# The Transmission and Distribution System

## Plans, Forecasts, and Implications for the Future of Electrification in Vermont

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# About Me

- ➢ Rising Senior at Wheaton College MA
- ➢ Economics and Political Science (Double Major)
- ➢ Thesis - Effects of IRA tax credits on household energy consumption

# Policy Context

## Global Warming Solutions Act (GWSA):

- Emissions reduction requirements necessitate the replacement of high emission sources of energy (such as greenhouse gas producing fossil fuels) with low emission sources (such as clean, renewable electricity)

- The increased electrification of transportation and heating are among the top priorities of the state’s legally mandated 2025 Climate Action Plan.

# Project Purpose

The purpose of this project was to research and describe in a format for general audiences:

- Key elements of the transmission and distribution (T&D) system serving Vermont; and
- Key T&D issues benefitting from future planning, policy, and/or program development as Vermont seeks to increase electrification while maintaining a reliable T&D grid.

Key issues include: T&D system regulation and planning, load management and system reliability, expanded use of non-transmission alternatives, and T&D infrastructure needs.

# Key Questions

- Who regulates and operates the transmission and distribution grid in Vermont?
- What is the Forward Capacity Market that purchases power for the grid?
- What roles do energy efficiency, demand response, distributed generation from solar and wind, and battery storage have in the capacity market and for the grid, overall?
- Are increases in demand for electricity projected for the future and what are the implications for the T&D grid delivering that power?
- What opportunities exist for managing future load and ensuring system reliability for the T&D grid?

# Methodology and Terminology

## Methodology:

- Interviews with T&D, utility, and system planning professionals
- Technical reports prepared by ISO New England, VELCO, PSD, and utilities
- Data collected by the EIA, DOE, etc.

## Terminology:

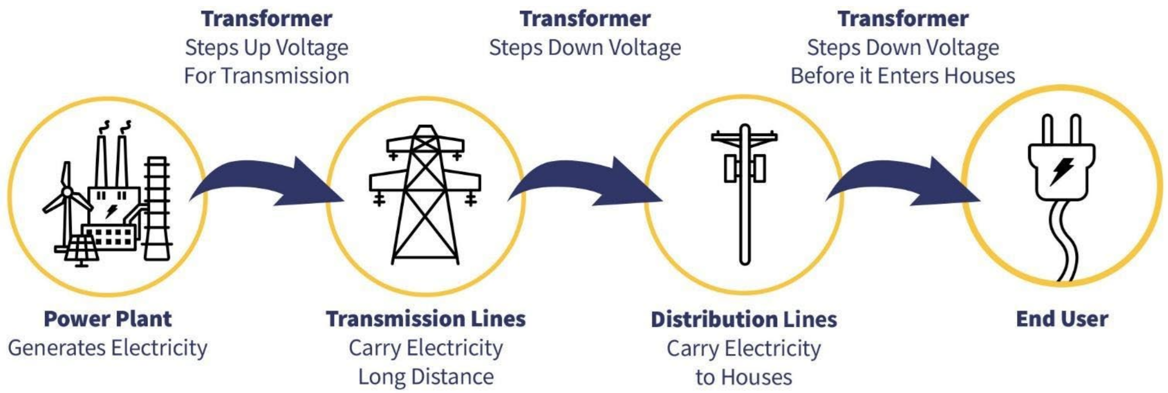
| | |
|---|---|
| **Load:** | The amount of power needed to supply the demand for electricity. Measured in MW (megawatts) or GW (gigawatts). |
| **Peak:** | Specific times of the day when electricity demand is at its highest. |
| **Capacity:** | The maximum amount of electricity a battery can store or a power plant, solar installation, or wind generator can produce. |

