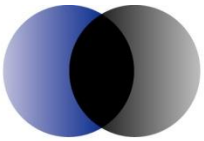
Report on revised demand forecasts for Jemena Gas Networks

For the Access Arrangement period commencing 1 July 2010

Prepared for the Australian Energy Regulator

Final Report – 8 June 2010



ACIL Tasman

Economics Policy Strategy

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1 Background

The Australian Energy Regulator (AER) engaged ACIL Tasman to review the adequacy and appropriateness of the methodology used by Jemena Gas Networks (JGN) to develop forecasts of demand in its New South Wales gas distribution networks for the access arrangement period commencing 1 July 2010, as set out in the proposed access arrangement information submitted by JGN.

The *National Gas Rules* (NGR 72(1)(a)(iii)) require the access arrangement information provided by the service provider to include usage of the pipeline over the earlier access arrangement period showing:

- minimum, maximum and average demand
- customer numbers in total and by tariff class.

In making a decision whether to approve or not to approve an access arrangement proposal, the AER is required under rule 74 of the NGR to be satisfied that forecasts required in setting reference tariff(s) are arrived at on a reasonable basis and represent the best forecast or estimate possible in the circumstances.

The process followed by the AER for assessing proposed access arrangements and access arrangement revisions is set out in the Final Access Arrangement Guideline published in March 2009(AER, 2009).

1.1 The review process to date

1.1.1 Report on access arrangement proposal

ACIL Tasman's report for the AER draft decision on the JGN access arrangement proposal (ACIL Tasman, 2010a) was submitted to the AER on 2 February 2010.

ACIL Tasman (2010a) concluded that, whereas the methodological approach adopted by JGN was sound, the assumptions made in applying the methodology had resulted in forecasts that showed very significant downward movements from historical trends from historical trends, in both the small customer (Volume) and large customer (Demand) segments of the market that, if accepted, would establish low starting points for the next access arrangement period. In the case of the Volume Customer segment, the step change in average consumption per customer that was implicit in the forecast for the year ended June 2010 was not apparent in the actual consumption data for the relevant period, nor were convincing reasons presented why the mix of government policies and consumer trends (most of which had been in

evidence for some time) would lead to a step change in consumption. The draft report therefore recommended that the Volume Customer demand forecast should be adjusted upward to reflect an average rate of consumption per customer consistent with historical trends.

The forecasts for the Demand Customer segment showed a steep decline from 65.6PJ in 2008–09 to 60.7 PJ in 2009–10, attributed to weak economic conditions in the New South Wales market as a result of the GFC. However actual consumption data to end December 2009 did not show any such decline in demand, and JGN advised in January 2010 that it expected Demand Customer load in 2009–10 to be some 3.6 PJ above the forecast in the access arrangement information.

The draft report concluded that a better forecast of Demand Customer load would be obtained by extrapolating the past five years of historical data (weather normalised) on linear trend, and proposed an alternative forecast on this basis.

1.1.2 Draft decision

The AER released the public version of its draft decision on JGN's access arrangement proposal on 9 February 2010 (AER, 2010). The draft decision required JGN to revise its demand forecasts in line with the advice set out in ACIL Tasman (2010a).

1.1.3 Jemena response to draft decision

In response to the AER draft decision (AER, 2010) JGN noted that the AER appeared to have exclusively relied on the ACIL Tasman analysis and the forecast methodology outlined in ACIL Tasman (2010a). Consequently, JGN did two things:

- reviewed the ACIL Tasman analysis and methodology for completeness, and in particular whether it would be capable of providing forecasts which are consistent with the requirements of the NGR for a forecast to be 'arrived at on a reasonable basis' and to 'represent the best forecast possible in the circumstances'
- engaged the National Institute of Economic and Industry Research (NIEIR) to review and update the assumptions previously used in the NIEIR 2009 report (NIEIR, 2009), re-run its forecasting model and to update its forecasts where necessary. The revised NIEIR forecast is referred to in this report as the NIEIR 2010 report (NIEIR, 2010).

JGN noted that the NIEIR model has been accepted by regulators in the past and that ACIL Tasman had acknowledged that it is methodologically sound.

JGN presented analysis to show that statistically, it could not be claimed with any confidence that of the forecasts in the NIEIR 2009 report were inconsistent with the historical data, and that the ACIL Tasman extrapolation did not produce a forecast of average consumption per volume customer that was statistically better than that derived from the more robust NIEIR forecast. JGN argued that the different results produced by simple extrapolation of linear trends do not provide a *prima facie* basis for rejecting the forecasts in the NIEIR 2009 report which were produced by a detailed methodology which ACIL Tasman has endorsed.

2 This report

A key part of the information submitted by a service provider in support of a proposed access arrangement is a forecast of the level of demand for the reference services provided, over the course of the access arrangement period. This typically involves forecasting demand for services for a period of five years from the commencement date of the new access arrangement. It is important to ensure that the forecasts represent best estimates arrived at on a reasonable basis because:

- Demand forecasts may impact the forecast capital expenditure required to meet the new demand of prospective users or the increased demand of existing users and may therefore influence forecast revenue.
- Demand forecasts influence the tariffs set to meet forecast revenue in each year of the access arrangement period, and how this revenue is to be allocated between tariff classes for different reference services.

JGN's initial demand forecasts were set out in Chapter 5 of the document titled "Jemena Gas Networks (NSW) Ltd Access Arrangement Information (Commercial-in-Confidence)" dated 25 August 2009 (JGN, 2009a)[1].

Following the release of the AER's draft decision (AER, 2010), JGN submitted revised demand forecasts which are set out in Chapter 4 of the document titled "Jemena Gas Networks (NSW) Ltd Revised Access Arrangement Information" dated 19 March 2010 (JGN, 2010a).

In this report ACIL Tasman has reviewed the revised demand forecasts to advise the AER on whether the revised demand forecasts proposed by JGN are reasonable. As part of this process we have re-assessed the appropriateness of the methodology and the assumptions used to determine demand forecasts, and considered whether they provide a reasonable basis to assist the AER in assessing the building block revenue components and tariffs which utilise these

[1] A public version of the access arrangement information which excludes certain information of a commercially sensitive nature also provides information on the demand forecasts.

forecasts. In our report for the AER draft decision (ACIL Tasman, 2010a) we also considered the reasonableness of demand forecasts in the previous access arrangement period in the light of actual demand outcomes: that analysis is not repeated in this final report, which focuses on the revised demand forecasts for the forthcoming access arrangement period.

2.1 Approach to the review

In undertaking this review, ACIL Tasman has again considered the following issues:

1. the adequacy of the overall approach and methodology
2. the reasonableness of the assumptions
3. the currency and accuracy of the data used
4. the account taken of key drivers
5. whether the methodology has been properly applied.

The review has been undertaken as desktop analysis into the methodology, data and parameters, and assumptions used to develop the demand forecasts. ACIL Tasman has used its own knowledge of Australian gas markets to test assumptions.

3 Scope of Jemena operations

ACIL Tasman (2010a) included a review of the scope of JGN's operations. Since there has been no significant change in the scope of JGN's operations, that information is not repeated in this report.

3.1 Historical gas demand

The historical customer numbers for the JGN distribution network are shown in Table 1. There have been minor amendments to the Volume Customer numbers for 2008–09, but the data is otherwise unchanged from the August 2009 access arrangement information.

Table 1 **JGN New South Wales gas networks — historical customer numbers, by class**

Year ended 30 June	2001	2002	2003	2004	2005	2006	2007	2008	2009
Residential	802,361	834,719	866,131	899,400	932,707	945,257	965,653	995,074	1,022,084
Small business	24,815	25,816	26,788	27,816	28,847	29,293	30,683	30,869	30,210
Volume Customer Total	**827,176**	**860,535**	**892,919**	**927,216**	**961,554**	**974,550**	**996,336**	**1,025,943**	**1,051,834**
Demand Customers	n/a	n/a	n/a	n/a	n/a	483	444	430	414
Total customers	**827,176**	**860,535**	**892,919**	**927,216**	**961,554**	**975,033**	**996,780**	**1,026,373**	**1,052,248**

Data source: *(JGN, 2010a)*; data for 2004, 2005 were forecasts from the August 2009 access arrangement information *(JGN, 2009a)*

Historical gas demand, by customer class, is summarised in Table 2. This data is unchanged from the information provided in the corresponding table in the August 2009 access arrangement information.

Table 2 **JGN New South Wales gas networks — historical customer demand (TJ), by class**

Year ended 30 June	2001	2002	2003	2004	2005	2006	2007	2008	2009
Residential	18,606	18,903	19,381	20,269	20,799	20,010	20,649	21,327	23,041
Small business	10,927	11,101	11,383	11,904	12,215	11,790	11,843	12,210	11,946
Volume Customer Total	**29,533**	**30,004**	**30,764**	**32,173**	**33,014**	**31,800**	**32,492**	**33,537**	**34,987**
Demand Customers	69,730	66,728	66,363	65,914	65,656	62,988	64,857	65,452	65,618
Total customers	**99,263**	**96,732**	**97,127**	**98,087**	**98,670**	**94,788**	**97,349**	**98,989**	**100,605**

Data source: *(JGN, 2010a)*; data for 2004, 2005 were forecasts from the August 2009 access arrangement information *(JGN, 2009a)*.

4 Forecast methodology and assumptions

4.1 Forecast methodology for the 2010–15 access arrangement period

The revised market forecasts in the NIEIR 2010 report were developed using the methodology described below. The revised forecasts in the NIEIR 2010 report cover a period from 2008 to 2015 and were based on a combination of historical load, and economic, climate and government policy factors. The revised forecast in the NIEIR 2010 report was produced in February 2010 based on available data as at 31 December 2009.

The objectives of the NIEIR 2010 report were to develop the forecast that JGN has used in preparing the volumes of gas to be transported for the period relating to revised access arrangement submission.

JGN required an opinion report detailing the quantitative incremental impacts (both positive and negative) of each of the following contributing factors during the period 2009-10 to 2014-15 upon:

1. annual gas consumption of JGN's existing residential, business and large industrial consumers;
2. annual gas consumption of JGN's new residential, business and large industrial consumers; and
3. hourly and daily demand for business and large industrial consumers using more than 10 terajoules per annum.

The contributing factors considered were set out in the NIEIR 2010 report (NIEIR, 2010, p. 3):

a) market trends affecting the installation of existing gas appliances, including but not limited to, the impacts of installing alternative appliances such as reverse cycle air conditioning in lieu of gas heating, continuous flow gas systems in lieu of storage gas systems, solar or electrical systems, and the impacts of water conservation measures on the consumption of hot water;

b) government energy efficiency policies including but not limited to, minimum efficiency performance standards for gas hot water systems, energy efficiency home rating schemes, business energy efficiency reporting schemes and hot water rebate schemes for solar and heat pump hot water system replacements; and

c) implementation of the Government's Carbon Pollution Reduction Scheme (CPRS) including the impacts on fuel substitution, reduction in demand of increased cost of gas especially in the large industrial market, economics of small and large scale cogeneration and electricity production.

The forecasting methodology is described in detail, together with the forecast results, in the NIEIR 2010 report which was presented as Appendix 11.1 of JGN's revised access arrangement information.

For the purpose of developing reference tariffs it was again necessary for JGN to modify the forecasts in the NIEIR 2010 report, disaggregating them to align with the proposed tariff classes and charging parameters. So, for example, where NIEIR has forecast total consumption per year for Volume Customers, JGN has disaggregated these forecasts into the relevant item tariff classes ('coastal' and 'country') and applicable consumption blocks to which different rates of network throughput charges apply. JGN has also adjusted the forecasts in the NIEIR 2010 report to take into account the expected impact of a proposed marketing strategy on Volume Customer load, and also to reflect the demand associated with a new major customer. The methodology used by JGN to adjust the NIEIR forecasts is described in the document JGN (2010b) 'NIEIR demand forecasts adapted for reference tariffs – Update to Access Arrangement Information Appendix 15.2', dated 19 March 2010 and presented as Appendix 12.1 of JGN's revised access arrangement information.

4.1.1 Methodology for the NIEIR projections

The NIEIR 2010 report first provides a medium term outlook for the world and Australian economies, together with a base economic outlook for New South Wales over the period to 2018-19. This provides the macro-economic and policy framework within which the projections of gas demand are developed.

NIEIR's national and State economic models were used to generate economic forecasts to 2014–15. A regional economic model of New South Wales was used to generate forecasts of key drivers of gas demand including population, dwelling stock and gross regional product (by industry).

On this basis, NIEIR prepared projections of JGN's annual gas usage for:

- the Volume sector of the market (referred to by NIEIR as the Tariff sector), comprising those loads less than 10 TJ/a, and
- the Demand sector of the market (referred to by NIEIR as the Contract sector), comprising those loads greater than 10 TJ/a, on an industry basis.

