

# Renewable Programs Overview

## Public Service Department

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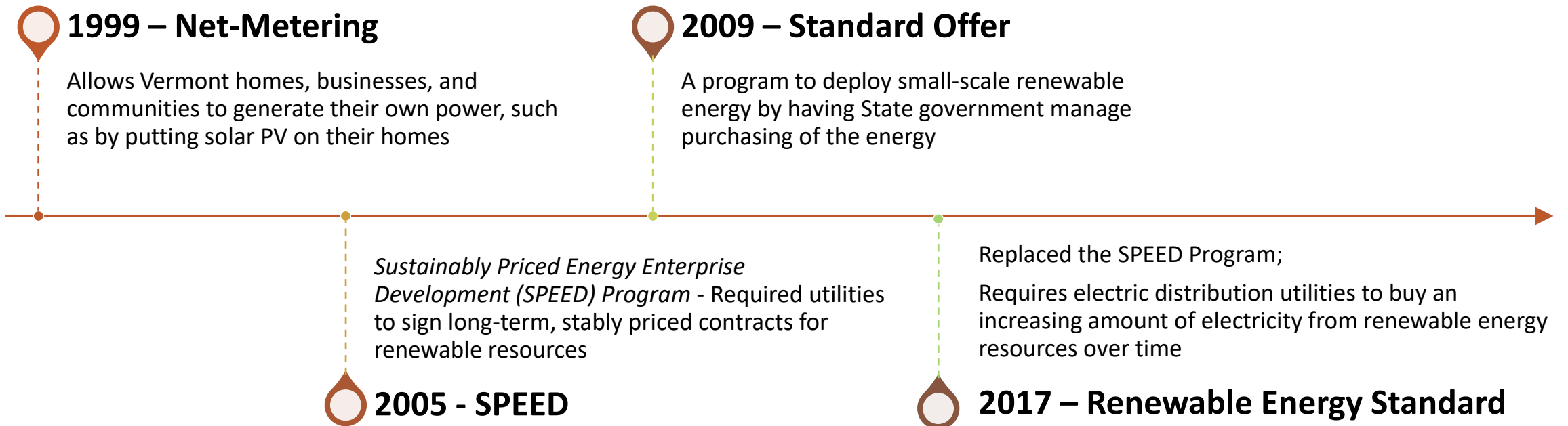
BEFORE SENATE FINANCE COMMITTEE, 2/23/2023

TJ POOR, DIRECTOR OF PLANNING



# Core Policies & Programs

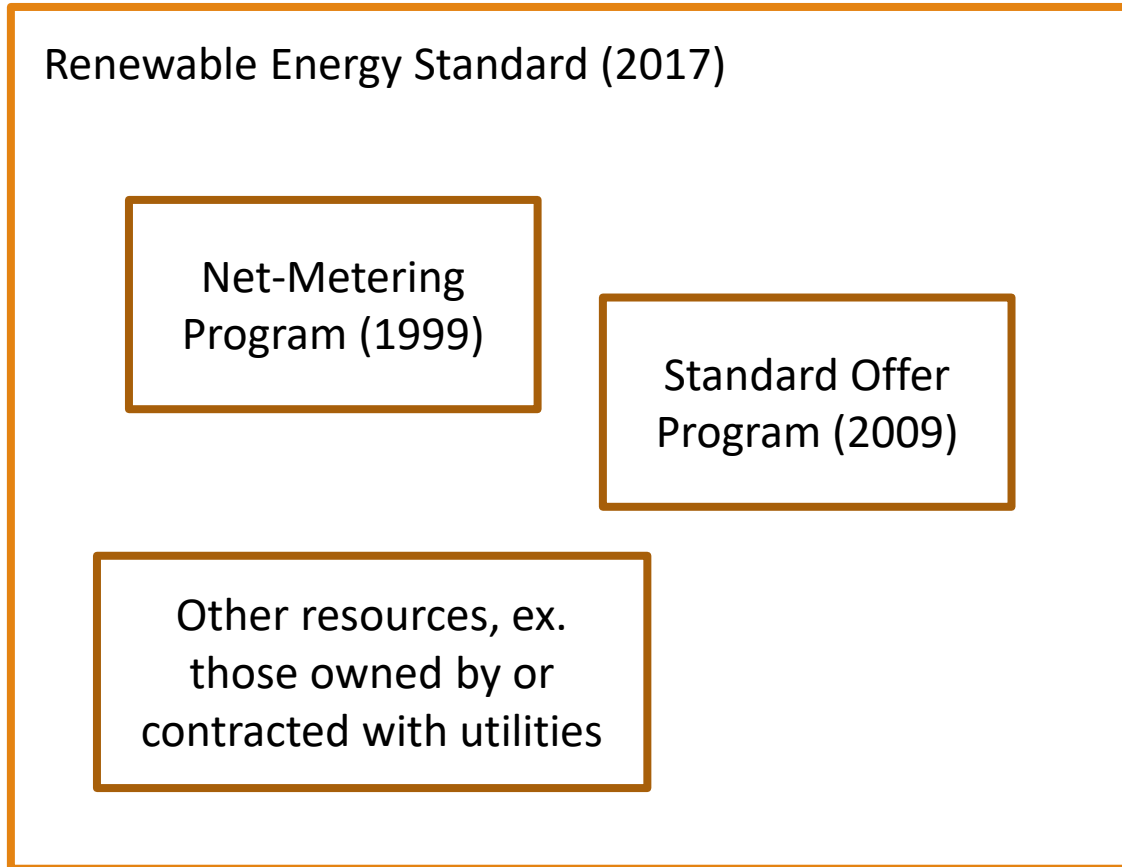
Over the last 20+ years, Vermont has developed several policies and programs to support renewable electricity in the state. These include:



In Vermont law, these programs are described in [Title 30, Chapter 89 “Renewable Energy Programs”](#)

# Core Policies & Programs

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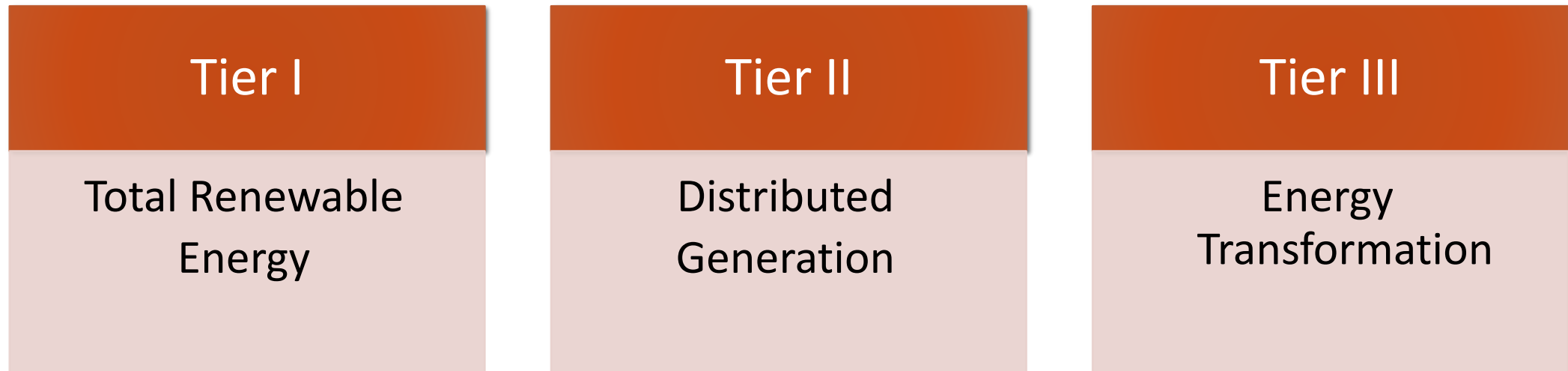
Currently, the **Renewable Energy Standard (RES)** sets the overarching requirements for increasing the supply of renewable electricity in Vermont.

