ISO-NE Net Loads with Increasing Behind-the-Meter PV

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Outline

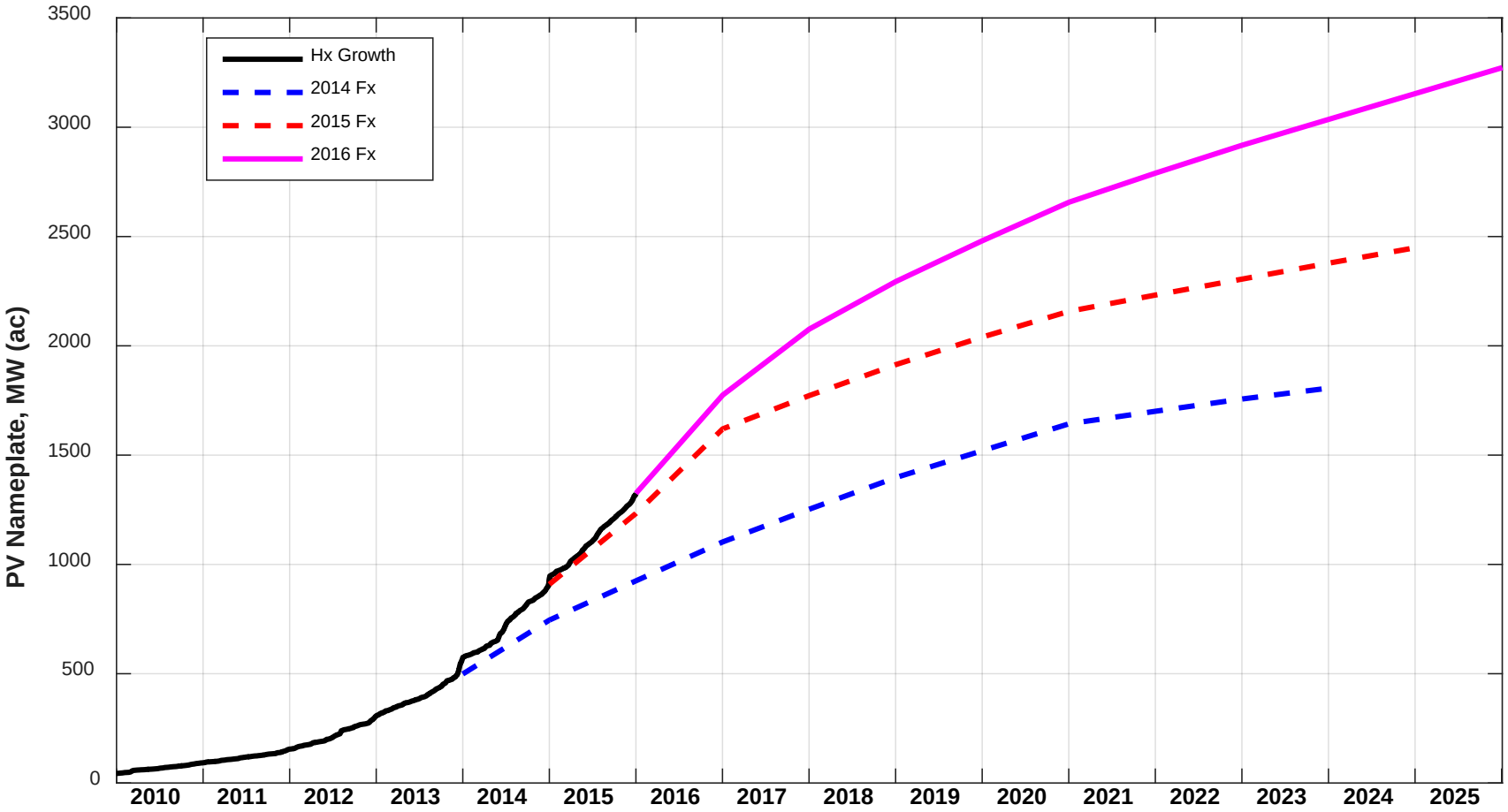
- Introduction
- Net Load Simulation - Methodology
- Net Load Simulation – Results
- Conclusions

INTRODUCTION

Introduction

- Large-scale growth of distributed, behind-the-meter (BTM) photovoltaic (PV) resources is occurring in New England and is forecast to continue
- Distributed PV is generally not metered in real-time and therefore is not visible to or dispatchable by ISO operations
- ISO is seeking to understand the effects of large-scale PV on the region's future load characteristics
- This presentation describes the results of a net load (i.e., load net of PV) simulation with up to 8,000 MW of PV installed
- This simulation is in part meant to illustrate the effects of *larger-than-expected* PV penetrations to help identify key changes in net load characteristics as PV increases

