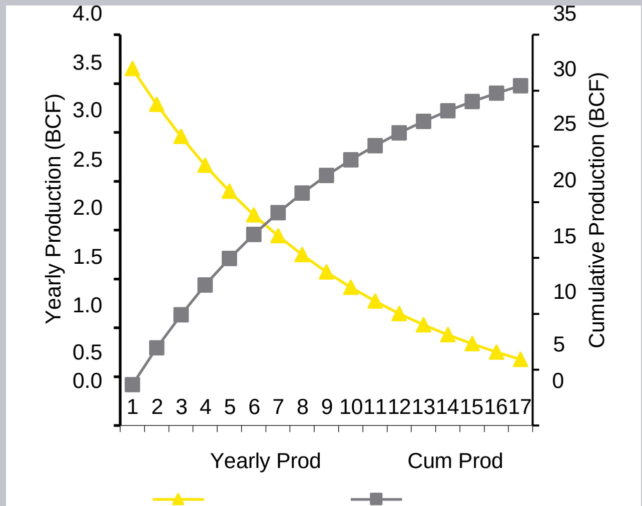
*Note: * The total and average GRI figures are measured from the start year to the end year stated for each scenario. These start and end years align to the periods where there is gas production and / or investment for each scenario, as outlined by the CGE Model Inputs described in this document. ^ All net present values are calculated using a 7per cent real discount rate, consistent with the guidelines issued by the Victorian Department of Treasury and Finance (Source: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case).*

Key assumptions

The CGE model uses the assumptions shown in Table 149.

Table 149: Economic model key assumptions

Item	Assumption / value	Source / rationale
Evaluation Period	30 years commencing 1 July 2020	► Project assumption
Prices and values	Prices and values expressed in FY2019 dollars.	► Project assumption
Conversion	The BCF to PJ multiplier is 1.076	► Project assumption based on data provided by the department
Gas production start date	2024	► Project assumption based on Departmental analysis ► Assumed time to first production is four years after restart (i.e. four years after 1 June 2020)
Years of gas production	12 years (2024-2050 inclusive)	► Project assumption
Gas price forecast	Yearly prices for the duration of the project based on Victorian delivered wholesale gas price forecasts	► Data was extracted from the Core Energy 2019 *Wholesale gas price outlook databook*, prepared for AEMO's 2019 *Gas Statement of Opportunities* ► Price forecasts were extrapolated out from 2040 – 2050 using the average annual change in price over the forecast period
Gas production forecast volumes - Baseline	Victoria's baseline supply was extrapolated from AEMO's projected eastern and south-eastern Australia gas production supply from existing projects and committed developments using current Victorian supply as a proportion of Australian supply and trends from 2019-2023.	► Data was extracted from the 2019 Gas Statement of Opportunities – report figures and data and the Victorian Gas Planning Report, March 2019 from AEMO

Item	Assumption / value	Source / rationale
Gas production forecast volumes - Scenarios	**Otway Scenarios** ► The minimum case: 81BCF ► Low scenario: 294 BCF ► Medium scenario: 434 BCF ► High scenario: 660 BCF **Gippsland Scenarios** ► Low scenario: 35 BCF ► Medium scenario: 70 BCF ► High scenario: 105 BCF	► Gas production data was provided by the department on a per location basis (see hypothetical scenario descriptors in Table 15 and Table 87) ► In order to forecast the gas production timeline, the following was performed: ► Gas production was extrapolated on a per well basis based on the location of production and expected number of exploration and development wells. For the purposes of the analysis, all exploration wells that encountered gas (i.e. were a discovery) and subsequent development wells in a region were assumed to have equal production of gas. *For example, if 13 BCF was to be produced from a reservoir unit and two development wells were to be drilled. Each well (the two original exploration wells that encountered the gas and two subsequent development wells therefore had expected production of 3.25 BCF each.* ► The department provided an example average expected production profile.  ► Using the expected production profile per well, yearly production was estimated on an individual well basis. *For example, in year one the individual wells in a play area were each expected to produce 3.65 BCF and produce 2.85 BCF in year two. This results in total production of 6.5 BCF per well.*

Item	Assumption / value	Source / rationale
Number and nature of infrastructure developments	**Otway hypothetical scenarios** ► Minimum scenario: 18 exploration wells (12 well sites rehabilitated), 14 development wells (inclusive of the six exploration wells that were discoveries), one new modular processing plant ► Low scenario: 54 exploration wells (36 well sites rehabilitated), 52 development wells (inclusive of the 18 exploration wells that were discoveries), two new modular plants and one full-scale processing plant ► Medium scenario: 81 exploration wells (54 well sites rehabilitated), 81 development wells (inclusive of the 27 exploration wells that were discoveries), one new modular plant and a full-scale processing plant ► High scenario: 138 exploration wells (92 well sites rehabilitated), 125 development wells (inclusive of 46 exploration wells that were discoveries), one new modular plant and a full-scale processing plant **Gippsland hypothetical scenarios** ► Low scenario: 70 exploration wells (63 well sites rehabilitated), nine development wells (inclusive of seven exploration wells that were discoveries) and a new modular plant ► Medium scenario: 70 exploration wells (63 well sites rehabilitated), 18 development wells (inclusive of seven exploration wells that were discoveries) and a new modular plant ► High scenario: 70 exploration wells (63 well sites rehabilitated), 27 development wells (inclusive of seven exploration wells that were discoveries) and a new modular plant	The number and nature of infrastructure developments was provided by the department on a per location basis (see hypothetical scenario descriptors).

Item	Assumption / value	Source / rationale
Timing of infrastructure development	**Otway scenarios:** ► Minimum scenario: see Figure 76 and Figure 77 ► Low scenario: see Figure 79 and Figure 80 ► Medium scenario: see Figure 82 and Figure 83 ► High scenario: see Figure 85 and Figure 86 **Gippsland scenarios** ► Low scenario: see Figure 88 and Figure 89 ► Medium scenario: see Figure 91 and Figure 92 ► High scenario: see Figure 94 and Figure 95	► Time to develop infrastructure was based on benchmark industry estimates as follows: ► Well development: Less than one year ► Pipeline tie-back works: Less than one year ► New processing plant: three years ► Timing of the development of infrastructure calculated with the following assumptions: ► All production occurs within the evaluation period; therefore, no wells will be drilled in the final year of the period. That is, exploration and development well production would cease in 2039. ► First exploration wells are expected to be drilled in year two as provided by the department. Exploration wells with discoveries are assumed to commence production in year 4 as per the gas production start date assumption. Exploration wells that do not have discoveries are assumed to be plugged and abandoned. ► First development wells and discovery wells are expected to be drilled from year four as provided by the department and based on the production start date. Development wells have been apportioned across total gas producing wells for CAPEX purposes. ► CAPEX for production wells would be incurred in the year prior to construction. That is capex for production well would be incurred from year three ► Average number of exploration wells per year, based on historical average provided by the department: ► Minimum and low scenario: four wells ► Medium and high scenario: five wells ► Average number of gas producing wells (exploration and development) per year is as follows: ► Minimum and low scenario: two to three wells ► Medium and high scenario: four to five wells This is to ensure all production occurs within the evaluation period, consistent with the first assumption. ► Pipelines are expected to be constructed in the first year of production in the associated region (as provided by the department). If more than one pipeline is expected to be constructed for a given region, this has been apportioned across the timeline based on the number and location of wells, associated infrastructure (e.g. new plants), and forecast production volumes. ► New plants (both full scale and modular) are expected to be constructed before production in the associated hypothetical development area (as provided by the department). If more than one plant is expected to be constructed for a given region, this has been apportioned across the timeline and number of wells with the first plant developed in the first year of production.

Item	Assumption / value	Source / rationale
Infrastructure capital expenditure	See Table 150	► Drilling costs provided by the department based on benchmark estimates with similar drill depths to the regions analysed within this report ► Modular gas plant costs based on benchmark data ► Processing plant costs based on benchmark data on unit cost basis (TJ/D). This has been apportioned to reflect the anticipated production capacity required within the scenario based on the production profile. ► Pipeline costs have been estimated using Core Energy Group data based on the Cooper Basin. The report showed a range of pipeline costs from $750,000 for custom conventional wells and $400,000 for custom infill wells. The report has adopted the midpoint for the purpose of this analysis. Core Energy Group Cooper-Eromanga Basin Outlook, October 2016., available at: http://www.energymining.sa.gov.au/petroleum/latest_updates/core_energy_cooper-eromanga_basin_outlook_2035_published_october_2016
Infrastructure operating expenditure	$1,270,000 AUD/PJ	► Opex has been estimated using Core Energy Group data on marginal costs for conventional gas. ► Core Energy Group Cooper-Eromanga Basin Outlook, October 2016., available at: http://www.energymining.sa.gov.au/petroleum/latest_updates/core_energy_cooper-eromanga_basin_outlook_2035_published_october_2016
Price impacts of development	0% impact	► Analysis of price impacts in RBI assessment (see 4.2.1.5 ER5: Gas prices)

Source: Various, as described in table.