Resources developed under **other programs** support achieving the requirements of the RES.

# Renewable Energy Standard

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The Renewable Energy Standard requires Vermont electric distribution utilities to purchase or own a specific amount of electricity generated from renewable resources. This requirement is outlined in three different Tiers:



Tiers 1 and 2 require that utilities retire renewable energy certificates (RECs) to show they are in compliance, and utilities had to start complying in 2017.

# What is a Renewable Energy Credit?



## RENEWABLE ENERGY GENERATORS



RECs provide a mechanism to:

1. Demonstrate that someone created the electrons coming from renewable resources
2. Prevent two different entities from claiming credit for supporting the same resource
3. Demonstrate compliance with the Renewable Energy Standard

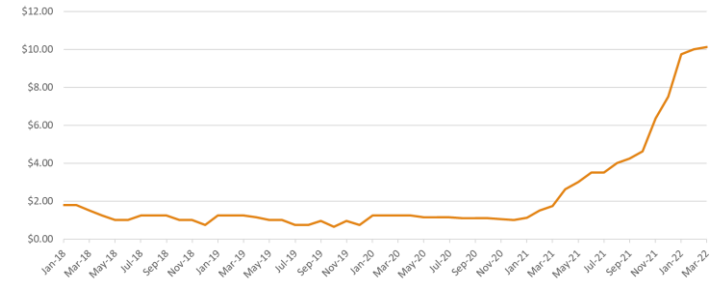
RECs can be sold together with the electricity (i.e. bundled together) OR separately from the electricity (i.e. unbundled).

# How does Vermont define “renewable”?

In Vermont law (**30 V.S.A. § 8002**), “**renewable energy**” is defined as:

*Energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate*

# Tier 1 – Total Energy



- Eligibility – any renewable resource that can deliver into New England, regardless of when resource was constructed.
  - Includes resources from NY and Quebec
  - Has largely been met with hydroelectric resources from New England, NY, and Canada
- Required Amounts:
  - 55% of retail sales in 2017, increasing 4% every three years, until 75% in 2032
    - Tier II is included in Tier I
  - Current Requirements:
    - 2020-2022: 59%
  - Maintained at 75% thereafter
- Alternative Compliance Payment = \$11.97/REC in 2023, increasing by CPI annually
- REC prices have historically been relatively low (ex. \$0.35/REC average in 2019 & \$0.63/REC in 2020) although have increased substantially in the past year (\$5-9/REC)

# Tier 2 – Distributed Generation

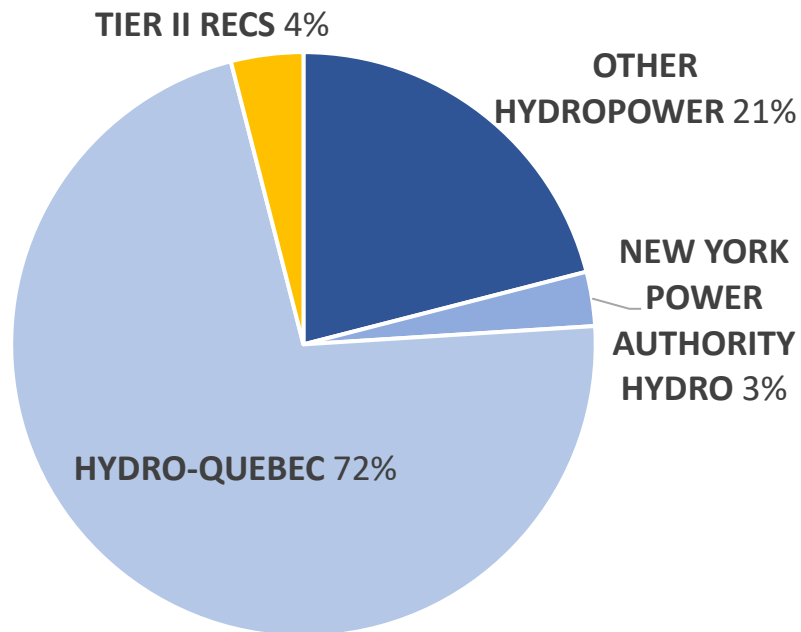


- Eligibility – renewable resources commissioned after June 30, 2015; connected to a distribution or sub transmission line in Vermont; nameplate capacity of less than 5 MW
  - Resources used to demonstrate compliance typically include net-metering, standard offer, utility PPAs
- Required Amounts: 1% of retail sales in 2017, increasing 0.6% every year, until 10% in 2032
  - 2022: 4% Maintained at 10% thereafter
  - Carve out of Tier 1 requirements (not additional)
- Alternative Compliance Payment = \$71.83/REC in 2023, increasing by CPI annually
- Tier 2 REC price forecast for new RECs: ~\$35/REC in the near-term, decreasing to ~\$30/REC by 2030

