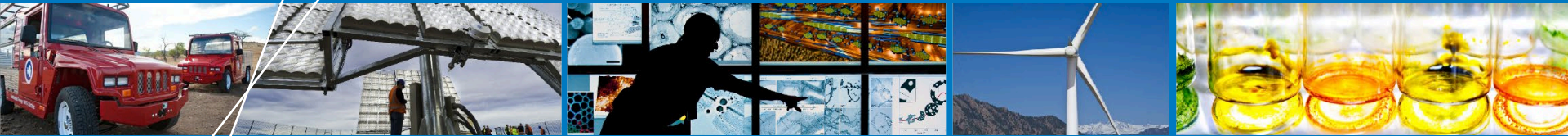# Review of the dWind Model Conceptual Results

Ian Baring-Gould

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**Robert Preus**

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WINDExchange Webinar - September 16, 2015

What Is This Model?

- **This model simulates consumer purchase decisions based on economics and consumer behavior.**
- **It models large consumer populations on a statistical basis, applied to high-resolution wind data.**
- **It is not a siting tool and covers only distributed wind (DW) associated with a customer load.**
  - Community wind is not covered.
  - Wind gardens are not covered.
  - Of 842 MW of DW, 45% is behind the meter.
- **Permitting and zoning barriers are not directly modeled.**
  - Population density is used as a proxy for siting exclusions and height restrictions.

Purpose/Background

- **Simulate DW market growth through 2050**
  - Simulates customer purchase decisions
- **Explore market impacts of:**
  - Price changes
  - R&D improvements
  - Available incentives and net energy metering policies
  - Electricity rates and rate structure
  - Customer behavior.
- **Create a strategy for the future of DW**
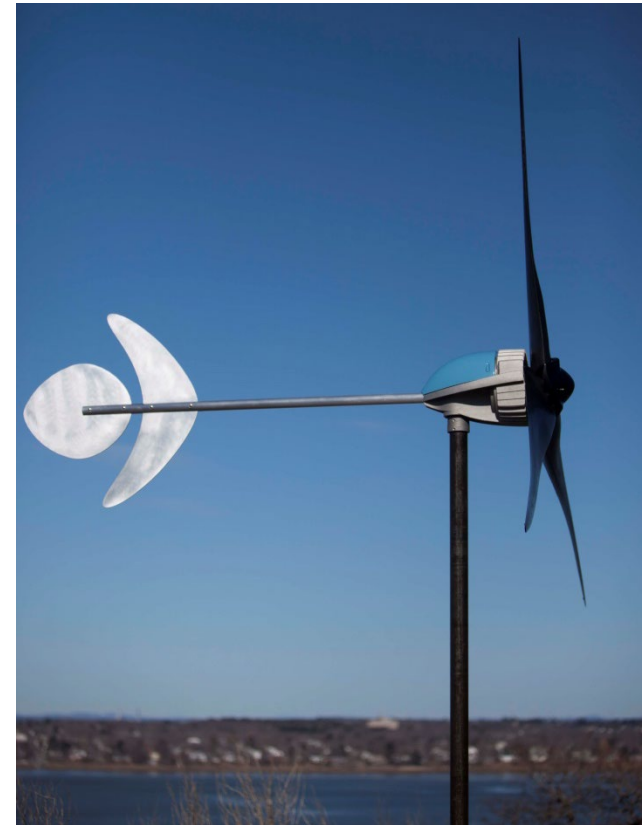
Photo by Pika Energy, Inc., NREL 31729

Status

Work to date has focused on model verification and defining the base case, not on scenario analysis. **We feel the model is performing as expected**, but we are still working to understand how changes in the input data are reflected in model output.

Recent improvements:

- Incorporated utility rate structures and expanded siting considerations
- Updated financing assumptions based on industry-solicited input
- Aligned payback period and cash flow calculations with solar model
- Updated wind turbine performance curves
- Identified initial sensitivities simulations
  - Cost, financing, performance, and parcel size limits
- Completing reference and sensitivity studies and detailed overview of specific model components.

Draft Reference Case Assessment and Results

Photo by Evan Osler, NREL 14660

Preliminary Results

- **Initial draft results have been primarily for model validation.**

- **Reference case still needs internal and industry vetting.**

- **Primary open issues for reference case:**
  - Assumptions on incentives
  - Technology cost reductions
  - Financial assumptions.