Gas usage in New South Wales

The NIEIR gas demand projections take into account the purposes for which gas is used in New South Wales and trends that may be apparent in relation to those end-use sectors. Using Australian Bureau of Statistics (ABS) data, NIEIR has established that, in 2008, the proportions of end-user appliances in New South Wales using natural gas were as follows:

- ovens – 15.8 per cent
- cook tops – 27.9 per cent
- spacing heating – 17.2 per cent (with 23.9 per cent of households not using a heater)
- water heating – 23.9 per cent.

In the NIEIR 2010 report this component of the analysis is unchanged from the original NIEIR 2009 report. The ABS has not released any new data on which the analysis could have been updated.

Weather normalization

There is a well-established relationship between residential and commercial gas demand and temperature—gas demand is highest in the winter months, and increases as temperature decreases because of increased need for space heating. In order to make meaningful comparisons of consumption from year to year and to establish a datum from which to forecast future consumption, it is necessary to normalise observed consumption for the differences in average temperature between years. This is usually done on the basis of "Heating Degree Days" (HDD) calculated from meteorological data as the sum, over a year, of the negative differences between the average temperature on each day and 18° Celsius.

NIEIR has used a recognised method to normalize historical gas demand to take account of weather variations, using data obtained from the Bureau of Meteorology for the Sydney weather station.

The normalising adjustment was obtained by taking the difference between the observed number of HDD for the year and the standard number of HDD for a year and multiplying that difference – referred to by NIEIR as "abnormal HDD" – by a temperature sensitivity coefficient for the relevant market (TJ/HDD).

The coefficient has been estimated by analysing historical market performance. In the analysis NIEIR determined separate coefficients for the Volume and Demand markets. This is appropriate because some of the large Demand market loads are not sensitive to changes in temperature (for example, gas used as a feedstock in industrial processes) and so the Demand market overall tends to be less affected by seasonal changes in temperature.

Weather nomalisation in NIEIR 2010 revised report

In the NIEIR 2010 report the treatment of weather normalization is somewhat different from the NIEIR 2009 report.

In the NIEIR 2009 report a standard number of HDD for a year was determined to be 489 HDD based on the long-run trend of HDD between 1984–85 and 2007–08. The forecasts for the 2010-15 access arrangement period incorporated an assumed decline of 3 HDD per year. The NIEIR 2009 report noted that this somewhat understated the underlying rate of decline observed from the historical data. ACIL Tasman reviewed the data and assumptions on which the weather normalization in the NIEIR 2010 report was undertaken, and independently examined Sydney (Observatory Hill) weather data for the period 1859 to 2008 (ACIL Tasman, 2010a, pp. 22-26). We observed an average decline of approximately 2.3 HDD per year over that extended period, with a steeper decline of around 5.5 HDD per year over the period since 1990.

In the NIEIR 2010 report the standard number of HDD for a year has been taken as a declining series incorporating an observed long term decline rate of around 5.56 HDD per year (consistent with the ACIL Tasman analysis of the data for the period since 1990), with a 2010 value of 490 HDD. The forecasts in the NIEIR 2010 report incorporate an assumed decline of 5.56 HDD per year.

Volume (Tariff) customers and volumes

Residential gas usage dominates consumption in the Volume sector. The NIEIR 2010 report modeled the residential gas demand by disaggregating users into new and established customers. New customers were separated into net new customers from new dwellings and new customers in existing dwellings (electricity to gas or "E-to-G" customers).

Historical residential gas demand was normalized for differences in Heating Degree Days (HDD). The residential forecasts were prepared on a weather normalised basis and incorporated the impact of changes in real household disposable income and real gas prices. Residential customer number forecasts were linked to NIEIR's projections of dwelling stock.

The residential gas consumption forecast model also took account of Federal and State Energy and greenhouse policies including:

- the Building Sustainability Index (BASIX) certification scheme for new New South Wales homes, implemented in July 2006
- the program to review and standardise energy labeling of gas appliances followed with the development of Minimum Energy Performance Standards (MEPS) for new gas appliances
- the increased penetration of energy efficient showerheads
- the effective banning of electric resistance hot water appliances from 2012
- the ongoing negative impact of high sales of reverse cycle air conditioning equipment
- the Commonwealth stimulus package with subsidies for home insulation
- other new policies or developments, such as the New South Wales Government's NSW Energy Efficiency Trading (NEET) scheme and the Commonwealth's Renewable Energy Target (RET) scheme.

Projections for the business component of the Volume sector were derived using a regression model which took account of commercial output growth and movements in real gas prices.

"Old" vs "New" residential customers

NIEIR has considered the average annual rate of gas consumption for "old" or existing customers and for "new" customers to assess how changes in government energy policies and building standards are affecting average consumption of natural gas by residential Volume Customers on the JGN gas network.

The NIEIR 2009 report used 2008–09 data which showed that, as a result of various energy efficiency improvements, "new" estate and high rise customers consume around 2 GJ/a less than "old" established customers, averaging 18.9 GJ/a compared to 20.8 GJ/a for the "old" customers[2].

The NIEIR 2010 report used 2009–10 data which shows a wider gap of around 4.5 GJ/a between "new" estate and high rise customers and "old"

[2] Weather normalized data

established customers. The more recent data shows "new" customers average 17.0 GJ/a compared to 21.5 GJ/a for the "old" customers.

Electricity-to-gas (E-to-G) conversion customers show an even lower average consumption rate of 14.6 GJ/a, reflecting the fact that some of these customers may convert only one electric appliance (for example, a cook top) to gas while maintaining other electric appliances or installing non-gas facilities such as solar-electric hot water heating.

Substitution to electricity

The forecasts in the NIEIR 2010 report allow for conversion of some existing gas consumers to electricity. The projections assume that as gas space heaters break down, 25 per cent of existing customers will convert to reverse cycle air conditioning. This leads to a small reduction in total gas use for heating in existing dwellings of 0.1 GJ/a per household.

Demand (Contract) customers and volumes

The gas demand forecast in the NIEIR 2010 report for Demand Customers was developed on an industry basis. JGN supplied NIEIR with around eight years of data on customer gas usage and Maximum Daily Quantity (MDQ) of individual customers. NIEIR industry coded these data on a customer by customer basis.

Gas demand models were parameterised using NIEIR's State gas forecasting model. The industry regression model relates gas consumption to the change in output for each industry within the gas distribution area as well as changes in real gas prices for that industry.

The output and price elasticities at regional level were adjusted to reflect differences in the gas intensity between industries and regions. Forecasts of MDQ were also developed on an industry basis. The MDQ forecasts were determined from NIEIR's projections of energy growth by industry and industry specific load factors.

4.1.2 Impacts of government policies

The forecasts in the NIEIR 2010 report take into account a range of New South Wales and Australian government policy initiatives that have implications for gas demand. In the NIEIR 2010 report these components of the analysis are unchanged from the NIEIR 2009 report.

Carbon Pollution Reduction Scheme (CPRS)

The NIEIR 2010 report discusses the implications of the Carbon Pollution Reduction Scheme (CPRS) which was expected to come into force during 2011, and seeks to incorporate the effects of the CPRS into the forecast methodology assuming:

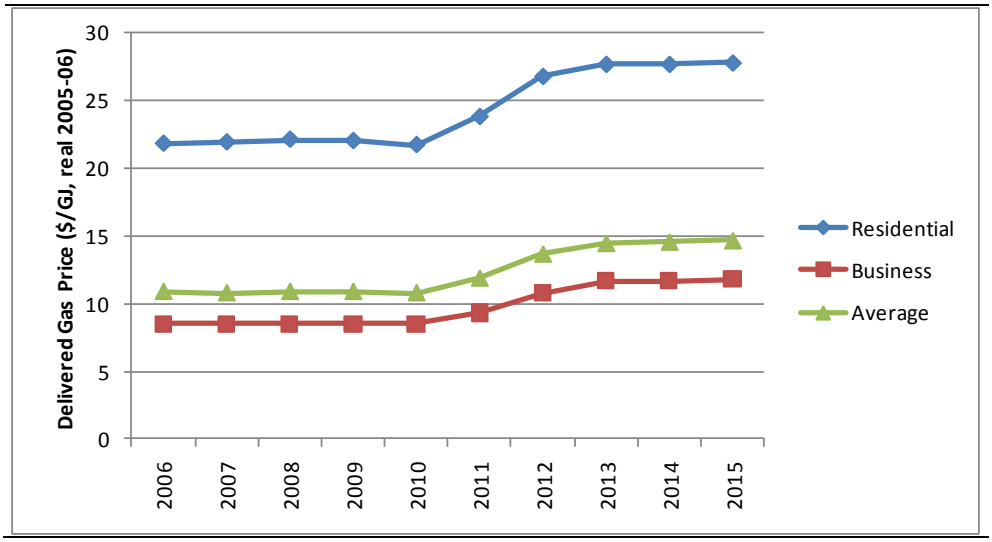
- the Treasury CPRS-5 scenario applies out to 2015, with a gradual change to the CPRS-15 scenario by 2025
- similar gas, coal and renewable and CCS prices to Treasury
- similar impacts (pass through) of permit prices on gas prices given in the Australian Government White Paper on the CPRS.

The effects of the CPRS on retail gas demand will be determined by a number of factors including the cost of reducing emissions domestically, the price and availability of international permits, compensation to households and certain industry sectors and other design features of the CPRS.

The principal way in which NIEIR has sought to take account of the impact of the CPRS is through price and income effects that influence overall demand. NIEIR has also factored in, in a simplified way, substitution effects such as reduced rates of replacement of appliances or visits to restaurants.

Importantly, NIEIR has made assumptions about the impacts of CPRS on New South Wales gas prices, by major customer class, to 2014-15. The results are summarized in Figure 1.

Figure 1 **NIEIR projections for New South Wales gas prices**



Data source: (NIEIR, 2010, pp. 40, Table 4.10)

The gas prices projected by NIEIR show no significant change (in real terms) over the period 2006 to 2010. However NIEIR is forecasting that, under the

influence of CPRS, gas prices in the residential sector will rise by some $6/GJ or 28 per cent between 2010. The corresponding rise in the business sector is forecast to be $3.20/GJ or 38 per cent. These results raise two areas of concern:

- The quantum of the gas price impact
- The timing of the gas price impact

Quantum of the gas price impact

The fundamental reason why CPRS might lead to higher gas prices is because explicitly pricing carbon emissions would make gas "more valuable". CPRS would, for example, result in gas-fired generators becoming more competitive when compared with coal-fired generators, because gas-fired generators would face relatively low emission costs compared to coal-fired plant. The additional costs incurred by gas-fired plant as a result of paying for carbon emissions would be more than offset by higher electricity pool prices. Coal-fired generators, on the other hand, would face higher cost of emissions that would not be fully covered by increased electricity pool prices.

The quantum of any gas price rise as a result of introduction of CPRS is subject to a range of uncertainties. The details of the scheme would have an impact, as would the bargaining power of the gas producers in seeking to share the gains enjoyed by the gas-fired generators and other major gas users whose competitiveness, relative to plant using higher-emitting fuel. In a highly competitive gas market with many suppliers competing for customers, there is little reason to think that gas prices would rise at all: the costs incurred by the generator in paying for carbon emissions would not, after all, push up the suppliers' costs of producing gas (although under the CPRS, gas producers may seek to pass on costs incurred as a result of fugitive emissions and emissions arising from gas processing and compression). However the current gas supply situation in Eastern Australia is not highly competitive: there are a limited number of competing producers and so there should be some capacity for gas producers to negotiate with generators for a share of the gains.

Taking these factors into account, ACIL Tasman has independently estimated that, with carbon prices equivalent to the Treasury CPRS-5 scenario, an increase in wholesale gas prices could be expected of *up to* $1.00/GJ in the first year of scheme operation, rising *up to* about $2.00 in real terms after ten years. If a transition to a CPRS-15 carbon price trajectory is assumed, we estimate that wholesale gas prices could rise by *up to* about $3.00/GJ in real terms after ten years.

There may be secondary effects of CPRS (or any similar carbon pricing scheme) on gas prices as a result of the increased demand for gas that such a

scheme would introduce. However those impacts are likely to emerge over the medium to long term (for example, as a result of replacement of brown coal fired electricity generators by lower-emitting combined cycle gas turbine plant) and are unlikely to have a substantial influence within the period of the next access arrangement.

The impacts of CPRS on gas prices should occur principally at the wholesale level. It is therefore, in our opinion, unlikely that introduction of CPRS would lead to the large increases in delivered gas costs that NIEIR has assumed will occur within three years of scheme commencement: $3.20/GJ for business customers and $6.00/GJ for residential customers.

