DER in PJM Load Forecasting

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Overall DER Strategy

Visibility

Forecast and measure

Incent

Visibility helps **measurement and forecast** in Operations, Markets and Planning

- **Operations:** Communicates real-time performance of injections or withdrawals from the grid
- **Markets:** Enhances regional least-cost dispatch solutions for the wholesale market
- **Planning:** Improves efficiency of long-term transmission expansion planning

Snapshot of DER in PJM Today

Wholesale DER

1 GW Demand Response

Customer-sited generation:
Offers into capacity, energy and/or ancillary services markets

74%	24%	2%
Diesel	**Natural Gas**	**Other**

Remaining ~8 GW of DR is load modification without any generation (e.g., industrial process management)

1 GW Generator

Front-of-the-meter generation:
Offers into capacity, energy and/or ancillary services markets.
Can be sited at customers.

Mostly solar but also other fuels

Non-Wholesale DER

~7 GW DER

Solar PV DER: Retail/rooftop solar

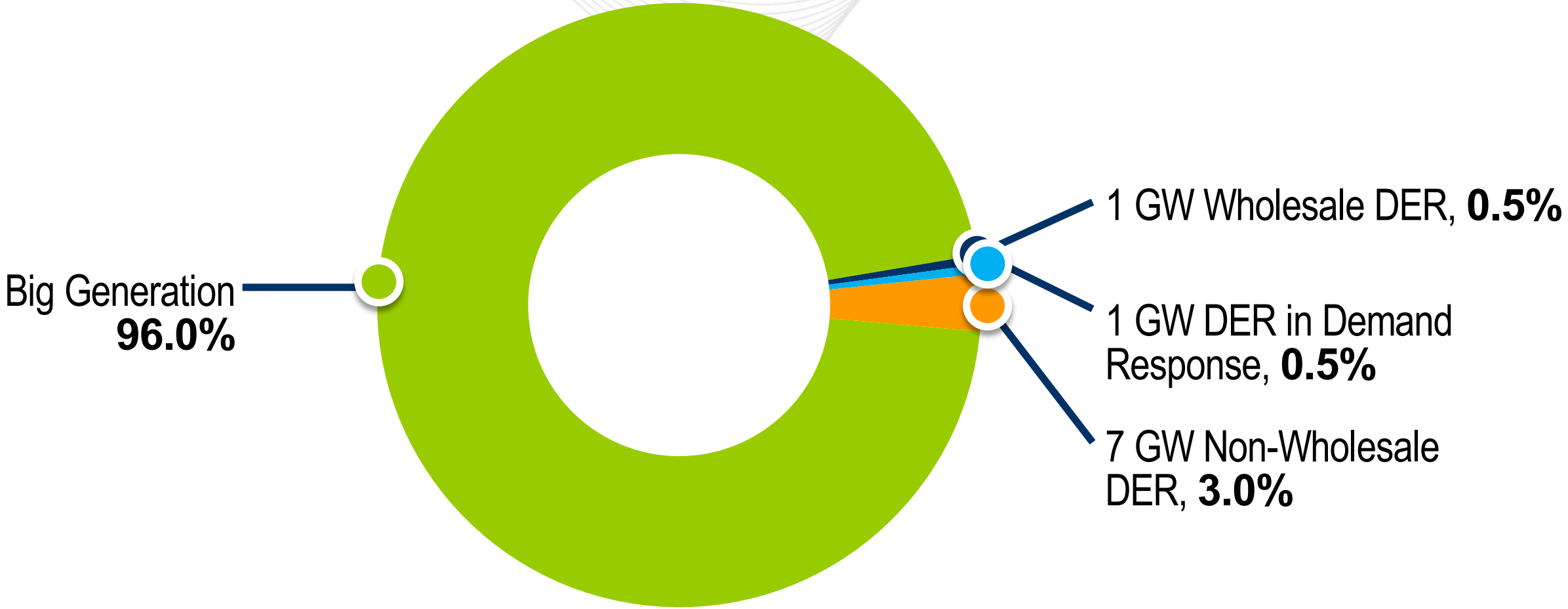
Municipal DER: Municipal electric company distribution-level generators