Table 150: Indicative gas cost development summary

Asset type	Capacity	Units	Indicative cost ($, million)
Development well	1	Qty	5.00
Exploration well	1	Qty	5.00
Tie back	50	km	0.58
Modular gas plant	10	TJ/D	31.00
Processing plant (Low)	58.6	TJ/D	156.27
Processing plant (Medium)	83.1	TJ/D	221.61
Processing plant (High)	86.3	TJ/D	230.14

Notes: Estimates are based on recent Australian benchmark cost estimates; however, costs can be influenced by local factors and also depend on specifications of individual asset types (e.g. whether compressor stations are included). Capacity estimates have been provided by DJPR or based on EY analysis of the production profile of each scenario.

Otway minimum scenario

Figure 76: Timing of infrastructure constructed in the Otway minimum scenario

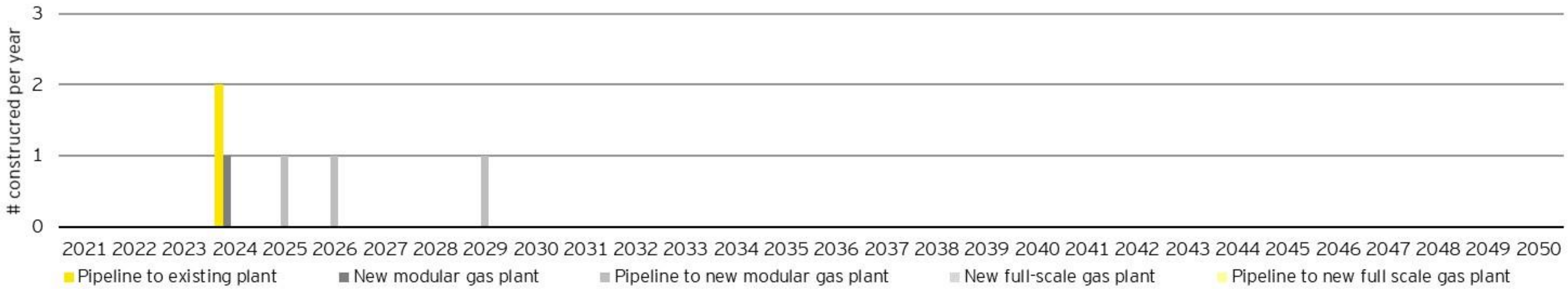
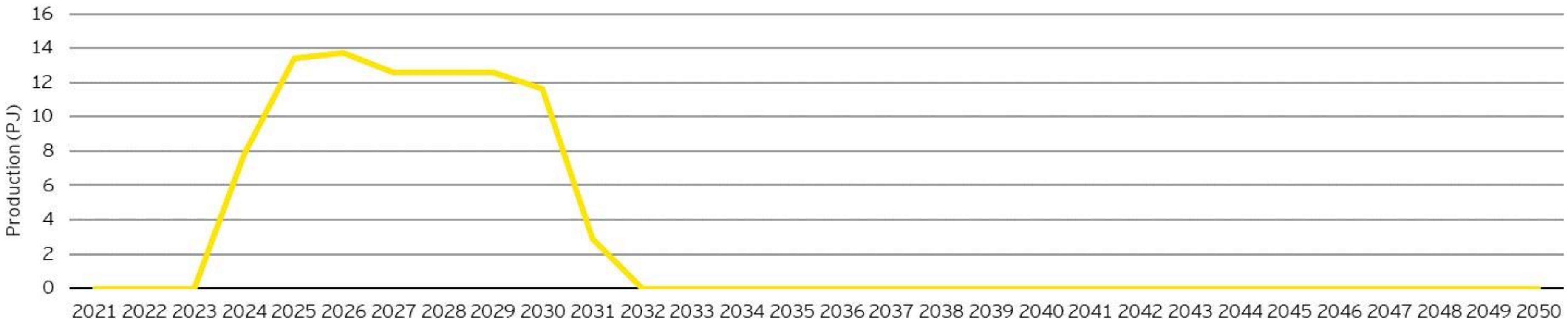


Figure 77: Timing of wells drilled Otway minimum scenario

Figure 78: Gas production Otway minimum scenario



Source: EY analysis

Otway low scenario

Figure 79: Timing of infrastructure constructed in the Otway low scenario

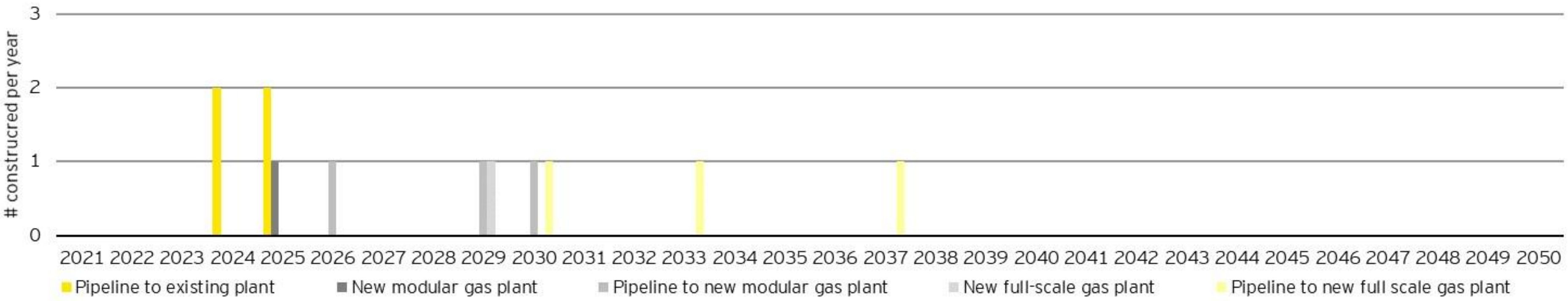


Figure 80: Timing of wells drilled Otway low scenario

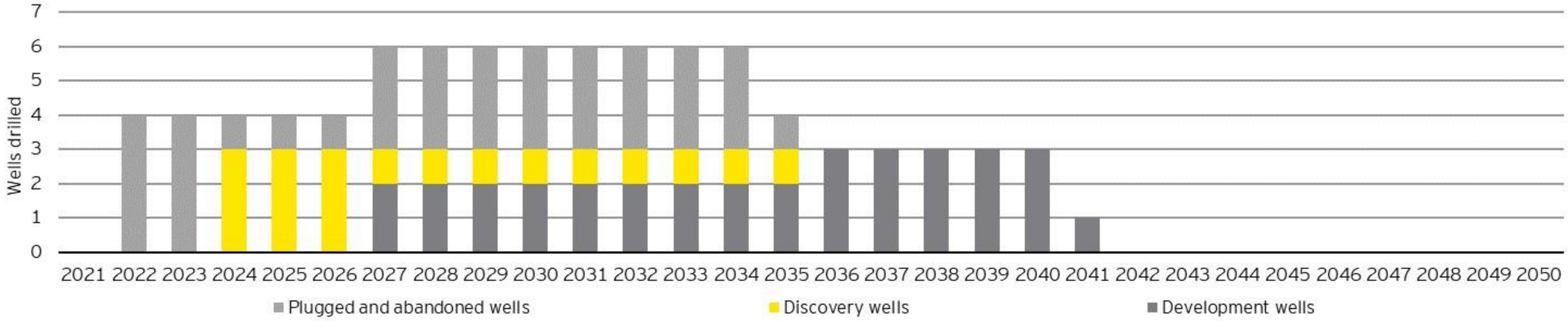
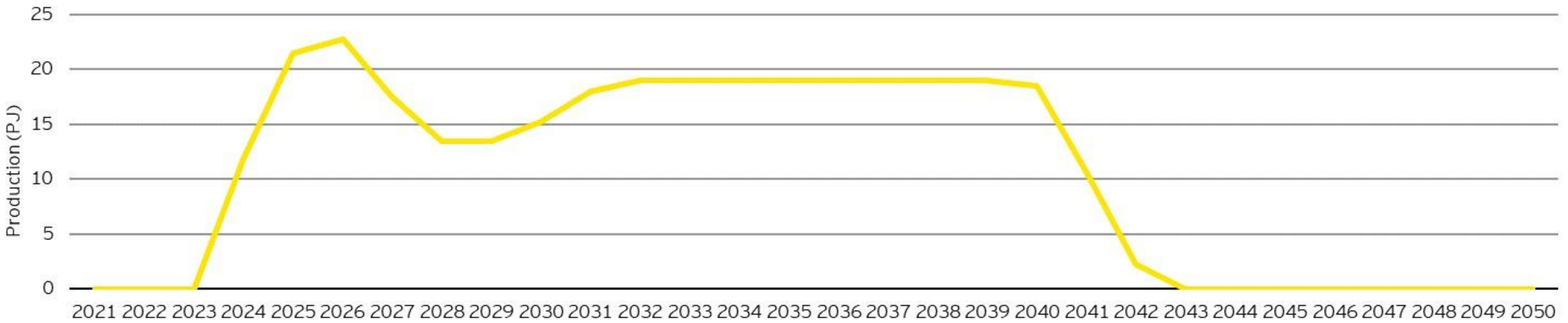


