



**Energy Policy**  
INSTITUTE OF AUSTRALIA



## **Public Policy Paper**

**Paper 7/2016**

# **INVESTING IN ELECTRICITY INFRASTRUCTURE IN A LOW-CARBON ERA**

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December 2016

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*The Institute advocates that Australia must maintain a secure investment climate and be internationally competitive, whilst moving towards and contributing as much as it can to global efforts to build a low-carbon society.*

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## Key Points

- The increasing penetration of variable renewable energy (VRE) in the National Energy Market (NEM) is causing the closure of coal- and gas-fired power stations, threatening power system security and creating unmanageable risks for investors. This is giving rise to social effects for which the community is not prepared and is occurring during a period of heightened community dissatisfaction with traditional political processes.
- The contemporary investment risk profile of each of the three main components of the power system: generation, networks and downstream supply, could not be more different.
- There is plenty of money available for investment but electricity generation has become a 'no-go zone' unless it is supported by government subsidies or by power purchase agreements (PPAs).
- Investment in electricity networks is almost the opposite - institutional investors are queuing to invest because independent economic regulation provides them with predictable long-term revenues.
- The NEM is in need of fundamental redesign.<sup>1</sup>
- Sound economic and scientific information on energy, as well as new processes of end-user and community consultation, will be required to gain community support for the necessary reforms but the focus of reforms should be the formulation of a truly national energy vision.

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<sup>1</sup>The challenge of redesigning the NEM will be addressed in a separate EPIA public policy paper to be published in early 2017.

## **Background: Concerns About Power System Security**

The State of South Australia has the highest penetration rate of VRE in the country and one of the highest in the world. Concerns regarding the security of the power system had been apparent for some time but it was only when a system-wide blackout occurred in the State in September 2016 that proper attention was paid to this issue, prompting the Australian Minister for the Environment and Energy to declare that *“Energy security is non-negotiable and we are unapologetic in making it our foremost priority ... We cannot trade away the reliability of the system as we transition to a low-carbon future ...”*<sup>2</sup> The Coalition of Australian Governments (COAG) Energy Council then agreed to establish an independent review of system security in the NEM (‘the Finkel Review’).

The Energy Policy Institute of Australia (EPIA) welcomed COAG’s decision, declaring it to be of the utmost national importance and urgency. EPIA submitted to the Finkel Review that energy security is paramount: that is, the lights must always stay on. Once energy security is established, then the market can optimise for price and emissions.<sup>3</sup>

The Finkel Review presented a preliminary report in December 2016 and is expected to deliver its final report in April 2017.<sup>4</sup>

Leading up to the establishment of the Finkel Review, there had been plenty of warning signals about power system security. Concern had often been expressed both overseas and in Australia over the impact of high penetration levels of VRE in power systems.

In 2011, a study for the European Commission (EC) had concluded that *“The policy implication of this analysis is that there are significantly increasing costs associated to the deployment of intermittent generation technologies in the EU-27, and in that sense limits to further deployment. If the cost of integrating intermittent generation was to be limited to about 25 billion EUR per year, no more than about 40% of intermittent generation can be integrated in the European power market.”*<sup>5</sup>

By July 2015, the EC had acknowledged that Europe’s electricity system was no longer fit for purpose and there was a need for a new market design to accommodate the increased share of VRE.<sup>6</sup>

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<sup>2</sup> Josh Frydenberg MP, *“The public expects nothing less than energy security,”* The Australian, 30 September 2016.

<sup>3</sup> EPIA, Submission to the Finkel Committee on Security of the NEM, November 2016, downloadable from <http://www.energypolicyinstitute.com.au/>

<sup>4</sup> *“Preliminary Report of the Independent Review into the Future Security of the National Electricity Market,”* Commonwealth of Australia, 2016. The report professes to be an issues paper to guide a process of open consultations on the design of a new blueprint for the electricity sector. Designing a blueprint is a much more ambitious task than simply getting to the bottom of the energy security problem in the NEM and it is likely to require permanent institutional capacity and consultation arrangements.

