South Australia's Virtual Power Plant

FRONTIER ECONOMICS ASSESSMENT

Overview

The South Australian government has carefully designed an integrated energy plan to help overcome some of the current difficulties with the National Electricity Market (NEM). The South Australian energy plan will improve power system security, reliability and competition in the state while preserving incentives for the private sector to invest in new capacity.

In fact, the South Australian government's energy plan has significantly extended opportunities for the private sector to invest in and develop a truly 21st century power system. For example, the South Australian government has negotiated a contract with Solar Reserve to build the world's largest solar thermal generator, Aurora, in Port Augusta to supply the government's own electricity load. Not only will this plant add much needed dispatchable capacity to the system, it will deliver a new generator competitor to the market. Similarly, the government underpinned the investment by Tesla in the world's largest battery. In the short time the battery has been operating, it has already played a crucial role in improving system security and reliability over this summer by providing power supplies to the market at unprecedented delivery times. This has stabilised the power system and improved security and these improvements will lower wholesale prices for all consumers.

Another critical aspect of the government's energy plan has been the development of a back-up generator that will only run to avoid customers being off-loaded if the private sector power stations fail to have sufficient capacity available to meet South Australian customer load.

The energy plan also involved the establishment of a Renewable Technology Fund (RTF) which is explicitly designed to support innovations to improve the reliability of renewable energy supply. In response to the establishment of this fund Tesla made a submission to the fund for the development of a Virtual Power Plant (VPP).

Recently AGL committed to the development of what they reported as the world's largest VPP involving 1,000 households. The Tesla proposal is for a VPP they envisage will involve, at full scale, up to 50,000 households.

The technology involves four key components:

- smart meters installed at every participating household;
- a network of rooftop solar photovoltaics (PV) installed on public housing (5 kW solar panel system);
- battery storage installed on public housing in South Australia (5 kW/13.5 kWh Powerwall 2 Tesla battery); and
- a computer system to control the storage, use and transfer of renewable and battery stored power between houses and the grid to maximise value for customers.

If there are ultimately 50,000 households that participate in the program this would add 250 MW of peak capacity to the system, or alternatively, it would reduce demand on the central grid by 250 MW, freeing 250 MW of capacity to supply other customers.

How does a VPP work?

The central idea behind a VPP is that all consumers can benefit by sharing surplus energy produced by rooftop solar panels when it is not being used.

A VPP works by storing or selling electricity produced by individual rooftop solar panels that will be installed on public houses to use when it is most valuable to the SA power system. Often this will mean storing surplus renewable power generated by a household for later use when the sun has gone down.

The technology is relatively simple and well developed – a network of rooftop solar panels and household batteries to store surplus energy and smart meters to assist in controlling these elements as well as measuring power flows. The main innovation lies in the way in which renewable power is shared between a group of customers. This is where the computer system is required. The computer system will figure out, automatically, which system is producing surplus power and whether that power should be stored and/or moved to another customer that is using more power than they produce. The control system will make these decisions in a way that minimises costs to customers.

All South Australian Housing Trust customers are eligible to participate and have the choice to take up the VPP offer whether or not they have the space to install rooftop solar panels and/or batteries.

Tesla VPP consistent with SA Energy Plan objectives

The proposal delivers the following outcomes to the State and taxpayers, which are all consistent with the objectives of the South Australian energy plan:

- **Competition:** the rollout to SA Housing Trust customers alone would add approximately 130MW of additional rooftop PV generation capacity, and 130MW/330GWh of distributed, dispatchable battery storage. This approximately doubles if the rollout is extended to a similar number of private customers.
  - This additional capacity would materially increase competition in the SA generation sector as (a) this adds a considerable quantity of **dispatchable** capacity and (b) the VPP would be managed by a retailer appointed through a competitive tender.
  - This should reduce wholesale energy costs for all SA energy consumers (relative to without the program), as well as directly lowering costs for SA Housing customers. Frontier Economics estimate that the wholesale price in SA will reduce by about $3/MWh for all customers with each additional 50MW of capacity that is brought onto the system that would not otherwise be operating. This suggests that the Tesla proposal could reduce the wholesale price by around $8/MWh, or about $90m p.a. across all South Australian customers if just the SA Housing Trust customers participated in the arrangement. The savings would be approximately double this if the project its full scale of production of 250 MW.
  - SA Housing Trust customers would also be insulated from fuel price and carbon price risk, as prices won't rise in future.
- **Reliability:** The addition of 130MW/330GWh of distributed, dispatchable battery storage, to be managed as a portfolio (in a VPP) will materially improve the reliability of the SA market. This will reduce the likelihood of the Value of Lost Load event, which reduces the likelihood of the market price reaching the $14,200/MWh Market Price Cap (MPC) and this value is reflected in the $3/MWh reduction in price for each 50 MW of additional capacity.
- **Security:** The addition of 130MW/330GWh of distributed, dispatchable battery storage, to be managed as a portfolio (in a VPP) will materially improve the security of the SA market by providing further capability, if required, to discharge stored electrical power in the Powerwall II systems to help manage system stability. For example, based on the first full month of trading in December 2018 the Tesla 100 MW battery resulted in about a 75% reduction in the costs being paid for by customers for frequency control services.

