Vermont Weather Analytics Center

Game-Changing Breakthrough in Grid Forecasting & Weather Accuracy

vermont electric power company

VELCO

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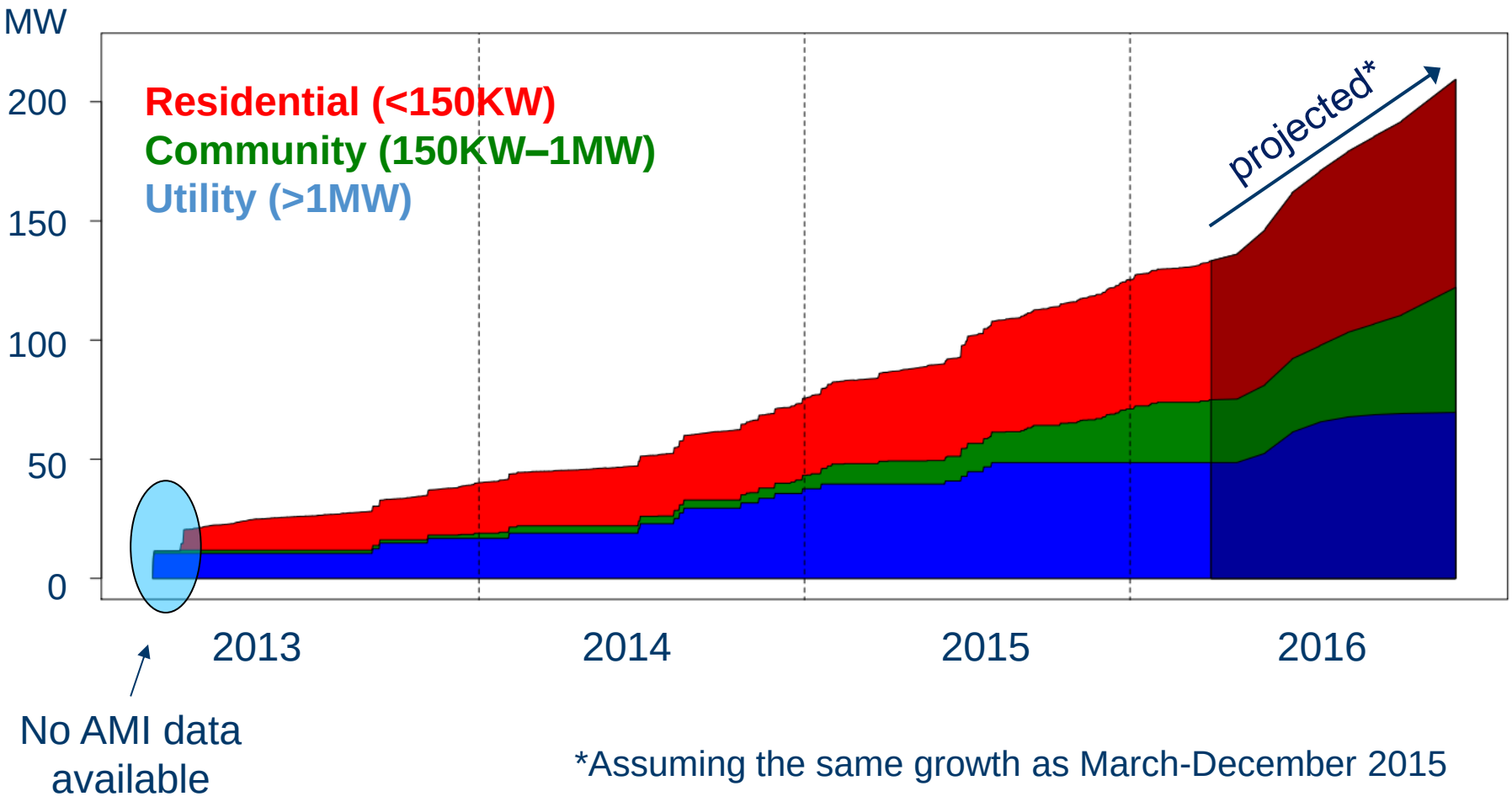
To the Vermont System Planning Committee

