CENTRALISED TO DE-CENTRALISED ENERGY: WHAT DOES IT MEAN FOR AUSTRALIA?

DRAFT DISCUSSION PAPER

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1. A TIME OF TRANSFORMATION

We are in the early stages of a transformation in the way we build, operate and finance our electricity infrastructure in Australia. For decades, Australia's electricity sector – just like most across the western world – has operated on a model of centralised, state-owned power plants, typically co-located with major sources of fuel.

This has meant that not only have a small number of large power plants provided the vast bulk of electricity needs, but that often these plants have been physically clustered together in places like the Latrobe Valley in Victoria and the Hunter Valley in New South Wales. Today, Australia's energy market is increasingly integrated into one large east coast market and several smaller grids, with the Victorian market fully liberalised. Others, such as Queensland, Western Australia, and Northern Territory are still largely state-owned, and the remaining states are in various degrees of transition.

The core logic behind the physical co-location of generation plants was that the economic efficiency gains from being positioned close to the fuel source (typically coal or large hydro) were greater than the economic inefficiency of transmission losses from transporting power long distances to major population and industrial centres.

New technology and the economic dynamic of the market mean this is now changing. Along with increasingly empowered consumers and communities, shifts in the basic cost parameters of many sources of energy allow generation to be built closer to where it is used. So, what if, instead of a small number of large power plants being owned by a few companies, we had a much larger number of generation facilities, with a larger number of owners? And what if consumers were mobilised to participate directly in the financing of much of the new infrastructure, lowering barriers to entry and spreading the risks and rewards of investment?

The advantages of such a system could be enormous – more competition, lower cost infrastructure and more efficient use of resources. Each of those outcomes would have benefits for consumers, and the combination of all three could transform the industry and the role of consumers in it.

While we still have a long way to go, and the path ahead includes many uncertainties, Australia, along with a number of other economies, is, in reality, embarking on exactly this type of transformation. The stresses and strains of this are increasingly appreciated, as are the predicted benefits, with profound implications for the nature of the infrastructure that will be needed.

As with all disruptive technologies, a more distributed form of generation creates winners and losers, and many of those who have benefited from the traditional system will have an obvious tendency to resist change. Others will embrace it. It is potentially an exciting and dynamic time

for the energy sector to drive innovation and reach for the future.

2. MORE COMPETITION

Australia is a relatively small market for many goods and services. It is prone to domination by small numbers of incumbent players, such as the big four banks, the supermarket duopoly and the current 'triopoly' of three electricity 'gentailers' (integrated generators and retailers), which together have a market share of around 75 per cent.

One reason why such tight concentration of market share occurs across the world is that the scale of investment and risk is too big to accommodate more than a handful of major players. Indeed, in the energy market, vertical integration and scale of operation is itself a risk management strategy to balance out the risks of the energy trading model first driven by Enron in the USA. The volatility in the wholesale electricity market, which can swing from the usual price of around $50 per MWh to over $10,000 per MWh during peak demand events, creates enormous exposure risks for electricity retailers and generators with supply contracts.

Vertical integration allows companies to offset their risk, and gives them sufficient balance sheet depth to finance their operations cheaply (including the high cost of acquiring new generation assets) and to survive occasional exposure to extremely high price periods. For all of those reasons, the centralised market structure tends to drive market concentration. A decentralised market has different economic principles and potentially increases the space for new market entrants and a different form of infrastructure.

Although the big three Australian 'gentailers' are, in terms of the domestic market, large companies, they are still not big enough to maintain the same proportional level of ownership of generation assets in a decentralised system than in the traditional centralised industry. While the gentailers have tended to involve themselves as partners in the development of large-scale renewables projects, this has not always been the case. The proliferation of wind farms in Australia over recent years has substantially increased wholesale market competition in places like South Australia, which had previously seen very high levels of market power concentration.

Australia has managed to shift around 13 per cent of its electricity generation to more decentralised renewable sources so far, and clearly there is still a mostly centralised market in place, with all the attendant transitional challenges. However, since South Australia has over half of Australia's total fleet of wind farms, it is in many ways at the leading edge of the trend towards a different approach, and the benefits this may well provide.