Process DER: Industrial generators, combined heat and power

Resilience DER: Emergency backup

Qualified Facilities: Direct sales to distribution utilities

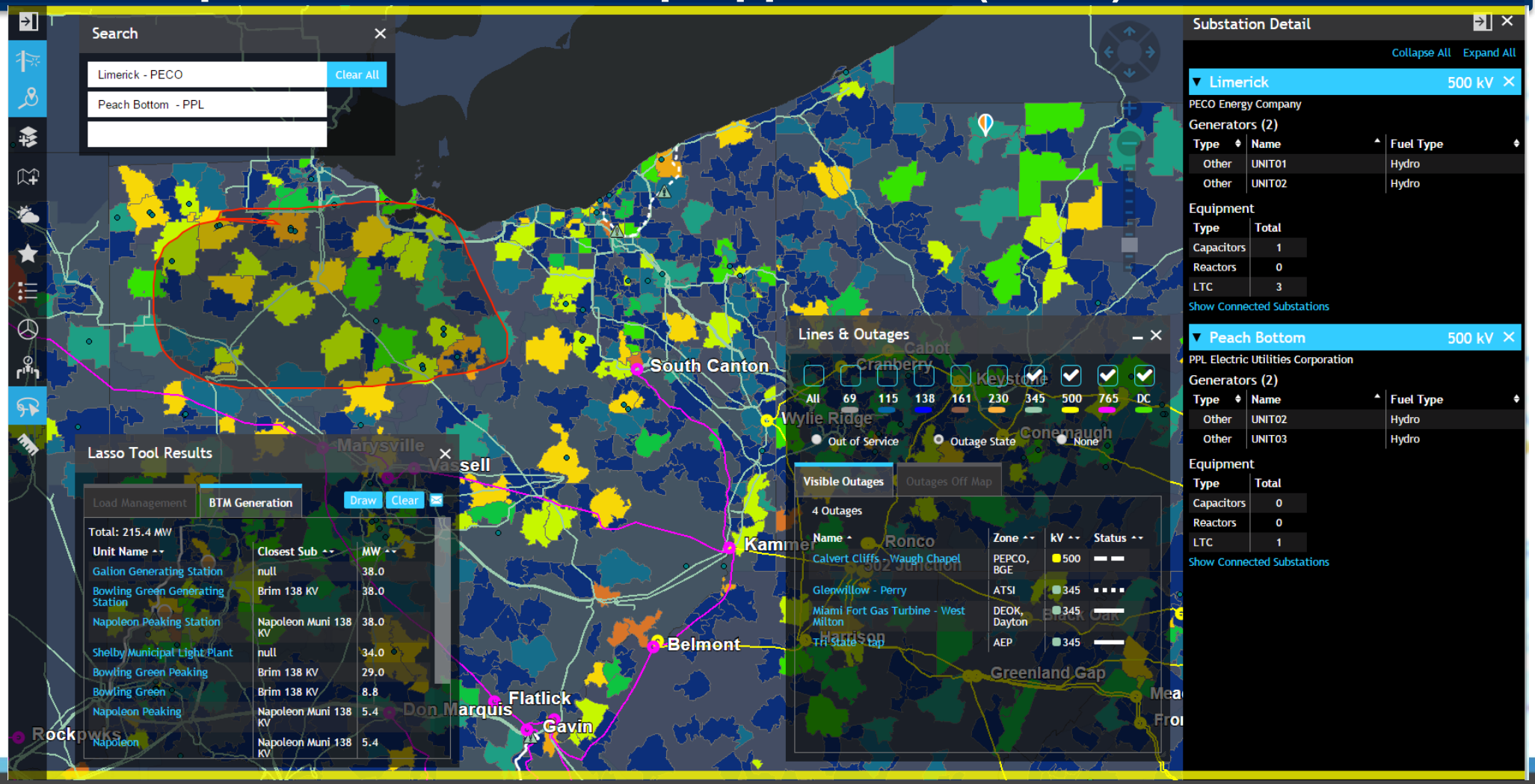
DER in PJM in Perspective



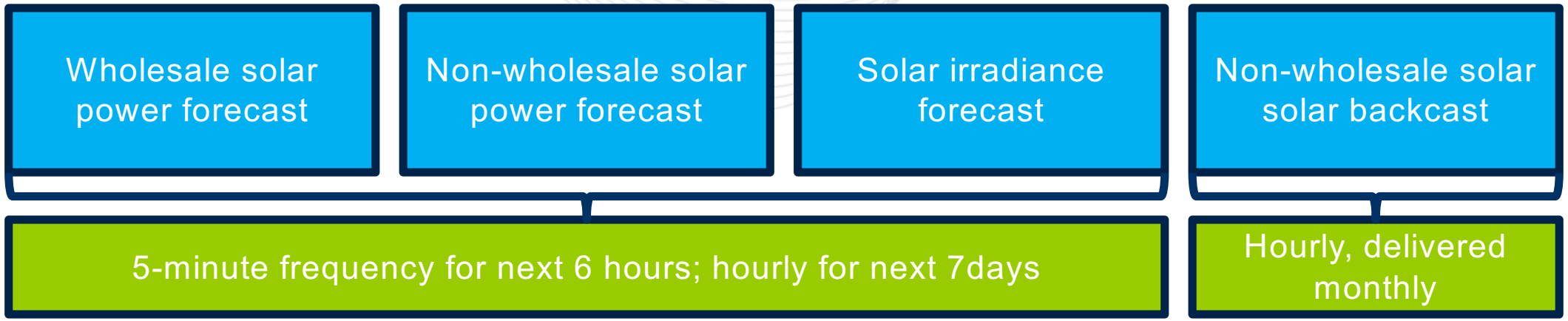
Visibility of DERs

Dispatch Interactive Map Application (DIMA)

- "Lasso" tool for dispatchers
- Non-wholesale BTM generation and Demand Response, by closest substation
- Rooftop solar PV in the future
- Other features



