California ISO

Technical Perspective in System Operation: US Perspective

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The California ISO: One of nine grid operators in North America – 2/3 of the U.S. is supported by an ISO

- One of 38 balancing authorities in the western interconnection
- Uses advanced technology to balance supply & demand every 4 seconds
- Operate markets for wholesale electricity & reserves
- Manage new power plant interconnections
- Plan grid expansions

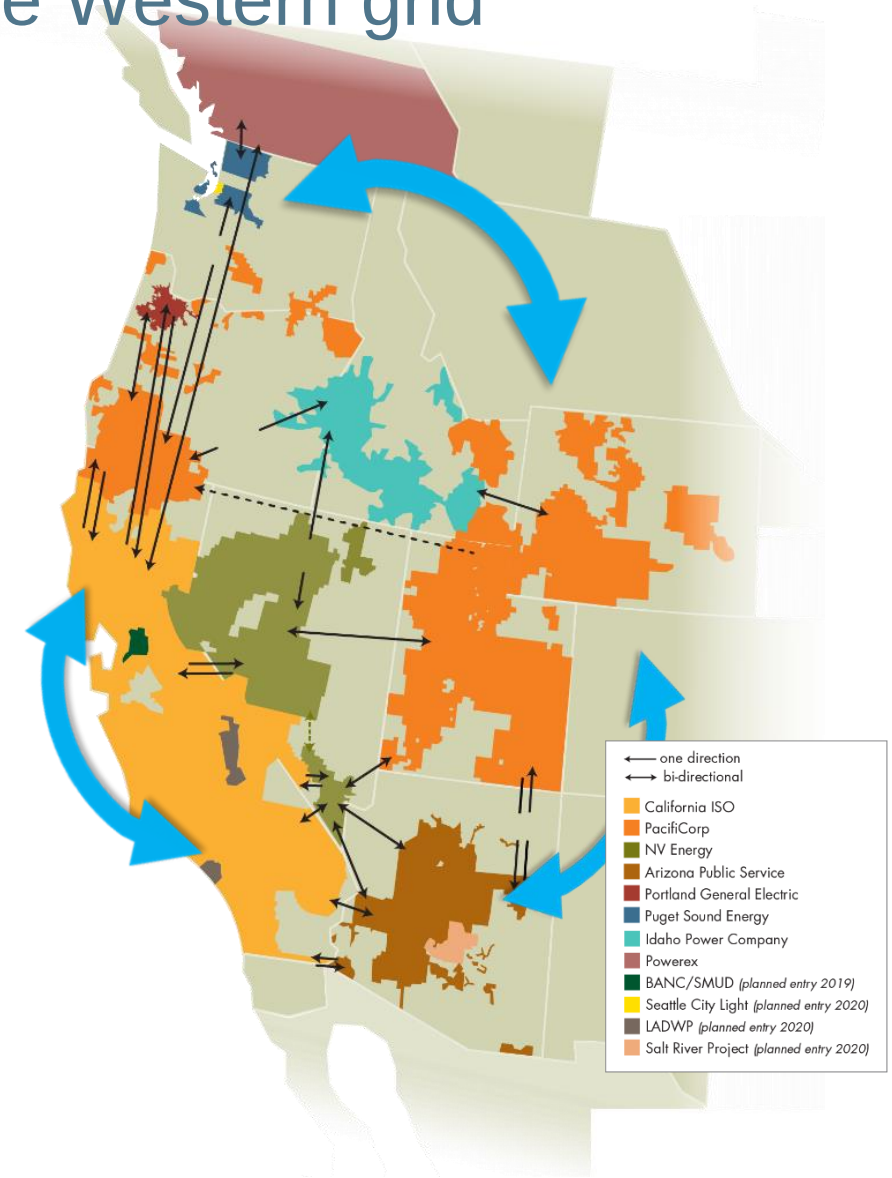
Key functions of an ISO

- Uses advanced technology to balance supply and demand every 4 seconds
- Operate markets for wholesale electricity and reserves
- Manage new power plant interconnections
- Plan grid expansions

The Modernization of the Western grid

Western Energy Imbalance Market (EIM):

- Total savings of $650 million since start in Nov 2014
- 810,116 MWh curtailment avoided, displacing an estimated 346,649 metric tons of CO2



Power industry transformation

Wind

- 6,705 MW Installed Capacity
- 5,221 MW Peak – May 8, 2019

Solar Thermal / Photo Voltaic

- 11,949 MW Installed Capacity
- 11,363 MW Peak – June 1, 2019

Roof Top Solar

- Behind the meter – Residential
- 7,500 MW Estimated Capacity

Comparing conventional to variable generation

Conventional Generation

- Predictability
- No surprises
- Dependable energy schedules
- Accurate forecasts
- Contingency reserves available
- Generators that follow dispatch commands
- Excellent tools for visibility of system status
- High quality data
- De-rate information on units is timely and accurate

Variable Generation

- Hard to predict
- Forecast inaccuracy is high
- Maximum generation at night when loads are low and there is no place for the energy – 70 % of the wind produced during a 24 hour period is at nights and 30 % of the Solar produced in a week is on weekends
- Large ramp demands both up and down
- Lack of visibility of anticipated generation production changes
- May not follow dispatch commands --- treated as “Must Take” generation

