APPENDIX 21

ARROW LNG PLANT

Economic Impact Assessment

arrow energy
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Economic Impact Assessment: Arrow LNG Plant

Report prepared for:

Arrow CSG (Australia) Pty Ltd

and

Coffey Environments Australia Pty Ltd

Version 5.0

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Executive Summary

Project Background

Arrow CSG (Australia) Pty Ltd (Arrow Energy), a subsidiary of Arrow Energy Holdings Pty Ltd, and Coffey Environments Australia Pty Ltd (Coffey Environments) have commissioned this report to examine the likely impacts of the Arrow LNG Plant on the Gladstone economy (where the proposed Arrow LNG Plant is to be located), as well as impacts to the Queensland and Australian economies as relevant. Specifically, this report addresses section 5.1 (Economy) of the Environmental Impact Statement (EIS) terms of reference for the Arrow LNG Plant.

Existing Local Economic Environment

Examination of the characteristics that define the Gladstone economy identify it as:

- One of Queensland's fastest growing regions with a population that is projected to grow approximately 50% faster than the Queensland average over the next 20 years;
- An industry-led, developing economy with a lagging service base. The economy is centred on heavy industry, with manufacturing contributing over 40% of the economy's total value added activity. This is supported by transport, postal and warehousing, mining and construction which provide a further 25% of value add;
- An export-oriented economy, which can be volatile following fluctuations in global demand, commodity prices and exchange rates. This includes volatility in the labour market, largely resulting from a high degree of contract labour arrangements in key industries that are reliant on global demand;
- Currently experiencing considerable shortages in supply of construction labour, which is reflected in high construction costs in Gladstone. Skills shortages are also being experienced for key occupations required by the LNG industry;
- Currently experiencing a very 'tight' property market, with high demand for property resulting from a number of large new and expansion projects being developed in the region (and associated FIFO construction workforces); and
- Well serviced in terms of key infrastructure, with well developed road, port, rail and airport infrastructure, and some existing spare capacity in all utilities and information and telecommunications technology infrastructure.

Economic Impacts of the Arrow LNG Plant

Potential beneficial impacts arising from the Arrow LNG Plant include:

- Significant **increases in industry output, GRP, employment and incomes** throughout the project life through both direct and indirect impacts;
- **Opportunities for local business to secure new contracts** and increase sales to supply and service the needs of both the project and the workforce;
- **Increased productivity through economic rationalisation**, resulting in an increase in factor incomes per unit of factor input, in particular for labour;
- Households will be beneficially effected by the project, through **increased job and income earning opportunities**, as well as a moderate **increase in real wages** (i.e., above inflation) resulting from competition for labour and upward pressure on prices;
- The Arrow LNG Plant will provide a **lift in local, Queensland and Australian Government taxation revenues** through a variety of taxes and duties; and
- **Support for the Australian dollar** through production and export of high value LNG, resulting in lower comparative prices for foreign goods and services.

Key adverse impacts are examined in Table ES.1, including proposed mitigation strategies and potential cumulative impacts if all proposed major industrial developments for the region proceed.

Table ES.1. Assessment of Adverse Impacts of the Arrow LNG Plant Before and After Mitigation

Initial Impact Description	Initial Impact Rating	Mitigation Strategies	Residual Impact Rating
Impacts on Business: The Arrow LNG Plant is likely to adversely impact on some businesses and industry in Gladstone and the rest of Queensland as a result of: • Competition for and draw of labour to the Arrow LNG Plant and its supply chain. This has the potential to deepen skills shortages in the region and Queensland (for both construction and energy related skills) and place upward pressure on labour prices (wages and salaries) for business to attract and retain labour; • Escalating costs of labour and other inputs to production, which could reduce business profits and viability for some businesses/ industries; and • Support for the Australian dollar as a result of the high level of exports generated by the project, which has the capacity to adversely impact industries which sell their products and services overseas, as these products and services will be more expensive to foreign buyers.	**High**	• Support strategies aimed at addressing skills shortages in the construction and LNG industries, as well as those that assist local business back-fill positions vacated through labour draw. • Provide assistance/ guidance to local business to secure supply contracts, including: o Informing local business of the goods and services required of the project; o Developing and implementing a Local Content Strategy; and o Examining options for establishing a local cooperative service or network/ alliances to connect local business and enable collaboration in meeting service supply requirements of the LNG industry (should be led by council).	**Medium**
Impact on Housing Prices and Availability of Affordable Housing: Demand for residential property from the Arrow LNG Plant, particularly during initial construction, will likely place some upward pressure on prices in the local residential market. However, impacts on the Gladstone property market are anticipated to be most acute over the next couple of years (prior to commencement of the Arrow LNG Plant) as construction labour demand in Gladstone peaks to support projects such as the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project. Residential developments are planned to accommodate some of the peak demand, and will assist in mitigating the impact of the Arrow LNG Plant on the local property market.	**Medium**	• Minimise impacts on local property demand by: o Ensuring worker camps are operational and capable of accommodating all required labour as soon as practicable following final investment decision; o Facilitating information flow to the local residential development market regarding the nature and timing of demand resulting from construction and operational activities of the Arrow LNG Plant. o Monitoring the availability of residential property and median house prices to accommodate construction and operational workers migrating to the region.	**Medium** (a)
Impacts on Local Infrastructure and Service Capacity: In consideration of existing and planned future capacity, Gladstone is expected to be well serviced in terms of provision of most types of infrastructure to support the Arrow LNG Plant, with the exception of road infrastructure. Existing road infrastructure will likely be inadequate to accommodate proposed increases in traffic loads (without increasing congestion and travel times) arising from the project at the following points: • Blain Drive/ Alf O'Rourke Drive/ Hanson Road; • Dawson Highway/ Blain Drive; and • Dawson Highway/ Phillip Street.	**Medium**	• Implement mitigation measures associated with traffic impacts in accordance with the Traffic and Transport Impact Assessment specialist study (GTA Consultants, 2011) to minimise impacts to local households and business of additional traffic on travel times.	**Low**

Note: (a) The mitigation measures proposed will assist in minimising adverse "impacts on housing prices and availability of affordable housing" experienced in Gladstone, however, the coarseness of the assessment framework utilised does not register a lower residual impact rating (compared to the initial impact rating). One of the key factors influencing the minor change is the initial impact rating includes consideration of Arrow Energy's existing commitments regarding development worker camp accommodation, a worker accommodation plan, and company facilitated communal accommodation for EPC management and Arrow Energy workers, as well as operational workers.
Source: AEC*group*.

Conclusion:

Despite some adverse impacts likely associated with the project, economic modelling indicates the Arrow LNG Plant is estimated to generate significant net economic benefits for Gladstone, Queensland and Australia through increased economic activity, over and above any potential draw down in some sectors.

Cumulative Impacts

Cumulative impacts on the Gladstone economy from a large number of major infrastructure and industry projects being developed were assessed. Projects included for consideration in the cumulative impact assessment were as follows:

- Arrow LNG Plant;
- Yarwun Alumina Refinery Expansion;
- Gladstone LNG Project;
- Queensland Curtis LNG Project;
- Arrow Surat Pipeline Project;
- Australia Pacific LNG Project;
- Boyne Island Aluminium Smelter Expansion;
- Arrow Bowen Pipeline Project;
- Fisherman's Landing Northern Expansion Project;
- Gladstone – Fitzroy Pipeline Project;
- Gladstone LNG Project – Fisherman's Landing;
- Gladstone Nickel Project;
- Gladstone Steel Plant Project;
- Hummock Hill Island Community Project;
- Moura Link – Aldoga Rail Project;
- Western Basin Strategic Dredging and Disposal Project; and
- Wiggins Island Coal Terminal Project.

The cumulative impact assessment focuses on the potential for impacts identified in Table ES.1 to be exacerbated by the concurrent development of a range of projects in Gladstone. In undertaking the analysis, it has been assumed that all projects identified above proceed in accordance with timelines outlined in existing information in the public domain. ***This is considered a cautious scenario (i.e. an extreme scenario that is unlikely to be realised) as it is highly unlikely that all projects proposed will proceed to development, or that all proposed timelines will be achieved***. As such, it is highly likely that impact ratings assessed in this cumulative impact assessment are overstated.

In interpreting the impact assessments, it should be noted that many of the projects included in the cumulative assessment are anticipated to be winding down or completed by the time the Arrow LNG Plant commences construction activity in 2014. As such, much of the peak adverse cumulative effects in Gladstone attributable to concurrent project development will likely occur prior to commencement of the Arrow LNG Plant. Even so, the cumulative impact assessment has included the effects prior to commencement of the Arrow LNG Plant as the environment this creates will contribute to the efficacy of cumulative impacts during the Arrow LNG Plant project timeline.

It should also be noted that the cumulative impact assessment examines the impact of all projects combined rather than the contribution of the Arrow LNG Plant to cumulative effects. The marginal impact of the Arrow LNG Plant (i.e., impact of the Arrow LNG Plant over and above the impacts of the other projects) will in fact likely be quite small considering that the peak cumulative construction activity is anticipated to occur prior to commencement of the Arrow LNG Plant, therefore Arrow LNG Plant will extend the impact rather than increase the peak effect.

The cumulative impacts of all projects outlined above proceeding are outlined in Table ES.2.

Table ES.2. Assessment of Adverse Cumulative Impacts

Impact Description	Impact Rating
Impacts on Business: Concurrent development of a number of major projects in Gladstone will almost certainly result in additional demand and competition for labour and other inputs to supply these projects. This will place upward pressure on input prices, and can result in "crowding out" of some businesses and industries.	**Very High**
Impact on Housing Prices and Availability of Affordable Housing: The overlapping development of a number of major industrial projects is likely to exacerbate and prolong peak demand for housing in the region, even in consideration of construction camps to be used. The number of projects will likely result in an extended tail of the labour demand curve supporting higher residential property prices over the medium to longer term. Impacts on the property market (i.e., lift in prices) generated by concurrent timing of projects are anticipated to be most acute in the short to medium term.	**High**
Impacts on Local Infrastructure and Service Capacity: Development of multiple major industry projects in Gladstone, and the increase in resident and transient population and associated traffic, is expected to strain existing local road networks as well as a wide range of social, community, recreational and, potentially, utilities infrastructure and services.	**High**

Source: AEC*group*.

Mitigating the cumulative impacts of multiple projects being developed requires significant coordination of activities across project proponents, local, state and national governments, relevant economic and industry organisations, local business, imported workers and local residents.

Glossary & Abbreviations

Abbreviations

Abbreviation	Meaning
$2009 / 10	Monetary values given in 2009 / 10 Australian dollars
$M	Monetary values given in million dollars
ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industry Classifications
APLNG	Australia Pacific LNG Project
AUD	Australian dollars
CGE	Computable General Equilibrium
CPI	Consumer Price Index
CSQ	Construction Skills Queensland
DEEDI	Queensland Government Department of Employment, Economic Development and Innovation
DEEWR	Australian Government Department of Education, Employment and Workplace Relations
DERM	Queensland Government Department of Environment and Resource Management
DIDO	Drive in, drive out workers
DIP (now part of DEEDI)	Queensland Government Department of Infrastructure and Planning (now part of DEEDI)
DLGP	Queensland Government Department of Local Government and Planning
EIA	United States Energy Information Administration
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPC	Engineering, procurement and construction
ESQ	Energy Skills Queensland
FIFO	Fly in, fly out workers
FTE	Full time equivalent employment position
GADPB	Gladstone Area Promotional Development Board
GAWB	Gladstone Area Water Board
GDP	Gross Domestic Product
GLNG	Gladstone LNG Project
GRP	Gross Regional Product
GSP	Gross State Product
GST	Goods and services tax
GVA	Gross value add
ha	Hectare
HEIRG	Heavy Engineering Industry Reference Group
ICN	Industry Capability Network
km	Kilometre
LNG	Liquefied Natural Gas
m	Metres
m^2	Square metres
m^3	Cubic metres
MMBTU	Million British Thermal Units
Mt	Million tonnes
Mtpa	Million tonnes per annum
OECD	Organisation for Economic Co-Operation and Development
PJ	Petajoules
PPP	Productivity Places Program
QCLNG	Queensland Curtis LNG Project
QGC	Queensland Gas Company

Abbreviation	Meaning
QLD or Qld	Queensland
Q or Qtr	Quarter
QR	Queensland Rail
REIQ	Real Estate Institute of Queensland
RTA	Queensland Residential Tenancies Authority
SALNG	Shell Australia LNG Project (now known as the Arrow LNG Plant)
SDPWO Act	*State Development and Public Works Organisation Act 1971* (Qld)
t	Tonne
TWAF	Temporary workers accommodation facility
US$ or USD	United States dollars

Glossary of Terms

Term	Meaning
Back-filling	Refers to filling employment positions that are vacated as a result of a draw of labour from one sector to another.
Baseline scenario	Refers to the base scenario used in this report to compare and examine the impacts of the Arrow LNG Project on the local, state and national economies. This scenario includes the committed projects of the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project.
Building Price Index	An indicator of the variation in building costs over time including the costs of labour and building materials inputs.
Computable General Equilibrium modelling	An economic modelling technique that estimates the net increase in demand generated by the project after taking into account resource constraints.
Consumer Price Index	The Consumer Price Index is an indicator that is constructed to measure changes over time in the general level of prices of consumer goods and services that households acquire, use or pay for consumption.
Direct economic impacts	Refers to impacts associated directly with an increase in expenditure within an economy.
Draw down on labour	Refers to a transfer of labour from one sector (sector a) of the economy to another (sector b) as a result of increased demand and wage improvements in sector b.
Study Area	The study area refers to the Gladstone Local Government Area and represents the region in which the project is located and expected to have the greatest direct impact.
Environmental impact statement (EIS)	The information document prepared by the proponent when undertaking an environmental impact assessment. It is prepared in accordance with terms of reference prepared or approved by government. EIS is the term used by the *Environment Protection and Biodiversity Conservation Act* 1999 and the *Environmental Protection Act* 1994, and it is defined in Part 4 of the *State Development and Public Works Organisation Act* 1971.
Exchange rate	Rate at which one currency may be converted into another.
Factor incomes	Comprises compensation of employees by, and operating surplus of, producers.
Factors of production	Represent the factors used during production activities that are not consumed during the process. Includes land, labour, capital and entrepreneurship.
Flow-on / indirect economic impacts	Flow-on (or indirect) economic impacts refer to impacts throughout an economy induced by a direct increase in expenditure.
Full employment	A labour market point in which there is no cyclical unemployed persons. The remaining unemployed are either frictionally unemployed (i.e., people simply between jobs due to quitting one before starting another) and structurally unemployed (i.e., those who lack the skills for the available jobs but who could get work with the right training).
Full time equivalent (FTE) employment position	Represents one employee working full time for a period of one year.
Gross Domestic / State / Regional Product	Represents the market value of all final goods and services produced within the Australian / state / regional economy during a given period of time.
Gross operating surplus	Represents the excess of gross output over the sum of intermediate consumption, compensation of employees and taxes less subsidies on production and imports.
Gross value add	Measurement of the contribution to the economy of each individual producer, industry or sector based on the net activity at each stage of production. Gross value added only measures the additional value added at each stage of production, and as such is considered a true measure of economic activity.
Indicators	Anything that is used to measure the condition of something of interest. Indicators are often used as variables in the modelling of changes in complex environmental systems.

Term	Meaning
Industry output	Measurement of the contribution to the economy of each producer, industry or sector based on the gross sales throughout the whole economy. As a gross measurement, industry output includes the purchases of goods and services consumed in the production process, and as such "double counts" the contribution of these goods and services.
Labour force	The labour supply available for the production of economic goods and services in a given period. Labour force is the most widely used measure of the economically active population.
Local Government Area	A geographical area under the responsibility of an incorporated local government Council
Long term	For the purposes of this study, long term reflects a period more than 4 to 5 years in the future.
Medium term	For the purposes of this study, medium term reflects a period 2 to 5 years in the future.
Offsetting	Anything that balances, counteracts, or compensates for something else; providing compensation. For example carbon offsetting is the process of reducing greenhouse gas emissions by purchasing credits from others through emissions reductions projects, or carbon trading schemes.
Place of work	The geographic area in which a person's job is located.
Place of usual residence	The geographic area in which a person's permanent address is located.
Real wage impact	Measurement of the change in wages and salaries as a result of a project over and above impacts on inflation.
Resident population	Resident population refers to people permanently residing in a region or staying in a region for a period of one or more years.
Short term	For the purposes of this study, short term reflects a period within 1 (or less than 1) to 3 years in the future.
Skills shortage	An economic condition in which there are insufficient qualified candidates (employees) to fill available positions.
Stakeholder	A person or organisation with an interest or stake in a project.
Steady state operations	Refers to a state in which operational activity does not change substantially over time.
Tight market	A 'tight' market refers to a market that is experiencing considerable shortages in supply, leading to upward pressure on prices.
Transient population	Transient population refers to those people temporarily staying in a region and thereby increase demand and loads for a range of services, accommodation and facilities. This includes both imported workers as well as tourists/ leisure visitors.
Value chain / supply chain	Refers to the chain of interlinked value-adding processes and activities that convert inputs into outputs.

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1. Introduction

1.1 Background

Arrow CSG (Australia) Pty Ltd (Arrow Energy) proposes to develop a liquefied natural gas (LNG) facility on Curtis Island off the central Queensland coast near Gladstone. The project, known as the Arrow LNG Plant, is a component of the larger Arrow LNG Project. The proponent is a subsidiary of Arrow Energy Holdings Pty Ltd which is a joint venture company wholly owned by Royal Dutch Shell plc and PetroChina Company Limited.

The project is planned to have a base capacity of 16 Mtpa, with a total plant capacity of up to 18 Mtpa, across staged construction of four LNG trains of 4 Mtpa each. The facility is planned to utilise gas resources supplied from coal seam gas developments in the Surat and Bowen Basins in south east and central Queensland.

A proposed feed gas pipeline from near the Gladstone City Gate to Curtis Island will supply gas to the LNG plant where it will be processed, cooled and stored in LNG tanks for subsequent loading onto LNG carriers via a jetty and export to international markets. The project comprises an LNG plant, LNG loading facility, a feed gas pipeline in a tunnel crossing from Port Curtis to the LNG plant site, ancillary infrastructure including quarantine, temporary construction facilities, a materials offloading facility and localised dredging.

1.2 Legislative Context

This section outlines the Australian, Queensland and local government legislation and policy specifically relevant to an assessment of the economic impacts associated with the Arrow LNG Plant.

1.2.1 Australian Government

Assessment of potential economic impacts of major developments is recognised as a key mechanism prior to approval being granted. Whilst legislation pertaining to impact assessment primarily resides within the jurisdiction of state governments, assessment provisions are contained within the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act aims to balance the protection of environmental and cultural values with Australian society's economic and social needs by creating a legal framework and decision-making process based on the guiding principles of ecologically sustainable development. The Department of Sustainability, Environment, Water, Population and Communities is responsible for administering the EPBC Act and it provides a national framework for assessing actions (defined as 'controlled actions') likely to have an impact on a matter of national environmental significance.

The Arrow LNG Plant (formerly the Shell Australia LNG Project) was referred to the Australian Government Minister for the Environment, Heritage and the Arts and was determined as constituting a controlled action pursuant to the EPBC Act. Controlling provisions are sections 18 and 18A (listed threatened species and communities).

To minimise duplication of the environmental impact assessment process, the EPBC Act contains provision for the Australian Government to accredit a state assessment process for the purposes of its own assessment. Queensland's EIS process has been accredited for the assessment under Part 8 of the EPBC Act) in accordance with the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland (2004). The EIS for the Arrow LNG Plant is being prepared to address both Australian and Queensland government requirements.

Aside from the EPBC Act, there is no specific Australian Government legislature or policy identified as being relevant to the conduct of the economic impact assessment.

1.2.2 Queensland Government

The Arrow LNG Plant was declared a "significant project" for which an Environmental Impact Statement (EIS) is required in accordance with Part 4 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) on 12 June 2009, by the Coordinator General. As part of the EIS, an assessment of the project's impact on the local, state and national economic environment is required. The EIS terms of reference set out for assessing the economic impacts of the Arrow LNG Plant are outlined in section 2.1.

Aside from the EIS terms of reference, there is no specific Queensland Government legislature or policy outlining the requirements of an economic impact assessment. However, the Queensland Government Department of Infrastructure and Planning's Social Impact Assessment Unit provide an outline for conducting social impact assessment, which identifies the economy as one of five potential sensitive areas for consideration (DIP, 2011). The framework for analysis is consistent with that outlined in the EIS terms of reference.

1.2.3 Gladstone Regional Council

Gladstone Regional Council has developed and committed to a range of policies and strategies pertaining to economic development in the Gladstone region. An Economic Development Strategy for the Gladstone region was released in May 2010 on behalf of Gladstone Regional Council and Gladstone Area Promotion and Development Limited, which consolidates and builds upon previous strategies for economic development in the Gladstone region prior to local government amalgamation (SGS Economics, 2010). The strategy sets out the following key objectives for economic development in Gladstone:

- Continue to grow and diversify Gladstone's economic base, building on existing industrial, manufacturing and port infrastructure strengths;
- Continual development of local business and industry from within the region, and across all communities, providing a diversity of sustainable employment and career opportunities;
- Gladstone's key industrial strength to be balanced by a depth and diversity of business and employment across the region's supply chain, including retail and service industries as well as agriculture;
- Continue to develop the tourism sector building on the region's existing coastal, city and rural assets;
- Recognise and observe key values such as strong leadership and governance, environmental sustainability, people safety, cultural diversity, community wellbeing, social inclusion and opportunity for all; and
- Maintain and enhance the region's lifestyle attributes including a diverse geography, a wide range of quality education, environmental values, recreational and community services and facilities and the diversity of the regional economy.

1.3 Purpose of the Report

This report is developed as a background technical document for use in preparing the EIS. The report quantifies the expected beneficial and adverse economic impacts of the Arrow LNG Plant on the regional and state economies.

The report also recommends mitigation strategies as well as monitoring regimes to ensure regional economic values are enhanced or, at least, maintained if the Arrow LNG Plant proceeds.

2. Methodology

2.1 Terms of Reference

Terms of reference for the Arrow LNG Plant EIS (formerly the Shell Australia LNG Project EIS) were finalised and released by the Department of Infrastructure and Planning on behalf of the Coordinator-General of the state of Queensland (Coordinator-General, 2010). Section 5.1 (Economy) of the final terms of reference broadly requires:

- Describing the existing economic environment that may be affected by the project;
- Undertaking an economic analysis of potential economic benefits and costs of the project at the national, state, regional and local level (as appropriate to the scale of the project); and
- Developing and proposing mitigation and enhancement strategies and monitoring regimes.

The detailed assessment criteria, as described in the final terms of reference, and the sections of this report that address specific criterion are summarised in Table 2.1.

Table 2.1. Final EIS Terms of Reference – Economic Impact Assessment Cross Reference

Terms of Reference	Section(s)
Description of affected local and regional economies	4
Definition of the economy in which the project is to be located	3.5
Description of the economy, including:	
• Gross Regional Product	4.2.2
• Population	4.2.1
• Labour force statistics	4.3.1
• Infrastructure	4.5
Description of the regional economy's key industries and contribution to regional income	4.2.2, 4.4
Description of the key regional markets relevant to the project:	
• Labour market	4.3.1
• Housing and land markets	4.3.2
• Construction services and building inputs market	4.3.3
Description of the region's key industries and their current input costs	4.4
Discussion of land values in the region by type of use	4.3.2.5
Potential Impacts and Mitigation Measures	**5, 6**
Direct economic impacts on industry and the community, including:	
• Property values	5.4
• Industry output	5.1
• Employment	5.2
• Factor incomes	5.3
General economic benefits of the project, including:	
• The relative significance of the proposal in the local and regional economic context	5.6
• The extent to which local and other Australian goods and services will be used	5.7
• The short and long term beneficial and adverse impacts that are likely to result	Throughout 5
• The potential needs for skills training in the new LNG industry	5.2.2.2
• The need for any additional infrastructure provision by government to support the project	5.8
• Implications for future development in the locality	5.9
• The potential impact of the project on the domestic gas market and gas prices, including the ability of the power generation sector to meet government emission targets and gas-power level targets	5.9
Identify any new skills and training to be introduced in relation to the project	5.2.2.2
Identify the occupational skill groups required and potential skills shortages	5.2.2.1, 5.2.2.3
Identify all potential impacts on households	5.5
Outline strategies to mitigate disruption to the local economy during construction and operation	6

In addition to the above table, the final terms of reference for the Arrow LNG Plant require an assessment of cumulative impacts of the project in consideration of the effects of other known, existing or proposed project(s). This assessment is undertaken in chapter 7.

2.2 Project Scope

The purpose of the economic impact assessment is to examine the Arrow LNG Plant in terms of its anticipated economic impacts. Analysis in this report focuses on local, regional and state level impacts, with national level impacts discussed as relevant. This is considered appropriate for the scale of the project. Data limitations constrain economic modelling to the regional, state and national levels.

2.3 Method of Assessment

2.3.1 Existing Economic Environment

The existing economic environment section provides an overview of the existing economic profile of the project study area, and provides a current baseline for assessment of the significance of potential impacts of the proposed development. Regional economic data collected during this stage is used to develop economic models, and informs the 'base case' (or baseline scenario) against which the Arrow LNG Plant's impacts are assessed. In preparing this section, data and information was sourced from:

- The Australian Bureau of Statistics, Office of the Government Statistician, regional councils and other public sector agencies;
- Consultations with local businesses and peak industry bodies (a summary of stakeholder consultation findings is presented in **Appendix A**);
- Private sector data providers and company websites; and
- AEC*group* propriety economic models.

The existing economic environment provides an assessment and overview of the prevailing conditions of the economy based on available data sets. Recent investment decisions for projects such as the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and the Queensland Curtis LNG Project are unlikely to be appropriately reflected in the statistics and data presented as release of data sets often lag by months and even years. Where appropriate, discussion of the likely implications of these major projects on prevailing economic conditions has been provided based on information obtained through consultation.

2.3.2 Economic Impact Assessment

This economic impact assessment section uses information from the previous sections to analyse, assess and discuss the economic impacts of the Arrow LNG Plant in relation to the terms of reference items outlined in Table 2.1.

The economic impact assessment includes input and information from:

- Economic modelling using Computable General Equilibrium (CGE) modelling techniques (a brief description of CGE modelling is provided below with additional detail in **Appendix B**);
- Consultation with business, industry and key industry organisations to identify potential economic impacts (a summary of stakeholder consultation findings is presented in **Appendix A**);
- Interpretation of modelling output in the context of the regional and state economies, and analysis of other, non-quantified changes to the economic environment;
- Evaluation of the significance of impacts in relation to economic resources; and
- A summary assessment of the magnitude of key identified impacts based on the above analysis and using a risk assessment framework as outlined in **Appendix C**.

The assessment identifies the economic impacts specific to the Arrow LNG Plant compared to what would be anticipated if the project does not proceed (i.e., compared to a baseline scenario). The baseline scenario is not simply the existing economic environment – rather, the baseline scenario accounts for future anticipated economic growth in the local, regional, state and national economies based on available projections of future economic activity from relevant government bodies (refer to **Appendix B** for more details on these assumptions).

Additionally, the baseline scenario includes the anticipated future effects on economic growth and activity resulting from development and operation of the Yarwun Alumina Refinery Expansion, the Gladstone LNG Project (including all 3 trains) and the Queensland Curtis LNG Project (including all 3 trains). Descriptions of these projects are provided in Table 2.2 (in section 2.3.4), with additional detail provided in **Appendix B**.

CGE modelling estimates the net increase in demand generated by the project after taking into account resource constraints. An example would be the necessity to pay higher wages to attract workers from other businesses or regions in a tight labour market.

A fixed domestic labour assumption has been used in the modelling, as per modelling undertaken on the LNG industry by McLennan Magasanik Associates (2009) for the Queensland Government. A constrained labour mobility assumption has been utilised between states, with labour mobility assumed to be motivated by real wage differentials. Labour mobility assumptions include both inter-industry labour movement within regions as well as inter-regional and interstate labour movement. Labour is assumed to not be sufficiently mobile to remove these real wage differentials completely (i.e., in order to attract labour, real wages will increase).

2.3.3 Development of Mitigation Strategies

This mitigation strategies section identifies strategies to avoid, reduce or mitigate the negative economic impacts (and facilitate the capture of the positive impacts identified in the impact assessment where relevant). This includes:

- Defining and describing the objectives of the task/ strategy;
- Identifying practical methods to protect and/or enhance economic values; and
- Identifying practical monitoring measures.

A residual impact assessment was also undertaken utilising the risk assessment framework outlined in **Appendix C** to qualitatively describe the anticipated magnitude of identified impacts where mitigation measures are appropriately implemented.

2.3.4 Cumulative Impact Assessment

This cumulative impact assessment section qualitatively examines the potential impacts in terms of capacity constraints of the Arrow LNG Plant on the local and regional economy where other proposed projects in the region also proceed. Cumulative impacts have been assessed using the risk assessment framework described in **Appendix C**.

