



# NARUC

*Summer Committee Meetings*

# Staff Subcommittees on Electricity & Electric Reliability



# Vermont Weather Analytics Center

Helping to make  
Renewable Energy  
Reliable



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# Extreme weather a top global risk

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological

2011                      2012                      2013                      2014                      2015                      2016

Storms and cyclones

Severe income disparity

Severe income disparity

Income disparity

Interstate conflict with regional consequences

Large-scale involuntary migration

Flooding

Chronic fiscal imbalances

Chronic fiscal imbalances

Extreme weather events

Extreme weather events

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Corruption

Rising greenhouse gas emissions

Rising greenhouse gas emissions

Unemployment and underemployment

Failure of national governance

Failure of climate-change mitigation and adaptation

Biodiversity loss

Cyber attacks

Water supply crises

Climate change

State collapse or crisis

Interstate conflict with regional consequences

Climate change

Water supply crises

Mismanagement of population ageing

Cyber attacks

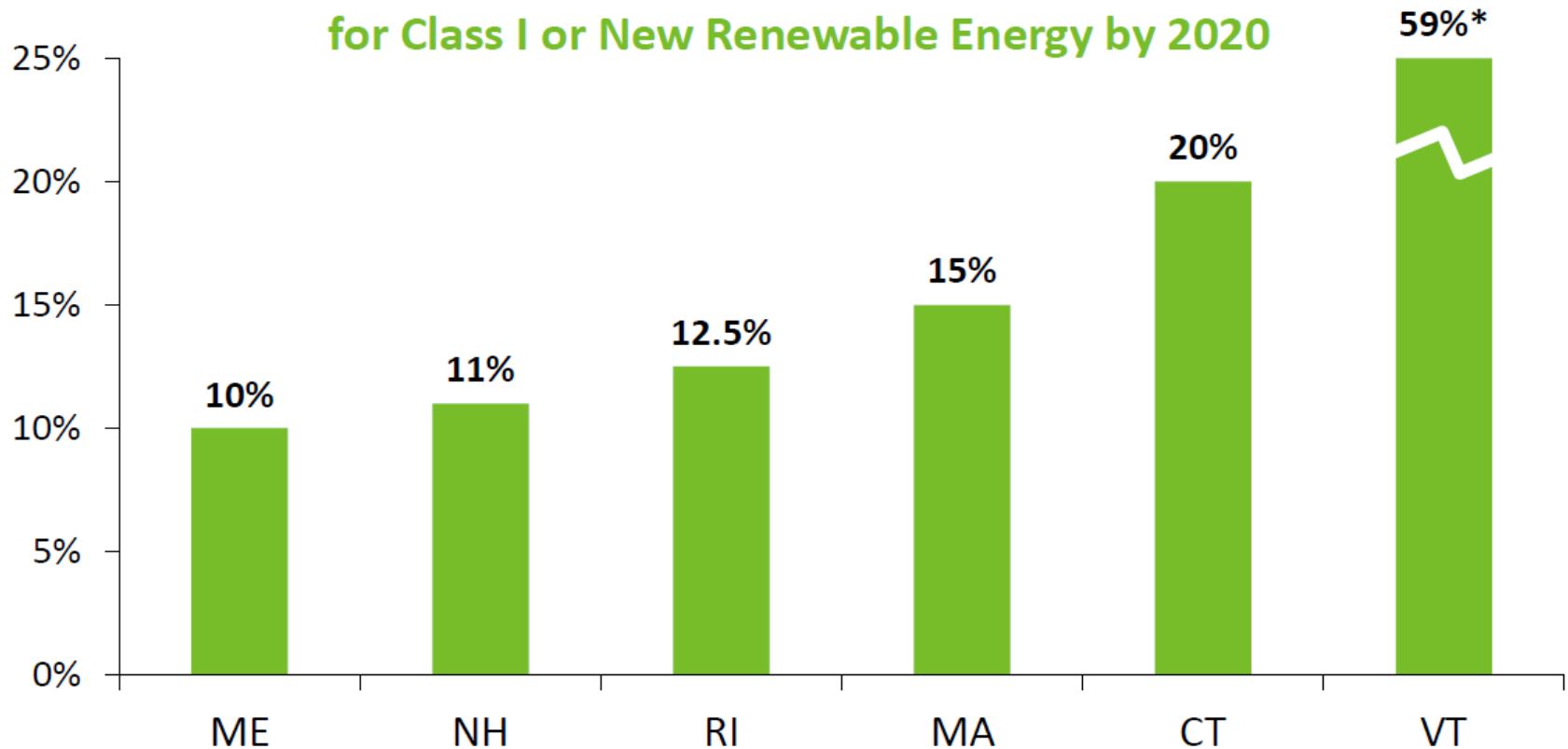
High structural unemployment or underemployment