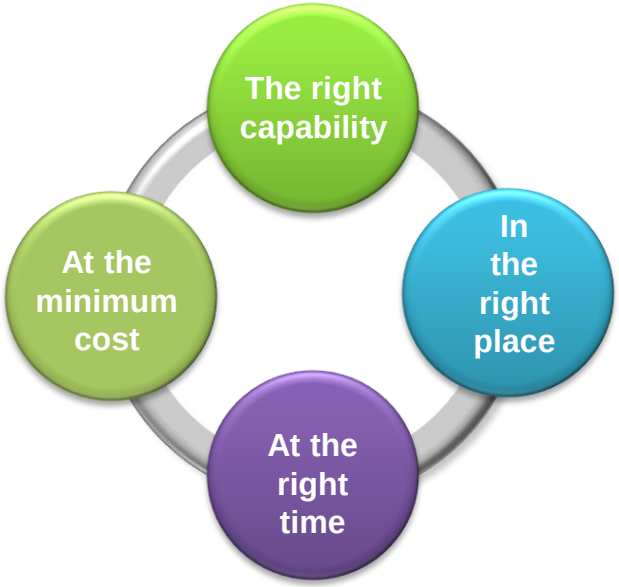
Our Challenge

- System needs (ramping, load following, etc) changing dramatically over this decade.
- Resource mix changing dramatically
  - Increasing levels of wind & solar
  - Decreasing levels of flexible/dispatchable resources due to:
    - OTC Retirements
    - Potential retirements due to current market conditions

Challenges –

How to ensure we identify and secure the resource capabilities needed in future years.

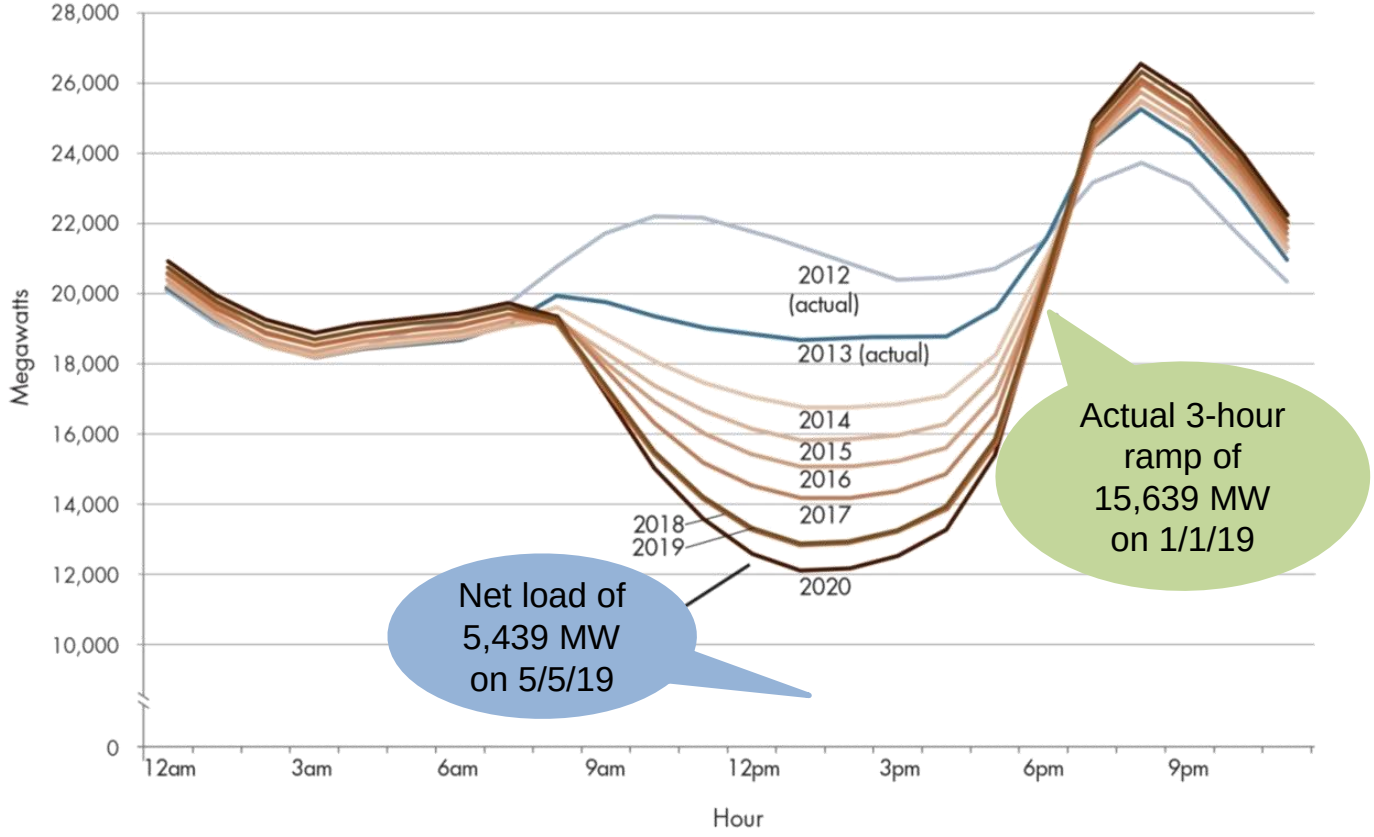
How to ensure we optimally utilize and price resource capabilities in the ISO markets.



