East Coast Gas Market Scenario and Implications for South Australia

An independent report prepared by EnergyQuest

1 July 2016

ENERGYQUEST

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Terms of Reference

The Australian Energy Council has appointed EnergyQuest to prepare an appendix to a report to be prepared by ACIL Allen to consider the challenges associated with integrating variable or intermittent renewable generation into South Australia's electricity system, given the relatively significant extent of renewable energy generation as a proportion of total energy generation in South Australia.

EnergyQuest develops and maintains Australian gas supply/demand analysis which is published on a quarterly basis as part of EnergyQuest's EnergyQuarterly report on the energy industry, and also used in varied consulting assignments.

Scope of Work

The Energy Council has requested that EnergyQuest prepare an appendix that documents an Australian East Coast gas supply/demand scenario consistent with that included in the EnergyQuest May 2016 EnergyQuarterly Report and a comparison of the EnergyQuest scenario to the work carried out by AEMO (the Australian Energy Market Operator) that is documented in the 2016 Gas Statement of Opportunities (GSOO) report. Furthermore, EnergyQuest has drawn out implications of its supply/demand scenario for South Australia.

Summary[1]

- EnergyQuest expects that the east coast domestic gas market will remain tight over the 2016-25 timeframe.
- Despite the expectation of falling domestic demand, in part because of increasing gas prices, the commencement of Queensland LNG production has already created a tight domestic market.
- The east coast domestic gas demand and supply outlook is subject to considerable uncertainty. However, under plausible assumptions, there is a scenario under which there is a growing domestic supply gap in the southern states over the next decade and possibly emerging much earlier than 2025.
- The fundamental issue is whether or not gas supply from the Cooper and Surat-Bowen basins is sufficient not only to meet Queensland demand (including for LNG) but also to supply the southern states. A scenario under which demand in the southern states is largely reliant on supply from Victoria, results in a shortfall of around 1,000 petajoules (PJ) in the period 2016 to 2025 for the southern states without taking account of any drawdown of gas in storage.
- It appears unlikely that Cooper Basin gas will supply southern demand to any material extent after 2016. There is a possibility that gas demand for LNG production will be less than forecast due to the low LNG price environment, which could reduce the supply/demand gap identified. However this is extremely uncertain and low oil and LNG prices are also likely to inhibit gas development.
- There are some material development projects that may reduce the shortfall. However the projects in southern Australia all carry particularly significant risks or challenges.
- AEMO's 2016 GSOO medium scenario does not identify a supply gap in the east coast gas market overall in the period to 2025, but AEMO's supply estimate includes all reserve classes, without consideration of risk or uncertainty, and production estimates based on Proved and Probable reserves that are considerably higher than EnergyQuest's production forecasts.
- The AEMO scenario also assumes significant gas flows from north to south. In the absence of material gas supplies from Queensland and the Cooper Basin, total demand in the southern states (as forecast by AEMO) exceeds Victorian supply in all years to 2025, with a cumulative gap of circa 700 PJ.

[1] In this Report, gas demand estimates are consistent with the AEMO medium scenario from the 2016 Gas Statement of Opportunities (GSOO). Southern demand means the demand in South Australia, Victoria, New South Wales, Tasmania and the ACT. Northern demand means the demand in Queensland, including that resulting from LNG projects in Queensland. Southern supply refers to the Gippsland, Otway and Bass basins plus 40 PJ of Cooper Basin gas in 2016 which is a Southern contractual obligation. Victorian supply refers to the Gippsland, Otway and Bass basins. East coast demand refers to the aggregate of southern and northern demand.

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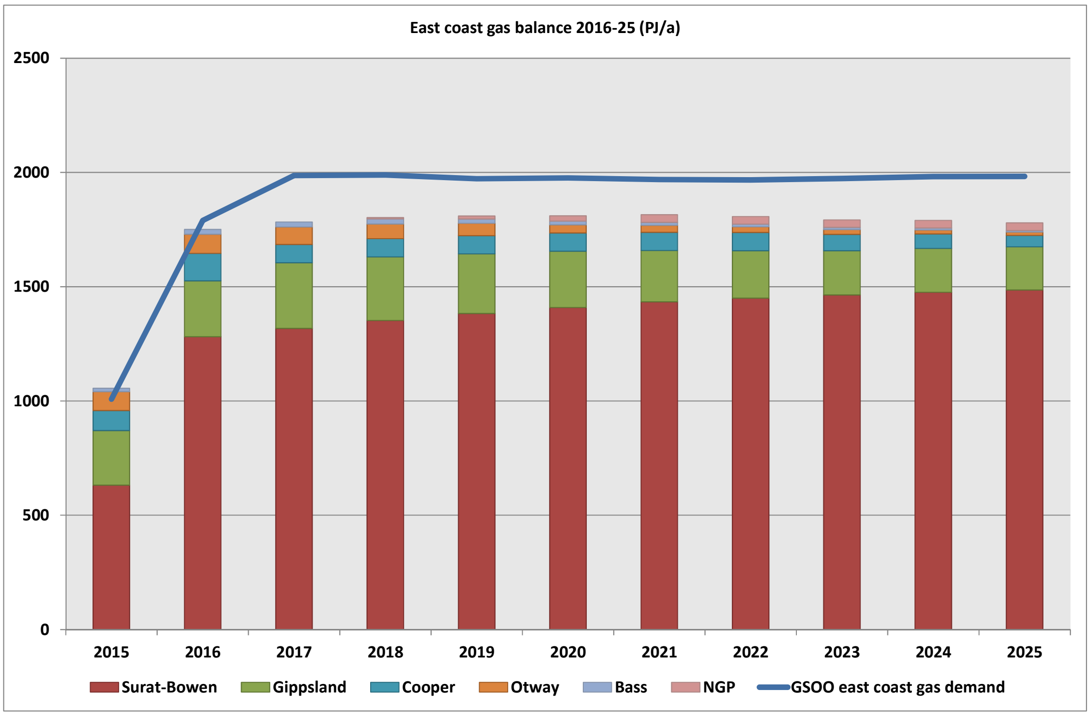
- Under the scenario considered in this report, without material supply of northern gas, South Australian baseload gas demand exceeds Otway Basin supply from 2020, even in a best assumed case whereby all Otway gas supplies South Australia. This does not necessarily preclude gas being available to back-up intermittent renewables but it would imply high gas prices and difficulty in contracting more generally.

