ACIL ALLEN CONSULTING

REPORT TO
ASHURST AUSTRALIA ON BEHALF OF GLADSTONE LNG

12 FEBRUARY 2015

COMET RIDGE—WALLUMBILLA PIPELINE LOOPING PROJECT

REPORT ON RELEVANT MARKETS AND DEMAND FOR SERVICES

PREPARED IN SUPPORT OF A PROPOSED APPLICATION FOR A NO COVERAGE DETERMINATION

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Executive summary

As part of the Gladstone Liquefied Natural Gas project, GLNG Operations Pty Ltd (**GLNG**) is in the process of expanding its Comet Ridge to Wallumbilla Gas Pipeline (**CRWP**) by duplicating (or "looping") the existing pipeline. The new pipeline is referred to as the Comet Ridge to Wallumbilla Pipeline Loop (**CRWP Loop**). ACIL Allen has been engaged by Ashurst Australia on behalf of GLNG to prepare an expert report in support of a planned application under s.151(3) of the *National Gas Law* 2008 for a 15-year no-coverage determination that will exempt the CRWP Loop from being a covered pipeline for purposes of third party access. Both the CRWP and the CRWP Loop will convey gas from Wallumbilla to Fairview where the gas will pass into the GLNG Gas Transmission Pipeline system for transportation to the GLNG liquefied natural gas plant on Curtis Island, near Gladstone.

The CRWP Loop could potentially be used by third party shippers to carry gas north from Wallumbilla to Fairview for onward carriage to either the Gladstone LNG facilities on Curtis Island, or via Jemena's Queensland Gas Pipeline (QGP) to domestic markets in Central Queensland and the Wide Bay region.

Downstream markets

Chapter 2 discusses the relevant domestic markets downstream of the CRWP Loop. We assume that third party shippers could potentially inject gas into the CRWP Loop at Wallumbilla (at the southern end of the pipeline) or at a mid-line injection point and could, by this means and in combination with other gas pipelines, transport gas either to an LNG plant on Curtis Island or to domestic gas markets in Central Queensland and the Wide Bay region.

Theoretically, the CRWP Loop could also act as part of a delivery system for carriage of gas to the Wallumbilla hub, from whence it could be delivered to markets throughout eastern Australia. However, in practice there is no apparent reason for any gas shipper to take gas from Wallumbilla, north through the CRWP Loop, only to return it to the Wallumbilla Hub for onward carriage to south-eastern Australian domestic markets. There are several existing alternative pipeline routes that would allow gas from fields in the vicinity of the CRWP Loop to be delivered to the Wallumbilla Hub, including via the QGP (backhaul), CRWP, APLNG's Spring Gully Pipeline, the South West Queensland Pipeline (SWQP) or the Roma – Brisbane Pipeline (RBP). For these reasons, and bearing in mind that the CRWP Loop is a unidirectional pipeline incapable of physically delivering gas south to Wallumbilla, we do not regard markets to the south and east (accessible from Wallumbilla by the SWQP and RBP respectively) as being relevant downstream markets for the purposes of the CRWP Loop.

Gas demand in the downstream markets

The significant domestic market locations potentially serviced by gas carried in the CRWP Loop are:

- Industrial facilities at Moura
- Industrial, cogeneration and retail consumers at Gladstone
- Industrial and retail consumers at Rockhampton
- Retail consumers (commercial, residential and small industrial) in the Wide Bay region at Bundaberg and Maryborough.

Current gas demand in this region is around 50 PJ/a, with the majority of this demand being for industrial and co-generation use in the Gladstone region. The approximate split of demand within the region is as follows:

- Gladstone – 45.2 PJ/a
- Rockhampton – 1.6 PJ/a
- Wide Bay – approximately 0.4PJ/a
- Moura – 2.8 PJ/a

Overall domestic gas demand levels are expected to show little if any growth over the next 15 years.

Gas prices in the downstream markets

Based on limited public domain information regarding existing gas supply contracts, we estimate that wholesale delivered prices into Gladstone and Rockhampton under legacy contracts are presently in the range A$4.00 to A$5.50/GJ, including transport on the QGP. Cost of gas supply under new long-term supply contracts is understood to be considerably higher, with one recent supply contract reported to have been settled at an oil-linked price of around A$8.60/GJ at an oil price of US$100 per barrel. At current exchange rates and oil prices of around US$50/bbl the implied gas price is much lower — about A$5.80/GJ.

Impact of government policies

A number of Federal and State government policies have the potential to impact on future gas demand in eastern Australia.

At a Federal government level, the most significant policy developments relate to recent changes in carbon pricing arrangements with the carbon price introduced by the previous Labor government under the Clean Energy Future package having been repealed. Potential changes to the Large-scale Renewal Energy Target (LRET) may also have some effect on gas demand.

State government policies related to energy efficiency and water conservation also have the potential to impact on future gas demand—some positively and others negatively in terms of the rate of demand growth.

Downstream global LNG markets

Chapter 3 discusses global LNG markets and the significance of the CRWP Loop in the context of those markets.

LNG currently represents about 10 per cent of total global gas supply. The 237 million tonnes of LNG sold in 2013, equivalent in energy terms to about 13,130 PJ, is around twenty times greater than the amount of gas currently consumed in the eastern Australian domestic market.

Global demand for natural gas, and in particular for LNG, is expected to grow strongly over the next decade and beyond, with the strongest demand growth being in the Asia-Pacific region. China and India are expected to show the fastest growth in LNG demand within the region.

The global LNG market—already large and diversified—is continuing to grow and to become more competitive. Over the past twenty years or so, the global LNG industry has seen strong growth in trade volumes and also in the number of both exporting and importing countries. The increasingly liquid and competitive nature of the global LNG market is also demonstrated by the growing proportion of world trade now transacted through spot sales and re-exports, which now account for around 30% of global LNG trade.

At present, about half of Australia's gas production is used domestically while half is exported as LNG. The proportion of exports will increase dramatically over the next four years as seven new LNG projects now under construction around Australia come on line. Currently ranked third with respect to installed LNG production capacity, Australia will become the world's number one LNG producer within the next five years with production capacity more than tripling to around 86 Mtpa.

Further growth in Australian LNG production capacity beyond the projects currently under construction is likely to face strong competition, particularly from North American projects that enjoy access to low-cost gas supplies and lower construction and operation costs.

At Gladstone in Central Queensland, three world-scale LNG projects are currently under construction. These projects have so far committed to six LNG liquefaction trains, resulting in total capacity of 25.3 Mtpa, with a requirement of around 1,500 PJ of CSG each year for feedstock and ancillary use. This is more than double the size of the current eastern Australian domestic gas market.

Implications for global LNG markets of third party access to CRWP Loop

Providing third party access to the CRWP Loop would have no discernible effect on the competitiveness of global LNG markets, primarily because the quantity of gas that could be moved through the CRWP Loop is relatively insignificant in the context of the volumes of gas involved in global LNG trade. Furthermore, the QCLNG and APLNG projects (and any other LNG project likely to be built at Gladstone in the future) will provide their own pipeline infrastructure and would be very unlikely to proceed on the basis of reliance on third party access to pipeline capacity that they do not control.

Alternative pipelines

Chapter 4 considers the availability of alternative pipelines to transport gas from upstream CSG producers to the relevant domestic markets and/or to global LNG markets. It also considers the projected cost of transportation on alternative pipeline routes.

Gas producers looking to deliver CSG from the Surat Basin in the vicinity of the CRWP Loop to domestic markets in Central Queensland and Wide Bay have a number of alternative pipeline transport options:

- from the field to Wallumbilla via either RBP or CRWP or SGWP, then via QGP to market
- from the field via the Fairview Lateral to the Ridgelands receipt point on the QGP, then via QGP to market
- from the field via a new receipt point on the CRWP or CRWP Loop to the Gooimbah receipt point on the QGP, then via QGP to market.

Other more elaborate paths could be envisaged but would be likely to involve greater transport costs without conveying any obvious advantage in terms of ease of market access.

For third party gas producers looking to sell gas into global LNG markets, we consider two groups of potential shippers:

- other LNG projects including QCLNG, APLNG or a new LNG project not yet committed to construction
- third party gas producers not involved in a downstream LNG project.

If the CSG producer is another LNG project then transport to the relevant plant on Curtis Island will most likely be via that LNG proponent's dedicated pipeline infrastructure. If the CSG producer is a third-party supplier that is not currently a part of any LNG project, it is unlikely that the producer will build its own LNG plant. It is more likely they would sell first to one of the large LNG projects, in which case the pipeline transport path to the relevant plant on Curtis Island will be via that LNG proponent's dedicated pipeline infrastructure.

We have considered whether access to the CRWP Loop might improve domestic market access by relieving any capacity "bottlenecks" on the QGP given that there is little, if any, uncontracted firm capacity on QGP. It is clear from feasibility studies into gas transport to the proposed Fisherman's Landing LNG Project that the capacity of QGP could be significantly expanded to meet new user demand. QGP owner Jemena has shown a willingness to expand pipeline capacity to accommodate new users. Use of the CRWP Loop to circumvent any short-term capacity constraint on the QGP would be unlikely to prove effective because it would not avoid the need to use QGP to access the Central Queensland/Wide Bay domestic markets. It would merely shift the receipt point into the QGP north from Wallumbilla to Gooimbah. Firm capacity in QGP would, in any case, need to be made available downstream from the Gooimbah receipt point.

Cost of transport on alternative pipelines

In terms of costs of transporting gas to the domestic market, carriage of gas on the CRWP Loop appears unlikely to reduce costs for users. Indeed carrying gas on the CRWP Loop from Wallumbilla and transferring it to the QGP at Gooimbah would be more costly than carrying gas on QGP from Wallumbilla, since there would be no reduction in transport costs on QGP (the firm capacity charges for which are calculated on a "postage stamp" basis that does not vary with receipt point) and there would be additional transport costs on the CRWP Loop.

Small CSG producer assessment

Chapter 5 examines the potential for small gas producers not associated with the Gladstone LNG plants to benefit from access to the CRWP Loop.

Our investigations show that the only petroleum exploration tenement that is located north of Wallumbilla within a 50 km corridor around the CRWP Loop and that is not either controlled by, or in a commercial arrangement with, one of the Gladstone LNG projects is ATP 854, held by Eureka Petroleum which is a wholly-owned subsidiary of listed company Blue Energy Limited.

ATP 854 has been assessed to contain a contingent resource of 103PJ of CSG, but currently contains no commercially recoverable reserves.

There is no apparent reason why it would be advantageous to the operators of ATP 854 to have mandated access to the CRWP Loop given that the Jemena QGP passes through the eastern part of the exploration area, whereas the CRWP Loop is located further to the east. A connection into the QGP would therefore be likely to provide a lower capital cost option than a connection to the CRWP Loop.

1 Introduction

Key Findings Chapter 1

Chapter 1 provides background on the various elements of the GLNG Project including the upstream gas fields, the LNG facility, and the gas transmission pipeline facilities associated with project and their relationships to and interconnections with both the domestic transmission pipeline system and the other Gladstone LNG projects at Gladstone. It summarises the design and technical characteristics of the Comet Ridge – Wallumbilla Looping Project (CRWP Loop) which will form a key part of the GLNG gas transmission infrastructure.

The previous no-coverage application in relation to the main GLNG Transmission Pipeline is briefly discussed.

The remainder of the chapter sets out the scope of the current study and explains ACIL Allen's qualifications to undertake this work.

1.1 The GLNG Project

The GLNG Project is a fully integrated, two train LNG project being developed by the Participants (companies owned by Santos, PETRONAS, Total and KOGAS). Natural gas produced at the Gas Fields will be transported via a gas transmission pipeline (the GLNG GTP) to an LNG Facility at Curtis Island for conversion to LNG and export.

The Participants have also contracted to purchase natural gas for supply to the LNG Facility from various third party producers, as well as from a related body corporate of one of the Participants (Santos), holding interests in other gas fields in Australia (Third Party Gas).

As part of the GLNG Project, GLNG has developed underground reservoirs at Roma (Roma Underground Gas Storage Facility) to allow for additional temporary storage and flexibility in managing supply to the LNG Facility, particularly during the LNG Facility commissioning phase, Gas Fields ramp up stage and LNG Facility shutdowns. All gas temporarily stored by the Participants at the Roma Underground Gas Storage Facility is ultimately intended for delivery to the LNG Facility via either the CRWP Loop or the CRWP, and then the GLNG GTP.

The GLNG Project comprises three inter-related and inter-dependent components:

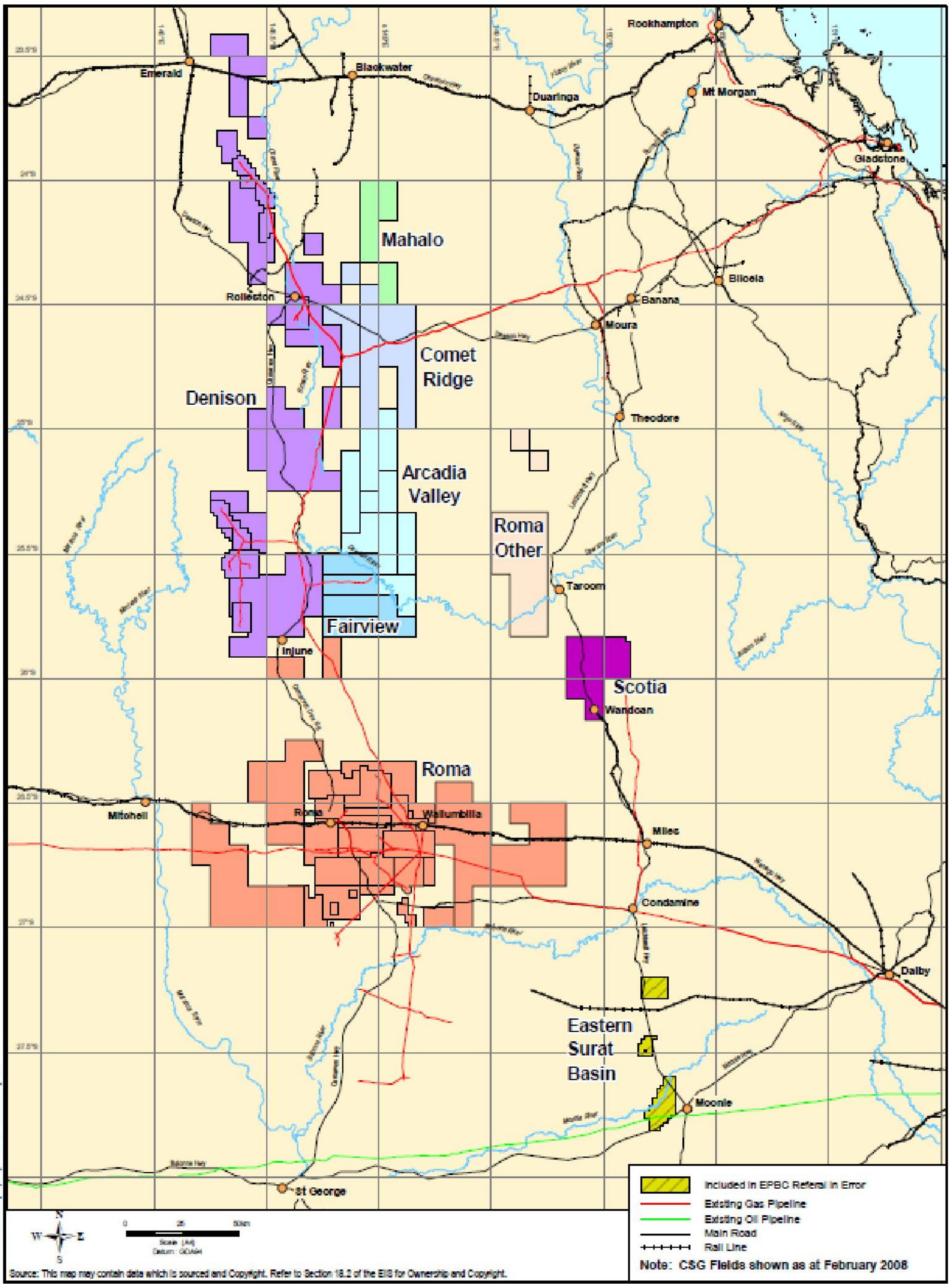
- the Gas Fields;
- the Pipeline Facilities; and
- the LNG Facility.

1.1.1 The Gas Fields

Coal seam gas (CSG) is essentially methane (natural) gas extracted at low pressure from coal seams. The development of CSG fields involves the drilling of exploration and production wells down into the coal seam. Water is pumped from the coal seam, reducing the pressure within the coal and allowing the CSG to be released. The CSG flows through coal cleats (small fractures or joints in the coal) toward the well bore. If the release of gas is not sufficient for commercial production, then processes such as hydraulic fracturing may be used to open the coal seams and increase the rate of CSG and water production. An average CSG well may produce for up to 20 years, but the amount of gas depends on the thickness of the coal, gas content and the depth of the coal seam. A typical CSG well produces mainly water for around 12 months as water pressure is reduced, following which CSG flow rates increase and remain steady for a number of years.

The Gas Fields are located at Fairview, Arcadia, Comet Ridge, Roma and Scotia as shown in Figure 1.

Figure 1 **Location of the GLNG Gas Fields**



Source: GLNG Environmental Impact Statement, Figure 3.4.1

The existing Gas Fields at each of these locations, which are at various stages of development, will be further developed for the GLNG Project with GLNG currently having approval to develop up to 2,650 exploration and production wells in the Gas Fields over the life of the GLNG Project. GLNG also has commenced the EIS process for the development of additional wells within the Gas Fields area.

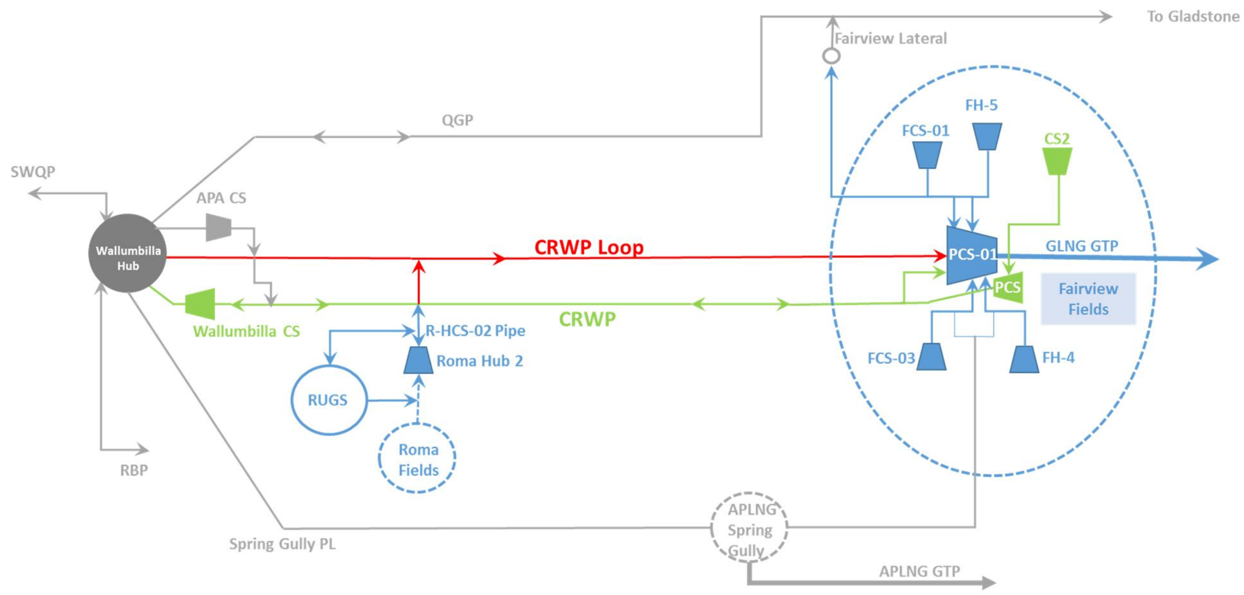
The first and second trains of the LNG Facility will be supplied by gas produced from existing production wells in the Gas Fields (including upon the expiration of domestic gas contracts), gas produced from the further development of the Gas Fields and Third Party Gas.

In addition to the drilling of exploration and production wells and the construction of field gathering lines, the development of the Gas Fields also includes centralised compression and water treatment facilities, accommodation facilities, power generation, water management facilities and other incidental infrastructure and activities.

1.1.2 The Pipeline Facilities

Figure 2 is a schematic diagram illustrating the pipeline facilities associated with the GLNG project and their relationships to and interconnections with both the domestic transmission pipeline system and the main transmission pipelines and CSG fields associated with the other LNG projects at Gladstone.

