Submission No 246

INQUIRY INTO ELECTRICITY SUPPLY, DEMAND AND PRICES IN NEW SOUTH WALES

Organisation: SolarReserve Pty Ltd

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Legislative Council
Select Committee on Electricity Supply, Demand and Prices in New South Wales
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Re: Inquiry into electricity supply, demand and prices in NSW

Thank you for the opportunity for SolarReserve Australia Pty Ltd (SolarReserve) to provide a submission to the New South Wales (NSW) Legislative Council's Select Committee *Inquiry into Electricity Supply, Demand and Prices in NSW*. It is with pleasure that we can provide information to the Committee on Concentrating Solar Power (CSP) and how it can assist in meeting future electricity demand in NSW. Please find a summary of:

- Who is SolarReserve;
- How our technology works; and a
- Response to a question raised at the fourth Committee hearing.

1. Who is SolarReserve

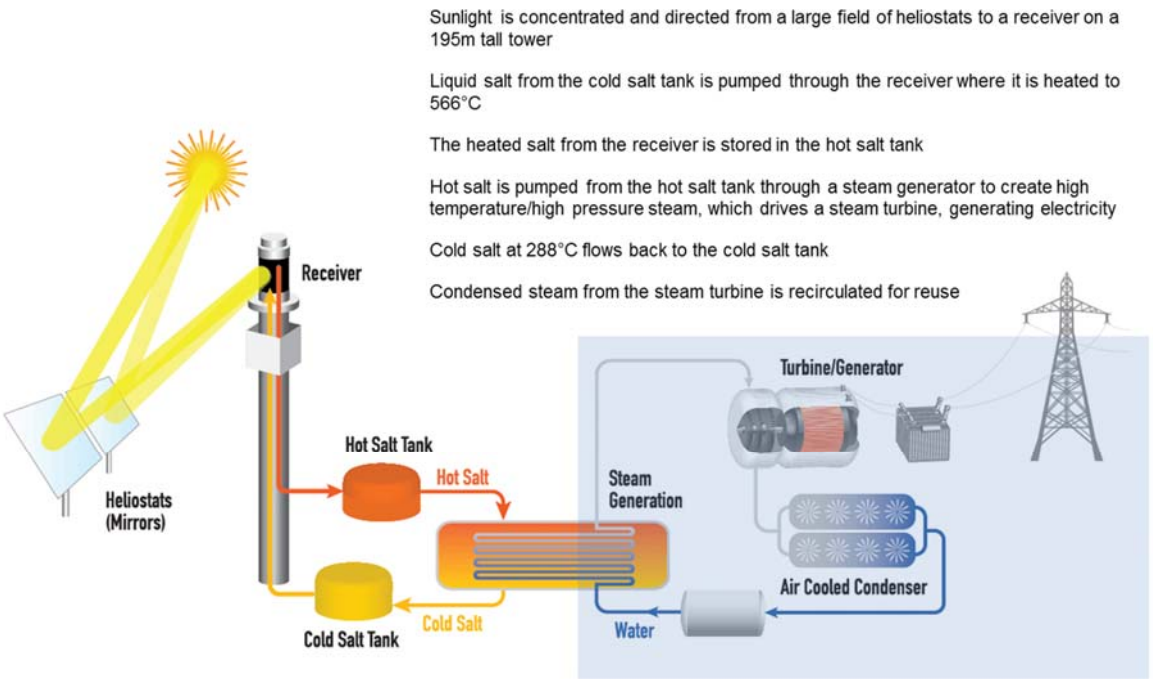
SolarReserve is a leading global developer of Concentrating Solar Power (CSP) and photovoltaic (PV) solutions, that combine our proprietary molten salt power tower storage technology with project development, financing, and operating expertise. Our technology can provide firm, fully dispatchable, non-intermittent renewable energy, day and night. Its power generation capabilities are nearly identical to that which is found in a coal or natural gas-fired power station.

SolarReserve has successfully financed and constructed more than US$1.8 billion of large scale solar projects worldwide. These include the 110 MW Crescent Dunes CSP project in Nevada; the 150 MW_{DC} combined Letsatsi and Lesedi Solar PV Projects; and the 96 MW_{DC} Jasper Solar PV Project in South Africa, all fully operational. Construction is due to commence shortly on the 100 MW Redstone CSP project in South Africa, and a 150 MW Aurora CSP project in South Australia (see Part 3 of this letter for details on Aurora).

Crescent Dunes Solar Energy Project, Nevada, USA. 110MW with 10 hours of full load storage (1,100MWh)

2. How our Technology Works

SolarReserve's CSP with storage technology utilises molten salt to collect and store heat from sunlight during the day and then power a conventional steam turbine whenever electricity is needed. Low-cost thermal storage allows the facility to deliver clean energy at full output 24 hours a day, or whenever it is needed by the grid, rather than being subject to the moment-by-moment variability of sunshine or wind. CSP with molten salt storage can be configured to a variety of load profiles, including peak or baseload operations.