Total east coast gas demand and supply

Figure 1 illustrates an east coast gas supply/demand scenario which was developed for the May 2016 EnergyQuest EnergyQuarterly report. EnergyQuest has an expectation that the east coast domestic gas market will remain tight over the 2016-25 timeframe, notwithstanding that it is subject to considerable uncertainty. Despite the expectation of falling domestic demand, the commencement of Queensland LNG production together with the fall in oil prices has already created a tight domestic market.

Figure 1 East coast gas balance



Source: AEMO and EnergyQuest; 2015 figures are actuals

The scenario in Figure 1 draws its demand assumptions from AEMO's medium scenario from the 2016 GSOO, which is described by AEMO as the most likely case.

Supply forecasts in the scenario illustrated are based on EnergyQuest's industry insights and technical analysis. Insights on operator plans and assumed likely activities reflect the recent oil price and general economic environment, that is, current Brent oil prices of less than or around US$50/bbl and severe cost cutting by the vast majority of oil and gas producers. Producers themselves emphasise the uncertainty surrounding supply forecasts,

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due both to uncertainties about future oil prices plus uncertainties about reservoir performance in many fields.

Supply assumptions are as follows -

- The Cooper Basin is assumed only to produce sufficient gas to meet existing contracts, including the Horizon contract with GLNG. This reflects the significant fall in Cooper Basin drilling activity. The implications of this are that no Cooper Basin gas is assumed to flow to Adelaide after 2016. The Cooper Basin may produce less than the amount assumed if, for example, Santos finds it is cheaper to supply gas from elsewhere. On the other hand, if the oil price recovers to around US$70-80/bbl for a sustained period and drilling costs are reduced, Cooper Basin development would become more viable.
- Gippsland Basin Joint Venture (GBJV) production is assumed to increase over the next four years (Kipper is expected to be commissioned in the second half of 2016), but then goes into a steep decline, from a peak of 289 PJ in 2017 to 164 PJ in 2025. Production from the CO_2 prone fields will be limited by the capacity of the CO_2 removal plant while the legacy fields that do not require CO_2 removal (Marlin, Barracouta and Snapper) are assumed to decline at 20% pa.
- Surat-Bowen production estimates are premised on the assumption that the three operational LNG projects continue development drilling at the rate of at least 800 wells per year (as advised by the operators) or 200 wells per quarter, which includes QGC's Charlie project. Currently Origin and QCLNG are meeting or exceeding their guidance, but Santos is drilling at about half the guidance rate. We assume initial rates for new wells of 0.9 terajoules per day (TJ/d) for QCLNG and APLNG wells, 1.2 TJ/d for Fairview and 0.5 TJ/d for Roma, typically with well decline factors of 15% and 90% uptime. (Note - Notwithstanding that circa 6,100 wells have received environmental approval for GLNG alone, the CSG production profiles have been developed on the basis of operator plans, as opposed to environmental approvals,)
- In addition, we assume a contribution from Senex's Western Surat development of up to 18 PJ pa (PJ/a), with first gas production assumed as 2018.
- Assumed gas flows from the Northern Territory to Queensland via the Northern Gas Pipeline (NGP), reflect the publically announced initial pipeline capacity of 90 TJ/d and a view that early flows will increase only gradually (due to the impact of the oil price downturn and NT fracking moratorium fears). We assume the pipeline to be in operation by 2018 as per current plans and fully contracted at the initial capacity from 2021.
- Production from the Sole Gas Project is assumed to commence in 2019 and to produce 25 PJ/a, reflecting plans by proponent Cooper Energy.
- Otway-Bass forecast production over the next decade reflects the disappointing results from recent Yolla wells and recent performance of the Casino wells. It includes production from the Halladale and Speculant fields commencing in 2016, and with a relatively short field lives of 6-8 years. Otway-Bass production is projected to fall dramatically by 2025 unless there is further field development.

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Based on this overall scenario, as illustrated in Figure 1, a supply gap is indicated for the east coast of Australia as a whole.

Key uncertainties and risks to the supply forecast

Few upsides

Whilst there are some realistic upside projects that could feasibly be included in our “plausible” scenario (for example, further exploitation of Arrow’s acreage and Ironbark in Queensland) these are in the north and both are currently being primarily talked about predominantly in the context of LNG. If these projects were included in our forecast, a significant southern supply deficit would remain unless there was sufficient economic incentive for gas to flow south in the short to medium term.

Arrow has shelved further development of its Queensland Bowen and Surat Basin acreage, (which has nearly 9,000 PJ of 2P reserves booked), whilst undertaking further studies to try to improve the economics. Since the Shell takeover of BG (the owner of Arrow), most public comments have suggested eventual supply to LNG or, (less so), local Queensland domestic markets.

