Understanding the Impact of Behind-the-Meter Solar on Grid Operations and Regional Planning

Consumer Liaison Group Meeting

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ISO New England (ISO) Has Two Decades of Experience Overseeing the Region's Restructured Electric Power System

- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and **neutral** on technology

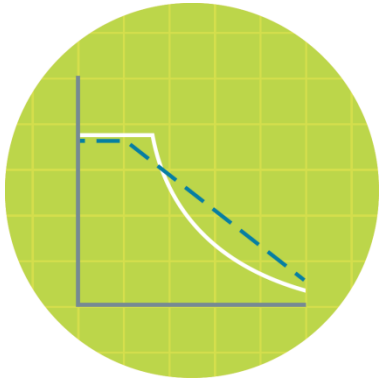
ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

Grid Operation

Coordinate and direct the flow of electricity over the region's high-voltage transmission system

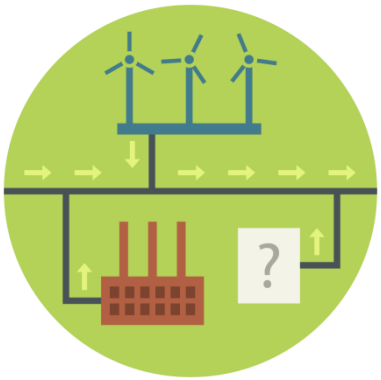
Market Administration

Design, run, and oversee the markets where wholesale electricity is bought and sold



Power System Planning

Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years

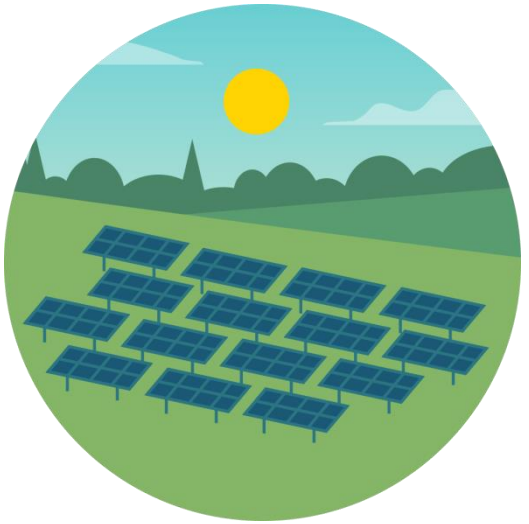


TODAY'S KEY MESSAGES

- New England has experienced significant growth in solar photovoltaic (PV) resources, and more is on the way
- ISO New England is leading efforts to account for solar PV resources connected to the distribution system
- ISO New England's solar PV forecast is an iterative process; the methodology and policy inputs are updated each year
- Solar PV resources are having a significant impact on regional operations and planning

ISO New England Forecasts Growth in Distributed Generation Resources

- Since 2013, the ISO has led a regional **Distributed Generation Forecast Working Group** (DGFWG) to collect data on distributed generation (DG) policies and implementation, and to forecast long-term incremental DG growth in New England
- The DGFWG focuses on the following types of DG resources:
  - Under 5 MW
  - Connected to the distribution system
  - Not visible to the ISO directly
  - Specifically solar photovoltaic (PV) resources, the largest DG component
- The ISO forecasts strong growth in solar PV over the next 10 years