Figure 81: Gas production Otway low scenario



Source: EY analysis

Otway medium scenario

Figure 82: Timing of infrastructure constructed in the Otway medium scenario

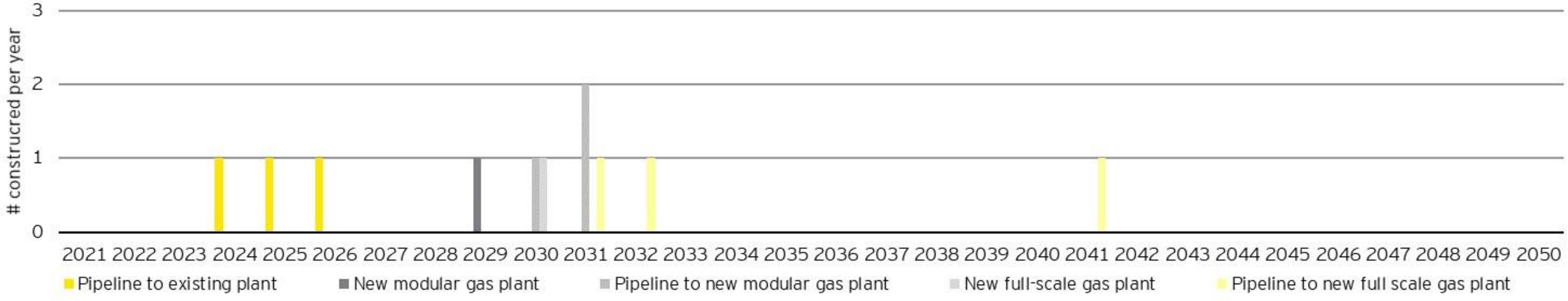


Figure 83: Timing of wells drilled Otway medium scenario

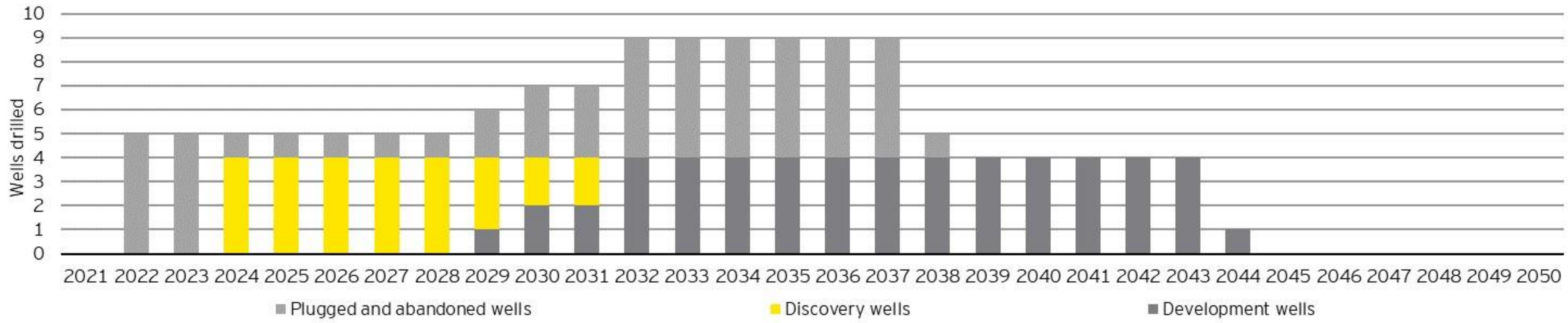
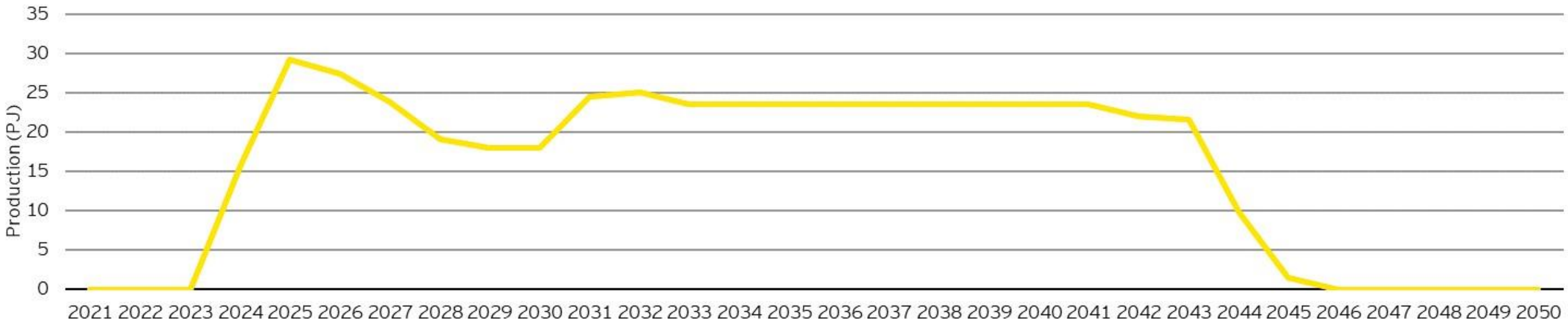


Figure 84: Gas production Otway medium scenario



Source: EY analysis

Otway high scenario

Figure 85: Timing of infrastructure constructed in the Otway high scenario

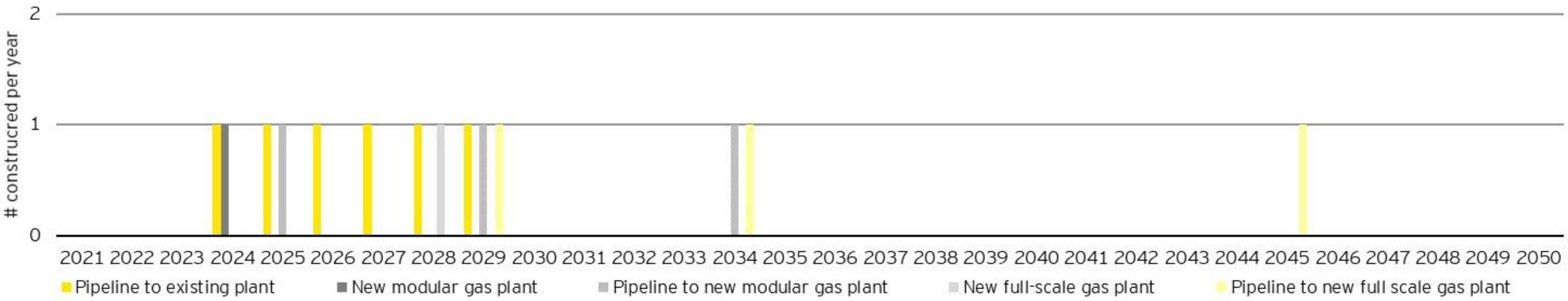


Figure 86: Timing of wells drilled Otway high scenario

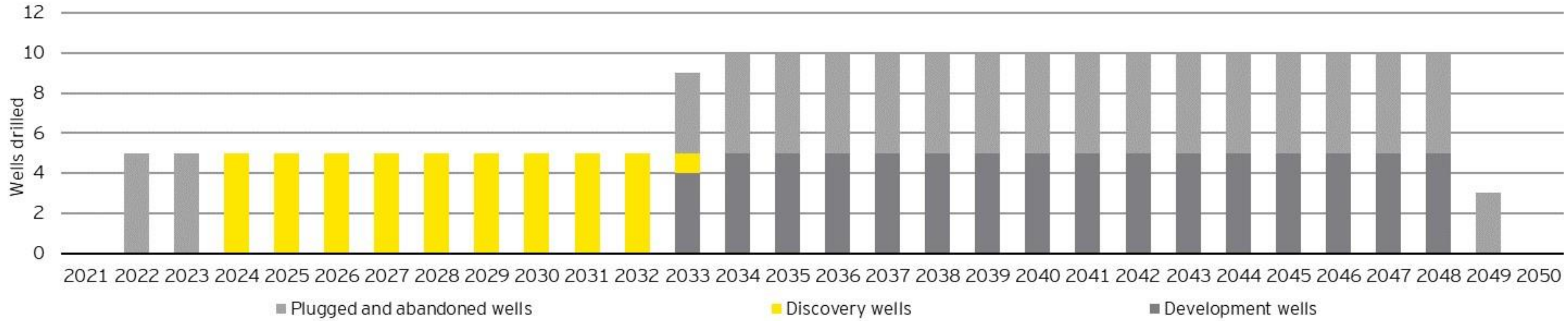
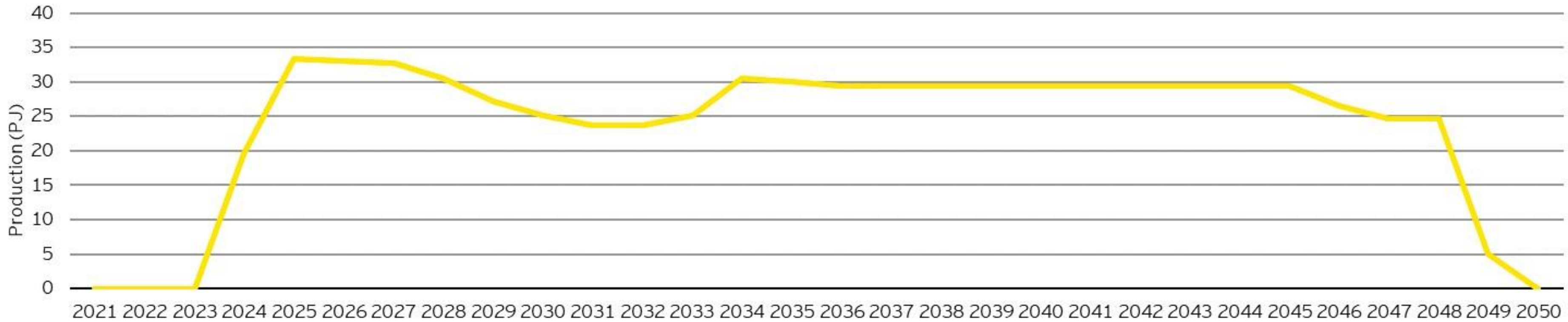


