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The value of local gas resources

A scenarios-based analysis of the gas industry futures in South East South Australia

February 2020

GISERA
Gas Industry Social and Environmental Research Alliance

ISBN (print): 978-1-4863-1310-5

ISBN (online): 978-1-4863-1311-2

Citation

Poruschi L., Measham T., and Marcos-Martinez R. 2020. The value of local gas resources: A scenarios-based analysis of the gas industry futures in South East South Australia. CSIRO, Brisbane, Australia.

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Acknowledgments

We are grateful to the Technical Reference Group comprising Dr Elizabeth Perkins, Dr Cameron Huddlestone-Holmes and SA Principal Geologist Tony Hill for their assistance and guidance throughout the project. We thank Rod McCrea and Karin Hosking for helpful comments on earlier drafts of the report. We are also thankful to the stakeholders and experts who gave their time and enthusiasm in the workshop. Any errors or omissions belong to the authors. We acknowledge using the EconSearch (2017) IO model in the analysis with the permission of the South Australia Government.

This work has been funded through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), which is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is for CSIRO to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, biodiversity, land management, the marine environment, human health impacts and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research outputs.

More about this work and about GISERA can be found here.

This research was approved by the CSIRO Social and Interdisciplinary Science Human Research Ethics Committee.

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Executive summary

This report presents the findings of research to assess the potential local benefits from the conventional gas industry in the south east region of South Australia on the eve of new gas coming online from the renewed Katnook gas plant. The report focuses on the different roles that the gas industry could play in the economy of this region and presents a detailed economic analysis based on Input-Output (IO) modelling of the whole regional economy under four different scenarios projected over 10 years. The research presented in the report is focused on the conventional gas industry – a sector which has historical roots in the region with a different economic profile to the unconventional gas industry being developed elsewhere in the country. The focus of this research is concerned with local use of the resource. In contrast to research focusing on gas as an export industry, this report considers the potential role for locally extracted gas to supply the energy needs of local businesses operating in south east South Australia such as food and dairy processing in addition to timber and paper product manufacturing. Due to the regional scale focus, Input-Output analysis was selected as the most appropriate economic modelling method compared with other recognised techniques such as CGE modelling which are better suited to State or National scale.

A scenario approach was taken to help inform decisions about the future of the region. In this context the role of the research is to understand stakeholder views and values and to estimate, based on the most robust economic analysis available, the likely outcomes in terms of how different futures may play out. The research employed a twin-access scenario methodology that has been used successfully in other contexts to navigate different trajectories. The research combined qualitative and quantitative data and commenced with drafting four scenarios based on a detailed historical overview of the local economy and the history of the conventional gas industry within it. These draft scenarios were presented to stakeholders during a workshop conducted in Mt Gambier in March 2019 for feedback and refinement. During this qualitative component, a crucial focus at the workshop was to understand the feasibility and desirability of the four scenarios from the perspective of local industry and regional development stakeholders, and the reasons underpinning these perspectives. Another important aspect of the qualitative phase was to assess the importance of gas relative to other forms of energy. This was particularly relevant to understanding the extent to which gas can be substituted with other energy sources and how this varies between sectors. Qualitative analysis of the findings from the workshop emphasised that gas resources need to be both affordable and locally accessible in order to bring about desired outcomes. Stakeholders were hopeful that locally produced gas would reduce costs for local businesses which are paying high prices for gas transported from outside the region. In this regard, a renewed gas industry providing cheaper local gas would alleviate energy costs and help avoid future job losses in heavy gas users such as food and fibre manufacturing.

A subsequent quantitative phase of the research further developed the scenarios and projected the potential impacts of each scenario on the regional economy based on observed trends. The analysis focused on long-term changes to local employment (over 10 years) and did not consider short term spikes in project-specific activities. Although they are not considered in this report, the temporary job increases from well drilling could be much higher in the short-term compared with the on-going jobs in the long term represented in scenario three.

Combining the results of the qualitative and quantitative analysis provides important insights for the development of the region, summarised in Table 1. The scenario seen as most desirable was also considered the least likely, comprising rapid investment in gas at the same time as growing economic diversity. Economic modelling based on this scenario identified the highest economic

outcomes in terms of contribution to gross regional product and employment (an additional 497 jobs over 10 years). The second most desirable scenario was also seen as the second most likely, involving slow investment in gas at the same time as growing economic diversity. Economic modelling of this scenario identified the second highest contribution to the economy and job creation. The third most desirable scenario involved fast investment in gas at the same time as decreasing economic diversity. Though this scenario was seen as undesirable, it was also seen as the most likely scenario, with the possible closure of some businesses. Finally, the least desirable scenario was business as usual.

Table 1. Summary of scenario desirability, perceived likelihood and economic outcomes over 10 years

Scenario	Desirability	Perceived likelihood	GRP* 10 years ($m)	Employment FTE 10 years
1 Diversified Energy Mix	2nd	2nd	132	429
2 Gas and general Industrial Expansion	1st (highest)	4th (lowest)	150	497
3 Gas Supply Chain expansion	3rd	1st (highest)	35	32
4 Business-as-usual	4th (lowest)	3rd	24	–13

* modelled addition to Gross Regional Product (GRP) in millions of dollars. Desirability and perceived likelihood based on stakeholder preferences.

Considering the results, the report shows that investing in gas alone, without fostering diversification of the broader economy, would lead to only marginal benefits over business as usual. A key reason why Scenario 2 was the most desirable was that some manufacturing industries are highly reliant on gas. Currently the high domestic price for gas is placing strain on these industries which, due to the nature of their operations, cannot readily switch to another energy source. Not all industries are reliant on gas and this underlies the relative appeal of Scenario 1 '*Diversified Energy Mix*'. Seen as quite likely and quite desirable, the modelling for this scenario indicates relatively high contributions to the economy and employment. Considering the two most desirable scenarios together, the report reinforces the importance of economic diversity in general.

The stakeholder responses to the *Gas and General Industrial Expansion* reflect additional factors at play in the region. While there has previously been a local gas industry, and the potential for locally extracted gas to supply local businesses is seen as desirable, there are major logistical constraints which impede action towards realising this scenario. In particular, the gas transmission network, in the form of pipeline infrastructure, was a major limitation to providing locally extracted gas to a broad range of local industries. At the time this research was conducted, the major pipeline infrastructure was owned and operated by a company that was external to the region and has a monopoly over transmission to key industrial gas users in south east South Australia. The State Government had provided important incentives for local exploration and policies to encourage local delivery of gas, however it was not logistically feasible for locally extracted gas to be supplied to local users at the time of conducting this research.

The report concludes that the potential advantage of cheaper local gas may not be realised without changes to gas transmission systems. To bring about the most desirable scenario, the report lists policy options that were identified during this research. Among these, providing incentives for new gas transmission infrastructure is a key area for consideration. Another is to develop policies to increase competition within existing pipeline infrastructure currently supplying industries in the south east region of South Australia.

Part I Regional Profile

1 Profile of the gas industry in the Limestone Coast region

1.1 Local onshore conventional gas history

Conventional gas represents Australia's third largest non-renewable energy resource after coal and uranium (in energy units expressed as PJ) and there are 50% more economic demonstrated resources of conventional gas than of coal seam gas across Australia (Geoscience Australia, 2018). The Otway Basin in South East South Australia's Limestone Coast has been actively explored since the 1890s. Part of the geological basin stretches under the Limestone Coast region in the South East of South Australia. The Limestone Coast region stretches more than 21,000 km^2 with the largest urban area being Mount Gambier (the second largest city in South Australia).

Currently, gas destined for the Limestone Coast region is sourced from offshore gas fields in the Otway Basin located near Port Campbell in Victoria and the underground gas storage at nearby Iona. The gas is transported from Victoria, via the South East Australia Gas (SEA Gas) pipeline that links Port Campbell with Adelaide, and supplied to regional gas users via the 45 km South East South Australian (SESA) pipeline (Figure 1). SESA can deliver 22 terajoules of gas per day (TJ/day) to the Ladbroke Grove Power Station and 16 TJ/day to the South East Pipeline System (SEPS) at Katnook, which in turn supplies gas to Mt Gambier, Penola and Snuggery. This capacity is sufficient to cover current local industrial needs.

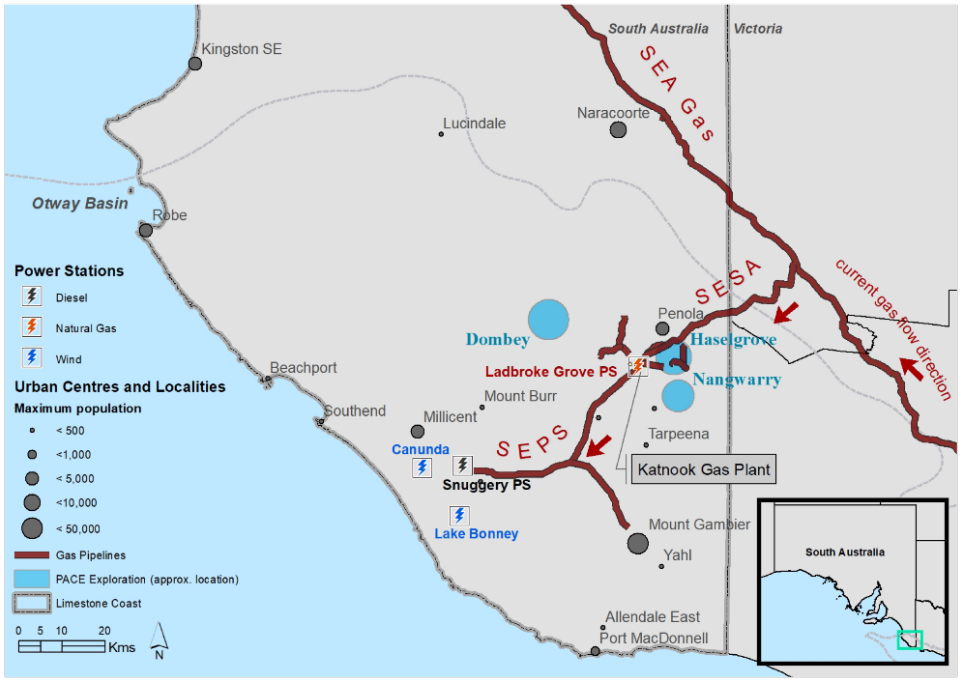

Figure 1. Limestone Coast gas pipelines and power stations locations in relation to the Otway Basin. Gaps in the pipelines are as per the original data. Data source: (Australian Bureau of Statistics, 2016b; Geoscience Australia, 2013, 2014)

In this region, the first commercial conventional gas discovery was made at Katnook in 1987, South of Penola, followed by discovery of the Ladbroke Grove field in 1989. As a result of these discoveries, the southern part of the Limestone Coast had an active onshore gas industry during the 1990s and the 2000s. Industry activity diminished in 2010 with the official closure of the local Katnook Gas Plant in 2013. The Katnook field produced 484 million cubic metres of gas from 1991 to 2011 and onshore gas was supplied locally via the Katnook gas plant (Table 2). Gas supplied locally was used by local businesses including timber milling, pulp and paper milling, commercial food preparation, for gas-fired power generation and for domestic use in the Limestone Coast region. Figure 2 presents a short timeline of gas resources and gas industry-related highlights in this region.

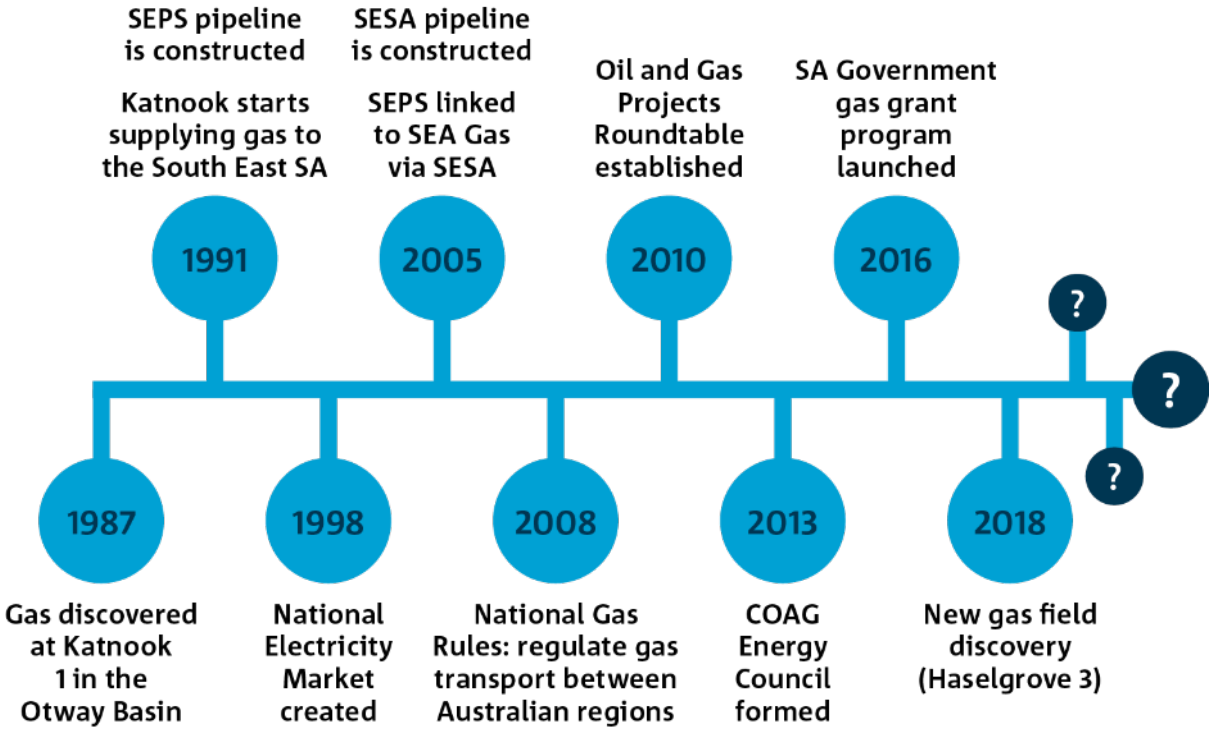

Figure 2. Timeline of the gas industry in the Limestone Coast Region. Source: Compiled by authors

Table 2. Otway Basin historical gas extraction (onshore and offshore). Data source: (SA Government, 2018b)

Field	Co-Formation	Gas (m3E6)	First Production Date	Last Production Date
Haselgrove	Pretty Hill Fm	307.624	31 Jul 1994	31 Oct 2011
Haselgrove	Sawpit Shale Member	4.522	28 Feb 2018	28 Feb 2018
Hollick	Sawpit Shale Member	0.017	31 May 2011	31 Aug 2011
Jacaranda Ridge	Sawpit Shale Member	4.356	31 Aug 2007	31 Oct 2011
Katnook	Eumeralla Fm	6.086	31 Jan 1991	31 May 1992
Katnook	Pretty Hill Fm	477.881	31 Jan 1991	31 Oct 2011
Ladbroke Grove	Pretty Hill Fm	1,377.472	31 Dec 1999	31 Dec 2006
Limestone Ridge	Pretty Hill Fm	10.156	30 Apr 2010	31 Jul 2011
Patrick	Sawpit Shale Member	0.175	31 Dec 2010	31 May 2011
Redman	Pretty Hill Fm	163.331	31 May 1999	30 Sep 2011

1.2 Exploration

Gas exploration for economically viable onshore conventional gas resources has support from the South Australian Government's Plan for Accelerating Exploration (PACE) Gas program. This program provides grants to gas development companies to encourage exploration, and to develop commercial arrangements with electricity generators, industrial users and retail consumers. During 2017, the PACE program allocated three grants for onshore exploration in the Otway Basin.

Companies currently carrying out exploration activities in the region are Beach Energy, Vintage Energy, and Rawson Oil and Gas. Following the success of its PACE grant exploration well at Haselgrove-3 (drilled in 2017-18), Beach Energy, through its subsidiary Adelaide Energy, is building a new Katnook gas plant capable of processing up to 10 TJ/day to replace the old Katnook facility. First gas sales from the plant are scheduled for February 2020 according to the company's ASX FY20 Half Year results presentation. In addition, Beach drilled in 2019 the Haselgrove-4 appraisal well and the Dombey-1 exploration well. Additional exploration activity in the area could also lead to successful discoveries in the region close to the new Katnook gas plant. Rawson (a subsidiary of Lakes Oil NL) and Vintage Energy are drilling the exploration well Nangwary-1 in the Penola Trough, the joint venture having received $4.95 million from the PACE grant program. Rawson signed a gas sale non-binding memorandum of understanding in 2018 with retailer Weston Energy. The deal could mean up to 4 PJ of gas per year is made available to the local market in Mt Gambier and around Snuggery.

1.3 The regional energy mix

The Limestone Coast region has a diverse regional energy mix. It is connected to the National Electricity Market. In cases where demand outstrips local supply the whole state of South Australia can import electricity from the eastern states via the Heywood and Murraylink interconnectors (SA Government, 2018a). Out of the natural gas used in South Australia, about 40% is piped to households and businesses and the rest is used to generate electricity (SA Government, 2017).

