



Impact of PTCs on the Wholesale Energy Markets

December 4, 2023



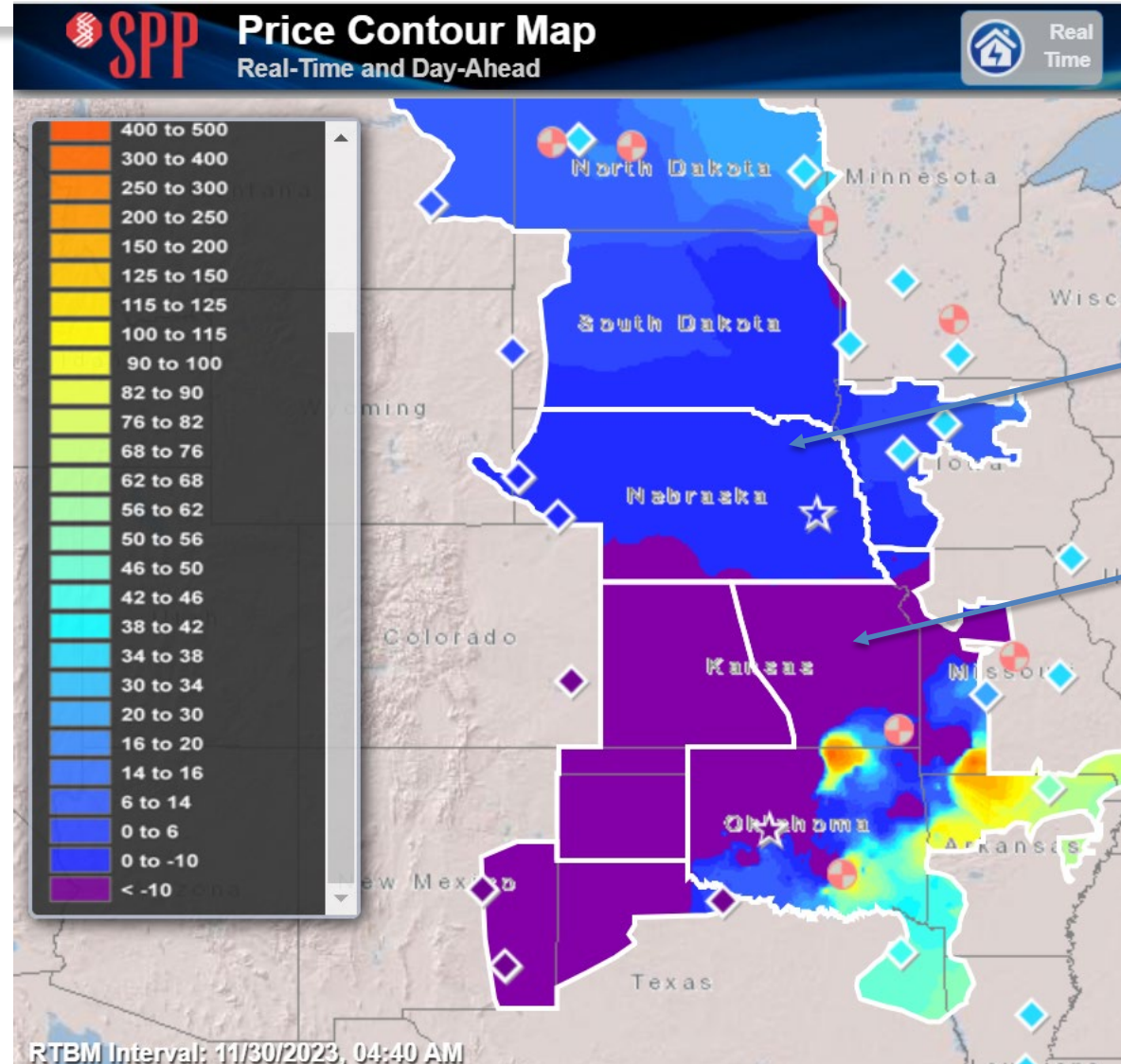
Wholesale Energy Markets

- The Southwest Power Pool (SPP) operates a regional energy market whose footprint includes western Arkansas. The Midcontinent Independent System Operator (MISO) operates a regional energy market whose footprint includes central and eastern Arkansas.
- The energy markets continuously balance load and generation. Generation dispatch is based on each plant's offer with the effort by the market to minimize overall cost to serve load.
- Transmission lines can carry a limited amount of power, and this "congestion" is managed with market pricing, with varying prices at electric substations across the system.