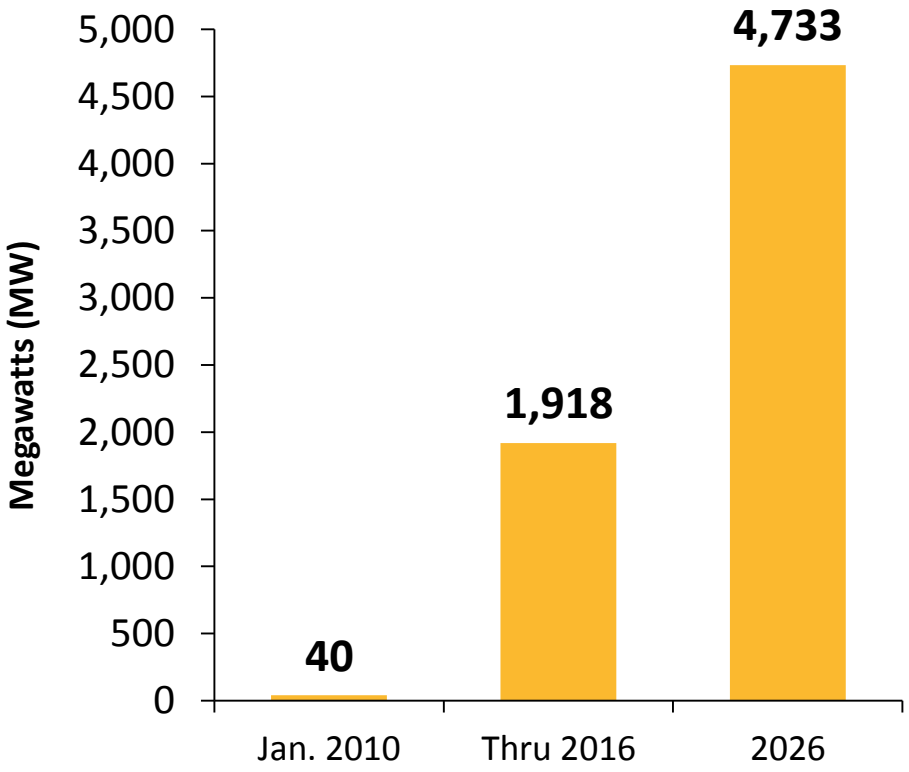


ISO New England Forecasts Strong Growth in Solar PV

December 2016 Solar PV Installed Capacity (MW_{ac})

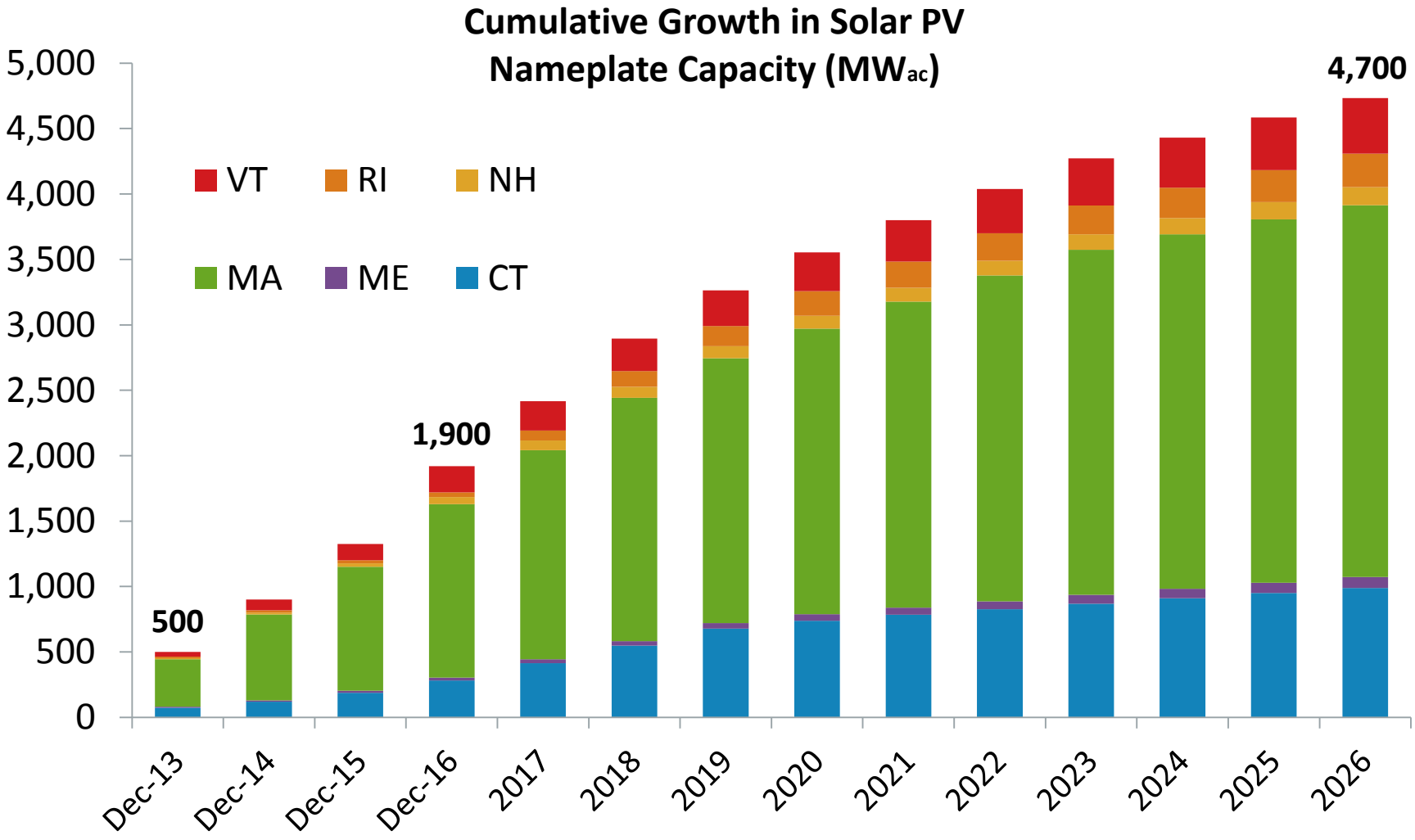
State	Installed Capacity (MW_{ac})	No. of Installations
Connecticut	281.55	23,544
Massachusetts	1,324.77	65,883
Maine	22.14	2,745
New Hampshire	54.30	5,873
Rhode Island	36.81	2,202
Vermont	198.39	7,612
New England	**1,917.96**	**107,859**

