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Evaluation of CSP Opportunities in Australian Electricity Networks

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Concentrated solar power (CSP) has had limited commercial uptake in Australia despite the apparent benefits of the technology in providing an opportunity to embed large scale storage within the plant and the high solar availability in many inland areas. However, the continuing retirement of large-scale fossil fuel power plants and the increased use of intermittent renewables is likely to result in increasing issues with maintaining network stability and CSP is a technology that has the potential to address this. One of the major challenges that CSP has in gaining commercial acceptability is that it is not a simple modular technology where a standard design can be used in all locations and has a consistent costing. Instead, the design must be optimised to match the site conditions and there is considerable flexibility in configuring the field size, storage capacity and power block output. Using this flexibility, CSP systems can be designed to generate electricity in configurations that can range from baseload to peaking. However, CSP has typically been represented simply by a single system design in previous assessments of the market potential for CSP, such as AEMO's 2013 100% Renewables study, and it is considered that improved plant designs to match network demands are likely to increase the potential for uptake of the technology in different applications within the Australian electricity network.

An improved representation of CSP systems has been undertaken in this study using models of the NEM, SWIS, NWIS and DKIS electricity networks developed within IEA's TIMES open framework and the future scenarios proposed in AEMO's Integrated System Plan. This has been used to assess the potential locations and scales of different types of CSP system within the Australian networks in the future. The target types of system include plants with storage capacities ranging from 6 to 15 hours operating to meet projected network demands and a peaking plant design utilising 3 to 4 hours of storage that targets generation only during the evening peak demand period. The design and performance of each of these plants designs for each zone within the networks, with the number of zones totalling approximately 50 across Australia. The modelling approach taken is then to minimise the overall cost of electricity generation within each network by combining the different available generation systems from the AEMO's GenCost assessment combined with the customised CSP systems. Costing for the CSP systems varies between different designs, with the basic component costs based on an assessment of current commercial plant costs that is comparable to the GenCost estimates for a similar system specification. Using these default current costs, the modelling suggests that a significant uptake of CSP with large storage capacity is beneficial in the shorter term for the SWIS, NWIS and DKIS electricity networks, but there is limited uptake in the NEM where a more diverse generation portfolio apparently reduces the need for the storage capabilities of CSP. Given that conventional CSP technologies have experienced significant cost reductions and new technology variants are the subject of extensive research internationally, an additional modelling study was undertaken to assess what needs to be achieved in CSP improvements to promote significant uptake in the NEM and the type of CSP system design that appears most beneficial to the projected future requirements.