

Unit Strategic Resource Assessment & Advice - GSNSW
Subject Narrabri Gas Project: Resource Assessment

Introduction

This resource assessment conducted by the Division of Resources and Geoscience (DRG) is designed to review the resource/reserve estimates stated in a proponent's Environmental Impact Statement and whether the project will deliver significant social and economic benefits to NSW from the efficient development of the resource and that resource recovery is optimised and waste minimised. It is also to ensure an appropriate return to the State from developing the resource.

The objects of the Petroleum (Onshore) Act 1991 are to encourage and facilitate the discovery and efficient development of petroleum resources in NSW. Of particular relevance to this resource assessment is:

Part 1 - Section 2A Objects:

- (a) to recognise and foster the significant social and economic benefits to New South Wales that result from the efficient development of petroleum resources, and
- (d) to ensure an appropriate return to the State.

The relevant section of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 is Part 3, Clause 15: Resource Recovery requires that resource recovery is efficient, optimised and minimises waste.

Background

The Narrabri Gas Project (NGP or the Project) is located in the Gunnedah Basin of NSW about 20 km south-west of the town of Narrabri. The Project is owned and will be operated by Santos NSW (Eastern) Pty Limited (the Proponent). The Proponent is a wholly owned subsidiary of Santos Limited. Santos Limited is an Australian petroleum company established in 1954, which has been supplying natural gas to NSW since 1976. Santos Limited and its subsidiary companies have been involved in developing natural gas from coal seams in Queensland for 20 years and commenced exploring for natural gas from coal seams in the north-west of NSW in 2008.

In November 2011, Santos Limited acquired Eastern Star Gas and its subsidiary Eastern Star Gas Eastern Pty Ltd (ESG) who was the operator of PEL 238, PAL 2 and PPL 3. The Proponent then became the operator of the ESG tenements.

The Proponent has submitted an Environmental Impact Statement (EIS) to the Department of Planning & Environment which went on public display on 21 February 2017.

Economic Benefits of the Project

The Project will contribute a significant increase in economic activity to the region, as expected of a new (greenfield) coal seam gas project of this magnitude. Many locally established businesses will receive flow through benefits from the Project, such as increased demand for both products and services. Project approval is likely to encourage new industry related businesses to commence, further contributing to the State's priorities of job creation, particularly in rural and regional areas.

From the Proponent's EIS on the Project, DRG also notes the following economic benefits have been calculated independently on behalf of the Proponent:

- real economic output of \$11 billion (\$4.5 billion NPV) in the Narrabri LGA
- real economic output \$572 million (\$348 million NPV) in the wider region
- real economic output of \$384 million (\$295 million NPV) in NSW
- real income of \$526 million (\$250 million NPV) in the Narrabri LGA
- real income of \$690 million (\$396 million NPV) in the wider region
- real income of \$4.8 billion (\$2.1 billion NPV) in NSW
- establishment of a Gas Community Benefit Fund which would receive an estimated \$120 million over the life of the Project
- average direct and indirect employment over the life of the Project of 127 full time equivalent jobs in the Narrabri LGA
- average direct and indirect employment over the life of the Project of 161 full time equivalent jobs in the wider region
- average direct and indirect employment over the life of the Project of 224 full time equivalent jobs in NSW

Over the identified life of the Project, average direct and indirect employment would be 512 full time equivalent employees. Capital investment during the construction phase of the Project would be of the order of \$3.6 billion in nominal terms. Ongoing operating costs over the life of the Project would be around \$5.5 billion in nominal terms.

Over the life of the Project the value of gas production is estimated to be worth around \$13.6 billion in current dollars.

DRG has estimated the net present value of this revenue stream at approximately \$6.3 billion.

Royalty Generated from the Project

The Project is a proposed coal seam gas operation and as such a royalty rate of 10% is applicable to the well head value. Well head value is the saleable value of gas produced minus any allowable deductions. Allowable deductions are related to four broad categories; conversion of the well head gas to a marketable product, delivery of gas to market, depreciation of the assets of the refining process, and administration costs.

