April 2013 **Issue 14**

Update: What is driving the decline in electricity demand?

Introduction

We revisit the topic of demand trends and factors given the interest and feedback from the previous issue, the continued decline in 2012 and updates to the data. Over the last twelve months there have been numerous reports on the drivers of individual demand components, here we try to summarise and bring the data together with a focus on NSW, the largest NEM state by demand.

Investment in generation and network infrastructure, and more broadly in economic terms, economic growth can be seen in real time through the consumption of electricity where prevailing demand is a leading indicator. The past 12 months has seen a further decline in electricity demand in the National Electricity Market (NEM) driven by its relationship with weather, off-grid electricity generation[i] and economic activity. The following sections provide some analysis into factors driving demand and insight into trends going forward.

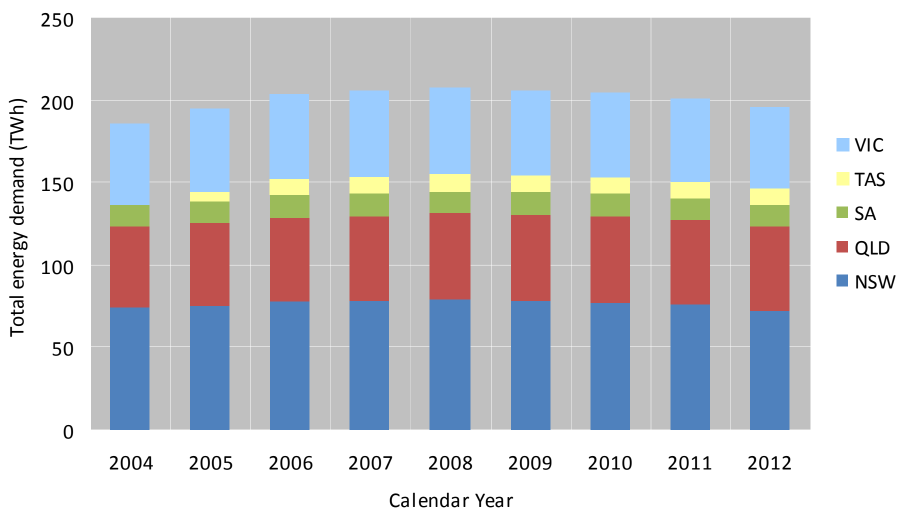
We also touch on topics such as "does this represent a fundamental change in the nature of electricity demand and, if so, what are the implications for investment and planning?" More broadly, does the trend of declining demand represent a threat to the profitability of on-grid power stations, regardless of whether they are renewable or fossil-fuel fired? We then conclude by discussing these issues.

For an explanation of methodology or definitions used in this article please refer to Issue 13 of the Insider[ii].

Historical levels of electricity demand

Figure 1 shows historical electricity demand across the NEM by region from 2004 to 2012 and figure 2 shows the change in annual energy demand against the base year of 2004.

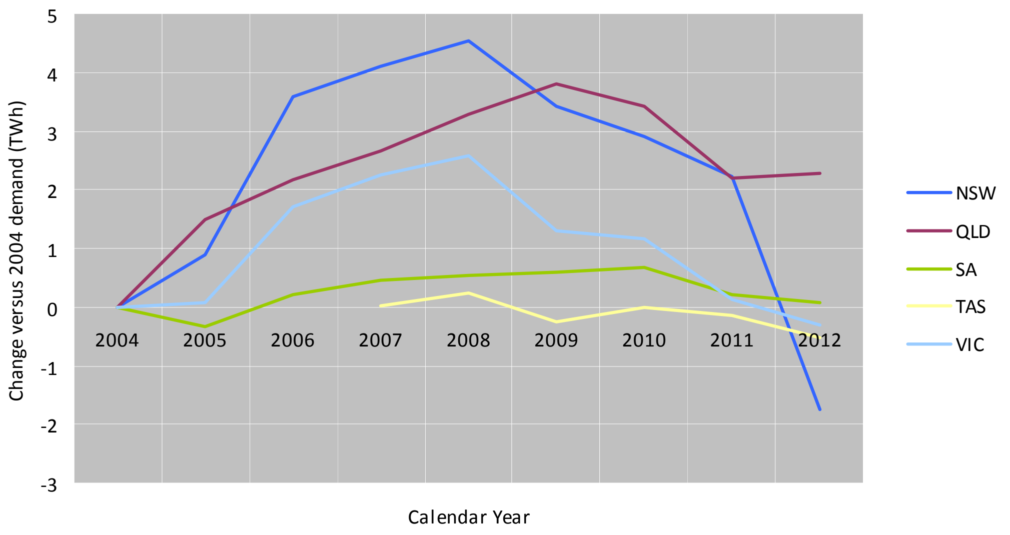
Figure 1 Annual demand across NEM regions – 2004 to 2012



