Sheffield-Highgate Export Interface

SHEI

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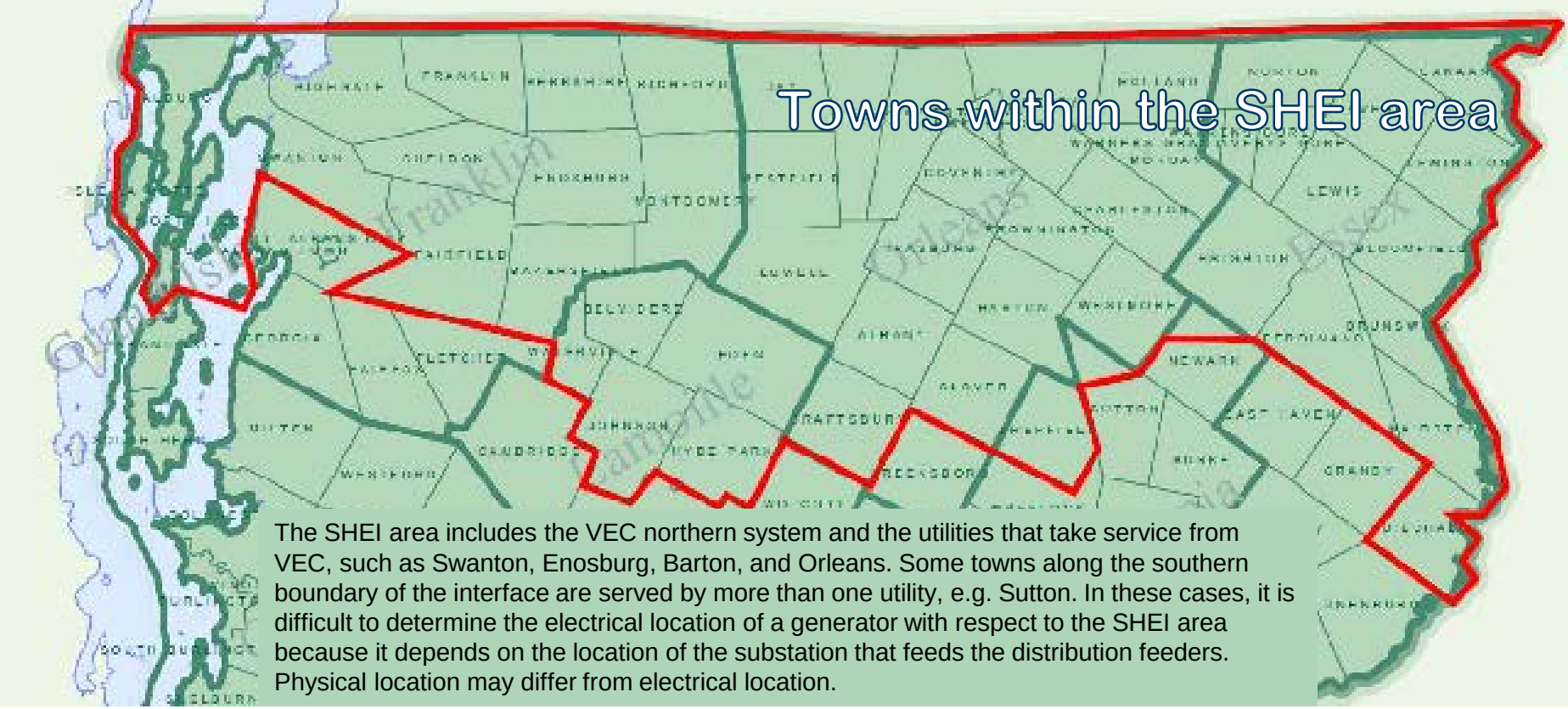
vermont electric power company

VELCO

FERC Standards of Conduct 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 discuss solution options and range of benefits for those solutions
  - Some market-related and Critical Energy Infrastructure Information we can't share



The SHEI area includes the VEC northern system and the utilities that take service from VEC, such as Swanton, Enosburg, Barton, and Orleans. Some towns along the southern boundary of the interface are served by more than one utility, e.g. Sutton. In these cases, it is difficult to determine the electrical location of a generator with respect to the SHEI area because it depends on the location of the substation that feeds the distribution feeders. Physical location may differ from electrical location.