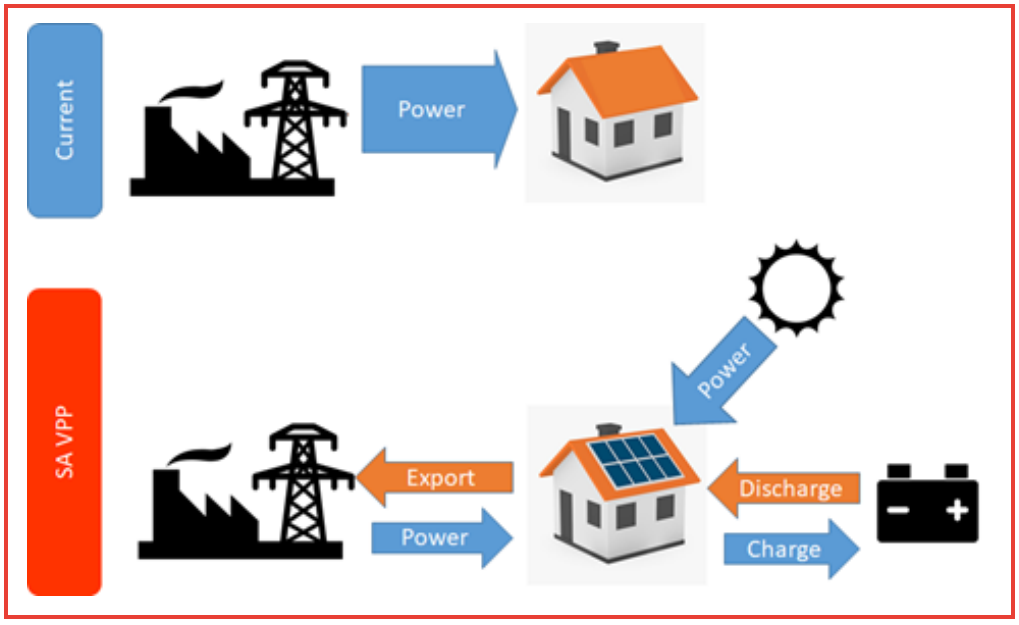
Where are the VPP savings?

Almost all electricity consumers currently draw their power from the central grid. Electricity bills include **generation**, **network**, "**green**" costs (certificate schemes) and **retail** costs.

The proposed scheme would increase generation from solar PV, which would be stored and consumed from local, distributed batteries. Excess power would be exported to the grid at times of high value. Charge/discharge and power exports would be managed by a retailer, just as it would be by a retailer for a centralised power supply (see Figure 1).

Participants would pay a price that reflected the costs of the solar panels, battery and smart meter. While the costs of the solar panels and battery are likely to cost more than centralised power this additional cost would be offset by largely avoiding network charges for poles and wires, which accounts for the largest share of the bill for most consumers. Further, the government will contest for the provision of retailing services. The retailer will be responsible for managing the arrangement. This competitive process for appointing a retailer will ensure the lowest retailing costs.

Figure 1: South Australia VPP



Rollout phases

The VPP project will be rolled out in an orderly, staged manner. The three roll-out phases are summarised in Table 1.

Table 1: Program roll-out phases

Phase	No of customers	Timing	Overview
Phase 1	100	January to June 2018	Government acquisition, installation and management of 100 PV and storage systems Designed to test physical rollout, system operation and facilitate data collection for a number of representative customers. Customers who receive these systems would see a reduced retail bill, and eventually be rolled in to the program retailer to be commissioned to operate the system.
Phase 2	1000	July 2018 to June 2019	Government acquisition, installation and management of 1,000 systems, designed to further test physical rollout, VPP operation and retailer arrangements. Customers who receive these systems would see a reduced retail bill, and eventually be rolled in to the program retailer;
Phase 3	25000	July 2019 to June 2022	Final roll-out over three years to 24,000 Housing Trust homes and scheme extended to 25,000 non Housing Trust customers.

Participant benefits

Current residential retail costs in SA are approximately 40c/kWh (on average, though some offers are less). Much of the recent rise in power prices has been due to a rise in network costs from around 2010 due to significant strengthening of the reliability standards network businesses were required to meet. More recent price rises across the NEM are due to higher wholesale and green costs.

As indicated above the VPP would result in **reduced network** and **green costs** faced by households that participate in the program. However, this reduction in network costs would be offset to a degree by a rise in **energy** costs related to the costs of installing solar panels, batteries and smart meters.

Comparing the average price currently being paid by customers in South Australia to the preliminary costs of the VPP, customers would reasonably expect a reduction in electricity tariffs of about 30% once all reasonable costs and benefits are taken into account. That is, based on Frontier Economics' preliminary analysis, customers could reasonably expect to see a price of around 27c/kWh. However, the precise level of savings for participating will depend on a range of factors, including the level of the alternative tariffs available to participating customers over time, the extent of savings that can actually be achieved from optimising the use of batteries having regard to actual customer loads, and the final costings from

Tesla for their systems and the contract that is agreed with a retailer to manage the program. These factors will become clearer as the program is rolled out and highlights the need to have a staged approach to implementation.

Benefits and costs to other SA customers

There are benefits to non-participating customers in South Australia, including:

- **Greater retail competition:** To the extent that the arrangements bring in a new retailer this will increase retail competition, which would lower retailer margins and reduce retail prices;
- **Greater generation competition:** The entry of the VPP (upwards of 125MW) will introduce a new competitor to the wholesale market. The VPP will be able to provide value over and above conventional generation by time-shifting. Frontier Economics estimate that every 50MW of additional independently operated capacity in the SA region reduces prices by around $3/MWh. This suggests that the proposal is likely to reduce wholesale prices by around $8/MWh. This will reduce annual consumer bills across the State by around $90m p.a. This reduction needs to be considered as part of the package of other measures the State has put in place to reduces prices in SA, including the Solar Reserve plant (more than $90m p.a.) and the battery (reductions expected to be around $40-50m p.a. from lower frequency control ancillary service costs); and
- **Avoided grid costs:** There may be grid or ancillary service benefits, for example deferred network augmentation due to reduced peak demand. However, we expect this value to be small/immaterial for the medium term and at this stage none of these benefits have been incorporated into any analysis undertaken by Frontier Economics.