There is another critically important way that a decentralised energy market has the potential to be more competitive than the centralised model. The core principle of the centralised model is that power flows in one direction, from a small number of large generators to a large number of small consumers, whereas in a decentralised market power flows in both directions.

With the enormous cost reductions that have been achieved by solar photovoltaic (PV) technologies, households and businesses can now generate much of their own power needs, and export any temporary surpluses to their neighbours. That means that while overall demand

might stay the same (or even increase), demand for energy from large-scale generators might fall, and that creates a supply and demand imbalance that puts downward pressure on electricity prices.

What has just been described is essentially what has been occurring in Australia over the last five years, and looks set to continue for many more years to come. Already more than two million household clean energy systems have been installed across Australia (mostly solar PV or solar hot water) and this has had a real and measurable impact on demand levels.

There are some other factors that are also contributing to demand reductions in specific states, but the spread of PV is part of it and the continued growth in the use of PV will further entrench this effect.

The impact on the wholesale electricity generation sector has been substantial. Around 1000 MW of coal-fired generation capacity has been mothballed and, despite this, the wholesale price of electricity remains at historic lows in many places. This is great news for price-driven consumers – but what does it mean for our infrastructure needs?

3. LOWER COST INFRASTRUCTURE

In the previous section we looked at how decentralised energy generation assets can be developed and how this increase affects the potential to increase competition in the wholesale electricity market. Decentralised projects can be delivered through a different ownership model because they are an inherently lower-cost form of infrastructure.

Wind farms for example, are highly modular. They can consist of just a handful of turbines, or more than a hundred. Conversely, coal plants, and in some cases gas as well, tend to be built at a large scale. A conventional coal plant would typically consist of six or more generation units linked together, the economics of which requires their full use in order to make most efficient use of the fuel resource.

The operating costs of renewable energy projects are typically significantly lower than for the same capacity of thermal plant, primarily because there is no direct fuel cost associated with most renewable energy technologies such as wind, solar and, in many cases, hydro.

However, it is true to say that the commercial viability of large-scale renewable energy projects in Australia is currently fundamentally tied to the existence of the Renewable Energy Target and the obligation for liable parties to purchase Large-scale Generation Certificates (LGCs). This ‘risk’ is usually managed by entering into long-term off-take agreements with electricity retailers, which gives wind projects a fairly stable revenue stream with relatively low risk. This in turn attracts institutional investors.

Moreover, at the smaller-scale end of the renewable energy technology spectrum, up-front costs have come down dramatically for solar PV, and this allows even households on fixed or relatively low incomes to invest in solar. Evidence shows that lower-income suburbs have the highest concentration of solar PV ownership, while wealthy suburbs have a lower take-up of

solar PV.

The recent emergence of innovative business models such as leasing arrangements (with no up-front costs to consumers) and community ownership (allowing people to invest at any scale) are providing new ways to bypass the old capex-intensive models of financing energy infrastructure and opening up the market to a new tranche of consumers.

The solar PV market has, in some respects, followed quite a traditional course for technology deployment. It was initially a high-cost and unproven technology at a consumer scale, so was limited to the 'early adopters' who were not particularly motivated by economic considerations but instead were drawn to new technology for its own sake.

However, as costs came down through scale of production and support from governments, a new class of consumers took up the technology. This second wave of consumers were motivated primarily (if not entirely) by the clear economic benefits that low-cost solar presents. But even with take-up being larger in lower-income households, this second wave was still largely from owner-occupiers, because of legal complexities faced by tenants and the problem of split incentives.

Yet we can see now that the new business models, such as those described above, are enabling a third wave of investors in solar (and other technologies such as community-owned wind farms), even if they are renters or their own home is not suitable for the technology for other reasons (such as apartments).

Further innovation in the business models will potentially unleash still more waves of investment until solar PV has fully transitioned from disruptive technology to the new incumbent technology.

In a similar way we are witnessing the battery energy storage market emerge. Like the solar PV market, it is initially focused on early adopters, but spreading quickly as the economic case for investment becomes favourable.

Whether or not the spread of low-cost energy storage will result in households disconnecting from the distribution grid entirely – which represents the most radical vision for a decentralised energy sector – remains to be seen. For the moment it would seem more likely that households will stay on the grid, but that the role of grid-supplied power will be inverted, from the primary source of power (supplemented by embedded generation like solar PV) to a safety net supplier of last resort, with embedded generation being the primary source of power. Even this more moderate vision would require a fundamental rethink in the financial model for distribution network services businesses.