The NIEIR 2010 report states (at page 39) that "similar gas, coal and renewable and CCS prices to Treasury" have been assumed for modeling purposes. Yet NIEIR assumes that the price of gas to residential customers rises by 28 per cent, from $21.70/GJ in 2010 to $27.70/GJ in 2013, as a result of CPRS. By contrast, Treasury modeling reported in the CPRS White Paper found that residential gas prices would rise by only 12 per cent as a result of carbon prices consistent with a 5 per cent reduction in emissions below 2000 levels by 2020 (Australian Government, 2008, p. 17-2).

We further note that in making assumptions about gas prices at the retail level (that is, delivered to residential and business customers) NIEIR implicitly incorporates assumptions about gas distribution charges. These assumptions have not been made explicit.

The timing of the gas price impact

In late April 2010 (after the NIEIR 2010 report was completed) the Australian government announced a deferral of the CPRS until at least 2013.

As a result, even if the quantum of the gas price impacts projected by NIEIR were to be accepted, the timing of those impacts has now been delayed by at least two years.

Conclusions regarding treatment of CPRS and impact on gas prices

NIEIR has, quite appropriately, sought to take into account the impacts of CPRS on gas prices and the consequent implications for gas demand (through price-demand elasticity effects). However, we consider that the forecast significantly overstates the impact of CPRS on gas prices on two counts:

- First, increases in delivered gas costs of $3.20/GJ for business customers and $6.00/GJ for residential customers within three years of CPRS scheme commencement are, in our opinion, likely to be significantly overstated. The impact in percentage terms on residential gas prices is more than twice that estimated by Treasury in the CPRS White Paper.

- Second, the announced deferral of the CPRS to at least 2013 means that any impacts on gas prices arising from CPRS or a similar carbon pricing scheme now need to be delayed for at least two years.

The overstatement of increases in gas price for residential and business customers during the access arrangement period should be expected, all else being equal, to result in under-estimation of gas demand.

Expanded Renewable Energy Target (RET)

The expanded Renewable Energy Target (RET) is a key component of the Australian government's strategy for increasing the proportion of Australia's electricity generated from renewable sources to 20 per cent by 2020.

The expanded RET scheme will, all else being equal, reduce the requirement for conventional electricity generation in the National Electricity Market (NEM) and will therefore result in less growth in demand for gas for power generation than would be expected in the absence of the RET scheme. Because the RET scheme is aimed at altering the mix of electricity generation technologies, it will have relatively little effect from the point of view of retail gas demand (and hence demand for gas distribution services). However, it may result in some indirect reduction in retail gas demand because the ability to generate Renewable Energy Certificates will create a financial incentive for conversion to renewable technologies such as solar hot water systems.

NIEIR has not stated what, if any, adjustment to the demand forecast has been made to take account of the expanded RET scheme—we would expect any such adjustment to be small.

Other energy policies

Other energy policies that NIEIR considers will result in lower gas demand include:

- the BASIX certification system for new New South Wales homes
- the program to review and standardise energy labelling of gas appliances followed with the development of MEPS for new gas appliances
- the increased penetration of energy efficient showerheads
- the effective banning of electric resistance hot water appliances from 2012
- the ongoing negative impact of high sales of reverse cycle air conditioning equipment
- the Commonwealth stimulus package with subsidies towards home insulation
- other new policies or developments, such as the new NEET policy of the New South Wales Government and the RET scheme.

Building Sustainability Index (BASIX)

The BASIX certification system for new New South Wales homes and major extensions and alterations was implemented in July 2006. BASIX requires all new homes in New South Wales to use up to 40 per cent less potable water and to produce up to 40 per cent less greenhouse gas emissions than the average home. Targets vary depending on building type, location and regional variations such as soil type, climate, rainfall and evaporation rates. The NIEIR 2010 report notes (at pp. 41-42) that average gas consumption will decrease as a result of BASIX in new homes. This is because BASIX aims to regulate the development of new dwellings to reduce greenhouse gases, which at the same time reduces the average energy use of new dwellings. Average gas usage in new dwellings for heating is around 6.6 GJ per year, some 9 per cent lower than for existing dwellings.

Mandatory Energy Performance Standards (MEPS)

MEPS includes a proposed initiative under which gas water heaters with an efficiency rating less than 4.5 star would be phased out, together with a (currently) voluntary efficiency labeling program for gas appliances and a ten-year strategic plan ("Switch on Gas") intended to implement a nationally-consistent regulation scheme for energy efficiency of gas appliances. NIEIR has developed a "Hot Water Model" to assist in projecting hot water gas usage from new and existing customers. The model takes into account the improved efficiency standards for gas hot water appliances, as well as the fact that conventional electric resistance waters will be banned in all new and existing homes in gas reticulated areas from 2010, and will be extended to new flats and apartments in reticulated areas and established houses in non-gas reticulated areas from 2012. The model identifies the following trends:

- average gas use for *hot water in new dwellings* of 10.5 GJ/a, declining 1 per cent per year over the projection period
- for existing dwellings, failure or scrappage rates for each type of hot water system with gas accounting for 43 per cent of replacement of electric resistance heaters by 2012 (solar electric and heat pumps together account for 49.5 per cent)
- for E-to-G conversions, 60 per cent switch to gas hot water in year 1, with the remainder converting in accordance with the failure or scrappage rates set out above.

Energy efficient shower heads

Both the New South Wales Greenhouse Gas Abatement Scheme (GGAS) and the Australian Government Water Efficiency Labelling Scheme (WELS) promote the use of more efficient shower heads to reduce water consumption.

These schemes will indirectly reduce gas demand for hot water heating because they will reduce average consumption of hot water. The effect is expected by NIEIR to be small, resulting in a reduction of annual average gas consumption for existing dwellings of around 0.1GJ/a per household (NIEIR 2010 report, p. 48).

Insulation and heating

When the NIEIR 2010 report was prepared, both the New South Wales and Australian governments had schemes in place to subsidise home insulation. NIEIR estimated that increased uptake of home insulation will result in an average reduction of gas demand of 0.4 GJ/a per household. The NIEIR 2010 report pre-dated the Australian government decision in February 2010 to discontinue the Home Insulation Program.

4.1.3 Jemena forecast adjustment methodology

JGN has modified the forecasts in the NIEIR 2010 report to align them with the tariff classes and charging parameters proposed by JGN for the new access arrangement. JGN also adjusted the NIEIR forecasts to take into account the expected impact of a proposed marketing strategy on Volume Customer load, and to reflect the demand associated with a new major customer.

Appendix 15.2 of JGN's original access arrangement information (JGN, 2009b) translated the aggregate NIEIR forecasts into proposed tariff classes and charging parameters, and explained in detail the process JGN had followed to translate the NIEIR forecasts. A numerical update of Appendix 15.2 has been provided by JGN in its new Appendix 12.1 (JGN, 2010b). The NIEIR forecast tables have been updated in this appendix to reflect the forecasts in the NIEIR 2010 report. This appendix also includes the final tables that feed into the pricing model as these have changed also.

The methodology used by JGN to adjust the NIEIR forecasts is summarized below.

Volume Customers

Volume Customer delivery points

JGN used the forecasts of Volume Customer numbers in the NIEIR 2010 report, expressed on a calendar year basis, to calculate the *average* number of customers over the calendar year (the NIEIR projections show the numbers *at the end* of each calendar year).

The proposed tariff structure in the access arrangement comprises two tariff classes for Volume Customers:

- V-Coastal tariff – Applicable to Volume Customer delivery points located in the Wilton network section, which is supplied from the JGN northern and southern trunks
- V-Country tariff – Applicable to Volume Customer delivery points located in country network sections that do not utilise JGN trunk mains.

JGN split the customer numbers into coastal zone and country zone customers using billing data for the year ended 31 December 2008 to determine the split ratio.

Gas marketing strategy

JGN further adjusted the forecasts in the NIEIR 2010 report to allow for the impact of a gas marketing strategy aimed at increasing awareness of gas as an environmentally friendly energy source, together with targeted incentives to installers to encourage the uptake of natural gas appliances where upfront capital costs may otherwise discourage the purchase of gas appliances. Additional gas sales attributable to the impact of the marketing strategy were included for each year of the forecast.

This is an estimate made by JGN based on its commercial experience. While there is no further explanation of the basis of the estimates, the increase is modest relative to total demand (around 0.5 per cent per year) and therefore not material in terms of the acceptability of the forecasts.

Block split

The tariffs for Volume Customers vary depending on the individual customer's total gas consumption. There are six tariff "blocks", with the highest unit tariffs applying to the customers with lowest annual usage and vice versa. This structure reflects the fact that there are significant fixed and semi-variable costs involved in providing services to each customer.

JGN split the Volume Customer demand into the six tariff blocks, based on the actual block splits for the 2008 calendar year.

JGN then split each of the six tariff blocks into coastal and country components, based on 2008 actual data.

Metering fees

Delivery points with meters that have capacity less than $6m^3/hr$ pay a fixed fee for the meter provision charge component. However, delivery points with meter capacity greater than $6m^3/hr$ pay a fee based on their throughput. JGN used 2008 base data to divide both the country and coastal customer groups

into those paying the fixed fee and those paying a metering fee based on throughput.

JGN also used the 2008 base data to calculate the split between Volume Customers with meters read monthly and those meters read quarterly.

Demand Customers

Demand (or Contract) customers consuming over 10 TJ/a account for the majority of the gas transported through JGN's distribution network, but represent only about 10 per cent of the total revenue base.

JGN currently charges for services to Demand Customer delivery points on a zonal basis that reflects the customer's location within the local network. JGN proposes to retain this approach, as a result of which there will be 12 location-based demand tariff classes (11 in the coastal zone and a single, uniform country zone). JGN is also proposing an additional set of location-based capacity charge tariffs for very large customers who agree to participate as "first response" respondents in network load shedding events. In effect this means that JGN proposes to establish 24 demand tariff classes in the Access Arrangement. With the exception of the demand throughput tariff class, there are five volume tranches within each demand tariff class.

The information set out in both the NIEIR 2010 report and the JGN report on adjustments to the NIEIR forecasts (JGN, 2010b) is provided on an aggregated basis across all zones and tariff classes. It does not provide a basis for understanding the level of demand in each geographic zone or volume tranche.

To rebalance the forecast in the NIEIR 2010 report for expected deletions and additions to the customer base, JGN generated a list of all Demand Customers connected at 31 December 2009, then adjusted this customer list to:

- remove a number of customers that were considered unlikely to be large customers as at 1 July 2010
- add a number of customers that were considered likely to connect before 1 July 2010.

These adjustments resulted in a list of 401 customers. The consumption for the year to 31 December 2008 associated with the 401 Demand Customers was the actual demand for that period. In order to balance the forecast in the NIEIR 2010 report to these actual customers and retain their relative shares of total consumption, JGN had to scale the recorded consumption of customers on the list, thereby enabling JGN to ensure that the translated forecasts balanced back to the NIEIR forecast (excluding a new major customer subsequently added—see below).

The scaling method involved dividing the actual 2008 consumption by the NIEIR total demand for each year to derive scaling factors. The adjustments required were small—less than 3 per cent in all cases. This approach ensured that the forecasts in the NIEIR 2010 report were translated in a manner that maintained the existing customer shares of total consumption.

New Demand Customer

JGN adjusted the forecast in the NIEIR 2010 report for Demand Customers to take into account a large new customer load that was not included in the NIEIR data.

Forecast Demand Customer MDQ

As well as forecasting annual consumption, NIEIR also forecast contracted MDQ over the access arrangement period. Again, the forecast in the NIEIR 2010 report was rebalanced to take account of the deletions and additions to the Demand Customer base. JGN determined scaling factors by dividing the NIEIR forecast MDQ for each year by the 2008 value. Again the adjustments required were quite small—less than 1.5 per cent in all cases.

Chargeable demand

For the access arrangement period, JGN is proposing a different charging structure for Demand Customers. Currently, Demand Customers are charged on the basis of their contracted MDQ. For the access arrangement period, JGN proposes to use a "chargeable demand" approach which is based on the consumption characteristics of the end-user customer, rather than the contract management and optimization practices adopted by the retailers. Under the proposed new access arrangement, chargeable demand will in most circumstances be directly related to the *ninth highest withdrawal of an end customer*, irrespective of their retailer's approach to contract management.[3]

The logic behind the ninth highest MDQ is that contract periods for each Demand Customer will no longer exist. Under current practice, customers are permitted nine overruns per year before they incur annual overrun charges. The transition to a rolling customer contract and mechanical chargeable

[3] In its submission on JGN's Revised Access Arrangement, EnergyAustralia notes that the Reference Services Agreement requires that the Chargeable Demand be greater than the MDQ for the Delivery Point and ten times the MHQ for that Delivery Point, with the latter requirement not applying to all sites. EnergyAustralia goes on to note that for any sites subject to this latter requirement, the Chargeable Demand will be in excess of the historical MDQ. Further as liabilities for overruns relate to MDQ rather than Chargeable Demand it is possible that the Chargeable Demand will be at a level higher than the ninth highest withdrawal.

demand billing leads to a requirement that all customers' chargeable demand on 1 July 2010 needs to be based on their ninth highest usage in the prior 12 month period. The ninth highest daily usage values for each customer were determined (proxies were used where there was less than 12 months of history for a particular customer). The aggregate MDQ based on ninth highest MDQ was determined for the 2008 Base Year, and the scaling factors previously calculated were then applied to adjust the MDQ forecasts for the forecast years.

