

Sheffield- Highgate Export Interface

SHEI

vermont electric power company



VSPC

July 12, 2017

Version 2

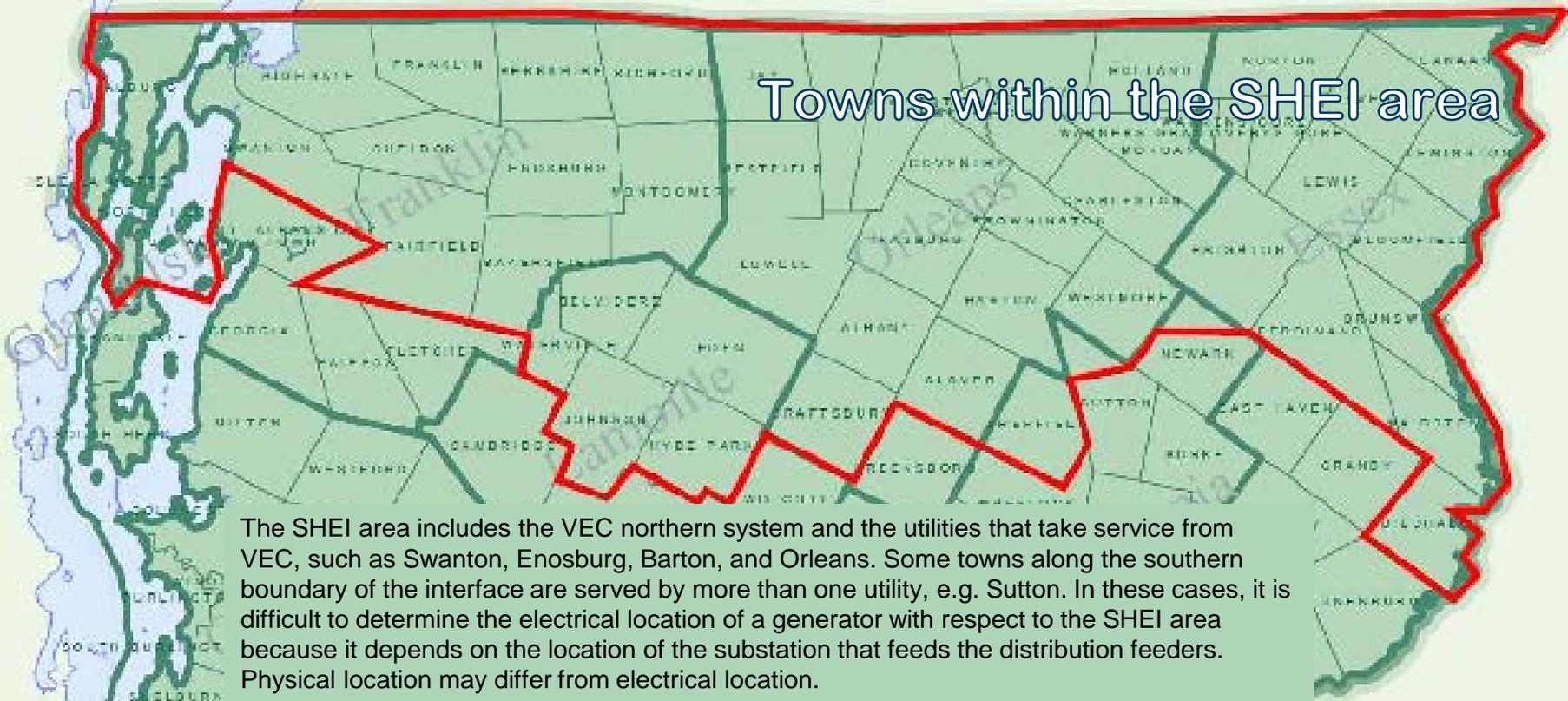
SHEI OVERVIEW

Frank Etori

*VELCO Director of ISO New England
Relations & Power Accounting*

FERC Standards of Conduct, Critical Energy Infrastructure Information and SHEI discussion

- Overall VELCO goal: publicly share information with all stakeholders contemporaneously through VSPC website and, where appropriate, OASIS website
- During today's meeting
 - VELCO can describe the problem in general terms, discuss solution options and range of benefits for those solutions
 - Some market-related and Critical Energy Infrastructure Information we can't share



