VELCO, Transmission and the Future of Distributed Generation

vermont electric power company

VELCO

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House Natural Resources & Energy
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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

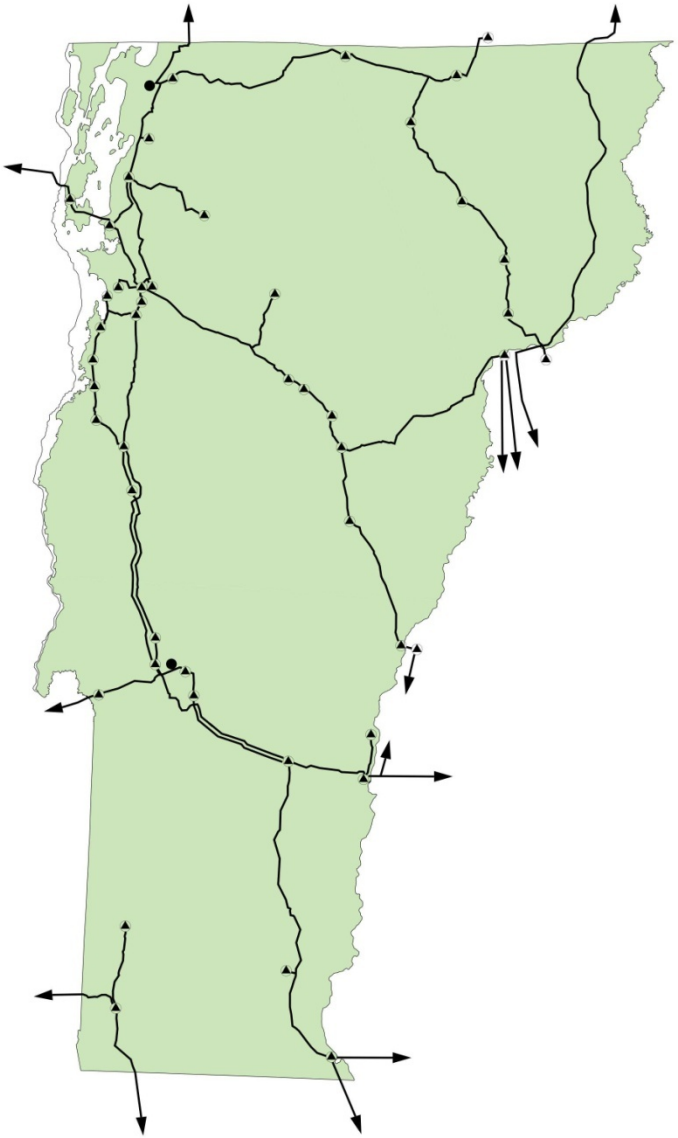
To live our values we…

- 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

VELCO-managed assets

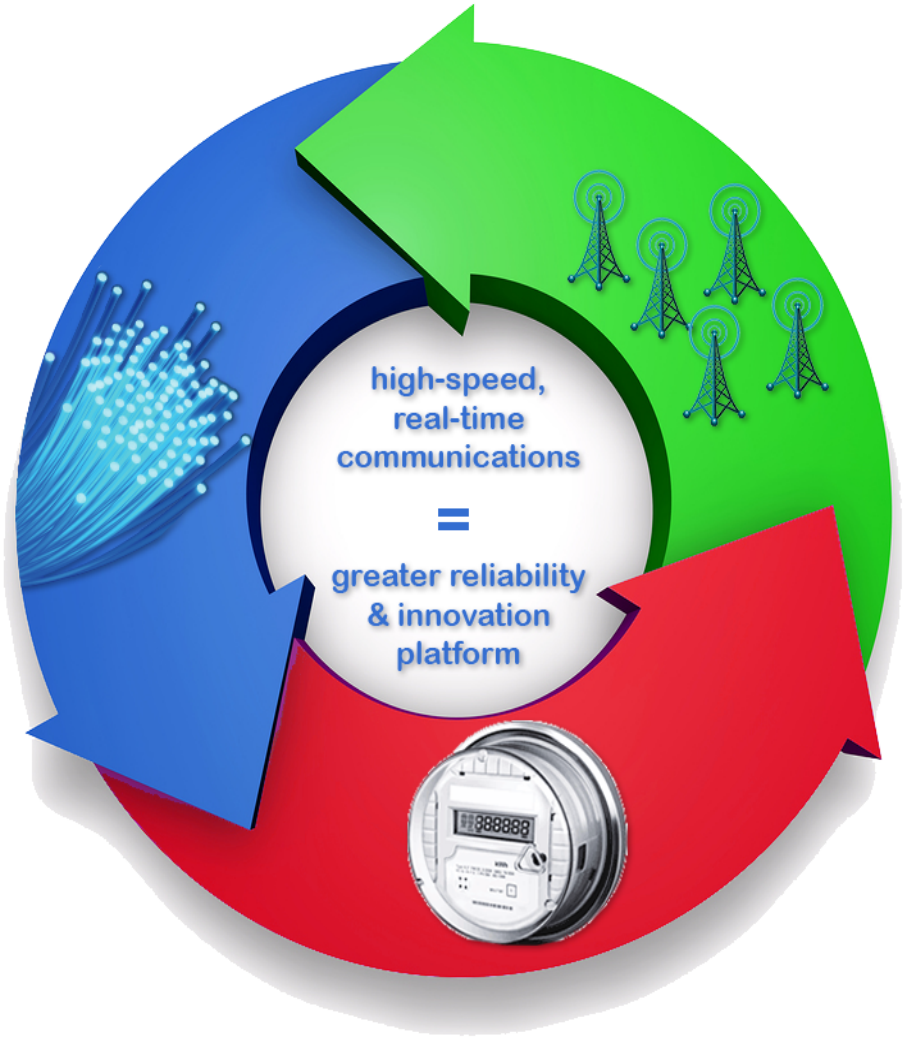


- 738 miles of transmission lines, 115 kV and higher
- 14,000 acres of rights-of-way
- 55 substations, switching stations and terminal facilities