Table 3. Local energy existing generation capacity (scheduled and non-scheduled). Data source: AEMO (2019)

Power Station	Nameplate Capacity >1 MW	Fuel Source	Technology	Owner
Lake Bonney Wind Farm (Stages 1, 2, 3)	279	Wind	Wind – Onshore	Lake Bonney Wind Power Pty Ltd
Ladbroke Grove	80	Natural Gas	Open Cycle Gas turbines (OCGT)	Origin Energy Electricity Limited
Snuggery Power Station	63	Diesel	Open Cycle Gas turbines (OCGT)	Synergen Power Pty Limited
Canunda Wind Farm	46	Wind	Wind – Onshore	Engie and Mitsui & Co Ltd
Blue Lake Milling Power Plant	1	Diesel	Compression Reciprocating Engine	Vibe Energy Pty Ltd
Tatiara Meats Bordertown Plant	1	Diesel	Compression Reciprocating Engine	Vibe Energy Pty Ltd

Introduction of significant amounts of wind energy generation in recent years has transformed the Limestone Coast region's energy mix (Table 3). The total local capacity is around 470 MW, comprising around 70% wind energy, with gas and diesel delivering the remaining 30%. This represents about 19% of the renewable generation and 5% of the fossil fuel-based capacity of the total South Australian energy generation capacity.

1.4 Gas-related industrial activity in South East South Australia

The Katnook gas plant, south of Penola, operated between 1991 and around 2010 supplying gas to the region. The production of the Katnook and Ladbroke Grove gas fields fell drastically between 2004 and 2006 from 9 PJ/year to 1 PJ/year with new gas supply sourced via pipeline from Victoria.

Local industrial users of gas include Kimberly Clark Australia (KCA) which operates a paper mill at Millicent producing domestic paper products[1], the Midfield Union Dairy Company, and Ladbroke Grove Power Station. In the past the Safries potato processing plant at Penola (McCain Foods) and the timber mill in Nangwarry (Carter Holt Harvey) were also relevant gas users.

In recent years, the dairy processing industry has increased its presence in the region. The former McCain potato chip factory at Penola became a dairy processing plant producing milk powder, developed by the Midfield Group. Also, the Blue Lake Dairy Company processing plant opened in Tantanoola in 2016 on the site of the former Star Fries potato chip plant.

Dairy processing involves intensive energy demands, using gas heat in a certified milk drying process, and the technology cannot at present be replaced by renewables. An assessment of the energy use in dairy product manufacturing puts natural gas as the main source of energy (55%), followed by grid-based electricity at 29% (Dairy Australia, 2013).

[1] Note pulp is mostly imported into the region.

2 Local Economy and Population

2.1 Mount Gambier and the Limestone Coast region profiles

2.1.1 Socio – Demographic Profile

Population

The population of Mount Gambier increased from around 23,500 residents in 2001 to around 27,000 in 2016 (Figure 3). The 15% increase in resident population is larger than the 7% increase in the Limestone Coast region, but smaller than the 23% increase observed nationally. A reduction in the number of young people combined with the increasing number of people above 60 years of age highlights an ageing trend in the Limestone Coast, in line with regional South Australia, and more rapid when compared with national trends.

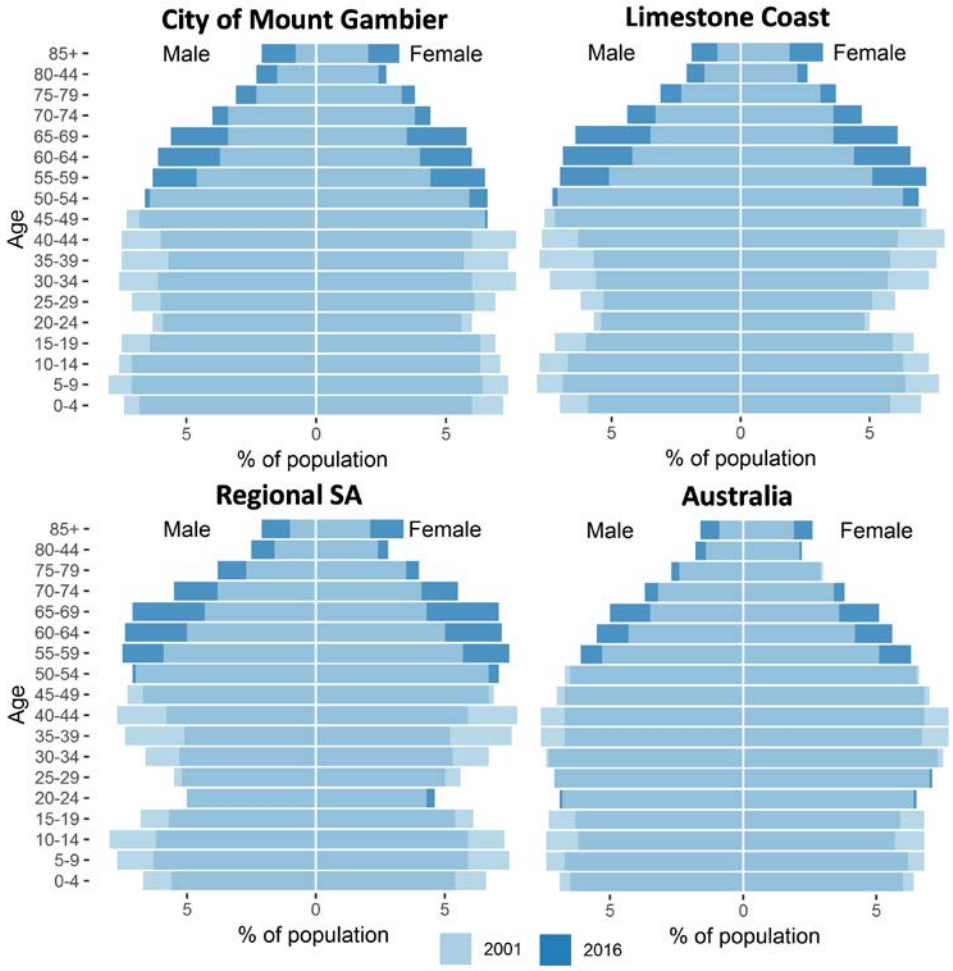

Figure 3. Population distribution by sex and age (2001 and 2016). The 2001 data are shown in semi-transparent colour to allow comparison of changes relative to 2016 data. Mid-blue tone is due to the overlap effect of 2001 and 2016 data. Data source: RDA Limestone Coast (2018)

Income

The average household income in Mount Gambier increased by 27% in real terms between 2001 and 2016, up from $1,608 to $2,044 per week (Figure 4). This change was smaller than the increase in income observed in the Limestone Coast region (34%) and Australia (38%) but larger than the income change in regional South Australia (19%). In 2016, the average weekly household income in Mount Gambier was lower than the income in the Limestone Coast region ($2,555), regional South Australia ($2,359), and Australia ($2,824), a 25%, 15%, and 38% difference, respectively. Business income has a larger share in households in the Limestone Coast region and Regional South Australia than nationally and in Mount Gambier.

Regions in Australia with an active resource extractive industry have been seen to experience higher incomes and reduced income inequality between residents of the same region while the industry is active in the region (Fleming & Measham, 2015). Based on this measure of financial wellbeing, where the emphasis is on inequalities in income distribution, the income distribution in the South East South Australian region has remained almost constant over the 2006–2016 period (see Figure 5). The southern part of the Limestone Coast compares favourably with the rest of the State. Compared to other regions in South Australia the distribution of income is homogenous in the South East (Limestone Coast).

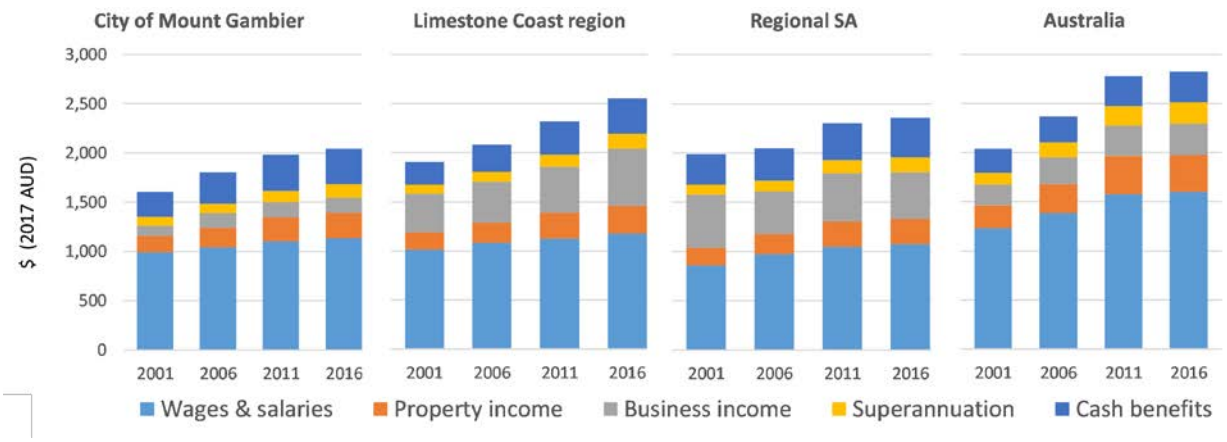

Figure 4. Distribution of weekly household income by income source

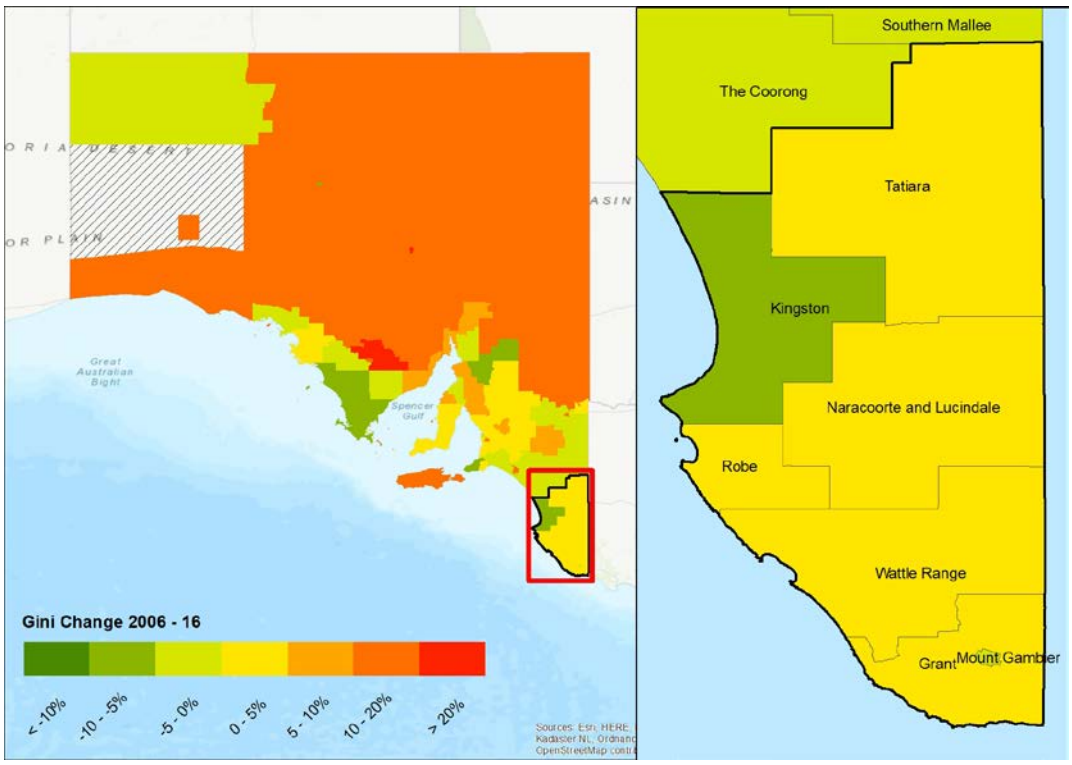

Figure 5. Limestone Coast income distribution: Income inequality (Gini) coefficient change over 2006–2016. Source: authors' calculations. Data Source: ABS Census 2016

Education

The proportion of the population aged 15 and more years with tertiary education has increased from 2001 to 2016 in all the assessed South Australian regions and Australia (Figure 6). However, the proportion of the population without post-school qualifications is higher than national figures. While both the Limestone Coast and Mount Gambier show a growing trend in the percentage of people with a vocational or higher degree qualification, a 10% gap remains when compared with national averages.

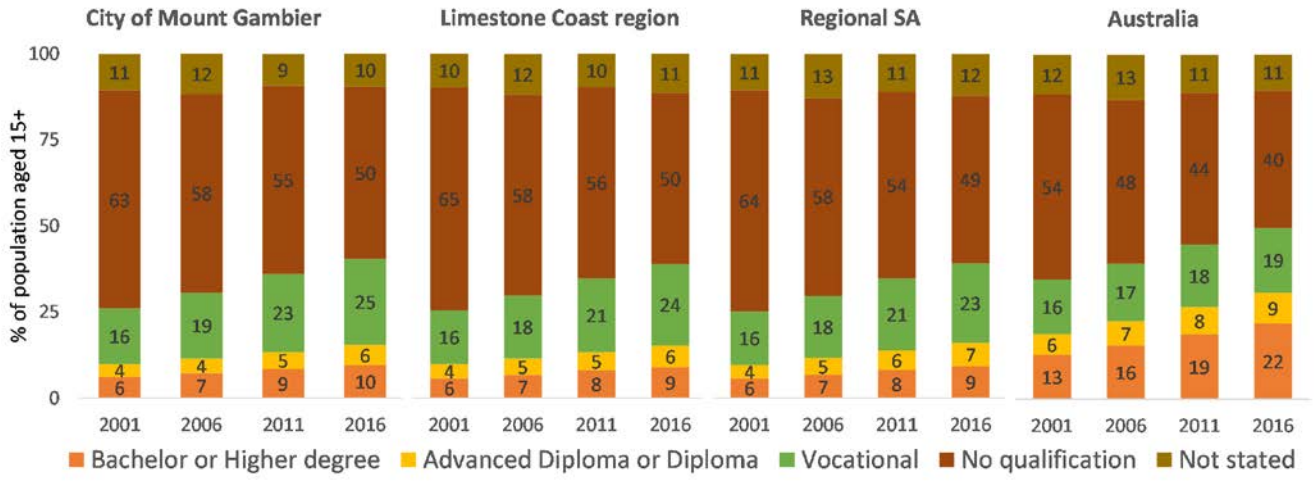

Figure 6. Highest qualification achieved (% of the population aged 15+). Data source: RDA Limestone Coast (2018)

2.1.2 Local industries

The Limestone Coast is known for premium food and wine products and has a diverse, vibrant economy. The Coast's strong economic contribution is reflected in its increasing share of Regional Australia's gross regional product: from 15% to 18% during 2001 to 2018. The contribution of industries to the total local gross product displays clear differences between Mount Gambier, the Limestone Coast and regional South Australia. The configuration of Mount Gambier's economy is more closely related to the characteristics of the Australian economy, with service industries generating significant added value to the economy[2] (Figure 7).

The labour force of the Limestone Coast was around 31,550 people according to the 2016 Census. This number includes about 0.5% of people employed in Mining and 0.8% employed in Electricity, Gas, Water and Waste services (Australian Bureau of Statistics, 2019a). Specific employment in occupations related to gas extraction, processing and distribution is included in these figures and can be quite low. RISE model data (see section 6.2) estimates only about 3 to 4 FTEs for 2015–16 in Oil & Gas Extraction and Gas Supply industries (EconSearch, 2017). During the exploration for economically viable gas resources at Haselgrove 3, 4, Dombey-1, Nangwarry-1 and the building of the new Katnook gas plant it can be expected that more jobs will have been created in industries such as gas extraction and construction. However, numbers are not available as to how many FTEs these amount to and whether the employment was mainly sourced locally or consisted of specialist FIFOs.

[2] Value added is a productivity measure considering how much output is generated in addition to input expenditure.

Figure 7. Average value added by industry from 2001 to 2016. Data source: RDA Limestone Coast (2018)

Percentage contribution of relevant industries to the average added value observed in 2001, 2006, 2011, and 2016. For readability the figure omits labels for industries with marginal contribution to the total added value.

Between 2001 and 2016, the main economic activities in Mount Gambier in terms of added value were *Wood and Product Manufacturing, Retail Trade,* and *Health Care and Social Assistance* (Figure 7). *Forestry and Logging* and *Agriculture* accounted for only 4.6% and 2% of the average added value during that period respectively. In contrast, the wider Limestone Coast region's economy was mostly driven by agricultural activities which accounted for around one-fifth of the average added value. Forestry and logging and wood product manufacturing accounted for 5.6% and 3.2% of the average added value during such period. The average characteristics of the economy of Regional South Australia (RAS) are overall similar to the economic configuration of the Limestone Coast (LC) region. However, while *Mining* is the second most important economic sector in RAS with around 13% of average added value, it accounts for less than 1% in the LC region. In Mount Gambier, *Mining* represents less than 0.5% of the total added value.

The contribution of the Agriculture and Forestry industry to the added value of the economy of Mount Gambier and the Limestone Coast region increased between 2001 and 2016 (Figure 8). This trend was contrary to the change in Agricultural activities observed in the country. Consistent with the population ageing observed in the study area, Residential Care Services increased their added value contribution. Between 2001 and 2016, the contribution of Mining to the total added value changed from 0.8% to 0.3% in Mount Gambier, from 1.4% to 0.5% in the Limestone Coast, and increased from 12.8% to 16% for Regional South Australia and from 5.5% to 7% in Australia.