**Two main constrained areas in VT—
focus on north-central tier**

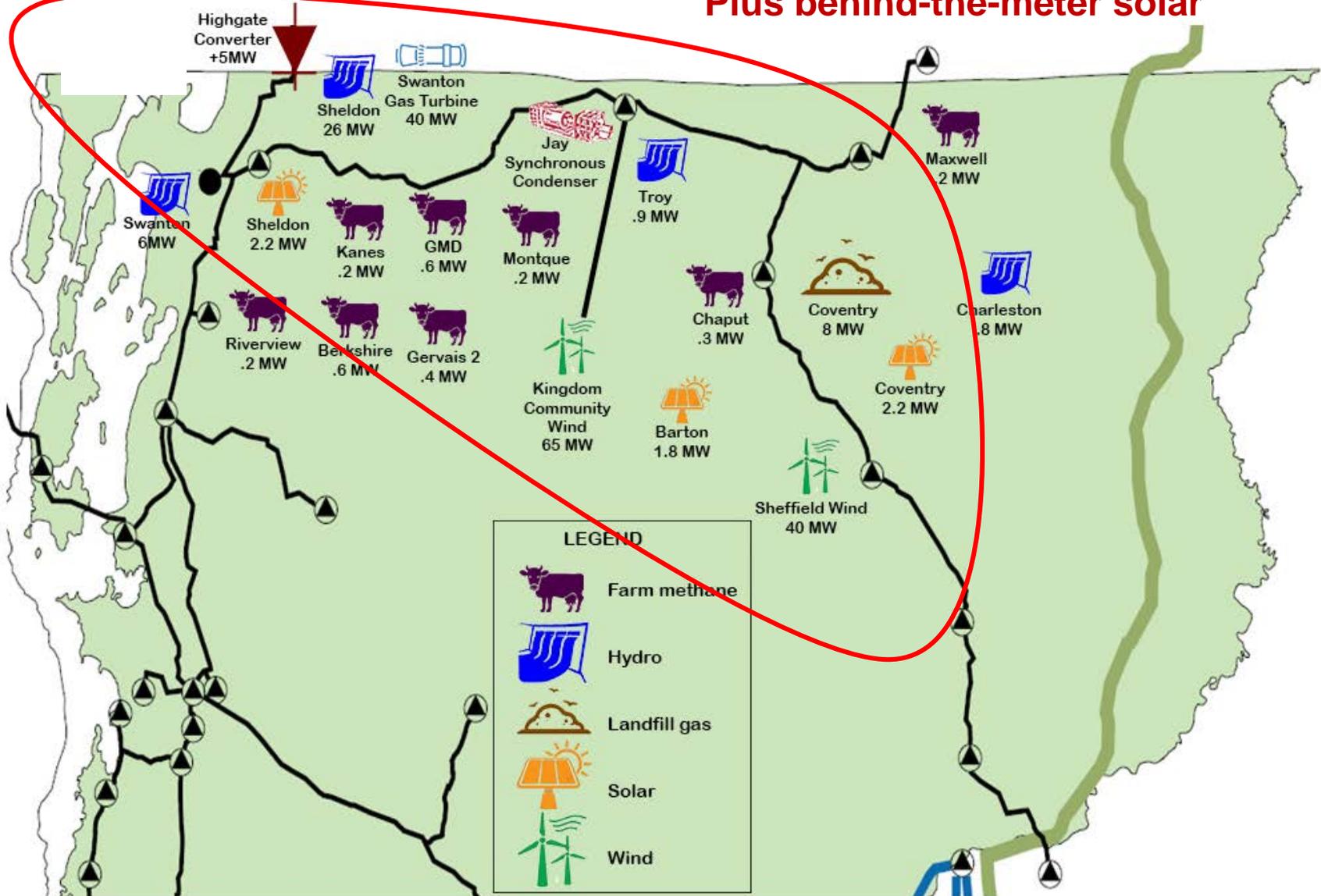
**Region very rural, history of limited
economic activity, limited grid
investment and relatively
inexpensive land**

What has changed?