# Elements of the T&D System

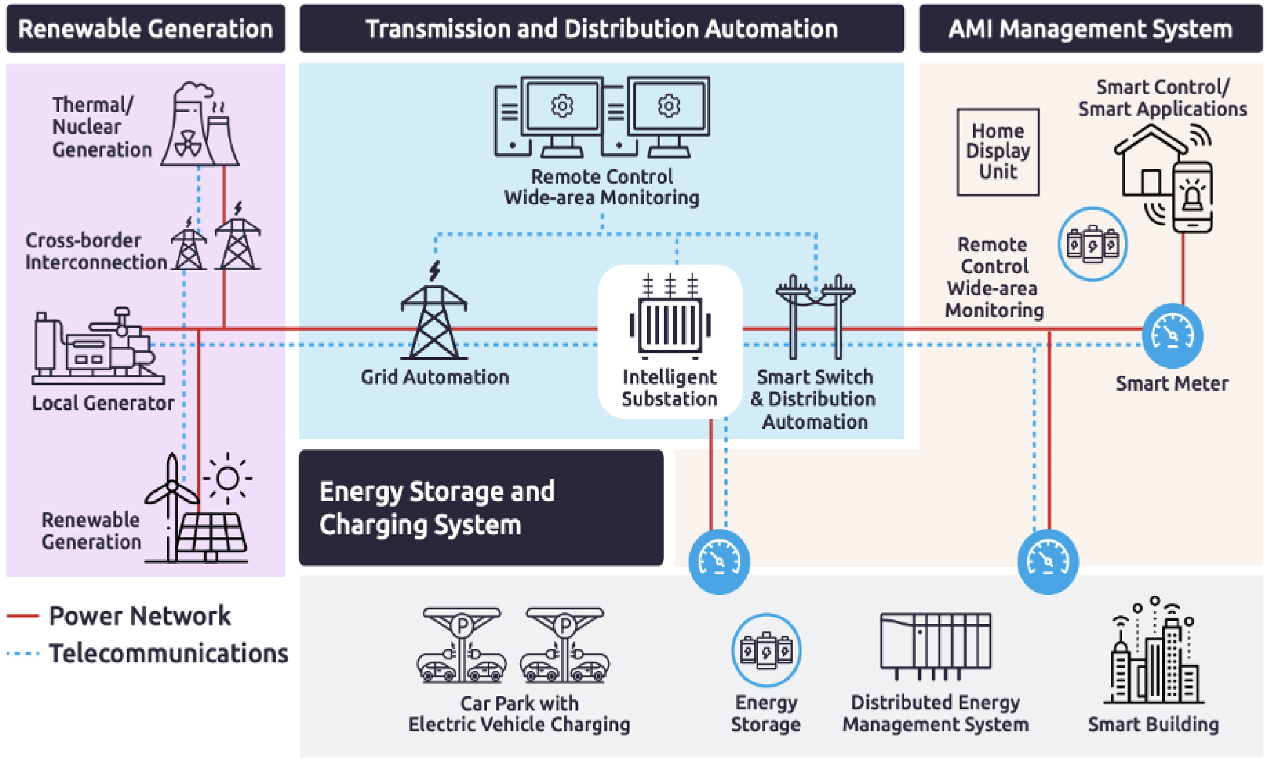
| | | |
|---|---|---|
| 01 | Federal Energy Regulatory Commission (FERC) | Sets national standards and regulations for interstate transmission of energy |
| 02 | ISO New England | Operates New England's transmission system<br>Implements and complies with FERC regulations. |
| 03 | State Regulators and Planners | **Vermont PUC** - Regulates distribution utilities<br>**Vermont PSD** - Represents public interests<br>**VSPC** - Multi-stakeholder T&D planning committee<br>**VELCO**- State transmission operator |
| 04 | Distribution Utilities | 17 Distribution Utilities (DUs)<br>Develop Integrated Resource Plans for PSD review<br>Deliver power to customers |

# Vermont’s Smart Grid

## Traditional Grid:




## Smart Grid:



# New England Forward Capacity Market

## New England "Capacity Market"

- Three-year forward-looking market
- Designed to provide New England with a reliable supply of electricity
- ISO New England hosts auctions for market participants

