Optimising Renewable Integration

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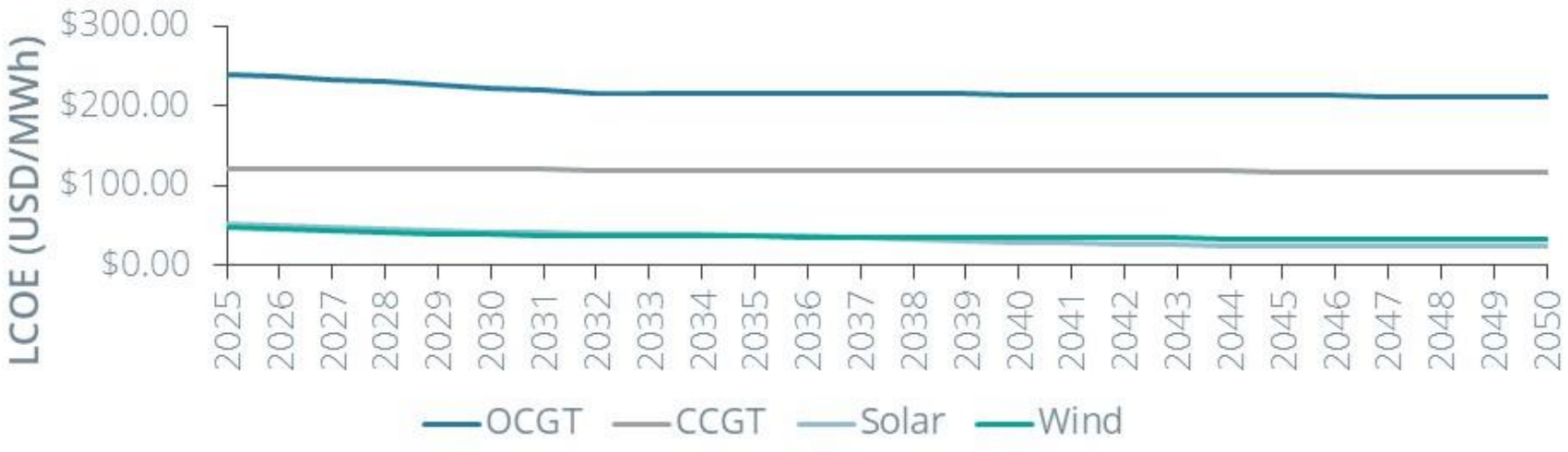
frontier economics

Renewables have the lowest Levelised Cost of Electricity (LCOE)



But LCOE is an increasingly poor guide for investment decisions …

Whole Electricity System Cost (WESC) extends LCOE

LCOE

LCOE accounts for capital costs, operating costs, fuels costs (and carbon costs) of a technology.

