COAL SEAM GAS
A SIGNIFICANT DRIVER FOR NEW GAS PIPELINE INFRASTRUCTURE IN EASTERN AUSTRALIA

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Abstract

The commercial production of coal seam gas [CSG] in Australia is only a decade old. Over the last ten years it has become a significant part of the Eastern Australian upstream gas industry, particularly in Queensland. In 2005 approximately 65 PJ of CSG was supplied to the market in Queensland and New South Wales. This is nearly 10% of the current Eastern Australian gas market. In Queensland CSG now accounts for 45% of the total market and 65% of the gas utilised in Eastern Queensland.

The CSG industry has reached maturity with a number of gas fields, especially those in the Bowen Basin having a history of continuous production. In addition the commissioning of a number of new fields in the Surat Basin has established the credibility of CSG as another reliable source of natural gas. By the end of 2008 CSG production in Australia is expected to reach 165 PJ per year with 90% being produced in Queensland. This production will be backed by a significant increase in certified 2P reserves. They are currently just over 4,000 PJ or approximately 25% of the total Eastern Australian gas reserves. The CSG reserves of the Bowen-Surat Basins are the largest onshore gas reserves in Australia.

The rapid growth in CSG production since 2000 has resulted in the construction of a number of new gas transmission lines to connect CSG fields directly to markets or to the existing gas pipeline infrastructure. Since year 2000 when CSG started to impact on the Queensland gas market, approximately 1,550 km of high pressure gas transmission line has been constructed in that State. Some 77.5% of this has been driven by the growing level of CSG production. A further 300 km of new transmission lines to service CSG is under construction while 470 km is expected to receive project sanction by early 2007.

In addition to the gas transmission lines and laterals, the CSG Industry has installed over 2,000 km of gas gathering lines and close to this amount of water gathering and disposal piping as part of the development of CSG fields. A further 1,200 km of gas transmission pipeline investment to meet the needs of the continuing growth in CSG output expected by the end of 2008 is under detailed investigation.

Introduction

In 1996, the certified 2P gas reserves in Eastern Queensland were less than 100 PJ. At the same time gas demand in South Eastern and Central Queensland was approximately 40 PJ per year and growing at 5 percent per year.

As a consequence of the apparent shortage of gas reserves to meet the longer term gas market for Eastern Queensland, gas contracts were finalized in early 1996 to supply gas to these markets from the Cooper-Eromanga Basin in South West Queensland where the economically recoverable gas resource at the time was estimated to be 1,950 PJ. At the same time, Chevron Asiatic Limited announced that it was undertaking a feasibility study into supplying gas from the Southern Highlands of Papua New Guinea to Queensland and other Eastern Australian markets by mid 2001. Gas reserves in the PNG Southern Highlands at the time were some 5,000 PJ on a Proved plus Probable [2P] basis.
A decade later, the independently certified 2P gas reserves in the Bowen and Surat Basins of Eastern Queensland are 4,123 PJ of which coal seam gas accounts for approximately 93%. The CSG reserves in Queensland [3,842 PJ] together with those in New South Wales [105 PJ] now comprise 25.4% of the total certified 2P gas reserves in Eastern Australia [15,537 PJ]. The current level of certified CSG reserves in the Bowen and Surat Basins are the largest onshore reserves in Australia being nearly twice the size of the remaining 2P conventional gas reserves in the Cooper-Eromanga Basin.

The 3P [Proven plus Probable plus Possible] gas reserves in Eastern Queensland are 12,666 PJ of which 11,986PJ or 94.6% is coal seam gas. In addition to the current level of reserves, there is a significant CSG resource in the existing coal basins including an estimated further 25,000 PJ in existing fields and prospects within the Bowen and Surat Basins as well as a substantial gas resource in the Clarence-Moreton, Galilee, Gunnedah, Hunter, Otway and Sydney Basins.

The Queensland Government policy for 13 percent of power generated in the State to be gas fired that came into effect from 1 January 2005 has been a major facilitator in the development of the CSG industry. The policy which had a focus on the environmental effects of power generation was aimed, in part, at underwriting the proposed PNG gas developments. With the ongoing delays with the PNG Gas Pipeline, CSG has filled the bulk of the market opportunities that earlier would have been taken up by gas from Papua New Guinea.

The development of CSG in Eastern Australia and its recent acceptance in the market as being a reliable source of natural gas though from a different reservoir from conventional gas has been a significant driver for new gas pipeline infrastructure since 2000.

**Coal Seam Gas History**

Modern CSG exploration commenced in the Bowen Basin in 1976 when Houston Oil and Minerals of Australia Limited drilled two wells and reworked two earlier wells as CSG producers. The results of the program were unsuccessful due to a lack of knowledge of the importance of the stress regimes and their influence on the cleating of the coals being targeted. Throughout the 1980s and up until 1995, a lot of exploration and development activities associated with CSG was undertaken by a number of major petroleum exploration groups including MIM Holdings Limited, Mitsubishi Gas Chemicals [Australia] Pty Ltd and Conoco Australia Pty Ltd, mostly with a lack of success. Again this has been attributed to a misunderstanding of the regional geology of the coal measures targeted and the impact of coal seam stresses on permeability.

