NSW Infrastructure Capability Assessment

Energy Baseline Report

April 2012

Report Outline

- **Key Highlights**
- Introduction
- Energy Industry Overview and Current Situation
- Electricity
- Gas

Key Highlights – Electricity

- The majority of electricity generation and all transmission and distribution infrastructure assets in NSW are government owned
- The NSW government recently privatised the retail electricity sector and announced plans to sell electricity generation assets
- 82% (or 16,600MW) of electricity in NSW is generated by 4 key state owned corporations . Electricity is transmitted over a 12,000km transmission system and distributed over ~250,000km distribution system. The book value of this infrastructure is $34bn and the annual capital expenditure is around $4.5bn
- Electricity infrastructure is planned through a number of national and operator network plans including the Electricity Statement of Opportunities, the National Transmission Network Development Plan, TransGrid's Annual Transmission Network Development Plan, the distributors Annual Network Development Plans and Performance Reports, and the 5-year Regulatory Proposals and Determinations by the Australian Energy Regulator
- These reports provide evidence that, while a number of the state owned electricity distribution assets are beyond or approaching their standard design lives, electricity infrastructure appears to be in good condition and is capable of meeting demand
- The performance of electricity generation, transmission and distribution infrastructure is monitored via a number of indicators. The NSW Government sets reliability and security standards through its Network licences. Key electricity operating licence performance indicators such as the average duration and frequency of interruptions have been improving over time
- Electricity demand has been flat for the past 5 years partly due to slower economic growth, efficiency and in response to large price increases. Peak demand is forecast to grow by 1.6% pa, driven by life-style choices (eg air-conditioning) and weather (colder winter/warmer summer). Peak demand growth drives investment in infrastructure
- A number of transmission projects in NSW are needed to increase interstate transmission capacity to allow wholesale trading across the national market to share spare capacity
- The introduction of a carbon price to the Australian economy is changing the electricity generation mix i.e. favouring wind energy and other renewable energy technologies which need gas powered generators to provide load balancing capacity. This could potentially increase prices and make investment in low cost base-load electricity less attractive.

Key Highlights – Gas

- All gas infrastructure in NSW is privately owned. Private sector is responsible for planning, managing and maintaining the asset
- There are no significant conventional gas reserves in NSW – only a small volume of natural gas is sourced from deposits at Camden. While known coal seam gas (CSG) reserves are increasing as exploration continues at Narrabri and in the Gloucester and Gunnedah Basins
- NSW has a 26,000 km gas piping network, which accounts for 23% of gas transmission and distribution networks in Australia
- There have been significant developments in the Australian gas industry over the last few years including additional pipeline infrastructure, new gas supply sources, the introduction of full retail contestability, as well as the introduction of AEMC and AEMO for coordinating infrastructure planning and the economic regulation of transmission and distribution assets by AER according to National Gas Law and Rules
- Gas transmission and distribution networks appear to be in good condition. The overall number of defects and network leaks in transmission and distribution networks have declined
- Gas distribution network reliability is relatively stable, however transmission network performance may require improvement
- Gas demand will be driven by population growth, an upsurge in gas fired power stations, and environmental requirements for new housing developments (BASIX)
- Although projected gas reserves appear sufficient to meet domestic and export demand, the security of the gas supply is a contentious issue with gas supply for domestic consumption likely to be impacted by export prices
- Due to the lack of conventional natural reserves within NSW, it is likely that gas will need to be extracted from non-conventional reserves in the future which will impact the way existing infrastructure is used
- The environmental impact of coal seam gas extraction remains unclear. With the pending CSG Inquiry to be released by the NSW Parliament in May 2012, the development of the sector is still uncertain

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Infrastructure NSW is conducting a Capability Assessment of the State's economic infrastructure to inform the development of the 20 year NSW State Infrastructure Strategy

Purpose of Capability Assessment

This project will provide a baseline for input into the NSW 20 year Infrastructure Strategy and will seek to answer the following questions

- How is infrastructure planned and managed?
- What is the condition of the asset?
- What is the current capacity and ability to meet demand?
- How is the infrastructure performing?
- Where are the critical interfaces and bottlenecks?

Scope

The scope of the Infrastructure Baseline spans regional and urban economic infrastructure owned/ managed by the NSW government across the following sectors including:

- Transport (roads, rail, seaports (excluding airports), freight and intermodal, and infrastructure supporting public transport)
- Water (potable water, waste water, storm water and irrigation)
- Energy (gas and electricity)

The Infrastructure Capability Assessment will create an understanding of the condition, capacity, coverage and overall performance of existing infrastructure in NSW

Coverage

- What is the extent of the infrastructure sector?
- How large / small is the network?

Planning

- How is the infrastructure sector planned and managed?
- Who is responsible for planning?

Condition

- What is the physical quality of the infrastructure?

Capacity

- Is current infrastructure capable of meeting expected demand?
- Are there any capacity constraints in the short, medium or long term?

Performance

- Is the infrastructure performing?
- How is performance measured?

Key Issues

- Where are the critical interfaces and bottlenecks?
- What are some of the key infrastructure issues and risks facing the sector?

This document provides a high level overview of the energy sector based on desktop research and discussions with key stakeholders

Purpose and Structure of This Document

- Provides an overview of the energy sector in NSW
- Each segment (gas and electricity) is then explored in more detail in terms of:
  - Coverage
  - Planning
  - Condition
  - Capacity
  - Performance
  - Key Issues
- This document will guide discussions with key stakeholders to validate key findings, gather additional information and develop a more detailed understanding of the capability and capacity of energy infrastructure in NSW

Desktop Research Data Sources

- The document is based on the findings of the Engineers Australia 2010 NSW Infrastructure Report Card
- The document draws on a number of publicly available data sources such as:
  - Infrastructure owner/operator websites
  - Government websites
  - Annual reports
  - Energy Supply Association of Australia

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The NSW electricity infrastructure industry is largely owned by the NSW government, while the gas industry is privately owned

EXAMPLE

Energy Infrastructure Industry

Key players	Policy & Regulation	Generation/ Production	Transmission	Distribution	Retail
Electricity	• Australian Energy Regulator • Australian Energy Market Operator (AEMO) • Independent Pricing and Regulatory Tribunal (IPART) • Industry & Investment NSW (NSW Department of Industry & Investment) • Australian Energy Market Commission (AEMC)	• Delta Electricity[8] • Macquarie Generation[8] • Snowy Hydro • Tarago • Origin Energy • Earing Energy [8] • EDL Group • Redbank Energy • Marubeni • TruEnergy	• TransGrid [8]	• Ausgrid[1] [8] • Endeavour Energy[2] [8] • Essential Energy[3] [8]	• TruEnergy[5] • Origin Energy[6] • ActewAGL • Aurora Energy • Australian Power and Gas Pty Ltd • + 18 other suppliers
Gas	• Independent Pricing and Regulatory Tribunal (IPART) • Industry & Investment NSW (NSW Department of Industry & Investment) • Australian Energy Market Commission (AEMC) • Australian Energy Regulator	There are no conventional natural gas reserves in NSW – A small percentage of natural gas is sourced from coal seam gas reserves however, the majority of conventional gas consumed is imported from other states CSG owners: • Santos • Metgasco • AGL • Dart Energy	• APA Group • Jemena • Envestra[4] • ActewAGL • Wesfarmers Kleenheat Gas Pty Limited[7] • ERM Power Pty Ltd • Lucas/Molopo JV • Metgasco • Eastern Star Gas (owned by Santos)	• ActewAGL • Jemena • Elgas Limited[7] • Elgas Reticulation Pty Limited • Envestra • Origin Energy[7] • Wesfarmers Kleenheat Gas Pty Limited[7]	• AGL Retail Energy • Origin Energy • ActewAGL • TruEnergy

Not focus of study

Notes

[1] Ausgrid , formerly Energy Australia (distribution)
[2] Endeavour Energy, formerly Integral Energy
[3] Essential Energy, formerly Country Energy
[4] Envestra, formerly Country Energy Gas
[5] TruEnergy formerly Energy Australia (retail)
[6] Origin Energy formerly Integral and Country Energy
[7] LPG distribution
[8] NSW State Owned Corporation (SOC)

The electricity and gas industry has undergone significant structural reform which has led to an unbundling of integrated public monopolies and increased competitive pressures

Gas Reform Highlights

- There have been significant developments in the Australian gas industry over the last few years including additional pipeline infrastructure, new gas supply sources and the introduction of full retail contestability
- 1997 – Federal and State Governments agreed to a uniform national framework for third party access to all gas pipelines *Gas Pipelines Access (South Australia) Act 1997* (commonly known as the Gas Code)
- 2006 – Ministerial Council on Energy released a new gas legislative regime that gives effect to the Australian Energy Market Agreement. The new legislation transfers the regulatory function from States to two national bodies: Australian Energy Market Commission and Australian Energy Regulator
- 2008 – Introduction of *National Gas (South Australia) Act 2008* (known as National Gas Law and National Gas Rules) to tighten decision making frameworks for pricing determinations requiring gas entities to provide significant justification for capital investment
- 2010 – Introduction of the Short Term Trading Market (STTM) to facilitate the trading of wholesale gas and provide certainty in supply, balancing and investment

Electricity Reform Highlights

- In 1991, the Industry Commission recommended the separation of generation and retail from natural monopoly elements of transmission and distribution to enhance competition and efficiency
- This has led to the corporatisation and retail contestability of electricity utilities under *Energy Services Corporations Act 1995* and *Electricity Supply Act 1995*
- 1998 – the National Electricity Market (NEM) and National Electricity Code Administrator (NECA) were created and the National Electricity Code was published
- In 2005, policy advice and standards setting for the electricity wholesale and transmission regulation function of NECA was transferred to the Australian Energy Market Commission (AEMC), while the Australian Energy Regulator (AER) commenced operating as the regulator and administrator of the National Electricity Law and National Electricity Rules (replaced National Electricity Code)
- 2008 – role of the AEMC expanded to electricity distribution network services
- 2009 – Australian Energy Market Operator (AEMO) was created by merging six industry bodies in both the electricity and gas markets
- In 2011, NSW privatised its electricity retailers and gentrade contract separates production and wholesale

AEMO (2011) http://www.aemo.com.au/planning/gsoo2010.htm
Nemmco (2011) www.nemmco.com.au
AMEC (2011) www.aemc.gov.au
National Competition Council, http://www.ncc.gov.au

Gas and electricity markets are regulated on the basis of network access, pricing and compliance

NSW natural gas and electricity regulatory bodies and functions

Segment	Regulatory Function	Regulator in Gas	Regulator in Electricity
Generation/ Production	Market and system operator[1]	Australian Energy Market Operator (AEMO)	
	Rule maker	Australian Energy Market Commission (AEMC)	
	Regulator	AEMC / Australian Energy Regulator (AER)	
	Relevant legislation	*National Gas (New South Wales) Act 2008*[2]	*National Electricity (New South Wales) Act 1997*[3]
Transmission	Access and pricing	National Competition Council (NCC) & AER	AER
	Relevant legislation	*National Gas (New South Wales) Act 2008*	*National Electricity (New South Wales) Act 1997*
Distribution	Access and pricing	NCC & AER	AER
	Licensing and compliance	Minister for Resources and Energy & Independent Pricing and Regulatory Tribunal (IPART)	
	Relevant legislation	*Gas Supply Act 1996 / National Gas (New South Wales) Act 2008*	*Electricity Supply Act 1995 / National Electricity (New South Wales) Act 1997*
Retail market	Balancing, metering and customer transfer	AEMO	
	Monitor service delivery and licence compliance	IPART (& AEMC monitors competitive market)	
	Regulated tariffs for small use customers	IPART	
	Relevant legislation	*Gas Supply Act 1996 / National Gas (New South Wales) Act 2008*	*National Electricity (New South Wales) Act 1997 / Electricity Supply Act 1995*

ESAA (2011) Electricity Gas Australia 2011

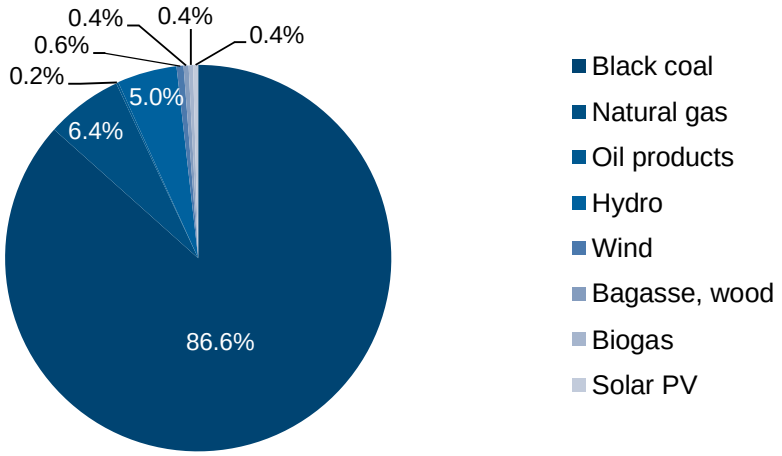
[1] Includes day to day STTM operator for gas industry

[2] This act is an application act of the *National Gas (South Australia) Act 2008,* National Gas Law and National Gas Rules

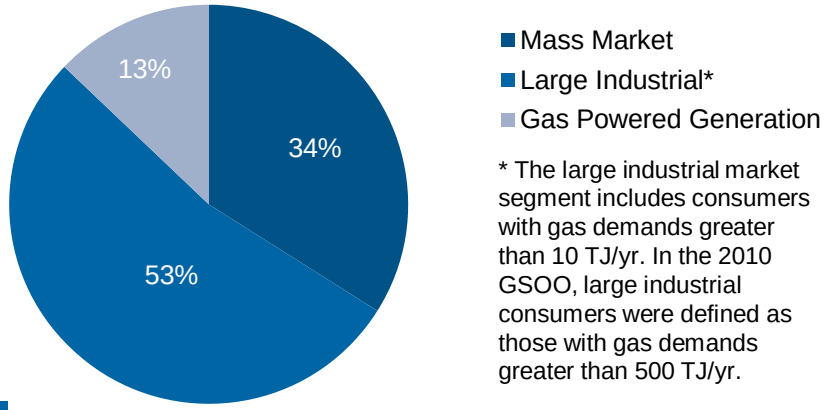
[3] This act is an application act of the *National Electricity (South Australia) Act 1996,* National Electricity Law and National Electricity Rules

NSW consumed about 79,046 GWh of electricity during 2010/11 and about 130 PJ of gas during 2009/10

Electricity Generation by Fuel Source



NSW Gas Demand



* The large industrial market segment includes consumers with gas demands greater than 10 TJ/yr. In the 2010 GSOO, large industrial consumers were defined as those with gas demands greater than 500 TJ/yr.

Electricity

- During 2010/11, NSW is estimated to have consumed 74,902 GWh of electricity
- Of the electricity generated, 93% was from non-renewable fuels (black coal, natural gas and oil products)
- 82% of electricity in NSW is generated by 4 key players; Macquarie Generation; Delta Energy; Eraring Energy; Snowy Hydro
- NSW transmission networks total over 12,000 km and is owned by TransGrid, a state owned corporation (SOC)
- The NSW network is linked to the National Electricity Market by 3 interconnectors (QNI, Terranora and VIC-NSW) which create a national transmission network

Gas

- NSW currently has no conventional gas reserves but there is a coal seam gas reserve currently being exploited in the south west of Sydney
- In 2009/10, NSW (including ACT) consumed about 130 PJ of gas
- Gas transmission networks in NSW are owned and operated by 2 key players (APA Group and Jemena)
- Jemena has the largest distribution network in NSW which provides gas to metropolitan customers

ABARE (2011) Australian Energy Statistics;
AEMO (2011) Gas Statement of Opportunities

There are a number of key energy industry issues that have impacts on investment in infrastructure

Gas

- The emergence of coal seam gas as a fuel source and potentially export
- Understanding the environmental issues surrounding the exploration and use of coal seam gas
- The very large pipeline investments to be delivered in the next 5 years
- The increasing use of gas powered electricity generators in NSW

Electricity

- Investment in networks has driven prices up by over 40% in the past 4 years
- Carbon price policies will have implications for carbon emitting power sources and prices
- The emergence of coal seam gas as a power source for electricity generation

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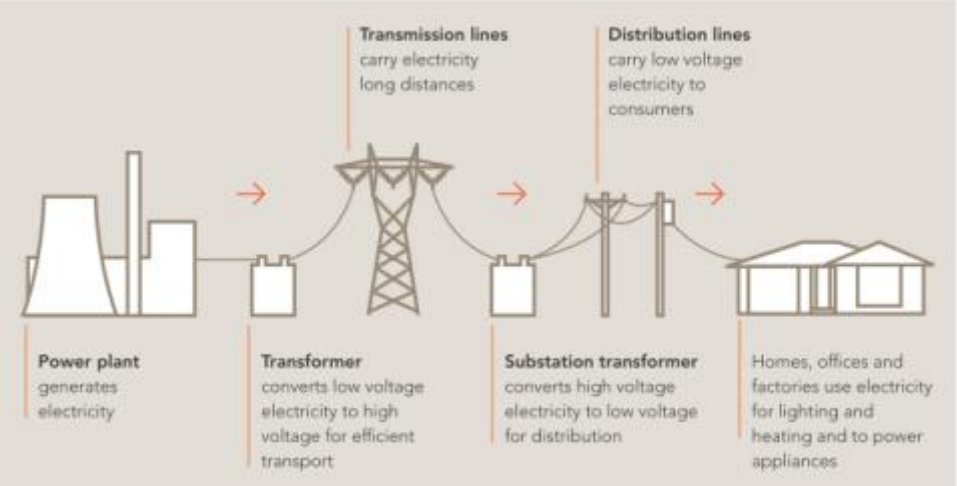
Electricity is generated at power stations, transmitted at high voltage to a substation which transforms the electricity to lower voltages for distribution to end users

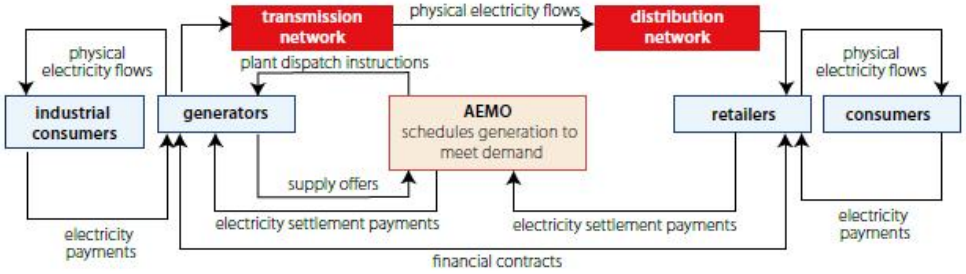
Overview

- As an appliance is switched on electricity is immediately provided from the power generation plant
- Electricity transformer converts low voltage energy into high voltage energy to ensure efficient delivery through the transmission system, the distribution lines this high voltage energy before it is reconverted from high to low voltage for safe distribution of energy to households and businesses
- 90% of Australian electricity is generated from processes involving the burning of fossil (non-renewable) fuels
- Modern power stations in NSW generate electricity mechanically by the spinning of powerful magnets. The motion can be powered by steam, gas, wind or water turbines
- The Australian National Electricity Market (NEM), established in 2009, is the longest connected power system in the world
- It creates a virtual national pool of electricity with a set of procedures designed to manage the day to day supply and demand within the network. It totals 5,000 km with over $10 billion of electricity traded annually
- Wholesale electricity market contracts bind trades made by participants in the NEM. A dispatch price is determined every 5 minutes, and 6 dispatch prices are averaged every 30 minutes to determine the spot price. AEMO then uses the spot price as the basis for settlement of financial transactions for all energy traded in the NEM.
- Supply of electricity is then provided by generators through transmission and distribution networks according to AEMO's plant dispatch instructions.

