DEMAND-SIDE RESPONSE IN A MARKET WITH INCREASING ENERGY COSTS

Industrial electricity users need not be passive consumers. By playing a more active role, they can help contain electricity prices and reduce emissions, while making a profit from their actions.

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Prices in Australia's National Electricity Market (NEM) are increasing rapidly. Figure 1 shows that retail prices are forecast to nearly double by 2015. Both the underlying wholesale energy costs and the network charges are expected to double. The same force is driving both of these increases: ever more extreme peaks in demand.

PEAK DEMAND IS THE ISSUE

Figure 2 shows histograms of total half-hourly demand across the NEM for the last eleven years. Average demand, and hence total energy consumption, has been growing only steadily, and even dropped slightly in 2009. Maximum demand, however, is growing much faster.

The extreme peaks are driven largely by the increasing penetration and use of residential air conditioning, but many other trends also contribute. These trends are proving very difficult to address at source.

The traditional way to address rising peak demand is on the supply side, by building infrastructure to meet it:

- Network companies forecast the growth in peak demand, and upgrade substations and lines to meet it. The most recent regulatory proposals from network companies show that 40% of the $31b of capital expenditure they are planning over the next five years is purely to address increases in peak demand.
- The electricity market provides price signals which lead to new generating capacity being built – usually large open-cycle gas turbine power stations.

Both these activities involve large amounts of money being spent. It is the end user who pays for it, through increased network charges and increased retail tariffs (due to higher prices paid by retailers for hedge contracts).

Rising peak demand is not a new phenomenon. However, when the NEM was established in the 1990s, there was substantial overcapacity both in generation and in the sizing of many parts of the networks. Increases in peak demand over the last decade have used up much of this buffer.

FALSE ASSUMPTIONS

This supply-side expenditure is obviously the only solution, if you assume two things:

1. Electricity end-users are passive consumers, with no ability to alter their consumption patterns.
2. Only dedicated power stations generate power.

These assumptions are false.

Industrial users in particular can be very sophisticated about their energy use, so long as they are given an opportunity to profit from doing so. We call this demand-side response.

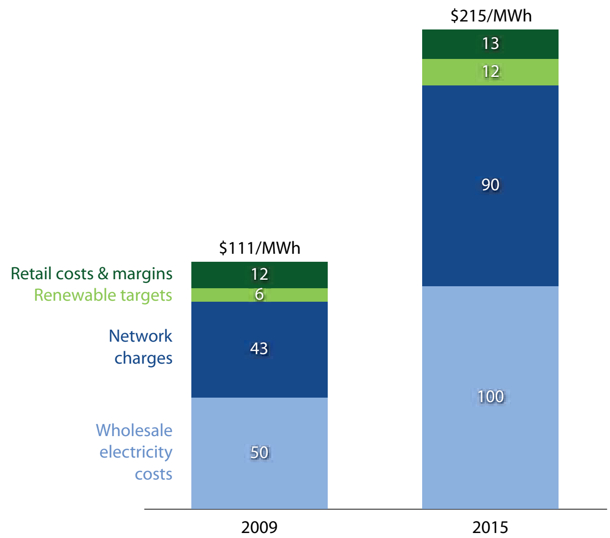

Figure 1 *Forecast increases in retail electricity prices (Edwin O'Young, Port Jackson Partners, August 2009)*

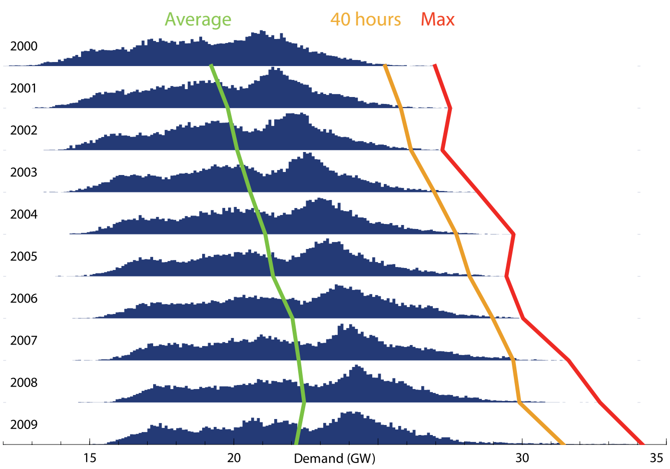

Figure 2 *NEM-wide demand histograms and trends (AEMO; years to 30 September; excluding Tasmania)*

There is also a large quantity of standby generation installed at industrial sites, which is largely ignored by the electricity industry. Much better use can be made of this, in a way which benefits the owners.