Figure 2 **Upstream infrastructure schematic diagram**



Source: ACIL Allen based on Santos GLNG Investor Visit Presentation, 25-26 June 2014

Gas produced at the Gas Fields will be transported through a network of underground trunklines and flow lines to centralised hub stations for compression and dehydration. This gas, together with Third Party Gas, will be transported to the LNG Facility through the GLNG GTP from the Gas Fields, the CRWP or the CRWP Loop from PCS-01, or from various receipt points along the GLNG GTP's route.

GLNG GTP

The GLNG Gas Transmission Pipeline (GLNG GTP) is a 420 kilometre gas transmission pipeline designed to deliver gas from the Gas Fields to the LNG Facility. The GLNG GTP is a class 600 high pressure transmission pipeline with an external diameter of 1,067 millimetres (42 inches). It is designed to run at pressures up to 10.2 MPag.

The GLNG GTP is subject to a 15 year no-coverage determination made by the relevant Minister, on the recommendation of the NCC, on 20 June 2013.

The capacity of the GLNG GTP varies throughout the year as conditions, such as temperature and gas composition, change, however average capacity of the GLNG GTP has been estimated at 1,400 TJ/d across the year. Each train of the LNG Facility requires a daily average flow rate of about 600 TJ/d (or 1,200 TJ/d for two trains) averaged across the course of a year in order to meet the foundation offtake agreement commitments. The actual capacity of the LNG Facility will, for technical reasons, vary from its name plate capacity from day to day such that on some days the LNG Facility will be operating at less than full capacity and less than 600 TJ/d will be able to be processed. At other times the LNG Facility will need to operate at or close to its maximum capacity (above name plate capacity) to make up this reduction. This will require that the GLNG GTP also be available to transport at the pipeline's maximum capacity, delivering around 695 TJ/d to each train (or 1,390 TJ/d for two trains) at any time. Any notional "spare capacity" in the pipeline is therefore required to ensure that the LNG Facility can be operated at its maximum capacity where technically possible.

The GLNG GTP will also operate as an important buffer between the operations of the LNG Facility and the Gas Fields. The LNG Facility will, on occasion, have planned and unplanned shut-downs as a result of which less gas will be able to be received. It is difficult to shut down the Gas Fields at short notice without loss of production due to the nature of CSG production and the number of wells needed to produce the gas for the LNG Facility. GLNG has limited storage options for CSG produced at the Gas Fields, but not required by the LNG Facility, and intends to use the "line pack" in the GLNG GTP together with underground storage facilities near Roma to temporarily store the CSG in these situations.

If the GLNG Project is ultimately expanded to include a third liquefaction train, there would be a need to either expand the capacity of the GLNG GTP through compression or looping, or to construct a second pipeline. No decision has yet been made on expanding the LNG Facility to include a third train.

CRWP existing pipeline

The original Comet Ridge – Wallumbilla Pipeline (CRWP) was constructed in 2006. It is 127 km long and 356 mm (14 inches) in diameter. The CRWP runs from the Fairview field (Compressor Station 2) to the Wallumbilla gas transmission hub. It provides one of two transmission pipeline options for delivering CSG from Fairview to Wallumbilla, the other option being transport via the Fairview Lateral and backhaul on the Queensland Gas Pipeline (owned and operated by Jemena). From the Wallumbilla hub, gas produced at Fairview is able to be delivered to customers in south east Queensland (via the Roma – Brisbane Pipeline) or to Mount Isa and the southern States (via the South West Queensland Gas Pipeline, Carpentaria Pipeline and the Moomba–Sydney or Moomba–Adelaide pipelines).

The CRWP is not a covered pipeline for purposes of third party access regulation.

The CRWP connects the Wallumbilla Gas Hub to Compressor Site 2 (CS2) at Fairview (see schematic diagram in Figure 2). CS2 lies approximately 6.5 km north-west of the GLNG GTP inlet at Pipeline Compressor Station PCS-01. A manifold to tie the CRWP into PCS-01 has been constructed, such that the CRWP Loop will be manifolded into the CRWP in PCS-01 into a single connection to the GLNG GTP. The CRWP has several existing intermediate connections to the Roma Underground Gas Storage Facility. Once commissioned, the R-HCS-02 Transmission Line will provide an additional connection from the CRWP to the Roma Underground Gas Storage Facility and the Gas Fields (Roma).

The CRWP is capable of bi-directional operation and currently transports gas in a southerly direction from the Gas Fields (Fairview) to the domestic market and the Roma Underground Gas Storage Facility. After first LNG cargo and export from the LNG Facility commences, the CRWP will generally transport gas in a northerly direction to the GLNG GTP for transport to the LNG Facility. However, particularly prior to start-up of Train 2 of the LNG Facility, the CRWP may, if required, transport gas on occasion in a southerly direction to the Roma Underground Gas Storage Facility or the domestic market to manage LNG Facility commissioning, Gas Fields ramp up and LNG Facility shutdowns.

CRWP Loop

The CRWP Loop is a 119 km long, 610 millimetre (24 inch) diameter pipeline designed to transport gas from the Gas Fields (Roma) and Roma Underground Gas Storage Facility (via the R-HCS-02 Transmission Line) and Third Party Gas (via the Wallumbilla Gas Hub) in a northerly direction to the GLNG GTP inlet at Pipeline Compressor Station PCS-01and ultimately to the LNG Facility (Figure 2). The CRWP Loop (24 inch diameter) is much larger than the CRWP (12 inch diameter).The location of the CRWP Looping Project is shown in Figure 3.

Figure 3 **Location of the CRWP Looping Project**

Source: Santos Fact Sheet: "Comet Ridge to Wallumbilla Pipeline Loop", November 2013

Key design elements of the CRWP Loop are summarised in Table 1.

Table 1 **CRWP Loop design elements**

Design element	Details
Pipeline type	API 5LX70 Electric resistance welded steel pipeline
Pipeline length	119km
Pipeline capacity	750 TJ/day
External diameter	610mm
Wall thickness	Approximately 12mm to 15mm
Maximum allowable operating pressure (MAOP)	15,300 kPa
Design operating pressure	15,300 kPa
Design life	40 years
External pipeline coating	Yes
Depth of cover	Exceeds AS 2885.1. Typically 1,200mm in cross country sections including roads and tracks
Buried marker tape	At open cut road crossings and other crossings
Cathodic protection	Impressed current CP system

Source: GLNG

The CRWP Loop design basis adopts a more stringent (narrower) gas specification than the National Gas Specification AS4654 and is limited by two factors; namely the fracture control and the narrow gas design specification for the LNG facility. Accordingly, the CRWP Loop will not be able to accept gas up to the National Gas Specification AS4654; any gas received will need to meet the narrower design limit specification.

It is not expected that the CRWP Loop will be utilised for the haulage of gas until the second half of 2015 when cool down and start-up of the LNG Facility is scheduled to commence. The CRWP Loop will commence haulage of gas on a commercial basis to the LNG Facility (via the GLNG GTP) upon the loading of the first LNG commissioning cargo, currently scheduled for the second half of 2015.

Gas transport on the CRWP Loop

Unlike the original CRWP which was originally designed to transport gas **in a southerly direction** from Fairview to the Wallumbilla hub for onward shipping to domestic customers, the purpose of the CRWP Looping Project is to allow gas to be shipped **in a northerly direction** from Wallumbilla to the start of the GLNG Transmission Pipeline at Fairview. There is no intention to operate the CRWP Loop in a southerly direction. Its sole purpose is to provide additional capacity for the transportation of gas, northwards, to the LNG Facility. The CRWP Loop will not be capable of operation in a southerly direction unless additional compression is installed at Fairview. This is not planned.

Although the CRWP and the CRWP Loop largely run in parallel for most of their length and both connect the Wallumbilla Gas Hub to the GLNG GTP inlet, they can each be operated entirely independently of the other, potentially in different directions, and with separate metering and pressure control.

Gas delivered to the Wallumbilla Gas Hub can be manifolded by a system of valves to either or both of the CRWP and CRWP Loop. Gas from the R-HCS-02 Transmission Line can also be directed to either or both the CRWP and CRWP Loop.

Capacity of the CRWP Loop

The CRWP Loop will have a nominal design capacity of 750 TJ/d. This capacity will vary throughout the year due to factors such as ground temperature and gas composition. Like all gas transmission pipelines, the CRWP Loop is expected to have greater capacity in winter than in summer.

The capacity of the CRWP Loop will be less than the GLNG GTP, which has an average capacity across a year of 1,400 TJ/d. GLNG intends to use all of the capacity of the CRWP Loop and all of that capacity can be accommodated by the GLNG GTP.

For many wells in the Gas Fields, it is difficult to cease or turn down production at short notice due to the nature of CSG without jeopardising future production. The ramifications of an LNG Facility shutdown are compounded by the number of wells required to produce gas for the LNG Facility. Accordingly, as for the GLNG GTP, any spare capacity available in the CRWP Loop from time to time will be used by the Participants to reduce the impacts of short-term variations in LNG plant feed requirements on the Gas Fields and specifically will provide greater flexibility:

- to accommodate variable gas supply requirements during the LNG Facility commissioning phase;
- to manage Gas Fields ramp up during the initial years of the LNG Facility operation; and
- in the event of planned or unplanned LNG Facility maintenance and other shutdowns, particularly prior to commissioning of Train 2 (a second Train provides greater flexibility to manage LNG Facility shutdowns).

In these circumstances, the CRWP Loop will be line packed with gas from the Gas Fields and/or Third Party Gas. Without these storage options (CRWP Loop, CRWP, GLNG GTP and the Roma Underground Gas Storage Facility, RUGS) it may be necessary in some circumstances for GLNG to flare upstream gas production in the Gas Fields.

1.1.3 The LNG Facility

The LNG Facility cools natural gas to the point at which it turns into a liquid. At atmospheric pressure, natural gas becomes liquid at -162ºC.

While the process to convert natural gas to LNG differs between plants, the process is broadly the same: a LNG plant is essentially a large cooling system which lowers the temperature of the natural gas by using refrigerants. Natural gas is piped into the plant and is initially treated to remove impurities, carbon dioxide and water. The gas then undergoes a liquefaction process by using refrigerants to lower the temperature of the natural gas until it liquefies. The LNG is then stored in full containment LNG tanks at atmospheric pressure prior to shipping.

The LNG Facility consists of:

- a liquefaction facility which includes the on-shore gas liquefaction and storage facilities;

- marine facilities which include a product facility for loading LNG into tankers for export, and a facility and haul road for the delivery of equipment, plant, materials and personnel to and from the LNG Facility site; and
- a swing basin and access channel from the existing Targinie Chanel in Port Curtis.

GLNG will include two liquefaction trains with a nameplate capacity of 7.8 Mtpa. The LNG Facility may produce more or less LNG than the nameplate capacity at any point in time depending on feed gas composition, GLNG GTP/plant interface pressure and temperature, site ambient air temperature, refrigeration compressor and refrigeration gas turbine de-rating, refrigeration compressor gas turbine inlet air temperature and facility operating mode (for example, whether concurrent ship loading is occurring) with an ultimate capacity of 8.82 Mtpa under favourable conditions. Total LNG production in each year will also be affected by breakdowns of the LNG Facility and ship delays, amongst other things.

If the GLNG Project proceeds to full development (ie three trains), the LNG Facility will have a nominal capacity of approximately 10 Mtpa. GLNG is yet to make a final investment decision on expanding the LNG Facility to include a third train. The Participants will also have to obtain or seek to amend the relevant secondary approvals before a third train can be constructed.

1.2 Previous no coverage application

In March 2013 GLNG applied to the National Competition Council (NCC) under s.151 of the *National Gas Law 2008* for a 15-year no coverage determination to exempt the GLNG GTP from being a covered pipeline for purposes of third party access. As a part of that application process, ACIL Allen (then known as ACIL Tasman) was engaged to prepare an independent expert study of gas markets downstream of the coal seam gas (CSG) fields that will supply gas to the LNG plant. The application was successful with a no coverage determination being issued by the relevant Minister in May 2013.

1.3 Scope of the market study

ACIL Allen has been engaged to provide an expert opinion on the following matters:

Downstream domestic markets:

a) the downstream domestic location of gas markets that may be served by the CRWP Loop;
b) the projected demand and price in those downstream gas markets until 2035;
c) the effect of any Federal or State Government policy on the projected consumption and price in those downstream markets;

Downstream global Liquefied Natural Gas (LNG) market:

d) a description of LNG facilities, including their capacity, that have been proposed by third parties and, if construction of any of those projects has commenced, the stage of development;
e) the competitiveness of the global LNG market and the effect that access by third parties to the CRWP Loop would have on that competitiveness;

Alternative pipelines:

f) the projected availability of alternative pipelines to transport gas:
   i) from upstream coal seam gas producers;
   ii) to the domestic market; and/or

iii) to global LNG markets,

until 2035 including the projected cost of that transportation; and

Upstream coal seam gas resources:

g) a description of the LNG projects proposed by third parties at Curtis Island, Queensland and the stage of development of those projects;

h) an estimate of the potential coal seam gas production by small producers that may seek to access the CRWP Loop including:

   i) the name and company information of those producers;

   ii) the estimated gas reserves and projected production rates for those producers; and

   iii) the relative costs of using the CRWP Loop to transport that gas versus alternative pipelines identified above.

ACIL Allen has been asked to provide economic analysis and advice and to prepare a written expert report addressing the above matters.

1.4 ACIL Allen's qualifications

ACIL Allen is the largest specialist economics and policy consultancy business in Australia. The firm has extensive experience in the gas industry, both in Australia and internationally. This experience covers areas including policy development, market analysis and the provision of economic and commercial advice to public and private sector clients. The firm's analytical and advisory services to the gas industry encompass the entire supply chain—from gas producers, pipeline operators, gas distributors and retailers—to major customers such as power stations and industrial facilities, as well as investors, developers and financiers. This study has been prepared by Paul Balfe, an Executive Director of ACIL Allen who has overall responsibility for the firm's gas business.

Summary curriculum vitae information for Mr Balfe is set out in Appendix A.

2 Downstream markets

Key Findings Chapter 2

Chapter 2 discusses the relevant domestic markets downstream of the CRWP Loop. We assume that third party shippers could potentially inject gas into the CRPW Loop at Wallumbilla (at the southern end of the pipeline) or at a mid-line injection point.

The gas would then be carried in a northerly direction to the northern end of the CRWP Loop where it could potentially be transferred either:

a) into Pipeline Compressor Station 1 (PCS-01) for injection into the GLNG Transmission Pipeline (GLNG GTP), for onward carriage to the GLNG plant on Curtis Island; or

b) into the Fairview Lateral which connects to the Queensland Gas Pipeline (QGP, operated by Jemena). After delivery into QGP, the gas could be transported either

   i) to the north to Gladstone and downstream markets, or

   ii) to the south (backhaul) to Wallumbilla; or

c) into the existing CRWP pipeline for backhaul to Wallumbilla.

By these means, gas carried in the CRWP Loop could reach domestic gas markets in Central Queensland (Gladstone, Rockhampton, Bundaberg, and Maryborough) as well as to LNG facilities on Curtis Island at Gladstone.

In theory, the CRWP Loop could also act as part of a delivery system for carriage of gas to the Wallumbilla hub, from whence it could be delivered to markets throughout eastern Australia. However, in practice there is no apparent reason for any gas shipper to take gas from Wallumbilla, north through the CRWP Loop, only to return it to the Wallumbilla Hub for onward carriage to south-eastern Australian domestic markets. Given that the CRWP Loop is a unidirectional pipeline incapable of physically delivering gas south to Wallumbilla, we do not regard markets to the south and east (accessible from Wallumbilla by the SWQP and RBP respectively) as being relevant downstream markets for the purposes of the CRWP Loop.

The significant domestic market centres within this region are:

- Industrial facilities at Moura
- Industrial, cogeneration and retail consumers at Gladstone
- Industrial and retail consumers at Rockhampton
- Retail consumers (commercial, residential and small industrial) in the Wide Bay region at Bundaberg and Maryborough.

Total domestic gas demand in the region is currently around 50 PJ/a, and is forecast to remain flat over the next 15 years. Around 90 per cent of the total domestic demand is for industrial and co-generation use in and around Gladstone.

We estimate that wholesale delivered gas prices into Gladstone and Rockhampton under legacy contracts are presently in the range A$4.00 to A$5.50/GJ, including transport cost on the QGP. The cost of gas supply under new long-term supply contracts is likely to be considerably higher, with contracts now containing linkages to oil price. One recent contract was settled at a price of around A$8.50/GJ based on oil at US$100 per barrel, but would be only around A$5.80/GJ (ex-plant) with oil at US$50 per barrel.

In this section, we first consider the question of what are the relevant downstream markets (domestic and export) that could be serviced by gas carried in the CRWP Loop. We also discuss how state and federal government policies potentially affecting gas demand have been taken into account in developing the demand forecasts.

For the domestic gas markets, we discuss the major existing and prospective gas loads that constitute the local demand for natural gas; the nature of their current gas supply arrangements and load characteristics; and the overall demand for gas in the market location based on the requirements of the individual loads. A breakdown of demand by category of user (power generation; industrial use including co-generation; commercial and residential) is provided.

The last part of this section discusses current gas prices and price structures for different categories of gas customer in the region.

2.1 Relevant downstream markets

In considering the question of what are the relevant downstream gas markets (domestic and LNG) that could be supplied by gas using the CRWP Loop, we assume that third party gas suppliers using the CRWP Loop would potentially inject gas either:

1. at the southern end of the CRWP Loop (Wallumbilla Hub); or
2. at a mid-line injection point (not yet constructed) on the CRWP Loop.

The gas would then be carried in a northerly direction to the northern end of the CRWP Loop where it could potentially be transferred either:

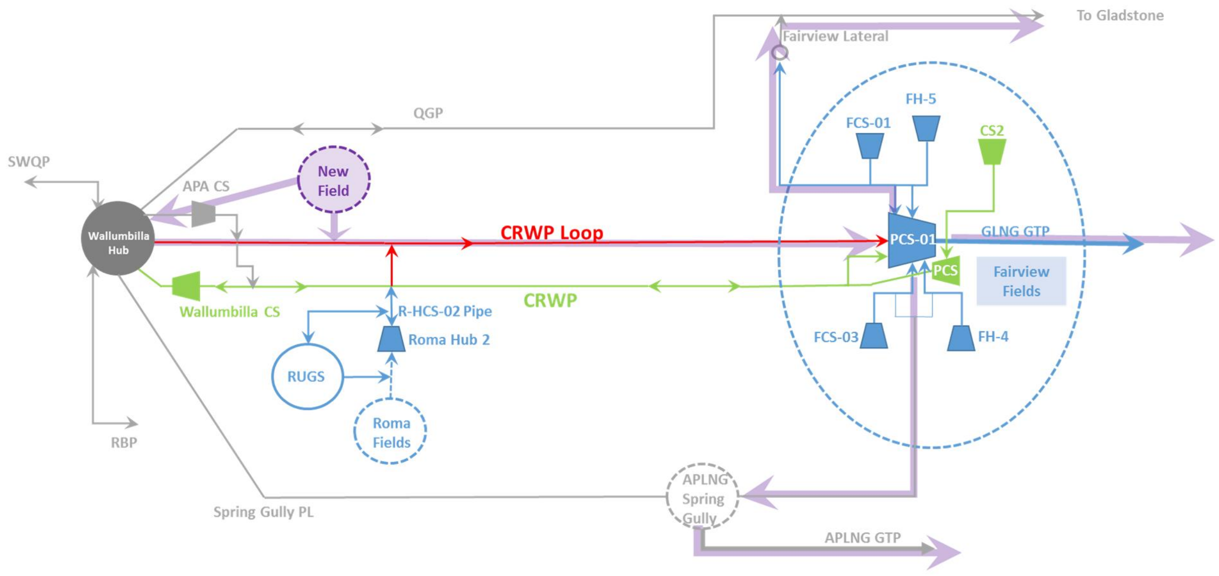
- a) into Pipeline Compressor Station 1 (PCS-01) for injection into the GLNG Transmission Pipeline (GLNG GTP), for onward carriage to the GLNG plant on Curtis Island; or
- b) into the Fairview Lateral which connects to the Queensland Gas Pipeline (QGP, operated by Jemena). After delivery into QGP, the gas could be transported either
  - i) to the north to Gladstone and downstream markets, or
  - ii) to the south (backhaul) to Wallumbilla; or
- c) into the existing CRWP pipeline for backhaul to Wallumbilla.

Options (a) and (b)(i) above would allow the CRWP Loop to act as part of a system for delivery of gas to domestic gas markets in Central Queensland (Gladstone, Rockhampton, Bundaberg, Maryborough) as well as to LNG facilities on Curtis Island at Gladstone.