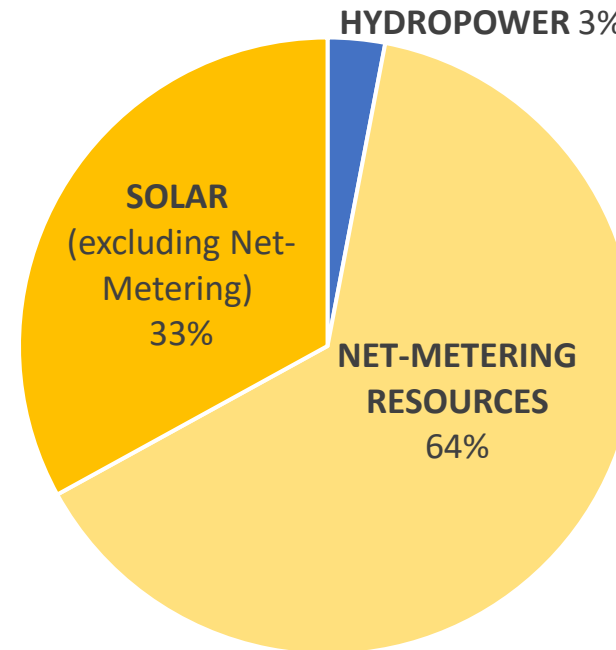


# 2021 Tiers 1 & 2 Compliance by Resource

2021 RES TIER I REC RETIREMENTS



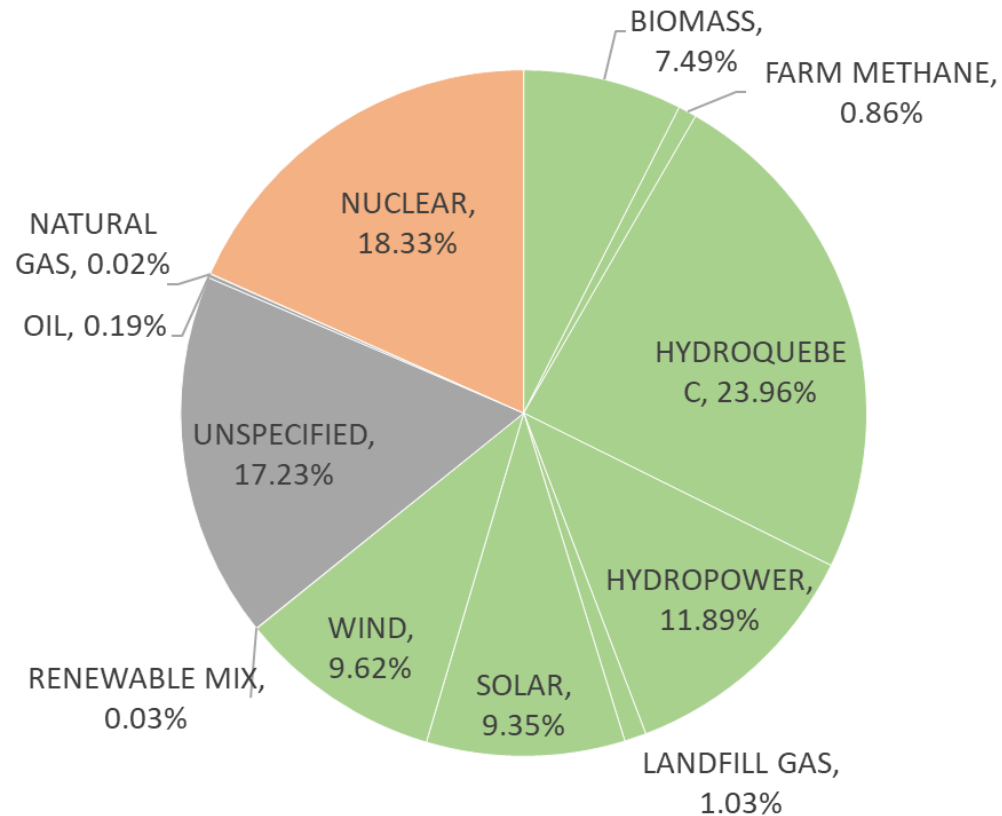
2021 RES TIER II REC RETIREMENTS



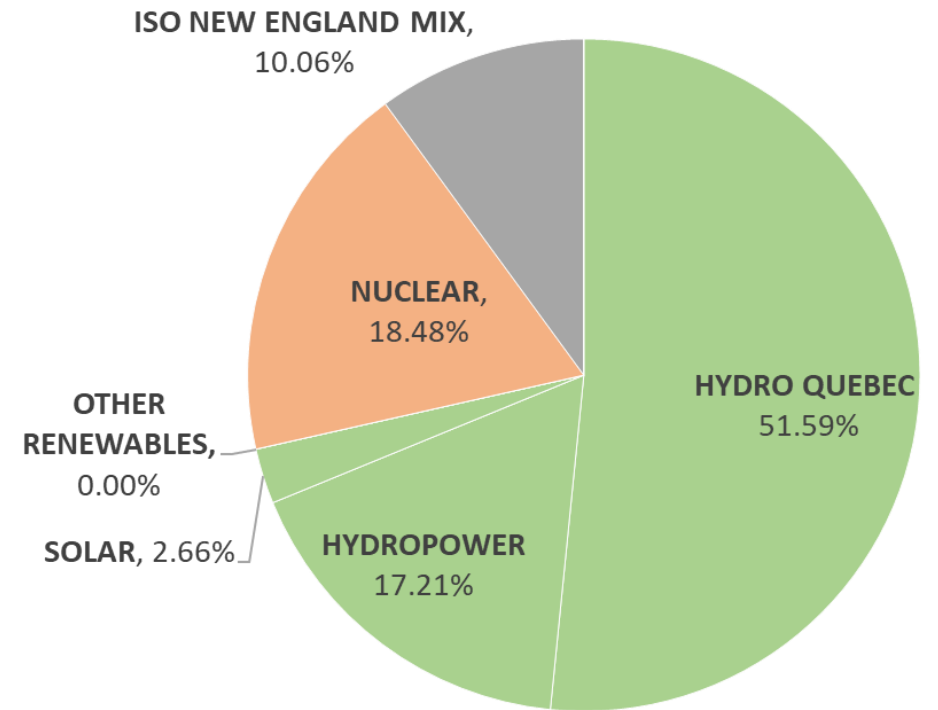
Note: Utilities must retire Renewable Energy Certificates (RECs) assigned to them from net-metering projects installed after 2017. They do not have to (but can) retire RECs from resources in the Standard Offer program.