BHP Australia Coal Pty Ltd [BHP] had some success from 1988 through their subsidiary Seamgas Enterprises Pty Ltd using in-seam boreholes at Moura as part of a methane pre-draining activity prior to mining. This built on BHP’s earlier experience with coal mine methane draining at some of its coal mines in the Sydney Basin. The results were to lead to further work which culminated in the Moura CSG project developed by Oil Company of Australia Limited [OCA, now a subsidiary of Origin Energy]. The Moura or Dawson Valley CSG field is now operated by Anglo Coal [Moura] Limited.
In the mid 1990s Tri-Star Petroleum Pty Ltd at Fairview on the Comet Ridge approximately 130 km north east of Roma and OCA which took over Conoco’s operations in the Dawson Valley were instrumental in gaining an understanding of the issues affecting the permeability of coals in the Bowen Basin. This resulted in successful identification of targets, application of low cost drilling techniques, development of practical means of stimulating gas recovery as well as implementation of effective well completion techniques. More recently the use of surface to in-seam drilling has resulted in significant increases in well productivity in most CSG fields.

The results of the successes in unlocking CSG from the various coal measures in the Central and Southern Bowen Basin were subsequently applied to the Northern Bowen Basin and to the Walloon Coal Measures within the Surat Basin. The experience within the industry is now being applied to new projects in other coal basins, particularly the Clarence-Moreton and Gunnedah Basins while production by the AGL-Sydney Gas joint venture recovering CSG from the Coal Measures of the Sydney Basin is ramping up production to produce the planned 40 TJ per day by mid 2008.

**Current CSG Operations**

From a production of approximately 1.5 PJ in 1995-1996 from the Bowen Basin, CSG output has grown significantly, particularly since 2002. At the end of 2005 the estimated production of CSG in Eastern Australia for the year was 65 PJ [180 TJ per day] including the 4 PJ produced from the Sydney Basin.

The CSG operations in Eastern Queensland in commercial production are recovering gas from various coal measures within the Bowen Basin and from the Walloon Coal Measures in the Surat Basin. The current CSG operations in commercial production are at Dawson Valley, Fairview, Moranbah, Peat, Scotia and Spring Gully in the Bowen Basin while Kogan North and Berwyndale South are producing gas from the Surat Basin. The location of these operations are shown in the accompanying map at Figure 1.

Sydney Gas Limited commenced commercial production of CSG in the Camden area south west of Sydney in 2002. Gas from the coals within the Sydney basin was sold to AGL. In December 2005 AGL took a 50% interest in the Camden Project which is being expanded to supply 14.5 PJ per year by mid 2008. The Sydney Gas-AGL joint venture has commenced a major exploration program for CSG in the Broke-Bulga area of the Hunter Valley.

**Dawson Valley**

These operations comprise the Moura CSG Project of Anglo Coal [Moura] Limited which includes the original developments at Moura by the SeamGas joint venture of BHP Coal and US Steeland the Dawson River, Moura, Mungi and Nipan operations developed by Oil Company of Australia Limited [Origin Energy] from the earlier work undertaken by Conoco Australia Limited. In September 2005, Origin Energy sold all of its interests in the Dawson Valley operations to Anglo Coal and its joint venture partner, Mitsui Moura Investments Pty Ltd. Molopo Australia
Limited and Helm Energy-Australia LLC between them hold a 50% interest in the Mungi operations and in the adjacent Harcourt/Bindaree and nearby Timmy prospects.

The Dawson Valley operations are based on recovering gas from the thick, gassy coals of the Baralaba Coal Measures. There are up to 10 seams in the region with aggregate coal thickness up to 30 m at depths ranging from 300 m to a maximum of 1,000 m. Permeabilities reduce with depth. Current production from the Dawson Valley is approximately 9 PJ/a.

Gas produced in the Dawson Valley is used as a feedstock [about 3.2 PJ/a] by the ammonium nitrate plant of Queensland Nitrates Pty Ltd located at Moura with the balance being compressed and fed to the Queensland Gas Pipeline [Alinta Pipeline] to supply markets in Central Queensland, principally in Gladstone.

The Dawson Valley CSG fields are connected to the Wallumbilla to Gladstone Gas Pipeline [PPL 30] of Alinta at Moura by two pipelines, one an 18 km, 168 mm facility [PPL 26] and the other a 23 km, 219 mm unit [PPL 61].

