The Electricity Journal 29 (2016) 1–7

Contents lists available at ScienceDirect

The Electricity Journal

journal homepage: www.elsevier.com/locate/electr

Climate and electricity policy integration: Is the South Australian electricity market the canary in the coalmine?

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ARTICLE INFO

Article history:
Available online 8 May 2016

JEL codes:
D04
D47
Q40
Q41
Q48

Keywords:
Climate change
Renewables
Energy-only markets
Market design

ABSTRACT

An examination of the dynamics of the South Australian market finds that decarbonization-related policy objectives for the South Australian electricity system are unachievable with continued reliance upon an energy-only market. To avoid extreme pricing volatility and possible security of supply issues, it is vital that Australia urgently review its energy market frameworks to ensure they are better integrated with climate change policies.

1. Introduction

South Australia is a region of the east-coast Australian National Electricity Market (NEM). The NEM is an energy-only gross pool electricity market in which prices are formed under a uniform first-price auction clearing mechanism – put simply, prices during off-peak periods tend to reflect short-run marginal costs of power generation, while prices at peak periods can increase by around 25,000% to over $13,000 per megawatt-hour (MWh). In theory, this allows heavy capital costs to be recovered over the business cycle. Participants manage this market volatility by entering into financial market contracts.

The state of South Australia is at the frontline of how to incorporate large volumes of renewable energy while maintaining reliability and system security, given issues related to renewable intermittency in an energy-only market. Wind generation comprises around one-third of total electricity load and approximately one-quarter of all residential properties have installed embedded solar PV generation. In a market with a peak load of approximately 3–3.5 GW, renewable generation capacity is around 2 GW, but at times of peak demand the system is reliant upon an aging fleet of gas-fired generators and a relatively small interconnector to the neighboring Victorian region. Synchronous generation capacity is relied upon for reliability purposes but the value of "energy" (fuel) in non-peak times is effectively zero as wind and distributed solar have been substituted for gas and coal.

The policy objective underpinning the creation of the NEM in the 1990s related to improvements in capital allocation and pricing efficiency (see Hilmer et al., 1993, for the original "blueprint" for energy-market reform). From the early 2000s, it became clear that the NEM reform process had not adequately considered community expectations around anthropogenic greenhouse gas emission reductions and the development of new generation technologies. A 20% Renewable Energy Target and Premium Feed-in Tariffs (PFiT) were established that created non-electricity market incentives for adding substantially to the stock of generation capacity. Pollitt and Haney (2013, p. 9) make the salient observation that when markets such as the NEM were liberalized, "competitiveness was the overriding priority. Today, competitiveness, energy security and decarbonisation are the three main energy policy priorities."

This article explores the dynamics in the South Australian market and finds that decarbonization-related policy objectives for the South Australian electricity system are unachievable with continued reliance upon an energy-only market. This is due to pricing outcomes being inconsistent with real-world constraints including financing new generation infrastructure, customer

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http://dx.doi.org/10.1016/j.tej.2016.04.007
1040-6190/

preferences in relation to stable pricing, and the inability of intermittent renewable generation to provide "firm" contract pricing. In the long run an "energy-only" market makes little sense in a system with very high penetration of renewables given that the energy (sun, wind, etc.) is free. It is recommended that policy-makers urgently review the NEM and its governance and institutional frameworks to ensure consistency with climate-change objectives. The article is structured as follows: Section 2 outlines how the South Australian market has evolved and discusses emerging issues related to reliability concerns. Section 3 explores why optimal investment decisions are not forthcoming even with impending potential shortages. Policy recommendations and concluding remarks are provided in Section 4.

2. The evolution of the South Australian electricity market

At the time of market start in the late 1990s, South Australia had approximately 740 MW of coal and 1680 MW of oil/gas/diesel generation capacity. Peak load was around 2200 MW. Investment decisions in new generation capacity were driven by increasing peak load and market fundamentals for the first few years of the market's operation. There was almost no large-scale renewable generation and very few distributed generation facilities.

In 2001, the Commonwealth Government introduced a Mandatory Renewable Energy Target (MRET). This policy was expanded in 2009 to a 20% Renewable Energy Target (RET) and one year later split into a Large Scale Renewable Energy Target (LRET) and Small-Scale Renewable Energy Target (SRES). In the late 2000s, various state governments also introduced PFiT policies for installers of distributed solar PV generation. The end result of these policy decisions was the provision of material subsidy support for investment in both large-scale and distributed renewable energy generation. Almost no attention was paid to the interaction of these policy decisions with the "energy-only" electricity market design. Policymakers were largely confident that demand would continue to increase, which would offset any adverse impacts of the increase in renewable energy generation capacity.