# Vermont Electric Supply - 2021

## Physical Deliveries – Owned or Contracted



## Based on REC Retirements

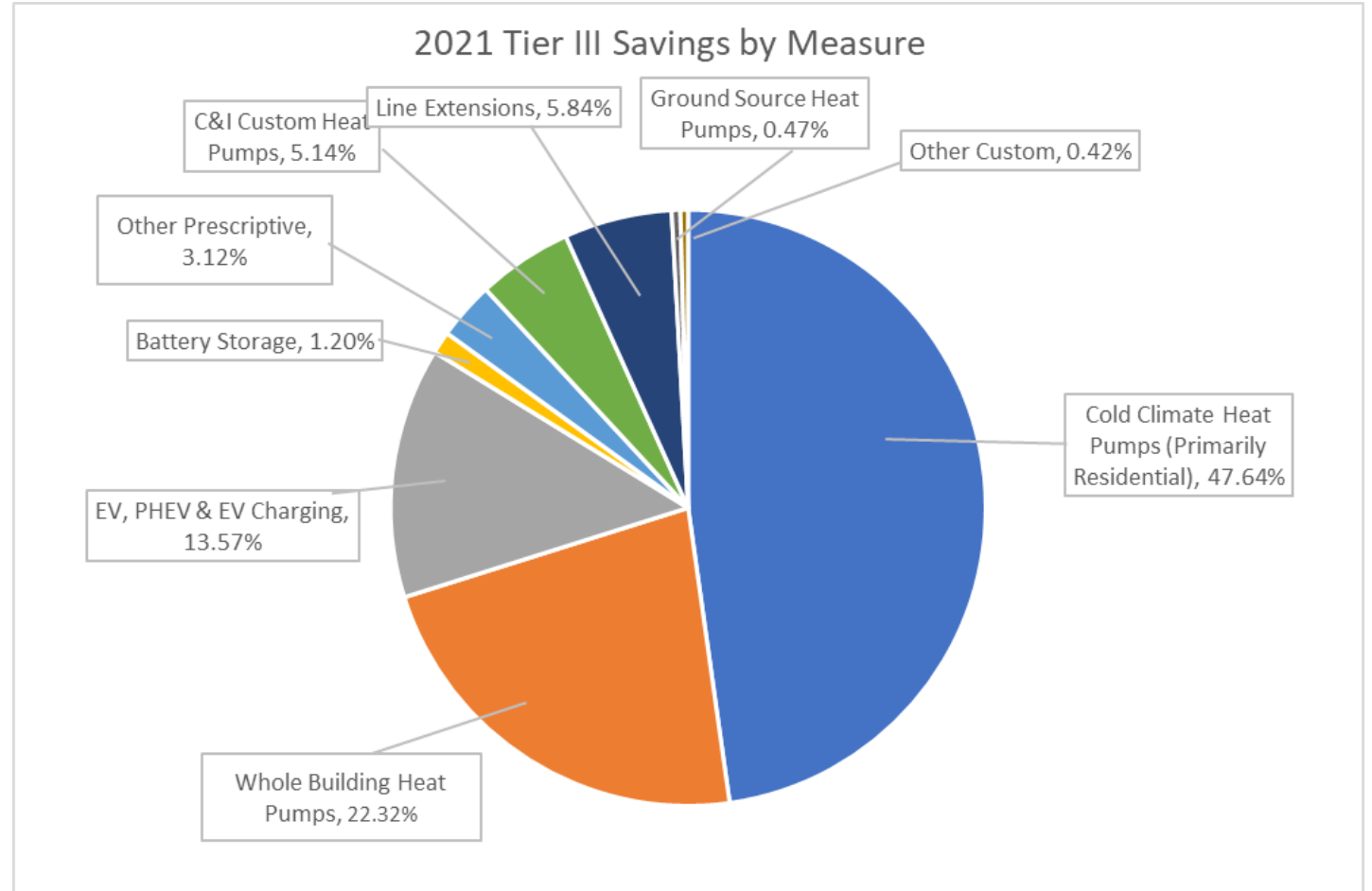


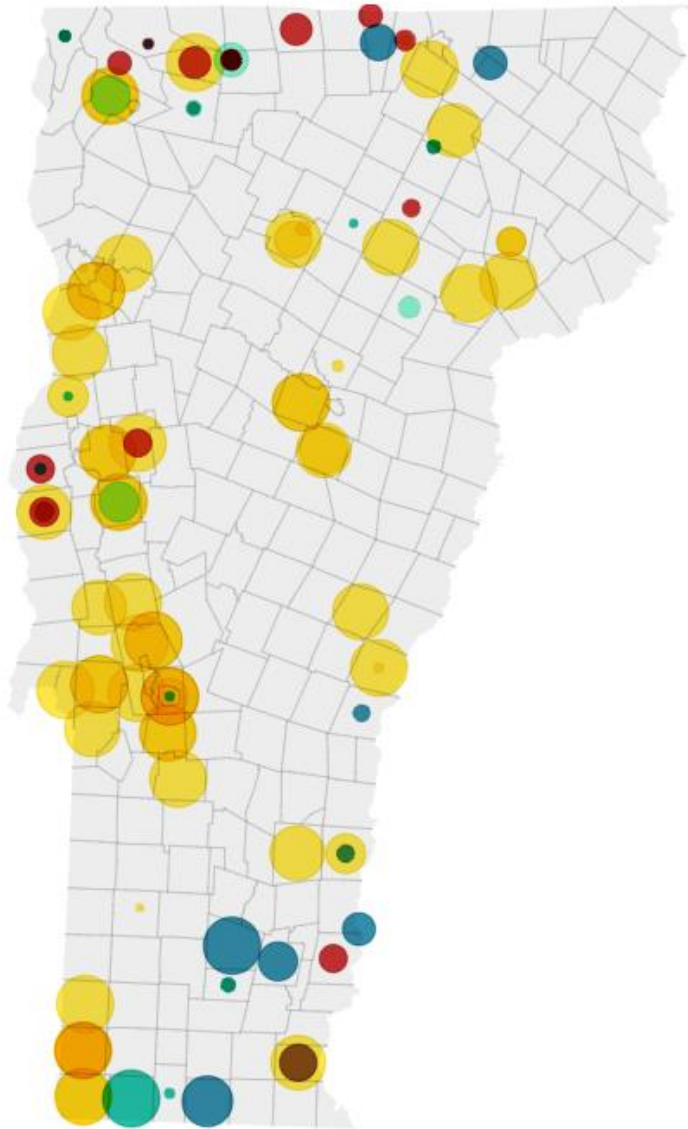
# Tier 3 – Energy Transformation

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- Purpose: Support fossil fuel reductions for utility customers
- Eligibility: electrification (vehicles, heat pumps); sawmills; sugaring operations; weatherization; Tier 2 RECs
- Required Amounts: 2% of retail sales in 2017, increasing by 0.67 % each year until reaching 12% in 2032
  - Maintained at 12% thereafter
  - Later start date and lower overall requirement for small municipal utilities
- Alternative Compliance Payment = \$60/REC in 2017, increasing by CPI annually
- Costs vary considerably in terms of incentives paid to customers. Average cost was ~\$32/ MWh in 2021 (gross cost)

# Tier 3 – Energy Transformation





Created with [Datawrapper](#)



# Standard Offer Program

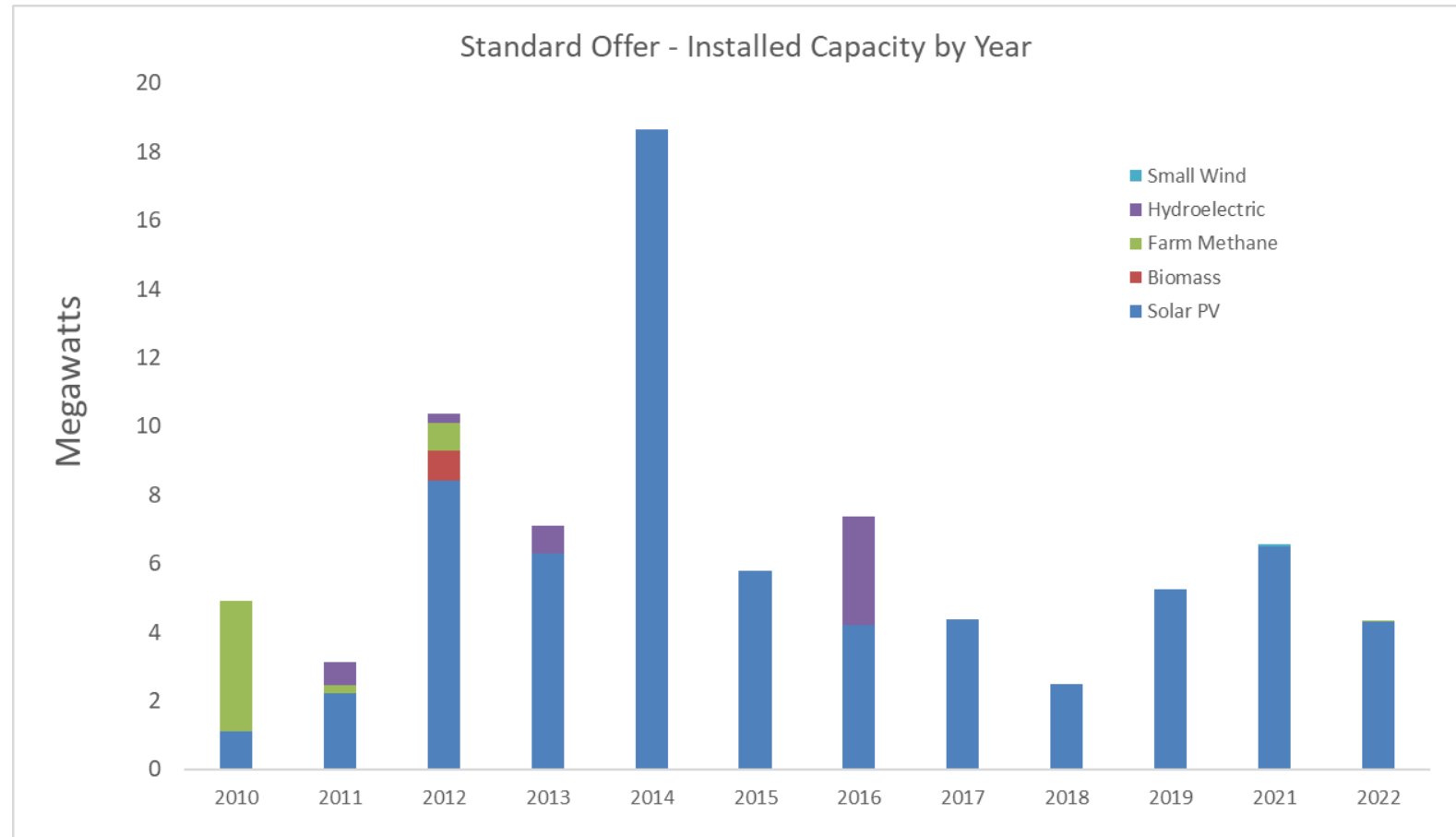
The Standard Offer program aimed to stimulate **small ( $\leq 2.2$  MW), in-state** renewable energy development.