**Fairview**

The important Fairview CSG field on the Comet Ridge was discovered in 1989 by Tri-star Petroleum Company and developed by that Company in 1994. Commercial production commenced in February 1998. At Fairview three seams of high gas content coals in the Bandanna Formation have been targeted at depths ranging from 500 m to 800 m. Aggregate coal thickness varies but on average is approximately 10 m.

Tipperary Oil and Gas [Australia] Pty Ltd [TOGA] assumed the operatorship of Fairview on 22 March 2002. On 13 July 2005, Santos Limited acquired TOGA which had a 75.25 % capital interest in Fairview. Origin Energy Limited has a 23.93 % interest in Fairview.

At the end of 2005, Fairview was producing approximately 38 TJ/d [13.9 PJ/a]. This was limited by gas processing constraints. Production capacity has been increased by Santos to 48 TJ/d and on completion of the new 130 km, 355 mm direct pipeline [PPL 118] from Fairview to Wallumbilla early in 2007, Fairview is expected to be delivering 65 TJ per day [23.7 PJ/a]. Long term planning is for Fairview to have the capability of producing up to 200 TJ per day [73 PJ per year].

**Moranbah Gas Project**

The Moranbah Gas Project [MGP] in the northern part of the Bowen Basin was commissioned in February 2005. The project produces CSG from the Moranbah Coal Measures at depths of approximately 300 m where the coals are lightly stressed and have moderate permeabilities. CH4 Gas Limited which recently merged with Arrow Energy NL is the operator of MGP. The company developed a novel horizontal in-seam drilling arrangement where two in-seam wells in a chevron configuration intersect a common vertical well. Average daily production from this well arrangement is close to 900,000 cfd with a number of wells producing over a million cfd or approximately 1 TJ/d. The wells at the MGP are characterized by relatively low co-production of water.
The MGP was established as a joint venture between CH4 Gas Limited and BHP Billiton Coal Pty Ltd. AGL has recently acquired BHP's 50% interest in the MGP. Gas produced by the MGP is delivered to Enertrade which treats and compresses it before transporting it to Townsville in the 393 km long, 273 mm diameter North Queensland Pipeline [PPL 89]. The gas is used in the 220 MW base load combined cycle Yabulu power station owned and operated by Transfield Services Limited, by the Xstrata copper refinery at Stuart and at the QNI nickel refinery at Yabulu. A small quantity of gas is also supplied to Ergon Energy for its 12 MW power station at Moranbah. The MGP is currently producing 46 TJ/d and is on schedule to increase sales to the Townsville market to 49 TJ/d [17.9 PJ/a] in 2007 rising to 19.4 PJ per year by 2010.

Arrow Energy has entered into a Memorandum of Understanding with Transfield Services to supply gas to a proposed 100 MW power station at Moranbah to be commissioned in late 2008. This project will primarily use coal mine methane extracted from a number of underground coal mines around Moranbah.

Enertrade is now finalising the approval processes for a new 450 km gas pipeline of up to 450 mm diameter [PPL 121] connecting Moranbah to Gladstone via Stanwell. This pipeline, which will be rated at 15.3 MPa, will provide the MGP with a connection to the rest of Eastern Australia. The Environmental Impact Statement for this project has been issued for comment. It is anticipated that Queensland Government approvals for this project will be given in early 2007 enabling CSG from Moranbah to be delivered into Central Queensland by mid 2008.

**Peat**

The Peat Gas Field of Origin Energy is located near the township of Wandoan in the south east section of the Bowen Basin. The field, which commenced production in February 2001, is located on the Burunga Anticline and recovers gas from highly fractured coals from the Baralaba Coal Measures. There are four coal seams at Peat with an aggregate thickness of 18.3 m. The seams range in depth between 500 m and 900 m. There is virtually no water production at Peat.

The Peat CSG Field currently averages 16 TJ per day or 6 PJ per year. The gas is primarily supplied to a 30 MW co-generation power facility at the BP Refinery, Bulwer Island, Brisbane. Gas from Peat is transported to markets by way of the Scotia/Peat 273 mm, 110 km lateral [PPL 74] which joins the Roma to Brisbane Pipeline [RBP] at Condamine. Both the Scotia/Peat lateral and the 434 km, 273 & 400 mm fully looped RBP [PPL 2] are owned and operated by the Australian Pipeline Trust [APT].

**Scotia**

Scotia is located immediately north of Peat. It occupies the northern part of the Burunga Anticline recovering gas from the same coal seams as at Peat. Production from Scotia is supplied to the Swanbank "E" Power Station. Production is approximately 25 TJ per day or 9 PJ per year. The Scotia Field, which commenced gas production in May 2002, is owned and operated by Santos Limited. Gas produced at Scotia is conveyed to the RBP in the Scotia/Peat Lateral [PPL 74].
**Spring Gully**

The Spring Gully Project of Origin Energy Limited [96.6 % interest] commenced commercial gas production at the end of June, 2005. Initially the project had 42 CSG production wells producing 36 TJ/d [13 PJ/a]. Production is currently ramping up to 49 TJ per day. On 25 July Origin announced a $114 million expansion program to expand production at Spring Gully to 85 TJ per day [31 PJ per year].

