Power Connection: Vermont Weather Analytics Center Project

vermont electric power company

VELCO

Kerrick Johnson

VP—Strategy & Communication

kjohnson@velco.com

(802) 770-6166

Mission

VELCO manages the safe, reliable, cost-effective transmission of electrical energy throughout Vermont. Our goal is to provide an optimal system of electric transmission facilities as part of an integrated regional network designed to meet both current and future energy needs.

Vision

VELCO's vision is to serve as a trusted partner in all we do

Values

VELCO values people, safety, creativity and great work

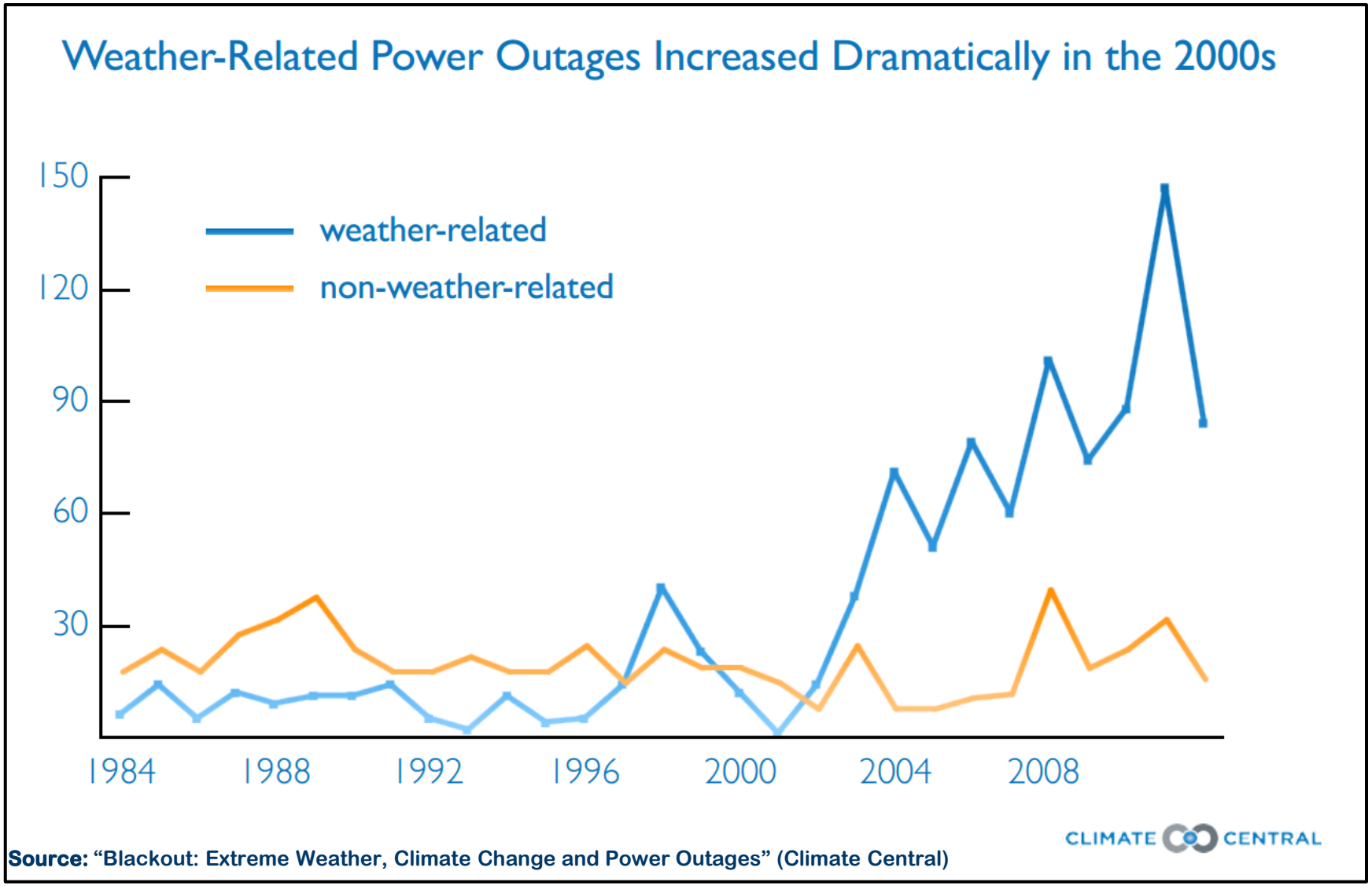
To live our values we…

- Treat everyone with respect
- Act with care
- Empower people
- Expect the best from everyone

Motives

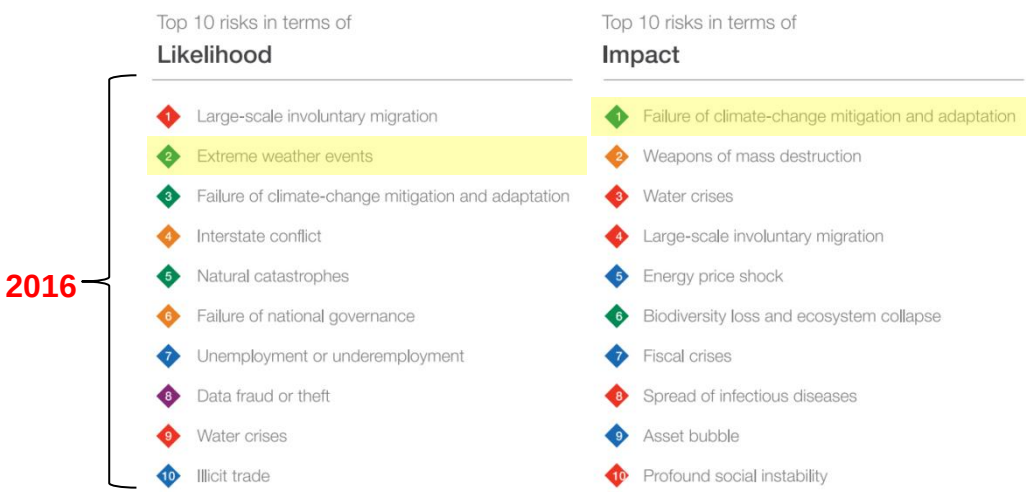
- Provide public benefit
- For-profit company structured to achieve cooperative goals

Extreme weather impacts



Source: "Blackout: Extreme Weather, Climate Change and Power Outages" (Climate Central)