These resources were developed through a centralized solicitation process overseen by the Public Utilities Commission. Originally a lottery system, the program evolved to an annual solicitation for projects.

Projects were selected based on **least-cost** and **resource diversity** criteria and provides long-term, fixed price contracts for resources paid by utilities

The program had a cap of 127.5 MW, which has now all been awarded in contracts. **This means that as of 2023 no new solicitations are scheduled.**

# Standard Offer Installed by Year, Type



# Standard Offer Program – Base Load

## **30 V.S.A. § 8009** Baseload renewable power portfolio requirement

- Encourages plants that “produces electricity essentially continuously at a constant rate”
- Specific to one biomass facility in Vermont: Ryegate Biomass Facility
- Fixed price contract, through 2032 if meets certain contract milestones
- The Public Utility Commission has a contract with the facility and the Vermont distribution utilities are required to purchase the energy and Renewable Energy Credits from the contract

# Net-Metering (30 V.S.A. § 8010 and PUC Rule 5.100)

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- PUC directed by Legislature in Act 99 of 2014 to initiate proceedings to redesign net-metering.
- Current program (“NM 2.0”) started January 1, 2017, fifth rate revision effective Sept 1. (“NM 2.5”)
- Four categories of NM systems based on size and whether it is a “preferred site”, plus hydro
  - Category I: 15 kW and under
  - Category II: 15-150 kW on preferred sites\*
  - Category III: 150-500 kW on preferred sites
  - Category IV: 15-150 kW not on preferred sites
- Production is netted with consumption within the billing period (i.e., these kWh are valued at retail rate)
- Compensation for any excess generation is based on whichever is lower, the utility’s blended residential rate or the statewide average blended residential rate (\$0.17141/kWh as of September 1, 2022), Group system generation is generally all treated as excess.
- Credits roll over for 12 months from genesis (i.e., summer production can offset winter consumption). Credits cannot be used toward non-bypassable charges.

\*Pre-existing structures, parking lot canopies, previously developed land, brownfields, landfills, gravel pits, town-designated sites, Superfund sites, on the same parcel as a customer taking at least 50% of output



# Net-Metering Program – Compensation Structure

In the current program, net-metering systems are compensated for their production based on:

Generation



How much electricity did your system generate each month and how did that compare to your electric usage? Is the system offsetting consumption?

Category (Capacity x Location)



Category I: smaller than 15 kW  
Category II: 15 -150 kW on a preferred site\*  
Category III: 150-500 kW on a preferred site  
Category IV: 15-150 kW not on a preferred site



REC Disposition



Did you keep the Renewable Energy Certificate or assign it to the utility?

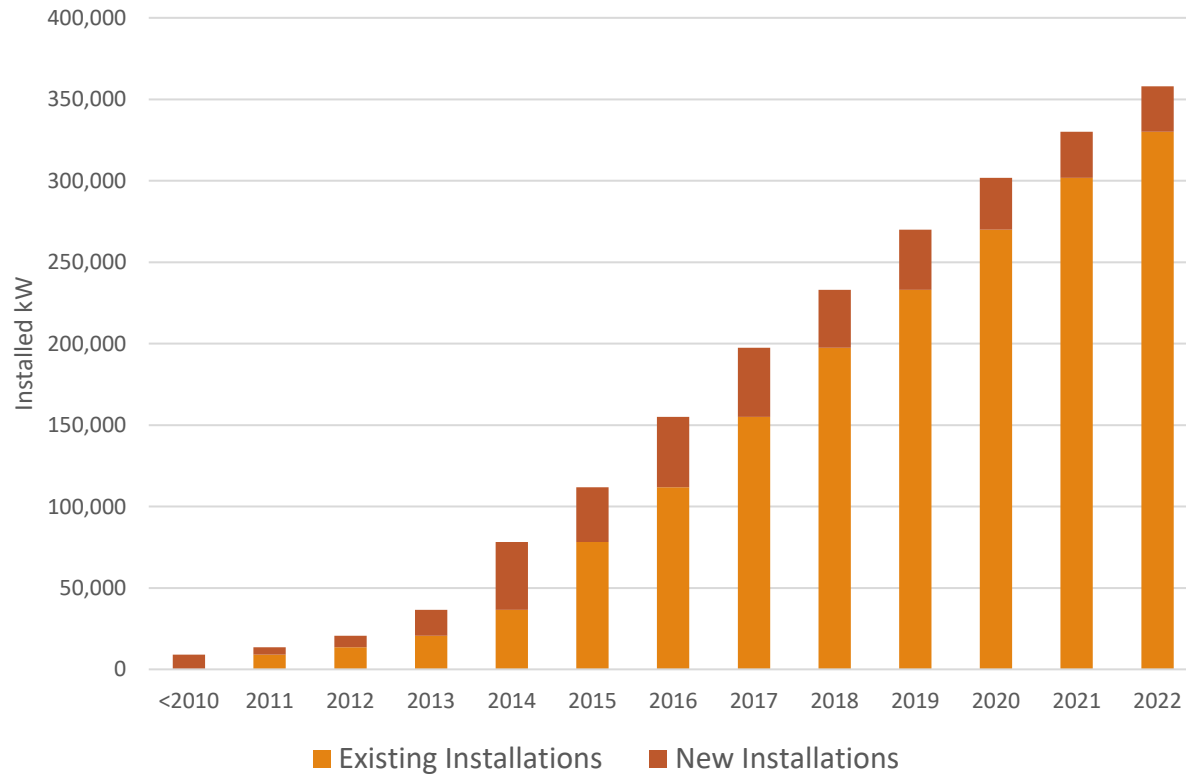
\*Preferred sites include pre-existing structures, parking lot canopies, previously developed land, brownfields, landfills, gravel pits, town-designated sites, Superfund sites, on the same parcel as a customer taking at least 50% of output