Reference Case Assumptions

Contiguous United States for residential, commercial, and industrial markets:
- *Installed costs:* Adapted from Distributed Wind Market Report, other PNNL data, and detailed feedback from industry partners
- Load growth: AEO2015 Reference Case
- Rate structures: Complex rates based on URDB
- Rate escalations: AEO2015 with continued growth after 2040
- Net metering: Current policy – incorporated in most states with generally low limits but all net metering expires when defined or by 2030
- *Incentives:* Based on 2013 DSIRE data; ITC expires in 2016; state incentives expire when specified or in 2024
- Carbon price: None
- Siting: High-resolution tree cover, population density, and lot size data incorporated
- Performance improvement: Projected BAU improvements, being vetted with industry
- *Finance:* Fairly liberal, based on solar base assumptions; host-owned and third-party ownership allowed.

Notes:
- Utility rate escalations do not include EPA Climate Plan impact
- Reference model information for Alaska and Hawaii has not been developed.

Collative Installed Capacity

Largest growth is in the industrial sector – typically using larger turbines – with growth in commercial and residential as market economics improve.
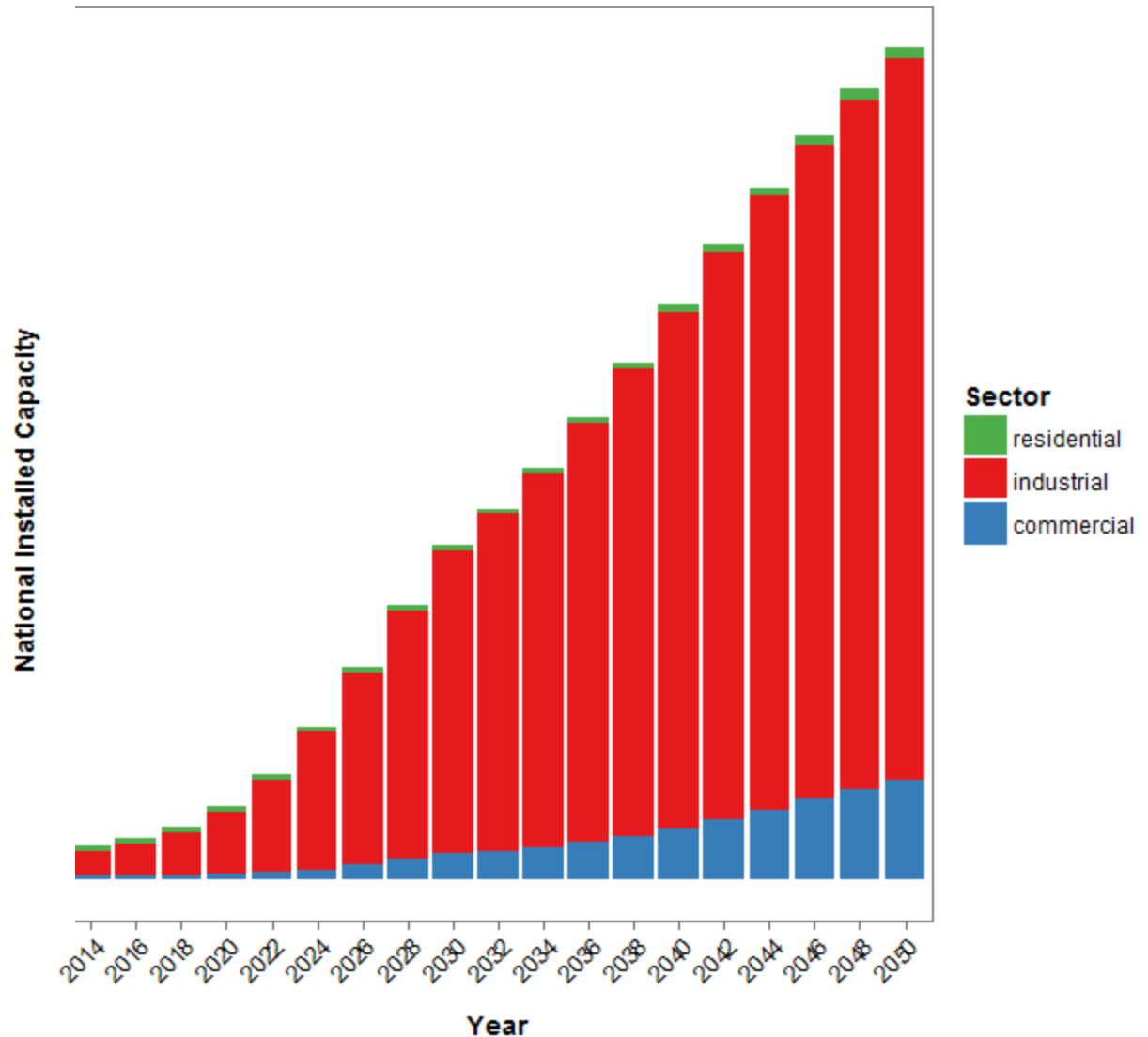
Annual Deployments