Options (b)(ii) and c) above could both, in theory, allow the CRWP Loop to act as part of a delivery system for carriage of gas to the Wallumbilla hub, from whence it could be delivered to markets throughout eastern Australia. However, in practice there is no apparent reason for any gas shipper to take gas from Wallumbilla, north through the CRWP Loop, only to return it to the Wallumbilla Hub for onward carriage to south-eastern Australian domestic markets. There are several existing alternative pipeline routes that would allow gas from fields in the vicinity of the CRWP Loop to be delivered to the Wallumbilla Hub, including via the QGP (backhaul), CRWP, APLNG's Spring Gully Pipeline, the South West Queensland Pipeline (SWQP) or the Roma – Brisbane Pipeline (RBP). **For these reasons, and bearing in mind that the CRWP Loop is a unidirectional pipeline incapable of physically delivering gas south to Wallumbilla, we do not regard markets to the south and east (accessible from Wallumbilla by the SWQP and RBP respectively) as being relevant downstream markets for the purposes of the CRWP Loop.**

Figure 4 illustrates the gas transportation pathways that would potentially be available to third party shippers using the CRWP Loop.

Figure 4 **Notional gas transportation pathways using the CRWP Loop**



Source: ACIL Allen Consulting

The CRWP Loop will connect to the Wallumbilla Gas Hub from a point adjacent to the APA compressor station. The following existing pipelines also connect to the Wallumbilla Gas Hub and are capable of delivering into the CRWP Loop:

- SWQP (South West Queensland Pipeline; APA, PPL24)
- BWP (Berwyndale to Wallumbilla; APA, PPL123)
- DDPL (Darling Downs Pipeline; Origin, PPL134)
- SGPL (Spring Gully to Wallumbilla Pipeline; Origin, PPL90)

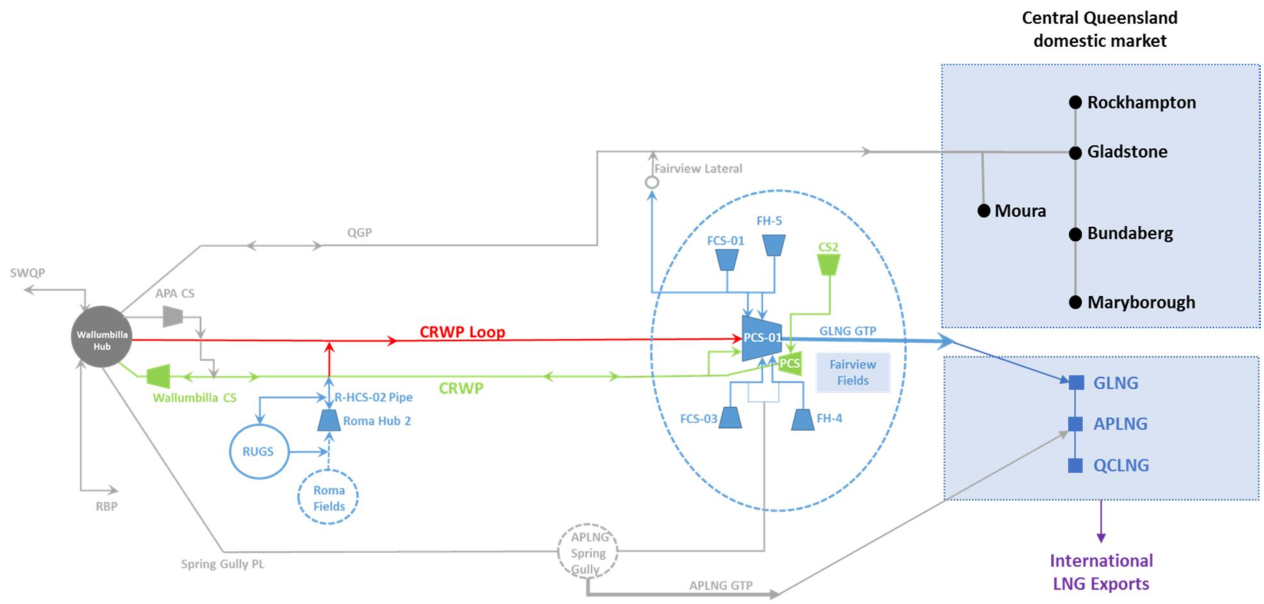
The QGP (Queensland Gas Pipeline; Jemena, PPL30) and RBP (Roma Brisbane Pipeline; APA, PPL2) also connect to the Wallumbilla Gas Hub but are exit pipelines, such that gas can only flow out of Wallumbilla through these pipelines. GLNG expects that infrastructure will be built in future which will also allow the RBP to be used to transport gas into the Wallumbilla Gas Hub. Gas entering the CRWP Loop either at Wallumbilla or mid-line (via a new receipt point) could be delivered:

1. To the GLNG liquefaction plant on Curtis Island, via PSC-01 and the GLNG GTP.
2. To the APLNG liquefaction plant on Curtis Island, via the APLNG Fairview-Spring Gully Pipeline and the APLNG GTP
3. To domestic markets in Central Queensland via the Fairview Lateral & QGP (Gladstone) plus the Dawson Valley Pipeline (Moura), the QGP Rockhampton lateral (Rockhampton) and the Wide Bay Pipeline (Bundaberg, Maryborough)

Gas from the CRWP Loop would also be able to access the QCLNG export project via the interconnection between the GLNG and QCLNG plant sites on Curtis Island.

The downstream markets for the CRWP Loop pipeline are illustrated in Figure 5.

Figure 5 **CRWP Loop downstream markets**



Source: ACIL Allen Consulting

We conclude that the relevant downstream gas markets serviced by the CRWP Loop comprise:

- **the Central Queensland domestic gas supply system including gas markets in the Gladstone, Rockhampton, Moura and Wide Bay regions.**
- **Export LNG market internationally, serviced via the LNG liquefaction plants on Curtis Island at Gladstone.**

The remainder of this chapter provides a review of the downstream domestic gas markets in Central Queensland. The following chapter discusses relevant LNG markets.

2.2 Projected demand and price in downstream domestic gas markets

2.2.1 Demand overview

Figure 5 shows the location of the downstream gas markets that could be accessed by gas passing through the CRWP Loop. The significant domestic market centres within this region are:

- Industrial facilities at Moura
- Industrial, cogeneration and retail consumers at Gladstone
- Industrial and retail consumers at Rockhampton
- Retail consumers (commercial, residential and small industrial) in the Wide Bay region at Bundaberg and Maryborough.

The industrial city of **Gladstone** is the main downstream market potentially served by the CRWP Loop. The Gladstone market is currently serviced via the QGP, operated by Jemena. Gas delivered to Gladstone via the QGP system can also enter the Larcom Creek –

Rockhampton Lateral which is the only gas transmission pipeline currently available for transport of gas to customers at **Rockhampton**. Alternatively, gas delivered to Gladstone via the QGP can be transferred to the Wide Bay Pipeline (owned by Envestra, which was recently acquired by Hong Kong-based Cheung Kong Group) to customers in the **Wide Bay** area (Bundaberg, Maryborough and Hervey Bay).

The only other domestic gas market that could potentially be serviced by gas passing through the CRWP Loop is at **Moura** where a single large industrial gas customer (Queensland Nitrates Pty Ltd – a joint venture involving Dyno Nobel and CSBP Wesfarmers) is currently supplied from the adjacent Moura – Dawson River CSG fields. Moura also has existing access to gas supplied via the QGP.

2.2.2 Current gas consumption in the relevant downstream markets

In 2014 levels of gas consumption in the relevant downstream markets are estimated by ACIL Allen[1] to have been as follows:

- Gladstone – 45.2 PJ/a
- Rockhampton – 1.6 PJ/a
- Wide Bay – approximately 0.4PJ/a
- Moura – 2.8 PJ/a

2.3 Summary of demand

The current and projected gas loads in the relevant downstream markets in Gladstone, Rockhampton and Wide Bay are summarised in Table 2. The projections show how demand is split between the three regional sub-markets. Table 2 also provides a split of the total regional gas demand by customer category: industrial, cogeneration and retail small customers (including residential, commercial and small industrial users serviced by the Envestra distribution business in Gladstone and Rockhampton and by Origin in the Wide Bay region). There is no existing or anticipated gas-fired power generation other than through co-generation in the relevant markets.

[1] Estimate based on ACIL Allen's GMG Australia *GasMark* database and National Gas Market Bulletin Board data on actual daily gas flows on QGP.

Table 2 **Summary of current and projected demand in relevant downstream markets**

	2010–11*	2014	2020	2025	2030
Gladstone	37.9	45.3	45.8	44.9	45.2
Rockhampton	1.6	1.6	1.6	1.6	1.6
Wide Bay	0.3	0.3	0.4	0.5	0.5
Moura	2.8	2.8	2.8	2.8	2.8
TOTAL	42.6	50.0	50.6	49.8	50.1
Industrial	35.3	36.4	36.3	36.4	36.3
Cogeneration (Gladstone)	6.7	13.0	13.6	12.5	12.8
Retail small customers	0.6	0.7	0.8	0.9	1.0

* Demand in PJ per year; totals may not add due to rounding

Data source: Values for 2011, 2014 based on National Gas Market Bulletin Board throughput data for QGP plus ACIL Allen estimates for non-GBB facilities; forecast data from ACIL Allen's GMG Australia *GasMark* model

2.4 Demand by market location

2.4.1 Gladstone

Gladstone is a substantial gas market centre with a number of large industrial users as well as a small reticulation market serving mainly small industrial customers. Table 3 provides a breakdown of current and projected demand in Gladstone by customer.

Table 3 **Current and projected demand in Gladstone**

	2011	2015	2020	2025	2030
Boyne Is. Smelter	1.4	1.4	1.4	1.4	1.4
YAR Stage 2 Calcining	7.2	7.2	7.2	7.2	7.2
Yarwun Refinery - Calcining	4.0	4.0	4.0	4.0	4.0
Gladstone Base Market	0.2	0.2	0.2	0.3	0.3
Orica	6.5	6.5	6.5	6.5	6.5
QAL Alumina Plant	11.8	12.3	12.9	13.0	13.0
Yarwun Cogen	3.9	13.1	13.6	12.5	12.8
TOTAL	**35.0**	**44.6**	**45.8**	**44.9**	**45.2**

Demand in PJ per year; totals may not add due to rounding

Data source: ACIL Tasman GMG Australia model

Gladstone demand profile

It is worth noting that the apparent levelling out of demand at Gladstone after 2015 is a result of the fact that almost all demand growth in this market relates to large-scale industrial loads, and there are no such new loads currently identified as coming on line post 2015. This is an artefact of the planning horizon for large industrial projects of this type, rather than an indication that the Gladstone market will have reached any form of natural size limit. While there may well be further growth in gas demand at Gladstone post 2015, no such emergent demand has been included in the projections because any such growth would, at this stage, be purely speculative.

Queensland Alumina Limited (QAL)

The Gladstone alumina refinery operated by Queensland Alumina Limited is one of the largest in the world, with a maximum annual rated capacity of 3.95 million tonnes. Bauxite from the Weipa mine on Cape York Peninsula is processed in the refinery to produce alumina, which is then shipped to smelters in Australia (including the nearby Boyne Island smelter) and overseas. Refinery operations commenced in 1967. The site has seen a series of expansion programs resulting in a six-fold increase in capacity from the initial 600,000 tpa plant.

QAL uses energy primarily for process steam-raising and for calcining (the process in which aluminium hydrate is converted to aluminium oxide). Current energy requirements are:

- About 1.5 million tonnes of coal per year (equivalent to about 34 PJ/a) of coal for steam-raising
- Up to 16 PJ/a of natural gas
- 16 MW of grid electricity and 16 MW of internally-generated electricity.

QAL was initially supplied with its full gas requirements under contract from conventional gas fields in the Denison Trough (Origin). The initial contract ran until late 2006. In December 2003, QAL announced signing of a new gas supply agreement that will see Origin supply some 11 PJ/a to QAL over a period of 15 years, commencing 1 November 2006. The main source of supply is said to be Central Queensland CSG – presumably from Origin's interests in the Fairview and Spring Gully fields although it is understood that there is no restriction on the source of gas. QAL also has some flexibility to purchase gas from other suppliers above take-or-pay levels as specified under the Origin supply agreement. Deliveries under the contract are now understood to have increased to a maximum 16 PJ/a following expansion of Origin's production capacity at Spring Gully in 2006 and 2007 and development of the Talinga CSG production facility.

Yarwun Alumina Refinery (YAR)

The Yarwun Alumina Refinery (YAR, formerly known as CAR – Comalco Alumina Refinery) is situated in the Yarwun area, 10km north-west of Gladstone. Stage 1 of YAR involved a 1.4 Mtpa alumina refinery at a cost of US$750m. Construction commenced in 2002, with the plant fully operational by early 2005.

The project includes:

- the refinery process site containing production facilities including a steam generation plant
- the bauxite residue storage area, 10 km west of the refinery site
- the port facility, materials handling and transportation, and associated stockpile areas.

YAR's energy use is primarily for process steam-raising and for calcining (the process in which aluminium hydrate is converted to aluminium oxide). The energy requirements for Stage 1 are:

- About 23 PJ/a of coal for steam-raising[2]
- 4 PJ/a of natural gas for calcining

[2] While the Stage 1 steam plant has been designed to operate on coal, it could be converted to run on gas (most likely through a retrofitted cogeneration plant) if adequate low-priced gas supply becomes available.

— 63 MW of grid electricity.

Rio Tinto subsequently completed a US$2.2 billion expansion, increasing alumina capacity to 3.4 Mtpa. As part of the expansion, a 160 MW gas cogeneration plant was constructed providing the plant with its entire electricity requirement (approximately 90 MW after expansion) and meeting a portion of its steam needs. Gas requirements for the cogeneration plant and additional calcining volumes total around 22.8 PJ/a. Coal is used to supplement steam requirements for process heat.

There is potential for a further 2 Mtpa expansion (Yarwun Stage 3).[3] We have not factored Yarwun Stage 3 into our demand projections.

Orica

The Orica site at Yarwun Industrial Estate, 10 km north of Gladstone, incorporates the following chemical plants:

- Sodium cyanide plant (95,000 tpa following progressive uprating of original 20,000 tpa plant)
- Chloralkali production (9,500 tpa as caustic soda)
- Ammonium nitrate (NH_4NO_3 capacity 580,000 tpa). It presently uses some 100,000tpa of ammonia transported from Incitec's Gibson Island (Brisbane) plant, complemented by imports.

Ammonium nitrate production capacity was increased by approximately 25,000 tpa to 300,000 tpa in 2005, and further increased to 580,000 tpa in 2006. It is now said to be the largest industrial grade ammonium nitrate complex in the world (Mossop, 2008).

The plant currently relies on a mix of local and overseas imports of ammonia, rather than local manufacture of ammonia. At the current production scale, local production would require around 12.6 PJ/a of natural gas.

ACIL Allen understands current gas requirements to be around 6.5 PJ/a.

Boyne Smelters Ltd

The Boyne Island aluminium smelter began operation in 1982 and, following the commissioning of a US$1 billion expansion in 1997 and subsequent upgrades, has a production capacity of 557,000 tpa[4]. It is the largest smelter in Australia and presently the fourth largest in the world. The smelter operates three reduction lines, a metal casting house, an anode production plant and ancillary facilities.

BSL uses natural gas for anode production and in the carbon plant. Current gas requirements are understood to be about 1.4 PJ/a. Fuel alternatives to natural gas are liquid fuel or LPG.

2.4.2 Rockhampton

Rockhampton is a relatively small gas market with a single large industrial user and a small reticulation market serving small industrial, commercial and residential customers.

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[3] Rio Tinto, "Bauxite and Alumina Investor Site Visit", 23 June 2010. http://www.riotinto.com/documents/Media-Speeches/100623_Yarwun_Analyst_Visit_June2010.pdf accessed 11 April 2012.

[4] As at 31 December 2008: (Rio Tinto, 2009).

Queensland Magnesia (QMAG)

The sole major industrial gas user in Rockhampton at present is QMAG.

Queensland Magnesia (QMAG) based at Parkhurst, Rockhampton in Central Queensland is one of the world's largest magnesite, calcined magnesia and refractory magnesia operations.

QMAG was established as a joint venture in 1987 to mine and process magnesite from the Kunwarara magnesite deposit. Since 1997 it has been a wholly owned subsidiary of Australian Magnesium Corporation Limited. Construction of the mine and processing facilities began in 1989 and commercial production of beneficiated magnesite and magnesia products commenced in 1991.

Approximately 3 million tonnes of ore is mined each year at Kunwarara to yield some 450,000 tonnes annually of high grade beneficiated magnesite - a simple first stage washing, sorting and screening process. Parkhurst processes the beneficiated magnesite ($MgCO_3$) into calcined magnesia, deadburned magnesia and electrofused magnesia.

Current gas requirements are 1.5 PJ/a with the site also using around 120 GWh/a of electricity.

QMAG has in the past investigated plans to double the capacity of the current Parkhurst operations. Consideration has also been given to locating a new plant at Kunwarara due to issues transporting ore to North Rockhampton. The expansion would result in doubling of current gas requirements (from 1.5 PJ/a to 3.0 PJ/a). However, at this point in time it is unclear whether the expansion will occur, and if so when.

2.4.3 Reticulated demand

Envestra's Northern distribution network supplies small customers in both Gladstone and Rockhampton. Reticulated gas demand is relatively small at around 0.3 PJ/a, as shown in Table 4.

Table 4 **Gladstone & Rockhampton: actual and forecast reticulated demand (TJ/a)**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Domestic	17	18	23	23	23	23	23	23	22	22	22
Commercial	118	133	92	93	93	96	101	104	105	106	108
Large users	144	152	159	133	134	136	140	142	141	141	142
Total	278	304	274	249	251	255	264	269	269	269	272

Data source: Historical consumption and demand forecasts for Envestra, from 2011 Access Arrangement Information

Origin Energy is the primary retailer in the Envestra networks although the market is now exposed to competition as full retail contestability for all users commenced in July 2007.

2.4.4 Wide Bay region

The Wide Bay region—which includes Bundaberg, Maryborough and Hervey Bay— is supplied with gas delivered via the Wide Bay Pipeline which runs from Gladstone south to Maryborough, a distance of some 309 km. The pipeline has a low capacity, being only 100 mm in diameter.

Neither the Wide Bay Pipeline nor the gas distribution systems in the Wide Bay region are covered pipelines under the National Gas Law. As a result, there is little public domain information regarding gas demand serviced by the pipeline. However, we understand that the market comprises entirely retail customers (residential, commercial and small industrial) and that the total gas demand in the region is small—currently around 0.4PJ/a. Because of rapid population growth in the area (particularly Hervey Bay) there is some modest scope for demand growth in the region.

2.5 Gas prices in the relevant markets

Wholesale gas prices delivered into the relevant markets include two components: the cost of gas and the cost of pipeline transmission. Final delivered prices are contract-specific and are not publicly available. However, based on limited public domain information regarding existing gas supply contracts, we estimate that wholesale delivered prices into Gladstone and Rockhampton **under legacy contracts** are presently in the range A$4.00 to A$5.50/GJ, including transport cost on the QGP of A$0.80 to A$1.00/GJ depending on customer load factor.

Anecdotally the cost of gas supply under new long-term supply contracts is considerably higher. Again, there is little verifiable information on new long-term contract prices, but one recent deal provides some insight. In March 2014, a GSA between the Meridian Seamgas Joint Venture (WestSide Corporation [WCL] 51%, Mitsui E&P Australia 49%) and GLNG was announced.

According to WestSide's ASX release at the time, the agreement provides for future sales volumes of up to 65 TJ/d. At the maximum rate for the full 20 year term, this would mean delivery of up to 475 PJ over the life of the contract. The WCL investor presentation released on 27 March 2014 states that: "A conservative development plan could see the Meridian joint venture supplying 40 TJ/d by 2017, in which case WestSide's share of revenues over the contract term could significantly exceed $1 billion." This implies an average gas price in excess of $6.70/GJ, given that WCL holds 51% of the Meridian JV.

Further information on the gas price under this GSA was contained in a Target Statement released by WCL on 16 May 2014 in response to a takeover offer from a Chinese company, Landbridge. The Target Statement confirms that the deal with GLNG is for sale of up to 65 TJ/d over 20 years commencing 2015, and indicates the following key pricing terms:

- During 2015 the price is fixed in A$/GJ.
- From 1 January 2016 the price of the gas is determined in US dollars (US$) per gigajoule (GJ), and is referenced to JCC oil price. It is based on a formula which includes both a variable component and a relatively small fixed component
- From 1 January 2017 the price increases slightly as a result of a change to one of the parameters of the formula.