PV Growth: Reported Historical vs. Forecast



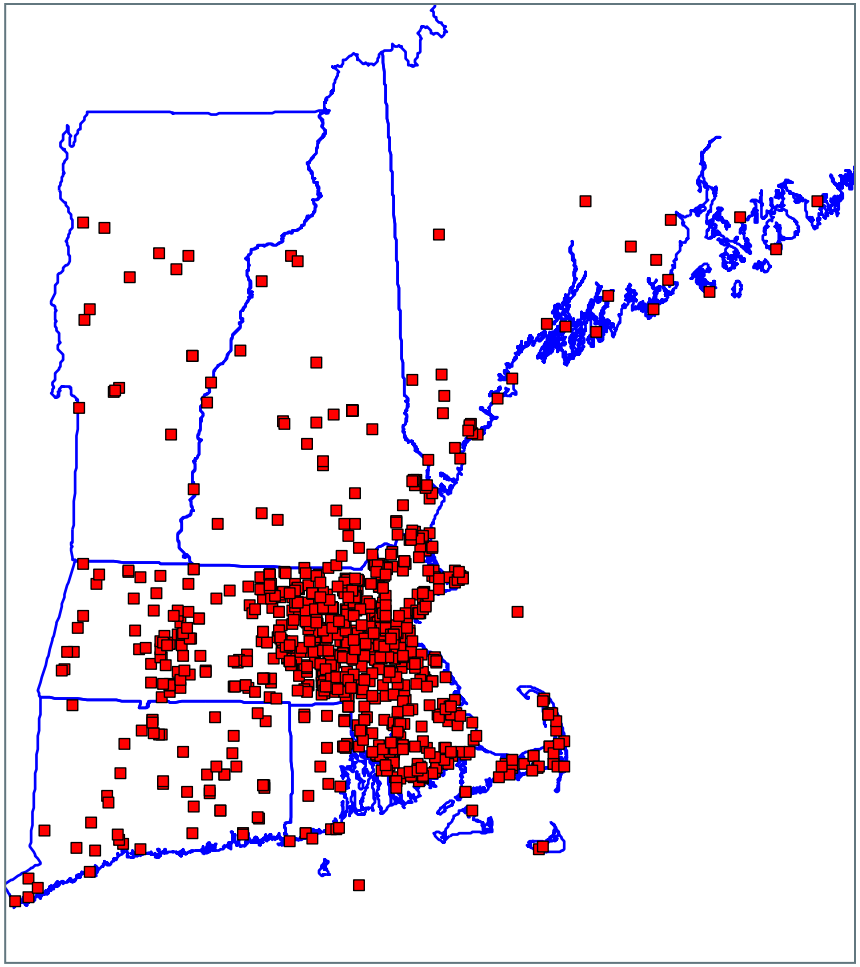
NET LOAD SIMULATION – METHOD

Net Load Simulation Method

- Future net load scenarios are based on coincident, historical hourly load and PV production data for the period 1/1/2012 – 8/31/15
- PV production data accessed via Yaskawa-Solectria Solar's SolrenView*
  - >1k PV sites totaling > 125 MW_{ac}
- Normalized PV profiles were developed for each New England state, blended into a regional profile which was then "upscaled" to each PV scenario

