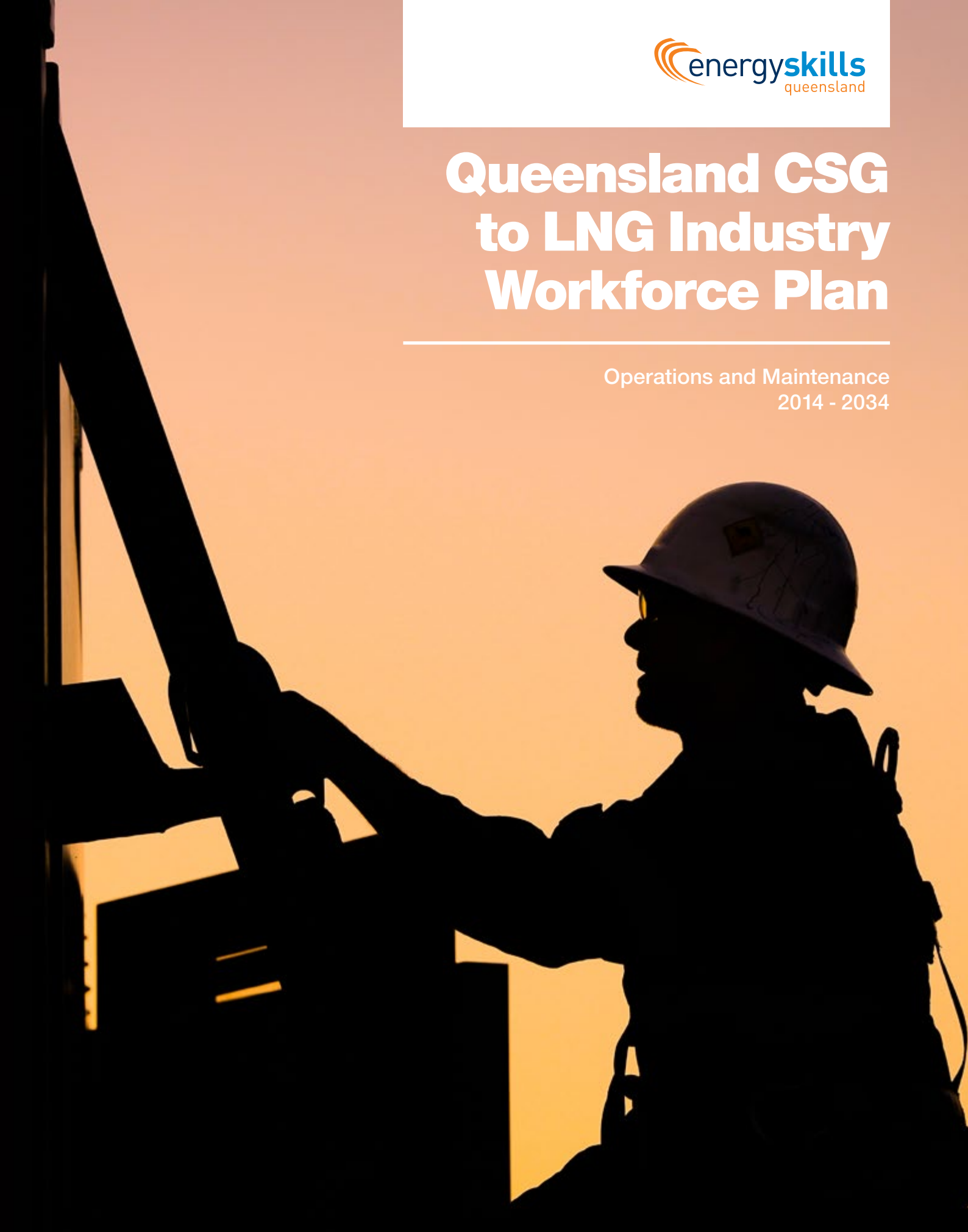


Queensland CSG to LNG Industry Workforce Plan

Operations and Maintenance
2014 - 2034



Energy Skills Queensland (ESQ) is the Industry Skills Body leading energy industry and government engagement on education and training, skills development and labour market issues. Energy Skills Queensland is at the forefront of developing solutions to help industry plan and develop their workforce, and providing opportunities for organisations and individuals to improve workforce skills by brokering training funding.

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Queensland CSG to LNG Industry Workforce Plan

Operations and Maintenance
2014 - 2034

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Foreword



Energy Skills Queensland is proud to present the Queensland CSG to LNG Industry Workforce Plan, Operations and Maintenance 2014 - 2034.

This important research including high level recommendations has been developed in conjunction with the CSG to LNG industry and is an update of Energy Skills Queensland's seminal workforce plan released in 2009.

In 2008, Energy Skills Queensland established the CSG to LNG Skills Taskforce with representatives from the four principal gas companies (Arrow Energy, Origin Energy, Santos and QGC).

This group was established to create a strategic framework for the identification of future workforce issues and to develop an industry driven response to these identified issues.

In early 2009, the CSG to LNG Skills Taskforce contracted Energy Skills Queensland to undertake strategic workforce planning for the CSG to LNG industry. Each company provided workforce data and information regarding their projected workforce needs. This data was aggregated into an industry skills demand forecast. Energy Skills Queensland then reviewed the Queensland labour market to gain an understanding of the supply of skills in order to forecast the skill gaps.

The mismatch between skills demand and supply provided the industry with a list of critical occupational grouping which has enabled the industry to focus its attention and resources on strategies to meet identified skill shortages.

Through this unique collaboration of the gas companies, the CSG to LNG Workforce Planning Report was developed with the research providing a shared understanding of their projects' combined future workforce skilling needs.

In 2012, it was identified that the original research needed to be updated to reflect the significant development of the four projects; Queensland Curtis LNG (QCLNG), Santos GLNG (GLNG), Australia Pacific LNG (APLNG) and Arrow Energy.

Each of the four projects had progressed significantly during that timeframe with three of the projects achieving their Final Investment Decision (FID), and had commenced their construction phases. Technologies within the industry had also changed, directly impacting upon the skill mix of the workforce. A greater understanding of the contracted workforce had also developed, particularly in areas such as drilling, well servicing, and gas field development.

This updated Queensland CSG to LNG Industry Workforce Plan was developed with the contribution and financial support of the four gas companies and Skills Queensland. A significant amount of workforce data and information was once again provided by the four companies, as well as data from major contractors and government sources.

Energy Skills Queensland's team of professional analysts and workforce planners examined and interpreted the magnitude of data provided and combined with various interviews with technical specialists, developed this report.

The Queensland CSG to LNG Industry Workforce Plan, Operations and Maintenance 2014 - 2034 will greatly assist the industry to develop its workforce further. The companies continue to demonstrate industry best practice through their close collaboration within a high growth industry to build the supply of skilled workers.

However, this report highlights the critical need to work more with the contracted workforce, as this is where the majority of workers are employed, and where the greatest risks are from a health, safety, environment and productivity perspective.

Energy Skills Queensland and the CSG to LNG industry will continue to work with government, training organisations and key stakeholders to further develop the training infrastructure and capability in Queensland to deliver a highly skilled, competent, safe and productive workforce.

I would like to acknowledge and thank the companies that contributed to developing this workforce plan. I would also like to acknowledge and thank Energy Skills Queensland's workforce planning team for the excellent job they have done in preparing this important research.

Energy Skills Queensland looks forward to working with the industry, government and key stakeholders to implement the high level recommendations outlined in this report.

A handwritten signature in black ink, appearing to read 'Glenn Porter'.

Glenn Porter
Chief Executive Officer, Energy Skills Queensland

Executive Summary

Energy Skills Queensland is pleased to present the 2013 Industry Workforce Plan for the CSG to LNG Operations and Maintenance workforce.

This research identifies the future demand for skilled workers over a 20 year forecast period, with the workforce expected to peak at around 14,900 workers in 2024.

The report also identifies the many and varied skills development and training needs for the long term growth of the CSG to LNG industry in Queensland.

The first CSG based LNG project was announced in Queensland in May 2007. Since then, the industry has continued to grow with six LNG trains currently under construction: Australia Pacific LNG (APLNG) - two trains; Santos LNG (GLNG) - two trains and Queensland Curtis LNG (QCLNG) - two trains. The Arrow LNG project is scheduled to go to Final Investment Decision (FID) late 2013.

The CSG to LNG industry will generate significant positive economic and social benefits on a national scale for Australia, Queensland, and for regional economies of the Mackay, Fitzroy, Wide Bay, Western Downs, and Darling Downs and Maranoa regions. It is anticipated the CSG to LNG industry will continue to grow in Queensland for more than 30 years, and will provide ongoing career opportunities across a number of occupations.

CSG to LNG project areas

The CSG to LNG industry requires a broad range of skills and occupations, across a vast regional landscape. Because of this, the research is divided into two key project areas of operations and maintenance:

1. Upstream: CSG field facilities including drilling, plant and pipeline components of the project.
2. Downstream: LNG processing facilities.

Upstream and downstream operations are geographically different with upstream roles being predominantly based in the Surat and Bowen Basins with some roles in Brisbane. The downstream workforce will be located in Gladstone and Brisbane. Approximately 85% of the overall operations workforce will be required in the Surat Basin and surrounding areas, with approximately 10% and 5% required in Gladstone and Brisbane respectively.

Drivers of skills demand

The key drivers for determining critical skills and job roles that will be ongoing in the CSG to LNG industry without further intervention are categorised as:

1. Level of experience
2. Training and education – length of training
3. Training and education – low completion and study rates
4. Labour mobility

These drivers were identified through stakeholder engagement as part of the critical skills and occupational requirements for industry.

Projected workforce demand

The 20 year workforce plan for the operations and maintenance phase of the CSG to LNG industry has identified total workforce requirements will peak in 2024 at 14,900 workers (based on six LNG trains and 45,000 wells) (Figure 1). The workforce peak could increase to 17,000 workers in 2024 under the alternative scenario based on 59,000 wells and six LNG trains.



The CSG to LNG industry will generate significant positive economic and social benefits on a national scale for Australia, Queensland, and for regional economies



Image courtesy of Australia Pacific LNG

Projected total workforce scenario one (six trains)

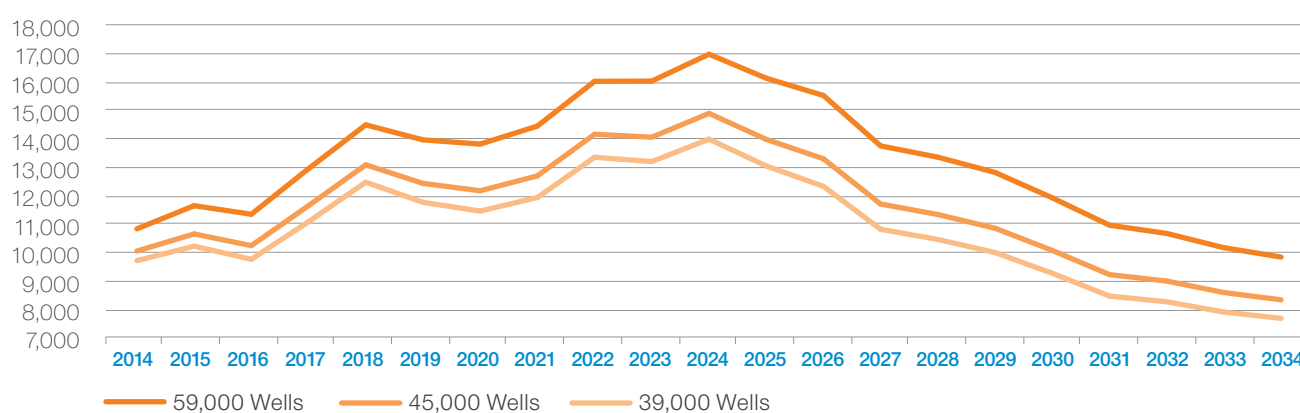
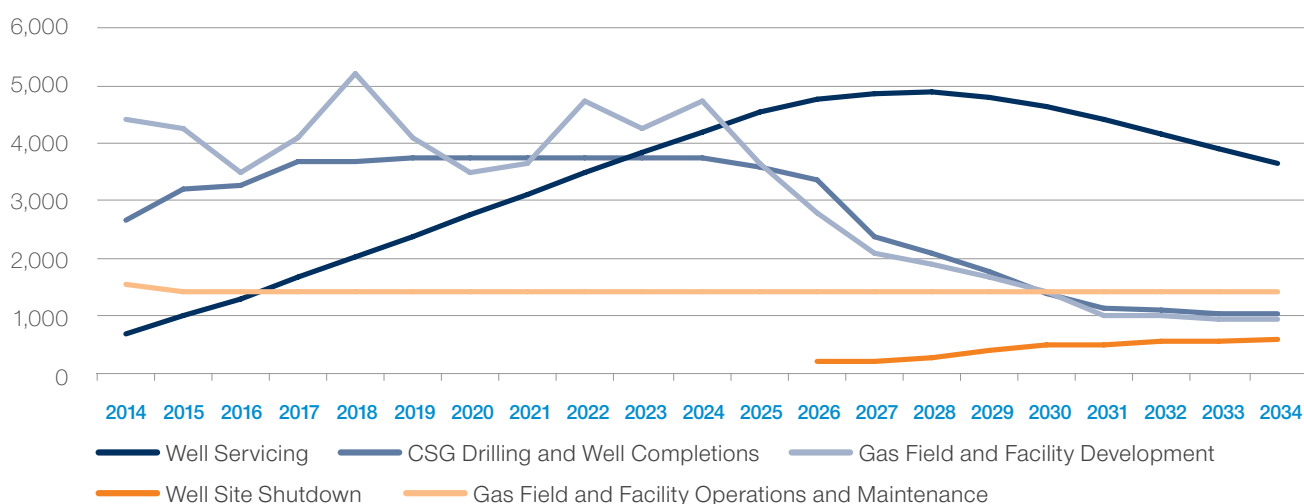


Figure 1: Projected total workforce for the CSG to LNG industry in Queensland 2014 to 2034 (six LNG trains)

The upstream workforce will require the largest workforce numbers and is anticipated to consist of approximately 35% direct employees of the gas companies, with the majority of workers (65%) to be a contracted workforce through the supply chain contractors. Figure 2 details the upstream workforce that will be required over the 20 year forecast period at around 14,100 workers.