Major natural catastrophes

Source: World Economic Forum

# State Policy Requirements Drive Proposals for Renewable Energy

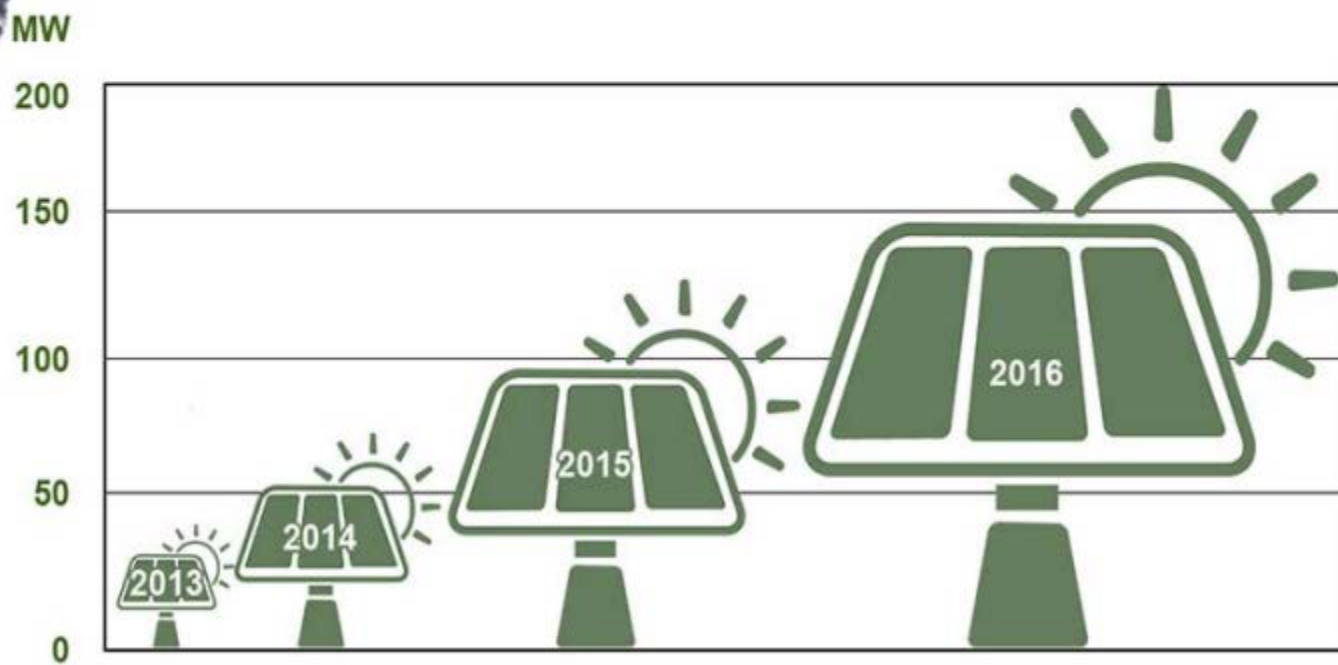
**State Renewable Portfolio Standard (RPS)\*  
for Class I or New Renewable Energy by 2020**



\* State Renewable Portfolio Standards (RPS) promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Vermont's new Renewable Energy Standard has a 'total renewable energy' requirement (reflected above), which recognizes large-scale hydro and all other classes of renewable energy.