4.2 Key forecast assumptions

4.2.1 Economic growth

The NIEIR 2010 report for JGN is based on NIEIR's economic outlook for Australia and its breakdown to New South Wales. This report was produced in February 2010, based on available data as at 31 December 2009. At this time, it had become apparent that the effects of the GFC in Australia had not been as severe as the NIEIR 2009 report had anticipated. The revised forecasts in the NIEIR 2010 report reflect this more positive outlook.

Importantly, however, NIEIR is now forecasting a tightening of economic conditions in the last two years of the forecast period (2014 and 2015). NIEIR's rational for this view is based on an expectation that:

- Growth in consumption expenditure relative to income will be constrained by a need to stabilise average household savings ratios, debt to income ratios, and household debt service ratios.
- Consumption expenditure growth will have to slow after 2012 as interest rates rise and fiscal stimulus is withdrawn.

NIEIR further explains the weak outlook for 2014 and 2015 as follows:

> '…the most powerful factor which will determine Australia's economic growth is not household debt, but whether or not foreigners will be willing to lend to meet Australia's international financing requirements. With gross international debt to [Gross Domestic Product] GDP ratio at approximately 100 per cent of GDP, and the amount of gross debt that has to be rolled over each year, Australia has to refinance half of its GDP plus the current account deficit for the year less Australia's international reserves … in 2009 the international financing ratio is around 55 per cent of GDP due to the falling terms of trade from the commodity price downturn. However, extra impetus will come from the recovery when capital expenditure increases and the real trade deficit expands quickly from imported capital equipment. As a result, by 2012 the international financing requirement reaches two thirds of GDP. This is very dangerous, well beyond the levels reached by Argentina and South Korea in their exchange rate-banking crisis of 2001 and 1997 respectively.

> This means that as the recovery proceeds all focus will be on controlling the balance of payments outcomes. Thus, despite Australia having a very low public sector debt to GDP ratio … the fiscal stimulus will be withdrawn in 2012, perhaps associated with a "horror" budget for the 2011-12 fiscal year.
>
> This explains fully why the projection of the Australia's economic growth rate is low over the 2013 to 2015 period.' (NIEIR, 2010, p. 11)

NIEIR based the economic outlook for New South Wales on the overall Australian economic outlook together with key indicators at regional level that included growth in population, dwelling stock and gross regional product. We consider this general approach to be appropriate for the purpose of developing the demand forecasts. However, the NIEIR economic outlook is much more pessimistic than other forecasts, including one that Jemena has relied on elsewhere in the revised access arrangement. BIS Shrapnel in its report to Jemena on "Wages Outlook for the Electricity, Gas and Water Sector in New South Wales" has presented forecasts of Australian Gross Domestic Product (GDP) and New South Wales Gross State Product (GSP) that show much stronger growth than the NIEIR forecasts, particularly in the second half of the access arrangement period. The latest New South Wales Treasury forecasts also show much stronger economic performance than NIEIR has assumed. A comparison of the NIEIR economic forecast with other economic forecasts is provided in Table 3.

Table 3 **Comparison of Economic Forecasts**

	NIEIR 2010	BIS Shrapnel 2010	NSW Treasury 2009
Australian GDP Annual % change			
2009	1.0	1.1	na
2010	1.2	1.7	na
2011	2.2	3.6	na
2012	4.6	3.8	na
2013	2.8	3.6	na
2014	1.7	2.3	na
2015	1.8	4.0	na
NSW GSP Annual % change			
2009	0.0	0.2	1.0
2010	0.3	1.4	1.5
2011	1.4	3.7	2.5
2012	4.9	4.3	3.8
2013	2.2	3.5	3.8
2014	0.9	2.2	na
2015	0.5	3.7	na

Data source: (NIEIR, 2010), (BIS Shrapnel, 2009b), (NSW Treasury, 2009)

4.2.2 Energy efficiency

There are a number of federal and State policies regarding energy efficiency that are expected to influence overall energy demand as well as consumer choice with regard to different forms of energy in New South Wales. NIEIR has provided a detailed account of the effects of such policies upon gas demand in New South Wales. However, as discussed in section 5.2 the effects of these policies may have been overstated.

4.3 Conclusions regarding key forecast assumptions

In developing the demand forecasts, NIEIR has given consideration to the key drivers affecting future gas demand. Account has been taken of factors that might cause future gas demand growth to follow a different growth trajectory when compared to past experience. In terms of methodology we consider that the approach adopted in the NIEIR 2010 report is sound. The main risks to the forecast accuracy relate not to the methodology that has been followed, but to the assumptions regarding specific demand drivers and their impacts on demand. In this regard, the critical assumptions adopted by NIEIR include:

- the overall economic growth outlook in New South Wales
- the impact of energy efficiency policies on gas demand
- the impact of climate change policies, in particular the proposed CPRS.

With regard to the economic growth outlook, NIEIR has concluded that growth in Australia generally, and New South Wales in particular, will be weak over the period 2013 to 2015. This conclusion has significant implications for the demand projections adopted by JGN for the second half of the next access arrangement period, and explains why demand, particularly in the Demand Customer sector of the market, is forecast to weaken significantly over this period. NIEIR has pointed to a number of macro-economic factors that might lead to this outcome. Some of these appear to be highly speculative—for example the hypothesis that:

> 'Thus, despite Australia having a very low public sector debt to GDP ratio … the fiscal stimulus will be withdrawn in 2012, perhaps associated with a "horror" budget for the 2011-12 fiscal year.' (NIEIR, 2010, p. 11)

NIEIR's views on New South Wales GSP, particularly over the second half of the access arrangement period, appear to be extremely pessimistic when compared to other forecasts that have been relied on elsewhere in the access arrangement information (see Table 3). The much lower New South Wales economic growth forecasts used by NIEIR for 2013 to 2015 are likely to result in forecast demand in those years being lower than would be the case if the stronger economic growth forecasts were applied.

The NIEIR 2010 report identifies a number of energy efficiency measures and policies on gas demand that have the potential to impact on gas demand. However, as discussed in section 5.2, the extent of the impacts attributed to particular interventions may well have been overstated.

The proposed CPRS is correctly identified by NIEIR as having the potential to increase gas prices (and therefore to reduce gas demand relative to a "no CPRS" scenario). However, the NIEIR 2010 report was prepared prior to the announcement of the deferral of CPRS commencement from mid 2011 to at least 2013. We consider that the NIEIR forecast significantly overstates the impact of CPRS on gas prices on two counts:

- First, increases in delivered gas costs of $3.20/GJ for business customers and $6.00/GJ for residential customers within three years of CPRS scheme commencement are, in our opinion, likely to be significantly overstated. The impact in percentage terms on residential gas prices is more than twice that estimated by Treasury in the CPRS White Paper.
- Second, the announced deferral of the CPRS to at least 2013 means that any impacts on gas prices arising from CPRS or a similar carbon pricing scheme now need to be delayed for at least two years.

Overstating the increases in gas price for residential and business customers caused by CPRS during the access arrangement period would, all else being equal, result in under-estimation of gas demand.

In summary, therefore, we consider that the demand forecasts set out in the NIEIR 2010 report reflect a number of key assumptions—low New South Wales economic growth; high impacts of CPRS on gas prices; and high impacts of energy efficiency policies on gas demand—that are open to question and that collectively are likely have resulted in forecast gas demand being understated, particularly in the last three years of the forecast period.

AGL Energy Limited in its submission in relation to the Draft Decision released by the AER in February 2010 raised similar concerns[4]:

> "The revised demand forecast for the tariff or volume market is not in line with what AGL sees. As was the case with the initial forecast, we are not convinced that a sufficient case has been demonstrated for the assumptions employed."

AGL Energy Limited further noted that[5]:

> "… the improved economic outlook and changes to government programs and policy since the initial forecasts for JGN were prepared in early 2009, all of which ought to

[4] AGL Energy Limited submission on JGN Access Arrangement 2010–2015 — Draft Decision and Jemena's revised proposal, dated 28 April 2010, p.1.

[5] AGL Energy Limited submission on JGN Access Arrangement 2010–2015 — Draft Decision and Jemena's revised proposal, dated 28 April 2010, p.5.

translate into further increases in gas volumes in NSW, have somehow not resulted in a revised forecast that aligns with generally accepted outlooks. At a high level, some of these changes are:

- Improvement in economic conditions;
- An increase in the current existing residential per customer usage since the previously quoted figure;
- An increasing trend in the residential usages which contradicts the projected decline; and
- Delay or cancellation of the ETS and home insulation schemes."

In the following section we further examine the impacts of the assumptions used by NIEIR on the reasonableness of the forecasts, including statistical comparison of the forecasts with historical trends.

5 The forecasts

In this chapter we review the revised forecasts themselves, to consider whether the application of the methodologies and assumptions used by NIEIR and JGN has produced forecast results that are reasonable in light of historical patterns of demand as well as current and anticipated influences on retail gas demand in New South Wales. We consider separately the forecasts for the Volume and Demand sectors of the market.

5.1 Use of trend extrapolation for forecast verification

In its initial response to the draft determination, JGN was critical of ACIL Tasman's use of linear trend extrapolation as a forecasting basis, stating that:

> 'JGN considers that a simple linear extrapolation of historic trends is not a reasonable basis for arriving at demand forecasts and therefore would not be consistent with the requirements of the NGR. Linear extrapolation runs the risk of producing inaccurate forecasts since it will (among other things):
>
> - fail to account for non-linear movements in any driver variable ignore non-linear relationships between any driver variable and demand
> - fail to account for one-off events with ongoing demand impacts (e.g. changes in government policy).
>
> In the context of gas demand forecasting, linear extrapolation is likely to be particularly problematic given the range of potential demand drivers and the interaction between them. Any forecast will need to take into account factors such as macroeconomic conditions, price elasticity, substitution to other energy sources, changes in government policy and so on. The ACIL Tasman extrapolation takes none of these factors into account, except to the extent that that they are evident in historic trends'. (JGN, 2010c, p. 209)

ACIL Tasman accepts that forecasting on the basis of extrapolation of historical trends involves a risk of overlooking changes in market drivers that could result in future trends differing from historical trends. As we acknowledged in our draft report, the NIEIR methodology looks to take into consideration the key drivers affecting future gas demand and factors that may cause future gas demand growth to follow a different trajectory from past experience. However a sound methodology alone does not ensure that the forecasts produced by application of that methodology are reasonable. The methodology needs to be supported by accurate data and appropriate assumptions in relation each of the input parameters. In our analysis we have used historical trend analysis as a cross-check on the results generated using the NIEIR methodology. As we recognised in our draft report, the fact that a

forecast diverges from the historical trend cannot in itself be taken as proof that the forecast is unreasonable. Rather, such divergence prompts us to ask whether there are good reasons for the break in trend. In ACIL Tasman's review of the initial demand forecasts set out in the NIEIR 2009 report, it became clear that there were major departures from historical trends that could not reasonably be explained by any realistic assessment of changed demand drivers. Furthermore, once actual results became available for the initial year of the forecast period, those results confirmed our view that the first year forecasts were unrealistically low. Notwithstanding the use of a sound methodology, the assumptions that were adopted within that methodological framework led to forecasts that were demonstrably incorrect and could not be considered reasonable.

In its response to the draft decision, JGN argued that:

> '... the NIEIR forecasts in their entirety should not be dismissed by the AER based on the understatement of just one year during a period of unprecedented economic uncertainty.' (JGN, 2010c, pp. 205-206)

We acknowledge that 2008–09 was a period of great economic uncertainty. However we do not accept the view that the significant discrepancy between the first year forecasts and actual performance should somehow have been overlooked and the remainder of the forecast allowed to stand. It was clear that the assumptions underpinning the forecasts had led to a significant understatement of demand in 2009, and there was no reason to believe that this error would somehow self-correct in subsequent years.