Spring Gully is located on the southern part of the Comet Ridge immediately to the south of Fairview and is targeting the same coal seams within the Bandanna Formation. Aggregate coal thickness is between 5 m and 9 m with good permeabilities. The resource concentration of gas in place is in excess of 5 PJ/km². Spring Gully is connected to the Roma to Brisbane Pipeline at Wallumbilla by way of a 300 mm, 89 km pipeline [PPL 90] owned and operated by Origin.

Origin Energy on 19 September 2006 received the necessary Queensland Government approvals to build and operate a notional 2 x 500 MW gas fired, combined cycle power plant at Spring Gully. The first stage of 500 MW is planned to be operational by early 2009. The project will have a CSG demand of approximately 90 TJ per day [33 PJ per year] for each 500 MW module.

**Kogan North**

The Kogan North CSG project is located 40 km west of Dalby and adjacent to the RBP. It is a joint venture between Arrow Energy and CS Energy, a Queensland Government owned power generator. The 31 well coal seam gas field commenced commercial gas deliveries to the Swanbank "E" power Station of CS Energy via the RBP in January 2006. It is currently supplying 8 TJ per day as it ramps production up to the contracted 11 TJ per day [4 PJ per year] by early 2007. Kogan North was the first commercial CSG producing field based on the Walloon Coal Measures of the Surat Basin.

The central gas processing facility for Kogan North is owned and operated by Australian Pipeline Trust [APT]. It tolls gas through the plant for the Arrow/CS Energy joint venture. APT has also owns the short 1 km, 300 mm pipeline [PPL 104] connecting the gas processing unit to the RBP.

**Berwyndale South**

Berwyndale South was the second of the Surat Basin CSG fields to move into commercial production. The field is located on the Undulla Nose structure 32 km south west of Chinchilla and is owned 90% by Queensland Gas Company [QGC] which is the operator. Sentient Gas Australia Pty Ltd has the remaining 10% interest. Gas was first supplied to the Swanbank "E" Power station of CS Energy in early May 2006. Further commercial deliveries commenced to the new 3 x 150 MW Braemar Power Station in June 2006. Berwyndale South is currently producing at approximately 25 TJ per day [9.1 PJ per year], well ahead of contract rates. The field is highly productive with the average gas flow per well from the 25 wells averaging over 1 million cfd or approximately 1 TJ per day.

The central gas processing plant at Berwyndale South is linked to the RBP by way of a 14.5 km,
250 mm pipeline [PPL 91]. QGC also has a pipeline licence [PPL 108] for a 15 km, 250 mm pipeline to link its developing Argyle Gas Field with the Berwyndale South gas processing plant. Argyle is scheduled to come into production in mid 2007. QGC has also been issued with PPL 107 for an 18.5 km, 250 mm pipeline linking Argyle directly with the RBP should this pipeline be needed.

The 14.5 km pipeline from Berwyndale South to the RBP also has a direct connection to the 80 km, 405 mm gas accumulator [PPL 103] connected to the Braemar Power Station. This pipeline which is connected to the RBP at Condamine provides a large amount of line pack for the intermittent operating characteristics of the gas turbine units at Braemar operating as peak load units.

Developing CSG Projects

A number of CSG projects are currently in the commissioning, pre-production development and pilot operation phases. These include the new projects at Argyle, Daandine and Tipton West. All are based on the Walloon Coal Measures of the Surat Basin. They are all scheduled to be in commercial production by the end of 2006 to mid 2007.

All of these projects have grown from successful pilot operations. They have established certified reserve bases which have underpinned the signing of Gas Supply Agreements and finance for commercial development.

In addition to these projects, a number of other pilot operations have been established or are planned. Most of these are focused on the Walloon Coal Measures in the Surat Basin. These include projects at Coxon Creek, Dundee, Lacerta, Lauren, Millmerran, Orana, Talinga and Woleeebee. Of particular interest have been the coals around the Undulla Nose, a significant anticlinal structure approximately 30 km south west of Chinchilla where both the Juandah and Taroom Coal Measures are well cleated with many jointing structures resulting in reasonable to good permeabilities. The Roma to Brisbane Pipeline crosses the Undulla Nose.

CSG pilot operations have been established in the northern parts of the Bowen Basin at Annandale and South Walker east of the Moranbah Gas Project by the MGP partners. Planning is also well advanced for a pilot operation at Tilbrook to the west of the Newlands coal mine and adjacent to the Moranbah to Townsville Pipeline. In the Central Bowen Basin pilot operations are being developed at Bindaree north of Moura and at the Timmy Prospect to the south of the Dawson Valley CSG operations of Anglo Coal.