Cumulative Growth in Solar PV through 2026 (MW_{ac})

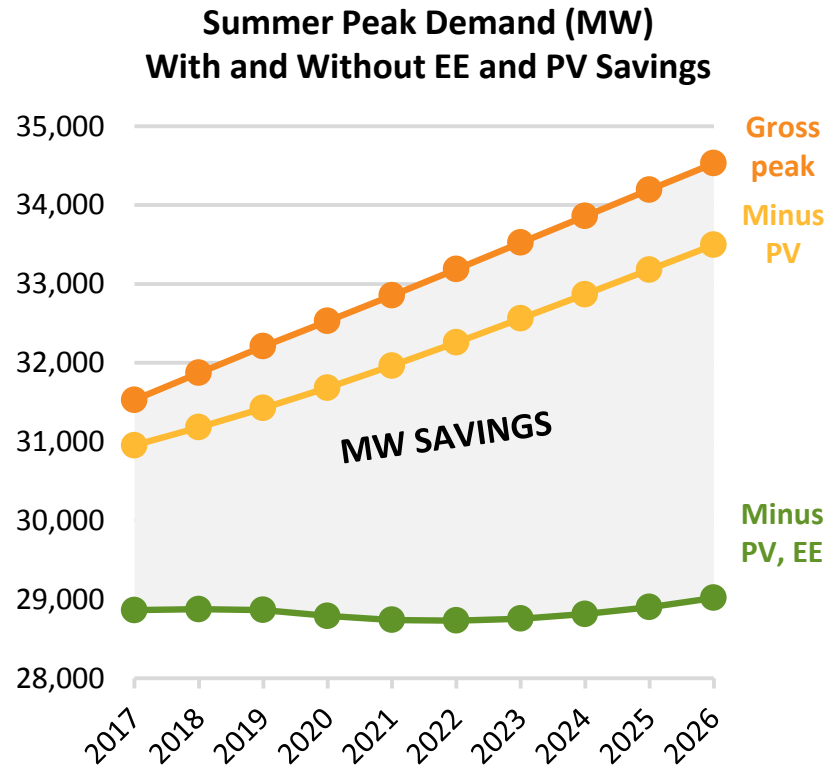


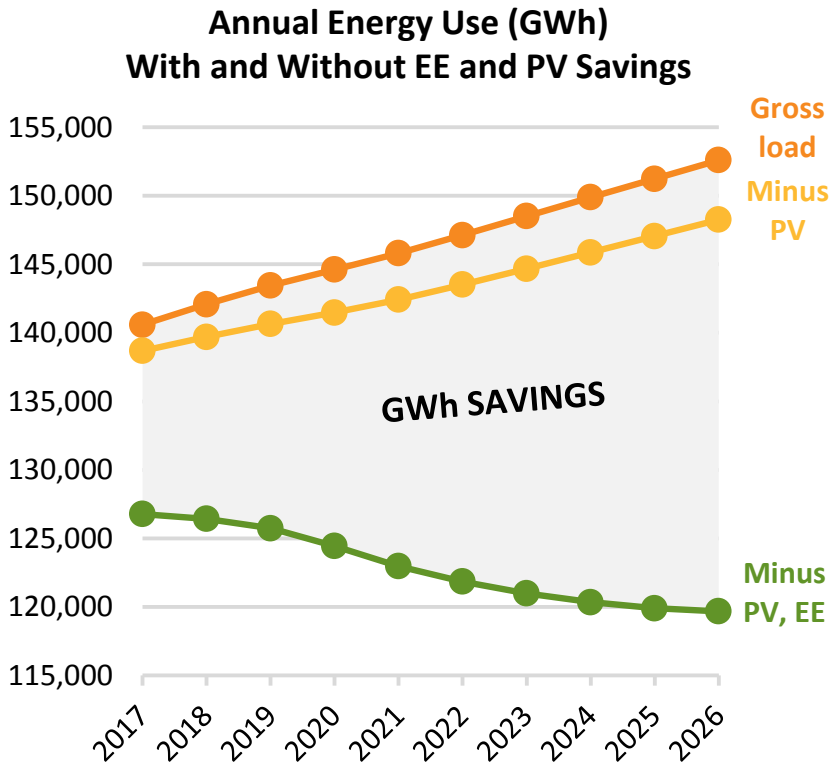
Note: The bar chart reflects the ISO's projections for nameplate capacity from PV resources participating in the region's wholesale electricity markets, as well as those connected "behind the meter." Source: Final 2017 PV Forecast (April 2017); MW values are AC nameplate.

Solar PV Investment Varies by State



Energy Efficiency and Behind-the-Meter Solar Impact Peak Demand and Annual Energy Use



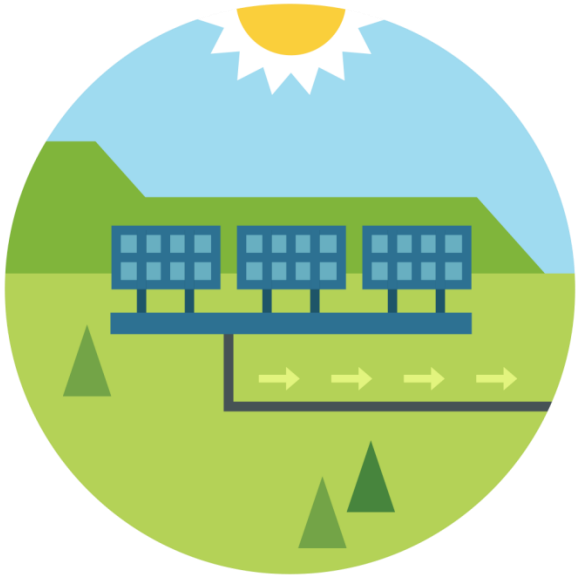


- **The gross peak and load forecast**
- **The gross peak and load forecast minus forecasted "behind-the-meter" (BTM) solar PV resources**
- **The gross peak and load forecast minus forecasted BTM solar PV, minus energy-efficiency (EE) resources in the Forward Capacity Market 2017-2020 and forecasted EE 2021-2026**