Figure 87: Gas production Otway high scenario



Source: EY analysis

Gippsland low scenario

Figure 88: Timing of infrastructure constructed in the Gippsland low scenario

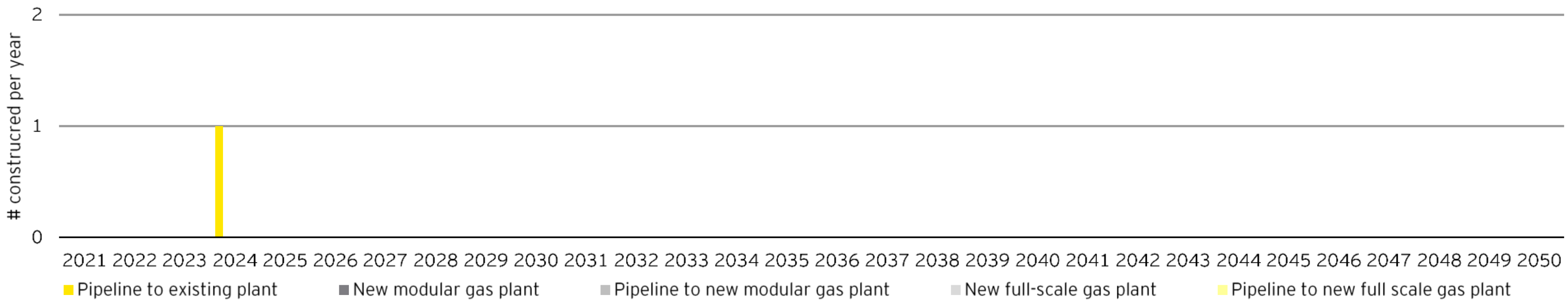


Figure 89: Timing of wells drilled Gippsland low scenario

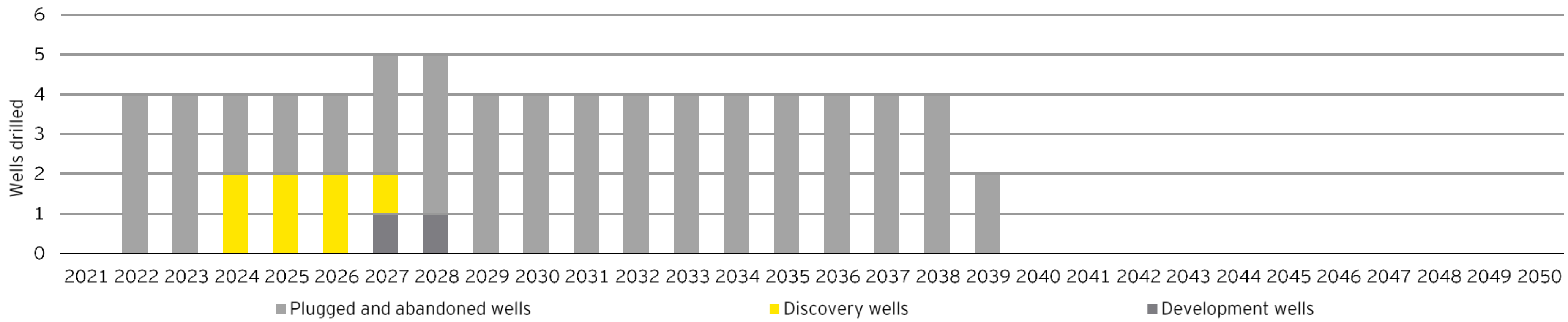


Figure 90: Gas production Gippsland low scenario

Source: EY analysis

Gippsland medium scenario

Figure 91: Timing of infrastructure constructed in the Gippsland medium scenario

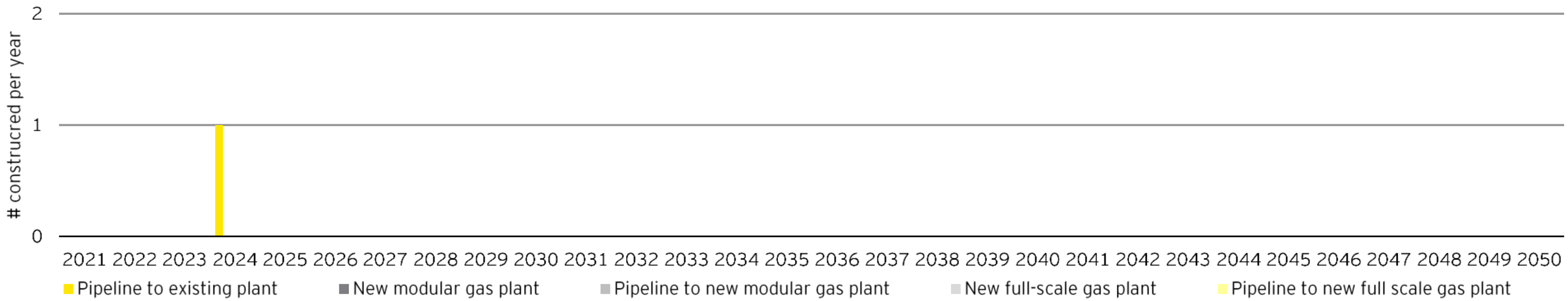


Figure 92: Timing of wells drilled Gippsland medium scenario

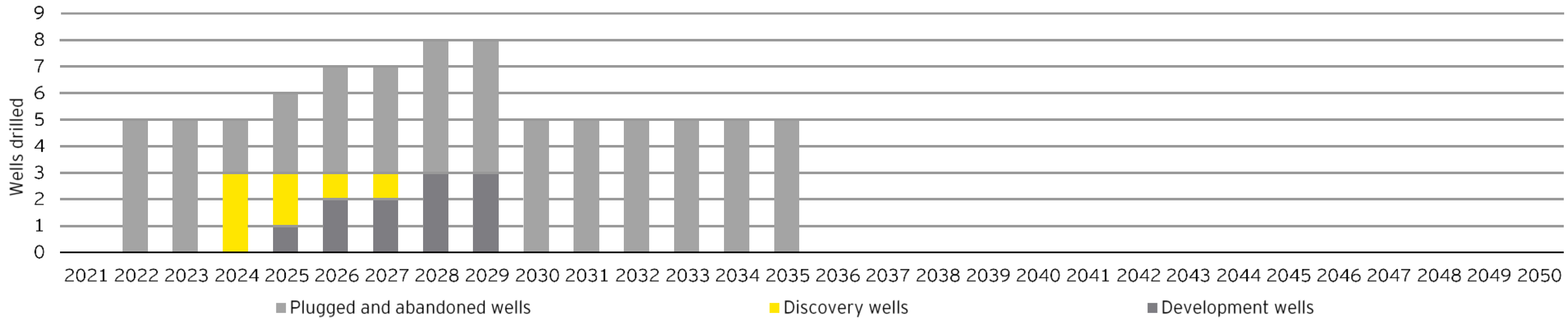


Figure 93: Gas production Gippsland medium scenario

Source: EY analysis

Gippsland high scenario

Figure 94: Timing of infrastructure constructed in the Gippsland high scenario

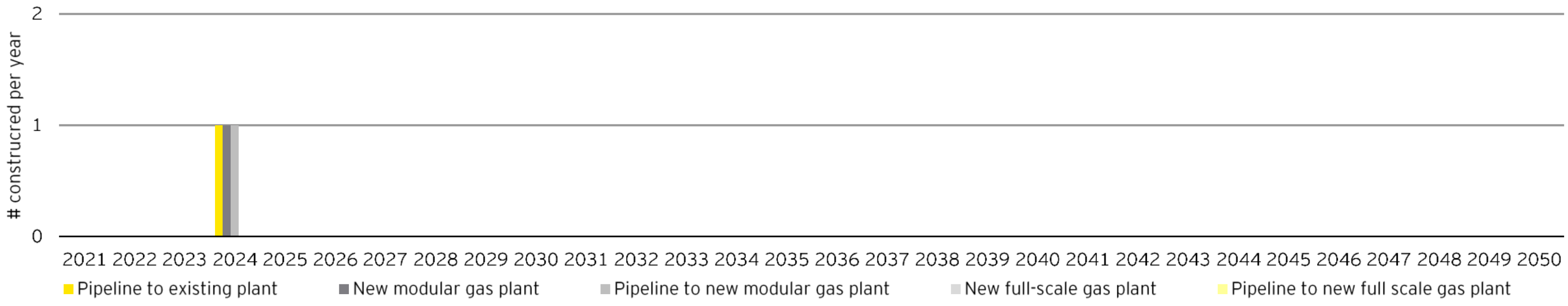


Figure 95: Timing of wells drilled Gippsland high scenario

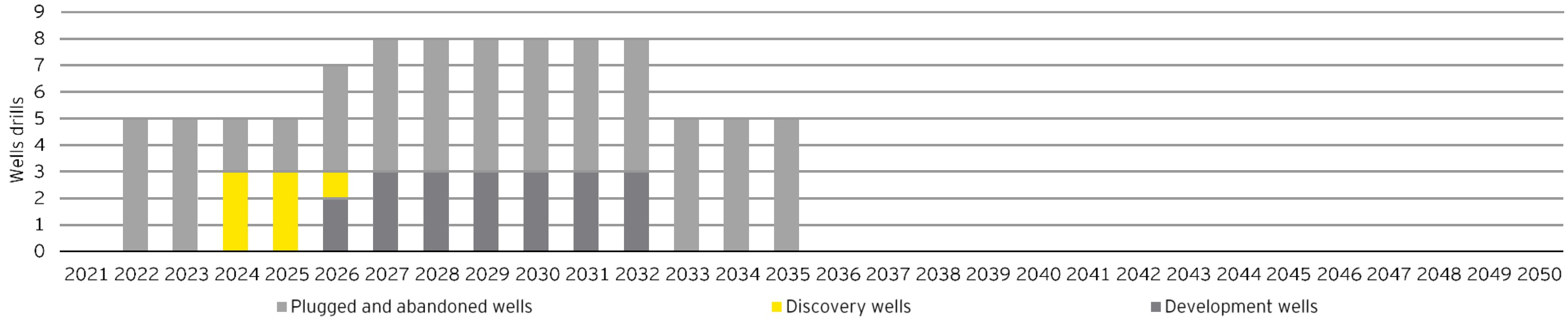
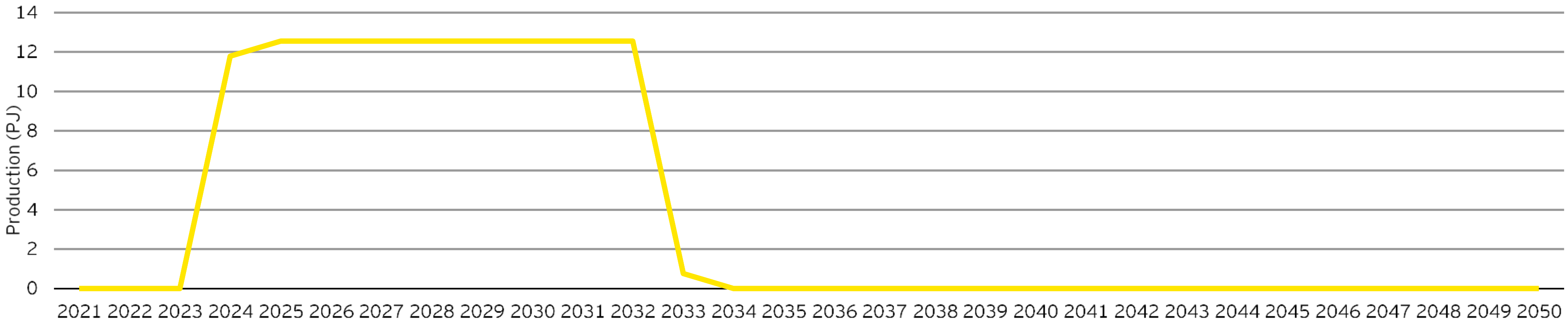


Figure 96: Gas production Gippsland high scenario



Source: EY analysis

Appendix C Overview of GHG analysis

This section provides an overview of the approach used to quantify GHG emissions for VGP's proposed onshore developments. An emissions inventory was created based on the onshore gas development scenarios that were developed for the Otway and Gippsland basins by the department. This inventory modelled the total GHG emissions[245] over the life of the proposed onshore developments for the selected scenarios. Refer below to a detailed outlined of the methodology followed including an analysis of the modelled outputs.

Methodology

VGP's GHG emissions profile was developed based on the following stages:

Current state analysis

A review was undertaken over scientific research and environmental studies conducted as part of the VGP, including outputs of regional atmospheric surveys to determine a baseline profile of the GHG emission sources that are relevant. In addition, discussions were held with key stakeholders to understand outcomes from relevant environmental studies and to develop scenarios that were representative of the potential onshore developments.

Identify GHG calculation boundary

The key stages of a natural gas processing cycle were mapped based on end-to-end activities that are typically applicable from exploration of potential natural gas reserves to the provision of gas for consumers for end use. This exercise coupled with discussions with the department determined appropriate reporting boundaries that would be considered when accounting for GHG emissions. Some activities (e.g. natural gas storage, liquefication to LNG, etc) were excluded from the reporting boundaries as it was deemed immaterial to the overall process or was not particularly relevant for Victoria. End use was excluded from the because the analysis in sections 4.2.1.4 and 4.2.1.5 found that the scenarios do not result in significant additional supply so as to change market dynamics, and Victoria is forecast to become a net importer of gas in the medium term to meet existing consumption, therefore emissions associated with natural gas consumption by the end user would occur irrespective of the proposed developments.