The Clarence-Moreton Basin with its close proximity to the South East Queensland markets and the coal measures in many of the coastal Tertiary Basins are now receiving attention through additional seismic and core drilling. Metgasco Limited has established certified CSG reserves in its Casino Prospect in the Northern New South Wales part of the Clarence-Moreton Basin and has begun testing a recently completed pilot near Casino airport. With regard to the Queensland coastal basins work recently has been undertaken in the Nagoorin Graben close to Gladstone and in the Styx Basin north of Rockhampton. Gladstone is likely to be the largest gas market in Queensland by 2010. Exploration and development of a CSG pilot is planned at Rodney Creek in
the Galilee Basin in Central West Queensland, approximately 50 km north west of the 53 MW Barcaldine gas fired power generator.

In addition to the exploration and development activities being undertaken in New South Wales by Sydney Gas, a number of other exploration companies are actively pursuing CSG activities in this State. Arrow Energy, Metgasco and Molopo are active in Northern New South Wales in the Clarence- Moreton Basin while in the Gloucester Basin, approximately 100 km north of Newcastle, Molopo and AJ Lucas are developing a CSG pilot operation on the Stratford Prospect.

Eastern Star Gas has recently established a 10 well CSG pilot operation in the Gunnedah Basin approximately 30 km south of Narrabri. The Company has extensive exploration acreage over the Gunnedah and southern Surat Basins in New South Wales. Carbon Minerals NL has undertaken CSG exploration to the south and south west of Gunnedah and is now testing a number of wells.

In Victoria three companies have been targeting CSG. Eastern Star Gas developed a 5 well pilot in the Eastern Otway Basin 35 km west of Melbourne with disappointing results. Likewise Purus Energy Limited has failed to delineate commercial quantities of CSG in two prospects in the on-shore section of the Otway Basin in south west Victoria. Karoon Gas has delineated gassy black coals in one well within the western on-shore part of the Gippsland Basin. Planning for further drilling is being undertaken by Karoon Gas.

Pure Energy Resources Limited which was recently floated on the ASX has CSG tenements in the north eastern parts of the Bowen Basin, east of the MGP as well as over parts of eastern Tasmania.

The three major CSG projects under development are at Argyle, Daandine and Tipton West. All are in the Surat Basin. They are scheduled to commence commercial deliveries from late 2006 to mid 2007.

**Argyle**

Queensland Gas Company has undertaken CSG pilot operations at Argyle and Argyle East since 2003. Development of Argyle as a commercial gas producer has commenced. Raw gas from Argyle will be transported approximately 15 km in a 250 mm pipeline [PPL108] to the Berwyndale South gas treatment and compression facility for transport to the RBP via the Berwyndale South to RBP pipeline [PPL 91]. QGC [59.375%] and the operator and Origin Energy, its partner in Argyle with 40.625% have a Gas Supply Agreement with Incitec-Pivot to supply 14.4 PJ per year for 10 years to the ammonia fertiliser complex at Gibson Island in Brisbane from July 2007. QGC’s share of this contract is 74 PJ.

**Tipton West**

The Tipton West Project, 20 km south of Dalby, is being developed by Arrow Energy NL to supply 10 PJ per year of CSG in early 2007. Tipton West has undergone lengthy testing with a 12 well pilot operation. Beach Petroleum Limited has a 40% interest in Tipton West.
Arrow has a Gas Supply Agreement to supply 6 PJ per year for 15 years to the 450 MW Braemar Power Project, approximately 40 km west of Dalby. The project also involves the construction of gas pipeline laterals to the RBP, to Braemar and a projected power plant for Ergon Energy at Dalby which will use 3.9 PJ per year. Pipeline Licence PPL 102 has been issued covering the 141 km of 203 and 406 mm pipelines for these projects.

**Daandine**

The Daandine Project of Arrow Energy [PL230] is located to the immediate south of Kogan North and adjacent to the Kogan North Central gas Treating and Compression Facilities.

Daandine is being developed to initially supply 5.5 TJ per day [2 PJ per year] of CSG to a 27.4 MW base load power station to supply power to Country Energy under a long term Power Purchase Agreement. Development of the 15 well Daandine Field is complete while installation of the 11 x 3 MW GE Jenbacher reciprocating gas engines is well advanced. Commissioning is scheduled for the end of 2006. Arrow is planning to further expand the Daandine CSG field to produce up to 5 PJ per year utilising the spare gas treating and compression capacity built into the Kogan North facility.

**Eastern Australia-Certified Gas Reserves**

At 30 June 2006 the certified gas reserves in Eastern Queensland were calculated to be 4,123 PJ on a Proven and Probable [2P] basis with 93.2 % being CSG. More specific details of the reserves are outlined in Table 1.

