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Facilitating efficient augmentation of transmission networks to connect renewable energy generation: the Australian experience

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ABSTRACT

Australia is heavily dependent on coal for electricity generation. The Renewable Energy Target has spurred growth in the utilization of renewable energy sources, with further growth expected into the future. Australia's strongest renewable energy sources are generally distant from the transmission network in resource 'basins'. Investment is needed to augment the transmission network to enable delivery of electricity from these sources to consumers. Considerable economies of scale flow from anticipating the connection of numerous generators in an area over time and sizing augmentations accordingly.

Following a lengthy rulemaking process, the National Electricity Rules were recently amended by a new rule, designed to facilitate the construction of such efficiently sized augmentations. However, the new rule is more conservative than initially envisaged, making little substantive change to the current frameworks for augmentation and connection.

This paper outlines these frameworks and the rulemaking process and identifies the key debates surrounding the rule change are identified. This paper then provides a detailed analysis of the new rule, concluding that it is defective in a number of respects and is unlikely to result in the efficient and timely augmentation of the network needed to unlock the potential of Australia's strongest renewable energy resources.

1. Introduction

Australia depends heavily on coal to meet its electricity needs. Coal accounts for around 80% of electricity output in the National Electricity Market (NEM), while gas accounts for around 10% (AER, 2010b). Overall, electricity generation accounts for 36% of Australia's total carbon emissions (DCCEE, 2011).[1] As concerns over climate change mount, there is increased movement towards less carbon-intensive methods of electricity generation, including renewable energy, as well as renewed interest in the demand-side of electricity markets.

Australia's Renewable Energy Target (RET)[2] is intended to ensure a transition to renewable energy sources by altering the underlying economics of electricity generation to make renewables more commercially attractive (MCE, 2010; AEMC, 2010c). Furthermore, the recently adopted Clean Energy Future package of legislative reform includes a carbon price that will ultimately transition to a cap-and-trade system (MPCCC, 2010). These measures will provide

[1] This figure is unusually low due to unseasonal flooding which caused coal mine closures and increased hydro generation capacity.

[2] Implemented by the Renewable Energy (Electricity) Act 2000 (Cth) and now divided into a Small Scale Renewable Energy Scheme and the Large Scale Renewable Energy Scheme.

Abbreviations: ABARE, Australian Bureau of Agricultural and Resource Economics; AEMC, Australian Energy Market Commission; AEMO, Australian Energy Market Operator; AER, Australian Energy Regulator; AGL, AGL Energy Ltd (previously Australian Gas Light Company); CEC, Clean Energy Council; COAG, Council of Australian Governments; CREZ, Competitive Renewable Energy Zones (Texas); DCCEE, Department of Climate Change and Energy Efficiency; DECC, Department of Energy and Climate Change (UK); DSP, Demand Side Participation; ERCOT, Electricity Reliability Council of Texas; ESAA, Energy Supply Association of Australia; ESOO, Electricity Statement of Opportunities; FERC, Federal Energy Regulatory Commission (US); MCE, Ministerial Council on Energy (now called the Standing Council on Energy and Resources); MEU, Major Energy Users; MPCCC, Multi-Party Climate Change Committee; NEB, National Electricity Board (Canada); NECA, National Electricity Code Administrator (roles and functions now transferred to the AEMC and AER); NERA, National Economic Research Associates; NEB, National Energy Board (Canada); NEL, National Electricity Law; NEMMCO, National Electricity Market Management Company; NEM, National Electricity Market; NEO, National Electricity Objective; NER, National Electricity Rules; NGF, National Generators Forum; NGMC, National Grid Management Council; NSP, Network Service Provider; NTNDP, National Transmission Network Development Plan; OECD, Organisation for Economic Cooperation and Development; OFGEM, Office of the Gas and Electricity Markets; PUC, Public Utilities Commission (Texas); RET, Renewable Energy Target; REMF, Review of Energy Market Frameworks in light of Climate Change Policies; RIIO, Revenue = Incentives + Innovation + Outputs; RIT-T, Regulatory Investment Test for Transmission; RPI-X, Retail Price Index-X; SENEs, Scale Efficient Network Extensions; TNSP, Transmission Network Service Provider; TEC, Total Environment Centre

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a disincentive to carbon-intensive electricity generation and likely further increase the utilization of renewable energy.

As with all electricity generation, renewable energy power stations must be connected to the transmission network (Network) in order to transmit electricity to the distribution network and to end consumers. Australia's Network has developed alongside the coal industry. As a result, the transmission network is close to coal resources, but distant from the best renewable energy sources. In addition, the present regulatory framework is geared toward infrequent connection requests from large coal-fired power stations, but ill-suited to clustered generation, i.e. the connection of multiple smaller generations in the same area over time.