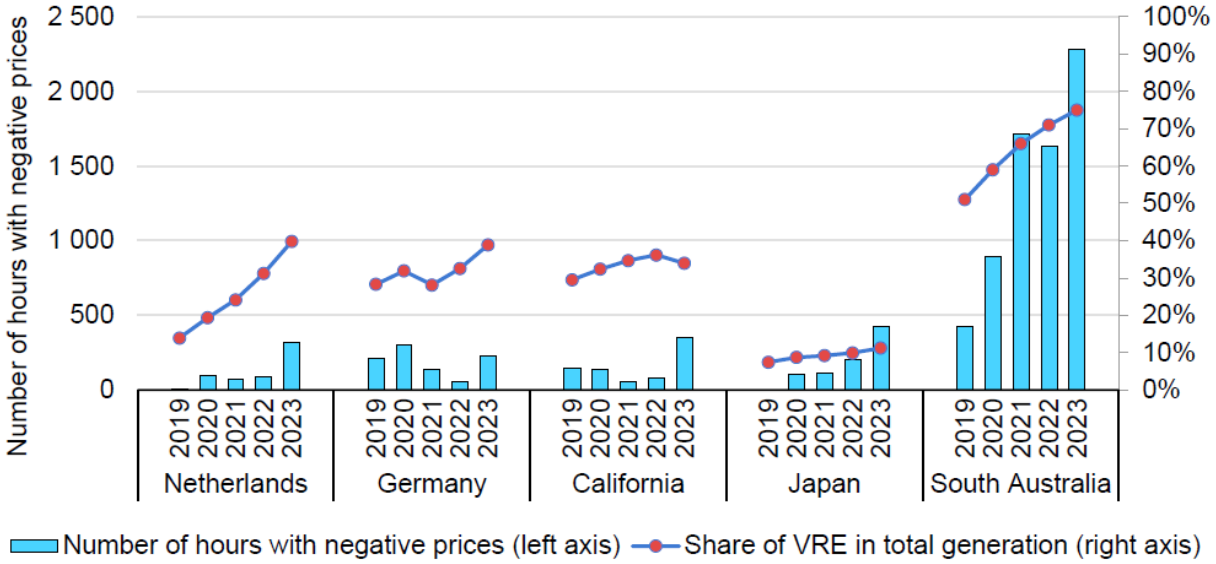
WESC

WESC accounts for impacts of each technology, including direct costs (as for LCOE), displaced investment, displaced generation, network impacts and balancing impacts.

WESC seeks to answer the question: **what would be the overall impact on system costs?**

Integrating high levels of renewables creates particular issues due to impacts on system dispatch and investment

Number of hours with negative wholesale electricity prices and share of variable renewable energy in total electricity generation in selected regions, 2019-2023



Source: IEA, *Electricity 2024 – Analysis and forecast to 2026*, page 67.

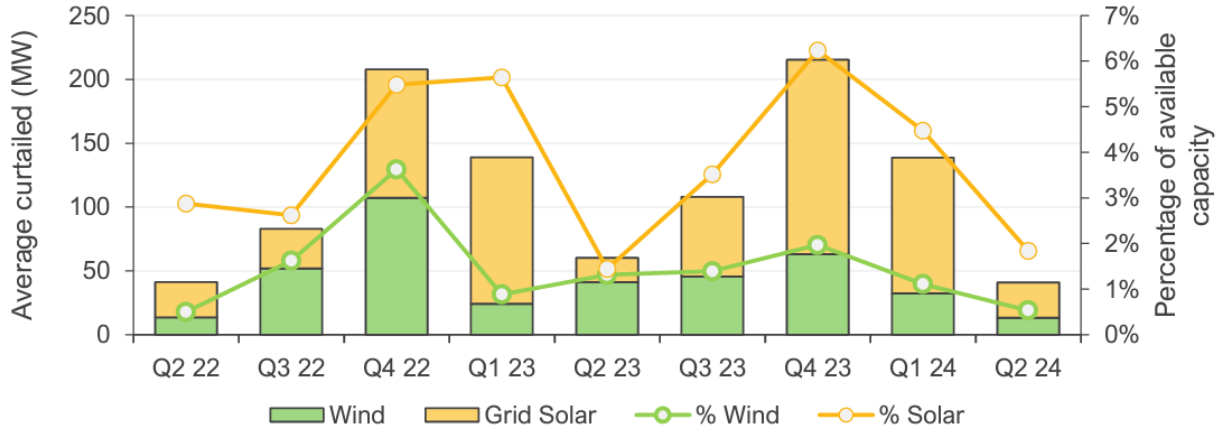
Negative prices are one indication of the challenges of integrating high levels of renewables.

South Australia (and Victoria) have seen significant increases in negative pricing as renewables have expanded.

Integrating high levels of renewables creates particular issues due to impacts on system dispatch and investment

Figure 52 Curtailment reduced in wind but increased for solar year-on-year

Average MW curtailment and percentage of availability by fuel type



Source: AEMO, Quarterly Energy Dynamics Q2 2024, July 2024.