A royalty rebate would apply to any Gas Community Benefit Fund established by the Proponent. This could reduce royalties paid directly to the State by up to 10% a year in full production. However for every \$1 of royalty rebate paid in to the CBF, the proponent must have contributed \$2 indicating a significant contribution to community projects in the area.

One of the most important assumptions in the calculation of future royalty for the Project is the estimate of a future gas price over the life of a project. The Proponent has assumed a gas price of \$8.70/gigajoule (GJ). DRG is of the opinion that this price lies within the range of expected future gas prices in the east coast gas market over the more than 20 years of the Project life. Given that current prices being asked for domestic gas in NSW and the east coast gas market for new contracts are well above this price, the \$8.70/GJ price may be conservative.

Another important aspect of future royalty calculation for the Project is estimation of future annual production. The Proponent has estimated that if the Project is approved, over 1500 petajoules (PJ) of gas would be able to be economically extracted from the Project area from 2019 to 2041. The maximum rate of extraction would be up to 200TJ/day of gas. DRG has concluded that both the total amount of gas to be produced from the Project and maximum rate per annum is achievable given current information of the area.

Using the above parameters DRG has calculated that in a typical full production year, excluding an CBF royalties rebate, the State will receive around \$32 million per annum in royalty, and the net present value of this royalty stream over the life of the Project would be \$313 million using a 7% real discount rate.

Relevance of the strategic energy project for east coast gas supply

In the EIS for the Project, Santos has stated that gas produced from the Project would be made available to the NSW market. The Project has indicated the potential to supply up to 200TJ of natural gas per day. This increased volume would provide NSW with a secure, long-term domestic supply of this resource as both a critical energy source and industrial input, reducing the State's reliance on contracts with interstate suppliers, now at 95% of gas consumed. The reliance of NSW on its gas requirements from interstate has potential security of supply risks for the State.

The Project has been viewed in a strategic context (Addendum C). According to many informed sources there is an identified shortage of gas in eastern Australia which is starving some users of supply and leading to significant increases in prices for short, medium and long term contracts. NSW is particularly vulnerable due to only 5% of its gas being produced within the State as mentioned previously. In NSW around 500 heavy industrial users currently consume 75% of NSW gas with possibly 300,000 jobs relying on a secure gas supply. It is possible that some heavy industrial users may vacate NSW due to both security of supply and pricing issues.

Of the 95% gas imported by NSW, the largest gas supplier has been Victoria which has traditionally supplied around 55% mainly from the Gippsland Basin – with lesser quantities from the Bass and Otway Basins. South Australia has supplied around 40% from the Cooper Basin.

In its latest Gas Statement of Opportunities (GSOO, March 2017) the Australian Energy Market Operator (AEMO), highlights that gas for LNG exports is projected to continue dominating gas demand and supply in eastern and south-eastern Australia to 2036. Due to the interconnected gas pipeline network in the east coast gas market it is now possible for

any gas produced in this market to be exported as LNG via the three major Gladstone facilities (Queensland Curtis LNG, Asia Pacific LNG and Gladstone LNG).

According to AEMO GSOO, it is likely that 2017 will see some levelling off of Gladstone LNG exports at close to their maximum capacities expected to be reached in the early 2020's. As a result of the increasing demand for LNG exports out of Gladstone the majority of gas previously contracted from the Cooper Basin has now been contracted to meet export requirements.

Of particular relevance to the Project, AEMO states "Development of the proposed Narrabri Gas Project could provide extra supply into the domestic market. Assuming first production in 2020, AEMO's modelling shows that the Project has the potential to remove all domestic gas shortfalls from 2020 to 2024." The Project is not a complete solution to meeting the long term east coast gas supply requirements but is a credible solution at least in the medium term, as longer term solutions are realised.