No firm plans yet exist in relation to Origin’s Queensland Ironbark field (circa 18 PJ/a), but it is understood that the development is likely to require at least a $7-8 per gigajoule (GJ) gas price.

There are some potential incremental supply projects in the south (for example Leigh Creek Energy Project, Real Energy’s acreage, Strike’s acreage, Basker Manta gas) but these are all at a less advanced stage or still have many challenges or risks to overcome if they are to impact upon the near to mid-term. Santos’ Narrabri project is still moving ahead but it remains to be seen whether it will result in material production as a result of community concerns regarding “fracking”. With the fall in spending and the actual or threatened moratoria on onshore drilling and/or “fracking”, there are few other opportunities, with the possible exception of upside associated with the GBJV. The GBJV’s stated position is that it is hard to be specific about the remaining lives of its legacy fields since they are water drive reservoirs, which tend to exhibit sudden, unpredictable production declines, and the newer Kipper and Turrum fields are only just coming into production.

The scenario does not take account of gas in storage, for which there is over 100 PJ on the east coast, or slower than previously anticipated ramp-up of GLNG Train 2, and these could alleviate any immediate problems but the longer term issue remains. Furthermore, it will be necessary for some gas to remain in storage, since this plays a fundamental role in the market in balancing out peaks and troughs in demand.

Significant risk and uncertainty

- The assumptions about CSG drilling rates, peak production per well and recovery per well are critical for projecting CSG production. Unfortunately there is only limited information available in the public domain on peak production and recovery per well. (Indeed, given the absence of long-term production history, the operators themselves are uncertain about appropriate long-term assumptions.) A forecast of 1,450 PJ of production pa based on drilling 800 wells pa assumes average recovery of 1.8 PJ per well across the Surat Basin. We know some fields are doing better than this, even up to 3.5 PJ per well, but others are doing worse, more like 1.0 PJ per well. Also, average recoveries from new wells are likely to decline over time.

- We know that there is likely to be some upside to our assumptions for existing production in some areas. For example, APLNG upstream production is expected to exceed contracted demand. Well production levels are being constrained to match demand. Current field performance is expected to result in production (expected to exceed 2,000 TJ/d) exceeding contract commitments by 100-200 TJ/d, allowing APLNG to defer, sustain capex or monetise surplus production through LNG or domestic gas. As for all the LNG producers, APLNG will have the scope to optimise between production, domestic gas supply and LNG production.
- Nevertheless, there remains an unquantifiable uncertainty range associated with CSG production rates. Illustrating this, in its Report to the COAG Energy Council on Coal Seam, Shale and Tight Gas in Australia, November 2015, Geoscience Australia said, "There is a risk of shortfall in the rate of gas supply due to production capacity that is dependent on actual well production rates. The data required to estimate the magnitude of the risk is not currently available to Geoscience Australia." The difficulty is exacerbated by the fact that some early CSG drilling has tended to focus more on more predictable areas of production, so the uncertainty may persist for some time.
- There can be greater certainty about the fact even if 800 wells pa is adequate to satisfy LNG demand and Queensland domestic contracts, it is not likely to be sufficient to also meet the growing gap between demand and supply in the south (which is discussed further below).
- Whilst production from Sole has been included in the supply scenario as FEED on the project is well advanced and Cooper Energy has conditional gas contracts in place, Cooper does not operate the field and Santos, the operator, has had to drastically reduce its spending, so the project may be at risk.

Demand forecast – key uncertainties

Whilst the emphasis of this report is on gas supply, it is also prudent to consider the key uncertainties associated with the demand forecast over and above the expected uncertainties associated with domestic demand, since these will clearly impact on supply adequacy in South Australia.

- Whilst initial indications are that gas demand for the Queensland LNG projects is likely to be in line with the GSOO medium scenario, it is still possible that under a "lower for longer" oil price scenario particularly, some of the LNG producers reduce their offtake as their margins are destroyed. This risk is likely to increase if LNG customers attempt to renegotiate pricing, or the LNG glut worsens. In this case, it is feasible that Queensland gas again flows south, reducing the southern supply/demand gap. However low oil and LNG prices also reduce the cash flow available for ongoing development.
- Moreover, it is already apparent that some GBJV gas and possibly Otway gas is being sold for LNG production in Queensland, which is not reflected in our analysis. This can only exacerbate the southern supply/demand gap.