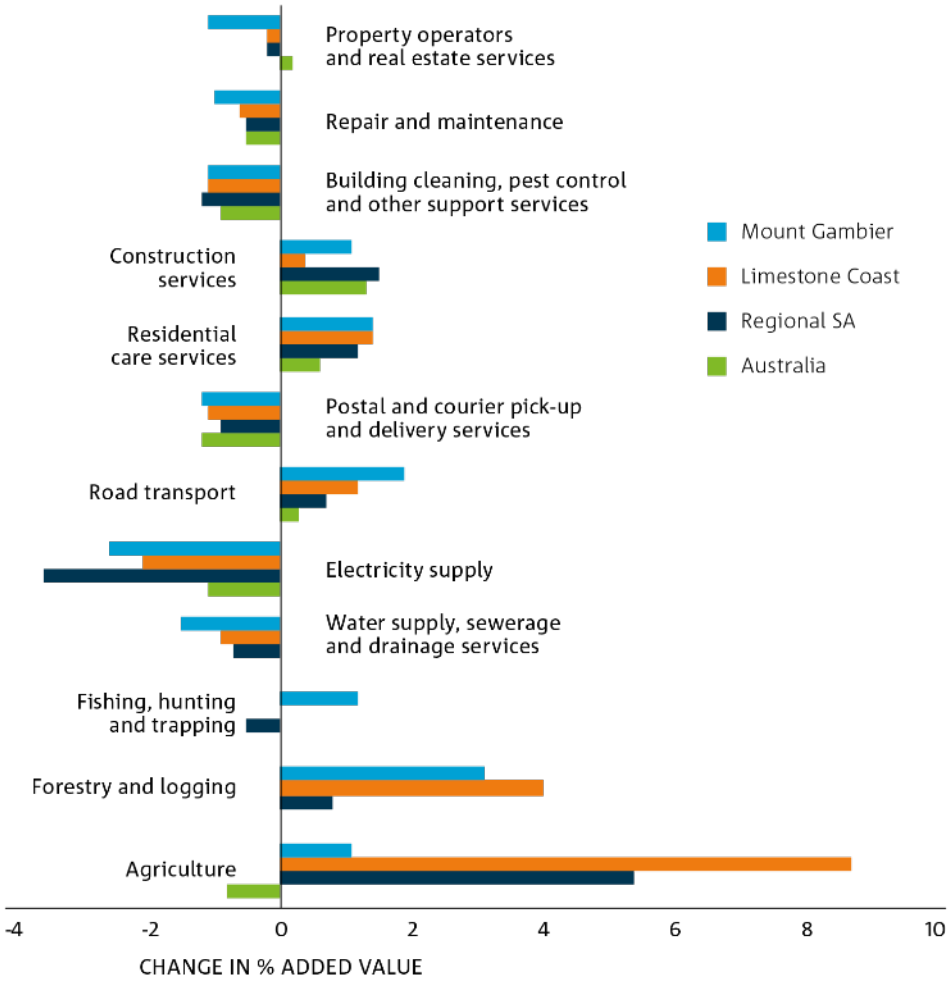

Figure 8. Subsectors with significant change in percent added value between 2001 and 2016. Data source: RDA Limestone Coast (2018)

2.2 Structural change in the local economy

Structural changes are occurring in the value added and jobs distribution across industries within the Limestone Coast region. The Limestone Coast region shed about 4% of jobs while in the same period the agricultural value added to the economy increased by 8%. This is likely due to automation and other efficiency gains in agricultural production, reducing the need for workers while contributing more to the local economy. While Mount Gambier followed the Limestone Coast pattern in manufacturing employment, the city had the lowest percentage change in employment in agriculture, forestry and fisheries (Figure 9).

Change in employment in the regional oil and gas industry was marginal relative to the overall increase observed in regional South Australia. The health care and social assistance industry had the largest percentage increase across all regions from 2001 to 2016. Overall, continued reduction in the diversity of the local industry can pose a challenge to the sustainability of economic activity.

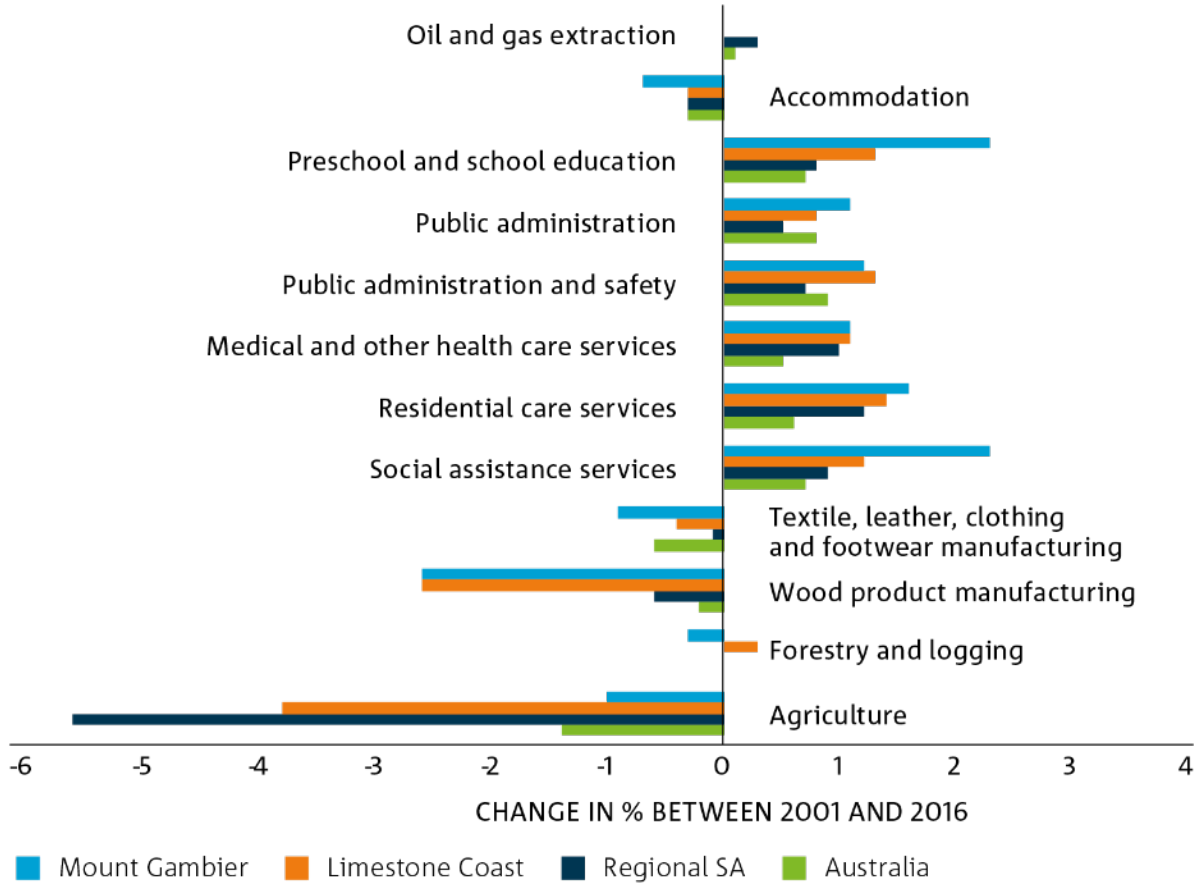

Figure 9. Business types with the largest change in employment between 2001 and 2016. Change in the percentage of people employed by business type between 2001 and 2016. Data source: RDA Limestone Coast (2018)

Part II Scenarios

3 Scenario axes technique

The method of scenario building is based on the scenario axes technique (Scearce & Fulton, 2004; van't Klooster & van Asselt, 2006). This method allows the exploration of potential futures with the goal of enabling communication between stakeholders. The technique is not meant to provide accurate forecasts of a particular gas industry development path, but it is a strategic foresighting method. Its application needs to take into account limitations to knowledge which attract uncertainties. It explores alternative futures with the goal of identifying desirable pathways for industry and government stakeholders exploring the scenarios.

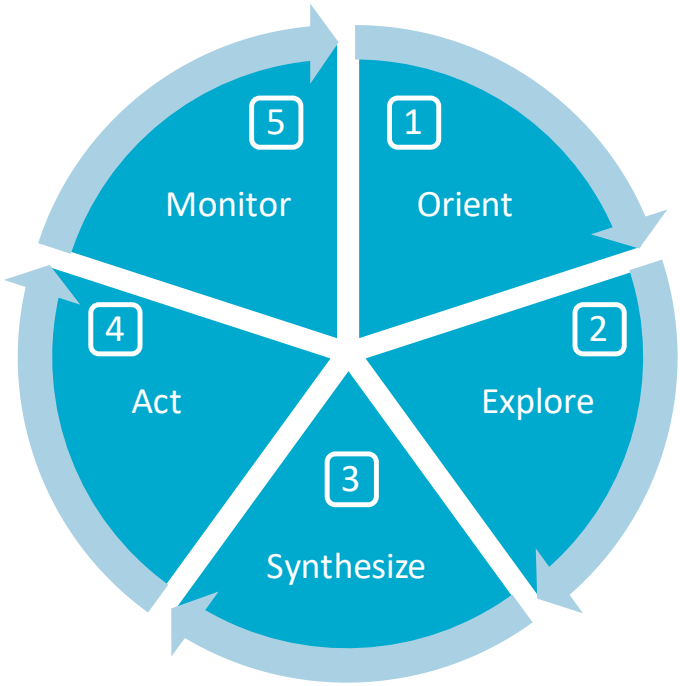

Figure 10. The process of the scenario axes technique. Based on: Scearce and Fulton (2004)

The first phase in this method is the orientation phase (see Figure 10). It consists of first establishing a timeframe of analysis and then carrying out interviews to define the focal issue, which for this research is the value of local gas (locally extracted and supplied). The focal issue was identified through discussion with local stakeholders at a workshop in 2018, a literature review, and validated with the project's technical reference group. A key topic which emerged from the discussions was the potential future gas industry's role among the other local user industries. A set of questions used to frame the focal issue and form the basis of future development of the scenarios were:

- What role should Limestone Coast conventional gas play in the future energy mix of South Australia?
- How can the Limestone Coast region benefit from an onshore gas industry?

- How could an onshore gas industry influence the changing demographics of the Limestone Coast region?
- What are the implications for the Limestone Coast region if locally produced gas were to be exported to other regions?
- In the context of a globalised economy how might an onshore gas industry support the next generation of future potential industries in the Limestone Coast?
- How important is access to cheap gas for industry development, relative to other inputs and access to infrastructure?

The second phase consists of an exploration of the 'driving forces' that shape the focal issue. The question to be answered in this phase is 'What are the main [social and] economic drivers of interest?'. Table 4 shows the preliminary forces, developed based on an additional literature review and validated with the project's technical reference group.

Third, these forces are then synthesised into a set of main uncertainties which can be represented along axes to express the notion of a range of possible levels. This phase sees the development of potential futures' scenarios based on these driving forces.

Fourth, the action phase is the level where scenarios are used to drive action through an interrogation of the scenarios' application. Interested stakeholders use the scenarios to gain insights and identify pathways to desirable futures. It is possible that a course of action is identified as being the best to follow to get to a desirable future. Yet, rather than a 'correct' course of action, the scenarios can reveal 'common denominator' actions, which should be pursued across a range of potential outcomes.

Last, Scearce and Fulton (2004) articulate the monitoring phase as that where leading indicators need to be developed. To ease the use of the tool in policymaking and the application of the monitoring phase, an alternative is to develop leading indicators in the exploration and synthesis phases.

Table 4. Driving forces of interaction of the gas industry with local industry users

Driving Force	Type
Local gas demand	Economic
Local gas supply	Economic
Local energy consumption growth	Economic
Changes in global gas prices	Economic
Investment in the energy industry	Policy & Economic
Investment in other industries	Policy & Economic
Gas pipelines capacity	Technological

4 The scenarios

One of the project outputs is a scenario assessment of economic and socio-demographic indicators. In the orientation phase the scope of the scenarios was outlined (Table 5). The timeframe considered relevant for analysis has been set to about 10 years, up to 2030. This timeframe has been estimated to be needed for a potential gas industry to reach maturity, given the progress of exploration activities in the region. The PACE Gas program of the South Australian government awarded exploration grants during 2016–2017. Exploration activities supported through this program occurred in 2018 and others are scheduled for 2019. Economically viable gas resources could be processed at a gas plant facility scheduled to be developed around 2019–2020.

The Limestone Coast region has been chosen as an integrated economic unit of analysis, representing a local regional economy and labour market.[3] The area coincides with the ABS-defined Statistical Area 3 (SA3). These units of spatial organisation 'represent areas which are widely recognised as having a distinct identity and similar social and economic characteristics' (Australian Bureau of Statistics, 2016a).

Table 5. Framing checklist for scenarios scope definition

Item	Contents	Output
Goal of scenario project	Definition of the questions to be solved: What is the focus of the scenario analysis?	The objective of the scenarios is to develop an outlook of possible outcomes for the economy and gas industry in South East South Australia
Focal issue	What is the central topic under discussion?	Gas industry's interaction with the local user industries
Participants	Which key experts should be involved in the scenario workshop?	Local gas users, gas industry, policy makers
Time horizon	What is the time horizon for the scenarios?	2030
Region	What is the focus region?	Limestone Coast

The objective of the scenarios is to develop an outlook of potential future outcomes for SA South East industries where the gas industry will be active. Four scenarios were developed to reflect the potential development of the regional gas industry development in the context of the South East South Australian economy over the next decade. Based on consultation with the technical reference group, the driving forces were synthesised into two main uncertainties summarised as two axes. The scenarios were developed along these two axes which represent the two key uncertainties:

[3] The Limestone Coast region includes the Local Government Areas of City of Mount Gambier, District Council of Grant, Kingston District Council, Naracoorte Lucindale Council, District Council of Robe, Tatiara District Council and the Wattle Range Council.

- Horizontal axis: the level of investment in local gas resources development
- Vertical axis: the level of economic diversity.

4.1 The horizontal axis: investment in gas resources development

The horizontal axis describes the level of investment in gas resources development. The level of investment ranges from slow to fast. Table 6 summarises potential outcomes posited for the different levels of investment in gas resources development.

Table 6. Horizontal axis: potential outcomes of different levels of investment in gas resources development in addition to PACE

Slow	Fast
• Little to no investment in developing gas resources • Gas resources availability and price continue to be a challenge for industrial users • Limited range of suppliers • Energy generation in power plants and at industrial facilities gradually shifts to other fuels • Industrial gas users decrease their demand and can adjust their inputs and local supply chain	• Strong investment in developing gas resources in the region • Investment in the gas industry facilitates broad regional distribution of local gas resources • Local gas supply increases • Potential for gas demand to be met by an increased range of suppliers • Natural gas is competitive in price • Industrial gas users grow their gas demand • Industrial gas users develop/ increase their local vertical integration (supply chain)

4.2 The vertical axis: level of economic diversity

Level of economic diversity is a proxy for economic resilience of the region. Diversity of economic activity can decrease from current levels or increase. Table 7 summarises potential outcomes posited for the different directions of evolution of economic diversity in the region.

Table 7. Vertical axis: potential outcomes of different directions of evolution of economic diversity in the region

Decreasing	Growing
• The local economy relies on one or a smaller number of industries • Industries operate in silos • Narrowing types of employment opportunities • Exposed to shocks: specialised economy, dependent on input resources	• The local economy is driven by several strong industries • Key economic sectors develop/grow their local vertical integration (supply chain) • Additional industries emerge further contributing to a diverse local workforce • Diverse input resources • Flexible economy, resistant to shocks

4.3 The scenarios

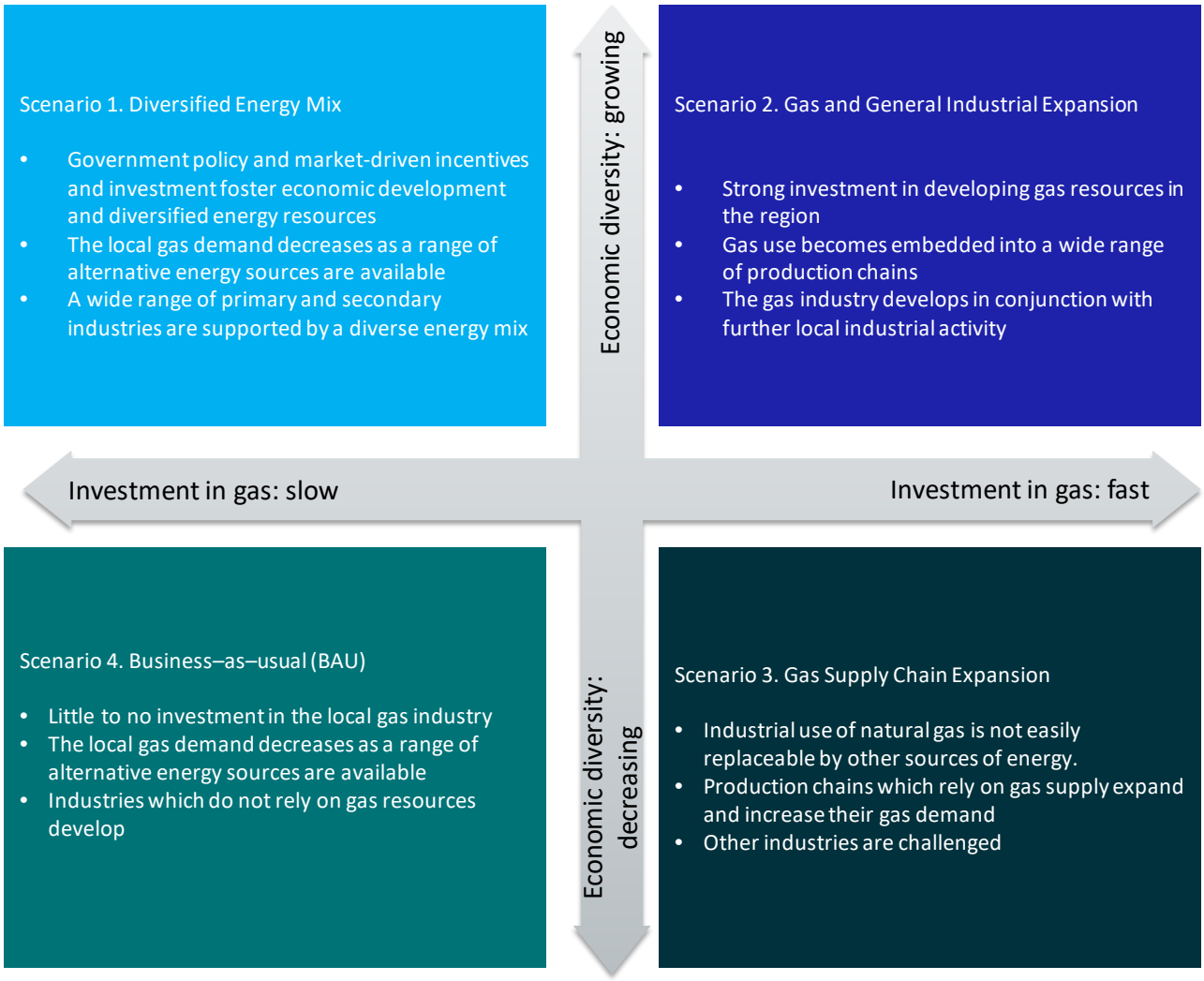

Figure 11. Scenarios of local gas demand and evolution of the economy for the Limestone Coast region

Figure 11 displays the scenarios developed for consultation with the stakeholders along the horizontal and vertical axes.[4] In the design of the scenarios the development of the gas industry is analysed from the perspective of whether it supplies gas locally or not. This does not preclude the industry from exporting locally produced gas to other regions of Australia or internationally through the pipeline system stretching over several states. However, this outcome largely depends on the result of the gas exploration process. The magnitude of the reserves will be a key driver whether it is economically viable to establish a conventional gas industry that will feed gas only locally or expand to serve both local and wider demand. Other factors, e.g. global demand and availability of alternative energy resources, will also determine whether the gas industry will be compelled to

[4] Originally the scenarios were not assigned titles, so as to not influence the perspective of the stakeholders regarding their desirability.

respond to this local and wider demand. However, the main focus for this project is to explore how the local supply can evolve and what role it can play in the local economy.