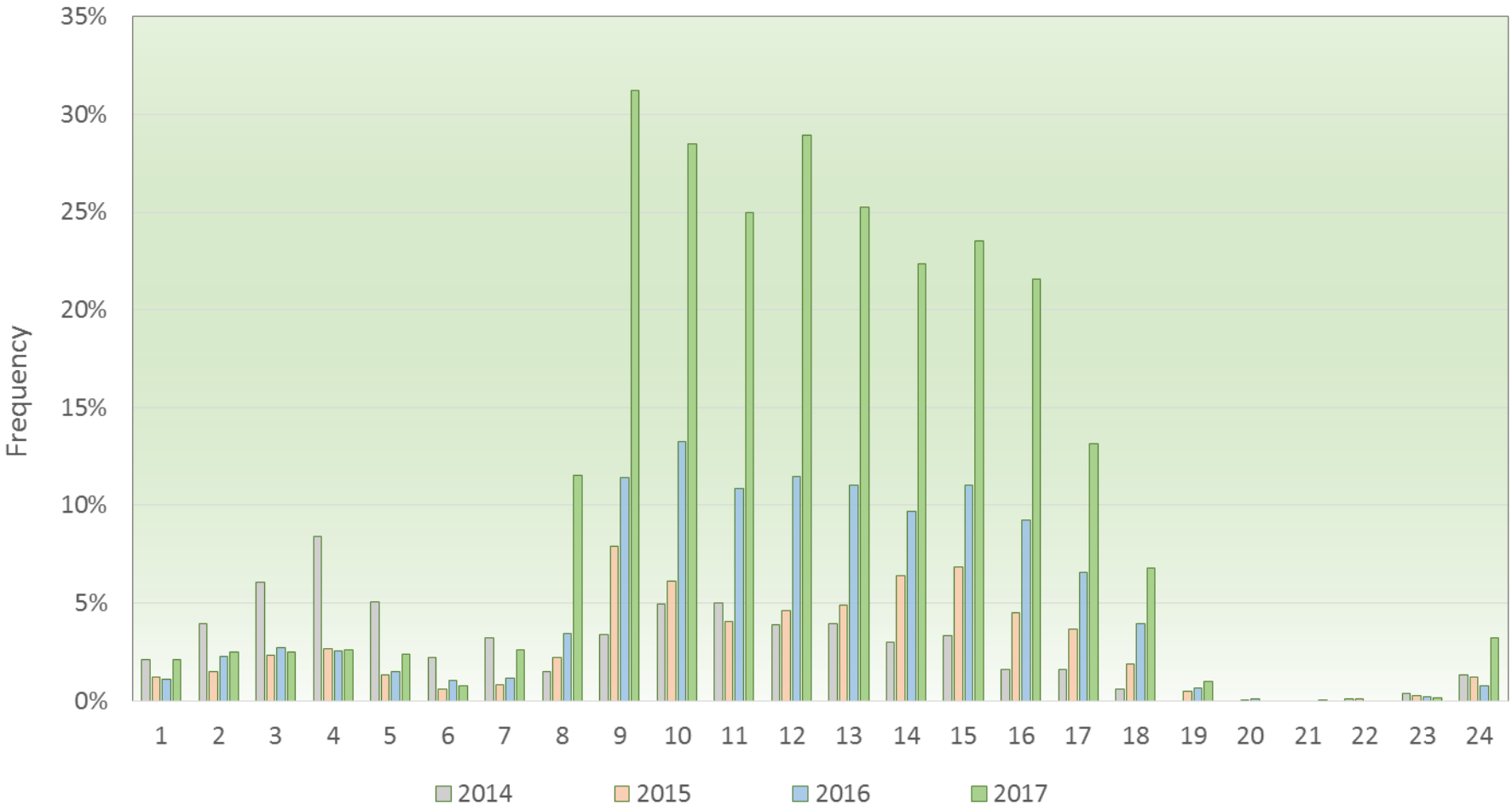
Changing Net Load

Net load = load – wind – solar

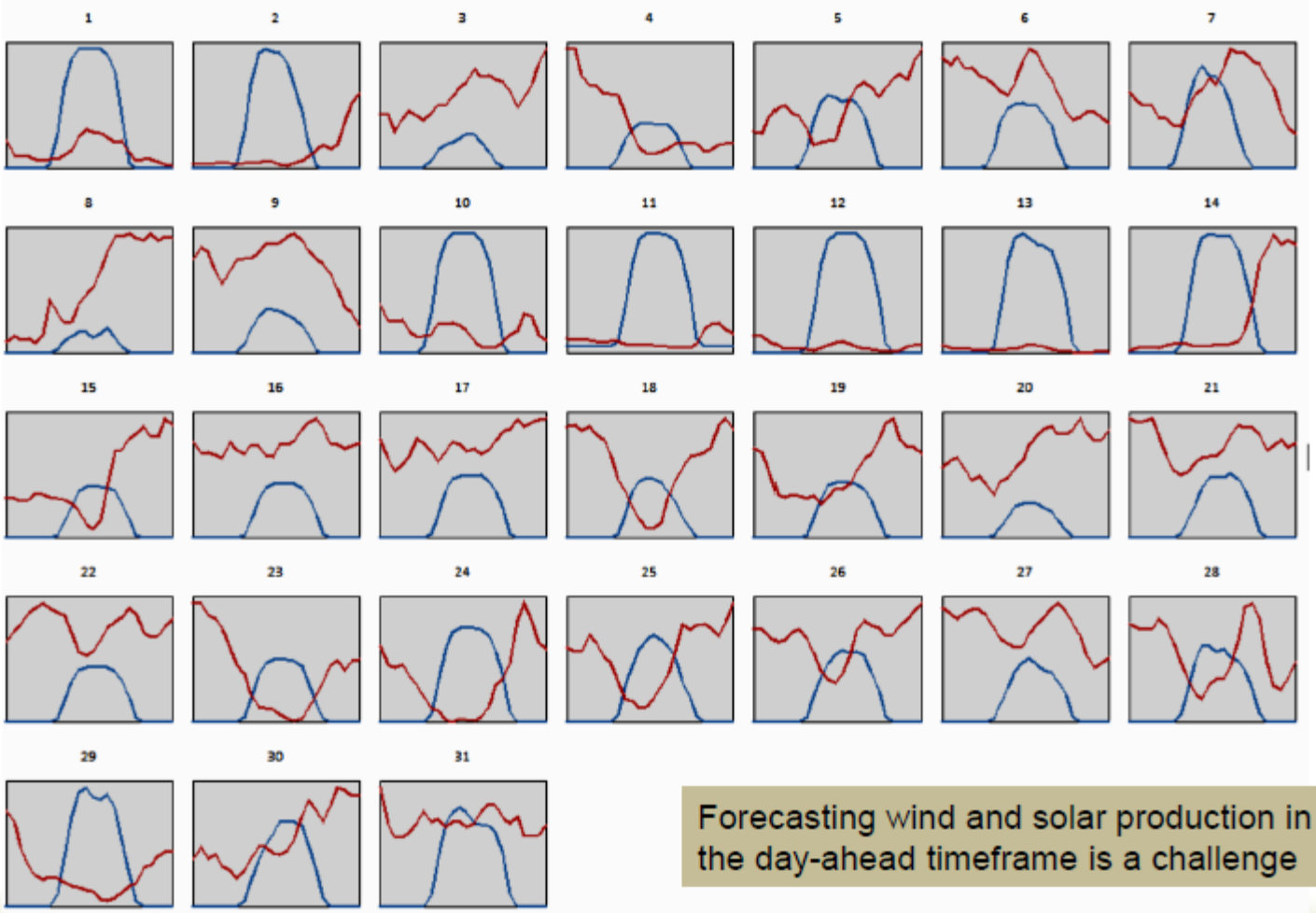
Typical Spring Day



Distribution of negative prices have