Source: AEMO

[i] Defined here as solar PV, solar water heating and embedded generation
[ii] www.iesys.com/ies/advisory/NewsPublications/Insider.aspx

Figure 2 Change in demand across NEM regions – 2004 to 2012



Source: AEMO

From both charts we can see NEM demand reached its peak in 2008 but has since trended down consistently. Most of the NEM decline can be attributed to NSW particularly the sharp drop from 2011 to 2012 representing 3.9TWh as seen in Figure 2. The remainder of this article will focus NSW given its size and impact in the NEM.

Is this indicative of a decline in the underlying demand for grid-sourced electricity, or can the variation be explained by year-to-year temperature variation?

Adjusting NSW demand for weather

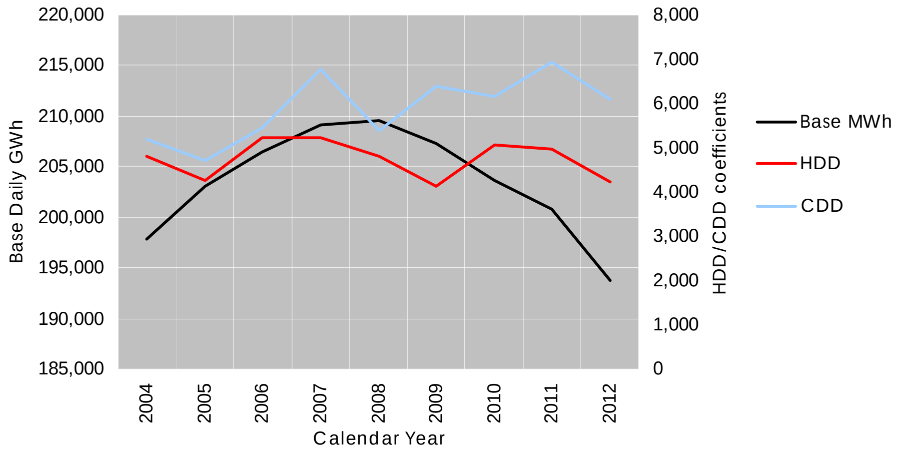
To adjust demand levels each year for variation in weather we can construct a model representing demand levels on moderate days, and the incremental demand response to a heating and cooling degree days. These three parameters are then regressed to obtain an estimate of the relationship each calendar year. Further information on the methodology is detailed in the previous Insider article including parameters and charts supporting the theory[iii].

The updated regression results are presented below in Figure 3. Base demand (grey) represents the demand for electricity in the absence of heating or cooling; CDD's represent the increase in cooling load for each additional cooling-degree (blue); and HDD's represent the increase in heating load for each additional heating degree (red). What this clearly shows is the base demand level and HDD and CDD coefficients are considerably lower than in 2011.