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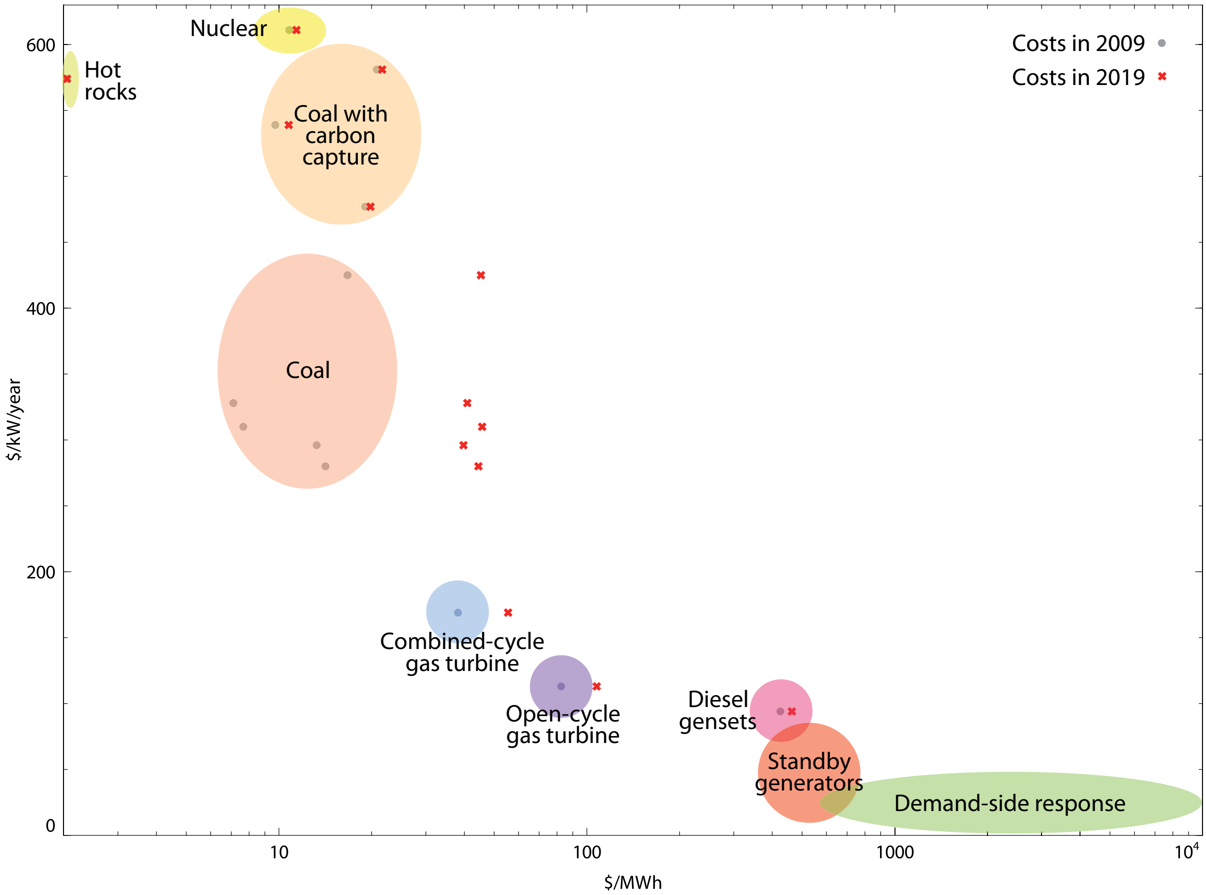

Figure 3 *Energy and capacity costs for new-build generation and demand-side response (ACIL Tasman 2009; Energy Response estimates)*

DEMAND-SIDE RESPONSE

Many industrial processes have stages which do not need to run all the time. There are many processes which can be interrupted for a few minutes, or in some cases a few hours, without disrupting the main activities on the site. Typical examples include compressors, chillers, and pumps running on a fairly low duty cycle. Where there is a substantial buffer between the output of one stage and the input of the next, the earlier stage can be interrupted with impunity.