Electricity Transport



National Electricity Market



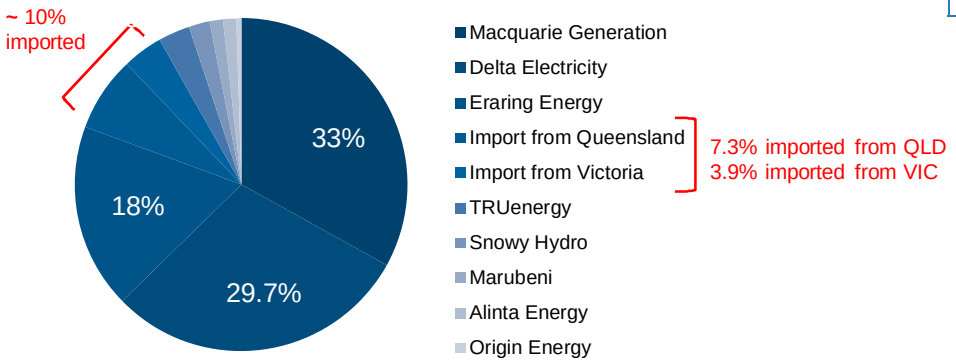
AMEO (2010) *An Introduction to Australia's National Electricity Market*
ABARE (2011) *Energy in Australia 2011*

NSW is part of the National Electricity Market and generates ~90% of it's electricity supply for domestic consumption within the state

Overview

- Electricity generation in NSW is provided by both state owned corporations and the private sector
- State owned corporations provided a large proportion of electricity generated in 2010/11. They are:
  - Macquarie Generation
  - Delta Electricity
  - Snowy Hydro
  - Eraring Energy
- 82% of electricity in NSW is generated by the four largest players

NSW Energy Generation, 2010/11



Power Generation	Capacity	Power Source
Macquarie Generation	4,640 MW	Coal
	0.85 MW	Hydro
Delta Energy	4,320 MW	Coal
	668 MW	Gas
	68 MW	Bio-mass
	0.11 MW	Hydro
Eraring Energy	2,840 MW	Coal
	337 MW	Hydro
	40 MW	Diesel
	15 MW	Wind
Snowy Hydro	3,696 MW	Hydro

NSW Treasury (2011) *Owen Review*
ESAA (2011) *Electricity Gas Australia 2011*
Macquarie Generation (2011), http://www.macgen.com.au/Generation-Portfolio/
Delta Electricity Annual Performance Report (2010), http://www.de.com.au/ArticleDocuments/50/Delta%20Annual%20Report%20Editorial%20-%20final.pdf.aspx
Eraring (2011), http://www.eraring-nergy.com.au/Default.aspx?aCateId=846
Snowy Mountain Scheme (2010), http://www.snowyhydro.com.au/LevelThree.asp?pageID=244&parentID=66&grandParentID=4

The transmission network in NSW is owned and operated by TransGrid

TransGrid Transmission Network [1]

TransGrid Network

• Australia's largest transmitter of energy
• 6 main load areas (indicative peak load)
  • NSW North – 1,000 MW
  Newcastle – 2,400 MW
  • Greater Sydney – 6,000 MW
  • Western Area – 600 MW
  • South Coast – 700 MW
  • South and South West – 1,600 MW

TransGrid Assets	
High voltage over head and underground	12,609 km
Substations/Switching stations	91
Asset value	$4.2 billion (2010)

TransGrid (2010) *TransGrid Network Management Plan 2011-2016.*
TransGrid (2010) *NSW electricity network performance report 2009-10.*

Interconnectors link the NSW network to transmission networks in other states which creates a national supply system

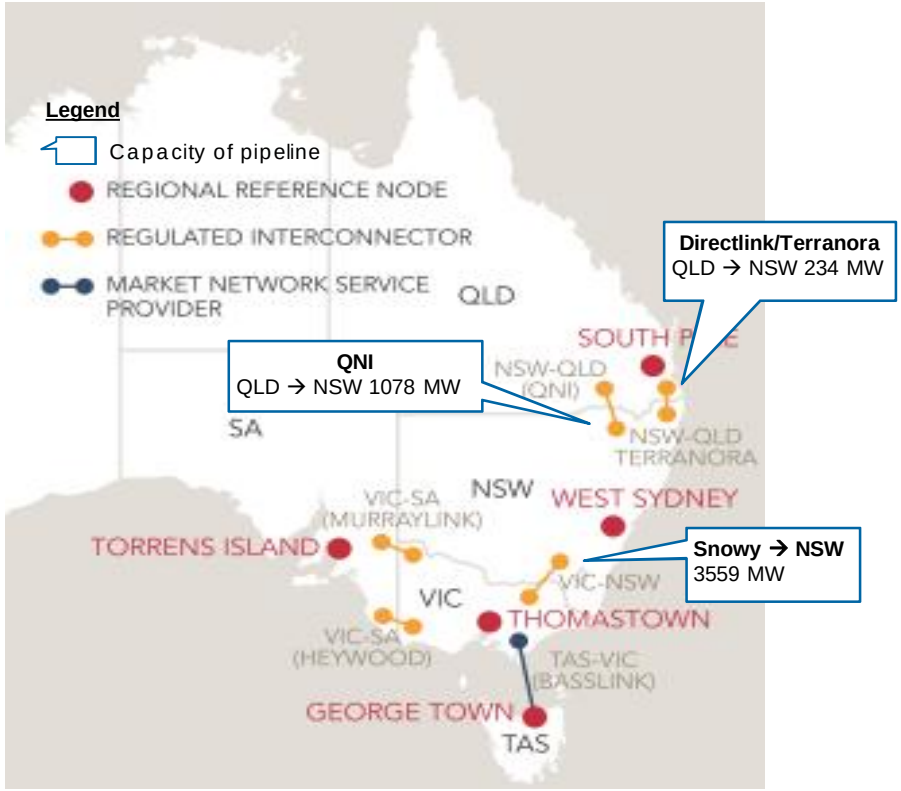
The National Network

- Cross-border interconnectors link the transmission networks in NSW with Victoria and Queensland:
  - Qld-NSW (QNI), jointly owned by Powerlink and TransGrid, was commissioned in 2002
  - Terranora (NSW-QLD) previously called Directlink, owned by Energy Infrastructure Investments Group
  - Victoria-NSW – EA
- Interconnectors are important infrastructure components. They secure supply and facilitate the national electricity market

The NSW Network

- 60% of NSW electricity is generated west of the Great Dividing Range
- 75% of energy is consumed on the eastern sea-board within the Sydney, Wollongong and Newcastle regions
- This requires transmission of a significant amount of electricity for consumer markets

Interconnectors in the NEM



[1] Engineers Australia (2010) *Infrastructure Report Card 2010 NSW.*
[2] TransGrid website, http://www.TransGrid.com.au/network/an/Pages/default.aspx.
[3] AMEO (2010) *An Introduction to Australia's National Electricity Market.*
[4] NERA (2008) *The Wholesale Electricity Market in Australia – a report to the Australian Energy Market Commission*

Three state owned corporations provide electricity distribution services throughout NSW - Ausgrid, Endeavour Energy and Essential Energy

Network Statistics	Ausgrid [1, 4]	Endeavour Energy [2, 5]	Essential Energy [3, 6]
Transmission substations	43	0	20
Zone substations	187	153	325
Distribution substations	30,551	29,994	134,947
Customers	1,619,988	877,340	803,889
Revenue	$2 635.6 million	$1,136.5 million	$1,464.3 million
Asset value	$9 949.7 million	$4,711.9 million	$6,278.7 million
Maximum demand	6,072 MW	4,002 MW	2,238 MW
Transmission system	962 km	0	0
Sub-transmission system	3,662 km	3,463 km	11,391 km
Pole numbers	506,101	306,355	1,385,780
Streetlights	251,298	189,870	148,158
High voltage overhead	10,195 km	11,326 km	145,835 km
High voltage underground	7,384 km	3,718 km	2,011 km
Low voltage overhead	20,834 km	8,871 km	26,652 km
Low voltage underground	6,673 km	6,794 km	4,810 km
Geographical area	• Eastern Sydney • Central Coast • Newcastle • Hunter Valley	• Greater Western Sydney • Blue Mountains • Southern highlands • South Coast	• Rest of NSW

[1] Ausgrid (2011) *Network Performance Report 2010/11*
[2] Endeavour Energy (2011) *Network Performance Report 2010/11*
[3] Essential Energy (2010) *Electricity Network Performance Report 2010/11*
[4] Ausgrid (2011) *Annual Report 2010/11*
[5] EnergyAustralia (2010) *Network Performance Report 2009/10*
[6] CountryEnergy (2010) *Electricity Network Performance Report 2009/10*

There is a national approach to electricity infrastructure planning which is supplemented by planning at the operator network level

Planning Tool	Description
National Network Planning	
Electricity Statement of Opportunities (ESOO)	The Electricity Statement of Opportunities provides an insight into demand forecasts and the future capacity of the NEM
NSW 2021	NSW 2021 outlines a number of goals specific to the NSW electricity market in order to: • Decrease the cost of living by containing electricity costs with the efficient use of energy • Increase renewable energy to 20% by 2020 [1]
Annual National Transmission Network Development Plan (NTNDP)	Provides an independent 20 year strategic plan for the NEM and each jurisdiction within the system as well as a 5 year view on required network support and control ancillary services [2]
Operator Network Planning	
ESOO (Generation)	Identifies capacity deficits, proposals for new power stations are declared 'critical infrastructure' and assessed under the Environmental Planning and Assessment Act 1979 [3]
TransGrid's Annual Planning Review (Transmission)	Outlines annual plan for TransGrid's transmission network
Electricity System Development Review (Distribution)	Identifies future demand and pinch points within the service providers network [4]
Network Management Plans (Distribution)	Ensures distributors provide a reliable, safe electricity supply of appropriate quality

[1] NSW Government (2011) NSW 2021
[2] AEMO (2010) National Transmission Network Development Plan
[3] Trade and Investment (2011) http://www.trade.nsw.gov.au/energy/electricity/generation#Projects-in-the-planning-system
[4] TransGrid (2011) NSW Annual Planning Report

Electricity infrastructure typically has a long design life with asset condition reported every year

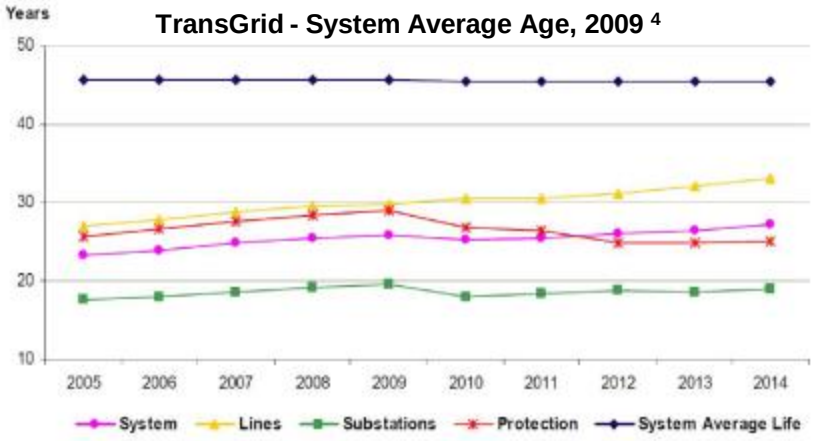
Generation Asset Conditions[1]

- Civil infrastructure has long design lives, approximately 100 years
- ESAA has identified 20 principal power stations within NSW which have an average age of 29 years
- Mechanical and electrical infrastructure has a shorter design life, and is replaced on a more frequent basis

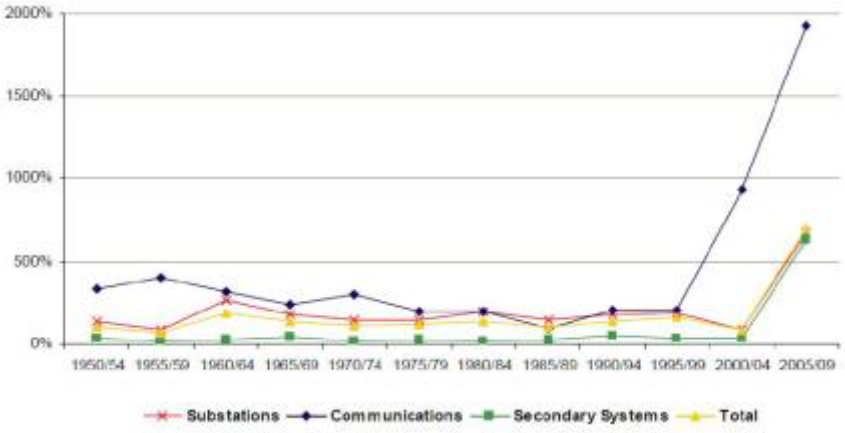
Transmission Asset Conditions & CAPEX

- TransGrid's annual report identifies network asset design lives as between 20 and 50 years[2]
- Some 35% of TransGrid's substations and switching stations were commissioned before the 1970s.[3] This would suggest that a significant proportion of TransGrid's assets are at least half way through their design life with major replacement to be delivered in next 20 years
- NSW has seen a limited number of major transmission links built in recent years
- Capital expenditure in the 2009/10 period totalled $428 million which was a $191 million decrease from the previous period
- The system average age for the Protection and Substations asset classes reduces over the period but the impact on the entire system average life is very minimal. For the critical asset class of substations, PB notes that the average age is reduced slightly over the period 2009 to 2012

TransGrid - System Average Age, 2009 [4]



TransGrid - Defect Ratio vs. Commissioning Date, 2009 [4]



[1] ESAA (2011) *Electricity Gas Australia 2011.*
[2] TransGrid (2010) *Annual Report 2009/10.*
[3] Engineers Australia (2010) *Infrastructure Report Card NSW .*
[4] TransGrid (2008) *Strategic Network Development Plan 2008.*
[5] PB (2009) *TransGrid Revised Revenue Proposal – An independent review.*
[6]
[7]
[8]

Electricity infrastructure typically has a long design life

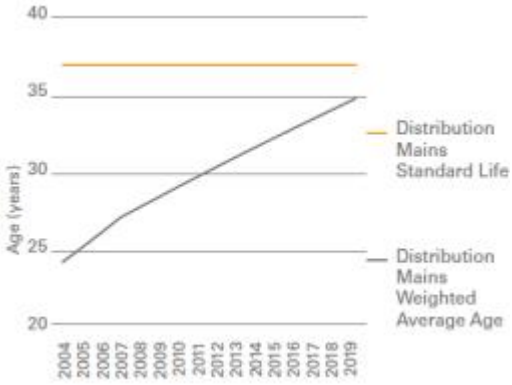
Distribution Asset Conditions & CAPEX

- Asset age profiles provide useful information in relation to asset condition and replacement requirements for the network
- Many of NSW's distribution assets were built between the 1960s and 1980s and are operating beyond standard design lives
- Ausgrid has one of the oldest distribution networks in Australia with many of it's assets over 50 years old and approximately 15% of assets currently in service beyond their standard design lives [2]
- Nearly a third of Endeavour Energy's zone and transmission substations are now at, or are close to, replacement age: 25 are 45 years or older, and an additional 70 will reach 45 years within the next 10 years. About 45% of Endeavour Energy's transformers are greater than 36 years old

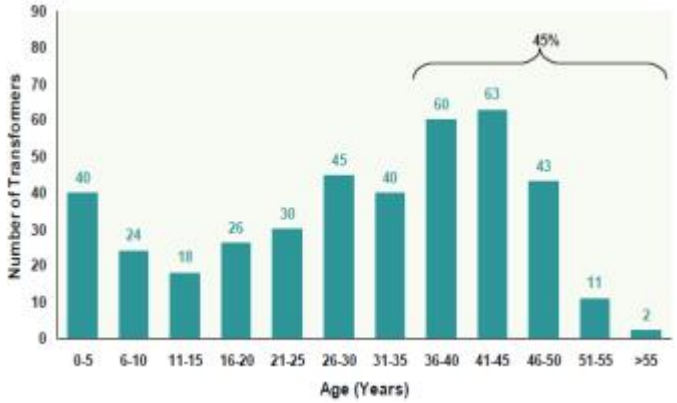
Distribution Asset Conditions & CAPEX

- The weighted average age across all asset classes for Essential Energy is around 27 years. Around 33% of existing asset base (by replacement cost) was installed during the 1950s and 1960s, and around 18% was installed over 45 years ago.
- Capital expenditure is following an upward trend in all distribution network providers. The 2011/12 Budget Papers confirm this continuing trend and identify expected 2011/12 capital spends of:
  - Ausgrid - $1.8 billion
  - Endeavour Energy - $674 million
  - Essential Energy - $917 million

Ausgrid - Weighted Average Age of Distribution Mains, 2008 [2]



Endeavour Energy – Transformer Asset Age Profile, 2008 [3]



Essential Energy – Overall Age and Replacement Profile for All System Assets, 2008 [2]

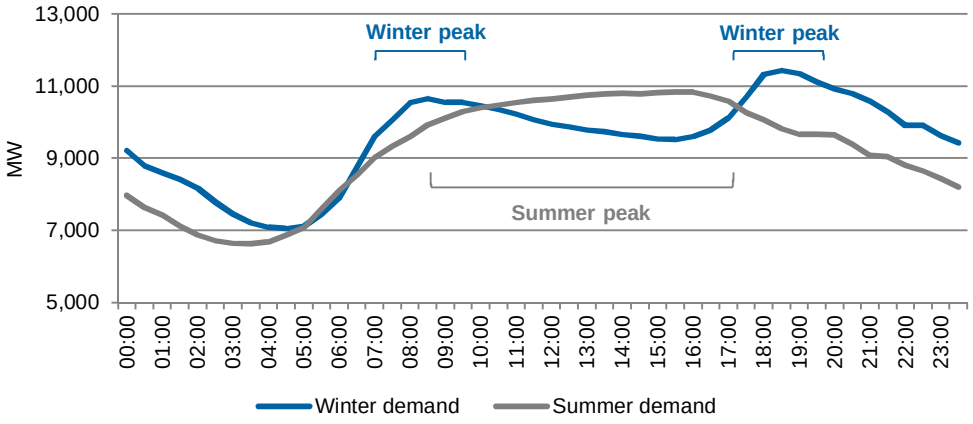
[1] Engineers Australia (2010) *Infrastructure Report Card NSW*.
[2] Energy Australia (2008) *Regulatory Proposal 2009-2014*.
[3] Integral Energy (2008) *Regulatory Proposal to the Australian Energy Regulator 2009 to 2014*.
[4] Country Energy (2008) *Country Energy's Electricity Network Regulatory Proposal 2009-2014*.

Electricity demand follows distinct peak loading daily and seasonal trends, peak demand is forecast to grow by 17% by 2021

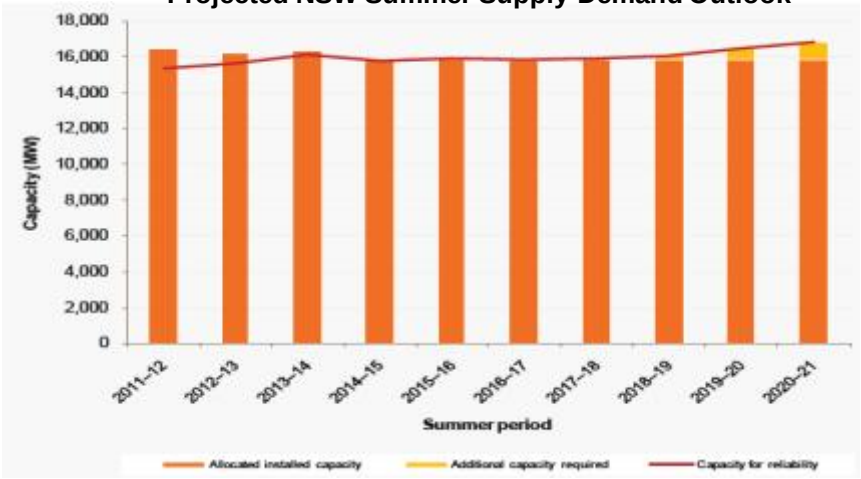
Electricity Demand

- Electricity demand is projected to continue to grow by 17% by 2021 (average annual growth of 1.6%)[1]
- Generation capacity is expected to decrease slightly over the next ten years
- However, projected generation capacity is not sufficient to meet the increase in demand, which leads to the low reserve condition (LRC) point to be reached in 2018-19, where at least 104 MW of new generation would be required[5]
- Daily demand trends follow seasonal variability
- Summer demand peaks during the warmest part of the day (probably due to the use of air conditioners)
- Winter demand has two peaks, early morning and evening (probably due to the use of heaters in the colder parts of the day)
- Peaks in demand are met using 'peaking' power stations which 'boot' up very quickly in response to a surge in demand (normally at the request of AEMO on behalf of the NEM), and are turned off when no longer needed
- Peaking generators in NSW are typically gas powered. These power generators are cheaper to build than baseload (coal fired) generators. However, operational costs per unit of power are substantially higher

Australian Average Daily Demand[2]



Projected NSW Summer Supply-Demand Outlook[1]



[1] AEMO (2011) *Electricity Statement of Opportunities*
[2] ESAA (2011) *Electricity Gas Australia 2011*
[3] Ausgrid (2011) http://www.ausgrid.com.au/Common/Our-network/Network-regulation-and-reports/Regulatory-submissions.aspx
[4] NSW Treasury (2011) *Owen Review*
[5] AEMO (2012) *2011 Electricity Statement of Opportunities,* update as at 2 March 2012

Estimation from AEMO projections indicate an additional base-load generation of about 4,000 MW per annum to the current capacity is required

Discussion

- In calculating the additional base-load generation required by 2030/31, two data sets produced by AEMO have been used to estimate the ballpark base-load supply shortfall by 2030/31
- According to AEMO's *2011 Electricity Statement of Opportunities* Supply-Demand Calculator model, NSW will require additional generation of 104 by 2018/19
- Note there is some discrepancy between the maximum demand forecast used for the 2011 ESOO Supply-Demand Calculator and the maximum demand forecast contained in the *2011 National Transmission Network Development Plan*. Clarification was obtained from AEMO regarding the discrepancy with confirmation on the 2011 ESOO projections being the most up-to-date forecast on maximum demand. Given the data provided in ESOO is a 10-year forecast, the magnitude of demand increase from 2018/19 onwards has been assumed to be the difference between the demand forecasts for 2030/31 and 2018/19 in 2011 NTNDP. This amount has then been combined with the supply shortfall of 104 in 2018/19 as calculated in the latest update to 2011 ESOO, which equates to approximately 4,000 MW
- This methodology is a back-of-the-envelop calculation based on available limited public information on supply and demand projections on a 20-year timeframe. To obtain a more accurate projection of the likely supply shortfall by 2030/31, a more detailed comprehensive modelling would be required

Summer Maximum Demand (MD) & Supply Shortfall Forecast [1, 3]

Date	Medium MD at 10% POE (MW)	Supply Shortfall (MW)
2011/12	15,827	0
2012/13	16,121	0
2013/14	16,440	0
2014/15	16,781	0
2015/16	17,121	0
2016/17	17,470	0
2017/18	17,837	0
2018/19*	18,121	104
2019/20*	18,501	481
2020/21*	18,874	843

* Figures calculated using 2011 ESOO update released on 2 March 2012.