These factors are then used to generate the demand adjustments (using 2008 as the base year) required to explain whether the variations against 2008 demand were due to weather alone. Given the demand adjustments were very small relative to the load (less than 0.4%) weather by itself does not explain the large demand drop in 2012. Ruling weather out, we continue with other possible drivers of the reduction in NSW demand, as suggested by the 6% drop in daily base demand from approximately 200GWh in 2011 to 194GWh in 2012 principally from hot days as seen on the CDD's on the following chart.

[iii] www.iesys.com/ies/advisory/NewsPublications/Insider.aspx

Figure 3 Regression parameters for NSW demand and weather – 2004 to 2012



Source: IES Advisory

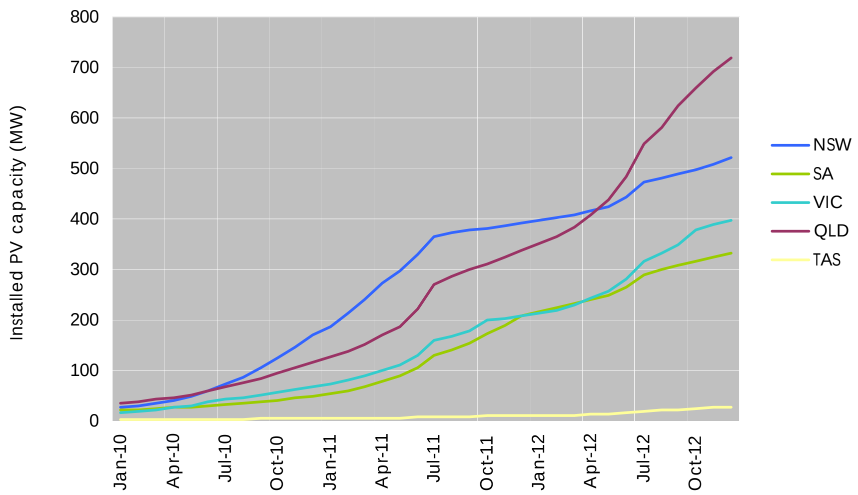
The increasing role of off-grid generation

Our definition of demand only includes grid-sourced electricity and does not capture consumption associated with off-grid technologies. In our view a large proportion of the reduction in demand in NSW can be attributed to a continued rise in off-grid technologies displacing demand for grid-sourced electricity. Here we consider three of the major off-grid technologies: rooftop PV systems, solar water heaters and larger embedded generators.

Rooftop PV systems

Despite the changes to state-based feed-in tariffs and the rolling off of the PV multiplier, rooftop PV in NSW still saw an increase in installations from 177,000 to 226,000 from 2011 to 2012. These systems will continue to offset demand for grid-sourced electricity due to reduced electricity off-take and exports back to the grid. Although the focus here is NSW it is worth noting ORER figures show 2,000MW of rooftop PV installed across the NEM at the end of 2012, up 73% or 840MW since 2011[iv].

Figure 4 Cumulative installed PV capacity across NEM regions – 2004 to 2012



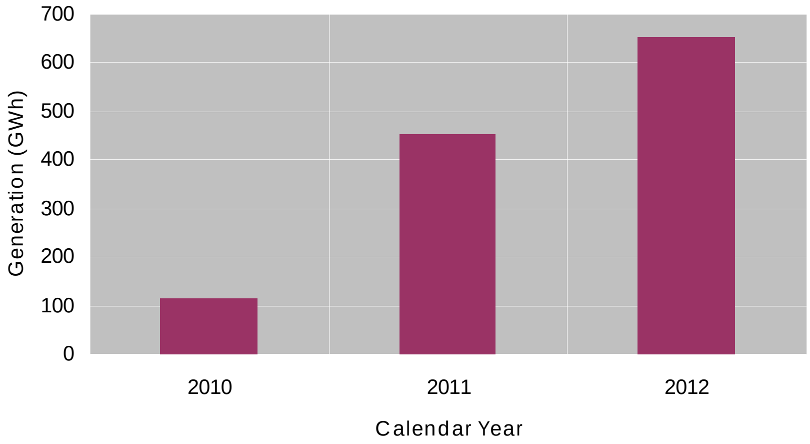
Source: AEMO

[iv] ORER data as at 5 April 2013

Figure 4 shows the penetration of rooftop PV across the NEM states with installed capacity in NSW increasing from 393MW in 2011 to 521MW in 2012.