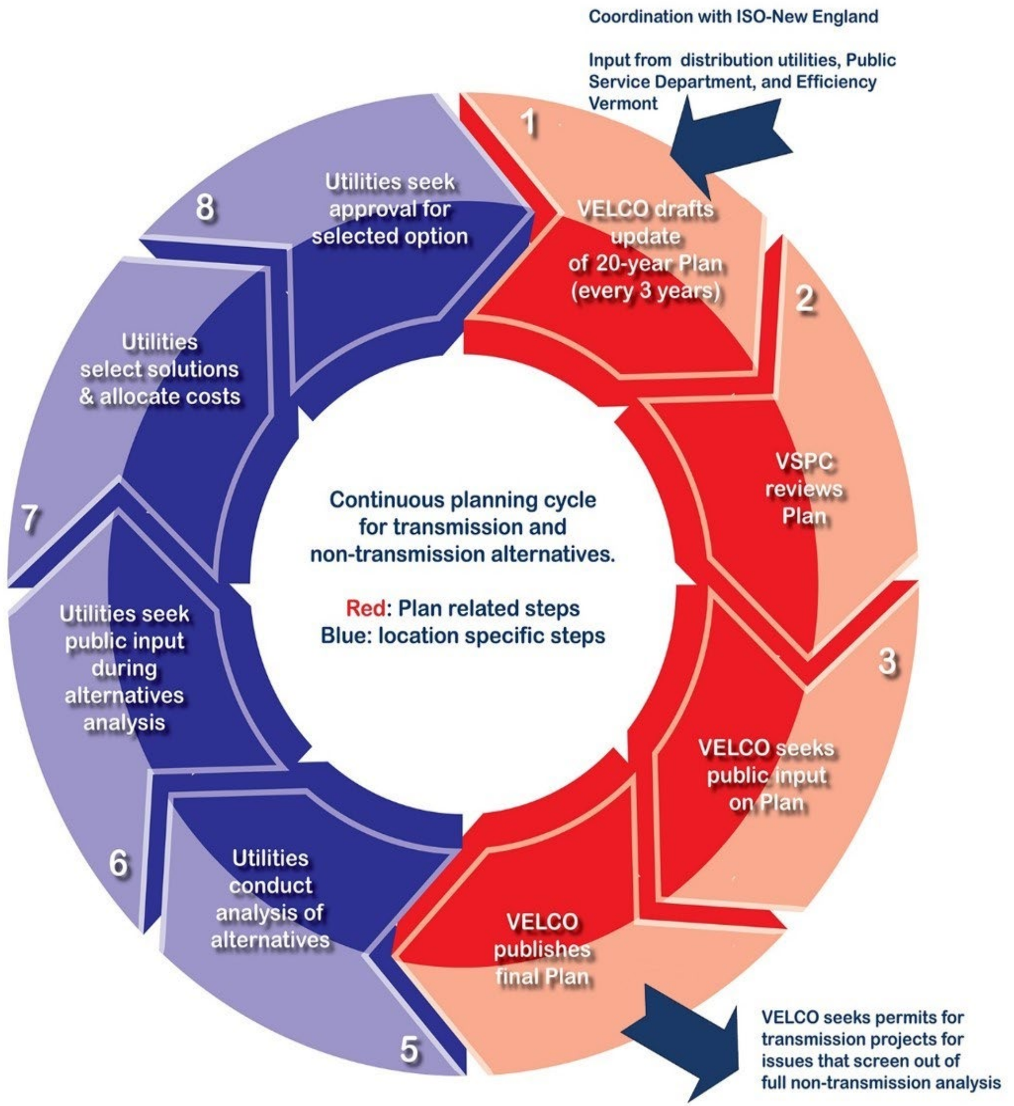
## 2024 Forward Capacity Auction

- Held February 5, 2024
- Demand response, energy efficiency and aggregated residential solar, and battery storage = 2,614 MW (8%)
- Energy storage = 1,800 MW (6%)
- Solar and wind = 1,250 MW (4%)