*Accessed via http://www.solrenview.com/

Yaskawa-Solectria Sites

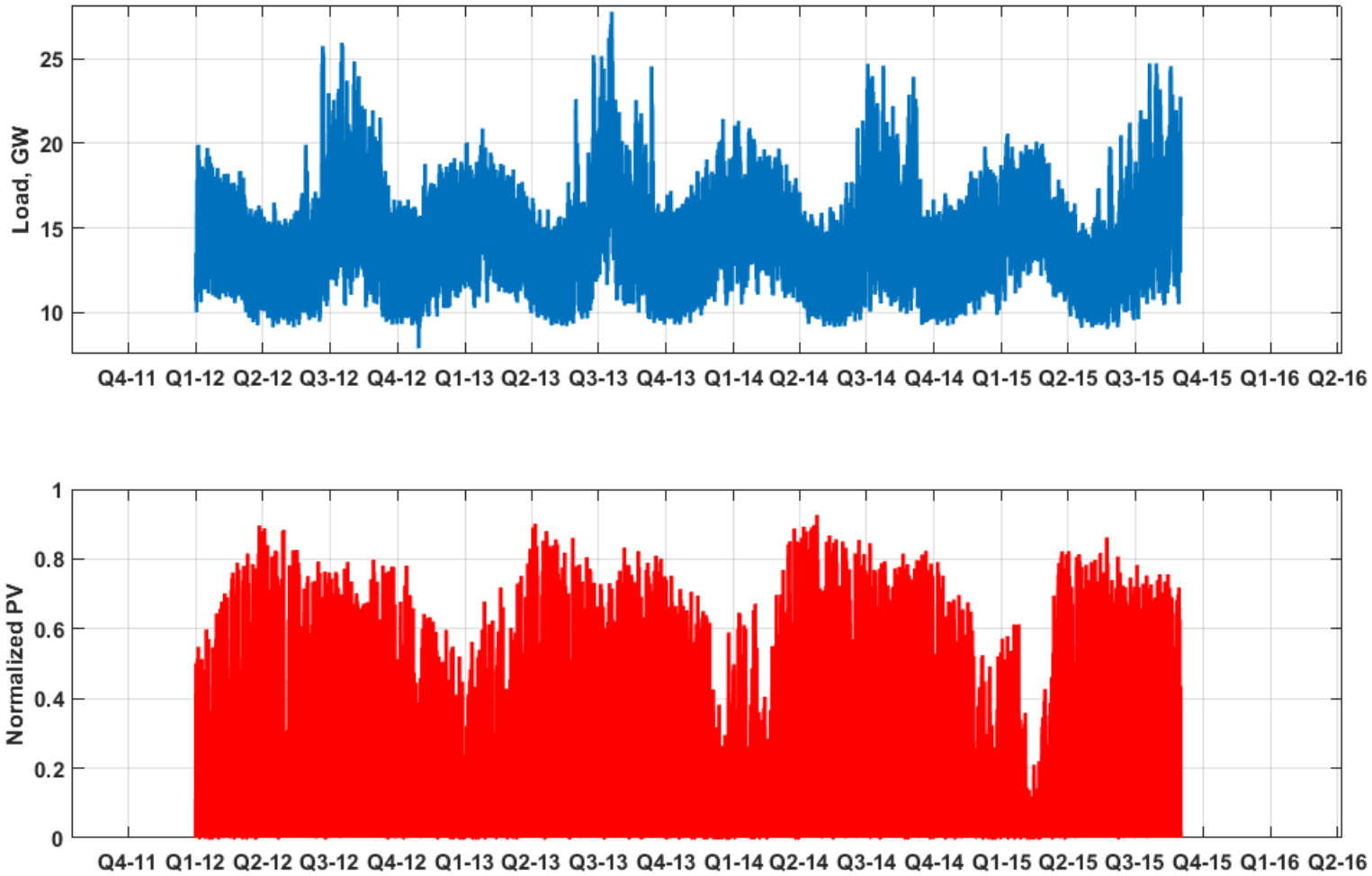


Net Load Simulation Method *continued*

- Existing PV system design and technology trends are not anticipated to change *significantly* over the next decade.
  - It is assumed that upscaling of these profiles yields a reasonable estimate of future profiles associated with larger PV fleets that is adequate for simulation purposes
- Hourly load profiles were first reconstituted for active demand response as well as BTM PV in existence during the historical period used
- Hourly net load profiles were then calculated by subtracting calculated production from increasing amounts of PV developed in 200 MW (AC nameplate) increments up to 8,000 MW
- Slides 11-13 show resulting characteristic seasonal daily profiles for 1GW increments of PV