# Net-Metering Program – Compensation Structure

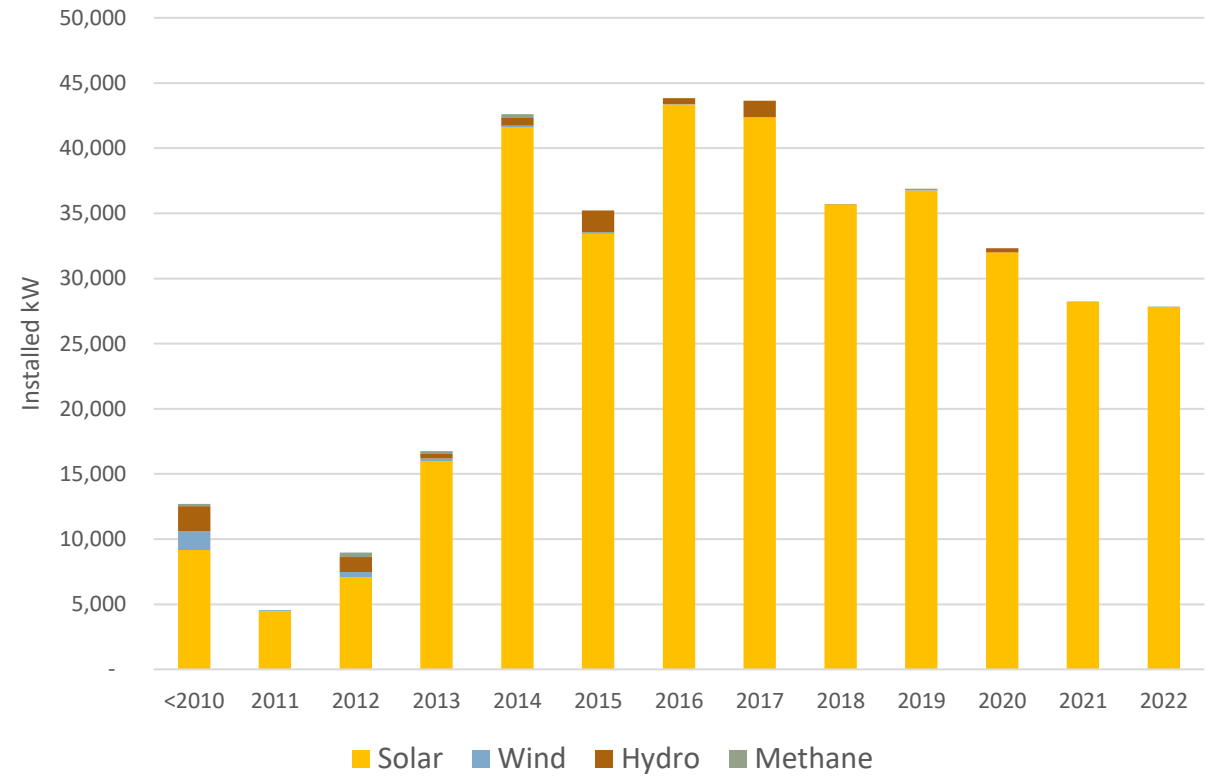
Program	CPG Application Date	Statewide Blended Rate	RECs		CATEGORY				
			Transfer to Utility	Retain Ownership	I	II	III	IV	Hydro
NM 1.0 <sup>27</sup>	before 1/1/2017	\$0.149	n/a		n/a				
NM 2.0	1/1/2017 - 6/30/2018	\$0.149	\$0.03	-\$0.03	\$0.01	\$0.01	-\$0.01	-\$0.03	\$0.00
NM 2.1	7/1/2018 - 6/30/2019	\$0.154	\$0.02	-\$0.03	\$0.01	\$0.01	-\$0.02	-\$0.03	\$0.00
NM 2.2	7/1/2019 – 2/1/2021	\$0.154	\$0.01	-\$0.03	\$0.01	\$0.01	-\$0.02	-\$0.03	\$0.00
NM 2.3	2/2/2021 – 8/31/2021	\$0.164	\$0.00	-\$0.04	\$0.00	\$0.00	-\$0.03	-\$0.04	\$0.00
NM 2.4	9/1/2021 – 8/31/2022	\$0.164	\$0.00	-\$0.04	-\$0.01	-\$0.01	-\$0.04	-\$0.05	\$0.00
NM 2.5	9/1/2022 – 6/30,2024	\$0.17141	\$0.00	-\$0.04	-\$0.02	-\$0.02	-\$0.05	-\$0.06	\$0.00

# Net-Metering Installations

### Solar Net-Metering Installations



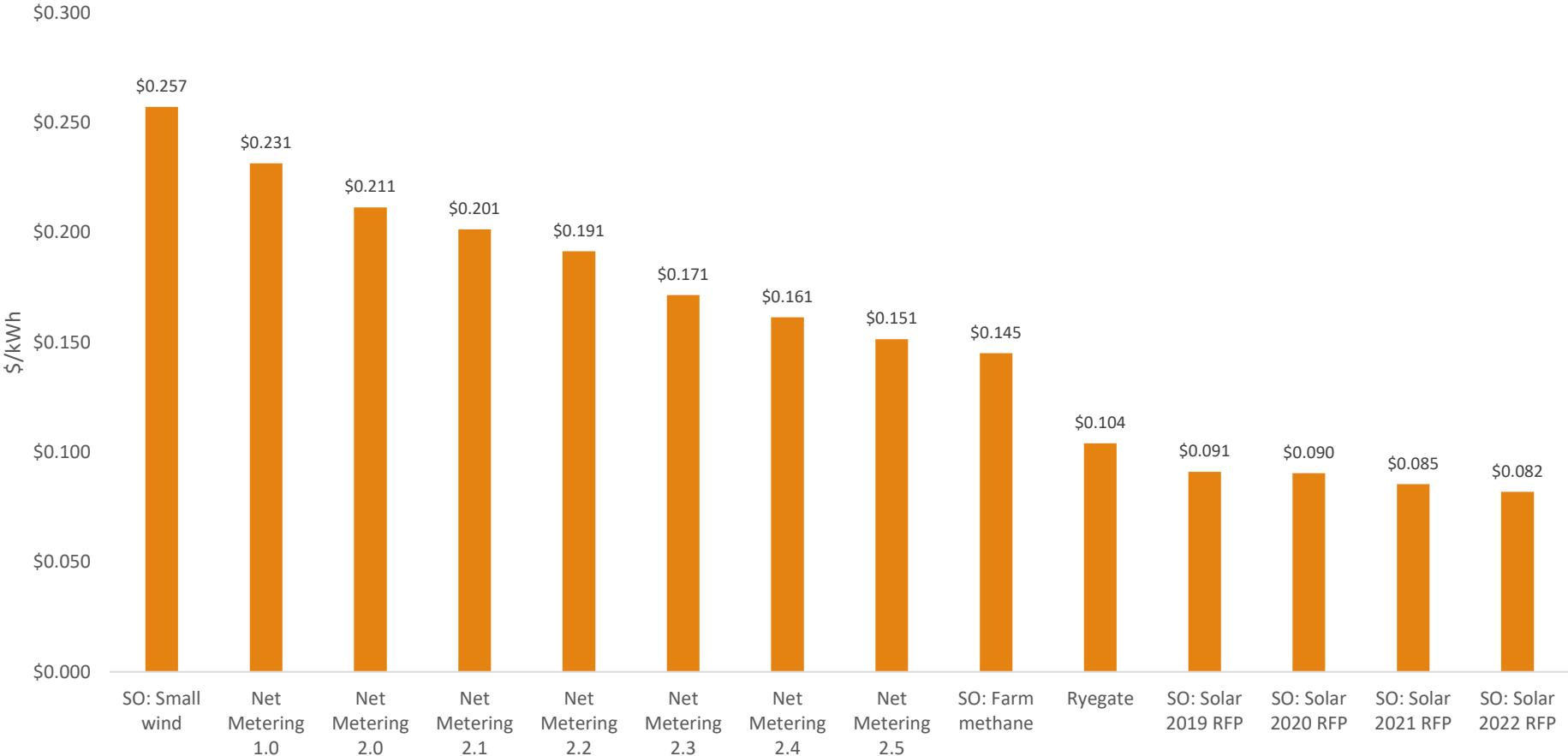
### Net-Metering Annual Installations by Technology