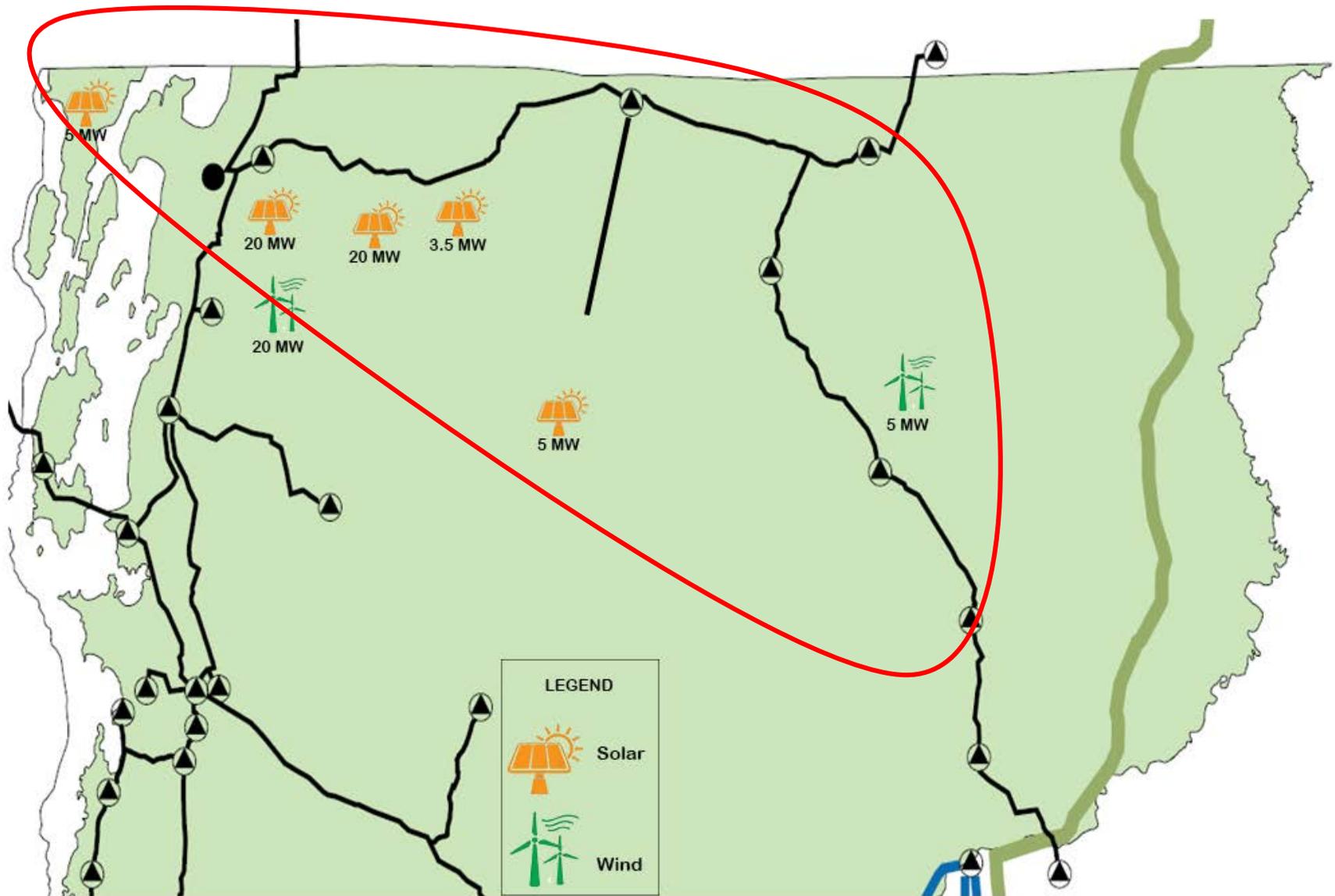
- Growth of generation driven by NE demand for renewables (utility-scale) and customer choice (net metered)
- ISO-NE changes
- Reliability-driven grid maintenance work