It then goes on to provide the following price estimates:

Figure 6 **Meridian Seamgas – GLNG gas price**

Exhibit 3: Estimate of gas price under GLNG GSA from 2017

JCC Oil Price (US$/bbl)	100	110	120
Gas Price (US$/GJ)	7.95	8.60	9.24
Gas Price (A$/GJ)[3]	8.58	9.28	9.98

Note: Assumes AUD/USD = 0.9261
Source: Westside Corporation Limited Target Statement dated 16 May 2014

The prices shown in Figure 6 are consistent with an oil-linked gas pricing formula of the form $P = A \times \phi + B$ where A = 6.5%, Φ = JCC oil price and B = 1.45.

Hence the gas price received under this GSA from 2017 will range between about A$8.60/GJ and $9.30/GJ for JCC oil prices in the range US$100 to US$110/bbl. However, at the much lower oil prices now prevailing (around US$50/bbl) the implied gas price is much lower: about A$5.80/GJ assuming AUD/USD = 0.81.

The cost of gas to retail customers is considerably higher, because as well as the cost of the gas ex field and transmission pipeline costs, customers also pay for low-pressure distribution and retail charges. Because of the fixed service charge component in retail tariffs and volume-scaled charging for gas consumption, the average price of gas to retail customers typically reduces as the total amount of gas used per billing period increases. Origin Energy is the main supplier of retail gas in Gladstone, Rockhampton and Wide Bay. According to Origin Energy's published schedule of tariffs applicable from 20 July 2011 for retail supply in these areas, the price of gas to typical retail customers in these areas are as shown in Table 5.

Table 5 **Retail gas prices – Gladstone, Rockhampton, Wide Bay**

Customer Type/Size	Gladstone/ Rockhampton A$/GJ	Wide Bay A$/GJ
Residential 10 GJ/a	56.13	67.05
Residential 20 GJ/a	37.57	35.89
Commercial/Industrial 100 GJ/a	31.39	31.14
Commercial/Industrial 250 GJ/a	29.13	29.80

Note: Prices shown exclude GST
Data source: Origin Energy tariff schedule as published by Origin Energy Retail Limited

2.6 Implications of government policies

We have been asked to consider the effect of any Federal or State Government policy on the projected consumption and price in the relevant downstream markets.

A number of Federal and State government policies have the potential to impact on future gas demand.

At a Federal government level, the most significant policy developments relate to recent changes in carbon pricing arrangements with the carbon price introduced by the previous

Labor government under the Clean Energy Future package having been repealed. Potential changes to the Large-scale Renewal Energy Target (LRET) may also have some effect.

State government policies related to energy efficiency and water conservation also have the potential to impact on future gas demand—some positively and others negatively in terms of the rate of demand growth. In the following sections we briefly review the nature of these potential impacts, and explain how they have been taken into account in the gas market modelling.

2.6.1 Carbon policy

The current Coalition government has acted to repeal the Carbon Pricing Mechanism with effect from 30 June 2014 and to commence implementation of a "Direct Action Plan" to source low cost emissions reductions. The Direct Action Plan includes an Emissions Reduction Fund (ERF) to provide incentives for abatement activities across the Australian economy.

The main impact of the repeal of the carbon pricing mechanism relates to the relative competitiveness of natural gas and coal as fuels for electricity generation. In the absence of a direct price for carbon dioxide emissions, it is reasonable to expect that the level of utilisation of coal-fired electricity generators will rise, and the utilisation of gas-fired electricity generators will fall. Hence demand for gas as a fuel for electricity generation will decrease.

The gas demand projections discussed in section 2.4 take into account the repeal of the Carbon Pricing Mechanism from 1 July 2014.

2.6.2 Renewable Energy Target

The Renewable Energy Target (RET) scheme is designed to ensure that 20 per cent of Australia's electricity comes from renewable sources by 2020. Since January 2011 the RET scheme has operated in two parts—the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET).

The Small-scale Renewable Energy Scheme (SRES) and Large-scale Renewable Energy Target (LRET) have the potential to affect demand for gas in electricity generation. Both schemes tend to suppress consumption of gas for power generation. Installation of solar photovoltaic panels under the SRES has seen a significant reduction in wholesale electricity demand growth throughout the National Electricity Market (NEM).

The LRET requires liable electricity retailers to source 20% of the electricity that they sell to consumers from renewable sources, by 2020. The scheme is directionally unfavourable for gas demand because it results in more power generation in the National Electricity Market coming from renewable sources (in particular, wind generation with possible contributions from geothermal), at the expense of opportunities for base and intermediate load gas-fired power generation using Combined Cycle Gas Turbine technology. This suppression of demand for gas in power generation is incorporated into ACIL Allen's demand assumptions in the *GMG Australia* gas market modelling.

During 2014, the government undertook a review of the RET scheme. The review recommended scaling back the 2020 renewables target in the light of declining electricity demand. The government is yet to announce its responses to the reviews recommendations.

2.6.3 Queensland Gas Scheme

The Queensland Gas Scheme (QGS) began in 2005 and was established to boost the state's gas industry and reduce greenhouse gas emissions. Under the QGS, Queensland electricity retailers and other liable parties were required to source 15 per cent of their electricity from gas-fired generation. The scheme was successful in increasing the level of natural gas use for electricity generation in the state. It also assisted in encouraging the development of new gas sources—in particular it provided an important policy underpinning for the development of Queensland's coal seam gas (CSG) industry.

The QGS scheme closed on 31 December 2013.

2.6.4 Domestic gas reservation policies

With gas prices rising and many large gas users reporting difficulty in securing new supply contracts, there has been considerable debate in recent times whether governments in eastern Australia should introduce some form of domestic gas reservation policy to ensure supply for local consumers on "reasonable" terms. To date only the Western Australian government has an active reservation policy. It requires large-scale LNG projects (and potentially other export-oriented gas-using industries such as gas-to-liquids) to set aside 15% of their gas reserves for domestic use. In the eastern states the debate has been highly polarised. Many major gas users have called for gas reservation policies along the lines of the current Western Australian arrangements, while gas producers have argued that such policies would be counter-productive, creating a disincentive to exploration that would tend to reduce rather than increase gas supply.

So far, State and Federal governments in the eastern states have been reluctant to intervene in gas markets by imposing gas reservation policies. In 2009 the Queensland government announced that, rather than imposing a domestic reservation requirement on LNG proponents, it would set aside areas of land prospective for CSG that could, if required, be released for exploration and development of resources for future domestic gas supply. No such domestic gas land release has been made, and with the change of government in Queensland it appears unlikely that the scheme will be activated. There remains a question whether this situation will change over the next few years if serious domestic gas shortages occur following LNG start up, potentially leading to closure of major gas-consuming businesses and consequential job losses.

2.7 CRWP Loop significance with regard to competition in domestic gas markets

We have been asked to consider the effect that third party access to the CRWP Loop would have on the competitiveness of the relevant domestic gas markets.

The short answer is that third party access to the CRWP Loop would have **little if any effect on the competitiveness of domestic gas markets in eastern Australia**. The domestic markets relevant to the CRWP are those located in Central Queensland and the Wide Bay region. Those regions are already served by domestic gas pipeline transmission infrastructure. Any gas passing through the CRWP Loop in order to access domestic markets would still need to travel through that existing infrastructure (the QGP, operated by Jemena, and other downstream pipelines). Use of the CRWP Loop might in some instances change the point at which gas bound for the domestic market enters the QGP (for example, from Wallumbilla to the location where the Fairview Lateral joins the QGP) but would be very unlikely to result in any significant transportation cost savings.

Given that Jemena has in the past shown a willingness to expand system capacity in the QGP to meet market demand growth, and given also that little if any domestic gas demand growth is anticipated over the next fifteen years in the relevant markets, availability of transmission pipeline capacity is unlikely to impose a constraint on domestic market development in Central Queensland.

On this basis we see no reason to expect that provision of access to the CRWP Loop would lead to more competitive outcomes in the domestic gas market, either in terms of the quantity and diversity of gas supply or the price of gas delivered.

3 Downstream global LNG markets

Key Findings Chapter 3

Chapter 3 discusses global LNG markets and the significance of the CRWP Loop in the context of those markets.

LNG currently represents about 10 per cent of total global gas supply. The 237 million tonnes of LNG sold in 2013, equivalent in energy terms to about 13,130 PJ, is around twenty times greater than the amount of gas currently consumed in eastern Australia.

Global demand for natural gas, and in particular for LNG, is expected to grow strongly over the next decade and beyond, with the strongest demand growth being in the Asia-Pacific region.

The global LNG market—already large and diversified—is continuing to grow and to become more competitive. Over the past twenty years or so, the global LNG industry has seen strong growth in trade volumes and also in the number of both exporting and importing countries. The increasingly liquid and competitive nature of the global LNG market is also demonstrated by the growing proportion of world trade now transacted through spot sales and re-exports, which now account for around 30% of global LNG trade.

At present, about half of Australia's gas production is used domestically while half is exported as LNG. The proportion of exports will increase dramatically over the next four years as seven new LNG projects now under construction around Australia come on line. Currently ranked third with respect to installed LNG production capacity, Australia will become the world's number one LNG producer within the next five years with production capacity more than tripling to around 86 Mtpa.

Further growth in Australian LNG production capacity beyond the projects currently under construction is likely to face strong competition, particularly from North American projects that enjoy access to low-cost gas supplies and lower construction and operation costs.

At Gladstone in Central Queensland, three world-scale LNG projects are currently under construction. These projects have so far committed to six LNG liquefaction trains, resulting in total capacity of 25.3 Mtpa, with a requirement of around 1,500 PJ of CSG each year for feedstock and ancillary use. This is more than double the size of the current eastern Australian domestic gas market.

We conclude that providing third party access to the CRWP Loop would have no discernible effect on the competitiveness of global LNG markets, primarily because the quantity of gas that could be moved through the CRWP Loop is relatively insignificant in the context of the volumes of gas involved in global LNG trade. Furthermore, the QCLNG and APLNG projects (and any other LNG project likely to be built at Gladstone in the future) will provide their own pipeline infrastructure and would be very unlikely to proceed on the basis of reliance on third party access to pipeline capacity that they do not control.

3.1 Overview of global LNG markets

Gas currently accounts for about one-fifth of global energy consumption (BREE, 2013, p. 2). Over the past thirty years or so, international gas trade has grown rapidly, both through large diameter transcontinental pipelines and more recently in the form of liquefied natural gas (LNG). Increased use of gas in the electricity sector is expected to continue to drive an expansion of gas use in all major regions of the world over the next decade. According to the International Energy Agency (IEA), global consumption of gas will grow by 2 to 3 per cent per year over the next five years, and by around 50 per cent over the period to 2035 (IEA, 2013).

In this chapter we provide an overview of global LNG markets and discuss the level of competition in global LNG supply.

A number of public domain reports provide comprehensive information on global LNG trade, including LNG production facilities, receiving terminals, current and forecast LNG demand and LNG pricing. For this chapter we draw on a number of these sources, in particular the International Gas Union's World LNG Report 2013 and 2014 (IGU, 2013), (IGU, 2014) and the Bureau of Resource and Energy Economics "Gas Market Report 2013" (BREE, 2013).

3.1.1 Global LNG trade

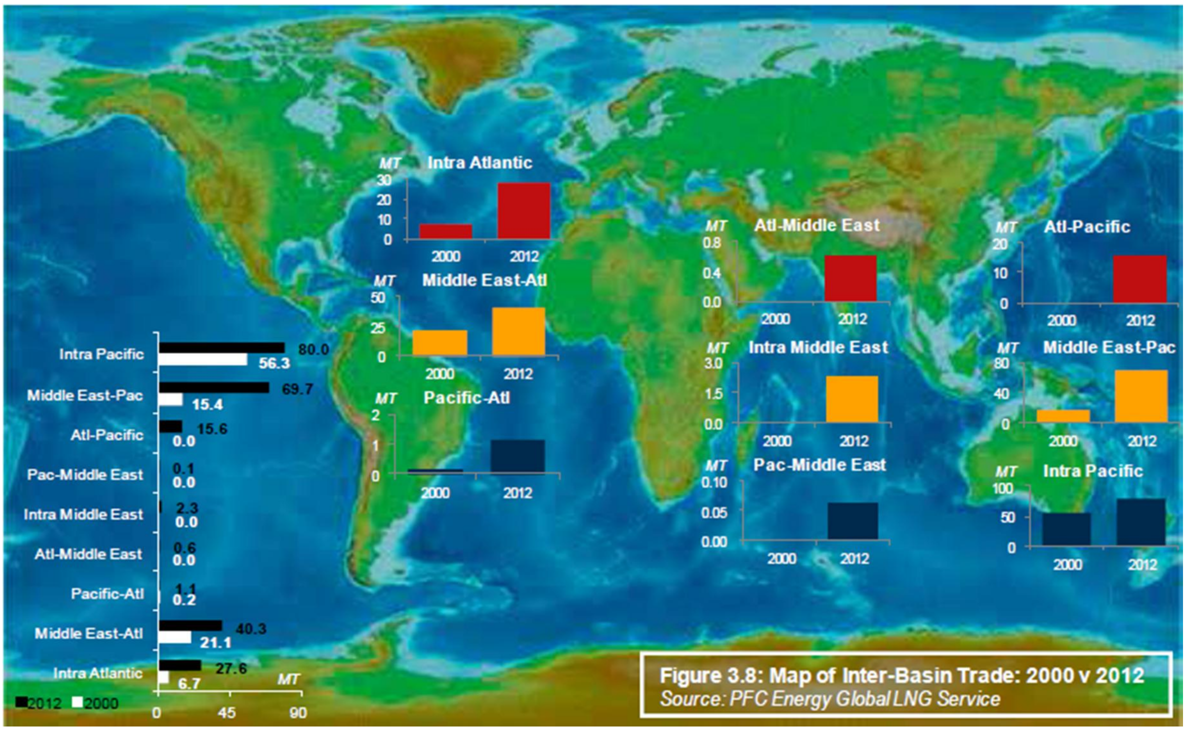
LNG currently represents about 10 per cent of total global gas supply. In 2013, the total quantity of LNG produced was around 237 million tonnes, equivalent in energy terms to about 13,130 PJ. To put this in context, the current eastern Australian domestic gas market consumes about 650 PJ per year. The three LNG projects currently under construction in Gladstone will have a combined production capacity, based on firmly committed investment[5], of about 25 million tonnes per year and will consume about 1,500 PJ of gas per year. This includes gas used in the production process as well as gas contained in the final LNG product.

Globally, LNG accounts for about 60 per cent of interregional trade in gas (IEA, 2013, p. 121). Figure 7 illustrates the patterns of global LNG trade and shows how inter-regional trade has developed over the period 2000 to 2012. The following points are of particular note:

- Intra-Pacific trade together with LNG imports from the Middle East into the Pacific Basin accounted for almost 150 million tonnes or about 63 per cent of global LNG trade in 2012.
- Intra-Atlantic trade together with LNG imports from the Middle East into the Atlantic Basin accounted for a little over 68 million tonnes or about 29 per cent of global LNG trade in 2012.
- Trade between the Pacific and Atlantic Basins grew from only 0.2 million tonnes in 2000 to 16.7 million tonnes or about 7 per cent of global trade in 2012.

[5] Each of the projects has potential for further expansion to which the owners have not yet committed.

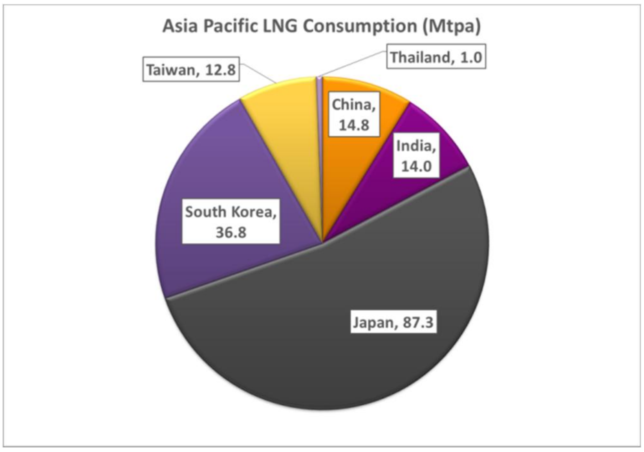
Figure 7 **Inter-regional LNG trade**



Source: IGU 2013, p. 12

The Asia-Pacific region currently accounts for 61 per cent of global LNG imports (IGU 2014, p. 9). Figure 8 shows consumption of LNG in the Asia-Pacific region, by country, in 2012. Japan and South Korea are the largest regional markets, with China and India the fastest growing.

Figure 8 **Asia Pacific LNG consumption, by country**



Source: ACIL Allen compilation of data presented in (IGU, 2013)

3.1.2 Global LNG demand outlook

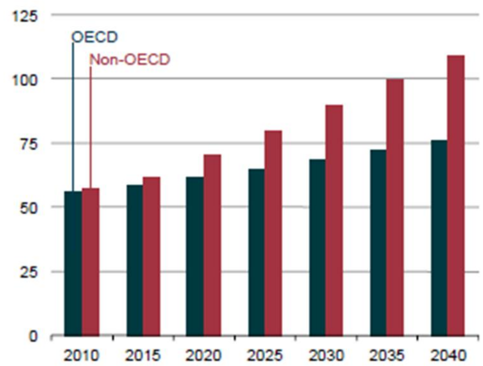
Global demand for natural gas, and in particular for LNG, is expected to grow strongly over the next decade and beyond. Over the period 2012 to 2018, the IEA forecasts world gas demand to increase by 15.6% (2.4% per year), to reach 3,962 bcm/a (140 tcf/a or about 150,000 PJ/a). This represents an increase of 535 bcm/a (18,900 tcf or about 20,200 PJ/a) and is equivalent to current Middle Eastern gas production, or 1.7 times that of the current global LNG trade (IEA, 2013, p. 4).

The US Energy Information Administration in its 2013 “International Energy Outlook” publication forecast that natural gas would be the world’s fastest-growing fossil fuel, with consumption increasing from 113 trillion cubic feet (about 121,000 PJ) in 2010 to 185 trillion cubic feet (about 198,000 PJ) in 2040 (EIA, 2013, p. 41). This gas demand growth will be met by a combination of new pipeline capacity (intra-national and international) and LNG capacity.

One of the main reasons for growth in global LNG demand is the fact that natural gas continues to be favoured as an environmentally attractive fuel compared with other fossil fuels. The EIA notes that gas is the fuel of choice for the electric power and industrial sectors in many of the world’s regions, in part because of its lower carbon intensity compared with coal and oil, which makes it an attractive fuel source in countries where governments are implementing policies to reduce greenhouse gas emissions. In addition, it is an attractive alternative fuel for new power generation plants because of relatively low capital costs and the favourable heat rates for natural gas generation.

Under the EIA’s Reference case, growth in natural gas consumption is forecast to be particularly strong in non-OECD countries, where economic growth leads to increased demand over the projection period. Consumption in non-OECD countries grows by an average of 2.2 percent per year through 2040, more than twice as fast as the 1.0-percent annual growth rate for natural gas demand in the OECD countries (see Figure 9).

Figure 9 **Projected world natural gas consumption to 2040**



Note: Consumption in trillions of cubic feet per year
Source: (EIA, 2013, p. 41)

Exports of LNG to Japan—already the world’s largest importer at 87.3 million tonnes in 2012—are now expected to grow more strongly than previously anticipated as a result of the large scale shut-down of nuclear plants in the wake of the Fukushima disaster. Large increases in LNG imports are also expected in China and India. Growth in other major LNG importing countries in Asia, such as the Republic of Korea and Chinese Taipei, is projected to be more moderate (BREE, 2013, p. 9).

As a result of increased energy demand in the developing economies of the Asia-Pacific region, LNG trade is projected to increase rapidly. Production capacity in the region is expected to approach 500 billion cubic metres (367 million tonnes) by 2020, up from 240 billion cubic metres (176 million tonnes) in 2006. This capacity growth includes large LNG expansions (totalling 105 billion cubic metres or about 77 million tonnes per year) in Qatar that were commissioned between 2006 and 2010, several new projects in Australia and, towards the end of this decade, new projects in North America (BREE, 2013, p. 9).

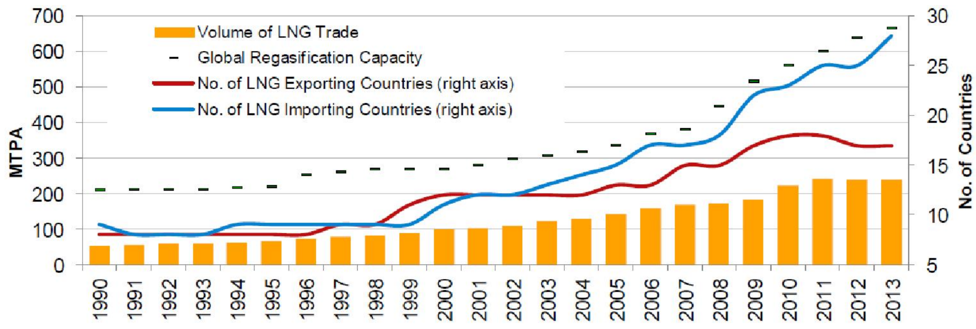
3.1.3 Competition in global LNG markets

The global LNG market—already large and diversified—is continuing to grow and to become more competitive.