**Source:** ISO-NE

By the end of 2016, installed solar is likely to equal 20% of Vermont's electric demand



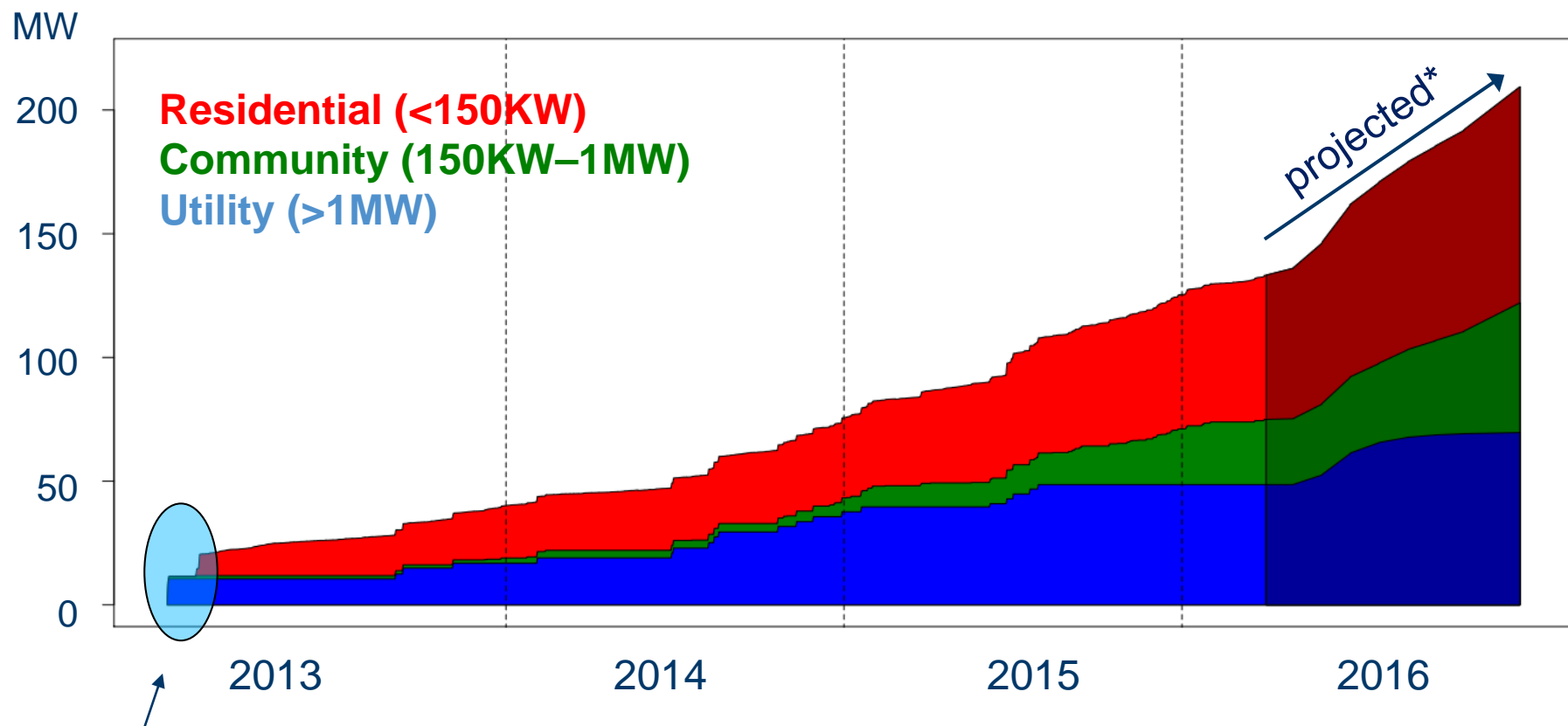
# Climate Change and Health in Vermont

## Climate-related effects already threaten Vermonters' health\*:

- Extreme weather events
- Heat-related illness and deaths
- Cyanobacteria (blue-green algae) blooms
- Rising tick-borne disease incidence
- Runoff from heavy rains polluting water bodies
- Increase in allergenic pollen

\*Source: Vermont Department of Health

# Rising sun — solar capacity growth accelerates



No AMI data  
available

\*Assuming the same growth as March-December 2015



# Vermont Weather Analytics Center

*A powerful weather, energy data and analytics platform built with IBM that utilizes four coupled models and leading-edge analytics to deliver the most precise and accurate wind and solar generation forecasts in the world. VWAC enables us to:*