The Australian Energy Market Commission (AEMC), the rule-making body of the NEM, has developed a rule change to the National Electricity Rules (NER or the Rules)[3] to facilitate the construction of suitably sized extensions to the Network that will accommodate clusters of renewable energy generators in a geographic area over time. Such a rule is intended to enable the exploitation of the economies of scale that flow from building an efficiently sized augmentation, rather than a number of separate augmentations for each generator. Such augmentations have been termed 'Scale Efficient Network Extensions' (SENEs), though some have colorfully referred to them as 'fields of dreams' (ESAA, 2011). The AEMC first suggested a SENEs rule in its Review of Energy Market Frameworks in Light of Climate Change Policies (REMF) (AEMC, 2009; Fig. 1).

On 30 June 2011, the AEMC issued the National Electricity Amendment (Scale Efficient Network Extensions) Rule 2011 (Final Rule), which implemented a very different approach to the concept initially envisaged.

In this paper I will give a brief contextual overview of the electricity market in Australia and discuss the current regulatory regime for the connection to, and augmentation of, the Network. I will identify the inefficiencies that flow from this framework and argue that amendments to the framework are needed.

This paper summarizes the rule change process and identifies the stakeholders and their responses to the proposal. It assesses whether the Final Rule is apt to address the issues facing investment in transmission infrastructure in the context of a changing electricity system. I conclude that the Final Rule is not apt for this purpose.

Two international examples of differing approaches to this problem will be outlined and I will propose a more suitable option for Australia's National Electricity Market. This proposal would grant ownership rights over any infrastructure built to the builder, giving investors certainty that they will be able to secure a return on their investment.

I also suggest that electricity market regulation more broadly needs to become more responsive to environmental and social concerns and that a narrow economic rationalist approach is inadequate to meet the challenges that electricity networks are facing.

Finally, the paper identifies some lessons that can be learned from Australia's experience.

2. Australia's electricity system: context

Australia's network has some unique characteristics. For example, it is very long and thin, stretching 4000 km from the North of the country at Port Douglas in Queensland along the coast and West to Port Lincoln in South Australia. The NEM is one of the world's longest interconnected power systems where electricity is traded across state boundaries.

[3] This article refers to the National Electricity Rules Version 43 (2011).

Australia's electricity system is, in common with many other states, highly liberalized. This liberalization brings with it the delicate balance between market forces and regulatory oversight, and the concomitant difficulties involved in aligning Transmission Network Service Provider (TNSP) incentives and regulation with public good outcomes.

As is also common, Australia's best renewable energy resources are generally far from the Network or load centers. However, even where renewable energy resources are located close to the Network, such as in smaller and denser countries, connecting clusters of renewable energy generation in proximate locations is also challenging because "it is not desirable to establish many connections on a high voltage transmission line, nor is it the most economic outcome overall" (AEMO, 2010a). This is partly due to technical constraints and partly because transmission infrastructure is inherently expensive. Thus the notion that efficiencies can be gained in augmenting the network is also applicable to non-remote generation.

3. Location of the Network and renewable energy resources in Australia

Renewable energy resources, like coal and gas, can be conceptualized as being present in distinct 'basins'. The most powerful winds in Australia blow offshore and on the Eyre Peninsula, 300 km west of Adelaide in South Australia, while the sun shines the strongest in the far northwest of New South Wales and in mid- to north-Queensland (Geoscience Australia and ABARE, 2010).

The Network that the renewable energy generators must connect to, however, is concentrated on the east and south-east coasts of the country, centered on the coal basins and load centers that necessitated its construction (Geoscience Australia and ABARE, 2010).

4. Scale Efficient Network Extensions

As generation from renewable energy sources increases, there is a need to augment the Network to transmit this additional electricity. The Network will need to be augmented more quickly and on a larger scale than would have been necessary absent the RET (AEMC, 2009). Where a generator wishes to utilize the best renewable energy resources, those furthest from the existing Network, the cost of this augmentation will be high.

As renewable energy sources are concentrated in specific geographic locations, it is expected that numerous generators will seek to develop power stations and connect them to the network in close proximity to each other over time. This is similar to the way in which multiple coal-fired power stations have developed and connected over time in close proximity to coal basins, though the renewable energy facilities will be smaller and more numerous.

There is, however, a 'chicken and egg' problem involved in transmission augmentation for renewable energy. Renewable energy generators are unlikely to develop generation facilities in remote areas unless sufficient transmission capacity exists to ensure a low-cost connection to the Network. On the other hand, interest in investing in infrastructure is likely to be low until it is clear that sufficient generation exists to utilize it and that a return on investment can be secured.

Ideally, generators with an interest in a certain geographic area would cooperate to build necessary network augmentations together. However, the current framework leaves open the possibility for strategic gaming: it incentivizes abstinence from the necessary cooperation and encourages generators to wait until other parties build the infrastructure and subsequently seeking