According to the International Group of Liquefied Natural Gas Importers (GIIGNL) there were 93 LNG regasification terminals worldwide at the end of 2012. These were located in 26 countries and had a combined capacity of 668 million tonnes per year. Regasification terminal capacity considerably exceeds global liquefaction capacity which, at the same point in time, stood at 282 million tonnes per year with some 89 liquefaction trains operating across 18 countries (GIIGNL, 2012). The disparity reflects the fact that much of the regasification capacity services seasonal markets and therefore has relatively low levels of average utilisation across the year.

Over the past twenty years or so, the global LNG industry has seen strong growth in trade volumes and also in the number of both exporting and importing countries (Figure 10).

Figure 10 **LNG trade volumes, 1990 – 2013**

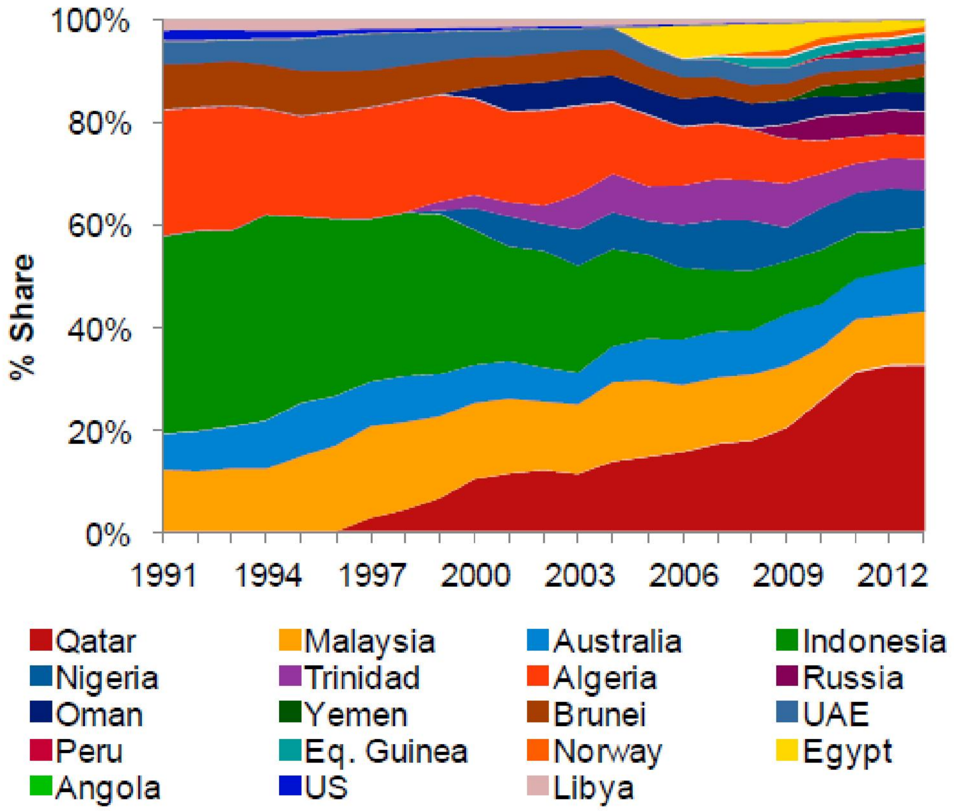


Source: (IGU, 2014, p. 7)

Figure 11 and Figure 12 illustrate, respectively, the increasing diversification of LNG production (from eight producing countries in 1990 to 18 in 2011) and the number of importing countries (from seven in 1990 to 25 in 2011). The number of importing countries continues to grow, with Malaysia having recently commissioned its first LNG receiving terminal and regasification capacity now being built in Indonesia.

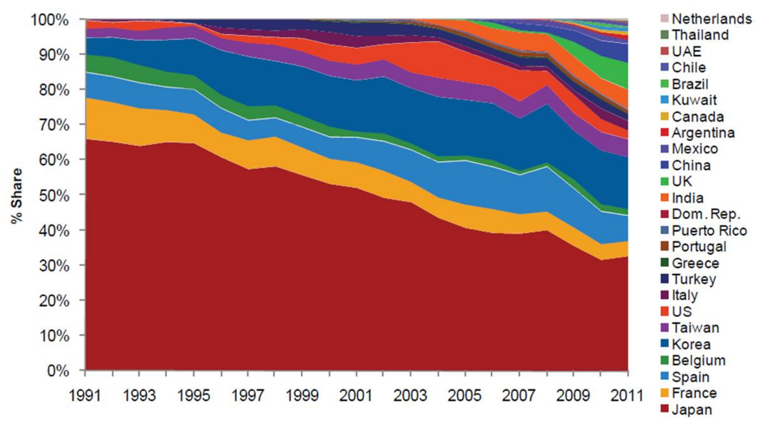
The increasingly liquid and competitive nature of the global LNG market is also demonstrated by the increasing proportion of world trade now transacted through spot sales and re-exports. Prior to the mid-1990s volumes of spot-traded LNG were negligible. Virtually all sales occurred under long-term contracts. Long-term contracts continue to provide a vital underpinning for investment in liquefaction and regasification capacity. However, as shown in Figure 13, the level of spot and short-term LNG trading (which effectively represents re-trading of LNG sold initially under long-term contracts) has increased rapidly over the past 15 years and now accounts for nearly one-third of global LNG trade.

Figure 11 **Share of global LNG exports, by country**



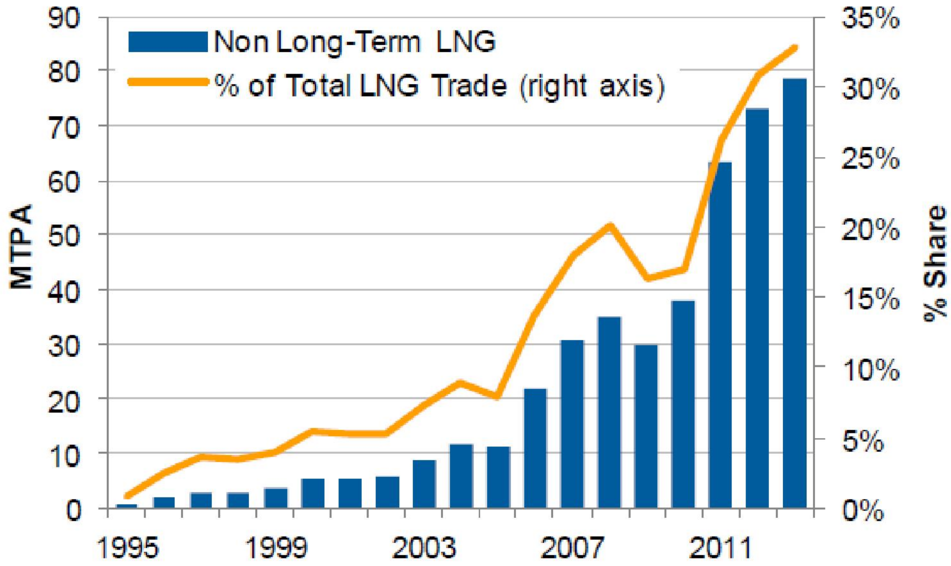
Source: (IGU, 2014, p. 8)

Figure 12 **Share of global LNG imports by country, 1990 – 2011**



Source: (IGU, 2012, p. 13)

Figure 13 **Spot and short-term LNG trade**



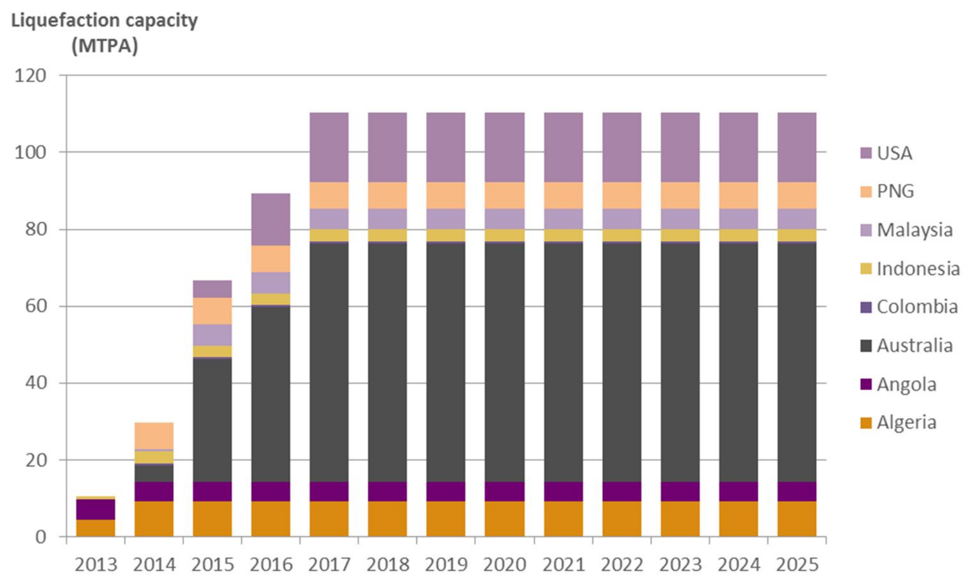
Source: (IGU, 2014, p. 13)

3.2 Australia's role in global LNG markets

Australia currently produces approximately 1.5% of the world's gas and in 2012 was ranked as the eighteenth largest gas producing nation (BP, 2013). At present, about half of Australia's gas production is used domestically while half is exported. The proportion of exports will increase dramatically over the next four years as seven new LNG projects now under construction around Australia come on line. Australia currently ranks third with respect to installed LNG production capacity (IGU, 2014, p. 18). At the end of 2013 Australia had 24.2 Mtpa of operational LNG liquefaction capacity, accounting for 8.3% of the world total 291 Mtpa (IGU, 2014, pp. 16-18).

International trade in LNG continues to grow, as does Australia's share of LNG trade. At the end of 2013 there were 29 LNG liquefaction trains under construction, with a combined capacity of a 117 Mtpa. Well over half of this new capacity—62 Mtpa across seven separate projects—is being built in Australia (Figure 14). By 2018, Australia will have 86 Mtpa of operational liquefaction capacity representing 22% of the global total of 397 Mtpa, making Australia the world's largest LNG producer (IGU, 2014, p. 17).

Figure 14 **New LNG production capacity under construction as at end 2012**



Source: ACIL Allen compilation of IGU data (IGU, 2013)

Further growth in Australian LNG production capacity beyond the projects currently under construction is likely to face strong competition, particularly from North American projects that enjoy access to low-cost gas supplies (in particular, large volumes of shale gas in the U.S. which have, in turn, reduced the demand for conventional gas imports from Canada) and lower construction and operation costs.

The IEA has noted that:

> "Looking beyond 2018, there is intense competition among the 900 bcm per year of LNG projects currently at the planning stage, notably in North America, East Africa and Australia, each of which will bring some 100 bcm per year to global gas markets. While some projects in Australia and the United States have already signed a few long-term contracts, they face various challenges: uncertainties on approvals by the Department of Energy (DOE) and Federal Energy Regulatory Commission (FERC) in the United States, and a steep rise in capital costs in Australia. Meanwhile, East African projects appear much less advanced." (IEA, 2013)

West coast projects in Canada and the U.S will compete directly into the Asian markets that are the natural targets for Australian LNG producers. U.S. Gulf Coast projects will face higher transport costs to Asia, but that barrier will be reduced with the commissioning of the Panama Canal expansion in 2016.

By late March 2014 the U.S. Department of Energy had granted approvals for six projects to export LNG to non-FTA countries[6]. The total approved production capacity of these six projects (Sabine Pass, Freeport, Lake Charles, Dominion Cove, Cameron and Jordan Cove) is about 71 Mtpa. The Sabine Pass project, with a capacity of 16 Mtpa to be commissioned 2015 to 2017, is the only one currently under construction. Others are expected to follow in the timeframe 2017 to 2020. The Canadian government has approved LNG exports from eight projects with a combined capacity of up to 121 Mtpa. All of these projects are located on the Pacific coast. While it is perhaps unlikely that all of this North American capacity will

6 Approval of exports to non-FTA countries (that is, countries that do not have a Free Trade Agreement with the United States) is important because only one FTA country (South Korea) is a significant LNG importer.

be built, it is clear that at least some of these projects will proceed and will compete strongly for the Pacific Basin markets being targeted by new LNG projects in Australia.

3.2.1 Current status of eastern Australian LNG projects

Three separate proponent groups have made final investment decisions and moved into construction of CSG LNG projects:

- BG Group (through its wholly-owned company QGC) is building the **Queensland Curtis LNG** project. China National Offshore Oil Corporation (CNOOC) and Tokyo Gas have equity in the QCLNG Project. The first shipment of LNG from QCLNG Train 1 left Gladstone in December 2014.
- the Santos/Petronas/Total/KOGAS joint venture's **Gladstone LNG** project (GLNG). First LNG shipment is scheduled for 2H2015.
- the Origin Energy/ConocoPhillips/Sinopec **Australia Pacific LNG** project (APLNG). First LNG shipment is scheduled for 2H2015.

Altogether the three projects have so far committed to six LNG liquefaction trains, resulting in total committed LNG capacity of 25.3 Mtpa. Taken together, these projects will require around 1,500 PJ of CSG each year for feedstock and ancillary use. This is about double the size of the current eastern Australian domestic gas market and, assuming that these projects run for 25 years, will effectively commit some 37,500 PJ of CSG reserves to LNG production.

Shell through its subsidiary company Arrow Energy, together with PetroChina, was pursuing development of an independent LNG project at Gladstone, potentially adding at least two more LNG trains (9 Mtpa). However in late 2013 Shell announced reduced activity levels on the project, indicating that it would not make a final investment decision in the near term. In January 2015 Shell announced that the Arrow LNG greenfield project was cancelled, the Chief Executive Officer of Royal Dutch Shell plc stating that "Arrow greenfield LNG is off the table".[7]

Shell Australia subsequently indicated that "Work continues on development of Arrow's substantial gas resources in the Bowen & Surat basins … Discussions are ongoing on collaboration opportunities".[8] In Figure 15 the two Arrow LNG liquefaction trains are shown as "Prospective" on the basis that the capacity could be constructed as an expansion of one or more of the three projects currently in construction.

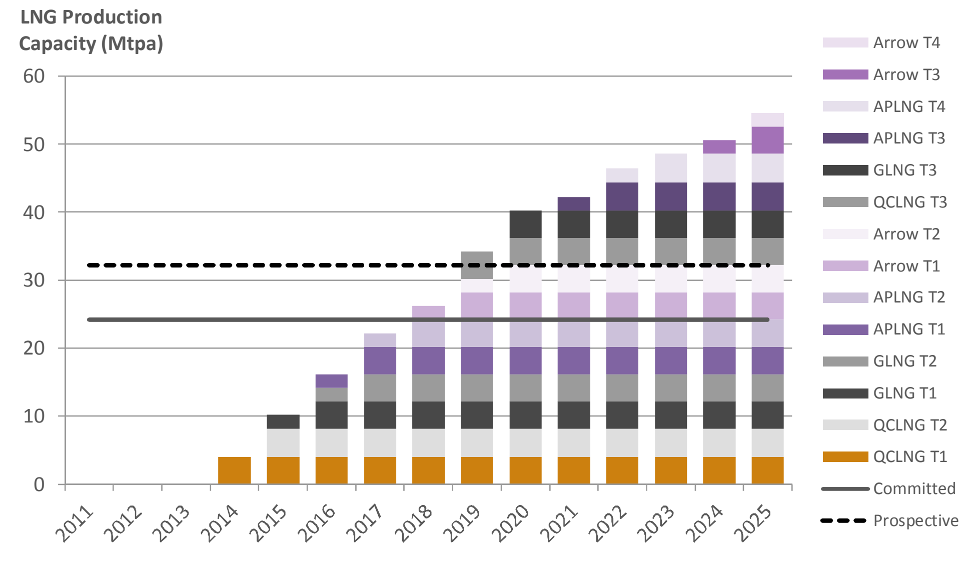
In recent times it has become increasingly apparent that the projects currently under construction in Queensland face significant challenges in ramping up rates of CSG production to the levels required to fully utilise the liquefaction capacity. As a result, there may be a transitional period during which the plants will be seeking additional sources of gas to supplement CSG production from the fields that are being developed to supply the LNG projects. Increasing construction cost pressures that have become evident are symptomatic of the high level of LNG development activity in Australia at present, and the consequent shortage of skilled labour and specialist equipment. Whether or not Train 7 and Train 8 proceed, and if so the timing of their development, is therefore likely to depend on

[7] Royal Dutch Shell plc, Fourth Quarter 2014 Results, January 29th 2015, Webcast to Analysts, accessed at http://s06.static-shell.com/content/dam/shell-new/local/corporate/corporate/downloads/quarterly-results/2014/q4/q4-2014-analyst-presentation-transcript.pdf

[8] Shell Australia 29 January 2015 accessed at https://twitter.com/shell_australia

performance of the first six trains at QCLNG, GLNG and APLNG. The progress of competing proposals for new capacity elsewhere in the world, and particularly out of the U.S. and Canada, is also likely to be a significant factor.

Figure 15 **Committed and planned Queensland CSG LNG production capacity**



Data source: ACIL Allen compilation of public domain sources

The following sections summarise the current status of the active CSG LNG projects in Queensland.

Queensland Curtis LNG (QCLNG)

BG Group is a leading player in the global energy market with operations in some 27 countries. It is listed on the London and New York Stock Exchanges. QGC Limited (QGC), a wholly-owned subsidiary of BG Group, is developing a world-scale, integrated LNG project in Queensland, known as the Queensland Curtis LNG (QCLNG) Project.

The QCLNG Project involves expanding QGC's existing CSG operations in the Surat Basin of southern Queensland and transporting the gas via an underground pipeline to a gas liquefaction and export facility on Curtis Island, near Gladstone, where the gas will be converted to LNG for export.

The project's total capital cost is estimated to be US$20.4 billion for a two train LNG project with a nominal capacity of 8.5 Mtpa.

QCLNG is underpinned by BG Group global LNG sales agreements for almost 10 million tonnes a year with the China National Offshore Oil Corporation (CNOOC); Tokyo Gas; GNL Chile; Chubu Electric; and the Energy Market Authority of Singapore.

The project was initially solely proposed and developed by QGC but is now a joint venture with CNOOC and Tokyo Gas both holding equity interests in the plant and upstream acreage. CNOOC has acquired 25% of certain QGC tenements and 50% of the first LNG train. Tokyo Gas has acquired 1.25% of certain QGC tenements and 2.5% of QCLNG Train 2.

BG Group's entry to Australia was through its acquisition of QGC is 2008 through a $5 billion takeover offer which gave it a resource base to develop the QCLNG project. BG Group acquired smaller Queensland CSG players Sunshine Gas in 2008 and Pure Energy in 2009.

The QCLNG project was the first of the Curtis Island projects to reach a Final Investment Decision. Construction began late in 2010 and the project achieved its first commercial shipment of LNG from QCLNG Train 1 in December 2014.Train 2 is scheduled to commence production during the second half of 2015.

The site can accommodate an expansion to 12 Mtpa per year, but BG Group management has indicated that it does not anticipate making an investment decision on a third train in the near future[9].

Gladstone LNG (GLNG)

The Gladstone LNG (GLNG) project is a two train, 7.8 Mtpa LNG project currently under construction on Curtis Island at Gladstone. The $A18.5 billion project is a joint venture between Santos (30%) and PETRONAS (27.5%), Total (27.5%) and KOGAS (15%).

The GLNG project is an integrated resource development project involving large scale production of CSG from fields located in the Bowen and Surat Basin region of southern Queensland; transportation of the gas by pipeline to a liquefaction facility located on Curtis Island, near Gladstone; production and storage of LNG at the liquefaction facility; and shipping facilities to allow loading of LNG onto ships for transportation to overseas customers.

The GLNG Project is a fully integrated LNG project, which comprises three inter-related and inter-dependent components:

- the upstream component at the gas fields
- the 420 km export pipeline to Curtis Island
- the downstream LNG facility.

The final investment decision for the two-train GLNG facility was made on 13 January 2011. Construction commenced in May 2011. The first stage of the development, Train 1, will have a nameplate capacity of approximately 3.9 Mtpa with the first cargo expected in the second half of 2015. Ramp up to full capacity is expected to occur over a 3-6 month period.