Total upstream workforce required (45,000 wells)¹



¹ Well site shutdown is expected to be part of the workforce from the start as wells dry-up early or underperform, however the bulk of well site shutdown is expected to take-off around 2026 and increase over time. For this reason it is included from 2026 onward.

Figure 2: Total upstream workforce required 2014 to 2034

The downstream operations workforce will peak at around 800 workers under a six LNG train scenario in 2015 (Figure 3). The workforce numbers are expected to remain stable across the life of the projects, with the majority of workers to be based in Gladstone and directly employed by the gas companies.

Projected workforce downstream



Figure 3: Projected workforce needed (downstream) for the CSG to LNG industry in Queensland 2014 to 2034

As well as the core operational workforce, approximately 600 workers (per LNG train) will be required to perform scheduled maintenance shutdowns periodically. Minor shutdowns will occur more frequently and will require additional staff of approximately 40 to 60 workers. It is unlikely that more than one LNG train will be shutdown at any one time across all of the plants on Curtis Island. The maintenance workforce is likely to be required for only part of the year and only in the years when shutdown occurs, therefore have not been included in the overall workforce requirements (14,900 workers).

Critical skills and occupations

The following list represents the skills and occupations that will be critical to the CSG to LNG industry during the next 20 years across the two key project areas of operations and maintenance i.e. upstream and downstream (Table 1).

Table 1: Critical job roles for the CSG to LNG operations and maintenance phase

Upstream	Downstream
Lease Hand	Field Technician and Operations Technician
Floor Hand	LNG Plant Operators and Superintendents
Motorman	Electrical Fitter/Mechanic
Derrick Hand	Instrumentation and Control Technician
Assistant Driller	Telecommunication Technician
Driller	Health, Safety and Environment Officer
Tool Pusher	Procurement Manager
Rig Manager	Project Manager
Electrical Fitter/Mechanic	LNG Technical Trainer
Cable Jointer	Engineer
High Voltage Switching Electrician	Specialist Trainers and Assessors (oil and gas)
Telecommunication Technician	Operations Technicians
SCADA Professional (Supervisory Control and Data Acquisition)	
Health, Safety and Environment Officer	
Specialist Trainers and Assessors (oil and gas)	
Project Manager	
CSG Technical Trainer	
Engineer	
Geologist	
Geophysicist	

Opportunities and recommendations

The CSG to LNG industry presents Queensland with a wealth of long term employment and economic benefits. With an anticipated span of more than 30 years, there is great opportunity for individuals and organisations to build sustainable career paths within the CSG to LNG industry. There are a number of key recommendations included in this report to leverage a range of workforce development activities which continue to build a flexible and competent workforce and to ensure all benefits from this emerging industry are realised.

Recommendations include:

Recommendation 1	Prioritise workforce planning initiatives for the CSG to LNG supply chain, in particular drilling, well servicing, electrotechnology, telecommunications and camp operations.
Recommendation 2	Establish a CSG to LNG training fund to develop the skills needed for a flexible and competent workforce.
Recommendation 3	Support employment and training programs for Aboriginal and Torres Strait Islander people which are focused on long term career outcomes.
Recommendation 4	Prioritise funding for well servicing training to ensure workers in this area are appropriately qualified.
Recommendation 5	Increase training provider support for the CSG to LNG industry.
Recommendation 6	Develop an LNG operator training centre in Gladstone for use by whole of industry.
Recommendation 7	Increase industry collaboration for Original Equipment Manufacturer (OEM) vendor training to reduce training costs.
Recommendation 8	Review competency assurance management systems for supply chain contractors to reduce risks associated with a predominantly 'green hands' workforce.
Recommendation 9	Improve access to support and funding for training in health, safety and environment for small and medium sized supply chain contractors.

Image courtesy of Saxon Energy Services

“

With an anticipated span of more than 30+ years, there is great opportunity for individuals and organisations to build sustainable career paths within the CSG to LNG industry.



Introduction

Building a skilled workforce which meets the ongoing needs for the CSG to LNG industry is vital to its success. In 2009, Energy Skills Queensland produced the initial 20 year workforce plan for the operations and maintenance phase of the CSG to LNG industry in Queensland. The research resulted in the creation of the Queensland CSG to LNG Skills Taskforce to advance the development and skills which meet the long term sustainability of the industry.

Key successes from the taskforce include:

- Establishment of the CSG to LNG Skills Formation Strategy
- Establishment of the \$10 million CSG to LNG Training fund by the Queensland Government
- Development and delivery of the CSG Drilling Skills Program
- Development and delivery of the Gladstone Workforce Skilling Strategy
- Development and delivery of the Queensland Workforce Skilling Strategy
- Establishment of the Drilling Industry Leaders Group
- Development of Well Servicing competencies and qualifications
- Completion of the CSG to LNG Construction Workforce Plan (2009)
- Development and delivery of the Electrician to Electrical and Instrumentation Technician Program
- Establishment and delivery of the Electrotechnology Pre-Apprenticeship Program
- Creation of Careers in Gas, the CSG to LNG job referral website
- Establishment of Gas Work Authorisation for stationary reciprocating gas engines

Changes in workforce understanding from 2009 to 2013

The understanding of the workforce requirements have matured greatly since the 2009 report was released. Table 2 outlines the key differences:

Table 2: Changes in workforce understanding 2009 to 2013

Report	2009	2013	Key differences
Scenarios	Three scenarios were used based on levels of production, using a four, six and eight LNG train model.	Two scenarios based on levels of production i.e. six and eight LNG trains, as well as the number of wells that will need to be drilled to obtain appropriate quantities of gas i.e. base level: 39,000 wells, 15% increase: 45,000 wells, and a 30% increase: 59,000 wells.	The addition of the CSG well drilling scenarios enabled more detailed workforce numbers for the upstream component of the project for the 2013 report.
Critical Workforce Issues	Six priority areas identified: 1. Labour shortage 2. Skills shortage 3. Lack of competent workforce 4. Inadequacies in capacity and capability of training providers 5. Misalignment of competency based training packages to meet industry requirements 6. Replacement demand	Four key drivers for determining criticality of skills and occupations: 1. Level of experience 2. Training and education – length of training 3. Training and education – low completion and study rates 4. Labour mobility	There are similar themes for the determination of critical workforce issues in both reports.
Critical Skills and Occupations	Grouped by professional, technical and non-technical/unskilled	Detailed breakdown of occupations impacted by the critical workforce issues in each sector of the CSG to LNG industry e.g. LNG plant, drilling, gas field operations	More detail has been provided in the 2013 report on specific skills and occupations in demand including, where available, location and employee type i.e. direct employee or contractor.
Total Workforce Numbers	Workforce to peak under each scenario in 2020: Four LNG trains – 3,451 workers Six LNG trains – 5,129 workers Eight LNG trains – 6,291 workers	Workforce to peak under each scenario in 2024: Six LNG trains: <ul style="list-style-type: none">39,000 wells – 14,000 workers45,000 wells – 14,900 workers59,000 wells – 17,000 workers Eight LNG trains: <ul style="list-style-type: none">39,000 wells – 14,300 workers45,000 wells – 15,200 workers59,000 wells – 17,200 workers	The peak workforce numbers have more than doubled from the original workforce plan in 2009. The increase is created by a greater understanding of the required contracting workforce, as well as an increase in the number of wells expected to obtain the volume of gas required.

Report	2009	2013	Key differences
Upstream	Breakdown of workforce demand projections were not included for upstream roles.	<p>It is estimated the upstream workforce will peak in 2024 under each scenario:</p> <ul style="list-style-type: none"> • 39,000 wells – 13,200 workers • 45,000 wells – 14,100 workers • 59,000 wells – 16,100 workers 	The 2013 report provides greater detail of upstream workforce numbers as well as the skills and occupations needed.
Downstream	Breakdown of workforce demand projections was not included for downstream roles.	<p>It is estimated the downstream workforce will peak in 2024 under each scenario:</p> <p>Six LNG trains – 800 workers</p> <p>Eight LNG trains – 1,100 workers</p>	The 2013 report provides greater detail of downstream workforce numbers as well as the skills and occupations needed.
Total Number of Wells	Not stated in 2009 report. The 2009 CSG Construction Workforce Plan (released after the Operations plan) stated there would be approximately 34,700 wells.	<p>Three scenarios used:</p> <ul style="list-style-type: none"> • Base level: 39,000 wells (rounded) • 15% increase: 45,000 wells (rounded) • 30% increase: 59,000 wells (rounded) 	The addition of this data into the 2013 report allows for more detailed and flexible strategy and intervention decision making.

The report contains information on the current drivers for skills demand, forecasted data for critical job roles and ongoing skills demand faced by the industry. Opportunities for workforce development and recommendations are also included. The final part of the research, to create an action plan for industry and government, will be facilitated by Energy Skills Queensland following the release of this document and will include substantial consultation with industry and government stakeholders.

Image copyright of Arrow Energy



Overview of the CSG to LNG process

The CSG to LNG process starts at the well (upstream) where a mixture of gas and water is extracted and separated. This gas is then compressed (compressed natural gas) and is transported by pipeline to the LNG train (downstream) in Gladstone. At the LNG train, the compressed gas is cooled in stages to form LNG, which is then pumped into specially designed vessels for transport overseas.

Figure 4 visualises this process and includes additional important components such as necessary stakeholder engagement and the control centres.

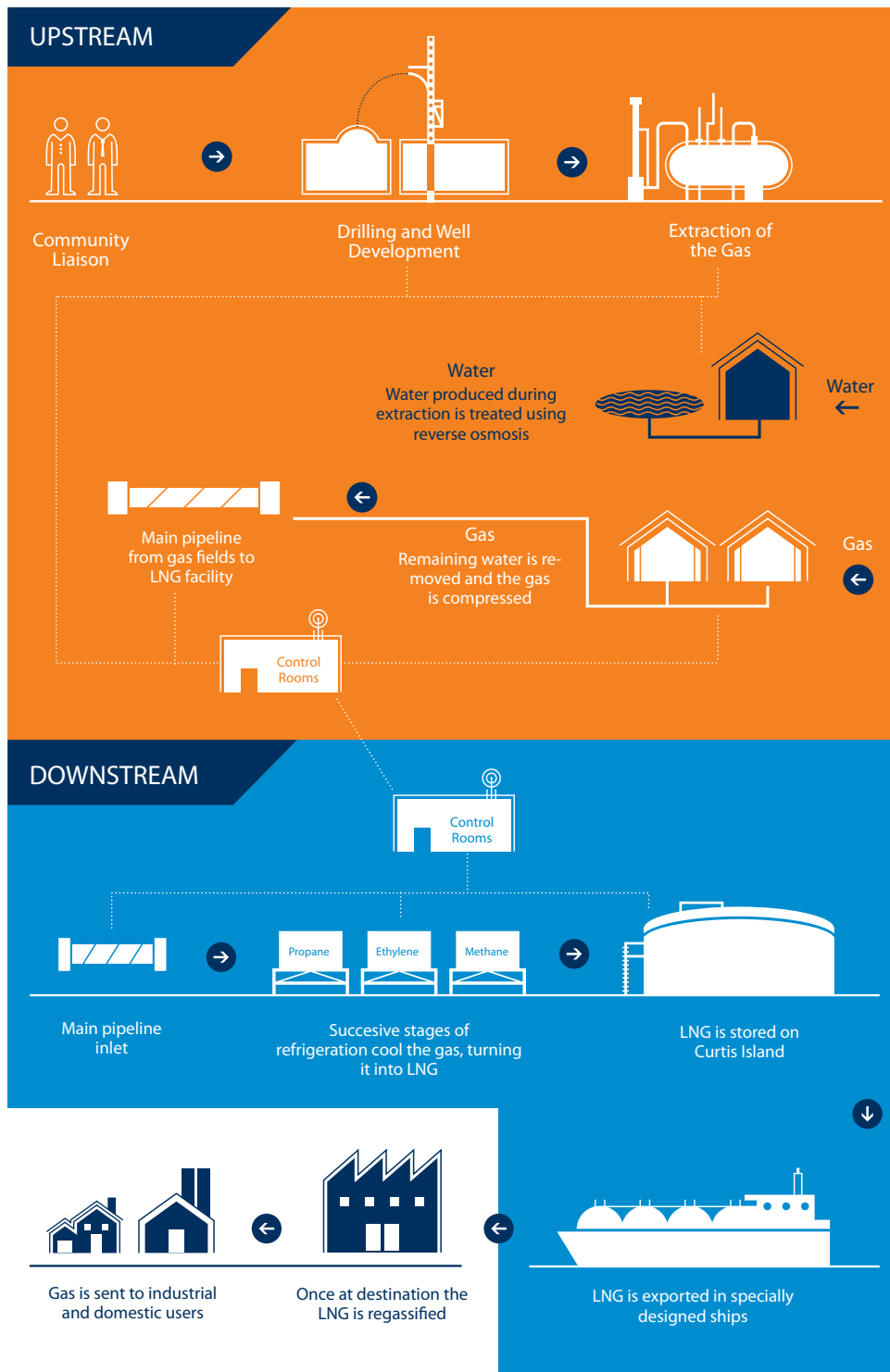


Figure 4: The CSG to LNG Process

Scope and Methodology

Data

Workforce data was provided to Energy Skills Queensland by Arrow Energy, ConocoPhillips, Origin Energy, QGC, and Santos. This data was collected to report the whole of industry view detailed in this report. For workforce areas such as drilling, modelling was used to determine future workforce demand which has been validated by external sources within the CSG drilling industry.