Note: Summer peak demand is based on the "90/10" forecast, which accounts for the possibility of extreme summer weather (temperatures of about 94° F).
Source: Final ISO New England Energy-Efficiency Forecast 2021-2026 and Final 2017 Solar PV Forecast (May 2017)

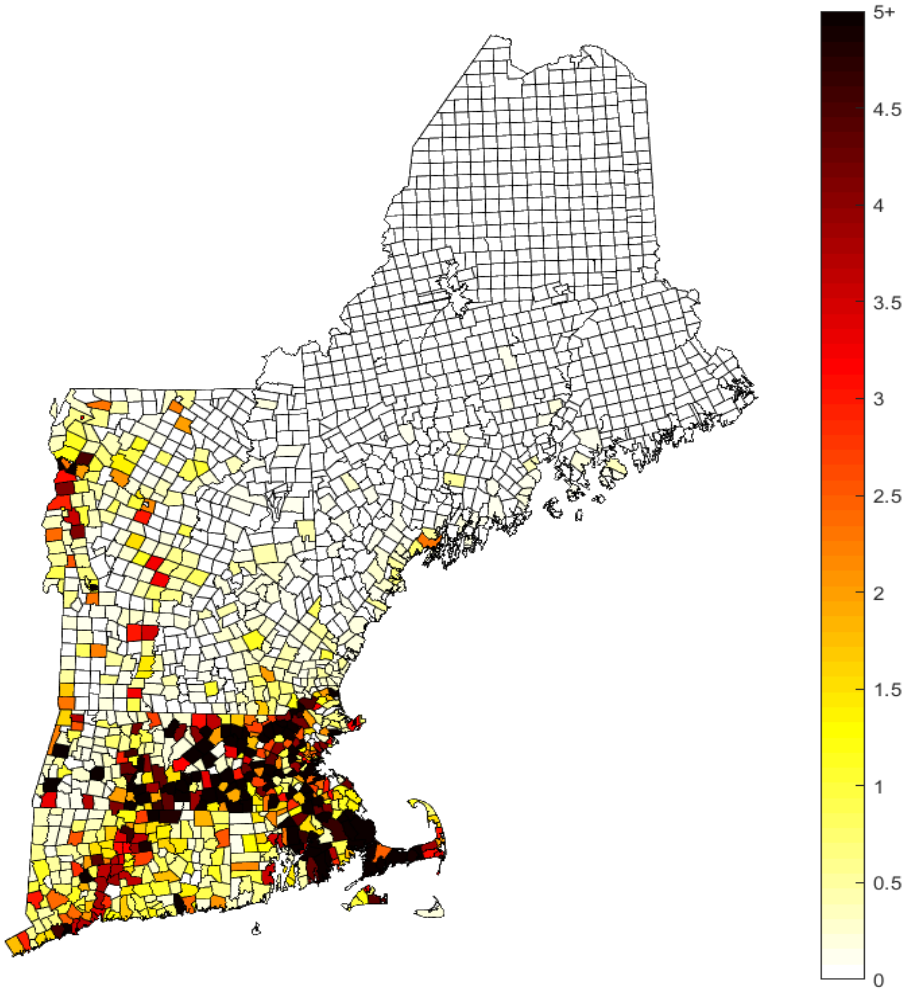
The ISO Is Leading Efforts to Account for Solar Resources Connected to the Distribution System

- **Forecasting Long-Term Solar Growth**
  - The ISO tracks historical growth and predicts levels of solar development 10 years into the future
  - The solar forecast is used in transmission planning and market needs assessments
- **Forecasting Short-Term Solar Performance**
  - The ISO creates daily forecasts of solar generation production to improve daily load forecasts and situational awareness for grid operators
- **Improving Interconnection Rules**
  - The ISO is engaged with industry stakeholders to strengthen interconnection standards and reduce reliability concerns