Background of PJM's Short-Term Solar Forecast Efforts



2015

- Research solar forecast approaches
- Release RFP

2016

- Select vendor
- Gather data
- Begin receiving forecast

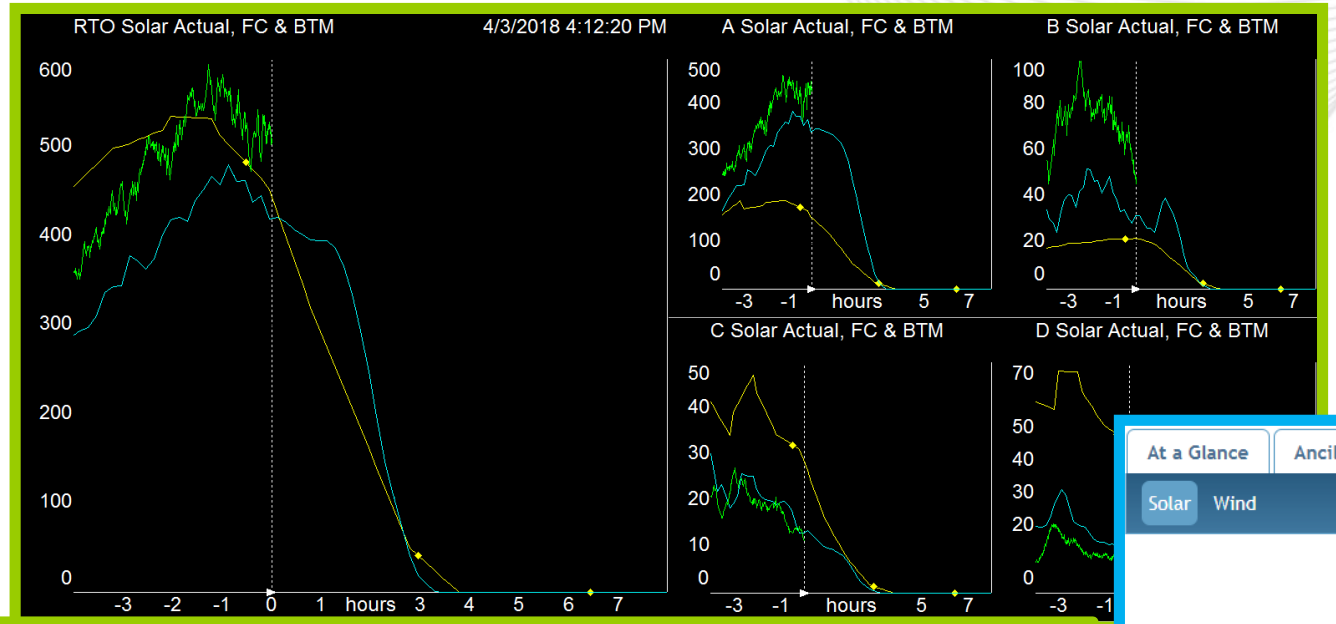
2017

- Improve accuracy of wholesale solar forecast

2018

- Integrate non-wholesale solar forecast into load forecast

Short-Term Solar Forecast Visibility

