

Changing Flexibility Requirements & New Resources

DOE Solar Energy Technology Office Summit,
Oakland

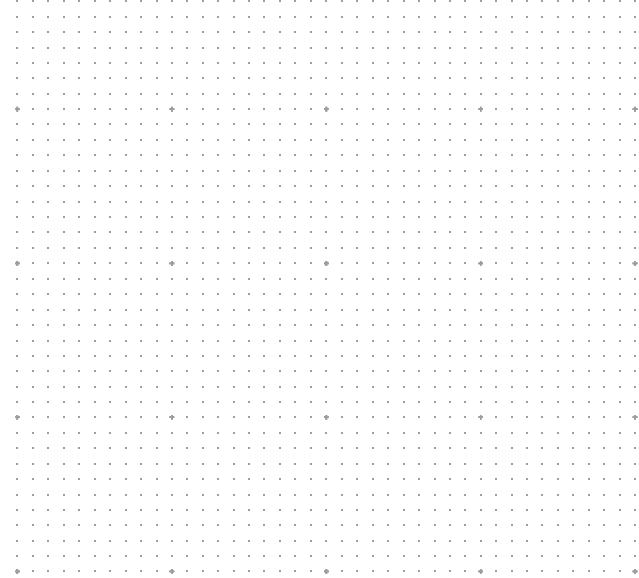
Logan Goldie-Scot

March 18, 2019



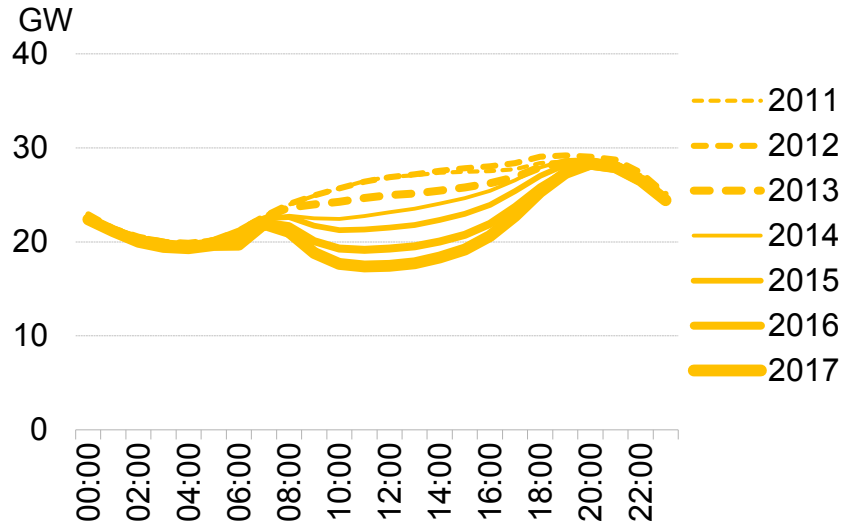
BloombergNEF

The problem



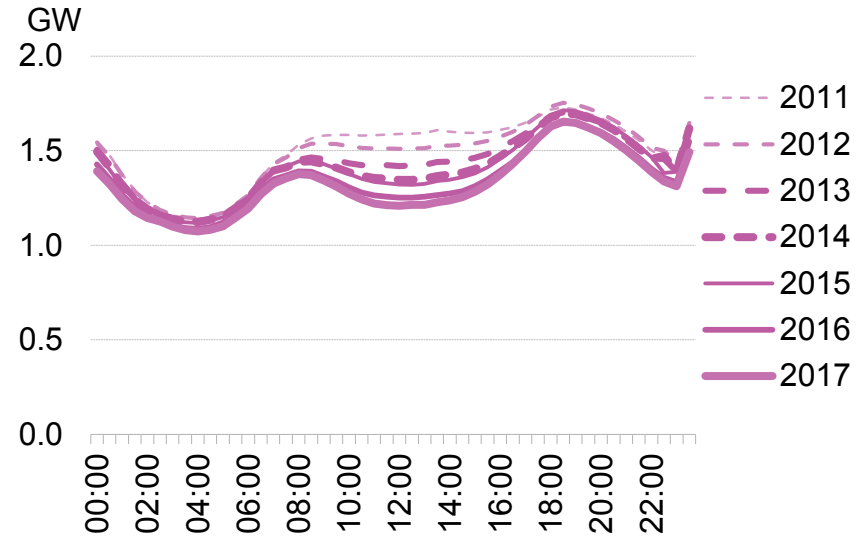
Net load profiles are becoming steeper in many markets