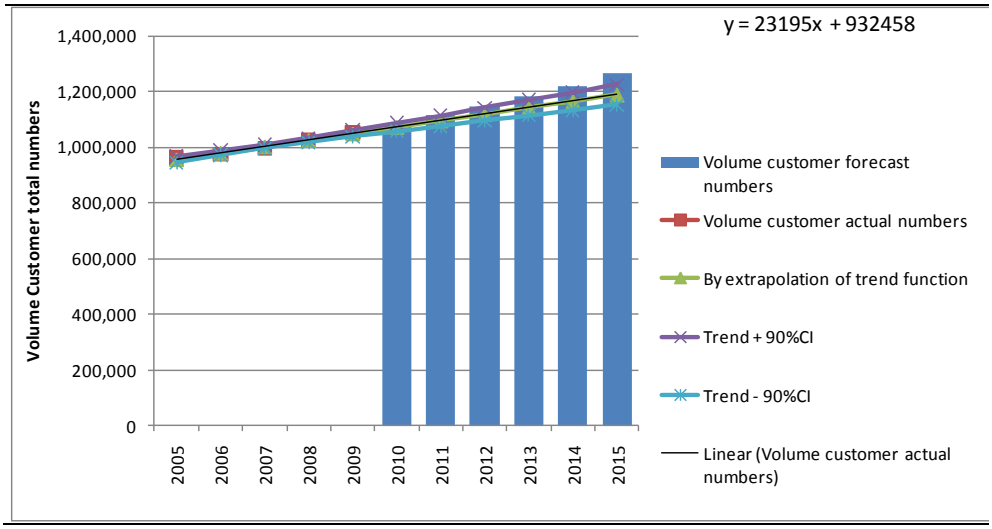
In our opinion the NIEIR methodology—if coupled with appropriate assumptions about key demand drivers—provides a better basis for forecasting gas demand than linear extrapolation of historical data. However we hold to the view that statistical analysis of historical trends continues to offer a valuable cross-check on the reasonableness of the forecasts generated using the NIEIR methodology, and we have adopted this approach in the following review of the forecasts in the NIEIR 2010 report.

5.2 Volume Customer forecasts

5.2.1 Customer numbers

The revised forecast of total customer numbers for the Volume sector is summarised and compared with historical actual customer numbers in Figure 2. The historical data is tightly correlated. The forecast shows stronger growth in customer numbers than in the past, with total customers for 2013 to 2015 above the 90 per cent confidence interval around the trend-extrapolated data.

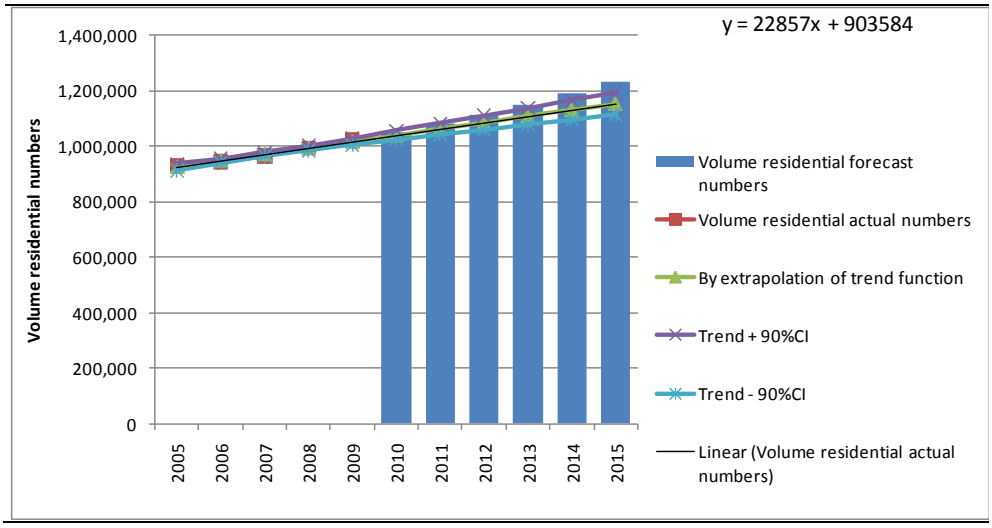
Figure 2 **Historical and forecast customer numbers—Volume total**



Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

Figure 3 shows the corresponding data and forecast trends for residential customer numbers as a subset of the Volume Customer class. The results are very close to those for the total Volume Customer class—a wholly expected result given that residential customers account for 97 per cent of the Volume class total customer numbers.

Figure 3 **Historical and forecast customer numbers—Volume residential**

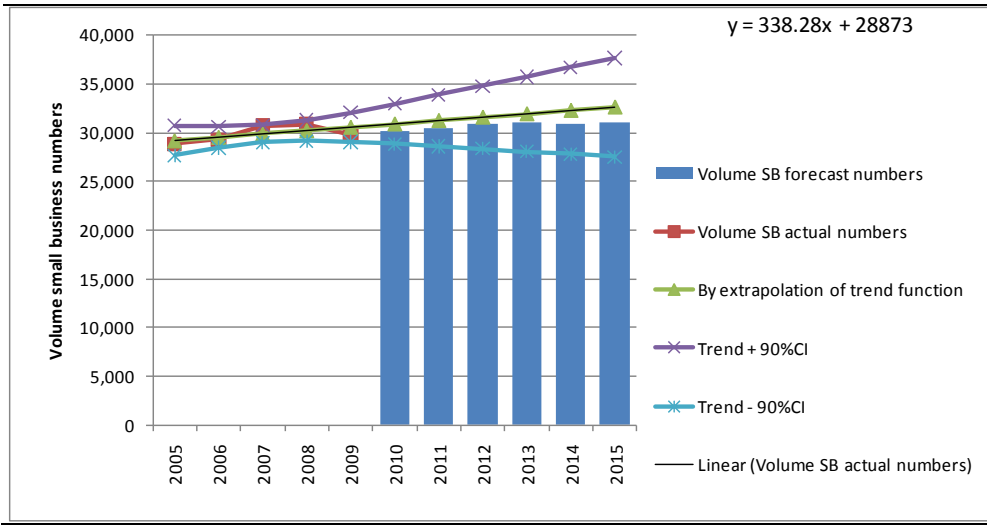


Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

Figure 4 shows the corresponding results for the small business customer numbers as a subset of the Volume Customer class. With a much smaller customer number set and greater sensitivity to economic cycles, the growth trend for small business customer numbers shows a weaker correlation and a correspondingly wider confidence interval around the extrapolated trend data.

The forecast for small business customer growth lies somewhat below the long-term trend, but well within the 90 per cent confidence interval.

Figure 4 **Historical and forecast customer numbers—Volume small business**



Data source: (JGN, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The in the NIEIR 2010 report identifies two factors that could reasonably be expected to push growth in new residential customer connections to a higher rate:

- The BASIX certification system for new New South Wales homes and major extensions and alterations. BASIX will tend to encourage installation of gas appliances rather than electric, but will also tend to reduce average gas consumption because it aims to reduce the average energy use of new dwellings.
- The fact that under MEPS installation of new conventional electric resistance waters will be banned in all new and existing homes in gas reticulated areas from 2010, and in new flats and apartments in reticulated areas and established houses in non-gas reticulated areas from 2012.

Another factor that could be expected to increase the rate of growth for Volume Customers is the gas marketing strategy to be undertaken by JGN.

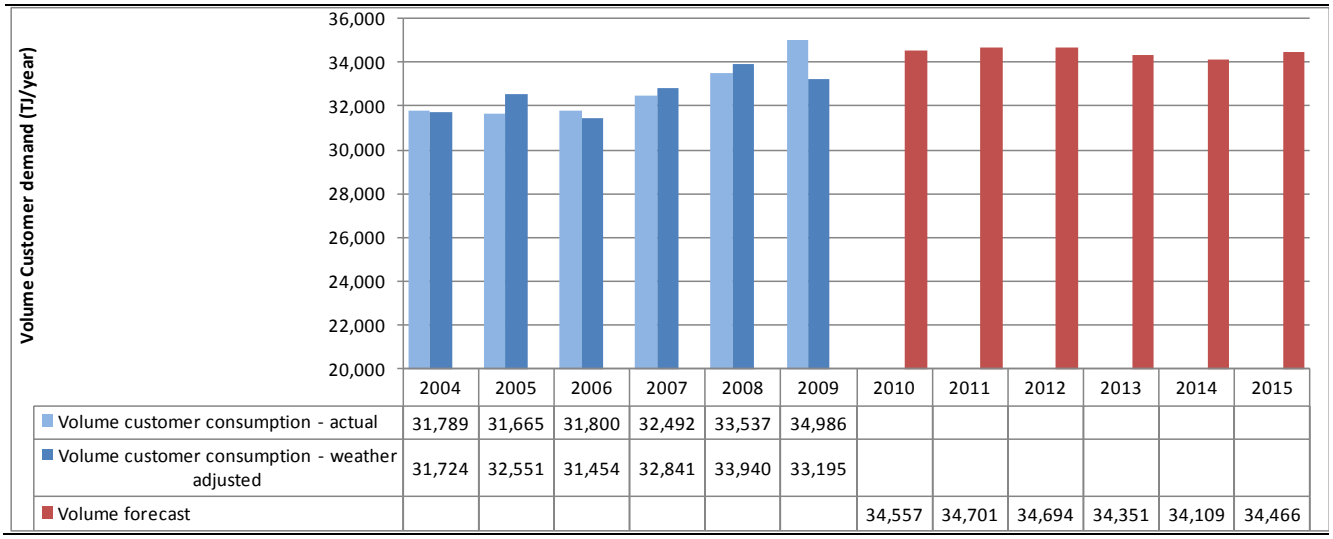
Overall the forecast rates of growth in customer numbers do not appear to be unreasonable.

We note, however, that there is a fundamental tension between a forecast overall rate of growth in Volume Customer numbers that significantly exceeds past trends, and a forecast decrease in Volume Customer gas demand below historical trends. This implies a steep decline in average gas use per customer. The issue is further explored in the following section.

5.2.2 Volume Customer gas demand

The revised forecast of gas demand for the Volume Customer sector is summarised and compared with historical actual consumption (raw and weather adjusted) in Figure 5.

Figure 5 **Historical and forecast consumption—Volume Customer sector**



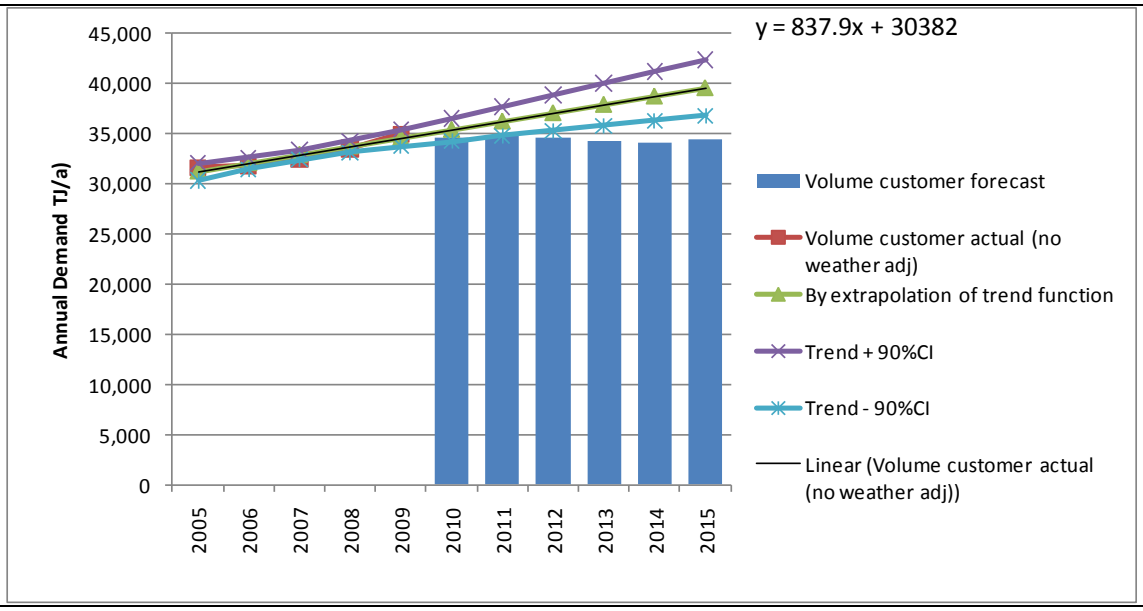
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Volume customer consumption - actual	31,789	31,665	31,800	32,492	33,537	34,986						
Volume customer consumption - weather adjusted	31,724	32,551	31,454	32,841	33,940	33,195						
Volume forecast							34,557	34,701	34,694	34,351	34,109	34,466

Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

Figure 6 shows the forecast Volume Customer demand compared to raw historical trends (that is, without weather normalisation) based on linear extrapolation, with a 90 per cent confidence interval shown around the trend line[6].

[6] See Appendix B for an explanation of the method of calculation of the 95 per cent confidence intervals.