Scenario C "Medium"	Modest rate of change Assumptions
Carbon price trajectory	-15%
Gross State Product	Medium
Electricity price	Medium & CPRS-15%
Gas price	Medium & CPRS-15%
Consumer prices	Medium
Employment	Medium
Exports	Medium
Energy efficiency	Medium
Fuel Prices	Medium
Penetration of Electric Vehicles	High

Summer MD Forecast in NTNDP [2]

Date	Scenario C MD at 10% POE (MW)
2011/12	16,169
2012/13	16,544
2013/14	16,927
2014/15	17,322
2015/16	17,714
2016/17	18,101
2017/18	18,493
2018/19	18,884
2019/20	19,266
2020/21	19,636
2021/22	19,946
2022/23	20,246
2023/24	20,546
2024/25	20,836
2025/26	21,126
2026/27	21,396
2027/28	21,676
2028/29	21,956
2029/30	22,236
2030/31	22,650

[1] AEMO (2011) *Electricity Statement of Opportunities*.
[2] AEMO (2011) *National Transmission Network Development Plan Consultation*, Demand Forecast Input Spreadsheet.
[3] AEMO (2012) *2011 Electricity Statement of Opportunities,* update as at 2 March 2012.

Electricity demand forecast is estimated based on a number of key assumptions about demand drivers

Key Demand Drivers

- Electricity demand is dependent on a number of long-term and temporary factors
- Long-term drivers:
  - *Economic and demographic factors* – increases in gross state product (GSP) and population generally increases the amount of electricity being consumed through increased housing stock and business activity
  - *Temperature* – demand increases as temperatures rise above or fall below certain 'comfortable' range
  - *Electricity price* – some price elasticity, but hard to measure
  - *Carbon price* – indirectly through price elasticity
  - *Public policy* – e.g. Green Star building standards reward developers for using private generation to offset electricity use from the grid
  - *Consumer behaviour* – difficult to measure or estimate
- Temporary, unexpected drivers:
  - Unexpected economic events
  - Weather and natural disasters
  - New policy development

Scenario assumptions underlying AEMO/KPMG's modelling

Key Assumptions for Medium Growth Scenario (Scenario C)	2011-15 (short-run)	2016+ (long-run)
Global economic growth	4.5%	3.3%
Gross State Produce for NSW (GSP)	2.6%	2.3% (2016-2025) 1.9% (2026+)
Productivity growth	1.5%	1.5%
Migrant intakes (persons)	168,700	180,000
Fertility rate	1.9%	1.8% from 2017/18
CPRS – 15 (carbon price based on 15% cut in emission) Carbon prices (2009/10 dollars)	$10/t CO_2e (2013/14) $37.44/t CO_2e (2014/15)	4% growth p.a. (peak in 2030 $67.36/t CO_2e)
Electricity prices in NSW – compound annual growth rate (CAGR)	2.74%	2.74%
Gas prices in NSW – CAGR	4.15%	4.15%

Committed Generation Projects[2]

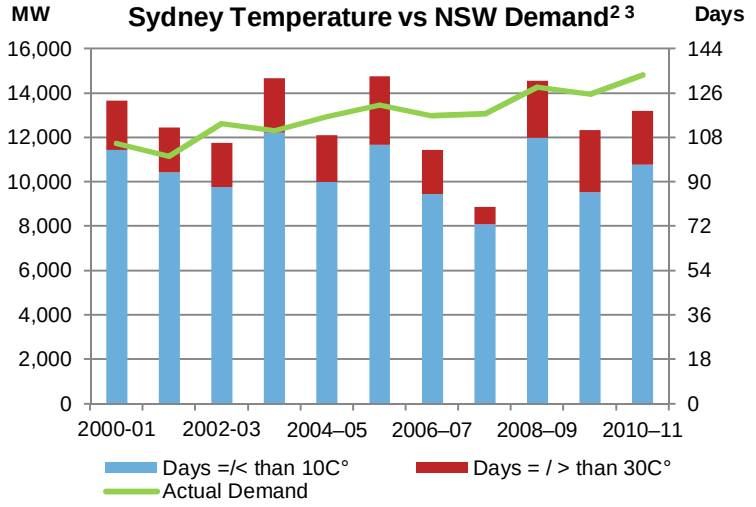
- Eraring Power Station (upgrade): Work on Unit1 is underway and will be followed by completion of the Unit 4 upgrade
- Woodlawn Wind Farm 48MW
- Construction of 1MW Woodlawn Bioreactor unit 4 is expected to commence in August 2011

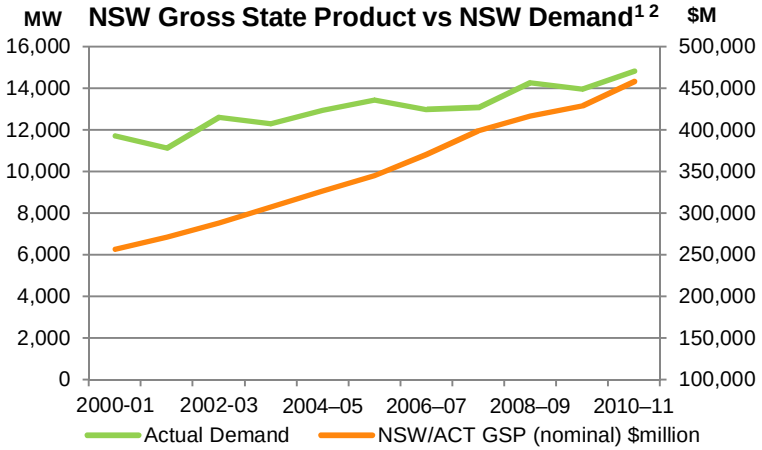
[1] KPMG (2011) *State 2 Report: Economic Scenarios and Forecasts 2010-11 to 2034-35, A Report to the Australian Energy Market Operator*.
[2] AEMO (2011) *Electricity Statement of Opportunities*

Fluctuations in electricity demand over the past 10 years appear to be most closely related to variations in temperature, economic activity and household efficiency

Discussion

- Electricity demand is dependent on a number of long-term and temporary factors such as temperature, economic activities, electricity prices, population growth, transition to energy efficient appliances, air conditioning or heating ownership, large industrial projects in the region, carbon pricing (going forward) and policies regarding energy efficiency and renewable energy targets
- Fluctuations in electricity demand over the past 10 years appear to be most closely related to temperature. Using the temperature data for Sydney (Observatory Hill) as a proxy (given the concentration of NSW population resides in Sydney metropolitan area), demand for electricity seems to move in trend with the number of cold days (days equal or less than 10 degrees Celsius) and hot days (days equal or greater than 30 degrees Celsius)
- The explanatory power of weather on demand projections is also confirmed by TransGrid's econometric modelling for maximum demand, which uses a multi-variable regression model by regressing historical data against demographic, economic and weather variables
- However, TransGrid points out historically, the most significant drivers of energy consumption have been NSW/ACT Gross State Product (GSP) and Electricity Prices. Generally GSP growth increases energy consumption while electricity price increases tend to reduce demand[2]





[1] KPMG (2011) *State 2 Report: Economic Scenarios and Forecasts 2010-11 to 2034-35, A Report to the Australian Energy Market Operator*, Forecast Spreadsheets.
[2] TransGrid (2011) *New South Wales Annual Planning Report 2011.*
[3] Bureau of Meteorology (2011) Climate Data Online, maximum daily temperature; minimum daily temperature.

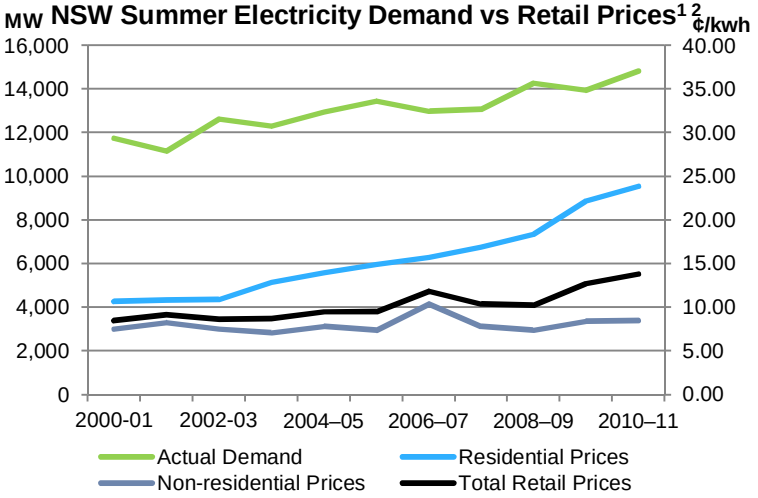
Electricity prices may explain the relatively flat demand growth on per capita basis

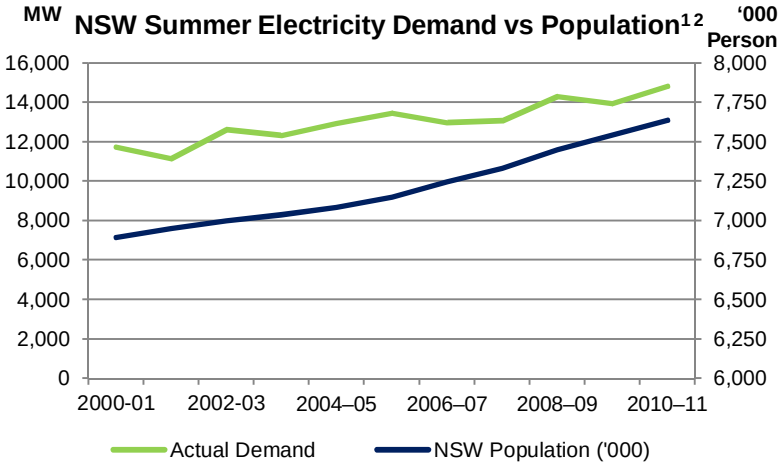
Discussion

- Data suggests electricity demand generally moves in trend with population increases and have an inverse relationship with electricity retail price. However, in recent years demand has increased despite the continual increase in retail electricity prices
- By expressing demand in terms of kilowatt (kW) per capita, demand has grown from 1.70kW per person in 2000/01 to 1.94 kW per person in 2010/11, but it has been a relatively flat growth during the past 6 years
- A number of demand management initiatives supported by the $700 million NSW Climate Change Fund have been in place since July 2007 and may explain the relatively flat growth in electricity demand per capita [3]
  - $170 million NSW Home Saver Rebates
  - $20 million School Energy Efficiency program
  - $150 million program under the Energy Efficiency Strategy

NSW Summer Electricity Demand per capita (kW/person)

2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1.70	1.60	1.80	1.75	1.83	1.88	1.79	1.78	1.92	1.85	1.94





[1] TransGrid (2011) *New South Wales Annual Planning Report 2011.*
[2] KPMG (2011) *State 2 Report: Economic Scenarios and Forecasts 2010-11 to 2034-35, A Report to the Australian Energy Market Operator*, Forecast Spreadsheets.
[3] Department of Environment, Climate Change and Water – Climate Change Fund, http://www.environment.nsw.gov.au/grants/ccfund.htm.

The type of communication technology demand management smart meter utilises has a fundamental impact on the cost of installation and its useful life

NSW Adoption of Smart Meters

- NSW has been slower to in adopting smart meters. Given the merging of information technology and electricity grids coupled with the large price declines of the necessary equipment, there was no advantage in being the first to act [1]
- For example, Endeavour Energy is estimated to have only a few hundred thousand of the meters in use and believed that the smart meters have not delivered the benefits it claimed for consumers in Victoria [1]
- As part of the Australian Government's *Smart Grid, Smart City trial*, advanced smart meters and pricing trails is planned to be offered by Ausgrid to at least 30,000 households in Sydney and the Hunter since October 2011 to test whether they make the grid more efficient and reduce household power bills [2]
- As at October 2011, Ausgrid had more than 400,000 first-generation smart meters installed, with 250,000 customers on "time-of-use" contracts. George Maltabarow, the managing director of Ausgrid, estimated that these households reduced their electricity bills by as much as $270 a year, on average, with time-of-use contracts, while the median saving was about $70 a year [1]

Issues for Consideration

- Lessons from Victorian roll-out of smart meters (refer to next page) indicate the sound and robust analysis such as an in-depth cost-benefit analysis should be an important part of the program decision making process
- Locking in a particular choice of technology at an early stage on a mass scale may lead to expensive changes later in the process as better and cheaper technology come onto the market. The issue can be exacerbated by any changes to communications infrastructure such as the current roll-out of the NBN that impacts on the technology used in the remote communication feature of the smart meter.[3] The progressive roll-out of new smart meters would benefit from cost savings by installing NBN compatible smart meters
- In Victoria, the introduction of smart meters has been coupled with time-of-use contracts, which ensure households pay higher prices for electricity at peak demand periods and less at low demand periods. This has implications for vulnerable customers who are unable to switch its peak period use to off-peak or shoulder-peak periods due to socio-economic or health reasons
- The recent fire incidents point to safety issues around smart meters and the importance of training and qualification requirements for anybody installing a smart meter[4]

[1] Robins, B (2011) 'Smart Meters Given a Fail', *The Age*, 4 October 2011.
[2] Ausgrid (2011) *New technology trials to help reduce power bills*, Media Release 2 October 2011.
[3] Premier of NSW (2007) *Smart Meters – Fact Sheet*, Media Release 12 December 2007.
[4] Savage A (2012) 'Premier defends 'safe' smart meters', *ABC News*, 31 January 2012.

Current and future capacity of the transmission and distribution network has been well planned in the NSW metropolitan region

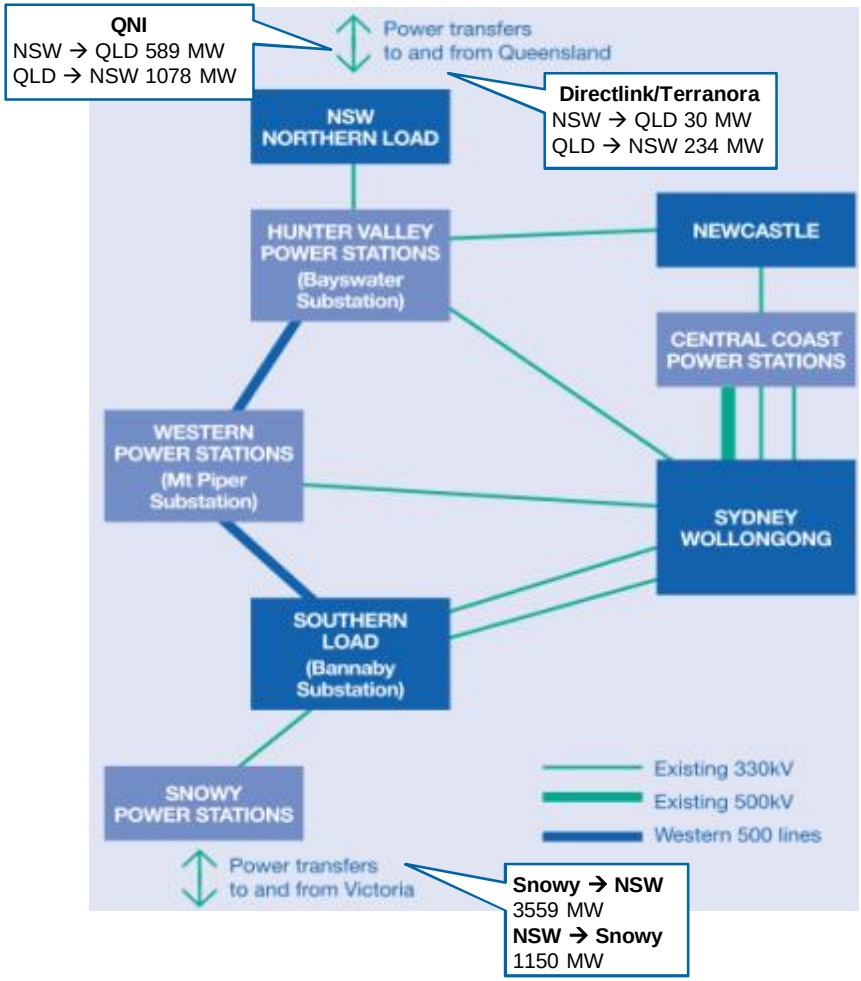
Transmission

- TransGrid's transmission networks operate at voltages of 500, 330, 220 and 132 kV
- The Western 500 project is an example of long term planning over the last 30 years to increase capacity as and when it is needed
- TransGrid's transmission lines have been upgraded progressively since the 1980s and were initially energised at 330 kV (which is below their maximum capacity)
- Now with an increase in demand, lines that connect the Bayswater, Mt Piper and Barnaby substations are being energised at 500 kV
- The lines now operating at 500 kV provide additional benefits to the network as electricity transmitted at higher voltages results in lower residual losses

Distribution

- Annual electricity development reviews, by distribution network providers ensure adequate system planning, able to respond to expected demand and supply, is conducted down to local government authority level

TransGrid Transmission Network Capacity [2]



[1] TransGrid (2008) Strategic network Development Plan 2008
[2] TransGrid (2009) Energising the Western 500 Project

Planned/proposed transmission projects identified in TransGrid's annual planning report and NTNDP

	Transmission Projects (identified in 2010 NTNDP) [1]	Status
1	Series compensation on the Armidale–Dumaresq 330 kV circuits and the Bulli Creek–Dumaresq 330 kV circuits	TransGrid and Powerlink are actively investigating upgrade impacts and benefits, and outcomes will be released in 2011.
2	A new 220 kV, 250 MVA phase angle regulator on the Buronga–Red Cliffs 220 kV circuit	The feasibility of a phase angle regulator installation is under investigation
3	Upgrade of VIC–NSW interconnector	Preparatory work done by TransGrid and AEMO
4	Hunter Valley–Eraring (via Newcastle) 500 kV development	TransGrid is actively working on this development
5	Replacement of the 500/330 kV Eraring Power Station transformer with a 1,500 MVA unit, and add a new parallel 500/330 kV Eraring Power Station transformer	Second transformer is expected to be required soon
6	Hunter Valley–Northern NSW zone 500 kV developments	Dependent on load growth in the Northern NSW zone and interconnector power flow
7	Upgrade terminal equipment on the Ingleburn–Wallerawang Power Station 330 kV circuit to achieve the full line rating. Address attendant voltage control issues for Sydney's 330 kV transmission network.	Minor works to be undertaken if economic in advance of any potential limitations
8	additional Mt Piper –Wallerawang 330 kV circuit	Options and needs being investigated

[1] AEMO (2011) *National Transmission Network Development Plan*.