SHEI area: growth in generation since 2005

Plus behind-the-meter solar



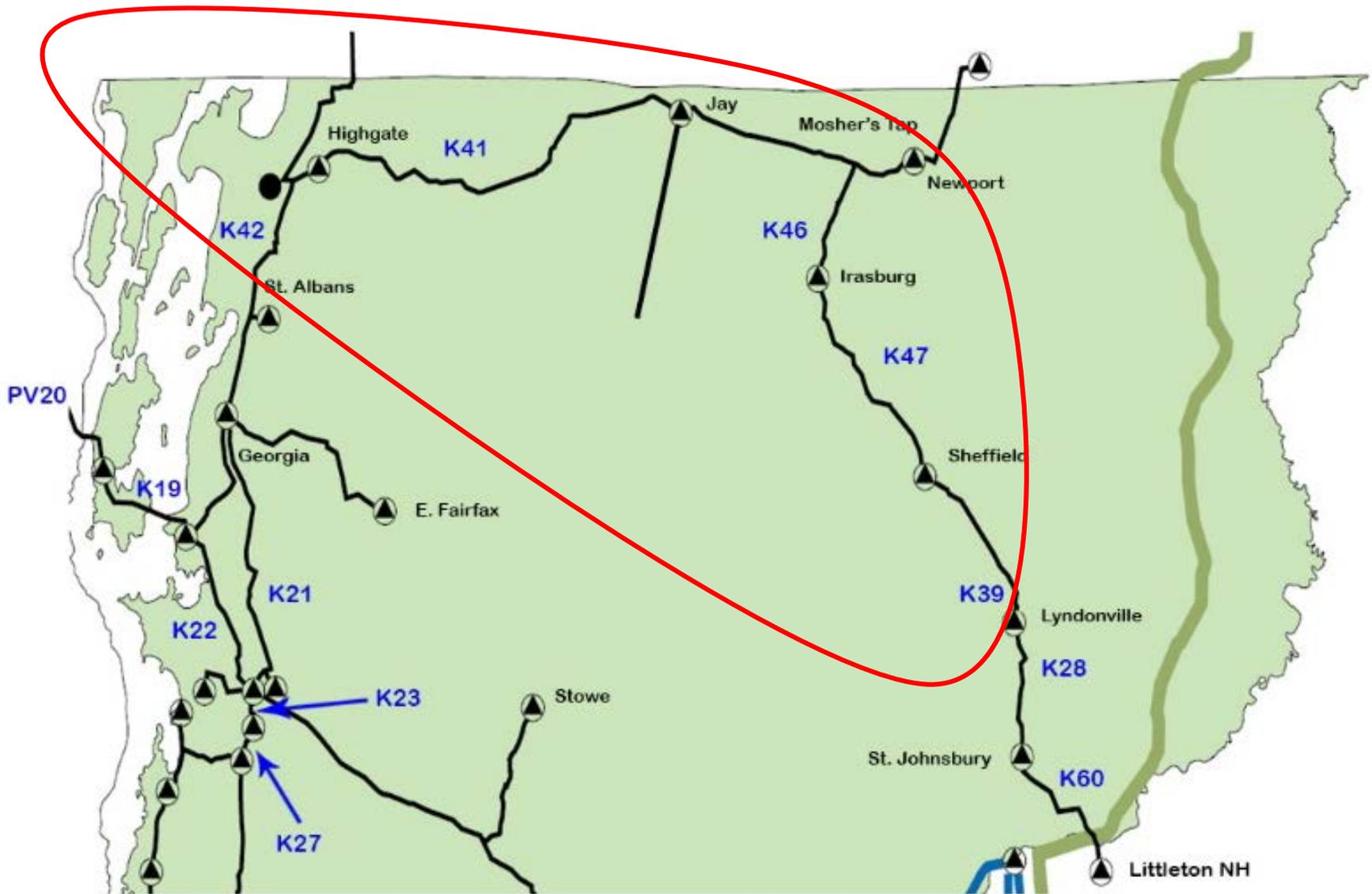
And more generation proposed (2017 & beyond)



What is the purpose of the SHEI?

- Sheffield-Highgate Export Interface created in 2013 by ISO New England to ensure accountability for system reliability
 - Operating guide from ISO New England
 - Calculated in real time
- Interface limit is based on a voltage and stability constraint
- Thermal limit is not much above voltage limit

What does the SHEI protect?