Schematic of SolarReserve's CSP with storage technology

The power block within the facility, as presented in the blue shaded area above, is nearly identical to that found in a coal-fired power station. The key difference with SolarReserve's CSP technology is the absence of fossil fuel. Our technology relies instead on energy collected from the sun, stored in molten salt and converted to steam through a heat exchanger.

Transition from Coal to Renewables

CSP with molten salt energy storage enables the transition from fossil fuel to renewable energy based generation. The storage element of the technology enables CSP to provide nearly identical dispatchability, energy security, network strengthening and wholesale price stability to that which traditional coal-fired power stations provide, but wholly from a renewable energy resource.

The Value of CSP with Storage

Our technology delivers multiple value streams which are increasingly important in the changing energy landscape. CSP with storage provides an alternative to traditional network augmentation solutions, enhancing energy security by providing energy locally from an indigenous generation solution. The benefits that are provided by CSP can be divided into the following four categories:

- Energy and Capacity Value: Molten salt storage allows a CSP facility to shift energy generation to match the highest-value times on the grid. With enough storage, this shift includes covering both the typical "peak" period, and also the unexpected event of a price spike at another time, whether morning, evening, or overnight. This shifting ability allows CSP to replace conventional infrastructure not only for energy supply but for reliable capacity supply, meaning it can fully replace baseload generators like coal power plants. Storage enables CSP to operate at a high capacity factor which leads to a higher utilisation

of transmission infrastructure, reducing the capital and environmental cost of building new transmission lines and interconnectors. Because CSP can operate reliably and stably, it reduces the fuel use and Operations and Maintenance (O&M) impact of flexing the conventional generation fleet in response to intermittent solar and wind conditions.

- Ancillary Services: The dispatchability afforded by molten salt storage allows a CSP plant to deliver ancillary services to the grid. "Ancillary services" include the various functions a plant can provide a wholesale market which enhance the market operator's ability to maintain stability. For instance, the practice by which a plant operates at partial capacity but turns up to full capacity rapidly in response to variations in load and generation is often called "spinning reserve." SolarReserve's CSP with storage is capable of providing frequency regulation, spinning reserve, non-spinning reserve, load following services, and black start capability. Each of these is important to the reliable functioning of the grid.

- Intrinsic Stability: A steam turbine, a massive piece of machinery spinning at thousands of RPM, provides significant inertia to the grid. It resists short-term fluctuations which would otherwise cascade into a brownout or blackout. CSP with storage offers fault ride-through capability, frequency response, and voltage / VAR support. These attributes are of enormous value to the grid, particularly in grids like New South Wales that is transitioning towards high penetrations of intermittent renewables such as wind, and where even a momentary disruption could have severe economic consequences.

- Risk Management: Renewable energy technology is a hedge against future electricity price increases (as it has no fuel cost), but CSP with storage is also a hedge against other risks. Because it provides ancillary services rather than requiring them from the grid, it is a hedge against future ancillary service costs. Because it enhances the stability of the grid rather than degrading it, CSP is a hedge against the future cost of integrating a high penetration of renewables into the grid – a cost which today is typically socialised in the cost of expensive transmission upgrades and interconnectors and the implementation of higher reserve margins. The output of an individual CSP plant is also lower-risk than PV's due to the nature of *integrated* storage; because all of the collected energy is stored before being dispatched, a CSP plant's output is far less sensitive to momentary fluctuations in sunlight. Weather conditions will only affect the number of operating hours – the MWh amount delivered per day – and will not affect the MW level that the system produces. Importantly, CSP with storage can also change its behaviour mid-life, 10 or 20 years after commencing operations, to adapt to new market realities. This allows CSP to maintain its value over the long term, even while the wholesale market value of additional PV or wind declines precipitously as more and more of those technologies are added to the grid.

Wholesale Market Value

The energy landscape in Australia is rapidly changing as coal fired generation is phased out and solar and wind power gain traction. SolarReserve's CSP facility can adapt to the changing profile of the market, both now and into the future. SolarReserve's CSP technology is designed with price risk management in mind, featuring two key elements:

- High capacity factor: SolarReserve's CSP technology can run for up to 24 hours per day throughout the summer months, smoothing intermittency generated by wind and solar PV and adding stability to the network. This guarantees that the facility will meet all high demand periods on the grid.

- High storage capacity: When not running baseload, 8-12 hours of storage capacity (typical for plants of this scale) allows for unprecedented discretion in dispatch patterns. The facility could run principally at night during the winter, if it were advantageous to avoid hours when intermittent generation is generating. The dispatch pattern can adapt as markets change, allowing the CSP facility to adjust its behaviour following contingency events and as the States load profile changes over the next 20 years.