Scenarios

When developing the scenarios for this report, two key drivers became apparent - the number of LNG trains and the number of wells required. The whole of workforce forecasts are based on two factors. Firstly, the number of LNG trains that will be built by the gas companies on Curtis Island in Gladstone, and secondly, the number of wells that will be required to supply the gas to the LNG trains.

Two scenarios are used for downstream based on consultation with the industry. The number of LNG trains used in each downstream scenario for forecasting purposes is six and eight.

The base number of wells for all four upstream projects is reported to be 39,000 wells for the life of the projects, which span beyond the 20 year forecasting period of this report. The number of required wells is determined by the volume of gas each well produces i.e. not all wells will produce the same amount of gas. This variability increases the likelihood that the baseline number of wells will increase over time, and not every well drilled will become operational with some producing limited or no gas. For the purposes of the scenario development and forecasting, the base number is increased by 15% (to 45,000 wells) and 30% (to 59,000 wells) respectively to account for the likely variation.

Scenario factors

Number of LNG trains

The number of workers needed for each additional train increases slightly due to economies of scale. Table 3 shows an example increase of one LNG train to two LNG trains.

Table 3: Example workforce numbers for one and two LNG trains

	LNG trains	
	1	2
Maintenance	30	40
Operations	20	30
Administration	30	35
Total onsite	80	105

The impact on the operations workforce with additional trains is minimal and forecasting a six and eight train scenario builds an accurate picture of the current and projected workforce needs for the CSG to LNG industry in Queensland. These six and eight trains scenarios were used for the overall workforce requirements, as well as the downstream component of the project.

Number of wells

The second driver for the scenarios is the variability in the number of wells that will be drilled throughout Queensland during the life of the current projects (30+ years). The number of wells across the CSG gas fields will depend on the quality of each well, and it is likely the amount of gas produced by each well will be variable. Three scenarios for upstream have been developed (all figures are rounded to the nearest 100):

- 39,000 wells: base level
- 45,000 wells: 15% increase
- 59,000 wells: 30% increase

The baseline number of wells has been calculated using forecasts provided by the participating gas companies. The increase of 15% and 30% respectively for scenarios two and three, were determined through extensive stakeholder engagement and the external scan researched by Energy Skills Queensland as a precursor to this report. It is anticipated the 45,000 wells scenario is the most plausible based on the engagement and research to date, and these workforce figures have been used throughout the report.

Final scenarios

The final scenarios used for forecasting purposes are outlined in Table 4. For a total workforce forecast, the six and eight LNG train scenarios were used in conjunction with the drilling factors. For the upstream and downstream sections of the report, these scenarios were divided into separate functions, i.e. upstream was forecasted using the drilling factors, and downstream was forecasted on the number of LNG trains.

Table 4: Scenarios for the Queensland CSG to LNG Industry Workforce Plan, Operations and Maintenance 2014-2034

Scenario 1: Six LNG trains	Scenario 2: Eight LNG trains
First gas will commence in 2014, and will follow into 2015 with all six trains completing construction.	First gas will commence in 2014, and will follow into 2015 with six trains completing construction. The remaining two trains will complete construction late 2017.
Drilling factors applied to both scenarios ² :	
39,000 wells	
45,000 wells (+15%)	
59,000 wells (+30%)	

² Total number of wells drilled during the next 30 years.

Image courtesy of Santos GLNG



Scope and Assumptions

The 'engineering' terminology has also traditionally included para-professional roles trained under the VET system in maintenance and operational services. The use of engineer in this report reflects the tertiary education degree and above roles.

CSG to LNG projects in Queensland

The report contains collected workforce information on the CSG to LNG projects listed in Table 5.

Table 5: CSG to LNG projects in Queensland

Project	Abbreviation	Company
Queensland Curtis LNG project	QCLNG	QGC - a BG Group Business
Santos LNG	GLNG	Santos / Petronas / Total / Kogas
Australia Pacific LNG	APLNG	Origin / ConocoPhillips / Sinopec
Arrow LNG	n/a	Shell / PetroChina

Workforce included in scope

The areas of focus for this research include the following areas of operation for the CSG to LNG industry in Queensland:

Upstream:

1. CSG drilling and well completions
2. Well servicing
3. Gas field and facilities development
 - Gas field facilities development
 - Well gathering networks (water and gas)
 - Steel trunklines
 - Power supply and communications
4. Gas field and facilities operations and maintenance
 - Well site operations
 - Field gas compression
 - Integrated operations centres
 - Water management
 - Well gathering networks (water and gas)
 - Control rooms
 - Land care and cultural heritage
 - Gas transmission pipeline
5. Well site shutdown

Downstream:

- LNG processing facilities

Workforce excluded from scope

- Communications and power workers required for the gas field and facilities development. These workers are highly skilled and form part of the critical workforce required for the CSG to LNG industry. Approximate numbers have been included in the report, however, there was insufficient industry data available at the time of publication of this report. This workforce will require further investigation to determine workforce demand.
- Support service areas such as:
 - Camp services
 - Sewerage and water treatment plants for camp facilities
- Other forms of gas extraction e.g. tight and shale gas.
- Construction activity still taking place on Curtis Island in Gladstone.
- The industry plan uses a 20 year forecast to best represent the ongoing skills needs. Workforce planning is an iterative process, and it is expected that the research will need to be repeated every three to four years to maintain relevancy. A 'decommissioning phase' workforce plan will also be required in the future to identify strategies to de-mobilise workers for cross and up-skilling initiatives.



Image courtesy of Australia Pacific LNG

Supply

Labour supply for the CSG to LNG operations and maintenance workforce has been difficult to quantify. The CSG drilling industry is relatively new to Australia and has not been sufficiently identified by the Australian Bureau of Statistics (ABS) to detail the diversity of workforce geographically and by job role types. In addition, vocational education training (VET) in the CSG to LNG industry is currently dominated by organisational and non-government funded training. At the time of writing this report, the reporting of training to the Queensland Government Department of Education, Training and Employment (DETE) was not mandatory in Queensland unless there had been a government funding contribution towards the training. The result of this is an incomplete understanding of training numbers for critical roles. Labour supply information for each critical skills and occupations has not been included as a result of these factors.

The External Scan Report, produced by Energy Skills Queensland as a precursor to this document outlines the available labour market statistics including regional age profiles and employment indicators.

Operations vs. maintenance workforce

Where available, information has been provided for the separate skills and occupations required in the operations or maintenance phase of the CSG to LNG industry. While all care has been taken to represent the figures accurately, there are some operations and maintenance workforce figures that were unavailable at the time of publication.

Direct employees vs. contracted workforce

Throughout the report, a distinction is made between direct employees and a contracted workforce of the CSG to LNG industry. These are defined as:

- Direct employees – Workers who are directly employed by the gas companies, i.e. Arrow Energy, ConocoPhillips, Origin Energy, QGC, and Santos. This includes permanent, casual, and employees on short or fixed-term contracts.
- Contracted workforce – Workers who will be engaged to work in any part of the industry through a contractor organisation i.e. supply chain organisations.



Image courtesy of Santos GLNG

Assumptions

- All numbers for total workforce projections are rounded to the nearest 100.
- Where forecasts are presented for individual workforce areas i.e. upstream and downstream, numbers are rounded to the nearest 10.
- Baseline employment is reported as 9,000 workers and was calculated using rounded workforce numbers required for a six train operation and a corresponding number of wells.
- The term 'midstream' is used by QGC and refers to the LNG processing facilities referred to in this report as 'downstream'. Under the QCLNG project, 'downstream' refers to the delivery of gas to the buyer.

Total Workforce Requirements

The CSG to LNG industry plan provides 20 year workforce projections for the whole workforce and provides detailed projections on the upstream and downstream workforce needs.

Table 6 shows the four main projects by estimated year of first gas production, as well as the expected capacity (PJ) each company expects to produce.

Table 6: The four main CSG to LNG projects

Project	Company	Estimated year of gas production	Estimated new capacity (PJ)
Queensland Curtis LNG	QGC - a BG Group business	2014	450
Santos GLNG	Santos / Petronas / Total / Kogas	2015	410
Australia Pacific LNG	Origin / ConocoPhillips / Sinopec	2015	480
subtotal			1,340
Arrow LNG	Shell / PetroChina	2017+	420
Total			1,760

Figure 5 shows the projected total workforce for six LNG trains for each of the well scenarios. Using these projections, the operations and maintenance workforce is expected to peak in 2024 at 14,000, 14,900, and 17,000 workers for each well scenario. The workforce will consist of approximately 35% direct employees of the gas companies, with 65% representing the contracted workforce.

Approximately 85% of the operations workforce will be required in the Surat and Bowen Basins and surrounding areas, with approximately 10% and 5% required in Gladstone and Brisbane respectively.

Whilst the forecast shows a decline in workforce requirements from 2024, the introduction of tight and shale gas production in the coming years will see an ongoing need for workers in the industry in Queensland beyond the current forecast period.

Projected total workforce scenario one (six trains)

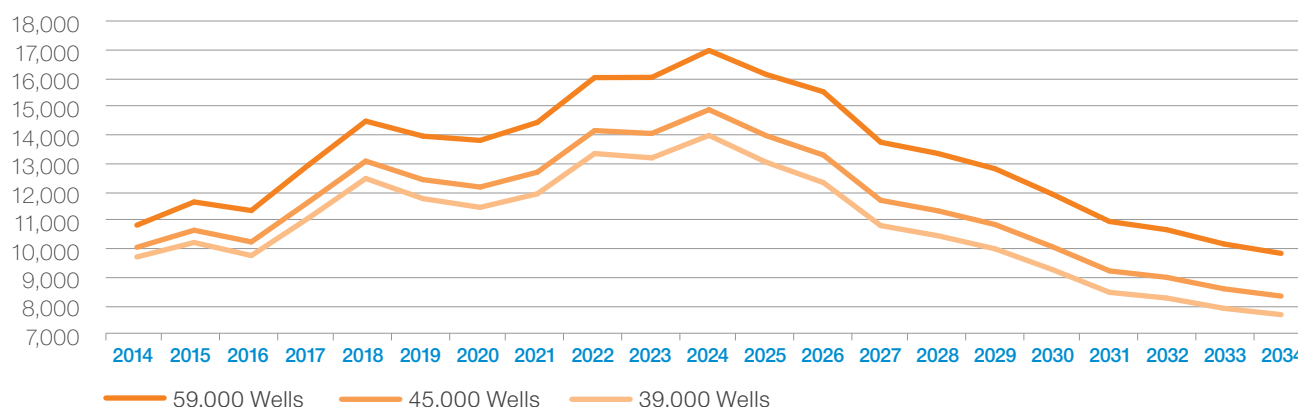


Figure 5: Projected total workforce for the CSG to LNG industry in Queensland 2014 to 2034 (six LNG trains)

Using a baseline employment of 9,000 workers determined by the starting workforce size required in 2014 (the first year of LNG production in Queensland), the number of workers needed is forecasted to almost double in the CSG to LNG industry by 2024 with an increase of 5,100 workers (Figure 6). This is based on the 45,000 wells scenario.

Projected workforce gap scenario one (six trains)

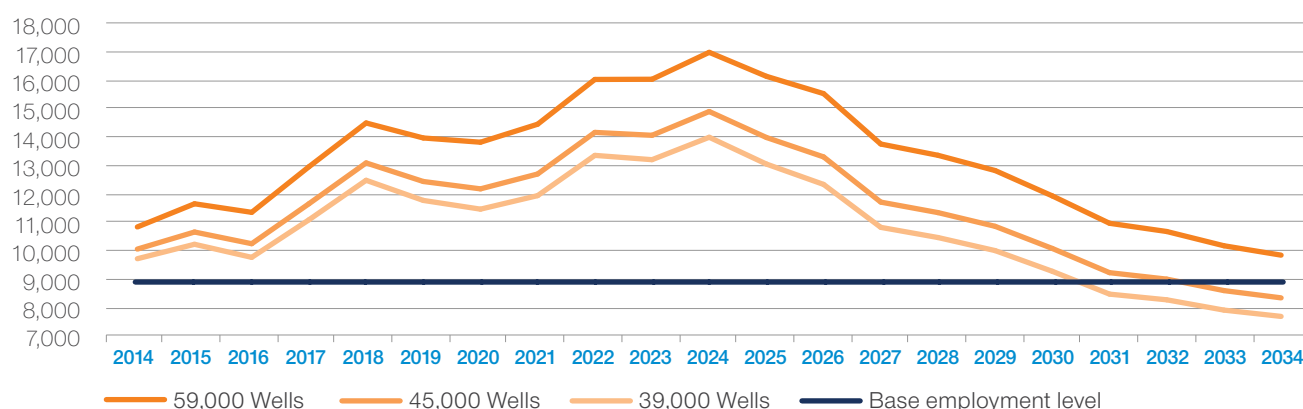


Figure 6: Projected workforce gap for the CSG to LNG industry in Queensland 2014 to 2034 (six LNG trains)

Using the eight train operation and 45,000 wells scenario, the workforce is expected to peak in 2024 with just over 15,200 workers (see Figure 7). The workforce is varied both in size; upstream represents the majority of the workforce numbers and capability, where specialised skills are needed in many operational roles.