<sup>5</sup> Weitze et al, *“Assessment of the Required Share for a Stable EU Electricity Supply Until 2050,”* European Commission, EUR 24996, October 2011.

<sup>6</sup> European Commission, *“Launching the public consultation process on a new energy market design,”* COM (2015) 340, 15 July 2015. See also *“Energy Union Package,”* COM (2015) 80, 25 February 2015 and the EC’s recently announced legislative proposals to implement the EU’s transition to a low-carbon economy: *“Clean Energy for All Europeans,”* COM (2016) 860, 30 November 2016.



In January 2016, leading UK energy economist Malcolm Keay observed that “... one set of technologies is receiving support from outside the market, while other technologies are expected to remunerate themselves from the market – yet both sets of technologies are operating in the same market ...[and], if it is accepted that the present situation is unsustainable, urgent consideration must be given to alternative market structures if we are to avoid major security and environmental risks and a consumer backlash”<sup>7</sup>.

In Australia, in September 2015, it had been reported by the Australian Energy Market Operator (AEMO) that the changing generation mix was giving rise to reliability concerns. In April 2016, AEMO linked the concerns to faulty market design – faulty because it had been designed around a conventional generation model based on synchronous generation, (where the voltage generated by the system is synchronised with the rotation of the generators that make up the system itself).<sup>8</sup> In August 2016, AEMO foreshadowed reliability problems as a consequence of the withdrawal of coal-fired generation.<sup>9</sup>

In May 2016, the South Australian Nuclear Fuel Cycle Royal Commission had recommended that the SA Government should collaborate on the development of a national energy policy that enables all technologies, including nuclear, to contribute to a reliable, low-carbon electricity network at the lowest possible system cost.<sup>10</sup>

In September 2016, Simon Bartlett warned that the scale-up of VRE would diminish the robustness of the power system, suggesting that it could also magnify the short and long-term risk of investing in non-renewable generation assets and the power grid itself. Bartlett explained that the total available revenue would need to be shared amongst all asset owners and that they, as well as consumers, would suffer if the power system collapsed.<sup>11</sup> Within days, this had happened in South Australia.

According to Bartlett, there were four technical solutions: (1) a greater level of interconnection with adjoining power systems, (2) more energy storage, (3) increased demand-side management and (4) regulatory changes. A detailed cost-benefit analysis of all options and their recommended timing and financing will be needed for the Finkel

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<sup>7</sup> Malcolm Keay, “*Electricity markets are broken – can they be fixed?*” OIES Paper EL 17, Oxford Institute for Energy Studies, Oxford UK, January 2016.

<sup>8</sup> “*The National Electricity Market was designed around a generation model based on synchronous generation, with the result that many of the services required to maintain system security (such as inertia and voltage control) have been provided for free as a by-product of energy generation. As the share of synchronous generation as a proportion of overall generation declines, it is necessary to consider how to source these services going forward.*” AEMO, “*Report of the Energy Market Leaders Forum*,” April 2016.

<sup>9</sup> “*Under a neutral economic and consumer outlook – and in the absence of new generation, network or non-network development – coal-fired generation withdrawals at the levels assumed may lead to reliability standard breaches ... Additional intermittent generation alone may not materially improve the reliability of the system.*” AEMO, “*Electricity Statement of Opportunities 2016*,” August 2016.

<sup>10</sup> “*The Commission has found that commercial electricity generation from nuclear fuels is not viable in South Australia under current market rules. However, it has found that nuclear energy has the potential to contribute to national emissions abatement after 2030. Given the need for significant decarbonisation of our electricity sector to meet future emissions reduction goals, the Commission has recommended the development of a comprehensive national energy policy, which enables all technologies, including nuclear, to contribute to a reliable, low-carbon electricity network at the lowest possible system cost.*” Report of the SA Nuclear Fuel Cycle Royal Commission, Adelaide, 2016, Chapter 10: Recommendations and Next Steps, p 170.