California



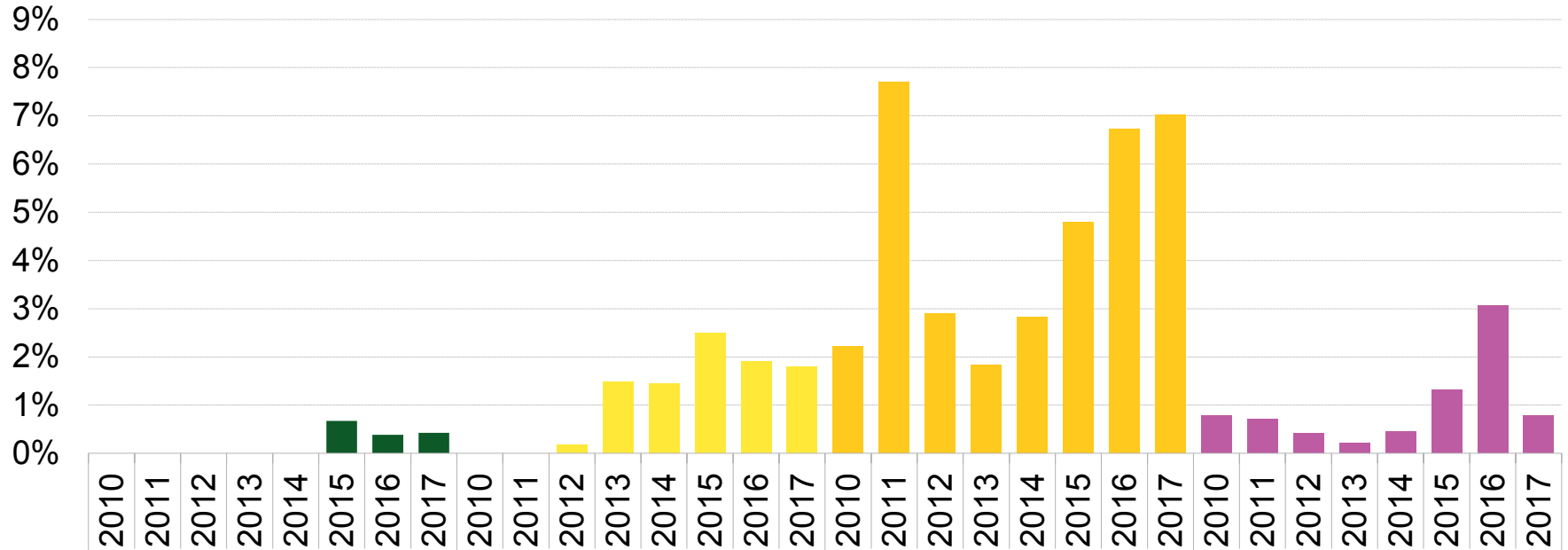
Source: BloombergNEF

Australia



Source: BloombergNEF

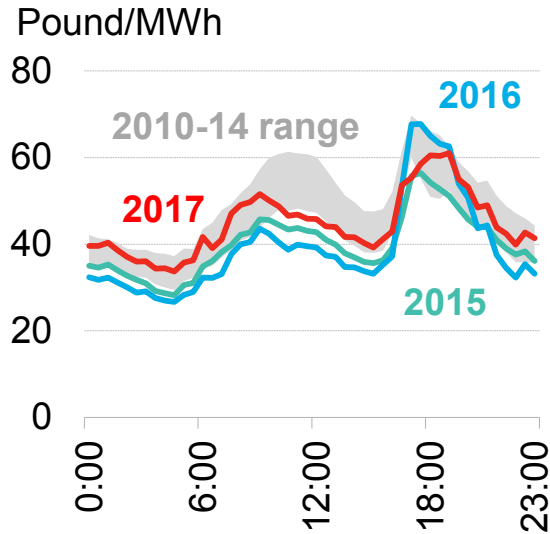
The frequency of annual negative power occurrences is increasing in many markets