Hourly Reconstituted Loads and Normalized PV

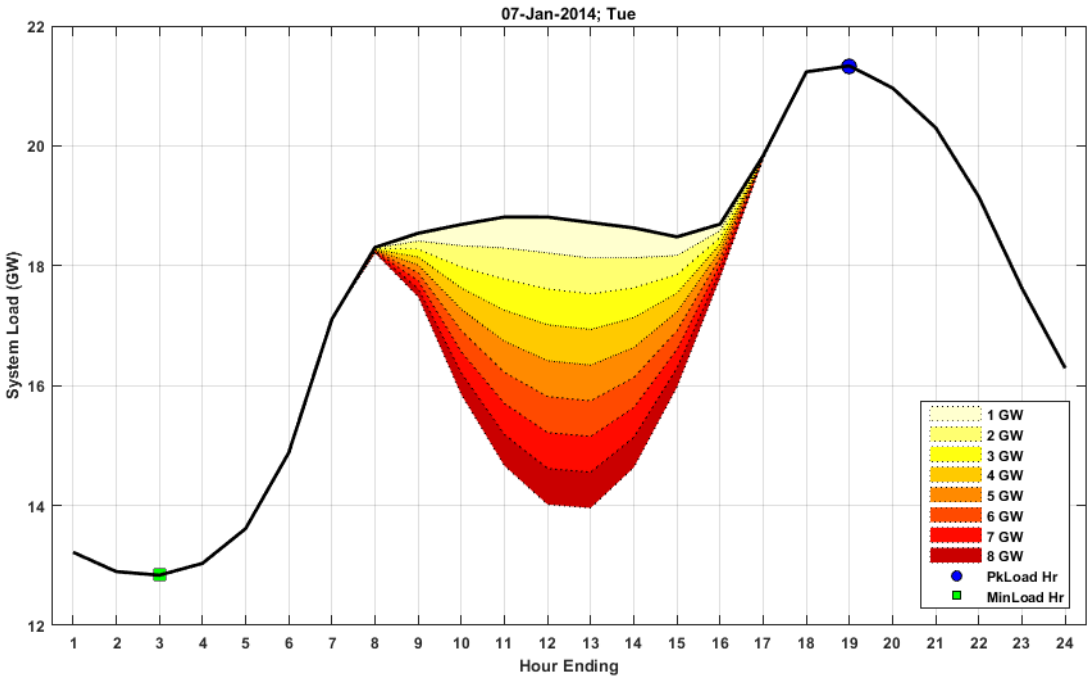
1/1/2012 – 8/31/2015



NET LOAD SIMULATION – RESULTS

Winter Season Net Load Profile

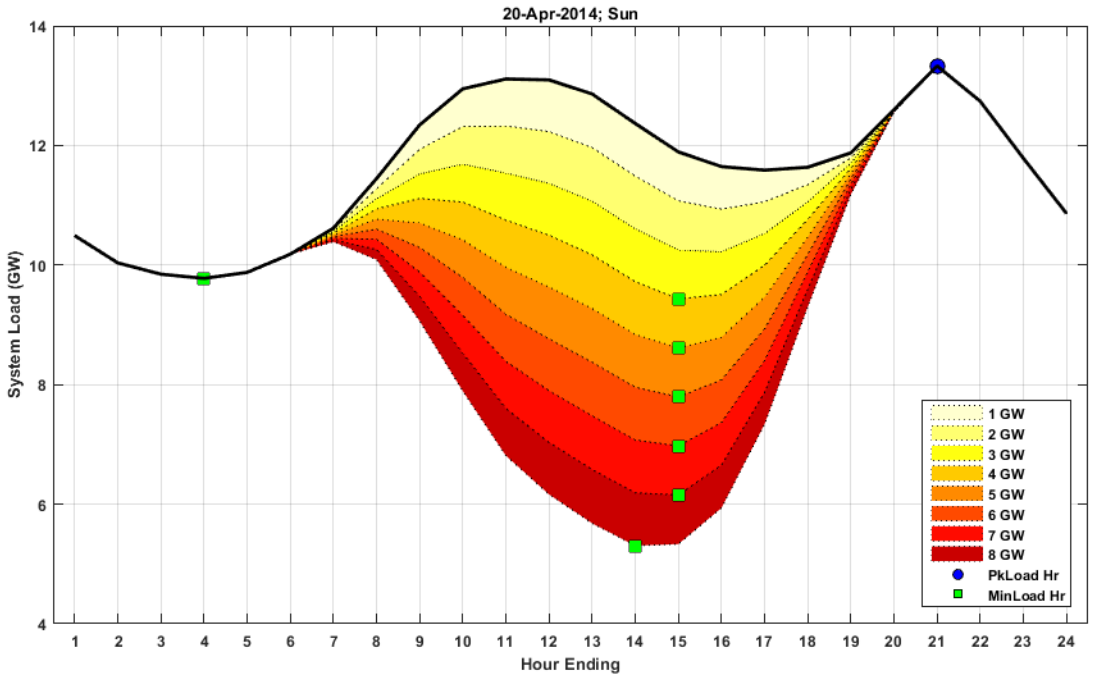
Tuesday, January 7, 2014



- PV does not reduce winter peak
- Load reductions from PV can be significant during midday hours on sunny winter days
- High PV penetrations will increase the need for ramping capability throughout sunlight hours