The assessment of likelihood and consequence of cumulative impacts has been undertaken based on input and information from:

- Desktop review of other projects proposed for the region and the impacts identified in relevant documentation;
- Consultation with business, industry and key industry organisations to identify potential cumulative effects and impacts (a summary of stakeholder consultation findings is presented in **Appendix A**); and
- Considered application by the project team of the risk assessment framework to identified impacts.

In identifying relevant projects to be included within the scope of the cumulative impact assessment, the following eligibility criteria have been examined:

- The project is located in the Gladstone region;

- The project is being assessed by one of the following:
    - The SDPWO Act and has been declared by the Queensland Coordinator-General as a 'project of state significance' for which the status of the EIS is either complete or, as a minimum, has an Initial Advice Statement published on the Department of Infrastructure and Planning (DIP) website; and
    - The Environmental Protection Act 1994 (Qld) and has completed an EIS or has an Initial Advice Statement (or similar) listed on the Department of Environment and Resource Management (DERM) website;
- The project is envisaged in statutory planning documentation; and
- The project has the potential to impact on the Gladstone economy and demand for a range of economic factors.

Based on the above criteria, the following projects outlined in Table 2.2 have been included for consideration in the cumulative impact assessment. It should be noted that the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project have also been included as part of the baseline scenario for the economic impact assessment section.

The various beneficial and adverse economic impacts of these projects have or will be examined in their relevant EIS studies being conducted for these projects separately, and have not been assessed in this report. Rather, the cumulative impact assessment section focuses on the potential for the concurrent undertaking of these projects to exacerbate the impacts of the Arrow LNG Plant identified in the impact assessment.

Table 2.2. Major Projects Underway & Proposed for Gladstone

Project	Description/Capacity	Estimated CapEx ($M)	Employment [a]	Commence Operation	Location
Projects Included in the Baseline Scenario					
Gladstone LNG Project (GLNG)	• Up to 10Mtpa export LNG plant and pipeline to be developed in three stages with each train having a 3 to 4 Mtpa capacity	US$16,000	**C:** 5,000 (3,000 for LNG plant) [b] **O:** 1,000	2014	Curtis Island (LNG plant), with gas supplied from Bowen and Surat Basins
Queensland Curtis LNG (QCLNG)	• Staged development of a 12 Mtpa LNG plant and export terminal on Curtis Island. • Three trains developed in two stages, with each train having a capacity of 4 Mtpa o Stage 1: 2 trains o Stage 2: 1 train	$8,000	**C:** 5,000 (3,250 for LNG plant) [b] **O:** 1,000	Early 2014	Curtis Island (LNG plant), with gas supplied from Surat Basin
Yarwun Alumina Refinery Expansion	• 2Mtpa expansion of Rio Tinto's Yarwun Refinery	$1,800	**C:** 1,300 **O:** 250	Mid-2012	Yarwun
Projects Considered in the Cumulative Impact Assessment					
Arrow Surat Pipeline Project	• Construction of 467km of high-pressure gas pipeline to transport coal seam gas from the Surat Basin to Gladstone	$600	**C:** 450	2013	Dalby to Gladstone
Australia Pacific LNG Project	• 18Mtpa export facility and pipeline o Stage 1: 2 x 4.5Mtpa o Stage 2: 2 x 4.5Mtpa • Gas Fields in Surat and Bowen Basins • Pipelines connecting gas fields to the LNG plant	$35,000 (through to 2020, including all components)	**C:** 3,300 [b]	2014	Curtis Island (LNG plant), with gas supplied from Surat and Bowen Basins
Boyne Smelter	• Baking furnace • Crane runway upgrade	$617	**C:** 450	2011 (Delayed)	Boyne Island
Arrow Bowen Pipeline Project	• Construction of an approximately 600km high-pressure gas pipeline to transport coal seam gas from Bowen Basin to Gladstone	N/a	**C:** 300	N/a	Moranbah to Gladstone
Fisherman's Landing Northern Expansion	• Reclamation of 153 ha adjacent to existing port facility	$82.5	N/a	N/a	Fisherman's Landing
Gladstone-Fitzroy Pipeline Project	• Underground water pipeline connecting existing infrastructure from Laurel Bank to Yarwun	$345	**C:** 400	Earliest 2013	Rockhampton-Gladstone
Gladstone LNG Project – Fisherman's Landing	• Initial 1.5Mtpa • Potential 3Mtpa	$400	**C:** 120 (average) **O:** 32	2012	Fisherman's Island
Gladstone Pacific Nickel Limited (GPNL)	• 63,000 Tpa Nickel • 6,000 Tpa Cobalt	$3,800	**C:** 1,000-2,300 **O:** 530	N/a	Gladstone State Development Area
Gladstone Steel Plant Project	• Integrated Steel Plant o Initial 2.1Mtpa o Later 5Mtpa	$2,800	**C:** 3,000 **O:** 1,150	2014	Gladstone State Development Area

Project	Description/Capacity	Estimated CapEx ($M)	Employment [(a)]	Commence Operation	Location
Hummock Hill Island Community Project	• Residential and tourist community development	$950	**C:** 350 **O:** 700	N/a	Hummock Hill Island
Moura Link-Aldoga Rail Project	• New rail line via the Moura Short Line to the existing North Coast Line • Rolling stock maintenance yard at Aldoga • Quadruplication of the North Coast Line from the new yard to east of Yarwun	$1,000	**C:** 350 **O:** 550	2013	Moura to Gladstone State Development Area
Western Basin Dredging and Disposal Project	• Swing basins, deepening/widening channels	N/a	**C:** 100-300	2011	Curtis Island
Wiggins Island Coal Export Terminal	• Development of a coal terminal (25Mtpa initially and upgrade capability to a nominal 70Mtpa)	$3,700	**C:** 800 **O:** 120	2011-2014	Wiggins Island

Note: (a) C = Construction at peak; O = Operation. (b) Construction workforces provided are for stage 1 development only. Additional details for subsequent stage workforces of the Queensland Curtis LNG Project and Gladstone LNG Project are provided in **Appendix B**.
Source: Gladstone Economic Development Board (2011), DERM (2011), DIP (2011b), HEIRG (2011), APLNG (2010), QGC (2010), QGC (2009), Santos (2011), Santos (2009a and 2009b).

3. Project Overview and Description

3.1 Project Overview

The Arrow LNG Plant is a component of Arrow LNG (a collective name covering the development of gas fields in the Surat and Bowen Basins, an LNG plant in Gladstone and pipelines connecting the gas fields to the LNG plant).

Arrow Energy proposes to construct the Arrow LNG Plant in the Curtis Island Industry Precinct at the southwestern end of Curtis Island, approximately 6 km north of Gladstone and 85 km southeast of Rockhampton, off Queensland's central coast.

The LNG plant will have a base-case capacity of 16 Mtpa, with a total plant capacity of up to 18 Mtpa. The plant will consist of four trains, each with a nominal capacity of 4 Mtpa. The project will be undertaken in two phases of two trains (nominally 8 Mtpa in each phase), with separate final investment decisions (FIDs) undertaken for each phase.

Operations infrastructure associated with the LNG plant includes the LNG trains, LNG storage tanks, cryogenic pipelines, seawater inlet for desalination and stormwater outlet pipelines, water and wastewater treatment, a 110m high flare stack, power generators, administrative buildings and workshops.

Construction infrastructure associated with the LNG plant includes construction camps, a concrete batching plant and laydown areas. The plant will also require marine infrastructure for the transport of materials, personnel and LNG during construction and operations.

The Arrow LNG Plant will be supplied with coal seam gas from gas fields in the Surat and Bowen basins via high-pressure gas pipelines to Gladstone, from which a feed gas pipeline will provide gas to the LNG plant on Curtis Island. A tunnel is proposed for the feed gas pipeline crossing of Port Curtis.

3.2 Project Timings

The LNG plant will be constructed in two phases. Phase 1 will involve the construction of LNG trains 1 and 2, two LNG storage tanks (each with a capacity of between 120,000 m^3 and 180,000 m^3), Boatshed Point construction camp and, if additional capacity is required, a mainland temporary workforce accommodation facility (TWAF). Associated marine infrastructure will also be required as part of Phase 1. Phase 2 will involve the construction of LNG trains 3 and 4 and potentially a third LNG storage tank.

Construction of Phase 1 is scheduled to commence in 2014 with train 1 producing the first LNG cargo in 2017. Construction of Phase 2 is anticipated to commence approximately five years after the completion of Phase 1 but will be guided by market conditions and a financial investment decision at that time.

3.3 Workforce

The LNG plant (Phase 1), tunnel, feed gas pipeline, and dredging components of the project each have their own workforces with peaks occurring at different stages during construction. The following peak workforces are estimated for the project:

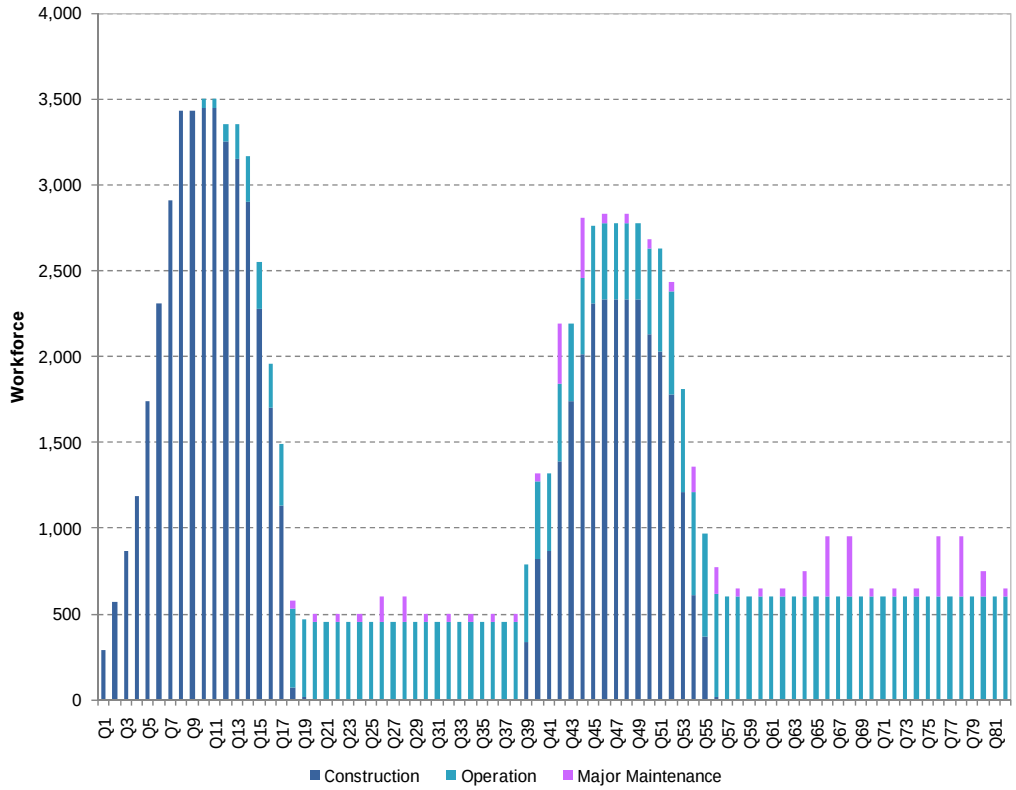
- LNG plant Phase 1 peak workforce of 3,500, comprising 3,000 construction workers, 350 engineering, procurement and construction (EPC) management workers and 150 Arrow Energy employees;
- Tunnel peak workforce of up to 100;
- Feed gas pipeline (from the mainland to Curtis Island) peak workforce of up to 75; and
- A dredging peak workforce of between 20 and 40.

The operational workforce will gradually increase as each of the trains comprising the LNG plant is completed. To support the operation of trains 1 and 2, an ongoing workforce of approximately 450 personnel will be required, comprising 250 staff and 200

contractors. This would increase to 600 personnel should trains 3 and 4 be developed, comprised of 400 staff and 200 contractors.

A histogram of the proposed construction, operation and major maintenance workforce and timing is provided in Figure 3.1. This figure does not include the tunnel, pipeline and dredging workforce.

Figure 3.1. Arrow LNG Plant Construction and Operation Workforce by Quarter



Source: Arrow Energy (unpublished).

Of the approximately 3,000 construction workers for the LNG plant, it is estimated that between 5% and 20% will be from the local community (and thus will not require accommodation) and the remaining 80% to 95% will be fly-in, fly-out (FIFO) workers.

Two workforce construction camp options are being assessed:

- A construction camp at Boatshed Point on Curtis Island for the bulk of the construction workforce. Establishment of the Boatshed Point construction camp will be preceded by a pioneer camp, which will likely be established between quarter 1 and quarter 3; and
- A smaller possible mainland construction camp, referred to as a temporary workers accommodation facility (TWAF).

With the exception of local workers, EPC and Arrow Energy staff, the construction workforce will be housed in these camps.

Prior to the construction of these camps, 200 to 300 construction workers will be housed on the mainland. Arrow Energy will develop a specific detailed workforce accommodation plan for the period between commencement of construction and commissioning of the worker camp(s) to manage any potential impacts on Gladstone during this period. The workforce accommodation plan will likely include the use of construction camp facilities provided by third parties or, if unavailable, other forms of temporary accommodation.

After initial site preparation and the first tranche of the camp have been completed, the first 250 workers can live in the construction camp. It is expected that this will occur around 12 months from FID. After establishment of the first tranche, subsequent rooms will be handed over in tranches of 200 – 250 beds every six to eight weeks.

EPC and Arrow Energy staff will be housed on the mainland. The majority of these (anticipated to be approximately 380) will be housed in company facilitated communal accommodation which will be constructed specifically for their use. The remainder will either be locals (assumed 5% of EPC workers and 10% of Arrow Energy workers will be locals) or will migrate to the region with their families, to be housed within the community (approximately 90 homes).

The tunnel workforce is anticipated to be accommodated in the mainland TWAF while the dredging workforce will be housed onboard the dredge vessel. The feed gas pipeline workforce is expected to be accommodated in a separate construction camp associated with the construction of the gas pipeline assessed as part of the Arrow Surat Pipeline project.

Approximately 30% of operational staff are expected to be sourced locally, and 40% of contractors. This would provide employment for approximately 155 local workers during operation of trains 1 and 2 (with 295 workers sourced from outside Gladstone), increasing to 200 locals (400 workers sourced from outside Gladstone) for the operation of trains 3 and 4. The operational workforce will be located in private housing on the mainland. It is assumed that the maintenance workforce will be located in a combination of local housing and temporary accommodation where FIFO workers are utilised.

3.4 Project Costs and Revenue Assumptions

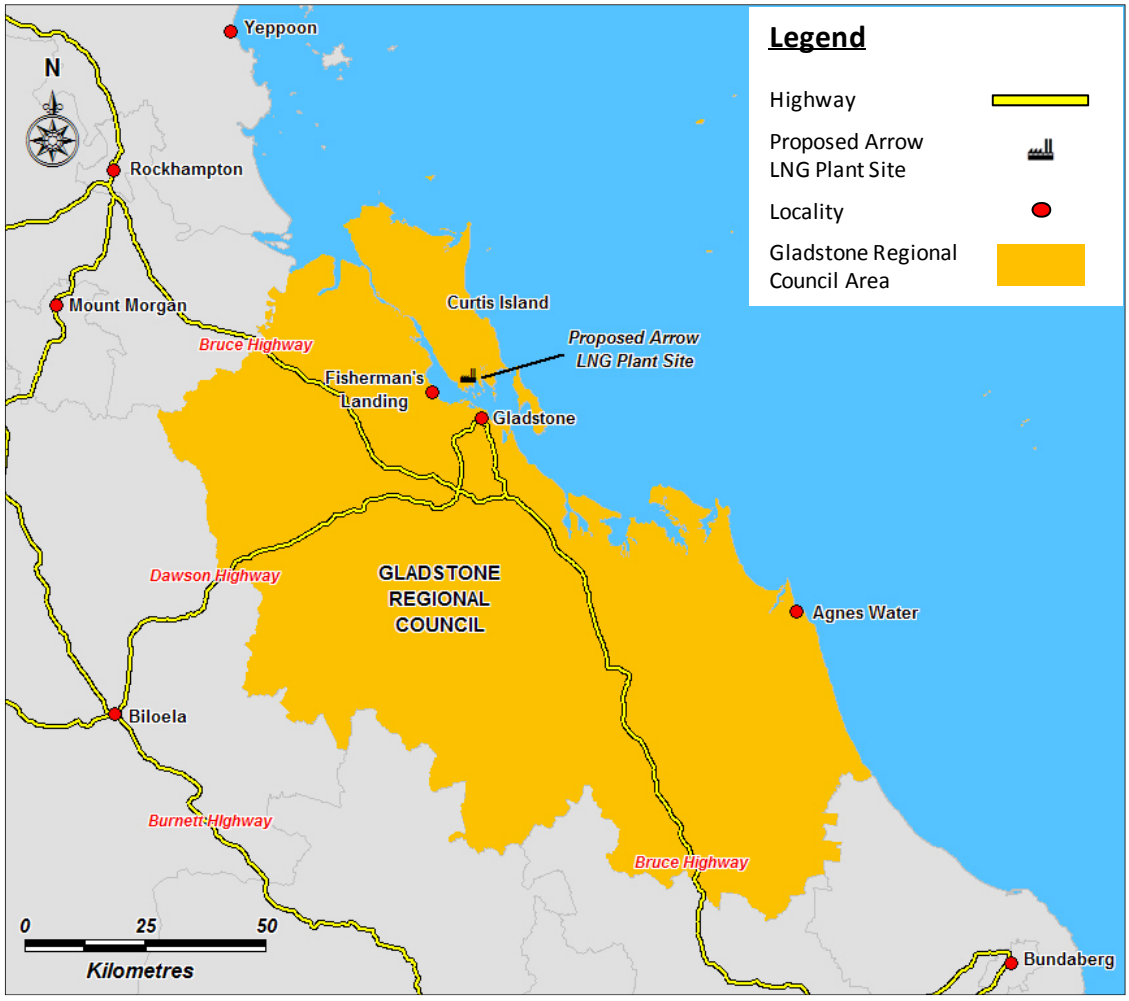
Estimates of projects costs and revenues are held commercial in confidence. For the purposes of this project, a number of assumptions have been made regarding potential costs and revenues for the purposes of economic modelling. Key assumptions utilised include:

- Total capital expenditure estimate of US$15.2 billion, estimated based on assumed capital costs of US$1,100 per tonne of LNG for the first train, and US$900 per tonne for trains two, three and four;
- Annual operating expenditure (at full production) of approximately 5% of total capital expenditure (excluding the cost of feed gas); and
- An LNG price of between US$8 MMBTU and US$12 MMBTU (for the purposes of modelling an average price of US$10 MMBTU has been utilised).

3.5 Study Area

Given the location of project works, the Gladstone Regional Council geographic area has been used in this project as a relevant study area for assessing local impacts of the proposed Arrow LNG Plant. The Gladstone Regional Council area encompasses the pre-2008 amalgamation local government areas of Gladstone, Calliope and Miriam Vale, and is outlined in Figure 3.2.

Figure 3.2. Map of the Arrow LNG Plant Study Area



Source: ABS (2003), AEC*group*.

4. Existing Environment

This chapter summarises the key economic indicators for Gladstone, which are expected to be directly impacted by the Arrow LNG Plant, with comparisons to Queensland and other benchmark regions where appropriate.

The existing economic environment provides an overview of the local economy based on available data sets. The most up-to-date data has been used wherever possible to most appropriately reflect existing conditions, however, **lags in data release means that recent trends and investment decisions for major projects are unlikely to be appropriately reflected in the statistics**.

To address this issue, discussion of the likely implications of recent trends and major projects (such as the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and the Queensland Curtis LNG Project) on prevailing economic conditions has been provided where appropriate based on information obtained through consultation.

Even so, the existing economic environment described in this chapter may differ from results obtained in the recent 2011 Census of Population and Housing, which will provide a complete and accurate depiction of the local economy, when available. First release data for the 2011 Census is anticipated to be released in June 2012, and are therefore not able to be included in this report.

4.1 Summary of Environmental Values

This chapter highlights the key attributes of the Gladstone economy including:

- Gladstone is one of Queensland's fastest growing regions with a resident population that is projected to grow approximately 50% faster than the Queensland average over the next 20 years. In addition to growth in the resident population, Gladstone is expecting a significant increase in the transient population in the short to medium term as a result of fly-in, fly-out (FIFO) construction workforces for planned major industry projects;
- Gladstone is an industry-led, developing economy with a lagging service base. Key characteristics of Gladstone's economic structure include:
    - The Gladstone economy is centred on heavy industry, with manufacturing contributing over 40% of the economy's total value added activity. This contribution is anticipated to rise over the next few years as major manufacturing projects currently under investigation and/ or construction are commissioned, including the Yarwun Alumina Refinery Expansion, Boyne Smelter Expansion, Gladstone LNG Project and Queensland Curtis LNG Project;
    - Key heavy manufacturing support sectors of transport, postal and warehousing, mining and construction provide a further 25% of Gladstone's total value add, highlighting the importance of heavy manufacturing to the regional economy;
    - As an export-oriented economy, Gladstone's economy can be volatile following fluctuations in global demand, commodity prices and exchange rates. This includes volatility in the labour market, largely resulting from a high degree of contract labour arrangements in key industries that are reliant on global demand;
    - Service based sectors are under-represented compared to the state average, with many service sectors contributing less than half the state average to value added activity. This could present issues (and opportunities) for service provision in an economy that is expected to experience significant population growth;
- Gladstone is currently experiencing considerable shortages in supply of construction labour, which is reflected in higher construction costs in Gladstone compared to other nearby regional centres. Skills shortages are also being experienced for key occupations required by the LNG industry;
- Gladstone's property market is currently very 'tight', with high demand for property resulting from a number of large new and expansion projects being developed in the

region (and associated FIFO construction workforces) as well as strong residential population growth in recent years. This has been exacerbated by:

  - Local content policies for these major projects, which have encouraged some tradespersons from outside Gladstone to seek rental accommodation locally in order to qualify for the local buy criteria; and
  - The timings of both the Gladstone LNG and Queensland Curtis LNG projects in developing construction worker camps, which has resulted in the current workforces for these projects needing to be accommodated within the local community;

- With a significant number of projects proposed for the region, the property market is likely to remain tight in the short term, resulting in escalating housing prices; and
- Gladstone is well serviced in terms of key infrastructure, with well developed road, port, rail and airport infrastructure, and some existing spare capacity in all utilities and information and telecommunications technology infrastructure.

4.2 Description of the Economy

4.2.1 Population Size and Projected Growth

Gladstone recorded a resident population of 60,316 people in 2010, representing 1.3% of Queensland's population. Gladstone's resident population grew at an average annual rate of 2.8% between 2006 and 2010, above the Queensland average of 2.5%.

Data from the Queensland Treasury (2011) and Department of Infrastructure and Planning (DIP, 2008) suggests population growth is anticipated to accelerate to an average of 3.2% per annum between 2010 and 2015, reaching a resident population of 70,570. Population growth in Gladstone is expected to remain high thereafter at around 2.8% per annum on average through to 2030. By comparison, Queensland's population growth is expected to slow to an average of 2.0% per annum between 2010 and 2015, and then to 1.8% per annum to 2030.

While data from the Queensland Government does not specifically account for population growth from major industry projects planned or recently approved for the region, population projections have been developed by the Queensland Government based on likely high economic activity in the region through to 2030.

Table 4.1. Historic and Projected Population, Gladstone and Queensland, 2006 to 2030

Region	Historic Population		Population Projections			Average Annual Growth		
	2006	2010	2015	2020	2030	2006-10	2010-15	2015-30
Gladstone	53,941	60,316	70,570	81,264	106,329	2.8%	3.2%	2.9%
Queensland	4,090,908	4,513,850	4,991,668	5,484,779	6,487,854	2.5%	2.0%	1.8%

Source: ABS (2011a), Queensland Treasury (2011), DIP (2008).

The above population estimates and projections represent the historic and anticipated future resident population in Gladstone and Queensland. Resident population refers to people permanently residing or staying in a region for a period of one or more years.

However, there are a number of major infrastructure projects either currently or soon to be constructed in Gladstone, including the Yarwun Alumina Refinery Expansion, Boyne Smelter, Gladstone LNG Project and Queensland Curtis LNG Project, all of which utilise a considerable fly-in, fly-out (FIFO) workforce (noting that most, if not all, of the FIFO workforces for these projects are anticipated to be accommodated in construction worker camps). These workers form part of what is referred to as the transient population, which refers to those people temporarily staying in a region and can thereby increase demand and loads for a range of services, facilities and in some instances accommodation. The transient population includes both imported workers as well as tourists/ leisure visitors, and is in addition to the resident population figures outlined in Table 4.1. Descriptions of the Gladstone LNG Project and Queensland Curtis LNG Project provided in **Appendix B** suggest these two projects combined could provide an additional transient population of approximately 4,000 people during peak construction.

4.2.2 Gross Regional Product (GRP)

Gladstone is estimated to have recorded gross regional product (GRP) in 2009-10 of approximately $4.0 billion, representing 1.6% of total gross state product (GSP) for the year. Gladstone's GRP is estimated to have increased at an average annual rate of 3.6% per annum on average between 2006-07 and 2009-10, below growth in the Queensland economy of 5.0% per annum on average. This weaker growth has been driven by global economic factors (such as the financial crisis and weakening demand for some commodities over this period), as well as extreme weather events that have impacted on supply of some goods that are processed and exported from Gladstone.

Table 4.2. Gross Regional/ State Product and Growth, Gladstone and Queensland, 2006-07 to 2009-10

Region	GRP ($M)		Average Annual Growth (%) 2006-07 to 2009-10
	2006-07	2009-10	
Gladstone	$3,583.8	$3,990.7	3.6%
Queensland	$211,149.0	$244,159.0	5.0%

Note: All values are in nominal or current price terms (i.e., at the price received for the given year).
Source: AEC*group*.

Manufacturing is the largest industry in Gladstone, contributing over 40% ($1.5 billion) of total gross value added activity in 2009-10. Table 4.3 shows that over 65% of Gladstone's gross value add is generated by four industries – manufacturing; construction; transport, postal and warehousing; and mining – illustrating the importance of the resource sector to Gladstone's economy. With the exception of mining, these four industries represent a greater proportion of the Gladstone economy than the Queensland average (as denoted by location quotient's above 1 in Table 4.3), as is the fifth largest industry of electricity, gas, water and waste services, with Gladstone a key energy producer servicing local industry, as well as gas distribution point.

Gladstone's reliance on global demand for key commodities produced and exported from the region can leave the economy susceptible to future movements in global trade and demand for these products. Gladstone's mining and manufacturing industries operate in a globally competitive market where demand and prices for commodities can fluctuate considerably year to year. The reliance on these and other heavily trade based industries (such as transport and manufacturing) means local growth may be volatile in the future.

Table 4.3. Industry Contributions to Gross Value Add, Gladstone Compared to Queensland, 2009-10

Industry	Gladstone	Queensland	Location Quotient [(a)]
Manufacturing	40.2%	8.4%	4.81
Transport, postal and warehousing	11.8%	6.5%	1.83
Construction	9.3%	8.7%	1.07
Mining	4.8%	10.3%	0.47
Electricity, gas, water and waste services	4.4%	2.2%	2.01
Retail trade	3.7%	5.3%	0.70
Health care and social assistance	3.1%	7.0%	0.43
Professional, scientific and technical services	2.9%	5.9%	0.50
Financial and insurance services	2.9%	6.3%	0.46
Ownership of dwellings	2.7%	9.3%	0.30
Education and training	2.4%	4.2%	0.57
Wholesale trade	2.2%	5.0%	0.43
Public administration and safety	2.1%	5.5%	0.38
Other services	1.7%	2.0%	0.88
Administrative and support services	1.7%	2.3%	0.75
Accommodation and food services	1.5%	2.7%	0.56
Rental, hiring and real estate services	1.3%	2.9%	0.47
Agriculture, forestry and fishing	0.8%	2.7%	0.31
Information media and telecommunications	0.2%	2.3%	0.11
Arts and recreation services	0.1%	0.6%	0.19
Total Industry Value Add	**100.0%**	**100.0%**	**-**
Industry Value Add as a % of GRP	93.6%	93.6%	-
Taxes less Subsidies	6.4%	6.4%	-
Gross Regional Product	**$3,990.7**	**$244,159.0**	**-**

Note: (a) Location Quotient represents Gladstone percent contribution divided by Queensland percent contribution and represents the relative strength of each industry compared to Queensland as a benchmark.
Source: AEC*group*

4.2.3 Business Counts

In June 2009, there were 3,865 businesses in Gladstone, with industry figures showing 22.6% of those companies are in the construction industry, higher than the Queensland proportion of construction businesses (18.6%). Manufacturing also represents a larger proportion of Gladstone businesses compared to Queensland (5.3% compared to 4.5%), while financial and insurance services; professional, scientific and technical services; and health care and social assistance are proportionally under-represented compared to Queensland, indicating potential issues in provision of these services if population continues to expand rapidly.