We have modelled the output of rooftop PV systems using solar traces of representative meteorological years. Figure 5 shows the modelled output over the period 2010-2012. Rooftop PV output in NSW increased 44% or about 200GWh since 2011. PV accounted for 10% of the decline in NSW demand in 2012 since 2008 (last year was 20%).

Figure 5 Estimated annual PV generation in NSW – 2010 to 2012

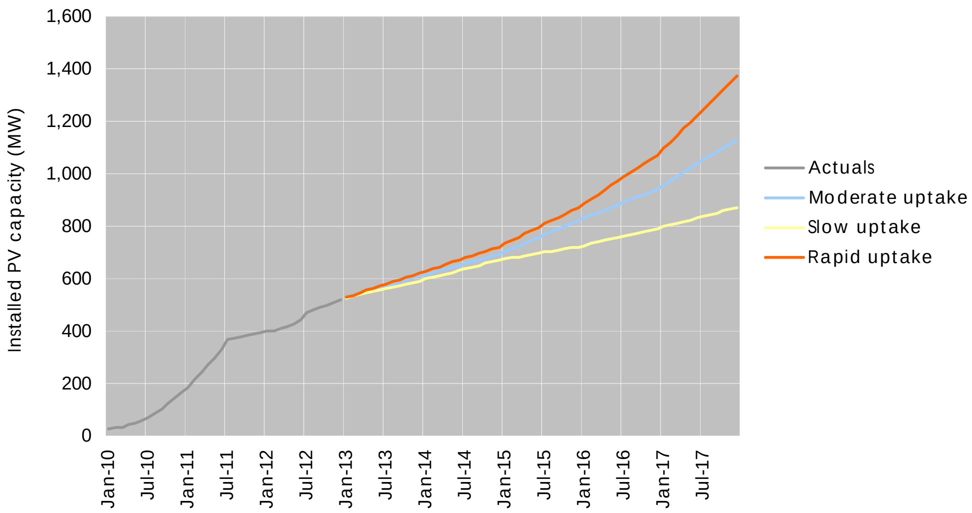


Source: IES Advisory

Side note: Rooftop PV forecasts by AEMO predicts solid growth across all states for all PV penetration scenarios (growth rates of 11% to 21% pa over the next few years for slow, moderate and rapid uptake scenarios)[v]. Figure 6 shows AEMO's rooftop PV forecast for NSW.

Some of the questions not explored here in detail relate to the impact on network planning, coincidence of generation against peak demands and any flow-on effects to the wholesale electricity market especially the continued displacement of scheduled generation.