Elements that impact interface limit

Positive impacts

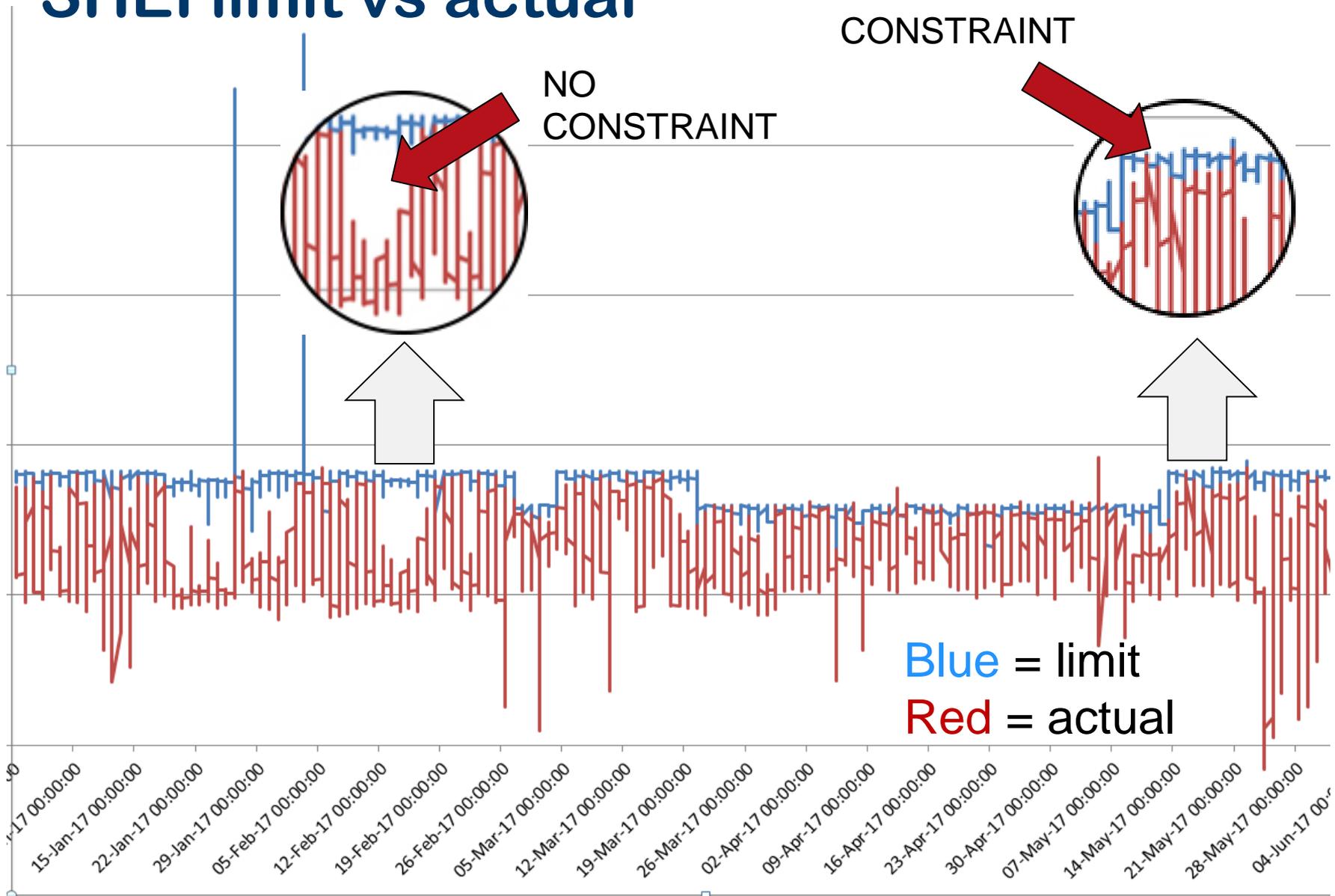
- Essex Statcom online
- Highgate Converter bus voltage
- Swanton GT 1 & 2 on with AVR enabled
- KCW on with AVR enabled and B20 in service
- Load level

Negative impacts

- Jay synchronous condenser off line or automatic voltage regulator (AVR) disabled
- Jay T1 and T2 transformers out of service
- Line outages on all 115 kV lines north of Williston

**Operating characteristics,
bids or other market sensitive
data cannot be discussed**

SHEI limit vs actual



When are exports constrained?

- More generation (minus load) than interface allows
 - Generation backed down to observe interface limit
- Dispatchable generators receive a Do-Not-Exceed (DNE) command (implemented 5/25/16)
 - Wind and hydro become dispatchable
- Curtailment priority is based on
 - Bid price
 - Distribution factor
 - Dispatch range (Ecomin/Ecomax)



EXPORT LIMIT EXPLAINED

Frank Etori

*VELCO Director of ISO New England
Relations & Power Accounting*

Do-Not-Exceed

Implemented by ISO-NE 5/25/16 to send dispatch instructions electronically that reflect market signals

Before DNE

Dispatch of intermittent resources to manage transmission constraints involved operator action