# T&D System Planning

**VELCO &**
**Vermont System Planning Committee**

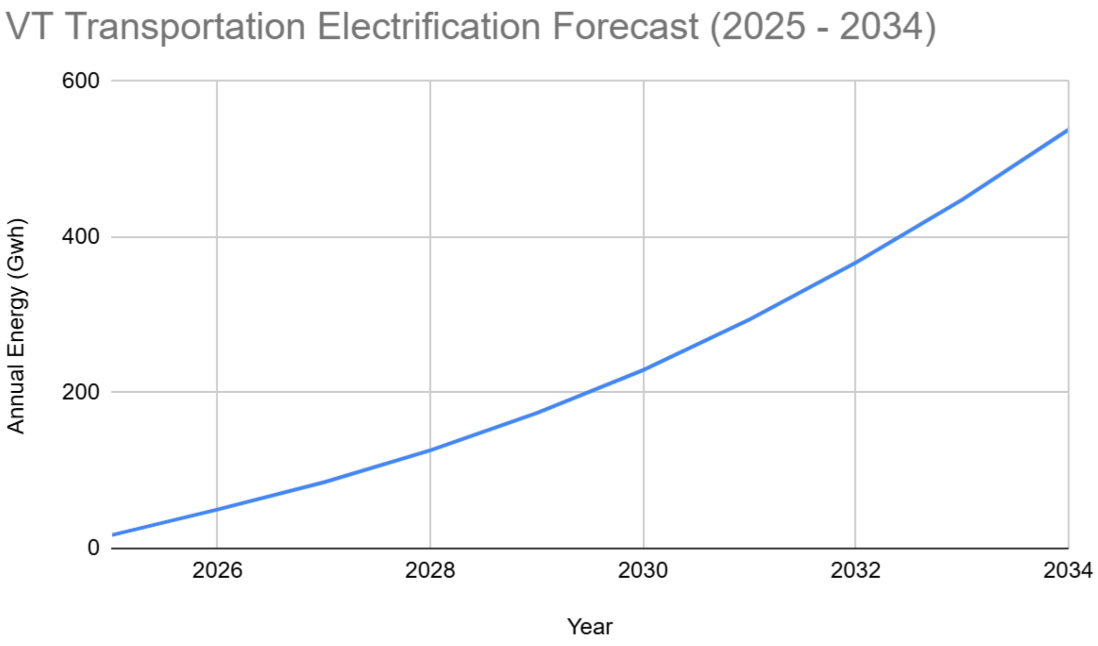
- Enables regional input from ISO New England via VELCO
- VSPC collaborative process involves:
  - VELCO
  - 17 Distribution Utilities
  - Efficiency Vermont
  - Department of Public Service
  - Other stakeholders
- Ensures consideration of non-transmission alternatives (EE, DR, DG, storage)