Motivation
Global Risk Trends



Sharp increase in environmental risks starting in 2011

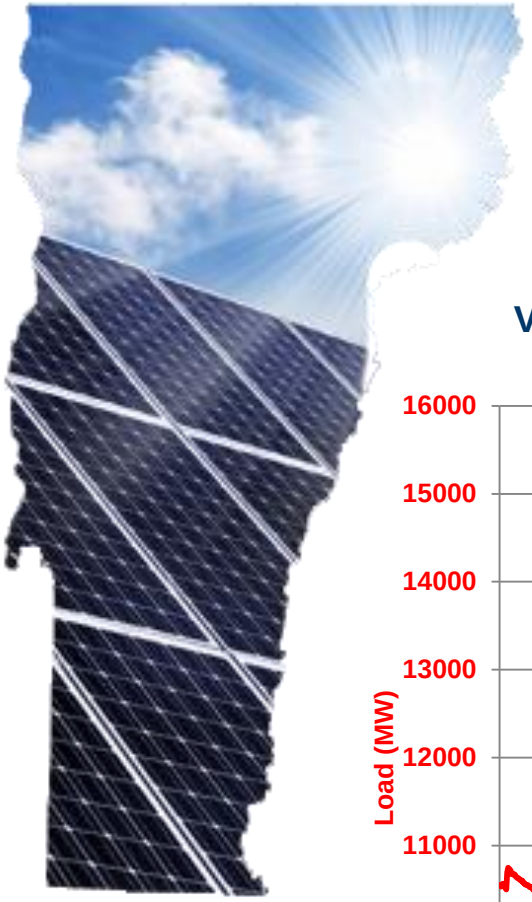
Top 5 Global Risks in Terms of Likelihood

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1st	Breakdown of critical information infrastructure	Asset price collapse	Asset price collapse	Asset price collapse	Storms and cyclones	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict with regional consequences	Large-scale involuntary migration
2nd	Chronic disease in developed countries	Middle East instability	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Flooding	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events	Extreme weather events
3rd	Oil price shock	Failed and failing states	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment and underemployment	Failure of national governance	Failure of climate-change mitigation and adaptation
4th	China economic hard landing	Oil and gas price spike	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber attacks	Water supply crises	Climate change	State collapse or crisis	Interstate conflict with regional consequences
5th	Asset price collapse	Chronic disease, developed world	Retrenchment from globalization (emerging)	Global governance gaps	Climate change	Water supply crises	Mismanagement of population ageing	Cyber attacks	High structural unemployment or underemployment	Major natural catastrophes

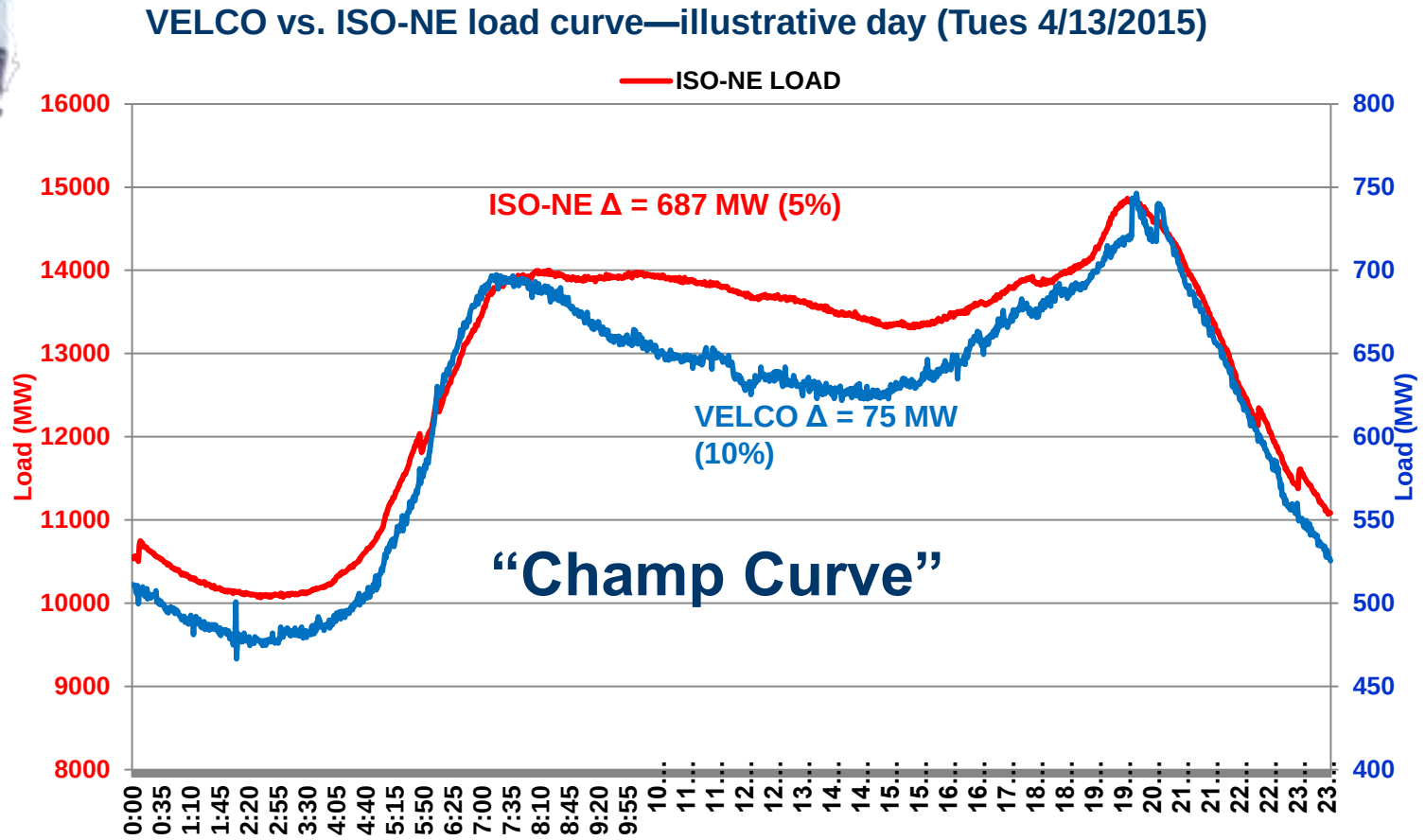
Economic Environmental Geopolitical Societal Technological

Source: World Economic Forum

5



Boom in distributed solar is already changing VT's load shape



VTWAC Project overview

The Vermont Weather Analytics Center (VTWAC) is an innovative, two-year, $16M project to develop an energy data and analytics platform that utilizes linked data, coupled models and leading-edge analytics to deliver actionable information. Its purpose is to **increase grid reliability**, **lower weather event-related operational costs** and **optimize utilization of renewable generation resources.**

Uses four models:

- **Deep Thunder:** to produce accurate weather forecasts up to 72 hours in advance down to 1 km² —lower weather event costs
- **Demand Forecast Model:** to increase accuracy of state load forecasts—better plan for future needs
- **Renewable Forecast Model:** to produce generation forecasts for solar and wind farms—improve power supply/planning
- **Renewable Integration Stochastic Engine (RISE):** to integrate the models' results to optimize the value of Vermont's generation, demand response, and transmission assets