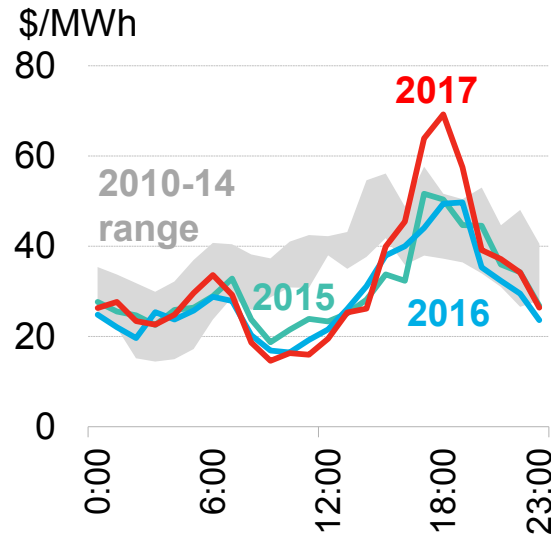
Source: BloombergNEF

Power price profiles are becoming more extreme

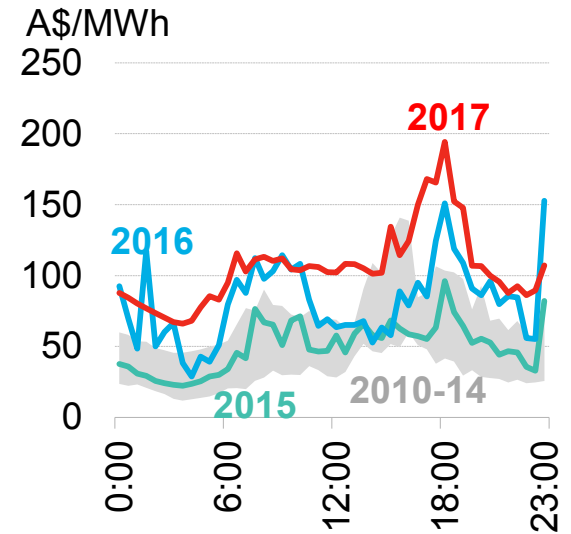
United Kingdom



California

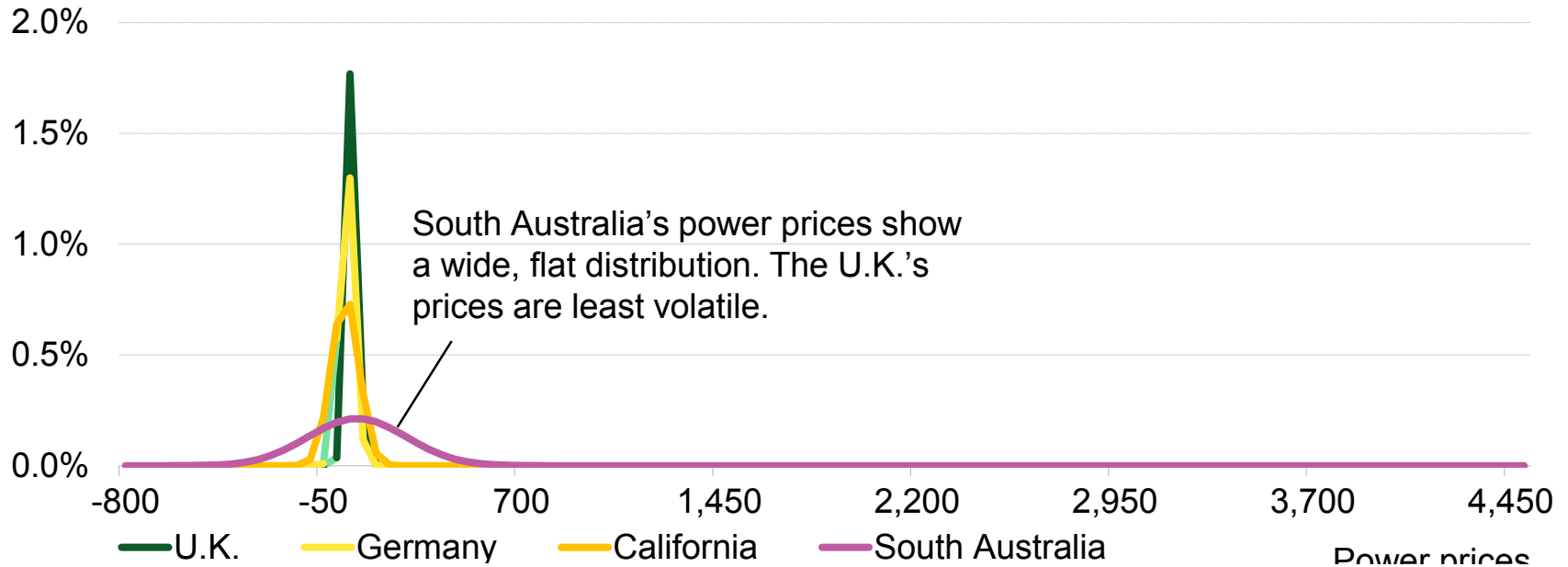


South Australia



A plant's viability may depend on a small number of high priced hours

Power prices frequency distribution, 2017