Initial market development driven by policy and incentives

- ITC has little impact because it ends in 2016

- State incentives cap out in 2024 – top off curve

- Pull back due to the expiration of net metering in 2030

- Higher costs of power kicking in ~2030 cause market to rebound through 2040

- Lack of technology improvement post-2040 cause the roll off as the best sites are built
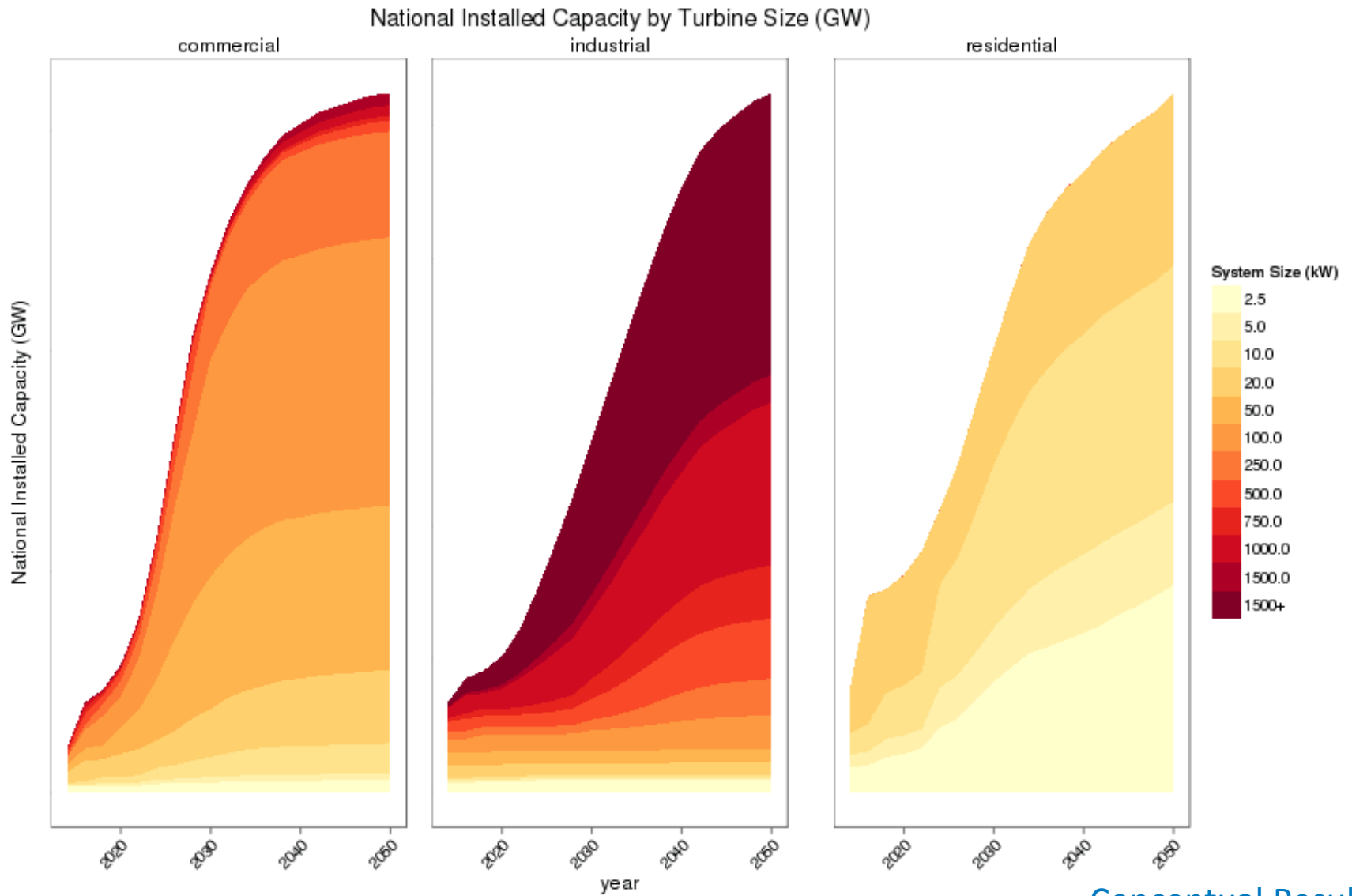