Figure 6 AEMO forecast of PV installations in NSW – 2013 to 2017



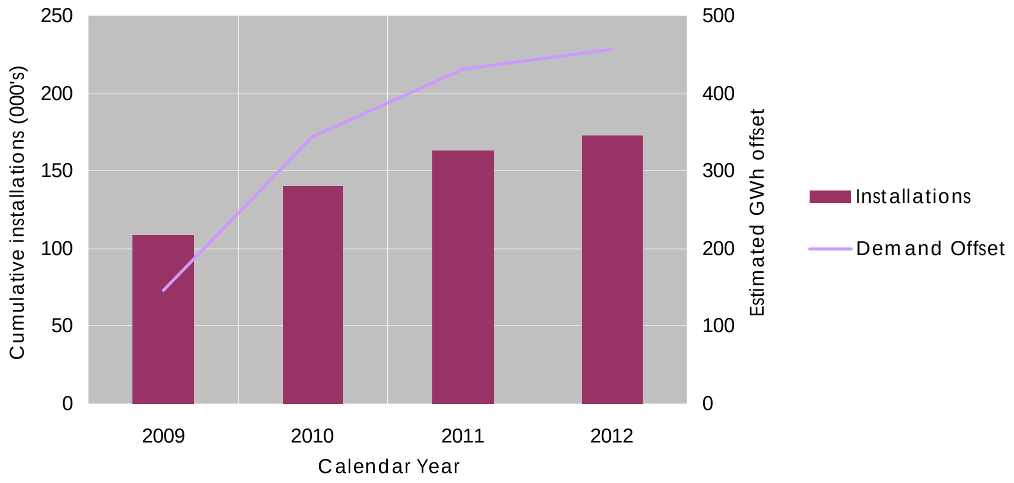
Source: AEMO

[v] http://www.aemo.com.au/Reports-and-Documents/Information-Papers/Rooftop-PV-Information-Paper-National-Electricity-Forecasting, accessed 15th April 2013

Solar water heaters

Solar water heater installations driven by Government subsidies peaked in 2009 with about 81,000 systems installed in NSW alone[vi]. This has since slowed as seen in Figure 7 below. We estimate the 173,000 systems in NSW displaced 460GWh of grid-sourced electricity in 2012. This accounts for 7% of the NSW demand reduction since 2008.

Figure 7 Cumulative SWH installations and displaced demand in NSW – 2009 to 2012



Source: ORER and IES Advisory

Larger embedded generators

The rise in off-grid generation is not restricted to PV systems. The number of embedded generators whose output is not published by AEMO, or who are exempted from registration entirely, has also increased over the last few years. Like PV systems, these units displace existing generation and reduce demand for grid-sourced electricity.

Following on from last year there has been no additional embedded renewable energy plants projects commissioned in 2012 using data obtained from the REC registry. As for embedded non-renewable generators, the only project with a proposed commissioning date in 2012 was the Qantas 9.6MW tri-generation plant. However it is our understanding it was not fully completed in CAL2012 and therefore has been excluded from this update. Going forward this should reduce NSW demand by a further 95GWh pa.

There have been no material changes to the previous year embedded generation total, and we estimate this to be approximately 420GWh in 2012. This represents roughly 7% of the demand drop in 2012 against the 2008 base year. Given the lack of publicly available data we expect these figures to be on the conservative side.

It is worth noting over the past 12 months discussions with several large corporates indicate varying levels of interest in the embedded generation space driven by rising electricity prices (particularly network charges), a broader sustainability push and the fact these projects have become economic relative to the delivered electricity cost. The slowdown in economic growth has also prompted a focus on managing input costs.

[vi] IES Advisory estimates

Shutdowns of large facilities

Most of the decline can be attributed to shutdowns of facilities over the past 12 months, driven by the combination of slowing domestic and international economies, low commodities prices and a prevailing high Australian dollar. Even though electricity consumption data is generally not available in most cases we can make several estimates as to how each of the following has contributed to the 2012 demand drop.

The Kurri Kurri smelter owned by Hydro Norsk was closed down due to the above factors combined with its inefficient operations relative to new plant. In CAL2012, Kurri Kurri smelter produced 73,000t of primary aluminium down from 180,000t in the previous period[vii]. Based on carbon emissions and the NSW intensity, we estimate the closure of Kurri Kurri smelter to have decreased the 2012 demand by approximately 1,700GWh, and a further 1,200GWh in CAL13.

BlueScope Steel mothballed its no.6 blast furnace in late 2011 reducing its Port Kembla steel capacity by 50% to 2.6mtpa as part of the decision to cease its exporting business. Emissions reported under the National Greenhouse Reporting Scheme show BlueScope Steel experienced a drop in scope 2 emissions of 478t from FY11 to FY12[viii] – figure includes the decision to also close the hot strip mill at the Western Port facility. Attributing most of the decline to the Port Kembla facility and adjusting for a full calendar year, we estimate the mothballing decision to have reduced NSW demand by 950GWh in 2012.