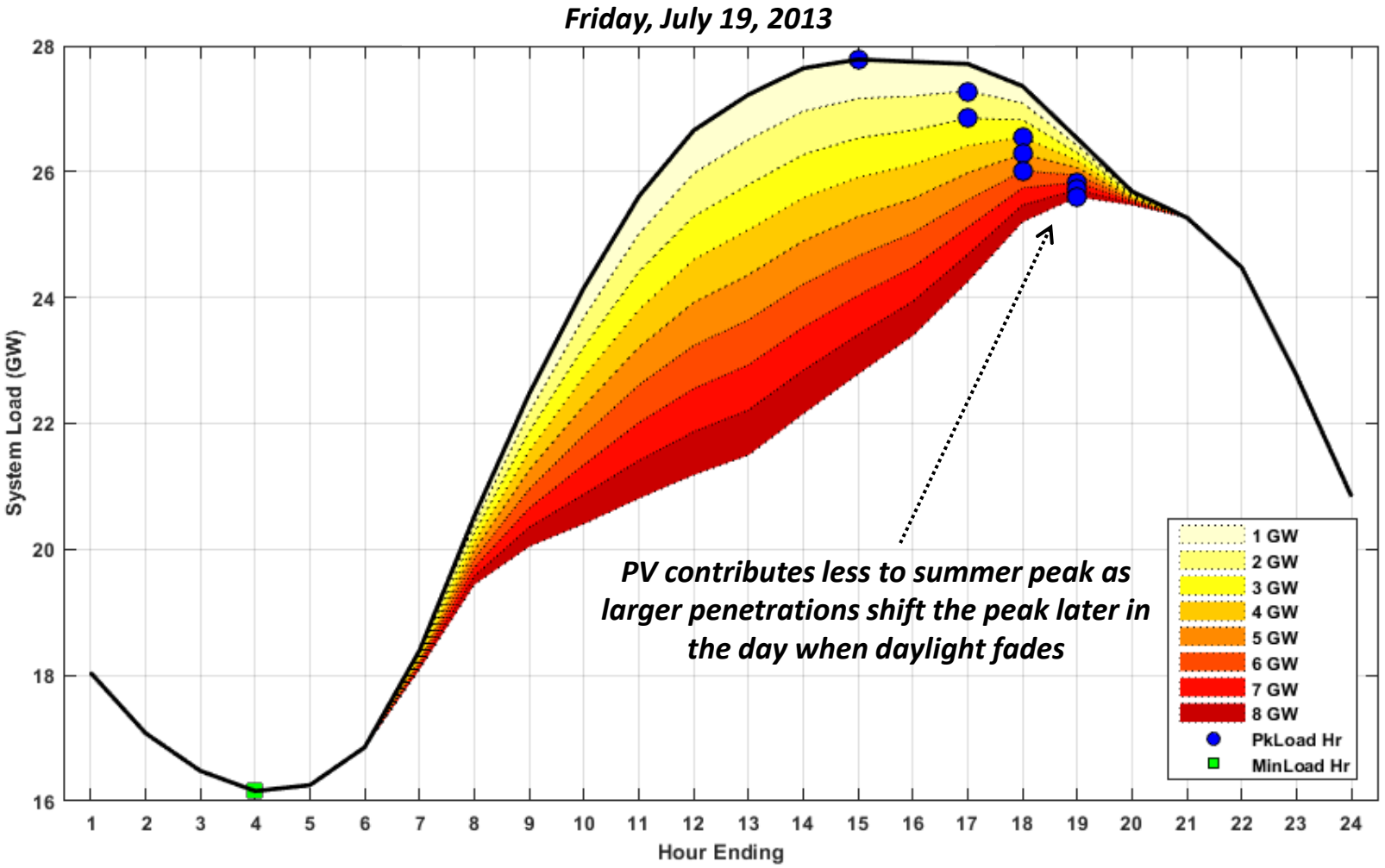


ISO New England Has Developed Solar "Heat Maps" to Better Understand Solar Activity Within the Region