Sector
- Residential
- Industrial
- Commercial
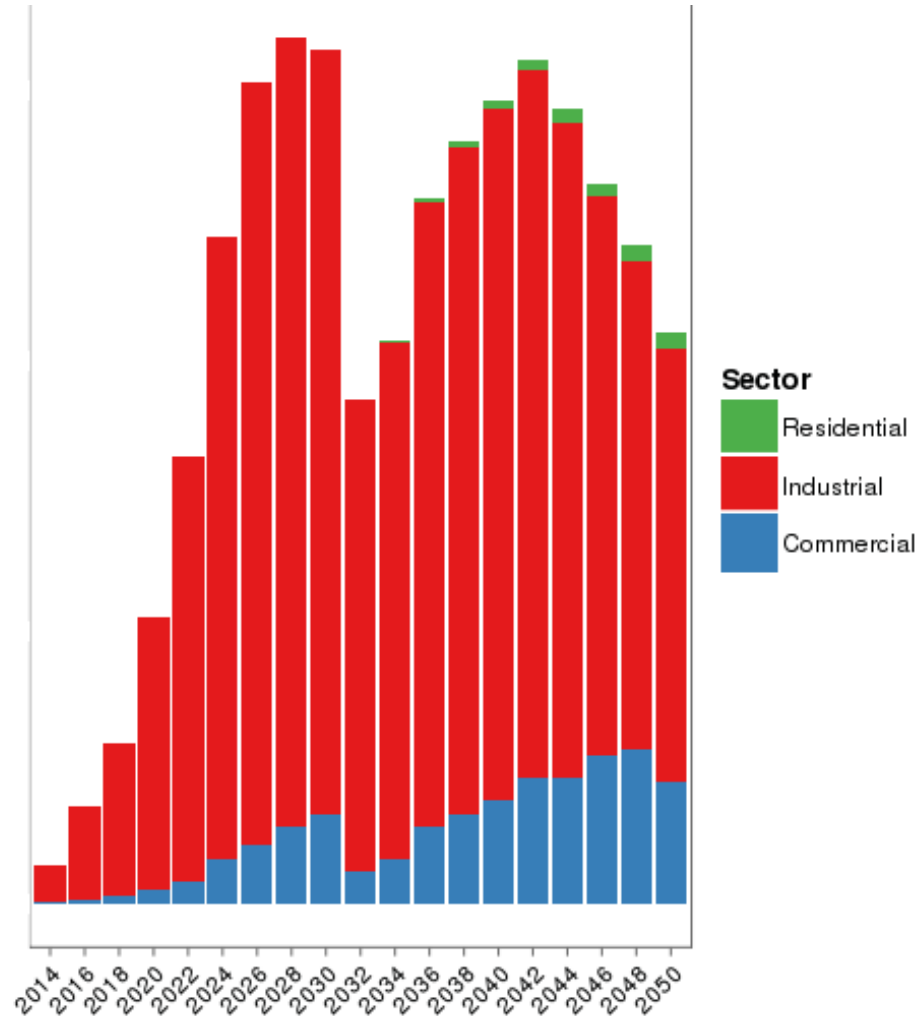
Conceptual Results