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

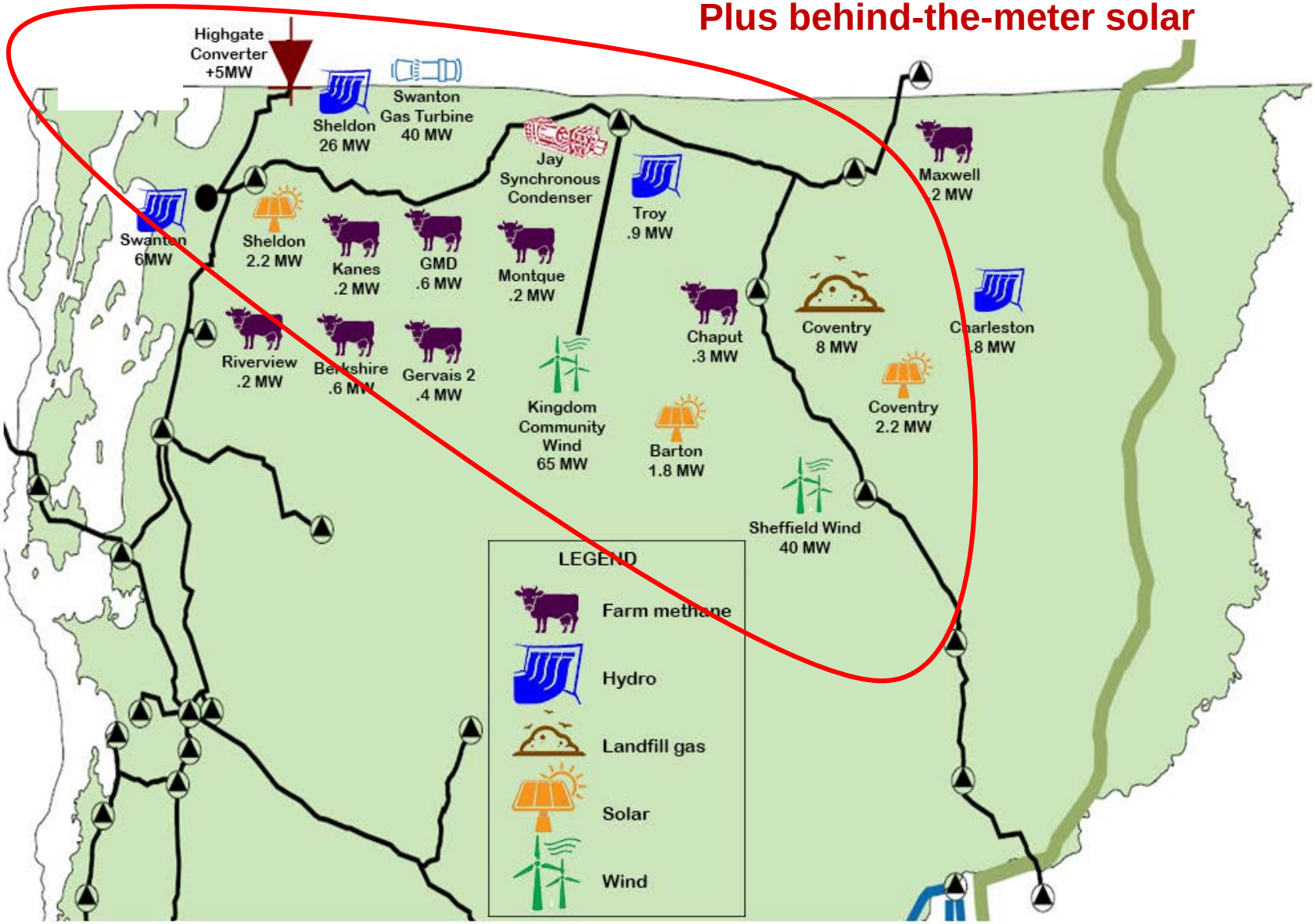
Region very rural, history of limited economic activity, limited grid investment and relatively inexpensive land

What has changed?