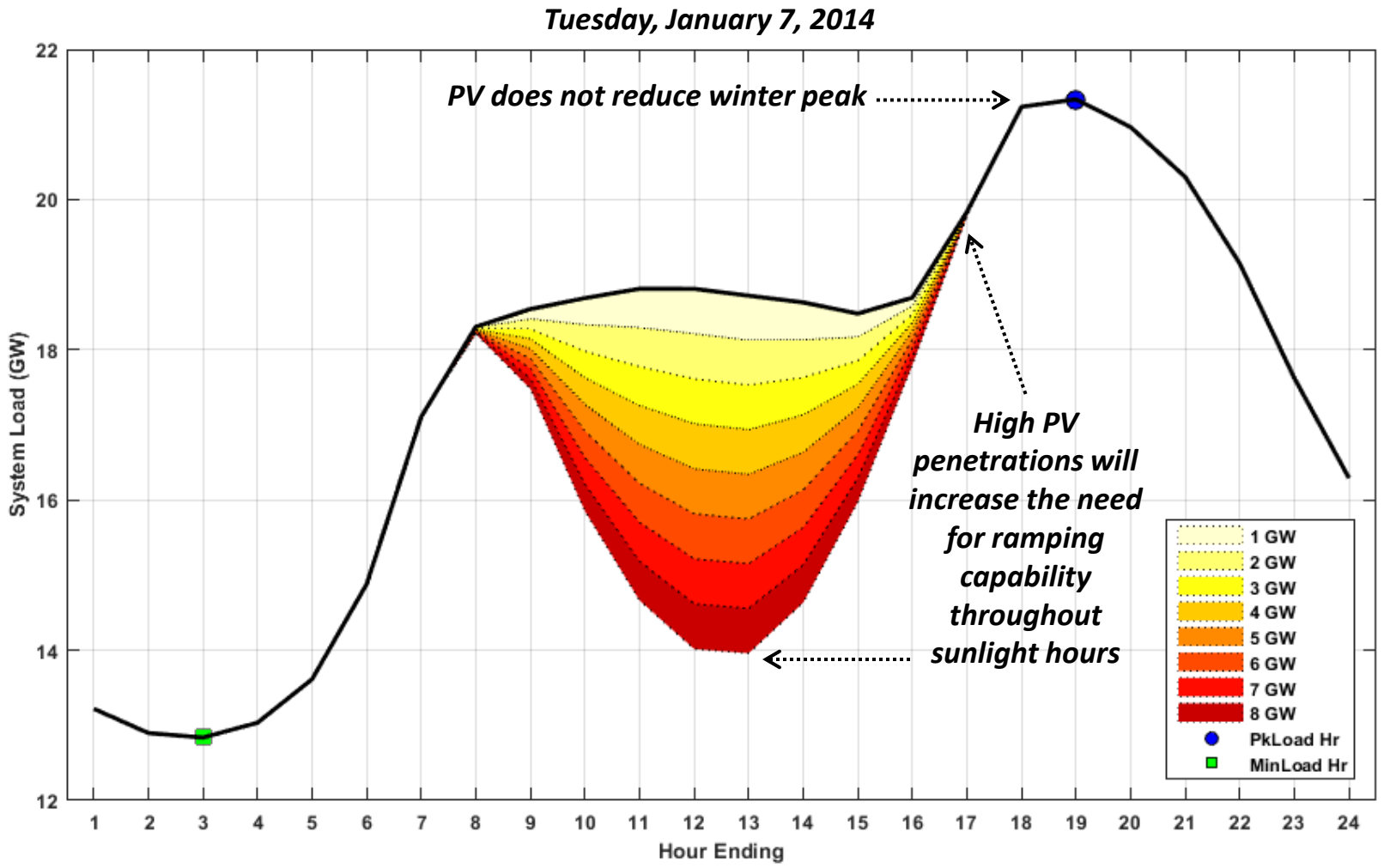
- Understanding the **spatial distribution** of existing solar PV resources will be critical to the ISO's ongoing integration activities within both System Planning and System Operations
- Based on the data provided by distribution owners, the ISO has aggregated the installed nameplate capacity by town within each state, and generated **heat maps** showing the results