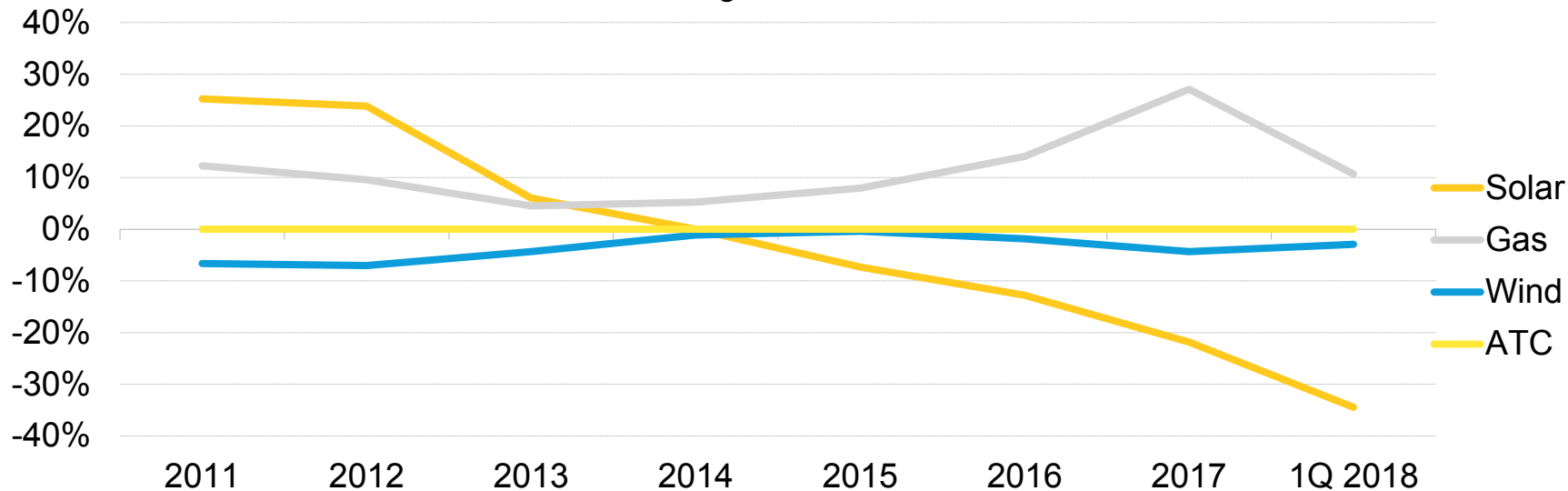


Source: BloombergNEF

Depending on resource concentration, the impact can be dramatic

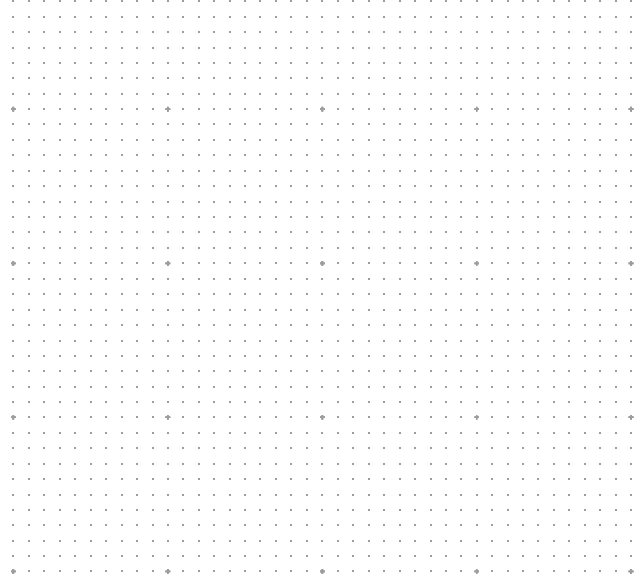
California realized power prices

Premium or discount to around-the-clock average



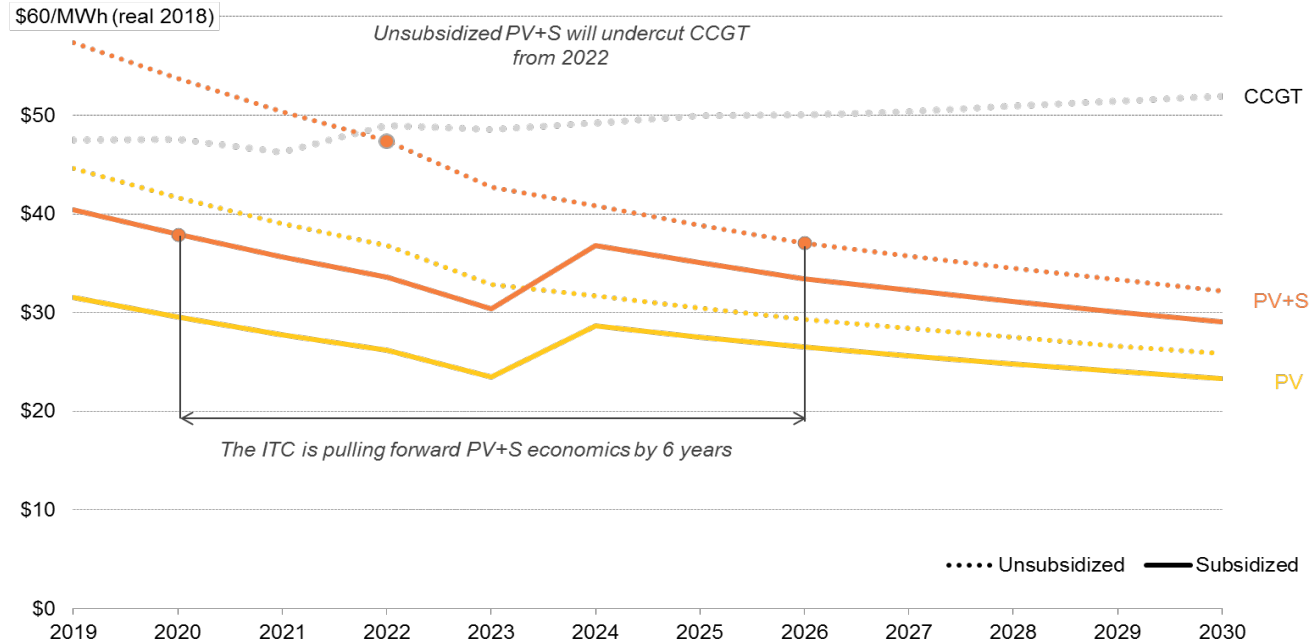
Source: BloombergNEF Note: Realized power prices are production-weighted power prices, based on the pairing of hourly price and production profiles