<sup>11</sup> Simon Bartlett, “*The “Pressure Cooker” Effect of Intermittent Renewable Generation on Power Systems*,” Public Policy Paper #5/2016, EPIA, September 2016, downloadable from <http://www.energypolicyinstitute.com.au/>



Review.

This raises two immediate questions that are discussed in this paper: who should actually be responsible for future power system security? And what are the implications for investors?

### ***The Critical Importance of Energy Infrastructure in General and Electricity Infrastructure in Particular***

To go back to basics, energy is the largest sector for infrastructure investment, ahead of transport and communication.<sup>12</sup> Investment in energy infrastructure remains critically important for the efficient functioning of the economy and for national competitiveness.<sup>13</sup>

The focus of this paper is on electricity infrastructure. This needs to be distinguished from other infrastructure forms, such as roads, bridges and ports.

Historically, in most economies, power systems were the province of vertically-integrated, state-owned utilities. Nowadays, the functions of generation, transmission and distribution have largely been unbundled, disaggregated and/or privatised in the pursuit of greater economic efficiency. However, the owners and operators of the unbundled components still share the responsibility of providing secure, reliable and affordable electricity to consumers. In entering a low-carbon era, all unbundled components, especially generation, are expected to function whilst the overall system moves also to reduce the emission of greenhouse gases. This involves incongruous tasks.

Nowadays as well, many governments are experiencing budget constraints and have a need to reduce debt. They are doing this is by privatising whatever infrastructure assets they have left on their books.

In electricity transmission and distribution, the network companies make investment decisions and can then earn regulated returns. There is no system to ensure the optimal investment in network assets that will optimise the performance of the network at least cost.

There is a deepening global pool of surplus savings available for investment in energy, although it is not held by the corporate sector. In 2016, institutional investors of all types held around US\$100 trillion in assets under management (compared with the total market capitalization in 2012 of US listed companies of US\$18.7 trillion).<sup>14</sup>

The right infrastructure investments can provide reliable, long-term returns to institutional investors. The IMF has referred to *“the growing realization among long term investors that infrastructure assets are a natural habitat for their investments ... which match their long-*

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<sup>12</sup> Arezxi et al, *“From Global Savings Glut to Financing Infrastructure: The Advent of Investment Platforms,”* IMF Working Paper WP/16/18, International Monetary Fund, February 2016, p 9.

<sup>13</sup> For the purpose of this paper, energy infrastructure is broadly defined as the basic facilities and systems that produce and supply all forms of primary and secondary energy to the economy; it includes both hard and soft infrastructure; and it includes of course all forms of electricity infrastructure.

<sup>14</sup> Arezxi et al, *supra*, p. 6.

term horizon, where they are likely to face less competition.”<sup>15</sup> Infrastructure investments are particularly attractive in the current low-yield environment where illiquid asset classes can provide investors with an illiquidity premium.

### **Contemporary Energy Investment Risks**

In Australia, the electricity sector accounts for a third of all of Australia’s greenhouse gas emissions, making electricity investments particularly susceptible to changes in climate policy.

At COP21 in Paris in December 2005, the goal of limiting global temperature increase to well below 2°C was reaffirmed, with the parties to make efforts to limit the increase to 1.5°C.<sup>16</sup> The overall aim was to achieve “*global peaking of greenhouse gas emissions as soon as possible.*”<sup>17</sup> Just how soon remains to be seen but it is widely thought to be quite early in the second half of the century. The Australian government has announced that it will review its climate policy in 2017.