Shoulder Season Net Load Profile

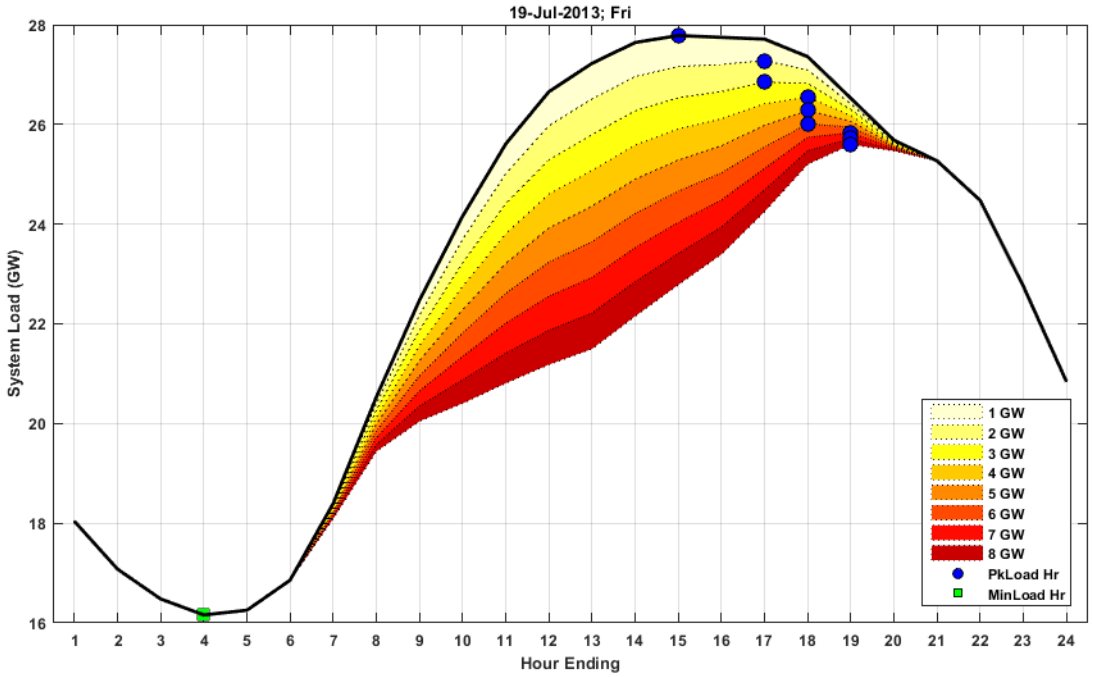
Sunday, April 20, 2014



- Profile sometimes referred to as the “Duck Curve”
- Lowest loads often occur on weekend days during spring/autumn and low demand for heating/cooling
- Increased PV will displace significant amounts of synchronous generation
- Potential minimum generation emergency events during midday hours (minimum load hours are shown in green)

Summer Season Net Load Profile

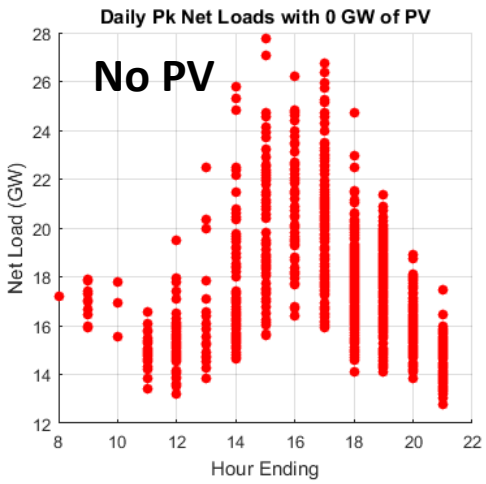
Friday, July 19, 2013

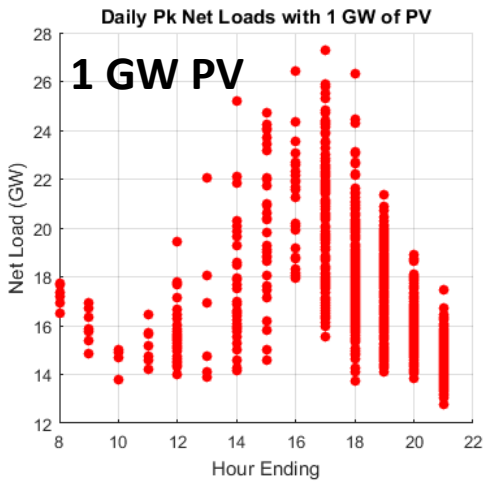


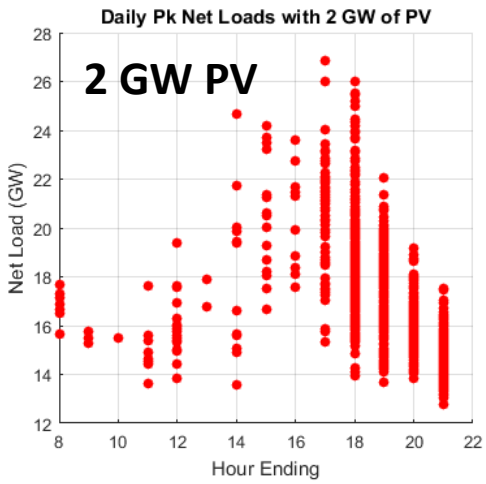
- As PV penetrations become higher:
  1. The timing of peak net loads (blue dots) becomes later in afternoon/evening
  2. Each successively larger PV scenario contributes less to serving summer peak net loads (which now occur later in the day), due to the setting of the sun
- The 2016 PV forecast incorporated results of analysis showing expected diminishing reductions of future summer peak loads due to PV (refer to slides 71-90 here: http://www.iso-ne.com/static-assets/documents/2016/05/2016_pvforecast.pdf)

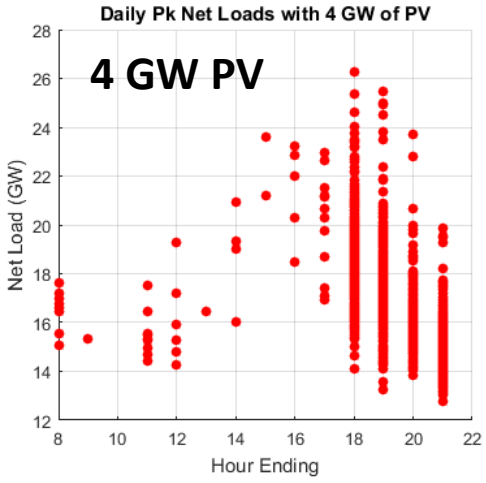
Magnitude and Timing of Summer Peak Net Loads

