



Watt now?

Australia's electricity system is facing a most uncertain future. Along with an unprecedented fall in demand, a combination of sundry other factors could have far-reaching implications on the viability of the national electricity supply chain. Sean McGowan explores why the experts are perplexed.

Something is up. But putting a finger on just what that "something" is, is keeping stakeholders of Australia's electricity supply chain awake at night.

Grid-based electricity demand across many parts of the nation is down – and down in a big way – leaving some to question whether Australia's electricity market is in a downward spiral from which it might never recover.

Mike Sandiford is professor of geology and the director of the Melbourne Energy Institute at the University of Melbourne. He says demand for electricity supplied by the national electricity market (NEM) across the eastern seaboard is collapsing, and heading towards numbers not seen since the 1900s.

"The 2013–14 financial year is the fifth consecutive year to see negative growth on the NEM," Sandiford says. "And the problem for the electricity utilities is that the demand is falling more sharply with each passing year."

In 2013–14 demand fell by almost 3 per cent – in sharp contrast to projections of 2 per cent growth per annum that could be counted on less than a decade ago.

Last financial year's drop equates to 600MW being shed from average demand.

Sandiford, who regularly blogs on the subject, says that since the global financial crisis, growth in demand has collapsed. After initially plateauing, it started going backwards, the direction it's been heading for the past five years.

It's a puzzle that also has economists stumped, and has challenged the theory that economic growth and growth in energy demand go hand-in-hand.

So what are the causes, and more importantly, what does it mean for the future supply of electricity in Australia?

ON THE ROOF

Although a slowdown – some might say shutdown – in Australia's industrial sector appears to have played a major part in the decline in electricity demand in recent years, other factors are also at play.

One of the suspected causes is the rapid uptake of on-site generation technology in Australia – and more precisely, the adoption of photovoltaic solar panels in the residential sector.

South Australia is leading the way. The Australian PV Institute estimates that about 25 per cent of South Australian homes already have solar panels installed, with that number rising.

Queensland is not far behind, with more than 20 per cent of homes doing the same.

Nationwide, it is estimated that about one million homes are benefiting from on-site solar power generation. More solar panels means, understandably, less demand on the national electricity grid.

The concern is that with the cost of solar PV prices falling, as well as on-site energy storage solutions becoming more commercially viable, these numbers will continue to increase against a backdrop of rising network electricity prices.

Indeed, according to findings from the CSIRO Future Grid Forum held in late 2013, scenario modelling shows that consumer choice around the use of on-site generation and managing peak demand can greatly influence Australia's electricity market.

It suggests that by the last 2030s, it may be economically viable for residential customers to disconnect from the grid.

ELECTRICITY IN 2050

What will our energy requirements be like come the middle of the century?

Although the reform of the national electricity market (NEM) will be the subject of much discussion in the short term, the CSIRO's most recent Future Grid Forum sees that the challenges facing the electricity supply chain will encourage new market structures and business models to emerge.

It believes Australia's electricity landscape will change substantially in the decades to 2050 as a result of two factors: "mega shifts" and consumer choice.

The CSIRO says "mega shifts" will be brought on by the advent of low-cost electricity storage, sustained low demand for centrally supplied electricity, and the need for significant greenhouse gas abatement.

New business models, higher levels of consumer engagement and a greater degree of cost-reflectivity in pricing will, it says, result in greater consumer choice.

"If the electricity sector is to effectively plan and respond to these changes," the analysis reports, "it is important for it to fully understand how all of this might play out."

The Future Grid Forum identifies four possible scenarios for how Australia's electricity system might look in 2050, and considers their potential impacts on the supply chain.

Scenario 1: Set and forget

The first scenario sees a trend toward peak demand management across the residential, commercial and industrial sectors, with demand management systems designed to be on a "set and forget" basis. This reflects most customers' preferred level of demand management.

Measures in this scenario include building large-scale on-site energy storage for equipment such as air conditioning and pumps, specialised industrial demand reduction markets, and electric vehicle charge management – as well as the advanced metering and communication to enable these services.

Scenario 2: Rise of the prosumer

The second scenario is what is termed as the "rise of the prosumer" where continued falling costs of solar PV panels and other on-site generation technologies and sustained high electricity prices leads to the widespread adoption of on-site generation.

Under this scenario, the use of on-site generation would be strong in the commercial and industrial sector, with a marked preference for cogeneration and trigeneration technologies.