Interrupting other processes, especially for longer periods, does affect production, but can still be worthwhile: if the end user can be sure that they'll be paid more for reducing their electricity consumption at a critical time than it costs them to interrupt production, it makes sense for them to do so. This situation occurs surprisingly often in energy-intensive industries.

STANDBY GENERATORS

Many industrial sites have standby generators. These are run during blackouts to maintain power to critical loads. Apart from that, they are typically only run for maintenance checks a few times a year, due to high fuel costs. The diesel consumed when these units generate costs more than three times as much as buying the same amount of electricity under a retail contract, so it does not make sense to run them any more than absolutely necessary.

Standby diesel gensets are typically designed to run up to 200 hours each year, but in reality many take 20 years to reach that number of running hours. Most of the time, they just sit there depreciating, even during extreme peaks when every kilowatt counts.

These generators can participate in the electricity market, by generating at the times when the spot market shows that the supply:demand balance is tight. How often this occurs depends on the weather, but it is typically for 20-40 hours per year.

Some generator installations allow export to the grid; at others, the generators only power loads on the site, substituting for supply from the grid. The effect on the electricity market is the same either way: an extra source of generating capacity at times when it is needed most.

WHY HAS THIS NOT HAPPENED BEFORE?

The problems of peaks in demand are not new, and neither are these methods of addressing them. However, the NEM is lagging significantly behind other electricity markets in the use of demand-side response.

This is partly a consequence of the "energy only" nature of this electricity market, partly due to some unintended regulatory disincentives, and partly a cultural issue. The net effect is that neither network companies nor retailers are particularly interested in making it worthwhile for end users to participate. Fortunately, there are now third party aggregators, such as ourselves, who don't have such conflicts, and work to get the best value from whatever end users are able to do.

DOES THIS MAKE ECONOMIC SENSE?

Figure 3 shows standby generators and demand-side response in the context of the costs of various types of power station. The horizontal axis shows the short-run marginal cost of each unit of energy produced – for most non-intermittent generators, this is dominated by fuel costs. The vertical axis shows the fixed cost of having a unit of capacity available – usually dominated by depreciation.

These data come from an ACIL Tasman study used by the Australian Energy Market Operator to predict where and when new power stations are likely to be built. The grey dots show estimated costs for various types of power station which could be built today; the red crosses show the expected costs in 2019, incorporating expected carbon costs and gas price increases.

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Standby generators and demand-side response are the most expensive ways to provide an extra megawatt-hour. However, their fixed costs are lower than any of the conventional supply-side options, as the assets involved were built for some other purpose; participating in the electricity market is merely a secondary use.

The trade-off between these two depends on how many hours a year the plant is run. For baseload plants, running 8,000+ hours per year, the energy cost dominates, so hot rocks, coal, and nuclear are the cheapest options. For intermediate plant, running around 2,000 hours per year, gas turbines work out the cheapest. Once you get up into the extreme peaks, they occur for so few hours each year that the energy cost becomes quite unimportant; it is the capacity cost which dominates.

Hence, standby generators and demand-side response are more economical ways to deal with the most extreme 40 hours of the year than any kind of power station. Where demand-side response can also reduce network costs, the case is even stronger.

BENEFITS

Demand-side response and the participation of standby generators are good both for the end users who participate and for the wider community:

- Flattening the most extreme peaks in demand puts downward pressure on both energy costs and network charges.
- Reducing demand and using local generation at peak times reduce electrical losses disproportionately.
- Making best use of existing facilities allows network upgrades and the construction of new power stations to be deferred or avoided.
- Having this extra controllable capacity available allows greater use of intermittent renewable energy sources without compromising security of supply.
- Participating end users gain a new, dependable revenue stream for making their facilities available, as well as having all their costs reimbursed.
- Extra telemetry equipment installed for demand-side response purposes gives end users a clearer picture of the components of their load profiles, often leading to efficiency improvements.
- In our experience, running standby generators more frequently, with realistic loading and environmental conditions, and remote monitoring, can lead to greatly improved reliability.

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