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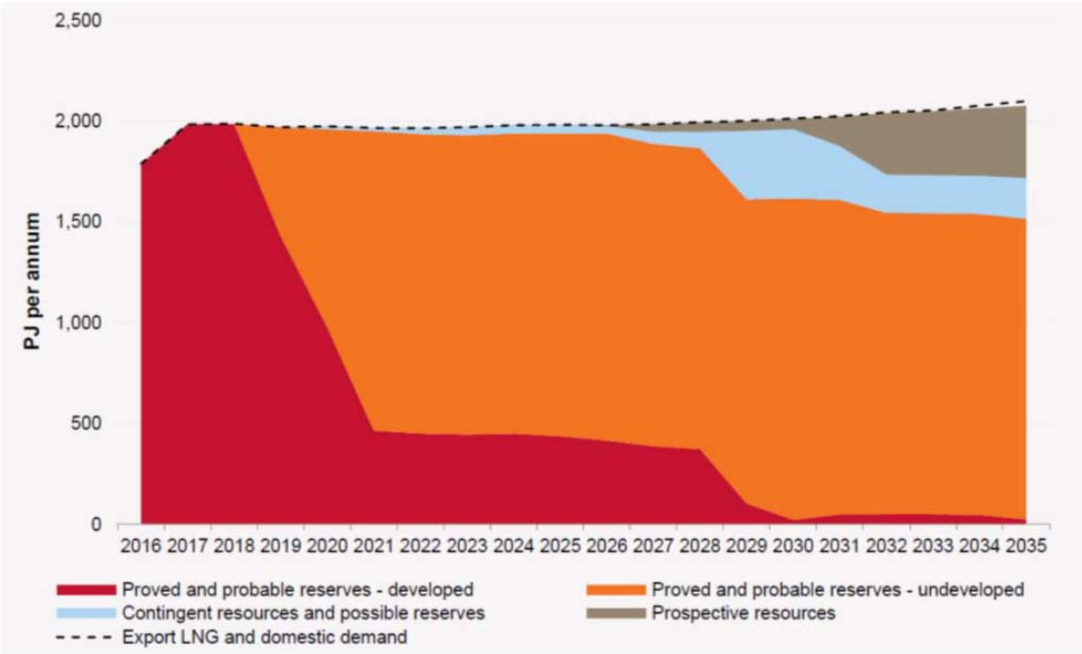
AEMO's GSOO Report

AEMO's 2016 GSOO reports on the adequacy of east coast gas markets to supply maximum gas demand and annual consumption. The demand forecasts were adopted from the 2015 National Gas Forecasting Report (NGFR), issued by AEMO last November, with minor updates. The GSOO report considers the period to 2035.

The 2016 GSOO report projects (Figure 2) for the east coast that under AEMO's medium scenario, 2P developed gas reserves and existing infrastructure will be sufficient to ensure market adequacy until 2019, but that market adequacy will require production from 2P Undeveloped Reserves from 2019, Possible Reserves or Contingent Resources from 2020, Prospective Reserves from 2026 and new infrastructure will be required by 2029. The report correctly identifies the need for development now to meet demand beyond 2019, and notes that there are risks attached to this development, which it addresses in part via a sensitivity case based on reduced - investment. (Note that the GSOO includes sensitivity scenarios and analysis relating to both supply and demand – our focus here is on AEMO's medium scenario.)

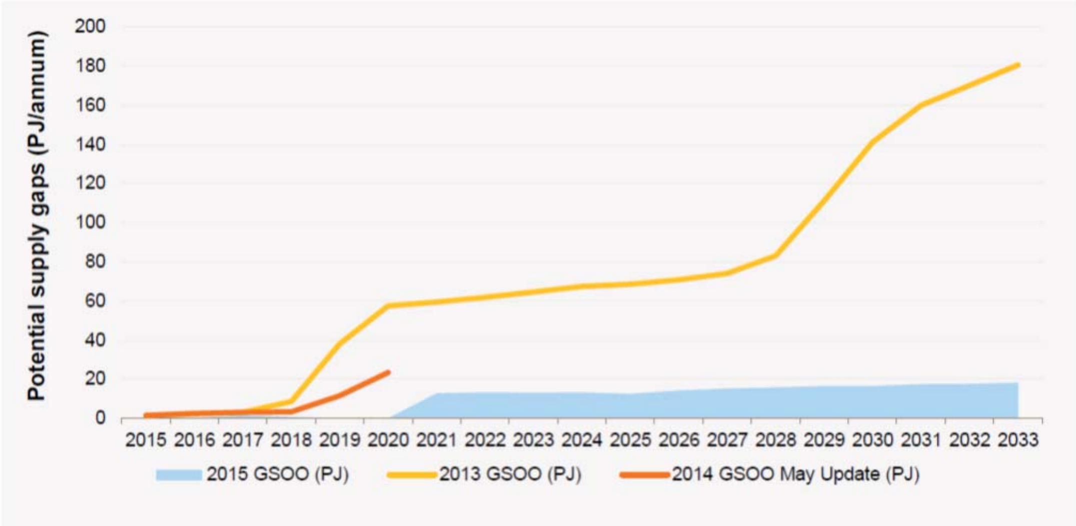
Figure 2 2016 to 2035 GSOO supply and demand utilising all reserve and resource classes



Source: AEMO

The GSOO places significant emphasis on whether or not infrastructure is adequate, as compared to reserves or deliverability risks. The report notes that in the event that identified pipeline and processing facility constraints are not remedied as required, shortfalls totalling 50 PJ across the period 2029 to 2035 are forecast in Queensland. This is a significant reduction of 164 PJ to the overall supply shortfall (to 2034) that was predicted in the 2015 GSOO, which also showed a significant change as compared to the two previous GSOOs – the shortfall (as defined by AEMO in terms of infrastructure) has **been reducing each year** as illustrated by Figure 3. The 164 PJ reduction in shortfall compared to the 2015 GSOO is also not ascribed to changes in reserves or available production, but rather to increases in infrastructure capacity.