Increase grid reliability, community resiliency



Lower weather event-related operational costs



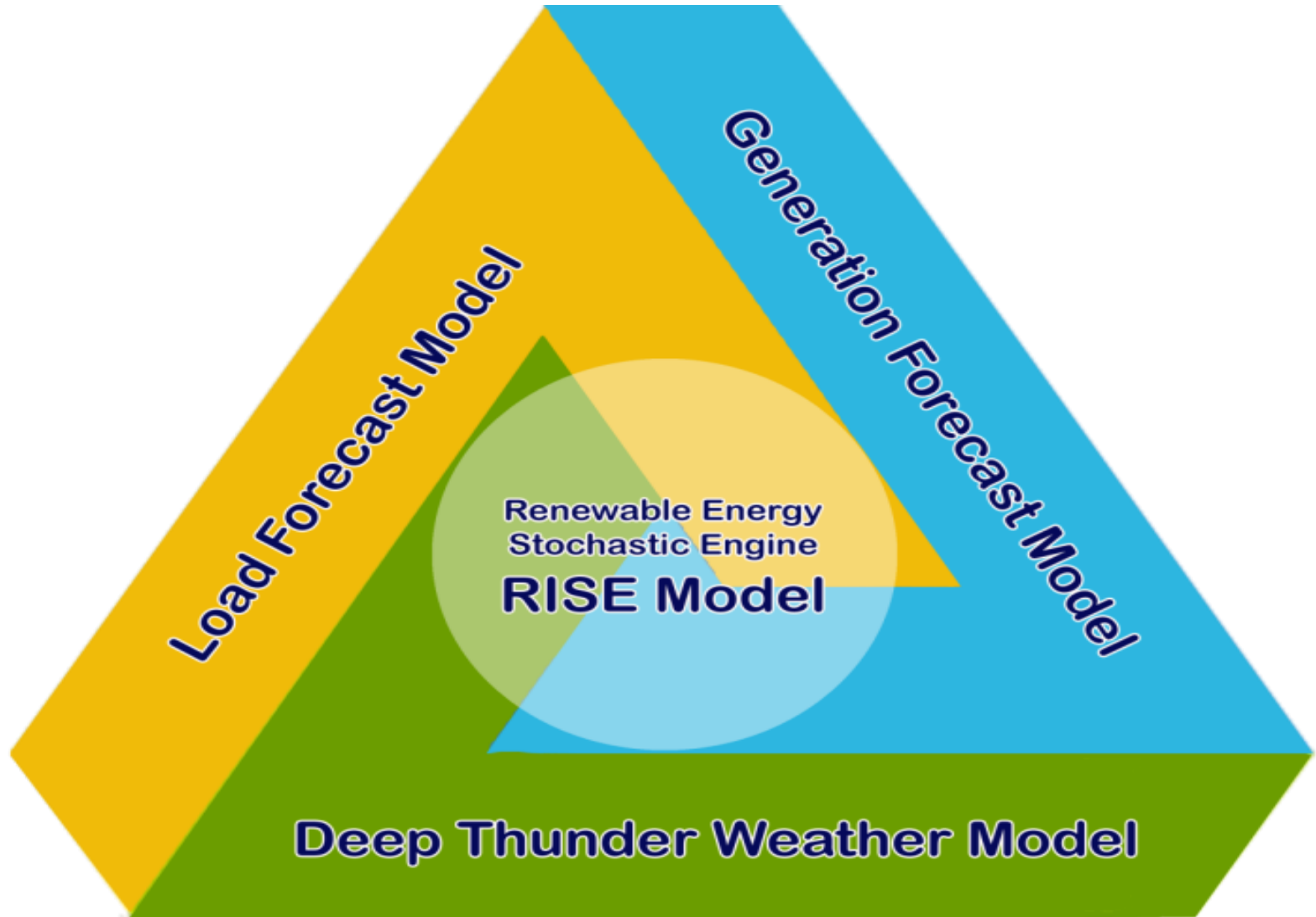
Garner full value from renewable generation