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<th>Category</th>
<th>Conv.</th>
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<tr>
<td>2P Proved + Probable</td>
<td>281</td>
<td>3,842</td>
<td>4,123</td>
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<td>3P Proved + Probable + Possible</td>
<td>680</td>
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The significance of the CSG reserves is illustrated by their rapid growth over the past five years as a consequence of the bringing on line of many fields, re-evaluation of reserves in the light of sustained production from producing fields and the development of pilot operations. The growth in certified CSG reserves is shown in Table 2.

<table>
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<th>Year</th>
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<td>905</td>
<td>1,300</td>
<td>2,466</td>
<td>3,755</td>
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This growth in CSG Certified 2P Reserves is illustrated in Figure 2.

Over the next few years it is expected that the size of the Proved plus Possible Reserves of CSG within Eastern Queensland Basins will increase substantially as production from existing CSG fields is increased, new projects are brought into production and additional resources are evaluated by way of drilling and follow up pilot operations. A substantial part of the current Possible [P3] Reserves of CSG which currently amounts to over 8,100 PJ is expected to be upgraded to 2P status while some of the existing major producers of CSG such as Anglo Coal, Arrow Energy, Origin Energy QGC and Santos have reported substantial gas in place resources which are yet to be accorded reserve status. These amount in total to over 15,000 PJ which, based on current recoveries, could be expected to yield a further 6,000 PJ of reserves. It has been estimated that the gas in place resource within the coal measures of the Bowen Basin is at least 152,000 PJ.

The Proved plus Probable [2P] Gas Reserves for Eastern Australia amount to just over 15,500 PJ. The distribution is illustrated in Figure 3. The 2P CSG reserves in Eastern Queensland now total approximately 26.5 % of the total 2P gas reserves of Eastern Australia. After the Gippsland Basin with 44.9 % of the reserves, Eastern Queensland CSG has the next largest 2P reserves with nearly twice the reserves of the Cooper-Eromanga Basin. This breakdown is illustrated in more detail in Figure 4.

Approximately 50% of Santos’ total 2P gas reserves in Eastern Australia are held in Eastern Queensland while nearly 65 % of the total Eastern Australian gas reserves held by Origin Energy are in Eastern Queensland. In both cases over 50 % of the Certified Proved plus Probable Gas Reserves in Eastern Australia held by Santos and Origin Energy are CSG.

**Gas Sales Agreements**

The growing acceptance of CSG as another source of natural gas has been confirmed by the number of Gas Sales Agreements [GSA’s] that have been finalized, particularly over the past two years.

The role of the Queensland Government owned Energy Corporations [GOCs] such as CS Energy, Energex, Enertrade and Ergon Energy has also been instrumental in driving the demand for CSG in Queensland. These GOC’s operating under the Queensland Government’s 13% Gas Policy [wherein from January 2005, 13 % of all non- exempt electrical loads are to be supplied with power generated from gas] helped underwrite many of the early CSG projects and shared part of the developmental risk. One of the ironies has been the role of the 13 % Gas Policy in the development of the CSG industry. While the policy had its main emphasis on achieving environmental outcomes, its secondary aim was to establish a sizeable gas market to help underpin the PNG Gas Project and lock in the PNG Gas Reserves to replace the limited remaining gas reserves in the Surat and Cooper-Eromanga Basins. The delays with the PNG Gas project from the late 1990s provided the catalyst and the market opportunities for CSG which were taken up by a number of new, smaller explorers building on the experience of earlier participants in the industry such as Origin Energy, through Oil Company of Australia and TriStar Petroleum.
The significant growth in the Queensland gas market has been driven by the recent installation of gas fired power generation to meet the 13 % Gas Policy. There is currently approximately 2,000 MW of gas fuelled installed capacity. In addition there is a further 1,000 MW either under construction or for which tenders have been called while a further 1,500 MW is reported to be under investigation. Some of the projects being planned are competing and not all will proceed in the short to medium term. The existing and planned power projects are a mixture of open cycle peaking units to full combined cycle base load plant though most of the latter are operating on an intermediate load basis. There are also some significant industrial gas loads, mainly in chemical and mineral processing plants.

The Gas Sales Agreements in place for supply of CSG currently total over 1,800 PJ. They cover the supply of 21 PJ delivered in 2003 to 140 PJ per year by 2010, the year that it was expected until recently that PNG gas would be available to Eastern Australian gas markets. Most of the existing contracts commence in the period 2005 to 2007 and are for periods of 10 and 15 years. A number of conditional contracts and heads of agreement totaling in excess of another 500 PJ are likely to be converted to GSA’s within the next 12 months. If all of these agreements are converted to GSA’s, approximately 50 % of the current Proved and Probable Reserves of CSG will be under contract.

The signing of GSA’s has been of critical commercial significance to a number of the developing CSG producers, for it has secured their future cash flow and provided necessary funding for further growth. However prospective producers have only been able to enter into GSA’s after establishing successful pilot operations which have confirmed gas deliverability, Proved reserves which affords bankability and Proved plus Probable reserves to support the marketability of the project.

The collective quantities of CSG to be supplied under current GSA’s are shown in Figure 5.