VT Weather Analytics Center benefits

Safety/reliability— more precise, localized weather prediction

Operations—better preparedness

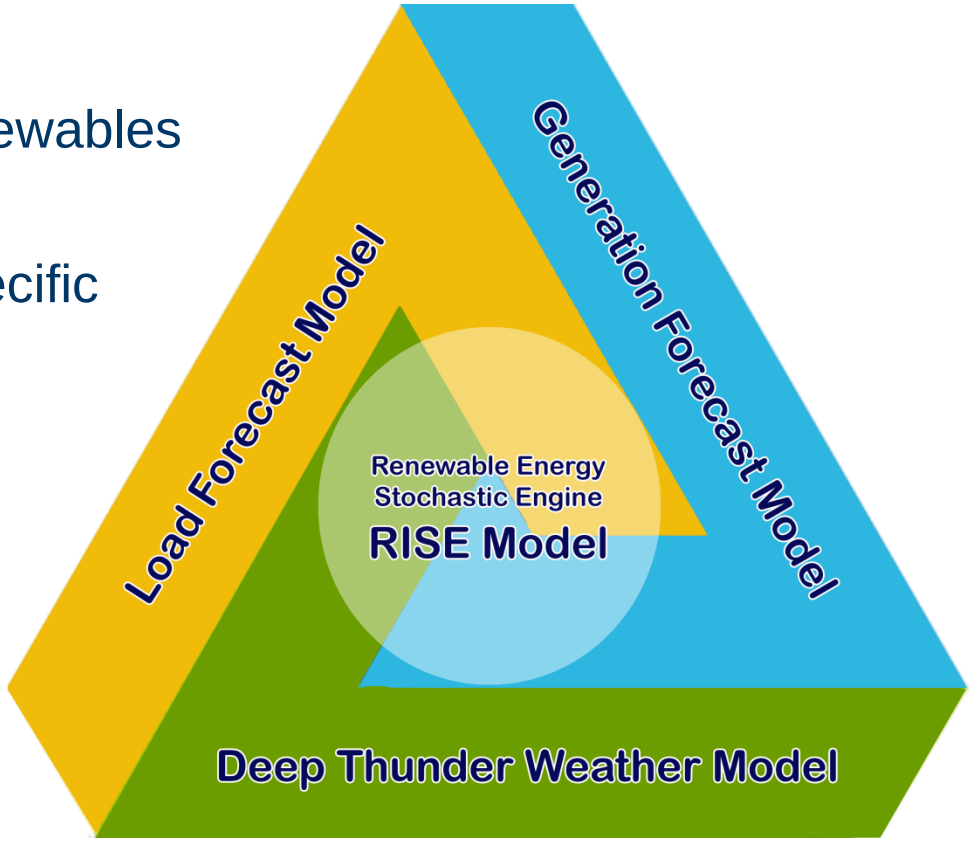
Maintenance/construction—better informed scheduling

Planning—improved prediction of renewables output

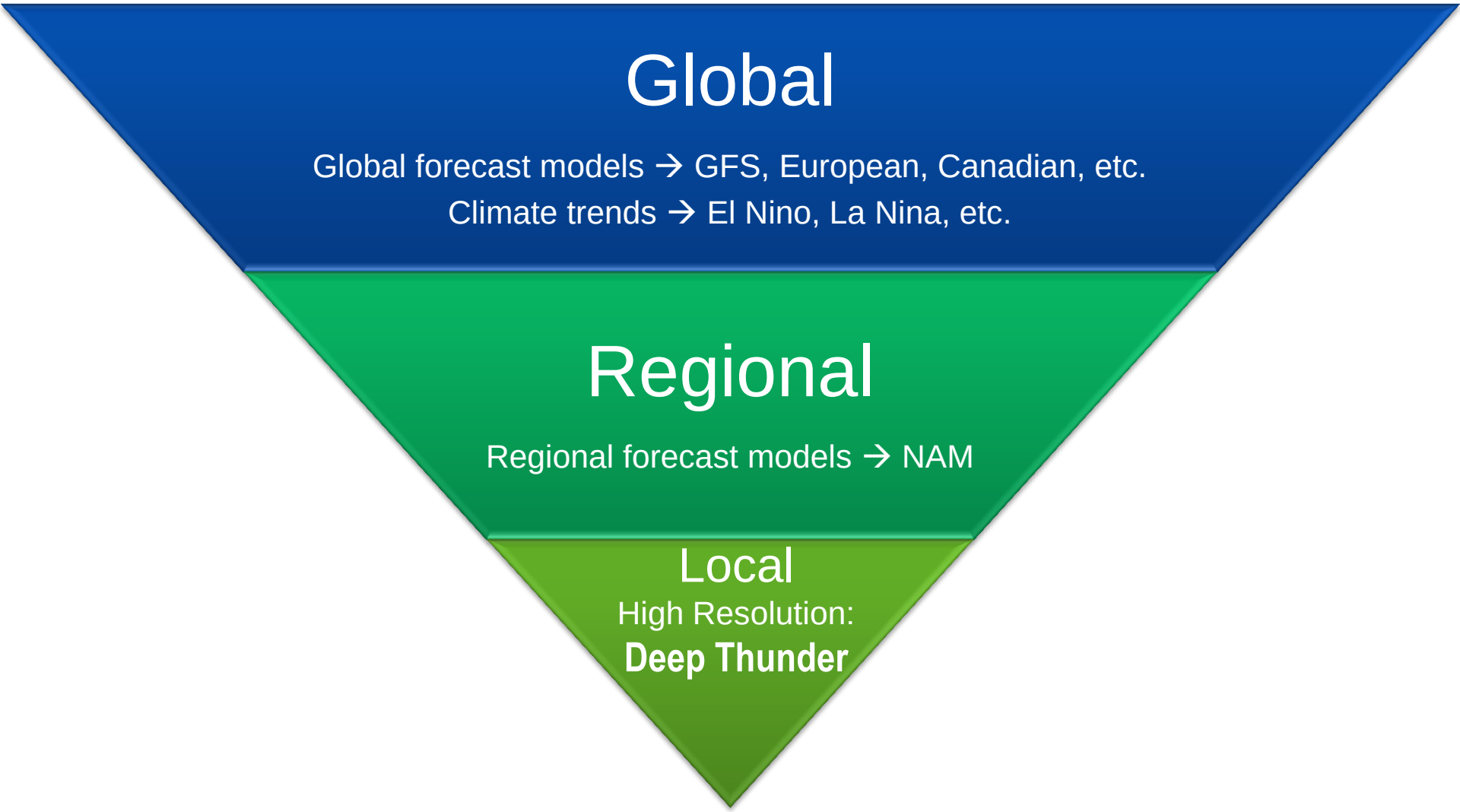
Generation siting—more location-specific information