shifted from early morning hours to midday hours

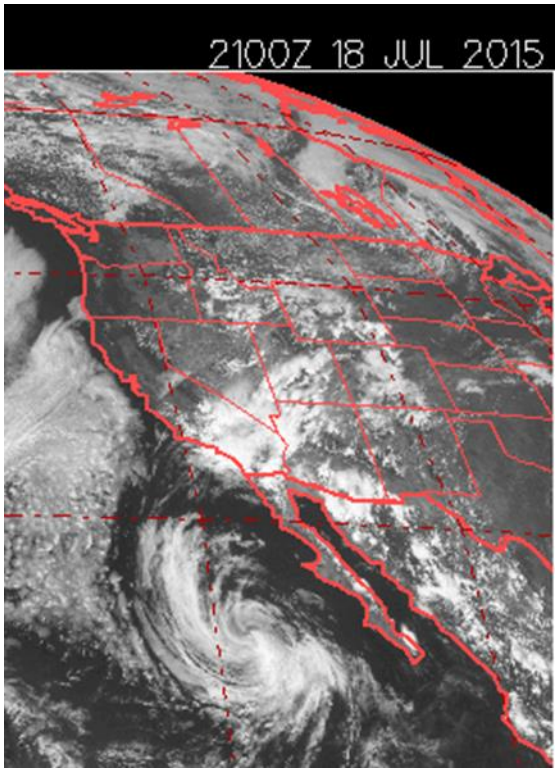


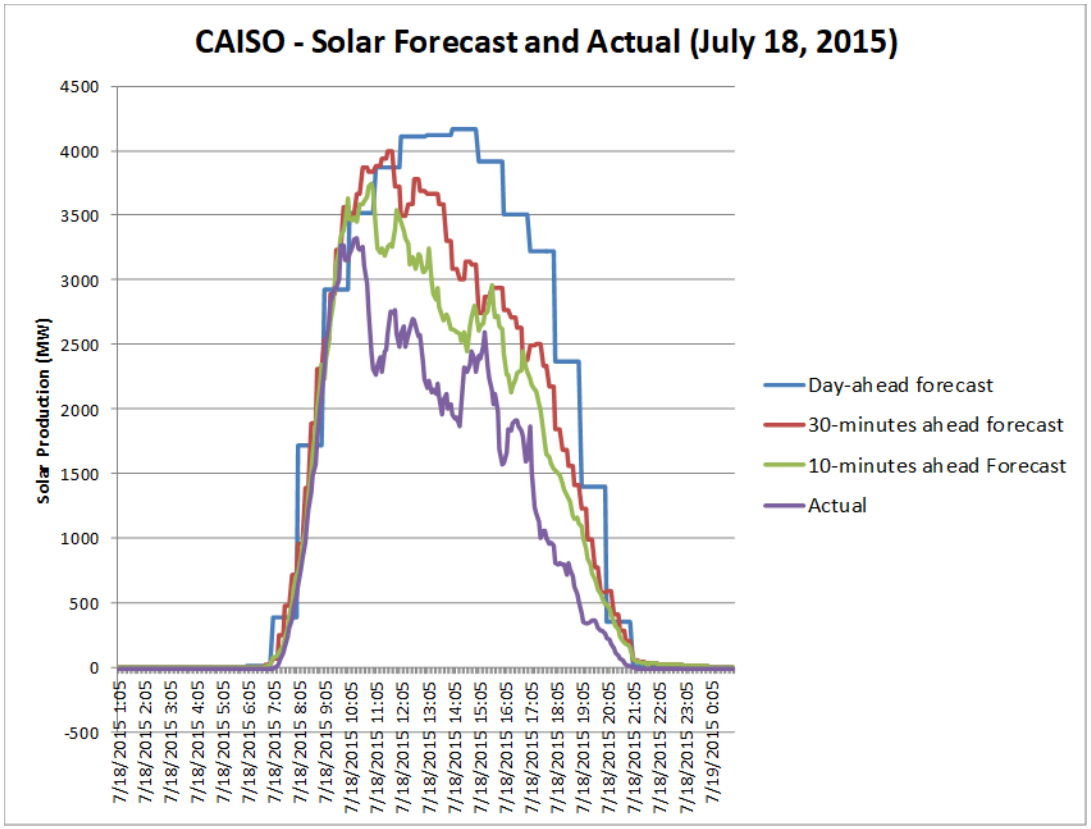
Wind and Solar production can vary significantly between days



