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Rooftop solar PV and the peak load problem in the NEM's Queensland region

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Abstract

Over the period 2016-2021 Australia's National Electricity Market (NEM) experienced an investment supercycle comprising 24,000MW of renewables. One of the more intriguing aspects of the supercycle was a partial shift of investment decision-making from utility boardrooms to family kitchen tables – rooftop solar PV comprised 8,000MW of the 24,000MW total. In NEM regions such as Queensland, take-up rates have now reached ~40% of households, currently the highest take-up rate in the world. At the household level there is a distinct mismatch between peak demand and solar PV output, which tends to suggest any peak load problem will be exacerbated. When the contribution of rooftop solar PV is abstracted to the power system level these results reverse. The partial equilibrium framework of Boiteux (1949), Turvey (1964) and Berrie (1967) has historically been used to define the optimal plant mix to satisfy demand growth. In this article, their partial equilibrium framework is used to define conventional plant 'dis-investment' in the presence of rising rooftop solar PV and utility-scale renewables in an energy-only market setting. Queensland's 4400MW of rooftop solar displaces 1000MW of conventional generation in equilibrium, 500MW of peaking plant and somewhat counterintuitively, 500MW of baseload coal plant – falling 'minimum system demand' being a driving factor. The NEM's energy-only market and its $15,000/MWh price cap proves tractable through to a 50% renewable market share, but relies critically on frictionless coal plant divestment and bounded negative price offers.

Keywords rooftop solar PV, renewables, power generation, energy-only markets, peak load problem

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