4.4 Scenario 1. Diversified Energy Mix

Table 8. Key uncertainties evolution directions for Scenario 1

Factor	Level
Investment in gas	Slow
Economic diversity	Growing

The defining assumptions are that investment in gas is slower than in other energy industries, while economic diversity in the region keeps growing. The way this scenario could play out is through both government policy and market-driven incentives and investment to foster economic development and the use of diversified energy resources. Local gas demand would decrease as a range of cheaper alternative energy sources are available. In this scenario a wide range of primary and secondary industries are supported by a diverse energy mix being available to them. The low demand for gas is a result of industrial processes moving away from using natural gas to other energy resources (e.g. those more abundant and cheaper).

Potentially, as local consumption of natural gas decreases, gas exports from the local region may increase proportionately, depending on what level of economically viable resources is discovered. In this scenario, locally produced gas plays a small role in the local energy mix.

4.5 Scenario 2. Gas and General Industrial Expansion

Table 9. Key uncertainties evolution directions for Scenario 2

Factor	Level
Investment in gas	Fast
Economic diversity	Growing

The assumptions in this scenario are that there is strong investment in developing gas resources in the region. The investment in gas is faster than in other energy resources and cheaper gas is available locally. One of the potential outcomes of this increase is the increase in local supply and an increased range of suppliers. The result of higher investment would most likely be lower local gas prices and increased local activity (e.g. more local vertical integration) for commercial and industrial gas users.

4.6 Scenario 3. Gas Supply Chain Expansion

Table 10. Key uncertainties evolution directions for Scenario 3

Factor	Level
Investment in gas	Fast
Economic diversity	Decreasing

The key assumptions of this scenario are a strong investment in gas development and industrial use of natural gas that is not easily replaced by other sources of energy. A potential outcome of this scenario is that cheaper gas supply is available and gas demand increases for production chains which rely on gas. Other industries are challenged in meeting their energy requirements. This could be due to low adoption or limited alternative energy technology and infrastructure to substitute for the use of gas (e.g. renewables).

4.7 Scenario 4. Business-as-usual (BAU)

Table 11. Key uncertainties evolution directions for Scenario 4

Factor	Level
Investment in gas	Slow
Economic diversity	Decreasing

A key assumption for this scenario is slower investment in the development of gas resources when compared with other energy industries. A second assumption is decreasing economic diversity in the region.

It is possible that due to local and national policy, limited investment in the gas industry restricts the supply that can come to the local market. Potential outcomes in the region are a small local gas industry, high gas prices leading to a decrease in industrial gas use, and for gas-dependent users to exit the market (e.g. relocate or close operations altogether).

5 Workshop and Stakeholder Input

A workshop to gather stakeholder input on the scenarios' potential outcomes for the local economy and desirability was held in Mount Gambier on 6 March 2019. A group of 13 stakeholders from industry and government, together with four researchers, participated in the workshop. Stakeholders were invited based on recommendations of the project's technical reference group, targeting 10 to 20 people, and in line with the approved ethics process. Local industry participants were sought from: (a) the local forestry, logging and paper industry; (b) agriculture and food processing; (c) the gas industry and energy sector; (d) government and experts with a focus on regional economic development.

The first part of the workshop was focused on presenting the context of the research and regionally relevant information on the gas PACE Program and regional economic development goals. The second part of the workshop presented the method behind the scenario building, social and economic trends in the Limestone Coast region, the key uncertainties for future development, and the draft scenarios. Along with the feedback collected through distinct activities (presented below), participants were asked to reflect on the validity of the main assumptions regarding the key uncertainties and the scenarios' narrative. Before and during the workshop, participants could refer to a factsheet containing a summary of the local energy mix, gas industry infrastructure and local social and economic data.

5.1 Workshop Activity: Feedback on scenarios

To receive input regarding each of the scenarios the participants were divided into four groups. Each group was asked to identify regional implications of the scenario which they were allocated and could refer to a set of guiding questions (see Table 12). Following each group's discussion, the envisaged outcomes fleshed out by all participants in their respective groups were reported to everyone in the room.

Table 12. Questions guiding group-based discussions on each scenario

1. What would the regional economy be like in 2030 under this scenario?
    - Employment (direct and indirect)
    - Agriculture
    - Forestry
    - Manufacturing and food processing
    - Other sectors (e.g. caring services)
2. What would be the role of locally produced gas in this scenario? (for different sectors)
    - e.g. energy demand/mix; influencing investment across sectors
3. Other relevant implications
    - e.g. population growth, services and facilities

5.1.1 Feedback on Scenario 1. Diversified Energy Mix

Stakeholders noted that under a scenario of slow gas investment and growing economic diversity, in 2030, the regional economy could see a reduction in industrial gas users. One explanation for this reduction would be the likely increased costs of gas compared to other energy sources that have entered the market. Any increase in other operating costs such as increasing labour and transportation costs would further reduce the attractiveness of the region for local industries. The likelihood of other energy resources serving as alternatives for industrial gas users would depend on costs to use these forms of energy. An example put forward was the potentially high cost of technology investment for generating electricity from biomass or using large-scale bioenergy. The group highlighted the impact of future energy policy to contribute to local industry's ability to manage any shift in energy pricing.

The group identified infrastructure as a key determinant for the progress of local industry and the direction of regional economic diversity over the next decade. Road transport was cited as one of the major production costs to local industries and the group emphasised the importance of railway or intermodal transport to containerised ports as potential solutions for reducing these costs. However, the group identified the risk of government-built infrastructure not necessarily translating to local advantage for regional businesses.

Even though gas development in this scenario is slow, the group indicated that locally produced gas, in combination with locally abundant water resources, could serve to attract new industries into the region. Moreover, the group noted the opportunity for existing local industries (e.g. dairy, livestock, and timber) to expand their production in the context of a water market being set up.

The group further noted that the local role of locally produced gas will largely depend on contracting arrangements and on ensuring the ongoing security of local gas supply. The risk for industrial gas users in the region is that large retailers may contract most of the local supply and create a market with reduced competition. To counter this potential outcome, the group suggested a gas reservation policy to secure local supply but saw this as a last resort option because of the potential for perverse and unintended negative outcomes. The group also discussed the potential for other energy sources facing supply interruptions. For example, wind generators can be turned off on hot days to avoid the risk of catching fire. The group also identified the potential for cogeneration options as long-term solutions for maximising high value use of gas. They recommended such options be explored.

5.1.2 Feedback on Scenario 2. Gas and General Industrial Expansion

This scenario potentially provides the region with a competitive advantage for local businesses and an opportunity for new businesses to relocate to the region if strong investment in gas were to result in cheaper and more reliable gas for the region. The group identified that in an economically diverse region, such as in this scenario, there would likely be other drivers beyond cheaper gas supporting economic diversity. They found it hard to determine which would come first, the investment in gas driving economic diversity or economic diversity driving investment in gas. Either way they described the need for good communication and relationships to be developed between regional businesses, regional development planning, and the gas sector to ensure that gas

development plans aligned with regional priorities and that regional businesses could maximise potential opportunities.

Two main risks were identified with this scenario. One risk related to a potential skill shortage in the region associated with the growth in economic diversity occurring concurrently with fast investment in the gas sector. A higher demand for employment could lead to a shift from lower paid employment, such as in the rural sector, to higher paid jobs which may be offered during the construction of the gas sector. In addition, to meet potential skill shortages FIFO work arrangements may expand, which could put pressure on the social fabric of the region. Moreover, participants noted that social infrastructure investment (e.g. housing, schools, and medical services) would need to grow to meet any increased population demand.

The group also suggested a higher proportion of the benefits from increased gas investment and economic diversity may flow to the larger centres, particularly Mt Gambier. Consideration would need to be given to ensure that benefits were distributed more broadly around the region so that smaller centres did not feel that they were taking on a higher burden of the 'costs' associated with gas development.

A second risk under this scenario is the longevity of cheaper gas to the region. If the gas resource runs out or if gas users are unable to secure cheaper gas prices over the long term this may leave industrial users unable to cover their supply needs with a resultant impact on businesses and a wider economic slowdown in the region.

5.1.3 Feedback on Scenario 3. Gas Supply Chain Expansion

Participants estimated that in 2030 the two main industries of timber processing and dairy industries would continue to account for around 80% of gas use in the Limestone Coast region. Group discussions highlighted that investment in these industries is significantly dependent on national and international markets and regulatory conditions. However, the group considered that volatile energy prices and uncertainty in long-term local gas supply will continue to impact future investments in the region. By 2030, local industries, which were exploring alternative energy sources (e.g. biodigestors or biofuels) in 2019, will find that some alternative options remain economically unviable due to high costs or expensive infrastructure requirements. The group suggested that despite potential technological advances, gas will likely be one of the most cost-effective forms of energy.

This scenario of low economic diversity can still lead to stability in the regional economy if the development of key industries has positive flow-on effects in other sectors. However, there are limits to the economic influence of a fast-growing local gas sector combined with a stable timber processing and dairy industries, even if these industries were to show modest growth. Participants noted that employment opportunities could reduce due to automation processes, with the gas industry requiring a limited amount of labour. For timber and dairy processing, increasing costs of environmental compliance (e.g. to manage wastewater), risks of market collapse, and poor infrastructure could outweigh potential benefits of cheap gas prices. The group identified the need to actively foster the development of other industries in the region to offset the potential for decreasing economic activity and to help it adapt to changing socioeconomic and environmental

pressures. This could include further developing industries such as tourism and increasing production from existing local industries.

There was a view in the room that the local gas resource should be protected for the long term. The monopoly over the control of the pipeline system is inflating delivery charges to the local industries; this may prove in the future to be an economic incentive to transport gas away from this local distribution system, i.e. cheaper to transport to non-regional markets.

5.1.4 Feedback on Scenario 4. Business-as-usual (BAU)

The stakeholders indicated that this scenario is a continuation of recent trends in the region for the period 2005 to 2019. Due to increased gas prices, further development of alternative energy sources would likely continue through to 2030. These would likely include solar, wind, biomass and waste to energy. At the same time, high gas prices would stifle new investments, particularly those which rely on gas, e.g. for heating and electricity generation. Considering whether there are incentives to drill further wells for more gas extraction, the group saw the gas industry as currently having limitations in terms of its infrastructure, preventing it from exporting resources outside of the region.

Gas prices would likely remain high under this scenario of limited gas development without changes to infrastructure. In the past, the limited number of pipeline operators has been seen to discourage competition and lead to higher prices for local gas users, thus further impeding economic growth and diversification. Stakeholders felt that these constraints would flow through to stagnating employment, citing a recent example of a manufacturing business that recently chose not to move to the region in part due to the high cost of energy.

Manufacturers and industrial gas users would need to be close to pipelines or to have easy access to gas. As manufacturing activities can be quite disparate across the regions, the costs to connect to pipelines directly may not be economically viable. While there have been recent examples of companies developing alternative energy sources, it is unclear whether the costs to switch to these alternatives would be viable for a broad range of industries.

In terms of other outcomes specific to an industry, the group could see little to no impact to forestry activities in these scenarios, although the forestry sector would also have to face future fossil fuel price increases.

5.2 Workshop Activity: Scenario preferences

Following group discussions about each scenario, participants were asked to identify which scenario they considered the most desirable by sticking green coloured dots on the scenario (e.g. Figure 12). Each participant was allocated four green labels to distribute according to their preferences. For example, all the labels could be placed on one scenario, or they could be split between several of them. Similarly, participants were asked to identify which scenario they thought was the most likely one and were allocated three yellow labels each. The last part of the voting was to identify the least desirable scenario with each stakeholder placing a red dot label that scenario.

Voting preferences showed Scenario 2 to be the most desirable and it was also considered to be the least likely (see Table 13). With 16 yellow dots, Scenario 3 was considered the most likely outcome for the development pathway of the region. The least desirable scenario was Scenario 4.

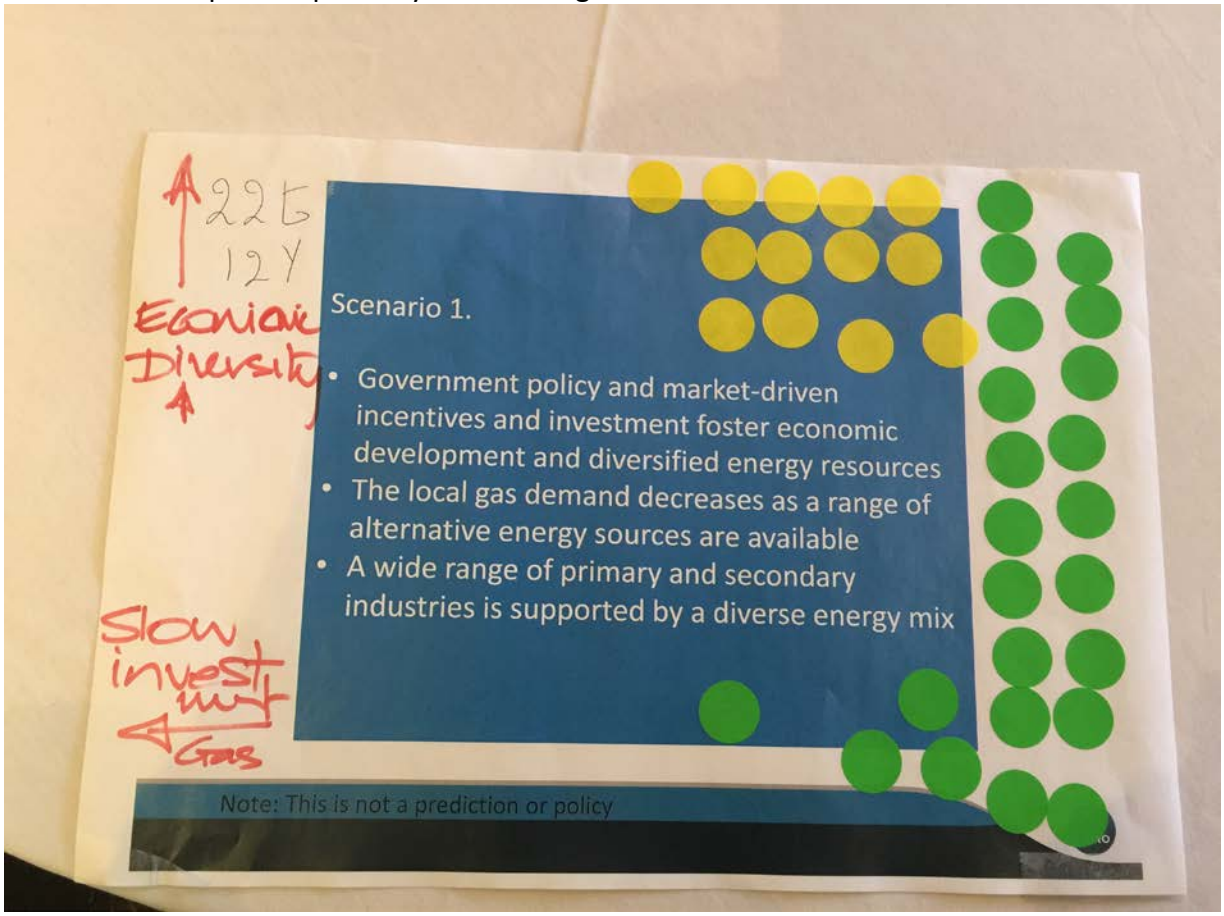

Figure 12. Illustration of how voting occurred based on Scenario 1

Table 13. Outcome of preference voting

Scenario	Most Desirable (green)	Least Desirable (red)	Most Likely (yellow)
Scenario 1. Diversified Industrial Mix	23	0	13
Scenario 2. Gas and General Industrial Expansion	**29**	0	2
Scenario 3. Gas Supply Chain Expansion	0	0	**16**
Scenario 4. Business-as-usual (BAU)	0	12	8

5.3 Workshop Activity: Deliberation on scenarios with stakeholders

Following the input of the participants on which scenarios were the most and least desirable, as well as which was the most likely scenario, a feedback session ensued to identify reasons behind these stakeholder perspectives and to identify intermediate steps needed to bring about the most desired scenario or avoid the least desired outcomes.