In addition, it was assumed that the natural gas processing plants will continue to operate throughout the processing cycle with decommissioning being excluded from the assessment. A detailed list of assumptions that were applied is outlined in the emissions inventory. Refer to Figure 42 that summarises the overall the natural gas production process which was taken into consideration when developing the emissions inventory for this RBI assessment.

Natural gas onshore development cycle for Otway and Gippsland basins

Exploration and processing: When developing VGP's GHG profile, key stages of the natural gas development cycle were mapped as outlined in Figure 97. The first stage involves exploration for potential natural gas sources to determine if there is a presence of commercially viable gas reserves. This is typically undertaken via seismic surveys and once an appropriate deposit is located, development wells are drilled to extract the natural gas. This extracted gas is then sent via pipelines to a natural gas processing plant where the gas is treated to strip any impurities (e.g. water) and non-hydrocarbons (e.g. sulphur dioxide, carbon dioxide) before it is ready to be transported. In addition, Natural Gas Liquids (NGLs) such as propane, butane and ethane, etc are extracted from the gas and sold to consumers, where applicable. At the processing stage, chemicals known as odorants are added to the natural gas to distinguish leaks in the pipelines when transported. The production of Liquified Natural Gas (LNG) was excluded from VGP's emissions inventory as this was not directly relevant based on gas consumption in Victoria.[246] As part of the natural gas production stage, some of this gas is flared to release excess gas from the processing

[245] Total emissions include end use.

[246] AEMO (2019). *Gas Statement of Opportunities; For eastern and south-eastern Australia.*

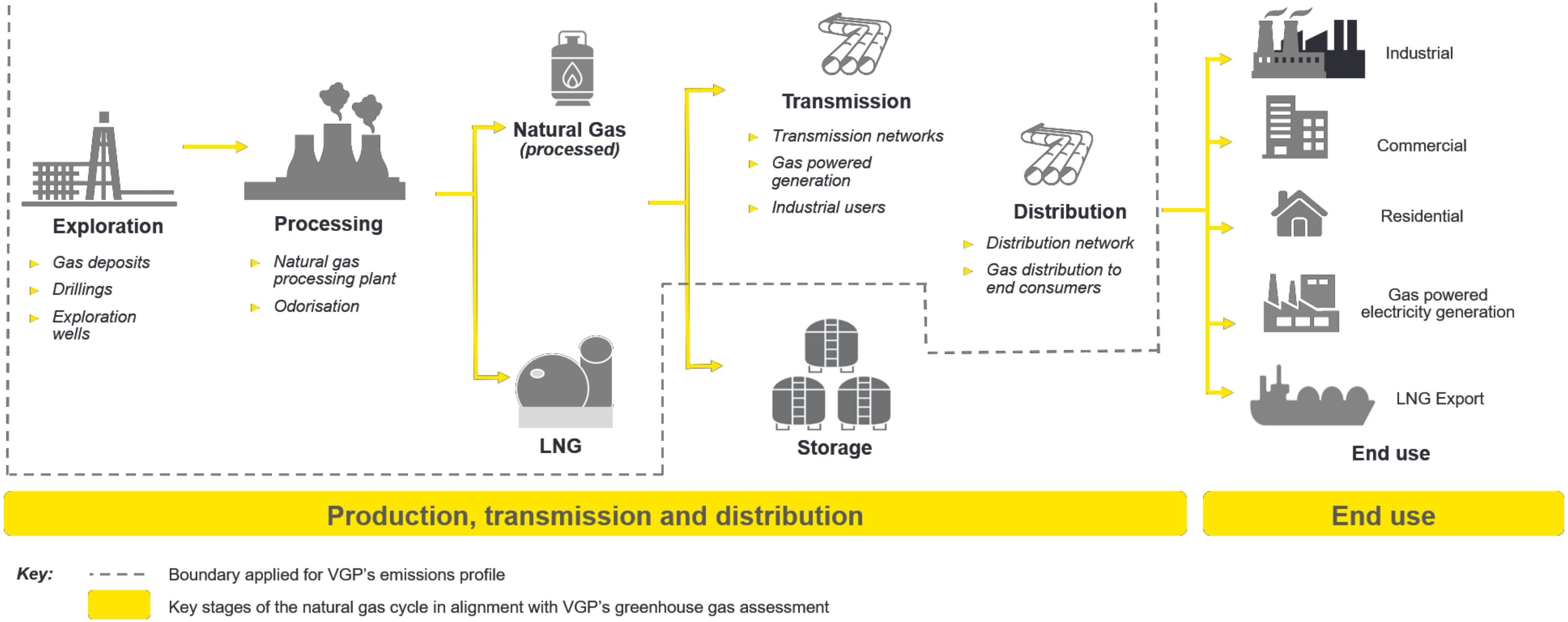
plants for safety reasons, to reduce the environmental impact of gas that would otherwise be vented into the atmosphere and to also burn gas that cannot be used on commercially during the production stage. There are very strict guidelines and requirements that are in place that each gas processing plant operator must be compliant with in this process. This stage of the cycle is energy and emissions intensive. Key emission sources include those from natural gas production and processing as well as fugitive emissions from flaring and venting.