- Equipment that enables interconnected operations with Hydro-Québec
- Fiber optic communication networks that monitor and control the electric system and provide the backbone for most Vermonters' high-speed data internet access
- 52-mile high-voltage direct current line through the Northeast Kingdom owned by Vermont Electric Transmission Company (VETCO)

Background

- Formed in 1956 by local utilities to share access to clean hydro power and maintain the state's transmission grid
- Nation's first statewide, "transmission-only" company
- Owned by Vermont's 17 local electric utilities and VLITE

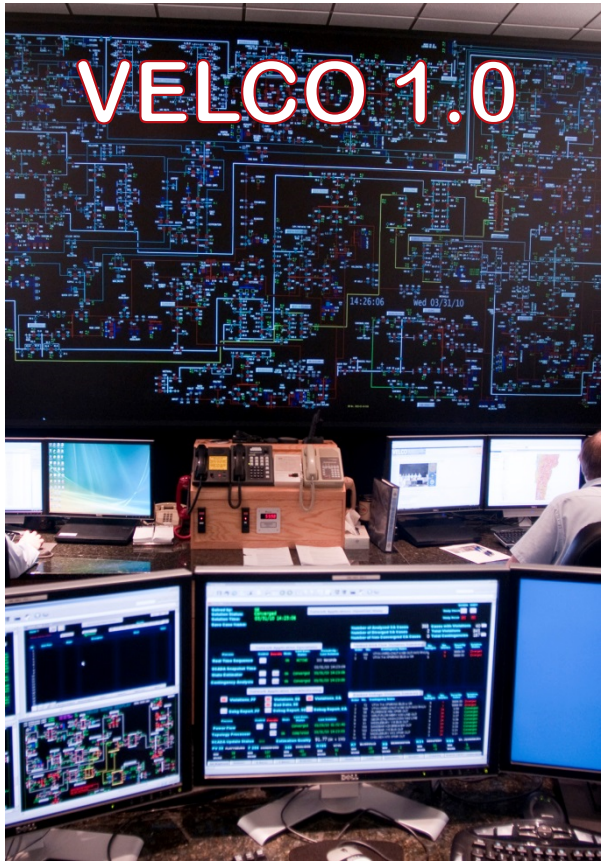
Communications critical; platform in place



