Power Connection: Vermont Weather Analytics Center Project

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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

Weather-Related Power Outages Increased Dramatically in the 2000s

Source: “Blackout: Extreme Weather, Climate Change and Power Outages” (Climate Central)
Motivation

Global Risk Trends

Sharp increase in environmental risks starting in 2011

Source: World Economic Forum

Top 5 Global Risks in Terms of Likelihood

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<tbody>
<tr>
<td>1st</td>
<td>Breakdown of critical information infrastructure</td>
<td>Asset price collapse</td>
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<td>Storms and cyclones</td>
<td>Severe income disparity</td>
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<td>Income disparity</td>
<td>Interstate conflict with regional consequences</td>
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<td>2nd</td>
<td>Chronic disease in developed countries</td>
<td>Middle East instability</td>
<td>Slowing Chinese economy (&lt;6%)</td>
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<td>Flooding</td>
<td>Chronic fiscal imbalances</td>
<td>Chronic fiscal imbalances</td>
<td>Extreme weather events</td>
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<td>3rd</td>
<td>Oil price shock</td>
<td>Failed and failing states</td>
<td>Chronic disease</td>
<td>Chronic disease</td>
<td>Corruption</td>
<td>Rising greenhouse gas emissions</td>
<td>Rising greenhouse gas emissions</td>
<td>Unemployment and underemployment</td>
<td>Failure of national governance</td>
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<td>4th</td>
<td>China economic hard landing</td>
<td>Oil and gas price spike</td>
<td>Global governance gaps</td>
<td>Fiscal crises</td>
<td>Biodiversity loss</td>
<td>Cyber attacks</td>
<td>Water supply crises</td>
<td>Climate change</td>
<td>State collapse or crisis</td>
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<td>5th</td>
<td>Asset price collapse</td>
<td>Chronic disease, developed world</td>
<td>Retrenchment from globalization (emerging)</td>
<td>Global governance gaps</td>
<td>Climate change</td>
<td>Water supply crises</td>
<td>Mismanagement of population ageing</td>
<td>Cyber attacks</td>
<td>High structural unemployment or underemployment</td>
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Top 10 risks in terms of Likelihood

- Large-scale involuntary migration
- Extreme weather events
- Failure of climate-change mitigation and adaptation
- Interstate conflict
- Natural catastrophes
- Failure of national governance
- Unemployment or underemployment
- Data fraud or theft
- Water crises
- Illicit trade

Source: World Economic Forum

2016
Boom in distributed solar is already changing VT’s load shape

VELCO vs. ISO-NE load curve—illustrative day (Tues 4/13/2015)

ISO-NE Δ = 687 MW (5%)
VELCO Δ = 75 MW (10%)

“Champ Curve”
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

Global
- Global forecast models → GFS, European, Canadian, etc.
- Climate trends → El Nino, La Nina, etc.

Regional
- Regional forecast models → NAM

Local
- High Resolution: Deep Thunder
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)
V TWAC links data, adds analytics

V TWAC 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

DT – Max Wind Gust Forecast
Maximum Wind Gust
Valid: 2016-01-09 19:00:00 - 2016-01-10 19:00:00 LT
DT Forecast: 2016-01-09 19:00:00 LT

Green Mountain Power
Outages @ 1300
Total metered PV generation in VT

Solar Generation
Growth of over 4X in less than 3 years

Residential Solar – displayed in black
Utility Scale Solar – displayed in blue
Wind direction is predicted with an error of only 0.09 degrees, and wind speed error is less than 1.65 m/s.
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 decarbonization 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.”

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