Preferred flexible resources



PV-plus-storage is already competitive in the U.S. against CCGTs

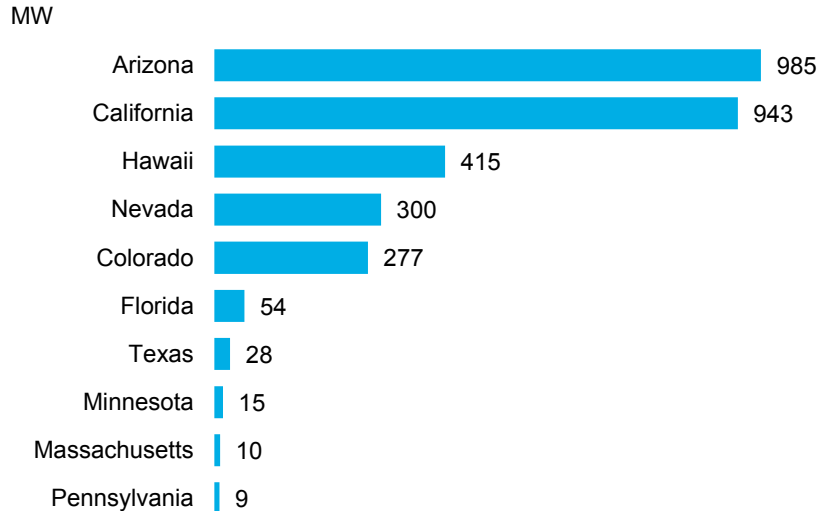
Estimated levelized cost of energy for U.S. Southwest projects



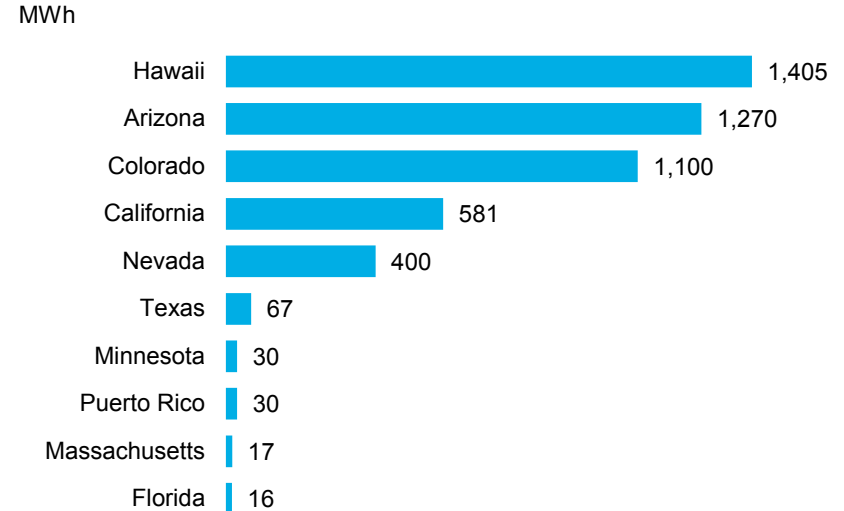
Source: BloombergNEF Note: This assumes a four hour battery at 25% of PV power output.