Transmission: Natural gas is then either sent to storage units (either underground unused gas fields or LNG storage) or transported via high pressure transmission pipelines to demand centres. For the purposes of developing VGP's emissions profile, natural gas storage was excluded from the assessment as it was deemed immaterial compared to the other stages of the natural gas development cycle. Fugitives are a key emission source that is incorporated into the emissions inventory from this stage which is associated with natural gas losses (i.e. leaks) from the transmission pipelines.

Distribution and end use: Transmission pipelines are connected to low pressure distributions networks which are used to deliver natural gas to its end consumers. Energy retailers purchase gas directly from the producers and typically use existing transmission and distribution infrastructure to sell this commodity to its customers. Gas is used as an energy source by residential and industrial consumers for heating and cooling purposes; in addition to it being used as a feedstock for some chemical production processes such as fertiliser and plastics by industrial users. For Victoria, the key consumers based on AEMO's latest gas statement of opportunities report include commercial and residential (58 per cent), industrial (31 per cent) and gas-powered generation of electricity (11 per cent).[247] This breakdown was incorporated into the emissions inventory that was developed for VGP's Otway and Gippsland scenarios. It is noted that most large industrial consumers receive gas directly from the transmission pipelines as rather than via the distribution network dependent on their needs.

247 AEMO (2019). *Gas Statement of Opportunities; For eastern and south-eastern Australia.*

Figure 97: Natural gas production cycle



Source: EY

Identify relevant GHG emissions

The GHG Protocol categorises emissions into three 'scopes'. The NGER legislation includes requirements to report for scope 1 and scope 2 emissions. These are defined in the NGER Regulations as 'the release of GHG emissions into the atmosphere either as a direct result of an activity that constitute the facility (scope 1) or as a result of activities that consume electricity, heat or steam at the facility (scope 2)'. Scope 3 emissions are not included within reporting requirements of the NGER legislation but are often considered important for voluntary emissions reporting particularly in the context of a claim of carbon neutrality. Scope 3 emissions include emissions that are an indirect consequence of the activities of the company but occur from sources not controlled by the company.

- Based on outcomes from the previous steps and referring to leading practice GHG standards (GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard, National Greenhouse Account (NGA) factors, Department of Environment and Energy Guidance for Scope 3 Calculations), determine the relevant GHG emission sources that are relevant across the life of the VGP. Table 2 outlines the relevant GHG emissions (scope 1 and 2) that were considered across the key stages of the natural gas production process in developing VGP's emissions profile. Scope 3 emissions were not considered when developing VGP's emissions profile as it was deemed to be outside of its boundary.

- Relevant primary data sources were identified for selected emissions sources and stakeholders from the department consulted to obtain this information. If primary data was not available or did not exist for certain activities, proxy measures were identified that could then be used to calculate the appropriate emissions. Based on discussions held with the department, it was noted that given the nature of the work the department undertakes, primary data sources were not readily available for use in this assessment. As a result, all emissions were estimated based on gas reserve outputs that were estimated for the different scenarios.

Table 151: Outline of the typical activities and associated emission sources associated with each stage of the natural gas production cycle

Stage	Exploration	Natural Gas processing	Transmission	Distribution	End use
Description	Conducting seismic surveys to identify gas resources. Through these surveys if appropriate geological formations are identified to have potential for natural gas, wells are drilled and tested.	Natural gas is extracted from development wells via pipelines are sent to a natural gas processing plant. Natural gas then is processed to remove oil, water and other impurities in the gas such as carbon dioxide, nitrogen, sulphur dioxide etc.	Processed gas is transported through high pressure transmission networks to consumers and retailers. This transmission network could include underground cables, towers, transformers and other supporting equipment.	A distribution network is used to deliver gas to the end consumers.	Natural gas reaches its intended end users either from metro distribution networks (mostly residential and commercial users) or directly through high pressure distribution pipelines (electricity generators and industrial plants).
Activities	▸ Seismic surveys (2D and 3D) ▸ Land based surveys ▸ Air based surveys ▸ Drilling of wells to identify gas resources	▸ Processing of the natural gas extracted from the wells ▸ Construction of new gas processing plants if existing infrastructure is not sufficient to process gas from the wells	▸ Transport of processed gas from the natural gas plants to transmission pipelines which includes leakages from infrastructure	▸ Transport of processed gas through to distribution networks which includes leakages from infrastructure	▸ Natural gas is used by its intended consumers for industrial processes and heating and cooling activities
Emission sources	▸ Fuel use for stationary equipment (e.g. drilling equipment, surveying equipment) ▸ Fuel use for transport purposes (e.g. vehicles used for surveys etc.) ▸ Fugitive emissions from production to processing plant (via pipelines)	▸ Processing of natural gas ▸ Fugitives (Flaring) ▸ Fugitives (Venting) ▸ Fuel used for operating stationary machinery ▸ Fuel used for transport purposes (fleet on site) ▸ Electricity purchased from the grid to power processing plant	▸ Fugitive emissions from transmission losses	▸ Fugitive emissions from distribution losses	▸ Emissions associated with the consumption of natural gas by end users

Modelling of GHG emissions

Emissions were calculated based on quantification methodologies outlined in Australia's National GHG and Energy Reporting (NGER) legislation. Associated emission factors were sourced from publicly available standards based on the type and format of source data that was utilised. These factors for VGP's emissions profile was predominantly sourced from the Department of Environment and Energy's latest National Greenhouse Accounts (NGA) and the NGER Measurement Determination. All emissions related calculations are outlined in the emissions inventory.

GHG emissions calculation approach applied to VGP's emissions modelling

The GHG Protocol Corporate Accounting and Reporting Standard provides guidance and requirements for organisations preparing a corporate-level GHG emissions inventory. For the purposes developing VGP's emission profile, the following key principles outlined in the GHG Protocol for GHG accounting and reporting were considered.[248]

Table 152: Key principles for GHG accounting and reporting

Relevance	Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.
Completeness	Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.
Consistency	Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
Accuracy	Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

The *NGER Act 2007* (the Act) and associated *NGER (Measurement) Determination 2008* (the Measurement Determination) and NGER Regulations 2008 (the Regulations) describe the legislative requirements for reporting GHG emissions and energy consumption. VGP's emissions inventory has been designed to meet the requirements of the Measurement Determination which sets out the methods and criteria for calculating GHG emissions data under the Act. The Measurement Determination is supported by annual NGER Technical Guidelines. The Guidelines for reporting year 2018-19 have informed these procedures.

The NGA factors were utilised in calculating VGP's emissions profile as it was determined to be the most robust and reliable source of information. These emission factors were determined based on actual facility data that was reported by operating entities as part of Australia's NGER scheme with clear distinctions between the processing of gas and other hydrocarbon products at these facilities; as well as between natural gas produced/ processed for domestic consumption rather than for liquefaction and export which caters to the objectives of VGP's onshore developments.

Assumptions

A detailed list of assumptions that have been applied in the GHG quantitative assessment is outlined in the emissions inventory. See below a summarised output of these assumptions.

[248] World Resources Institute. *The GHG Protocol: A Corporate Accounting and Reporting Standard*.