Wind and Solar Impact on the Power Markets

- A Federal production tax credit is available for wind and solar energy produced from a facility during its first 10 years of operation.
- Currently, the value is \$27.5/MWh, with the value increasing each year by the inflation rate.
- Wind and solar have no variable costs, so owners of wind and solar that are receiving the production tax credit would offer their generation at a negative price; i.e., a generator would have to pay for the ability to stay on-line and generate energy.

SPP Energy Prices Last Thursday Morning



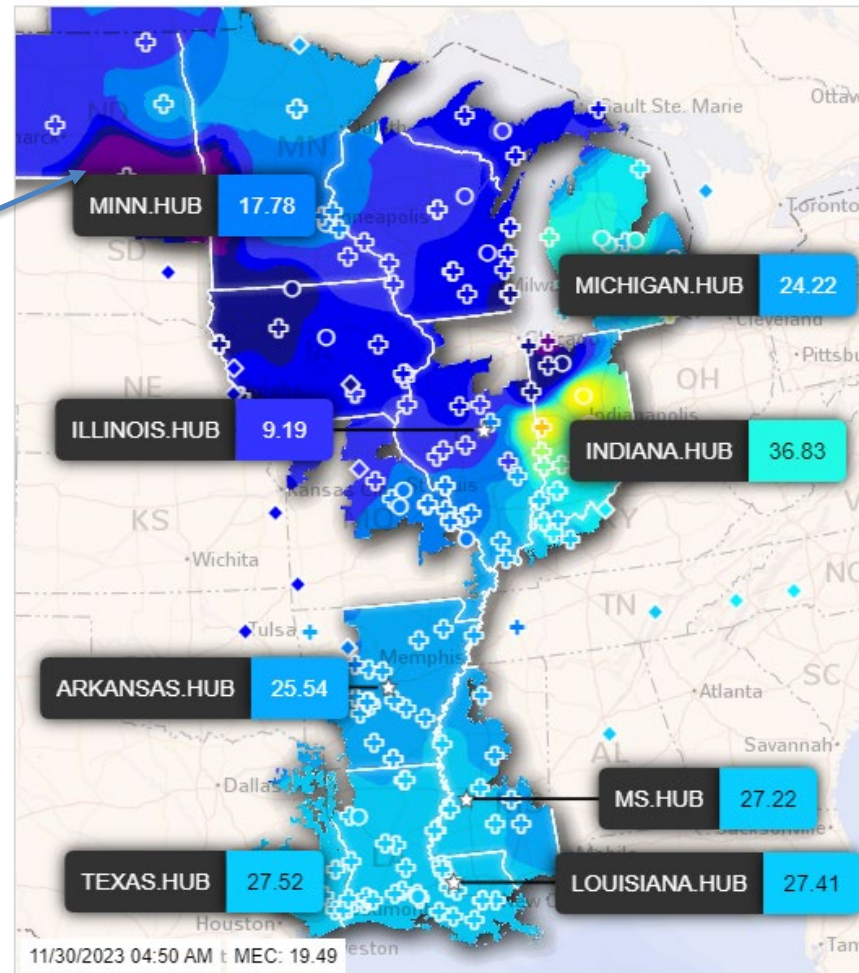
Dark blue is negative

Purple is below
negative \$10/MWh

MISO Energy Prices Last Thursday Morning

LMP Contour Map

30-Nov-2023 - 5:50 EST

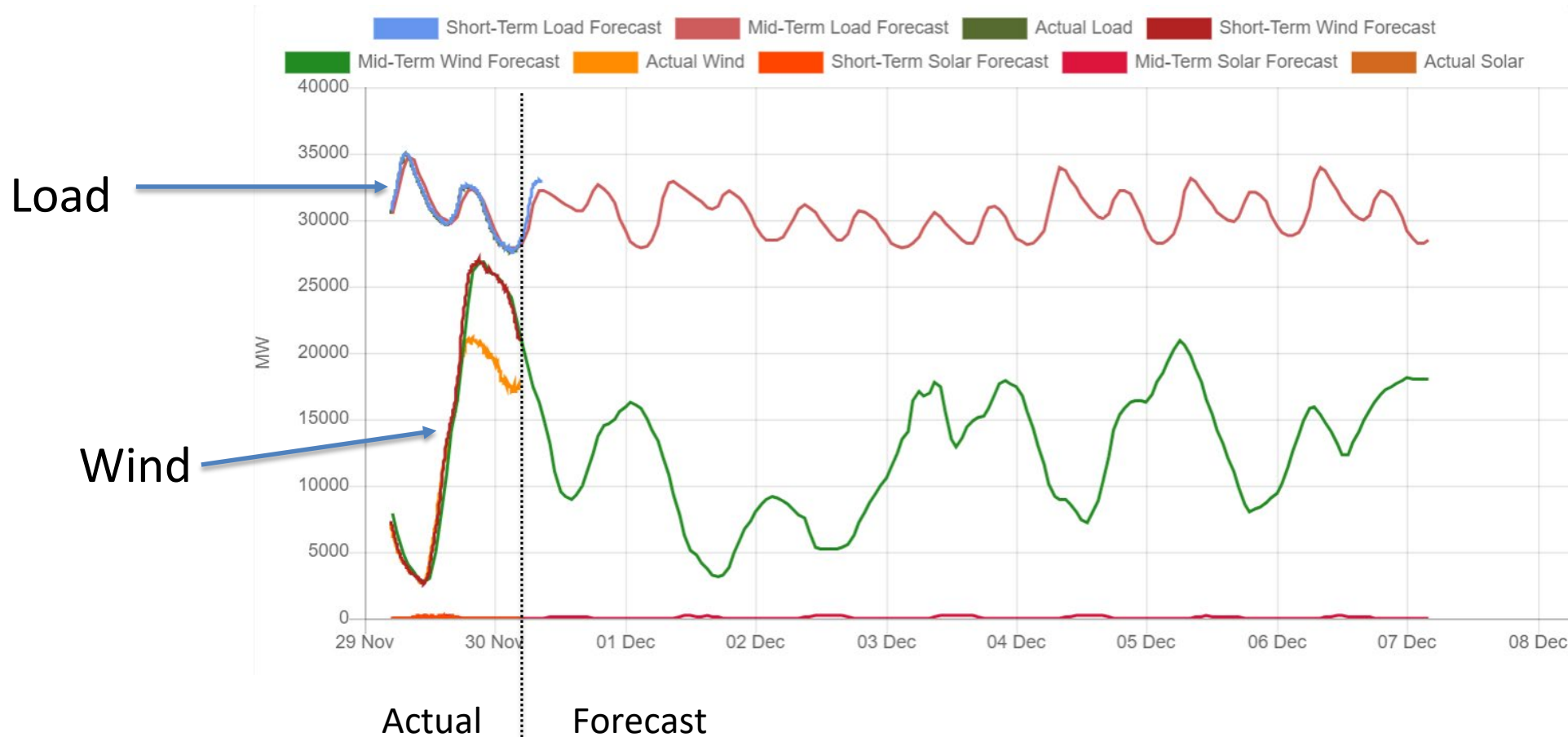


Purple is below
negative \$10/MWh

Example location priced
at -27.93/MWh:

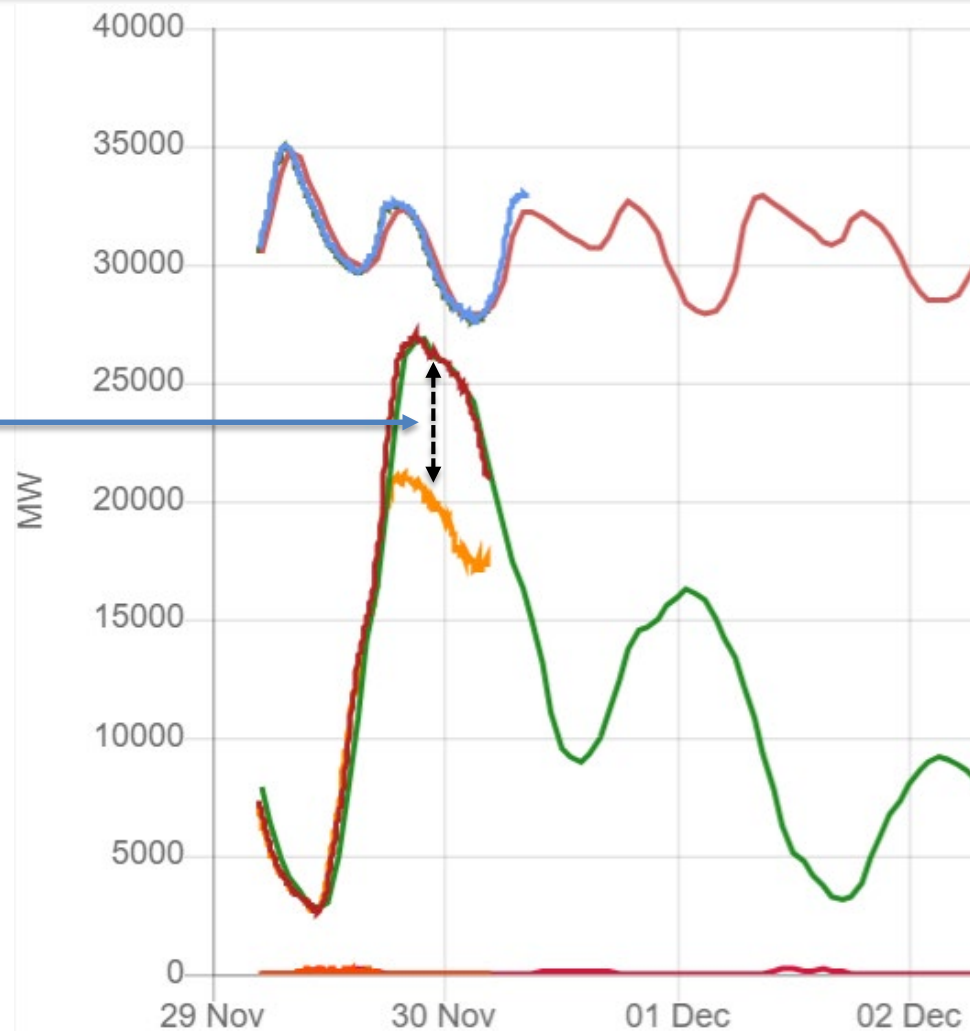
LMP Point
MDU.TATANKA1
LMP Value
-27.93

SPP - One Day Actual & Forecast as of Last Thursday



SPP Load vs Wind

Difference is
wind that curtailed
(pricing became
highly negative)