Table 4.4. Proportion of Businesses by Industry, 2009

Industry	Gladstone	Queensland	Location Quotient [(a)]
Construction	22.6%	18.6%	1.21
Agriculture, forestry and fishing	15.5%	13.3%	1.16
Rental, hiring and real estate services	10.2%	11.1%	0.91
Professional, scientific and technical services	8.1%	9.8%	0.83
Transport, postal and warehousing	6.8%	6.4%	1.06
Retail trade	6.5%	6.9%	0.94
Other services	5.5%	4.5%	1.23
Manufacturing	5.3%	4.5%	1.17
Financial and insurance services	4.6%	5.9%	0.79
Accommodation and food services	4.5%	3.7%	1.22
Administrative and support services	3.1%	3.7%	0.82
Health care and social assistance	2.6%	4.1%	0.64
Wholesale trade	1.4%	3.3%	0.42
Education and training	1.1%	1.1%	1.01
Arts and recreation services	1.1%	1.3%	0.84
Mining	0.5%	0.4%	1.18
Public administration and safety	0.3%	0.3%	0.92
Information media and telecommunications	0.2%	0.7%	0.35
Electricity, gas, water and waste services	0.1%	0.2%	0.32
Total (Percentage)	100.0%	100.0%	-
Total (Number)	**3,865**	**442,893**	-

Note: (a) Location Quotient represents Gladstone percent contribution divided by Queensland percent contribution and represents the relative strength of each industry compared to Queensland as a benchmark.
Source: ABS (2010a).

4.3 Key Regional Markets

4.3.1 Labour Market and Characteristics

4.3.1.1 Labour Force and Employment

Gladstone had a labour force of 31,634 in the September quarter of 2010. The number of unemployed people was 1,700 in the quarter, equating to an unemployment rate of 5.4%.

Over the year to September 2010, the unemployment rate lifted by 0.4 percentage points compared to September quarter 2009. Over this period, both the number of employed people and the labour force contracted in Gladstone. This was likely attributable to factors such as a strengthening in the Australian dollar and the global economic downturn (impacting on demand for Australian exports), as well as weather events that have impacted on supply.

Compared to four years ago, the unemployment rate has increased by 1.7 percentage points, while the number of employed people and people in the labour force has increased by 1.5% and 2.0%, respectively.

Gladstone had a lower unemployment rate than Queensland in the September quarter 2010, however, in contrast to Gladstone, Queensland's labour force and number of employed people increased over the past year.

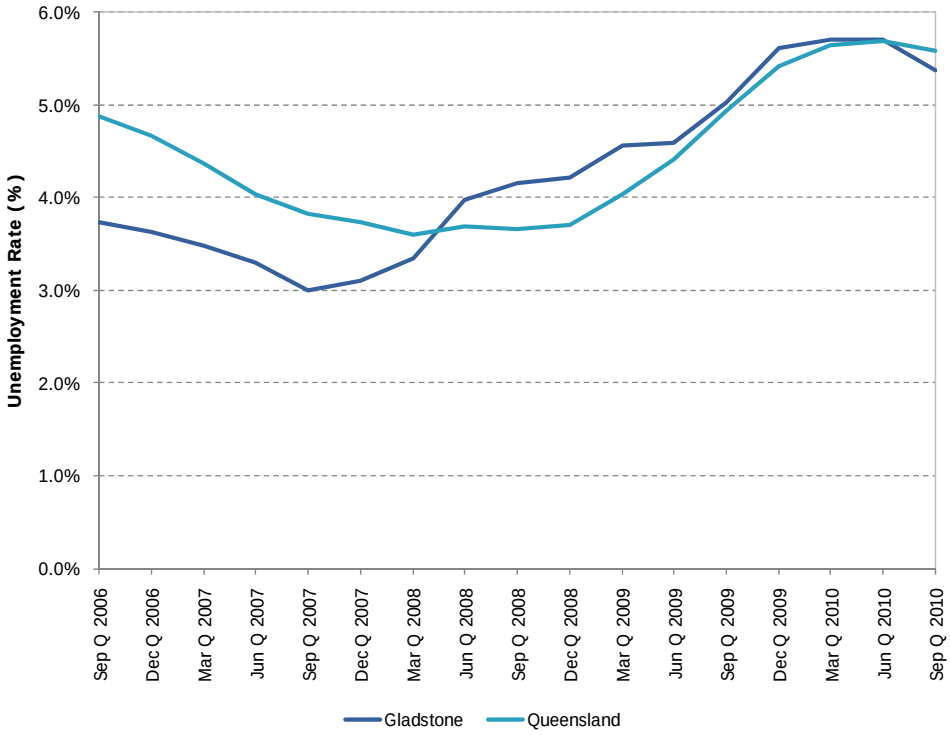
Table 4.5. Labour Market Characteristics, Gladstone and Queensland, September Quarter 2010

Labour Market Indicator	September Q 2006	September Q 2009	September Q 2010	Average Annual % Change Sep Q 2009 to Sep Q 2010 [(a)]	Average Annual % Change Sep Q 2006 to Sep Q 2010 [(a)]
Gladstone					
Labour Force	29,273	32,106	31,634	-1.5%	2.0%
Employed Persons	28,186	30,493	29,934	-1.8%	1.5%
Unemployed Persons	1,092	1,613	1,700	5.4%	11.7%
Unemployment Rate	3.7%	5.0%	5.4%	0.4%	1.7%
Queensland					
Labour Force	2,170,446	2,370,800	2,423,500	2.2%	2.8%
Employed Persons	2,064,636	2,253,700	2,288,100	1.5%	2.6%
Unemployed Persons	105,857	117,100	135,400	15.6%	6.3%
Unemployment Rate	4.9%	4.9%	5.6%	0.7%	0.7%

Notes: (a) For unemployment rate, this change depicts a percentage point change rather than a percent change.
Sources: DEEWR (2011).

Figure 4.1 shows Gladstone's unemployment rate has only recently dipped below that of Queensland, following a period of two years of higher unemployment than the Queensland average. This period of higher unemployment coincides with the global economic downturn (which commenced in late 2007/ early 2008) and is consistent with the relatively higher proportion of contract labour in Gladstone compared to most other regions in Queensland. As the global economy recovers, Gladstone's unemployment rate is likely to return to longer term trends of below the Queensland average.

Figure 4.1. Unemployment Rates, Gladstone and Queensland, September Quarter 2006 to September Quarter 2010



Sources: DEEWR (2011).

4.3.1.2 Employment By Industry

2006 Census data is the most recent data set available depicting employment by industry at a small regional level. However, this data set is unlikely to an appropriate description of the current Gladstone employment structure given the significant development in the

region since 2006 and a number of macroeconomic factors that have influenced the region.

To overcome this issue of out-dated employment by industry data, indicative employment estimates were developed for 2009-10 in full time equivalent (FTE) terms based on estimates of GRP by industry and gross value add per employee. A summary of employment by industry as a proportion of total employment for Gladstone and Queensland is presented in Figure 4.2.

In line with Gladstone's position as a heavy industry centre, manufacturing is the dominant employer in the region, accounting for an estimated 27.2% of jobs in 2009-10. This is more than three times the representation of manufacturing in the Queensland labour market, with the industry accounting for 8.7% of jobs in the state. Gladstone's manufacturing industry is supported by a strong transport, postal and warehousing sector, which is the third largest employer in the region (8.7% of total jobs in 2009-10). As with manufacturing, the contribution to jobs of the transport, postal and warehousing industry in Gladstone is higher than in Queensland (5.4%).

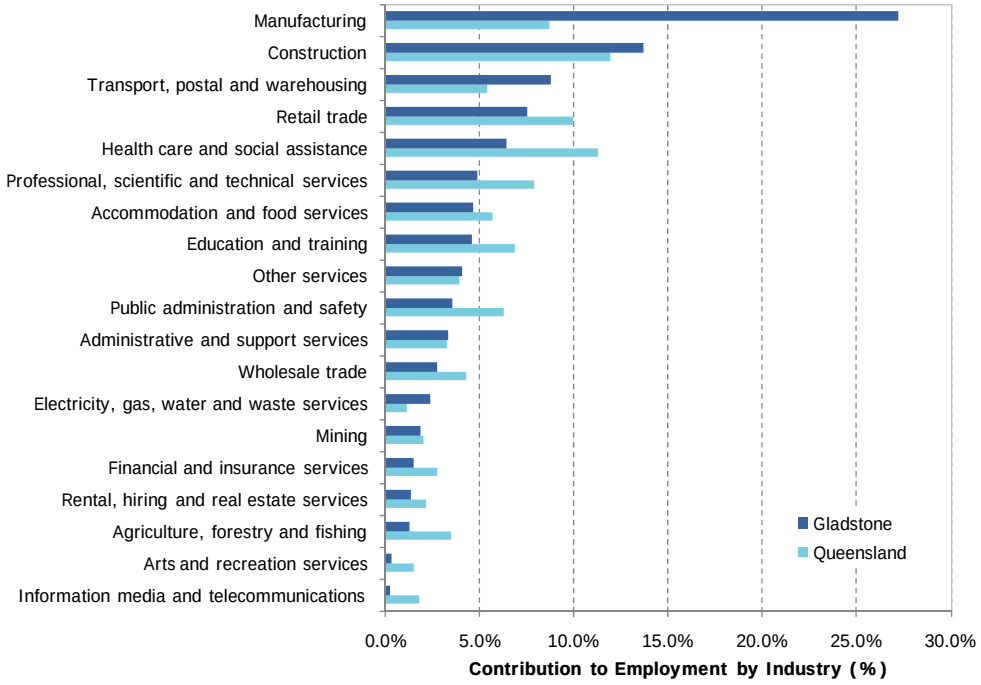
Gladstone has a lower proportion of jobs in most public and household service industries than in Queensland, including:

- Retail trade (7.5% in Gladstone, 9.9% in Queensland);
- Health care and social assistance (6.4% in Gladstone, 11.2% in Queensland);
- Education and training (4.6% in Gladstone, 6.9% in Queensland; and
- Public administration and safety (3.5% in Gladstone, 6.3% in Queensland).

Queensland also has a higher proportion of people employed in financial and professional services.

Both employment by industry and GRP estimates highlight Gladstone is an industry-led, developing economy with a lagging service base. As the region continues to grow, it is likely these service based industries will develop to support local business and residents.

Figure 4.2. Contribution to Total Employment by Industry (by Place of Work), Gladstone and Queensland, 2009-10



Source: AEC*group*.

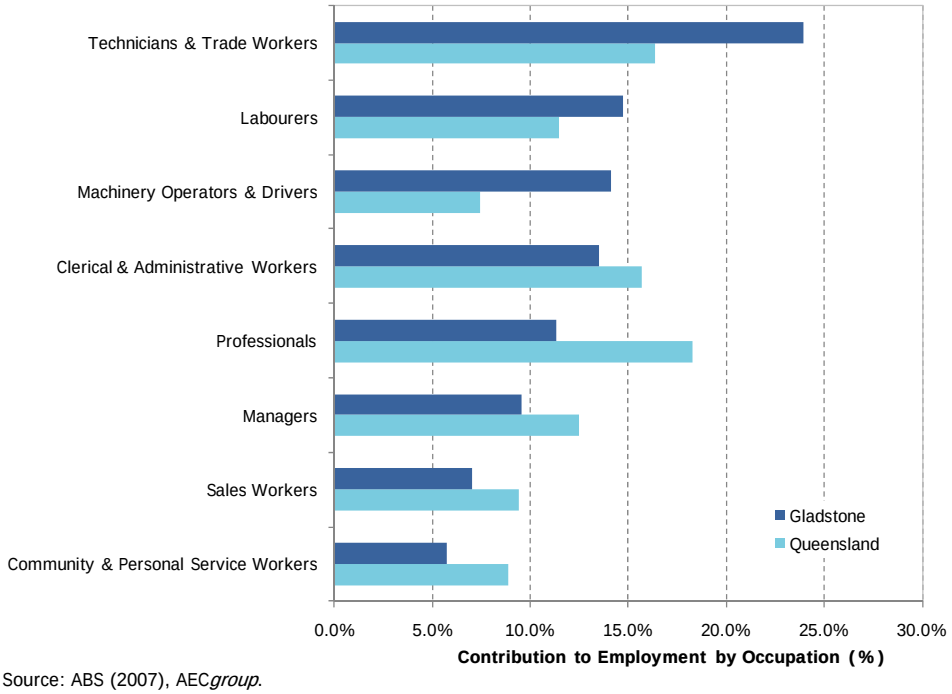
4.3.1.3 Employment By Occupation

As with employment by industry, 2006 Census data – which is the most up-to-date estimate of employment by occupation – is not considered to provide an appropriate

picture of existing employment demands and skills in Gladstone. To assist in overcoming this issue of out-dated employment by occupation data, indicative estimates of employment by occupation in 2009-10 were developed. These employment estimates have been developed using the employment by industry estimates outlined in section 4.3.1.2, combined with 2006 Census employment by industry by occupation data (to identify percent demands for certain occupations by industry). A summary of employment by occupation as a proportion of total employment for Gladstone and Queensland is presented in Figure 4.3.

Technicians and trade workers are estimated to have been the largest occupational grouping in Gladstone in 2009-10, accounting for 23.9% of total employment. This was considerably higher than the 16.4% of people employed as technicians and trade workers in the Queensland economy. Gladstone also had a considerably higher proportion of labourers (14.7% compared to 11.5%) and machinery operators and drivers (14.1% compared to 7.4%). This is consistent with a region that is highly skewed towards heavy industry, transport and distribution.

Figure 4.3. Contribution to Total Employment by Occupation (by Place of Work), Gladstone and Queensland, 2009-10



Source: ABS (2007), AEC*group*.

4.3.1.4 Existing Skills Shortages

Energy Skills Queensland (ESQ) have undertaken considerable research in understanding and identifying key skills required in the coal seam gas and LNG industries and existing shortages in these skills in Queensland. ESQ (2009a) identified the following occupations likely to be demanded by the LNG industry (during operations) as experiencing critical skills shortages:

- Chemical engineers;
- Mechanical engineers;
- Petroleum engineers;
- Electrical engineers;
- Engineering managers;
- Production managers;
- General and specialist electricians;
- Process plant operators; and
- Transport and logistics tradespersons.

Not all of the above skills are anticipated to be required for the Arrow LNG Plant. An outline of skills required for the Arrow LNG Plant is provided in section 5.2.2.1.

In addition to current state-wide skills shortages in skilled labour to operate LNG plants, the Australian Government Department of Education, Employment and Workplace Relations identify the Queensland construction industry as currently experiencing a range of skills shortages, particularly in regional areas of Queensland (DEEWR, 2010). This includes shortages in skills that will be required for construction of the Arrow LNG Plant, such as welders, fitters (mechanical and pipe) and electricians.

Consultation with ESQ and local economic development organisations identified that training programs have and are being put in place to assist in meeting the skills requirements of both coal seam gas and LNG projects during both construction and operation.

4.3.1.5 Average Weekly Income by Industry

The most recent data on average incomes by industry at a local government level is from the 2006 Census, however, as with employment data this is considered too out-dated to be a relevant estimate of existing incomes in the region. To provide a more up-to-date indication of incomes, 2006 Census data has been inflated to 2010 values based on growth in earnings by industry at a national level for each industry (ABS, 2011c). *It should be recognised that using national average growth does not provide a reflection of local wage cost pressures in Gladstone*.

Table 4.6 summarises these estimates of average weekly incomes by industry, and highlights an average weekly income in Gladstone of $1,125 in 2010. This is approximately 14.0% more than the estimated average weekly wage received in Queensland ($987) in 2010, and can largely be attributed to the region having over 65% of jobs in the five highest income paying industries in the region. Of note, employees in the manufacturing and transport, postal and warehousing industries in Gladstone earn a considerably higher income than their counterparts in other areas of Queensland.

Table 4.6. Average Individual Weekly Income by Industry, Gladstone and Queensland, 2010

Industry	Gladstone	Queensland
Mining	$1,781	$2,046
Electricity, gas, water and waste services	$1,557	$1,509
Construction	$1,432	$1,200
Manufacturing	$1,343	$936
Transport, postal and warehousing	$1,301	$1,020
Professional, scientific and technical services	$1,268	$1,304
Public administration and safety	$1,079	$1,224
Rental, hiring and real estate services	$1,011	$1,071
Wholesale trade	$1,006	$927
Financial and insurance services	$990	$1,218
Education and training	$920	$993
Information media and telecommunications	$875	$1,152
Administrative and support services	$816	$809
Other services	$778	$813
Health care and social assistance	$774	$895
Agriculture, forestry and fishing	$742	$734
Arts and recreation services	$571	$683
Retail trade	$549	$611
Accommodation and food services	$450	$540
Average All Industries	**$1,125**	**$987**

Source: ABS (2007), ABS (2011c), AEC*group*.

4.3.2 Property Market

4.3.2.1 House and Land Sales and Value

Gladstone recorded a median house price of $385,000 for the year to December 2010, 7.2% higher than the same period in 2009. Median house prices in Gladstone were higher than in the Rockhampton ($318,000) and Bundaberg ($285,000) regions but lower than those recorded for Mackay ($407,250). The total number of sales for houses in Gladstone for the year ended December 2010 was 755, an increase of 13.2% compared to the year ended December 2009. This increase went against the trend in the comparison regions, which all recorded a decline in the number of sales during the past year, particularly nearby Rockhampton, whose sale numbers declined by over 30% from December 2009.

Table 4.7 shows that over the past five years, Gladstone has experienced higher absolute growth in house prices (67.4%) than Bundaberg (32.6%) and Mackay (34.9%). The change in house prices in Gladstone over the past five years is similar to that experienced in Rockhampton (68.7%).

The median unit/ townhouse sales price in Gladstone was $340,000 for the year ended December 2010, a 13.3% increase when compared to the year ended December 2009 and 106.1% higher than five years ago. The increase in unit/ townhouse prices over the five years to December 2010 has been significantly higher than all other comparison areas. The same trend is observed in the number of unit/ townhouse sales, with Gladstone's unit sales for the year standing at 155 sales, a 59.8 % increase compared to the year before, with all other comparison regions showing a decline in the number of unit/ townhouse sales over the year to December 2010.

The median price for vacant land in Gladstone in the year ended December 2010 ($180,000) was 74.8% higher than in the year ended December 2005, and has increased at over twice the rate of the other benchmark regions over this period. Rural land sales prices have also increased considerably over the past five years (66.7%), although at a slower rate than in Rockhampton (122.8%) and Bundaberg (74.4%).

The strong growth in sales prices in Gladstone is indicative of high demand for property driven by strong growth in commodity trade through the port, as well as the development and expansion of a number of manufacturing enterprises in the region. The growing interest in and approval for the development of LNG plants in Gladstone is anticipated to attract people to the region for work and support demand and prices in the property market (in particular the rental market).

Table 4.7. Property Sales and Values, Year Ending December Quarter 2010

Region	Number of Sales			Sales Price		
	Number of Sales	Annual % Change	% Change From 5 Years Ago	Median Sales Price ($)	Annual % Change	% Change From 5 Years Ago
Houses						
Gladstone	755	13.2%	13.5%	$385,000	7.2%	67.4%
Rockhampton	1,007	-30.3%	-30.9%	$318,000	3.7%	68.7%
Mackay	1,167	-9.3%	-16.0%	$407,250	5.8%	34.9%
Bundaberg	924	-22.9%	21.4%	$285,000	3.6%	32.6%
Units/ Townhouses						
Gladstone	155	59.8%	78.2%	$340,000	13.3%	106.1%
Rockhampton	181	-14.2%	110.5%	$284,500	3.5%	63.5%
Mackay	205	-31.2%	-28.8%	$309,000	4.7%	41.1%
Bundaberg	166	-25.2%	124.3%	$251,350	-4.2%	16.9%

Region	Number of Sales			Sales Price		
	Number of Sales	Annual % Change	% Change From 5 Years Ago	Median Sales Price ($)	Annual % Change	% Change From 5 Years Ago
Vacant Land						
Gladstone	286	100.0%	N/a	$180,000	0.0%	74.8%
Rockhampton	302	-13.5%	N/a	$138,000	-4.8%	30.2%
Mackay	317	-35.0%	N/a	$183,000	5.8%	35.6%
Bundaberg	206	-17.3%	N/a	$140,000	3.7%	27.3%
Large Rural Vacant Land						
Gladstone	121	33.0%	N/a	$200,000	0.0%	66.7%
Rockhampton	76	-9.5%	N/a	$205,000	2.5%	122.8%
Mackay	58	-1.7%	N/a	$271,000	8.4%	35.6%
Bundaberg	121	-29.2%	N/a	$150,000	3.4%	74.4%

Source: REIQ (2011).

4.3.2.2 Residential Rental Market

There were 1,687 new rental bonds lodged for houses in Gladstone in 2010, 5.4% more than in 2009 and 8.9% more than in 2006 (refer to Table 4.8). Gladstone also recorded an increase in the number of rental bonds lodged for flats/ units in 2010 compared to 2009, up 4.1% to 844 bonds, although this was down 9.7% from 2006. The change in the number of bonds lodged for houses in Gladstone in the past year was higher than each of the benchmark regions of Rockhampton, Mackay and Bundaberg, but when compared to 2006 the change in the number of rental bonds lodged is in line with both Mackay and Bundaberg. By comparison, the decline in the number of rental bonds lodged for flats/ units in Gladstone compared to four years ago contrasts with the experience of the benchmark regions.

Average weekly rents in Gladstone were $332 for houses and $240 for units in the year ended December 2010. These prices were higher than those for both units and houses in the comparison areas of Rockhampton ($290 and $219 per week, respectively) and Bundaberg ($274 and $209 per week), however, were lower than the rental prices observed in Mackay ($410 and $307 per week, respectively). Between 2006 and 2010, average weekly rents in Gladstone have increased by 31.4% for houses and 34.6% for flats/ units. Growth in house rents over this period was 7% to 9% higher than in Mackay and Bundaberg (but lower than in Rockhampton), while rents for flats/ units increased at a similar rate to those in Mackay.

Anecdotal evidence identified through consultation with real estate agents and economic development organisations suggests the rental market has tightened appreciably in recent months as projects such as the Gladstone LNG Project, Queensland Curtis LNG Project and the Yarwun Alumina Refinery Expansion ramp up, with some local real estate agents and recent news articles (The Gladstone Observer, 2011) indicating that vacancy rates are less than 1% presently which is considerably below typical market conditions. This tightening has been exacerbated by a combination of:

- Local content policies for these major projects, which have encouraged some tradespersons from outside Gladstone to seek rental accommodation locally in order to qualify for the local buy criteria; and
- Timing of both the Gladstone LNG and Queensland Curtis LNG projects in developing construction worker camps has resulted in the current workforces for these projects needing to be accommodated within the local community.

Table 4.8. Rental Bonds Lodged and Average Weekly Rent, Gladstone and Benchmark Regions, 2006 to 2010

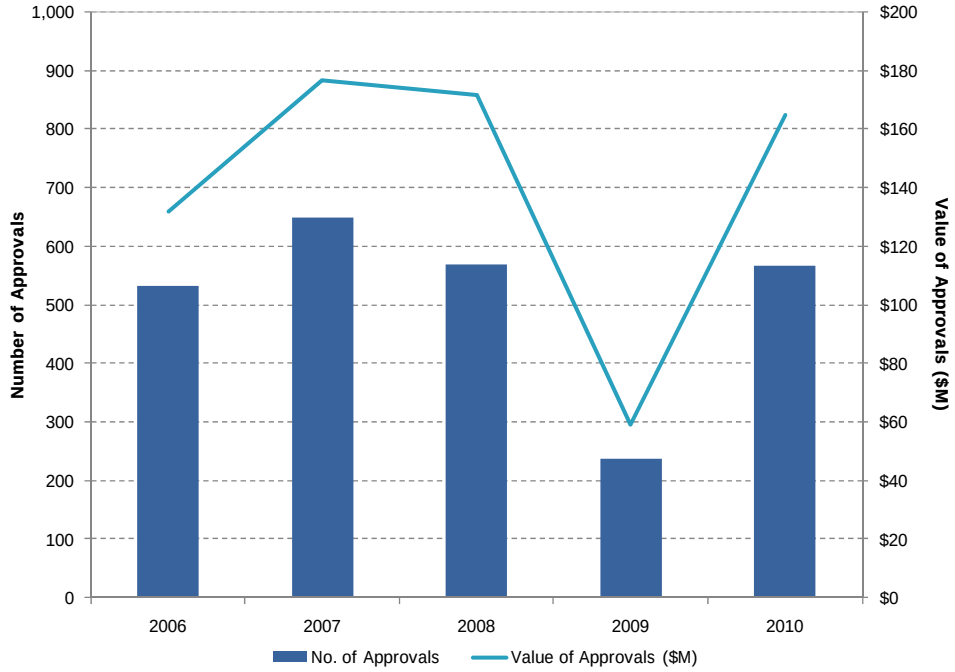
Region	Number of Rental Bonds Lodged			Average Weekly Rent ($)		
	2010	% Annual Change	% Change From Four Years Ago (2006)	2010	% Annual Change	% Change From Four Years Ago (2006)
Houses						
Gladstone	1,687	5.4%	8.9%	$332	0.8%	31.4%
Rockhampton	1,704	2.6%	-2.7%	$290	1.3%	34.1%
Mackay	2,324	0.8%	9.2%	$410	4.5%	22.5%
Bundaberg	2,169	-1.7%	9.0%	$274	3.2%	24.0%
Flats/ Units						
Gladstone	844	4.1%	-9.7%	$240	-1.8%	34.6%
Rockhampton	1,202	20.8%	20.8%	$219	2.7%	38.8%
Mackay	1,563	-1.6%	28.1%	$307	2.7%	35.5%
Bundaberg	1,026	2.4%	25.7%	$209	1.5%	31.2%

Source: RTA (2011), AEC*group*.

4.3.2.3 Residential Building Approvals

The number of residential building approvals in Gladstone has been between 530 and 650 for most years over the five year period from 2006 to 2010, with the notable exception of 2009 which saw a large dip in the number of residential building approvals to 237 (refer to Figure 4.4). The number of residential building approvals recovered in 2010 to 567 approvals for the year. The dip in the number of approvals in 2009 coincides with the trend experienced across Queensland, and was driven largely by reduced business confidence following the global financial crisis and a change in attitude to lending risk by financial institutions.

Figure 4.4. Number and Value of Residential Building Approvals, Gladstone, 2006 to 2010



Source: ABS (2011b).

Table 4.9 summarises recent trends in residential building approvals in Gladstone and Queensland. The table highlights the strong recovery experienced in Gladstone in 2010, above that achieved in Queensland overall. As a result, Gladstone recorded a higher number of residential building approvals in 2010 compared to both four years earlier (2006) and compared to the five year average. This contrasts with the Queensland experience, with the 30,689 residential building approvals below the number of approvals

in 2006 as well as the five year average. Ongoing and anticipated development activity in Gladstone has contributed to this recovery in dwelling approvals in response to expectations of strong resident and transient population growth.

Table 4.9. Residential Building Approvals and Values, Gladstone and Queensland, 2006 to 2010

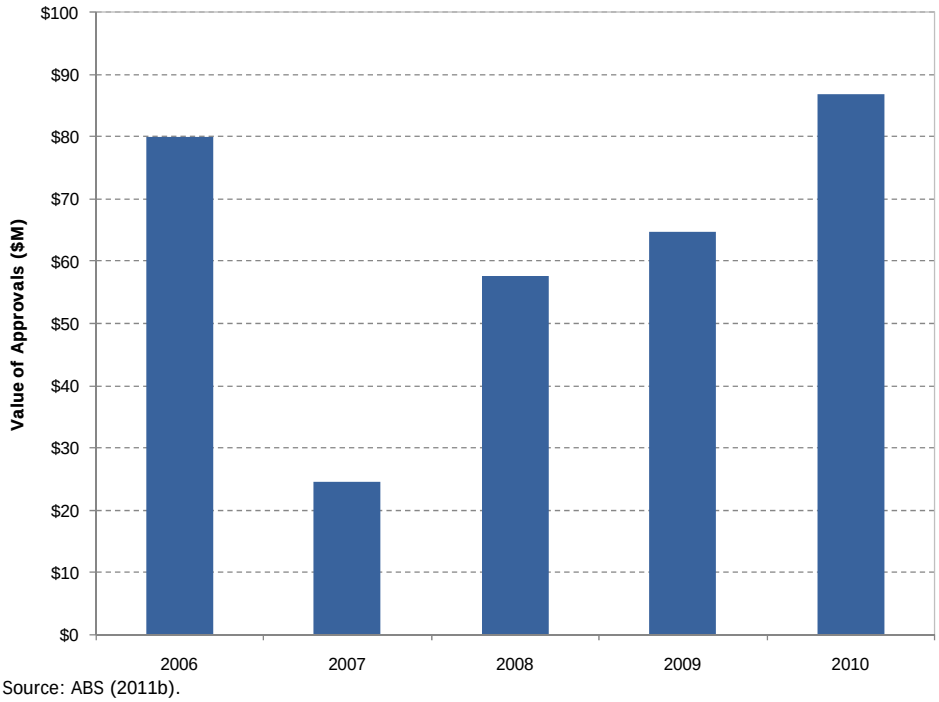
Region	2010	% Annual Change	% Change From Four Years Ago (2006)	% Change From Five Year Average
Number of Approvals				
Gladstone	567	139.2%	6.4%	11.0%
Queensland	30,689	6.9%	-20.7%	-14.3%
Value of Approvals ($M)				
Gladstone	$164.5	177.7%	24.8%	16.9%
Queensland	$8,864.3	7.2%	-7.3%	-10.6%
Average Value per Approval ($)				
Gladstone	$290,210	16.1%	17.3%	6.6%
Queensland	$288,842	0.3%	16.9%	3.7%

Source: ABS (2011b).