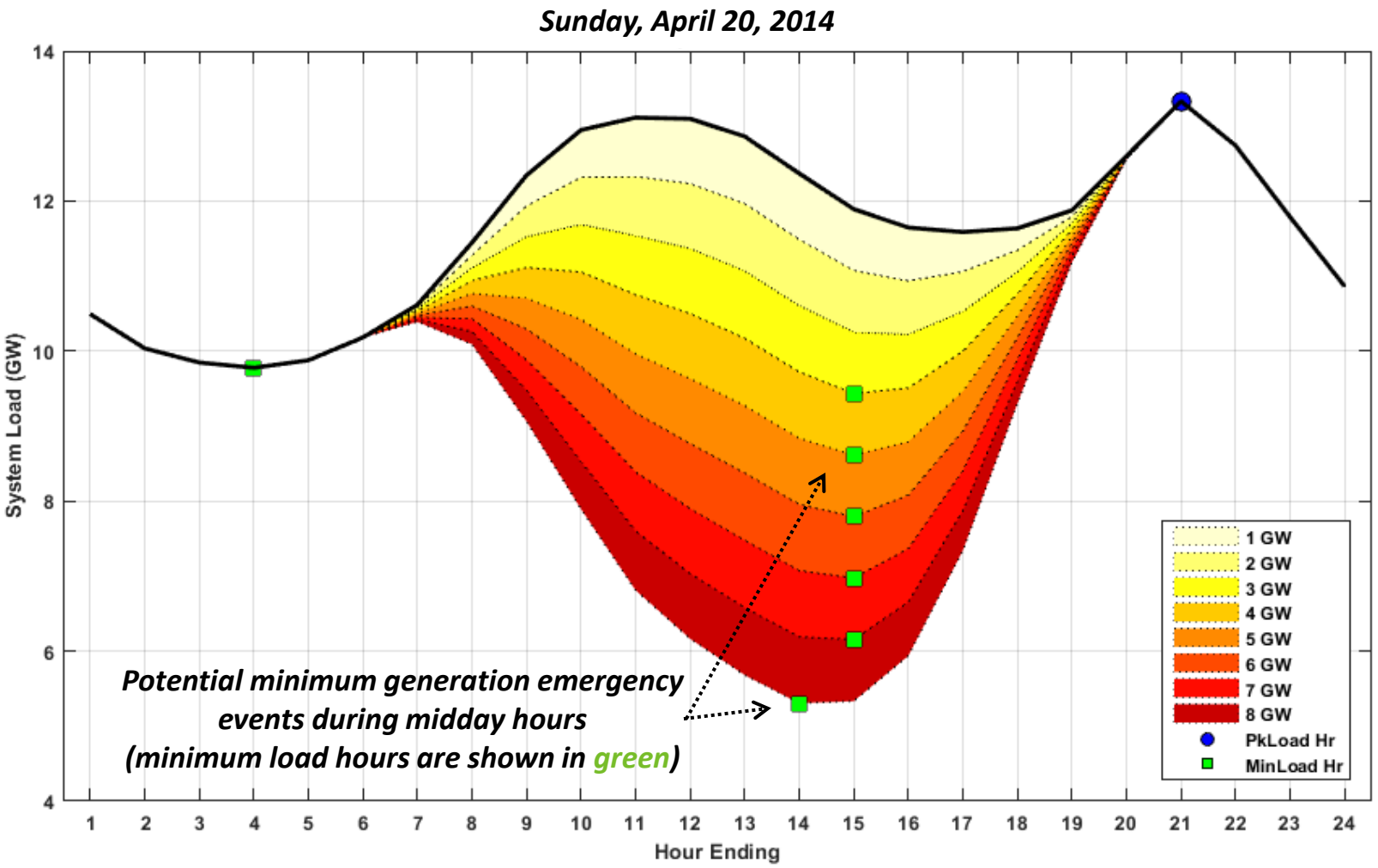
Solar PV Penetration Shifts Timing of Hourly Peaks Later in the Day During Summer



Deep Load Reductions During Winter Daylight Hours Result in Steep Ramp Into the Evening Peak



Solar in Spring/Fall Displaces Generation and Increases Need to Back Down Generation in Low-Load Hours



Questions