Projected total workforce scenario two (eight trains)

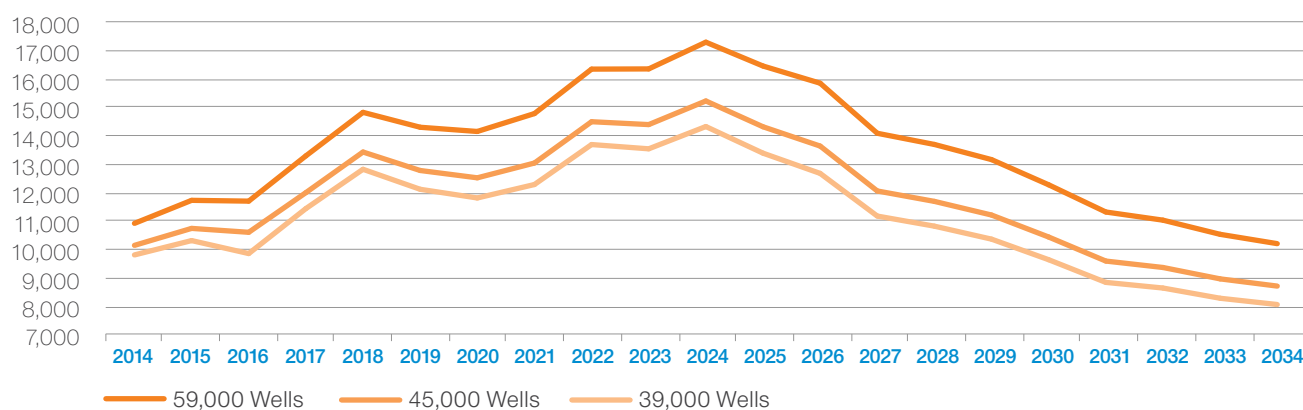


Figure 7: Projected total workforce for the CSG to LNG industry in Queensland 2014 to 2034 (eight LNG trains)

Using the baseline employment of 9,000 workers, a peak gap of 5,400 workers is forecasted in the CSG to LNG industry in 2024 (Figure 8) under an eight train scenario.

Projected workforce gap scenario two (eight trains)

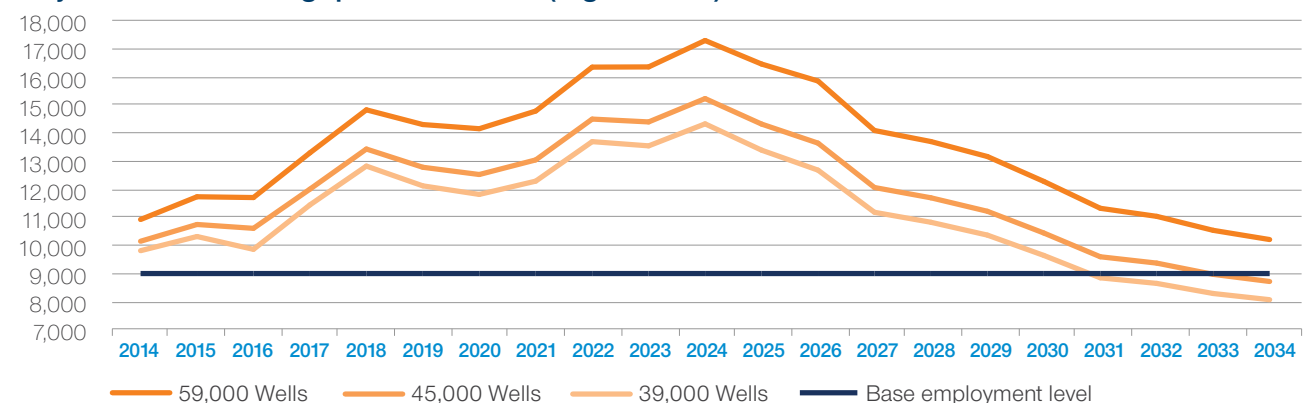


Figure 8: Projected workforce gap for the CSG to LNG industry in Queensland 2014-2034 (eight LNG trains)

Summary of Critical Skills and Occupations

There are a number of skill sets and occupations that will be critical for a high functioning and flexible CSG to LNG industry in Queensland.

The key drivers for determining criticality were identified through stakeholder engagement with industry as part of the critical skills and occupations review.

This report focuses on a number of roles which present critical skills needed during peak demand in the CSG industry, and which will potentially be difficult to recruit or train.

For a full list of CSG to LNG industry job roles please see Appendix One.

Drivers for skills and occupations

When categorising the drivers of criticality for specific job roles, consideration was given to the required levels of experience, training and education. The drivers for demand, the opportunities and recommendations for addressing future workforce needs can be focused on specific actions across a number of roles.

The drivers are identified as:

1. Level of experience

CSG to LNG is a new industry in Australia resulting in a gap of existing workers able to perform tasks specific to the industry. Roles such as LNG plant operators can generally be cross trained from other similar job roles and trained in relatively short timeframes. However, the depth of knowledge and experience is limited.

2. Training and education – length and cost of training

A number of critical job roles require four or more years training and/or education in order to be competent to work in those roles, most commonly trade and professional roles.

3. Training and education – low completion and study rates

A strong pipeline of new workers is the foundation for building a sustainable workforce in the energy, resources and telecommunications sectors. There is an on-going concern of low apprenticeship enrolment and completion rates for trades' roles, and low enrolment and graduation rates for professional roles across a number of the critical skills and occupations needed in the CSG to LNG industry.

4. Labour mobility

The impacts of an increasing CSG to LNG workforce in Queensland will be most keenly experienced in regional areas such as the Surat and Bowen Basins and Gladstone. Key drivers for critical shortages in regional areas include increasing populations, fly-in, fly-out (FIFO) and drive-in, drive-out (DIDO) workers, reduced access to skilled labour and under-developed socioeconomic infrastructure.

Image courtesy of Australia Pacific LNG



Critical skills and occupations in demand

The critical skills and occupations have been grouped by upstream and downstream to determine what actions need to be implemented at a regional level to address any potential skills gap. The determination of criticality was made through consultation with key stakeholders from all participating gas companies, using the drivers of demand outlined in the previous section.

Currently, workers in these roles complete the mandatory units for drilling under the RII09 training package e.g. work safely and follow occupational health and safety (OHS) policies and procedures, and then perform on-the-job training to become competent in specific skills required for well servicing.

The critical job roles identified are as follows:

Table 7: Critical job roles by qualification and training requirements

Job Titles	Minimum Qualification	Type	Driver of Criticality and Current Barriers
Upstream			
Lease Hand	Certificate II in Drilling Oil/Gas (On shore) – Part Certificate II	Entry level role	Labour mobility
Floor Hand	Certificate II in Drilling Oil/Gas (On shore)	Entry level role	Labour mobility
Motorman	Certificate II in Drilling Oil/Gas (On shore)	Entry level role	Labour mobility
Derrick Hand	Certificate III in Drilling Oil/Gas (On Shore)	Traineeship	Level of experience, labour mobility
Assistant Driller	Certificate III in Drilling Oil/Gas (On Shore)	Traineeship	Level of experience, labour mobility
Driller	Certificate IV in Drilling Oil/Gas (On shore)	Higher VET	Level of experience, labour mobility
Tool Pusher	Diploma of Drilling Oil/Gas (On shore)	Higher VET	Level of experience, labour mobility
Rig Manager	Diploma of Drilling Oil/Gas (On shore)	Higher VET	Level of experience, labour mobility
Electrical Fitter/Mechanic	Certificate III in Electrotechnology	Apprenticeship	Training and education – length of training, low completion and study rates
Cable Jointer	Certificate III in ESI Cable Jointing	Apprenticeship	Training and education – length of training, low completion and study rates
High Voltage Switching Electrician	Certificate III in Electrotechnology or equivalent Electrical workers with skills to switch high voltage networks.	Apprenticeship	Level of experience
Telecommunication Technician	Certificate IV in Telecommunications Network Engineering	Higher VET	Training and education – length of training, low completion and study rates
	Diploma of Telecommunications Network Engineering	Higher VET	Training and education – length of training, low completion and study rates
SCADA Professional (Supervisory Control and Data Acquisition)	SCADA is a certification for engineers, IT professionals, and trades workers	Higher VET/Further Education	Training and education – low completion and study rates
Health, Safety and Environment Officer	Certificate IV in Work, Health and Safety	Higher VET and Higher Education	Labour mobility
	Diploma of Work, Health and Safety	Higher VET and Higher Education	Labour mobility
Specialist Trainers and Assessors (oil and gas)	Minimum Certificate IV Training and Assessment	Higher VET and Higher Education	Level of Experience

Job Titles	Minimum Qualification	Type	Driver of Criticality and Current Barriers
Project Manager	Certificate IV in Project Management Practice	Higher VET and Higher Education	Level of experience
	Diploma in Project Management	Higher Education	Level of experience
CSG Technical Trainer	Minimum of a Certificate IV in Training and Assessment	Specialised experience, Higher VET and Higher Education	Level of experience, training and education – low completion and study rates
Engineer	Tertiary Engineering degree from a recognised university, with relevant experience	Higher Education	Training and education – length of training, low completion and study rates
Geologist	Tertiary Geology/Geoscience degree from a recognised university, with relevant experience	Higher Education	Labour mobility, training and education – length of training, low completion and study rates
Geophysicist	Tertiary Geophysicist/Geoscience degree from a recognised university, with relevant experience	Higher Education	Labour mobility, training and education – length of training, low completion and study rates
Downstream			
Field Technician and Operations Technician	Certificate III in Process Plant Operations	Traineeship	Level of experience, labour mobility
LNG Plant Operators and Superintendents	Certificate IV in Process Plant Operations	Higher VET and Higher Education	Level of experience
Electrical Fitter/Mechanic	Certificate III in Electrotechnology	Apprenticeship	Training and education – length of training, low completion and study rates
Instrumentation and Control Technician	Certificate III in Instrumentation and Control	Apprenticeship	Level of experience, training and education – length of training
	Certificate IV in Instrumentation and Control	Higher VET	Level of experience, training and education – length of training
Telecommunication Technician	Certificate IV in Telecommunications Network Engineering	Higher VET	Level of experience, labour mobility
	Diploma of Telecommunications Network Engineering	Higher VET	Level of experience, labour mobility
Health, Safety and Environment Officer	Certificate IV in Work, Health and Safety	Higher VET	Labour mobility
	Diploma of Work, Health and Safety	Higher VET	Labour mobility
Procurement Manager	Certificate IV in Purchasing	Higher VET	Level of experience
	Diploma of Purchasing	Higher VET	Level of experience
Project Manager	Certificate IV in Project Management Practice	Higher VET and Higher Education	Level of experience
	Diploma in Project Management	Higher VET and Higher Education	Level of experience
LNG Technical Trainer	Minimum of a Certificate IV in Training and Assessment	Specialised experience, Higher VET and Higher Education	Level of experience, training and education – low completion and study rates
Engineer	Tertiary engineering degree from a recognised university, with relevant experience	Higher Education	Training and education – length of training, low completion and study rates
Specialist Trainers and Assessors (oil and gas)	Minimum Certificate IV Training and Assessment	Higher VET and Higher Education	Level of Experience

Engineering programs identified in Table 8 are the qualifications of Bachelor's Degree and above delivered in the tertiary education sector in Queensland. They provide the basis for employment and diversification into the large variety of professional engineering roles. It is the combination of the formal qualification, graduate programs and experience which creates the skills sets identified in the CSG to LNG critical skills shortages.

There are multiple pathways into geology, geosciences and geophysics. To become a geologist the completion of a degree in science or applied science is required, with a major in geology, geological science, applied geology or earth sciences. A bachelor's degree is adequate for some entry level positions, however most geoscientists require a master's degree in general geology or earth science for employment. All Queensland based universities offer some form of geosciences program.

Table 8: Tertiary engineering courses offered in Queensland

Undergraduate engineering courses on campus in Queensland			
Central Queensland University	15	Griffith University	13
James Cook University	8	Queensland Institute of Business and Technology (QIBT)	2
Queensland University of Technology	4	University of Southern Queensland	10
University of the Sunshine Coast	2	University of Queensland	25
Postgraduate engineering courses on campus in Queensland			
Griffith University	10	Queensland University of Technology	2
University of Queensland	12	University of Southern Queensland	9

Image courtesy of Santos GLNG



Upstream – Projected Workforce Demand

The upstream workforce represents approximately 85% of the total CSG to LNG industry in Queensland. Table 9 shows the number of wells that are likely to be drilled under each scenario per year to 2034. These numbers were used to determine the upstream workforce requirements.

Table 9: Number of wells drilled per year to 2034³

	39,000 wells	45,000 wells	59,000 wells
2014	1,500	1,700	2,200
2015	1,800	2,100	2,700
2016	1,800	2,100	2,800
2017	2,100	2,400	3,100
2018	2,100	2,400	3,100
2019	2,100	2,400	3,100
2020	2,100	2,400	3,100
2021	2,100	2,400	3,100
2022	2,100	2,400	3,100
2023	2,100	2,400	3,100
2024	2,100	2,400	3,100
2025	2,000	2,300	3,000
2026	1,900	2,200	2,800
2027	1,300	1,500	2,000
2028	1,200	1,300	1,800
2029	1,000	1,100	1,500
2030	800	900	1,200
2031	600	700	1,000
2032	600	700	900
2033	600	700	900
2034	600	700	900

³ The numbers listed in the tables under each well scenario are for the wells to be drilled each year to 2034. As the CSG to LNG industry is projected to span beyond the forecast period used in this report, the well scenario numbers are based on the total planned wells, which are currently scheduled to 2045.