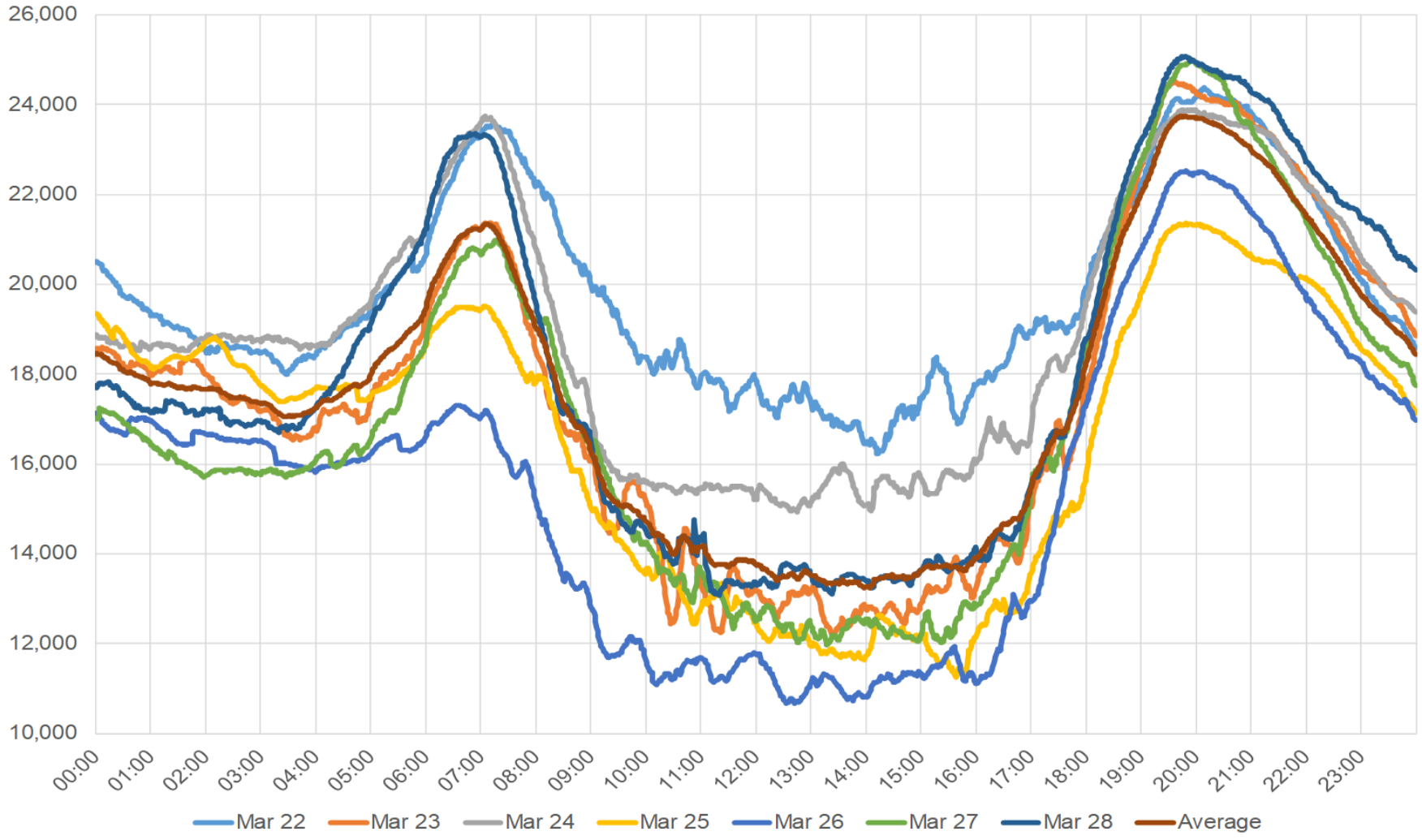
Forecasting wind and solar production in the day-ahead timeframe is a challenge