The second stage of the development, Train 2, also has a nameplate capacity of 3.9 Mtpa. Start-up of Train 2 is expected by the end of 2015.

Australia Pacific LNG (APLNG)

The Australia Pacific LNG Project (APLNG) is a joint venture between Origin Energy (37.5%), ConocoPhillips (37.5%) and Sinopec (25%). The project was sanctioned in July 2011 for an initial 4.5 million tonnes per annum LNG train and infrastructure to support a second LNG train of the same size. The second LNG train was sanctioned in July 2012.

The $24.7 billion project consists of three key parts:

[9] BG Group – Q4 and Full Year Results Presentation – 4 February 2014, p.22.

- Development of CSG fields in the Surat and Bowen Basins in south-west and central Queensland
- Construction of a 530 km gas transmission pipeline from the gas fields to an LNG facility on Curtis Island off the coast of Gladstone
- An LNG facility on Curtis Island, with the first two gas production trains together processing up to 9 million tonnes per year.

Off-take for the project is 95% contracted under two long-term agreements:

- 7.6 Mtpa over 20 years to Sinopec (China)
- 1 Mtpa over 20 years to Kensai Electric Power Company (Japan).

The upstream component of the project (gas production, compression and pipeline) will be operated by Origin Energy, whilst the downstream components will be operated by ConocoPhillips. The project has approvals for expansion at Curtis Island for up to 4 liquefaction trains with a total capacity of 18 Mtpa.

The Project commenced construction of the gas fields, pipeline and LNG facility in 2011. It will be developed in stages to meet the required demand for LNG. In June 2013 the roof of the first storage tank on Curtis Island was completed, marking the half-way point of project construction. As at October 2014 the project was reported by Origin Energy to be 85% complete and on track for first LNG in mid-2015 with full production expected from both trains by the end of FY2016.

3.3 CRWP Loop significance with regard to competition in global LNG markets

We have been asked to consider the effect that third party access to the CRWP Loop would have on the competitiveness of global LNG markets.

The short answer is that third party access to the CRWP Loop would have **no discernible effect on the competitiveness of global LNG markets**. This is primarily because the quantity of gas that could be moved through the CRWP Loop is relatively insignificant in the context of the volumes of gas involved in global LNG trade.

The additional pipeline capacity that will be provided by the CRWP Loop will be important to the GLNG project because it will allow gas available at the Wallumbilla hub (both Project CSG and third party gas) to be delivered to the inlet of the GLNG Transmission Pipeline at Fairview for onward transport to the GLNG liquefaction plant at Gladstone. The pipeline capacity that will be provided as a result of the CRWP Loop project is nominally 750 TJ/day (see Table 1). Much of this capacity will be required by GLNG for its day-to-day operations. However, for the purposes of this analysis we ***assume*** that 25% of the incremental capacity (that is, 188 TJ/d) is made available to other LNG producers to transport gas for their projects.

The first questions to ask are who might use such capacity, and how might they use it? Currently there are two prospective LNG producers at Gladstone—QCLNG and APLNG—that might (at least in theory[10]) have an interest in using capacity on the CRWP Loop in

[10] In practice, the QCLNG and APLNG projects (and any other LNG project likely to be built at Gladstone in the future) will provide their own pipeline infrastructure and will not proceed on the basis of reliance on third party access to pipeline capacity that they do not control.

conjunction with the pipeline infrastructure that they are constructing for their own projects in order to deliver additional gas to Curtis Island.

Assuming that another LNG producer did want to access the CRWP Loop and that there was as much as 188 TJ/d of capacity available, the question then is how significant that would be in the context of global LNG markets. 188 TJ/d of pipeline capacity operating at an annual load factor of 90 per cent would be capable of transporting around 62 PJ of gas per year, which would be sufficient (after allowing for gas used in processing) to make about 1 Mtpa of LNG. Current world trade in LNG is around 240 million tonnes per year (see section 3.1). Therefore the LNG that could be produced by the third-party LNG producer accessing capacity in the CRWP Loop would account for **no more than about 0.4% of the current global market for LNG**. Furthermore, LNG buyers have access to many sources of LNG in a highly liquid global market: there were 89 liquefaction trains operating across 18 countries at the end of 2012, with a further 30 trains scheduled to enter the market by 2017. There is also an active short term trade in LNG with spot sales accounting for around 30% of global trade (that is, about 72 Mtpa).

For these reasons it is reasonable to conclude that providing third party access to pipeline capacity in the CRWP Loop would have no discernible effect on the competitiveness of global LNG markets.

4 Alternative pipelines

Key Findings Chapter 4

Chapter 4 considers the availability of alternative pipelines to transport gas from upstream CSG producers to the relevant domestic markets and/or to global LNG markets. It also considers the projected cost of transportation on alternative pipeline routes.

Gas producers looking to deliver CSG from the Surat Basin in the vicinity of the CRWP Loop to domestic markets in Central Queensland and Wide Bay have a number of alternative pipeline transport options:

- from the field to Wallumbilla via either RBP or CRWP or SGWP, then via QGP to market
- from the field via the Fairview Lateral to the Ridgelands receipt point on the QGP, then via QGP to market
- from the field via a new receipt point on the CRWP to the Gooimbah receipt point on the QGP, then via QGP to market.

Other more elaborate paths could be envisaged but would be likely to involve greater transport costs without conveying any obvious advantage in terms of ease of market access.

For third party gas producers looking to sell gas into global LNG markets, we consider two groups of potential shippers:

- other LNG projects including QCLNG, APLNG or a new LNG project not yet committed to construction
- third party gas producers not involved in a downstream LNG project.

If the CSG producer is another LNG project then transport to the relevant plant on Curtis Island will most likely be via that LNG proponent's dedicated pipeline infrastructure. If the CSG producer is a third-party supplier that is not currently a part of any LNG project, it is unlikely that the producer will build its own LNG plant. It is more likely they would sell first to one of the large LNG projects, in which case the pipeline transport path to the relevant plant on Curtis Island will be via that LNG proponent's dedicated pipeline infrastructure.

We have considered whether access to the CRWP Loop might improve domestic market access by relieving any capacity "bottlenecks" on the QGP given that there is little, if any, uncontracted firm capacity on QGP. It is clear from feasibility studies into gas transport to the proposed Fisherman's Landing LNG Project that the capacity of QGP could be significantly expanded to meet new user demand. QGP owner Jemena has shown a willingness to expand pipeline capacity to accommodate new users that are willing to commit to the incremental capacity. Use of the CRWP Loop to circumvent any short-term capacity constraint on the QGP would be unlikely to prove effective because it would not avoid the need to use QGP to access the Central Queensland/Wide Bay domestic markets. It would merely shift the receipt point into the QGP north from Wallumbilla to Gooimbah. Firm capacity in QGP would, in any case, need to be made available downstream from the Gooimbah receipt point.

In terms of costs of transporting gas to the domestic market, carriage of gas on the CRWP Loop appears unlikely to reduce costs for users. Indeed carrying gas on the CRWP Loop from Wallumbilla and transferring it to the QGP at Gooimbah would be more costly than carrying gas on QGP from Wallumbilla, since there would be no reduction in transport costs on QGP (the firm capacity charges for which are calculated on a "postage stamp" basis that does not vary with receipt point) and there would be additional transport costs on the CRWP Loop.

We have been asked to consider the projected availability of alternative pipelines to transport gas:

i) from upstream coal seam gas producers;

ii) to the domestic market; and/or

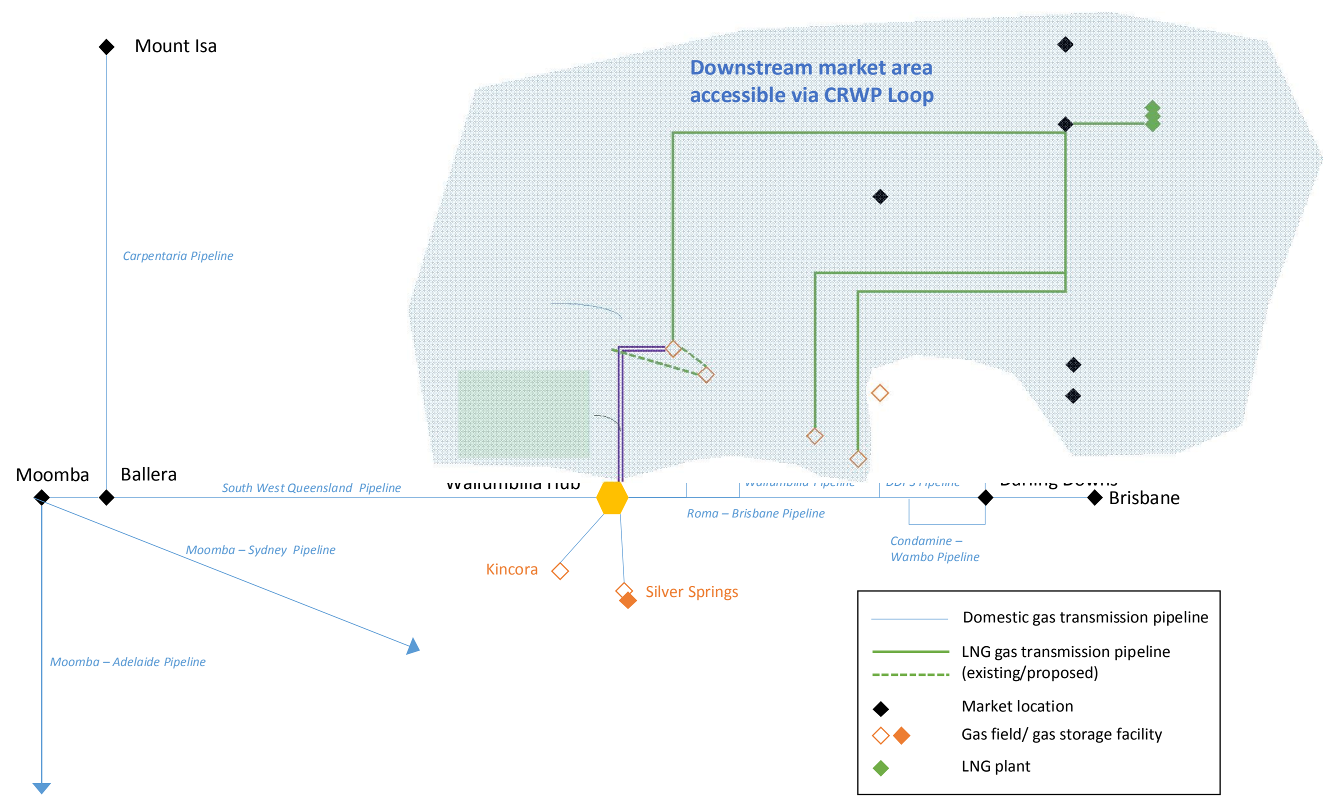
iii) to global LNG markets

over the period to 2035, including the projected cost of that transportation.

Figure 16 is a schematic diagram of the main pipelines in Eastern Australia that are potentially available for upstream CSG producers in the vicinity of the CRWP Loop to transport their gas to domestic markets or to global LNG markets. It shows that there are numerous alternative pipelines available that would allow CSG producers to access downstream domestic markets throughout Eastern Australia as well as international LNG markets. We will consider separately the pipelines that would be relevant to third party producers wishing to supply into the domestic market and those looking to access global LNG markets.

Available alternative pipelines would potentially allow Surat Basin CSG producers to access markets throughout Eastern Australia, whereas access to the CRWP Loop would potentially facilitate access to a much more geographically constrained set of markets located within the pale blue shaded area in Figure 16.

Figure 16 **Alternative pipeline schematic**



Source: ACIL Allen Consulting

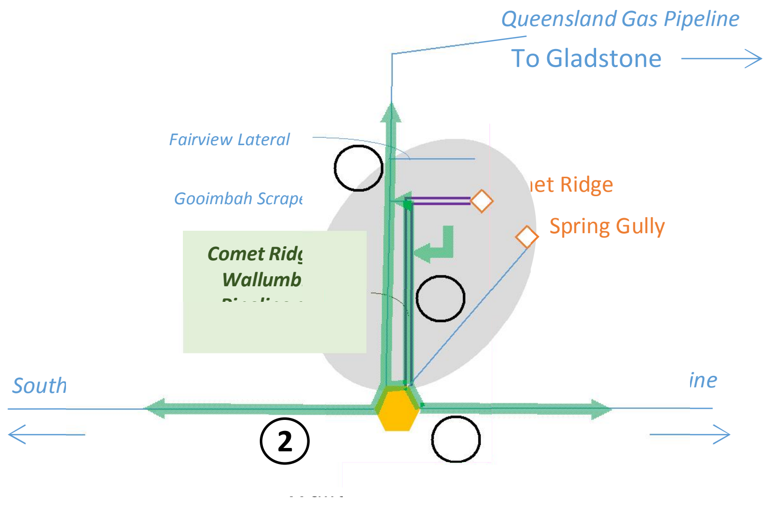
4.1 Pipelines for supply from CSG to domestic markets

Figure 17 illustrates four potential paths to domestic gas markets that could be available to third-party CSG producers in the vicinity of the CRWP Loop.

CSG produced in the green-shaded area could potentially follow any of the following paths to market:

- From the field to Wallumbilla, then east along the Roma to Brisbane Pipeline (RBP) to customers in southeast Queensland (**Path 1**). This transportation path would not require access to the CRWP Loop.
- From the field to Wallumbilla, then west along the South West Queensland Pipeline (SWQP) to Ballera and Moomba, from where it could be transported via the Carpentaria Pipeline to the Mount Isa region, via the Moomba to Adelaide Pipeline System (MAPS) to South Australian customers, or via the Moomba to Sydney Pipeline system (MSP) to customers in New South Wales, ACT and Victoria (**Path 2**). This transportation path would not require access to the CRWP Loop.
  - Paths 1 and 2 correspond to the transportation strategies that were adopted by Santos when the original CRWP was built to deliver Fairview gas to the domestic market, and by Origin Energy when the Spring Gully to Wallumbilla Pipeline was built to deliver Spring Gully gas to the domestic market.
- North from Wallumbilla along the Queensland Gas Pipeline (QGP) to customers in Gladstone, Rockhampton or the Wide Bay region (**Path 3**). This transportation path would not require access to the CRWP Loop.
- North from Wallumbilla or a mid-line delivery point along the CRWP Loop, then transferring into the original CRWP which connects to the QGP at Gooimbah (**Path 4**). From there gas could travel north along the QGP to customers in Gladstone, Rockhampton or the Wide Bay region. This is effectively the same as Path 3 except that it utilises the CRWP Loop rather than QGP for the transport sector from Wallumbilla to Gooimbah.

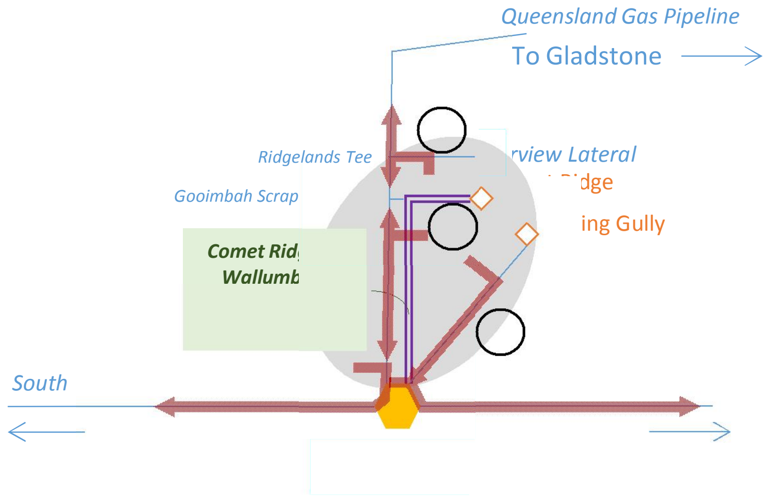
Figure 17 **Paths for CSG to domestic markets**



Source: ACIL Allen Consulting

Figure 18 illustrates further variants of these potential paths to domestic gas markets that could be available to third-party CSG producers in the vicinity of the CRWP Loop by using capacity in other existing pipelines.

Figure 18 **Paths for CSG to domestic markets via Alternative Pipelines**



Source: ACIL Allen Consulting

Path 1 would see third-party CSG injected into the existing Fairview Lateral, then into the QGP at the Ridgelands Tee, from where the gas can be transferred:

- by forward haul along the QGP to customers in Gladstone, Rockhampton, Moura or the Wide Bay region; or
- by back haul in QGP to Wallumbilla, then either on the RBP to customers in southeast Queensland, or via the SWQP to customers in Mount Isa, South Australia, New South Wales, ACT or Victoria.

Path 2 is similar to Path 1 but would involve establishing a new injection point on the QGP, from where the gas could again be sent north to Gladstone and surrounding markets, or south to the Wallumbilla Hub for onward carriage.

Path 3 would see third-party CSG transported to Wallumbilla via the existing Spring Gully to Wallumbilla Pipeline (operated by Origin Energy), then either on the RBP to customers in southeast Queensland, or via the SWQP to customers in Mount Isa, South Australia, New South Wales, ACT or Victoria.

4.2 Pipelines for supply from CSG to global LNG markets

In considering the options available for transport of gas to Gladstone for LNG production and sale into global LNG markets, there are two groups of potential shippers that need to be considered:

- other LNG projects including QCLNG, APLNG or a new LNG project not yet committed to construction
- third party gas producers not involved in a downstream LNG project.

If the CSG producer is another LNG project then transport to the relevant plant on Curtis Island will most likely be via that LNG proponent's dedicated pipeline infrastructure which typically includes:

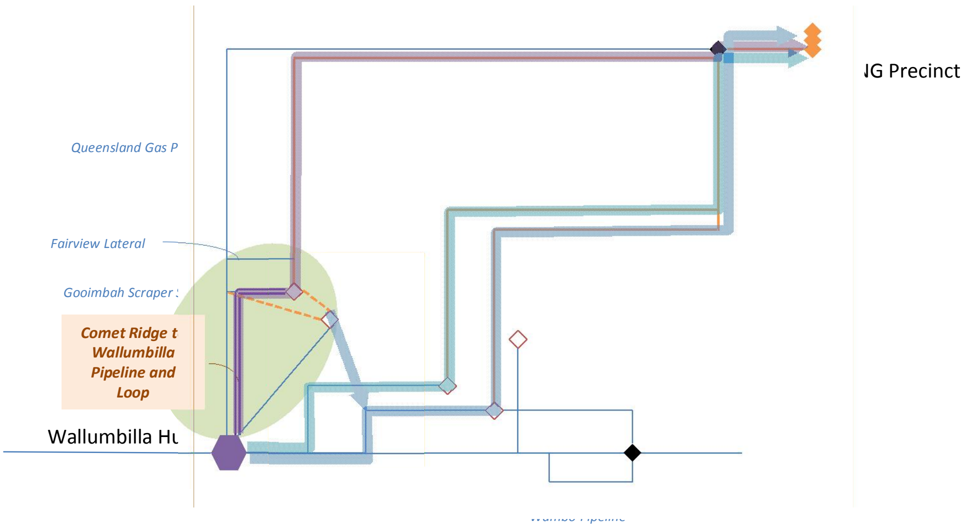
- low pressure in-field gathering systems;

- high pressure headers linking gas processing facilities and field hub compressor stations; and
- large diameter, high pressure export pipelines to the Gladstone liquefaction facilities.

Figure 19 illustrates schematically the separate and dedicated gas transmission infrastructure associated with the GLNG, QCLNG and APLNG projects which will allow CSG produced from the fields dedicated to those projects, together with any third party gas sourced by those projects and delivered either to the Wallumbilla Hub or to a field hub compressor station, to be transported to Curtis Island. We refer to these systems as being separate and dedicated because all three of these systems have been granted 15-year no coverage declarations for the main large-diameter transmission pipelines.

There are also interconnections (existing and proposed) that will allow physical transfer of gas under commercial arrangements between the LNG projects. For example, the APLNG Spring Gully – Comet Ridge pipeline will be able to facilitate physical exchange of gas between the GLNG and APLNG projects. Transfer of gas between the LNG projects may also be achieved by way of commercial swap arrangements.