Figure 3 Comparison of previous GSOO supply gaps



Source: AEMO

Due to the approach taken by AEMO in terms of developing the supply forecast, it is likely that the medium scenario in the GSOO report presents an overly optimistic view of the likelihood of supply adequacy. Mathematically, it is too optimistic to sum 2P Reserves, Possible Reserves, Contingent Resources and Prospective Reserves and then compare the aggregate to a demand forecast in a scenario described as "medium". The reserve/resource categories carry different risks and cannot logically be summed. AEMO take account of demand-side risk with consideration of different probabilities of peak demand but on the supply side, although it is clear that there has been a successful attempt to bring increased operational realism into the modelling in the 2016 GSOO, all gas molecules are treated as equally certain, whether they are Proved (90% chance of minimum recovery), Proved and Probable (50% chance), Possible (10% chance) or Contingent Resources (not yet demonstrated to be technically or economically producible). Possible reserves and Contingent Resources may or may not smoothly transition to Proved and Probable or Proved reserves.

Other differences between AEMO and EnergyQuest approaches

There are other significant differences, which we have drawn out by comparing our figures to AEMO's 2P (only) numbers.

Our aggregate supply forecast for the east coast is 1,432 PJ less than the sum of AEMO's 2P field forecasts (which we extracted from their medium case) over the period 2016 to 2025.

The main reason for this is that our Surat-Bowen forecast is 1,089 PJ lower (including 328 PJ for Arrow's acreage and 210 PJ for Ironbark, which we currently exclude). We assume 195 PJ flow through the NGP which AEMO does not, since this pipeline has been approved since AEMO prepared its supply forecast. We assume 231 PJ less for the Cooper Basin. AEMO is effectively assuming a higher level of gas development in the north, which then flows south to meet southern demand. If this does not occur, there is still a southern shortfall.

In our Victorian supply projection we assume 60 PJ less for the Gippsland Basin than AEMO and 203 PJ less for the Otway Basin, a much smaller difference of 263 PJ.

Timing will have introduced some optimism into AEMO's forecasts, since the reserves that were assumed back in 2015 would not have reflected the full impact of the recent and current price environment. Our forecast results in an east coast shortfall of 1,657 PJ in the period 2016 to 2025, an AEMO "2P only" case (if it existed) would result in a shortfall of less than 225 PJ in the same period, as compared to no shortfall over the 2016-2025 period in the total AEMO mid-case, which includes all reserve classes.

Implications for the southern states and for South Australia

Figure 4 illustrates that, under the "plausible" supply scenario developed by EnergyQuest, by 2025, Victorian production is about equal to Victorian demand alone (that is, without allowing for any material supply to the other southern states, or for that matter, the north). In all years, demand in the southern states exceeds Victorian supply, mainly due to the decline of some Victorian fields. This will be exacerbated by any flows north to Queensland, such as are currently occurring.

This scenario, under which demand in the southern states is largely reliant on supply from Victoria, results in a shortfall of over 1,000 PJ in the period 2016 to 2025 for the southern states without taking account of any drawdown of gas in storage.

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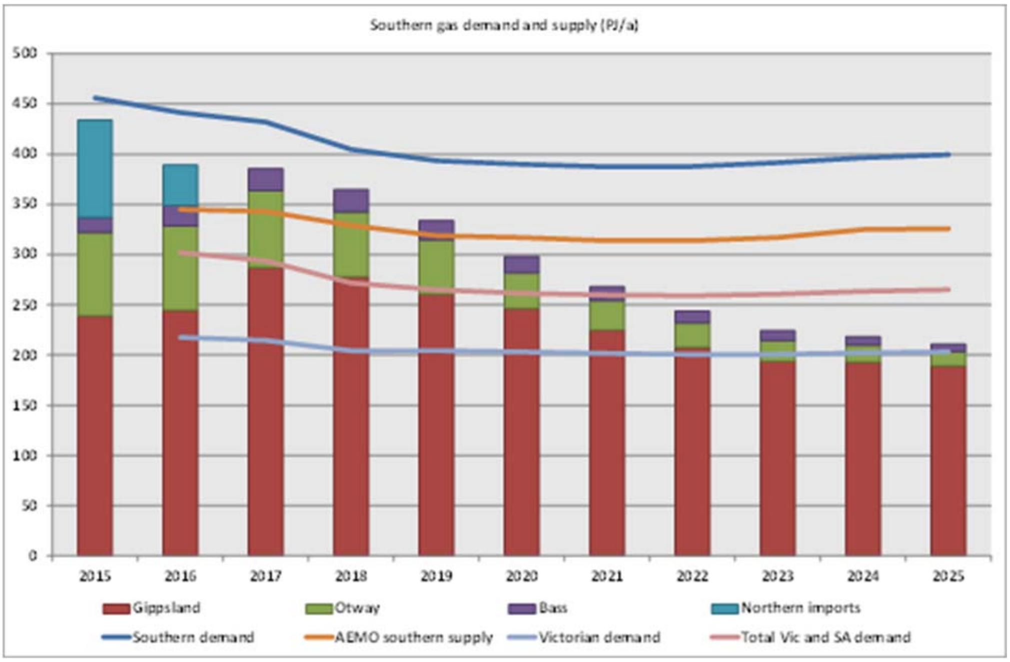
Figure 4 Southern gas demand and supply (PJ/a)



Source: AEMO, EnergyQuest;2015 numbers are actual; Note that AEMO southern supply numbers are adjusted to exclude Camden