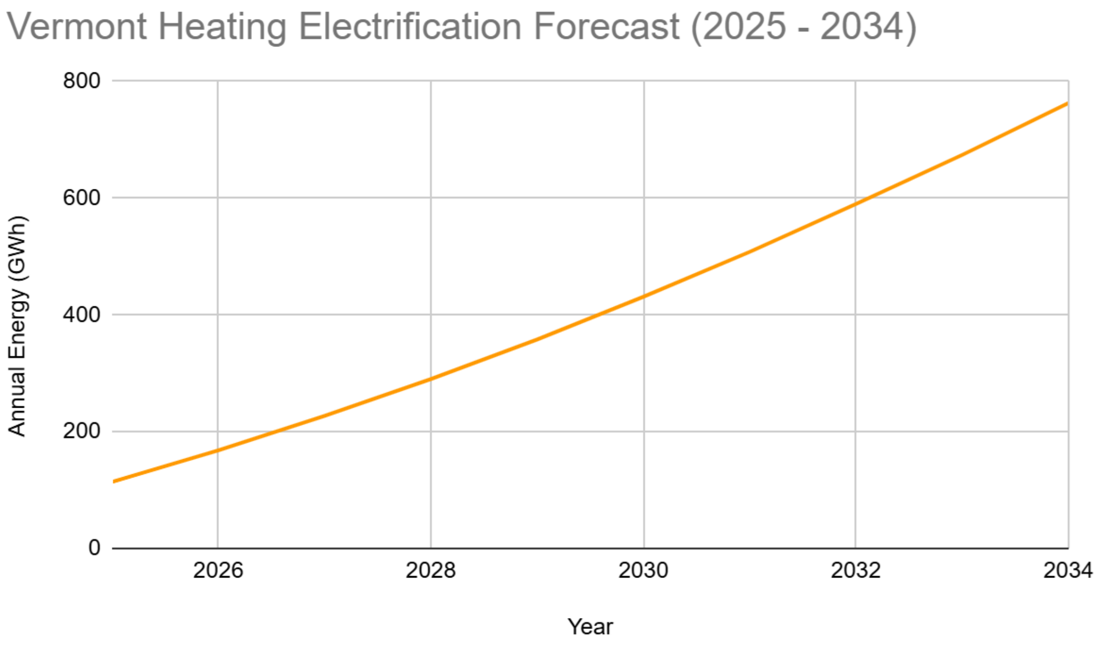


# Key Planning Documents

| | |
|---|---|
| **Vermont Long-Range Transmission Plan - 2024** | VELCO's analysis of projected load growth and transmission needs over a 20-year period. Makes notice of concerns about:<br>➢ Continued substation reliability;<br>➢ Potential system overloads in certain locations in the state; and the<br>➢ Need for infrastructure maintenance & upgrades. |
| **Comprehensive Energy Plan - 2022** | Mandated by law & updated every six years by the PSD in order to;<br>➢ Establish a framework for progress towards Vermont's energy goals; and to<br>➢ Identify strategies for promoting efficiency, demand response, renewables, EVs, etc. |
| **Annual Energy Report - 2025** | Summarizes progress toward CEP Goals using trends across multiple sectors. |

# One Projection of Vermont Electrification Growth




Source: ISO New England CELT Report, 1.7 Electrification Forecast, [2025_celt.xlsx].

# Flexible Load Management

Flexible load management seeks to optimize energy use and enhance grid reliability by:

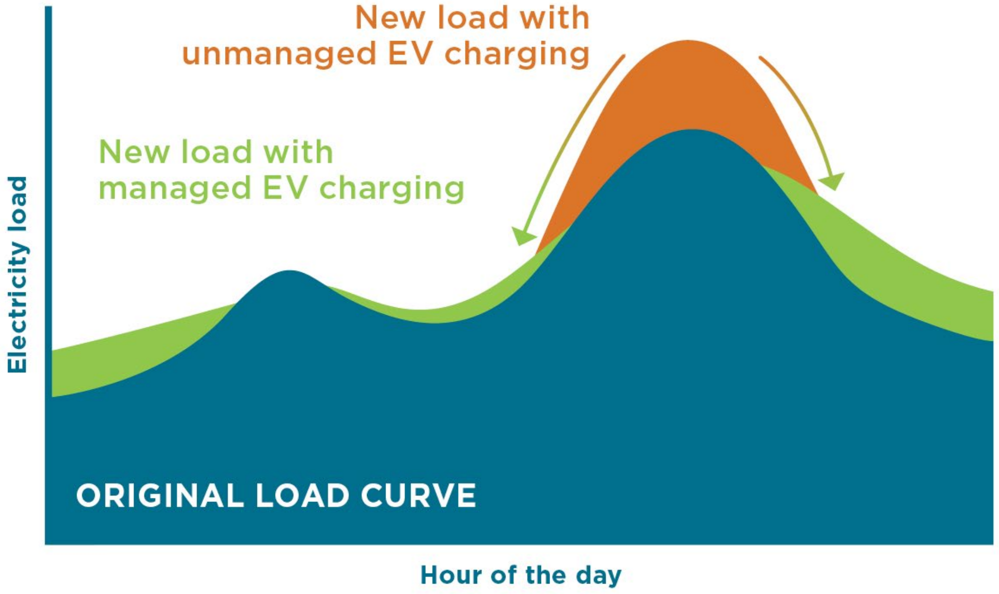
- Shifting energy consumption to reduce demand during peak hours.
- Using smart appliances that can adjust operation during peak hours.
- Implementing demand response programs that incentivize users to reduce usage during high-demand periods.
- Integrating renewable energy sources to balance load and generation.
- Monitoring and analyzing energy use patterns to improve load forecasts.
- Collaboration among those involved with load management and NTAs.