Independent studies have shown that CSP with a significant amount of storage is capable of consistently supplying electricity into the peak demand periods.[1] Additional studies have shown that intermittent renewables (PV and wind) without storage *lose their value* as additional intermittent renewables come on line, while CSP with storage maintains its value.[2,3]

3. Response to question raised at the fourth Committee hearing

SolarReserve would like to respond to an important question raised at the fourth Committee hearing on Tuesday 8 May 2018 raised by the Hon. Taylor Martin:

> *Spain has around 2,300 megawatts of concentrated solar capacity. It comes up in the news every now and then, with big arrays of mirrors concentrated on one spot. Is that technology up there with photovoltaics, or is it a pipe dream?*

Response Part A: CSP is happening in Australia – the Aurora Project

The Aurora Solar Energy Project (Aurora) demonstrates that CSP with integrated storage is technically and commercially viable in Australia. SolarReserve has been awarded a contract to build Aurora in Port Augusta to supply the South Australian (SA) government's electricity load (e.g. hospitals, police stations, government buildings and schools) over the next 20 years. Aurora will:

- be Australia's first utility-scale CSP project;
- will consist of a 150 MW CSP facility with 8 hours (1,100 megawatt-hours) of full load storage;
- will provide reliable, dispatchable, renewable electricity into the National Electricity Market (NEM);
- assist the Port Augusta economy transition following the closure of coal fired power stations in the town; and
- Offset 200,000 tonnes of CO_2 each year.

SolarReserve is currently progressing with the final project approvals; engineering, procurement and construction (EPC) contracts; and financing arrangements. For more information on Aurora see: https://aurorasolarthermal.com.au/

Response Part B: Cost of CSP

When comparing the installed cost of CSP (with integrated storage) versus solar PV, several important factors need consideration:

- CSP projects with integrated storage have a minimum 40-year operating life, whereas solar PV projects typically only have a 25-year life before electricity generation deteriorates below 80% of the nameplate output.
- The price of CSP projects include integrated storage, whereas as the price of solar PV projects need to include a storage system such as pumped hydro or batteries. Importantly:
  - The cost and efficiency of a pumped hydro system needs to be considered, as these elements can be significant, and

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[1] *Madaeni, S.H., R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants: A Case Study of the Southwestern United States," IEEE Transactions on Power Systems, Vol 27, No 2, pp 1116-1124, May, 2012a.*

[2] *Mills, A., and R. Wiser, "Changes in the Economic Value of Variable Generation at High Penetration Levels: Pilot Case Study of California", Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, LBNL-5445E, June 2012b. See http://eetd.lbl.gov/ea/ emp/reports/lbnl-5445e.pdf.*

[3] *Jorgenson, J., P. Denholm, and M. Mehos, "Estimating the Value of Utility-Scale Solar Technologies in California Under a 40% Renewable Portfolio Standard," National Renewable Energy Laboratory, Technical Report, TP-6A20-61685, May 2014.*

- Whilst battery systems are becoming more prevalent and more cost effective, the largest battery in Australia (Hornsdale Power Reserve, SA) only has 1/10th the storage capacity of Aurora.

- The cost of CSP projects also includes a range of ancillary services essential to the electricity network such as inertia, frequency regulation, spinning reserve, load following services etc, which are not provided by solar PV. These services need to be provided in addition to solar PV.

Response Part C: Opportunities for CSP in New South Wales

New South Wales has significant potential for the development of CSP, as well as a pressing need. Specifically, New South Wales:

- has an excellent solar resource in the North-Western part of the state, and
- similar to South Australia, needs to consider its energy future following the announcement to retire coal fired power stations such as Liddell in several years-time.

As demonstrated by the Aurora project in South Australia, transitioning from coal fired power stations to CSP could be a practical solution for NSW. CSP and coal fired power stations both have the same technology base: they both use steam turbines. The difference is the fuel source, with coal fired stations using fossil fuels and CSP the sun. Both technologies are also dispatchable during the day and night, and operate in similar ways on the electricity network, unlike solar PV and wind, which operate very differently and only provide intermittent electricity when the sun is shining or the wind blowing.

Overall, CSP has significant development potential in NSW and SolarReserve is already working with the NSW government and TransGrid to plan for future projects.

4. Next Steps

We thank you for the opportunity to contribute to this Select Committee inquiry. Please feel free to contact me or a should you wish to discuss any of the above further. SolarReserve is also available to present to the Committee at the upcoming hearing 10 October 2018 should this be of value to the Committee.

Yours sincerely,

Daniel Thompson
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SolarReserve Australia Pty Ltd