Compliance—Act 56, water quality and other regulations

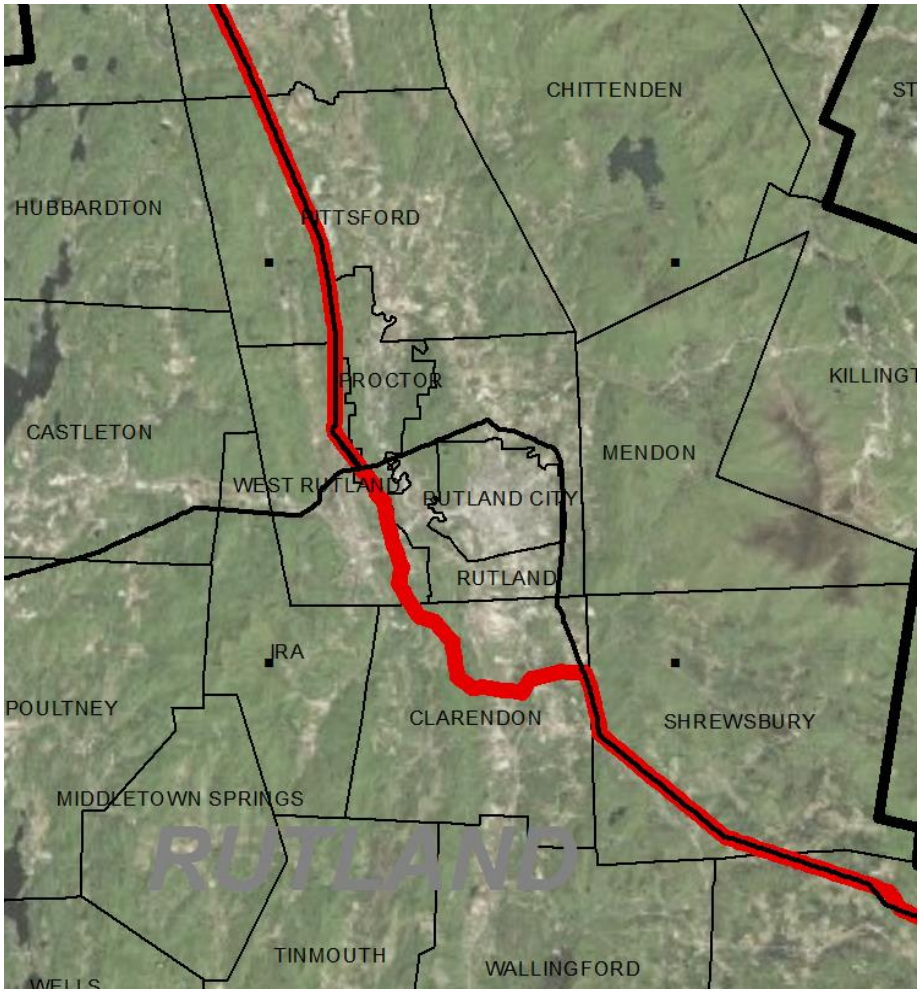
Demand-side management— better informed demand response and peak management, and efficiency measure validation