- The GHG considered are those reported under the NGER Scheme and include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulphur hexafluoride (SF6) and specified kinds of perfluorocarbons and hydro fluorocarbons and are calculated as tonnes of CO2 equivalent

- The model quantifies the absolute or gross emissions for the defined boundary and does not consider other fossil fuels which may be offset by increased natural gas consumption

- Emissions associated with natural gas and LNG storage and LNG export has been excluded from the GHG modelling. Emissions associated with construction and decommissioning have been excluded from the boundary and are immaterial

- Emission factors are assumed to be constant throughout the life of the well

- The model has only considered direct (scope 1) and indirect (scope 2) emissions holistically but excludes scope 3 emissions such as embodied emissions of the infrastructure

- Emissions are modelled based on occurrence/ownership to the State rather than a particular company (e.g. the producers or retailers) or the consumer

- The model does not account for technological advancements that may increase the efficiency of natural gas being processed, reduce transmission and distribution losses, etc. It utilises the current state to project future state which is consistent with using existing plants and building new plants in the near-future

- Natural gas use by end users – allocation to residential, commercial and industry splits based on AEMO's 2019 Gas Statement of Opportunities

- The emissions intensity metric is calculated based on the natural gas to the consumers.

Appendix D Other regulatory controls

In addition to the Petroleum Act 1998, there are a number of other regulatory controls applicable to the onshore petroleum industry. Below is an overview of these controls and how they apply to the onshore petroleum industry.[249]

Occupational Health and Safety Act 2004

Regulation of occupational health and safety in Victorian workplaces is governed by the *Occupational Health and Safety Act 2004* (OHS Act). The OHS Act sets out legislative requirements to protect the health, safety and welfare of employees, and to also ensure that the health and safety of the public is not put at risk by work activities. The OHS Act amended the Petroleum Act and any provisions inconsistent with those in the Occupational Health and Safety Act 2004 (OHS Act) or Dangerous Goods Act 1985 were deemed to be of no force or effect.

The key regulator responsible for regulation of occupational health and safety is WorkSafe. The OHS Act contains a power for WorkSafe Victoria to appoint inspectors for the purposes of the Petroleum Act. Additionally, gas processing facilities are defined as major hazard facilities that must be licensed and follow an extensive, strict legal framework.

Planning and Environment Act 1987

Planning covers a very broad range of issues relating to how a proposed land use will impact the environment from a local, social and environmental perspective. The aim of planning is to consider the local context and protect and conserve the land of Victoria while also enabling sustainable development. Accordingly, planning covers issues ranging from the permitted boundaries of a building, to native vegetation clearance and bushfire management. Planning is generally administered by local councils in conjunction with the state government depending on the scale of a proposed development. Planning schemes are developed in alignment to planning policies, zones, overlays and other provisions that affect how land can be used and developed.

The Planning and Environment Act 1987 sets out the requirements for planning and land use in Victoria, including processes for obtaining permits under this regulatory framework. A planning permit allows a certain use or development on land and contains conditions that must be met during that use or development. A proponent generally applies to the relevant local council but may need to apply to the Minister for Planning depending on the intended use.

The holder of an authority as defined in the Petroleum Act is able to undertake exploration without a planning permit. This is regardless of the conditions in the planning scheme that applies to the authority area and allows exploration even if the planning scheme prohibits the use or development of the authority area for exploration.

Production operations require a planning permit prior to beginning and undertaking petroleum operations. Production operations also override planning schemes similarly to exploration activities. The holder of a petroleum production licence may be granted a planning permit for the licence if a planning scheme prohibits petroleum operations in the licence area and does not provide for the grant of a permit for these activities.

Planning permits may contain conditions relating to how an operation is conducted and how land is to be used. This includes the operating hours for an operation, signage, times that trucks are able to use local roads, the design of an operation in terms of where, and to what specification structures may be erected, and how storage and waste disposal may take place. The planning permit process includes a public comment process that allows the local community to have input into the process and influence the impact an operation will have from a land use and enjoyment perspective.

[249] This Appendix contains information provided by the Department.

Bushfire Management Plan
If the area in which a petroleum production is located is subject to a Bushfire Management Overlay, a component of the planning scheme developed under the Planning and Environment Act 1987, a Bushfire Management Plan must be submitted to the Country Fire Authority as part of the planning permit application. This plan incorporates all bushfire protection measures that will be implemented through the project to reduce the risk of and from a bushfire to an acceptable level.

Native Vegetation Removal

The removal of native vegetation, including offsets, is primarily regulated through the native vegetation clearing regulations effected through the Victorian Planning Provisions, that are made pursuant to the Planning and Environment Act 1987. The Victorian Planning Provisions provide for permits that allow the removal of native vegetation.

If a petroleum production operation requires the clearance of native vegetation, a Native Vegetation Clearing Permit is required. This is incorporated into the planning permit application process. In order to clear native vegetation, a proponent must outline how they will avoid, minimise or offset the removal of native vegetation.

Under the native vegetation clearing regulations, the removal, destruction or lopping of native vegetation requires the authority holder to avoid, minimise and offset any destruction of native vegetation which includes all onshore exploration and development.

Ecological surveys must also be undertaken to determine the presence of threatened communities or species. This will allow them to be avoided when locating the well, which will minimise the impact on them.

Environment Effects Act 1978

In Victoria, environment assessment of the potential environmental impacts or effects of a proposed development may be required under the Environment Effects Act 1978. The process under this Act is not an approval process itself, rather it enables statutory decision-makers (Ministers, local government and statutory authorities) to make decisions about whether a project with potentially significant environmental effects should proceed.

The Environment Effects Statement (EES) process is required when a project may have a significant effect on the environment. In the context of conventional onshore petroleum, a referral for an EES may be made by a project proponent, the Minister for Resources, or the Minister for Planning. While in the past, production operations have largely been authorised by planning permits, it is possible that future projects will be subject to an EES.

An EES contains:

- a description of the proposed operation
- an outline of consultation undertaken during investigation and development of the project and any issues raised
- a description of the existing environment that may be affected
- prediction of significant environmental effects of the proposal and relevant alternatives
- proposed measures to avoid, minimise or manage adverse environmental effects
- a program for monitoring and managing environmental effects during the operation.

The EES process supplants the need for a planning permit and is a far more comprehensive consideration of land use relating to the area of a production licence.

If the Minister for Planning decides that an EES is required, the project proponent is responsible for preparing the EES and undertaking the necessary investigations. The matters to be investigated and documented in an EES are set out in the 'scoping requirements' issued by the Minister. These are different for each project and depend on the associated environmental risks. In the case of gas development, if significant impact on groundwater was expected this would be scoped in by the Minister for Planning. The end effect would be that negative impacts would be reduced to the lowest level possible.

Climate Change Act 2017

The Victorian government has committed to climate change action through law and any new gas development in the future will need to align to this at a State-wide level.

A long-term target of net zero CO2 emissions by 2050 has been enshrined in the Climate Change Act 2017 (Vic). As part of achieving this emissions reduction target, the Victorian Government will set interim targets every five years to 2050. The Government has committed to pledging contributions to emission reduction in key emissions producing sectors, and other levels of government, businesses and communities are also able to pledge contributions (the 'sector pledges').

Sector pledges to reduce emissions will also be set later in 2020, and this will include an energy sector pledge as well as reforms affecting industry who use gas for combustion (e.g. in heating processes or as a feedstock). Any gas producers will need to work within the requirements of the Climate Change Act 2017.

Native Title Act 1993

The Commonwealth Native Title Act 1993 (the Native Title Act) recognises the traditional rights and interests to land and waters of the Aboriginal and Torres Strait Islander people. The Native Title Act allows Native Title claimants to make an application to have their Native Title recognised by Australian law. Native title applies to Crown land and not to private land. Native title recognises rights and interests over land or water where Aboriginal or Torres Strait Islander groups have practiced and continue to practice traditional laws and customs prior to the arrival of the British in Australia. The Petroleum Act requires proponents and Government to comply with the future act provisions of the Native Title Act when granting petroleum titles.

As part of the petroleum regulatory framework the Government must advertise that it is considering an application over an area that includes Crown land where Native Title has not been extinguished. This allows interested Aboriginal parties to determine if they will make an application for the recognition of Native Title in that area. If Native Title already exists over an application area, the proponent and Native Title holder must enter into a land use agreement that outlines the terms on which the Native Title holders will allow activities to take place on Native Title land.

Traditional Owner Settlement Act 2010

The Traditional Owner Settlement Act 2010 provides Victorian traditional owners an alternative to the Native Title Act 1993. The Act allows the Victorian Government to recognise traditional owners and certain rights in Crown land. In order to enter into a settlement under this act, traditional owners are required to enter into an agreement that they will withdraw and not pursue any claims under the Native Title Act. Settlement packages usually recognise a traditional owner group and traditional owner rights over Crown land, grants of land in freehold or Aboriginal title, funding agreements, Natural Resource Agreements (recognition of traditional owners' rights to take and use specific natural resources and input into land and resource management) and agreements that allow traditional owners to comment on or consent to activities taking place on public land.

There is only one traditional owner group so far that has entered into a settlement under this act: the Dja Dja Wurrung people from Bendigo and its surrounds. However, traditional owners and the Government are in advanced negotiations to enter into a settlement in the Otway area. This will require future proponents in the area to comply with agreements made under the act.