Shell closed the Clyde refinery on Oct 12 which had refining capacity of 85,000 barrels per day and Caltex announced Kurnell, with capacity of 100,000 barrels per day, to be completely shut down by the second half of 2014. Impacts of the shutdowns have not been estimated due to the timing and proposals to convert the refineries to other operations.

Other smaller shutdowns over the CAL12 period include: Heinz's Wagga Wagga factory, Cement Australia's Kandos cement plant, Mortein production Reckitt Benckinser's closure of its West Ryde plant, and interruptions at Orica's Kooragang Island plant.

There is also the trend of gas producers moving towards LNG netback rather than a cost-plus pricing basis adding to rising input cost pressures. Recent gas supply negotiations have revealed "price shock" to consumers due to the levels shown by producers and the high price dynamic has directly caused very short term contracting relative to what we are familiar seeing historically in the gas market, in order to avoid inevitable price pain. There is no doubt there is a significant gas contract cliff edge in the near term leaving retailers and generators without upstream gas supply, and large consumers heavily exposed to a market exhibiting multiple buyer timing price pressure dynamics. Historically the market has entered into gas contract negotiations several years before expiry and contract price levels were easy to agree as the forward price outlook has been benign with this dynamic being accepted by both the buyer and more importantly the seller.

Gas price rises combined with a conservative economic outlook will certainly have flow on effects to electricity demand over the short to medium term. Ironically significantly higher gas prices increasing the short run marginal cost of gas-fired generators leading to uplifted electricity bid-stacks could have a significant dampening effect on electricity demand via the potential for further industrial shutdowns driven by rising input costs from gas and in-turn electricity prices. We believe very little cause and affect analytical work has been undertaken across the broader market to fully understand the impacts, risks and budget effects of higher gas prices, which are fast approaching. Gas consumers collectively appear to be underprepared for the flow on effects of higher gas prices, particularly against the back drop on recent electricity price rises and the lack of strategy to mitigate carbon tax exposure.

[vii] Norsk Hydro 2012 Annual Report
[viii] http://www.cleanenergyregulator.gov.au/National-Greenhouse-and-Energy-Reporting/published-information/greenhouse-and-energy-information/Pages/Default.aspx, accessed 15 April 2013

Summary

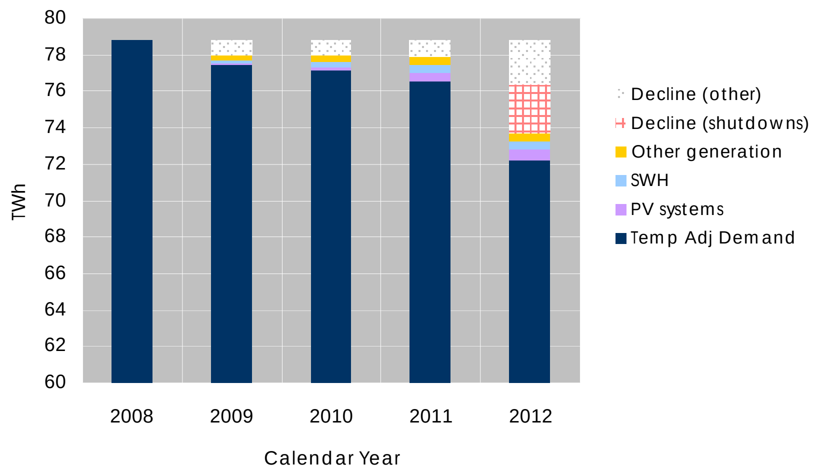
Figure 8 combines our estimates to show what has contributed to the decline in demand since 2008. The decline in 2012 against 2008 is made up of:

- variations in weather (differences already included in the adjusted demand);
- increasing penetration of rooftop PV systems (650GWh);
- impact of solar water heaters (460GWh) and embedded generators (420GWh); and
- closure of the Kurri Kurri aluminium smelter (1,700GWh)
- mothballing of BlueScope's Port Kembla blast furnace (950GWh)

The reduction in demand that remains unaccounted for (2,400GWh) is also shown. We appreciate a significant portion of this can be attributed to energy efficiency measures at both the residential[ix] and commercial and industrial level[x] given escalating power prices and a broader sustainability push across all sectors. We believe a portion of the 2,400GWh is also due to economic pressures cascading down to the small to medium business level.