Figure 19 **Gas transport paths for CSG LNG proponents**



Source: ACIL Allen consulting

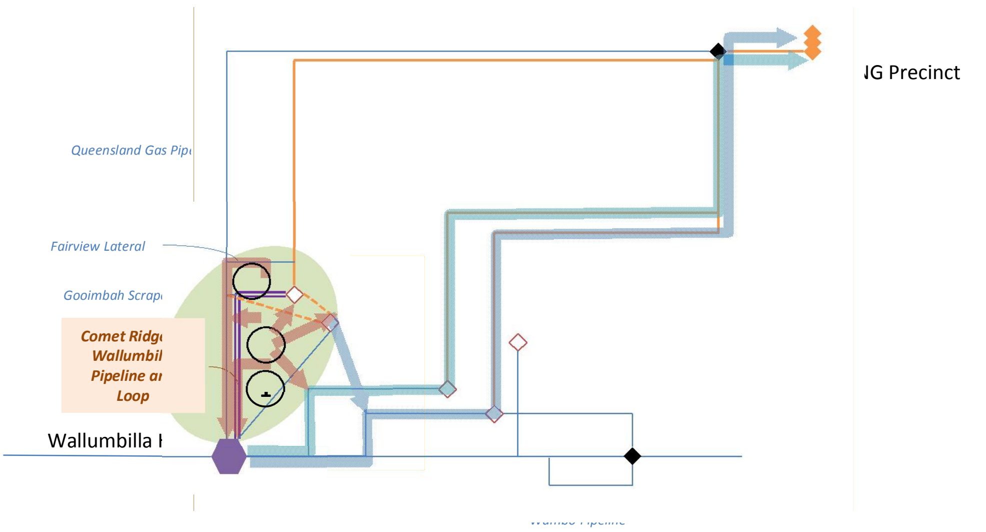
Given the integrated nature of the CSG to LNG projects, we consider it highly unlikely that another CSG LNG project would rely on third party access to pipeline infrastructure controlled by another party in order to transport feed gas from its CSG fields to its liquefaction plant.

If the CSG producer is a third-party supplier that is not currently a part of any LNG project, it is unlikely that it will be able to build its own LNG plant in order to sell gas into the global LNG market. New entrants into the LNG production industry face very high barriers to entry which relate to both capital cost and required gas resource backing. The Gladstone LNG projects currently under construction are typical of modern world-scale LNG projects in having capital costs of the order of $20 billion each. Each project requires a secure gas supply of around 500 PJ/a backed by recoverable reserves of at least 10,000 PJ in order to give a project life of at least 20 years. Given these entry requirements, construction of their own LNG plant is not a feasible option for most potential third-party CSG producers. Therefore, the only way they can sell gas into the global LNG market is by selling it first to one of the large LNG projects, in which case the pipeline transport path to the relevant plant on Curtis Island will be via that LNG proponent's dedicated pipeline infrastructure.

At present this would mean selling gas to GLNG, QCLNG or APLNG, delivered either at the Wallumbilla hub or at a central field processing and compression facility. This is a realistic scenario: both GLNG and QCLNG have already signed substantial third-party gas purchase agreements for supply into their Gladstone plants.

Figure 20 is a schematic illustration of the alternative transport paths potentially available to third-party CSG producers to enable them to sell gas to LNG proponents for liquefaction at Gladstone and sale into global LNG markets.

Figure 20 **Alternative transport paths for third-party CSG producers to LNG**



Source: ACIL Allen Consulting

Path 1 would involve access to the CRWP (**not** the CRWP Loop) for backhaul to Wallumbilla, then passing into the LNG proponent's dedicated pipeline system.

Path 2 would achieve the same outcome by delivering the gas into the QGP (either via the existing Fairview lateral or via a new injection point on the QGP) for backhaul to Wallumbilla, then passing into the LNG proponent's dedicated pipeline system.

Path 3 would see the third-party gas supplied directly to a Field Processing and Compression Station operated by the gas buyer (GLNG, QCLNG or APLNG) where it would be processed to meet the required LNG feed specification and then transferred into the LNG proponent's dedicated pipeline system.

4.3 Costs of transport on alternative pipelines

The only pipelines for which alternative costs of transport are relevant for the current purpose are:

- the CRWP Loop Pipeline
- the Queensland Gas Pipeline (including the Fairview Lateral)
- the Spring Gully to Wallumbilla Pipeline.

The costs of transmission (and availability of pipeline capacity) beyond the Wallumbilla Hub will be the same irrespective of how the gas is delivered to Wallumbilla.

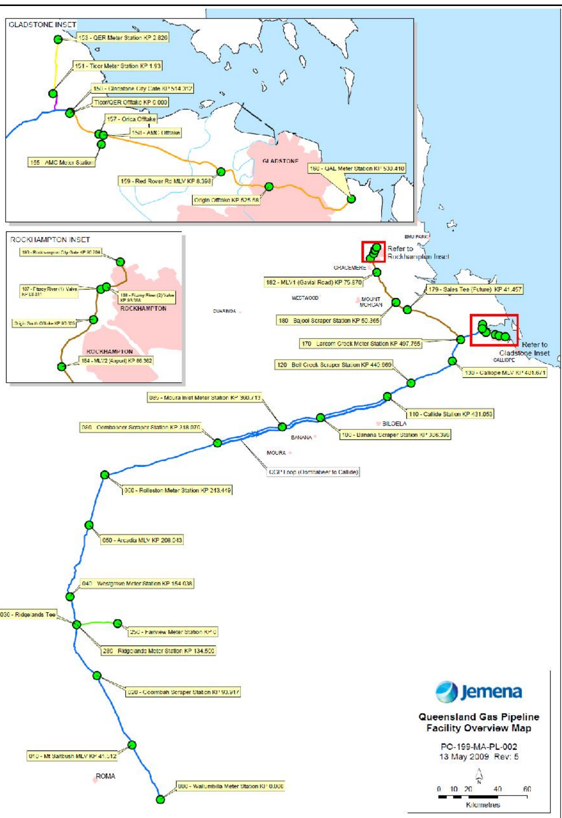
4.3.1 CRWP Loop Transport Costs

The CRWP Loop will be 119 km long and 610 mm (24 inch) diameter. Assuming a current benchmark pipeline construction rate of $65,000 per inch-kilometre we estimate a pipeline capital cost about $185 million. Further assuming a compressor capital requirement of $2 million per PJ/a over the uncompressed capacity of the pipeline, we estimate a compression capital cost of $264 million giving a total system capital cost of about $450 million. We assume annual operating costs (pipeline and compression) of 1.5% of relevant capital costs. Finally, we assume a pipeline throughput of 250 PJ/a (nominal 750 TJ/day at 91% load factor) from 2015, with a 20 year project life. On this basis, we estimate the implied pipeline tariff to yield a 10% real pre-tax rate of return on marginal gas throughput to be around $0.17/GJ MDQ, or $0.21/GJ for a user with a load factor of 80%.

4.3.2 QGP transport costs

Commissioned in 1990, the Queensland Gas Pipeline (QGP) is a 627 km, 324 mm/219 mm pipeline transporting natural gas between Wallumbilla in the west and Gladstone and Rockhampton on the Central Queensland coast. The pipeline connects most supply sources in Queensland, including Northern and Southern Denison Trough, Surat Basin and Bowen Basin CSG supplies directly to markets in Gladstone and Rockhampton. The location of the QGP is shown in Figure 21.

Figure 21 **Location of Queensland Gas Pipeline**



Data source: Jemena (http://jemena.com.au/Assets/What-We-Do/Assets/Queensland-Gas-Pipeline/Map.pdf)

The Queensland Gas Pipeline comprises three sections:

- **Wallumbilla to Gladstone**: 514.4 km of 323.9 mm O.D. Class 600 transmission pipeline. This line has an inlet pressure operating range of 5,000 – 10,200 kPa. Normal operating pressure range is 8,200 – 9,500 kPa as measured at Rolleston Meter Station.
- **Gladstone City Main**: 16.1 km of 323.9 mm O.D. Class 300 pipeline and associated laterals from Gladstone City Gate Station to QAL Meter Station. The normal operating pressure of this pipeline segment is approximately 2,700 kPa.
- **Larcom Creek – Rockhampton**: 96.7 km of 219.0 mm O.D. Class 600 pipeline from Larcom Creek Meter Station (the tee off from the main line) to Rockhampton City Gate Station. Normal operating pressure for the Rockhampton Branch Pipeline is approximately 4,500 kPa.

The Pipeline currently has five gas receipt stations:

- **Wallumbilla**: Wallumbilla Station (K.P. 0.00). This receipt point services the Surat, Cooper & Eromanga Basins and provides interconnection with the Roma to Brisbane and South West Queensland (Ballera to Wallumbilla) pipelines.
- **Fairview**: The Fairview lateral ties into the main line at KP 134.5 (Ridgelands Scraper Station). There is 25.6 km of 200mm NB Class 900 pipeline between the Fairview meter station and the main line.
- **Westgrove**: Westgrove Station (K.P. 154.04) is a single producer receipt point servicing the South Denison Trough.
- **Rolleston**: Rolleston Station (K.P. 243.45) is a single producer Receipt Point servicing the North Denison Trough.
- **Moura**: Moura Station (K.P. 360.71) is a dual producer Receipt Point, servicing the CSG production from the Moura mine and Dawson Valley areas of the southern Bowen Basin.

Jemena currently owns and operates seven dedicated delivery stations on the pipeline. An additional three delivery points are owned and operated by Origin Energy Ltd, two located in Rockhampton and one in Gladstone.

The seven Jemena delivery points are:

- **ORICA Australia Operations Pty Ltd**: The ORICA Delivery Point is located downstream of the Gladstone City Gate at K.P. 516.26
- **Queensland Alumina Limited [QAL]**: The QAL delivery station is located at the end of the Gladstone City Main at K.P. 530.41. It acts as a dual delivery station servicing both the QAL and Boyne smelters
- **Boyne Smelter Metering Skid**: (K.P. 530.41)
- **AMC**: (K.P. 514.716)
- **TICOR**: (K.P. 516.25) - disused since the closure of the Ticor plant
- **SUNCOR**: (K.P. 519.08) - disused
- **Queensland Magnesia (Operations) Pty Ltd [QMag]**: The QMag delivery site is located within the Rockhampton City Gate Station at the end of the RBL (96.7 km from Larcom Creek).

Current transportation contracts

The QGP has current firm capacity contracts for 145 TJ/d of capacity (around 53 PJ/a at 100% load factor) and transports gas to major industrial facilities including:

- Queensland Alumina
- Rio Tinto Yarwun
- Orica
- Queensland Magnesia
- Boyne Smelter

It also supplies gas to Origin Energy for on-selling to domestic, commercial and residential users.

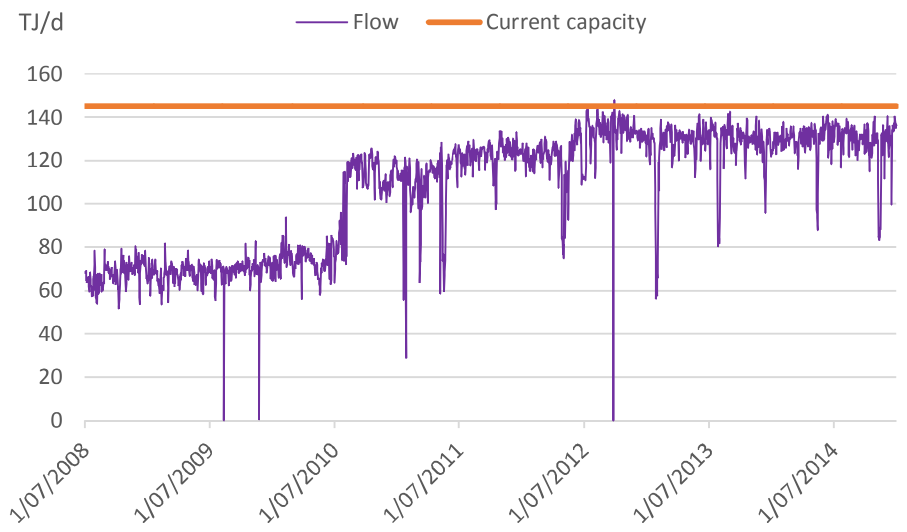
Most of the market for QGP is assured through long term firm forward contracts until 2016/17 with some capacity contracted to 2021.

4.3.3 Pipeline capacity and flow

According to the National Gas Market Bulletin Board, the current nominal capacity of the QGP is 145 TJ/day. A pipeline expansion in early 2010 increased the capacity by 49 TJ/day. The expansion involved both looping and compression to increase capacity to 52 PJ/a. The additional compressors are located at Rolleston and Banana. The 113 km section of duplicated (400mm, 16 inch) pipeline is located between Oombabeer and Callide.

Jemena is considering a further capacity expansion on the QGP with a 35 km section of the pipeline to be duplicated in the vicinity of Rolleston. This would increase the capacity of the pipeline by about 10 TJ/d to 155 TJ/d (56 PJ/a).[11]

Figure 22 **QGP throughput July 2008 – December 2014**



Data source: ACIL Allen based on Gas Market Bulletin Board data

[11] Jemena Manager Queensland Pipelines, Bob Boesten (personal communication)

Figure 22 shows the historical flows on the QGP over the period from July 2008 to December 2014. Over this period, average throughput on QGP rose from around 65 TJ/day to 135 TJ/day, primarily as a result of increased deliveries to the Rio Tinto Yarwun alumina refinery. Based on its current capacity of approximately 145 TJ/day, the system average load factor is high at around 92% reflecting the fact that major customers are large process industries.

Nearly all of the additional capacity created on the QGP as a result of the 2010 expansion has already been taken up by new contracts. Most of this additional capacity has been contractually committed to service the expanded gas requirement of Rio Tinto for the Yarwun project.

Further expansion may be undertaken to meet the needs of new customers. A study undertaken by Jemena in 2011 confirmed that large increases to the existing capacity would be feasible: the Pre-Front End Engineering Design (Pre-FEED) to assess the viability of expanding the QGP system to carry gas feed for a proposed mid-scale LNG project at Gladstone (the Fisherman's Landing LNG project) showed that the pipeline could be expanded to supply enough gas for two 1.5 Mtpa LNG trains. Given that 3 Mtpa of LNG equates to about 165 PJ, this implies that the QGP system is capable of expansion to at least 215 PJ/a.

4.3.4 Transportation tariffs

The QGP was previously a covered pipeline under the *National Third Party Access Code for Natural Gas Pipelines* ('Gas Code') and was required to have an approved Access Arrangement. The tariffs under the Access Arrangement were the subject of a derogation following the Queensland Government's sale of the QGP in 1996 and the introduction of the Gas Code in 1997.

The Gas Code has, pursuant to the *National Gas (Queensland) Act 2008 (Qld)* and the *National Gas (South Australia) Act 2008 (SA)*, been replaced by the National Gas Law ('NGL') and the National Gas Rules ('NGR').

The introduction of the NGL and NGR means that the QGP is no longer a covered pipeline for the purposes of third party access regulation. With the removal of coverage the Access Arrangement published pursuant to the Code no longer applies to new access agreements. Different tariffs apply for existing shippers with transportation contracts in place prior to the introduction of the NGL on 1 July 2008, and for new users after that date.

Pre-NGL contracts

For transportation contracts in place prior to the introduction of the NGL, tariffs for firm forward haul transportation consist of:

- a capacity reservation charge equal to the capacity reservation rate multiplied by the relevant user's MDQ. As of 1 July 2006 the capacity reservation rate was A$0.58/GJ[12]
- a distance reservation charge equal to the distance reservation rate multiplied by the distance component multiplied by the relevant user's MDQ. As of 1 July 2006 the distance reservation rate was A$0.000943/GJ/km (A$0.000660/GJ/km after expansion date).

[12] Tariff escalation provisions allow for an increase to the capacity reservation rate of $0.04 on 1 July 2011, 2016, 2021, 2026 and 2031.

For pre-NGL contracts, charges on the pipeline are limited by a rate cap of A$0.795/GJ. The rate cap declines to A$0.71/GJ after the Expansion Date, which is the date upon which the Service Provider first commences transportation Services under Access Agreements providing for firm Contracted Capacity for Firm Forward Haul Services of 25 PJ or more on an annualised basis.

Table 6 **QGP transportation tariffs for pre-NGL contracts**

	Units	Before expansion date (<25 PJ)	After expansion date
Capacity reservation rate	A$/GJ/MDQ	0.58	0.58
Distance reservation rate	A$/GJ/MDQ/km	0.000943	0.00066
Rate cap	A$/GJ/MDQ	0.795	0.71
80% LF tariff cap	A$/GJ	0.994	0.888

Note: Tariffs are for firm forward haul service, as at July 2006
Data source: Jemena; ACIL Allen analysis

Post-NGL shippers

Following the introduction of the NGL Jemena accepted new transitional arrangements proposed by the Queensland Government under which the QGP became an unregulated pipeline. However, Jemena has continued to provide a voluntary non-discriminatory pipeline access undertaking for parties wishing to contract for services on the QGP.[13] The tariffs currently offered to post-NGL shippers are set out in Table 7.

Table 7 **QGP transportation tariffs for post-NGL shippers**

Firm Gas Transport Service					
Capacity Tranche	Currently available	Tariff	Comments		
0 -145 TJ/d	0	n/a	Fully contracted		
145+ TJ/d	*	0.9371	* Capacity available varies depending upon path contracted		
As Available Transport Service					
Receipt Point	Wallumbilla	Gooimbah Lacerta	Fairview Westgrove	Rolleston	Moura Inlet
Delivery Point					
Rockhampton	1.6807	1.5501	1.5292	1.3423	1.1792
Gladstone	1.5917	1.4610	1.4404	1.2534	1.0904
Yarwun	1.5693	1.4387	1.4179	1.2309	1.0678
Moura	1.3559	1.2254	1.2046	1.0176	n/a
Wallumbilla	n/a	Refer Backhaul	Refer Backhaul	Refer Backhaul	Refer Backhaul
Backhaul Service (delivery to Wallumbilla)	n/a	0.5422	0.5422	0.5422	0.5422

Note: Tariffs effective from 1 January 2014
Data source: Jemena website

[13] Jemena website, accessed 14 January 2015

A capacity charge of $0.9371/GJ (as at 1 January 2014) applies for firm forward haulage. This tariff is indexed at CPI on 1 January each year. The tariff is calculated for the entire pipeline system on a “postage-stamp” basis: the distance rate with cap no longer applies. Importantly, this means that the tariff for transport on the QGP is the same for injection at either Wallumbilla or at a mid-line point such as Gooimbah (connection with CRWP).

The firm forward haulage rate for post-NGL shippers is not subject to the volume-triggered rate reduction that applies to pre-NGL contracts.

On this basis, the effective cost to transport gas on QGP to service a customer with an 80 per cent load factor under a new firm gas transportation contract would currently be about $1.17/GJ of gas delivered.

Table 8 **QGP Gas Transmission Pipeline tariffs**

Transportation task	Tariff
FFH Transport @ 100% Load Factor	$0.9371
FFH Transport @ 80% Load Factor	$1.1714

Data source: ACIL Allen analysis

As available (interruptible) transportation is offered at rates of between $1.02/GJ and $1.68/GJ of gas delivered, the applicable rate being determined by the location of the receipt and delivery points (see Table 7). For full line transport from Wallumbilla to Gladstone, the As Available haulage rate is currently about $1.59/GJ delivered. Because interruptible service does not involve firm capacity reservation, effective rates per GJ delivered do not vary with customer load factor. The “as available” tariff differential between Wallumbilla and Gooimbah (CRWP receipt point) is about $0.13/GJ, which is less than the estimated cost of transport on the CRWP Loop (see section 4.3.1).

4.3.5 Spring Gully to Wallumbilla Pipeline transport costs

The Spring Gully – Wallumbilla Pipeline (SGWP), owned by Origin Energy was constructed in 2004–05. It is 87 km long and 300 mm (12 inch) diameter. We have been unable to find any information on the capital cost of construction. However, assuming a benchmark pipeline construction rate at the time of $45,000 per inch-kilometre we estimate a pipeline capital cost about $47 million. Further assuming a compressor capital requirement of $2 million per PJ/a over the uncompressed capacity of the pipeline, we estimate a compression capital cost of $69 million giving a total system capital cost of $116 million. We assume annual operating costs (pipeline and compression) of 1.5% of relevant capital costs. Finally, we assume a pipeline throughput rising from 25 PJ/a in 2006 to 50 PJ/a in 2009 and subsequent years, with a 20 year project life. On this basis, we estimate the implied pipeline tariff to yield a 10% real pre-tax rate of return on marginal gas throughput to be around $0.27/GJ MDQ, or $0.34/GJ for a user with a load factor of 80%.

4.3.6 Conclusions regarding alternative pipelines

Gas producers looking to deliver CSG from the Surat Basin in the vicinity of the CRWP Loop to domestic markets in Central Queensland and Wide Bay have a number of alternative pipeline transport options:

- From the field to Wallumbilla via either RBP or CRWP or SGWP, then via QGP to market.

- From the field via the Fairview Lateral to the Ridgelands receipt point on the QGP, then via QGP to market
- From the field via a new receipt point on the CRWP or CRWP Loop to the Gooimbah receipt point on the QGP, then via QGP to market.