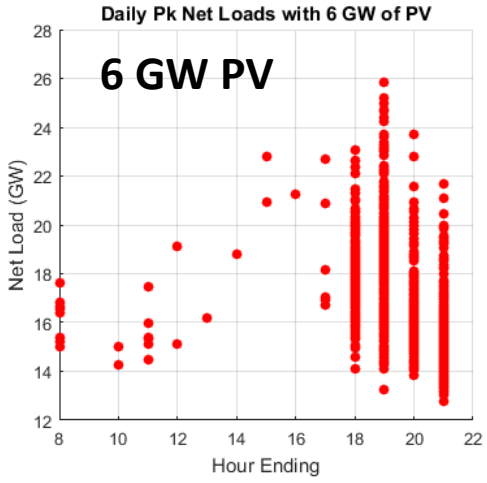
Daily Peak Net Loads – Jun-Sep, 2012-2015

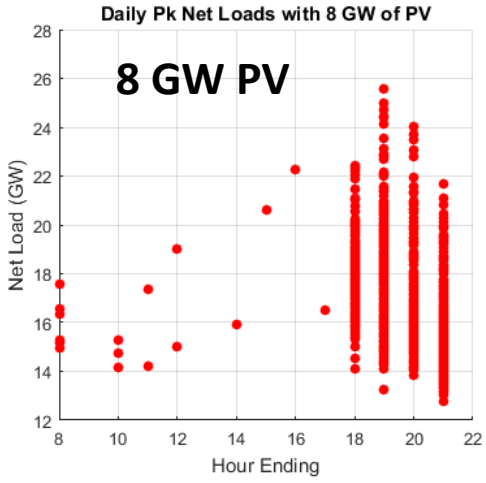










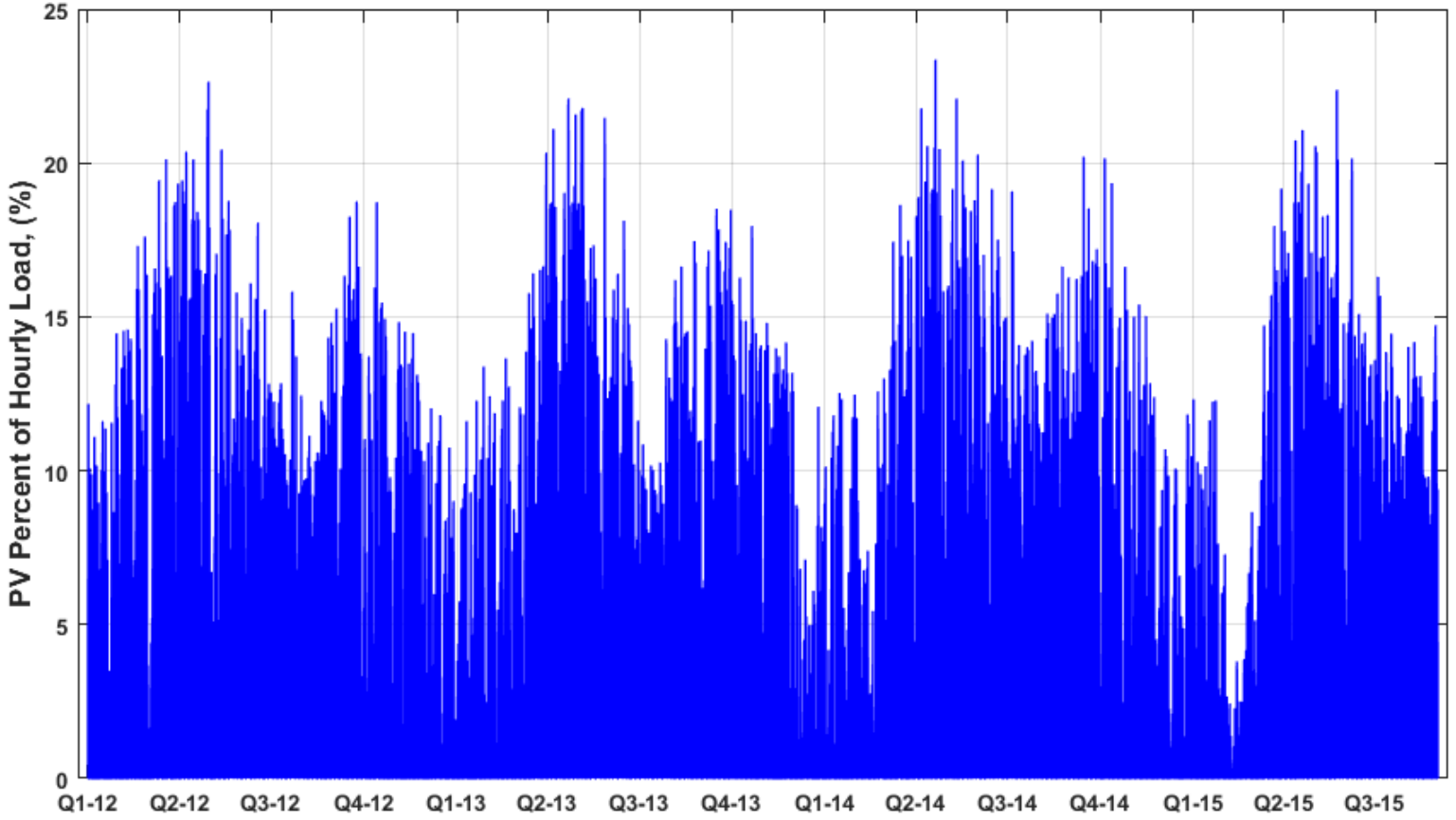


PV Contribution to Serving Load

- Based on the PV production data described on slide 7 PV in aggregate is estimated to have an annual capacity factor of ~14.1%