South Australia experienced relatively rapid investment in large-scale renewable generation. While the 20% RET was a national policy, South Australia's wind resource was superior to neighboring states and project planning policies were more supportive. At the time of writing, total installed capacity of large-scale wind is approximately 1400 MW and a further 110 MW is under construction. There has also been rapid growth in small-scale embedded generation. Around one in four households in South Australia have installed premise-based solar PV. Total solar PV distributed generation capacity is around 600 MW. Figs. 1 and 2 show the additional large-scale and small-scale generation capacity added to the system since the late 1990s, respectively.

Fig. 1 shows that around 1.2 GW of new thermal capacity and 1.5 GW of wind capacity has been added to the system since the late 1990s. When combined with the *c.a.* 600 MW of embedded generation shown in Fig. 2, around two-thirds of the new capacity in the South Australian system is some form of intermittent renewable energy. Figs. 1 and 2 are instructive because they collectively demonstrate that around 2 GW of the 3.2 GW of capacity additions have been driven by renewable policy interventions implemented *externally* to electricity policy.

The other dynamic at play within the South Australian market is declining grid-based electricity demand. The maximum demand registered within the SA region was recorded in fiscal year 2011 and since then peak demand has fallen by 17.4% (AER, 2015, p. 27). Energy-demand has also fallen across Australia due to the closure of some industrial manufacturing, improved energy efficiency, price elasticity responses to higher grid-based tariffs, and a relatively high currency. Australian electricity demand and the "grinding down" of official forecasts is shown in Fig. 3.

So where do these historical trends leave South Australia today? The system's peak demand is likely be in the order of 3000 MW to 3300 MW (depending upon summer weather) with average load in the order of 1500 MW and a ratio of peak to underlying of up to 2.4 (ESAA, 2015). In FY15, wind generation in South Australia represented 29% of total registered capacity and supplied 37% of total electricity consumption. At times during FY15, wind generation alone was up to 109% of underlying South Australian electricity demand. In fact for 30 of the 8760 h of fiscal year 2015, wind was producing more than South Australia's energy requirements, necessitating the export of surplus energy to Victoria (the neighboring region). In FY15, around 7% of South Australia's total energy consumption was sourced from distributed solar PV. At lunchtime on Boxing Day 2014, embedded solar PV generation produced 36% of the total state load (AER, 2015).

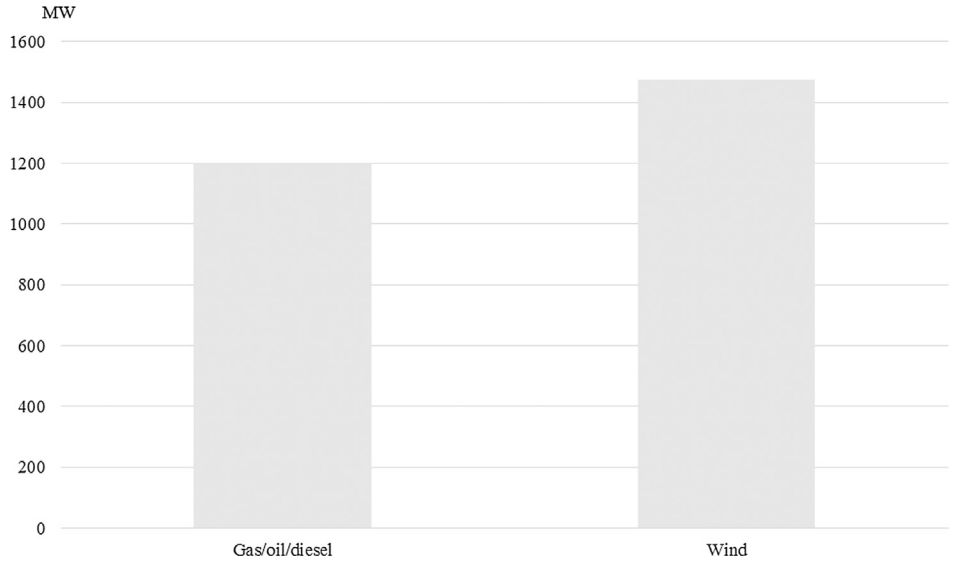

Fig. 1. Large-scale generation capacity added to the South Australian market since late 1990s.
Source: ESAA (annual reports).