With increasing economic and environmental concerns, there are many more ways of upsetting an investor’s apple cart.<sup>18</sup> Investors in all energy assets face a unique range of policy, regulatory, institutional and technological risks that can limit or diminish the return on their capital. AEMO has recently spoken of the need for new market rules, new policy settings and reform of market incentives.<sup>19</sup> Minister Frydenberg for his part has explicitly acknowledged the need for a conducive investment environment, the need for a technology-neutral energy market and the need to take a whole-of-system approach to reform.<sup>20</sup>

### **Generation Investments**

In contemplating investment in the disaggregated functions of generation, networks and downstream supply, the risk profiles could hardly be more different. For their part, generation investments depend on electricity markets that are particularly sensitive to policy changes and intervention by governments.

The challenge for electricity generation in transitioning to a low-carbon power system is nothing less than massive. Australia’s generation sector is presently oversupplied, with

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<sup>15</sup> Arezzi et al, supra, p. 7.


<sup>16</sup> UNFCCC, Paris Agreement Art. 2.

<sup>17</sup> UNFCCC, Paris Agreement Art. 4.

<sup>18</sup> Robert Pritchard, “*The Legal Landscape of International Energy Investment After the 2008 Global Financial Crisis*,” in Weiler and Baetens (eds), “*New Directions in International Economic Law*,” Martinus Nijhoff Publishers, Leiden, 2011.

<sup>19</sup> Frank Montiel, AEMO Group Manager Market Policy Development, “Why does a customer need a future grid?” address to Engineers Australia conference Brisbane, 25 November, 2016

<sup>20</sup> “*Policies need to provide the right environment to create and maintain flexible, well-functioning and competitive energy markets that provide clear price signals. They need to provide investment certainty for industry but also provide an environment that encourages and rewards innovation. This means having an energy market that is technology neutral. Building on from our current energy market reforms, we need to take a whole-of-system approach that addresses all of the interlocking components of the energy market.*” Josh Frydenberg MP, address to the ANU Energy Change Institute, Canberra, 29 November 2016.



many fossil fuel generating plant having already been closed down and more closures expected.

Despite a projected 30% growth in population, and modest growth in the economy, electricity consumption is forecast to remain flat over the next 20 years.<sup>21</sup> Even so, there are obvious practical limits as to how far VRE could replace the existing fleet of fossil fuel generators. This underscores the valuable part historically played in the NEM by the Snowy Mountains and Tasmanian hydroelectric schemes and the potentially important future part of other larger-scale solutions such as pumped hydro, carbon capture and storage (CCS), nuclear power and fuel cells. Certainly, none of these potential options should be ruled out.

The present installed capacity of the NEM is approximately 45,000 MW, some 30,000 MW of which is coal-fired. According to the most recent AEMO forecast, approximately 9000 MW of coal generation will reach its technical end-of-life in the 2030s. However, this does not take account of earlier redundancies that could be forced by stricter emissions-reduction measures. This is the greatest challenge for the security of the NEM. Whether potentially redundant capacity is refurbished or replaced, by what, and by when, and in particular whether CCS might be an affordable solution for greenhouse gas emissions, will depend on future climate change policy, future technological advances, future fuel prices, resource availability and a range of locational and site-specific factors.

Power station redundancies may also have dramatic upstream and downstream impacts; rehabilitation provisions may be inadequate and the social consequences of the readjustment may be dramatic. The community is ill-prepared and gravely concerned, as can presently be seen in the Latrobe Valley where the recently-announced closure of the Hazelwood Power station has been met with shock and dismay.


Until energy and climate policy is clarified, the Australian generation sector is likely to remain a 'no-go zone' for investors. It is already problematic to invest in generation in Australia without special support, such as subsidies under the Renewable Energy Target (RET) scheme<sup>22</sup> or power purchase agreements (PPAs).<sup>23</sup> There are however no subsidies for clean coal, clean gas, CCS or new nuclear technologies such as small modular reactors (SMRs). Nuclear power generation is still prohibited by legislation of the Commonwealth and in several states. There is a need to remove all barriers that discriminate against low-emission technologies, map out long-term pathways to all lower emission solutions and provide policy and financial support to those options that provide the best outcome in terms of low-emissions power for the lowest cost.