The pipeline for PV-plus-storage projects in the U.S. is growing

Power output (MW)

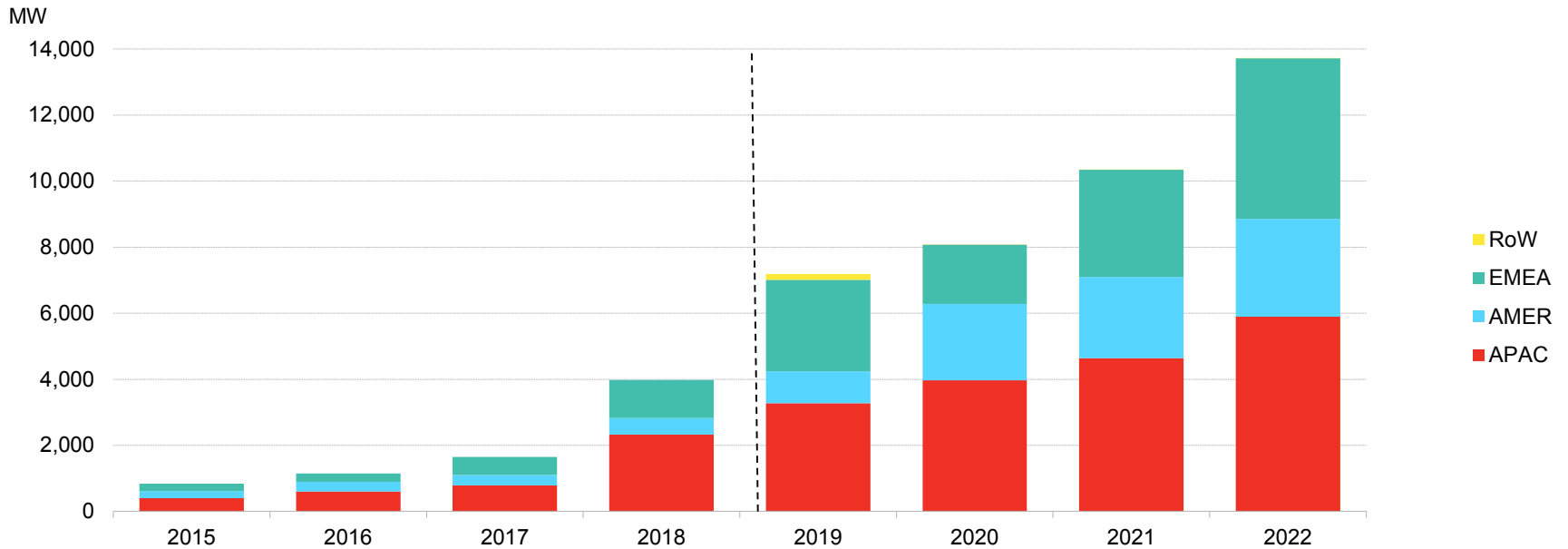


Energy Capacity (MWh)