- Periodic calculations
- Verbal communications
- Instructions “as needed”

After DNE

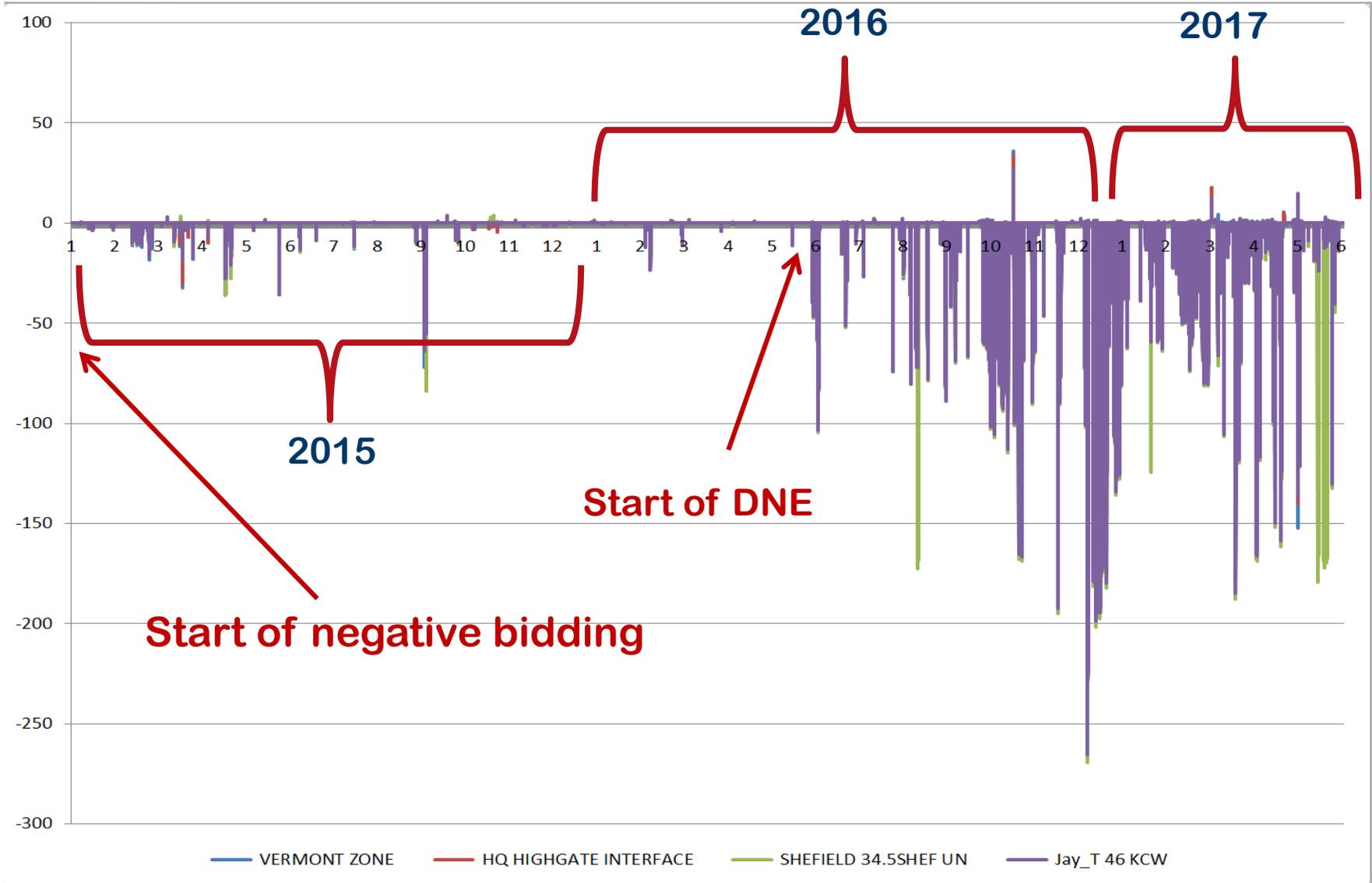
Dispatch of intermittent resources to manage transmission constraints is handled automatically

- Software-based algorithms
- Electronic communications
- DNE instruction (i.e., dispatch limit) sent to each dispatchable generator at least every 5 minutes
- Wind and hydro can set the Locational Marginal Price

Economics of market resources

- Behind-the-meter (BTM) resources (e.g., net metering) do not participate in ISO-NE markets and compensation is not based on market prices
- Generators with a Power Purchase Agreement (PPA) get paid based on PPA terms, which frequently do not reflect ISO-NE market prices
 - Standard offer resources are both BTM and PPA
- Generators can bid down to -\$150
 - Negative bids mean units pay to generate
 - Determines prices utilities pay to purchase energy in ISO-NE market settlements

Negative LMPs* in NW Vermont from DNE



*LMP: Locational Marginal Price

Data source: ISO-NE. Graphed by VEC. Annotations added.