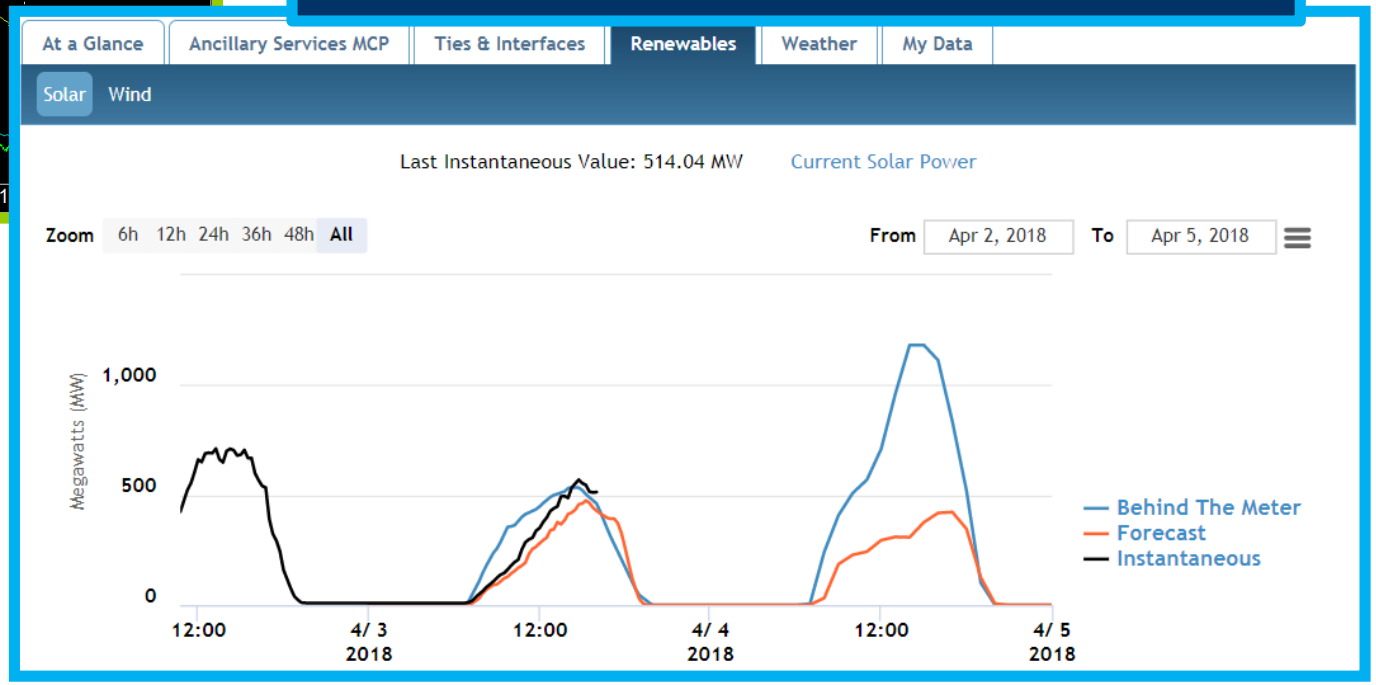


Operator Visibility

- Aggregate wholesale and non-wholesale output for RTO and zones with highest penetrations
- Hourly, unit specific forecast available through desktop tool

Stakeholder Visibility

- Aggregate wholesale and non-wholesale solar output through end of next day
- Hourly, unit specific forecast available to unit owners through online markets tool