Planned/proposed transmission projects identified in TransGrid's annual planning report and NTNDP

	Transmission Projects (additional identified in 2011) [1]	Status
9	Reinforce the 330 kV transmission network supplying the Sydney South, Liverpool, Ingleburn, Beaconsfield, and Haymarket Substations	Consultation process may be initiated by 2011-12
10	Upgrading the existing lines of Bannaby–Yass and Marulan–Yass 330 kV circuits to higher thermal ratings by modifying towers and other line work	N/A
11	Bannaby–Sydney (South Creek) 500 kV double circuit line	Consultation process may be initiated by 2011-12
12	Murraylink Runback Control System: inclusion of NSW sites in a scheme that already operates for Victorian circuits	Dependent on the owners of Murraylink completing communication links
13	The need for a reactive power ancillary services (RPAS) of up to 740 Megavolt amperes reactive (MVAr) for the next 5 years to ensure acceptable voltage quality	N/A

[1] AEMO (2011) *National Transmission Network Development Plan*.
[2] TransGrid (2011) *New South Wales Annual Planning Report 2011*, Chapters 5 and 6.

The performance of electricity generation, transmission and distribution infrastructure is monitored via a number of indicators

	Indicator [1]		2008/09	2009/10
Generation	System load factor	Ratio of total system energy to theoretical capacity	58.7%	52.9%
	Capacity factor	Percentage of total potential generation output that is actually generated	54.8%	49.6%
	Reserve plant margin	Amount of excess generation available within the region	5.4%	14.7%
	Equivalent availability factor	Overall availability of installed generation when planned, maintenance and forced outage are taken into account	86.8%	85.7%
	Forced outage factor	Percentage of total potential generation output that is lost due to forced outages	3.5%	4.9%
	Planned outage factor	Percentage of total potential generation output that is lost due to planned and maintenance outages	9.7%	9.4%
	Thermal Efficiency	Measure of what energy you get out of the system for the energy that you put in	34.7%	35%
Transmission	System minutes unsupplied	-	0.42 mins	1.28 mins
	Energy delivered	Total energy delivered	71,508 GWh	68,464 GWh
	Circuit availability	Actual circuit hours available / Total possible circuit hours available	98.4 %	98.2 %
	Outage duration SAIDI	System Average Interruption Duration Index (SADI)	197.6	160.1
Distribution	Outage frequency SAIFI	System Average Interruption Frequency Index (SAFI)	1.7	1.5
	Outage time CAIDI	Customer Average Interruption Duration Index (CAIDI)	115.7	108.8
	Distribution losses	(Electricity purchased – electricity sold) / electricity purchased	5.2%	4.9%
	Distribution utilisation factor	Electricity sold / (distribution transformer capacity / Period hours (8760)	16.6%	16.3%
	System load factor	Ratio of total system energy to theoretical capacity	57.1%	58.9%

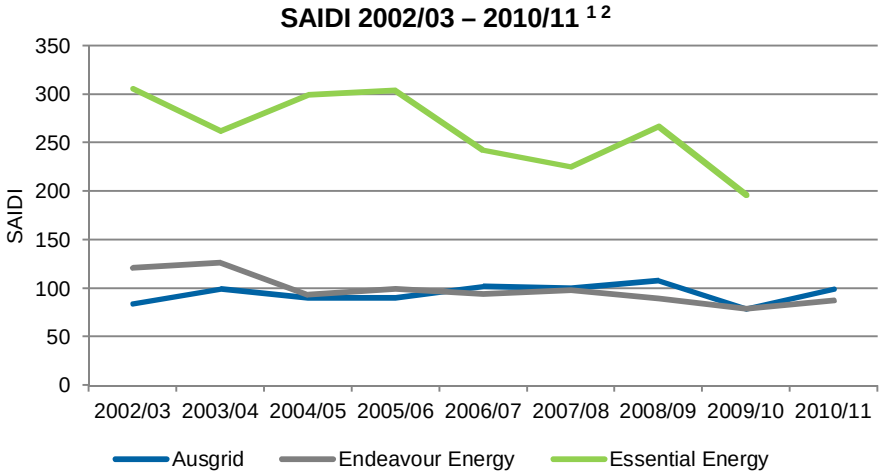
[1] ESAA (2011) Electricity Gas Australia 2011

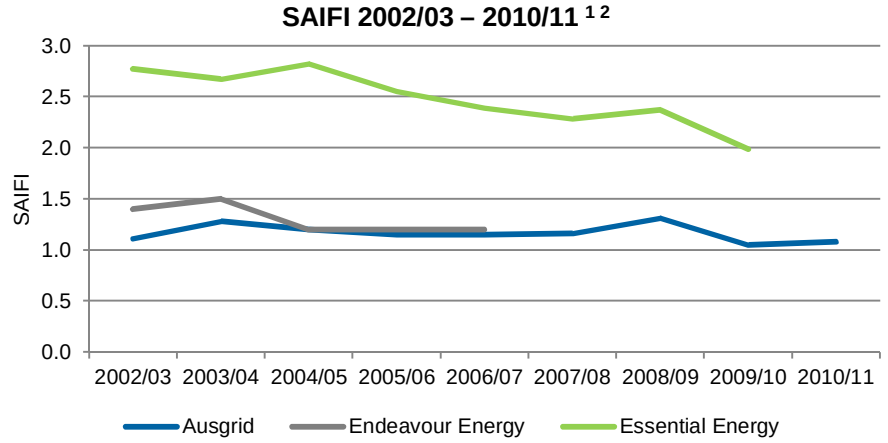
Key operating license performance indicators such as the average duration and frequency of interruptions have been improving over time

Definitions

- SAIDI - measure the average Duration of interruptions
- SAIFI - measures the average frequency of interruptions

Year	SAIDI			SAIFA		
	Ausgrid	Endeavour	Essential	Ausgrid	Endeavour	Essential
2002/03 [1]	84	121	306	1.11	1.4	2.77
2003/04 [1]	99	126	262	1.28	1.5	2.67
2004/05 [1]	90	93	299	1.2	1.2	2.82
2005/06 [1]	90	99	304	1.15	1.2	2.55
2006/07 [1]	102	94	242	1.15	1.2	2.39
2007/08 [2]	100	98	225	1.16	n/a	2.28
2008/09 [2]	108	89	267	1.31	n/a	2.37
2009/10 [2]	79	79	196	1.05	n/a	1.99
2010/11 [2]	99	87	n/a	1.08	n/a	n/a





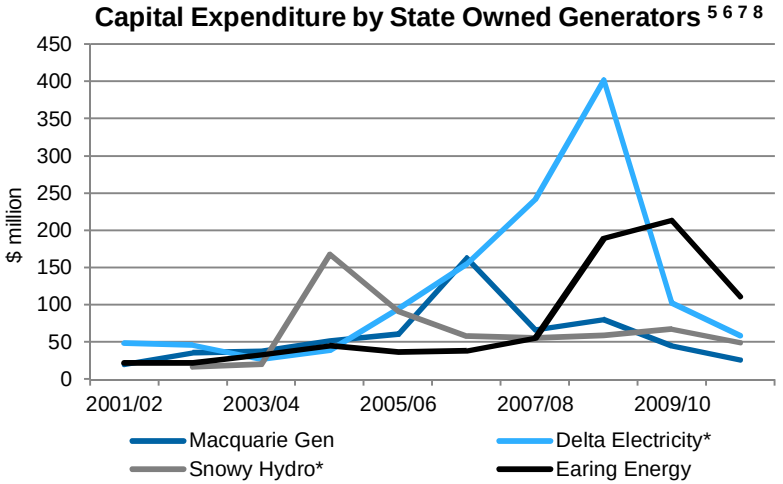
[1] IPART (2008) NSW Electricity Information Paper No 2/2008: Reliability and quality of supply of electricity to customers in NSW
[2] Relevant year Network Performance Report – Published by entity

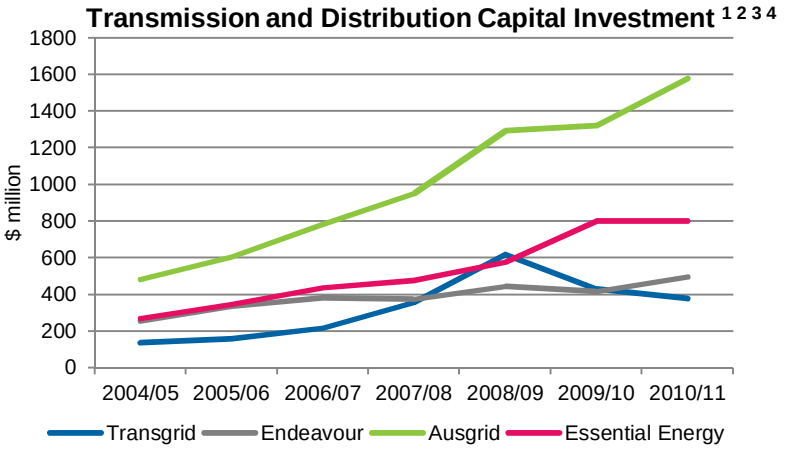
Capital investment decisions appear to be driven by network reliability, renewal and growth

Capital Investment Drivers

- Increased network performance (reliability)
- Increasing customer connections (growth)
- Meeting modern infrastructure standards (renewal)
- Ensuring safety

Capital Expenditure ($ million)				
Year	TransGrid [1]	Ausgrid [2]	Essential Energy [3]	Endeavour Energy [4]
2004/05	138.3	484.0	271.0	256.8
2005/06	158.6	604.0	347.0	336.5
2006/07	218.2	784.0	437.0	381.6
2007/08	355.0	951.0	474.0	373.5
2008/09	619.9	1,291.0	576.0	442.9
2009/10	428.7	1,319.0	800.0*	417.4
2010/11	378.6	1,578.0	800.0*	496.4



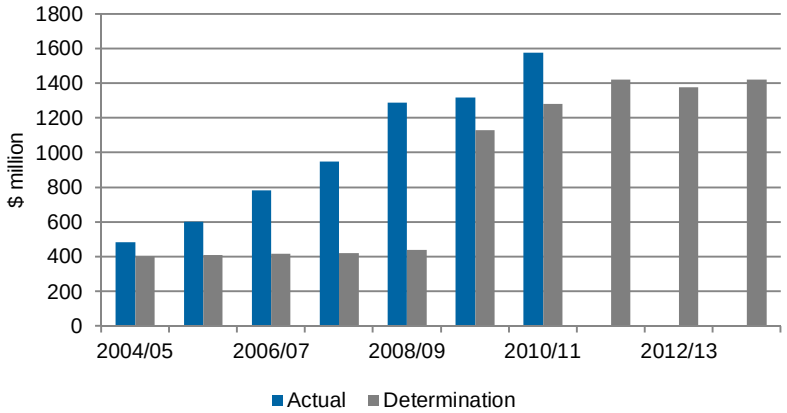


[1] TransGrid Annual Report for relevant years
[2] Ausgrid Annual Report for relevant years
[3] Essential Energy Annual Report for relevant years
[4] Endeavour Energy Annual Report for relevant years
* Essential Energy have a forecast spend of $4 billion 2009 – 2014 and it has been assumed that annual capital investment will be $ 800 million

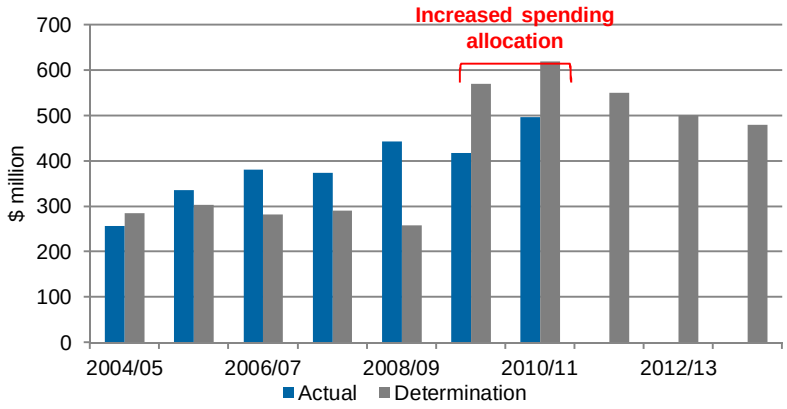
[5] Macquarie Generation Annual Report for relevant years
[6] Delta Electricity Report for relevant years
[7] Snowy Hydro Annual Report for relevant years
[8] Earing Energy Annual Report for relevant years

Approved capital determinations have been lower than actual capital spend

Ausgrid Capital Expenditure [1, 2, 3, 5, 6]



Endeavour Energy Capital Expenditure [2, 3, 4, 5, 6]



Discussion [5]

- Some overspend was seen by the NSW electricity distributors during the 2004 2009 determination period
- These overspends can be attributed to a number of reasons:
  - ACCC/IPART allowances were low
  - Unit rates for construction costs did not reflect market conditions
  - Higher than forecast reliability and augmentation expenditure
- AER has considered these claims and incorporated the information into the next determination period
- Evidence of such can be seen in Endeavour Energy capital expenditure. 2009/10 and 2010/11 were the first years actual spend fell below approved spend

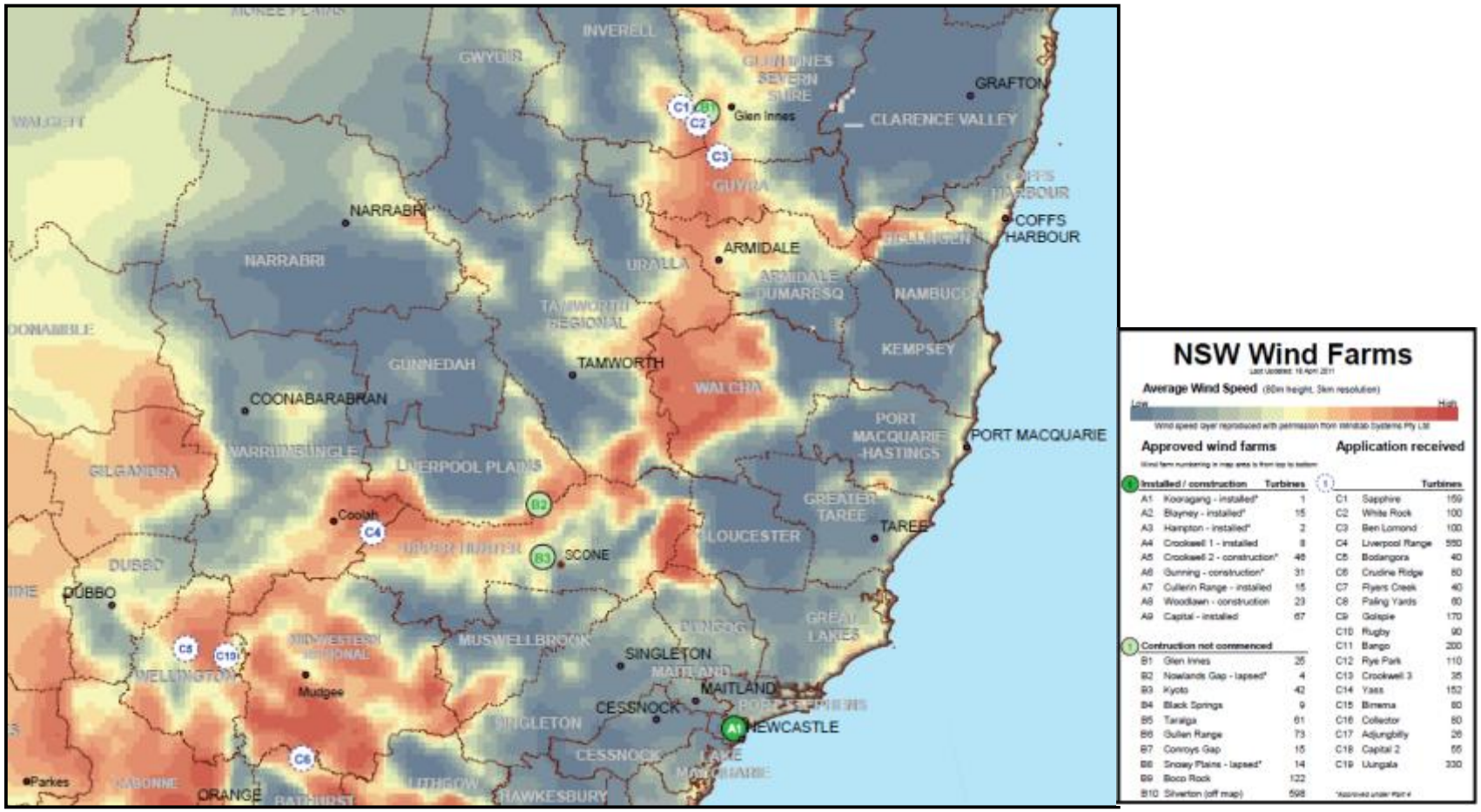
[1] Ausgrid Annual Report for relevant years
[2] AER (2009) NSW Distribution Determination 2009/10 - 2013/14: Final Decision
[3] IPART (2004) NSW Electricity Distribution Pricing 2004/05- 2008/09
[4] Endeavour Energy Annual Report for relevant years
[5] AER (2008) NSW Draft Determination Decision 2009/10 – 2013/14
[6] Figures for 2004/05 – 2008/09 are in nominal term, while figures for 2009/10 – 2013/14 are in 2008/09 dollars.

There are a number of environmental issues that may impact power generation infrastructure

Issue	Description
Peak and baseload demand	• Residential peak demand appears to be growing at a faster rate than energy demand which may have a direct impact on type of generation infrastructure investment [1]
Carbon price policies	• A price on carbon is likely to favour gas powered generators to provide baseload capacity along with continued expansion in wind energy and other renewable energy technologies as they become increasingly commercially viable.[2] (refer to following pages for a map of installed, construction-ready and proposed wind farms) • Price forecast for the next 4 years from impacts due to carbon policy (carbon price, renewable, gas and new plant costs in generation mix) will see average residential prices increase by ~10% above the projected price increases (discussed in the following pages)
NSW greenhouse gas emissions and trends	• Stationary energy (emissions from fuel consumption for electricity generation, fuels consumed in the manufacturing, construction and commercial sectors, and other sources like domestic heating) contribute 49% of NSW greenhouse gas emissions of which the burning fossil fuels for electricity generation accounts for 99% of this sector • Carbon emissions have declined, through a decrease in demand, due to the global financial crisis and through the increase in demand for gas fired power stations • Demand for electricity is forecast to continue to grow by about 1.8% annually to 2020 and beyond which will mean a continued increase in industrial emissions even if targets for renewable energy are achieved [3]
Coal seam gas	• The major coal producing basins of New South Wales are attractive targets for the emerging coal seam gas to LNG sector • It is estimated that the amount of methane contained within the coal seams is several times greater than the current reserves for conventional natural gas [4] • This is a potential good source for future electricity generation in NSW (albeit competing with LNG development). However, there is wide-spread community concern about the extraction of coal seam gas, in particular, issues associated with possible ground water impacts, disposal of salt / brine, impacts on cropping and pastoral land use and other environmental issues. A significant degree of uncertainty pertains to the coal seam gas sector in Australia currently. • A parliamentary inquiry which will provide the community with a forum to air their concerns is being undertaken, the final report from which is due next April [5]