*\*Derived from utility monthly DG resource surveys to ISO-NE and includes data for GMP, VEC, and BED through Oct. 2022; WEC and VPPSA through Sept. 2022; Hyde Park through August 2022; and Stowe through Dec. 2021*

# Example Renewable Resource Costs

Illustrative Cost Comparison of Renewable Resources



# 2021 RES Costs

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	<b>2021 RES Performance</b>		
	<u>REC Retirements</u>		<u>Compliance Cost</u>
Tier I	4,182,857	RECs	\$1,534,625
Tier II	173,623	RECs	\$6,208,135
Tier III	283,959	Mwh(e)	\$9,198,203
Total Cost of Compliance			<b>\$16,940,963</b>
Retail Sales	5,382,695	kWh	
Rate Impact of RES Compliance	1.9%		
CO2 Reduction from RES	717,019	tons of CO2	

# Estimated RES compliance costs: 2022-2031

	LOW INCREMENTAL COST		HIGH INCREMENTAL COST	
REC Price Scenario	HIGH		LOW	
NM Adoption Rate	HIGH		LOW	
Peak contribution of New Load	75%		10%	
Fossil Fuel Price	LOW		HIGH	
Load Scenario	BAU	CAP	BAU	CAP
Tier 1 Cost	\$64,000,000	\$76,000,000	\$119,000,000	\$150,000,000
Tier 2 Cost	\$105,000,000	\$112,000,000	\$110,000,000	\$121,000,000
+Tier 3 Cost	\$254,000,000	\$271,000,000	\$324,000,000	\$350,000,000
-Additional Revenue	-\$286,000,000	-\$300,000,000	-\$282,000,000	-\$296,000,000
Tier 3 Net Cost	-\$32,000,000	-\$29,000,000	\$42,000,000	\$54,000,000
<b>TOTAL Cost of RES</b>	<b>\$137,000,000</b>	<b>\$159,000,000</b>	<b>\$271,000,000</b>	<b>\$325,000,000</b>
Rate Impact	1.01%	1.19%	4.29%	4.88%

# Rate Pressure of RES

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- No recent rate cases have been a direct result/solely due to RES compliance costs or standard-offer
- Tier II of RES can be met with RECs from the following sources:
  - Net-metering ~ \$60/REC - \$40/REC
  - Standard-offer ~ \$0- \$25/REC (contracts are for bundled energy, capacity and RECs utilities assign the cost to each product)
  - Utility owned projects or long-term purchases ~ \$0 - \$20/REC
  - Short-term REC only ~ \$35/REC \*there is limited availability of Tier II RECs in Vermont
- Tier I of RES can be met from RECs from renewable energy from existing renewable energy delivered to New England: \$5-10/MWh

# Public Engagement Process

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The Public Service Department is currently conducting a process **to review our current state electricity policies and programs**, as recommended by the state Comprehensive Energy Plan and Climate Action Plan.

Throughout the process the Department **wants to hear from Vermonters** to better understand what they think is important in our state electricity policies and programs.







Thank  
you!

# Appendix

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# Topics Covered

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## Part 1:

- Components of the Electric Grid
- Regulated Utilities & ISO-NE
- Historical and Forecasted Demand
- Electricity Supply
- Components of electric rates
- Cost of electricity in Vermont

## Part 2:

- Renewable Energy Policies in Vermont
  - Renewable Energy Standard
  - Net Metering
  - Standard Offer

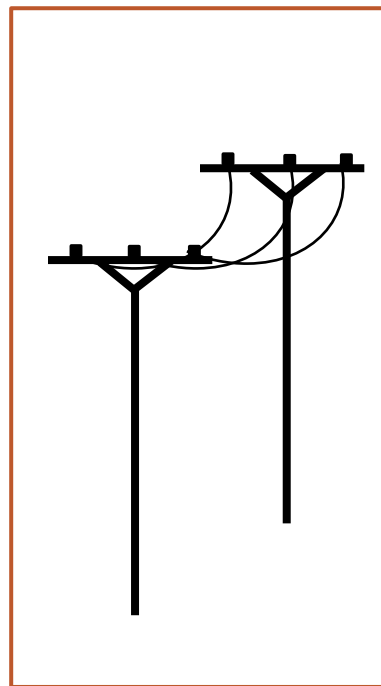
## Appendices Included for Reference

# Core Components of the Electric Grid

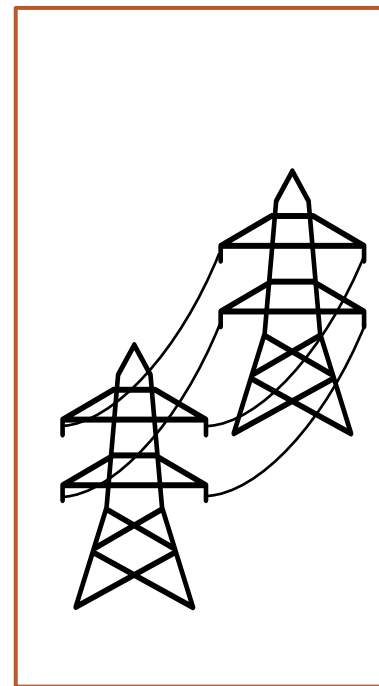
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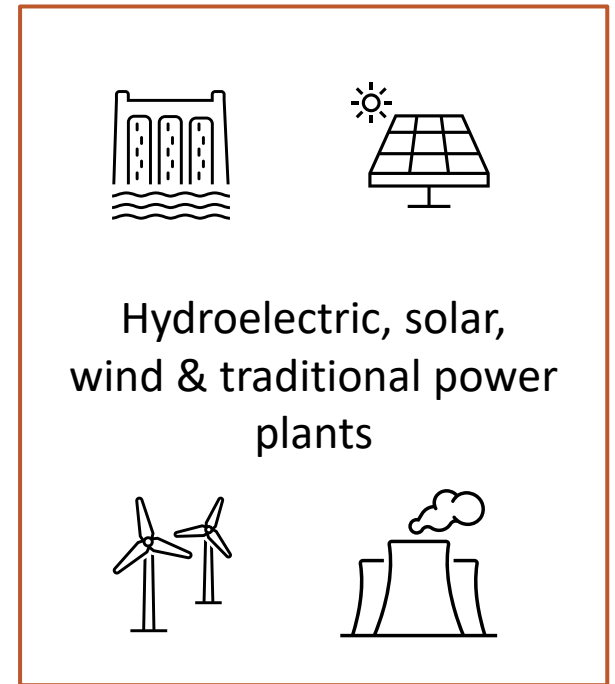
**Electricity Consumers**