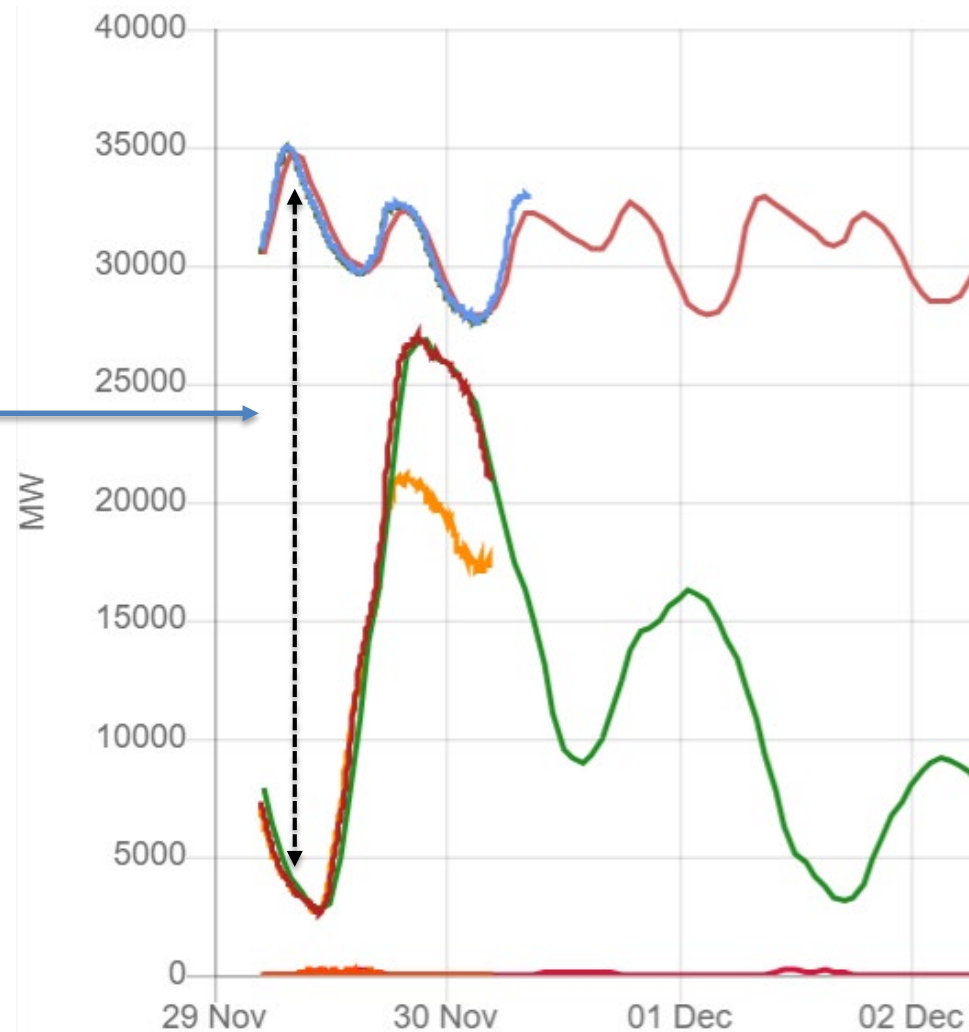


Wind and Solar Impact on the Energy Markets

- Fossil resources (coal, natural gas, nuclear) are needed to meet energy needs when the wind is not blowing, and the sun is not shining. This can be a highly variable need.
- While coal plants and most natural gas plants can ramp up and down from minimum to maximum loading, they cannot cycle on and off frequently. The min loading for coal plants, for example, is normally in the range of 30%-40% of max capacity.
- Nuclear plants have minimal ability to ramp and have no ability to cycle on and off.
- For gas plants that can cycle on and off frequently, there is often added costs to do so.