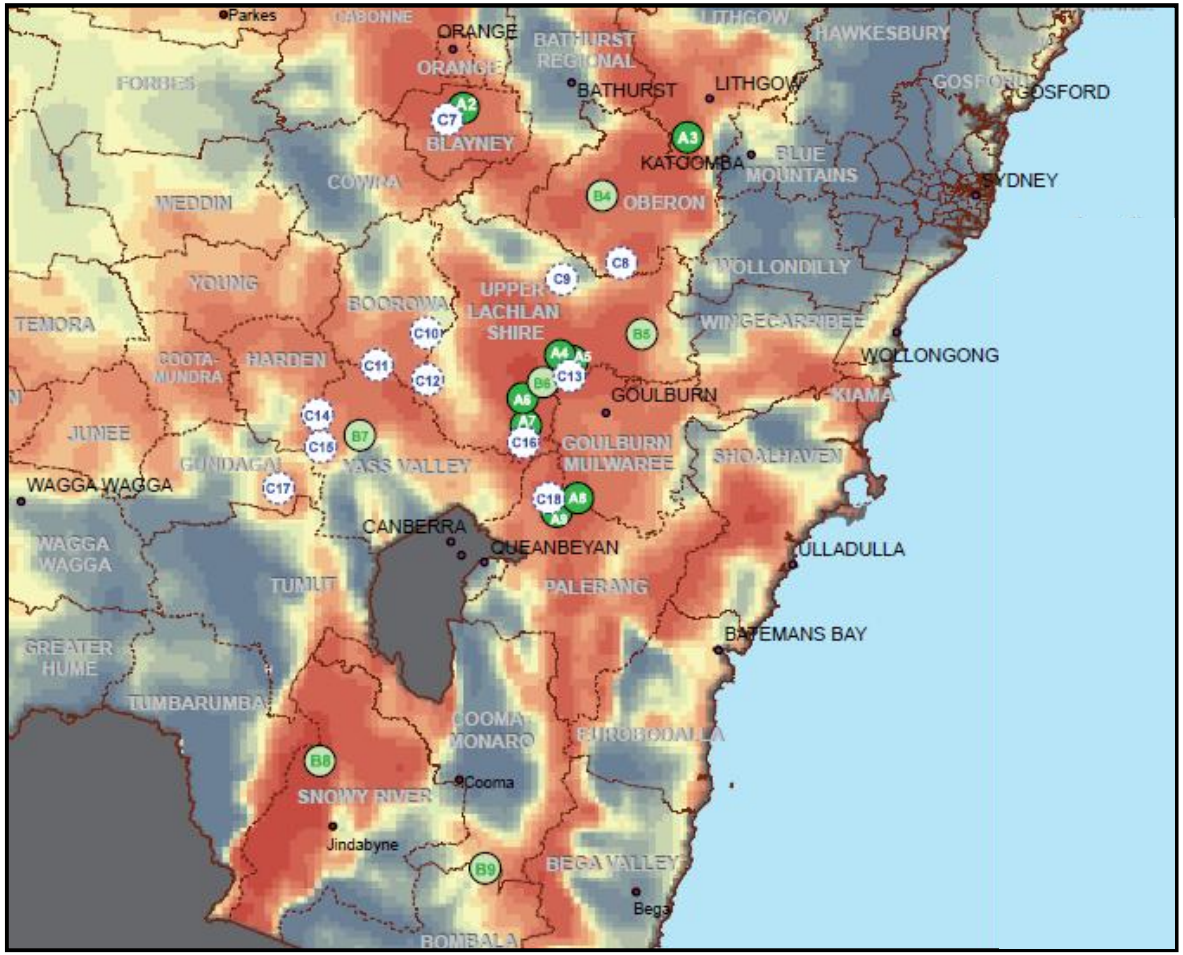
[1] Ausgrid (2011) http://www.ausgrid.com.au/Common/Our-network/Network-regulation-and-reports/Regulatory-submissions.aspx
[2] Commonwealth of Australia (2011) Draft Energy White Paper
[3] NSW Government Office of Environment and Heritage (2011) http://www.environment.nsw.gov.au/climatechange/emissionsoverview.htm
[4] NSW Government Department of Primary Industries (2011) http://www.dpi.nsw.gov.au/minerals/geological/overview/regional/sedimentary-basins/methanensw
[5] Newcastle Herald (2011) http://www.theherald.com.au/news/local/news/general/nsw-inquiry-on-coal-seam-gas-fracking/2249958.aspx

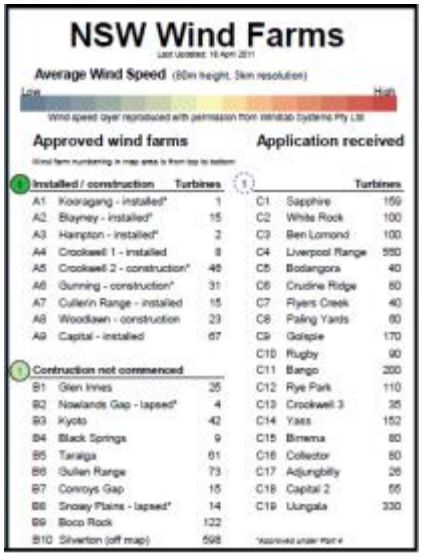
Installed, construction-ready and proposed wind farms are in locations where average wind speed is high and relatively near existing transmission pipelines



Adapted from Department of Planning and Infrastructure (2011) *NSW Wind Farms*, http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=HC-K5QiJVsM%3D&tabid=394&language=en-US.

Large number of installed, construction-ready and proposed wind farms are located within inner south-west of NSW





Adapted from Department of Planning and Infrastructure (2011) *NSW Wind Farms*, http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=HC-K5QiJVsM%3D&tabid=394&language=en-US.

Estimates from 2011 IPART review indicate an increase in retail electricity prices of 2%-10% in 2012/13 excluding the carbon price impact

Discussion

- The 2011 IPART[1] review indicates an estimated increase of 2%-10% increase in retail electricity prices in 2012/13. This reflects predominately increases in network costs, which accounts for about 52% of residential customer electricity bills in 2011/12
- Noting this increase excludes the effect from introduction of carbon price on 1 July 2012

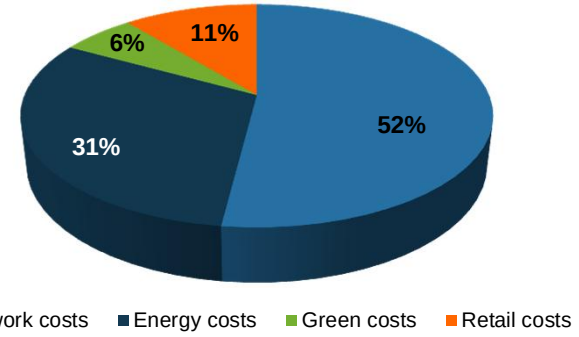
Indicative estimated annual bill for retail customers in each standard supply area ($ nominal) [1]

Retail customers	2011/12	2012/13	Change	% Change
Energy Australia (TRUenergy)	1,513	1,664	151	10.0%
Country Energy (Origin Energy)	1,607	1,639	32	2.0%
Integral Energy (Origin Energy)	2,063	2,259	196	9.5%
Business customers	**2011/12**	**2012/13**	**Change**	**% Change**
Energy Australia (TRUenergy)	2,365	2,601	236	10.0%
Country Energy (Origin Energy)	2,289	2,335	46	2.0%
Integral Energy (Origin Energy)	3,445	3,772	327	9.5%

Estimated cost of electricity in 2012/13 – Estimates made in March 2010 vs estimates made in 2011 (nominal ex-GST, $/MWh) [1]

Cost components	Energy Australia	Country Energy	Integral Energy
Network charges (as determined by the AER)	139	109	189
Wholesale energy costs	78	83	79
Retail costs and margin	29	24	30
Subtotal - $/MWh announced in March 2010	246	217	295
New costs arising from changes to RET in 2011	6	7	7
Other changes arising from 2011 update	4	2	-1
Total $/MWh for 2012/13	**256**	**226**	**301**

Cost components of an electricity bill in 2011/12 [2]



[1] Independent Pricing and Regulatory Tribunal (IPART) (2011) *Changes in Regulated Electricity Retail Prices from 1 July 2011*—Final Report.
[2] IPART (2011) *Fact Sheet: Updating regulated electricity price increases for 1 July 2012.*

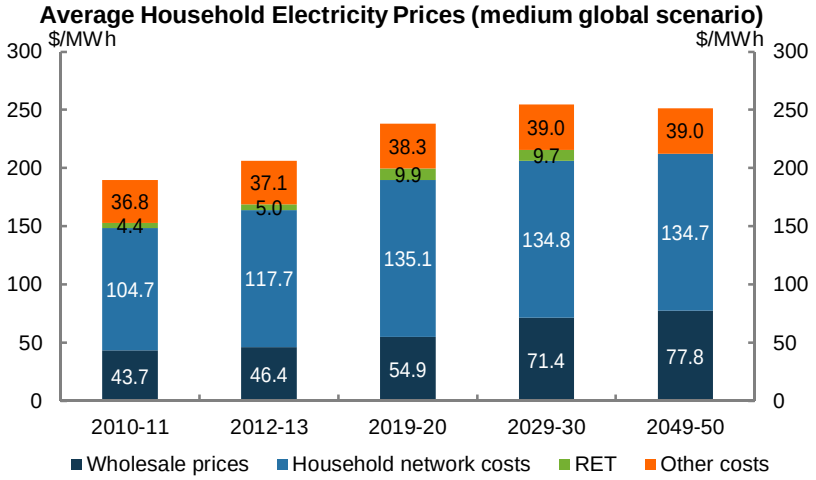
The carbon price will increase average residential prices by ~10% above the projected price increases for 2013-2017

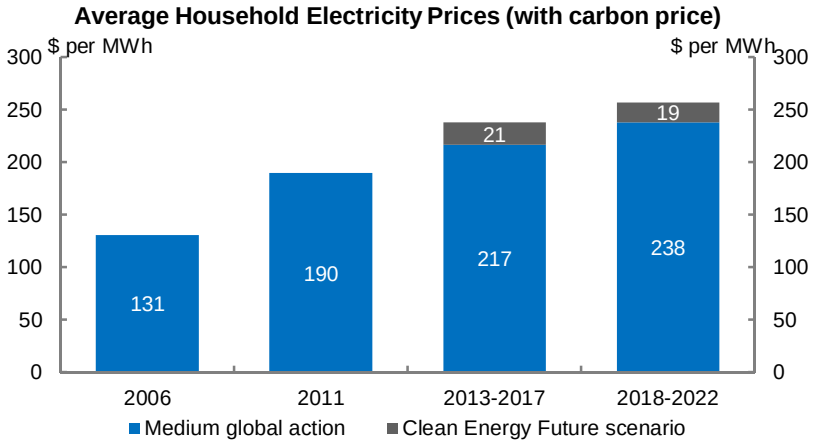
Discussion

- According to Treasury's modelling, household electricity prices are projected to increase by 16% over the next 5 years, partly from higher wholesale prices (driven by higher gas prices and increased costs of new generation capacity) but also from rising network charges. The costs from Renewable Energy Target (RET) are also expected to grow as the target increases
- The effect of carbon price in wholesale electricity prices will lead to an average increase in household electricity prices of an additional 10% over the first 5 years of the scheme
- Under the core policy scenario, Treasury projects average weekly household expenditure will be higher by around $9.90 in 2012-13, of which electricity accounts for around $3.30
- The carbon price effect on regulated electricity retail prices in NSW is the subject of a current review by IPART

Core Policy Assumptions

Carbon price nominal A$/t CO_2-e	2012-13	$20, $23 for household modelling
	Escalator	5% pa plus inflation for 2 years
	Flexible price	Projected to be $29 in 2015-16
World stabilisation target		550 parts per million
Australian emission reduction target		5% below 2000 levels by 2020 80% below 2000 levels by 2050
Emission-intensive trade-exposed industries (EITE)		Assistance starts at 94.5% or 66%, depending on intensity, and declining at an annual rate of 1.3% pa

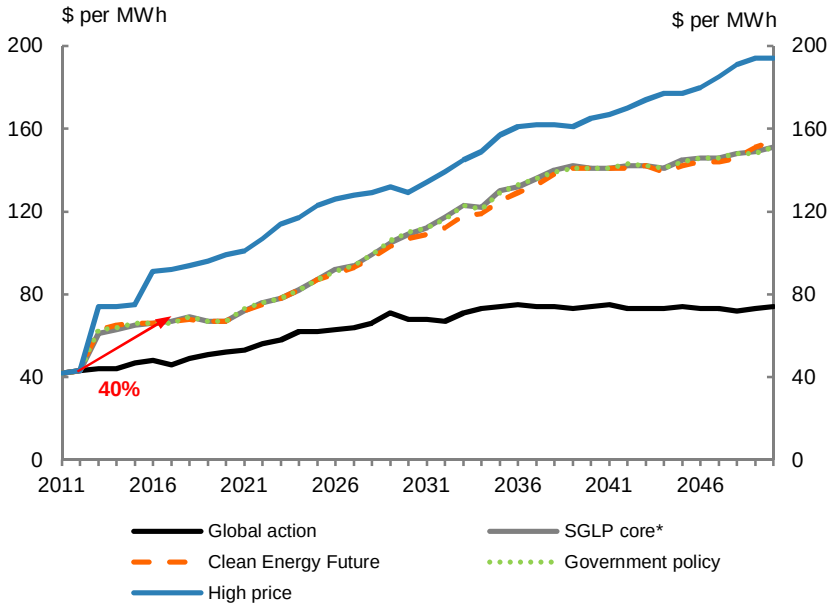




Commonwealth Treasury (2011) *Strong Growth, Low Pollution, Modelling a Carbon Price.*

The introduction of a carbon price will increase average Australian wholesale electricity prices by 40% in the first 5 years

Average Australian Wholesale Electricity Prices[1]



* SGLP core is the base case in the original modelling in *Strong Growth Low Pollution.*

Discussion [1]

- The average Australian wholesale electricity prices are forecast to increase significantly from the current level with around $18 per MWh higher on average over the first 5 years, equivalent to about 40% increase
- This increase reflects rising gas prices and new, higher capital cost plants entering the market to meet growing demand
- Noting wholesale electricity prices are sensitive to assumptions about energy commodity prices and capital costs. Changes in the prices of coal and gas would have an immediate impact on electricity prices
- Wholesale electricity prices in NSW will increase by about the same amount during the first 5 years

Average wholesale electricity price increases[1]	2013-2017 (%)	2018-2022 (%)	2046-2050 (%)
NSW	**40**	**34**	**123**
VIC	47	38	82
QLD	49	43	122
WA	34	38	103
SA	41	34	65
TAS	42	42	77
NT	42	37	106
Average	**40**	**34**	**123**

[1] Commonwealth Treasury (2011) *Strong Growth, Low Pollution, Modelling a Carbon Price.*

There are a number of key issues that may impact power transmission infrastructure

Issue	Description
Network reliability impacted by load growth	• Increases in load growth, and hence the utilisation of the transmission network, results in scheduling outages for construction and maintenance becoming increasingly difficult [1]
Ageing assets	• TransGrid's network is one of the largest and one of the oldest in Australia • More investment might therefore be needed for the next regulatory period [1]
Cost of infrastructure	• Cheaper capital cost for gas transmission infrastructure compared to same distance electricity transmission to support a combined-cycle gas turbine generator [2]
Community expectations	• Heightened awareness of environmental issues in the community has led to an increased expectation that electricity supply and construction will be undertaken in an environmentally sensitive manner • Areas of community concern include visual impact, noise, waste, conservation and preservation, and consideration of property owners. These expectations are reflected in stringent environmental regulations that impact TransGrid's operations. These regulations have become progressively more prescriptive and there is no expectation that these standards will be relaxed in the future • The major cost from an environmental point of view is likely to be expenditure on measures to ensure compliance [1]
Climate change policies	• The Renewable Energy Target (RET) scheme and the Federal Government's proposed emissions control schemes currently being debated are factors which could promote increased wind and other renewable generation development activity in NSW • There are a large amount of wind generation resources in NSW near existing transmission lines • Generation development connections that do not require the construction of new major transmission links can be developed relatively quickly [3]

[1] TransGrid (2008) *Revenue Proposal 1 July 2009 - 30 June 2014*
[2] AEMO (2011) *National Transmission Network Development Plan 2011 – Chapter 8*
[3] TransGrid (2011) *TransGrid New South Wales Annual Planning Report 2011*

The distribution network may face a variety of challenges from climate variability to changes in generation methods

Issue	Description
Growing demand	• Growth in peak demand is far more rapid than growth in general energy consumption [1] • Peak electricity demand is being driven up by the use of energy intensive domestic appliances • Electricity demand appears to be most closely related to variation in temperature and economic activity, while demand management strategies such as energy savings initiatives have also contributed to reducing energy consumption (refer to the following pages for a discussion on demand drivers) • COAG is intended to develop and implement better demand-side reforms to reduce growth in peak demand [2]
Ageing assets	• Unless appropriate maintenance and renewal regimes are effectively adopted, as assets age the ability of assets to provide a safe, secure, and reliable energy supply decreases • Some electricity distributors have a considerable portion of assets over 50 years old – this asset age profile will have to be taken into consideration in capital works programs and future pricing submissions
Climate variability	• Climate variability has direct consequences on electricity infrastructure such as increased temperatures, increased storm frequency, unprecedented weather events and more variable rainfall • Bushfires, severe thunderstorms, flooding and drought have the potential to have devastating effects on the physical infrastructure • Infrastructure will need to become increasingly resilient to such events to ensure supply is not interrupted and, if any interruptions do occur they are kept to a minimum • Climate variability will also impact the generation mix and changes in peak demand [3]
Emergence of co-generation facilities	• Deregulation within the electricity industry, in combination with increased international desires to reduce greenhouse gas emissions, is promoting the increased establishment of co-generation facilities • The existing and possible future use of embedded generation in the electricity network has created the need to review current network planning, network configuration and construction standards [4]

[1] Ausgrid (2011)http://www.ausgrid.com.au/Common/Our-network/Network-regulation-and-reports/Regulatory-submissions.aspx
[2] Commonwealth of Australia (2011) Draft Energy White Paper
[3] Endeavour Energy (2011) http://www.endeavourenergy.com.au/wps/wcm/connect/ee/nsw/nsw+homepage/environmentnav/climate+change/impact+of+climate+change
[4] Endeavour Energy (2011) Endeavour Energy Annual Planning Statement

Lessons from Victorian smart meters rollout indicate the importance of sound and robust analysis as part of the program decision making process

Background to Victorian Smart Meters Program[1]

- The Victorian Advanced Metering Infrastructure (AMI) (or the smart meters) Program was developed in 2004 with the aim to enable innovative network and retail tariffs and demand management services, which in turn would encourage peak demand reduction and improve the efficiency of the network and reduce the need to build peaking generation plants
- A cost-benefit analysis (CBA) study was conducted in 2005 to examine the net societal benefits of the AMI (the then Interval Meter Rollout (IMRO) Program) with the result of a net benefit of $79 million (benefits $432 million and costs $353 million)
- In 2009, the Victorian Auditor-General's Office (VAGO) criticised the 2005 AMI Program decision making process by the Department of Primary Industries (DPI). In response to VAGO's criticism, DPI commissioned further analysis of the benefits and costs in 2009 and 2010 with benefits conducted by Futura and costs conducted by EMCa with the report compiled by Oakley Greenwood
- The report concluded the AMI rollout would deliver low case benefit of $2.577 billion against expected costs of $1.813 billion. The Oakley Greenwood report was then reviewed by Deloitte to confirm its work aligned to Victorian government guidance material on best practice
- In 2011, Deloitte was appointed by the Department of Treasury and Finance (DTF) to undertake a reassessment of the costs and benefits of the AMI Program. CBA study from Deloitte indicated a lower benefit of $2.03 billion against higher costs of $2.349 billion

Benefits and Costs of the AMI Program

- The review provided a number of scenarios: (1) total AMI Program over 2008-28; (2) continuing the AMI Program from 2012; and (3) removing the AMI mandate from 2012

($ million)	1. AMI Program 2008-28 (NPV at 2008)	2. Continuing AMI from 2012 (NPV at 2012)	3. Slowing the pace from 2012 (NPV at 2012)
Total cost	2,349	1,572	1,394
Total benefits	2,030	2,285	1,736
Net	**-319**	**713**	**343**

- Although the 'slowing the pace' scenario concludes with a net benefit of $343 million, it would involve significant risks, which if they eventuate, could significantly reduce net benefits. These risks include risks associated with a significant customer backlash and rejection of smart metering technology and the potential for a lack of customer engagement
- Deloitte acknowledged that they may not have quantified all possible benefits of smart meters, especially given AMI creates a platform for changing the way electricity is delivered to customers. Over time, as market participants, policy makers and customers experience and understand the potential of AMI over time, it could deliver additional benefits in network operations and energy management that were yet unknown
- It has been reported that the AMI installed have a lifespan of just 15 years and that they are incompatible with the National Broadband Network (NBN). Communications analyst Paul Budde believes the cost of Victoria's smart meter program would be cut by more than $500 million if broadband-friendly meters were used[2]

[1] Deloitte (2011) *Department of Treasury and Finance: Advanced metering Infrastructure Cost Benefit Analysis – Final report*.
[2] Crawford, C (2011) 'Smart meters incompatible with National Broadband Network', *Herald Sun*, 6 October 2011.