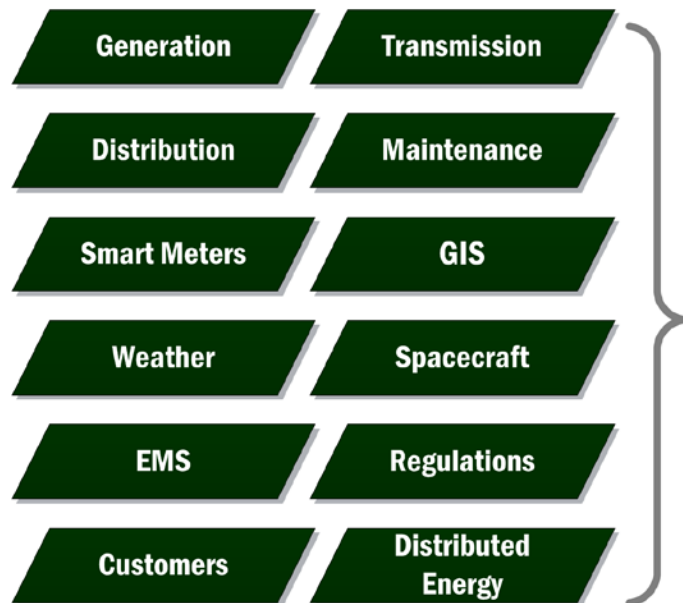
# Vermont Weather Analytics Center

## Four integrated models

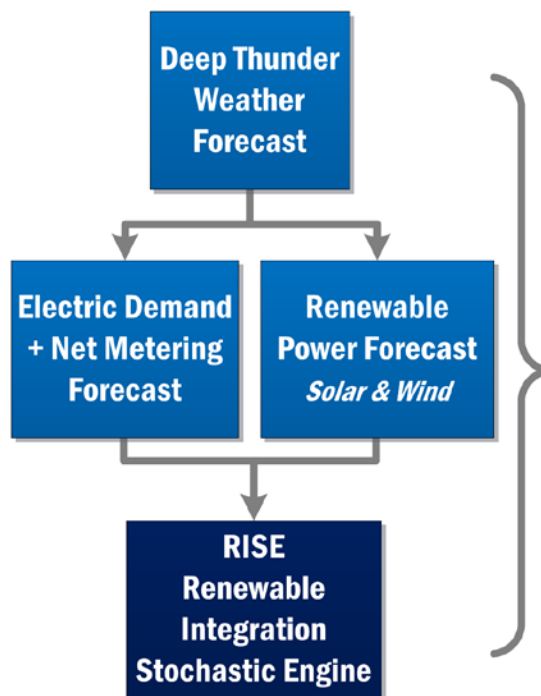


# Vermont Weather Analytics Center

## Data Sources