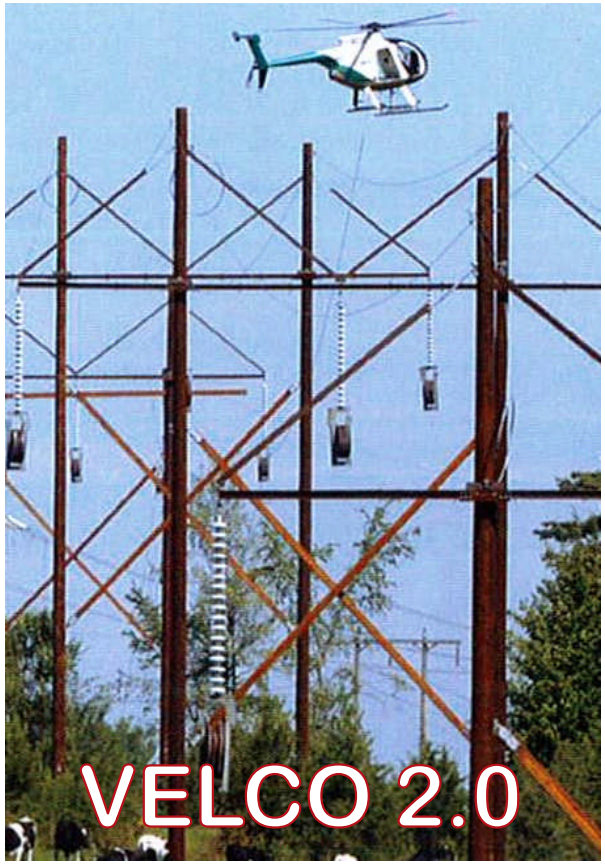
Statewide Infrastructure

- eEnergy VT smart grid
- Fiber optic network
- Radio system

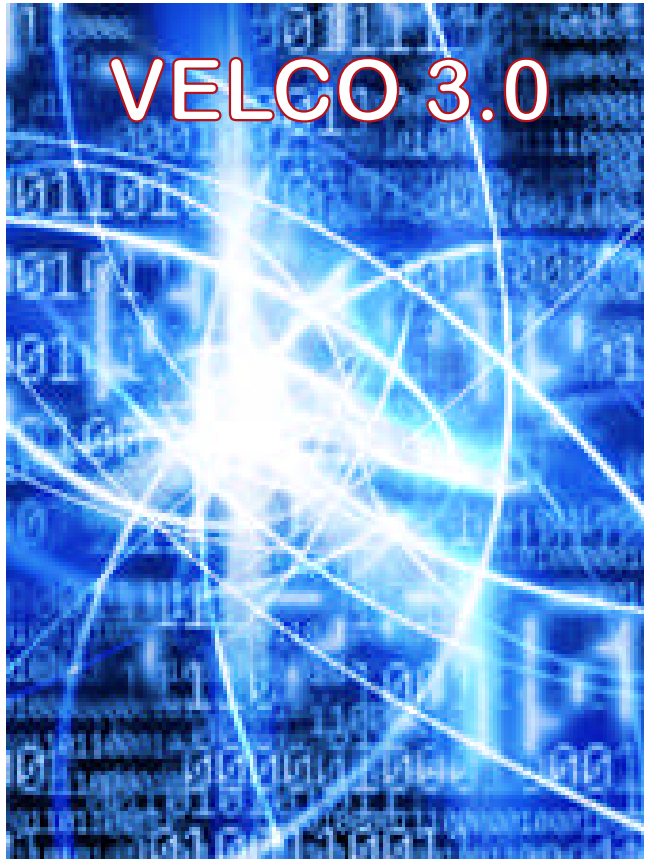
Evolution



Operations



Construction



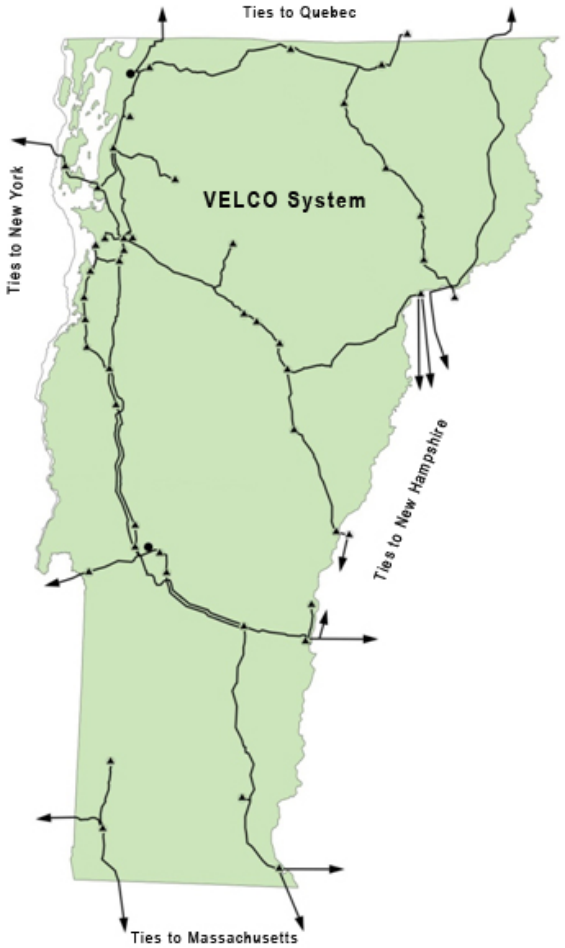
Information

Transmission planning: why should you care?

- ISO-NE responsibility for grid planning means regional strongly influences local. ISO-NE determines:
  - **How much renewables "count"**
  - Economics of renewables
  - Need for transmission upgrades
  - Merchant projects
  - Cost of our power

- Key issues to understand
  - Vermont influential for our size, but we are only 4% of regional load
  - Vermont dependence on imported power
  - Renewables—particularly solar—are changing the grid
  - **Location of distributed resources determines benefit to grid**
  - Innovation is creating new tools with many uses: local, state, regional