Annual Turbine Sales
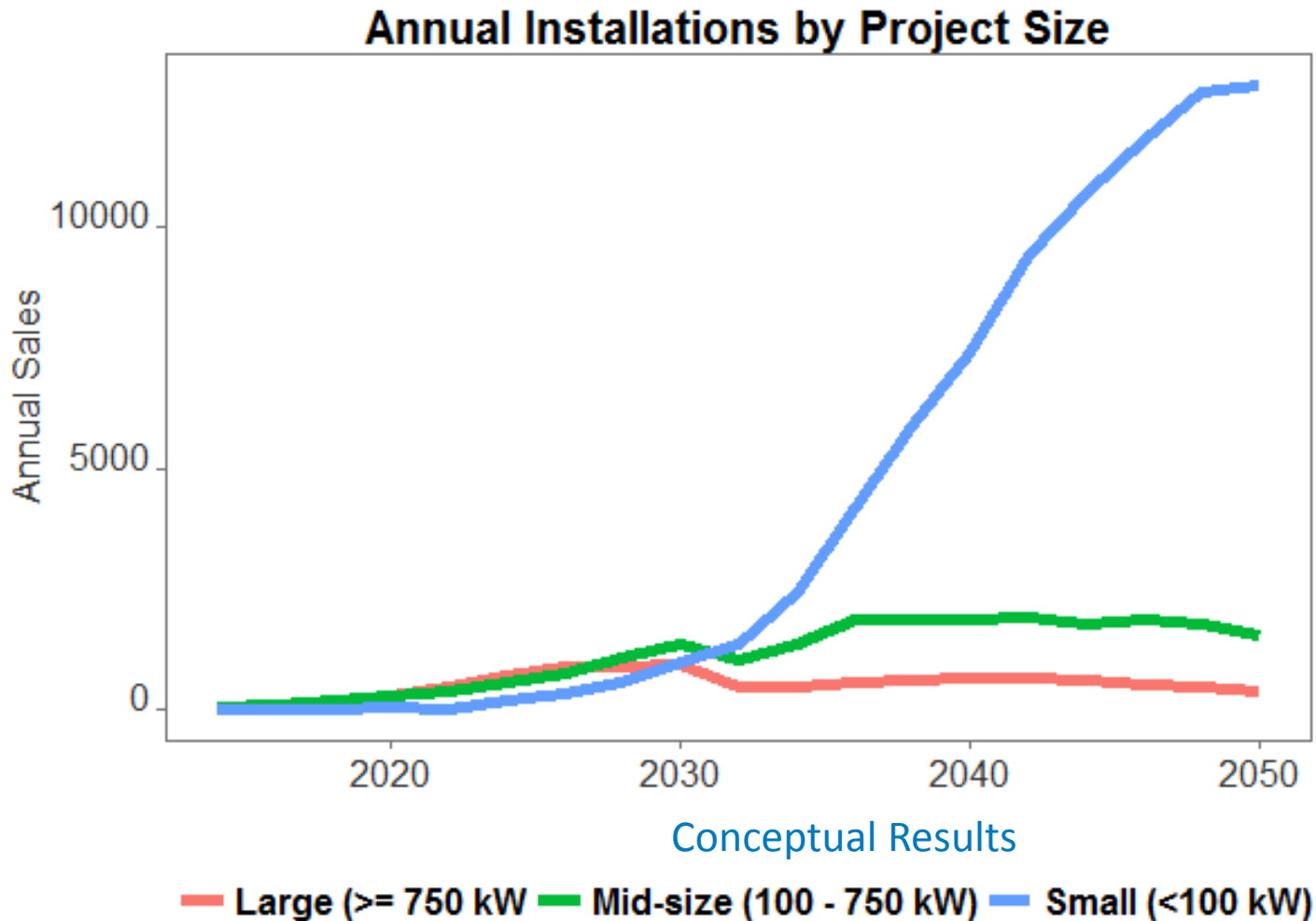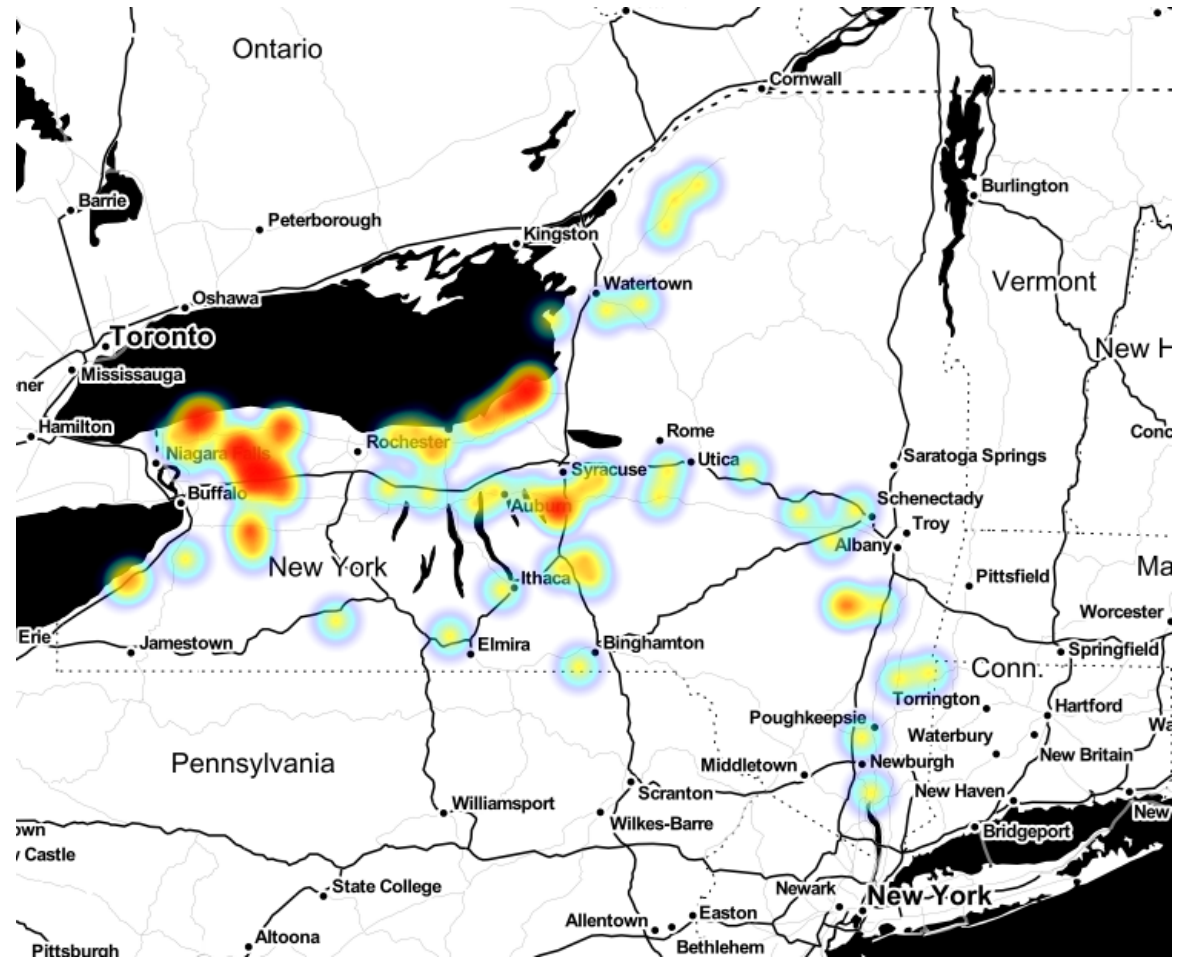
Cumulative Installed Capacity by System Size