# Flexible Load Management Strategies

Examples include:

- Energy efficiency
- Demand response
- On-site solar and wind generation
- Energy storage (batteries, etc.)
- Managed (off-peak) EV charging

Managed EV charging avoids electricity demand during peaks

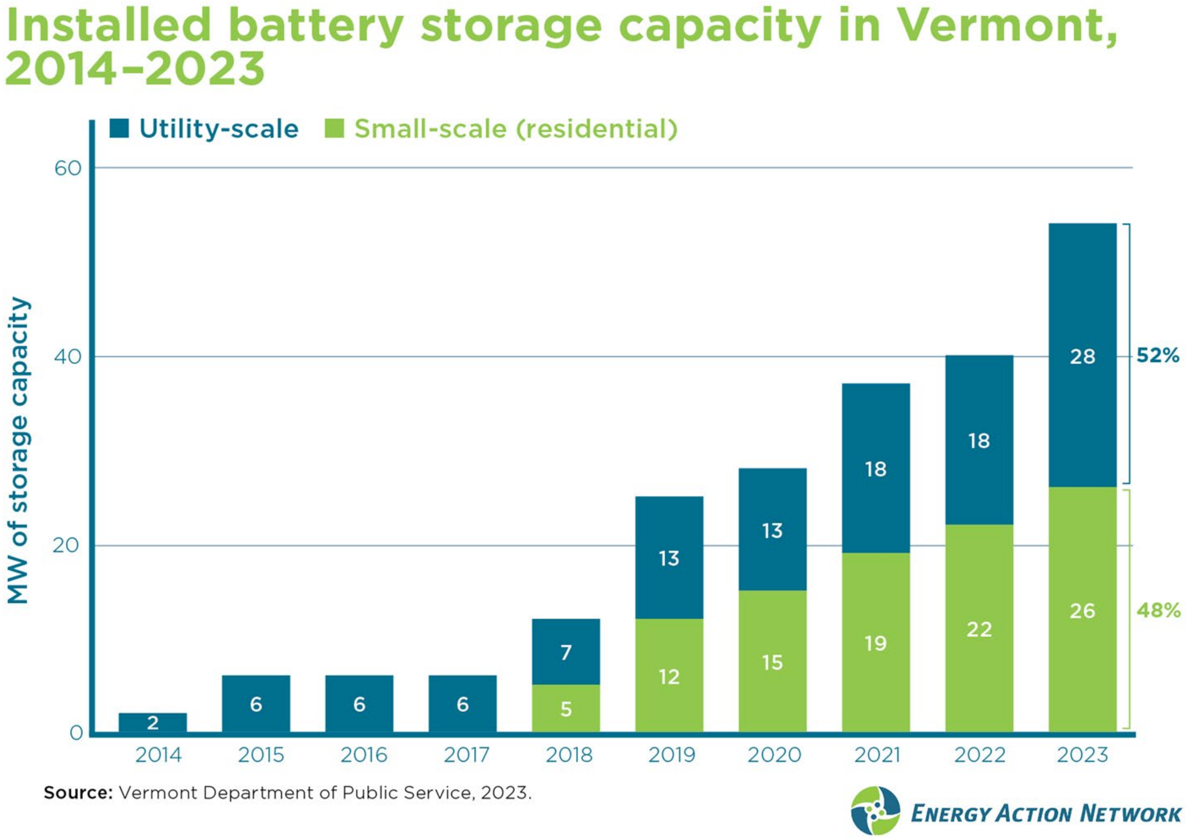



**Note:** Scenario for illustrative purposes.

# The Value of Load Management

## June 2025 Three Day Peak Event

- ➢ Extreme heat and unexpected power plant outages
- ➢ Wholesale electricity prices > $1,000 per MWh
- ➢ New England ratepayers saved $20 million from:
  - Energy efficiency
  - Demand response
  - Distributed solar and wind
  - Storage from batteries, etc.