"By 2050, on-site generation supplies almost half of all consumption," the CSIRO says.

Scenario 3: Leaving the grid

The third scenario takes into consideration the fact that in 2050, it will be economically viable for consumers to leave the grid.

"The continued dominance of volume-based pricing among residential and small commercial consumers encourages energy efficiency without accompanying reductions in peak demand growth," the CSIRO says. "The subsequent declining network utilisation feeds increases in retail prices."

In such a scenario, new energy service companies will emerge and invite consumers to leave the grid.

"By the last 2030s, with reduced (energy) storage costs, disconnection becomes a mainstream option," the report says, "and the rate of disconnection accelerates."

Scenario 4: Renewables thrive

Under the fourth modelled scenario, confidence in the improving costs of renewable technologies results in the introduction of a linearly phased 100 per cent renewable target by 2050 for centralised electricity generation.

"To shift demand and meet renewable supply gaps, (energy) storage technology is enabled to achieve the target at utility, network and consumer sites," the report says.

"Overall, the renewable share, taken as a share of both centralised and on-site generation, is 86 per cent by 2050."

Source: Change and choice – The Future Grid Forum's analysis of Australia's potential electricity pathways in 2050.

Another reason for the sharp decline in electricity demand is an understanding of and embrace of energy-efficiency initiatives.

From minimum energy performance standards (MEPS) to commercial building disclosure (CBD) and rating

schemes such as NABERS, Australia has taken a multi-pronged approach to reducing energy consumption.

Fact: these reductions are now approaching something meaningful and tangible, and doing this even faster than anyone might have predicted.

THROUGH THE ROOF

Since 2007, the average household electricity price in Australia has increased by two-thirds, from about 15c/kWh to more than 25c/kWh in 2012.

The causes of this increase are complex, various, and differ from state to state.

It is time step back and reconsider as a nation, what we want from our energy system and, importantly, how we get there

Among these is the well-publicised investment in asset replacement and refurbishment of the national electricity distribution network – commonly referred to as the “poles and wires”.

In some states there is also the issue of compliance with reliability licence conditions.

The impact of this on electricity prices has led to a pointed question: Have reliability standards been set too high, or too prescriptively, in some states?

“The main factor driving up prices in the last five years was the \$45 billion spent to augment the network,” says the Energy Efficiency Council (EEC) in its Plan for Affordable & Efficient Energy.

“While some of this expenditure was necessary, much of this investment could have been avoided if network investment had been more prudent, and peak demand had been proactively managed.”

One of the consequences of such investment is that while the grid is still being scaled up, it is transporting less and less electricity, thereby driving the cost of distribution through the roof.

Even as consumption has declined, the management of peak demand in Australia continues to have an escalating effect on electricity prices. Of course, this has been driven in large part by the rapid take-up of residential air conditioning.

“Expectations of rising peak demand were partly driven by increasing air conditioner ownership among Australians, which doubled from around 35 per cent in 2000 to over 70 per cent in 2012,” says the Future Grid Forum’s analysis document, *Change and choice*.

“Network capacity has been sized to provide power on days when air

conditioner usage is high because of weather extremes – and these same extremes lower the effective capacity of the network.”

Despite current peak demand also falling well short of projections, Sandiford warns that there remains considerable uncertainty in how it is managed.

“Victoria went close to setting a record for peak demand in the heatwave this summer (2013/14) at 10.3GW,” he says.

“While that made a lot of news, with the possibility of load-shedding mooted by AEMO (Australian Energy Market Operator), that was a long way short of the pre-2009 trend expectation of a peak of around 12GW for the sort of heatwave conditions we experienced.”

Sandiford says the challenge of maintaining capacity to serve peak loads, while consumption continues to fall, makes for an uncomfortable outlook for the industry.

“It necessarily leads to rising cost pressures for poles and wires electricity,” he says. “And that will undoubtedly further incentivise take-up of the new distributed solutions made possible by the new technologies, such as solar PV.”

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OVERSUPPLY

Naturally this confluence of events has also led to oversupply – another factor to affect electricity prices.

Analysis from the Future Grid Forum found that oversupply of generation capacity was a consequence of decreasing consumption, past investments in coal and gas generation assets, and, more recently, deployment of wind power as the main renewable generation platform under the Renewable Energy Target (RET).