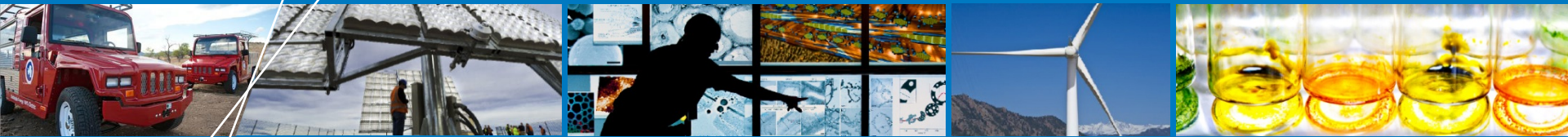National Installed Capacity by Turbine Size (GW)

Conceptual Results

Model Outputs: State Heat Maps

Heat maps of potential markets can help identify areas with better project dynamics.

Conceptual Results

What's Next

What's Next

- **Finalize reference case and initial sensitivity analysis (next few weeks)**
- **Review with industry (next few weeks)**
- **Publish summary results (October)**
- **Define market scenarios (November)**
- **Publish model documentation (December)**
- **Publish market scenarios (Winter)**
- **Additional analysis as appropriate (Spring)**
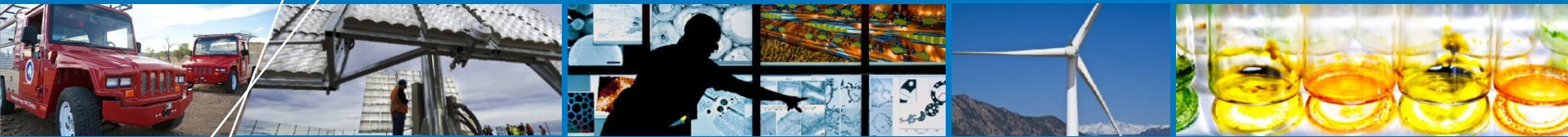- **Develop DW strategy with industry and DOE (FY17)**

Thank You

Questions

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