4.3.2.4 Non-Residential Building Approvals

Total non-residential building approvals in Gladstone in 2010 were valued at $86.8 million, an increase of 34.0% from the 2009 value of non-residential building approvals ($64.8 million). Figure 4.5 displays recent trends in non-residential building approvals and shows the value of non-residential building approvals in Gladstone declined sharply between 2006 and 2007, but has steadily increased each year since.

Figure 4.5. Value of Non-Residential Building Approvals, Gladstone, 2006 to 2010



Source: ABS (2011b).

Table 4.10 outlines trends over the past five years in the value of non-residential building approvals in Gladstone and Queensland, and shows that Gladstone's upward trend in non-residential building approvals is in contrast to the experience of Queensland overall, where the value of non-residential building approvals has been declining since 2008.

Table 4.10. Non-Residential Building Approval Values, Gladstone and Queensland, 2006 to 2010

Region	2010 ($M)	% Annual Change	% Change From Four Years Ago (2006)	% Change From Five Year Average
Gladstone	$86.8	34.0%	8.7%	38.4%
Queensland	$5,869.4	-34.0%	-5.3%	-22.0%

Source: ABS (2011b).

4.3.2.5 Land Values by Type of Use

Estimates of unimproved land values in for residential, rural and industrial/ commercial land are presented in Table 4.11. These estimates are based on data compiled from local government for 2008-09 (DLGP, 2010). However, it should be noted that consultation with local real estate agents indicates that current land values in Gladstone are approximately $30,000 to $50,000 higher than that depicted in the table for 2008-09.

The average unimproved capital value of residential land in Gladstone was approximately $142,000 in 2008-09 (DLGP, 2010). This was approximately $30,000 higher than the average unimproved residential land value in Rockhampton, but $32,000 lower than average residential land values in Mackay and $36,000 below the state average. As outlined in section 4.3.2.1, the median sales value for vacant land in Gladstone was $180,000 in 2010, and based on findings from consultation it is considered likely that current residential land values are more in line with this figure.

Values for unimproved rural land in Gladstone were not available. The average rural land value in Rockhampton was $284,000 in 2008-09, approximately $100,000 more than in Mackay but $57,000 less than the Queensland average.

In terms of industrial/ commercial unimproved land values, Gladstone recorded a higher average value than Rockhampton ($372,000 compared to $324,000), but below that of Mackay ($479,000) and Queensland ($587,000). Consultation with real estate agents indicated that industrial land values in Gladstone are averaging approximately $110/$m^2$ to $120/$m^2$, with a typical block size of approximately 2,000m^2. This equates to a land value of approximately $450,000 for industrial land in Gladstone, above that indicated in the table below for 2008-09.

Table 4.11. Number of Rateable Properties and Unimproved Capital Value of Land by Land Type, Gladstone and Benchmark Regions, 2008-09

Region	Number of Rateable Properties	Unimproved Capital Value	
		Total ($M)	Average ($)
Residential			
Gladstone	25,449	$3,623.6	$142,000
Rockhampton	42,686	$4,774.0	$112,000
Mackay	40,696	$7,101.0	$174,000
Queensland	1,675,998	$299,022.4	$178,000
Rural			
Gladstone	N/a	N/a	N/a
Rockhampton	1,601	$454.7	$284,000
Mackay	2,319	$425.0	$183,000
Queensland	75,219	$25,619.9	$341,000
Industrial/ Commercial			
Gladstone	1,451	$540.0	$372,000
Rockhampton	3,225	$1,045.5	$324,000
Mackay	2,415	$1,155.6	$479,000
Queensland	100,023	$58,690.6	$587,000

Note: Data was not available for the number and value of rateable rural properties in Gladstone in 2008-09.
Source: DLGP (2010).

4.3.3 Construction Services and Building Inputs Market

Construction industry price indices are provided by the Australian Bureau of Statistics and present estimates of growth in input prices to the construction industry in each Australian state and territory, as well as Australia overall (ABS, 2011d).

Comparison of the Queensland construction price index with Australia (refer to Table 4.12) indicates that over the past five years construction prices in Queensland have increased at a faster rate for houses and roads and bridges construction prices compared to other residential and non-residential construction prices. By comparison, other residential construction prices are approximately in line with five years ago, while non-residential construction prices have increased by 5.0 index points (or by 5.0%).

Construction prices for houses and roads and bridges have grown faster in Queensland than for Australia over the past five years, while other residential and non-residential construction prices have grown at a slower rate. Indices in March 2011 for houses and roads and bridges were approximately 10 index points higher in Queensland than Australia, while other residential and non-residential construction indices for Queensland were approximately in line with the national indices. Higher indices for houses and roads and bridges construction prices is consistent with Queensland being one of the fastest growing states in Australia in terms of population and economic growth for over a decade.

Table 4.12. Construction Price Index, March Q 2011 (1998-99 = 100.0)

Catchment/Price Indicator	March 2011	Index Point Change 2010-2011	Index Point Change 2006-2011
Queensland			
House	172.9	3.8	33.7
Other Residential	149.0	-1.1	0.2
Non – Residential	155.9	-0.7	5.0
Road and Bridge	173.3	2.5	35.0
Australia			
House	162.0	4.4	25.8
Other Residential	152.4	2.0	13.2
Non – Residential	156.8	3.1	18.0
Road and Bridge	162.9	3.5	29.0

Source: ABS (2011d).

The construction materials market is highly mobile with materials and labour sourced from inter-regional, interstate and overseas markets. Employment in construction in Queensland has, for the most part, been steadily growing over the past five years, however, at a regional level is highly variable and fluctuates depending on short-term contracts and investment occurring at a particular point in time, reflecting the mobile nature of construction workers.

Regional level building construction indices are available from the Rawlinsons (2011) "*Australian Construction Handbook*". These indices are not directly comparable to those released by the Australian Bureau of Statistics but provide a guide to percentage variation in building costs between regions and includes labour and building materials inputs costs. The price of building inputs in Gladstone is 15% higher than the cost for building inputs in Brisbane (Rawlinsons, 2011). This is above the cost of building inputs in other major regional cities/ towns such as Toowoomba (3% above Brisbane), Dalby (5% above Brisbane), Mackay (5% above Brisbane) and nearby Rockhampton (10% above Brisbane).

Over the past few years, the Gladstone region has experienced considerable construction activity with the development of major minerals processing facilities, port expansion and supporting infrastructure. This is supported by an above average construction workforce (12.9% of total employment in the region) when compared to the state. Anticipated future works in the region is anticipated to result in an increase in construction labour in the region in the short to medium term, and result in higher costs of labour and building prices. This is supported by consultation findings that indicate demand for local

construction trades workers is considerably exceeding supply, driving up costs of construction.

4.4 Key Industry Profiles

The four major industries in Gladstone's economy (in terms of contribution to GRP as outlined in section 4.2.2) are manufacturing; construction; transport, postal and warehousing; and mining. Additional details regarding these key industries is presented in this section.

Manufacturing

The manufacturing industry is of great importance to Gladstone's economy – employing over one quarter of the workforce and producing over 40% of total gross value add (GVA). The industry consists of some of the largest alumina refineries in the world, Australia's largest aluminium smelter, a nitrate and sodium cyanide plant and Australia's largest manufacturer and distributor of cement. The high concentration of industry in Gladstone has also created a large industry support sector of skilled workers. The decline in alumina prices during the global financial crisis contributed to Rio Tinto Alcan slowing construction of the Yarwun refinery in April 2009, although prices have recovered since that time and the refinery expansion is now anticipated to be online during 2012.

Table 4.13. Manufacturing Summary

Indicator	Time Period	Gladstone	Queensland
Employed			
% Industry Employment	2009-10	27.2%	8.7%
Average Weekly Earnings	2010	$1,343	$936
Industry Value Add			
Value Add ($M)	2009-10	$1,502.7	$19,125.1
% of Total GVA	2009-10	40.2%	8.4%
Business			
No. of Businesses	2009	201	19,617
% of Businesses	2009	5.3%	4.5%

Note: GVA = Gross Value Added, which is equivalent to GRP less taxes and subsidies.
Source: ABS (2011c), ABS (2010), ABS (2007), AEC*group*.

Construction

Construction represents 13.7% of Gladstone's workforce and 9.3% of Gladstone's total GVA, with workers in the industry earning over $200 more per week than the Queensland average for the sector. With several large scale projects, including Rio Tinto's Yarwun 2 Refinery expansion project as well as the Queensland Curtis LNG Project and Gladstone LNG Project, ramping up to construction stage (with a number of other developments currently in planning stages), this industry will remain a strong component of economic growth in Gladstone, particularly over the short term.

Table 4.14. Construction Summary

Indicator	Time Period	Gladstone	Queensland
Employed			
% Industry Employment	2009-10	13.7%	11.9%
Average Weekly Earnings	2010	$1,432	$1,200
Industry Value Add			
Value Add ($M)	2009-10	$348.3	$19,968.5
% of Total GVA	2009-10	9.3%	8.7%
Business			
No. of Businesses	2009	860	80,853
% of Businesses	2009	22.6%	18.6%

Note: GVA = Gross Value Added, which is equivalent to GRP less taxes and subsidies.
Source: ABS (2011c), ABS (2010), ABS (2007), AEC*group*.

Transport, Postal & Warehousing

Transport, postal and warehousing represents almost double the proportion of Gladstone's economy by value compared to Queensland, although the number of transport businesses in Gladstone is proportionally similar to Queensland's, indicating a highly efficient industry sector.

Key transport, postal and warehousing activities in Gladstone include:

- **Port of Gladstone:** The Port of Gladstone is a world class multi-commodity port recording throughput of 83.4 million tonnes of commodities in 2009-10. Coal exports are the largest commodity traded through the port, with 60.4 million tonnes of coal exported in 2009-10 (Gladstone Ports Corporation Limited, 2010). Cargoes associated with the alumina industry are the other main commodities traded through the port, with 13.2 Mt of bauxite and 1.4 Mt of caustic soda imported during the year, as well as 4.2 Mt of alumina exported;
- **Port Alma Shipping Terminal:** Port Alma Shipping Terminal handled 285,415 tonnes of commodities in 2009-10, representing an increase of 25.1% from the previous year (Gladstone Ports Corporation Limited, 2010). Ammonium nitrate, petroleum, tallow and explosives are the main commodities traded through the port;
- **Gas pipelines:** Gladstone is the termination point (at the Gladstone City Gate) of some of Queensland's major gas pipelines, linking with pipelines from south-west Queensland;
- **Gladstone Airport:** Gladstone Airport provides passenger and freight services to the region. To support growth in demand the airport recently underwent a $65 million reconstruction of the runway;
- **Road:** Gladstone is linked with the major highways of Bruce Highway (to the north and south) and the Dawson Highway (to the west); and
- **Rail:** The Gladstone rail network caters for general passenger travel and the local industry. Gladstone has two railway stations (Gladstone Central and South Gladstone) and links directly with export infrastructure at the Port of Gladstone.

Table 4.15. Transport, Postal & Warehousing Summary

Indicator	Time Period	Gladstone	Queensland
Employed			
% Industry Employment	2009-10	8.7%	5.4%
Average Weekly Earnings	2010	$1,301	$1,020
Industry Value Add			
Value Add ($M)	2009-10	$442.3	$14,761.8
% of Total GVA	2009-10	11.8%	6.5%
Business			
No. of Businesses	2009	258	27,882
% of Businesses	2009	6.8%	6.4%

Note: GVA = Gross Value Added, which is equivalent to GRP less taxes and subsidies.
Source: ABS (2011c), ABS (2010), ABS (2007), AEC*group*.

Mining

Mining is a smaller direct contributor to employment and GRP in Gladstone relative to the other key industries examined above, employing only 1.8% of the total regional workforce, and producing only 4.8% of total GVA. This is a reflection of the limited resource reserves available in the catchment. Despite this, Gladstone is highly reliant on the mining industry, in particular resources from the Bowen Basin, with over 60 Mt of coal exported from the Port of Gladstone in 2009-10 and considerable mineral and metal-based refining undertaken in the region for export from the Port of Gladstone.

Table 4.16. Mining Summary

Indicator	Time Period	Gladstone	Queensland
Employed			
% Industry Employment	2009-10	1.8%	2.0%
Average Weekly Earnings	2010	$1,781	$2,046
Industry Value Add			
Value Add ($M)	2009-10	$179.6	$23,456.0
% of Total GVA	2009-10	4.8%	10.3%
Business			
No. of Businesses	2009	18	1,749
% of Businesses	2009	0.5%	0.4%

Note: GVA = Gross Value Added, which is equivalent to GRP less taxes and subsidies.
Source: ABS (2011c), ABS (2010), ABS (2007), AEC*group*.

4.5 Infrastructure

Table 4.17 provides a summary of key infrastructure in Gladstone relevant to the economic assessment.

Table 4.17. Overview of Key Infrastructure in Gladstone

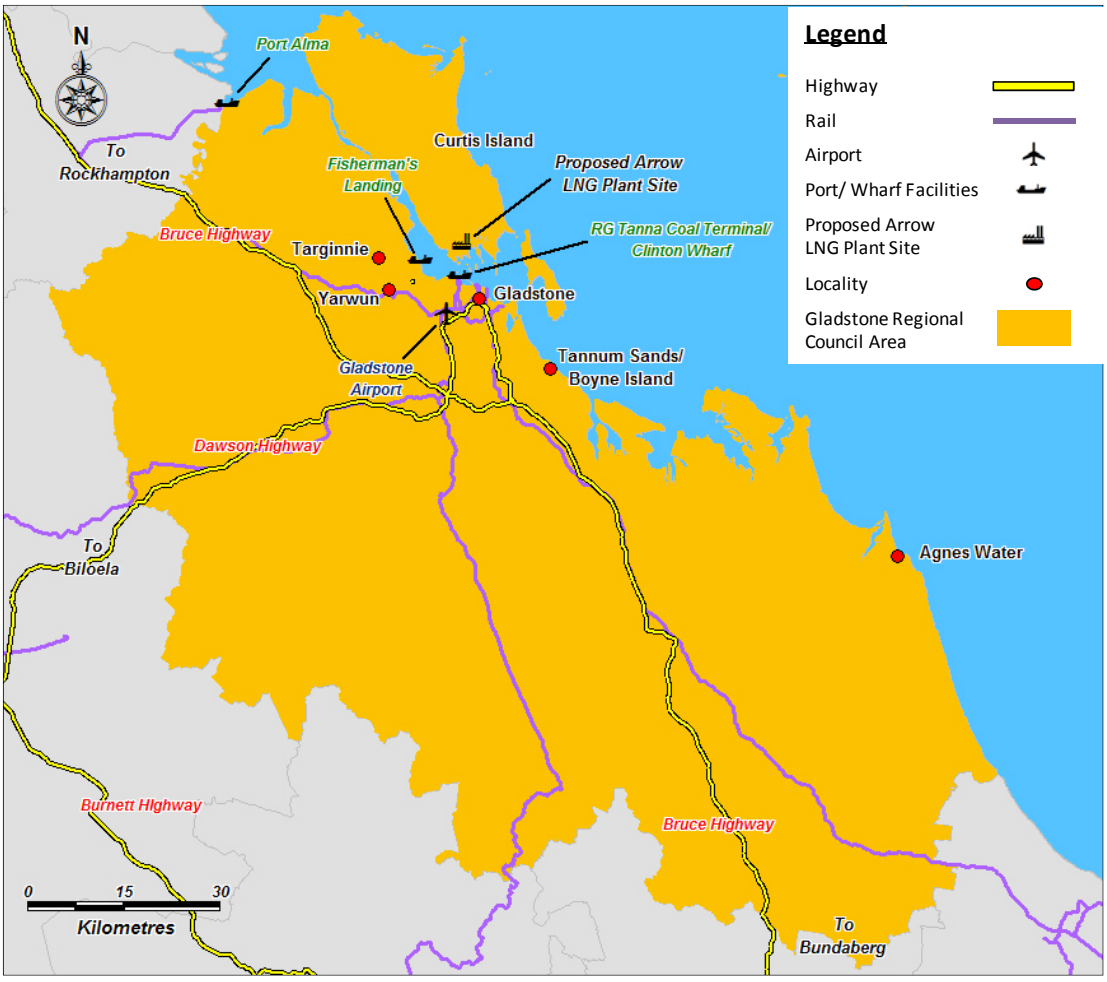
Infrastructure Type	Description
Road	The Bruce Highway is Gladstone's main road link to the north and south, with the Dawson Highway providing access to the west of the state through Biloela. The Gladstone-Benaraby and Gladstone-Mount Larcom Roads provide access from Gladstone city to the Bruce Highway.
Rail	QR National provides the rail infrastructure to transport resources from central Queensland for export in Gladstone using two systems: • The Blackwater Rail System is a network of rail lines which connects the coal mines in the southern Bowen Basin to export coal terminals at Gladstone, and to domestic coal users. The system is fully electrified and trains operated typically consist of 4 electric locomotives with 104x78 gross tonne wagons (nominally 6,450 net tonne trains); and • The Moura Rail System is a non-electrified line that connects the Moura, Callide and Boundary Hill coal mines to export terminals at Gladstone and to domestic coal users. Gladstone also has two passenger terminals (Gladstone and South Gladstone) that provide access to domestic rail links to the national system provided by Queensland Rail.
Air	Gladstone Airport is a single runway airport located in Gladstone's west, which was recently upgraded to better accommodate jet aircraft and to reconfigure departure and arrival halls. The runway is now 1,960 metres in length and is serviced by Qantaslink and Strategic Air. An upgrade to the instrument landing system is planned for the airport which will improve reliability of the airport during bad weather and safety.
Port	Port of Gladstone is Queensland's largest multi-commodity port, servicing a throughput of 83.4 million tonnes of cargo in 2009-10. The port is managed by Gladstone Ports Corporation, a Government-owned body that both owns and operates the port facilities. The port can cater for vessels of 200,000+ dead weight tonne and has a minimum draft of 17 metres year-round. Gladstone is also home to the Port Alma Shipping Terminal, which recorded 285,415 tonnes of commodity throughput in 2009-10.

Infrastructure Type	Description
Power	Gladstone houses Queensland's largest power station, with a generating capacity of 1,680 megawatts. The plant sells the majority of its power to Boyne Smelters (alumina refining) on a long term contract basis. The station is operated by NRG Gladstone Operating Services, a multinational power-generation company. Gladstone has a well developed electricity network.
Water	Water and water infrastructure in Gladstone is supplied and maintained by the Gladstone Area Water Board (GAWB), with water sourced from the Awoonga Dam, which has a storage capacity of 770,000 megalitres. Water planning in the region follows the Central Queensland Regional Water Supply Strategy. A potable water pipeline and sewer pressure main connecting the mainland to Curtis Island is currently being investigated by GAWB (the Curtis Island Water and Sewerage Infrastructure Project).
Wastewater	Residents in the former Calliope Shire Council and former Gladstone City Council areas have connective wastewater service infrastructure provided by Gladstone Regional Council. The Calliope River Sewage Treatment Plant treats about 97% of Gladstone's sewage. The remainder is treated at the South Trees Sewage Treatment Plant.
Information and telecommunications	Telecommunications infrastructure in Queensland was evaluated by Engineers Australia as holding a 'B' ranking in 2010. Gladstone is linked to Cairns, Townsville, Mackay, Rockhampton and major southern cities by a Telstra fibre-optic backhaul network, providing it with high-speed data links to major centres. An alternate network in Queensland is operated by Nexium telecommunications and will service regional mines in the Bowen and Surat regions when extensions are completed.

Source: Engineers Australia (2010), GAPDB (2010), GAPDB (2006), GAWB (2010), Gladstone Ports Corporation Limited (2010), Gladstone Regional Council (2011a and 2011b).

The location of key transport infrastructure in Gladstone is presented in Figure 4.6.

Figure 4.6. Map of Key Transport Infrastructure in Gladstone



Source: AEC*group*, ABS (2003).

4.6 Major Projects

Significant interest in developing Queensland's gas reserves has emerged in the past five years alongside strong global energy demand and high LNG prices. Gladstone's geographic location relative to Queensland's gas-fields, its existing port facilities and available industrial land has made it the export hub of choice for much of the Australian LNG industry, which is expected to develop strongly over the next five years. Four LNG projects proposed for Gladstone have already been approved subject to a range of conditions by the Queensland and Australian Governments (the Gladstone LNG Project, Queensland Curtis LNG Project, Australia Pacific LNG Project and Gladstone LNG Project – Fisherman's Landing).

In addition to the potential development of the LNG industry in the region, there is also potential for export of thermal coal from the Surat Basin through Gladstone Port. To date, export development of the Surat Basin's thermal coal deposits has been constrained by a lack of transport infrastructure. The Surat Basin Rail project is proposed to connect thermal coal deposits in the region with export terminals in Gladstone, although this is still in the planning stages, with construction hoped to be underway by 2012.

Major projects that have been approved or are currently being examined in Gladstone are outlined in Table 2.2.

5. Economic Impact Assessment

The following assessment examines the economic impacts of the Arrow LNG Plant within the project's study area (the Gladstone Regional Council area) as well as in Queensland in response to the EIS terms of reference (listed in Table 2.1).

This analysis utilises economic modelling outcomes as well as consultation with key stakeholders (including local council, economic development organisations, industry bodies and local business) to inform the assessment of economic impacts as appropriate.

The modelling outcomes identified throughout this impact assessment depict the *value and percent change* in a range of economic indicators anticipated as a result of the Arrow LNG Plant. These estimates represent the net change in the respective indicators compared to what growth may be without the Arrow LNG Plant proceeding in the regional, state and national economies.

Assumptions used in developing baseline estimates of growth are outlined in **Appendix B**. The baseline scenario includes the anticipated effects on economic growth and activity resulting from development and operation of the Yarwun Alumina Refinery Expansion, the Gladstone LNG Project (including all 3 trains, 10 Mtpa) and the Queensland Curtis LNG Project (including all 3 trains, 12 Mtpa).

These projects have been included in the baseline scenario to most accurately reflect anticipated future economic growth in the regional, state and national economies if the Arrow LNG Plant does not proceed. The modelling outcomes presented in this chapter **do not include** a representation of the impacts of the Yarwun Alumina Refinery Expansion, the Gladstone LNG Project and the Queensland Curtis LNG Project in combination with the Arrow LNG Plant, but rather the impacts of the Arrow LNG Plant **over and above what is anticipated to occur as a result of the other three projects**. The inclusion of these projects in the baseline reduces the level of resources and factors of production available to the Arrow LNG Plant in the regional, state and national economies.

All modelling outcomes are presented in 2009-10 dollar values.

Modelling results have been presented in this chapter in graph and table form. Results depicted in table form present average annual impacts across four timeframes:

- The initial construction period for trains 1 and 2. Construction commences in the first quarter 2014 and concludes in 2018. The modelling is undertaken in financial years, hence 2013-14 is the first reference period in the model results. The initial construction period, as summarised in the tables is thereby represented by the financial years 2013-14 through to 2016-17 (noting that construction activity will continue through to 2018 but will coincide with initial operational activity and is therefore termed a transitional year);
- Steady state operations of trains 1 and 2 between 2018-19 and 2021-22;
- An overlap period between 2022-23 and 2024-25 depicting ongoing operation of trains 1 and 2 and construction of trains 3 and 4; and
- Steady state operations of all four trains from 2026-27 to 2029-30.

Transitional years of 2017-18 and 2025-26 have not been reported in the tables as these years represent periods of construction activity tailing and LNG production ramping up but not yet at full, steady state production levels per annum. Including these years would artificially alter the construction or steady state operation averages.

Modelling has been undertaken to 2029-30 only as modelling outcomes beyond this period do not vary substantially once steady state production for all four trains has been reached.

5.1 Impacts on Industy Output and Gross Product

The Arrow LNG Plant will generate considerable output and value added activity, both:

- **Directly**, through construction activity as well as the production of 8Mtpa of LNG once the first stage is commissioned (trains 1 and 2) and 16Mtpa of LNG following commissioning of the second (trains 3 and 4); and

- **Indirectly**, through additional demand for goods and services to support the LNG plant, household consumption effects as a result of additional wages and salaries paid throughout the domestic economy, and government expenditure through additional taxation revenues.

The following sub-sections examine the Arrow LNG Plant's impact on gross regional (Gladstone local government area), state (Queensland) and domestic (Australia) product as well as impacts on output by industry in Gladstone and Queensland.

5.1.1 Impacts on Gross Domestic, State and Regional Product

5.1.1.1 Impacts on Gross State/ Domestic Product in Queensland and Australia

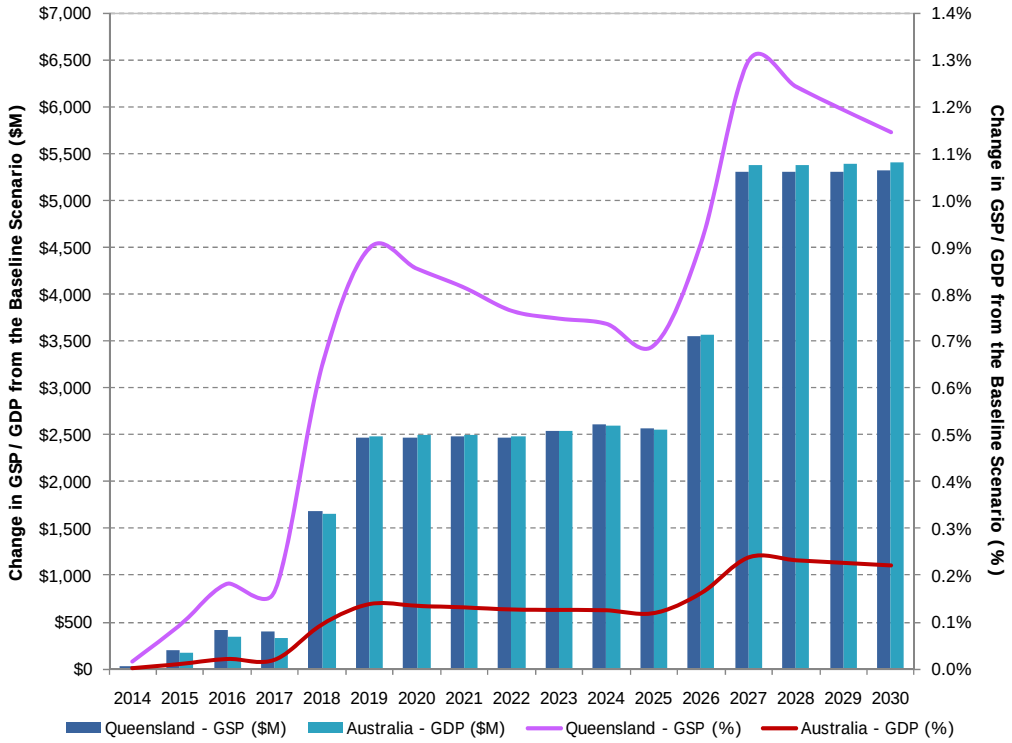
Modelling outcomes of the impacts of the Arrow LNG Plant on Queensland gross state product (GSP) and Australian gross domestic product (GDP) between 2013-14 and 2029-30 are presented in Figure 5.1.

During the four year construction phase between 2013-14 and 2016-17, the Arrow LNG Plant is estimated to increase GSP and GDP by approximately $200 to $300 million on average above the baseline scenario. In percentage terms, the Arrow LNG Plant is estimated to increase GSP above what would be expected to occur without the project by approximately 0.1% to 0.2% per annum during construction of trains 1 and 2, although from a national perspective the increase in GDP is expected to be only marginally above 0%.

Once trains 1 and 2 of the Arrow LNG Plant are operational, the impact on GSP/ GDP is estimated to be approximately $2.5 billion per annum (denoted by years 2018-19 to 2021-22). This equates to an increase in GSP of approximately between 0.8% and 0.9% per annum above the baseline over this period, and an increase in GDP of approximately 0.15%. The significant increase in GSP/ GDP between construction and operation highlights the very high value of LNG production compared to construction activity.