Report Outline

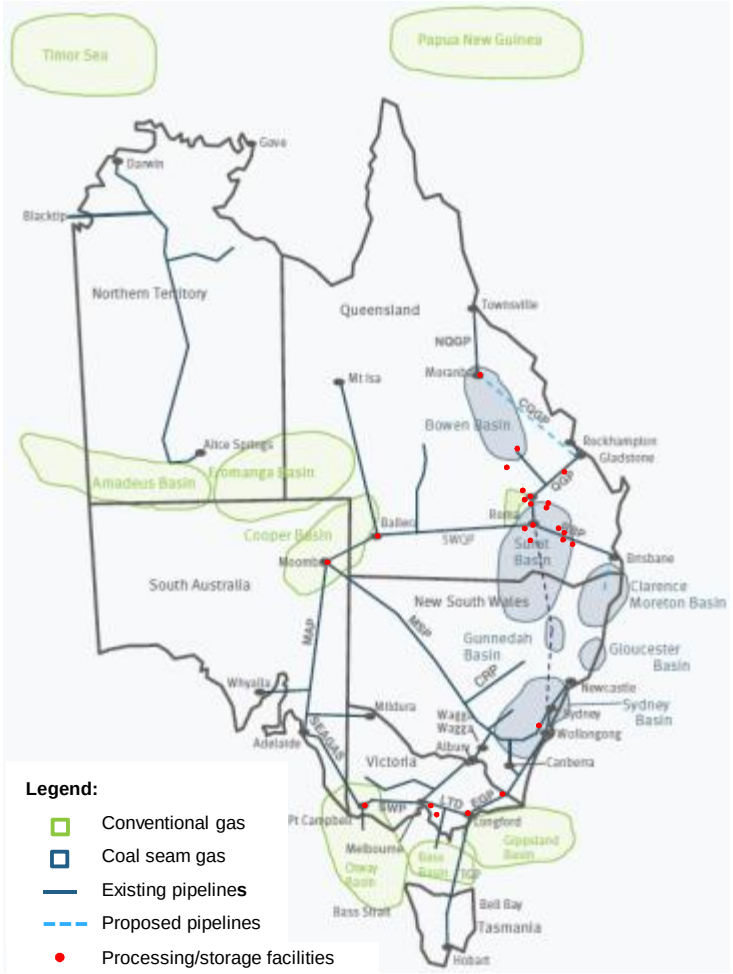
- Key Highlights
- Introduction
- Energy Industry Overview and Current Situation
- Electricity
- **Gas**

~8.6% of total energy needs in NSW are met by natural gas - 96.7% is imported from South Australia and Victoria

Overview

- All gas infrastructure is privately owned
- 8.6% of NSW energy needs are met by natural gas (2011)
- There are no significant conventional gas reserves in NSW - a small volume of natural gas is sourced from deposits at Camden by Sydney Gas Limited's Gas Project
- The majority (96.7%) of gas supplied to NSW is sourced from South Australia and Victoria via the Moomba, Eastern Gas Pipeline (EGP), and Culcairn interconnect pipelines
- Known coal seam gas (CSG) reserves are increasing as exploration continues at Narrabri by Western Star Gas and in the Gloucester and Gunnedah Basins
- NSW has a 26,000 km gas piping network, which accounts for 23% of gas transmission and distribution networks Australia-wide

Eastern Australia Gas Reserves and Pipelines[5] [6]



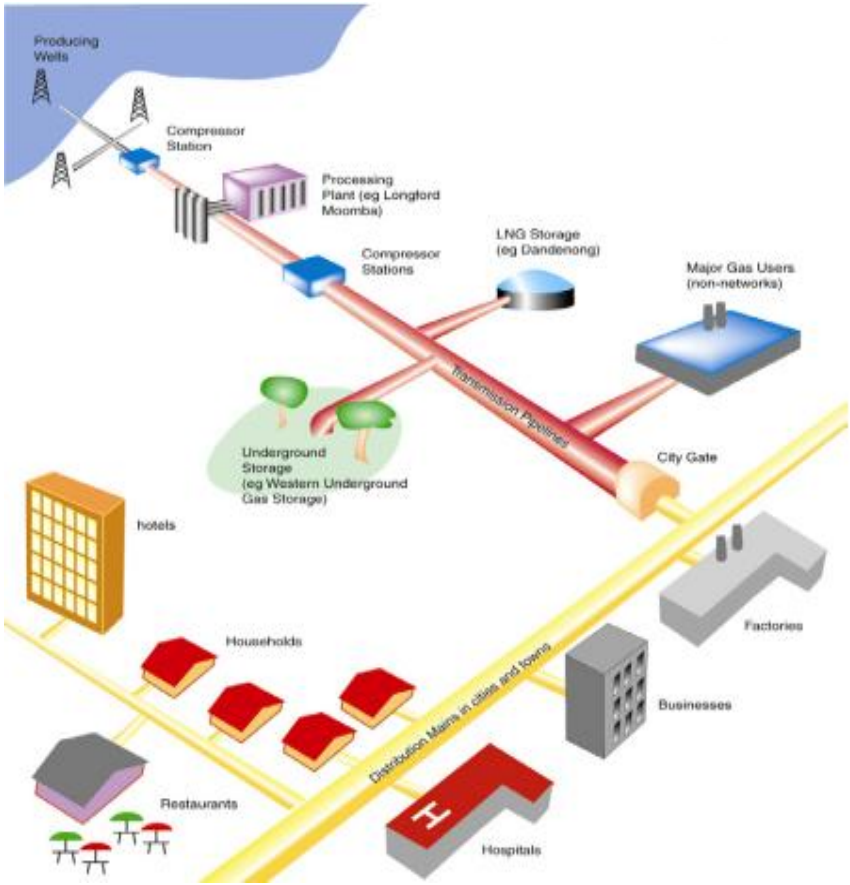
[1] ESAA (2011) Electricity gas Australia, ABARES (2011) Energy in Australia 2011 and GHD analysis
[2] ABS (2011) 13381DO002_201012 NSW State and Regional Indicators, Dec 2010
[3] NSW Trade and Investment (2011) http://www.trade.nsw.gov.au/energy/gas
[4] Engineers Australia (2010) Infrastructure Report Card NSW
[5] Department of Employment, Economic Development and Innovation (Qld) 2011, *2011 Gas Market Review Queensland*
[6] AEMO (2011) Gas statement of Opportunities

Gas transmission and distribution infrastructure is owned and operated by the private sector

Key Transmission Players	Description
APA Group	Total network of 2633 km, owner operator of the Moomba to Wilton pipeline and laterals, that connects the Cooper Basin to Sydney
Jemena	Total network of 1134 km, owner operator of the EGP pipeline and laterals connects Victoria to NSW
ActewAGL	Total network of 22 km
Envestra	Total network of 84 km

Key Distribution Players	Description
Jemena	Mains length of 30,000 kms and customer connections totalling ~1 million
ActewAGL	Mains length of 578 km and a customer base of 23,000
Envestra	Mains length of 1,790 km and a customer base of 51,119
Albury Gas	Provides gas on the Victorian border, in and around Albury
APT Allgas	Gas distribution services in Tweed Heads

Gas Delivery Process

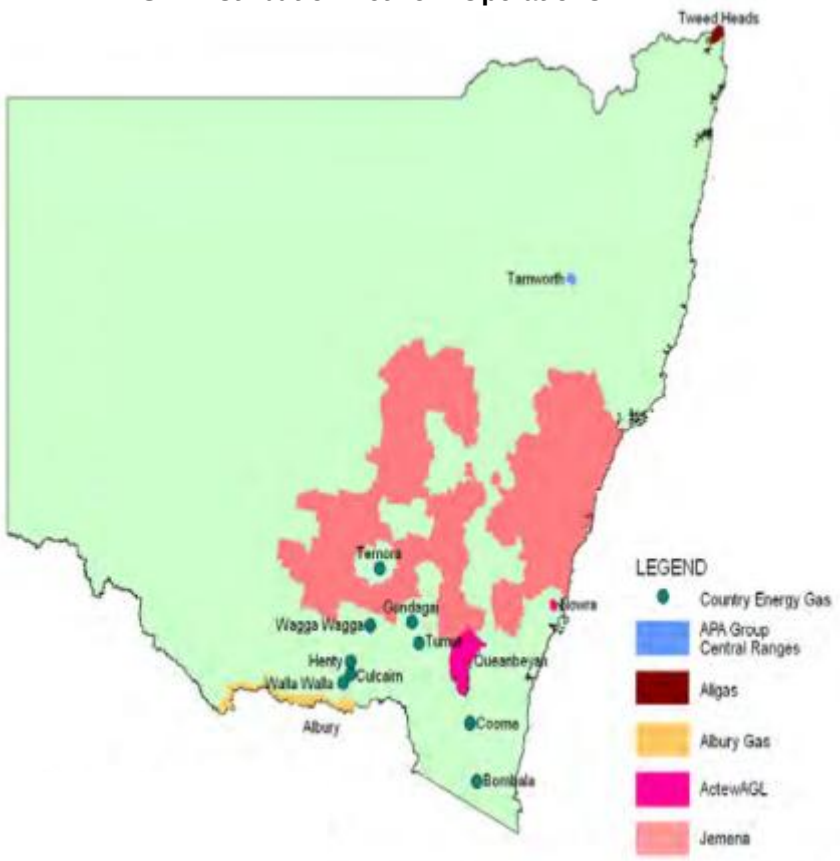


APA (2011) http://www.apa.com.au/our-business/gas-transmission-and-distribution/new-south-wales.aspx
Jemena (2011) http://jemena.com.au/what-we-do/assets/jemena-gas-network/
Energy Networks Association (2009) The Australian Gas Distribution Sector
Envestra (2011) http://www.envestra.com.au/our-business/operational-structure/gas-network-information-and-statistics/

There is a national approach to gas infrastructure planning which is supplemented by planning at the network operator level

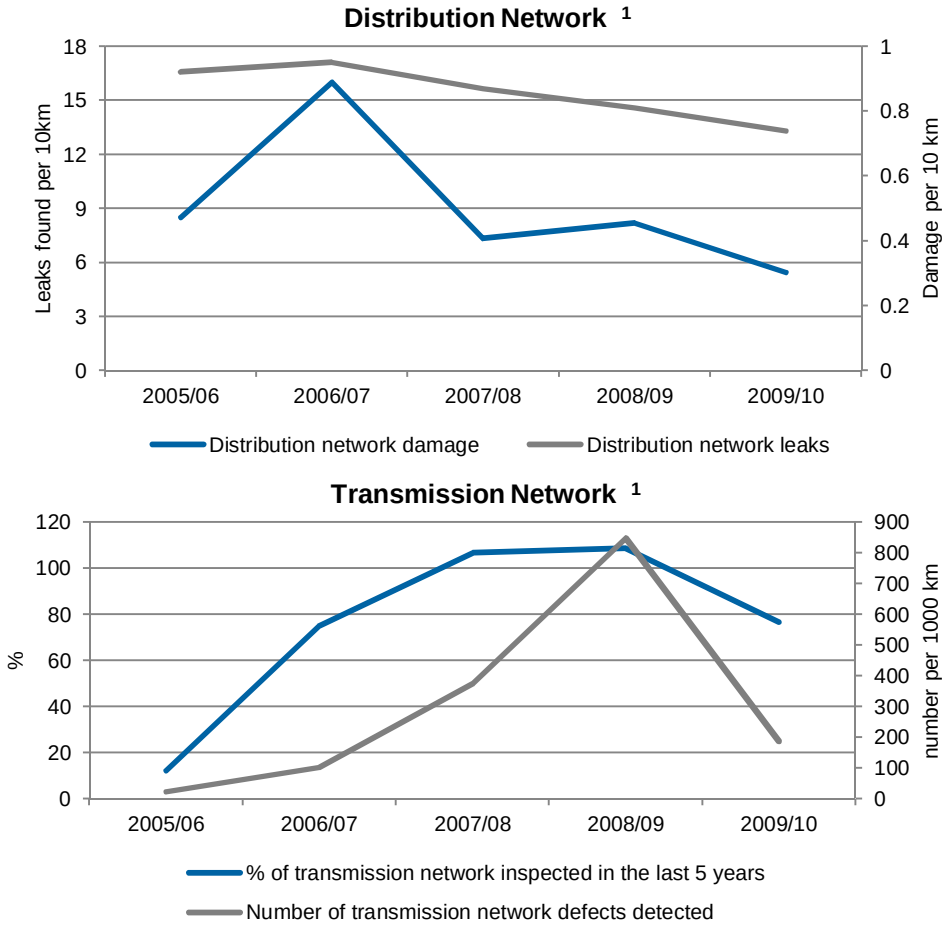
Planning Tool	Description
	National Network Planning
Natural Gas Market Development Plan	Developed by the Gas Market Leaders Group to meet the Ministerial Council on Energy's objectives and principles for Gas Market Development
Gas Statement of Opportunities	Provides existing and potential new investors with advice on making commercial decisions about investment in infrastructure within the eastern and south eastern regions of Australia [1]
PAS 30	Provide a range of planning measures on 20, 5, 2 and 1 year time frames. Providing a range of planning tools from strategic direction to annual capital investment programs
	Network Operator Planning
Safety and Operating Plan (SAOP)	Developed and implemented by the network operators. Performance is then monitored against these plans [2]
National Gas Rules	Annual planning reviews prepared by AEMO with annual forecasts by system withdrawal zones for each of the 5 years and each of the first 12 months.
Internal Asset Management plans	Guide and control capital investment to meet commercial and SAOP objectives

NSW Distribution Network Operations [3]



[1] AEMO (2011) http://www.aemo.com.au/planning/GSOO2011/gsoo.html
[2] NSW Trade and Investment (2011) http://www.trade.nsw.gov.au/energy/gas
[3] NSW Industry and Investment (2011) 2009/10 Gas Networks Performance Report

The privately owned gas distribution and transmission networks appear to be in good condition



Discussion

- In accordance with their operating license, distribution and transmission infrastructure owners are required to survey 100% of the network every 5 years
- This survey regime provides owners with a good understanding of the network condition
- Distribution network leaks have been declining since 2006/07
- Data implies that the condition of the transmission network has been declining. However the peaks in defects and damage detected could also be explained by the increase in the coverage of the inspection regime
- Additional data is required to further explore the condition of gas transmission and distribution network
- Over a 5-year regulatory period, the actual timing of individual capital and operational expenditure may be adjusted depending on current circumstances, e.g. throughput, actual cost of capital, supply and prudent business cases.

[1] NSW Industry and Investment (2011) NSW 2009/10 Gas Networks Performance Report
[2] Engineers Australia (2010) Infrastructure Report Card NSW

Demand for natural gas is expected to increase by ~50% over the next 20 years and industry will continue to be the largest consumer

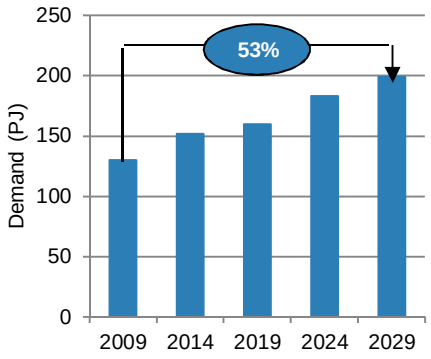
NSW Gas Demand

- The demand for gas in NSW is expected to increase by 53% by 2029
- Gas connections in NSW have grown by 14% since 2005-06
- This growth is expected to continue in response to major residential developments such as the north and south west growth areas in Sydney, South Wollongong, Central Coast and Hunter Region and; energy efficient housing requirements (BASIX)

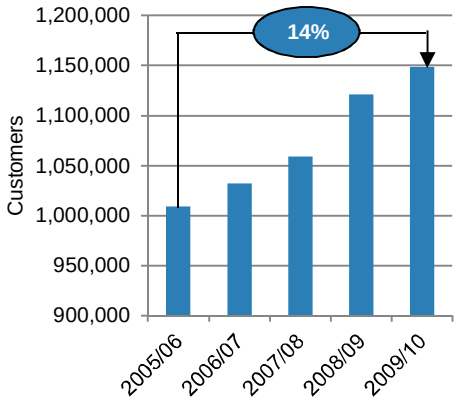
Industry Demand

- Manufacturing, electricity generation and the mining industries will continue to be the largest consumers of gas over the next 20 years (accounting for ~ 88% of consumption by 2029-30)
- The impact that this growth will have on residential supply requires further investigation

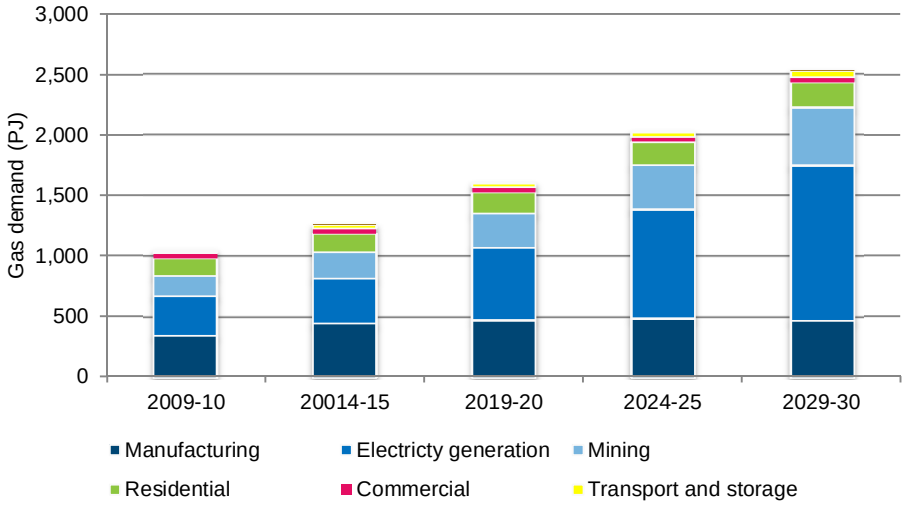
NSW Gas Demand



Active NSW Gas Connections



Projected Primary Domestic Gas Demand Nationally[2]



[1] NSW Industry and Investment (2011) NSW 2009/10 Gas Networks Performance Report
[2] ESAA (2011) Electricity Gas Australia 2011 and GHD analysis

Based on the current PJ to MW ratio, an additional 200 PJ is required to meet gas demand from proposed GPG projects

Gas demand for GPG

- Gas demand for gas powered generation (GPG) represents 28% of total domestic gas demand in Eastern Australia and consumed about 200 PJ in 2010
- Current publicly announced proposed GPGs will add an extra 10,310 MW to the current capacity of 14,661 MW and bring the total GPG capacity in Eastern Australia to 24,971 MW
- Given the current utilisation of PJ to MW ratio, this could mean an additional gas demand of around 200 PJ /pa

Market Segment	SA	VIC	TAS	NSW/ACT	QLD	Total
Mass Market (%)	11	56.9	4.8	34	3	28
Large Industrial (%)	26	39.4	35.5	53.2	52.2	43.9
GPG (%)	63	3.7	59.7	12.9	44.8	28.1
Total (PJ)	**101.7**	**213.4**	**10**	**129.8**	**200.8**	**655.5**

Current GPG in Eastern Australia	Capacity[2] (MW)	Number of Generating Units[3] (MW)	Electricity Generated in 2010 [4] (GWh)	Gas Used in 2010 [4] (PJ)	PJ/MW[4]
South Australia	2,668	36	6,553	60.54	0.0227
Victoria	2,396	24	675	7.79	0.0043
Tasmania	371	6	1,330	9.90	0.0316
New South Wales	2,109	15	2,959	22.20	0.0120
Queensland	3,563	56	10,627	97.51	0.0324
Total	11,107	137	22,143	197.94	0.0205

Proposed Projects in Eastern Australia	Generating Unit Type	Status	Planned Capacity (MW)	Planned Commissioning Date
South Australia			**1,595**	
Cherokee Power Station	OCGT	Publicly announced.	250	Dec-13
Pelican Point S2	OCGT	Publicly announced.	320	To be announced.
Point Paterson	CCGT	Publicly announced.	150	Dec-14
Quarantine 6	OCGT	Publicly announced.	125	Oct-15
Torrens Island C	OCGT	Publicly announced.	500-750	To be announced.
Victoria			**2,650**	
Mortlake Stage 2	OCGT	Publicly announced.	550	Jul-15
Shaw River	CCGT	Publicly announced.	500	To be announced.
Tarrone GT	OCGT	Publicly announced.	500-600	To be announced.
Yallourn CCGT	CCGT	Publicly announced.	1,000	To be announced.
New South Wales			**3,820**	
Bamarang	CCGT or OCGT	Publicly announced.	300 or 400	To be announced.
Dalton	OCGT	Publicly announced.	500	Oct-12
Kerrawawy GT	OCGT	Publicly announced.	1,000	Jan-17
Leafs Gully	OCGT	Publicly announced.	360	To be announced.
Marulan	CCGT or OCGT	Publicly announced.	350 or 450	To be announced.
Parkes Peaking	OCGT	Publicly announced.	150	To be announced.
Tallawarra B	OCGT	Publicly announced.	450	To be announced.
Wellington	OCGT	Publicly announced.	510	Sep-14
Queensland			**3,245**	
Braemar 3	OCGT	Publicly announced.	500	Dec-13
Darling Downs Stage 2	OCGT	Publicly announced.	501	May-14
Diamantina	CCGT	Publicly announced.	2 x 121	Dec 2013, Mar 2014
Spring Gully	CCGT	Publicly announced.	1,000	Jan-19
Westlink Stage 1, 2, and 3	OCGT	Publicly announced.	334 each	2014, 2016, 2018
Total			**11,310**	