Rising sun — solar capacity growth accelerates



*Assuming the same growth as March-December 2015

Continue to grow value in second Joint Development Agreement

- 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

VWAC Phase II—operationalize, maximize and quantify value delivered

Key scope of work objectives

- Secure improvements to VWAC portal and Deep Thunder visualizations
- Develop rolling or short-term solar forecasting capability
- Integrate weather/demand/renewable generation model data into VELCO operating systems, planning tools and other identified company applications
- Secure on-site operation of VWAC through installed HPCC
- Develop transmission-level peak demand management capability
- Develop short- and long-range planning capabilities for renewable energy resources including storage
- Develop icing prediction model for transmission and distribution lines, and for wind turbine blades

VWAC Phase II—develop performance metrics

- Performance metrics will help to quantify project value, focus team alignment, help ensure accountability and improve our ability to earn greater interest and support.
- Metrics will track the project's operational objectives and comprise four components
  - Technical Measurement — a quantifiable work feature or output
  - Performance Result — a measured, grid-related, quantifiable goal
  - Economic Benefit — the financial benefit of achieving the performance result
  - Societal Benefit — the public benefit, as can reasonably be established, of achieving the performance result

VWAC Phase II: Performance Metrics (Draft)

Operational Objective	Technical Measurement	Performance Result	Economic Benefit	Societal Benefit
Weather	• Temperature: bias 0.8, MAE 3.6 ^{o}F • Precipitation accuracy: 97% • Wind location/direction: bias 2.7^{o}, MAE 18.8^{o} • Wind speed: bias 0.9, MAE 3.0 mph • Icing occurrence accuracy: 80%	• 5% reduction in emergency response costs • 5% reduction in outage time for affected customers	• $300k in reduced costs • VWAC contribution to SAIFI/CAIDI improvements	• Increased responder safety • Reduced rate pressure • Increased community resiliency
Renewable Forecasting	• 5% MAE solar day-ahead lead time • 7% MAE wind day-ahead lead time	• 10% in increase in asset utilization • Stafford Hill Battery Pilot (intermittency or freq. regulation metric to be provided by GMP)	• $2M annual Vermont savings in combined increased efficiency and avoided losses*	• 0.6 tons of CO_2 per MWh reduction • Community investment goes up
Peak management	• xxx% accuracy in predicting statewide peak hour on a daily basis (need Mathieu, Frank Ettori to weigh in) • 24-hr lead time alerts with 5% MAE rate	• 1% drop in Vermont peak (approx. 8 MW) • Demand response program efficiency (batting average metric to be defined by BED, GMP, VEC)	• $1M savings ($700K for VT + $300K for exceeding other NE states' reductions) • $250k annually in peak power purchase savings/ cost avoidance	• 0.6 tons of reduced CO_2 per MWh • Increased grid reliability • Reduced transmission build imperative • Improved customer engagement/ collaboration
Grid Operations/ Asset Planning	• xxx% accuracy in refining "Do Not Exceed" limits • Scenario-based identification of CapEx (last 5 years baseline) that promotes an "Energy future aligned with Vermont values" • Reduced curtailment (last 2 years baseline)	• Verify and refine "Do Not Exceed" limits • CapEx identification that aligns with reliability, sustainability, and promotes regulatory goals • 5% curtailment reduction (last two years baseline)	• $250k annual OpEx savings • $45M in annual Capex identification (increase over last 5 years baseline) • $yyy from reduced curtailment	• Increased operator confidence • 0.6 tons per MWh of reduced CO_2 • Curtailment case/storage case • Reduced build imperative

*Extrapolating this capability to New England will yield an estimated $1.364M in annual fuel cost savings alone

Next steps — operationalize/quantify value

VELCO

Improve core service delivery

Develop core competence independent of IBM