- An estimated profile associated with the 2025 PV total nameplate forecast (3,272 MW_{ac}) was developed and compared to hourly and daily loads (shown on next slides)

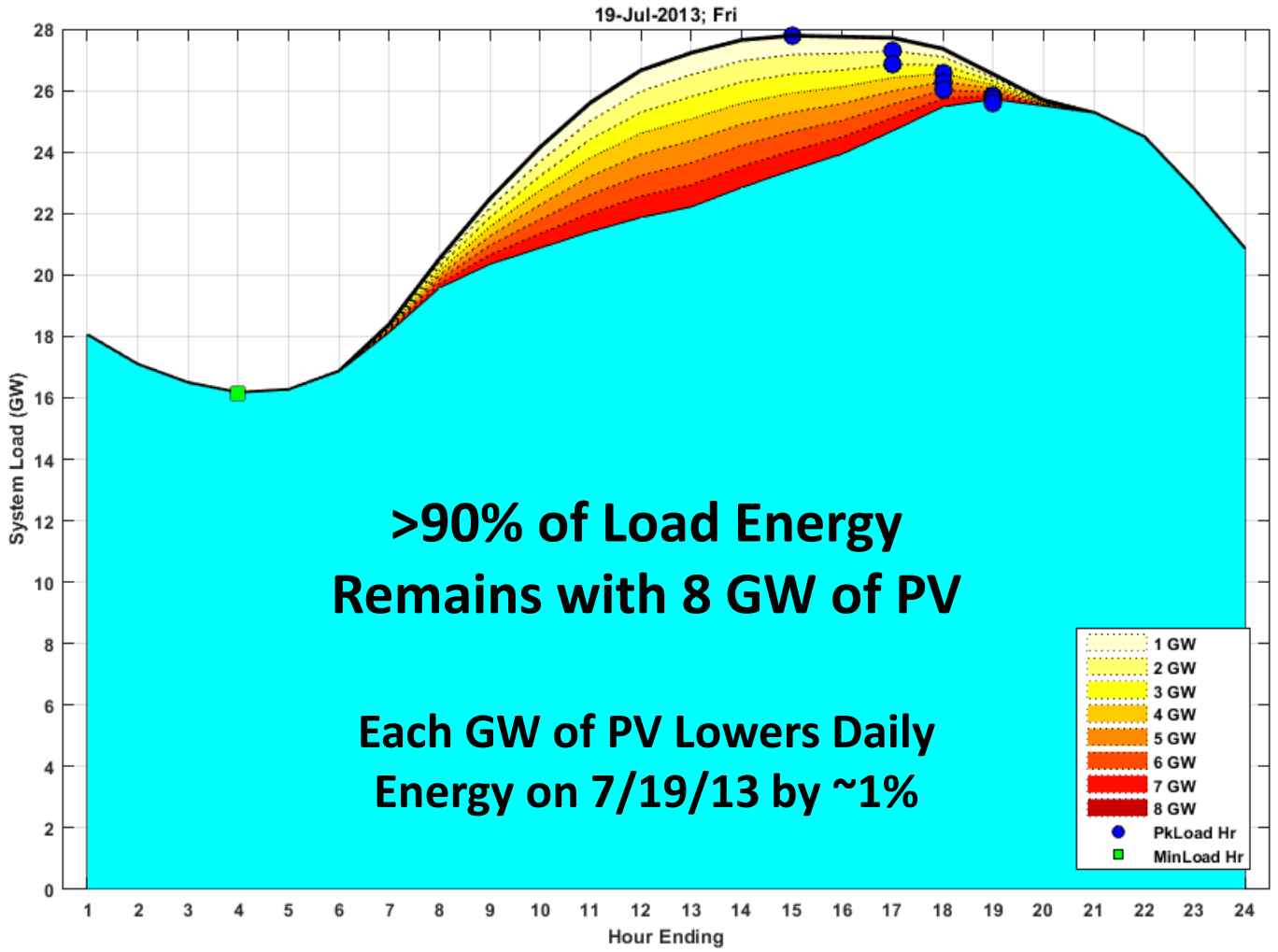
Contribution of PV to Hourly Loads

Assumes 2025 Total PV Forecast (3,272 MW_{ac} Nameplate)