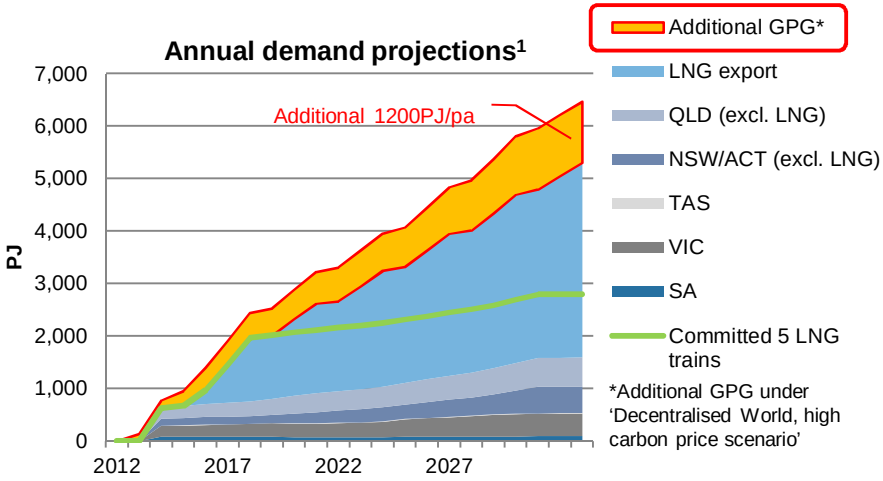
Total PJ required for planned capacity:
$\sum Planned\ Capacity \times PJ/MW = \sim$ **200PJ**

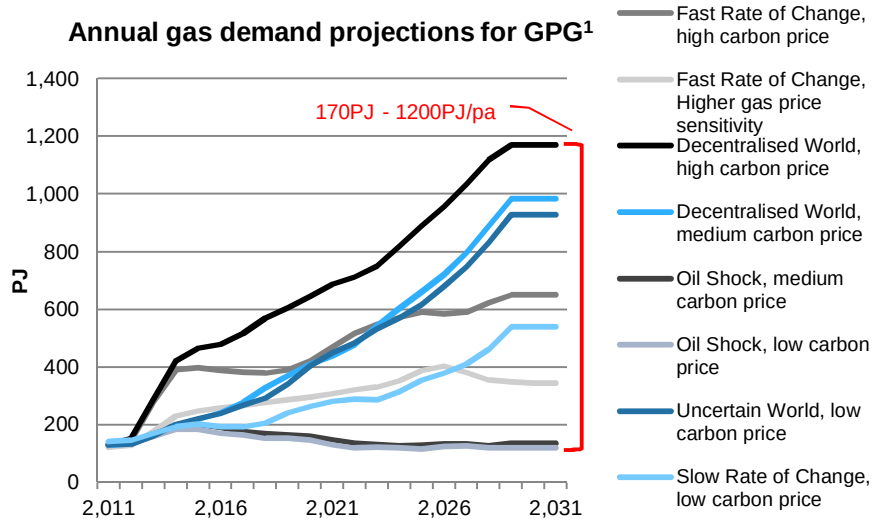
[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.
[2] Not all were operating during 2010
[3] Missing data have been assumed to be 1 generating unit
[4] Calculated from those with reported data

Existing gas processed in the southern basins would all reach maximum capacity leading to supply shortfall in the southern states

Gas demand for GPG[1]

- Under the Clean Energy Plan, Australian Government has established transitional assistance arrangements for gassy coal mines as well as for the highest-emitting power generators under the carbon price package
- With 2,000 MW brown coal fired power station in Victoria to be replaced by GPG under the Clean Energy Plan and the additional demand from the proposed GPG projects already announced to date, AEMO estimates, by 2031, annual gas demand for GPG will be in the order between 170 PJ and 1,200 PJ /pa
- Growth in gas demand for GPG is dependant on assumptions about future carbon prices, gas prices and economic growth
- AEMO's modelling suggests, under the Decentralised World scenario, gas demand for GPG is projected to reach more than 350 PJ/pa in 2029 in northern NSW, existing gas processed in the Bass, Gippsland, Otway and Sydney Basins flows east on the MSP and flows south on the MAPS would all reach maximum capacity leading to supply shortfall at one or more locations in the southern states[2]
- Under the worst case scenario, an additional 1,200 PJ is needed the current level of gas demand predominately in QLD and NSW, which would add to the annual demand projection



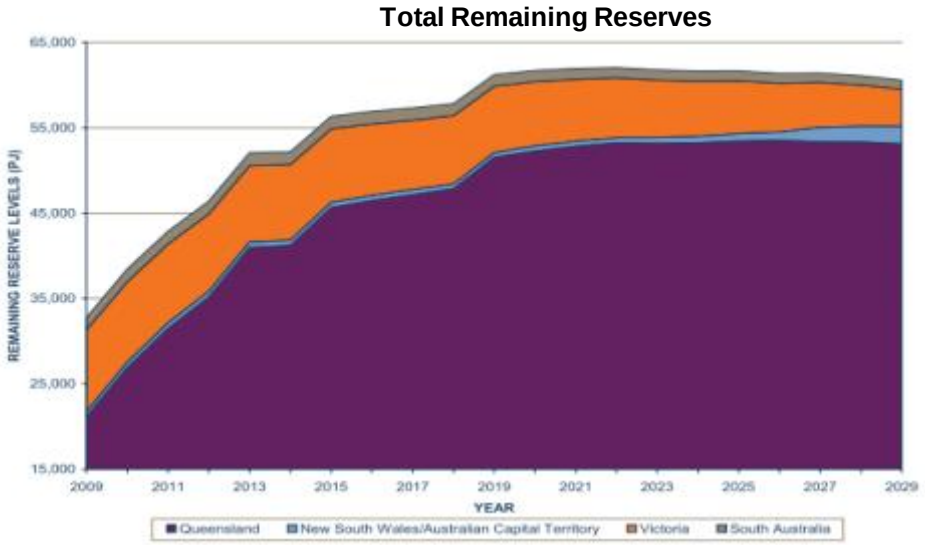


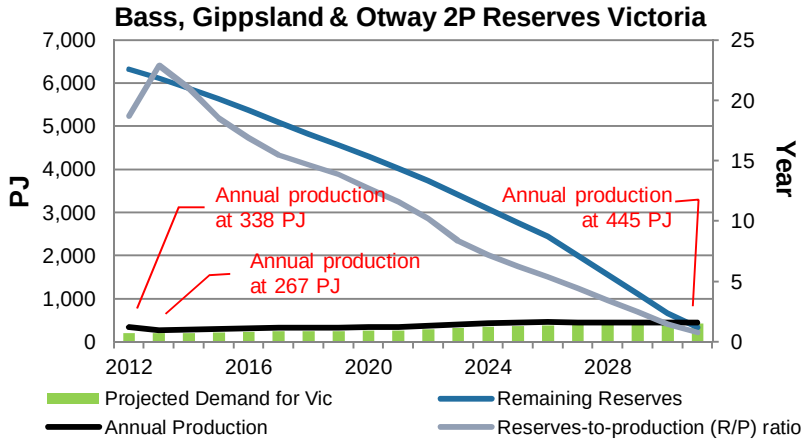
[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.
[2] The Model assumes that processing facilities in the Bass, Cooper-Eromanga, Gippsland, Otway, and Sydney Basins do not increase and the nearest surplus processing to these demands is in the Bowen-Surat Basin

2P reserves in Victoria are projected to deplete completely by 2031, however reserve growth in QLD and NSW will compensate

Discussion

- NSW is reliant on other states to supply gas through the national gas network
- 96.7% of gas consumed in NSW is imported from South Australia and Victoria
- Victorian gas reserves are expected to decline by more than 50% over the next 20 years to
- South Australian reserves are expected to decline by 25% between 2014 – 2029
- South Australian and Victorian gas fields will have less gas available for export to NSW
- However, AEMO estimates that by 2029, the total remaining reserves will have doubled. Reserve growth in QLD and NSW (primarily from CSG) is estimated to more than compensate for the depleting reserves in South Australia and Victoria
- With a 30% increase in annual production and a depleting 2P reserves in Bass, Gippsland and Otway Basins by 2031, gas supply for the southern states will need to come from alternative sources
- Annual demand in Victoria is projected to grow from current level of 214 PJ pa to 433 PJ pa by 2031



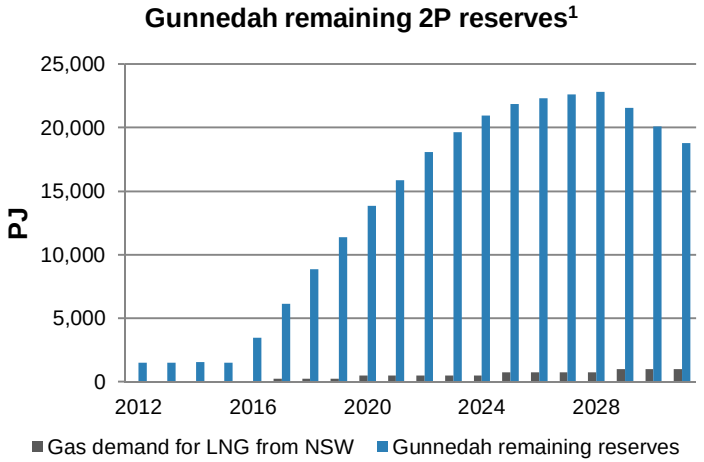


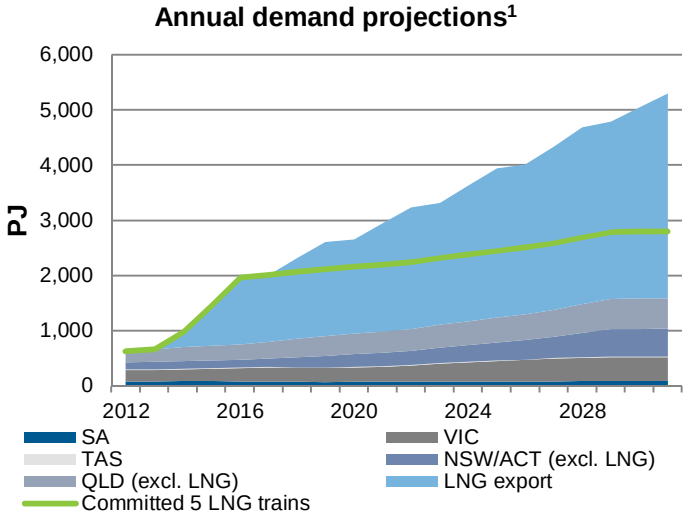
[1] Annual projections under the decentralised world scenario; AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.
[2] Annual demand projections under the decentralised world scenario in Gas Statement of Opportunities 2011.
[3] Department of Employment, Economic Development and Innovation (Qld) 2011, *2011 Gas Market Review Queensland*.

Projections indicate there is enough reserve in NSW to meet its own growing demand, supply to other states and potentially a growing export market

Discussion [1] [2]

- Annual demand in NSW is projected to grow from current level of 130 PJ pa to 505 PJ pa by 2031
- LNG export is projected to grow significantly over the next 20 years in the eastern seaboard dwarfing aggregate domestic gas demand in the region
- The demand and supply projections indicate there is enough reserve in NSW to meet its own growing demand, supply to other states and potentially a growing export market
- Most of the CSG gas reserves in NSW lies near existing pipeline infrastructure (next slide), the ability to supply from these reserves depend on the capacity of production and transmission infrastructure locations
- Chart on the right shows that sufficient reserves are projected for Gunnedah Basin to support the level of gas demand for LNG export projected under the highest-growth LNG export scenario (Fast Rate of Change). Site availability in Queensland is projected to be limited in the Fast Rate of Change scenario, therefore some LNG facilities would be located in NSW with supply for LNG provided by facilities in the Gunnedah Basin





[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.

With decline in southern basin reserves, meeting demand in southern region will require reverse flow of gas through existing pipelines

Gas pipeline capacity and utilisation 2010 [1]

Gas pipeline	Length (km)	Diameter (mm)[a]	Capacity reported as at end of 2010 (TJ/d)	Summer Utilisation[b] (%)	Winter Utilisation[b] (%)	Annual Utilisation[b] (%)
North Queensland Gas Pipeline (NQGP)	393	254	108	52	69	65
Queensland Gas Pipeline (QGP)	630	200, 300	142	52	69	65
Roma to Brisbane Pipeline (RBP)	438	250, 300, 400	219	81	83	78
South West Queensland Pipeline (SWQP)[c]	935	400	181	68	73	72
Carpentaria Gas Pipeline (CGP)	840	150, 300	119	70	78	77
Moomba to Adelaide Pipeline System (MAPS)	1185	150, 200, 550	253	50	57	51
Moomba to Sydney Pipeline (MSP)	2029	150, 200, 250, 300, 450, 850	439	29	59	59
Eastern Gas Pipeline (EGP), Longford to Sydney	797	450	268	74	84	79
South East Australia (SEA) Gas Pipeline	680	350, 450	314	47	59	51
Longford to Melbourne Pipeline (LMP)	174[d]	500, 750	1030	25	70	46
South West Pipeline (SWP), Victoria	144[e]	500	353	22	48	35
New South Wales – Victoria Interconnect (IC)	150	450	71 (to NSW),	n/a	n/a	n/a
			92 (to VIC)	n/a	n/a	n/a
Tasmanian Gas Pipeline (TGP)	734	150, 200, 350	129	32	37	33

Discussion

- Current data suggests there is still about 20-50% of capacity available in some transmission gas pipelines
- Given the projected decline of the southern basins, meeting demand in southern region will require transmission augmentation, including the reversal of flow on the Eastern Gas Pipeline and the New South Wales - Victoria Interconnect pipeline that currently flow from south to north
- However, utilisation rate for Eastern Gas Pipeline is already at the highest out of all the eastern seaboard transmission pipelines

Notes

[a] List of diameters for any pipeline may not be complete.

[b] Utilisation rate for summer, winter and annual during 2010.

[c] Includes "QSN Link".

[d] This figure does not include the Pakenham–Wollert section of the pipeline, which is 93 km long.

[e] This figure does not include the Brooklyn–Lara Pipeline section, which is 58 km long.

[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.

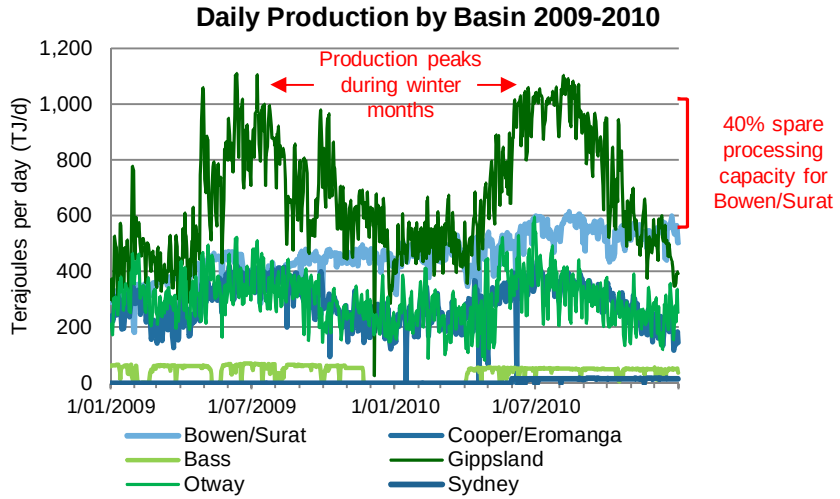
The amount of gas can be supplied is dependent on the daily production capacity of the processing plant and the capacity of transmission pipelines

Capacity of processing plants & transmission pipelines

- Pipeline capacity expansions can be achieved by compressing the gas up to the maximum allowable operating pressure (MAOP) under the pipeline engineering specification, or by 'looping', which is the construction of duplicate, parallel sections of pipeline
- However, even if capacity of transmission pipelines can be increased through MAOP or looping, the amount of gas can be supplied is dependant on the daily production capacity of the processing plant to meet the required engineering specification of the pipeline
- Processing capacity indicated from daily production in each basin suggests utilisation is near capacity and they are busiest during winter months in southern basins
- It seems there is still about 40% spare processing capacity in the Bowen-Surat Basins, which can be utilised if new transmission pipelines such as those proposed by the Eastern Option eventuates (refer to next slide)

Capacity of processing plants

Basin	State	Number of facilities	Types of gas processed	Processing capacity (TJ/d)
Bowen- Surat	QLD	19	mostly CSG	1,073
Cooper-Eromanga	QLD/SA	2	Conventional	580
Sydney	NSW	1	CSG	17
Bass	VIC	1	Conventional	70
Gippsland	VIC	2	Conventional	1,245
Otway	VIC	3	Conventional	846
Total		**28**		**3,831**



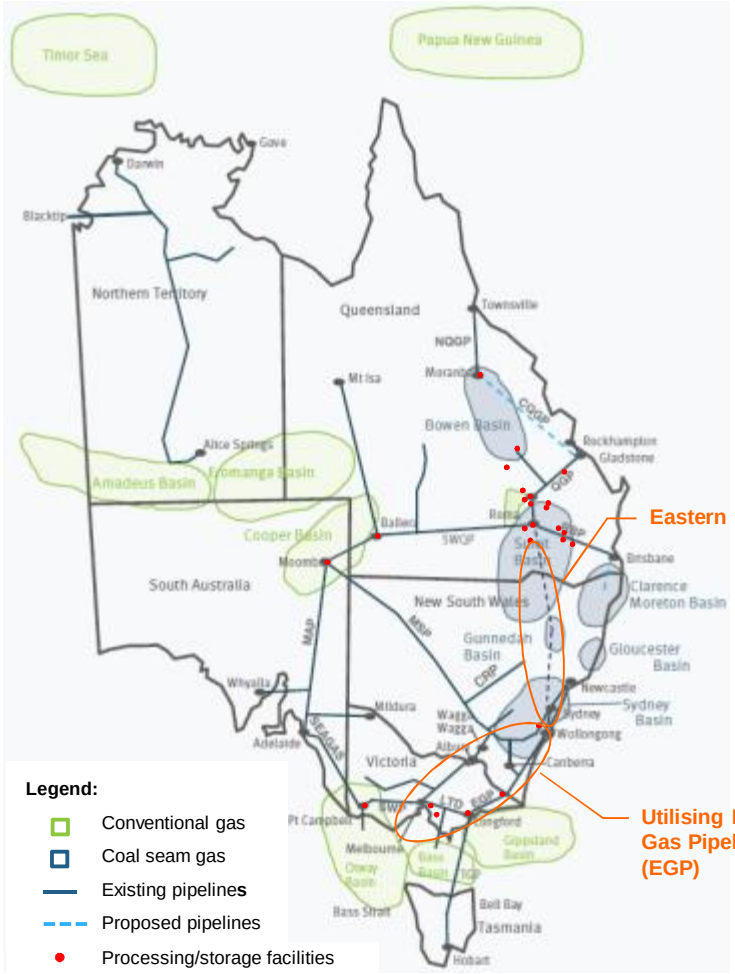
[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.
[2] GHD analysis based on AEMO Additional Data for Chapter 5 and conversion of annual PJ to TJ/d using the conversion calculation on Santos website http://www.santos.com/conversion-calculator.aspx

New transmission pipeline options are being explored for transporting gas directly from QLD to NSW and Victoria

Eastern Option

- This map outlines the location of gas reserves, existing pipelines and processing/storage facilities, and proposed pipelines
- Transmission pipelines are being proposed for transporting gas from Wallumbilla gas hub (in the Surat Basin) directly to Sydney–Newcastle via undeveloped reserves in the Gunnedah Basin (**Eastern Option**)
- This option would also require to develop a new gas storage at Sydney–Newcastle to supply peak demand, and impact on the northern end of the EGP for supply to Victoria
- Under the decentralised world scenario, augmentation of the MSP or the MAPS alone would not be sufficient to address the supply shortfall, because the SWQP is projected to operate close to capacity under these conditions. Supply adequacy may be restored to the system by applying one of the following five strategies:
  - increase existing processing capacity drawing on the Bass, Gippsland, Otway, or Sydney basins
  - increase the transmission capacity of the MAPS and the SWQP
  - increase the transmission capacity of the MSP and the SWQP
  - develop new processing facilities in the Gunnedah Basin and establish a high-capacity link between the Gunnedah Basin and the transmission network near Sydney, or
  - develop a new high-capacity link between processing facilities in the Bowen-Surat Basin and the southern demand centres.

Eastern Australia Gas Reserves and Pipelines[1 2]



[1] AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.
[2] Department of Employment, Economic Development and Innovation (Qld) 2011, *2011 Gas Market Review Queensland*.