Vermont now imports close to half its power

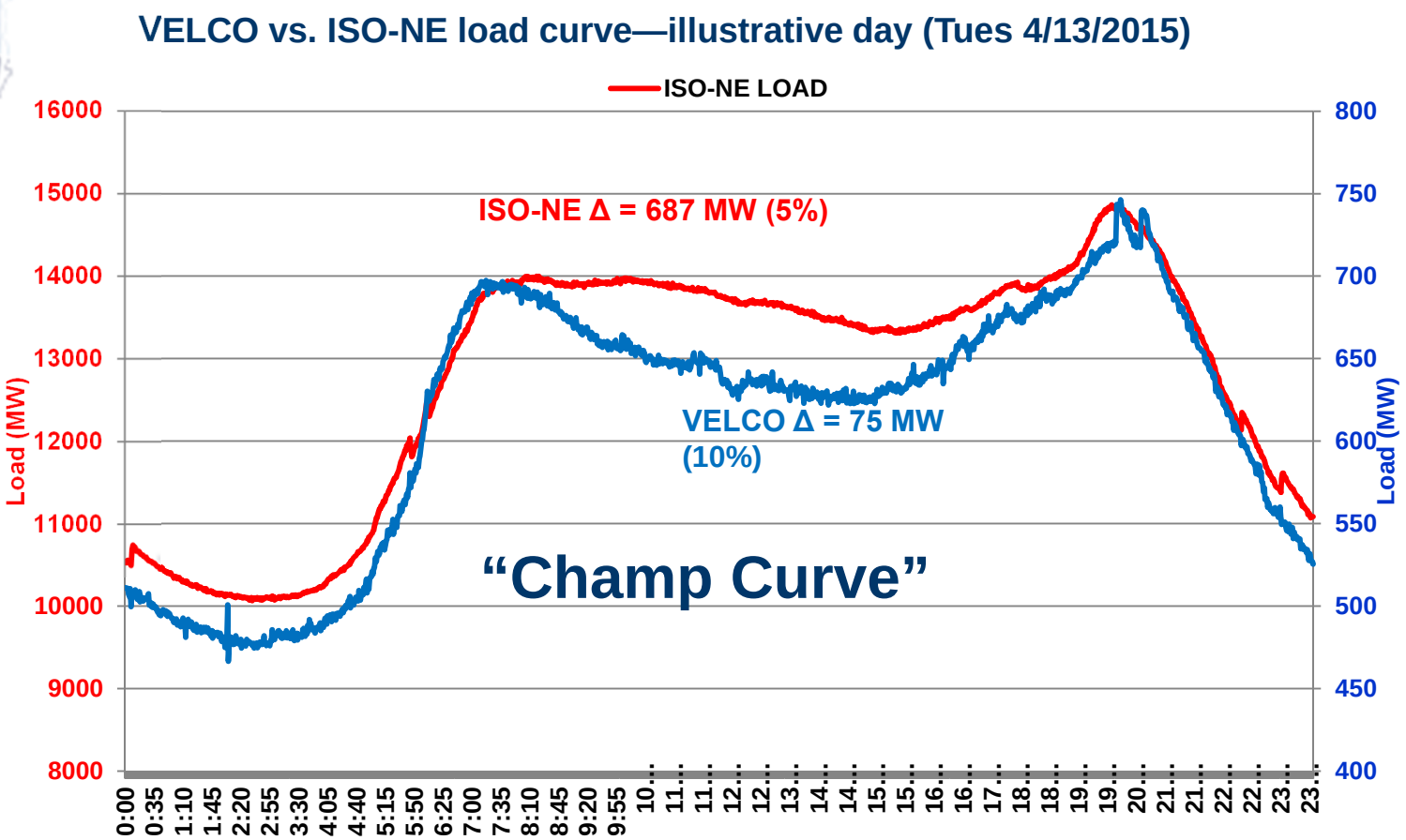


Type		MW 2014	MW 2015
Fossil (fast start units)	Winter	188	188
	Summer	138	138
Hydro		152	152
Wind		123	123
Trash-to-energy		9	9
Biomass (wood)		72	72
Nuclear		625	0
Solar and other, e.g. methane		~100 and growing	~100 and growing
TOTAL IN-STATE GENERATION		**1265**	**640**