# Vermont T&D System Reliability

- “Reliability” refers to the ability of the T&D system to transport electricity with minimal or no interruptions.
- "Poor reliability” refers to regular and sustained outages.
- Two metrics are used and reported by the federal EIA:

  SAIDI – the average amount of time without electricity per year

  SAIFI – the average number of outages per year
- Maine had the highest cumulative SAIDI and SAIFI scores in New England for the 10-year period 2013 to 2023.
- Vermont had the second highest SAIDI and SAIFI scores.

# Infrastructure & Reliability Improvements

## Projects

### Reliability-Based Projects

- ➢ Projects aimed at improving system reliability:
  - Undergrounding
  - Installation of hendrix tree cable
  - Battery storage installations

### Asset Condition Projects

- ➢ Replacement or maintenance of aging facilities and assets
  - Replacing old poles, lines, or substations

## Infrastructure Needs

### Substations

- ➢ Many were built in the 1950s and are approaching the end of their usability;
  - Raises concerns over reliability

### Power Lines

- ➢ Some may need replacement to prevent overloads

# Implications & Opportunities for Vermont

## VT Will Need To Address

- Aging infrastructure affected by:
  - More extreme weather
  - Vermont’s rural landscape with long power lines serving few customers

## Opportunities

- EE, DR, DG, and ES provide essential tools for flexible load management
  - Vermont is fortunate to have successful experience with all of these important resources already

# Examples of T&D Infrastructure Solutions

| Transmission Solutions by Region | Cost | Screened In as Non-transmission Alternative | Lead and Affected DUs |
|---|---|---|---|
| **Northern Vermont**<br>• Install new 115 kV line between Essex and Williston<br>• Affected transformers: Queen City, Tafts Corner, Barre<br>• Timing - 2032 | $120 M<br>$ 33 M | • 75 MW load reduction by 2033<br>• NTA grows over time | Lead: GMP<br>Affected All VT |
| **Northwest Vermont**<br>• Rebuild West Rutland to Middlebury 115 kV line<br>• Affected transformer: Middlebury<br>• Timing – 2029 | $215 M<br>$ 13 M | • 80 MW load reduction by 20233<br>• NTA grows over time | Lead: GMP<br>Affected: All VT |
| **Central Vermont**<br>• Rebuild Coolidge – Cold River - North Rutland 115 kV line<br>• Affected transformers: N. Rutland, Cold River, Windsor<br>• Timing – 2034 | $185 M<br>$ 13 M | • Keeps load below 2033 level<br>• NTA grows over time | Lead: GMP<br>Affected: All VT |
| **Southern Vermont**<br>• Rebuild NGRID Bellows Falls-Ascutney Tap 115 kV line<br>• Affected transformer: GMP Vermont Road 115/64 kv<br>• Timing – 2034 | No Estimate | • Keeps load below 2033 level<br>• NTA grows over time | Lead: GMP<br>Affected: All VT, NGRID |
| **Statewide**<br>• Install new 345 kV line between Vernon and Eversource Northfield, MA<br>• Affected transformer: Bennington<br>• Timing – 2034 | $5 M for VELCO portion<br>$13 M | • Keeps load below 2033 level<br>• NTA grows over time | Lead: GMP<br>Affected: All VT, Eversource |

2024 Vermont Long-Range Transmission Plan, VSPC Draft Report, April 17, 2024, page 6

# Conclusion

Vermont's collaborative planning process - coupled with ingenuity-focused planners, utilities, and energy companies - enable Vermont to continue to optimize the grid, support adoption trends for technologies that push the state closer to its energy goals, and find cost-effective solutions to expected system challenges.

It's recognized in the 2024 VSPC draft of the VLRTP:
Transmission is just as important today as ever, as Vermont's electric grid is increasingly decentralized due to new DG resources, which are "intermittent, weather dependent, and out of alignment with daily peak demand" (Pg. 10) The goal of serving peak demand necessitates the pairing of solar with energy storage in order to see significant benefits.

# Thank you!

Questions and Comments?

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