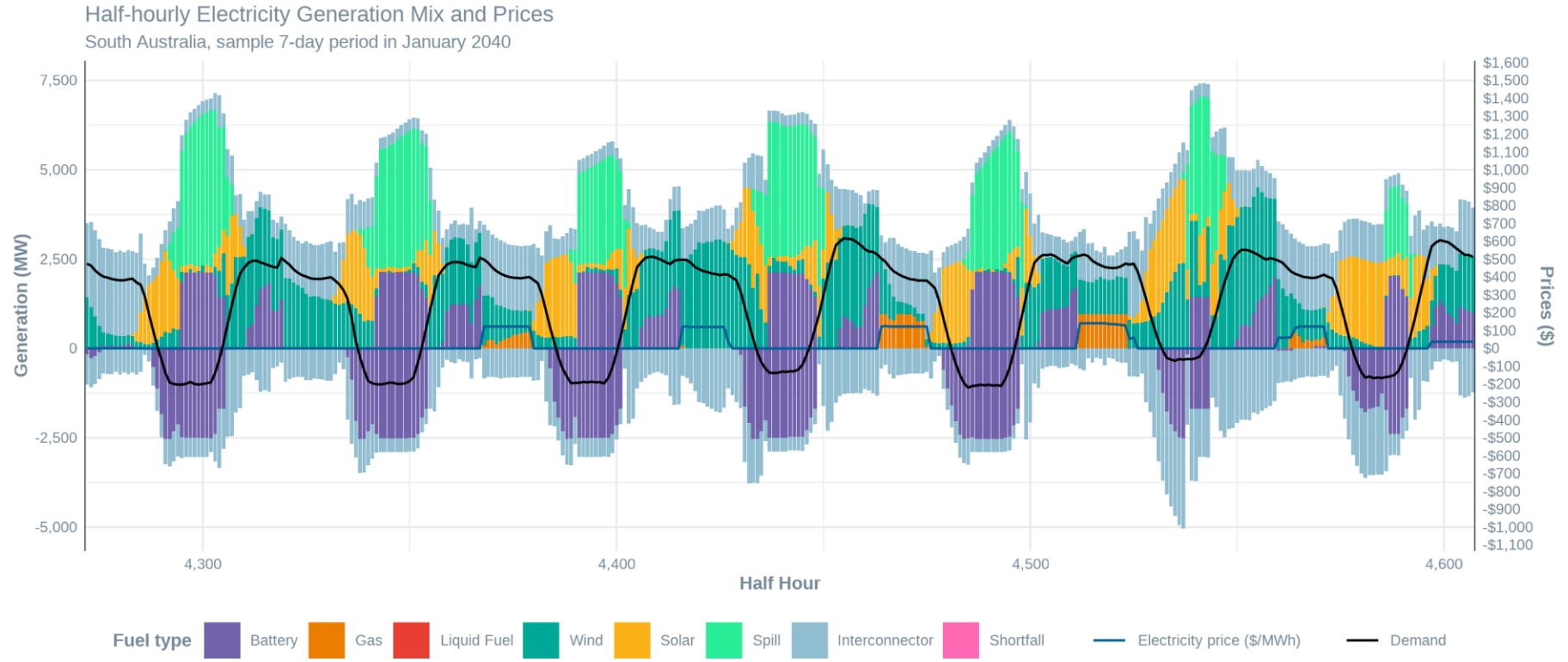
'Spill' of excess renewable generation is another indication of the challenges of integrating high levels of renewables.

Australia's NEM is already seeing solar 'spill' of around 6% in summer.