Incorporating Non-Wholesale Solar into Short-Term Load Forecast

Three-part strategy

Build

Direct Model: include non-wholesale as model input

Reconstituted Load: forecast total power used

Error Correction: manually adjust load forecast

Test

Different seasons in testing period

Different forecast horizons

Three zones with loads most impacted by solar

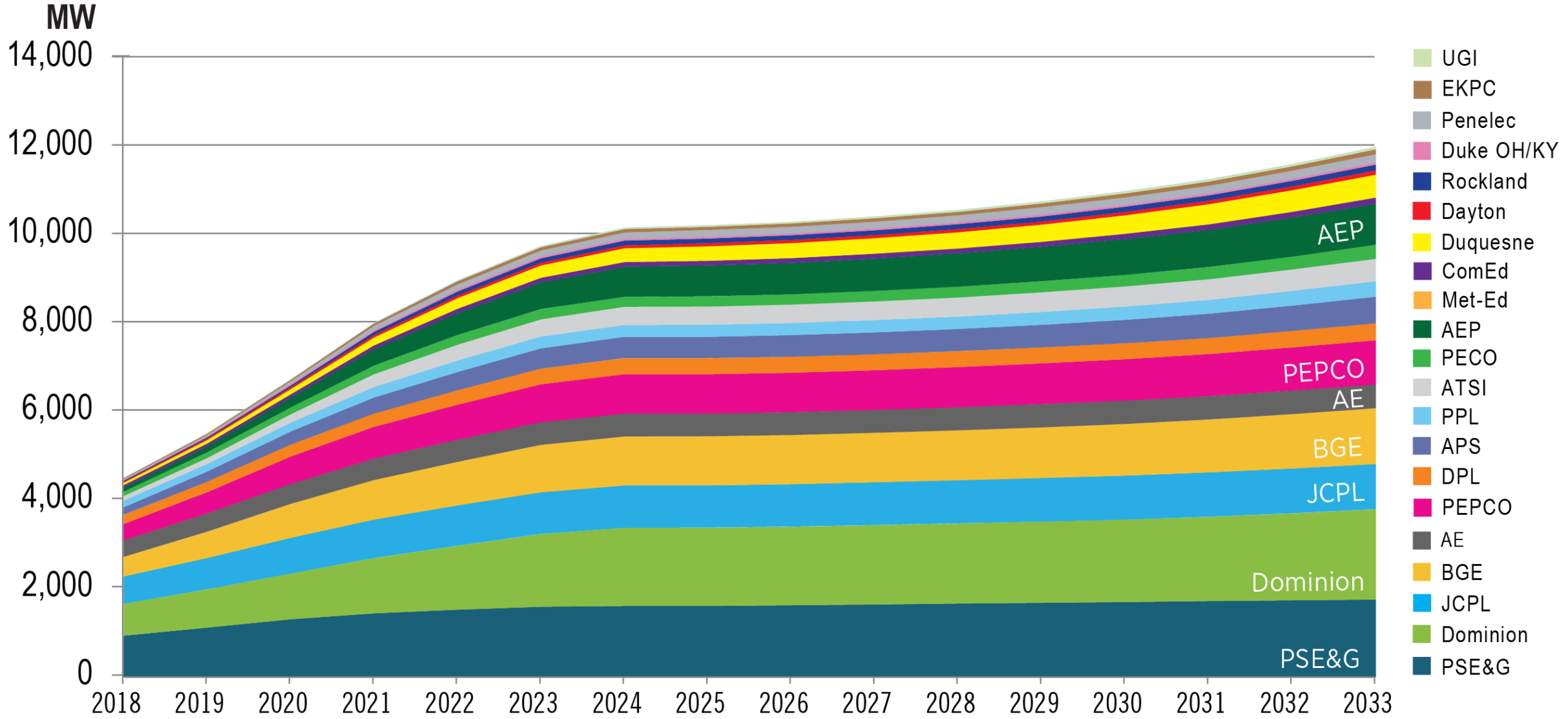
Implement

Upgrade forecast applications

Train operators that make forecasts

Increase visibility of solar forecast data

Long-Term Forecast of Non-Wholesale Solar



Distributed Solar in the Long-Term Forecast

PJM uses a two-step approach to address distributed solar generation in the long-term load forecast.