Other more elaborate paths could be envisaged—for example from the field to Wallumbilla via either RBP or CRWP or SGWP, then via the CRWP or CRWP loop to the Gooimbah receipt point on the QGP, then via QGP to market. However, these more circuitous routes would be likely to involve greater transport costs without conveying any obvious advantage in terms of ease of market access.

One consideration is whether access to the CRWP Loop might improve market access by relieving any capacity "bottlenecks" on the QGP. At present there is little, if any, uncontracted firm capacity on QGP. However, it is clear from feasibility studies into gas transport to the proposed Fisherman's Landing LNG Project that the capacity of QGP could be significantly expanded to meet new user demand. QGP owner Jemena has shown a willingness to expand pipeline capacity to accommodate new users that are willing to commit to the incremental capacity. Furthermore, use of the CRWP Loop to circumvent any short-term capacity constraint on the QGP would be unlikely to prove effective because it would not avoid the need to use QGP to access the Central Queensland/Wide Bay domestic markets. It would merely shift the receipt point into the QGP from Wallumbilla north to Gooimbah. Firm capacity in QGP would, in any case, need to be made available downstream from the Gooimbah receipt point.

In terms of costs of transporting gas to the domestic market, carriage of gas on the CRWP Loop does not appear likely to reduce costs for users. Indeed carrying gas on the CRWP Loop from Wallumbilla and transferring it to the QGP at Gooimbah would be more costly than carrying gas on QGP from Wallumbilla, since there would be no reduction in transport costs on QGP (the firm capacity charges for which are calculated on a "postage stamp" basis that does not vary with receipt point) and there would be additional transport costs on the CRWP Loop (estimated at around $0.20/GJ – see section 4.3.1).

5 Small gas producer assessment

Key Findings Chapter 5

Chapter 5 examines the potential for small gas producers not associated with the Gladstone LNG plants to benefit from access to the CRWP Loop.

Our investigations show that the only petroleum exploration tenement that is located north of Wallumbilla within a 50 km corridor around the CRWP Loop that is not either controlled by, or in j a commercial arrangement with, one of the Gladstone LNG projects is ATP 854, held by Eureka Petroleum which is a wholly-owned subsidiary of listed company Blue Energy Limited.

ATP 854 has been assessed to contain a contingent resource of 103PJ of CSG, but currently contains no commercially recoverable reserves.

There is no apparent reason why it would be advantageous to the operators of ATP 854 to have mandated access to the CRWP Loop given that the Jemena QGP passes through the eastern part of the exploration area, whereas the CRWP Loop is located further to the east. A connection into the QGP would therefore be likely to provide a lower capital cost option than a connection to the CRWP Loop.

We have been asked to provide an estimate of the potential coal seam gas production by small producers that may seek to access the CRWP Loop including:

- the name and company information of those producers
- the estimated gas reserves and projected production rates for those producers
- the relative costs of using the CRWP Loop to transport that gas versus alternative pipelines identified above.

We take "small producers that may seek to access the CRWP Loop" to mean any existing or prospective gas producer company that:

- is not currently involved in one of the Gladstone CSG LNG projects
- holds gas exploration and/or production titles located north of Wallumbilla within a 50 km radius of the CRWP Loop.

This definition recognises that for those "non-aligned" producers, access to an alternative path to market might enhance the prospects of successfully commercialising the CSG within their exploration areas. We have not excluded from consideration producer companies in which LNG project participants may hold a minority, non-operating interest.

The analysis uses a proprietary mapping and data package known as *Encom GPinfo* to identify small gas explorers and producers in the vicinity of the CRWP Loop. *Encom GPinfo* software, marketed by Pitney Bowes, combines a comprehensive database of petroleum exploration information for Australia and New Zealand with a graphical interface for viewing and manipulating data. Data in this desktop data visualisation and manipulation software includes:

- all current petroleum, sequestration and geothermal permits with attributes including participants and percentage ownership, operator, expiry date and work commitments
- all petroleum and geothermal wells drilled in the region (over 20,000) with attributes including location, operator, spud and rig release dates, result and status

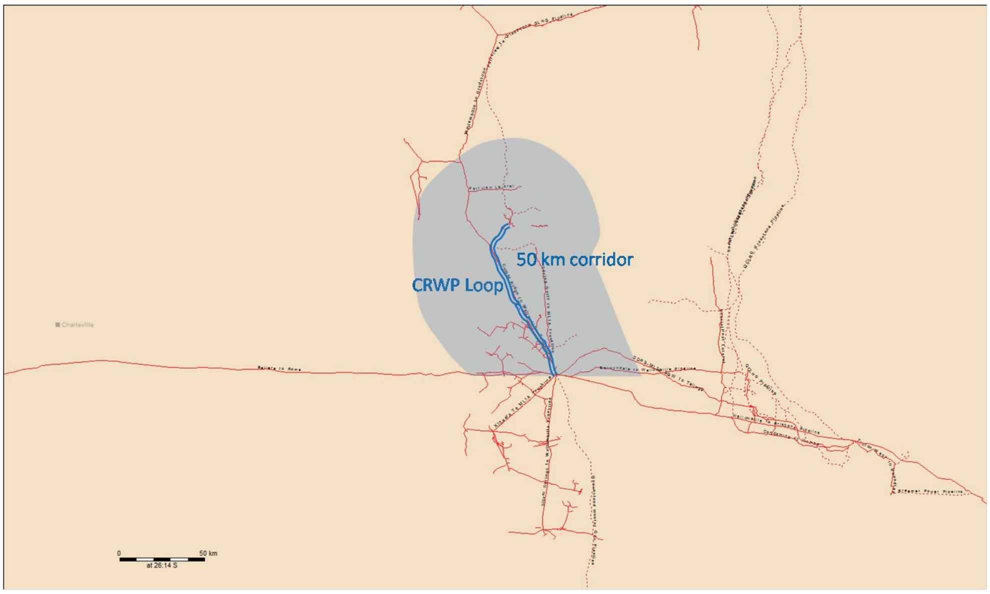
— full company information including details of parent/subsidiary relationships and contact information for offices and key personnel

— oil and gas field boundaries, pipeline routes, map sheets, coastlines, state and offshore boundaries, bathymetry and major towns.

5.1 Small independent producers

This section examines the potential for natural gas production by small independent producers and tenement holders in the vicinity of the CRWP Loop. The area of interest for this investigation is identified as a corridor extending approximately 50 km from the CRWP Loop pipeline south to Wallumbilla and the alignment of the Roma – Brisbane Pipeline and the South West Queensland Pipeline[14] (see Figure 23). Within that corridor, all “small independent producers” could be considered as potentially having an interest in accessing the CRWP Loop. Outside that corridor, it is unlikely that connecting into the CRWP Loop would provide a cost effective means of accessing the high pressure transmission pipeline system in order to move gas to market.

Figure 23 **Location of CRWP Loop and 50 km corridor of interest**



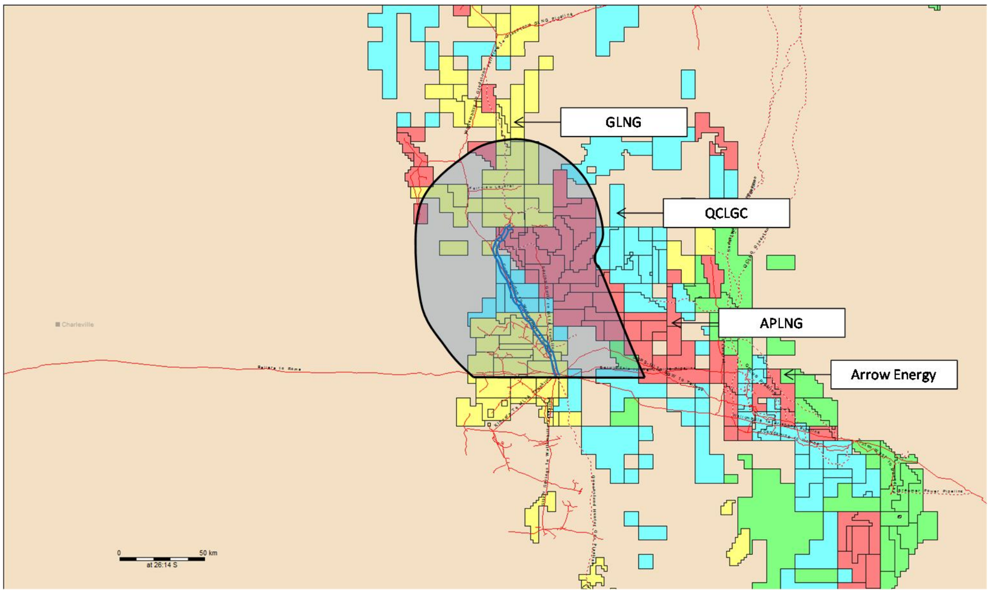
Source: ACIL Allen Consulting. Base pipeline map from *GPinfo*

As shown in Figure 24, the proponents of the Gladstone LNG projects—Arrow LNG[15], APLNG, GLNG and QCLNG—have extensive exploration and production title holdings within and adjacent to the 50km corridor around the CRWP Loop.

[14] Any third party producer with gas exploration or production titles located south of Wallumbilla and the alignment of the Roma – Brisbane Pipeline and the South West Queensland Pipeline would gain no advantage by accessing the CRWP Loop; it would be more cost effective to access the pipelines emanating from the Wallumbilla hub directly.

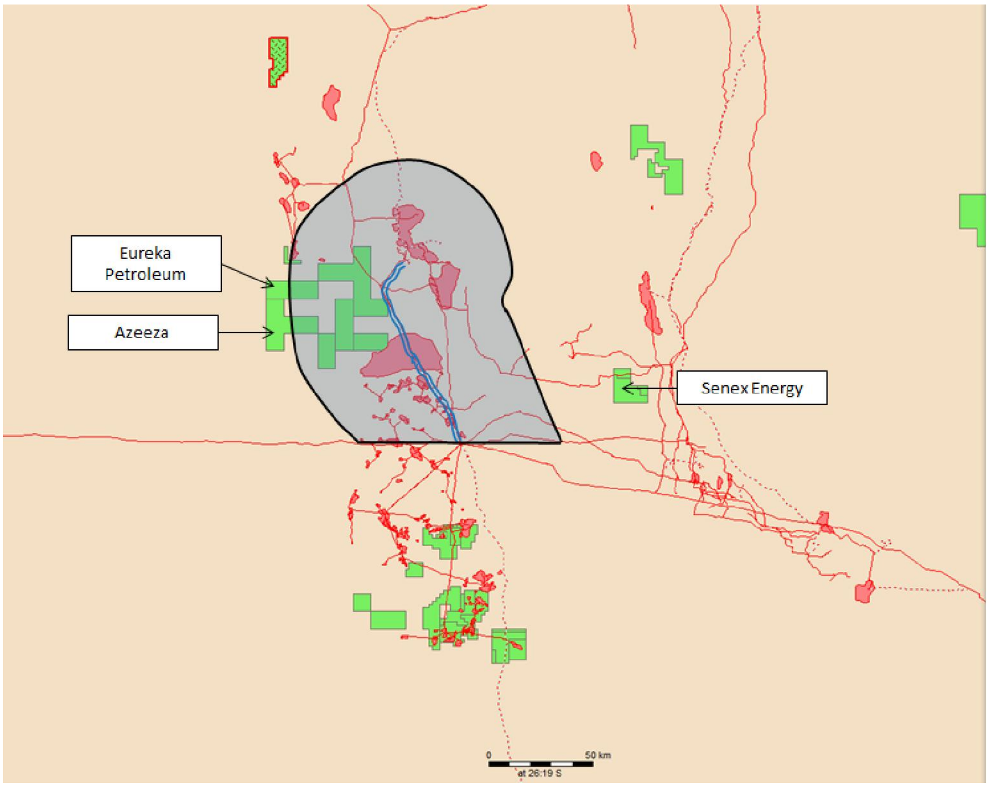
[15] Arrow is no longer proceeding with a standalone LNG project at Gladstone, but is continuing to work on development of its substantial gas resources in the Bowen & Surat Basin, with ongoing discussions on collaboration opportunities—see section 3.2.1.

Figure 24 **Exploration and production titles held by LNG proponents**



Source: ACIL Allen Consulting. Base pipeline map and tenement data from *GPinfo*.

Figure 25 **Other exploration and production titles**



Source: ACIL Allen Consulting. Base pipeline map and tenement data from *GPinfo*.

Figure 25 identifies a number of exploration titles within and adjacent to the 50 km corridor around the CRWP Loop that are held by the following parties:

- Eureka Petroleum Pty Ltd: ATP 854
- Azeeza Pty Ltd: ATP 593
- Senex Energy Ltd (directly and through Victoria Oil Pty Ltd): PCA 127, ATP 771

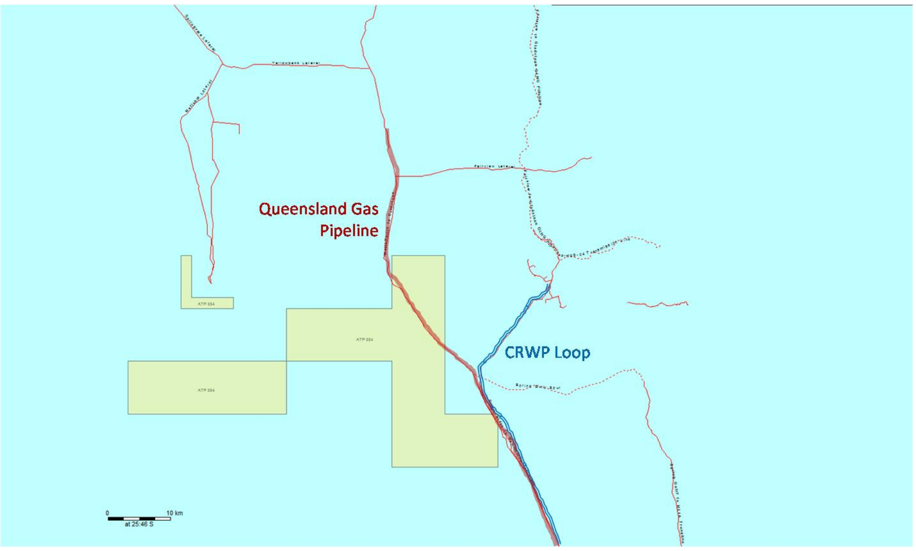
Two of these companies are either owned by, or are in commercial arrangements with, proponents of LNG projects at Gladstone:

- Azeeza Pty Ltd is a wholly-owned subsidiary of Senex Energy Ltd. ATP 593 relates to the western part of the Don Juan CSG fields where Senex is in joint venture with Arrow Energy. Arrow owns between 55% and 74% of the reserves in ATP 593 (different ownership shares for the shallow and deep resources). Development of the Don Juan CSG reserves would most likely occur through Arrow Energy.
- Senex Energy Pty Ltd is also in joint venture with Arrow Energy in ATP 771 and PCA 127 which contain the eastern part of the Don Juan CSG fields. Arrow holds a 55% interest in the shallow CSG reserves in these permits, and again development of these reserves would most likely occur through Arrow LNG.

Therefore the only exploration tenement located within the defined 50 km corridor around the CRWP Loop that is not either controlled by, or in a commercial arrangement with, one of the Gladstone LNG projects is ATP 854. This tenement is held by Eureka Petroleum, a wholly-owned subsidiary of listed company Blue Energy Limited. We note that GLNG participant company KOGAS owns 5.51% of the shares in Blue Energy and therefore holds a minority beneficial interest in Eureka. However we consider that Blue Energy is a “small independent producer” and ATP 854 is an “independent” tenement for the purpose of our analysis, on the basis that the KOGAS interest in Blue Energy is not a controlling interest, and there are no commercial arrangements between the GLNG Participants and Blue Energy regarding development of ATP 854 or supply of gas from that tenement to the GLNG project.

The location of ATP 854 relative to gas transmission pipeline infrastructure is shown in Figure 26.

Figure 26 **Location of ATP 854 relative to pipeline infrastructure**



Source: ACIL Allen Consulting. Base pipeline map and tenement data from *GPinfo*.

The following information regarding the CSG resources in ATP 854 is taken from Blue Energy's website:

> "ATP 854P is located near the township of Injune in Central Queensland. The Wallumbilla – Gladstone gas pipeline [that is, Jemena's Queensland Gas Pipeline] passes through the eastern portion of the permit, and gas discovered in this block is therefore well located to access this infrastructure and move gas either through to Gladstone, or back to Wallumbilla and into the south eastern Queensland, South Australian or Sydney gas markets.
>
> The results from the drilling campaign (Itude 1, 2 & 3 CSG core holes) which targeted the Walloon Coal Measure CSG play were reviewed and as a result the company has refocused exploration in ATP 854P toward the Late Permian CSG play. The Walloon exploration program identified that the Jurassic coals were poorly developed and had low gas content in the Itude area of the permit and as such this play was likely to be presently sub-economic in this part of the permit. Geological work is continuing to establish if this play is feasible elsewhere in the permit.
>
> The Late Permian CSG play in ATP 854P was initially investigated with the drilling of Cerulean 1 and Cobalt 1 core holes and the Cerulean 2 pilot test well in 2008. The test results from Cerulean 2 indicated that the coal seam targeted by the well had low permeability. During the current period, planning work has been undertaken to look at the feasibility, cost and detailed design of a lateral well into the coals at Cerulean. The rationale to drill a lateral well at Cerulean is based on the need to intersect a greater coal thickness and hence improve the chance of generating an economic gas flow from the coals. The core data from both Cerulean 1 and Cobalt 1 indicate the Permian coals are gas saturated with recorded gas contents of 8 – 13m^3/tonne (dry ash free). The Late Permian sequence is highly productive at the nearby Spring Gully and Fairview CSG fields."
>
> *Source: http://www.blueenergy.com.au/01_cms/details.asp?ID=19*

There are currently no proven, probable or possible reserves of CSG in ATP 854. According to an ASX announcement by Blue Energy dated 19 March 2013, ATP 854 has been independently assessed to contain a 3C contingent resource[16] of 103 PJ in the Permian Bandanna Formation.

As shown in Figure 26, the QGP passes through the eastern part of ATP 854. In order to reach the CRWP Loop, gas produced from ATP 854 would have to cross over the QGP. It is therefore reasonable to conclude that to provide market access for any future gas production from the ATP 854 area, a connection into the QGP would be likely to provide a lower cost option than a connection to the CRWP Loop.

5.2 Conclusion regarding small independent producers

Our analysis reveals that there is only one petroleum exploration tenement within the target area that is operated by a small independent producer not either directly involved in, or in joint venture with, a Gladstone LNG project. That tenement is ATP 854 operated by Blue Energy Limited.

At present ATP 854 is known to contain a contingent resource of 103PJ of CSG, but no commercially recoverable reserves.

There is no apparent reason why it would be advantageous to the operators of ATP 854 to have mandated access to the CRWP Loop given that the QGP passes through the eastern part of the exploration area, whereas the CRWP Loop is located further to the east. A

[16] Contingent resources are less certain than reserves. These are resources that are potentially recoverable but not yet considered mature enough for commercial development due to technological or commercial hurdles. For contingent resources to move into the reserves category, the key conditions, or contingencies, that prevented commercial development must be clarified and removed.

connection into the QGP would therefore be likely to provide a lower cost option and more flexible option than a connection to the CRWP Loop.

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Appendix A Curriculum Vitae

Paul Balfe, Executive Director

Paul Balfe is a director of ACIL Allen Consulting and has overall responsibility for the firm's gas business.

Mr Balfe graduated from the University of Queensland (B.Sc. (Hons 1) in Geology and Mineralogy 1976; MBA 1988). He has more than 35 years of experience working in the mining and energy sector in Australia as a geologist, government administrator and economics and policy consultant. He commenced his career working as a petroleum and coal geologist with the Geological Survey of Queensland, and subsequently held various managerial roles in energy resource development in the Queensland Department of Mines & Energy (QDME).

In 1995 Mr Balfe left the position of Director of Energy in QDME to join ACIL Economics & Policy, a national firm with a substantial consultancy practice in the area of energy markets and energy policy. ACIL Economics & Policy is now known as ACIL Allen Consulting Pty Limited.

As the Executive Director responsible for ACIL Allen's gas business, Mr Balfe has guided the development and commercialisation of ACIL Allen's *GasMark* model and its application to strategic and policy analysis throughout Australia and in New Zealand. He provides a range of analytical and advisory services to companies, government agencies and industry associations, particularly in the gas, electricity and resources sector. He has worked extensively on gas industry matters, particularly gas policy reform issues; gas market analysis; gas pipeline developments, acquisitions and disposals; and gas project commercial analysis. He has been closely involved in commercial and regulatory negotiations for various gas transmission pipelines, and has worked extensively in the Queensland coal seam gas (CSG) industry as an adviser to both government and corporate sector clients on regulatory, technical, economic and commercial aspects of CSG development.