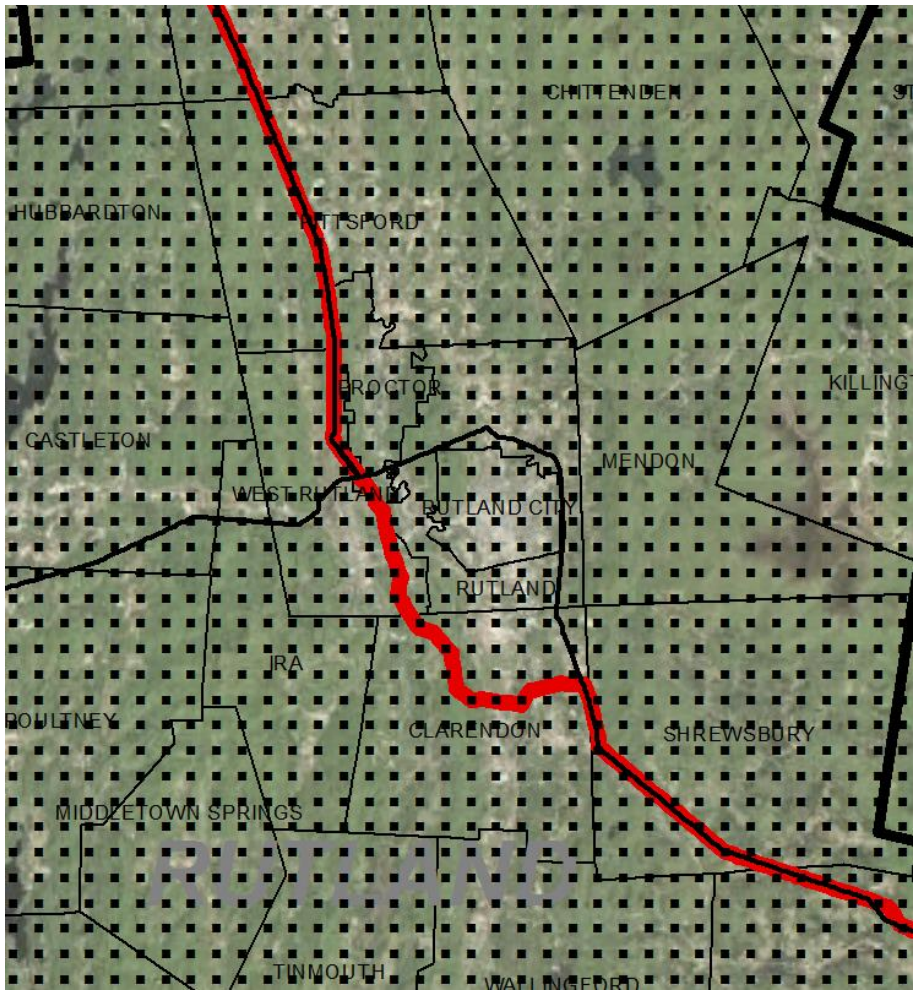
Weather forecasting tools



Model specifications

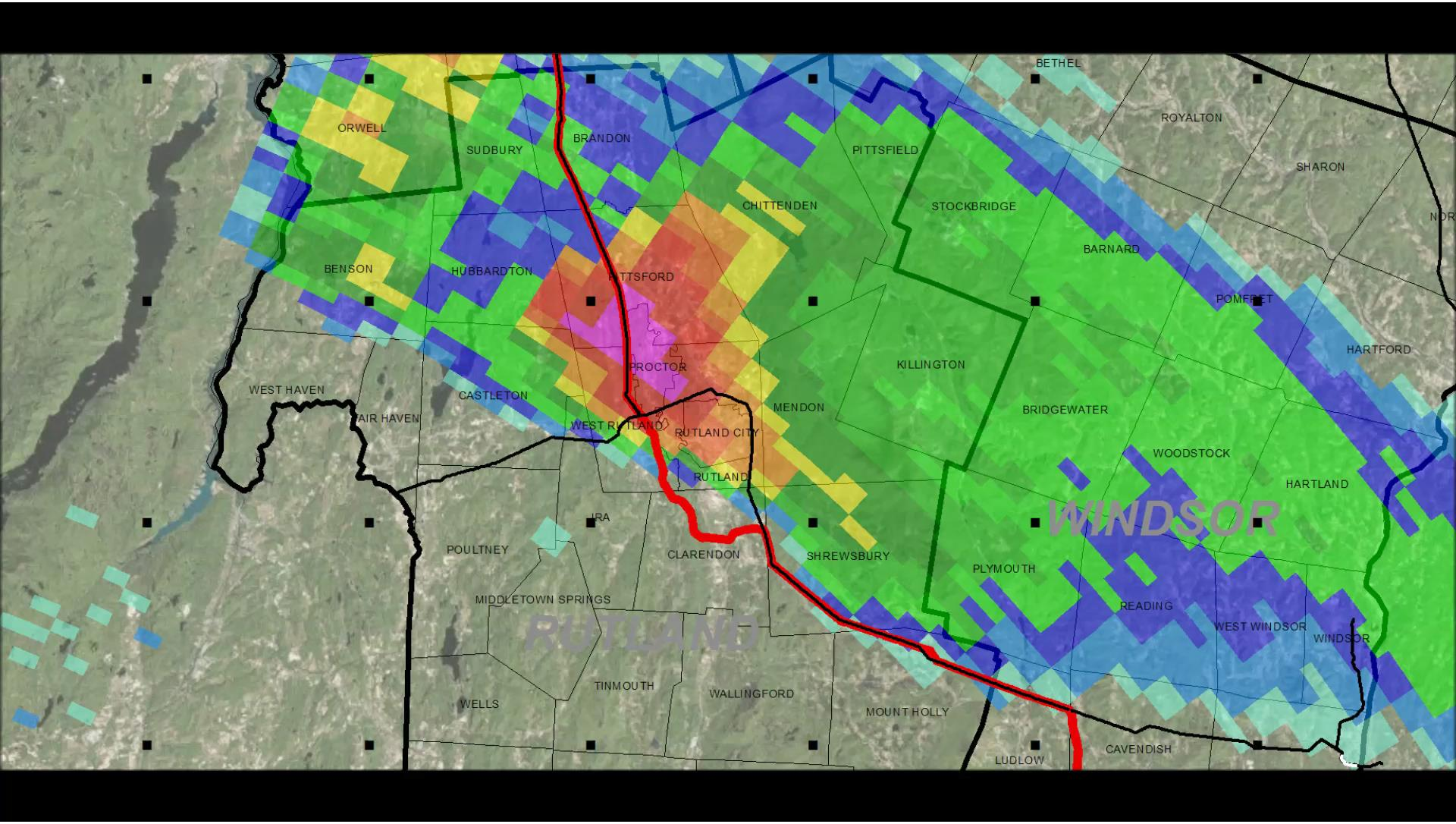


16km Resolution
(i.e. European Model)



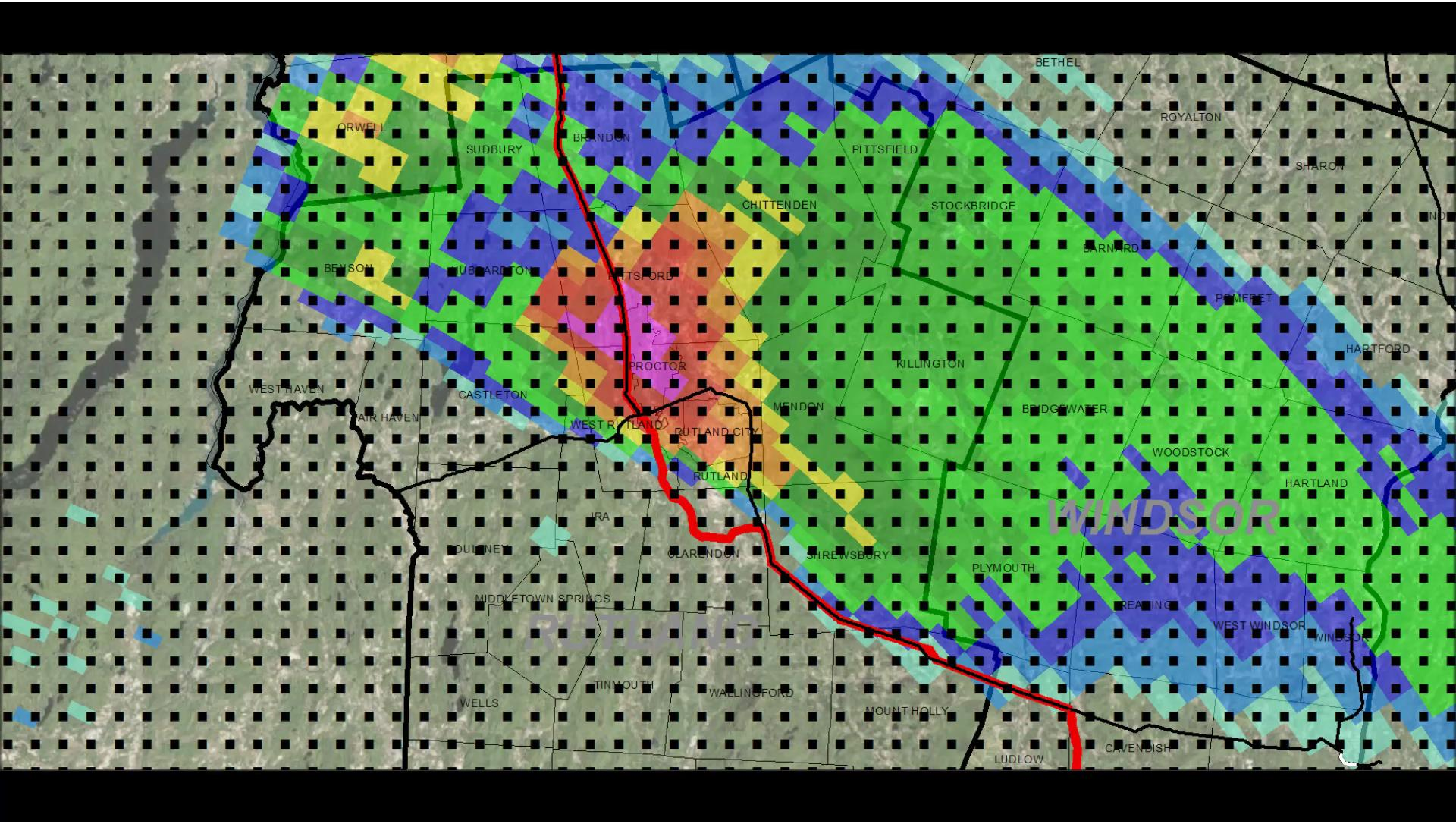
1km Resolution
(Deep Thunder)