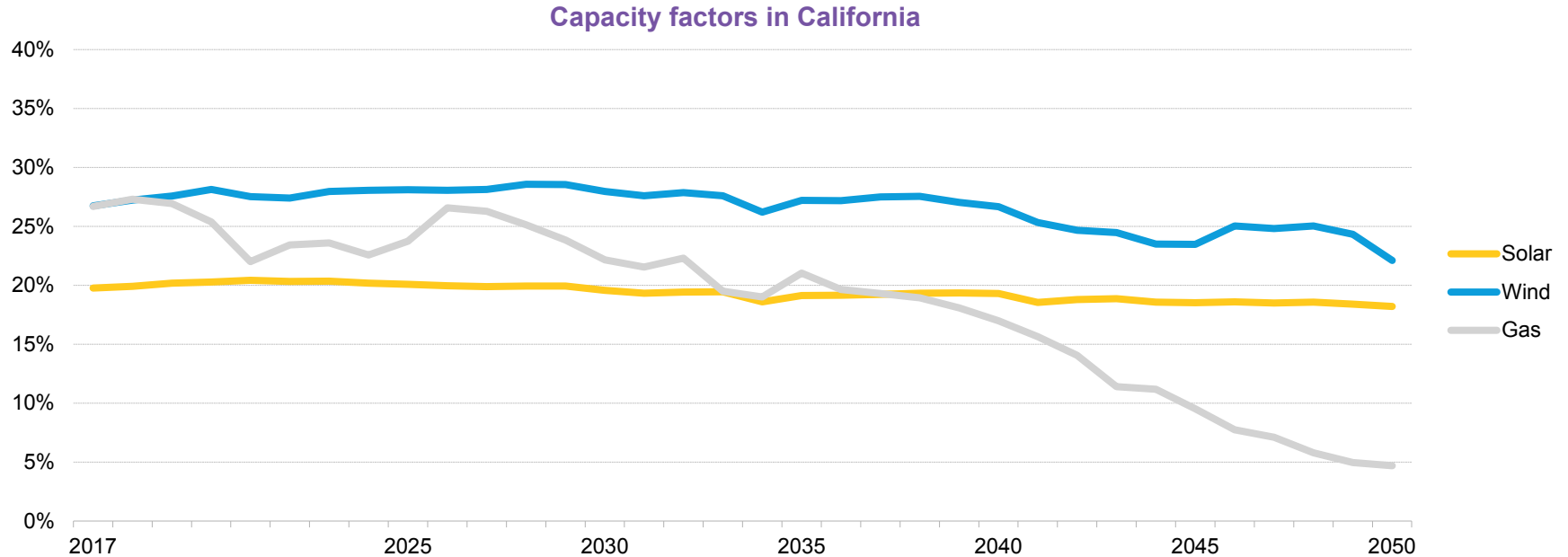


Source: BloombergNEF. Note: based only on disclosed capacity, some projects may not have MW, MWh disclosed. Arizona MWh estimated 1:1 ratio with MW for 2019 850 MW announcement