## VTWAC Models



## Outcomes



## Daily Data Volumes

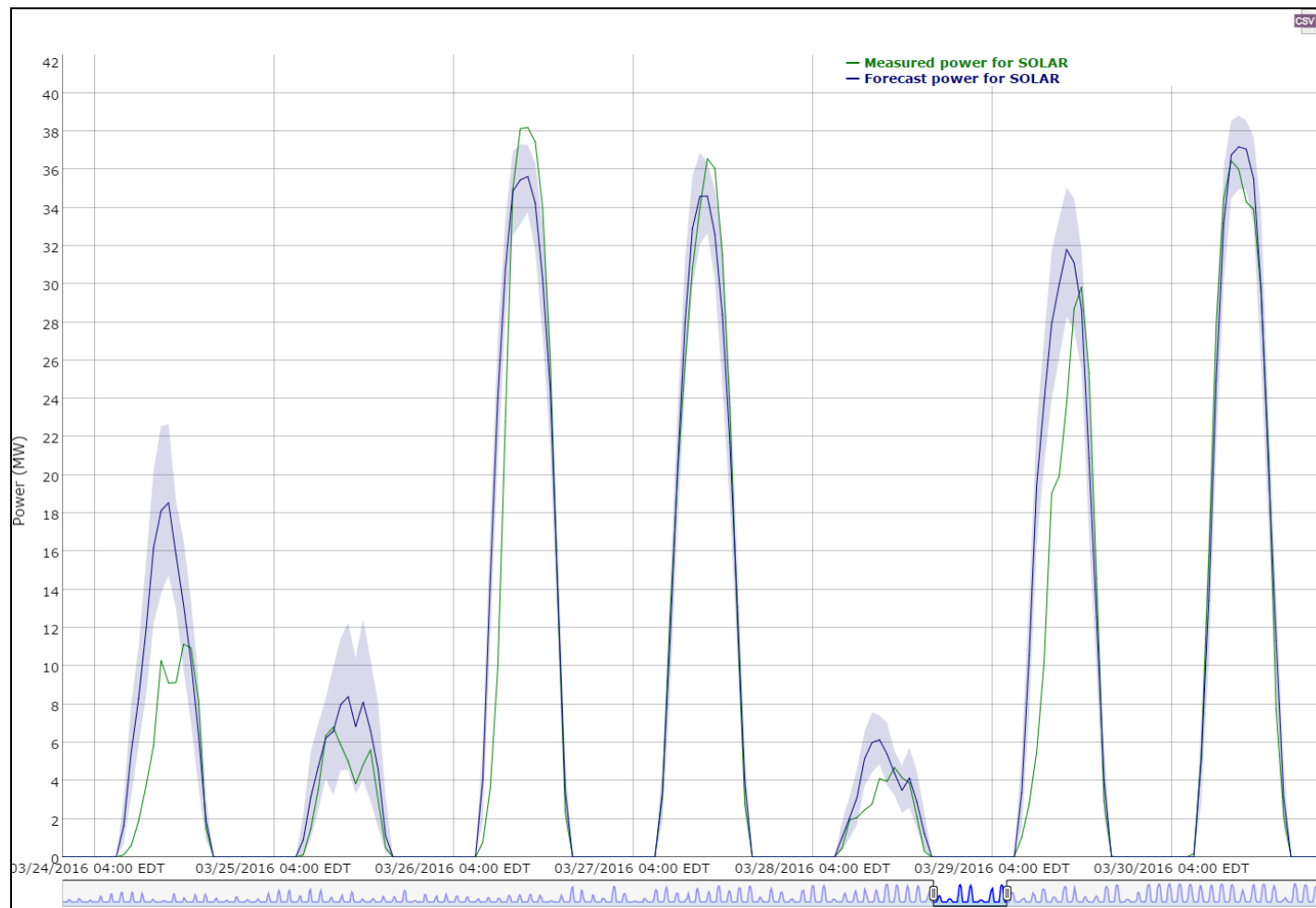
Model	Input	Output
Weather	5 GB	670 GB*
Solar	2 MB	15 MB
Wind	5 MB	3 MB
Demand	5 MB**	30 MB
RISE	20 MB	1.1 GB