Both GSP and GDP are estimated to increase slightly during construction of trains 3 and 4 (assumed for modelling purposes to occur between 2022-23 and 2024-25). Following second stage construction, a second jump in contribution to GSP/ GDP is expected to occur once trains 3 and 4 are operational (2025-26 onward), with the Arrow LNG Plant estimated to result in an increase in Queensland's GSP above the baseline of approximately $5.3 billion per annum between 2026-27 and 2029-30 (ranging between 1.15% and 1.3% above the baseline), and an increase in GDP of approximately $5.4 billion (or just over 0.2%) over this period.

Figure 5.1. Impact of the Arrow LNG Project on GSP/ GDP in Queensland and Australia, Deviation from the Baseline Scenario



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

The increase in GSP/ GDP generated by trains 3 and 4 (approximately $2.8 billion) is higher than the increase generated by trains 1 and 2 (approximately $2.5 billion), despite both stages producing an equivalent level of LNG. This is largely a reflection of the high level of competition for resources such as labour and supply chains that is anticipated during the early phase of the project, which will result in a significant draw of resources from other uses. That is, the Arrow LNG Plant will provide beneficial impacts to industry both directly and through flow-on activity, but will also result in negative impacts on some industries as it becomes increasingly difficult to source resources.

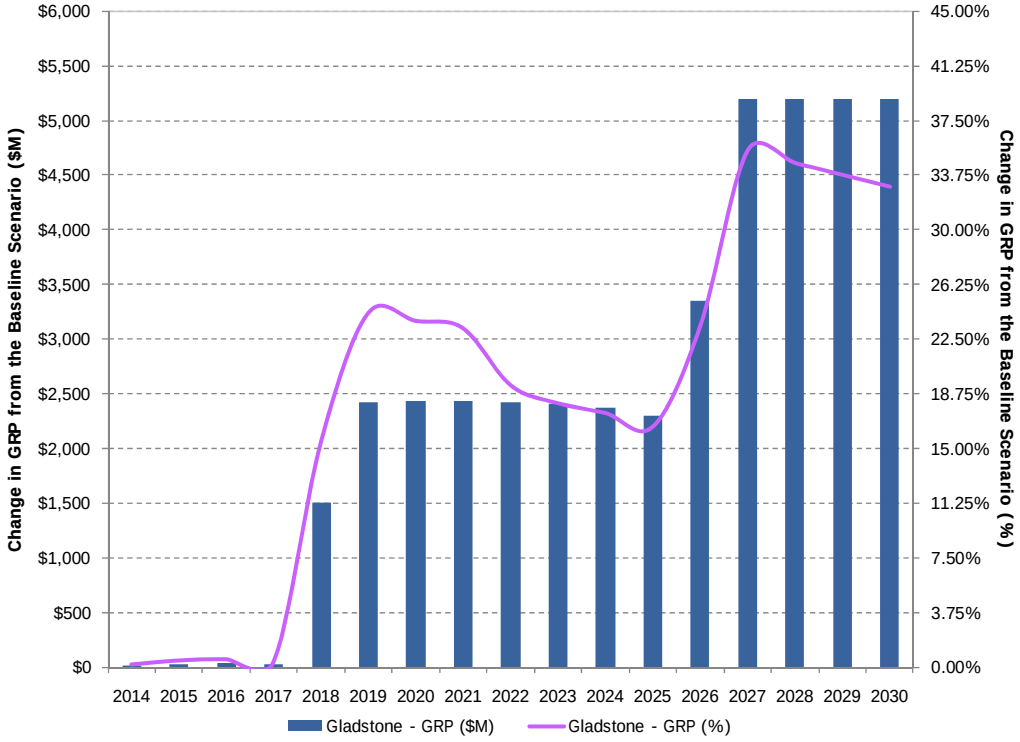
Supply-side constraints are anticipated to ease over the long term as natural growth in population and labour force provides additional resources in Australia, allowing for greater realisation/ capture of the direct and flow-on benefits of the Arrow LNG Plant without adversely affecting other industries.

5.1.1.2 Impacts on GRP in Gladstone

Impacts on GRP in Gladstone from the Arrow LNG Plant as estimated through economic modelling are outlined in Figure 5.2. A comparison of Figure 5.2 with Figure 5.1 indicates that the majority of impacts on gross product generated by the project will be felt in Gladstone, averaging approximately $2.4 billion more GRP compared to the baseline between 2018-19 and 2024-25 (accounting for 98% of total net Queensland impacts, with the other 2% occurring elsewhere in Queensland) for operation of trains 1 and 2. This increases to an average of approximately $5.2 billion once trains 3 and 4 are operational (also accounting for 98% of total net Queensland impacts).

In terms of percent change, this represents an increase above the baseline of approximately 23.0% to 24.5% between 2018-19 and 2020-21. This decreases to around 16.5%-19% during construction of trains 3 and 4 – as outlined in **Appendix B**, the third trains for the Gladstone LNG and Queensland Curtis LNG projects have been included in the baseline scenario as commencing operations in 2021-22, which results in a boost in Gladstone's GRP in the baseline scenario (not presented in the modelling results) and thereby lowers the percent increase from the baseline scenario resulting from the Arrow LNG Plant over this period. An increase above the baseline of approximately 33% to 36% is estimated once trains 3 and 4 are operational.

Figure 5.2. Impact of the Arrow LNG Project on Industry Output and Gross Regional Product in Gladstone, Deviation from the Baseline Scenario



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

5.1.2 Impacts on Industry Output

5.1.2.1 Impacts on Industry Output in Queensland

The impacts of the Arrow LNG Plant on industry output in Queensland compared to the baseline scenario are presented in Table 5.1.

The construction phase of trains 1 and 2 of the Arrow LNG Plant is estimated to result in an average annual increase in Queensland construction industry output (above the baseline scenario) of $356.4 million between 2013-14 and 2016-17, representing an increase of 0.7% in output compared to what would otherwise be achieved without the project. Other industries anticipated to record an increase in activity relative to the baseline scenario include trade, public administration, defence, health and education, electricity and water and recreation and other services. These increases will be brought about by a combination of increased demand for these services to supply the construction program and its workforce, as well as through additional household incomes and spending in the state.

Ownership of dwellings is also estimated to record an increase in output above the baseline scenario during the construction phase of $32.5 million per annum on average. Despite the project utilising worker camps to accommodate FIFO workers, it is expected that some contractors and employees will seek accommodation outside of the worker camps (and potentially people migrating to the region for flow-on employment opportunities), increasing demand for rental accommodation in the Gladstone which will encourage investors to purchase and develop housing in the region. The additional incomes generated by the project will also encourage property investment by households and individuals elsewhere in the Queensland economy. Impacts on the property market are discussed in more detail in section 5.4.

Once operational, trains 1 and 2 are estimated to result in a significant net increase in Queensland's manufacturing output of approximately $5.1 billion between 2018-19 and 2021-22 (or approximately 3.3% above the baseline scenario), through a combination of LNG production activities as well as flow-on impacts through increased demand for manufactured goods by industry and households. The project will also generate flow-on

benefits, primarily for household and business related services (including construction), through increased household and government incomes and expenditure.

Between 2022-23 and 2024-25, where construction of trains 3 and 4 is undertaken, construction industry output in Queensland is estimated to increase to $283.9 million per annum on average. Industry output for household and business related services is also anticipated to increase due to increased demand for these services during construction.

Once trains 3 and 4 are operational, additional manufacturing output (above the baseline scenario) is estimated to more than double from $4.8 billion between 2022-23 and 2024-25 to $10.3 billion between 2026-27 and 2029-30. The increase in demand generated by the additional manufacturing output is anticipated to provide a further boost to household and business related service industries.

The increase in construction and manufacturing activity directly generated by the Arrow LNG Plant, as well as additional demand for and activity in household and business related support services, will result in a reallocation of some constrained resources resulting in a potential overall "draw-down" on some sectors. These negative impacts will be driven by competition for constrained resources, in particular labour (this is examined further in section 5.1.2.3).

For example, during the construction phase for trains 1 and 2 (2013-14 to 2016-17), modelling outcomes suggest the industries of manufacturing, transport and storage, mining and agriculture could record a decline in output relative to the baseline scenario. Employees in these industries are typically more likely to transfer to construction as many of the skill sets required in these industries are similar. However, it should be recognised that these are modelled outcomes, and that employee movement may occur between any sector.

During operation, while the manufacturing industry is estimated to record a significant net increase in output during operation, primarily as a result of LNG production, there is also likely to be some negative impacts on Queensland and Australia's manufacturing industry through a combination of:

- A draw of labour between manufacturing sub-sectors; and
- Upward pressure on Australia's exchange rate as a result of exporting LNG, which may impact on the global competitiveness of manufacturing goods produced in Australia (although this impact, if any, is likely to be small).

Table 5.1. Average Annual Impact on Industry Output in Queensland, Deviation from the Baseline Scenario

Industry	Change in Industry Output			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Change in Industry Output (%)				
Agriculture	0.0%	0.0%	0.0%	0.0%
Mining	0.0%	0.0%	0.0%	0.0%
Manufacturing	-0.3%	3.3%	2.8%	5.5%
Electricity and water	0.0%	0.1%	0.2%	0.2%
Construction	0.7%	0.1%	0.4%	0.1%
Trade	0.0%	0.0%	0.0%	0.0%
Transport and storage	-0.2%	0.0%	-0.2%	-0.1%
Business, finance and insurance services	0.0%	0.0%	0.1%	0.1%
Public administration, defence, health and education	0.0%	0.0%	0.0%	0.0%
Recreation and other services	0.0%	0.0%	0.0%	0.0%
Ownership of dwellings	0.1%	0.0%	0.1%	0.1%
Total Change in Industry Output (%)	**0.0%**	**0.7%**	**0.6%**	**1.1%**

Industry	Change in Industry Output			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Change in Industry Output ($M)				
Agriculture	-$11.6	-$5.5	-$12.8	-$7.6
Mining	-$15.4	-$10.7	-$16.1	-$8.4
Manufacturing	-$441.5	$5,122.3	$4,770.7	$10,313.8
Electricity and water	$1.1	$17.0	$28.7	$30.1
Construction	$356.4	$42.2	$283.9	$77.2
Trade	$25.9	$23.4	$53.9	$44.5
Transport and storage	-$76.0	-$16.2	-$74.2	-$27.9
Business, finance and insurance services	-$23.5	$38.7	$59.7	$68.7
Public administration, defence, health and education	$4.4	$1.7	-$5.6	$1.8
Recreation and other services	$0.9	-$0.6	-$3.0	-$1.7
Ownership of dwellings	$32.5	$16.9	$34.0	$28.3
Total Change in Industry Output ($M)	**-$147.0**	**$5,229.4**	**$5,119.2**	**$10,518.9**

Note: (a) It should be noted that operation of Phase 1 (trains 1 and 2) is ongoing during these time periods.
Source: Prime Research (unpublished).

5.1.2.2 Impacts on Industry Output in Gladstone

Impacts of the Arrow LNG Plant on industry output in Gladstone are presented in Table 5.2. The table shows that in value terms, impacts in Gladstone are estimated to be approximately in line with those of Queensland. Key areas of note include:

- Net output of the manufacturing industry in Gladstone during operation is anticipated to be higher than in Queensland. This is a reflection of negative impacts on some manufacturing businesses in the rest of Queensland and Australia through a draw of labour and potential exchange rate impacts, which will be felt across the entire domestic economy, not just in Gladstone;
- Negative impacts on industry from a draw of labour (and other resources) are also felt in other sectors throughout Queensland and Australia, resulting in larger reductions in industry output in Queensland than in Gladstone for industries such as transport and storage, mining and agriculture; and
- The net increase in output of household and business services is expected to be considerably higher in Queensland than in Gladstone. While the Arrow LNG Plant will generate local demand for a range of goods and services to support the project and population growth, household and government incomes and expenditure will be redistributed throughout the state and national economy rather than being isolated to Gladstone. This will lead to increased demand for household and business services throughout Queensland and the domestic economy.

Table 5.2. Average Annual Impact on Industry Output in Gladstone, Deviation from the Baseline Scenario

Industry	Change in Industry Output			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Change in Industry Output (%)				
Agriculture	-1.0%	-0.4%	-0.7%	-0.3%
Mining	0.1%	-0.4%	0.0%	-0.3%
Manufacturing	-0.5%	24.7%	20.4%	40.3%
Electricity and water	-5.7%	-2.5%	-5.4%	-2.9%
Construction	11.6%	0.8%	6.5%	1.2%
Trade	0.7%	0.3%	1.1%	0.4%
Transport and storage	-5.4%	-1.5%	-4.9%	-1.9%
Business, finance and insurance services	-1.8%	1.2%	1.2%	1.9%
Public administration, defence, health and education	0.5%	-0.1%	0.1%	-0.2%
Recreation and other services	-1.9%	-0.5%	-1.9%	-0.6%
Ownership of dwellings	1.6%	1.1%	2.1%	1.4%
Total Change in Industry Output (%)	**-0.1%**	**19.0%**	**16.1%**	**30.9%**
Change in Industry Output ($M)				
Agriculture	-$1.0	-$0.5	-$1.0	-$0.5
Mining	$0.1	-$0.7	$0.1	-$0.7
Manufacturing	-$78.7	$5,270.4	$5,191.2	$10,563.7
Electricity and water	-$23.6	-$11.7	-$28.1	-$17.1
Construction	$110.9	$9.8	$83.6	$18.5
Trade	$7.7	$3.3	$15.7	$6.6
Transport and storage	-$36.2	-$11.1	-$42.0	-$18.2
Business, finance and insurance services	-$15.8	$11.5	$13.8	$23.0
Public administration, defence, health and education	$3.4	-$1.3	$0.9	-$2.5
Recreation and other services	-$1.8	-$0.6	-$2.3	-$0.8
Ownership of dwellings	$6.3	$5.3	$10.3	$7.4
Total Change in Industry Output ($M)	**-$28.8**	**$5,274.4**	**$5,242.3**	**$10,579.4**

Note: (a) It should be noted that operation of Phase 1 (trains 1 and 2) is ongoing during these time periods.
Source: Prime Research (unpublished).

5.1.2.3 Impacts on Local Small Business

While the Arrow LNG Plant is estimated to provide significant positive benefits in terms of total additional industry output, as outlined in the above sections some businesses and industries will likely be adversely impacted by the project. Additional detail on the potential beneficial and adverse impacts on local small business is presented in this section.

Local Supply Contracts

The Arrow LNG Plant will provide opportunities for local business to secure new contracts and increase sales to supply and service the needs of both the project and the workforce. This will support the viability of some local small businesses in Gladstone. Additional details on the potential for local business to supply the project are provided in section 5.7.

Competition for Labour

The Arrow LNG Plant will compete with local business and industry for constrained labour resources. Due to the high incomes on offer from the project during both construction and operation, it is expected that the Arrow LNG Plant will attract labour away from other businesses both locally and further afield.

Consultation with council and economic development organisations in Gladstone identified that some businesses and industries are already encountering difficulties in attracting and retaining staff due to the considerable development activity experienced in the region currently and in the recent past, as well as through competition from the nearby mining regions in the Bowen Basin. Where local businesses are unable to attract and/ or retain staff, this impacts on their capacity to sustain business productivity and limits potential for future business growth.

Attraction and retention of staff will be more of an issue for lower income paying industries (in particular agriculture, smaller manufacturing businesses and many service based industries such as retail, education and local government) that are unable to compete for labour on a price basis. Issues of attracting and retaining staff may be exacerbated by potential impacts of the project on costs of living, which has the effect of reducing disposable incomes and placing cost pressures on lower income earners. This issue is examined in more detail in the Arrow LNG Plant Social Impact Assessment (SKM, 2011).

Impacts of the project on employment and labour shortages are examined in more detail in section 5.2.2.

Increased Business Costs and Reduced Profitability

The Arrow LNG Plant is estimated to result in an increase in real wage rates (i.e., increase the average wages and salaries received by employees from industry) in Gladstone, Queensland and Australia, driven by increased demand and competition for labour (refer to section 5.3.1 for additional details on impacts to real wages). In order to recover costs and maintain business profitability, it is likely that some businesses will seek to increase prices for their goods and services (resulting in inflation in the Australian economy), placing additional cost pressures on business and industry that utilise these goods and services as an input to production.

For businesses where increases in labour and other input costs are not matched by an equivalent increase in the prices of their goods and services, this will erode business profitability, potentially impacting on business viability. This impact is likely to be felt most strongly by industries that are price takers, such as many agricultural and manufacturing businesses where final products compete on global markets with limited capacity to increase prices to match increases in costs.

Impacts on Exchange Rates and Global Competitiveness

The Arrow LNG Plant will produce 8Mtpa of LNG following completion of the first two LNG trains, increasing to 16Mtpa of LNG following completion of trains 3 and 4. With an assumed LNG price of approximately US$10/MMBTU, this equates to approximately AU$5 billion in export sales for stage 1 (trains 1 and 2), and approximately AU$10 billion once all four trains are operational.

It is realistic to expect this level of exports to support the Australian dollar over the medium to long term, highlighting the project's support for strong growth in the domestic economy. A strong Australian dollar will assist many businesses and households that purchase goods and services from overseas through potential effects of exchange rates on the price of these goods and services. However, a strong Australian dollar can also be a negative for industries which sell their products and services overseas, as these products and services will be more expensive to foreign buyers (for example, manufacturing, some agricultural commodities and tourism-related sectors).

5.2 Impacts on Employment

5.2.1 Employment Generation

This section examines the impacts of Arrow LNG Plant in terms of employment generation, including both direct and flow-on job creation, as derived using CGE modelling. All employment estimates presented in this section are based on **place of work** rather than **place of usual residence**. A large proportion of the construction workforce is anticipated to operate on a FIFO basis, with many of these workers having a permanent residence outside of Gladstone. As such, care should be taken in interpreting

the employment estimates presented in terms of their implications for permanent versus temporary population change.

Employment requirements of the Arrow LNG Plant are outlined in section 3.3 across the construction and operation phases. At its peak, the construction phase for trains 1 and 2 of the Arrow LNG Plant is estimated to generate approximately 3,500 jobs located in Gladstone. During construction of trains 3 and 4 (assumed for modelling purposes to commence in 2023), a second peak of approximately 2,850 workers is anticipated, comprised of 2,300 construction workers and approximately 450 operational employees for trains 1 and 2. The operational workforce of approximately 450 will increase to approximately 600 once trains 3 and 4 are operational.

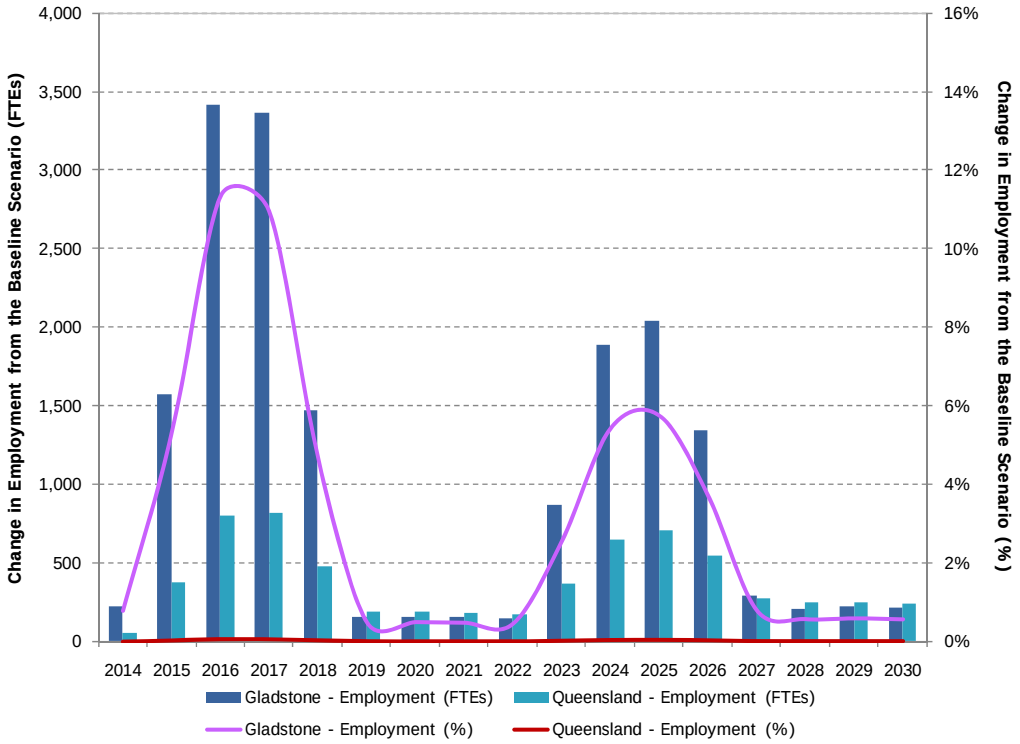
Modelling has been undertaken to understand the likely impacts of the Arrow LNG Plant on total employment in Gladstone and Queensland in consideration of constrained labour resources. Modelling has included in the baseline scenario strong growth in demand for labour generated by underlying growth in the Queensland economy as well as demand for labour from the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project (refer to **Appendix B**). From a supply perspective, it has been assumed for modelling purposes that the national labour market is approaching "full employment" and any growth in labour supply must be generated through natural population growth over time (and thereby labour force growth) or through inward migration.

An overview of modelled employment outcomes are presented in Figure 5.3. The figure highlights that the Arrow LNG Plant is anticipated to result in a net increase of 3,300 to 3,450 full time equivalent (FTE) employees in Gladstone above the baseline scenario during peak construction activity of trains 1 and 2. A second peak of around 2,000 net additional FTE employees is expected in Gladstone during peak construction activity of trains 3 and 4. Employment in Gladstone is anticipated to be approximately 11% to 11.5% higher than the baseline scenario during the first peak (2015-16 to 2016-17), and approximately 6% higher during the second peak (2024-25). In contrast, during operation net employment increases in Gladstone are estimated to average approximately 150 following commissioning of trains 1 and 2, increasing to approximately 230 once all four trains are operational.

Of note, modelling outcomes show that net employment impacts in Gladstone from the Arrow LNG Plant will be lower than the direct employment requirements of the project. This highlights the highly constrained labour pool in the Gladstone economy, with some employment positions being filled through a draw of labour from other sectors of the Gladstone economy.

By comparison, employment (by place of work) in Queensland (including Gladstone) is anticipated to increase above the baseline scenario by approximately 800 FTE employees during peak construction activity for trains 1 and 2, with a second peak of approximately 700 FTE employees during construction of trains 3 and 4. The lower overall employment impact in Queensland than in Gladstone is a reflection of the high FIFO labour requirement for the Arrow LNG Plant, with labour being drawn to Gladstone from the rest of Queensland.

Figure 5.3. Impact of the Arrow LNG Plant on Employment in Gladstone and Queensland, Deviation from the Baseline Scenario



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

Estimates of the average annual impact on employment by industry in Gladstone and Queensland, compared to the baseline scenario, are outlined in Table 5.3.

The table shows that employment in the construction industry in Gladstone will record the greatest increase during construction of trains 1 and 2, and again during construction of trains 3 and 4. The increase in employment in construction in Gladstone is estimated to be higher than the total employment impact, with some other industries anticipated to record a decline in employment (e.g., manufacturing and transport and storage during construction of trains 1 and 2) as constrained labour resources are drawn towards higher paying positions. This is based on the assumption that where demand outstrips supply for labour, wage rates are expected to increase to create movement in the labour force and attract labour not only from other regions, states and countries, but also from other sectors of the economy.

During operation, employment impacts in Gladstone are primarily anticipated to be felt in the manufacturing industry (which includes the direct employment impacts of the Arrow LNG Plant), while transport and storage is estimated to record the largest decline in employment compared to the baseline scenario. Of note, however, the average annual increase in employment in the manufacturing industry in Gladstone (which includes operation of the Gladstone LNG and Queensland Curtis LNG projects as well as the Yarwun Alumina Refinery Expansion) is less than half the 450 direct operational employees of the Arrow LNG Plant for trains 1 and 2, and 600 operational employees for all four trains, suggesting that other manufacturing businesses in the region may be negatively impacted in terms of securing labour through to 2029-30.

Table 5.3. Average Annual Impact on Employment by Industry in Gladstone and Queensland, Deviation from the Baseline Scenario

Industry	Change in Employment (FTEs)			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Gladstone				
Agriculture	-5	-2	-5	-3
Mining	1	-2	1	-3
Manufacturing	-218	208	85	267
Electricity and water	-42	-17	-48	-25
Construction	2,371	18	1,549	50
Trade	107	-15	75	-17
Transport and storage	-95	-36	-109	-54
Business, finance and insurance services	-25	17	41	39
Public administration, defence, health and education	44	-11	14	-18
Recreation and other services	1	-4	-5	-6
Ownership of dwellings	3	0	1	0
Total Change in Employment in Gladstone	**2,143**	**154**	**1,600**	**231**
Queensland				
Agriculture	-59	-24	-66	-42
Mining	-65	-28	-69	-50
Manufacturing	-1,089	-25	-804	-200
Electricity and water	-10	25	39	55
Construction	1,833	127	1,325	257
Trade	221	58	255	130
Transport and storage	-246	-27	-186	-37
Business, finance and insurance services	-132	83	119	166
Public administration, defence, health and education	29	-6	-45	-19
Recreation and other services	22	-4	1	-8
Ownership of dwellings	6	0	3	0
Total Change in Employment in Queensland	**511**	**180**	**571**	**251**

Note: (a) It should be noted that operation of Phase 1 (trains 1 and 2) is ongoing during these time periods.
Source: Prime Research (unpublished).

As outlined in Figure 5.3, the increase in employment in Queensland is estimated to be less than that in Gladstone, driven by a draw of labour to Gladstone from the rest of Queensland. This draw is shown more clearly in Table 5.3 where Queensland industries such as manufacturing, transport and storage, mining[1] and agriculture are all expected to record a decline in employment compared to the baseline scenario throughout the modelling period.

5.2.2 Skills Requirements and Potential Impacts on Skills Shortages

5.2.2.1 Skills Requirements of the Project

Arrow Energy estimate the Arrow LNG Plant will require the following skill sets during construction, depicted as a percent of total construction labour required:

- 15% construction – LNG tanks;
- 10% construction – marine;
- 30% civil works (e.g., early works, buildings, site preparation);
- 20% mechanical works;
- 9% electrical and instrumentation;

[1] The minor decrease in mining is likely a reflection of a reallocation of investment/ development capital and resources from projects that may otherwise occur rather than an actual reduction in existing activity.

- 3% painting and insulation; and
- 13% other, including service provisions (camp / catering / security / logistics).

Outcomes from modelling of employment by occupation impacts in Gladstone are presented in Table 5.4. The percentages presented in the table refer to the proportional change in total labour required from the baseline scenario for each occupation compared to what would be required if the Arrow LNG Plant did not proceed. The percentages provide insight into the types and acuteness of demand and impacts on certain occupations and skill sets in the Gladstone region.

Modelling results show that during the initial construction period demand for labour is anticipated to be considerably higher than would otherwise be expected to occur in the occupations of:

- Labourers (27.1% above baseline scenario employment in this occupation);
- Machinery operators and drivers (11.4% above baseline scenario); and
- Technicians and trade workers (11.0% above baseline scenario).

At a more detailed occupational split, key occupations identified in the modelling results that will be in highest demand during the construction period (including both direct and flow-on labour demand) include:

- Building and engineering technicians;
- Fabrication engineering trades workers;
- Mechanical engineering trades workers;
- Electricians;
- Electronics and telecommunications trades workers;
- Wood trades workers;
- Logistics clerks;
- Stationary and mobile plant operators;
- Truck drivers; and
- Construction labourers.

Table 5.4. Average Annual Impact on Employment by Occupation in Gladstone, Deviation from the Baseline Scenario

Occupation	Change in Employment (%)			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Managers	-0.2%	0.6%	0.8%	0.8%
Professionals	2.3%	0.5%	2.0%	0.7%
Technicians and trades workers	11.0%	0.5%	6.6%	0.6%
Community and personal service workers	0.4%	0.0%	0.3%	0.0%
Clerical and administrative workers	0.3%	0.4%	0.8%	0.5%
Sales workers	0.5%	0.4%	1.1%	0.6%
Machinery operators and drivers	11.4%	0.5%	7.1%	0.7%
Labourers	27.1%	0.6%	15.7%	0.9%
Total Change in Employment in Gladstone	**7.1%**	**0.5%**	**4.6%**	**0.6%**

Note: (a) It should be noted that operation of Phase 1 (trains 1 and 2) is ongoing during these time periods.
Source: Prime Research (unpublished).