Although Scenario 2 *Gas and General Industrial Expansion* was seen as overall the most desirable, Scenario 1 *Diversified Energy Mix* ranked high in terms of desirability. One way that some stakeholders considered the relationship between scenarios was that Scenario 1 served as a precursor to Scenario 2, with the two being considered quite similar. Scenario 2 was most popular due to the potential to provide cheaper gas, particularly for those businesses which cannot readily switch to another energy source. However, participants recalled historical examples of locally supplied gas being unreliable, which partly explains the relative desirability of Scenario 1. Other contributing factors were government policies underpinning diversified energy sources and market-driven incentives for businesses to seek to meet their own energy needs where possible, helping to explain why Scenario 1 was nearly as desirable as Scenario 2.

In explaining their voting preferences, stakeholders expressed a view that it was unclear whether an increase in gas investment or availability will result in an increase in economic diversity. Diversity in industries may not be reliant on gas. Despite having a local gas extraction industry present, the delivery costs could still be high, and this presence would not necessarily translate to a reduction in gas prices. If local gas resources were available, affordable and reliable, then additional industries would potentially be attracted to the region. However, other factors may still inhibit the continued presence of diverse industries, especially infrastructure limitations.

The least preferred scenario was Scenario 4 *Business-as-usual*. The stakeholders universally wanted to avoid reduced economic diversity, which implied a less resilient region and therefore decreased economic sustainability in the long term. Under this scenario, the local economy would go through a reduction in economic activity. In this potential scenario, slow gas investment would mean even less economic diversity than Scenario 3 *Gas Supply Chain Expansion*.

When considering the explanation for Scenario 3 being perceived as the most likely scenario, stakeholders said that this reflects current technology use and the expected costs involved in changing away from this technology, which make it unlikely that users will shift to other production processes in the near future. The dependence on gas resources was strongest for dairy products manufacturing, where gas is not just an energy input, it is part of the technology used to transform milk into milk powder. This implies that a switch would mean a change in technology.

However, in Scenario 3 the implication is that for industries to continue to use gas, they would have to be able to afford this resource, focusing on the cost to users inclusive of delivery charges. An approach of 'build it and they will come' to gas use will not work. If gas continues to be an expensive input, its use may not expand in the region, particularly considering that other input costs as well can be higher than those of international competitors (e.g. labour).

Scenario 2 *Gas and General Industrial Expansion* was seen as desirable but the least likely. To bring about desired outcomes, gas resources need to be both available and affordable. Gas supply can be

high, but prices may not drop. To avoid Scenario 4 *Business-as-usual*, the price in Scenario 2 needs to be considered. Gas transmission and distribution alternatives can help drive down costs, e.g. compressed natural gas can be trucked to users.[5] This can create competition on the supply side and drive prices down.

To bring about Scenario 2, two obstacles to overcome were put forward: (1) more gas would need to be found; (2) more of this gas would need to be made available locally. Government investment in infrastructure was noted as one contributing factor to bringing about this desired outcome. To increase economic diversity, new businesses and their distribution models would need be developed. An example given was the wine industry, which could be interested in accessing gas where a virtual gas network based on truck-delivery of the resources could achieve higher local gas use. However, the feasibility of truck transport may wane for larger amounts of gas. In general, understanding the technical and practical constraints of potential gas growth is essential. Participants thought that public perception of conventional gas could be seen as another barrier to bring about Scenario 2 if the gas industry is affected by broader concerns about fossil fuels in general.

Stakeholders expressed the view that alternative ways to increase competition in supply through policies targeting pipeline regulation should be explored and the ACCC may need to carry out additional reviews on any anti-competitive outcomes. One participant noted that this should be a priority for the region, as this would enable a broader understanding of what the true costs of gas access and supply are and contribute to maintaining the region's advantage and long-term access to local gas. PACE has incentivised exploration and local supply, and more policies of this type can help set the course for Scenario 2. In terms of government policy, stakeholders expressed that policies need to be reasonably detailed yet cognisant of their limitations to avoid creating perverse outcomes.

Additional suggestions from participants were to:

- investigate the local applicability of the Victorian government example of investing in virtual gas networks (via road) in terms of costs and benefits
- study the future of gas price forecasts and which regions can play a key role in influencing these
- reveal what competitively priced gas means from different perspectives: the seller vs the user; East Coast Australia vs West Australia and between Australian manufacturers and international manufacturers.

[5] An example from the room was to put compressors at extraction points and allow compressed natural gas to be delivered with more flexibility.

5.4 Workshop Activity: Interactions between sectors

Each workshop participant was asked to provide feedback about perceived impacts (positive, negative, or neutral) of the gas investment scenarios on other regional industries. The interaction of local industries was explored using a matrix of regional industries structured according to the ANZSIC classification (Table 14) (Australian Bureau of Statistics, 2006).

Table 14. Table to record stakeholders' perception on potential local gas industry interaction with other sectors active in the region

	LOCAL GAS INDUSTRY INTERACTION WITH…			
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
EXAMPLE INDUSTRY	*+*	*-*	*0*	
0131 GRAPE GROWING				
014 SHEEP, BEEF, CATTLE AND GRAIN FARMING				
016 DAIRY CATTLE FARMING				
OTHER AGRICULTURE				
03 FORESTRY AND LOGGING				
113 DAIRY PRODUCT MANUFACTURING				
1214 WINE MANUFACTURING				
OTHER FOOD PRODUCT MANUFACTURING				
14 WOOD PRODUCT MANUFACTURING				
15 PULP AND PAPER MANUFACTURING				
OTHER MANUFACTURING				
E. CONSTRUCTION				
F. WHOLESALE TRADE				
G. RETAIL TRADE				
H. ACCOMMODATION AND FOOD SERVICES				
I. TRANSPORT				
K. FINANCIAL SERVICES				
P. EDUCATION & TRAINING				
Q. HEALTH CARE AND SOCIAL ASSISTANCE				

Note: **–** indicates an expected negative economic effect of the modelled gas investment scenario on an industry; **+** indicates a potential positive economic effect; 0 indicates no effect.

Since the number of participants providing feedback to each scenario ranged from three to four stakeholders, we do not present scenario-specific results. However, in aggregate the data indicates that regardless of the scenario definition the workshop participants consider that the gas industry has a direct economic effect on paper manufacturing, dairy product manufacturing, and other food product manufacturing (i.e. a booming local gas industry would favour the development of those industries) (Figure 13). Wood product manufacturing, and other types of manufacturing were considered to have an inverse response to changes in the local gas industry.

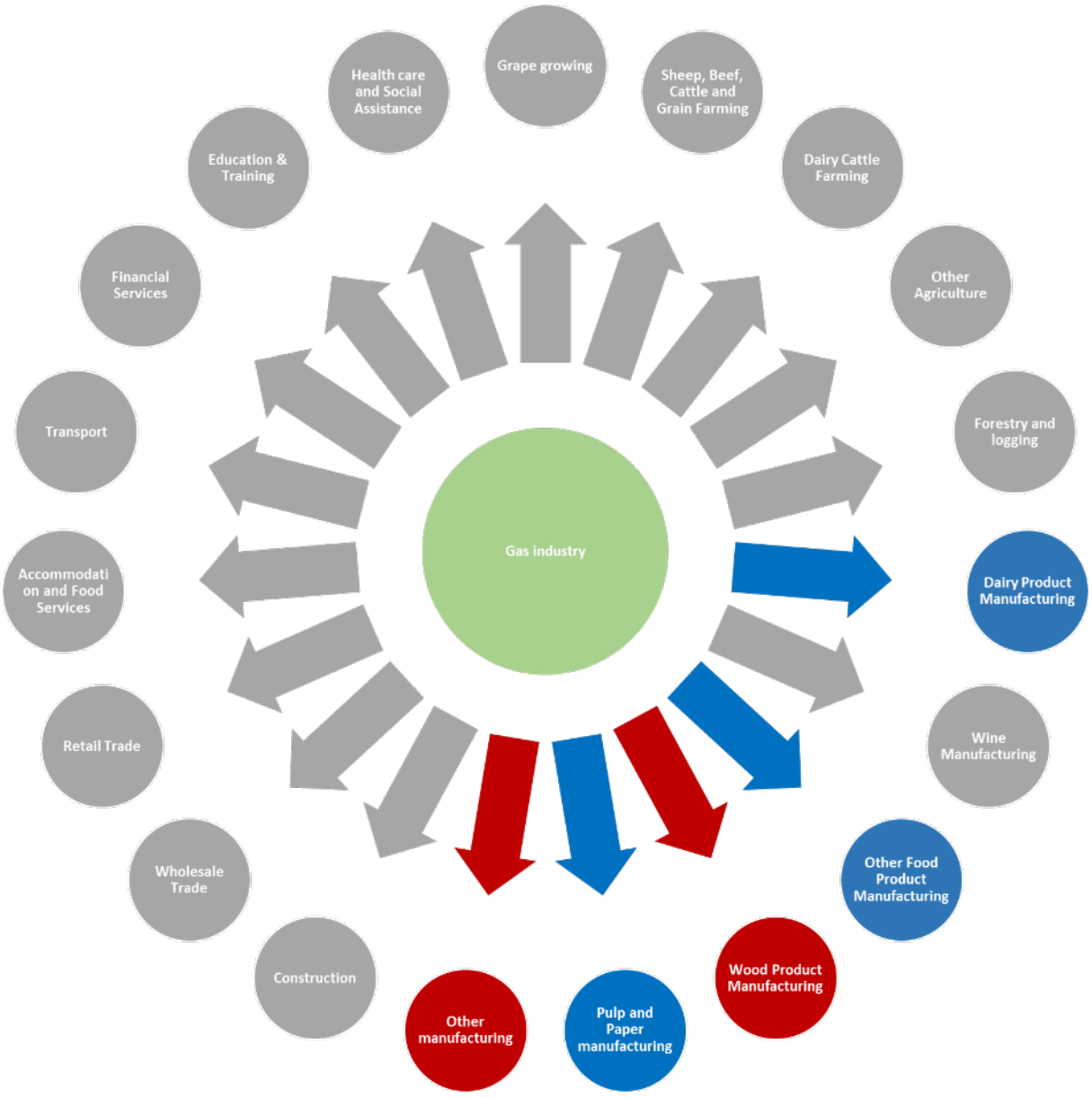

Figure 13. Stakeholders' perceptions of how the gas industry can potentially interact with local industries. Average effect across all scenarios. Legend: red = potential economic disadvantage; blue = potential economic advantage; grey = no significant interaction either way

Part III Economic modelling

6 Regional economic outlook

6.1 Economic trends for the Limestone Coast

6.1.1 Trends in regional industry indicators

In addition to the profile of the Limestone Coast region presented in Part 1 of this report, we applied a more detailed analysis of the intertemporal trends of key indicators of the economic performance of industries and sub-industries in the region. There are direct and indirect linkages between industries that influence the use of production inputs (e.g. capital, labour) and the generation of employment across industries. For instance, increasing capital investment in dairy farms may reduce capital available for agricultural production. Similarly, increasing labour demand from the services sector may reduce the number of people looking for jobs in other sectors. Therefore, we modelled changes in economic parameters as correlated across industries.

Industry-specific added value, employment, local sales, imports and exports observed between 2000 and 2017 were first converted to compositional time series data by dividing each industry value by the total value for all industries (RDA Limestone Coast, 2018). This data was then converted to log-ratios using *Other services* as the normalising industry (any industry can be selected without modifying the results). The structure of each log-ratio time series was analysed using exponential smoothing state space (ETS) forecasting models (Hyndman, Koehler, Ord, & Snyder, 2008). The fitted ETS models were then used to project trends of regional economic indicators from 2018 to 2030. A mathematical description of the method used to model and forecast compositional time series data can be found in Mills (2010).

6.1.1.1 Added value

The Limestone Coast's added value increased in real terms from $2.7 billion in 2000 to $3.3 billion in 2017 (2016–17 price base for all dollar figures in this section) (Figure 14A). Continuation of the historical trend could result in a total regional added value between $2.8 and $4.6 billion (average trend of $3.7 billion) by 2030. The economy in the region is highly specialised with Manufacturing, and Agriculture, Forestry, and Fishing being the two key industries. The manufacturing industry accounted for the largest proportion of regional added value in 2000 (around 24%) (Figure 15). Since that year, the contribution of this industry to the total regional added value has gradually declined. These industry dynamics have resulted in further specialisation of the regional economy. If the growing economic relevance of Agricultural, Forestry, and Fishing businesses continues at observed trends, by 2030 around 40% of the regional added value would be generated by this industry (Figure 15). On the other hand, the contribution of the Health Care and Social Assistance Services industry has gradually increased from 2000 to 2017 – possibly due to the increasing service demand of an ageing population (Figure 15). By 2030, this sector could account for around 8% of the total regional added value. The added value of other industries remained almost unchanged, and such a trend is projected to continue.

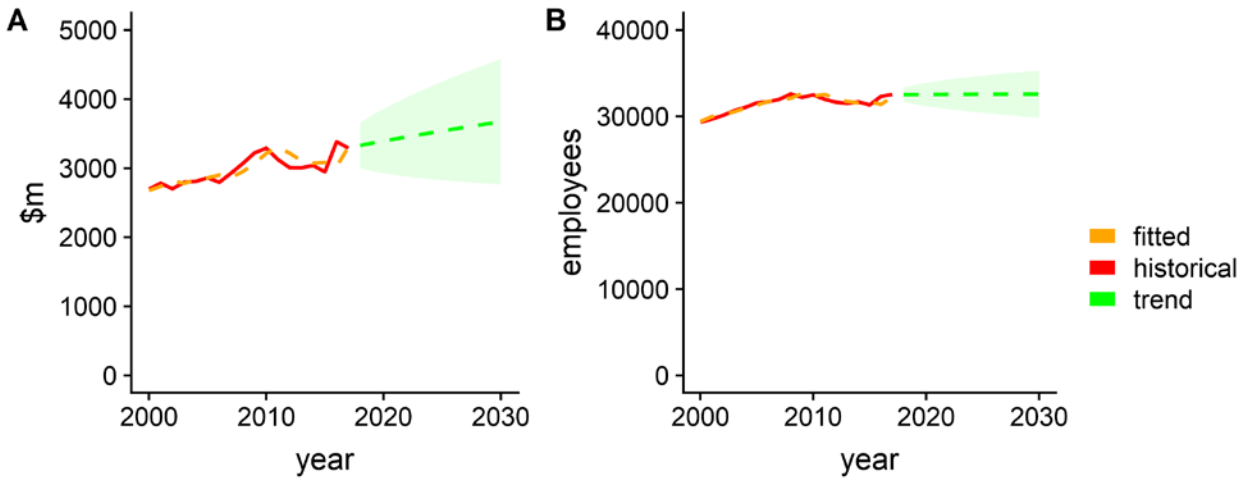

Figure 14. Long-term trends in regional added value (A), and employment (B). Historical data from 2000 to 2017 were used to project long-term trends and 95% confidence interval (green area) from 2018 to 2030