Model specifications



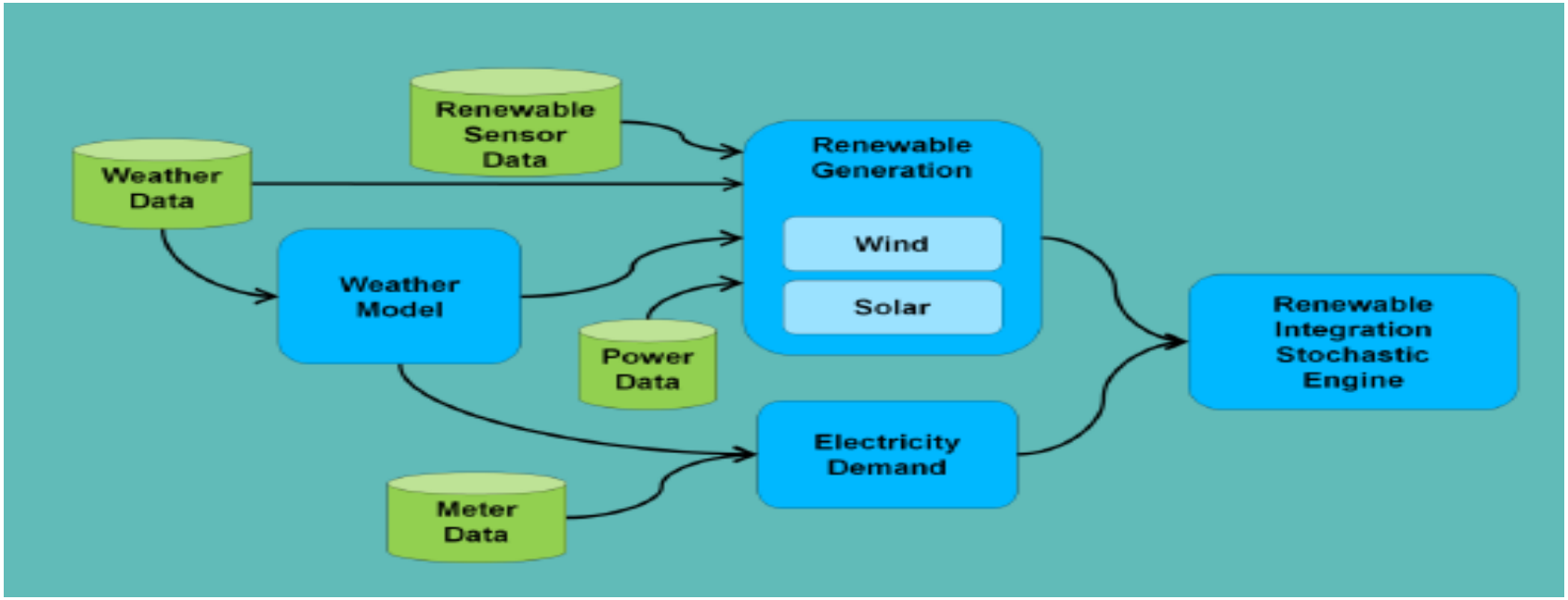
16 km Resolution (i.e. European Model)

Model specifications



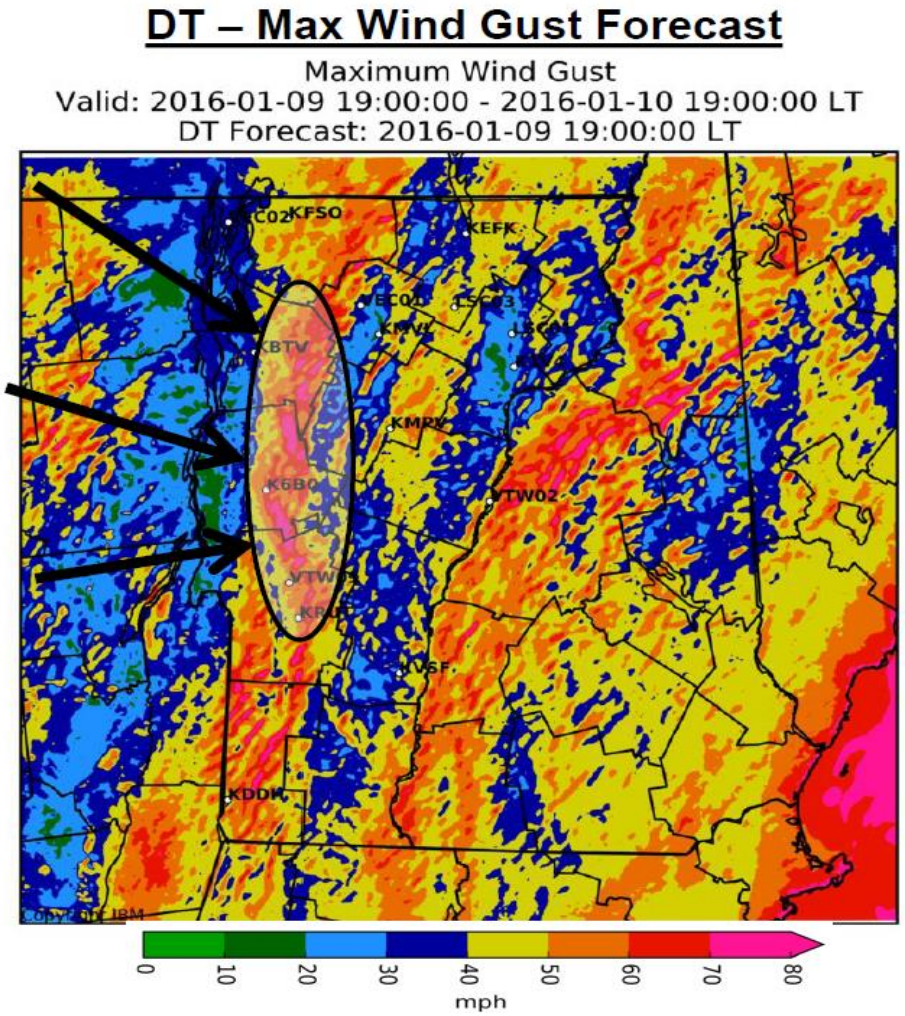
1 km Resolution (Deep Thunder)

VTWAC links data, adds analytics

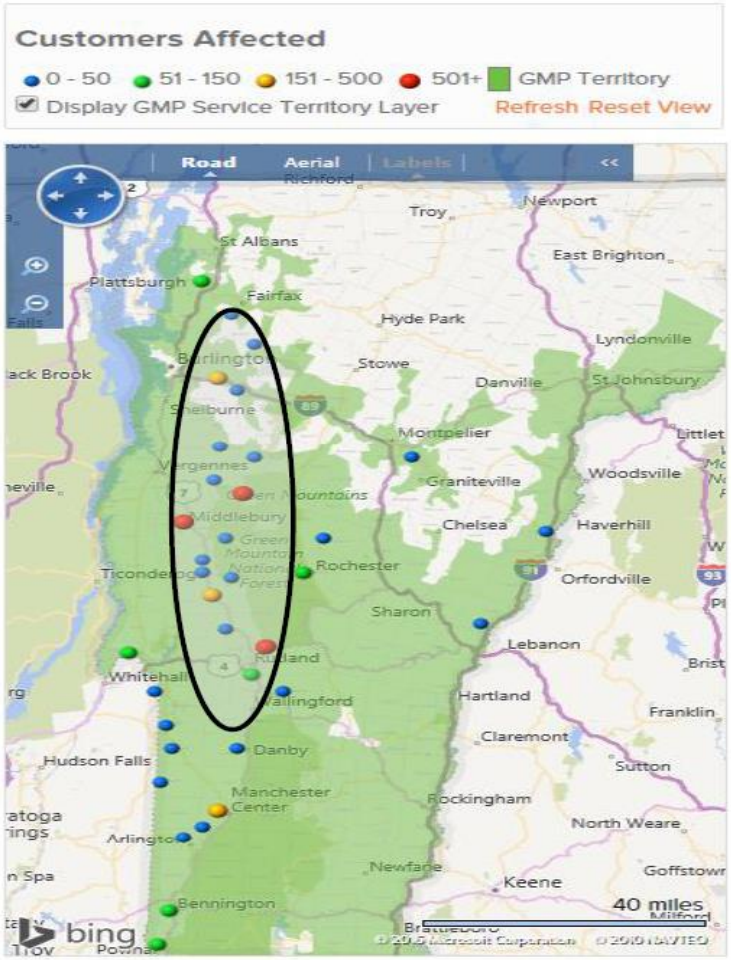


VTWAC integrates: high-resolution weather forecasts, real-time power measurements from network telemetry, smart meter data from hundreds of thousands of individual customers, and detailed information about the Vermont grid's physical properties.