During operation of the Arrow LNG Plant, Arrow Energy estimate the following skill sets will be required, depicted as a percent of total operational labour required:

- 2% management;
- 5% engineering;
- 1% administration;
- 5% human resources;
- 3% health and safety;
- 2% marine;
- 6% supply chain;
- 9% maintenance;

- 47% operations;
- 17% various contractors; and
- 3% security.

Modelling outcomes presented in Table 5.4 suggest a mild increase in demand for all occupational groups during operation of the Arrow LNG Plant compared to the baseline scenario.

At a more detailed occupational split, key occupations identified in the modelling results that will be in highest demand during operations (including both direct and flow-on labour demand) include:

- Distribution and production managers;
- Sales and marketing managers;
- Marketing and public relations professionals;
- Engineering professionals;
- Natural/ physical science professionals;
- Science technicians;
- Miscellaneous plant technicians/ trades workers;
- Logistics clerks;
- Insurance agents and sales representatives;
- Machine operators;
- Store persons;
- Product assemblers; and
- Factory/ plant process workers.

5.2.2.2 Skills Development/ Training and Attraction

Arrow Energy are committed to providing development and training opportunities in the local community to support the Arrow LNG Plant. As part of the project, Arrow Energy will develop plans/ strategies or similar with respect to skills acquisition, local employment, apprenticeships and training, primarily focusing on the permanent operation and maintenance of the LNG plant. Key strategies to be employed by Arrow Energy to develop required skills include:

- Development and implementation of a Gladstone Local Employment Program. This may include a local jobs referral and advertising service;
- Development of an Apprenticeship and Training Program (or similar), which will provide opportunities for school leavers, the lower skilled and trainees through the extension of the following programs in Gladstone during construction and operation:
  - Graduate programs;
  - Scholarships;
  - Vacation employment; and
  - School based training.
- Training opportunities for people in Gladstone working directly for Arrow Energy, such as:
  - Executive and management development programs;
  - External education program;
  - Environmental health and safety training;
  - Vocational/ trade training; and
  - Specialist training.

Details on these skills development and training opportunities are provided in the social impact assessment (SKM, 2011).

5.2.2.3 Potential Impacts of the Project on Skills Availability and Shortages

The strong demand for specific skill sets, particularly during periods of construction, suggest the project will place pressure on skills availability within Gladstone, leading to a further tightening of an already 'tight' labour market. An overview of occupations currently experiencing skills shortages is provided in section 4.3.1.4.

The likely deepening in skills shortages as a result of the Arrow LNG Plant is supported by the considerable increase anticipated in real wages (refer to section 5.3.1), which reflects

the anticipated pressures placed on business to increase employee compensation in order to attract and retain labour.

5.3 Impacts to Factor Incomes

The Organisation for Economic Co-Operation and Development (OECD) defines factor incomes as comprising "compensation of employees by, and operating surplus of, producers" (OECD, 2001). The Arrow LNG Plant's anticipated impacts on factor incomes are examined in the sub-section below.

5.3.1 Compensation of Employees (Labour Costs)

Labour is one of the key factors of production. As outlined in section 5.2, the Arrow LNG Plant will result in a draw of labour from some sectors to support the development and operation of the LNG plant. This draw will be generated by labour moving to higher paying positions and, through competition in a constrained labour market, will place upward pressure on the cost of attracting and retaining labour.

In general, industries that provide the highest value added activity per unit of labour (or highest profit) can afford the highest salaries. This implies that as labour moves towards higher paying positions, this will provide an overall increase in the value contribution of labour as a factor of production to the Gladstone, Queensland and domestic economies.

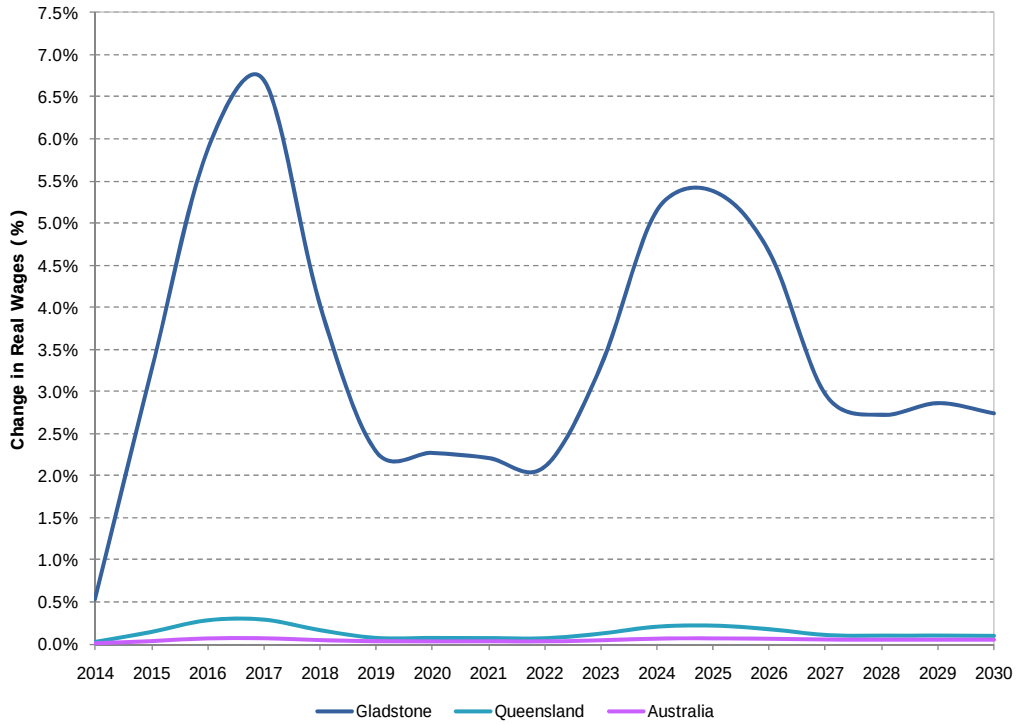
The implications of the project on the contribution of labour to factor production are best observed through impacts to real wages. Real wage impacts represent the real (i.e., above inflation) changes to average salaries in the economy, and thereby provide a measure of the change in labour's contribution to the value of production.

Modelling results are presented in Figure 5.4 and indicate that the Arrow LNG Plant could contribute to an increase in real wages of approximately 0.05% per annum on average in Australia and 0.15% per annum on average in Queensland between 2013-14 and 2029-30. The increase in real wages is expected to be considerably more acute in Gladstone where the project is located, with an estimated average increase of 3.5% between 2013-14 and 2029-30, peaking at 6.7% in 2016-17 which coincides with the peak construction workforce for trains 1 and 2.

Following the completion of the first two trains, real wage impacts are estimated to be approximately 2.0% to 2.3% higher than in the baseline scenario through to the first year of construction of train 3 (assumed for modelling purposes to be in 2022-23). Another peak in real wage impacts of 5.5% above the baseline scenario is expected in 2024-25, coinciding with development of trains 3 and 4. Once construction of trains 3 and 4 is completed, real wages are estimated to stabilise at around 2.7% to 3% above the baseline scenario, and over time (i.e., beyond the modelling period) would be expected to track back towards the baseline scenario.

The sizable increase in real wages, particularly during the two construction peaks, is a reflection of the tightness in the labour market generated by the other major industry projects in the region included in the baseline scenario (i.e., Gladstone LNG Project, Queensland Curtis LNG Project and Yarwun Alumina Refinery Expansion). The peaks in real wage impacts coinciding with construction peaks highlights the strong demand for construction labour in a constrained market will require significant increases in prices paid to contractors during these periods, but will soften once peak construction is over (though still be above what would be anticipated without the project).

Figure 5.4. Annual Percent Change in Real Wages Resulting from the Arrow LNG Plant, Year Ending June 2014 to Year Ending June 2030



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

As indicated above, this increase in the average real wage is over and above any increases in inflation, and therefore represents a real increase in household incomes in Gladstone, Queensland and Australia.

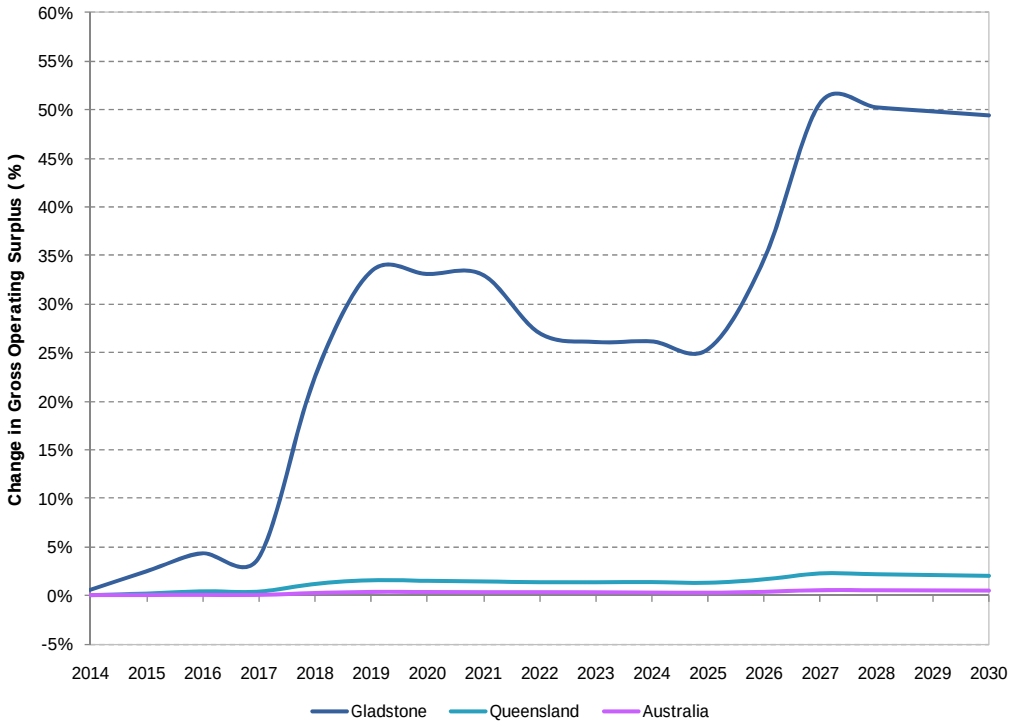
5.3.2 Gross Operating Surplus

Gross operating surplus is defined by the Australian Bureau of Statistics (2010a) as the excess of gross output over the sum of intermediate consumption, compensation of employees, and taxes less subsidies on production and imports. As such, gross operating surplus includes returns on factors of production such as land, capital and entrepreneurship.

Modelling results of impacts on gross operating surplus in Gladstone, Queensland and Australia are presented in Figure 5.5 and indicate that the Arrow LNG Plant could contribute to an increase in gross operating surplus above the baseline scenario between 2013-14 and 2029-30 of approximately:

- 27.8% per annum on average in Gladstone, with annual peak of just over 50% once all four LNG trains are operational. The increase in gross operating surplus is particularly high in Gladstone due to the very high value of LNG, combined with an anticipated draw of labour and other resources to the region to support LNG production;
- 1.3% per annum on average in Queensland (including Gladstone), with an annual peak of just over 2% once all four LNG trains are operational. The increase in gross operating surplus in Queensland is largely driven by impacts in Gladstone, but is reflective of a transition in the Queensland economy to higher value adding activity compared to the baseline scenario; and
- 0.3% per annum on average in Australia, peaking at just over 0.5% once all four LNG trains are operational.

Figure 5.5. Annual Percent Change in Gross Operating Surplus Resulting from the Arrow LNG Plant, Year Ended June 2014 to Year Ended June 2030



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

Total returns on land, capital and entrepreneurship are estimated to increase in Gladstone, Queensland and Australia as a result of the Arrow LNG Plant on a net basis. However, it should be recognised that returns on factors of production in some regions and industries may be negatively influenced by the project.

For example, with labour costs anticipated to increase as a result of the project (as outlined in section 5.3.1), this has the potential to erode operating profits for a range of businesses and industries throughout Queensland and Australia, resulting in lower gross operating surplus (and thereby a reduction in any of the returns to factor incomes of capital, land or entrepreneurship) where an equivalent increase in prices received for end products and services do not follow.

Similarly, returns on capital or land may be negatively influenced in some regions and industries where rising price pressures (through both labour costs and anticipated impacts in terms of inflation) results in higher costs of capital or land, without resulting in an equivalent increase in productivity or prices received for end products and services. This is particularly relevant for industries that are price takers, such as many agricultural and manufacturing businesses where final products compete on a global market, limiting capacity to increase prices to match increases in costs.

5.4 Impacts of the Project on Property Values

Potential direct impacts of the Arrow LNG Plant on property values have the potential to be generated through:

- Increased demand, both directly or indirectly, for industrial or commercial property to support the project and flow-on service development;
- Increased demand for residential property for accommodation of the construction and operational workforces, as well as people migrating to the region for flow-on employment opportunities; and
- Potential disturbance of or restricted access to land.

The Arrow LNG Plant is not anticipated to generate any impacts on the property market through disturbance of or restricted access to land, with no existing occupied land

expected to be altered or impeded. As such, the following sections examine the potential impacts to industrial/ commercial property and residential property.

5.4.1 Impacts on Industrial/ Commercial Property Values

The LNG plant for the Arrow LNG Plant project will be located in an industrial zoned precinct on Curtis Island. Given the considerable availability of industrial land in Gladstone, in particular in the Gladstone State Development Area, development of the plant is unlikely to have any noticeable impacts on industrial land values in the region. This is supported by consultation with local real estate agents and economic development organisations, which indicate industrial land values have not increased notably in recent years despite considerable development activity.

In terms of increased demand for industrial or commercial property through flow-on activity, modelling results presented in section 5.1.2 highlight that flow-on impacts of the project are not expected to result in any significant changes in industry activity outside of the direct impacts, largely due to resource constraints. Given existing availability of supply for industrial land in the region, impacts from flow-on activity are not anticipated to materially affect demand and prices above normal fluctuations for industrial or commercial property.

5.4.2 Impacts on Residential Property Values

5.4.2.1 Direct Construction Phase Impacts on Residential Property Values

Direct labour requirements of the Arrow LNG Plant are presented in section 3.3, and highlight that phase 1 construction is expected to commence in 2014, with a peak workforce of 3,000 construction workers in 2016. An additional 350 engineering, procurement and construction (EPC) management workers and 150 Arrow Energy employees are also expected.

The accommodation strategy for the construction workforce is described in section 3.3. The 3,000 construction workers will either already live locally within the community (expected to be between 5% and 20%) or will be accommodated within construction worker camps developed specifically for the project. Of the 500 EPC management and Arrow Energy workers, approximately 30 to 35 are assumed to already live locally, while approximately 380 are expected to be accommodated in company facilitated communal housing developed specifically for the Arrow LNG Project.

Given the use of construction camps, communal housing and a reasonable assumption that some of the EPC and Arrow Energy workers may already reside in Gladstone, in a worst case scenario the net additional demand for accommodation during construction could be up to around 90 dwellings.

In addition to construction of the LNG plant, construction activity will include:

- Construction of a tunnel linking the mainland to Curtis Island for gas supply;
- Construction of a feed gas pipeline; and
- Dredging activity.

Accommodation strategies for each of these components (outlined in section 3.3) indicate there will not be any additional demand from these workers on the local property market.

The residential property market is currently extremely tight (refer to section 4.3.2), with very low rental vacancy rates and escalating rental and sales prices. The current tightness of the market is largely attributable to demand from construction companies and their workforces associated with the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project. This is being exacerbated by the timing of development of construction worker camps for the Gladstone LNG and Queensland Curtis LNG projects which has resulted in their workforces needing to be accommodated within the local community.

Consultees noted that the most significant impacts on the property market in Gladstone from projects currently underway or proposed for the region are likely to be felt during the next two to three years while the Gladstone LNG and Queensland Curtis LNG projects

are developed. Over this period, it is anticipated that demand for housing in Gladstone will be high, and will result in upward growth in sales and rental prices.

These projects are all expected to have been completed or be ramping down by the time construction commences on the Arrow LNG Plant. This should minimise the overlap in demand for labour or housing in the region, effectively prolonging rather than increasing demand for accommodation in the region.

Consultation with Gladstone Regional Council identified that to accommodate the anticipated significant increase in workers migrating to Gladstone and associated population (both resident and transient) increases, Gladstone Regional Council have approved the release of up to 4,000 residential lots. The availability of this land and anticipated interest in Gladstone is expected to encourage development of residential accommodation over the medium term. However, some delays may be experienced as appropriately skilled residential construction workers become increasingly difficult to secure. In the past five years, Gladstone has averaged approximately 500 new residential building approvals per annum (refer to section 4.3.2.3)

Developers will likely be further encouraged by projections for significant population growth in the region. Stage 1 construction of the Arrow LNG Plant will provide employment opportunities for people attracted to Gladstone by the Yarwun Alumina Refinery Expansion, Queensland Curtis LNG Project and Gladstone LNG Project. This will support longer term or permanent migration to the region and thereby provide greater stability and assurance for residential property developers.

In consideration of the lead time to development and approved residential land release, the impact on property and rental prices from demand for up to 90 residences during construction will probably be small. However, given existing housing shortages it is possible this demand could place some upward pressure on prices and sustain housing costs growth driven by development of other projects in Gladstone prior to commencement of the Arrow LNG Plant.

There will be some overlap between the construction workforce and operational workforce for stage 1, though this will represent a ramping down of construction workforce and ramping up of operational workers. Demand for housing over this period is expected to be similar to that of the construction and operation (examined in 5.4.2.2) phases for trains 1 and 2.

Impacts of construction of trains 3 and 4 (concurrent with operation of stage 1) are likely to be smaller than for trains 1 and 2, with the construction workforce to be accommodated in the construction camp as is the case for trains 1 and 2. It is also highly likely residential development over the next few years to meet anticipated population loads in Gladstone will increase supply considerably in the region before construction commences on trains 3 and 4.

5.4.2.2 Direct Operational Phase Impacts on Residential Property Values

Once stage 1 construction is complete and fully operational, a permanent workforce of approximately 450 employees will be engaged to operate the first two trains of the facility, of which 295 workers are expected to be sourced from outside the region and relocate to Gladstone (refer to section 3.3). This is anticipated to increase to 400 workers relocating to Gladstone for trains 3 and 4.

Arrow Energy has estimated that the operational workforce will result in additional demand in Gladstone for up to 225 beds (to accommodate FIFO or single workers) and 130 dwellings (to accommodate the families of operational employees permanently relocating to the Gladstone).

It is anticipated that the full 225 bed demand will be met through the use of company facilitated housing. This housing demand will be met directly by the project, either through the development of purpose built housing or through agreements with third party providers. It is anticipated that this housing will be provided outside the existing stock of dwellings to minimise any impact on the local housing market.

Demand for housing in the local community will therefore be up to 130 dwellings to accommodate operational employees and their families that permanently migrate to the region. On a net basis, this reflects an increase in housing demand of 40 dwellings

compared to the construction phase. In consideration of the lead time to operation and residential land available, this is not anticipated to result in any tangible impacts on property prices.

5.4.2.3 Flow On Impacts on Residential Property Values

In addition to the direct impacts of the project on the residential property market, the Arrow LNG Plant has the potential to impact on demand for property through increased demand for residential property to accommodate workers and their families attracted to the region through flow-on activity.

However, examination of modelled labour impacts (refer to section 5.2.1) in consideration of the direct labour requirements of the Arrow LNG Plant shows that on a net basis (i.e., accounting for anticipated draw of labour from some sectors to supply the project) flow-on impacts of the project are not expected to result in any significant changes in the overall number of people employed in Gladstone. As such, impacts from flow-on activity are not anticipated to materially affect property demand and prices above normal fluctuations in the property market.

5.5 Impacts to Households

The Arrow LNG Plant has the potential to considerably increase household incomes and wealth. Figure 5.6 provides a summary of the modelling estimates of household incomes resulting from the Arrow LNG Plant in Gladstone, Queensland and Australia. These estimates are based on the **place of residence** of income earners, as this is where the majority of expenditure from households is likely to be captured.

For the purposes of modelling, a fixed labour assumption has been used to be consistent with modelling undertaken on the LNG industry by McLennan Magasanik Associates (2009) for the Queensland Government. This means all labour has been assumed to be permanently based in the domestic economy. Impacts on incomes in the rest of Queensland and rest of Australia may therefore be overestimated where labour is imported from overseas (and does not permanently migrate to Australia).

The figure highlights the wide ranging effects of the project on household incomes, with the rest of Queensland and the rest of Australia realising relatively larger proportions of total income effects of the project compared to Gladstone. This result is a reflection of two key factors:

- Strong growth in real wages (refer to section 5.3.1), which represents a lift in the average incomes paid to all employees. The increase in real wages is expected to be most acute in Gladstone, but will be felt throughout Queensland and Australia. The increase in real wages is over and above any increases in inflation, and therefore represents an increase in disposable incomes for Australian households; and
- Increased economic activity, spending and employment throughout Australia as a result of the Arrow LNG Plant, primarily driven by increased government taxation revenues and subsequent expenditure.

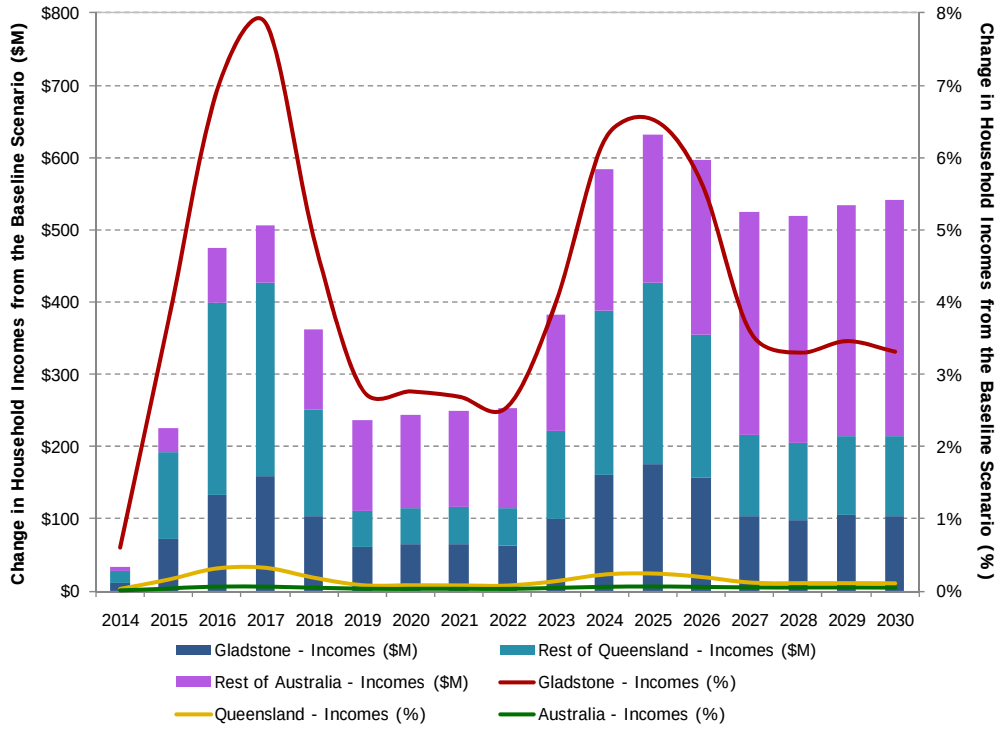
While a large proportion of impacts on household incomes will be felt outside of Gladstone, it should be recognised that on a percent basis, the increase in household incomes is estimated to be strongest in Gladstone. Between 2013-14 and 2029-30, total household incomes in Gladstone are estimated to increase by approximately $100 million per annum on average (above the baseline scenario).

Additional benefits to households in terms of wealth generation include:

- The generation of employment opportunities may also present a benefit in terms of reducing unemployment in Gladstone, Queensland and Australia, providing people that were previously unemployed with higher incomes and wealth (though it should be noted that current regional, state and national unemployment rates are historically low and benefits of the project on unemployment rates are likely to be minimal);
- Opportunities for wealth re-distribution to investors (i.e., shareholders) of the project and contribution to property owners through rental returns; and
- The increase in household incomes in the regional, state and national economies will increase household consumptive capacity (through an increase in household

disposable incomes). This is expected to encourage further household consumption and expenditure throughout Australia.

Figure 5.6. Impact of the Arrow LNG Plant on Household Incomes in Gladstone, Queensland and Australia, Deviation from the Baseline Scenario



Note: All years depicted in the figure are year ended June.
Source: Prime Research (unpublished).

Not all impacts on households from the Arrow LNG Plant, however, will be positive. For example, much of the additional wealth generated by the Arrow LNG Plant will be distributed to those directly engaged in the project (through wages and salaries). The high FIFO element during construction will therefore result in a repatriation of wealth to towns and cities where these workers reside rather than being captured in the local economy where the jobs are being created.

The distribution of wealth can also generate other negative impacts for local households, in particular lower income earning households, through an increase in the "wealth divide". Implications of this issue are examined in the Arrow LNG Plant Social Impact Assessment (SKM, 2011).

Consultation with local economic development organisations indicates that Gladstone residents are currently being impacted by increased traffic times as a result of concurrent construction of a number of major projects, including the Yarwun Alumina Refinery Expansion and Boyne Smelter Expansion, as well as start up of the Gladstone LNG Project and Queensland Curtis LNG Project. Analysis of traffic impacts detailed in the Arrow LNG Plant Traffic Impact Assessment by GTA Consultants (2011) and consultation with local economic development organisations suggest the increase in traffic in Gladstone from the Arrow LNG Plant may result in increased travel times for residents without strategies developed to mitigate these impacts. Proposed strategies for mitigating impacts of increased traffic on travel times are presented in the Transport Impact Assessment (GTA Consultants, 2011).

5.6 Significance of the Project on Local and Regional Economies

Impacts of the Arrow LNG Plant on industry output, GRP, employment and household incomes in Gladstone (examined in the above sections) have been summarised in Table 5.5.

As the table shows, the Arrow LNG Plant will result in significant increases in industry output and GRP. To demonstrate the relative significance of this increase, the addition of

$2.4 billion in GRP per annum between 2018-19 and 2021-22 is equivalent to a 60% increase in Gladstone's GRP in 2009-10 of approximately $4.0 billion (refer to section 4.2.2).

In consideration of anticipated baseline growth in the Gladstone economy, both output and GRP are estimated to increase by approximately one fifth compared to what would otherwise be expected to occur without the project once trains 1 and 2 are operational. The increase in output and GRP above the baseline scenario is estimated to magnify once trains 3 and 4 become operational.

Table 5.5. Average Annual Impact on Key Economic Indicators in Gladstone, Deviation from the Baseline Scenario

Economic Indicator	Change from Baseline Scenario			
	2013-14 to 2016-17 (Phase 1 Construction)	2018-19 to 2021-22 (Phase 1 Steady State Operation)	2022-23 to 2024-25 (Phase 2 Construction) [(a)]	2026-27 to 2029-30 (Phase 2 Steady State Operation) [(a)]
Change from Baseline Scenario (Value)				
Industry Output ($M)	-$28.8	$5,274.4	$5,242.3	$10,579.4
Gross Regional Product ($M)	$25.3	$2,426.3	$2,359.8	$5,200.1
Household Incomes ($M)	$42.5	$63.1	$145.5	$102.4
Employment (FTE)	2,143	154	1,600	231
Change from Baseline Scenario (%)				
Industry Output (%)	-0.1%	19.0%	16.1%	30.9%
Gross Regional Product (%)	0.4%	22.6%	17.3%	34.2%
Household Incomes (%)	4.8%	2.7%	5.6%	3.4%
Employment (%)	7.1%	0.5%	4.6%	0.6%

Note: (a) It should be noted that operation of Phase 1 (trains 1 and 2) is ongoing during these time periods.
Source: Prime Research (unpublished).

5.7 Extent to Which Local and Domestic Goods and Services Will Be Used

Arrow Energy is committed to utilising local labour and securing goods and services from the local supply chain to the extent possible and practical. To achieve this, Arrow Energy will develop a range of strategies and programs to assist in developing the required skills within the local labour force, as outlined in section 5.2.2.2.

However, even with these strategies and programs, it is anticipated that some labour will need to be sourced from outside of Gladstone given anticipated demands from other committed projects in the region, in particular during construction.

With this in mind, approximately 5% to 20% of the initial construction labour force is assumed to be available from the local Gladstone labour market, with the remainder to be sourced from the rest of Queensland in the first instance, and then the rest of Australia.

During operation, local labour will be utilised to the extent possible based on skills requirements and availability of locally skilled workers (including those trained as part of Arrow Energy training programs). Approximately 30% of operational staff are expected to be sourced locally, and 40% of contractors. This would provide employment for approximately 155 local workers during operation of trains 1 and 2, increasing to 200 locals for the operation of trains 3 and 4.

In terms of goods and services used in the development and operation of the project, Arrow Energy will develop a Local Industry Participation Plan to assist local business secure supply contracts. This is examined in more detail in the social impact assessment (SKM, 2011). During construction, however, there is anticipated to some components required of the project that will only be available from overseas, in particular the modular LNG trains.