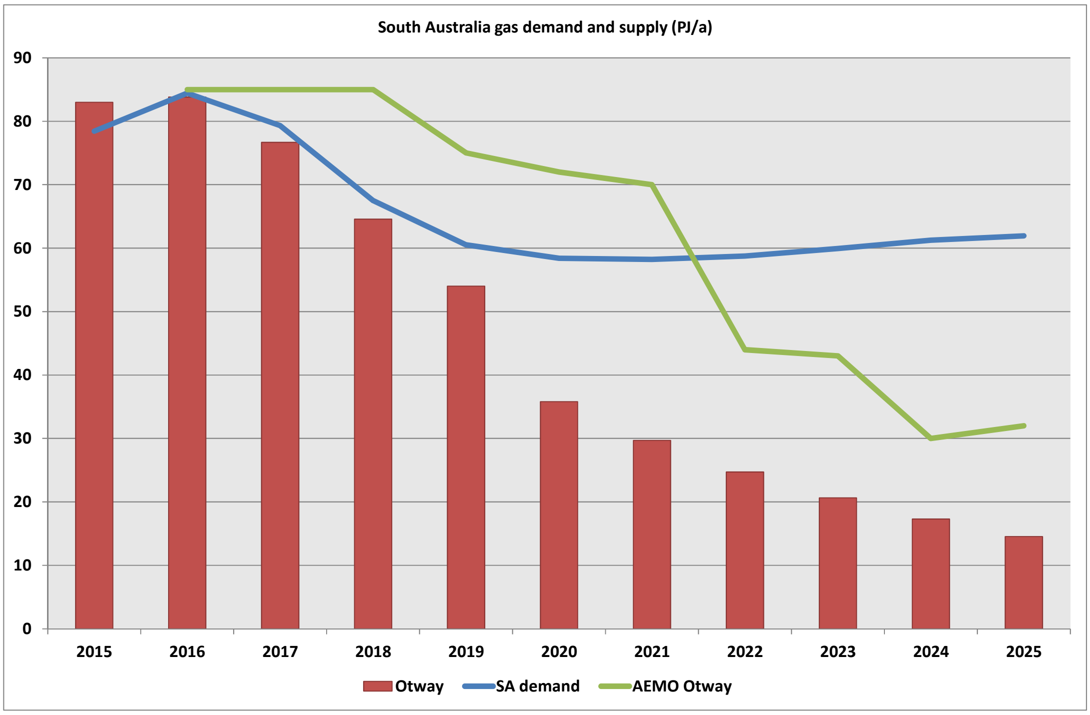
AEMO forecasts total southern demand to 2025 of 4,026 PJ, which is higher than current Victorian 2P reserves, some of which are likely to be produced well after 2025, of 3,667 PJ.

AEMO is assuming northern production (Cooper Basin plus Queensland) is higher than northern demand, allowing gas to flow south to meet the southern deficit. AEMO is also implicitly assuming development of 3P and 2C enabling more gas to flow south.

Meeting overall southern demand as forecast would require substantial new southern development over and above Sole, or imports from Queensland. As noted above, all of the potential material new southern developments are at less advanced stages or have many challenges or risks to overcome and meeting the shortfall with Queensland gas would require more drilling and development in Queensland than are currently planned.

Considering South Australia in isolation, with the cessation of contractual flows from Cooper Basin Gas in 2016, it is anticipated that in the near to mid- term, South Australia will be supplied largely with gas from the Otway Basin, given the location of the production from the Otway in the west of Victoria. Figure 5 illustrates that under the "plausible" scenario, from 2019, assuming reliance on Otway gas, the South Australian market is short, even assuming the best case that all Otway gas flows to South Australia. In the AEMO medium scenario, the South Australian market is short from 2022, again if the assumption is made of all Otway gas flowing to South Australia.

Figure 5 SA gas demand and supply (PJ/a)



Source: AEMO, EnergyQuest: 2015 numbers are Actuals

Conclusions

- The east coast domestic gas demand and supply outlook is subject to considerable uncertainty and is anticipated by EnergyQuest to become increasingly tight, in spite of an expectation of falling domestic demand
- Under plausible assumptions, there is a scenario which suggests there is a growing domestic supply gap in the southern states over the next decade and possibly emerging much earlier than 2025.
- This supply gap could be mitigated by material flows from the north (Cooper Basin, Queensland CSG), however beyond 2016, current northern development plans are unlikely to result in sufficient flows of gas to the southern market, once northern demand is satisfied.
- There is a possibility that gas demand for Queensland LNG production will be less than forecast due to the low oil price environment, which could reduce the southern supply/demand gap identified, however this is extremely uncertain.
- If South Australia is in future largely supplied by gas from the Victorian Otway Basin, under a plausible supply scenario, a shortfall may exist in South Australia from anytime between 2019 (EnergyQuest scenario) and 2022 (AEMO medium scenario) in the event that insufficient northern gas is developed.

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Resources Classification

In Australia resources are classified and reported according to the Petroleum Resource Management System (PRMS). The PRMS has been developed primarily by the Society of Petroleum Engineers (SPE) in association with a number other geoscientific societies.

At a very high level, the PRMS categorises resources as follows:-

Reserves

Are those volumes of hydrocarbons that have been discovered and not yet produced. Reserves are produced from existing facilities (Developed) or from facilities that have a reasonable expectation of being constructed (Undeveloped). Reserves are commercially producible at current or anticipated market conditions.

This report addresses 2P Reserves estimates which PRMS defines as having an equal chance of being greater or less than the stated number.

Contingent Resources

Are also hydrocarbons that have been discovered and for which technical productivity has been has been established. Contingent Resources are unable to be commercially developed for one or more technical, commercial, environmental or political reasons.

Within the Cooper Basin the governing factors are technical (well flow rates) and commercial (development costs, product prices). There is absolutely no certainty that all or part of Contingent Resources will eventually be converted to Reserves.

This report only addresses Contingent Resources in the context of unconventional gas.