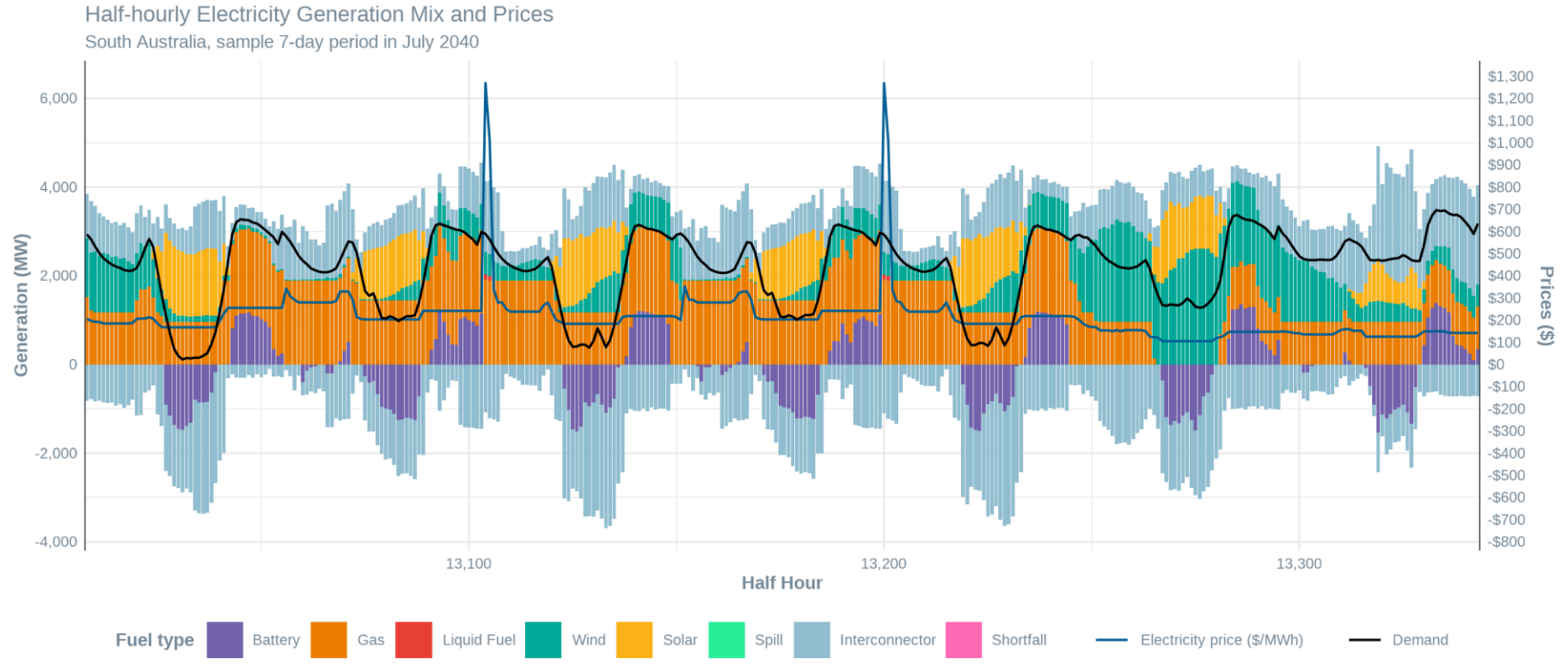
Options for improving integration

Load shifting	Aligning load with renewable generation helps integrate renewables, but it is a cost for customers, particularly industrial customers.
Storage	Storage (batteries, hydro, hydrogen) can time shift from times of excess renewable generation to times of excess load. Storage is most effective during periods of **high** renewable generation.
Dispatchable generation	Flexible, dispatchable generation can operate for extended periods during renewable droughts. Can manage periods of **low** renewable generation.

Batteries are effective in helping to integrate renewables during periods of **high** renewable generation



Other options are necessary during periods of **low** renewable generation



Key lessons

A mismatch between renewables investment and investment in supporting technologies can have significant impacts on the economics of investments.

In systems with high penetration of intermittent renewables, energy constraints become more problematic than capacity constraints.

Market settings need to send signals that reflect the value of energy supply during periods of low renewable generation – and this includes signals for upstream fuel markets.

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