SOLUTIONS

Chris Root

VELCO Chief Operating Officer



Potential non-transmission solutions

- Limit generation growth
 - Keeps the problem from getting worse, but doesn't solve it
 - Conflicts with state renewable energy goals
- Population, economic growth with concomitant increased electric demand
- Increase load
 - Beneficial electrification, such as heat pumps and electric vehicles
 - New business/economic development
 - Newport block load served from Vermont
- Energy storage
- Dynamic voltage support
 - SC, SVC, Statcom, DVAR, AVR on Sheffield and other units
 - Take credit for 1.15 service factor of Jay synchronous condenser
 - Must be audited by ISO-NE

Potential transmission solutions

- Dynamic voltage support
 - SC, SVC, Statcom, DVAR, AVR on Sheffield and other units
 - Take credit for 1.15 service factor of Jay synchronous condenser
 - Must be audited by ISO-NE
- GMP B20 upgrade (Johnson-Lowell—GMP evaluating)
 - Subtransmission system is monitored in real time
 - VELCO acts as approving authority for subtransmission outages
- For longer term
 - VELCO issued request for proposal (RFP) to study all potential solutions as shown on following slides
 - Results expected October 2017

VELCO Northern Vermont Export Study

- Purpose: Provide information to enable VELCO and DUs to evaluate all potential “transmission” solutions
 - Reactive support, transmission, subtransmission, and battery storage
 - Will analyze individual elements and combinations of solutions
 - Consultant’s analysis to provide basis for costing of options
- Fast turnaround for analysis—report due late August
 - Economic evaluation by October 2017
- Consultation with stakeholders
 - Requires efficient process due to tight deadlines
 - Further details on process TBA

Solution options/cases to be tested

Engineering solutions

- Equipment utilization
 - Voltage regulation at existing power plants
- Equipment installation
 - Synchronous condenser, battery storage
- Transmission and subtransmission line upgrades
- New transmission lines

Funding questions (out of scope for today's discussion)

- Not “regional reliability projects” so costs not shared as Pooled Transmission Facilities New England-wide
- Other mechanisms: ISO-NE public policy process, generators, ratepayers, etc.

Next steps

- Submit SHEI constraint information in appropriate project dockets
- Work with Sheffield and other units to install and model automatic voltage regulator (AVR)
- GMP B20 upgrade evaluation and potential filing
 - VELCO monitors sub-transmission network (line status and system values)
 - DUs notify VELCO days ahead of planned sub-transmission outages—VELCO approves planned outages (ISO-NE rules)
- Conduct study as described
- 2018 VT Long-Range Transmission Plan will identify potential system requirements necessary to achieve state's energy/climate goals
- Regulatory responses—Ed McNamara, DPS Director of Planning

APPENDIX

CEII and FERC Standards of Conduct restrict information sharing

Critical Energy Infrastructure Information

- FERC regulation
- Prohibits VELCO from publicly sharing “specific engineering, vulnerability, or detailed design information about proposed or existing critical infrastructure”

Four-part test:

1. Provides details about the production, generation, transportation, transmission, or distribution of energy;
2. Could be useful to a person in planning an attack on critical infrastructure;
3. Is exempt from mandatory disclosure under FOIA; and
4. Does not simply give the general location of the critical infrastructure.

Transmission information shared in this presentation by VELCO is being shared simultaneously with a broad range of energy marketing and non-marketing stakeholders and has been posted on VELCO’s OASIS website so that it is available publicly. Accordingly, the information, to the extent it can be deemed transmission system function information, is public and falls outside of the SOC restrictions.

FERC Standards of Conduct—SOC

Prohibit VELCO from sharing non-public transmission system information, including:

- information related to day-to-day transmission operations and planning
- denials or grants of transmission service requests
- available transmission capacity
- network configuration
- transmission outages
- reliability conditions and
- operations information