Prospective Resources

Prospective Resources are those quantities of petroleum which are estimated to be potentially recoverable from undiscovered accumulations.

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Abbreviations

1P	proved reserves
2P	proved and probable reserves
3P	proved, probable and possible reserves
2C	best estimate contingent resources
3C	high estimate contingent resources
ACCC	Australian Competition and Consumer Commission
AEMO	Australian Energy Market Operator
APLNG	Australia Pacific LNG
APPEA	Australian Petroleum Production and Exploration Association
bbl	barrel (159 litres or 35 imperial gallons)
bbl/d	barrels per day
Bscf	billion cubic feet (10^9 or a thousand million)
Bcf/d	billion cubic feet per day
Bcm	billion cubic metres
boe	barrels of oil-equivalent
bopd	barrels of oil per day
BREE	Bureau of Resources and Energy Economics
Btu	British thermal unit (1.055 kilojoules)
CCGT	combined cycle gas turbine
cf/d	cubic feet per day
CIF	cost, insurance and freight
CNOOC	China National Offshore Oil Corporation
CO_2	carbon dioxide
CSG	coal seam gas
DES	delivered ex-ship
DNRM	Queensland Department of Natural Resources and Mines
DRET	Department of Resources, Energy and Tourism
DST	drill stem test
EIA	Energy Information Administration
EIS	environmental impact statement
EPC	engineering, procurement and construction
FEED	front-end engineering and design
FID	final investment decision
FLLNG	Fisherman's Landing LNG
FLNG	floating liquefied natural gas
FOB	free on board
FPSO	floating production storage and offtake
GJ	gigajoule (1 billion joules or 10^9)
GL	gigalitre (1 billion litres or 10^9)
GLNG	Gladstone LNG
GSA	Gas sales agreement
GW	gigawatt
GWh	gigawatt hour
Ha	hectare

HOA	heads of agreement
Hp	horsepower
IEA	International Energy Agency
IMOWA	Independent Market Operator of Western Australia
JCC	Japanese crude cocktail
JPDA	Joint Petroleum Development Area (Timor Sea)
JV	joint venture
Kboe	thousand barrels of oil-equivalent
KJ	kilojoule (one thousand joules)
km	kilometre
kt	thousand tonnes
KTA	key terms agreement
LNG	liquefied natural gas
LPG	liquefied petroleum gas (propane and butane)
kbbl	thousand barrels
kbbl/d	thousand barrels per day
Mcf	thousand cubic feet
Mcf/d	thousand cubic feet per day
Md	millidarcy
MJ	million (10^6) joules
ML	million litres (6290 barrels or 796 tonnes)
mm	millimetre
MMbbl	million barrels
MMbbl/d	million barrels per day
MMboe	million barrels of oil-equivalent
MMboe/d	million barrels of oil-equivalent per day
MMBtu	million British thermal units
MMBtu/d	million British thermal units per day
MMscf	million cubic feet
MMscf/d	million cubic feet per day
MMcm	million cubic metres (35.31 million cubic feet)
MMscf/d	million standard cubic feet per day
MOU	memorandum of understanding
MPa	megapascal
Mt	million tonnes
Mtpa	million tonnes a year
MW	megawatt
MWh	megawatt hour
NEM	National Electricity Market
NGL	natural gas liquids (condensate and LPG)
NWS	North West Shelf
OCGT	open cycle gas turbine
OGIP	Original gas in-place
OIES	Oxford Institute of Energy Studies
OPEC	Organization of the Petroleum Exporting Countries
OSMR	optimised single mixed refrigerant
Pa	pascal

PJ	petajoule (one thousand terajoules)
PJ/a	petajoules a year
Psi	per square inch
QCLNG	Queensland Curtis LNG
QGC	Subsidiary of BG Group
qoq	quarter on quarter
SAP	system average price
SWQP	South West Queensland Pipeline
T	metric tonne
Tcf	trillion cubic feet (10^{12} or one thousand billion)
therm	100,000 Btu
TJ	terajoule (one thousand gigajoules)
TJ/d	terajoules per day
WHP	well head pressure
WTI	West Texas Intermediate
yoy	year on year

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Conversion factors

EnergyQuest converts the measures used by different companies to a consistent basis. In line with Australian industry conventions, we use joules for domestic gas, barrels for oil and condensate and tonnes for LPG and LNG. Where available we use individual company conversion ratios. Otherwise we use:

crude oil 1 barrel (bbl) = 1 barrel oil-equivalent (boe)

sales gas 1 petajoule (PJ) = 171,937 boe

sales gas 1 billion cubic feet (Bcf) = 1.06 PJ

LPG 1 tonne (t) = 8.458 boe

LNG 1 million tonnes (Mt) = 55.43 PJ

LNG 1 million tonnes (Mt) = 9531 Kboe

condensate 1 barrel = 0.935 boe

ethane 1000 tonnes = 0.05181 PJ

ethane 1 PJ = 15.1 MMcm

oil/condensate 1000 barrels = 158.97 kilolitres

LPG 1000 tonnes = 1.88 ML

sales gas 1 petajoule (PJ) = 26.71 MMcm

British thermal units 1 million (MMBtu) = 1.055 GJ = 1Mcf = 10 therms

British thermal units 1 billion Btu = 1.055 TJ = 1 MMcf

British thermal units 1 trillion Btu = 1.055 PJ = 1 Bcf

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a. we make no warranties in respect of any Consultancy except as required by law;

b. we accept no responsibility for misprints, errors, inaccuracies or omissions;

c. except as explicitly agreed with you under the Consultancy, materials that we publish from time to time do not constitute advice and should not be relied upon as such; and

d. you should not act, or refrain from acting, on the basis of any materials that we publish without seeking appropriate advice on the particular facts and circumstances at issue.