At the beginning of 2010, it has been estimated by ABARE that the Eastern Queensland demand for natural gas will be approximately 170 PJ per year of which 80 % will be supplied from CSG operations. In addition it is expected that a significant quantity of CSG from Queensland will be supplied into Eastern Australian Markets, particularly New South Wales and South Australia.

Impacts of CSG on Gas Pipeline Development since Year 2000

The growth in certified reserves of CSG along with the number of GSA’s signed to supply CSG into the market has underpinned the growth, and acceptability, of coal seam gas as a major source of natural gas. With the gas market growing at approximately 5% per year, considerable additional gas pipeline infrastructure will be required.

To the beginning of Year 2000, a total of 4,540 km of gas transmission lines has been constructed in Queensland. At this time only the 18 km Dawson Valley-Moura pipeline [PPL 26] had been specifically built to transport CSG. Since the beginning of Year 2000, a further 1,554 km of gas transmission line has been built and commissioned of which 77.5% has been for, or driven by,
CSG. This includes the full looping of the RBP. A further 286 km, solely to service CSG production, is currently under construction while a further 469 km is expected to receive project sanction by early 2007. The Queensland Hunter Gas Pipeline which will convey CSG from the Bowen-Surat Basins to Newcastle is scheduled to receive the go ahead in mid 2007. This would bring the total length of new gas transmission pipeline in and from Queensland since Year 2000 to approximately 3,160 km of which 89% is attributed to CSG.

The full looping of the Roma to Brisbane pipeline with 434 km, 405 mm section was driven by market growth in South East Queensland which is primarily being supplied by CSG from Fairview, Peat, Scotia, Spring Gully and more recently from Berwyndale South and Kogan North. Approximately 50% of the gas flowing down the RBP is CSG and the percentage is increasing. By mid next year when both Origin and QGC commence supplying CSG to the Incitec-Pivot fertilizer complex at Gibson Island on the lower Brisbane River, approximately 65% of all gas coming to the Brisbane region will be CSG.

By mid 2007, CSG from the Bowen and Surat Basins will commence to be supplied to other Eastern Australian markets. This will involve CSG flowing westwards from Wallumbilla to Ballera in Epic Energy’s 759 km, 406 mm pipeline [PPL 24] originally commissioned in 1998 to supply South East and Central Queensland with conventional sourced gas from Ballera in the Queensland section of the Cooper-Eromanga Basin.

Epic Energy has announced that Front End Engineering and Design [FEED] has commenced on the Ballera to Moomba Interconnect [BMI] to enable CSG to be supplied to both Epic’s Moomba to Adelaide pipeline and APT’s Moomba to Sydney pipeline. Planning is for the proposed 180 km BMI to be commissioned during 2008.

Australian Pipeline Trust is also undertaking detailed engineering of a pipeline from Ballera to the Omicron valve station on its Moomba to Sydney pipeline in Far South West Queensland. This approximate 180 km line will facilitate the flow of CSG from Central Queensland to New South Wales markets without the need to pass through or around the Moomba Hub.

Enertrade, the owner of the 393 km Moranbah to Townsville Gas Pipeline [PPL 89], has recently issued the Environmental Impact Statement for comment for a proposed 450 km pipeline to convey CSG from Moranbah to Gladstone to link up with the existing Eastern Australian gas pipeline network. The Central Queensland Gas Pipeline [PPL 121] has been designed for 450 mm diameter operating at 15.3 MPa which, with compression, would enable it to transport up to 100 PJ per year. Construction on the project is scheduled to commence in mid 2007 with first gas being supplied to Central Queensland 12 months later.

Work on planning for the proposed Queensland Hunter Gas Pipeline to supply predominantly CSG from Queensland to Newcastle and the Hunter Valley is well advanced. Hunter Gas Pipelines Pty Ltd, the company formed to develop the project has had its project declared as “critical infrastructure” by the New South Wales Government and approvals are being fast tracked. The route has been finalized and detailed survey work and discussions with local councils
and landholders in both Queensland and New South Wales are continuing. The relevant Environmental Reports and Management Plans are expected to be completed by the latter part of 2006.

The proposed 850 km, 508 mm pipeline will run from the Wallumbilla Gas Hub to Hexham via Moree, Narrabri, Gunnedah and Muswellbrook. A lateral from the Chinchilla Region to near Waggamba to tap into the productive Undulla Nose CSG area of the Walloon Coal Measures is planned. The route of the pipeline has taken cognizance of the potential of CSG production in the Southern Surat Basin in Northern New South Wales as well as the prospectivity of the Gunnedah Basin where both Eastern Star Gas and Carbon Minerals NL have CSG pilot operations. The proposed Queensland Hunter Pipeline will also cross the Central Ranges Pipeline from Dubbo to Tamworth at Breeza south of Gunnedah where there is a valve station facilitating a possible future interconnection.