Figure 6 **Forecast consumption compared to raw historical trend—Volume Customer sector**



Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

The historical data shows a strong correlation ($R^2 = 0.92$). As shown, the forecast demand levels are initially below the trend line, and fall so that from 2012 they lie outside the lower bound of the 90 per cent confidence interval. The break from the past growth trend requires explanation. The NIEIR 2010 report points to a combination of policy measures relating to improved energy efficiency as drivers of lower average rates of gas consumption in the future.

In its initial response to the draft decision, JGN noted that:

> 'Three significant Government programs have either been substantially changed in the last 12 months or will be implemented in the coming year, namely:
>
> - the home insulation scheme
> - the home solar rebate
> - minimum energy performance standards for gas hot water systems'
>
> (JGN, 2010c, p. 204)

We note that:

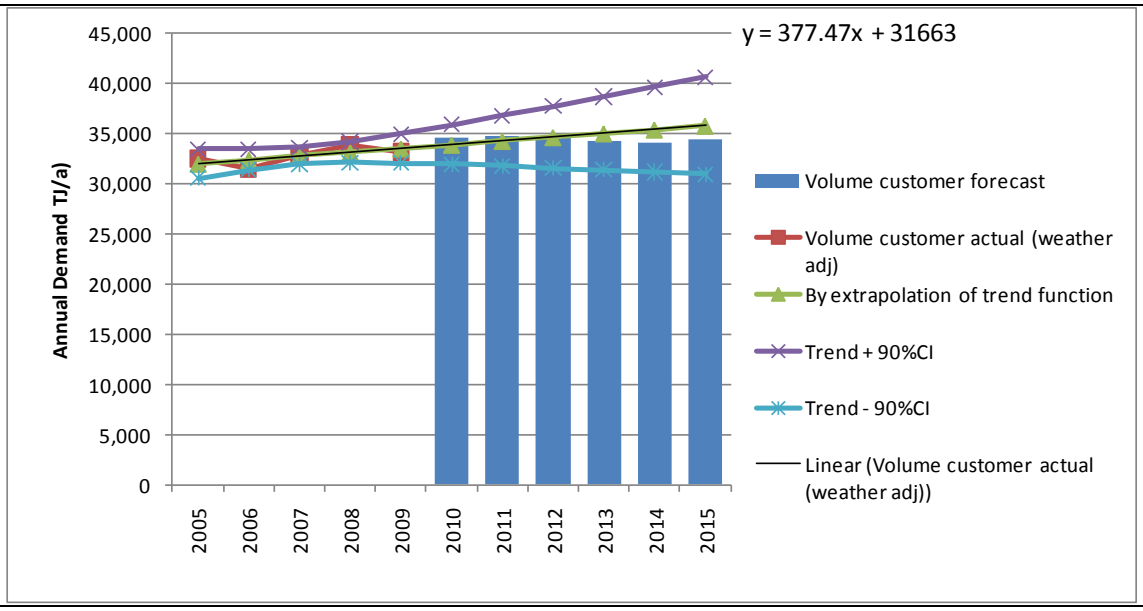
- The home insulation scheme was discontinued on 19 February 2010
- The home solar rebate was discontinued on 19 February 2010
  - These schemes were replaced by the Household Renewable Energy Bonus Scheme which provides modest rebates to help eligible home-owners, landlords or tenants to replace their electric storage hot water systems with solar or heat pump hot water systems.

  - The New South Wales Hot Water System Rebate Scheme provides rebates for replacement of electric hot water systems with efficient (5 star or better) gas systems as well as solar and heat pumps.
  - New South Wales has had a hot water system rebate (as part of the New South Wales Home Saver Rebate Scheme) since October 2007.
- MEPS requirements for gas appliances, including gas hot water heaters, are currently being revised. However, MEPS for gas water heaters are far from new: MEA & others (2002) note that "MEPS for gas water heaters have been in effect since at least 1983 in Australia". Gas water heaters and space heaters are required to carry an energy label and various appliance types also have MEPS requirements. Governments are working with the gas industry to revise the energy label and MEPS requirements for gas appliances. Standby targets for various gas products were released in 2004. The proposed regulatory changes to MEPS, if passed into law, will represent the next stage in an ongoing process of energy efficiency improvement for gas appliances, rather than a quantum change. We note also that under MEPS the ban on conventional electric resistance hot water systems will tend to increase the share of gas hot water systems in new houses and replacements. This trend is already apparent in ABS data [reproduced in Table 4.8 of the NIEIR 2010 report] which shows natural gas increasing its share of energy source used in water heating in New South Wales from 20.8 per cent in 1999 to 25.5 per cent in 2008.

However, in order to reach a conclusion on the reasonableness of the Volume Customer forecasts it is necessary to consider the data after weather normalisation.

Figure 7 shows the comparison based on weather normalised historical data. The forecast demand levels are initially slightly above the trend line and then fall below the trend but remain within the 90 per cent confidence interval. Therefore on the basis of an extrapolation of the last five years of weather normalised data, the forecasts of total gas consumption in the Volume Customer sector do not appear to be statistically unreasonable.

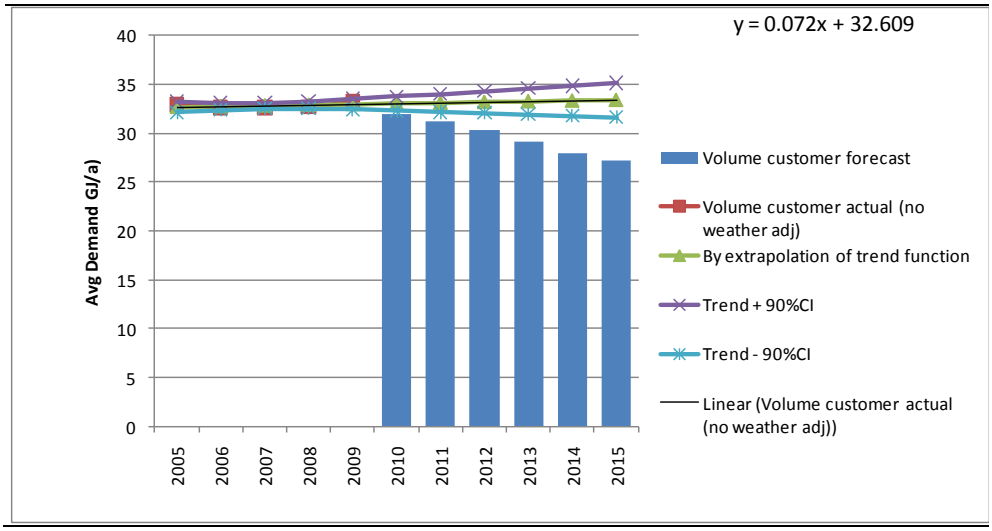
Figure 7 **Forecast consumption compared to weather-adjusted historical trend—Volume Customer sector**



Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

In the NIEIR 2009 forecast the implied average gas consumption per Volume Customer (derived from Volume Customer Demand and customer numbers) showed a significant step change decrease when compared to the historical average consumption (after weather adjustment). The corresponding comparisons using the NIEIR 2010 forecast are shown in Figure 8 (before weather adjustment) and Figure 9 (after weather adjustment).

Figure 8 **Actual vs forecast average gas consumption per Volume Customer, before weather normalisation**



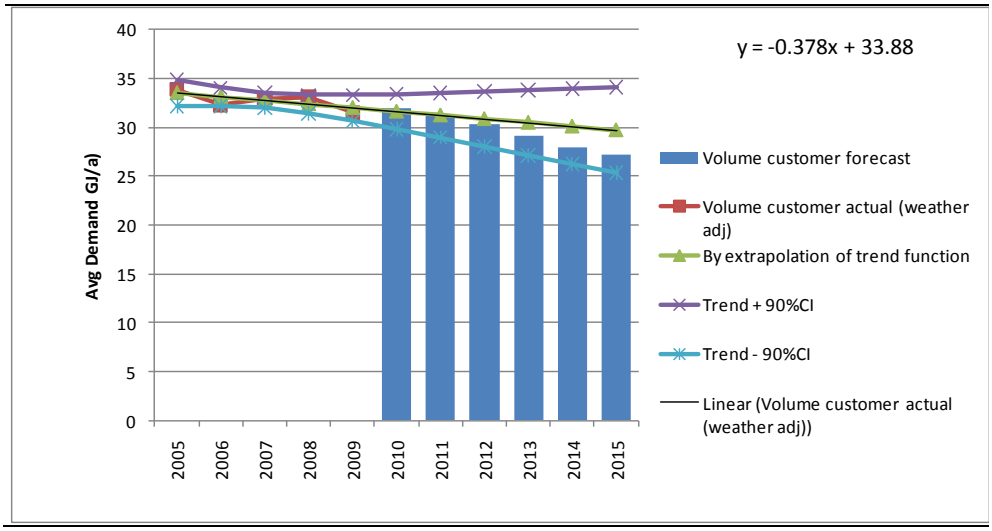
Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

The forecast no longer shows a large step change from historical trends. On a raw basis (before weather normalisation), the average gas consumption per Volume Customer falls rapidly below the historical trend, and the results for years 2011 to 2015 sit outside the lower bound of the 90 per cent confidence interval. Again, NIEIR and JGN have pointed to significant changes in policies such as the home insulation scheme, solar rebate scheme and changes to energy labelling and MEPS for gas hot water systems. Our earlier comments explain why we find this explanation for the rapid break from trend unconvincing.

Again, however, it is necessary to consider the weather normalised data in order to draw conclusions about the reasonableness of the forecast.

When the historical data is weather normalised, the forecast average gas consumption per Volume Customer is seen to be on the historical trend for the first two years of the forecast period. The forecast then falls below the historical trend but remains within the 90 per cent confidence interval. The weather-normalised historical trend shows a reduction of about 0.4GJ/a in average gas consumption per customer. The forecast, on the other hand, shows an average 0.9 GJ/a reduction in average consumption per customer. We do not consider that NIEIR and JGN have provided persuasive evidence to support such a steep rate of decline in annual average consumption across the entire Volume Customer segment. This is particularly so in light of recent policy developments including the discontinuation of the Home Insulation Scheme and deferral of the CPRS. However, as shown in Figure 9, the forecast does fall within the 90 per cent confidence interval around the historical trend based on the past five years of weather-adjusted data, and on this basis we consider that the forecast average consumption per customer is not statistically unreasonable.

Figure 9 **Actual vs forecast average gas consumption per Volume Customer, after weather normalisation**



Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

5.2.3 Conclusions regarding Volume Customer forecasts

In line with the views expressed in the draft report (ACIL Tasman, 2010a), we conclude that the Volume Customer forecasts have been derived using a well-established and soundly based methodology.

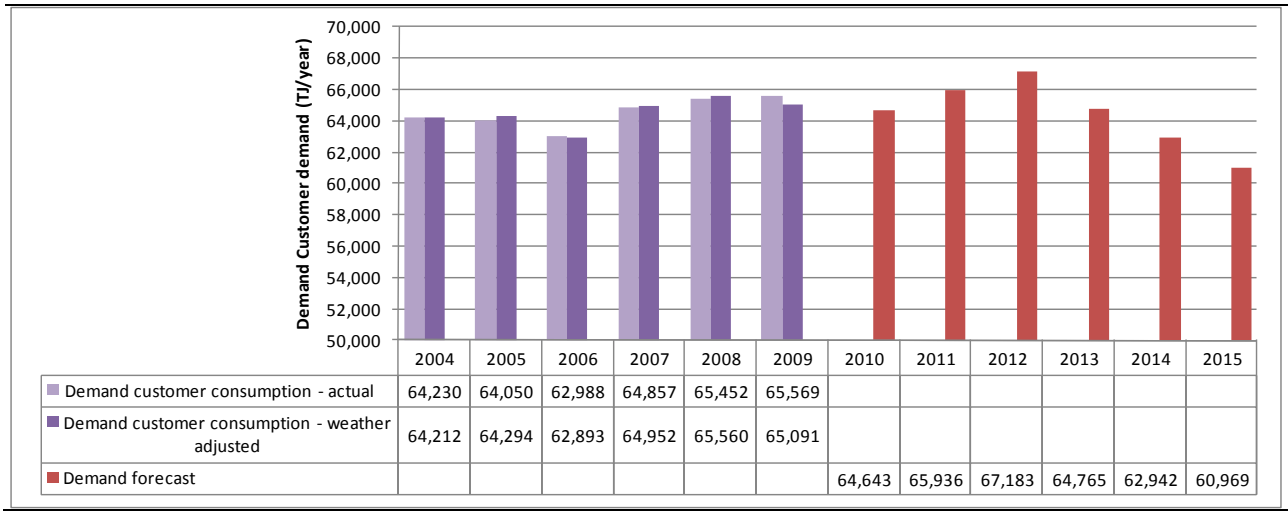
Overall we see it as reasonable to expect that average consumption per Volume Customer will continue to decline in light of government policies and public opinion that support improved energy efficiency, reduced hot water consumption, increased use of renewable sources such as solar electric and so forth.