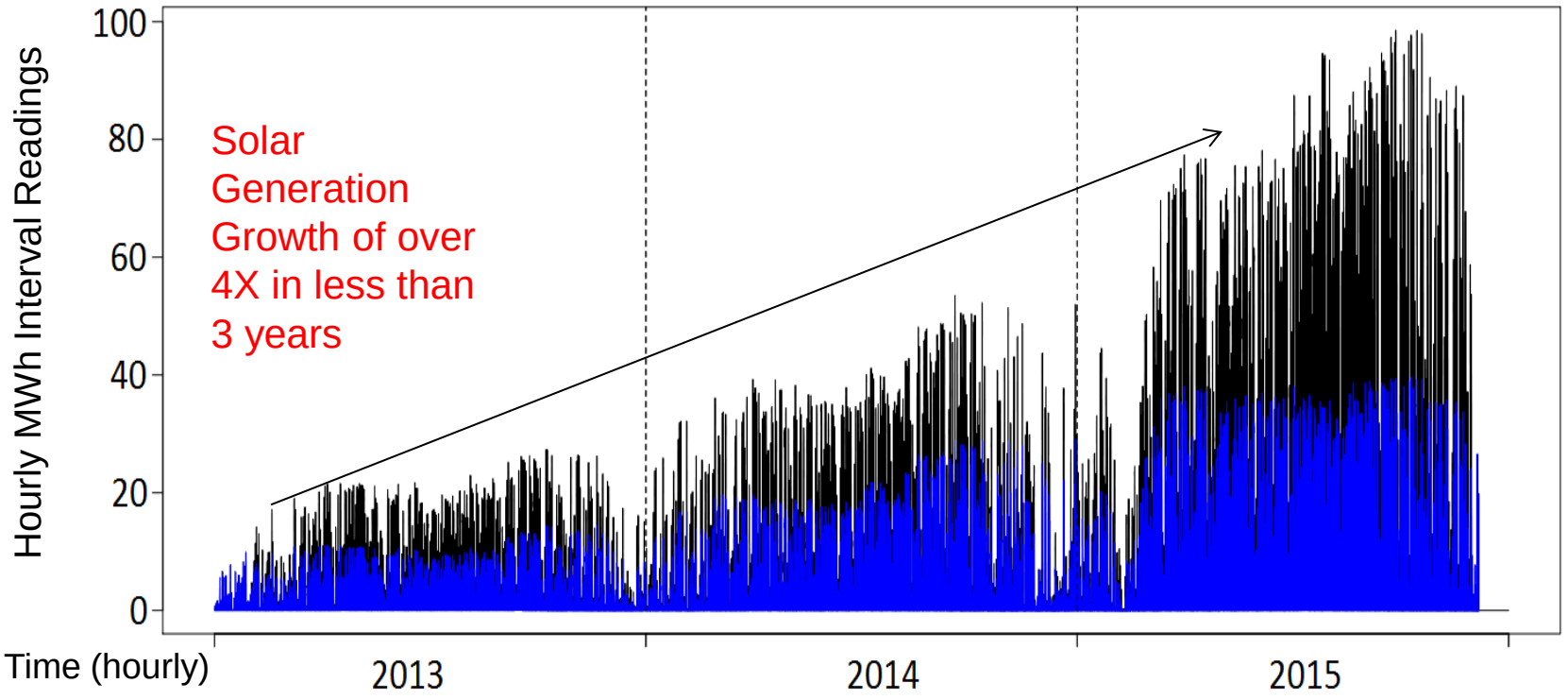
Wind forecast – advance warning



Green Mountain Power Outages @ 1300



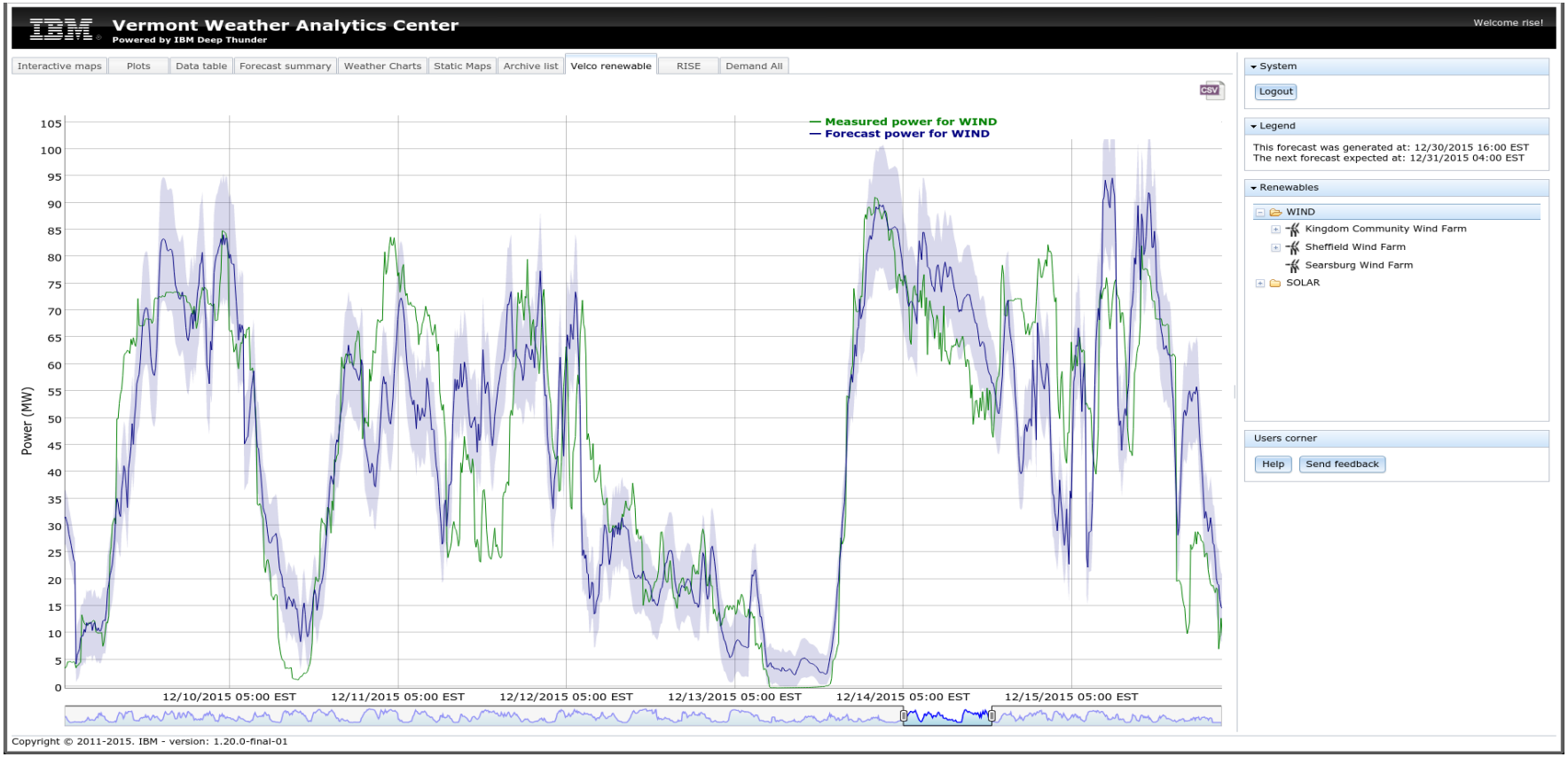
Total metered PV generation in VT



Residential Solar – displayed in black

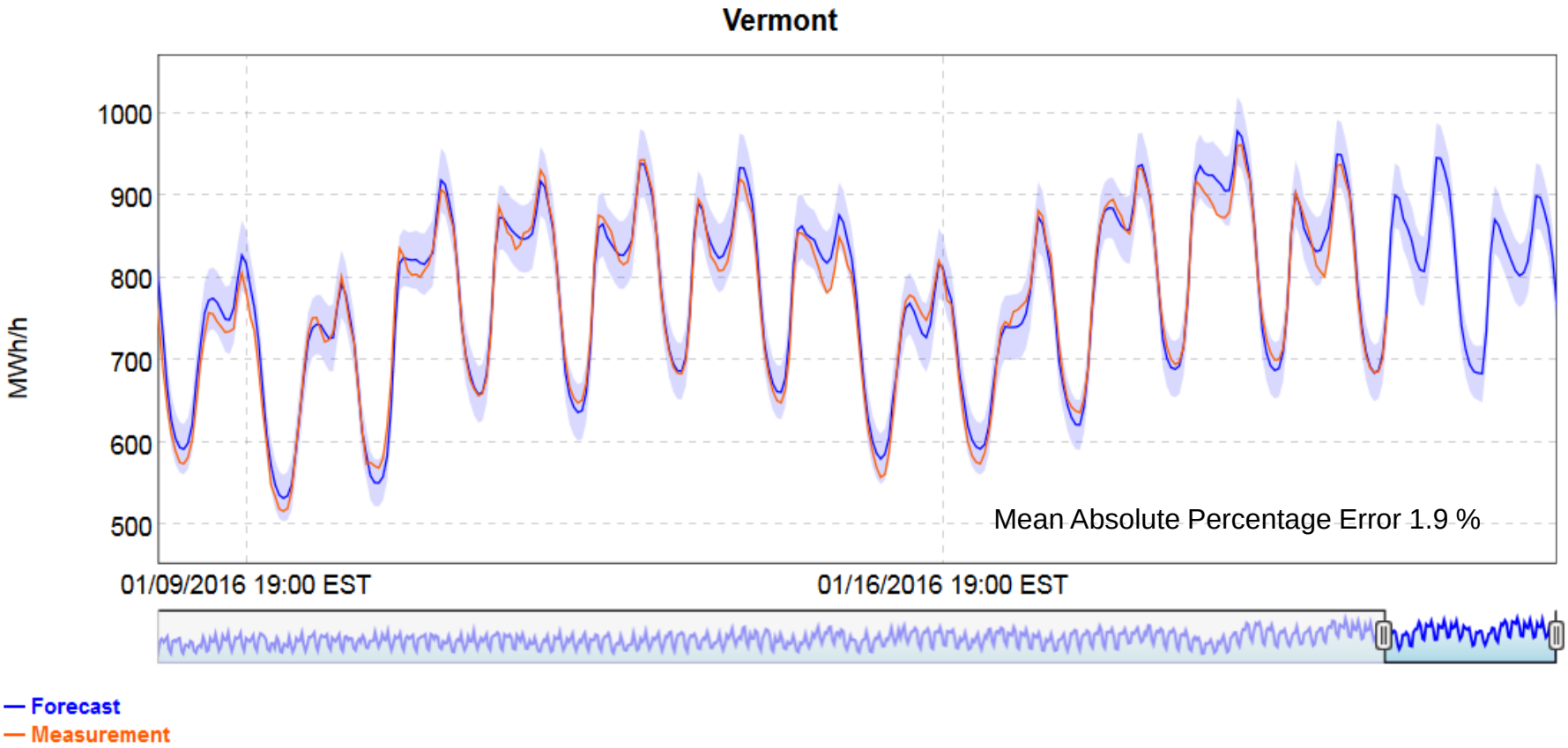
Utility Scale Solar – displayed in blue

Wind generation forecast results



Wind direction is predicted with an error of only 0.09 degrees, and wind speed error is less than 1.65 m/s.

Load forecasting results



Energy demand forecasting achieves an accuracy of 97.6% at the state-wide level and 97.3% at the Distribution Utility level.

Delivering Value

- Confirmed VELCO/DU benefits delivered or to be delivered by this project:
  - Safety/Reliability: more informed emergency response calls and crew augmentation decisions; targeted wind chill index, lightning potential info, and road condition updates provided to line crews; more accurate, geographically targeted updates provided to customers
  - Operations: improved outage scheduling; ability to determine grid capacity for additional solar on the transmission system down to the substation level; demand analysis capability to the substation level; contingency analysis with reliable 72-hour forecast of expected system conditions
  - Maintenance/Construction: greater assurance of successful cold-weather work, e.g., ice bridge construction, mat placement, wetland construction, etc.; scheduling wind farm maintenance, etc.
  - Planning: increased reliability of planning assessments due to AMI data integration; improved NTA development; reduced power supply market risk due to more accurate supply need assessments; improved developer/customer collaboration on solar installations; comparative generation assessments of competing prospective solar/wind sites