Discussions with potential gas customers including an anchor demand are being finalized. The project is planned to be able to deliver gas to the Newcastle-Hunter Region by mid 2008. Planning studies have also been undertaken for the supply of CSG from the Clarence-Moreton Basin in northern New South Wales to the local region including gas supplies to Casino and Lismore as well as the coastal developments from Ballina north to the Gold Coast. Arrow Energy and its affiliate Bow Energy as well as Metgasco are the principal players in this area. Metgasco have established a certified gas reserve base in the Casino area. Arrow has also established the presence of a significant CSG resource in the Southern Queensland section of the Clarence-Moreton Basin and is moving to establishing a number of pilot operations. These are likely to lead to future pipeline developments supplying gas to the southern part of urban Brisbane as well as the Brisbane-Gold Coast Strip.

The CSG developments in some of the Queensland coastal basins such as the Nagoorin Graben, 60 km south of Gladstone, the Styx River Basin to the north of Rockhampton and the Burrum Syncline of the Maryborough Basin are all likely to connected into the Queensland gas pipeline network within the next decade. All of these CSG driven developments including the Queensland Hunter Pipeline development will add approximately 1250 km to the existing Eastern Australian gas pipeline grid. This is in addition to the considerable in-field gas and water collection systems that characterize CSG operations.

Figure 6 illustrates the current gas pipeline system in Queensland.

**PNG Gas Pipeline**

Over a decade ago Eastern Queensland had only an estimated 100 PJ of 2P gas reserves, all conventional gas. Development of the Ballera gas processing plant and the pipeline from Ballera to Wallumbilla was well advanced when it was first proposed that gas from the Pandora Gas Field in the Gulf of Papua be piped into Queensland to supplement the reserves in the Queensland section of the Cooper-Eromanga Basin. The early studies resulted in a shift in the gas supply from Pandora to the Southern Highlands of Papua New Guinea.

As the project has gone through its many iterations over the years, CSG has developed to the stage
where the current level of 2P reserves are the largest onshore gas reserves in Australia and are approaching the level of those allocated to the PNG Gas Project. By early 2010 when the PNG Gas Project was scheduled to deliver gas to Eastern Australian markets, the CSG 2P reserves are expected to exceed those backing the PNG Gas Project as well as comprising more than 50% of the total Eastern Australian Proved plus Probable [2P] reserves.

It appears that PNG gas cannot compete at the present time with CSG in both Eastern Queensland and Eastern Australian markets.

Conclusions

Coal Seam Gas has come of age in Eastern Australia and its production is now accepted by the market as another reliable source of natural gas. The certified Proved plus Probable CSG reserves in Eastern Queensland are the largest onshore gas reserves in Eastern Australia. They are in an early stage of commercial production with much more development work being planned and implemented which will significantly increase the level of 2P reserves. By early 2010 when the PNG Gas Project was scheduled to deliver gas to Eastern Australian markets, the 2P CSG reserves are expected to exceed those backing the PNG Gas Project as well as comprising more than 50% of the total Eastern Australian Proved plus Probable [2P] Reserves.

CSG has firmly established itself in the Eastern Australian gas market filling the market supply gap as a result of declining reserves and production capabilities from conventional sources such as Cooper-Eromanga Basin, Denison Trough and the Surat Basin. It has provided strong gas on gas competition to the proposed PNG Gas Project and the current slippage by the PNG Gas Project is likely see further inroads made by CSG into it becoming, within the next decade, the major source of natural gas to the Eastern Australian market.

The rise and continuing growth of CSG in Eastern Australia has, in recent years been a major driver of new investment in gas pipelines since year 2000. In the foreseeable future the growth in CSG production in both Queensland and New South Wales will continue to provide a significant demand for new gas transmission pipeline infrastructure as well as considerable infield gas and water gathering systems.
Figure 1: Eastern Queensland – Major gas fields, gas pipeline infrastructure and major centres
Figure 2: Growth in CSG Reserves (2P) in PJ's
Figure 3: Eastern Australia 2P Gas Reserves in PJ's
(as at 30 June 2006)

CONVENTIONAL

CSG

Gippsland - 6975 (44.9%)

Cooper / Eromanga - 2113 (13.6%)

Otway - 1635 (10.5%)

Bass - 572 (3.7%)

Adavale - 14 (0.1%)

Bowen / Surat - 281 (1.8%)

Bowen / Surat - 3842 (24.7%)

Sydney - 83 (0.5%)

Clarence / Moreton - 22 (0.1%)

Total 2P Reserves:

CSG: 3947 PJ - 25.4%
Conventional: 11590 PJ - 74.6%
Overall Total: 15537 PJ - 100.0%
Figure 4: Eastern Queensland 2P Reserves by Field in PJ's
(as at 30 June 2006)
Figure 5: Gas Supply Agreements
Figure 6: Queensland Gas Pipeline System