\*50 GB drive downstream models

\*\*plus 5 GB smart meter data

# Accuracy

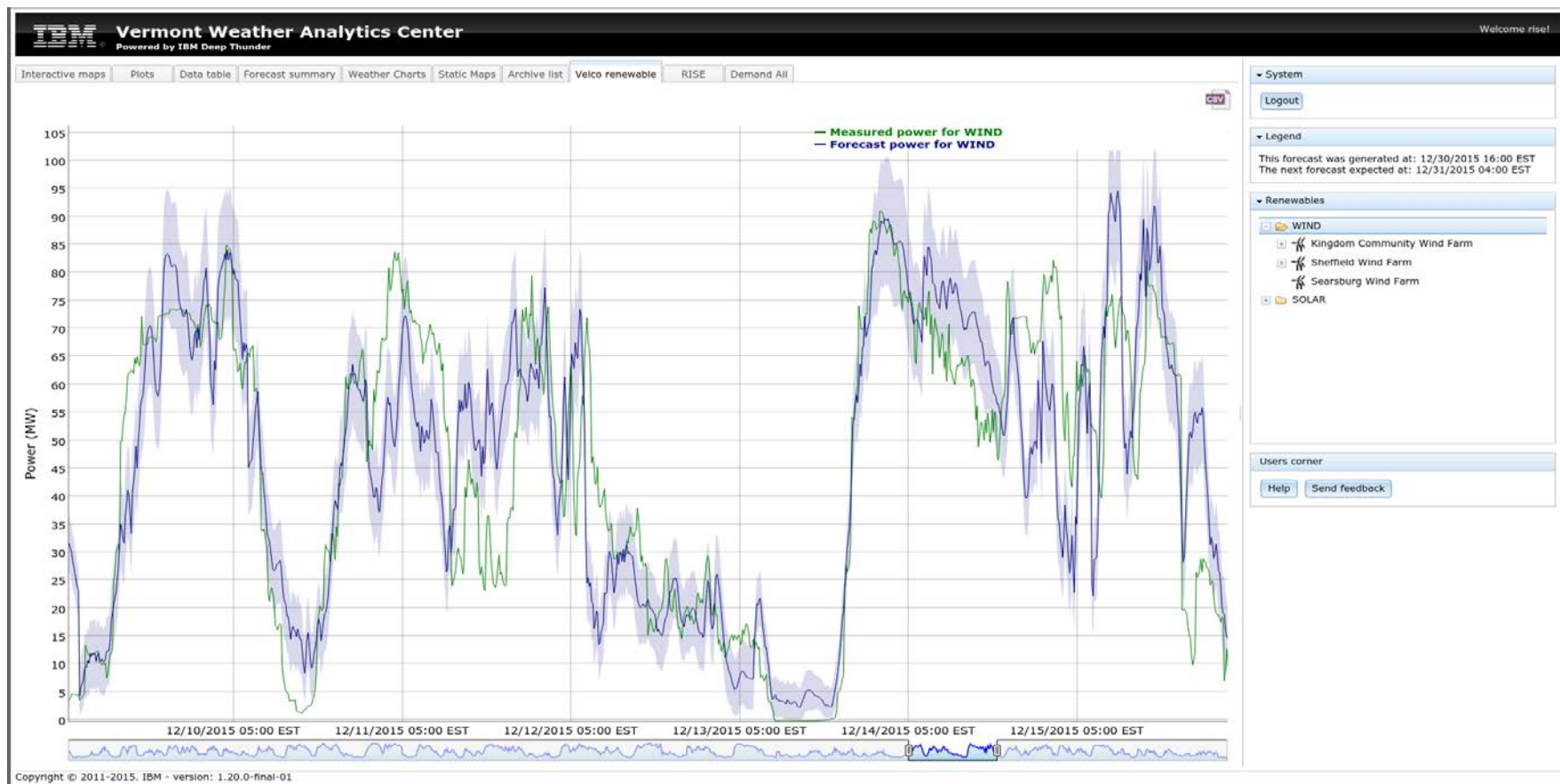
## Solar generation forecasts



**Solar power forecast accuracy = ~95% (20 farm aggregate)**  
(as of 3/2016)

# Accuracy

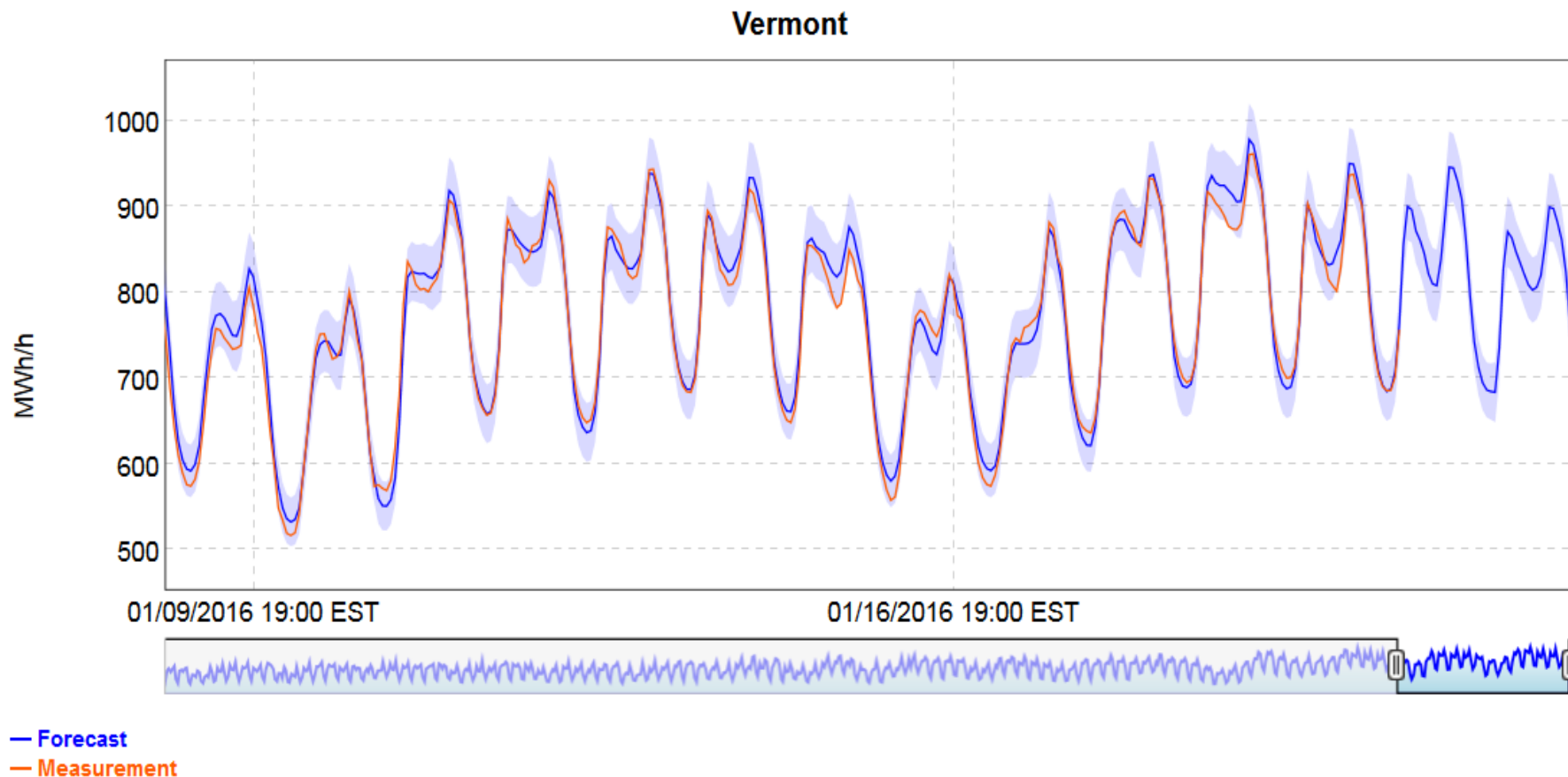
## Wind generation forecasts



**Wind power forecast accuracy = ~90%**  
(as of 3/2016)

# Accuracy

## Demand forecasts



Demand forecast accuracy - % Error (as of 3/2016)

**State: 2.3%**

**DUs: 2.6%**

**Substations: 3-8%**



# Demonstrated Benefits

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## Safety & reliability

- More informed emergency response
- Road condition updates
- Geographically targeted customer updates

## Operations

- Improved outage scheduling
- Ability to determine grid capacity for additional solar on the transmission system down to substation level
- Demand analysis capability to substation level

## Planning

- Increased reliability of planning assessments due to AMI data integration
- Improved Non-transmission alternative development

## Demand management

- Greater visibility to potential demand response events
- Increased peak management capability
- Efficiency measures validation



# Value Continues to Grow

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- Link VWAC data to VELCO's Energy Management System
- Deliver customized data streams to meet individual distribution utility needs
- **Finalize operational performance metrics**
- **Continue work with ISO New England for better renewables integration, forecasting and cost efficiency**

## In the future...

- **Link to VT emergency management, environmental and ag agencies for safety, water quality impacts, disaster cost recovery records, and more**
- Deliver weather intelligence for weather dependent businesses such as ski areas, agriculture, and tourism
- Monetize VWAC investment to further benefit customers

# Next steps – operationalize/quantify value



Improve core  
service delivery

Develop core  
competence  
independent  
of IBM

## VERMONT

Enable & complement  
grid transformation

Enhance renewables  
integration  
& operations

Secure  
collaborative  
value

## NEW ENGLAND

Uplift to ISO New England

Enhance grid  
effectiveness

Planning

Markets



**“Our great new adventure.”**



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