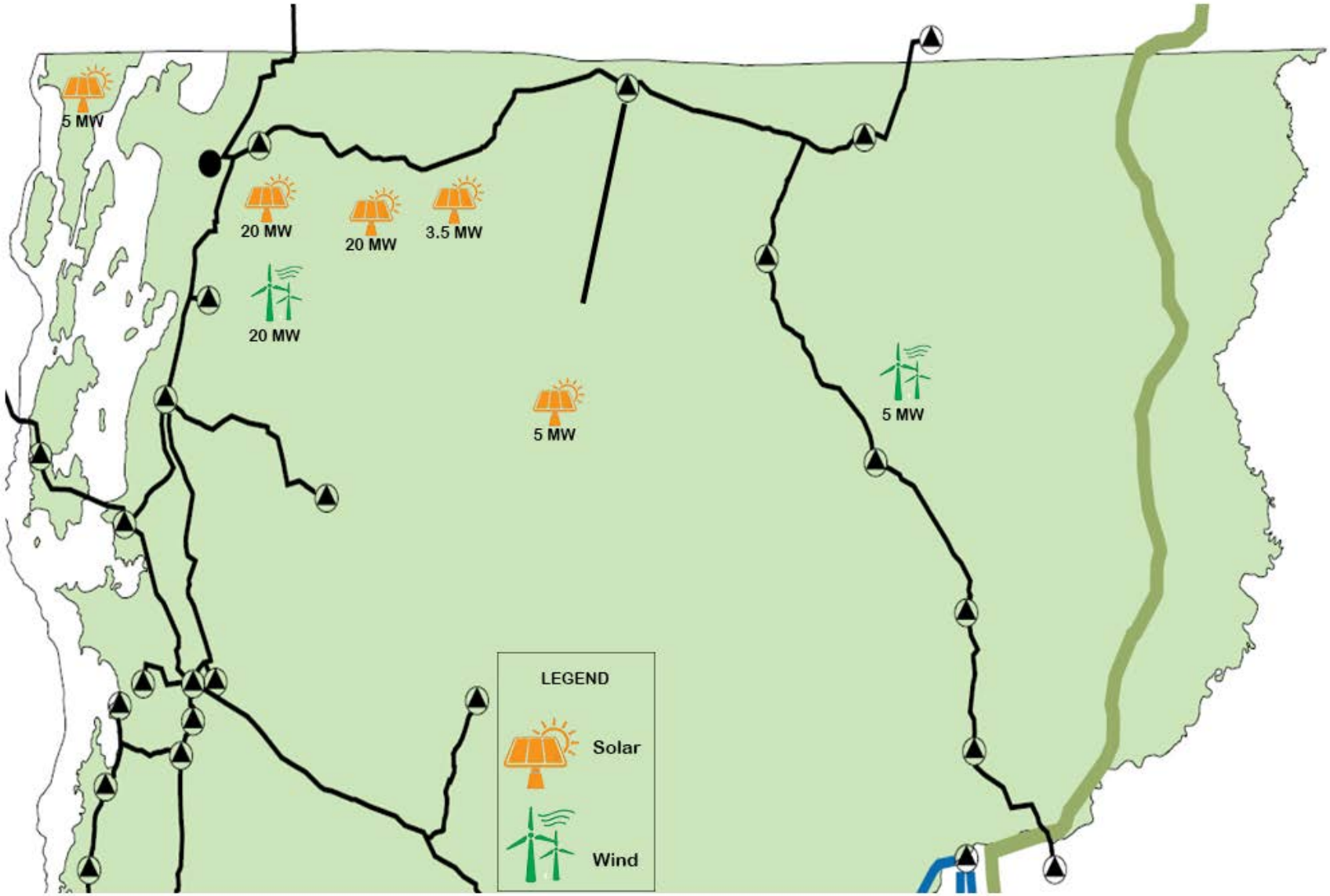
- Growth of generation driven by NE demand for renewables (utility-scale) and customer choice (net metered)
- ISO-NE changes
- Reliability-driven grid maintenance work