  - Demand Management: enables greater visibility to potential demand response events as demand forecast is built from substation level up to DU territory and state; increased peak management capability; efficiency measures validation

VTWAC – next steps

Near-term work

- Install High Performance Computer Clusters to enable VELCO to run software models independently during Q1-Q2 2016 – (currently 102 portal users)
- **New** – support additional value streams related to renewable integration including UVM's Packetized Energy Management Project with DOE/ARPA-E, and Sandia's award from DOE for a Grid Modernization Initiative to enable greater use of distributed energy resources
- **New** – complete scope of work necessary to link VTWAC output with VELCO EMS in order to improve day-ahead contingency analyses
- **New** – collaboratively establish scope of work necessary to share project lessons learned and link VTWAC output with emerging ISO-NE pilot project on data collection and solar forecasting

VELCO's ongoing work

- Meet transmission needs for reliability, power supply de-carbonization and microgrid deployment
- Evolve from construction to data analytics and advanced communication networks
- Create more adaptable, resilient and efficient grid that better serves customer choice
- Advocate appropriate recognition of DER's value at regional level
- Serve as resource/broker, innovation enabler and advocate

Improvement opportunities

- Secure funding parity for efficiency, generation and transmission solutions to transmission system reliability deficiencies
- Secure FERC/DOE/FCC policy alignment such that there are no needless barriers to robust utility fiber networks.
- Secure a balanced set of DER rights and responsibilities, e.g. communication interconnectivity
- Reduce the regulatory risk of utility innovation, increase incentive to innovate

“Our great new adventure.”

Kerrick Johnson, Vice President
Strategy and Communication
kjohnson@velco.com
(802) 770-6166