73% of 2014 hours VT was exporting power

~84% of 2015 hours VT will import >400 MWs

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



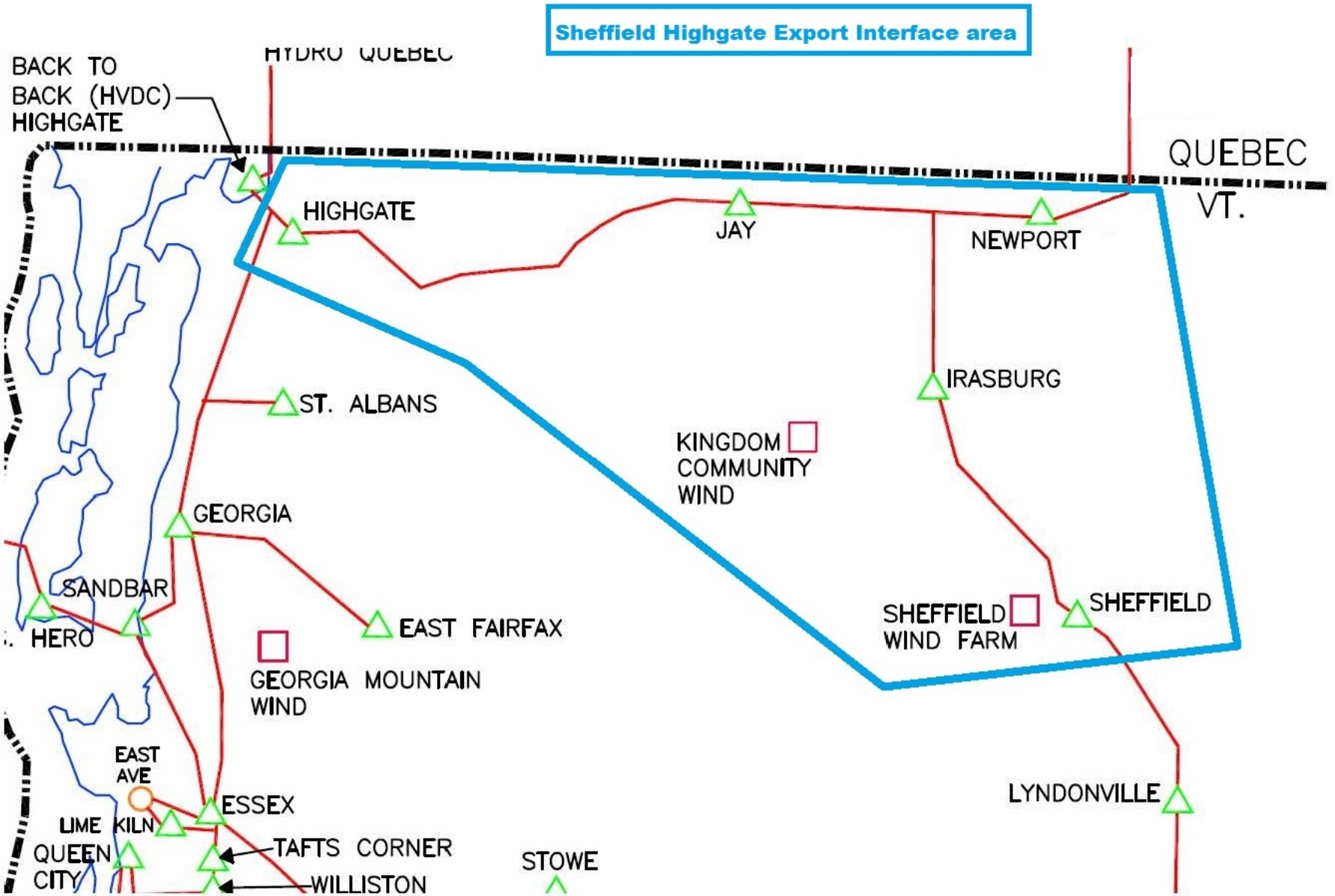
Proposed utility-scale generation projects

Hydro and wind

- 3.16 MW of hydro
- 140 MW total solar projects by two developers (7 @ 20 MW)
- 10.5 MW of solar (5 @ 2 MW)
- 151.73 MW of wind from four locations
- 9.59 MW of GMP solar projects from two locations