4. MORE EFFICIENT USE OF RESOURCES

Over the last five years Australians have seen electricity prices increase significantly and various commentators have called for quick fixes in a market that many analysts would suggest is going through a fundamental change.

The reality is that most of the growth in electricity prices has been a result of increased investment in distribution infrastructure required to connect households and businesses to the power supply. A combination of population growth, economic growth, ageing assets being replaced, increases in peak demand (forcing upgrades in some locations) driven by air-conditioning needs, and inaccurate forecasts of continued growth in electricity demand drove infrastructure expansion to meet expected future needs.

Although that third factor is being addressed now that demand has fallen well below forecasts, there are still plenty of legitimate reasons why distribution infrastructure will need further investment under the existing (mostly) centralised generation model. That means that while the dramatic rate of price growth of recent times will probably not be repeated, significant price rises are still likely over coming years, especially as Australia enters into the international gas market.

In the medium term the only way to avoid upgrades and contain cost pressures is to become much more efficient in the way we use existing assets and resources. Distributed generation can help achieve this in a number of ways.

Firstly, a decentralised model of generation offers scope to reduce loss factors in the transmission of electricity, reducing pressure for more transmission infrastructure to be built. Secondly, more households and businesses self-supplying their own power means less pressure on the distribution grid. Finally, new distributed technologies can avoid costly upgrades by using the infrastructure we have more efficiently.

To illustrate the final point, consider that although Australia officially has a ‘national electricity market’, what we really have is a number of partially connected demand centres that are mostly supplied by centralised generators in their home state, but which can trade surpluses and deficits of capacity to a limited extent with their neighbours.

A state like South Australia, with its abundance of wind generation capacity but relatively small local demand (due to small population size and changing industrial base), could be a great asset to neighbouring Victoria as a source of low cost power. However, limited interconnection infrastructure often limits exchanges and the lack of energy storage options further reduces the utility of any such energy surpluses.

Under the centralised business model the solution is to expand the transmission infrastructure. Indeed, a proposal to upgrade the South Australia – Victoria (Heywood) Interconnector was recently approved by the Australian Energy Regulator. However there is another opportunity as decentralised energy technology could well be a comparable, but potentially lower cost, solution.

One example of this alternative would be to deploy large-scale compressed air energy storage (CAES). CAES can be deployed in geological formations such as depleted natural gas wells (common off the coast between South Australia and Victoria) and could be used as a form of energy bank, soaking up surplus wind energy at times of lower demand, and putting it back into the grid in Victoria at times of higher demand. Such a plant would not just be a substitute for the transmission upgrade; it could also provide a range of ancillary services and support the efficient use of surplus clean energy generation from Victorian power plants.

Through more fully capturing the decentralised generation model we could ensure that the existing transmission infrastructure is used to full capacity more often, and is also most likely to

secure a range of other benefits in a more stable grid and with lower wholesale electricity prices more often. The alternative is that we get greater transmission capacity, which is only useful for a handful of hours each year and becomes a real cost burden to us all.

5. CONCLUSION

The previous discussion highlights just some of the potential benefits of shifting to a decentralised energy system, based on what can be observed from the limited process of decentralisation that has occurred so far in Australia.

The one thing that is relatively certain is that we can't be sure what the energy market and energy infrastructure will look like in 20 years' time, other than to say that the economics of the market suggest that it will not be based exclusively on the centralised model that some commentators have suggested may well have hit its peak over 20 years ago. The economic logic that underpinned that centralised model relied on assumptions that are currently being stretched through forces that it is has been suggested are irreversible.

The pace of innovation in distributed generation technology, the demand by consumers for greater involvement in, and control of, the ownership and usage of electricity, and the international drive to address climate change are all promoting real and fundamental change. A 'new normal' has not yet been established but all the indications are that the emerging model will lower the cost of new infrastructure, improve competition and greatly improve the degree to which existing infrastructure is used efficiently.

Distributed generation has already succeeded in moving beyond a characterisation as a niche part of the energy industry. However the speed of that transition will depend on the extent to which the market allows for innovation and how quickly the new entrants of today are allowed to become the incumbents of tomorrow.