SPP Load vs Wind

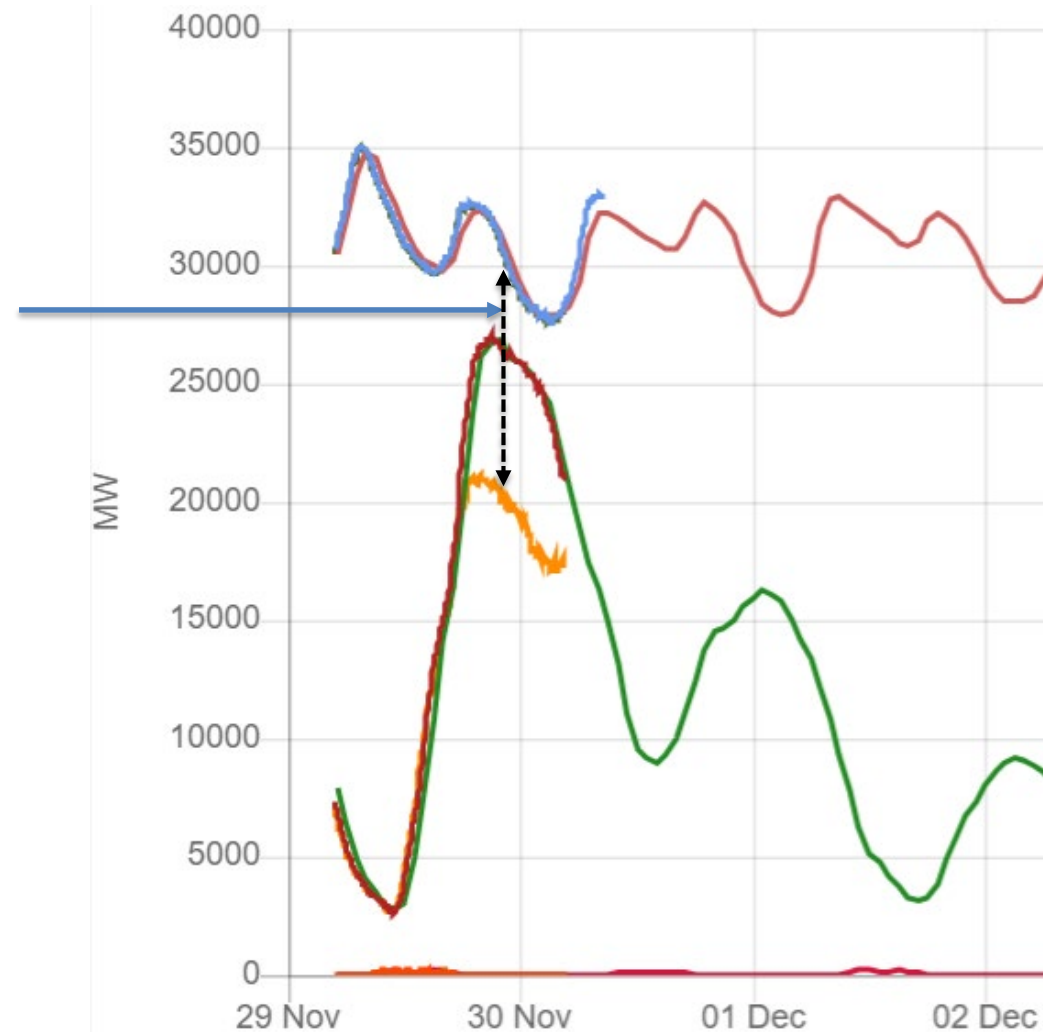
Difference between load and wind must be met by other resources, which are mainly fossil resources



SPP Load vs Wind

Some of this difference is met by fossil resources at minimum loads needed to stay on-line to meet demand when wind falls off.

The majority of these fossil resources will be receiving minimal revenue or will even have to pay (with negative prices) to stay on-line.



Wind and Solar Impact on the Energy Markets

- Wind and solar generation reduce revenues received by fossil generation, including that during negative-priced periods, generators must pay to stay on-line.
- Break-even variable price for coal is around \$25/MWh
- Break-even variable price for gas, at today's price, is around \$22/MWh
- Additional revenue is needed over time to recover fixed costs for these plants

Manufacturing Factor Analogy



**Build 1 Unit
Cost \$100M**

**Build 1M Units
Cost \$100**

Significant Solar Is Proposed for Arkansas

- Installed generating capacity in Arkansas in 2022 was about 15,000 MW.
- MISO has approved 5,000 MW of generator interconnections for solar in Arkansas.
- There are over 30,000 MW of generator interconnections requests for new solar still under study by MISO in Arkansas.
- If even a fraction of this is built, Arkansas could become like California already is today.