Total—1,715 MW of proposed projects

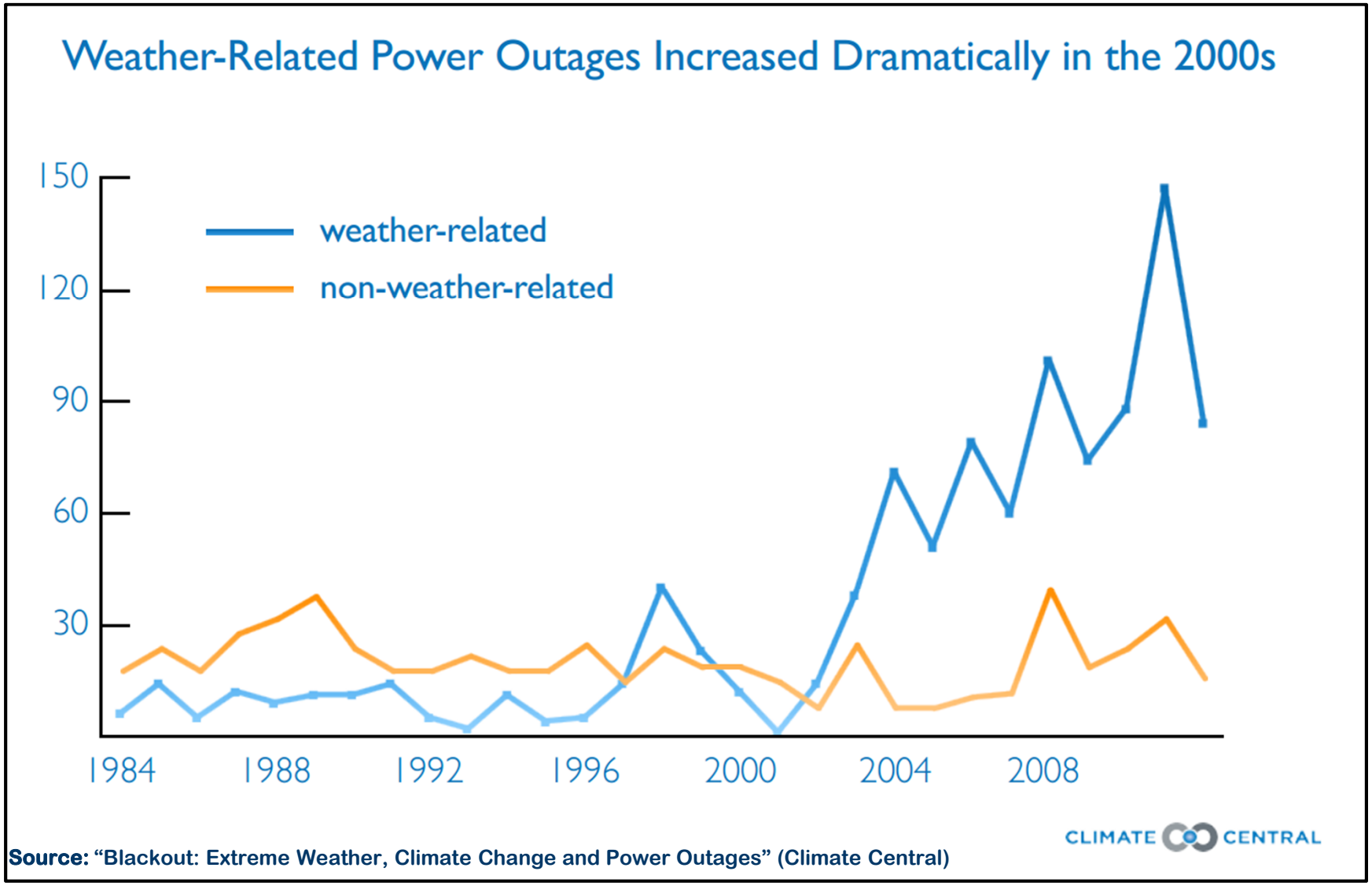
(including third-party transmission)