SHEI area: growth in generation since 2005

Plus behind-the-meter solar



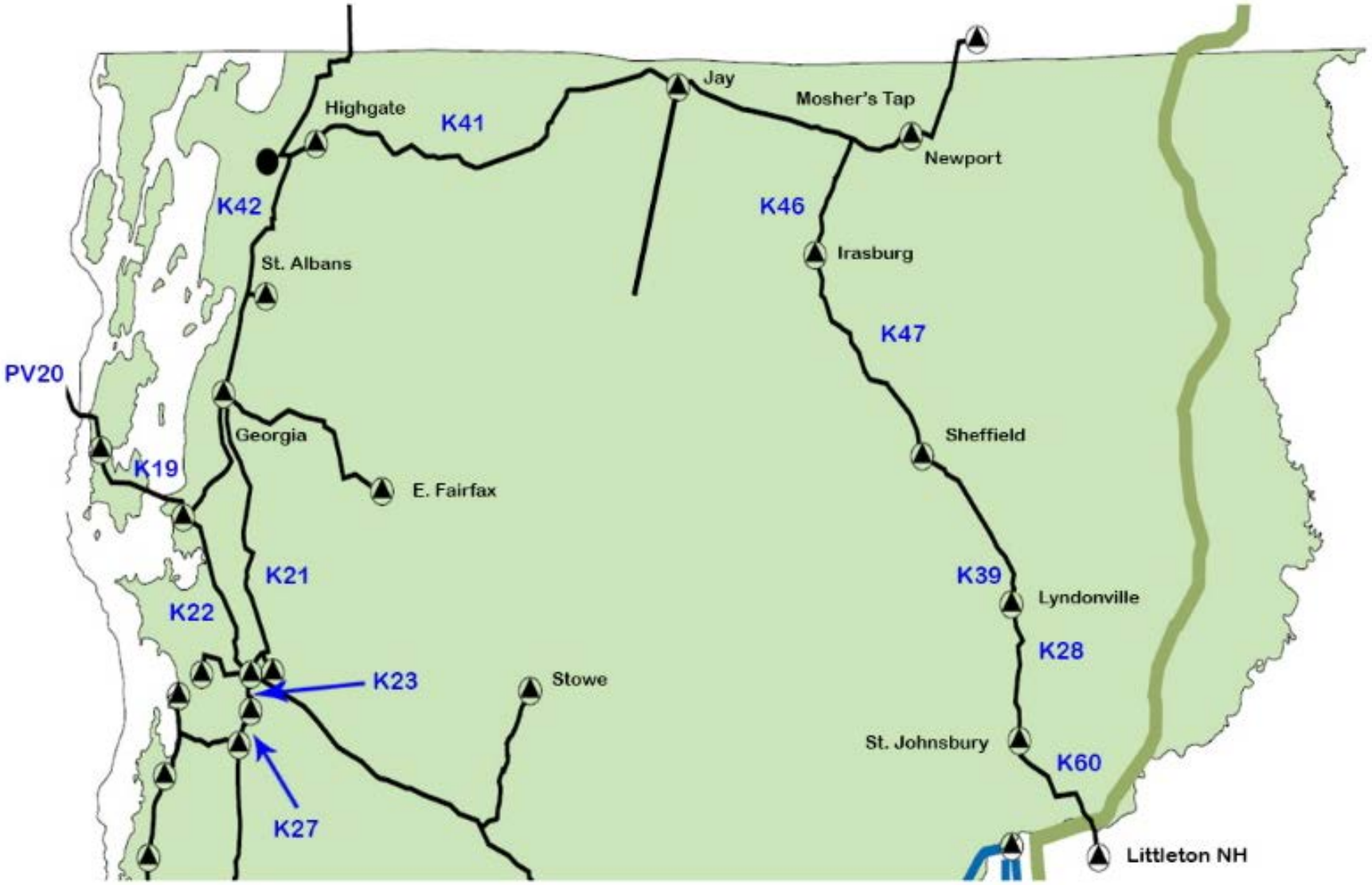
And more generation proposed (2017 & beyond)