The cumulative number of wells is likely to be larger than the peak number of operational wells (Figure 9). This is due to wells being decommissioned over the life of the project, with the average lifetime of a well approximately 15 years.

Number of operational wells

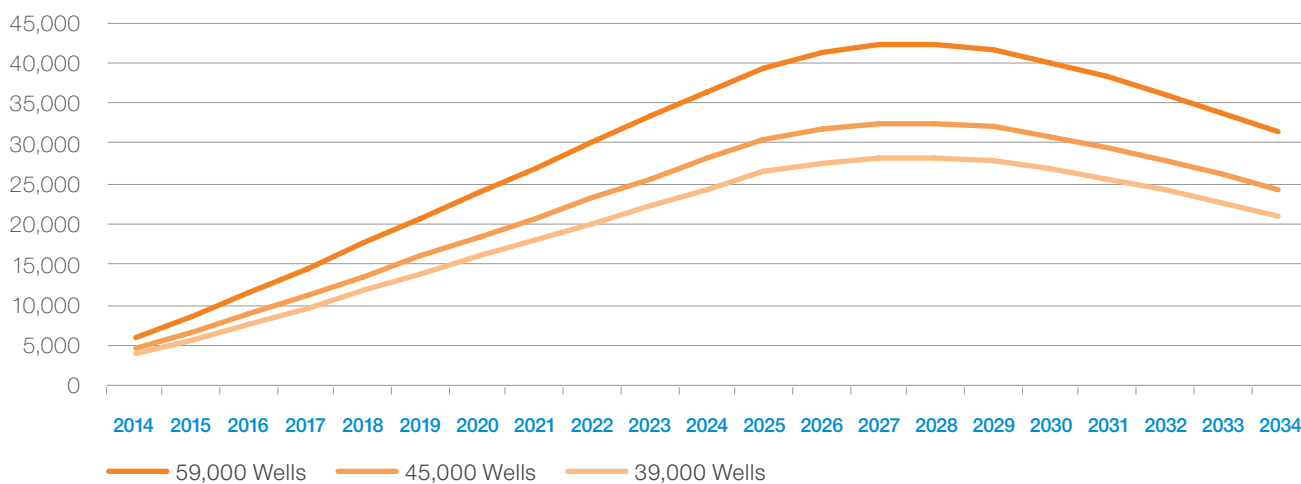


Figure 9: Projected number of wells for the CSG to LNG industry in Queensland 2014 to 2034

Projected growth – upstream (forecasts)

In line with the total workforce peak, the projected upstream workforce is expected to peak from 2022 to 2026. Figure 10 shows the workforce requirements for each well scenario, and indicates the workforce requirements will start to ease in 2027. Under the 45,000 well scenario, the workforce is expected to peak in 2024 at approximately 14,100 workers.

Projected workforce needed (upstream)

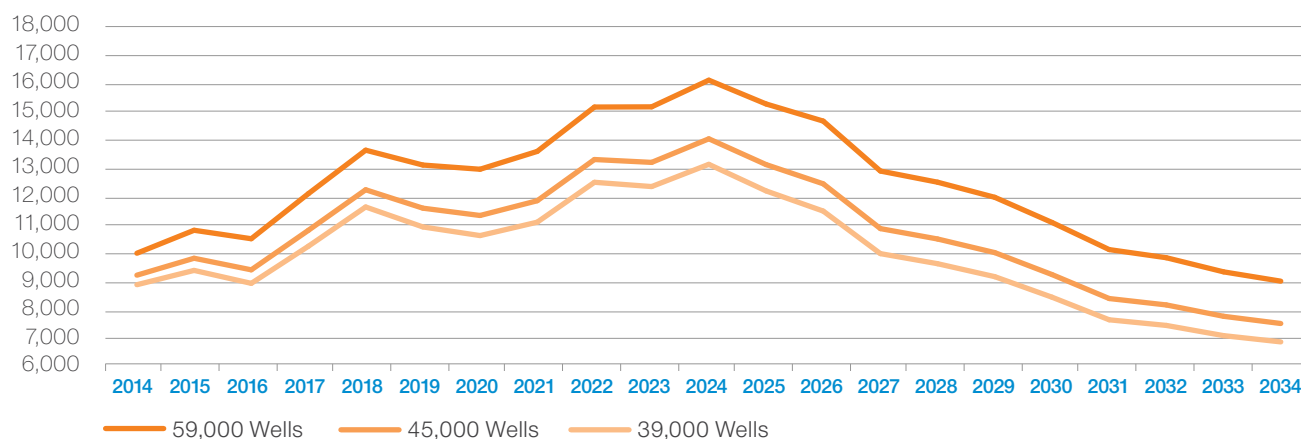


Figure 10: Projected workforce needed (upstream) for the CSG to LNG industry in Queensland 2014 to 2034

Table 10 provides a breakdown of the numbers required under each scenario for the peak from 2022 to 2024.

Table 10: Peak workforce requirement upstream 2022 to 2024

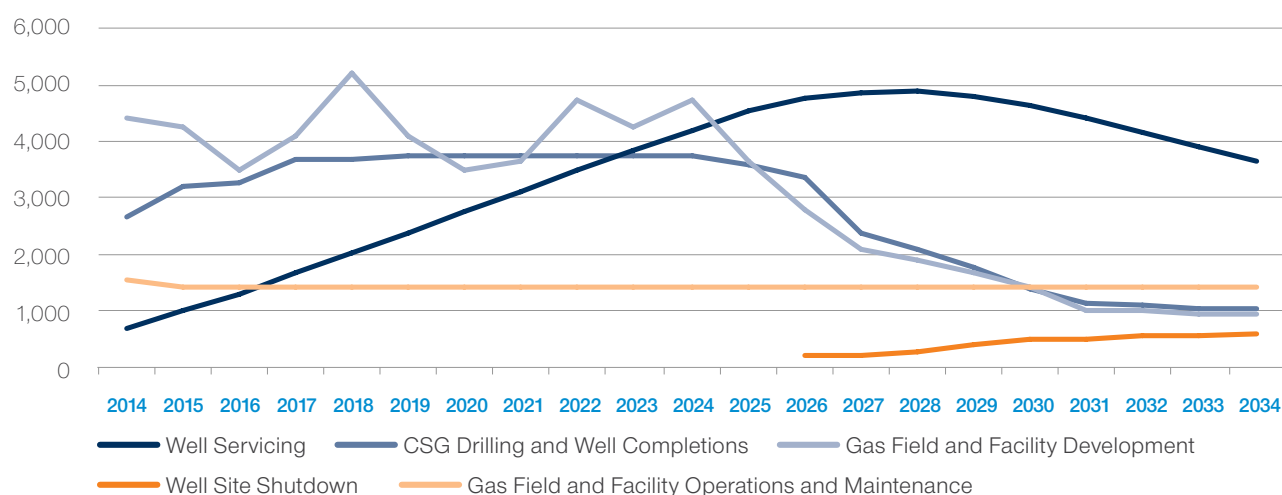
Number of wells	Workforce 2022	Workforce 2023	Workforce 2024
39,000	12,550	12,400	13,200
45,000	13,350	13,250	14,100
59,000	15,200	15,200	16,100

There are a number of components to the upstream workforce, categorised as:

1. CSG drilling and well completions
2. Well servicing
3. Gas field and facilities development
 - Gas field facilities development
 - Well gathering networks (water and gas)
 - Steel trunklines
 - Power supply and communications
4. Gas field and facilities operations and maintenance
 - Well site operations
 - Field gas compression
 - Integrated operations centres
 - Water management
 - Well gathering networks (water and gas)
 - Control rooms
 - Land care and cultural heritage
 - Gas transmission pipeline
5. Well site shutdown

Using the midrange scenario of 45,000 wells, Figure 11 forecasts the workforce numbers for each of the upstream components.

Total upstream workforce required (45,000 wells) ⁴



⁴ Wells site shutdown is expected to be part of the workforce from the start, as incidentally wells dry-up early or underperform, however the bulk of well shutdown is expected to occur around 2026 and increase over time. For this reason it is included from 2026 onward.

Figure 11: Total upstream workforce required 2014 to 2034

CSG Drilling and Well Completion

The process to operationalise a well is started by the drilling team using a drilling rig with approximately 20 workers. The coal seams are relatively close to the surface compared to traditional oil and gas drilling and take approximately seven days to drill the initial well-hole.

The CSG drilling workforce will peak at around 1,950 workers for CSG drilling specialists and this peak will remain stable for the years 2016 to 2025 (Figure 12). It is clear from the projections that the requirement for CSG drillers is likely to ease from 2027 once the gas fields have been fully engaged.

The drilling roles have a number of different naming conventions within the drilling industry and are listed as per the Queensland Government competency standard for the Petroleum and Gas Drilling Industry (2011) naming conventions:

- Lease hand
- Floor hand
- Motorman
- Derrick hand
- Assistant Driller
- Driller
- Tool Pusher/Tour Pusher
- Rig Manager
- Rig Superintendent

Drilling workforce by job role (45,000 wells)

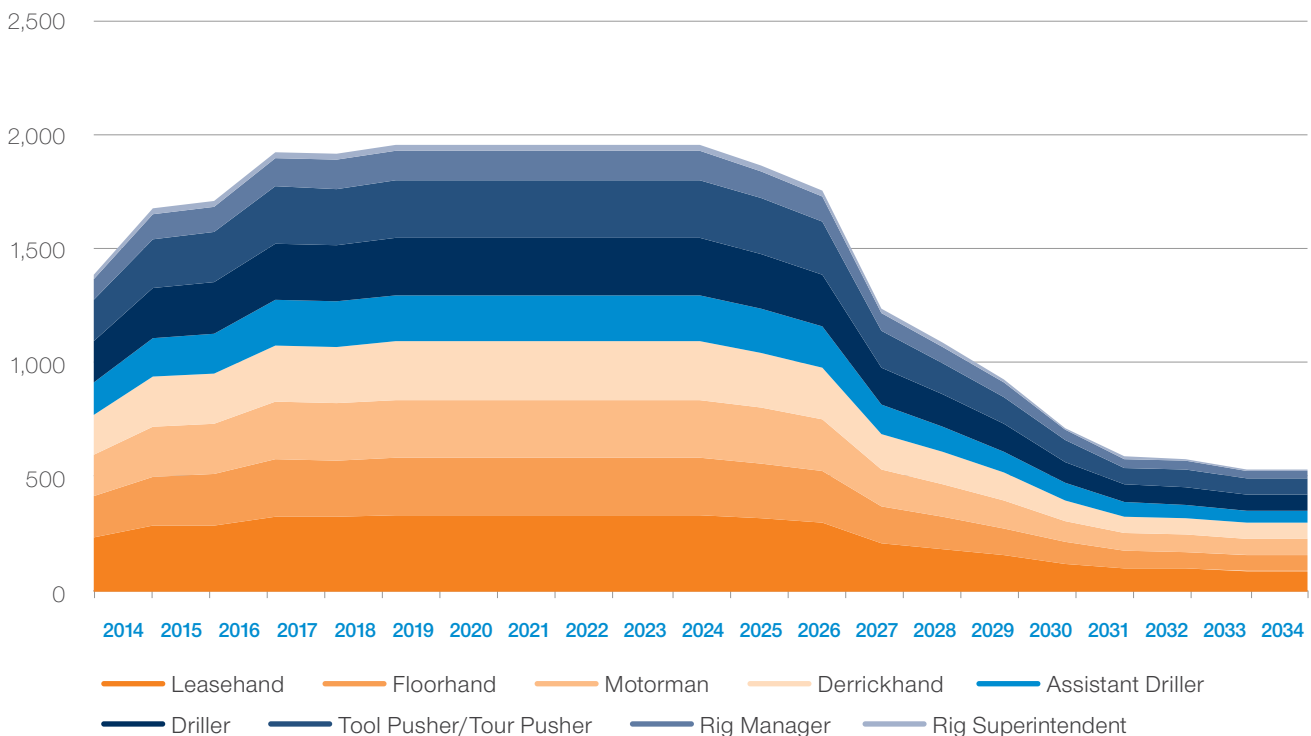


Figure 12: Projected CSG drilling workforce by job role 2014 to 2034

“

The CSG drilling workforce will peak at around 1,950 workers for CSG drilling specialists and will remain stable for the years 2016 to 2025.



Image courtesy of Origin Energy

Drilling and well servicing can accommodate a large number of entry level workers moving into roles that can be given basic training off a rig. However, there is a shortage of higher level skills as these jobs require both extensive experience on a rig and training using drilling equipment, both of which are difficult to achieve outside of the workplace.

Infill drilling is the process of adding new wells to an existing gas field within the original well patterns to accelerate the recovery and production of gas. This is driven by a number of factors, including the dewatering of a well leading to a subsequent decrease in pressure, and will require the drilling workforce to continue to increase its ability to drill more complex wells both safely and timely.

Infill drilling requires higher level drilling competence and training for the drilling workforce in well control and advanced well control skills will become critical. Some gas companies can provide training in this area, however, skills are normally obtained by specialist training providers e.g. International Well Control Forum (IWCF) and the International Association of Drilling Contractors (IADC) well control courses, and blowout prevention (BOP) courses.