July 18, 2015 illustrates variability and forecast challenges

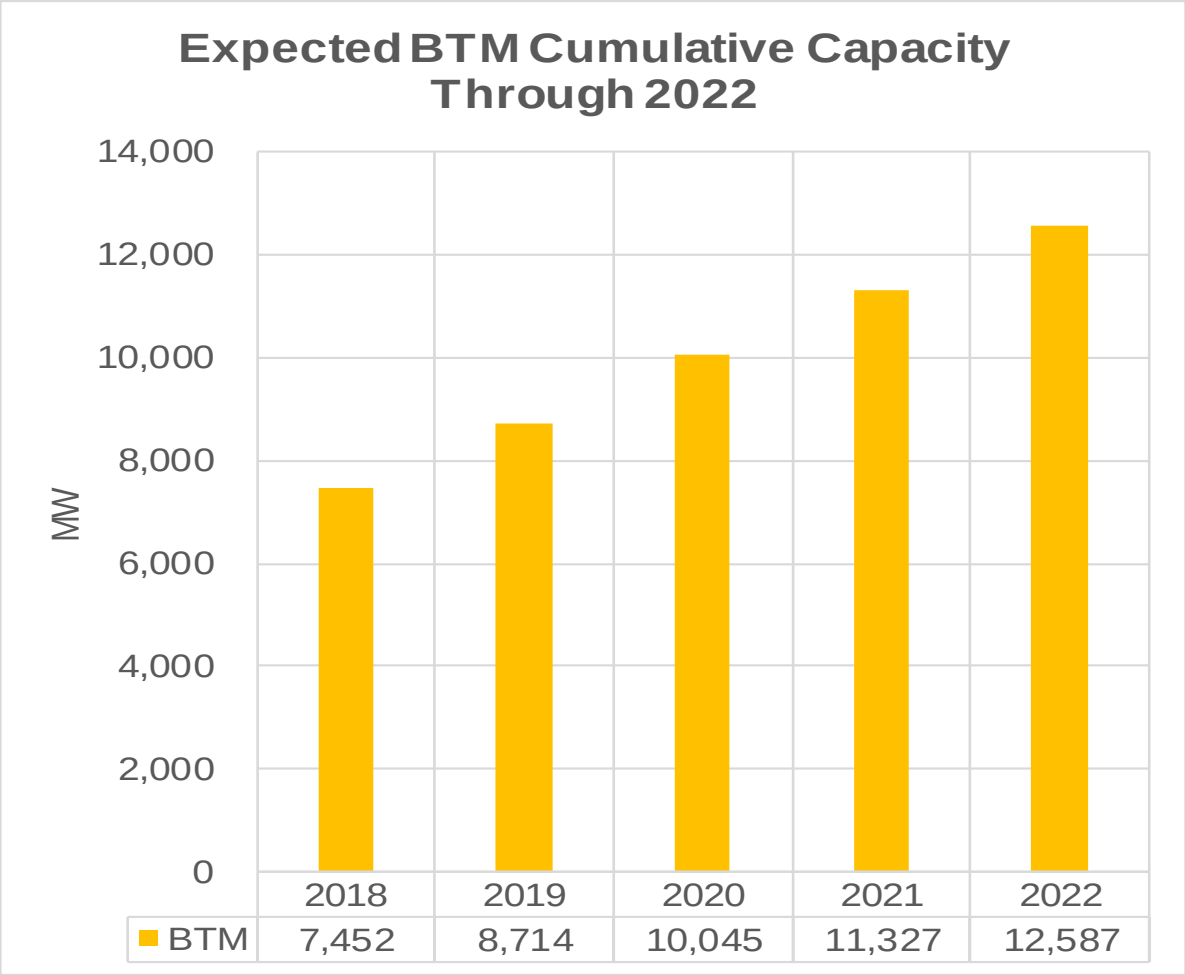




Net load varies significantly day-to-day and minute-to-minute



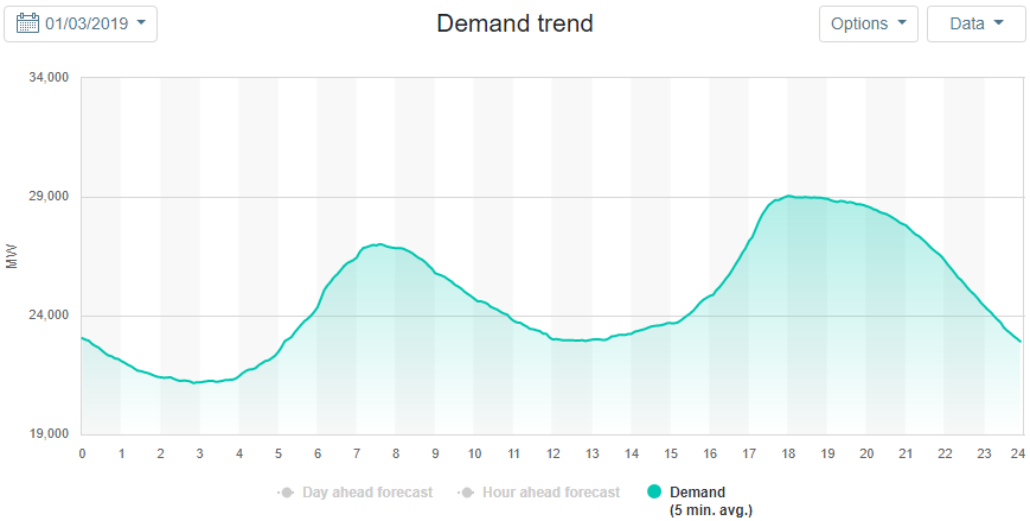
Behind the Meter Solar is Growing



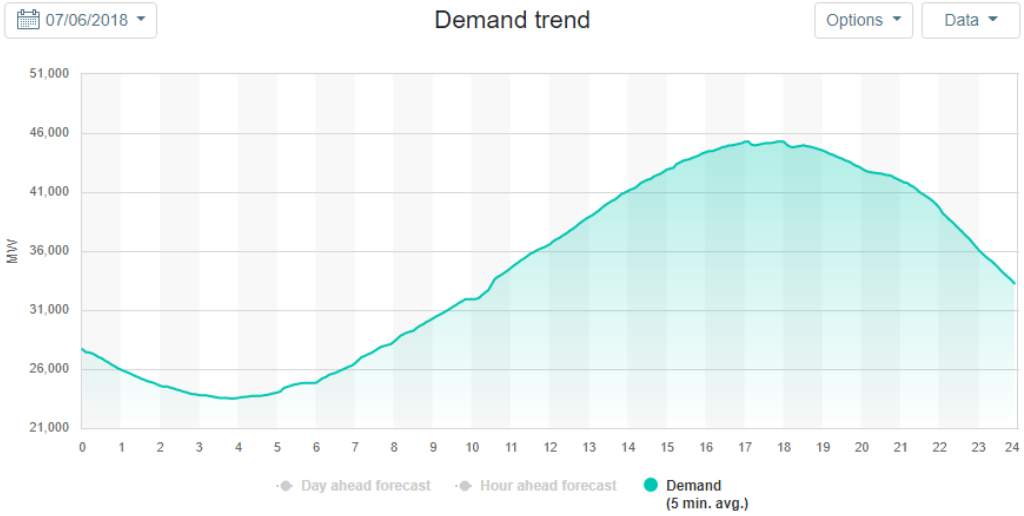
Seasonal Load Shapes