The near term outlook for battery storage looks promising

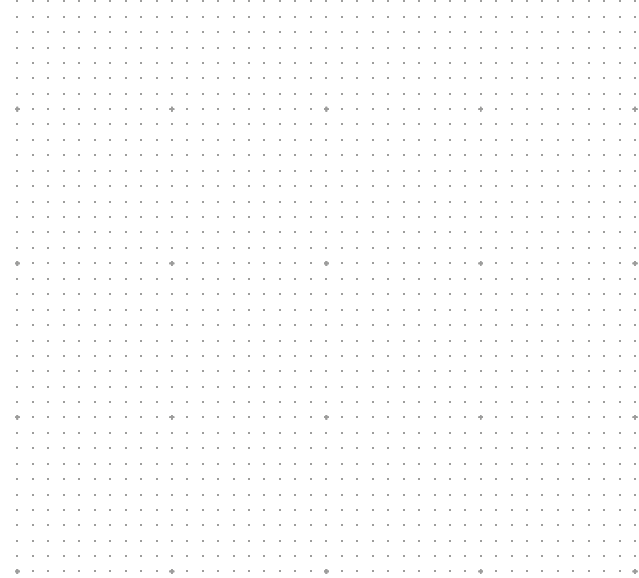


Whereas natural gas utilization will begin to fall

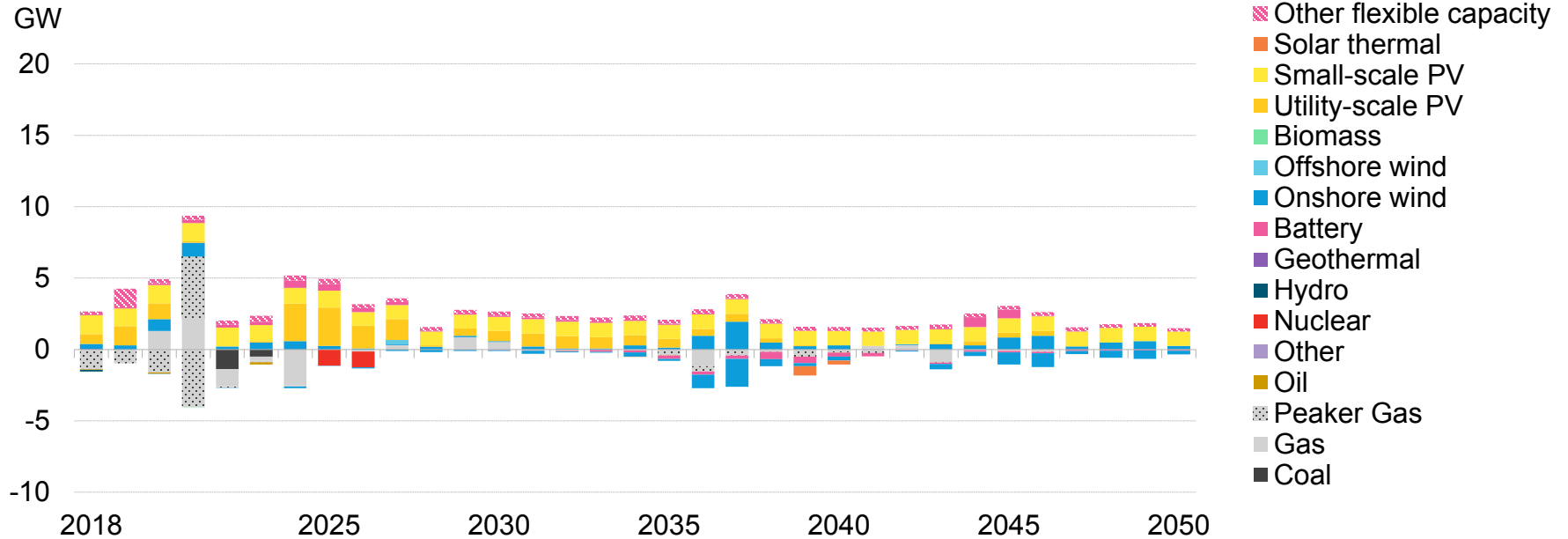


Source: BloombergNEF Note: Exercise run before SB 100 was passed.

What next?

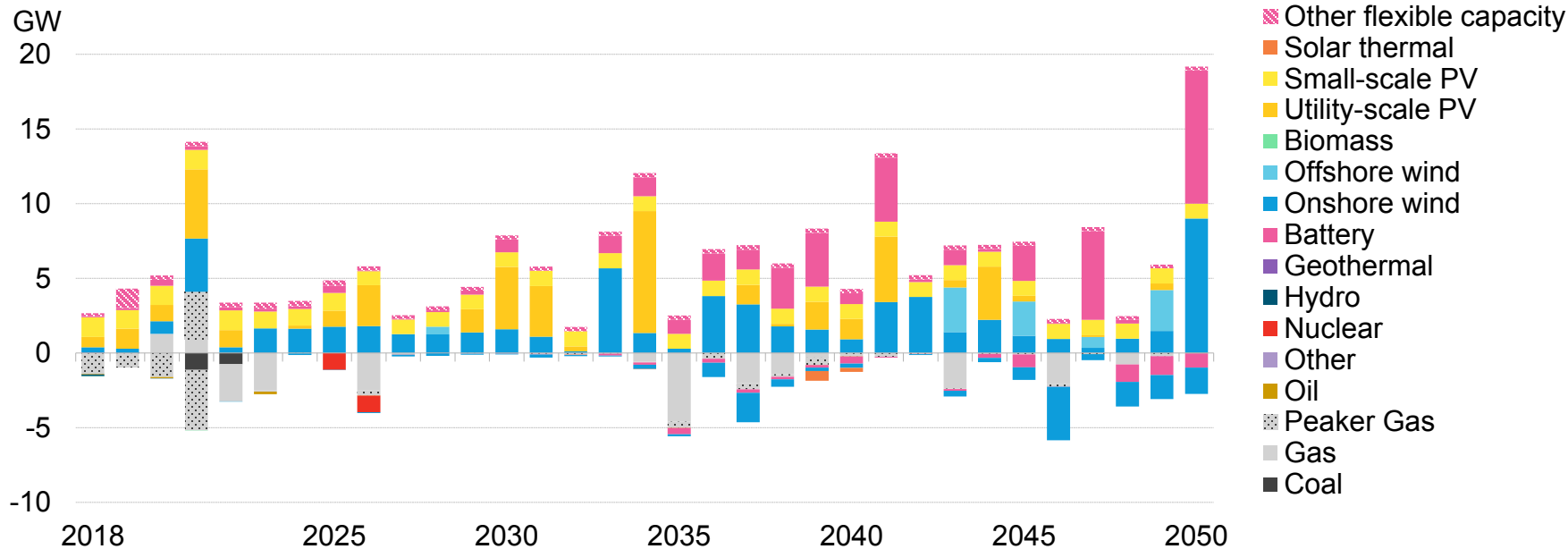


A lowest cost build model results in significant clean energy additions but limited retirements



Source: BloombergNEF

A two degrees scenario results in greater clean energy build and significant fossil fuel retirements



Source: BloombergNEF

What role with solar thermal play?



Source: Bloomberg

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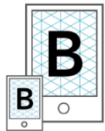
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