Aboriginal Heritage Act 2006

The Aboriginal Heritage Act 2006 protects Aboriginal places and objects regardless of their inclusion on the Victorian Aboriginal Heritage Register and regardless of their location on public or private land. The Act requires that a Cultural Heritage Management Plan be prepared when a high impact activity use is to take place in an area of cultural heritage sensitivity, as defined in the Aboriginal Heritage Regulations 2018. These are landforms and soil types where Aboriginal places area more likely to be located.

Under the act, any activity requiring an earth resource authorisation that will cause significant ground disturbance is deemed to be a high impact activity. Accordingly, intrusive petroleum exploration and petroleum production activities require a Cultural Heritage Management Plan to be approved prior to planning approvals being granted. Planning documents cannot be granted if a Cultural Heritage Management Plan is necessary and has not been approved.

A Cultural Heritage Management Plan is developed during the initial stages of the project and implemented throughout the development and exploration phases. A specialist cultural heritage consultant who is qualified and experienced may be engaged to undertake the necessary cultural heritage desktop research and field surveys to assess for all areas of possible disturbances. These areas must be then avoided during the exploration and development where possible. Where not possible, removal and relocation of the material is undertaken in accordance with Heritage Victoria and/or local council.

The Cultural Heritage Management Plan must be approved by a Registered Aboriginal Party.

Heritage Act 2017

The Heritage Act 2017 identifies and protects places and objects that are of state level cultural heritage to Victoria, including archaeological sites and artefacts, historic buildings, gardens, trees, shipwrecks, and cultural landscapes. The act establishes the Victorian Heritage Register that provides legal protection for heritage places and objects.

If a petroleum operation is proposed that may impact a registered place or object, the proponent must apply for a permit allowing the activity to take place, unless the proponent is able to satisfy Heritage Victoria that the activities will not harm the heritage fabric or significance of the place or object.

The Heritage Council can authorise personnel to inspect the site to ensure the permit holder is compliant.

Environment Protection Act 1970

The Environment Protection Act 1970 (EP Act) provides Victoria's regulatory framework for preventing pollution and environmental damage by setting environmental quality objectives. The EP Act establishes the Environment Protection Agency that is the responsible regulator for environmental matters and sets acceptable limits for pollution.

The State Environment Protection Policies (SEPP) are subordinate legislation made under the EP Act to provide more detailed requirements and guidance for the application of the Act to Victoria. SEPPs expressly state environmental quality objectives and outline how they may be met as well as management programs that will ensure environmental quality is maintained and improved. Petroleum Operations Plans must be consistent with relevant SEPPs.

The SEPPs relevant to the conventional onshore petroleum industry are:

- ► State Environment Protection Policy (Water)
- ► State Environment Protection Policy (Air Quality Management)

- State Environment Protection Policy (Ambient Air Quality)
- State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade).

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides a legal framework to protect and manage places or animals defined as matters of national environmental significance. The act deems world heritage places, national heritage places, 'Ramsar' wetlands, migratory species, Commonwealth marine areas, nuclear actions, nationally threatened species and ecological communities, the Great Barrier Reef Marine Park, and a water resource relating to coal seam gas or large coal mining development, to be of national environmental significance.

Proposals for petroleum exploration and development must be assessed under the EPBC Act if there is potential for impact on a matter of national environmental significance as listed above.

Catchment and Land Protection Act 1994

The Catchment and Land Protection Act 1994 (CALP Act) provides a framework for noxious weed and pest animal management in Victoria, protect catchments and encourage community participation in land and water management. The CALP Act prohibits the sale and transport of weeds and pests and imposes obligations on landowners in relation to these. Specifically, landowners must take all reasonable steps to eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds, and prevent the spread of - and as far as possible eradicate - established pest animals on their land. In the context of conventional onshore petroleum activities, authority holders must also ensure that their activities comply with these requirements.

Water Act 1989

The Water Act 1989 (the Water Act) governs the use of water under water licence, water share, or without these authorisations for domestic and stock purposes from surface water and groundwater sources. The Water Act is designed to make sure water resources are conserved and properly managed, water use is equitable and efficient, and the community is involved in conserving and managing water resources. In relation to conventional onshore gas activities, the act is relevant to the impact petroleum operations have on water as a result of production.

Under the Water Act, the Victorian Government retains the overall right to the use, flow and control of all surface water and groundwater on behalf of all Victorians. The Government manages the allocation of water resources across the State in accordance with the Act. To remove ground or surface water, gas operators must obtain allocations through licences under the Water Act. These licenses impose a water drawdown limit which cannot be exceeded. As this limit is set by the Minister prior to commencement, undue negative impacts associated from water extraction are minimised.

Flora and Fauna Guarantee Act 1998

The Flora and Fauna Guarantee Act 1998 protects species and habitats to prevent extinction and maximise biodiversity in Victoria. The Act sets out a framework that protects species and habitats that are registered at varying levels of risk. Under the Act, plans, strategies and determinations are made to protect threatened species and habitats while preventing potentially threatening processes. Onshore petroleum gas activities must be conducted in compliance with these plans, strategies and determinations.

Wildlife Act 1975

The Wildlife Act 1975 protects all native wildlife in Victoria. Under this Act, it is an offence to kill, take, control, or harm wildlife without an authorisation. Prior to applying for an Authority to Control Wildlife under the Act, proponents are encouraged to consider non-lethal methods to control wildlife. If this is unsuccessful, an application can be made to control wildlife if it is damaging property, posing a risk to human health and safety or damaging the environment. Wildlife that is have the above impacts on a conventional onshore petroleum project may be the subject of an Authority to Control Wildlife.

Australian Domestic Gas Security Mechanism

Restriction on the export of petroleum rests with the Commonwealth Government.[250] Division 6 of the Customs (Prohibited Exports) Regulations 1958, made under the Customs Act 1901 contain the Australian Domestic Gas Security Mechanism. The Australian Domestic Gas Security Mechanism (ADGSM) is in place to ensure sufficient gas is available to meet the forecast needs of gas users in Australia. The Commonwealth Minister for Resources and Northern Australia is responsible for activating this mechanism in the advice of the Australian Energy Market Operator, the Australian Competition and Consumer Commission, and industry and other government sources. If forecasts indicate a shortfall in the domestic market, gas export projects may be required to limit exports or find new gas sources.

Fair Work Act 2009 (Cth)

The Commonwealth Fair Work Act 2009 governs the employer/employee relationship in Australia, providing for minimum entitlements, flexible working arrangements, and fairness at work to prevent discrimination. Specifically, the Fair Work Act provides terms and conditions or employment, sets outs the rights and responsibilities of employers and employees relating to employment, sets up a compliance and enforcement regime for the regulatory framework and establishes the Fair Work Commission as a regulator and the Fair Work Ombudsman as an alternative dispute resolution agency to resolve workplace issues prior to the Fair Work Commission being involved.

This is the key legislation governing employment in Australia and applies to employees of conventional onshore gas employees.

Independent Contractors Act 2006

The Independent Contractors Act 2006 provides protections further than the Fair Work Act to independent contractors. The act creates a framework that governs contracting arrangements. This act is designed to allow the Courts to review agreements between businesses and contractors to ensure that they are not unfair or harsh and to enforce orders where a contract has been breached unfairly to set aside the whole contract or in part, vary the contract or enforce an injunction to prevent further breach. This Act applies significantly to the petroleum industry as contractors are commonly engaged to undertake specialised works.

Codes and Standards

Onshore conventional gas activities are relatively uniform and can often be codified in operating standards which the industry, being large multinational entities extensively implement.

A number of critical standards that underpin petroleum industry management practices are specified by the International Organization for Standardization (ISO). These include for materials handling, equipment and offshore structures for petroleum, petrochemical and natural gas industries. Well integrity management that ensures environmental risk mitigation is an excellent example of an important ISO standard that is routinely applied by the industry.[251]

In addition to ISO standards, the International Association of Oil & Gas Producers (IOGP) have developed standards in areas that ISO has not yet addressed, ranging from procurement practices, competency requirements for coating inspectors, to life cycle costing. The Australian Petroleum Production & Exploration Association, the peak national body representing Australia's oil and gas exploration and production industry, is a member of the IOGP as well as the majority of gas companies operating in Australia.

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[250] S 112, *Customs Act 1901 (Cth),* Div 6, *Customs (Prohibited Exports) Regulations 1958 (Cth).*
[251] ISO 16530-1:2017(en). Petroleum and natural gas industries – Well integrity – Part 1: Life cycle governance

ISO Standards also often form the basis for acceptable standards on the part of the regulator and are sometimes referred to directly in legislation.

Offshore Petroleum Regulation

Petroleum exploration and production in offshore Commonwealth areas is regulated under the Offshore Petroleum and GHG Storage Act 2006. The Commonwealth established the National Offshore Petroleum Titles Administrator (NOPTA) to handle the day-to-day administration of all petroleum and GHG titles in Commonwealth waters, and the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to serve as the national regulator for health and safety, well integrity, and environmental management. NOPSEMA also operates in state coastal waters if regulatory powers and functions have been conferred by state governments. Victoria has conferred well integrity and occupational health and safety functions on NOPSEMA while retaining environmental management responsibility.

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