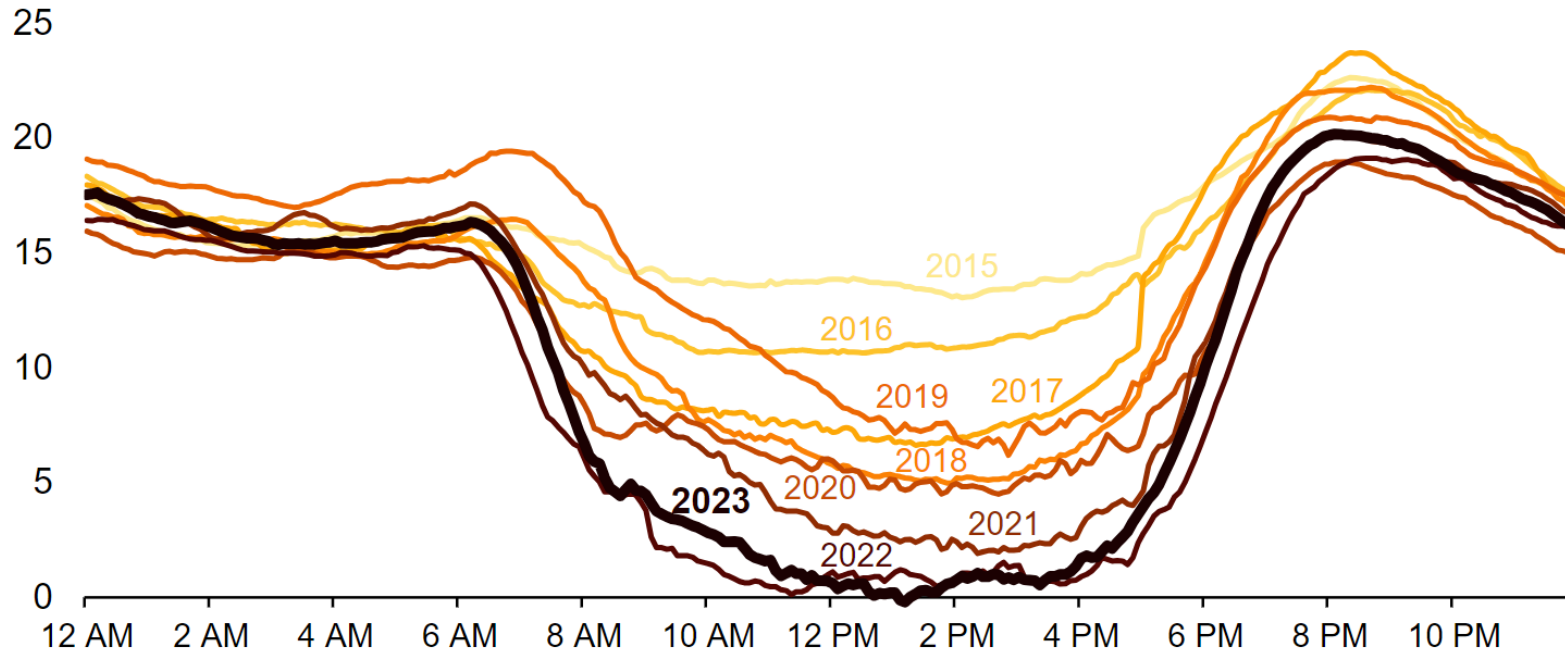
California's Canyon Curve (Load Less Solar)

JUNE 21, 2023

As solar capacity grows, duck curves are getting deeper in California

California's duck curve is getting deeper

CAISO lowest net load day each spring (March–May, 2015–2023), gigawatts



Data source: California Independent System Operator (CAISO)



Average Cost of Electricity by State