After the well-hole has been sunk, a different rig is needed to complete the well and further prepare it for operations. A work-over rig installs a pump and well-head, and makes the well ready to be attached to the separation equipment (gas and water). This operation takes approximately 12 workers four days to complete and requires drillers with specialised skills in well work-over.

There are a number of additional roles required for the completion of a well to make it operational. These workers will require a range of skills including:

- Construction workers
- Electricians
- Engineers
- Health and safety workers
- Security staff
- Wireline assistant drillers
- Superintendents
- Project managers

The current drilling workforce lacks experience, and anecdotally, the time frame for a career path from lease hand to driller takes half the time in Australia when compared to other gas producing countries. It has been reported that workers are often promoted into higher roles without the generally accepted levels of skills and experience to perform at a competent standard.

Well servicing

Well servicing crews of around 12 workers will perform maintenance on the well every two to five years, and can take a range of three to ten days to complete depending on the complexity of the servicing required.

The job roles for well servicing have the same naming conventions as CSG drilling teams. However, they perform different tasks and generally operate with smaller crew numbers. Currently, workers in these roles complete the mandatory units for drilling under the RII09 training package e.g. work safely and follow occupational health and safety (OHS) policies and procedures, and then perform on-the-job training to become competent in specific skills required for well servicing. Newly developed qualifications have recently been endorsed (Q3 2013), including Certificate levels II, III, IV and Diploma which will address industry needs for well servicing and related activities.

The number and frequency of wells that will need to be serviced is still largely unknown to the CSG industry as it will be dependent on the quality of each well. The following assumptions were made to forecast the workforce requirements for well servicing:

- Well servicing will start approximately two years after first gas.
- It takes an average of four days to service a well.
- Crew size varies between approximately 12 to 15 people, working 12 hour shifts on a 24 hour rotation.
- One crew can service between 36 to 48 wells a year, dependent on weather conditions.

The workforce for well servicing crews peaks in 2027, requiring approximately 4,850 workers (Figure 13). A large numbers of wells need to be drilled and worked over initially to generate a critical mass of productive wells. Once this critical mass of productive wells has been established, fewer numbers of wells will need to be drilled. Established wells need to be serviced throughout their life cycle as the number of operating wells increases.

This peak could increase or flatten depending on the number and quality of wells that are required to meet the desired LNG production levels for each company.

Well servicing workforce

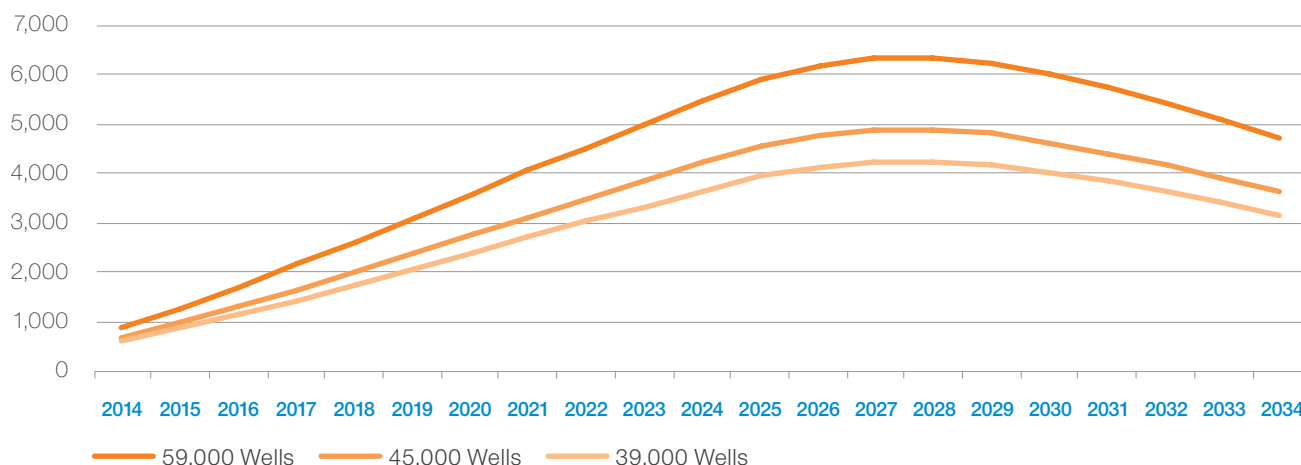


Figure 13: Projected well servicing workforce by job role 2014 to 2034

Gas field and facilities development

The gas field and facilities development includes integrated processing facilities, central gas processing facilities, field compression facilities, gas and water gathering networks, connection of steel trunklines, and the connection of power and communications to the pipeline. The field and facility development workforce will peak in 2018 with more than 5,000 workers (Figure 14).

Gas field and facilities development workforce

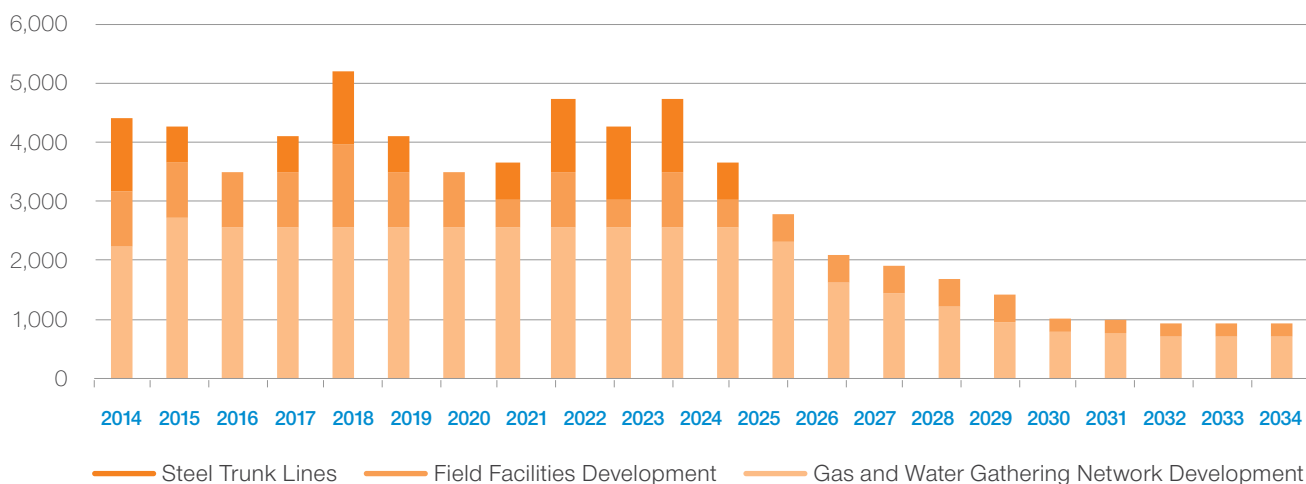


Figure 14: Gas field and facilities development workforce (excluding power and communications) 2014 to 2034

Gas field facilities development

The facilities development includes the construction of the Integrated Operations Centres (IOC), as well as the integrated processing facilities, central gas processing facilities and field compression facilities. The workforce will remain fairly stable between 2014 to 2024, requiring around 950 workers.

The workforce fluctuation for facility development is caused by the phased nature of each projects roll-out. One-off development of the main facilities in each subsequent gas field comprised of the IOC's, field compression stations, and steel trunklines causes workforce demand to spike during a short period of time. The fluctuation of the workforce demand could increase or decrease depending on the timing for development of each new gas field.

Once the gas field facilities have been developed, a commissioning crew connects all equipment and starts well production, which takes approximately four people and one day to complete. The commissioning crew then formally hands over the well to the operational crew.

Image copyright of Arrow Energy



Well gathering networks (water and gas)

Water and gas gathering system networks connect the well to the field compression stations, and therefore the development of these networks will closely follow the schedule of wells being drilled in each gas field. This workforce is expected to remain stable from 2016 to 2025, requiring around 2,550 workers (Figure 13).

Some of the job roles and skills required for this upstream component are:

- Butt welding skills
- Electrofusion skills
- High-density polyethylene (HDPE) pipe fabrication workers
- Surveyors
- Engineers
- Civil workers

At the well site, water and gas are separated and sent to different locations for processing. Generally, 20 to 30 wells are connected to a hub, which has a dehydration plant, a water (brine) collection pond, a field compression station and a communications hub.

Steel trunklines

Trunk pipelines will connect the field compression stations to the integrated operations centres. It is expected there will be around 6,000 kilometres of trunklines laid throughout the life of the project. This workforce is likely to consist of approximately 80% contractors and will be required for only short periods of time as new trunklines are developed.

Some of the job roles required for this upstream component are:

- Steel pipe welders and fitters
- Surveyors
- Engineers
- Civil workers

Power supply and communications

A work crew connects the power (either mains power or a stand-alone power supply such as a micro-turbine) and installs (but does not connect) equipment such as the separator and communication equipment. A communications line links the operations centres to a central control room.

Detailed workforce demand information for power supply and communications were unavailable at the time of publication, however, it is expected the following roles will be required for this workforce component:

- Electricians with high voltage switching skills
- Telecommunications technicians
- SCADA qualified workers

Gas field and facilities operations and maintenance

The gas field operations and maintenance include a number of integrated functional areas which require a variety of skills and occupations. The gas field workforce sectors include:

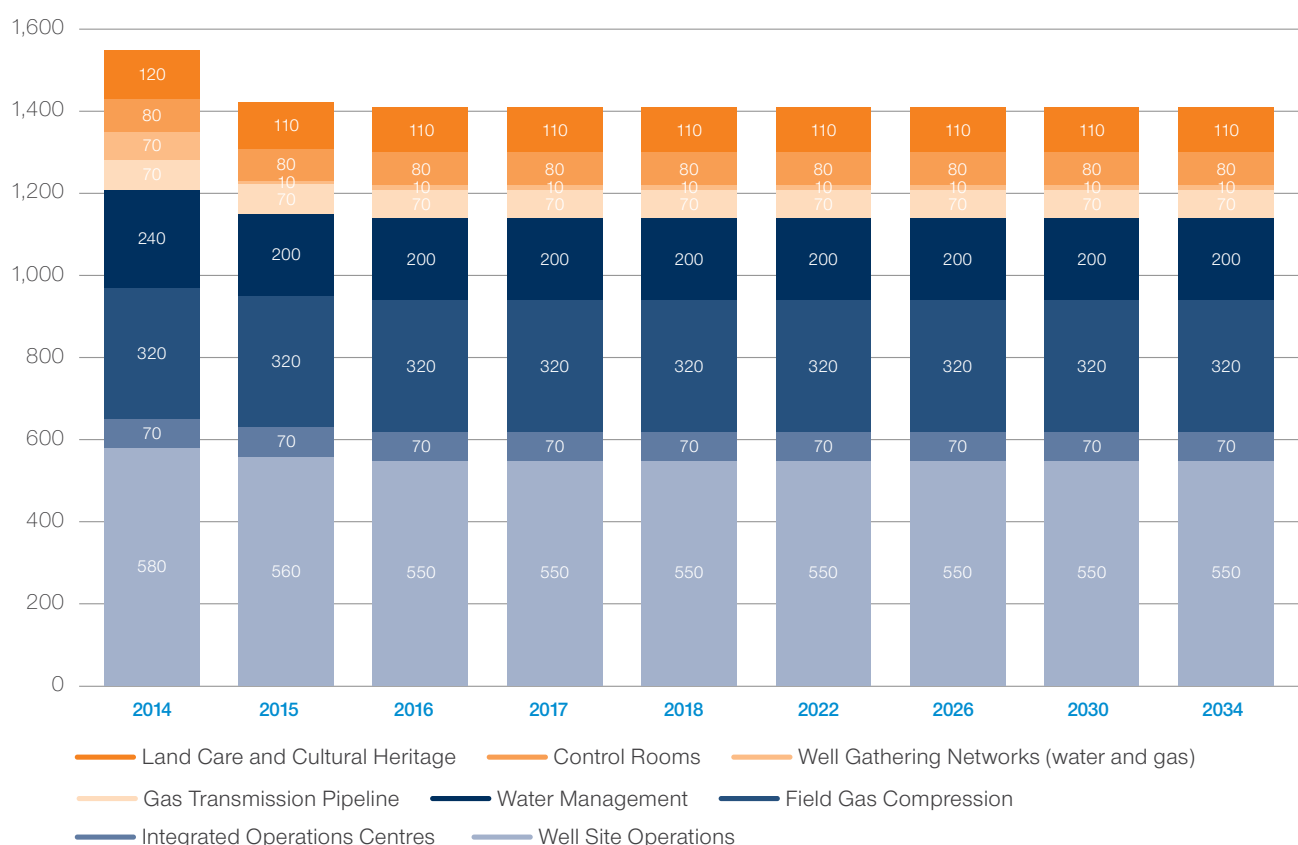
- Well site operations
- Field gas compression
- Integrated operations centres
- Water management
- Well gathering networks (water and gas)
- Control rooms
- Land care and cultural heritage
- Gas transmission pipeline

The gas field operations and maintenance workforce will remain steady requiring approximately 1,400 workers during the next 20 years (Figure 15), predominantly located in the Surat and Bowen Basins and surrounding areas.

There are multiple skilled occupations required within these functional areas, and include construction specialists, geologists, engineers, water treatment specialists, land negotiation specialists, occupational health safety and environment (OHSE) specialists and production specialists.

The approach to finding an appropriately skilled workforce is a strategic decision each gas company will make, but is likely to be a combination of FIFO, DIDO and local workers. The field operations and maintenance workforce will be a combination of direct employees and contractors.

