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Policy sequencing: on the electrification of gas loads in Australia's National Electricity Market

EPRG Working Paper EPRG2509

Cambridge Working Paper in Economics CWPE2528

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This article examines the implications of simultaneously pursuing power system decarbonisation, and gas market electrification, under imperfect market conditions in Australia's National Electricity Market (NEM). Using a suite of time-sequential electricity and gas market load and unit commitment models with 40 years of demand and renewable generation derived from historical weather re-analysis data (hourly resolution), we identify the least-cost generation plant stock required to maintain the power system in a secure state following the closure of Australia's coal-fired generation fleet. We also test these outcomes in a gas market model through an iterative process.

Model results suggest sequencing of electricity system decarbonisation, and electrification of the gas market, is important. Electrification of the gas market drives non-trivial increases in aggregate final electricity demand during winter periods. This happens to coincide with the period when renewable output hits its annual nadir.

While Australia's NEM has experienced an extraordinary run of investment in new renewables and rooftop solar – activity visibly slowed during the 2024 financial year. If this proves to be a structural problem with projects becoming progressively harder to develop (e.g. due to changes in environmental laws and community attitudes) then some level of policy adjustment or 'sequencing' may be required.

One issue which does present as problematic is flexible firming capacity. The limits of the transmission network and its (costly) augmentation, and the seasonal pattern of renewables means a large fleet of storage and firming capacity is required. Batteries will unquestionably be the power system's intra-day workhorse, helping move wind and solar through space (via existing transmission networks) and through time. But our simulations, based on 40 years of coincident wind, solar and electricity demand data, revealed the NEM cannot rely on short duration batteries alone. Our

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central electrification scenario required almost 35GW of GTs and hydroelectric (much of this pumped hydro) plant capacity. The NEM currently has ~20GW.

NEM policymakers at both State and Commonwealth levels will need to monitor both renewable investment commitments and firming and storage plant commitments against the expected trajectory and optimal portfolio to ensure policy settings, and policy sequencing, remain tractable.

Conversely, if renewable and firming project entry rates experience a structural slowing (which appears to be the case), it is at least possible that electrification of gas loads may work against the decarbonisation objective in the short- to medium-run. The reason for this is axiomatic, and forms the key policy implication arising from this research.

If renewable development slows, and electrification of gas loads accelerates (and leads to sharply rising electricity loads), extending the service life of coal plant to maintain a secure power system is a predictable outcome given the political economy of electricity supply. Unfortunately, this outcome then has the potential to create a vicious cycle of slower renewable entry rates. Quasi-coal exit announcements, followed by policy-driven coal plant life extensions facilitated by government, are not known for instilling confidence in renewable investors or their PPA counterparties.

Policymakers should be seeking to alleviate 'speed limits' where possible and accelerating the pace of decarbonisation to ensure Australia's carbon budget can be met. However, this needs to be done with full knowledge of where we are today. And this means policy sequencing is important, viz. to ensure that decarbonization is well advanced before tackling electrification.

Finally from a policy perspective, we found the shape of the gas load duration curve in our future scenarios to demonstrate sharply deteriorating load factors. Practical policy solutions to this problem will require larger gas storages to deal with sporadic PoE10+ weather events. And realistically, while rarely utilised, such storage is likely to be essential and unlikely to be commercial – suggesting further government investigation (and likely intervention) may be required. Planning around alternate fuels including liquids, biodiesel and hydrogen derivatives for critical event days presents as the other logical policy pursuit