ASIA-PACIFIC
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Electrified land transport and low temperature heating in Australia

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The world's energy systems are experiencing a rapid transformation due to increasing concerns regarding climate change and the rapid cost reductions in the renewable energy technologies wind and solar photovoltaics (PV). In 2018, about 160 Gigawatts (GW) of net new wind and PV was deployed, which was more than everything else combined. This transition provides opportunities to reduce the dependency on coal, oil and gas, which together cause around 80% of global greenhouse gas emissions.

Australia has excellent wind and solar resources. It is installing renewables at a rate of around 250 Watts per person per year, which is 4-5 times faster per capita than the USA, China, EU or Japan and fast enough to reach 50% renewable energy in 2024 [1]. Grid stabilisation with large deployment of PV and wind at modest cost is possible by utilising existing hydroelectric and bio generation capacity, pumped hydro energy storage (PHES), batteries, high voltage powerlines and demand management [2].

Emissions from land transport and low temperature heating account for 22% of Australian emissions. The electrification of these two sectors could remove around 122 million tonnes of greenhouse gas emissions if this change is coupled with the decarbonisation of grid electricity. Electrification can be achieved by replacing internal combustion engines with electric motors, and replacing the current use of gas and LPG in space heating, water heating and cooking with cleaner and more efficient electric heat pumps and electric cooking appliances. The electricity demand would increase by 48%, but much of this additional electric load would be flexible. EV batteries and hot water tanks allow load shifting or load shedding during critical periods, which would minimise extra utility-scale storage investments utilised for only a few days every few years.

Initial modelling finds that charging of electric vehicles and all other forms of land transport can be incorporated into the electricity system with only a small increase in the levelized cost of electricity (LCOE) of 4-8 percent compared with a 100% renewable electricity scenario without EVs under a wide range of scenarios, none of which have included active demand response. The LCOE with hourly balancing to provide grid electricity and energy for a 100% electrified land transport fleet is estimated to be around AU$80/MWh (US$60/MWh). This is below the LCOE of any alternative supply option and is close to the current NEM pool price. With the integration of low temperature heating load and active demand response, the LCOE is expected to be fully competitive with newly-built coal power stations.

References

[1] A. Blakers, M. Stocks, and L. Bin, 2018, "Australia: the renewable energy superstar".

[2] A. Blakers, B. Lu, and M. Stocks, 2017, "100% renewable electricity in Australia", *Energy*, vol. 133, pp. 471–482.