A total of more than 500km of new gas pipeline projects have been approved or planned since 2011

Project Name	Project Details	Status
Young to Wellington Gas Pipeline	ERM Power Pty Ltd is constructing a 220km high pressure natural gas pipeline to connect the Moomba to Sydney Pipeline at Young, to the Wellington gas fired power station	Approved on 10/03/2011
Gloucester Gas Project	The Lucas (70%) and Molopo (30%) Joint Venture is proposing to construct and operate a coal seam gas extraction, processing and transportation system. The project is consist of: - 60-90 gas wells and gathering lines within the total concept plan field area - a central processing facility - an approximately 100 metre wide pipeline corridor within the overall concept plan pipeline corridor between Stratford and Hexham	Approved on 22/02/2011
Coolah to Newcastle Gas Pipeline	Proposal by Eastern Star Gas for the construction and operation of an approximately 280km length high pressure gas pipeline between Coolah and Newcastle. The pipeline would tie-in to the company's proposed Narrabri to Wellington gas pipeline at Coolah and travel south east to connect with the company's proposed liquefied natural gas (LNG) facility at Kooragang Island in Newcastle.	DG's Requirements issued on 10/02/2011
Narrabri to Wellington Gas Pipeline	Eastern Star Gas is proposing to construct an approximately 272km long high pressure natural gas pipeline from the Narrabri Coal Seam Gas Project to the proposed Wellington Gas Fired Power Station	DG's Requirements issued on 10/11/2010
Young to Wagga Looping Pipeline	APA Group is proposing to construct and operate a gas pipeline and associated infrastructure that loops the existing 131km gas pipeline between Young to Wagga Wagga Stage 1 – loops 61km of the 131km between Bomen to Bethungra Stage 2 – loops 71km of the 131km from just north of Bethungra to Young	**Stage 1** Approved on 25/05/2010 **Stage 2** DG's Requirements issued on 21/09/2010

Department of Planning and Infrastructure website, http://majorprojects.planning.nsw.gov.au/page/development-categories/transport--communications--energy---water/pipelines/

A total of more than 1,200km of new gas pipeline projects were approved or planned during 2009-2010

Project Name	Project Details	Status
Newcastle Gas Storage Facility	AGL is proposing to construct and operate a gas storage facility with associated pipeline and access road located at Tomago	Under Assessment DG's Requirements issued on 13/10/2010
Queensland-Hunter Gas Pipeline	Hunter Gas Pipeline Pty Ltd proposes to construct and operate a $700 million 850km long underground high pressure gas transmission pipeline from the Wallumbilla Gas Hub in South Central Queensland to the existing Sydney-Newcastle pipeline at Hexham in NSW	Approved on 11/02/2009
Casino to Ipswich Gas Pipeline	Metgasco Limited is proposing to construct and operate a gas transmission pipeline from Casino in northern NSW to Ipswich in South-East Queensland	DG's Requirements issued on 25/02/2008

Department of Planning and Infrastructure website, http://majorprojects.planning.nsw.gov.au/page/development-categories/transport--communications--energy---water/pipelines/

The performance of privately owned gas networks is measured by network integrity and network reliability

Network Integrity

- Network integrity measures the quantity of product lost through gas escapes and third party activities
- Performance indicators include:
  - Gas leaks per 100 km
  - Gas leaks per 1,000 customers
  - Leak surveys as a percentage of total pipe length
  - Leaks per 10 km of pipe surveyed
  - Mechanical damage per 10 km of pipe
  - Mechanical damage per 1,000 customers
  - Number of emergency exercises

Network Reliability

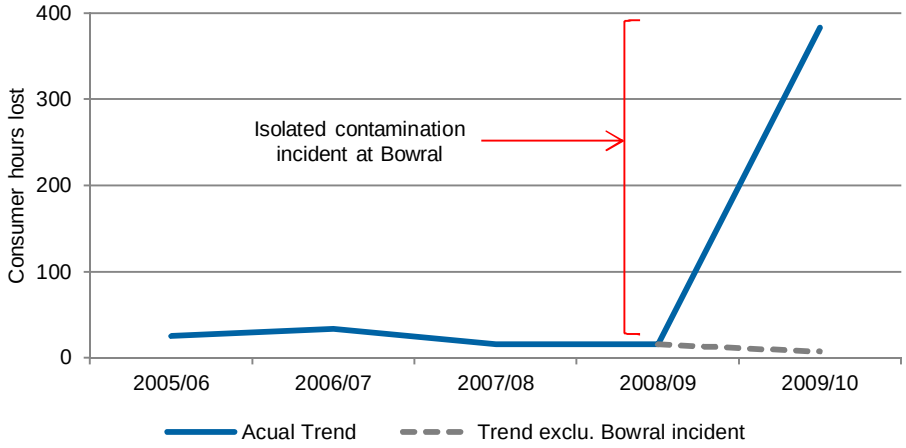
- Network reliability measures the ability for network operators to detect incidents and the time taken to rectify the incident
- Performance indicators include:
  - Loss of supply
  - Percentage of calls responder to within 60 minutes

Privately owned distribution network reliability is relatively stable, however transmission network performance may require improvement

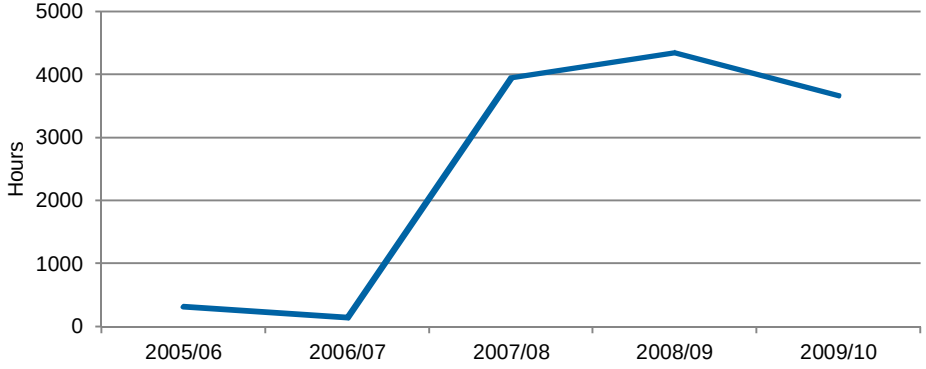
Discussion

- The impact of transmission pipeline outages typically has a relatively small effect on residential supply (since residential consumption is relatively low and the pipelines are able to store gas)
- As the largest user of gas, industry is likely to be more affected by transmission outages
- It is important to note that incidents occurring closer to Sydney will have a greater effect on domestic supply as there will be less pipeline to hold reserve gas
- Major interstate transmission pipelines that supply Sydney run through the Campbelltown and Appin region in South Western Sydney. This region is a known mining subsidence area. If a subsidence incident occurred, supply to the greater Sydney region would be interrupted
- Isolated local incidents on the distribution network can have a significant impact on network performance. For example – the contamination incident in Bowral in 2009

Unplanned Distribution Network Hours of Supply Lost[1]



Hours Transmission Pipeline Not Operational[2, 3]



[1] NSW Industry and Investment (2011) NSW 2009/10 Gas Networks Performance Report
[2] NSW Industry and Investment (2011) NSW 2009/10 Licensed Pipelines Performance Report
[3] Data include periods when pipelines have not been operated for market reasons. In future publications this data will only include periods when a pipeline is not available for operation due to maintenance, defects etc.

There are a number of emerging issues for private investment in gas infrastructure

Issue	Description
Certainty of additional gas supply and prices to NSW	• The capacity of the Victorian transmission system does not appear to be sufficient to meet NSW demand • International demand for gas could potentially impact the supply of gas to NSW (eg – increasing LNG exports from the QLD gas fields may reduce the available resource that could otherwise be used domestically and prices may rise) • Export price parity on the east coast of Australia is likely (based on AEMO and Australian Treasury forecasts) and will be heavily influenced by the LNG exports in Queensland. Producers will favour supply to higher priced export market which may encourage/facilitate additional infrastructure investments (discussed in the follow pages)
Quality of gas supplied to NSW	• As the Moomba resource depletes, the quality of the gas extracted is likely to decline • South West Queensland gas fields are now supplying NSW to help secure supply. However South West Queensland gas and Victorian gas have different quality levels. Poor quality gas can affect the condition of pipelines (eg – corrosion). This is therefore a risk to infrastructure owners in terms of infrastructure damage, and interruption to supply of gas and commercial agreement. The significance of this issue needs to be tested
Expecting coal seam gas	• The environmental impact of coal seam gas extraction remains unclear (eg – water aquifer contamination; disposal of wastewater / brine and salts, opportunities for beneficial reuse of water and salts) • With the pending CSG Inquiry to be released by the NSW Parliament in May 2012, the development of the sector is still uncertain
Increasing use of gas in electricity generation	• Gas is increasingly being used for electricity power generation • The sale of previously government owned power station development sites will almost certainly result in an increase in gas fired power generators (GPG) for both peak and base load. This is likely to impact gas market pricing, supply and infrastructure investment • New GPGs in QLD and NSW will likely source its gas from the Bowen-Surat Basins and the undeveloped Gunnedah Basin, while new GPGs in Victoria replacing 2000MW will have marginal impact to the Bass, Gippsland & Otway Basins (discussed in later pages)
New pipelines	• Progress and barriers relating to new and planned pipelines

Export price parity on the east coast of Australia is likely but highly dependent on international factors and the effects of domestic carbon price policy

Discussion [1] [2]

- Dominant transactions in the Eastern Australian gas market are long-term gas sales agreements ranging from 3 years to 15 years (contracts entered during the past decade)
- Contract prices are not publicly available but can be estimated as most domestic gas contract prices are CPI indexed and undergo periodic reviews to remain at market levels. Shorter-term bi-lateral contracts are also used but there is almost no publicly available information
- The Western Australia parliamentary inquiry into domestic gas prices reveals that despite the average price of all domestic gas contracts in WA in 2009/2010 was around $3.70 per GJ, gas under new contracts have been reported to be in a range of approximately $5.55 to $9.25 per GJ with an estimated incremental value of gas (value of the additional gas sold) in 2009/10 in the order of $13.80 per GJ
- Projections of delivered gas prices in Queensland in the period 2020 to 2028 varied considerably between modelling scenarios and locations, with new contract prices projected to be in the range of $4 to $8.50 per GJ

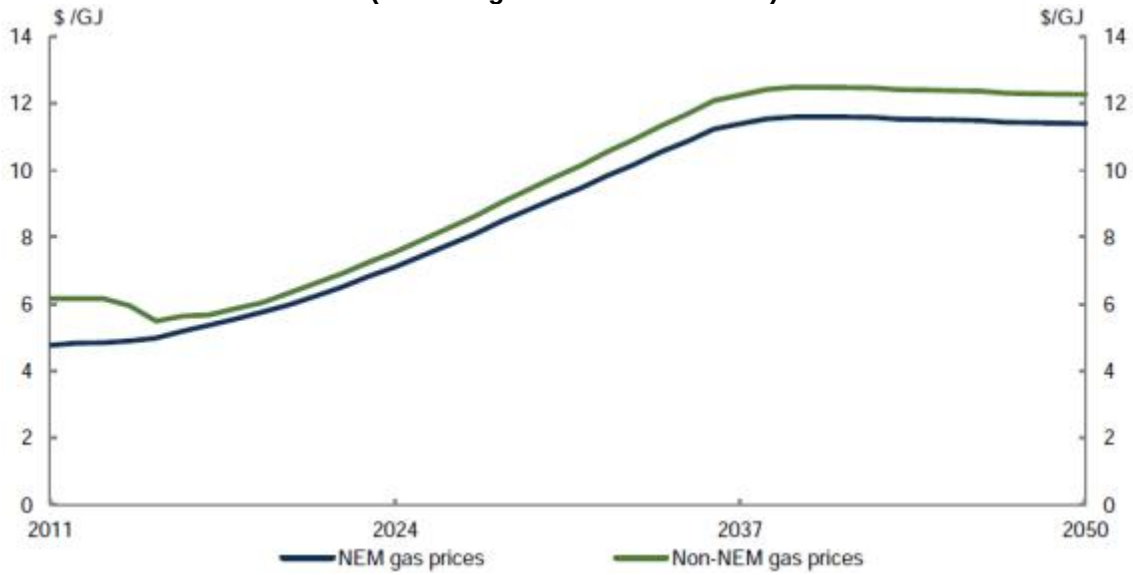
Key differences between Western and Eastern Australian gas markets [1] [2]

- Part of the reason why new gas contract prices in WA can be at least double that of the eastern states is due to the structural differences between the eastern and western domestic gas markets
- Eastern Australian states benefit from a competitive domestic gas market with multiple sources of supply much closer to major centres of demand and an integrated transmission pipeline sector that enables competition between four gas producing states
- Eastern states also benefit from mechanisms that promote greater liquidity and transparency, such as official secondary trading markets provided by AEMO
- The issue of export parity pricing (i.e. domestic gas prices reaching the LNG netback prices) is dependant on whether export capacity would increase more rapidly than overall reserves growth and constraints by domestic users' willingness to pay

[1] Economics and Industry Standing Committee (2011) *Inquiry into Domestic Gas Prices*, Report No. 6 in the 38th Parliament
[2] Department of Employment, Economic Development and Innovation (Qld) 2011, *2011 Gas Market Review Queensland*

Australian Treasury forecasts indicate a potential for domestic gas prices on the East Coast to reach export parity from 2020 primarily due to investments in LNG export facilities in QLD

Australian Treasury gas price projection [1]
(medium global action scenario)*



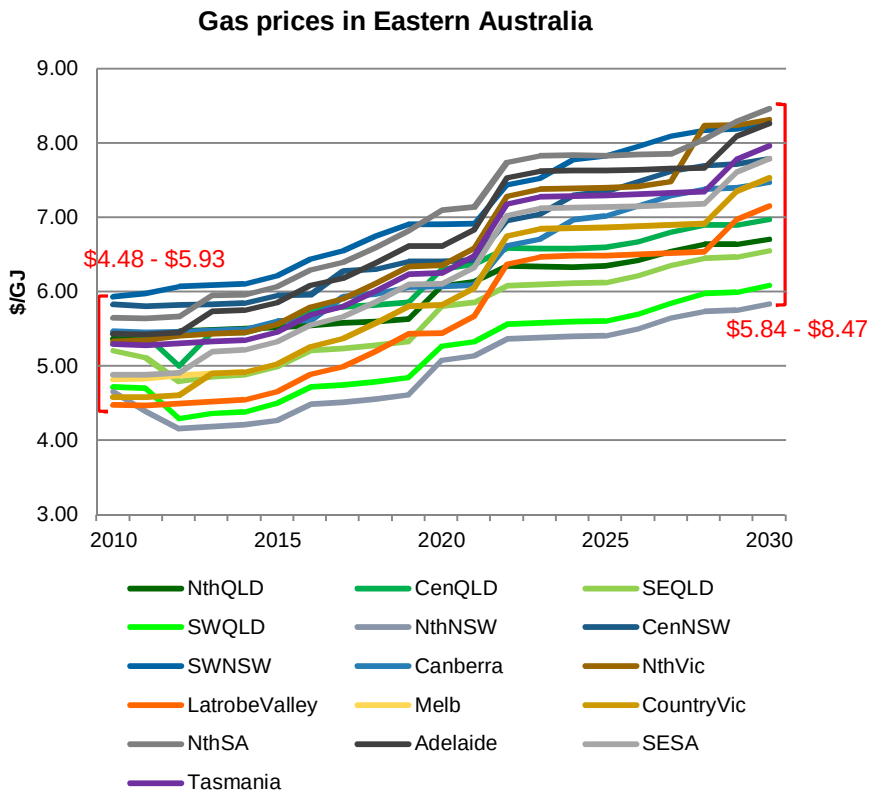
* The 'medium global action scenario' assumes countries implement the less ambitious end of their mitigation pledges made in the Cancun Agreements and Copenhagen Accord, and stabilise greenhouse gas concentrations at 550 ppm by around 2100.

Discussion [1]

- As part of its carbon price modelling, the Commonwealth Treasury modelled the price path for domestic gas prices for the west and east coast of Australia
- Western Australian gas prices are assumed to be at a domestic equivalent of the international price of gas, excluding export costs (such as for compression)
- Investment in production and LNG export facilities in Queensland is assumed to lead to domestic gas price in the east coast being linked to changes in world gas prices by around 2020
- Gas prices are expected to double its price level of 2011 by 2037
- NEM gas prices represents east coast gas prices, while Non-NEM gas prices represents gas prices for all other regions

[1] Commonwealth of Australia (2011) *Strong Growth, Low Pollution: Modelling a carbon price*.

AEMO projects gas prices in Eastern Australia to vary between $5.84 and $8.47 by 2030 without international oil price shocks



Discussion [1]

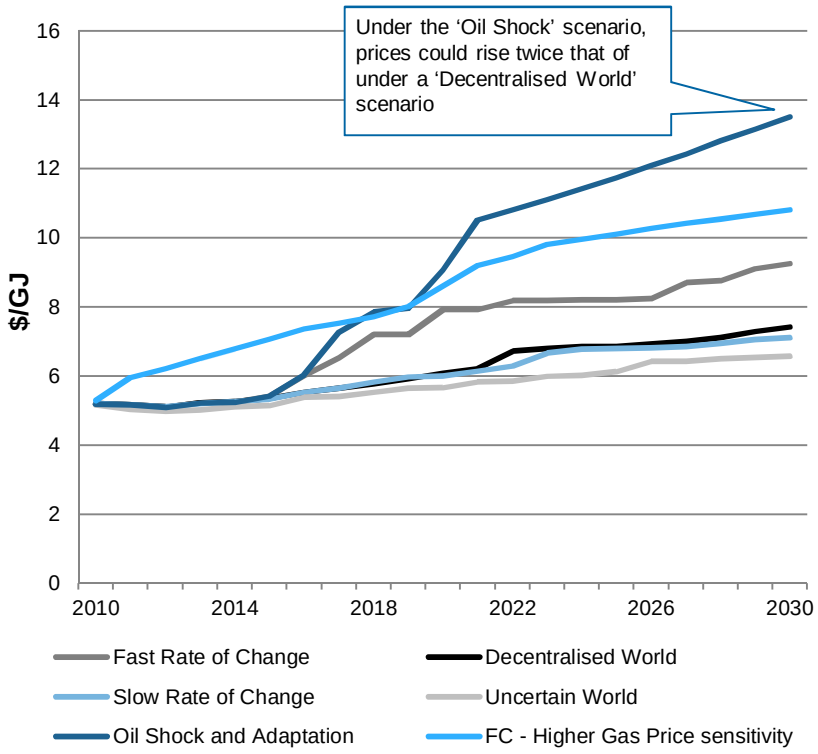
- Gas price forecasts for NSW regions are considered in the mid to high level of the forecast range for all Eastern Australian regions
- Queensland will continue to benefit from its abundance CSG reserves in the Bowen and Surat Basins with a low to mid level price forecast range
- Price forecast for regions in South Australia and Northern Victoria is expected to increase to a much higher level over the 20-year forecast period as reserve levels for Gippsland, Bass and Otway Basins continue to deplete

Assumption:
'Decentralised World Scenario' used in AEMO's 20-year projection assumes a world where Australia's energy network becomes highly decentralised by the end of the 20-year outlook period. A medium carbon price (c. 33 $/t CO2-e in 2013–14 rising, to 65 $/t CO2-e by 2031) and moderately high oil prices that motivates a large number of consumers to purchase electric plug-in vehicles, adding to off-peak energy requirements, but also providing energy storage for the electricity system. This is supported by the smart grid that helps to manage high levels of wind generated electricity.

[1] Projections under a 'decentralised world scenario'; AEMO (2011) *Gas Statement of Opportunities*; GHD analysis.

However, under an oil shock and adaptation scenario, prices in eastern states are forecast by AEMO to approach export price parity

Gas price projections used for AEMO's scenarios[1]



Discussion [1]

- For all of the scenarios (but excluding the Higher Gas Price sensitivity), 2011 gas prices cluster around $5/GJ and do not move apart until 2015
- After 2015, gas prices in the Oil Shock and Adaptation and Fast Rate of Change scenarios move toward export price parity

Assumptions

Scenario or Sensitivity	Primary Scenario, Secondary Scenario, or Sensitivity	Key Economic Parameter Projection used		
		Economic Growth	Carbon Price	Gas Price
Fast Rate of Change (FC)	Primary scenario.	High.	High.	High after 2017.
FC - Higher Gas Price	Sensitivity.	High.	High.	Higher than FC.
Decentralised World (DW)	Primary scenario.	Medium.	Medium.	Medium.
DW - High Carbon Price	Sensitivity.	Medium.	High.	Medium.
Slow Rate of Change	Primary scenario.	Low.	Low.	Medium.
Uncertain World	Secondary scenario.	High.	Low.	Medium.
Oil Shock and Adaptation (OS)	Secondary scenario.	Low.	Medium.	Very high after 2017.
OS - Low Carbon Price	Sensitivity.	Low.	Low.	Very high after 2017.

[1] AEMO (2011) *Gas Statement of Opportunities*.