Sheffield Highgate Export Interface area
BACK TO
BACK (HVDC)
HIGHGATE
HYDRO QUEBEC
QUEBEC
VT.
HIGHGATE
JAY
NEWPORT
IRASBURG
ST. ALBANS
KINGDOM
COMMUNITY
WIND
GEORGIA
SANDBAR
HERO
EAST FAIRFAX
GEORGIA MOUNTAIN
WIND
SHEFFIELD
WIND FARM
SHEFFIELD
EAST
AVE
ESSEX
LIME KILN
QUEEN
CITY
TAFTS CORNER
WILLISTON
STOWE
LYNDONVILLE

Securing benefits of distributed generation: location matters

- Northern VT has an operating limit constraining how much generation can be exported from Northern VT
- Even without additional new projects, existing wind and hydro generation is sometimes curtailed in that area
- Constraints on generation NOT a reliability issue at ISO-NE; they will just turn off generation
  - Therefore, costs of needed upgrades must be paid for by developers or locally

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
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
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
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
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
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

Economic Environmental Geopolitical Societal Technological

Source: World Economic Forum

Vermont Weather Analytics Center benefits diverse stakeholders

Safety/reliability— more precise, localized weather prediction

Operations—better preparedness

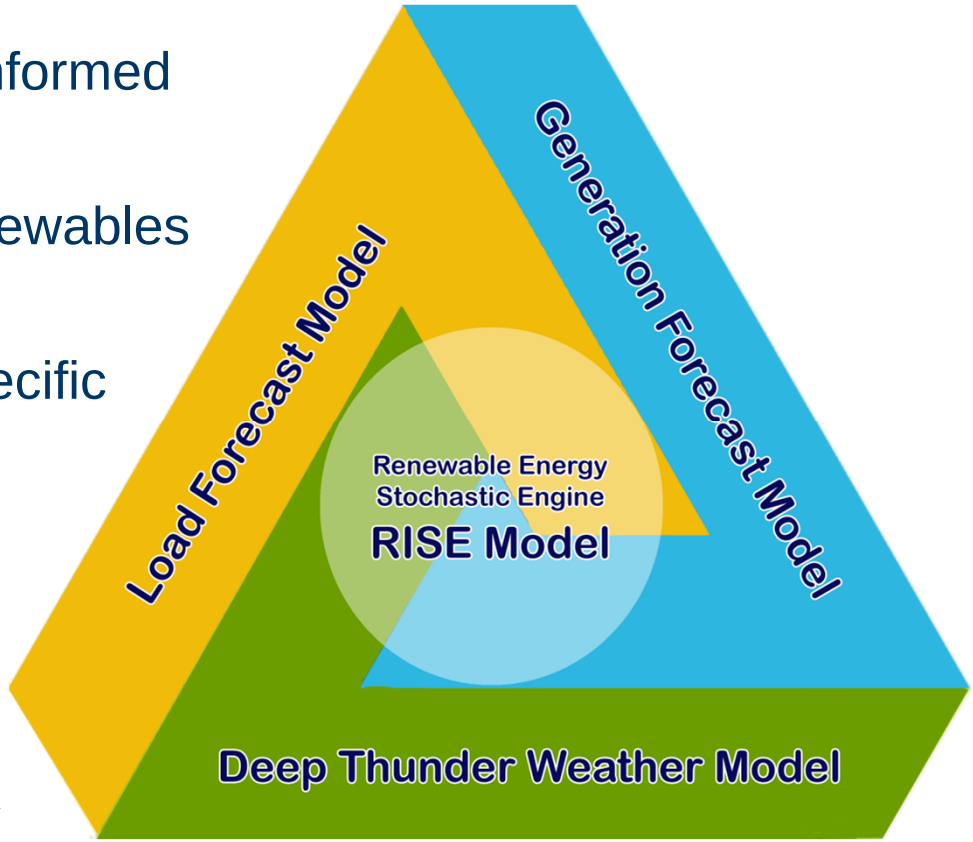
Maintenance/construction—better informed scheduling

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



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 DG's value at regional level
- Serve as resource/broker, innovation enabler and advocate