Although the analysis has been based on NSW we think these findings, particularly those related to the impact of off-grid technologies and plant shutdowns, are relevant to other NEM regions having experienced a similar decline in demand.

Figure 8 Components of the decline in NSW demand since 2008



Conclusion

The 2012 update does not change our previous thinking around the increasing role of off-grid technologies and the broader reduction in demand for grid-sourced electricity. The stark demand drop in 2012 has made it easier to understand the decline in demand since 2008.

Off-grid technologies – has there been a shift in the nature of electricity supply?

We estimate PV systems and solar water heaters are now displacing around 1,100GWh, up from 880GWh last year, of grid-sourced electricity in NSW each year. Similarly, investment in embedded generation systems driven by rising network costs and a broader sustainability push will represent a significant proportion of diminished demand over the next few years, further exacerbated by higher gas prices. It is certain off-grid technologies will continue to represent a significant component of supply. From the previous Insider:

[ix] Data as part of AEMO's National Electricity Forecasting Report 2012 is rough and doesn't not justify a separate split
[x] For an idea of the scale and uptake, http://www.ret.gov.au/energy/efficiency/eeo/participating_corporations/Pages/default.aspx

These changes have implications for reliability, network planning, and future investment in generation. For example, while it may take years for a large power station to receive planning approval and be constructed, smaller embedded generators can be rolled out very rapidly, as was observed with PV systems in 2010 and 2011. A rapid reduction in demand of this nature has the potential to undermine the profitability of grid-connected power stations, regardless of whether they are renewable or fossil-fuel fired.

We think if it is not already the case, off-grid technologies will soon have a significant impact on market outcomes. Even though subsidies have been wound back, we think the continuous rise in retail electricity prices and the decline in prices for off-grid technologies will result in higher penetration of these technologies, and thus further displacement of demand for grid-sourced electricity in the coming years.

The broader implications of shrinking demand

After we remove the impact of off-grid technologies there is still a significant reduction in demand for grid-sourced electricity as seen in the drop from 2011 to 2012. Whilst a considerable portion can be roughly attributed to the gradual increase in energy efficiency over the past few years, a much larger portion can be directly accounted for by large site shutdowns in 2012.

Looking into CAL2013 we will see the full year impact of the Kurri Kurri shutdown and we are aware of the gas trend towards LNG netback rather than a cost-plus pricing basis combined with the current economic outlook has the potential to reduce demand even further over the short to medium term.

From the previous Insider:

We think persistent rises in retail electricity prices have led consumers to reduce their usage of grid-sourced electricity, either by curtailing their electricity consumption, investing in energy efficiency, or substituting off-grid sources of electricity. Regardless of the cause, the downward trend in demand for grid-sourced electricity has significant implications.

If the trend continues, power stations at the top of the merit order will see their sales volumes eroded, and reduced spot-market prices will eventually translate into lower contract prices for all generators. Transmission networks will also be affected, with cost-recovery issues for transmission companies. Moreover, the reduction in demand creates risks for future investment in transmission infrastructure – namely whether the reduction in demand for grid-sourced electricity is a transient phenomenon, or an enduring change eventually leading to the stranding of assets.

Contacts

Jamie Summons
Phone: +612 8622 2226
jsummons@iesys.com

Patrick Wang
Phone: +612 8622 2216
pwang@iesys.com

Disclaimer