5.8 Need for Additional Infrastructure Provision by Government

The Arrow LNG Plant Traffic Impact Assessment (GTA Consultants, 2011) identifies that the local road network is anticipated to require additional investment over the next 10 to 20 years regardless of the whether the Arrow LNG Plant proceeds. Upgrades and maintenance are required to accommodate additional traffic flows generated by population growth and requirements of other projects being developed in the region such as the Yarwun Alumina Refinery Expansion, Gladstone LNG Plant and Queensland Curtis LNG Plant.

The Arrow LNG Plant will exacerbate demands on the local road network, generating at peak construction up to an additional 440 car trips or 28 bus trips on the mainland during peak hour traffic conditions. GTA Consultants (2011) identify the following intersections will require upgrading to cater for additional demand generated by the construction workforce of the Arrow LNG Plant:

- Blain Drive/ Alf O'Rourke Drive/ Hanson Road;
- Dawson Highway/ Blain Drive; and
- Dawson Highway/ Phillip Street.

It is anticipated that Arrow Energy will collaborate with Gladstone Regional Council to identify a relevant contribution for these upgrades.

The social impact assessment conducted by Sinclair Knight Merz (2011) identified the Arrow LNG Plant will likely result in an increase in demand for a range of social, community and recreational infrastructure and services during construction and operation. However, these impacts are likely to be small given the provision of a range of services in the worker camps during construction and small operational workforce during operation, with limited if any additional requirements for infrastructure provision by government.

Other types of infrastructure provided by government or government-owned corporations include water, wastewater, waste disposal, telecommunications, electricity, airport, rail and marine. Existing and future planned capacity in Gladstone for these infrastructure types suggests there may be sufficient capacity to cater to the Arrow LNG Plant once specific project related utilities and transport infrastructure is developed. However, it is recommended an assessment of the capacity of other infrastructure in Gladstone provided by government or government-owned corporations is undertaken to identify any requirements by government to increase provision of this infrastructure.

5.9 Impacts on the Domestic Gas Market and Gas Prices

An assessment of likely impacts of the Arrow LNG Plant on the domestic gas market and gas prices was undertaken by ACIL Tasman (2011). The analysis examines a range of scenarios, and identifies development of the Arrow LNG Plant will place increased pressure on Eastern Australian gas consumption and prices. Effects would be felt mainly in Queensland, where wholesale gas prices would rise by 8% to 14% on average over the period 2020 to 2030. Gas consumption is not anticipated to be sufficiently high to impede governments' capacity to meet emission targets.

5.10 Implications for Future Development in the Area

In understanding the implications of the project on future development in the Gladstone region, it is important to recognise that Gladstone has been identified by industry and government as a highly suitable location for export of LNG to international markets due to its existing industry mix, availability of suitable industrial land, proximity to export port facilities and accessibility to gas fields in the Surat and Bowen basins.

Key potential beneficial implications of the Arrow LNG Plant on future development include:

- The Arrow LNG Plant will provide access to the high value international gas market for coal seam gas resources within the Surat and Bowen basins, and has the potential to thereby unlock otherwise uneconomic gas deposits as an economically attractive alternative; and

- Development of the Arrow LNG Plant will contribute to the development of industry clusters and supply chain linkages, in particular where other proposed LNG projects are also developed. For example, co-location with other proposed LNG plants may provide potential benefits in terms of:
    - Port loading and potential for export infrastructure sharing, increasing cost effectiveness;
    - Development of a critical mass of demand for a range of goods and services supporting LNG plant operations; and
    - Development of integrated supply networks and synergies through improved industry coordination and collaboration.

Gladstone has significant tracts of available industrial land, in particular in the Gladstone State Development Area, and already supports substantial industrial activities. Manufacturing is estimated to have contributed 40.2% of Gladstone's total gross value added activity in 2009-10 and 27.2% of total employment (refer to sections 4.2.2 and 4.3.1.2), with a number of large manufacturing businesses operating in the region.

In consideration of the existing industrial base in the region and availability of industrial land, the Arrow LNG Plant is not likely to constrain future development in Gladstone from a land access point of view.

There is potential, however, for the Arrow LNG Plant to have some adverse implications for future development through the following avenues:

- The Arrow LNG Plant will compete in the short term for construction labour, impacting on the availability of skilled workers for other projects and placing upward pressure on prices. As such, resource constraints resulting from the development of the Arrow LNG Plant may result in some other projects being delayed or postponed; and
- The Arrow LNG Plant is expected to contribute to maintaining the strength of the Australian dollar, which may adversely impact the profitability and long term prospects of some sectors that are exposed to international competition. Key industries expected to be impacted by the exchange rate include manufacturing, some agricultural commodities and tourism-related sectors.

5.11 Other Potential Beneficial or Adverse Impacts

5.11.1 Government Revenues

The Arrow LNG Plant will directly and indirectly contribute additional revenues across all levels of government through a range of taxation and rates charges. Details of anticipated taxation revenues associated with the Arrow LNG Plant, relative to the baseline scenario, are summarised in Table 5.6.

It should be noted that a portion of Australian Government revenues are likely to provide benefits to Queensland through the subsequent expenditure and redistribution of these revenues to provide services and infrastructure throughout Australia.

Table 5.6. Aggregate Queensland and Australian Government Revenues from the Arrow LNG Plant, 2013-14 to 2029-30

Government	Estimated Revenue ($M)	Proportion of Total Government Revenue
Queensland	$221.4	1.7%
Australian	$13,132.5	98.3%
Total	**$13,353.9**	**100.0%**

Source: Prime Research (unpublished), AEC*group*.

More detail regarding the source of revenue is discussed in the following sections. Potentially off-setting additional government revenues will be a requirement for additional funding for capital investments (e.g., local road and community infrastructure) as well as additional service provision to meet the needs of a growing transient and resident population in Gladstone.

5.11.1.1 Local Government

Additional workers locating permanently or temporarily can be expected to contribute to council revenues, through additional rates revenue associated with dwellings and workers camps that are constructed to meet additional demand and any appreciation in land value brought on by increased population. For renters, and those in workers camps, council fees and charges will be met by the landlords and employers.

The net impact on council is expected to be neutral in the long run, with additional revenues (including headworks charges and developer contributions) used to fund additional capital and/or operating expenditure to ensure the marginal cost to users remains unchanged, assuming fees and charges are appropriately levied.

5.11.1.2 Queensland Government

The Arrow LNG Plant will increase Queensland Government revenues directly and indirectly through:

- Payroll tax;
- Transfer (Stamp) duty;
- Land tax;
- Tenure Rents; and
- Other duties (e.g., motor vehicle, insurance, gambling).

Payroll tax will be the largest contributor to Queensland Government revenues. Estimates of payroll tax revenues have been developed based on industry benchmarks for 2009-10 applied to results from CGE modelling. The Arrow LNG Plant is estimated to contribute approximately $221.4 million in total to Queensland Government revenues between 2013-14 and 2029-30 through payroll tax.

Queensland Government tax revenues from transfer duties, land tax, tenure rents and other duties are difficult to estimate in consideration of potential flow-on impacts of the project. Revenues from these taxes have not been estimated, but are likely to be considerably smaller than revenues provided by payroll tax.

5.11.1.3 Australian Government

The Arrow LNG Plant will have a positive impact on Australian Government revenues through increased personal income tax, fringe benefits tax, company tax and goods and services tax (GST) revenues. The aggregate value of the Arrow LNG Plant direct and indirect impacts on Australian Government revenues is estimated to be $13.13 billion in the period 2013-14 to 2029-30 (refer to Table 5.7).

Assessing tax impacts is complex due to exemptions, deductions, variable tax rates, and varying range of salaries, consumption and business profits. Estimates of Australian Government tax revenues have therefore been developed based on industry benchmarks for 2009-10 applied to results from CGE modelling.

Table 5.7. Aggregate Australian Government Revenues from the Arrow LNG Plant, 2013-14 to 2029-30

Revenue Source	Estimated Revenue ($M)	Proportion of Revenue
Income Tax	$1,803.8	13.7%
Fringe Benefits Tax	$61.8	0.5%
Company Tax	$10,049.9	76.5%
GST	$1,217.0	9.3%
Total Revenue	**$13,132.5**	**100.0%**

Source: Prime Research (unpublished), AEC*group*.

5.11.2 Cost of Living

The Arrow LNG Plant is expected to contribute to wage and cost increases throughout Australia, in particular in Gladstone where the increase in labour demand is anticipated to result in a considerable increase in real wage rates (refer to section 5.3.1), and may also have some effects in terms of maintaining higher costs for housing and accommodation

(refer to section 5.4). Higher costs of production is likely to see prices for some goods and services increase to maintain business profitability (refer to section 5.1.2.3).

For households, the increase in prices for goods and services and for housing represents an increase in the cost of living, the impact of which will be felt most acutely by lower income earning households. An increase in the cost of living will result in a reduction in disposable incomes, with the most obvious impact being on demand for discretionary expenditure items (e.g., luxury goods and other non-essentials).

However, it should be recognised that despite the likely increase in the cost of living, modelling outcomes indicate that residents of Gladstone, Queensland and Australia are expected to be, on average, "better off" as a result of an increase in the real wage, which reflects an increase in wages and salaries above an increase in the cost of living (excluding effects on the cost of housing, i.e., reflects an increase in wages over and above inflation).

5.12 Summary of Key Impacts

Assessment of the economic impacts of the Arrow LNG Plant in the above sections directly responds to the terms of reference (set out in section 2.1) and identifies a wide range of beneficial and adverse impacts associated with the project. However, there is considerable overlap between terms of reference items (e.g., impacts of the draw down on labour and other resources is relevant to and has been discussed in more than one terms of reference item).

The following summary distils the wide range of impacts down into the key beneficial and adverse impacts arising from the Arrow LNG Plant. Beneficial impacts are described in the dot points below, however, adverse impacts have been examined using a risk assessment framework described in **Appendix C** to enable comparison of impacts following appropriate mitigation measures in chapter 6.

Beneficial Impacts

Potential beneficial impacts arising from the Arrow LNG Plant include:

- Significant increases in industry output, GRP, employment and incomes throughout the project life through both direct and indirect impacts;
- Opportunities for local business to secure new contracts and increase sales to supply and service the needs of both the project and the workforce. This will support the viability of some local small businesses in Gladstone;
- Increased competition for resources will see an economy wide increase in productivity through economic rationalisation, resulting in an increase in factor incomes per unit of factor input, in particular for labour, and ultimately a higher value economy;
- Households will be beneficially effected by the project, through:
    - Increased job and income earning opportunities, with a potential decrease in unemployment;
    - Increased household incomes resulting from additional jobs, as well as through a moderate increase in real wages (i.e., above inflation) resulting from competition for labour and upward pressure on prices;
- The Arrow LNG Plant will provide a lift in local, Queensland and Australian Government taxation revenues through a variety of taxes and duties. These additional revenues would then be used to provide additional infrastructure and services to support business and households throughout Australia; and
- Support for the Australian dollar through production and export of high value LNG. The impacts of a strong domestic currency can be both positive and negative, with a key beneficial impact being lower comparative prices for foreign goods and services.

Adverse Impacts

Key adverse impacts arising from the Arrow LNG Plant are outlined in Table 5.8, including assessment of anticipated risk or level of impact associated (using a risk assessment framework described in **Appendix C**).

Table 5.8. Assessment of Adverse Impacts of the Arrow LNG Plant

Impact Description	Likelihood	Consequence	Impact Rating
Impacts on Business: The Arrow LNG Plant is likely to adversely impact on some businesses and industry in Gladstone and the rest of Queensland as a result of: • Competition for and draw of labour to the Arrow LNG Plant and its supply chain (refer to sections 5.2.1 and 5.1.2.3). This has the potential to deepen skills shortages in the region and Queensland (for both construction and energy related skills) and place upward pressure on labour prices (wages and salaries) for business to attract and retain labour; • Escalating costs of labour and other inputs to production (refer to section 5.1.2.3), which could reduce business profits and viability for some businesses/ industries; and • Support for the Australian dollar as a result of the high level of exports generated by the project (refer to section 5.1.2.3), which has the capacity to adversely impact industries which sell their products and services overseas, as these products and services will be more expensive to foreign buyers.	**Almost Certain**	**Moderate**	**High**
Impact on Housing Prices and Availability of Affordable Housing: Demand for up to 90 dwellings during initial construction and 130 dwellings during operation will probably place some upward pressure on prices in the local residential market, given existing supply shortages (refer to section 5.4.2). However, impacts on the Gladstone property market are anticipated to be most acute over the next couple of years (prior to commencement of the Arrow LNG Plant) as construction labour demand in Gladstone peaks to support projects such as the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project. Residential developments are planned to accommodate some of the peak demand, and will assist in mitigating the impact of the Arrow LNG Plant on the local property market.	**Likely**	**Minor**	**Medium**
Impacts on Local Infrastructure and Service Capacity: In consideration of existing and planned future capacity, Gladstone is expected to be well serviced in terms of provision of most types of infrastructure to support the Arrow LNG Plant, with the exception of road infrastructure. Existing road infrastructure will likely be inadequate to accommodate proposed increases in traffic loads (without increasing congestion and travel times) arising from the project at the following points (refer to section 5.8): • Blain Drive/ Alf O'Rourke Drive/ Hanson Road; • Dawson Highway/ Blain Drive; and • Dawson Highway/ Phillip Street.	**Likely**	**Minor**	**Medium**

Source: AEC*group*.

In addition to the adverse economic impacts outlined above, households will be adversely impacted through cost of living increases as a result of higher costs of goods and services as well as housing price impacts. Off-setting this increase will be an increase in the real wage over and above the rate of inflation. Impacts on households relating to cost of living are examined in more detail in the Arrow LNG Plant Social Impact Assessment (SKM, 2011).

Households may also be adversely impacted by increased travel times due to traffic generated by the project. Potential impacts on travel times are examined in the Arrow LNG Plant Traffic Impact Assessment (GTA Consultants, 2011).

An examination of impacts of the Arrow LNG Plant on gas prices and security of supply was undertaken by ACIL Tasman (2011) and is appended to the Arrow LNG Plant EIS.

6. Mitigation Measures for Key Impacts

This chapter summarises the key impacts and issues arising from development and operation of the Arrow LNG Plant as identified in chapter 5 and recommends strategies for addressing these issues.

6.1 Key Issues/ Impacts to be Addressed

Assessment of the economic impacts of the Arrow LNG Plant in chapter 5 identified the following key issues that need to be addressed in order to minimise any adverse impacts of the project and to maximise any potential benefits (excluding impacts on gas prices which are addressed by ACIL Tasman, 2011):

- Impacts on local business as a result of:
    - Competition for and draw of labour from other sectors to the Arrow LNG Plant and its supply chain;
    - Deepening skills shortages in both the construction and energy sectors;
    - Escalating costs of labour and other inputs to production, reducing business profits and viability;
- Potential impacts on availability and affordability of housing resulting from increased temporary and permanent population in the region;
- Impacts on local residents and business from increased travel times due to additional traffic.

To assist in addressing the above issues, the following mitigation strategies are proposed:

- Support strategies aimed at addressing skills shortages in the construction and LNG industries, as well as those that assist local business back-fill positions vacated through labour draw;
- Provide assistance/ guidance to local business to secure supply contracts;
- Minimise impacts on local property demand by:
    - Developing worker camps to accommodate the construction workforce, including a “pioneer camp” on Curtis Island to accommodate early stage construction workers, most likely developed during quarters 1 to 3;
    - Ensuring worker camps are operational and capable of accommodating all required labour as soon as practicable following FID;
    - Developing a detailed specific worker accommodation plan for the period between FID and commissioning of the worker camp(s) to accommodate workers during this period. This accommodation plan will seek to utilise third party operated worker accommodation that is either currently being developed or planned for Gladstone as part of other major projects in the region;
    - Developing company facilitated communal accommodation for up to 380 EPC management and Arrow Energy workers;
    - Either developing purpose built housing or undertaking agreements with third party providers to provide up to 225 beds for operational workers;
    - Facilitating information flow to the local residential development market regarding the nature and timing of demand resulting from construction and operational activities of the Arrow LNG Plant; and
- Develop appropriate strategies to minimise impacts to local households and business of additional traffic on travel times.

In addition to the above impacts and proposed mitigation strategies, there is potential for escalation of adverse economic impacts where the Arrow LNG Plant is developed concurrently with other major industrial projects approved or proposed for the region. This is examined in more detail in chapter 7. To assist in mitigating cumulative impacts it

is recommended that Arrow Energy coordinate construction works and infrastructure usage with other proponents where possible to minimise cumulative effects of overlapping timeframes.

Proposed mitigation strategies are discussed in more detail below.

6.2 Mitigation Strategies

6.2.1 Address Skills Shortages

Issue:

The Arrow LNG Plant will contribute to a deepening of existing skills shortages in the construction and LNG industries.

Objective:

Develop the local/ regional skills base to support the LNG industry and assist existing local business retain skills.

Recommended Mitigation Strategies:

In terms of addressing skills shortages anticipated to be generated by the Arrow LNG Plant, it should be recognised that skills shortages in both the construction and coal seam gas/ LNG industries has already been identified as a key issue by all levels of government, and a number of strategies and programs are currently being implemented to address these issues.

Energy Skills Queensland (ESQ) has undertaken considerable research into the workforce demands of the coal seam gas/ LNG industry and developed a range of strategies designed to assist in attracting and developing the required skills of the industry (ESQ, 2009b).

The following list of programs has been identified that are available to assist in developing the required skills for the Arrow LNG Plant:

- **Construction Skills Queensland Industry Support Program**: This program, run by Construction Skills Queensland (CSQ), is designed to increase retention rates of apprentices and trainees by providing a different approach to servicing the needs of regions' building and construction industry employers, apprentices and trainees through an industry driven mentoring and support model;
- **Energy Skills Solutions**: This program is a free information service provided by Energy Skills Queensland on behalf of Skilling Solutions Queensland and the Queensland Government. The program provides:
    - Career advice on skills and training opportunities for career advancement in the Queensland energy industry;
    - Skills evaluation to identify and match skills to qualifications;
    - Referral advice to registered training organisations for skills assessment and recognition;
    - Gap training advice on services provided by registered training organisations; and
    - Advice on regulatory requirements including licensing and permits;
- **Coal Seam Gas/LNG Industry Training Program**: This program is a flagship partnership between the Queensland Government (run through Energy Skills Queensland) and the coal seam gas/ LNG industry to train the thousands of workers needed for the new coal seam gas and LNG industries. $10 million will be invested in the coal seam gas/ LNG Industry Training Program to cater for up to 18,000 direct and indirect jobs, with the Queensland Government investment an initial $5 million to fund the program over two years, and matched funding by companies within the coal seam gas/ LNG industry when they access training through the program;
- **Gladstone Workforce Skilling Strategy**: The Gladstone Workforce Skilling Strategy is funded by both state and Australian government, with ongoing support by

industry. The program is designed to assist 200 Indigenous, Australian migrants, women and long term unemployed people develop the required skills to obtain jobs in key growth industries such as construction, LNG and a range of support services to assist in back-filling vacated positions;

- **Skills Queensland Strategic Investment Fund**: the Strategic Investment Fund provides up to $50 million of funding per year, including grants of up to $2 million for industry groups and companies, to provide industry and enterprises with the capacity to directly influence where public funding for skills and workforce development is invested; and
- **Australian Government Skills and Training Programs**: The Australian Government offer a range of funding and incentives for employers and employees to engage in skills training and development, including:
  - Australian Apprenticeships Program;
  - Training Pathways Program;
  - Productivity Places Program (The Queensland Government has recently expanded its partnership with Energy Skills Queensland to manage the delivery of an additional $8.1 million worth of training to job seekers and existing workers within the energy and telecommunications industries under the PPP); and
  - Workforce Innovation Program.

To assist in mitigating the impacts of the Arrow LNG Plant, it is recommended that Arrow Energy:

- Encourage contractors engaged by the project to utilise Australian and Queensland Government skills and training programs where possible, including the Australian Apprenticeship Program. This should include providing information and developing awareness of government incentives and programs to all contractors engaged, and direct contractors to relevant agencies;
- Engage and collaborate with CSQ to identify potential strategies for increasing the capacity of local job seekers to develop appropriate skills for construction;
- Collaborate with other LNG proponents and ESQ to identify opportunities for securing funding through the Skills Queensland Strategic Investment Fund; and
- Continue to support programs such as the coal seam gas/ LNG Industry Training Program and Gladstone Workforce Skilling Strategy to develop LNG industry skills in the local workforce.

In addition to the above, Arrow Energy is currently involved in skills development strategies and programs run by the Queensland Government and Energy Skills Queensland, including the Gladstone Workforce Skilling Strategy and the coal seam gas/ LNG Industry Training Program. These programs not only develop requisite skills for the construction and energy sector, but also assist small business in back-filling positions vacated as a result of labour being drawn to major infrastructure projects. These schemes seek to mobilise and develop the requisite skills in the long-term unemployed, women, indigenous persons and migrant workers. These schemes will have a significant role to play in ensuring negative impacts of labour draw arising from the Arrow LNG Plant on small business are minimised.

Responsibility:

Arrow Energy to collaborate with relevant agencies and registered training organisations in terms of the timing and nature of demand for workers and skills programs required to facilitate appropriate skills development.

6.2.2 Support Local Business Secure Supply Contracts

Issue:

As LNG is a new industry to Gladstone, local business is not currently equipped to maximise local benefits in terms of supplying the Arrow LNG Plant.

Objective:

Assist and provide incentives for local business to secure supply contracts for the Arrow LNG Plant.

Recommended Mitigation Strategies:

The following mitigation strategies are recommended to assist local business secure supply contracts for the Arrow LNG Plant:

- In collaboration with local Council, economic development organisations, the Industry Capability Network (ICN) and Queensland Government:
    - Inform local business of the goods and services required of the project, service provision opportunities and requirements of business to secure contracts;
    - Develop and implement a Local Content Strategy, including the development of relevant networks to assist qualified local and regional businesses tender for provision of goods and services to support the Arrow LNG Plant. The benefits of such a network could be enhanced where all LNG proponents participate, linking the LNG industry to local service providers through a common pathway such as a web portal operated by relevant economic or industry organisations;
    - Examine options for establishing a local cooperative service or network/ alliances to connect local business and enable collaboration in meeting service supply requirements of the LNG industry. This should be led by Gladstone Regional Council and the ICN, with input from Arrow Energy and other LNG participants to ensure needs of the industry are met; and
- Arrow Energy to inform local Council, economic development organisations, the ICN and Queensland Government of goods and services required by the Arrow LNG Plant that are not currently available or under-serviced from within Gladstone. This information should be utilised by relevant agencies and council to promote Gladstone and attract investment in order to build the local supply chain.

Responsibility:

Arrow Energy to collaborate with ICN, DEEDI, council and local business.

6.2.3 Minimise Impacts on Local Property Demand

Issue:

The Arrow LNG Plant will place additional demand on an already tight property market.

Objective:

Minimise adverse impacts on the property market from the construction and operation workforces.

Recommended Mitigation Strategies:

Potential impacts of the Arrow LNG Plant construction labour force on the local property market has been acknowledged by Arrow Energy as an important issue. Construction camps will be developed by Arrow Energy and utilised during construction of the project to accommodate the FIFO workforce and minimise additional demands placed on the property market.

To assist in minimising their impact on the local property market, Arrow Energy has also committed to (refer to section 3.3):

- Developing a “pioneer camp” on Curtis Island to accommodate early stage construction workers, most likely developed during quarters 1 to 3;
- Developing a detailed specific worker accommodation plan for the period between FID and commissioning of the worker camp(s) to accommodate workers during this period. This accommodation plan will seek to utilise third party operated worker accommodation that is either currently being developed or planned for Gladstone as part of other major projects in the region;

- Developing company facilitated communal accommodation for up to 380 EPC management and Arrow Energy workers; and
- Either developing purpose built housing or undertaking agreements with third party providers to provide up to 225 beds for operational workers.

However, experience from other projects in the region, notably the Gladstone LNG and Queensland Curtis LNG projects, indicates that while worker camps are developed there can be considerable tightening in demand if not appropriately planned for and delivered in a timely fashion.

To enhance the efficacy of Arrow Energy strategies to mitigate adverse impacts on demand in the local property market are minimised, it is recommended that:

- Construction worker camps be operational and capable of accommodating all required labour as soon as practicable following FID;
- Arrow Energy engage in ongoing dialogue with residential construction industry, State Government and local Council regarding timing and scale of anticipated worker accommodation requirements; and
- Arrow Energy monitor the availability of residential property and median house prices to accommodate construction and operational workers migrating to the region.

State Government and local Councils should also monitor the need for the implementation of affordable housing schemes to assist in providing affordable accommodation for low income and displaced households.

Responsibility:

Arrow Energy and contractor engaged to develop the Arrow LNG Plant.

6.2.4 Minimise Impacts of Increased Traffic

Additional road and water traffic will be generated by the Arrow LNG Plant, potentially impacting on travel times of local residents and marine operators. This issue, and appropriate mitigation strategies, are examined in the Arrow LNG Plant Traffic Impact Assessment (GTA Consultants, 2011).

6.2.5 Minimise Cumulative Impacts of Overlapping Timeframes

Issue:

Cumulative impacts of the Arrow LNG Plant with other major industrial projects could exacerbate the above issues.

Objective:

Minimise the impact of multiple projects competing for constrained resources.

Recommended Mitigation Strategies:

Mitigating the cumulative impacts of multiple projects being developed requires significant coordination of activities across project proponents, local, state and national governments, relevant economic and industry organisations, local business, imported workers and local residents. Relevant government authorities will be required to take a lead role in the coordination process.

To this end, the following mitigation strategies are recommended:

- Queensland Government and proponents of major projects being developed in the region (including Arrow Energy) to collaborate and identify key project timings and requirements to allow adequate and appropriate planning for and mitigation of cumulative project impacts and minimise overlap between peak activity. Project sequencing requires cooperation between proponents as well as relevant government authorities to coordinate activities and source from the same labour pool rather than creating intense competition for labour. However, it is acknowledged that commercial pressures may not always allow this to occur; and

- Proponents and government authorities to collaborate to develop regional plans for accommodation and support services. This may include shared use of construction camps to accommodate workforces.

Responsibility:

This should be a Queensland Government led strategy, with input from and collaboration with major project proponents, Gladstone Regional Council and industry organisations.

6.3 Residual Impact Assessment

An assessment of residual adverse impacts of the Arrow LNG Plant assuming the proposed mitigation strategies are adopted has been undertaken in Table 6.1 using the risk assessment framework outlined in **Appendix C**. The assessment shows that the impact rating for "impacts on business" and "impacts on infrastructure and service capacity" are able to be downgraded as a result of the proposed mitigation measures.

"Impacts on housing prices and availability of affordable housing" is not assessed as recording a lower rating based on the risk assessment framework outlined in **Appendix C**. However, it should be recognised that the original impact rating includes consideration of Arrow Energy's commitments regarding development worker camp accommodation, a worker accommodation plan, and company facilitated communal accommodation for EPC management and Arrow Energy workers, as well as operational workers. Further, it should be noted this framework used can be coarse, and the mitigation strategies proposed are expected to reduce the impact on the property market, but not by a degree that is observable in the framework.

Table 6.1. Assessment of Adverse Impacts of the Arrow LNG Plant Following Mitigation

Impact	Original Impact Rating	Relevant Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Impact Rating
Impacts on Business	**High**	• Address skills shortages • Support local business secure supply contracts	**Almost Certain**	**Minor**	**Medium**
Impact on Housing Prices and Availability of Affordable Housing	**Medium**	• Minimise impacts on local property demand	**Likely**	**Minor**	**Medium** [(a)]
Impacts on Local Infrastructure and Service Capacity	**Medium**	• Minimise impacts of increased traffic	**Possible**	**Insignificant**	**Low**

Note: (a) The mitigation measures proposed will assist in minimising adverse "impacts on housing prices and availability of affordable housing" experienced in Gladstone, however, the coarseness of the assessment framework utilised does not register a lower residual impact rating (compared to the initial impact rating). One of the key factors influencing the minor change is the original impact rating includes consideration of Arrow Energy's existing commitments regarding development worker camp accommodation, a worker accommodation plan, and company facilitated communal accommodation for EPC management and Arrow Energy workers, as well as operational workers.
Source: AEC*group*.

7. Cumulative Impacts

This chapter provides an assessment of the cumulative economic impacts arising from development of the large number of major projects either currently being developed or proposed for the Gladstone region outlined in section 2.3.4. In particular, this chapter is designed to address the cumulative economic impacts arising from large project workforces associated with proposed industrial projects being constructed in overlapping timeframes.

7.1 Cumulative Impact Assessment Framework

The cumulative impact assessment examines the potential cumulative impacts of a large number of major infrastructure and industry projects (including Arrow LNG Plant) being developed concurrently in Gladstone using a risk assessment framework described in **Appendix C**.