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<sup>21</sup> AEMO, "2016 National Electricity Forecasting Report," July 2016, p 3. This may be despite the trend towards electrification of transport.

<sup>22</sup> The RET scheme has now purchased 143 million tonnes of carbon abatement worth more than \$1.7 billion. However the Clean Energy Regulator considers that more innovative ways to finance new projects are still required. A 'safeguard mechanism' to ensure that emissions reductions purchased under the scheme are not offset by increases in emissions elsewhere in the economy commenced on 1 July 2016. See the 2015-2016 annual report of the Clean Energy Regulator.

<sup>23</sup> As is preferred under the current investment policies of the Clean Energy Finance Corporation. In July 2016, AGL Energy announced it would be joined by QIC and the Future Fund in a A\$2-3 billion fund called the Powering Australia Renewables Fund to acquire and develop around 1000 MW of large-scale renewable generation assets in Australia. It is understood that AGL will negotiate the terms of a PPA for each project as funds are drawn down.



A potentially game-changing future policy option has recently been identified by the Australian Energy Market Commission (AEMC) with the recent release of its findings on the integration of energy and emissions reduction policy. The AEMC found that an emissions intensity target is *“the most cost-effective, scalable, and robust emissions reduction mechanism ... of the ... pathways available to policymakers ... allowing emissions reduction and energy policy objectives to be simultaneously achieved at the lowest cost to consumers.”*<sup>24</sup> This was favoured by the AEMC over other mechanisms, such as the technology subsidy through the Renewable Energy Target Scheme or a future regulatory measure forcing fossil fuel generators to close in order to meet the emissions reduction target.

In the UK, the government has recently decided to kick-start a new round of nuclear new-build projects with a Contract for Difference (CfD) for the electricity to be generated by the Hinkley Point C nuclear generation project. The CfD has evolved in the UK as a mechanism for the financing all forms of low-carbon generation projects (renewables, nuclear and CCS) and is a key component of the UK energy security strategy. The Hinkley Point CfD has a term of 35 years at a pre-agreed strike price of UK £92.50/MWh. The indicative strike price of CfDs for offshore wind projects is UK £100-105/MWh.

#### *Network Investments*

The revenues of electricity network investments, by contrast with generation, are a function of independent economic and technical regulation. Network investors look for a robust regulatory regime and a settled appeals framework to hold regulators accountable for their regulatory decisions. Australia has so far provided this and investors have queued up to spend their money. In 2015, five institutional investors paid A\$10.3 billion to acquire the transmission entity Transgrid from the NSW Government. In 2016, two other institutional investors paid A\$16.2 billion to acquire a 50.1% interest in the NSW distribution entity Ausgrid.


There are nonetheless signs of stress. The COAG Energy Council is presently conducting a review of the appeal process that applies to regulatory decisions. Investors in network businesses are concerned that this review could adversely affect their investments. EPIA maintains that investors in network businesses should have a stable, independent regulatory regime with a well-understood, well-settled accountability framework that provides for robust review – with minimal delay and cost and without being over-legalistic. This is critical for all matters over which the regulator has discretionary powers. In the UK, noted energy economist Dieter Helm has recently suggested there are fundamental flaws in the UK regulatory regime and in particular, that their five-yearly regulatory reviews should be abolished.<sup>25</sup>

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<sup>24</sup> Australian Energy Market Commission, *“Integration of Energy and Emissions Reduction Policy,”* Final Report, 9 December 2016.

<sup>25</sup> Dieter Helm, *“Do we need any more periodic reviews?”* Cross Regulation Network Paper 6, 12 December 2016.





New investment in interconnectors and transmission assets will be required as non-synchronous generation increases.<sup>26</sup>

### *Downstream Supply Investments*

Over recent years, the field of supply to electricity consumers has become so highly competitive that it has almost shed the mantle of infrastructure. All players in the field are required to be licensed under the NEM and to follow common rules for participation in the market. Most of the field is now occupied by private investors.