Step 1:

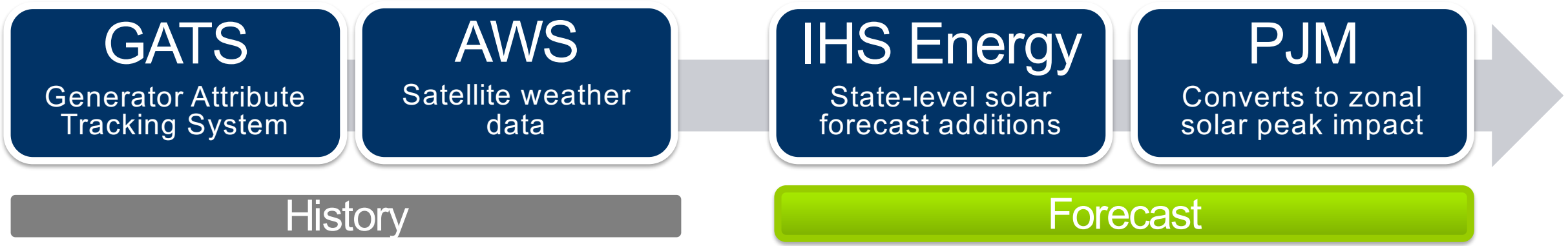
To account for the historical impacts of distributed solar generation, hourly values by zone are back-casted.

These estimates are then **added** to the unrestricted load used in PJM load models.

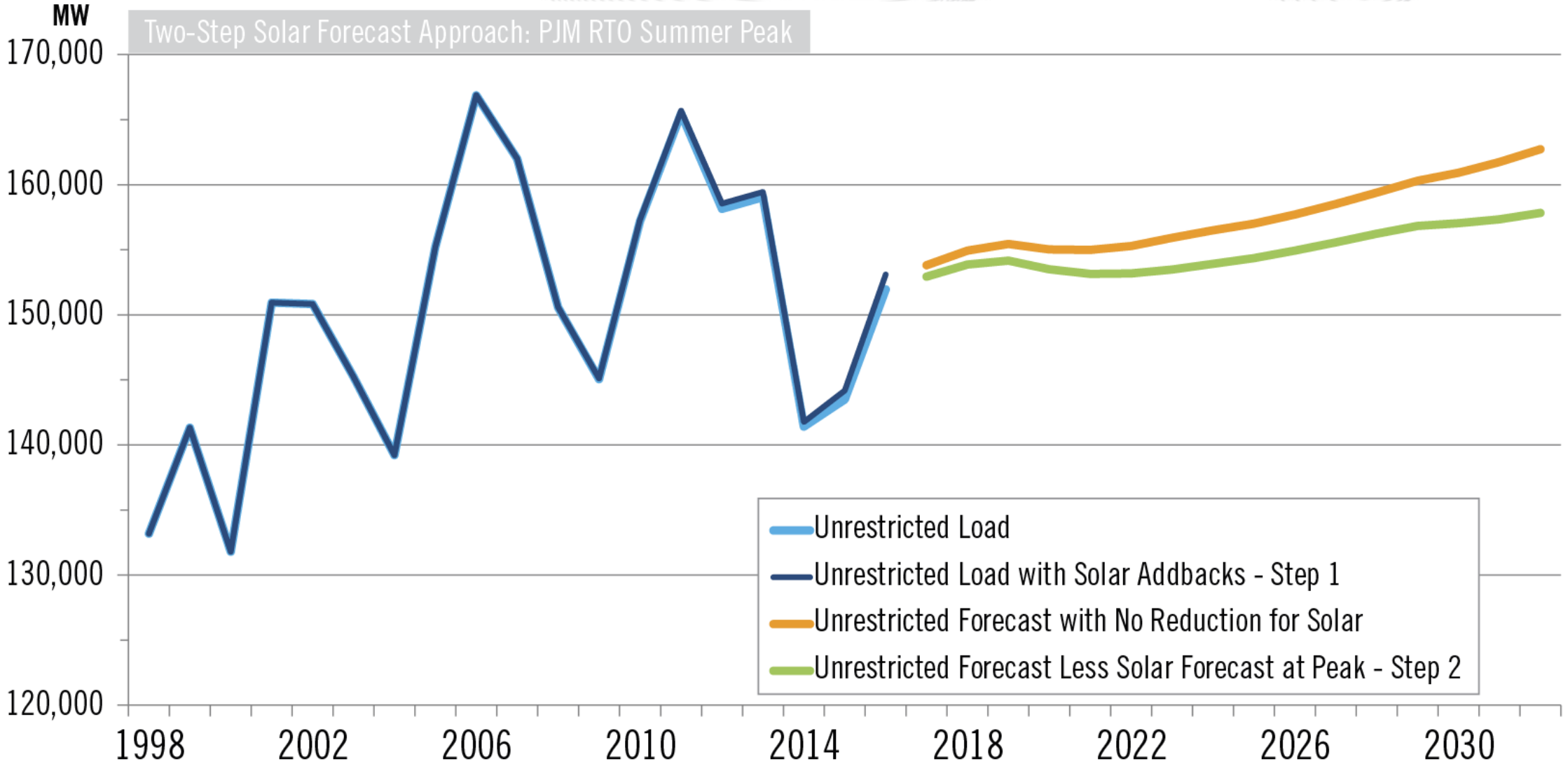
Step 2:

For forecasted values of distributed solar capacity, PJM contracts with IHS Energy to develop a distributed solar generation forecast specific to the PJM region. PJM uses the state-level forecast to derive a zonal solar impact at peak.

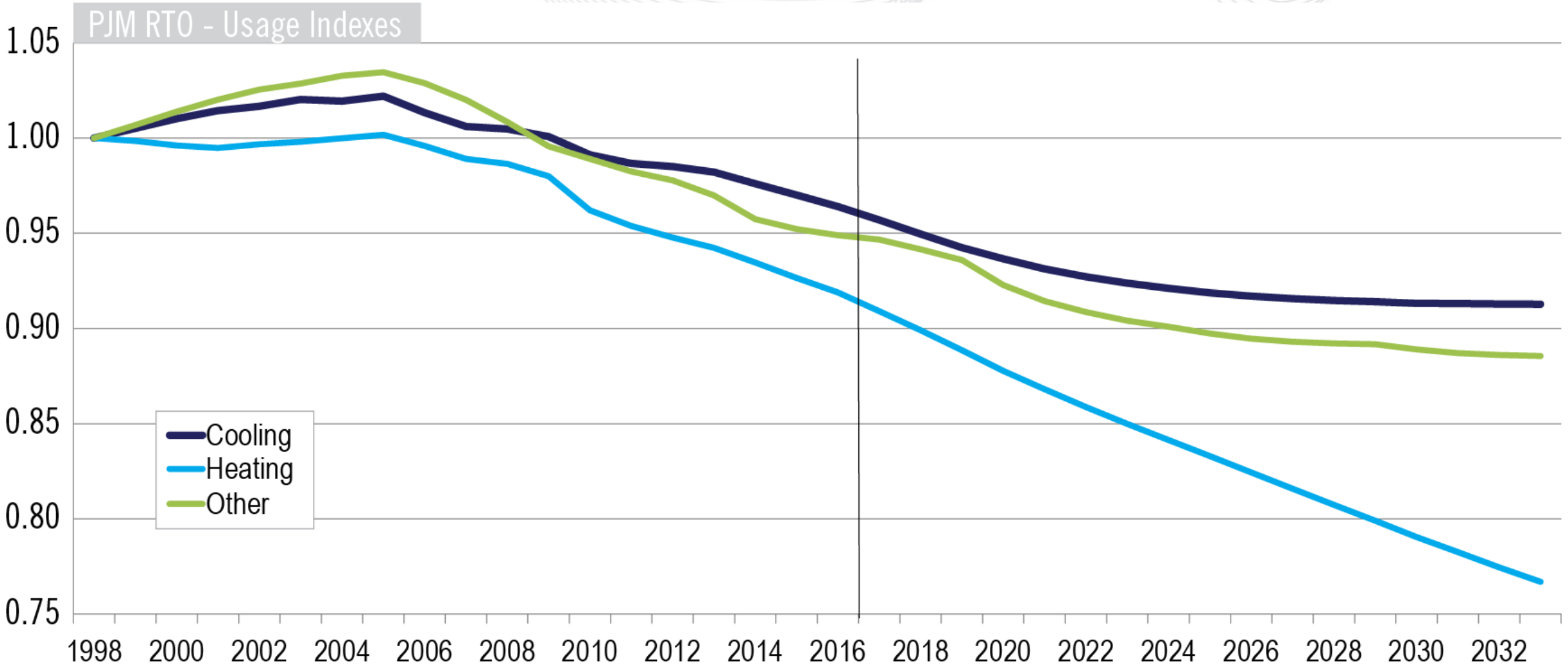
Those values are then **subtracted** from the forecast created with solar addbacks.



Distributed Solar in the Long-Term Forecast



Energy Efficiency in the Long-Term Forecast



Efficiency and Solar Impacts