Forming long term solutions necessitates an understanding of the time required to continue exploration, undertake appraisal, develop a project application and gain the required approvals to commence production and then build the required pipeline and processing infrastructure. A review of the work programs, for the remaining petroleum titles in NSW indicate that it would be highly unlikely that gas could be delivered into the East Coast Gas Market prior to 2026-2028. This is based on the time Furthermore it is anticipated that for any new petroleum titles granted under the Strategic Release Framework for Coal and Petroleum Exploration it would also be at least 8-10 years, subject to a significant discovery, to deliver gas into the market.

Concluding on the need for the Project, the east coast gas market has short, medium and long term supply issues, DRG views the Project as contributing to a solution to the forecast domestic gas supply shortfall particularly in the medium term.

Resource Assessment

Size of the Gas Resource

DRG is satisfied that the NGP contains a gas resource of approximately 1797 Petajoules (PJ) classified as a 2C (contingent) resource. The 2C gas resource estimation was generated using a conservative approach based on appraisal (pilot) wells and exploration data. There is sufficient contained gas to provide approximately 40% of NSW gas needs for over 20 years.

The Proponent completed the resource estimation for the Project in accordance with the Guidelines for Application of the Petroleum Resources Management System (PRMS) 2007. The PRMS is an industry standard professional system for defining petroleum reserves and resources and is accepted by the Australian Stock Exchange.

The Proponent engaged a third party, Netherland, Sewell & Associates, INC (NSAI) to audit the gas resource estimation of Santos. NSAI are a US based petroleum consulting company with expertise in coal seam gas resource and reserve estimation. The audit was completed in February 2016, using a different resource estimation methodology, and it verified the gas resource estimation by Santos.

Resource Recovery

Key Geological Aspects of the Resource

The majority of the gas resource in the NGP is within the coal seams from the Maules Creek Formation. There are four seams containing gas however the Bohena Seam is the major gas reservoir.

The formation of a coal seam gas reservoir, that is commercially viable to extract gas from, depends on the presence of several key geological factors. The key factors are the net coal thickness, coal rank, gas content, gas saturation and the coal seam permeability.

Geologists from DRG reviewed the main geological data for the NGP. This review included reports submitted to government under reporting requirements for petroleum titles. DRG also included an on-site meeting to review additional geological data and the interpretation of those data. DRG is satisfied that the NGP resource has a reservoir system that meets or exceeds all the requirements with respect to the geological factors, for a successful project, as the factors compare favourably when compared to those at producing coal seam gas projects.

Production Technique

The permeability and the nature of the natural structural geological features within the coal seam are of prime importance as to whether or not commercial gas flows can be achieved. Gas is released from coal seams by extracting water thereby depressurising them to allow gas to flow and the permeability must be high enough for this to occur.

The natural structural features that define the permeability of the target coal formations of the NGP area unusual in comparison to similar CSG operations within Australia. They are unusual due to the fact that they exhibit a dominant master cleat system which has a strong preferred unilateral orientation, characterized by long continuous vertical fractures every 0.5

– 1.0m apart, typically in a NE-SW direction. Further information on this cleat system is in Appendix A.

This master cleat system is the reason commercial gas flow rates can be attained from coal seams at depths of 800m to 1000m without fracking. At this depth, in coal seams with the more typical face and butt cleat structure, the permeability is generally low and difficult to produce commercial flow rates without fracking.

In the early stages of the appraisal of the Narrabri gas field, Eastern Star Gas fraced a series of vertical wells with very limited success in 1999. Subsequently between 2000 and 2006 horizontal wells were drilled and some were fraced. It was discovered with further appraisal work that the most effective and efficient way to produce commercial flow rates was to drill horizontal wells and not frac them.

The key to producing good gas flow rates was to drill horizontal wells perpendicular to the master cleat set. The master cleat set created a naturally occurring directional permeability that is fully utilised, by what at the time was a paradigm shift in extracting coal seam gas at Narrabri. The data on current appraisal wells indicate very good gas flow rates, after sufficient water has been extracted to allow the gas to flow.

DRG is satisfied that the proposed method of drilling horizontal wells is the most efficient way to produce gas from the NGP at significant commercial quantities. This method was developed over a decade of testing different methodologies and best utilises the naturally occurring directional permeability in the main target coal seams.