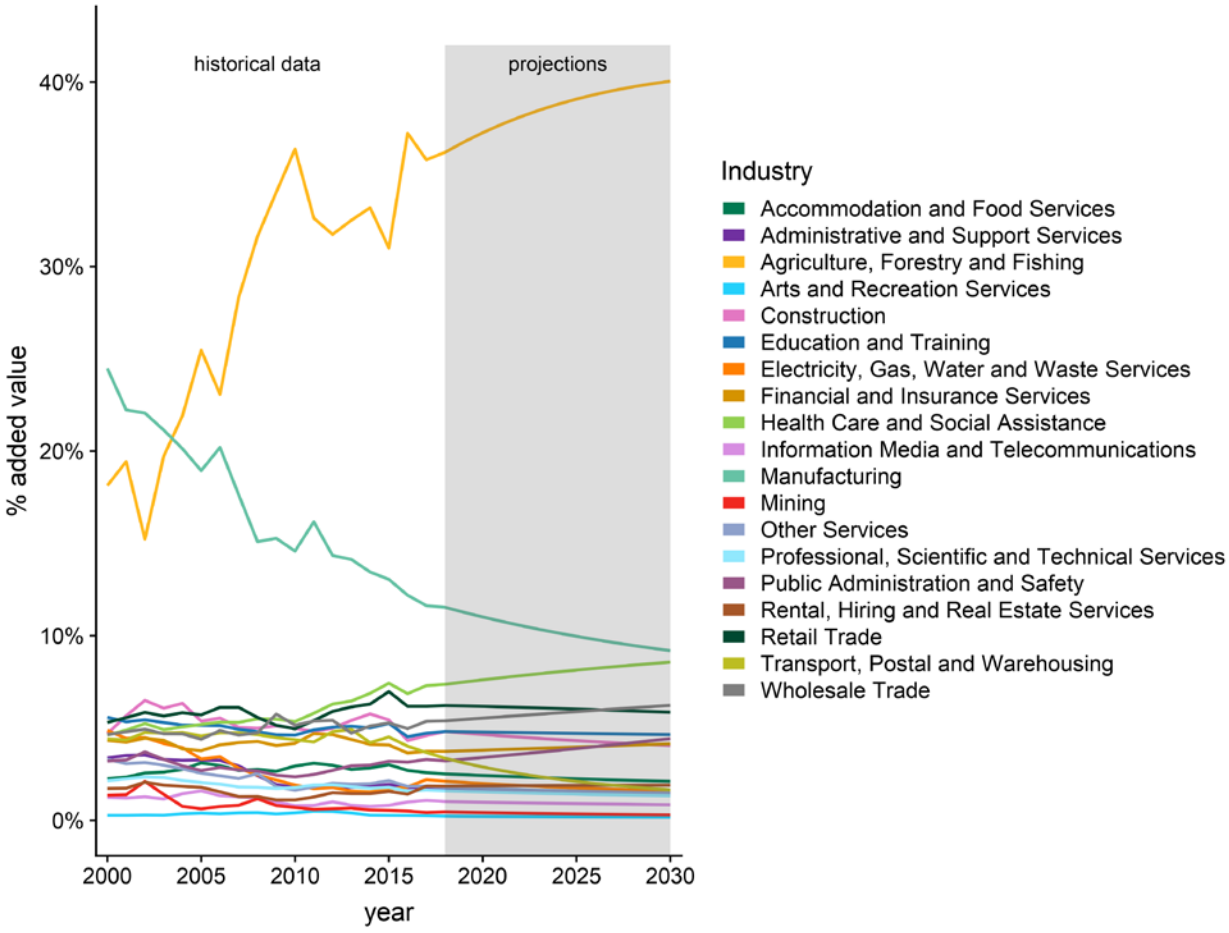

Figure 15. Percent composition of added value by industry. Trends in historical data from 2000 to 2017 were used to project the percent composition from 2018 to 2030

6.1.1.2 Local sales

Local sales are the amount of regional industry output that is sold locally (including sales of final and intermediate goods). This parameter indicates the value of the local demand of goods and services

covered by regional industries. Overall, a slight declining trend in the value of local sales occurred between 2000 and 2017 (2% reduction) (Figure 17). Due to the low historical variability of local sales, the long-term trend projection for this variable is almost constant at about $3.6 billion from 2018 to 2030. However, the possible values for this variable (green shaded area in Figure 17) range from $2.8 billion to $4.5 billion by 2030.

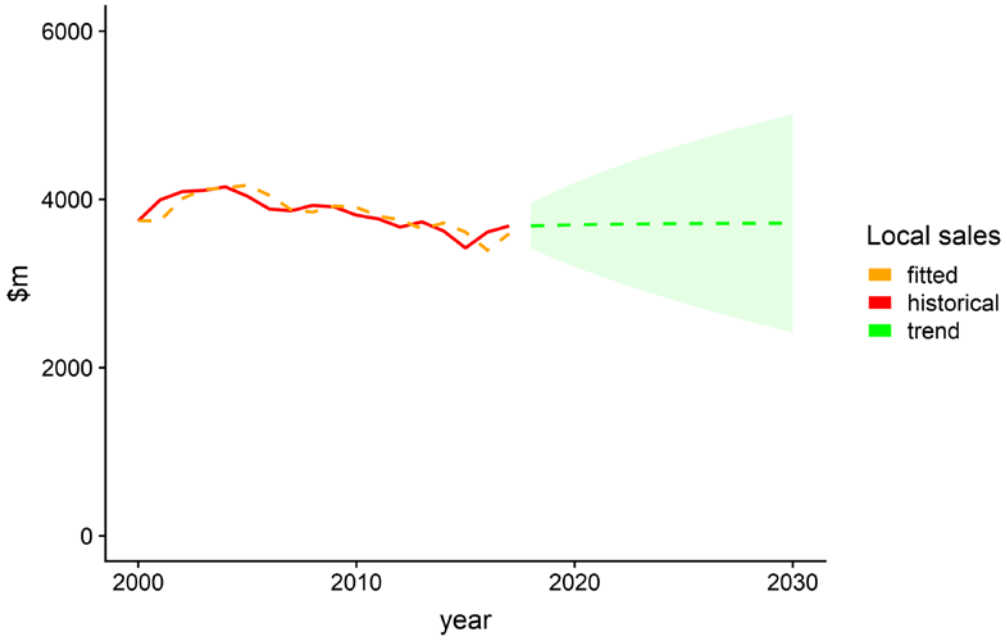

Figure 16. Historical and projected trends in local sales (2016–17 dollars). The shaded green area indicates the 95% confidence interval of the projections

The relevance of regional industries to fulfil local demand is more balanced than the added value and employment indicators (Figure 18). Historically, the four industries with the largest shares of local sales are: Construction; Agriculture, Forestry, and Fishing; Manufacturing; and Rental, Hiring and Real Estate Services. However, there has been a significant increase in the proportion of local demand for health care, financial, hospitality, and public administration services.

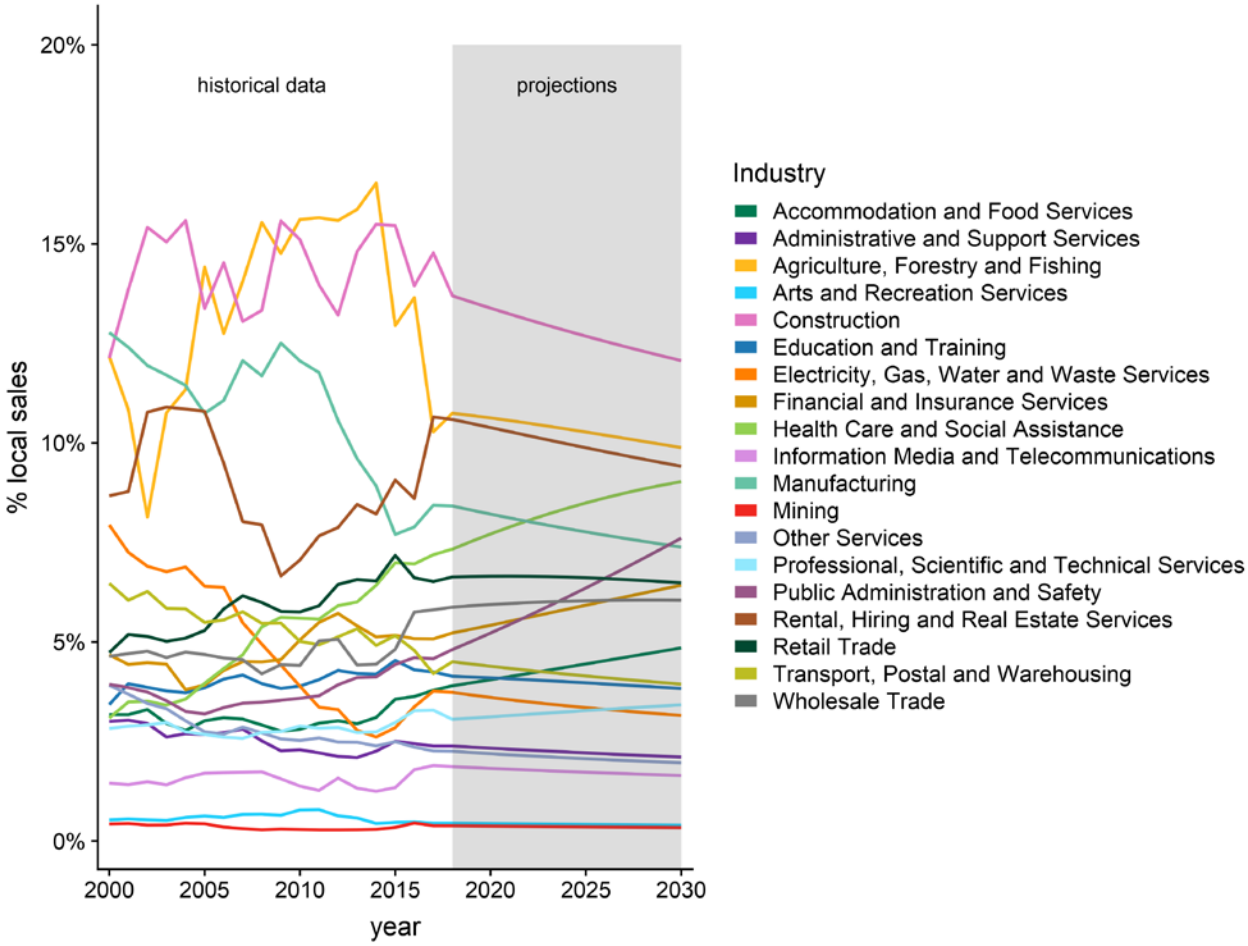

Figure 17. Historical and projected composition of local sales across regional industries

6.1.1.3 Trade

The value of local exports increased by around 4% between 2000 and 2017 (see Figure 19a). Projection of this trend suggests potential export values ranging from $2.9 billion to $3.5 billion by 2030 (green line in Figure 19). Local imports increased by 64% from 2000 to 2017, which is a significant increase relative to imports levels of $2.7 billion in 2000 (Figure 19b). This generated a drastic increase in the regional net trade deficit, an increase from a $4 million deficit in 2000 to a $1.6 billion deficit in 2016. Under projected trends the deficit could reach around $1.9 billion by 2030. The two main regional industries account for around 80% of the regional exports during the period 2000–2017 (Figure 19). Around one-third of the import value was related to manufactured products.

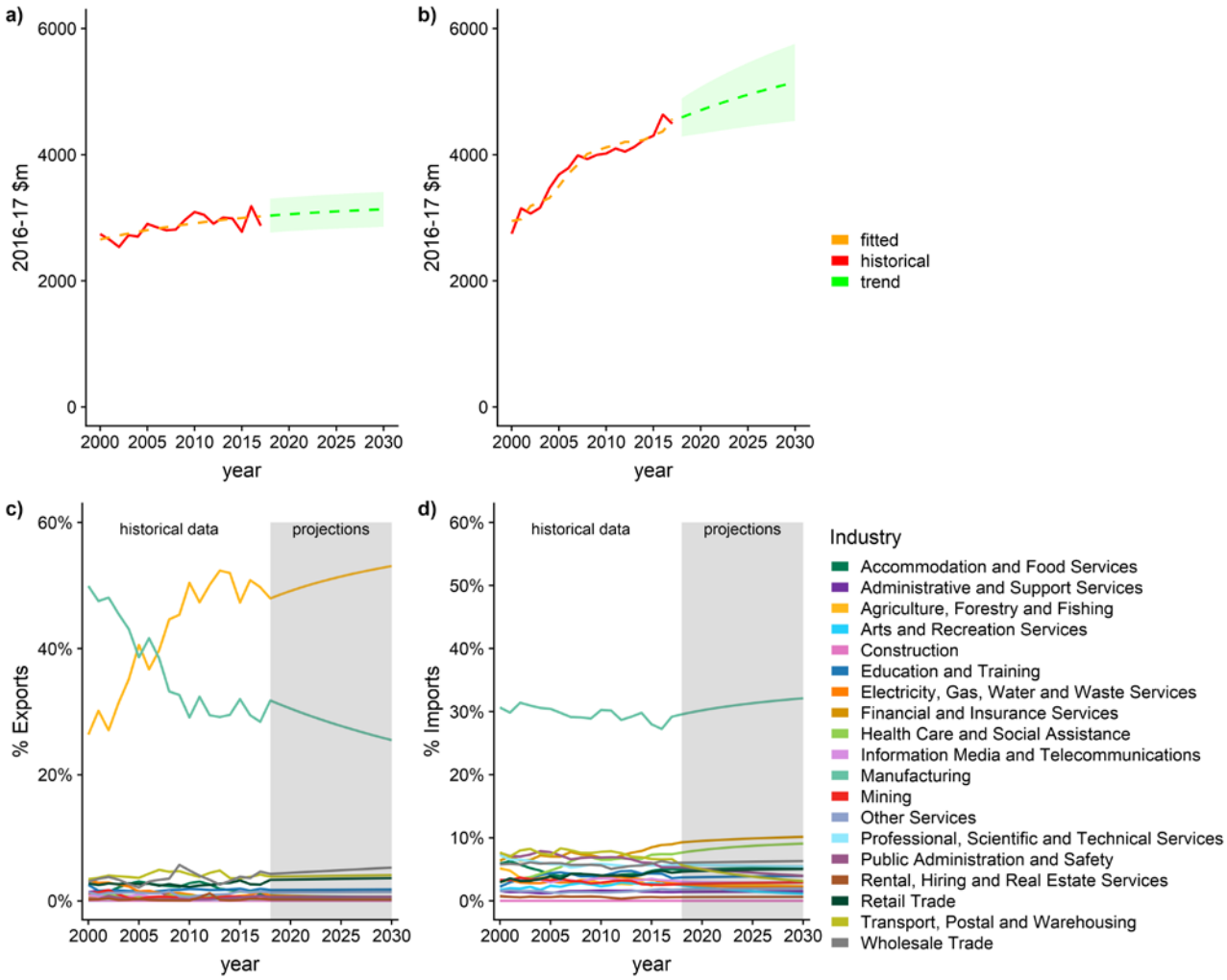

Figure 18. Historical and projected trends in the value of exports and imports and industry shares. a) Total export value; b) Total import value; c) Industry shares in export values; d) Industry shares in import values. The green shaded areas in a) and b) indicate the 95% confidence interval of the projections

6.1.2 Trends within key regional industries

Historical and projected trends in absolute values and industry shares on key economic parameters demonstrate the significant specialisation of the regional economy in agriculture and ongoing structural industry change in manufacturing. However, analysing trends within industries could provide more specific detail of the type of businesses driving changes in the regional economy. Analysing trends within sub-industries, we can observe that Agriculture has been the largest contributor to the added value generated by the Agriculture, Forestry, and Fishing industry (Figure 20A). The added value of Agriculture increased from $357 million in 2000 to $847 million in 2010 and presented a slightly declining trend afterwards (Figure 20A). In contrast, Forestry and Logging had a relatively stable added value output from 2000 to 2012 and recorded a large increase afterwards.

The reduction in the added value contribution of the manufacturing sector between 2000 and 2017 has been mostly driven by changes in Beverage and Tobacco Product Manufacturing (79% decline in such period); Pulp, Paper and Converted Paper Product Manufacturing (49% reduction); and Wood Product Manufacturing (25% decline). During the same period, the added value of forestry

and logging activities increased 971% and agriculture grew by around 90%, though the added value for agriculture was still greater.

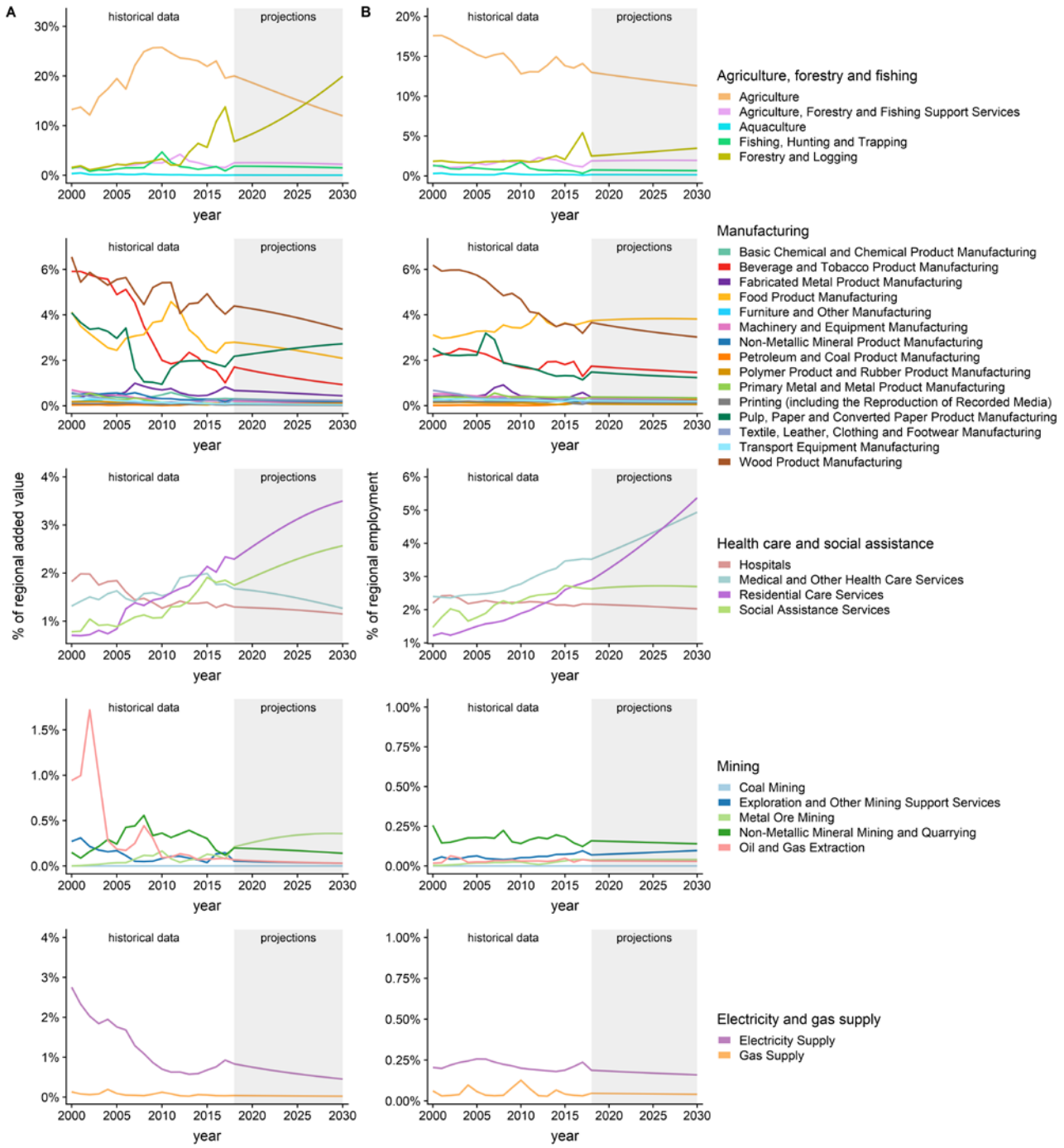

Figure 19. Historical and projected trends in A) added value and B) employment for key regional industries (2000–2017)

The added value of most of the businesses within the Health care and social assistance industry increased. The exception was hospital services, which declined from around $49 million in 2000 to $44 million in 2017. The contribution of the mining sector to the regional added value is marginal. The added value of Metal ore mining; non-metallic mineral mining and quarrying; and oil and gas extraction increased from 2000 to 2008 and decreased afterwards. Exploration and other mining support services presented a declining trend in added value from 2000 to 2017. Electricity supply generated around $74 million in 2000 and $30 million in 2017. The added value of gas supply

reduced from $2.4 million to $1.2 million during the same period, in part reflecting the closure of the Katnook Gas Plant in 2013.