Gas field operations and maintenance workforce⁵



⁵ The graph depicts the workforce number as an annual breakdown for years 2014 to 2018, and then in four year increments from 2018 onwards. This is due to the stabilisation of the workforce over time.

Figure 15: Gas field operations and maintenance workforce (2014 to 2034)



The total gas field operations workforce is expected to remain stable at around 550 workers during the next 20 years.

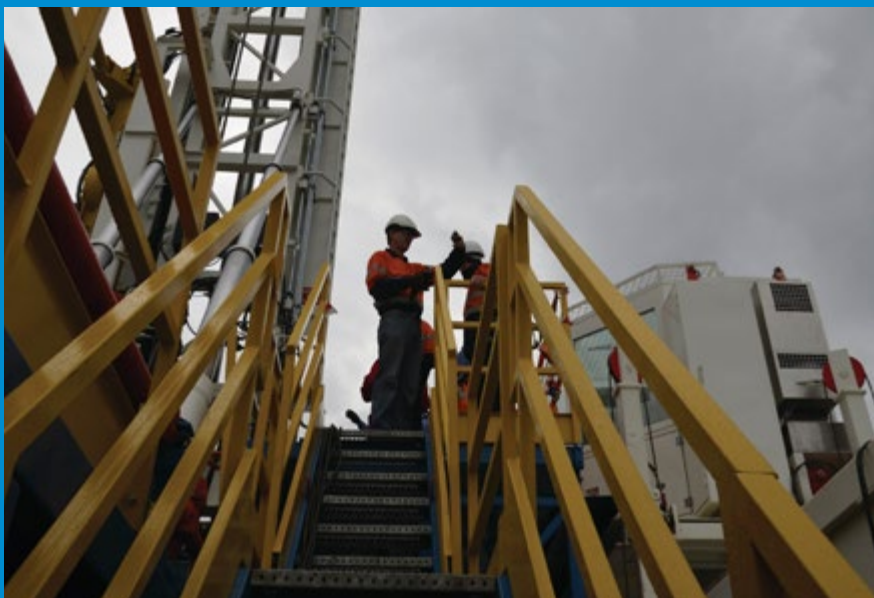


Image copyright of Arrow Energy

Well site operations

Once in operation, a team of approximately 14 workers will be responsible for a minimum of 300 wells initially, and potentially up to 2,000 wells as efficiency gains are made. The total gas field operations workforce is expected to remain stable at around 550 workers during the next 20 years.

There are a range of skills and occupations required for this area of the CSG to LNG process, including:

- Construction supervisors
- Drilling superintendents
- OHSE advisors
- Materials and equipment coordinators
- Plug and abandon (P&A) supervisors
- Well engineering construction compliance managers
- Well operators
- Well services superintendents
- Well site supervisors

It is expected that these roles will predominantly consist of direct employees of the gas companies.

Field gas compression

The gas compression stations connect a series of well sites to the Integrated Operations Centres (IOC). They are utilised throughout the gas fields to increase pressure and dehydrate gas for transportation. The specific number of compression stations will depend on the quantity of operational wells. Approximately 80 compression stations under the current four CSG projects are anticipated.

The workforce is expected to remain stable at approximately 320 workers across the life of the project and will require workers with gas plant and compression experience.

From each hub, the gas is transported to an IOC where the gas is compressed further and directed into the main pipeline.

Integrated operations centres (IOC)

The IOC's include three main facility types including integrated processing facilities, central gas processing facilities, and field compression facilities. Each gas field (multiple well sites) connects into an IOC and there will be approximately 14 facilities within the Surat and Bowen Basins. The workforce is expected to remain stable at around 70 workers during the life of the project and will include workers with a mix of skills in water and gas compression, as well as mechanical fitters. It is anticipated the workforce will perform both operations and maintenance roles.

Water management

Water management is critical to the ongoing growth of the CSG to LNG industry and will require workers with a unique skill set in this functional area. It is expected the workforce will remain stable at approximately 200 workers during the life of the project and will consist of direct employees and a contracted workforce.

Roles in this workforce include water compliance, treatment and operator specialists.

Image courtesy of Australia Pacific LNG



Well gathering networks (water and gas) The gas gathering networks gather CSG from wellheads and transfer it to field compression stations. A separate network transfers the water to holding ponds and water treatment facilities.

It is estimated the length of the pipeline network will initially exceed 20,000 kilometres, with additional phases currently unquantified for the identified four projects. One kilometre of pipeline has between 50 and 80 weld points. The welding of gathering pipelines and inclusion of additional connections to existing pipelines will be a feature of the CSG industry during the life of the industry. There will be an ongoing demand for these skills during the next 20 years.

The direct employee requirement is likely to remain steady at approximately 10 workers. This number is likely to increase with the addition of a contracted workforce, but at the time of publication these figures were not available.

The skills and occupations required for this area of the CSG to LNG process include:

- Butt welding skills
- Electrofusion skills
- Gathering operators
- HDPE pipe fabrication
- Civil workers

Butt welding pipes and fittings is the most commonly required skill for the development and maintenance of the well gathering networks. Additionally, electrofusion welds are required in particular circumstances and offer more challenges in both technique and application. These skills are likely to be a contracted workforce.

Control rooms

Each gas company will have one field control room which links all of the IOC's in the gas fields. These control rooms will operate 24 hours a day, seven days a week and will be staffed by operators who require skills in the extraction of water and gas, water processing and gas compression processing.

The central control rooms workforce is expected to remain steady at around 80 workers and will require the following job roles:

- Superintendents
- Leading hands
- Control room operators

All of these roles will need to have skills in control room operation, monitoring, problem solving and emergency response and will require experience in plant operations. Supervisory control and data acquisition (SCADA) professionals will also be critical for both the operations and maintenance phase of the project.

During scheduled and unscheduled maintenance, dual trade electricians (instrumentation) and electrical engineers with SCADA capability are expected to be required through a contracted workforce.

Land care and cultural heritage

Land care and cultural heritage are an important component of the CSG to LNG industry and will require approximately 110 workers during the life of the project. These workers will be required within a number of upstream functions and will include the following job roles:

- Environment monitoring officers
- Landholder and community liaison workers
- Cultural heritage workers

It is expected the majority of these roles will be direct employees of the gas companies.

Gas transmission pipeline

The gas transmission pipeline network is required to transfer compressed gas from CSG fields to the LNG facilities. Table 11 shows the estimated gas field to LNG plant pipeline requirements by project.

Table 11: Estimated gas field to LNG plant pipeline by project

Project	Pipeline (km)
Arrow LNG	500
Australia Pacific LNG (APLNG)	530
Queensland Curtis LNG (QCLNG)	540
Santos GLNG (GLNG)	520

The workforce is expected to remain fairly stable across the life of the project at approximately 70 workers. There are a range of skills and occupations required for this area of the CSG to LNG process, including:

- High pressure pipeline welders
- Project engineers
- Operations supervisors
- Pipeline engineers and technicians
- Environmental advisors
- Cultural heritage workers

It is anticipated the operations workforce will be predominantly direct employees of the gas companies. They will provide some of the ongoing maintenance to the pipeline, however it is likely major maintenance projects will require a contracted workforce.

Image courtesy of Santos GLNG



Downstream – Projected Workforce Demand

The LNG operations component of the CSG to LNG industry is referred to as downstream and has a split workforce between Gladstone and Brisbane. The LNG facilities in Gladstone will operate 24 hours a day, seven days a week and most likely utilise rotating shifts. Operational staff will need to be employed well ahead of plant commissioning in order to engage with and facilitate pre-commissioning and commissioning phases.

Under the six LNG train scenario, the workforce is expected to increase rapidly between 2014 and 2015, and then stabilise once all LNG plants are operational. The forecast in Figure 16 shows the increase and stabilisation of the workforce over time, and is based on the assumption that there are a number of key operational staff already in place for the operations phase of the projects.

The six LNG train scenario forecasts the workforce to peak in 2015 with approximately 800 workers. The downstream workforce consists predominantly of trade and professional roles, with some roles required on 24 hours a day, seven days a week roster.

Projected workforce downstream⁶



⁶ The graph depicts the workforce number as an annual breakdown for 2014 to 2018, and then in four year increments from 2018 onwards. This is due to the stabilisation of the workforce over time.

Figure 16: Projected workforce needed (downstream) for the CSG to LNG industry in Queensland 2014 to 2034

As production efficiency increases in parallel with the increase of experience in the downstream workforce, it is expected the workforce numbers will decline marginally over time.

Under the eight LNG train scenario, the workforce follows the six LNG train forecast and increases again in 2017 with the construction of two additional trains. Under this scenario, a peak workforce of 1,100 workers (Figure 16) is expected.

Table 12 provides a detailed breakdown of the job role classifications required under both scenarios, and where those job roles are likely to be based. Workforce numbers are provided at a high level job grouping.

The qualification for operators is a Certificate III in Process Plant Operations, and workers are recruited from a variety of backgrounds with existing trade or professional qualifications.

Control rooms

The function of the LNG control rooms is monitoring the gas flow through the pipeline from the well to Curtis Island. This operation will require approximately 100 people per shift (24 hour operations). The roles that will be required are predominantly control room operators and control systems technicians, and are all likely to be based in both Gladstone and Brisbane.

Table 12: LNG operations workforce six and eight train scenario

LNG Plants (six trains)	Based			Based		
	Six trains	Gladstone	Brisbane	Eight trains	Gladstone	Brisbane
Administrative Staff	105	105	0	140	140	0
Compliance Team Compliance Manager, Inspection Engineer, Site Services Coordinator and Site Project Services Manager	18	9	9	24	12	12
Control Room Technicians / Operators / Control Engineers Controls System Technician, Instrumentation Engineer, Assurance Engineer, Production Training Coordinator, Production Superintendent and Production Technician	84	84	0	112	112	0
Facility Engineers	30	27	3	40	36	4
Lab Technicians Lab Supervisor and Lab Analyst	18	18	0	24	24	0
Licensed Electricians / Electrical Engineers	30	30	0	40	40	0
Shipping and Marine Logistics Logistics Team Leader, Logistics Officer, Coordinator, Engineer and Superintendent	36	27	9	48	36	12
Maintenance Planners	9	9	0	12	12	0
Maintenance Supervisors	18	18	0	24	24	0
Maintenance Technicians	30	30	0	40	40	0
Health, Safety, Security and Environment OHS Advisor, Engineer and Superintendent	30	15	15	40	20	20
Shutdown Team Production Shutdown Coordinator	6	3	3	8	4	4
Installation Manager / Operations Team Lead	3	3	0	4	4	0
Operations Supervisors / Superintendents	18	18	0	24	24	0
Process Engineers	15	6	9	20	8	12
TOTAL Working	450	402	48	600	536	64
TOTAL Employed	810	730	90	1080	970	120

Maintenance workforce

As well as the core operational workforce, approximately 600 workers (per LNG train) will be required to perform scheduled maintenance shutdowns periodically. Minor shutdowns will occur more frequently and will require additional staff of approximately 40 to 60 workers. It is unlikely that more than one LNG train will be shutdown at any one time across all of the plants on Curtis Island. The maintenance workforce is likely to be required for only part of the year and only in the years when shutdown occurs and therefore has not been included in the overall workforce requirements (14,900 workers).

Scheduled shutdown

A major shutdown will take approximately 30 days per LNG train, and is estimated to follow the included schedule:

- First shutdown after first year
- Second shutdown after four years (three years after initial inspection)
- Third shutdown after eight years (four years after second inspection)
- Fourth shutdown after 13 years (five years after third inspection)
- Ongoing shutdowns every five years onwards, dependent on outcomes of maintenance i.e. a five year inspection may result with the recommendation that the next check is after four years.

There are a number of skills and occupations required for the major shutdowns, and will predominantly be a combination of a contractor and Original Equipment Manufacturer (OEM) vendor workforce. These roles include:

- Plumbers
- Electricians
- Engineers
- Fitter mechanics

Minor shutdowns

Minor shutdowns will occur every six months and will take approximately five days per LNG train. During this time the LNG plant runs on a rate reduction, in which one train operates at 50% capacity (two train plant at 75% capacity).

Gas turbine maintenance will need to occur every three to four years and will be performed by OEM vendors and contractors.

Image courtesy of Australia Pacific LNG



Education and Training

The CSG to LNG industry is still developing in Queensland, and consequently, the education and training sector that supports this industry is underdeveloped.

There are many roles that require significant technical skills and experience in the field development and gas processing subsectors.

In some cases, the training sector has not been able to consistently develop its capacity and capability to a suitable level to provide high quality skills training and assessment.

The gas companies have been required to lead training and education initiatives to meet workforce demand because of the lack of capability of training for a number of new job roles. Training and education initiatives have included developing in-house trainers and partnering with TAFE institutions for use of facilities to ensure workers are receiving relevant training within the time frames required by industry. Outsourcing of training to Western Australia and overseas, predominantly Canada, has become a common practice of sourcing appropriate training which is both a costly and time inefficient burden on each gas company.

The industry is also progressing workers at a pace that does not always enable workers to be fully competent in their current roles prior to being promoted to higher level positions. The effective management and assurance of a competent workforce is a high risk issue that requires further investigation.

There are a number of registered training organisations (RTOs) and universities in Queensland and Australia who are registered to deliver formal training and education across the critical job roles identified in this report. The main concern from the research undertaken is the lack of information on the numbers of students who are currently enrolled and completing qualifications, and for those who have already completed. Registered training organisations are only required to provide enrolment and completion data to the Queensland Government Department of Education, Training and Employment (DETE) if they are using a proportion of State funding to supplement the cost of training. This results in a lack of a full understanding of the workforce supply in critical roles.