The revised Volume Customer demand forecasts no longer show a significant step change from historical trends. The forecasts for both total consumption and average annual consumption fall below the raw historical trends (before weather adjustment) and lie outside the lower limit of the 90 per cent confidence interval. However comparison of the forecasts with weather normalized historical data that takes into account a long-term trend toward warmer winters (lower HDD) shows the forecasts of both total consumption and average annual consumption to be within the 90 per cent confidence interval about the trends, and on this basis we consider that the revised Volume Customer forecasts are not statistically unreasonable.

5.3 Demand Customer forecasts

The revised forecast gas demand for the Demand Customers is summarized and compared with historical actual consumption (raw and weather adjusted) in Figure 10.

Figure 10 **Historical and forecast consumption—Demand Customer sector**



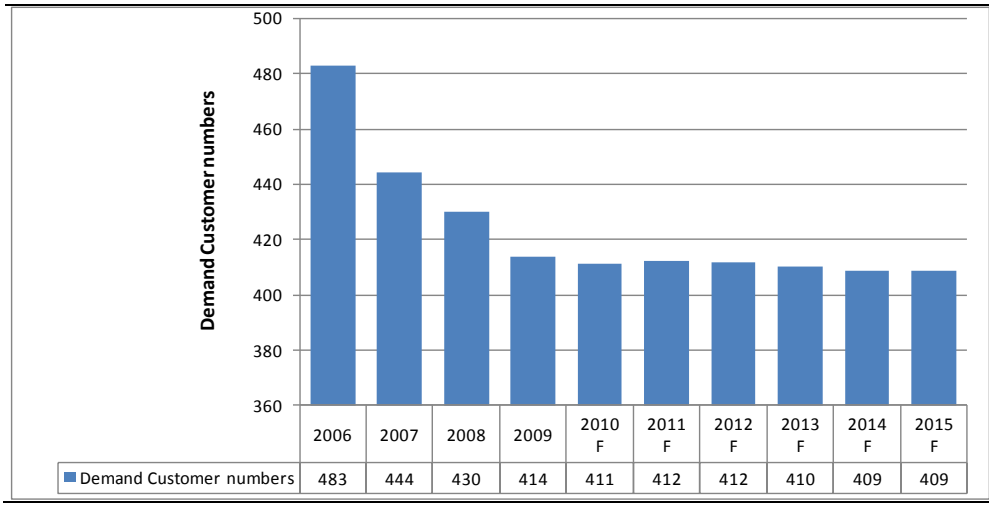
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Demand customer consumption - actual	64,230	64,050	62,988	64,857	65,452	65,569						
Demand customer consumption - weather adjusted	64,212	64,294	62,893	64,952	65,560	65,091						
Demand forecast							64,643	65,936	67,183	64,765	62,942	60,969

Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

5.3.1 Demand forecast compared to historical trend

Some softening of demand in the commercial and industrial sector could reasonably be expected in the short term as a result of flow-on effects from the GFC and this seems to be reflected in the actual demand for 2009. We also observe that there has been a decline in customer numbers in the Demand Customer sector from 483 in 2005–06 to an (actual) 414 in 2008–09. As shown in Figure 11, the forecast customer numbers remain relatively flat from 2010 on.

Figure 11 **Actual and forecast Demand Customer numbers**

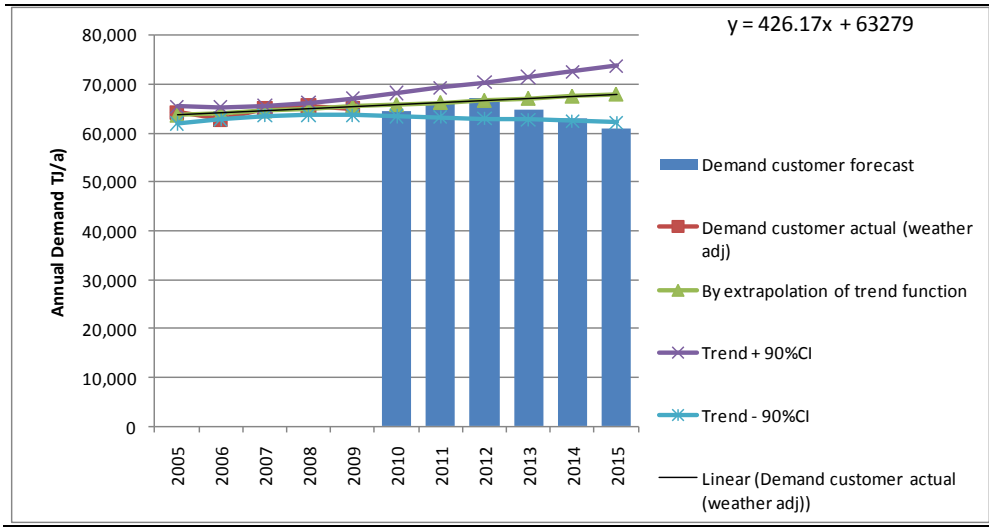


	2006	2007	2008	2009	2010 F	2011 F	2012 F	2013 F	2014 F	2015 F
Demand Customer numbers	483	444	430	414	411	412	412	410	409	409

Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

The forecast gas demand for Demand Customers is compared to weather normalized historical demand in Figure 12.

Figure 12 **Demand Customer forecast compared to weather normalized historical demand**



Data source: (JGN, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The previous forecast showed a sharp drop in gas consumption in the Demand Customer sector of around 4.4 PJ/a or some 6.8 per cent to 60.7 PJ in the year ended June 2010. The revised forecast shows weather normalised Demand Customer gas consumption starting out close to historical trend, but then falling rapidly post 2012, with the results for 2014 and 2015 sitting on and outside the lower bound of the 90 per cent confidence interval. The pattern of growth through to 2012, followed by declining consumption over the period 2013 to 2015 is consistent with the NIEIR 2010 macroeconomic forecast assumptions for the Australian and New South Wales economies, which predict strong growth in GDP/GSP and private consumption peaking in 2012, followed by a period of much lower growth (see section 4.2.1). The NIEIR modelling suggests that these macro-economic conditions together with the combination of policy measures relating to improved energy efficiency will see gas consumption fall below the previous slow growth trend, and in fact decline by 6.2 PJ or around 9 per cent over the period 2012 to 2015. A decline of this magnitude raises serious questions as to whether the assumptions that have been made in applying NIEIR's methodology are overly pessimistic. As discussed in section 4.2.1, NIEIR has adopted a forecast of New South Wales GSP that is much lower than other forecasts including the BIS Shrapnel study that has been relied on by JGN elsewhere in the revised access arrangement (BIS Shrapnel, 2009b).

The forecast decline in Demand Customer gas consumption will also have been influenced by NIEIR's assumptions in relation to CPRS including that gas prices to business customers under CPRS will rise 38 per cent over three years from 2010 to 2013. These assumptions exaggerate the potential impact of

CPRS, particularly given the recent decision to defer the scheme to at least 2013.

In light of these considerations we conclude that the revised JGN Demand Customer forecast volume is not reasonable.

5.3.2 MDQ forecasts for Demand Customers

Relationship between MDQ and gas demand

While it is important to consider the volume forecasts for Demand Customers, it is the forecasts of Maximum Daily Quantity (MDQ) bookings that are critical in terms of implications for tariff setting. This is because the charges for Demand Customers are calculated on the basis of the system capacity (MDQ) used, rather than the physical quantity of gas delivered.

The relationship between gas demand and MDQ is complex. The ratio of average daily throughput to peak daily throughput (that is, the "load factor") varies widely from customer to customer. MDQ is directly related to peak daily requirements, rather than average daily requirements.

Hence the loss or gain of a demand customer has an impact on aggregate system MDQ requirements that is not necessarily proportional to the corresponding impact on total gas demand. A very low load factor customer such as a peaking electricity generator may have a large MDQ requirement, but may consume only a small quantity of gas over the course of a year.

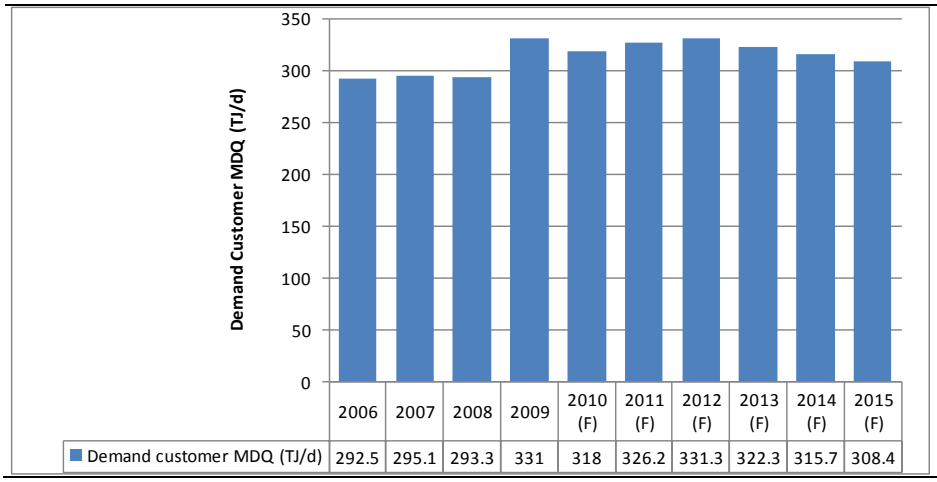
The impact of changes in MDQ is further complicated by the fact that capacity is not uniform throughout the pipeline network. Hence the cost impact of adding or subtracting a customer with a given MDQ requirement may vary depending on where that requirement is located within the system.

MDQ history and forecast

The revised demand forecasts in the NIEIR 2010 report include new forecasts of Demand Customer MDQ. Historical data on MDQ for the years ended June 2006 to 2009 is also presented.

Historical and revised forecast of MDQ for the Demand Customers is shown in Figure 13. Over the period 2006 to 2008 the MDQ requirement for Demand Customers was quite stable at between 290 and 295 TJ/d with an implied load factor (average/peak load) of between 59 per cent and 61 per cent. As indicated in Figure 13, a step change upward in MDQ occurred in 2009. This related to inclusion of a large new customer with a significant MDQ requirement. As a result of this inclusion, overall load factor is expected to decline to between 50 per cent and 55 per cent over the forecast period.

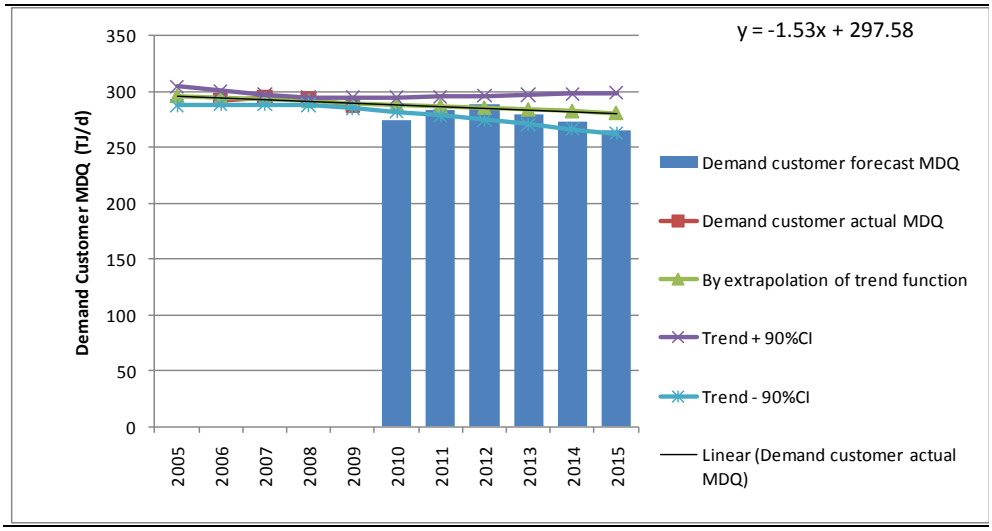
Figure 13 **Demand Customer Maximum Daily Quantity (MDQ, TJ/d)**



Data source: (JGN, 2009a) Tables 4.3 and 5.2

In order to compare the MDQ forecasts with historical levels of MDQ utilization, it is necessary first to remove from the data set the large new customer that came onto the system in 2009. The inclusion of this new customer load in the historical data analysis would result in a significant uplift in MDQ in 2009, which would in turn cause the MDQ history to show a strong rising pattern. In the absence of the new large MDQ customer which effectively distorts the historical data, the underlying pattern in the Demand Customer base is revealed to be one of mildly declining MDQ. The resulting trend analysis is shown in Figure 14.