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

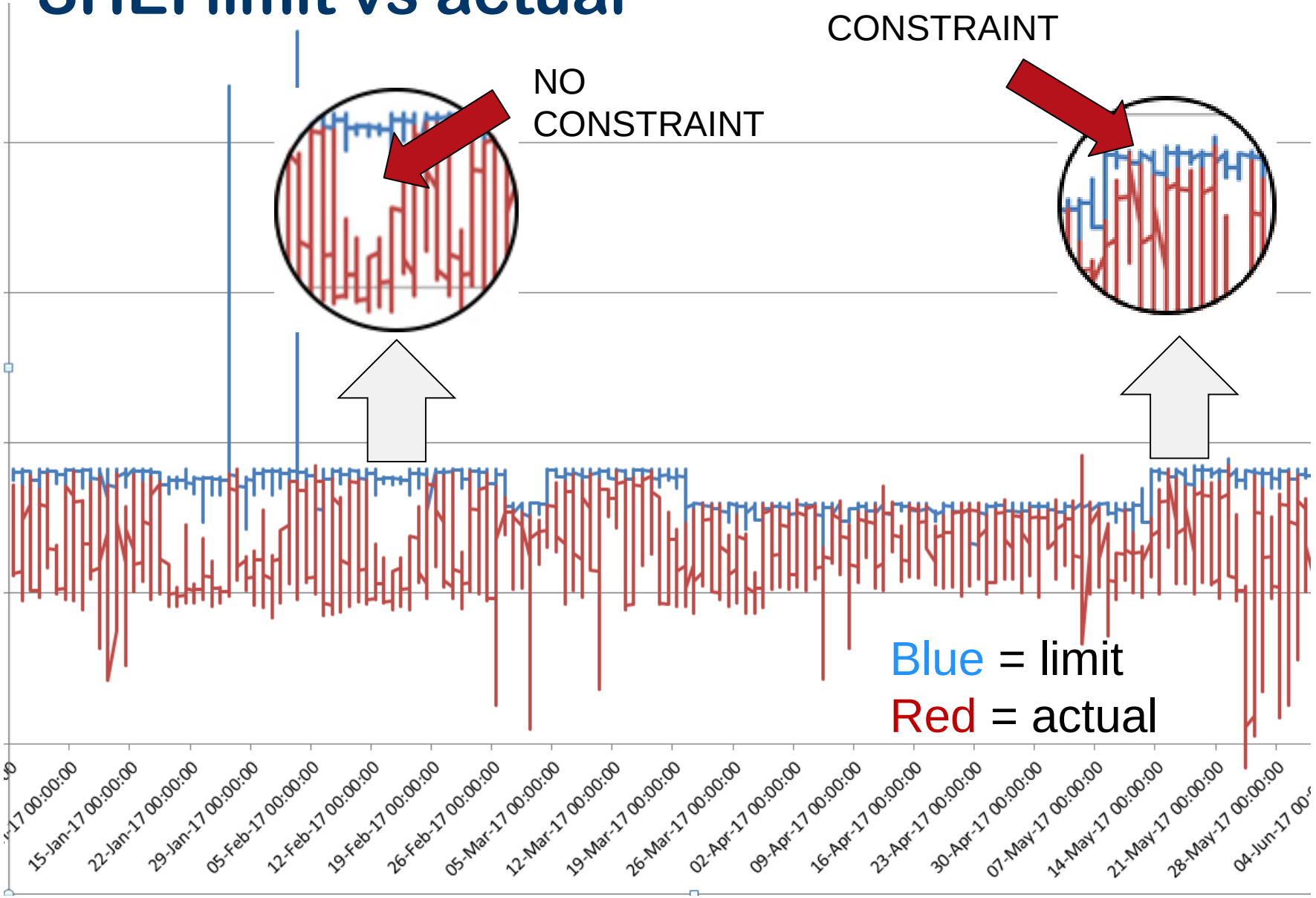
Positive impacts

- Dynamic reactive support (e.g., generator Automatic Voltage Regulators, Statcoms, Static Var Compensators, Synchronous Condensers)

Negative impacts

- Loss of dynamic reactive support
- Transmission outage

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
  - Wind and hydro become dispatchable
- Curtailment priority is based on
  - Bid price
  - Distribution factor
  - Dispatch range (Ecomin/Ecomax)