2. To the extent that any Consultancy includes forecasts:

a. you acknowledge that our prediction of future outcomes is based upon our current understanding of relevant circumstances and that such forecasts may prove to be incorrect; and

b. we will not be liable for any claim arising directly or indirectly in relation to any such forecast if it was prepared in good faith and using due care and skill.

3., You acknowledge that the Consultancy necessarily requires us to rely upon data and information supplied to us by third parties (Third Party Material). Provided that it is reasonable for us to assume that Third Party Material comes from a reliable source, you agree that:

a. unless explicitly obliged to do so by the terms of the Consultancy, we are not obliged to independently investigate or verify any Third Party Material;

b. we do not warrant the accuracy of Third Party Material; and

c. we will not be liable to you (or others) for any loss arising directly or indirectly by virtue of Third Party Material being inaccurate or incomplete.

4. You agree that we will not be liable for any incidental, special or consequential damages of any kind (including without limitation damages for loss of business or other profits) arising from the Consultancy.

5. You acknowledge that:

a. we retain exclusive ownership of all intellectual property rights (including copyright) in all materials (including reports, text, graphics, images, data etc) associated with the work that we perform for you under the Consultancy (EnergyQuest's IP);

b. you can use EnergyQuest's IP for your own purposes, but you do not acquire any ownership rights in any of EnergyQuest's IP;

c. EnergyQuest's IP is valuable and confidential;

d. EnergyQuest's IP must only be used by you and authorised persons for the purposes for which it was provided and it is your responsibility to ensure that your employees, affiliates and consultants:

i. are aware of; and

ii. comply with,

the restrictions imposed on you under these Terms in respect of EnergyQuest's IP;

e. if you subscribe to EnergyQuarterly as a Single User (limited use), then:

i. you must nominate the employees within your organisation who are authorised to use EnergyQuest's IP; and

ii. only those authorised employees may use EnergyQuest's IP (refer to paragraph d. above);

f. if you subscribe to EnergyQuarterly as a Corporate User, then all of your employees are authorised to use EnergyQuest's IP (but subject always to paragraph g.);

g. except as appropriate and reasonably required in the ordinary course of your business (and subject always to clause 7), you and your authorised employees must not without our prior written consent publish, transmit, distribute, on-sell, reproduce, cite, quote from or otherwise disclose EnergyQuest's IP (in whole, in part or in writing, by electronic means or in any other format) to any third party, which expression includes any of your unauthorised employees, affiliates, consultants, clients, customers, any other person, any other company (whether related or unrelated), and (if you are a government client) any other government department or authority; and

h. we can refuse such consent in our absolute discretion, but it would be reasonable for us to charge additional fees before agreeing to give any such written consent; and

i. EnergyQuest may suffer financial loss if you or any of your employees, affiliates or consultants breach these Terms.

6. If any third party suffers any losses as a direct or indirect result of that third party relying on EnergyQuest's IP in a manner which is inconsistent with your acknowledgements above, you agree that:

a. we will not be liable in any way for such losses (either to you or to any third party); and

b. you will indemnify us for any claim made by that third party against us in connection with the unauthorised use of EnergyQuest's IP.

7. Subject to our prior written consent, any use of EnergyQuest's IP by you or your related entities (by way of reference, citation, quotation or in any other way or in any form) must be clearly and directly attributed to us in an accurate manner and in the context in which it is intended. We accept no responsibility for any cost, expense or liability incurred by you or any other person as an indirect or direct consequence of any such use of EnergyQuest's IP in a manner which is inconsistent with the purposes of the Consultancy. You hereby release us, to the fullest extent permitted by law, in respect of any such claims, losses or expenses.

8. We observe the National Privacy Principles in the Privacy Act 1988. In dealing with you, we may collect certain information such as your name, contact details, personal and business information. Information collected about you is used only:

a. for the purpose of the Consultancy; and

b. in a manner which you would reasonably expect us to use or disclose it for that purpose.

9. If you do not accept these Terms or if you breach these Terms, we can terminate the Consultancy.

10. These Terms:

a. may be amended by us at any time by posting amended terms and conditions on our website, but otherwise cannot be varied without our written consent; and

b. are governed by and construed in accordance with the laws of South Australia, Australia. You irrevocably and unconditionally submit to the non-exclusive jurisdiction of the courts of South Australia.

11. If you breach any of these Terms:

a. we reserve the right to suspend or terminate the Consultancy;

b. we reserve the right to suspend or terminate your subscription to EnergyQuarterly;

c. we may take action against you in respect of any loss or damage that we suffer because of your breach; and

d. those restrictions imposed on you by these Terms (including those relating to EnergyQuest's IP) will continue to apply, even after the termination of the Consultancy.

12. For the purposes of these Terms:

a. “you” and “your” refers to:

in the case of a subscription to EnergyQuarterly for a limited-user licence, the subscriber and/or the holder(s) of that limited-user licence;

in the case of a corporate subscription to EnergyQuarterly, the subscriber and each of those of the subscriber's authorised employees to whom EnergyQuarterly is distributed; and

in all other cases the person who has engaged EnergyQuest,

b. “us”, “we” and “our” refers to EnergyQuest Pty Ltd.

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