Figure 14 **Historical and forecast Demand Customer MDQ**



Data source: (JGN, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

Note: Historical MDQ data adjusted to remove one new large MDQ customer that commenced in 2009.

The forecast Demand Customer MDQ falls outside the 90 per cent confidence interval around the historical trend in the first forecast year (2010) and again

falls to the lower bound of the confidence interval by the end of the access arrangement period.

The forecast decline in MDQ after 2012 reflects assumptions by NIEIR regarding New South Wales economic growth that are at odds with other reputable forecasts, including one used by JGN elsewhere in the revised access arrangement, as well an assessment of impacts of CPRS that are overstated. On this basis we do not consider the forecast of Demand Customer MDQ to be reasonable.

5.3.3 "First Response" service for Demand Customers

JGN is proposing to introduce a new "first response" service for large Demand Customers willing to have supply curtailed in the event of system constraints. The service is designed to give JGN improved capability to deal with unexpected supply constraints, rather than as a regular operational device. As such, it is not clear how this service will operate relative to other arrangements already in place for dealing with emergency outages or other circumstances that may require load shedding.

The original access arrangement proposed a tariff for the first response service that represented a discount of some 50 per cent on the proposed Demand tariffs. JGN also forecast a strong uptake of this service on the basis of an expectation that "(the) vast majority of eligible sites would take up this tariff and that more sheddable load will become available" (JGN, 2010d, p. 3). The result was that, in order to achieve overall recovery of allowable revenue, tariffs for customers not moving to the first response service would rise steeply. In view of the large differential impact on tariffs faced by some customers and the potential for windfall gains if the forecast levels of uptake of the first response service are not achieved, ACIL Tasman in its draft report advised that JGN should be required to provide clear justification for the level of discount offered and the assumptions regarding rate of uptake amongst eligible customers (ACIL Tasman, 2010a, p. 37).

Draft decision

In its draft decision, the AER required a number of changes to the first response service. Specifically, the AER required:

- the access arrangement information (Jemena pricing model) to halve the demand forecasts for demand first response tariff classes that contain more than one customer.
- the quantities removed from the first response to be allocated to appropriate demand coastal tariff classes
- the demand first response discount to be reduced to 25 per cent

- the additional revenue recovered by JGN as a consequence of the amendments in this amendment to be used to reduce tariffs for all coastal demand customers on an equal percentage basis.

JGN initial response

JGN surveyed large Demand customers to ascertain levels of interest in taking up the first response service and the level of discount that would be required to encourage customers to move to the first response tariff. Based on the results of this survey, JGN has proposed to maintain the 50 per cent discount for demand first response tariffs, on the basis that a 25 per cent discount would not attract sufficient uptake of the service.

Based on expressions of interest elicited through the survey process, JGN has also proposed to restrict the availability of the first response service to very large customers (gas demand greater than 350 GJ per hour).

6 Conclusions

ACIL Tasman considers that the revised forecast in the NIEIR 2010 report, and the adjustments to the NIEIR forecast made by JGN to take into account certain changes following the completion of the NIEIR analysis, have been prepared using established and clearly described methodologies. The revised forecasts have addressed a number of concerns raised in our draft report about short-term step changes from historical trends, in both the small customer (Volume) and large customer (Demand) segments of the market. Those step changes were inconsistent with actual result through 2009 and in our opinion established unreasonably low starting points for the forecasts in the next access arrangement period.

While the methodological framework is sound, we consider that the demand forecasts set out in the NIEIR 2010 report reflect a number of key assumptions—low New South Wales economic growth; high impacts of CPRS on gas prices; and high impacts of energy efficiency policies on gas demand—that are open to question and that collectively are likely have resulted in forecast gas demand being understated.

The forecast rates of growth in customer numbers do not appear to be unreasonable. However, there is a fundamental tension between a forecast overall rate of growth in Volume Customer numbers that significantly exceeds past trends, and a forecast decrease in Volume Customer gas demand below historical trends.

In the Volume Customer segment, customer numbers are projected to grow at an average of about 35,500 customers or 3.1 per cent per year over the forecast

period. However, the amount of gas delivered to the Volume Customer segment is forecast to remain almost flat, ranging between 34.1 and 34.7 PJ/a over the period to 2015. JGN expects new customers to consume much less gas on average than existing customers (15.2 declining to 12.9 GJ/a for new customers, compared to 20.9 declining to 18.2 GJ/a for existing customers). As a result, JGN is forecasting around 182,500 new network connections over the access arrangement period, but no increase in the amount of gas delivered.

The revised forecasts for both total consumption and average annual consumption in the Volume Customer segment fall below the raw historical trends (before weather normalisation) and lie well outside the lower limit of the 90 per cent confidence interval about those trends. The weather-adjusted historical trend data, including results for fiscal 2009, show demand rising slowly at around 0.4PJ/a with growth in customer numbers largely offset by lower average consumption per customer. The average annual gas demand per customer (after weather normalization) has been declining at about 0.4GJ/a over the past five years. The revised forecast, on the other hand, shows an average 0.9 GJ/a reduction in average consumption per customer. We do not consider that NIEIR and JGN have provided persuasive evidence that the combined impact of the various government programs will lead to such a steep rate of decline in annual average consumption across the entire Volume Customer segment. The assumed impact of CPRS has also been overstated, partly but not solely because of the deferral of the CPRS after the NIEIR 2010 report wasprepared.

Despite these reservations, the revised forecasts fall within the 90 per cent confidence interval around the historical trends based on the past five years of weather-adjusted data, and on this basis we consider that the forecast demand in the Volume Customer segment and average consumption per customer are not statistically unreasonable.

For the Demand Customer group, the revised forecast (weather normalised) shows gas consumption starting out on historical trend, but then falling rapidly post 2012, with the results for 2014 and 2015 sitting on and outside (respectively) the lower bound of the 90 per cent confidence interval. This pattern of growth through to 2012, followed by steeply declining consumption over the period 2013 to 2015 reflects a forecast of New South Wales GSP in the NIEIR 2010 report that is much lower than other forecasts, including one that has been relied on by JGN elsewhere in the revised access arrangement. The forecast decline in Demand Customer gas consumption has also been influenced by assumptions that exaggerate the potential impact of CPRS. We therefore conclude that the revised JGN Demand Customer forecast volume is not reasonable.

The forecast Demand Customer MDQ falls outside the 90 per cent confidence interval around the historical trend in the first forecast year (2010) and again falls to the lower bound of the confidence interval by the end of the access arrangement period. This again reflects assumptions by NIEIR regarding New South Wales economic growth that are at odds with other forecasts including one used by JGN in the revised access arrangement, as well an assessment of impacts of CPRS that are overstated. On this basis we do not consider the forecast of Demand Customer MDQ to be reasonable.

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A Curriculums Vitae

Following are brief curriculums vitae for the consulting team involved in the preparation of this report

Paul Balfe

Paul Balfe is an Executive Director of ACIL Tasman and has overall responsibility for ACIL Tasman's gas business. Paul has more than 30 years experience in the energy and resources sectors. Previously he held a number of senior executive positions in the Queensland Department of Minerals and Energy. He has a Masters in Business Administration and a degree in Science.

Paul is responsible for the development and commercialisation of ACIL Tasman's *GasMark* model and its application to strategic and policy analysis throughout Australia, New Zealand and in South East Asia. He provides a range of analytical and advisory services to companies, government agencies and industry associations, particularly in the gas, electricity and resources sector. He has expertise in gas, electricity, resources, mining, economic impact analysis and in the analysis of core risk management, safety and health.

He has advised government and corporate sector clients on matters relating to the coal, oil and gas industries, coal seam gas, oil shale, mining safety and health, environmental management and alternative and renewable energies. With qualifications in geology and business administration, his experience ranges across both technical and commercial aspects of project evaluation and development.

Paul has worked extensively on gas industry matters, particularly gas policy reform issues; gas market analysis; gas pipeline developments, acquisitions and disposals; and gas project commercial analysis. He has worked extensively in the Queensland coal seam gas industry as an adviser to both government and corporate sector clients on regulatory, technical, economic and commercial aspects of CSG development.

Owen Kelp

Owen Kelp is a Consultant with ACIL Tasman specialising in electricity and gas markets. Owen has worked extensively on energy industry matters and across a broad range of assignments including upstream conventional and coal seam methane economics; market demand, supply and price forecasting studies; strategic reviews; transmission and distribution networks (project evaluation, throughput forecasts, asset sales and due diligence work); project evaluation (financial modelling, market studies and economic benefits);

regulatory and policy change impact studies. Over the last eight years Owen has managed more than 50 energy industry assignments.

He has extensive modelling capability using various software packages and programming languages as well as practical experience with operations research methods including linear programming and optimisation. He also has a good theoretical knowledge of financial markets and instruments. Owen has been principally responsible for the development and maintenance of a number of ACIL Tasman energy market models, in particular:

- GasMark Global – ACIL Tasman's global model for gas trade for both LNG and pipeline gas
- GasMark – ACIL Tasman's regional model of the interconnected Australian gas market
- GasMark New Zealand – supply demand model for the New Zealand system
- PowerMark – detailed model of the National Electricity Market used for price forecasting and asset due diligence
- PowerMark WA – detailed model of the Western Australian electricity market.

Owen holds a Bachelor of Business (Economics and Finance) from Queensland University of Technology and a Graduate Diploma of Applied Finance and Investment from the Financial Services Institute of Australasia (FINSIA).

Alan Smart

Alan Smart is a Principal Consultant working in the Canberra office of ACIL Tasman. He provides advice on economics, markets and policy for corporate and government clients.

Alan consults in the energy, water and infrastructure sectors. He has also undertaken projects in evaluation and prioritisation of research and development, and in economics and strategy in trade, transport, defence, agriculture, geoscience and spatial information systems.

He is an expert in the energy sector. He has been gas market advisor for strategy and due diligence projects including gas market assessments in Australia and New Zealand for AGL, Alinta, Duke Energy, Zinifex, Edison Mission, Macquarie Bank and Mariner Financial Services. He has also undertaken projects in assessing the economics of power generation including carbon capture and storage.

Alan has also undertaken projects on energy, water and petroleum import infrastructure for the Federal Government. In the petroleum sector he

undertook a review of the *Liquid Fuels Emergency Act* in 2006, a review of liquid fuels vulnerability in 2007 and an audit of petroleum import infrastructure in 2008-09.

Prior to entering consulting in 1998, Alan had over seventeen years experience as a senior executive in the Commonwealth Government in the energy, water and agriculture. He has extensive experience in water policy reform and regulation. His appointments were in senior policy advising roles as well as in business operations including Chief Executive of the Pipeline Authority and Executive Director of the Timor Gap Joint Authority and General Manager in the Australian Maritime Safety Authority. Relevant areas of Alan's work included oil pricing and taxation, gas and electricity market reform, regulation, pipeline access, risk and safety policy and corporate governance.

Alan has qualifications in engineering and economics and completed the Advanced Management Program at Harvard Business School. He is Chartered Professional Engineer.

B Establishment of Confidence Intervals around historical trend lines

The following explanation of the construction of confidence intervals is based on information provided in the manual for the Statistica software package.

> The confidence intervals for specific statistics (for example, means or regression lines) provide a range of values around the statistic where the "true" (population) statistic can be expected to be located (with a given level of certainty).
>
> The confidence intervals for the mean give us a range of values around the mean where we expect the "true" (population) mean is located (with a given level of certainty). Confidence intervals can be calculated for any p-level; for example, if the mean in a sample is 23, and the lower and upper limits of the p=.05 confidence interval are 19 and 27 respectively, then we can conclude that there is a 95 per cent probability that the population mean is greater than 19 and lower than 27. If the p-level is reduced to a smaller value, then the interval would become wider thereby increasing the "certainty" of the estimate, and vice versa. The width of the confidence interval depends on the sample size and on the variation of data values. The calculation of confidence intervals is based on the assumption that the variable is normally distributed in the population. This estimate may not be valid if this assumption is not met, unless the sample size is large, say n = 100 or more.

Confidence Intervals (CI's) have the form:

$$Est \pm t_{1-\frac{\alpha}{2},(n-2)} SE_{est}$$

For the CI around the y-estimate in the linear regression equation, the CI is given by:

$$CI = Est_y \pm t_{1-\frac{\alpha}{2},(n-2)} SE_{est}$$

Where $t_{1-\frac{\alpha}{2},(n-2)}$ is the inverse of the Student's t-distribution for confidence level α given that n is the number of data points (so that n-2 is the number of degrees of freedom in the distribution)

and

$$SE_{est} = SE_y \times \sqrt{\frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum (x_i - \bar{x})^2}}$$