**generators that participate in the NE regional market*

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

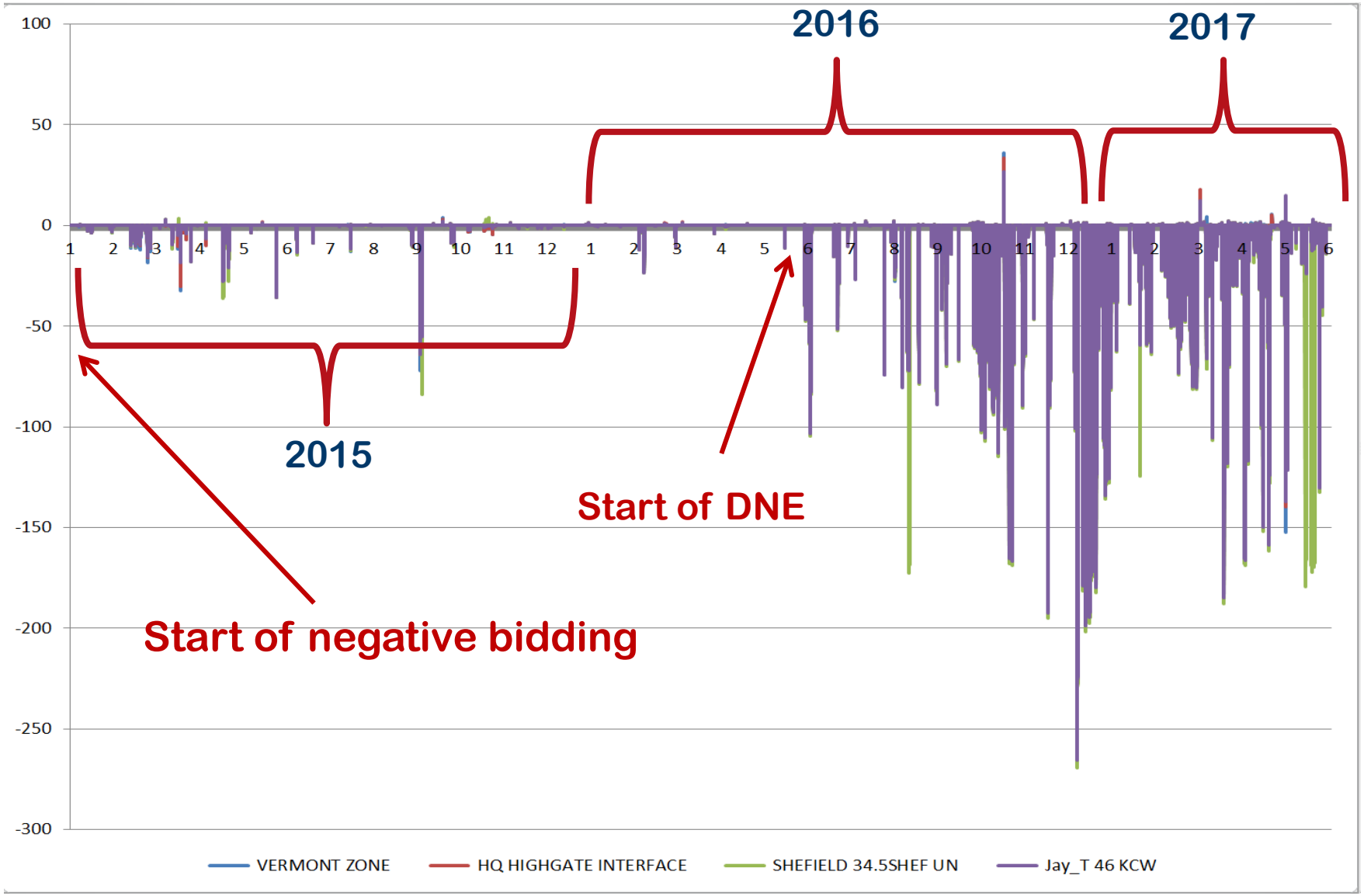
Dispatch of intermittent resources to manage transmission constraints is handled automatically

- Software-based algorithms
- Electronic communications
- DNE instruction (i.e., dispatch limit) sent to each dispatchable generator at least every 5 minutes

Economics of market resources

- Behind-the-meter resources (e.g., net metering) do not participate in ISO-NE markets—they receive retail rates and appear as reduced demand to grid operators
- Generators with a Power Purchase Agreement (PPA) get paid fixed price for energy regardless of market price
- 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.

Potential non-transmission solutions

- Limit generation growth (in conflict with state renewable energy goals)
- Population, economic growth with concomitant increased electric demand
- Increase load, e.g., beneficial electrification
  - Heat pumps
  - Electrification of 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

- 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
    - Results expected October 2017

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)
- VELCO to secure external resource to identify and evaluate SHEI constraint solution
- 2018 VT Long-Range Transmission Plan will identify potential system requirements necessary to achieve state's energy/climate goals
- Regulatory responses?

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.

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

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.