Overall, the trends in added value and employment are highly correlated for the analysed sub-industries (Figure 20B). The main exception is Agriculture where despite an increase in added value, employment in this sub-industry declined.

Forestry and logging is projected to become the main added value contributor to the regional economy by 2030 (Figure 20A). Despite a projected decrease in Agricultural employment, such sub-industry will continue accounting for the largest share of regional jobs (Figure 20B). The share of Pulp, paper and converted paper manufacturing [6] in the regional added value presents an increasing trend with trend projections indicating a 3% share by 2030. Projections for other manufacturing industries show decreasing added value shares. The shares of regional added value and employment for Residential care services, and Social assistance services are projected to increase. Trends for these two indicators and health care services have opposite directions. However, it is worth noting that projected trajectories for categories with small shares may have a high degree of uncertainty (i.e. large confidence intervals).

[6] Although the industrial classification covers both pulp and paper manufacturing, note that this refers mostly to paper, as pulp is imported in the region.

6.2 Economic modelling: approach and data

The analysis presented here is a parametrisation of the scenarios discussed at the March 2019 workshop to study the regional economy's potential evolution pathways. This modelling exercise seeks to identify the influence on a local economy when changes in demand for the output of an industry occur. Exploration of possible outcomes of the scenarios relied on the Regional Industry Structure and Employment (RISE) input-output (IO) model developed by EconSearch (2017) specifically for the Limestone Coast region.[7] Trend analysis data was used as input into the model (see section 6.1).

The purpose of the RISE model is to allow the exploration of potential economic outcomes for the region from changes in the demand for industries' outputs. The specific outcomes of interest are changes in the local gross regional product (GRP) and full-time equivalent employment (FTE) up to 2030. The RISE model in various incarnations has been applied in other scenario-based studies for South Australia, for example in modelling impact of alternative irrigation scenarios for the Murray Mallee region, modelling outcomes related to an infrastructure upgrade of the Kangaroo Island Airport and others (Australian Institute for Social Research, 2011; Iron Road Limited, 2015; Kangaroo Island Council, 2015; PIRSA Fisheries and Aquaculture, 2016).

The GRP is a measure of the net contribution of an activity to the state economy. It is calculated as the value of outputs less the cost of goods and services (including imports) used in producing outputs. It can be thought of as the sum of all the industries' estimated value added. Employment is a measure of the number of working proprietors, managers, directors and other employees (expressed as full-time equivalent numbers). In the case of this model employment is measured by place of employment rather than place of residence. Final demand is the sum of household consumption expenditure, government consumption expenditure, gross capital formation, changes in inventories, tourism expenditure and other exports. Intermediate demand is the total of all inputs, from all industries, that go into the production process of an industry's products and it does not include final demand (e.g. retail sales). Resulting regional GRP and employment changes from an assumed change in intermediate or final demand were recorded and discussed. [8]

Data at the core of the RISE model is a regional IO table from 2015/16. Other datasets, assumptions and default specifications which underlie the model are described in EconSearch's technical report EconSearch (2017). In general, economic activity input-output (IO) data can be used to model the structure, interlinkages, and dependences of industrial activity. A basic principle of IO analysis posits

[7] The Limestone Coast covers the Local Government Areas (LGAs) of Grant, Mount Gambier, Wattle Range, Robe, Naracoorte and Lucindale, Kingston and Tatiara.

[8] In practice, the GRP of each industry from the RISE model is given by the sum of the wages and salaries, which are recorded in the IO table as household income, the gross operating surplus and gross mixed income (GOS&GMI) and taxes less subsidies on products and production (Australian Institute for Social Research, 2011; EconSearch, 2017).

$$\begin{aligned} total\ demand &= intermediate\ demand + final\ demand \\ &= intermediate\ input\ costs + household\ income + GOS\&GMI + taxes\ less\ subsidies \\ &+ imports = total\ inputs \end{aligned}$$

that all industries within an economy are interconnected: they source their inputs from other industries and sell their products to consumers (which can be other industries or final consumers).[9] This model has 78 industries which cover, in a condensed form, the whole industrial structure of the standard Australian classification, ANZSIC (Australian Bureau of Statistics, 2006).

The parametrisation process employed trend analysis data (presented in section 6.1) to determine the direction of evolution for each industry in the RISE model. The added value average trend and its lower and upper boundaries of the 95% confidence interval were derived for each industry in the RDA Limestone Coast data for the period 2018 to 2030. These trends and their lower/upper boundary values supplied the year to year change ratio in the GRP of the total economic output of each industry in the model. The year to year dollar value change in GRP was assumed to be the yearly change in total demand for the output of an industry and it was used as the trigger of a 'shock' to the economy.[10]

Table 15 shows how scenarios are parametrised for the application of the RISE model. Scenario 1 *Diversified Energy Mix* assumes weak investment in gas and a potential outcome of this scenario noted during the workshop was a reduction in industrial gas users. The economic modelling input for Scenario 1 follows the lower boundary of the 95% confidence interval for the added value projected trend of the gas supply and extraction industry and the industries which are gas users (see Appendix A). Other industries follow the upper boundary line of the 95% confidence interval trend projections. Scenario 2 *Gas and General Industrial Expansion* describes a general growth in the Limestone Coast Region of economic activity and diversity. For the model input this is interpreted as an evolution of the local industries along the upper boundary trend for each industry. The input for Scenario 3 *Gas Supply Chain Expansion* is predicated on the continued growth of the gas industry, of industries using gas as well as the industries which stand to benefit the most from capital investment in construction of additional infrastructure. The latter refers to the local construction industries and exploration and other mining support services. This industry, for exploration and mining services, contributed almost 20% of its output in 2015-16 to the oil and gas extraction industry, which represents 5% out of the total industrial input into that industry for 2015-16. Hence the input data for these follows the upper boundary trend, while the input data for other industries follows the average trend. The *Business-as-usual* scenario, Scenario 4, is where each of the individual industries follow the average trend.

It is important to note the data used for the trend analysis has a different industrial structure to the RISE model data, although both map out the whole economy according to the ANZSIC standard. A concordance of the sectors is included in Appendix A . Based on this concordance the trend analysis

[9] A more detailed presentation of the IO analysis concept, methods and assumptions can be found in EconSearch (2017). There are 13 region-specific IO models in the State of South Australia that integrate the Regional Industry Structure and Employment (RISE) model (version 5.0) (EconSearch, 2017).

[10] This effect can be thought of as a change in the components of total local demand. For example, the effect can originate from a change in the final demand due to a change in volumes of exports to other regions, an increase in local household consumption or a change in the intermediate demand of other industries. Note that to account for differences between the value of the GRP in the RDA Limestone Coast data and the RISE model data the year to year change ratio in the GRP was used as an input.

data determined the industry level effects, i.e. the input data to serve as the 'economic shock' in the RISE model for which potential effects on local GRP and employment were calculated. More specifically about the application of this concordance, where the trend analysis indicated a change in an industry aggregating several other industries in RISE, the same ratio change was used for each component sub-industry. Conversely, where more sub-categories of industries' trends were available for a broader category in the RISE data, first the yearly change in the GRP value was derived for each detailed industry and then the yearly effect ('economic shock') was calculated as a sum of all industry level effects.

Table 15. Alignment between scenarios and economic models

Scenario	Data input and assumptions
Scenario 1. Diversified Energy Mix	Gas industry – lower boundary trend Gas users – lower boundary trend Other industries – upper boundary trend
Scenario 2. Gas and General Industrial Expansion	Gas industry – upper boundary trend Gas users – upper boundary trend Other industries – upper boundary trend
Scenario 3. Gas Supply Chain Expansion	Gas industry – upper boundary trend Gas users – upper boundary trend Gas supply chain – upper boundary trend Other industries – average trend
Scenario 4. Business-as-usual (BAU) scenario	Gas industry – average trend Gas users – average trend Other industries – average trend

Default data inputs were used for the base data and for elasticities of each industry's labour productivity, labour income, capital income, household expenditure, and import substitution.[11] This RISE model (version 5.0), unlike its previous versions and other IO models, considers the market response (e.g. version 3.0 used for Australian Institute for Social Research, 2011). That is, an industry may be able to increase output in the short run and not have to increase wages and employment. This is because this version of the EconSearch model incorporates price sensitivity, which accounts for the possibility of non-linear production (EconSearch, 2017; West & Jackson, 2005). In practical terms, using price adjusted models means that if an increase in the demand of the gas supply in the region is projected, this will lead to a more conservative increase in GRP and employment flow-on

[11] For the base data this partly refers to the Consumer Price Index (CPI) for Adelaide for the base year and year 1. The base year of the model is 2015–16. According to the technical paper, the CPI for year 1 can be updated from the basic value of 1.00 to reflect conditions in the first year of the impact analysis. Using ABS data, the updated CPI for FY 2018–19 was calculated and found to be 1.01 (Australian Bureau of Statistics, 2019b).

effects. Also, because the underlying RISE model IO data was for 2015–16, to carry out the forecast for the 10 years period from 2021 to 2030, the change modelled in the first year was an average of the dollar value changes in the GRP for the six year period between 2016 and 2020.

6.3 Economic modelling: results

As noted in the previous section the modelled changes are based on projected changes in Gross Regional Product based on the added value trend analysis described in section 6.1. Results of the total effects over the period to 2030 are given in Table 16 and the discussion of the results is in section 7.5.

All the models show an increase in the GRP from the baseline level in the RISE data of $2,595 million. The modelling also shows that in three out of four scenarios employment grows over the 10 year period. A notable difference between the models is that the first two show a larger increase in GRP and total employment figures than the last two. The results show that indeed the *Business-as-usual* scenario (Scenario 4) leads to the smallest Gross Regional Product increase and a very small decrease in the labour force (13 full-time equivalent jobs). The largest growth in GRP and employment is estimated to occur for Scenario 2, but Scenario 1 figures come close. The growth in GRP from Scenario 1 and Scenario 2 are equivalent to an estimated growth of 5.1% and 5.8% respectively from the total 2015–16 figures in the RISE model. In employment terms, these two scenarios lead to 1.9% and 2.2% growth in employment over a ten year period to 2030 from the baseline of about 22,700 FTEs.

Scenarios 3 and 4 have very similar estimated results, with very small growth over the next ten years. Scenario 3 seems to lead to a 1.3% increase in GRP, while Scenario 4 is estimated to lead to a 0.9% increase in total GRP. In terms of employment the modelling of Scenario 3 leads to a very small increase in employment while Scenario 4 leads to a decrease in employment.

Table 16. Modelling results for the parametrisation of the scenarios. Outcomes are totals over a 10 year period

Scenario	GRP 10 years ($m)	Employment FTE 10 years (no.)
M1. Diversified Energy Mix	132	429
M2. General Industrial Expansion	150	497
M3. Gas Supply Chain Expansion	35	32
M4. Business-as-usual	24	–13

6.3.1.1 Employment

Historical data shows that increasing added value has not resulted in more employment opportunities within the region (Figure 14B). If recent trends in total employment continue, the number of jobs in the region could remain at around 32,000 (with ±9.79% relative to the trend indicating the bounds of the 95% confidence interval, C.I.). The Agricultural, Forestry, and Fishing industry employs the largest proportion of people in the region (Figure 16). Like aggregated trends, increased business productivity in this industry (as observed through changes in added value) has not been accompanied by significant increases in regional jobs. Around 6,571 people were employed in this industry in 2000 and 6,862 in 2017 – an increase of only around 4%. The projected trend in employment for this industry indicates a slight decline by 2030 relative to 2017 levels. On the other hand, the proportion of regional employment attributed to the manufacturing industry changed from 17% in 2000 to 11% in 2017, with projections of around 8% by 2030. Increases in the proportion of employment in health care, social assistance, education and training, and administrative and support services were observed during the same period. This trend could result in this industry becoming the second largest employer during the early 2020s, and accounting for around 14% of all the regional jobs by 2030.

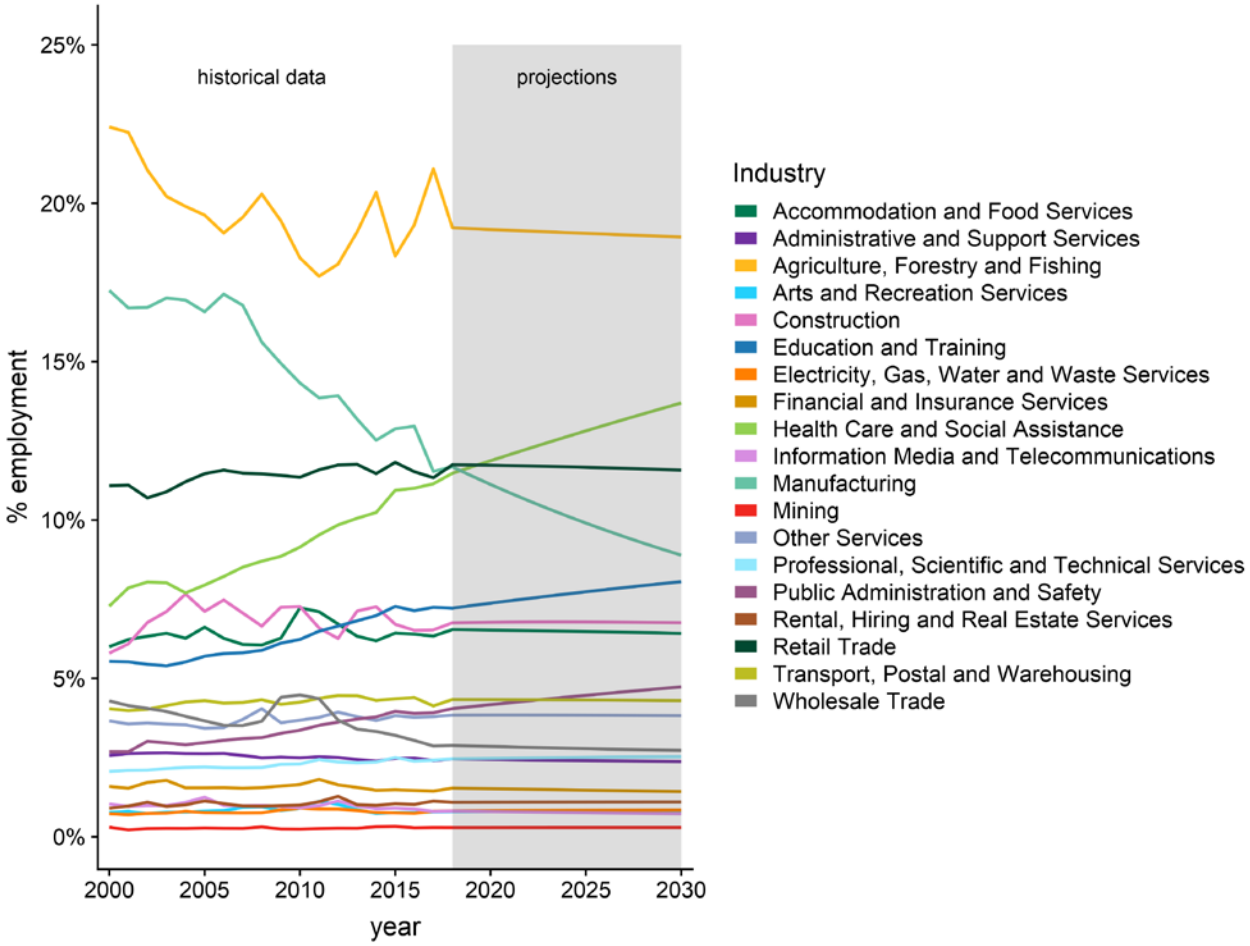

Figure 20. Percent composition of employment by industry. Trends in historical data from 2000 to 2017 were used to project the percent composition from 2018 to 2030

Part IV Outcomes

7 Discussion of stakeholders' responses to scenarios and regional economic modelling

The workshop scenarios have been used as a discussion facilitation mechanism and to draw out goals for regional economic development and intermediary steps to reach these goals. Based on the workshop input, there are two key step changes in infrastructure and energy supply which can help bring about Scenario 2 *Gas and General Industrial Expansion* in the region: (1) increasing the reliability of gas market prices for users; (2) shifts in infrastructure to enable reduction of non-energy input costs. Pursuing one or both of these step changes would make a significant change to local manufacturing industry operations. A more detailed discussion of the outcomes from the workshop is provided in sections 7.1 to 7.4.