- Load shape varies by:
  - Month

January

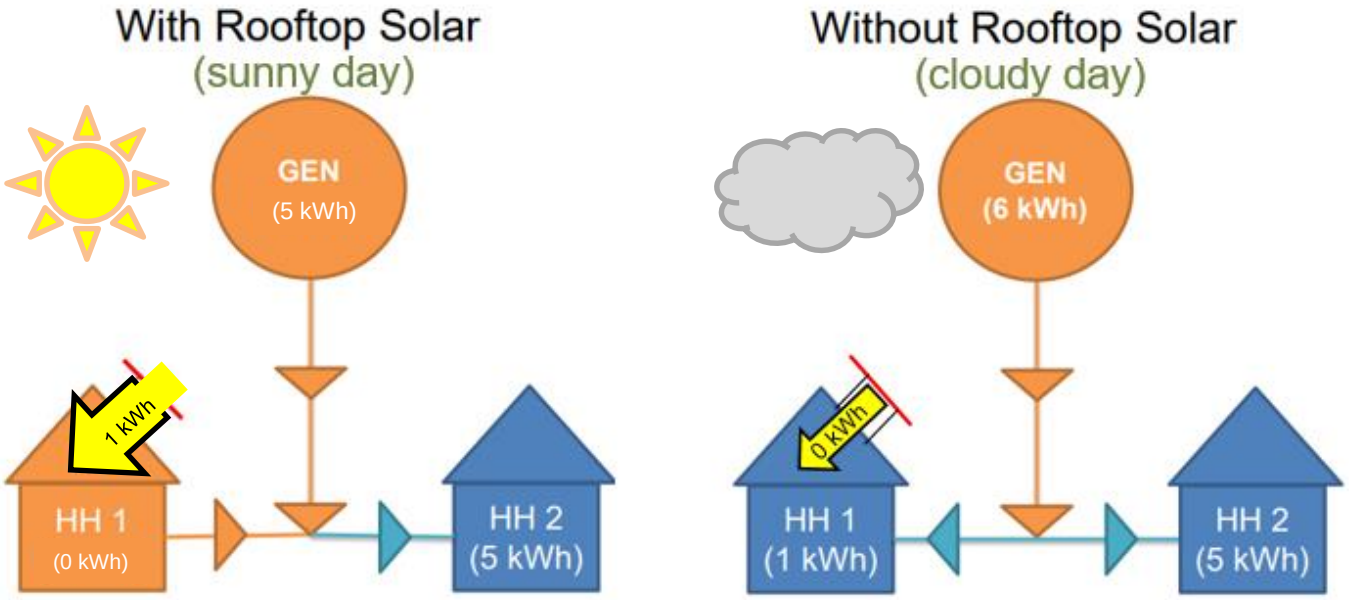


July

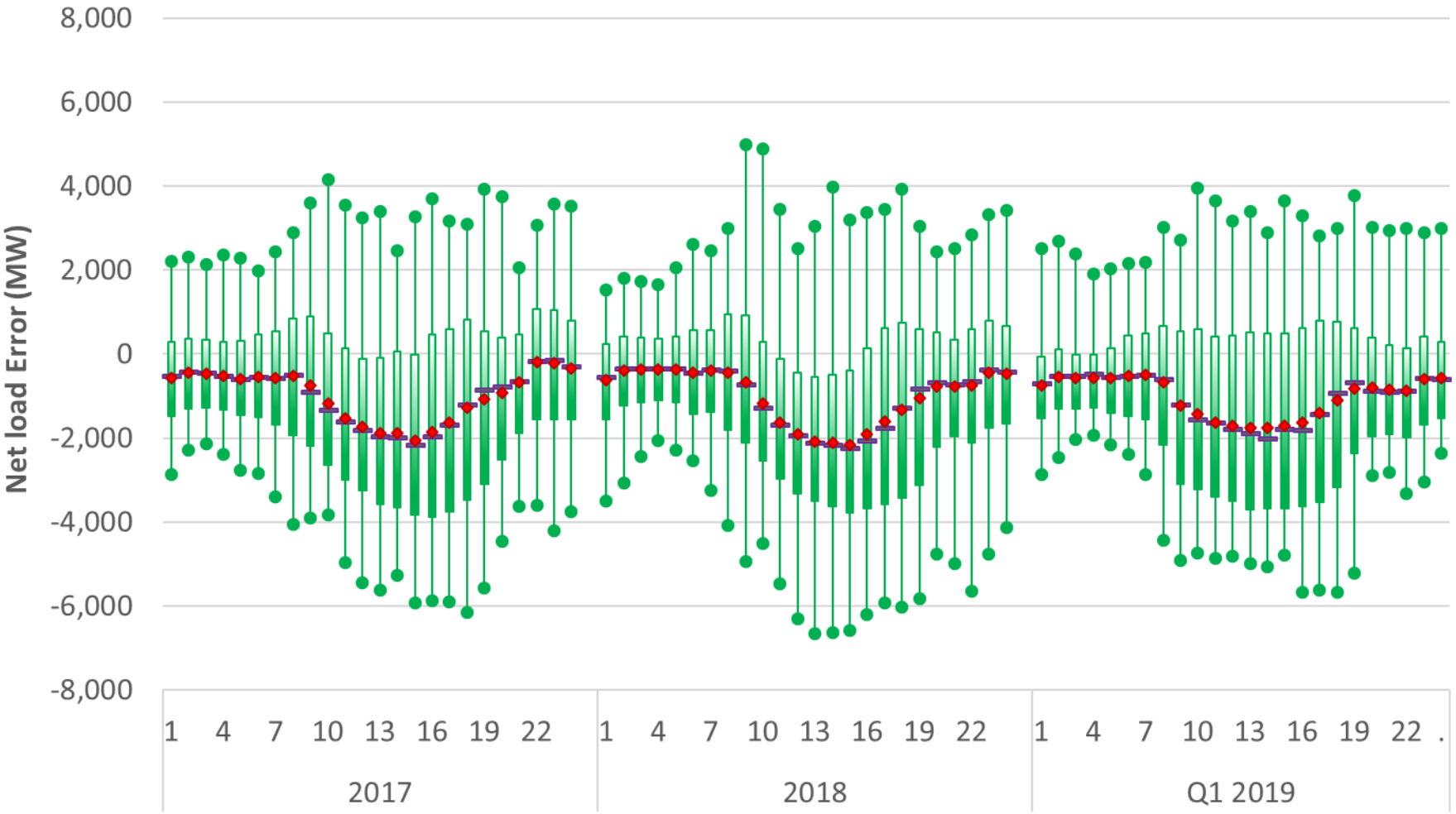


BTM Impacts

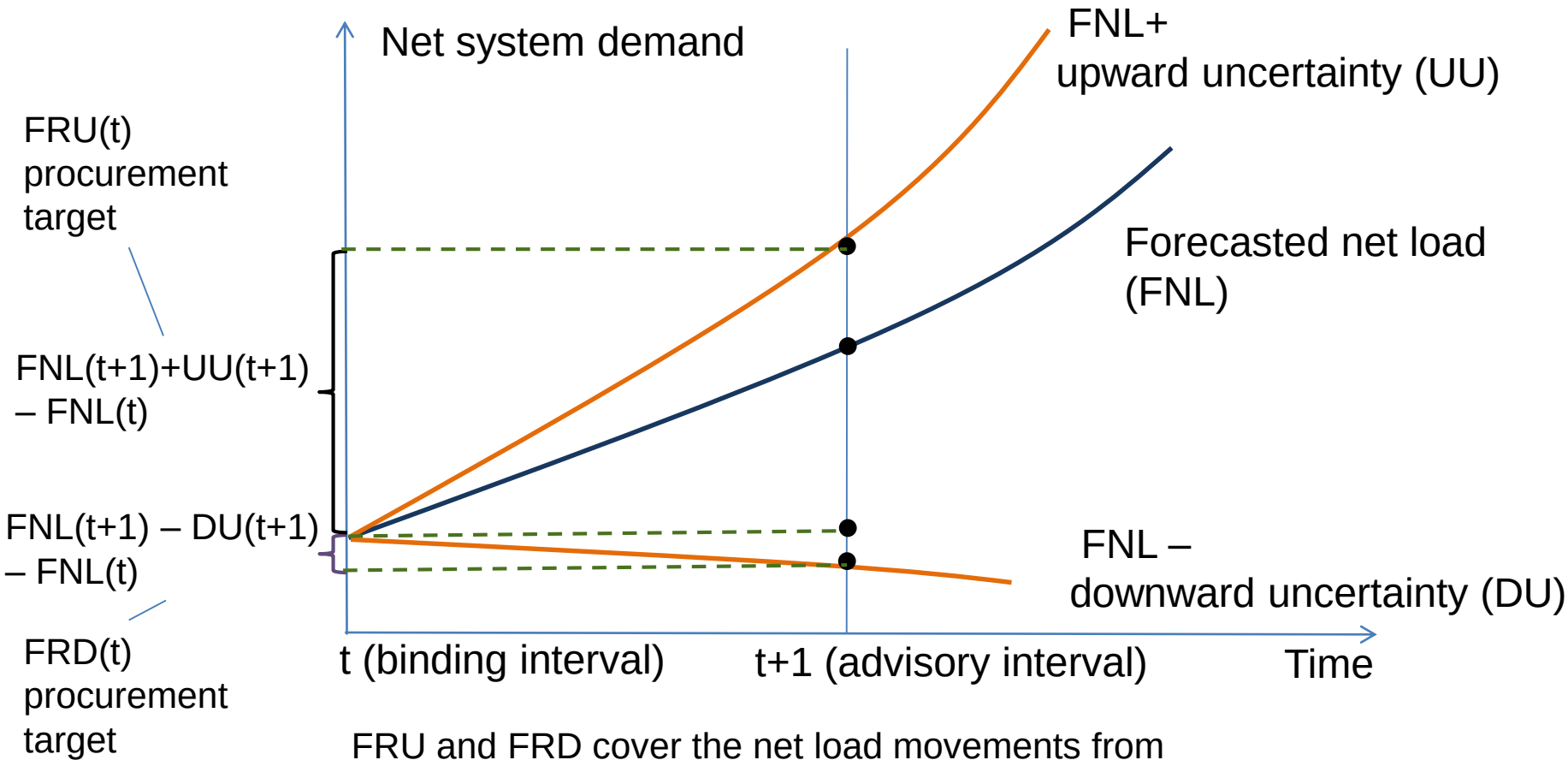
- Behind the meter solar
  - Non-utility scale solar, such as commercial or residential rooftop panels
- Sunny days lead to high BTM penetration and lower mid-day loads



Day-Ahead uncertainty in CAISO market



Flexible ramping product conceptual design



FRU and FRD cover the net load movements from binding interval t to the advisory interval t+1

Questions

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