“One factor that actually reduced pressure on retail prices during the past five years, but not enough to offset the increases in other factors, was lower generation costs,” says the forum’s analysis document.

“A recent unexpected decline in electricity consumption together with greater renewable generation has led to excess supply in the generation market, depressing wholesale prices. Several generation plants have been mothballed or retired as a result.”

THE NEED FOR REFORM

With plan for generation plants put permanently on hold, and annual demand reductions of 600MW a year, Sandiford says that on present trends we are set to take out another 1GW of capacity every 17 months.

“That is a write-down on a very significant investment,” he says. “At the same time, we have mandated to add new generation via the Renewable Energy Target (RET). So the write-downs of existing plant will happen even faster.”

It leads Sandiford and many others to question whether the entire model of energy delivery in Australia is in serious need of overhaul.

He says with average demand dropping almost 600MW in the past financial year, and large electricity consumers such as the aluminium sector exiting the country, it is hard to imagine anything but further reductions in demand.

“And that will put upward pressure on costs of distributing poles-and-wires electricity, which in turn will further encourage energy efficiency measures and distributed generation,” Sandiford says.

“It makes for challenging times for our energy utilities, who continue to want to operate a business model that involves servicing our need for the benefits of energy – heating, cooling, lighting, communication etc., – by supplying more and more energy across the grid.”

He says it is time step back and reconsider as a nation, what we want from our energy system and, importantly, how we get there.

“With concerns growing over how the bleak demand outlook will impact the viability of the electricity grid,” Sandiford says, “we could do well to ask: Why do we need to promote two energy grids – gas

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Such commentary is unlikely to impress those building owners who have invested in gas-fired cogeneration as a method of reducing reliance on the electricity grid.

A presentation by energy and water industry consultant Oakley Greenwood at the EEC National Conference in December 2013 highlighted the challenges ahead.

Referring to results of modelling undertaken for Infrastructure NSW, it found that while there is significant downward pressure on wholesale electricity prices, gas prices are set to increase materially over the next three to five years.

Among a host of reasons is that our local gas is beginning to link domestic prices with global gas market prices. And although such increases will likely drive energy efficiency on the part of gas users – in much the same way as has occurred with electricity – it may also engender a shift toward the use of electricity for space heating.

It begs the question: Is the balance of power in buildings about to tip?

Sandiford believes it should.

“It is the distribution of energy, particularly in electricity, that is consuming an ever-increasing cost,” he says.

“If you put winter-based energy back into the electricity grid, suddenly the electricity grid is a bit more viable because that’s not a peak load anymore. Nowhere around the country is there a peak load in winter.”

According to the EEC in its Plan for Affordable & Efficient Energy, the energy market reforms of the 1990s delivered

many benefits to Australians, but the process is far from complete.

“To keep energy affordable,” the EEC says, “we need to accelerate NEM reform, focusing on ensuring that network prices are fair and efficient, fostering demand-side services, and ensuring that network companies reduce expenditure by reducing peak demand.”

“The NEM should encourage consumers and suppliers to invest in the most cost-effective mix of demand and supply-side options. But the current rules favour supply-side approaches, even when it’s much more expensive.”

THE IMPACT ON HVAC&R

There is some irony in how the present situation has developed. Consider that low-energy building design and the drive toward energy efficiency – and a reduced reliance on the electricity grid – have contributed in some way to the uncertainty around energy prices and the future of Australia’s energy model.

And it would seem one of the few immediate solutions would be for the NEM to rely on the involvement of industry, including the HVAC&R sector, to help re-establish a balanced demand.

One area of particular interest is the ability for building services to shift load – not only to make the most from time-of-use (TOU) tariff price signals, but also to spread the demand on the grid across a full day.

“This emphasis on trying to even out the load is really important,” says Sandiford. “And there should be incentives for it.”

This will likely lead to the development of solutions such as thermal storage and, as the technology becomes more reliable and economically viable, perhaps the use of local batteries.

It may also mean that in the future, in response to peak demand pressures placed on the grid on a hot summer’s day, HVAC&R systems must have the ability to dynamically shift load.

“HVAC certainly plays into the emerging issue of needing to get value back into the grid, by managing peak loads,” says Sandiford.

“Load-shifting to ameliorate peak demand will be essential for managing the escalating costs in the electricity grid – and that is all about hot summer afternoons and air conditioning.” ■