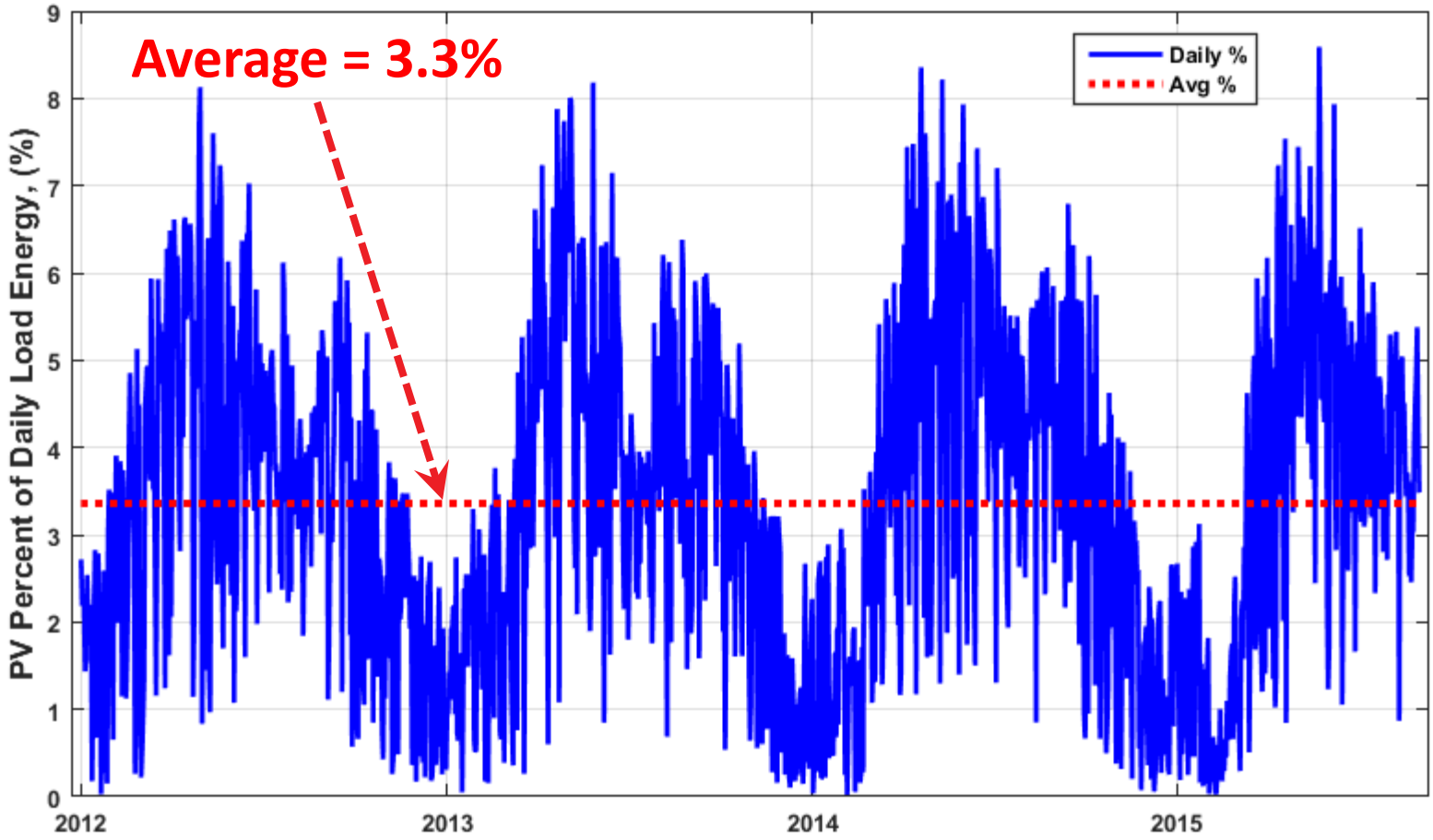
Summer Season Net Load Profile

Zoomed Out – July 19, 2013



Contribution of PV to Daily Load Energy

Assumes 2025 Total PV Forecast (3,272 MW_{ac} Nameplate)



Conclusions

- Large-scale PV that is installed “behind-the-meter” will significantly impact the regional load profile
- The amount of PV forecast for 2025 could serve more than 20% of hourly loads during light loads and ~3.3% of annual energy
- Results of net load simulation shows the following key changes:
  - Increased potential for minimum generation emergency events during light load conditions
  - Shifting of the timing of summer peak loads to later in the day outside of summer reliability hours
  - Overall increase in load ramping during all seasons

Questions