Projects included for consideration in the cumulative impact assessment include:

- Arrow LNG Plant;
- Arrow Surat Pipeline Project;
- Australia Pacific LNG Project;
- Boyne Island Aluminium Smelter Expansion;
- Arrow Bowen Pipeline Project;
- Fisherman's Landing Northern Expansion Project;
- Gladstone – Fitzroy Pipeline Project;
- Gladstone LNG Project – Fisherman's Landing;
- Gladstone Nickel Project;
- Gladstone Steel Plant Project;
- Hummock Hill Island Community Project;
- Moura Link – Aldoga Rail Project;
- Western Basin Strategic Dredging and Disposal Project; and
- Wiggins Island Coal Terminal Project.

Summary details of these projects are provided in section 2.3.4. In addition to the projects outlined above, it should be noted that the Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project have been included as part of the baseline scenario.

The cumulative impact assessment focuses on the potential for impacts identified in chapter 5 to be exacerbated by the concurrent development of a range of projects in Gladstone. In undertaking the analysis, it has been assumed that all projects identified above proceed in accordance with timelines outlined in section 2.3.4 (based on existing information in the public domain). ***This is considered a cautious scenario (i.e. an extreme scenario that is unlikely to be realised) as it is highly unlikely that all projects proposed will proceed to development, or that all proposed timelines will be achieved***. As such, it is highly likely that impact ratings assessed in this cumulative impact assessment are overstated.

7.2 Potential Cumulative Impacts

The development of the Arrow LNG Plant in combination with multiple other industrial projects will result in higher output, GRP, employment and household income estimates in Gladstone and Queensland than those depicted in chapter 5. Other potential beneficial impacts of concurrent development may include:

- Increased labour compensation and real wage effects in order to attract constrained labour resources, thereby enhancing some household incomes;
- Development of a "critical mass" of projects to support development and expansion of local supply chain networks;
- Coordinated and potentially enhanced use of infrastructure developed to support construction works; and
- Enhanced business, consumer and investor confidence arising from greater certainty in demand for goods, services and local infrastructure and assets.

While there are some potential benefits arising from concurrent development of the Arrow LNG Plant and other major industrial projects, it should be recognised that this will also increase competition for a range of constrained resources, resulting in a greater draw-down in other sectors of the economy to meet the needs of these projects, thereby placing additional pressures on constrained infrastructure available to meet the needs of the projects and their workforces.

Key resources (factors of production) likely to be affected by development of multiple projects in terms of increased demand and competition include:

- Labour;
- Capital;
- Accommodation; and
- Transport and other infrastructure and services.

An assessment of cumulative impact on gas resources has also been undertaken by ACIL Tasman (2011). Given the focus of assessing cumulative impacts is to identify and understand the inherent risks to the local, state and national economy of these projects being constructed in overlapping timeframes, this cumulative impact assessment has focused on examining potential adverse cumulative impacts only.

7.3 Assessment of Potential Adverse Cumulative Impacts

Potential adverse impacts have been assessed based on desktop review of other projects proposed for the region and the impacts identified in relevant documentation, as well as consultation with business, industry and key industry organisations to identify potential cumulative impacts. Assessments have been undertaken in consideration of the ability of markets to respond to pressures in the short to medium term (e.g., increased demand and responsiveness of supply), as well as anticipated long term trends toward market equilibrium over time.

In interpreting the impact assessments, it should be noted that many of the projects outlined in section 2.3.4 for inclusion in the cumulative assessment are anticipated to be winding down or completed by the time the Arrow LNG Plant commences construction activity in 2014. As such, much of the peak adverse cumulative effects in Gladstone attributable to concurrent project development will likely occur prior to commencement of the Arrow LNG Plant. Even so, the cumulative impact assessment has included the effects prior to commencement of the Arrow LNG Plant as the environment this creates will contribute to the efficacy of cumulative impacts during the Arrow LNG Plant project timeline.

It should also be noted that the cumulative impact assessment examines the impact of all projects combined rather than the contribution of the Arrow LNG Plant to cumulative effects. The marginal impact of the Arrow LNG Plant (i.e., impact of the Arrow LNG Plant over and above the impacts of the other projects) will in fact likely be quite small considering that the peak cumulative construction activity is anticipated to occur prior to commencement of the Arrow LNG Plant, therefore Arrow LNG Plant will extend the impact rather than increase the peak effect.

7.3.1 Impacts on Business Due to Increased Competition for Resources

Potential impacts of the Arrow LNG Plant on business as a result of increased competition are presented in sections 5.1.2 and 5.2.1, and outlines that competition for resources will result in a “crowding out” effect as resources (in particular labour) are drawn from some sectors of the local, state and national economy to the Arrow LNG Plant and its support services.

The development of the Arrow LNG Plant in addition to the projects listed in section 7.1 is **almost certain** (expected to occur in most circumstances) to exacerbate these impacts on business as a result of additional demand and competition for labour and other business inputs such as capital, goods and services used in production processes, transport infrastructure and utilities.

Key issues for business from competition for constrained resources include:

- Difficulties in attracting and retaining labour, in particular lower income paying sectors as labour is attracted to industries that offer higher wages and salaries;

- Increased reliance on imported goods and services, as well as other factors of production such as labour, to assist in meeting increased demand; and
- Reduced profit margins for business due to higher costs of production (e.g., wages, rents, additional transportation costs), eroding the viability of some businesses, particularly smaller businesses already operating on or near the margin.

As a result, impacts of competition for constrained resources are typically most keenly felt by small business and household service sectors. Where the projects considered in this cumulative impact assessment all proceed, the impacts of crowding out will be greater than the impacts outlined in sections 5.1.2 and 5.2.1. As such, the cumulative impact of competition from resources without appropriate planning is assessed to be of **major** (substantial and significant changes, uncertain if it can be successfully rehabilitated) consequence.

The cumulative impact associated with a combination of an 'almost certain' likelihood and a 'major' consequence assessed as a '**very high**' impact.

7.3.2 Impact on Housing Prices and Availability of Affordable Housing

Development of multiple projects concurrently will result in higher imported and FIFO labour requirements for each project than would be required if each project were undertaken in isolation. This will increase accommodation requirements to house these imported and FIFO workers.

Given constraints in existing accommodation supply, and anticipated lags in developing new supply (which will be exacerbated by competition for construction labour between major industry projects), to accommodate the imported and FIFO workers will require a large number of temporary worker accommodation options (e.g., construction camps) in the short term. Despite this, the local property market will be impacted in the short term by a combination of:

- Some work forces not being accommodated in the worker camps;
- Some workers choosing to permanently migrate to the region, thereby increasing loads on existing housing supply; and
- Non-project workers attracted to the region to back-fill positions vacated as a result of labour draw to the projects, or to support businesses involved in supplying major projects.

Where demand outstrips supply, this will place upward pressure on prices and reduce housing affordability and availability in the region.

Examination of the projects to be included in the cumulative impact assessment (refer to section 2.3.4) identifies that many of these projects' construction phases will be finalised by 2014 when the Arrow LNG Plant commences construction, with relevant documentation suggesting peak labour demand is likely to be around 2013. As such, the Arrow LNG Plant is not expected to increase the peak for labour demand in Gladstone over the next few years, but rather is expected to extend (prolong) the peak and tail of the labour demand curve.

This is consistent with consultation findings. Economic development organisations and real estate agents identified that impacts on the property market in Gladstone from projects currently underway or proposed for the region are likely to be most acute during the next two to three years, where demand for labour will peak while new supply of housing is anticipated to be constrained. The Arrow LNG Plant has the potential to impact on the local property market during this period by providing additional confidence and greater certainty of job opportunities in the region over an extended period, which will likely encourage construction and other workers to permanently migrate to the region to support these projects. As outlined in section 5.4, this is already occurring, with the effect of increasing prices and crowding out lower income households that can no longer afford costs of accommodation.

Following the anticipated peak in labour over the next few years, overall demand for labour is expected to ease as construction workforces are replaced by the smaller operational workforces for these projects. Meanwhile, supply of residential property is likely to increase as investors and developers are encouraged to build property in the

region to meet the accommodation needs of the increased permanent population in the region and realise higher returns. The combination of these effects will result in property prices stabilising (and potentially declining) to a new equilibrium point. It is considered likely that construction of the Arrow LNG Plant, and demand from up to 500 workers (up to 670 workers during the 6 to 12 month overlap period between construction and operation) seeking accommodation within the local Gladstone community, will support a higher equilibrium price over this period.

In the longer term, this higher equilibrium price will be supported by operational workforces of the Arrow LNG Plant and other major industrial projects, the likely development over time of a wide range of business and household services to support these projects through flow-on demands, as well as subsequent stage developments for LNG projects expanding production capacities.

The worst of the short term effects on housing prices will most likely occur prior to the Arrow LNG Plant being developed, and should therefore not be attributed to the project specifically. However, the effects of multiple projects being developed concurrently prior to 2014 is expected to result in an environment of higher prices at the time of commencement of the Arrow LNG Plant construction than would otherwise be anticipated, and this would likely be prolonged by the continued activity experienced in the region as a result of the number of projects being developed. In consideration of the above, it is considered **likely** (will probably occur) that impacts on property prices will be exacerbated and prolonged by the development of all projects outlined in section 7.1. The short term impacts are considered to be **major** (substantial and significant changes, will attract public concern) from the point of view of the Gladstone community, due to the prolonged nature of these impacts as increases in supply are expected to lag demand.

The cumulative impact associated with a combination of a 'likely' likelihood and a 'major' consequence is assessed as a '**high**' impact in the short term.

7.3.3 Impacts on Local Infrastructure and Service Capacity

GTA Consultants (2011) identify the cumulative effects of multiple projects on the local road network are expected to result in the following two intersections requiring upgrades in addition to those identified in section 5.8:

- Landing Road/ Gladstone – Mount Larcom Road; and
- Red Rover Road/ Hanson Road.

Similarly, the cumulative population increase expected as a result of concurrent development of multiple projects is estimated to increase demands for a range of social, community and recreational infrastructure and services, with current levels of service provision unable to service this increased demand (SKM, 2011). This will require significant increases in infrastructure and employees to provide these services, which will be made more difficult by the and higher costs of living, increase in labour costs and draw of labour from these services to support employment requirements of the major industrial projects.

The cumulative impacts of the Arrow LNG Plant in combination with other major infrastructure projects will **almost certainly** (expected to occur in most circumstances) impact on local infrastructure and service capacity for road infrastructure and social, community and recreational service demand.

It is recommended that research be undertaken into the likely cumulative impacts of multiple projects being developed concurrently on other infrastructure typically provided by government and government-owned corporations (e.g., water, wastewater, waste disposal, telecommunications, electricity, airport, rail and marine). Given the high population and industry loads attached to the projects considered in this cumulative impact assessment, it is expected that at least some of this infrastructure will be strained.

In consideration of existing resource limitations and likely difficulties in sourcing labour to develop required infrastructure and thereby mitigate these impacts in the short to medium term, these impacts are assessed as being of **moderate** (significant changes that may be rehabilitated with difficulty) consequence.

The cumulative impact associated with a combination of an 'almost certain' likelihood and a 'moderate' consequence is assessed as a '**high**' impact.

7.4 Summary of Cumulative Impacts

The cumulative impacts outlined in the sections above are summarised in Table 7.1.

Table 7.1. Assessment of Adverse Cumulative Impacts

Impact Description	Likelihood	Consequence	Impact Rating
Impacts on Business: Concurrent development of a number of major projects in Gladstone will almost certainly result in additional demand and competition for labour and other inputs to supply these projects. This will place upward pressure on input prices, and can result in "crowding out" of some businesses and industries.	**Almost Certain**	**Major**	**Very High**
Impact on Housing Prices and Availability of Affordable Housing: The overlapping development of a number of major industrial projects is likely to exacerbate and prolong peak demand for housing in the region, even in consideration of construction camps to be used. The number of projects will likely result in an extended tail of the labour demand curve supporting higher residential property prices over the medium to longer term. Impacts on the property market (i.e., lift in prices) generated by concurrent timing of projects are anticipated to be most acute in the short to medium term.	**Likely**	**Major**	**High**
Impacts on Local Infrastructure and Service Capacity: Development of multiple major industry projects in Gladstone, and the increase in resident and transient population and associated traffic, is expected to strain existing local road networks as well as a wide range of social, community, recreational and, potentially, utilities infrastructure and services.	**Almost Certain**	**Moderate**	**High**

Source: AEC*group*.

8. Conclusion

The economic impact assessment identifies that the Arrow LNG Plant will generate significant economic benefits for the regional (Gladstone), state and national economies. Potential beneficial impacts arising from the Arrow LNG Plant include[2]:

- Significant increases in industry output, GRP, employment and incomes throughout the project life through both direct and indirect impacts;
- Opportunities for local business to secure new contracts and increase sales to supply and service the needs of both the project and the workforce, supporting the viability of some local small businesses in Gladstone;
- Increased competition for resources will see an economy wide increase in productivity through economic rationalisation, resulting in an increase in factor incomes per unit of factor input, in particular for labour, and ultimately a higher value economy;
- Households will be beneficially effected by the project, through increased job and income earning opportunities;
- The Arrow LNG Plant will provide a lift in local, Queensland and Australian Government taxation revenues through a variety of taxes and duties. These additional revenues would then be used to provide additional infrastructure and services to support business and households throughout Australia; and
- Support for the Australian dollar through production and export of high value LNG, with a key beneficial impact being lower comparative prices for foreign goods and services.

While overwhelmingly beneficial, the Arrow LNG Plant will also likely result in adverse impacts within some cohorts of the regional, state and national economies, including:

- A potential draw down on business as a result of:
  - Competition for and draw of labour to the Arrow LNG Plant and its supply chain;
  - Deepening skills shortages in both the construction and LNG sectors;
  - Escalating costs of labour and other inputs to production, reducing business profits and viability; and
  - Support for the Australian dollar as a result of the high level of gas exports, potentially making "trade exposed" industries such as agriculture, some manufacturing and tourism more expensive to foreign buyers;
- Likely increases in demand and prices for housing resulting from increased temporary and permanent population in Gladstone; and
- Likely capacity constraints for local road infrastructure, as well as potentially utilities and other transport infrastructure and service capacity as a result of additional economic activity and population loads.

Despite some adverse impacts likely associated with the project, economic modelling indicates the Arrow LNG Plant is estimated to generate significant net economic benefits for Gladstone, Queensland and Australia through increased economic activity, over and above any potential draw down in some sectors.

Cumulative impacts resulting from the concurrent development of a number of major resource, industrial and infrastructure projects currently proposed for Gladstone is expected to exacerbate identified adverse impacts as they compete for the same pool of resources. Mitigating the cumulative impacts of multiple projects being developed requires coordination of activities across project proponents, local, state and national governments, relevant economic and industry organisations, local business and the local community.

[2] These benefits are assessed against the baseline environment, which is informed by the best available data at the time of writing. The first release of results from the 2011 Census of Population and Housing are expected mid 2012, which could change slightly the context of some impacts identified in this report.

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Appendix A: Summary of Stakeholder Consultation

In order to inform elements of the existing economic environment and relevant sections of the economic and cumulative impact assessments, consultation was undertaken with a range of stakeholders, including:

- Gladstone Regional Council;
- Industry and regional organisations including:
  - Energy Skills Queensland;
  - Gladstone Economic and Industry Development Board;
  - Gladstone Industry Capability Network;
  - Gladstone Area Promotion and Development Ltd; and
- Local real estate agents.

Key themes identified throughout consultation included:

- The rental market has tightened appreciably in recent months as projects such as the Gladstone LNG Project, Queensland Curtis LNG Project and the Yarwun Alumina Refinery Expansion ramp up. Vacancy rates are less than 1% presently which is considerably below typical market conditions.
- This tightening in the rental market has been exacerbated by a combination of:
  - Local content policies for these major projects, which have encouraged some tradespersons from outside Gladstone to seek rental accommodation locally in order to qualify for the local buy criteria; and
  - Timing of both the Gladstone LNG and Queensland Curtis LNG projects in developing construction worker camps has resulted in the current workforces for these projects needing to be accommodated within the local community.
- Residential land sales in Gladstone are averaging around $160,000 to $190,000, while industrial land is typically selling at around $110/$m^2$ to $120/$m^2$, with a typical block size of approximately 2,000m^2.
- Industrial and commercial land values have not increased notably in recent years despite considerable development activity and interest in both markets.
- The most significant impacts on the property market in Gladstone from current and future projects are likely to be felt during the next two to three years while the Yarwun Alumina Refinery, Boyne Smelter, Gladstone LNG and Queensland Curtis LNG projects are developed. There has been a slowdown in residential development since the Global Financial Crisis and this has led to an undersupply in developed residential stock in the region to cater for escalating demand.
- Small and medium sized businesses have reported having difficulties in retaining staff due to employees being attracted by larger companies (including retaining apprentices). As a result, back-filling of positions is primarily an issue for smaller businesses, and can be a considerable expense.
- High demand for construction trades has resulted in considerable inflow of FIFO and DIDO workers to Gladstone, which has placed increased pressure on housing as well as transport infrastructure, with impacts on both currently being felt within the community. This has also resulted in prices for construction trades related services increasing considerably.
- Training programs have and are being put in place to assist in meeting the skills requirements of both coal seam gas and LNG projects during both construction and operation. This includes the Gladstone Workforce Skilling Strategy, producing 200 targeted skilled workers, primarily to assist in back-filling vacated positions.

Appendix B: Computable General Equilibrium Methodology

Model Overview

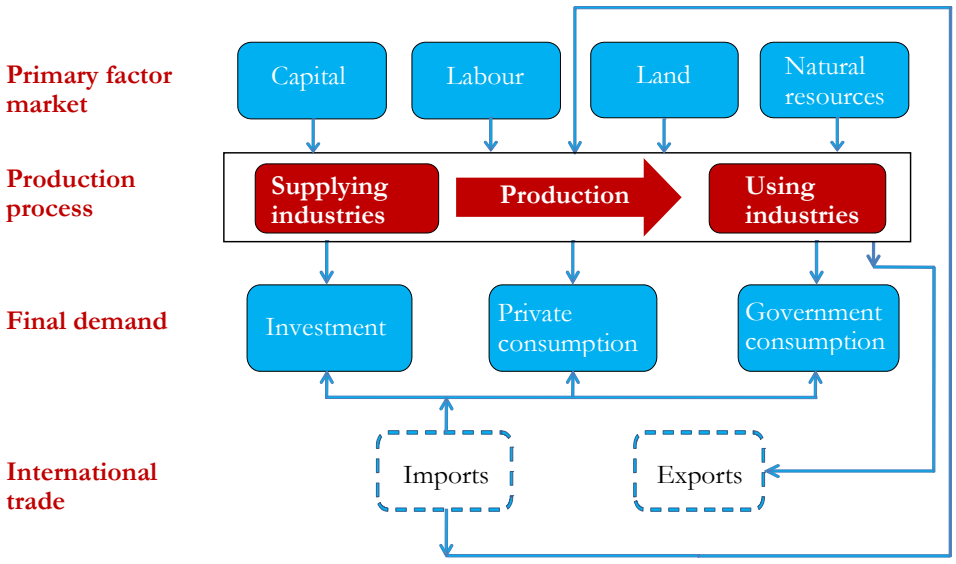
Computable General Equilibrium (CGE) economic models represent the workings of the economy through a system of interdependent behavioural and accounting equations linked to an input-output database.

A diagrammatic representation of a CGE model is presented in Figure B.1. Beginning with the production processes of individual industries, supported by inputs from other industries and the use of the primary factors of production, then adding in investment demand, private and government consumption, imports and exports, CGE modelling represents a fully integrated model of the world economy. In the model used for this assessment, production technology, individual markets, investment, trade and consumption are represented by equations with strong microeconomic foundations. The simultaneous solution of these equations in response to external changes (or 'shocks') generates the model solutions. When an economic shock, such as a new project, is applied to the model, each of the markets adjusts to a new equilibrium according to the economic theory and behavioural parameters that underpin the model.

In addition to recognising the linkages between industries in an economy, CGE models also recognise the constraints that apply in an economy (e.g. increased demand for labour will push the costs of labour up if there is full employment).

The CGE model used for this assessment is a dynamic model, which means it solves year-by-year, allowing a stream of annual results to be reported. Results are presented as deviations from a base (or reference) case, where the base case represents an anticipated growth path of the economy without the project.

Figure B.1. Representation of a Single Region in the CGE Model



Modelling Assumptions

The economic impacts of the Arrow LNG Plant on Gladstone, Queensland and Australia has been assessed by Prime Research utilising the Tasman Global Computable General Equilibrium (CGE) modelling framework.

Dynamic simulations using CGE modelling require two separate model runs. The first model run, known as the 'base case' (or baseline scenario), simulates one view of the economic future. In this view of the future the Arrow LNG Plant does not proceed

(although the currently committed projects of Yarwun Alumina Refinery Expansion, Gladstone LNG Project and Queensland Curtis LNG Project do proceed in the baseline scenario).

In the second model run, known as the 'with project case', an alternative view of the economic future is simulated. In this view of the future the Arrow LNG Plant development proceeds, and includes activities associated with gas extraction and transmission and the production of LNG.

Economic growth rates used in the modelling are based on near-term projections from Australian Government and State Treasuries, and medium to long term projections are a function of assumptions regarding changes in population, and particularly changes in the working age population), workforce participation rates and changes in labour productivity.

Regional population growth used in the modelling has been projected using an in-house demographic model. This model projects how populations change in each region and subsequently estimates changes in the working age population which flows through to regional labour supply and participation rates.

Population growth for the eight Australian states and territories incorporates detailed ABS data on population levels, births, deaths and migration.

Labour productivity growth is influenced by many factors, including capital intensity, training and education and composition of the workforce. Over the last 30 years Australia's labour productivity growth has averaged around 1.75% per annum. In the 'base case' Australian labour productivity growth is assumed to gradually slow from around 1.75% per annum in 2020 to 1.5% per annum in 2030.

In developing the base case, economic growth assumptions for the state, national and global were applied as outlined in Table B.1.

Table B.1. Base Case Economic Growth Assumptions

Region	Average Annual Growth (%)
Queensland	3.6%
Australia	3.0%
Rest of the World	3.1%

Source: Prime Research (unpublished)

In addition to the base assumptions outlined in Table B.1, the following key assumptions for the baseline scenario were applied to Gladstone:

- Queensland Curtis LNG Project proceeds at the maximum scale contemplated under the project environmental approvals, with three LNG trains each of 4 Mtpa capacity, for a total of 12 Mtpa. Key details of the Queensland Curtis LNG Project utilised in the baseline scenario have been developed based on EIS and Supplementary EIS documentation, as well as final investment decision information, and include:
    - The first two trains are assumed to commence construction in 2011 (early works has already commenced) and come on line at the beginning of 2014 and 2015 respectively;
    - Construction of the first two trains will commence with approximately 550 workers in early 2011, building to more than 1,500 workers by 12-16 months after commencement, and peaking at 3,250 between the 26th and 30th month of construction (early to mid-2013). Workforce numbers to decline from mid 2013 to 800 in mid- to late-2014, and to less than 200 by late 2015. Construction to be completed (for the first two trains) by end of 2015;
    - Average construction workforce during construction of trains 1 and 2 of approximately 1,500;
    - Local availability of construction workers as follows:
        - Local workers assumed to comprise approximately 42% of total workforce during construction of trains 1 and 2;
        - At peak this would decrease to 35%; and

        - Where the Queensland Curtis LNG Project is constructed concurrently with other LNG projects (e.g., the Gladstone LNG Project), peak local labour percentage assumed to drop to 20% - 25%;
    - The third train to commence construction in late 2018, with first production in 2021. Construction numbers are not provided in documentation for the third train and it has been assumed for modelling purposes that a construction workforce of approximately half the size of stage 1 will be required;
    - An operational workforce for the LNG facility is outlined as follows:
        - 160 operational employees for the first two trains, with 120 of these located in Gladstone;
        - 20 employees to be engaged in early 2013 (prior to first production), increasing to 75% just prior to construction completion;
        - Operational workforce will increase to 200 employees once train three is developed; and
        - Local workers assumed to comprise 80% of operational workforce.
- Gladstone LNG Project proceeds at the maximum scale contemplated under the project environmental approvals, with three LNG trains for a total of 10 Mtpa. Key details of the Gladstone LNG Project utilised in the baseline scenario have been developed based on EIS and Supplementary EIS documentation, as well as final investment decision information, and include:
    - The first two trains are assumed to be of 3.9 Mtpa capacity and to come on line in 2015 and 2016 respectively, in accordance with the configuration announced by the proponents as the basis for their final investment decision. Construction of train 1 to commence in 2011 (early works have already begun) with construction of train 2 to commence in 2014;
    - In order to remain within the overall 10 Mtpa capacity covered by the existing environmental approvals, the third train is limited to 2.2 Mtpa, assumed to commence construction in 2019 and come on line in 2022;
    - Construction of the three LNG trains involves a wave like pattern of construction employment in Gladstone. During construction of the first train (including ancillary facilities and infrastructure) a peak construction workforce of around 3,000 in the second year of construction will be required. A lower peak of around 1,500 will be required for trains two (2014-15) and three (2020-21);
    - Santos has assumed that approximately 35% of the construction workforce could be sourced locally, and 65% imported (although likely a higher proportion imported during peak construction periods); and
    - Once fully operational (i.e., all three trains operational) the LNG facility is expected to have a workforce of approximately 250 (with 140 required for the first train). The workforce is expected to almost entirely reside in Gladstone, although the original source of these workers will be dependent on availability and skills required for each position.
- The Stage 2 expansion of the Yarwun alumina plant is assumed to increase alumina production capacity at the facility from 2 Mtpa to 3.4 Mtpa by 2011. As modelling results commence for the 2013-14 financial year (with construction of the Arrow LNG Plant assumed to commence in quarter 1 of 2014), construction of this facility falls outside the modelling period. The increase in capacity is assumed to result in an additional 260 employees at the alumina plant from 2011. Natural gas demand at the Yarwun facility is assumed to increase by 7.2 PJ/a.
- A fixed domestic labour assumption has been used in the modelling, as per modelling undertaken on the LNG industry by McLennan Magasanik Associates (2009) for the Queensland Government. A constrained labour mobility assumption has been utilised between states, with labour mobility assumed to be motivated by real wage differentials. Labour mobility assumptions include both inter-industry labour movement within regions as well as inter-regional and interstate labour movement. Labour is assumed to not be sufficiently mobile to remove these real wage differentials completely (i.e., in order to attract labour, real wages will increase).

Appendix C: Risk Assessment Framework

A risk-based approach, adapted from the Australian/New Zealand Standard for risk management (AS/NZS 31000:2009), has been used in the assessment of cumulative impacts. The risk assessment framework used identifies and ranks risks into relevant levels (negligible, low, medium, high and very high) to inform key issues and impacts for avoidance, mitigation and management measures.

The assessment was undertaken by examining the likelihood of an effect occurring and the potential consequences (i.e., a measure of severity of environmental effect) should the effect occur. Table C.1 contains the descriptors used to classify the likelihood and consequence.

Table C.1. Descriptors Used to Classify Likelihood and Consequence

Descriptor	Description
Likelihood	
Almost certain	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to 10 times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible	The event could occur. There is likely to be an event on average every five to 20 years.
Unlikely	The event could occur but is not expected. May have heard it discussed as a possibility but an extremely unusual one. A rare occurrence (once per 100 years).
Rare	The event may only occur in exceptional circumstances. Very rare occurrence (once per 1,000 years). Unlikely that it has occurred elsewhere; and if it has occurred, it is regarded as extremely unique.
Consequence	
Insignificant	Possible impacts but without noticeable consequence. Temporary or short-term reversible environmental impact, localised event, location of little environmental value.
Minor	Some limited consequence but no significant long-term changes, may be easily rehabilitated.
Moderate	Significant changes, may be rehabilitated with difficulty. Direct or indirect environmental impacts beyond location (on site or off site). Repeated public concern. Reportable to the government.
Major	Substantial and significant changes, will attract public concern, only partially able to be rehabilitated or uncertain if it can be successfully rehabilitated. Actual or potential environmental harm either temporary or permanent, requiring immediate attention. Possible prosecution by regulatory authorities.
Catastrophic	Extreme permanent changes to the environment, major public outrage, or the consequences are unknown. Serious environmental harm that causes actual or potential environmental impacts that are irreversible or of high impact or widespread. Likely prosecution by regulatory authorities.

Source: Adapted from AS/NZS 31000:2009.

The level of risk associated with each potential cumulative impact was then determined by combining likelihood and consequence using the matrix in Table C.2.

Table C.2. Risk Evaluation Matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Very High	Very High
Likely	Low	Medium	Medium	High	Very High
Possible	Low	Low	Medium	High	High
Unlikely	Negligible	Low	Low	Medium	High
Rare	Negligible	Negligible	Low	Medium	Medium

Source: Adapted from AS/NZS 31000:2009.

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