Regional economic modelling has been employed as a mechanism to link the scenarios to potential quantitative outcomes. They serve to get a picture of the relative magnitude of outcomes from changes that could occur in the local economy and what the role of the gas industry may be. Their outcomes are discussed in section 7.5.

7.1 Desire to move forward with affordable local gas

Stakeholders expressed a desire to move forward from current circumstances which were characterised by expensive gas prices set by companies outside the region. Stakeholders from existing industries conveyed that the status quo was hindering the expansion of the regional economy, particularly for those businesses dependent on gas. Some large employers in the region expressed that the location no longer provided a competitive advantage for their operations with energy prices (along with other factors such as freight) being substantial costs for the businesses. Stakeholders could identify at least one major manufacturing operation which had considered moving to the region but decided against this move, in part, due to the monopoly on gas supply resulting in high prices. Access to locally produced gas could substantially contribute to overcoming these difficulties, provided it could be delivered to end users effectively and at a final price to users that was cheaper than the status quo.

7.2 Local drilling for gas will lead to substantial benefits if local access to gas exists

Despite the strong desire for investment in developing gas resources in the region, stakeholders thought it was unlikely that the local gas industry would become more embedded in local production chains and local manufacturing activity. There is stable demand for gas in the region and potential for this demand to increase. The workshops demonstrated that some local gas users depend heavily on gas with limited to no possibility of substituting gas for other energy sources. Other gas users could substitute other energy sources, but their operations are currently configured for gas use and substituting for other resources would involve additional costs due to changes to

equipment. The overall stability of the demand for gas was reflected in Scenario 2 being the most popular scenario. However, a major theme of the workshop was that the current focus on *extraction* of gas is unlikely to deliver increased *access* to gas for local businesses without changes to transmission systems, as represented in Figure 1. Stakeholders described a monopoly being held over existing pipeline infrastructure resulting in high prices within the region. Moreover, the delivery price to users was influenced by supply and demand dynamics set far outside the region, with delivery charges contributing a substantial proportion of the final price to end users. Therefore, without any changes to the transmission network, locally produced gas would be unlikely to deliver benefits in the form of cheaper gas to local businesses. This low probability was reflected in Scenario 2 (the most desirable) being seen as the least likely scenario.

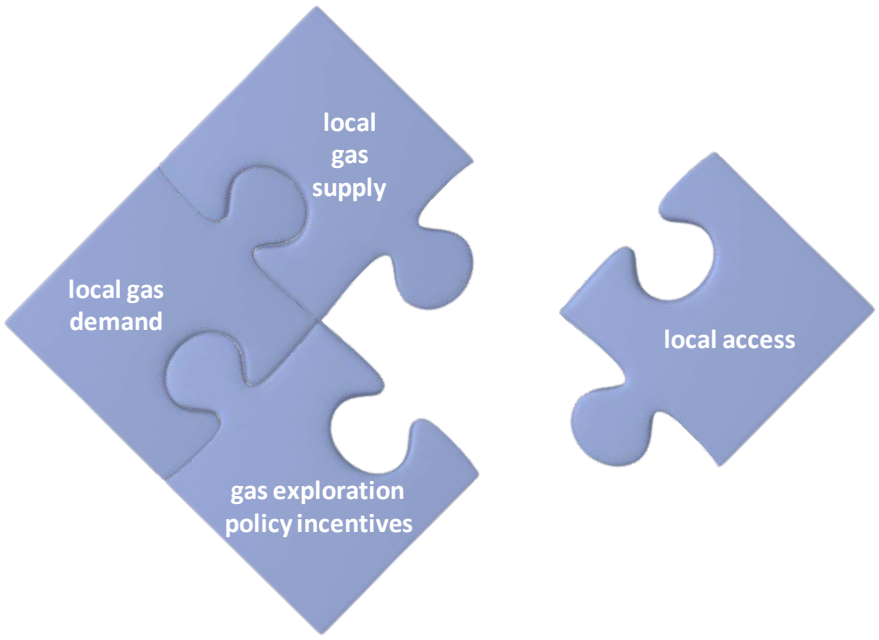

Figure 21. The missing link of increasing local use of locally extracted gas supply

7.3 Strong demand for diversified energy sources

Stakeholders emphasised the importance of diversification in energy sources and in the local economy in general. While there was strong enthusiasm for investing in gas infrastructure, a diversified economy drawing on a wide range of energy sources was a popular scenario. Some local businesses were completely dependent on gas, particularly in the manufacturing sector. However, many businesses were not heavily reliant on gas and the principle of substituting different forms of energy was appealing to a wide range of stakeholders. In part, this issue related to historic difficulties that were experienced in the region at a time of high dependence on gas. In particular, stakeholders recalled a time when access to gas was suspended and those businesses which relied on gas at the time had to find alternatives. In this regard, support for diversification reflects a concerns around being overly dependent on a single energy source. More broadly, it also reflects

interest in changing forms of energy, including solar and wind energy plus distributed generation of electricity from biomass, which some businesses found appealing. Having access to locally extracted natural gas provides a valuable option, however there are alternatives for some industries which are also appealing. Overall, the focus on diversification was more important than the focus on gas alone, as demonstrated by the lack of desirability for Scenario 3 *Gas Supply Chain Expansion* which implied fast investment in gas but decreasing economic diversity. Interestingly however, Scenario 3 was seen as the most likely scenario, suggesting that stakeholders are concerned about decreasing economic diversity in the region.

7.4 Role of gas within the broader energy mix

In general, the local supply of energy at low cost is one of the key development issues for keeping a vibrant local industry which includes gas users. While the energy mix powering activities in some industries is flexible and open to transitioning to alternative sources, for other users, the shift away from gas is not feasible.

Gas use itself would need to be directed to where it results in the highest value. An energy hub where gas-based cogeneration occurs can be a better alternative to a traditional gas plant. An alternative solution is also to co-locate industries which use part of the wasted heat. Locating production and processing facilities close to accessing gas resources would provide them with a competitive advantage, as road transport of energy resources is ineffective. Ideally a pipeline can supply and meet local needs. Having a local energy grid can be a solution useful to the local industry.

Renewable energy can form part of the energy solution, but it is not clear whether it is able to support a similar local economic structure because of the scale and costs of generation and distribution. A local natural advantage is the availability of biomass resources from tree plantations. Large-scale bioenergy plants can theoretically provide an alternative energy source, but some stakeholders thought costs to establish a facility of a sufficient size would exceed current energy costs. A technical shift from gas use in manufacturing to using biomass is currently prohibitive for several of the local plants.

The local energy mix currently consists of a large proportion of wind. However, this is not able to supply energy 24/7 without advances in energy storage technologies or other means to ensure continuous availability. Aside from the possibility of having interruptions in power generation due to the absence of wind, it emerged during the workshop that during hot days wind turbines can be turned off as a precaution to prevent them catching fire.

Avoiding an unwanted scenario implies considering competition and contracts in the supply of local gas. Large retailers securing supply contracts preclude access of other industries to locally produced gas. Aside from a gas reservation policy, structuring contracts to balance local gas supply with supply to retailers may be key in the process of ensuring locally extracted gas has a role in the local manufacturing industry. Policies need to be detailed enough to avoid unintended outcomes in the gas market or the local economy. While price is not directly under government control, policies to encourage competition and which ultimately can drive local gas prices down or reduce input costs are needed.

7.5 Discussion of trend analysis and economic modelling outcomes

It is important to note here that this modelling exercise does not claim to depict a certain future. Rather it is used to draw insights into how economic triggers could influence the development of the local economy. The RISE model has a series of limitations, with some stemming from the core assumptions and data underlying the model. In the model, the initial structure of the Limestone Coast economy influences any modelled developments in future years. In other words, given that the region has a small local gas extraction and small gas supply industry to start with, modelling various future economic shocks shows limited changes in the size of the gas industry and limited economic outcomes, such as small changes in Gross Regional Product or employment.[12]

A clear point of difference between the outcomes of the scenarios is the magnitude of changes observed between the first two and the last two scenarios. Scenarios 1 and 2 lead to the largest increases in GRP and employment over 10 years: $130–150 million added to GRP and 400 to 500 FTE jobs added to the economy. These figures are equivalent to a 5–6% increase in GRP from baseline levels and about 2% change in employment from the baseline level in the RISE data. Note that the scenarios parametrisation followed a conservative outlook in terms of regional development based on the 95% confidence interval of the added value trend analysis. That is, the economy was assumed to evolve along a historical (observed) trajectory and not allowed to deviate by much from this baseline. Nonetheless, these figures corroborate the perspective expressed at the workshop, where Scenarios 1 and 2 were the most desirable. Both scenarios entail regional development characterised by diverse economic activity.

Scenarios 3 and 4 ('*Gas Supply Chain Expansion*' and '*Business-as-usual'*) can be said to amount to almost no change when compared with 2015–16 figures. These two scenarios also follow the same conservative outlook as detailed above in terms of regional development over time. The parametrisation of Scenario 4 seeks to find what is the potential outcome for the local economy when a *Business-as-usual* scenario occurs. This *Business-as-usual* scenario implies following the average trend in the changes of the contributions to the GRP from local industries. The trend analysis revealed that, on average, manufacturing related activity will likely decline in its share of contributions to GRP, while Agriculture, Forestry and Fishing activities can increase their share (section 6.1). Quantitative modelling results align with the perspective of participants in the workshop that the least beneficial outcomes for the Limestone Coast region come from tracking the development pathways for these two scenarios.

Results from Scenarios 1 and 2 ('*Diversified Energy Mix*' and '*General Industrial Expansion*') modelling versus Scenarios 3 and 4 modelling illustrate the difference in whether most industries in the region will follow an average trend vs an upper boundary trend in the evolution of their contribution to the Limestone Coast GRP. In Scenarios 1 and 2 all industries follow the upper boundary trend for changes in the GRP, while in Scenarios 3 and 4, most industries that are not the

[12] Despite developments to the model to go beyond the linearity assumption, the price model used here still shows small economic flow-on effects. The linearity assumption refers to a fixed proportional relationship between input coefficients and output in traditional input-output modelling. See technical report on model construction (EconSearch, 2017).

gas industry or do not use gas in their production processes follow the average trend. Overall, based on the GRP and employment outcomes, the evolution of the economy based on expanding activities of gas-using manufacturing industries can be a more preferred outcome in terms of the benefits it can bring to the region, compared to a scenario following current specialisation trends (e.g. in agriculture).

7.6 Conclusion and policy options

The results from the qualitative and quantitative analysis demonstrate that investing in gas alone, without fostering diversification of the broader economy, would lead to limited benefits over the status quo. One of the main reasons why Scenario 2 was the most preferable was that key local industries representing large employers in the form of the paper products mill, the powdered milk factory and food manufacturing are highly reliant on gas. At the time of conducting this research, the high domestic price for gas was a major burden on these industries which, due to the nature of their operations, cannot readily switch to another energy source. It was noteworthy that during the workshop, participants were aware of other manufacturing businesses which had considered moving to the region but had chosen not to, partly due to the high price of gas.

Not all industries are reliant on gas and this underlies the relative appeal of the *Diversified Energy Mix* scenario. It was seen as the second most likely, the second most desirable, and had the second highest economic outcomes based on modelling. Considering the two most desirable scenarios together, the report reinforces the importance of economic diversity in general.

The stakeholder responses to the *Gas and General Industrial Expansion* scenario reflect additional factors at play in the region. While there has previously been a local gas industry, and the potential for locally extracted gas to supply local businesses is seen as desirable, there are major logistical constraints which impede action towards realising this scenario. In particular, the gas transmission network in the form of pipeline infrastructure is a major limitation for providing locally extracted gas to a broad range of local industries. At the time of conducting this research, the major pipeline infrastructure was owned and operated by a company that was external to the region and has a monopoly over transmission to key industrial gas users in south east South Australia. The State Government had provided important incentives for local exploration and policies to encourage local delivery of gas, however it was not logistically feasible for locally extracted gas to be supplied to local users at the time the research was conducted.

The results demonstrate that the potential advantage of cheaper local gas may not be realised without changes to gas transmission systems. To bring about the most desirable scenario, the following policy options were identified during this research.

7.6.1 Policy option 1

Consider ways to overcome the monopoly of transmission in the region through:

a) *incentives for new gas transmission infrastructure, and/or*
b) *policies to increase competition within existing pipeline infrastructure.*

Analysis of the workshop notes demonstrated that there was a clear need to address the limitations of existing transmission infrastructure. Having a supply of local gas, and demand for local gas, and policy settings to support extraction, may not realise local value generation from gas when key infrastructure is focused on taking gas away from extraction regions to urban markets and export markets. At present, new gas producers in the region would need to invest in additional compression infrastructure to distribute gas beyond the region. However, from a company perspective, investing in compression infrastructure to access a market beyond the region may be desirable in the absence of incentives for increasing local distribution.

7.6.2 Policy option 2

Communications between different stakeholders (policy, gas producers, pipeline operators and gas users) are particularly important at the regional scale. Feedback received by the research team indicated that the stakeholder workshop in Mt Gambier was valuable in terms of bringing stakeholders together in the region. Developing further mechanisms to promote increased communication and strong relationships between regional businesses, regional development planning, the gas sector and researchers to ensure that gas development plans aligned with regional priorities and regional businesses maximising potential opportunities. In particular:

> *A regional stakeholder forum be conducted to discuss the findings of this research bringing together gas producers, gas users, policy, research and regional planning to consider the best way to achieve desirable scenarios and avoid undesirable scenarios identified in this report*

7.6.3 Policy option 3

A combination of energy sources in conjunction with economic diversification formed part of the second most desirable and feasible scenario. However not all energy sources are cost effective. Therefore, it is important to explore local competitive advantage for the provision of energy from a diversity of sources in conjunction with a cost-benefit analysis for different energy forms. In particular,

> *A cost-benefit analysis be conducted for different energy forms to establish at what magnitude these can be cost-effective for their use in specific local industries.*

Appendix A Gas-using industries

This appendix details the method used to identify industries to include in the modelling as 'gas users'. Since manufacturing processes are some of the highest users of gas, the scenarios explore alternative futures types of the manufacturing of the Limestone Coast region and their regional implications. Manufacturing industries which represent the main industrial uses of natural gas and gas-derived products in Australia are non-ferrous metals (e.g. aluminium, copper, zinc, tin); chemicals, polymers and rubber (e.g. fertilisers, antifreeze); non-metallic mineral products (e.g. glass, ceramics, cement, bricks); and plastic packaging for foods and beverages (APPEA, 2019; Department of Environment and Energy, 2018).

First, to identify these industries in RISE a correspondence was drawn between major uses of gas in manufacturing and the standard ANZSIC classification.[13] Manufacturing industries with highest use of natural gas were identified based on their national levels of natural gas consumption for 2016–17 from Table F in the Australian Energy Update (Department of Environment and Energy, 2018). The first column in Table A.1 identifies the industries which account for 99% of the natural gas use in manufacturing in Australia.

Apx Table A.1 Major uses of gas in manufacturing and correspondence of these uses to standard Australian industry classifications and to the RISE model

Major uses of gas in manufacturing	ANZSIC industries	RISE Model industries
213-214 Basic non-ferrous metals	213. Primary Metal and Metal Product Manufacturing	Basic Non-Ferrous Metals
18-19 Basic Chemical and Chemical, Polymer and Rubber Product Manufacturing	18. Basic Chemical and Chemical Product Manufacturing 19. Polymer Product and Rubber Product Manufacturing 1911. Polymer Film and Sheet Packaging Material Manufacturing (included in 19.)	Pharma & Other Chemical Products
20 Non-metallic mineral products	20. Non-Metallic Mineral Product Manufacturing	Non-metal Mineral Products
11-12 Food, beverages and tobacco	11. Food Product Manufacturing 12. Beverage and Tobacco Product Manufacturing	Food Product Manufacturing; Beer, Wine and Spirits

[13] Although some manufacturing uses of gas fit under specific groups or class codes, due to the aggregated nature of the RISE models the change in production was assumed at a broader industry level, mostly at subdivision levels. For more on the classifications of industries as divisions, subdivisions, groups or classes see the Australian and New Zealand Standard Industrial Classification (Australian Bureau of Statistics, 2006)

15-16 Pulp, paper and printing within the Wood, paper and printing classification	15. Pulp, Paper and Converted Paper Product Manufacturing 16. Printing	Pulp, Paper & Paperboard; Paper Products; Printing (incl Recordings)
211-212 Iron and steel	211. Basic Ferrous Metal Manufacturing	Iron & Steel
1709 Other petroleum and coal product manufacturing; 1701 Petroleum refining	17. Petroleum and coal product manufacturing	Petroleum & Coal Products
13 Textile, clothing, footwear and leather	13. Textile, leather, clothing and footwear manufacturing	Textiles, Clothing & Footwear
23-24 Machinery and equipment	23. Transport Equipment Manufacturing 24. Machinery and Equipment Manufacturing	Motor Vehicles & Parts Other Machinery & Equipment

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