These issues have the potential to impact upon the safety and productivity of the CSG to LNG industry's workforce if significant intervention is not undertaken.

Appendix two details the expected qualification and skill sets for each critical job role, as well as the number of training providers who are currently registered to deliver training in these areas.

Opportunities and Recommendations

This report is an example of successful collaboration between the CSG to LNG industry, Queensland Government and Energy Skills Queensland, and will allow all stakeholders to make long term evidence based decisions on training, education and employment.

The CSG to LNG industry presents Queensland with a wealth of long term employment and economic benefits with \$3 billion in revenue expected annually once projects are fully operational.

This is an industry that will span more than 20 years, providing individuals and organisations the opportunity to build sustainable career paths in many regional Queensland areas.

The industry is well positioned to increase workforce participation for Aboriginal and Torres Strait Islander people, creating opportunities for long-term career progression and enabling the possibility of a 'Homeland movement' for a number of Traditional Owners of the Surat and Bowen Basins.

Building on the recommendations below, Energy Skills Queensland is committed to working with all stakeholder groups to develop an action plan that will drive workforce development initiatives for the CSG to LNG industry.

This action plan will be released in early 2014.

Recommendations

The findings of this research have outlined key areas of focus to leverage a range of workforce development activities. The recommendations will enable all stakeholders to continue to build a workforce which is flexible and competent to ensure all benefits from this emerging industry are realised.

1. **Prioritise workforce planning initiatives for the CSG to LNG supply chain** to improve training and employment investment decisions. The report outlines the ongoing demand for skilled workers in the CSG to LNG industry during the next 20 years. Further research is needed into the workforce supply of a number of supporting sectors. The report identifies the gap in current workforce supply information for a number of industries including the size, competency, and skill sets of the contracting workforce, in particular the drilling industry, well work over Electrotechnology and Telecommunications, and camp services. It is recommended that further investigation is completed urgently.
2. **Establish a CSG to LNG Training Fund** which would include co-contribution from the gas companies, their supply chain contractors and the Queensland Government. Greater access to flexible training funding is needed to help offset the high cost of training and the increasing requirement for workers to be trained on new technology. The proposed Queensland Government training funding model does not fully meet industry needs, as only funding for qualifications to Certificate III level are covered by the new systems, and not the attainment of skill sets or Certificate IV and above qualifications. This training fund could also include the development of training materials to encourage industry collaboration and participation in knowledge sharing e.g. LNG training package. The CSG to LNG industry is committed to providing workers with formal qualifications and skill sets to increase employment outcomes. Access to a training fund would strengthen this approach.
3. **Support employment and training programs for Aboriginal and Torres Strait Islander people** and Traditional Owner groups in regional Queensland to increase local employment opportunities and to reduce industry's reliance on non-resident workers. This could form part of the CSG to LNG training fund or be a separate program.
4. **Prioritise funding for well servicing training** to ensure workers in this area are appropriately qualified. When the newly developed qualifications are endorsed (expected Q4 2013), there will be an urgent need for workers to be either trained under the new competencies or have their existing skills recognised (recognition of prior learning). This is likely to be a high cost burden for most drilling organisations, as well as registered training organisations, and will require greater investment from both the gas companies and from the Queensland Government.
5. **Increase training provider support for the CSG to LNG industry.** Gas companies have faced difficulty finding training providers who are able to deliver appropriate training which is driven by RTO capability (staff, resources – physical and learning, equipment) to respond to a new industry sector. Greater support is needed from government to build training capability, including flexibility in industrial relations law to enable TAFE institutions and other RTOs to attract and retain highly skilled staff. It is anticipated the new TAFE reforms will assist this process, however, the CSG to LNG industry needs to be prioritised to ensure training providers are able to respond with expedience.

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The CSG to LNG industry presents Queensland with a wealth of long term employment and economic benefits with \$3 billion in revenue annually expected once projects are fully operational.



Image courtesy of Saxon Energy Services

6. Develop an LNG operator training centre in Gladstone to increase the number of qualified local workers and to reduce poaching issues faced by each gas company driven by a lack of qualified staff. A centralised and collaborative training centre would act as a training hub for the eastern seaboard of Australia. This would potentially have a more global reach through Asia, further increasing the inclusion of a local workforce working in the CSG to LNG industry, as well as in the training sector.
7. Increase industry collaboration for OEM training using registered training organisations (RTOs) as a mechanism for delivery. Currently OEM vendor training is delivered by each company which is both costly and time inefficient. It is recommended the gas companies work with RTOs to develop training facilities for training on vendor equipment to be used across all projects.
8. Review competency assurance management systems for supply chain contractors is needed to understand what improvements need to be made across industries without current uniform requirements. The increasing reliance on a contracted workforce requires the implementation of improved systems at industry level to manage and assure the competence of a flexible and dynamic workforce.
9. Improve access to support and funding for training in health, safety and environment for supply chain contractors. Small to medium sized contractors need assistance to improve their OHSE skills and internal systems as well as complying with the OHSE requirements of gas companies and the Queensland Government. Actioning of this recommendation would allow for greater standardisation of high quality training and assessment that covers the key issues for this high risk industry. This would allow for greater participation of local operators in regional areas to gain contracts with the tier one and tier two supply chain contractors, therefore increasing regional economic benefits.

Glossary

Blowout prevention (BOP)	Blowouts in gas wells occur when drillers encounter a gas “kick” or a surge of unexpected high pressure if they encounter a pocket of high-pressure gas. If the unexpected upward flow of liquids is not brought under control, a blowout can result, potentially pushing the steel tubing, or pipe, back up out of the well, damaging the well, the rig and potentially causing loss of life or injuries to the drill crew. Blowout Prevention (BOP) training modules are delivered to learn techniques to control and close off a well if there is an uncontrolled flow of oil and gas.
Coal seam gas (CSG)	Gas found in coal seams that cannot be economically produced using conventional oil and gas industry extraction techniques. CSG is also referred to as coal seam methane (CSM) or coal bed methane (CBM).
Compressed natural gas (CNG)	Produced gas, using conventional oil and gas extraction techniques, potentially mixed with biogas that has been compressed to less than 1% of its gaseous volume at standard atmospheric pressure, and is usually maintained between 2,900 and 3,600 psi. Natural gas consists mostly of methane and is drawn from gas wells or in conjunction with crude oil production. As delivered through the pipeline system, it also contains hydrocarbons such as ethane and propane as well as other gases such as nitrogen, helium, carbon dioxide, sulphur compounds, and water vapour. A sulphur-based odorant is normally added to CNG to facilitate leak detection. Natural gas is lighter than air and will normally dissipate in the case of a leak, giving it a significant safety advantage over gasoline or LPG.
Control rooms	Instruments attached to many of the wells, field operations centres, central processing stations, the LNG trains, and other equipment transmit key data, such as gas flow rates, to central control rooms. Wells and pipelines can be shutdown or opened remotely from these control rooms.
Conventional gas	Gas that is produced using conventional oil and gas industry extraction techniques.
Downstream	Refers to the operation of the LNG plants in Gladstone.
International well control forum (IWCF)	The International Well Control Forum is a not-for-profit membership organisation established in 1992. Its primary purpose is to develop and administer well control training, assessment and certification programs on behalf of the exploration and production sector of the oil and gas industry.
Liquefied natural gas (LNG)	<p>Natural gas stored as a super-cooled (cryogenic) liquid. The temperature required to condense natural gas depends on its precise composition, but it is typically between -120°C and -170°C (-184°F and -274°F). The advantage of LNG is that it offers an energy density comparable to petrol and diesel fuels, extending range and reducing refuelling frequency.</p> <p>The disadvantage, however, is the high cost of cryogenic storage on vehicles and the major infrastructure requirement of LNG dispensing stations, production plants and transportation facilities. LNG has begun to find its place in heavy-duty applications in the United States, Japan, the United Kingdom and some countries in Europe. For many developing nations, this is not a practical option.</p>
LNG train	A unit of gas purification and liquefaction facilities found in a liquefied natural gas plant. The train is used to describe the facility because the gas moves through the plant as it is purified, chilled and pressurised.
Natural gas	Natural gas is primarily methane gas that has been processed to remove impurities to a required standard for consumer use. It may contain small amounts of ethane, propane, carbon dioxide and inert gases such as nitrogen. Natural gas is commercially extracted from oil fields and natural gas fields.
Original equipment manufacturer (OEM)	OEM refers to a company whose products are used as components in another company's product. In the LNG processing plants, there are a number of OEM components used in the production of LNG which requires specialised training for both the operations and maintenance of that machinery.
Recognition of prior learning (RPL)	Recognition of prior learning, also referred to as RPL, is the formal acknowledgement of a person's current skills and knowledge, no matter how, when or where the learning occurred.
Upstream	CSG gas field facilities including drilling, plant and pipeline components of the project.



Image courtesy of Australia Pacific LNG

Appendix

Appendix One

The following tables provide a comprehensive overview of the CSG to LNG job roles. They form both the core staff and primary contracting staff requirements.

Table 13: Job roles for the coal seam gas field operations

Coal Seam Gas Field Operating Stage	
Area Managers	Field Services Supervisors
Completion Engineers	Field Services Utility Workers
Control Room Technicians	Logistics Supervisors
Cultural Heritage Coordinators	Logistics Technicians
Cultural Heritage Monitors	Maintenance Planners
Driller Supervisors	Maintenance Superintendents
Drillers	Maintenance Supervisors
Driller's Assistants	Maintenance Technicians (Mechanical)
Drilling Engineers	OHS Advisors
Electrical and Instrumentation Technicians	Operations Superintendents
Electrical/Instrument Control Engineer	Operations Supervisors
Electricians	Pipeline Welders
Environmental Advisors	Production Engineers
Facility Engineers	Production Technicians
Field Delivery Supervisors	Reservoir Engineers
Field Delivery Utility Workers	Senior Drillers

Table 14: Job roles for the gas transmission pipelines during operations

Gas Transmission Pipeline Operating Stage	
Cultural Heritage Coordinators	OHS Advisors
Cultural Heritage Monitors	Operations Superintendents
Electrical and Instrumentation Technicians	Operations Supervisors
Electrical/Instrument Control Engineer	Pipeline Engineers
Environmental Advisors	Pipeline Technicians
Field Construction Superintendents	Pipeline Welders
Field Construction Supervisors	Production Technicians
Field Construction Technicians	Project Engineers

Table 15: Job roles for the LNG plants during operations

LNG Plant Operating Stage	
Compliance Team	Maintenance Planners
Control Room Technicians	Maintenance Superintendents
Development Engineers	Maintenance Supervisors
Electrical and Instrumentation Technicians	Maintenance Technicians
Electrical/Instrument Control Engineer	OHS Advisors
Environmental Advisors	Operations Supervisors
Facility Engineers	Process Engineers
Field Technicians	Production Technicians
Generalist Operators	Project Engineer
Installation Manager	Shift Leaders
Lab Technicians	Shutdown Team
Licensed Electricians	Superintendents
Logistics Supervisors	Technical Interface Coordinators
Logistics Technicians	

Image courtesy of Saxon Energy Services



Appendix two

Table 16: Job roles by qualification and additional skill sets, Queensland and national

Job Roles	Minimum Qualification	Registered Training Organisations Queensland	Registered Training Organisations Nationally	Additional Skill Sets and Experience
Drillers				Vertical to Horizontal Drilling skills
Leasehand	Certificate II in Drilling Oil/Gas (On shore) – Part Certificate II	16	16	Well Work Over skills
Floorhand	Certificate II in Drilling Oil/Gas (On shore)	16	16	Core Rig Tubing skills
Motorman	Certificate II in Drilling Oil/Gas (On shore)	16	16	
Derrickhand	Certificate III in Drilling Oil/Gas (On Shore)	18	18	
Assistant Driller	Certificate III in Drilling Oil/Gas (On Shore)	18	18	
Driller	Certificate IV in Drilling Oil/Gas (On shore)	11	11	
Tool/Tour Pusher	Diploma of Drilling Oil/ Gas (On shore)	9	9	
Rig Manager	Diploma of Drilling Oil/ Gas (On shore)	9	9	
Health, Safety and Environment	Certificate IV in Work, Health and Safety	153	214	
	Diploma of Work, Health and Safety	63	82	
Procurement	Certificate IV in Purchasing	8	22	
	Diploma of Purchasing	7	19	
Project Management	Certificate IV in Project Management Practice	14	17	
	Diploma in Project Management	22	25	
Integrated Operations skills	Certificate II in Process Plant Operations	13	27	Control Room Operators
Field technician and Operations Technician	Certificate III in Process Plant Operations	19	33	Control Room Operators
Specialist Control Room Operators	Certificate IV in Process Plant Technology	9	23	Control Room Operators
High Voltage switching Electricians	Certificate III in Electrotechnology or equivalent	22	74	High voltage training (non-accredited), Experience in HV Switching
Telecommunication Technicians	Certificate IV in Telecommunications Network Engineering	12	18	
	Diploma of Telecommunications Network Engineering	8	14	

Job Roles	Minimum Qualification	Registered Training Organisations Queensland	Registered Training Organisations Nationally	Additional Skill Sets and Experience
Fitters, Cable Jointers and Instrument Technicians	Certificate III in Instrumentation and Control	9	17	SCADA
	Certificate IV in Instrumentation and Control	3	9	
Engineers	Tertiary Engineering degree from a recognised university, with relevant experience			SCADA
Geologists	Tertiary Geology/ Geoscience degree from a recognised university, with relevant experience			
Geophysicists	Tertiary Geophysicist/ Geoscience degree from a recognised university, with relevant experience			

Image courtesy of QGC



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