### *Power System Security*

In summary, in terms of risk, the three sectors of generation, networks and downstream supply can be viewed as entirely different industries, yet investors in each sector depend on the same pool of consumers to provide them with an economic return. The three sectors cannot exist without each other but they need to be managed very differently.

Responsibility for power system security is presently shared, directly or indirectly, amongst AEMC, AEMO, the state-based regulators who issue the licences for their respective states, and the various generators and network operators that are licensed to perform functions in each state. There is a strong argument for a single point of accountability for the security of the power system in its entirety, not only for short-term concerns but for long-term planning.

Energy innovation also has a role in energy security, in supporting the development of low-emissions energy technologies and facilitating the transformation to a low-carbon energy system.<sup>27</sup> There is much work to be done in Australia and internationally to develop new technologies to lower emissions, improve control systems, and match supply to demand in new and innovative ways. Australia has a significant challenge to move from its relatively high GHG emissions profile to a low one in a very short period of time. Many of the important technologies are being developed internationally and need to be rapidly adopted in Australia. It is vital that Australia creates a vibrant R&D environment to accelerate adoption of new technologies, and removes barriers to their deployment for this purpose.

### *The Need for a National Energy Vision*


EPIA has for some time advocated the need for a national energy vision to align Australia's energy and climate policy and provide long-term policy stability and certainty:

*“A national energy vision is needed to guide the nation toward a reliable and affordable energy system whilst maintaining the nation's energy export trade and*

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<sup>26</sup> Noted economist Ross Garnaut recently suggested that investments in new transmission assets could be centrally planned and publicly tendered to the lowest-cost provider rather than initiated by current transmission owners.

<sup>27</sup> The UK has established an Energy Innovation Board for this purpose. At COP21, Australia joined 20 countries in the *Mission Innovation* initiative, pledging to double their investment in clean energy R&D. Globally, investment in almost all low-emissions energy technologies is increasing. These include renewables, energy storage, LNG, CCS, nuclear power and fuel cells. There are also early signs of convergence amongst the energy, industrial and agricultural sectors.



*pursuing greenhouse gas emissions reduction – taking community and stakeholder concerns into account.*

*... if the world is to achieve its stated climate objectives, it will need to achieve a net-zero emissions position at some time during the second half of the century. The Institute recommends that Australia should prepare itself sooner rather than later to play an optimal role in achieving this.”<sup>28</sup>*

The key word here is ‘national’ – not just an energy vision that means different things to different governments when it suits the political mood of the moment.

In formulating a truly national energy vision, the needs of both investors and consumers must be kept foremost in mind. Without investors, we cannot be confident about maintaining our energy security. The need to bring investors back to invest in electricity generation without having to rely on subsidies is much more challenging than simply pinpointing and remedying the technical causes of the SA power system collapse.

In addition, without an understanding across the wider community of the underlying causes of power supply problems and rising electricity prices, and without community support for the necessary reforms, political solutions may remain out of reach. This is why consumer and community education is required, combined with strong consumer and community consultation.

December 2016

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### ***About the Author***

***Robert Pritchard*** is a lawyer and consultant on energy policy and strategy. He serves as executive director of the Energy Policy Institute of Australia and is a director of several companies involved in energy technologies and energy industry start-ups. He served for 9 years on the Finance Committee of the World Energy Council and chaired the 2001 WEC Study on Electricity Market Design and Creation in Asia-Pacific.

*This paper represents the views of the author and does not necessarily represent the views of EPIA or any of its members.*

*How Australia could redesign the NEM will be addressed by EPIA in a public policy paper to be published in early 2017.*

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<sup>28</sup> Most recently in EPIA, “An Australian Energy Vision and Framework for Energy Policy Priorities”, August 2016, downloadable from <http://www.energypolicyinstitute.com.au/>