**Distribution Lines**



**Transmission Lines**



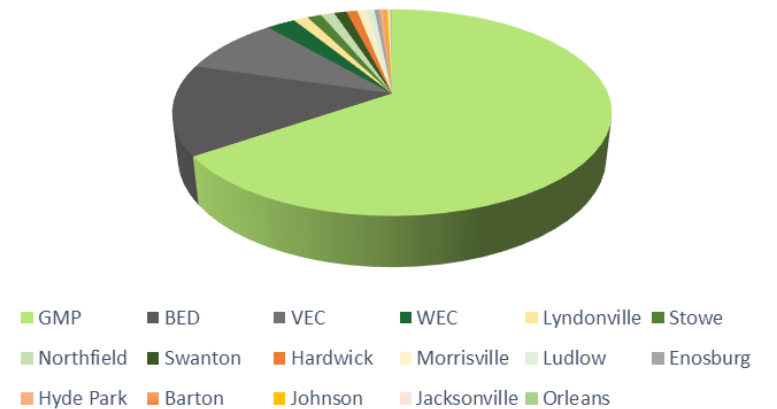
**Generation**

# Vermont's Distribution Utilities

## Vermont Electric Utilities

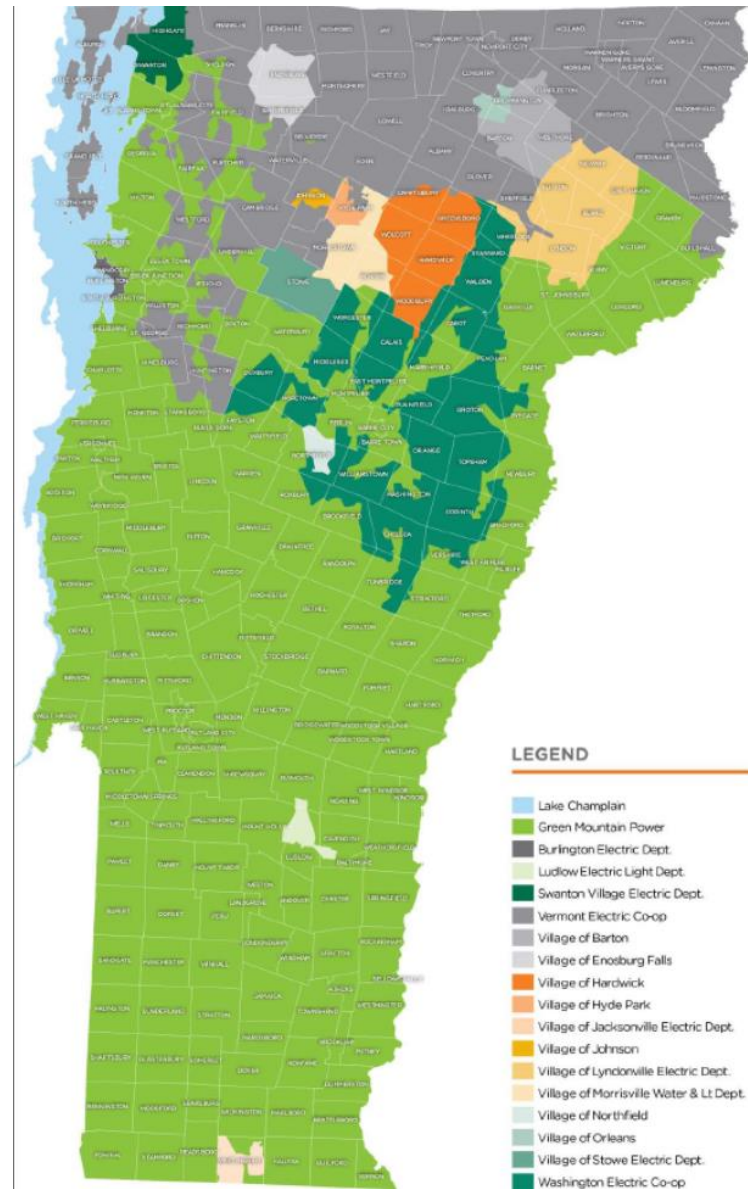
- 1 Investor Owned Utility (serving  $\frac{3}{4}$  of VT demand ~ 260,000 customers)
- 2 Cooperative utilities
- 14 Municipal Utilities
- 1 transmission utility

Share of VT load



## 1 Natural Gas Utility

- Investor Owned ~53,000 customers in 3 counties



# Vermont's Energy Efficiency Utilities

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## Efficiency Vermont

- “Statewide” Electric & Thermal Efficiency Programs for unregulated fuels

## Burlington Electric Department

- Electric and unregulated Thermal Efficiency services in own territory

## Vermont Gas Systems

- Natural Gas Efficiency Services

30 V.S.A §209 creates an Energy Efficiency Charge to acquire “all reasonably available cost- effective energy efficiency”

- Directs revenues from Vermont’s participation in Regional Greenhouse Gas Initiative and Forward Capacity Market to Thermal Fuels

# VELCO (Vermont Electric Power Company)

## Owned by Vermont's distribution utilities

- Established 1956 to access energy from New York Power Authority

Subject to federal and regional reliability standards and operational control by ISO-NE

## Funded through:

- Regional Network Service (RNS)– pays for transmission that provides regional reliability; same rate for all New England Transmission Owners
- Vermont Transmission Agreement – pays for local transmission and any other costs not recovered under RNS

# ISO New England

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Regulated by the Federal Energy Regulatory Commission

Responsible for:

- Designing and implementing wholesale electricity markets
  - Day-ahead and Real-time Energy Markets, Forward Capacity Market, Ancillary Services
  - Generally, generators over 5 MW required to participate in these markets, as well as all load-serving entities
- Operating the New England transmission system
  - VELCO owns but operation is under the direction of ISO-NE
- Power system planning to meet federal and regional reliability standards



# Some terminology:

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## Megawatt (MW)

A measure of power

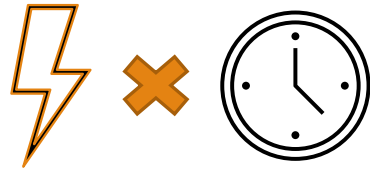
I.e. how much electricity something needs to turn on or can generate instantaneously when running at full speed



## Megawatt-hour (MWh)

A measure of energy

I.e. The amount of power used or generated over a certain amount of time



## DEFINITIONS



An average LED lightbulb requires **0.00001 MW** to turn on



A hydropower plant with a capacity of **10 MW** could help **10 million** light bulbs turn on at the same time.



If you turned on one LED light bulb for 3 hours, it would use **0.00003 MWh** of electricity.

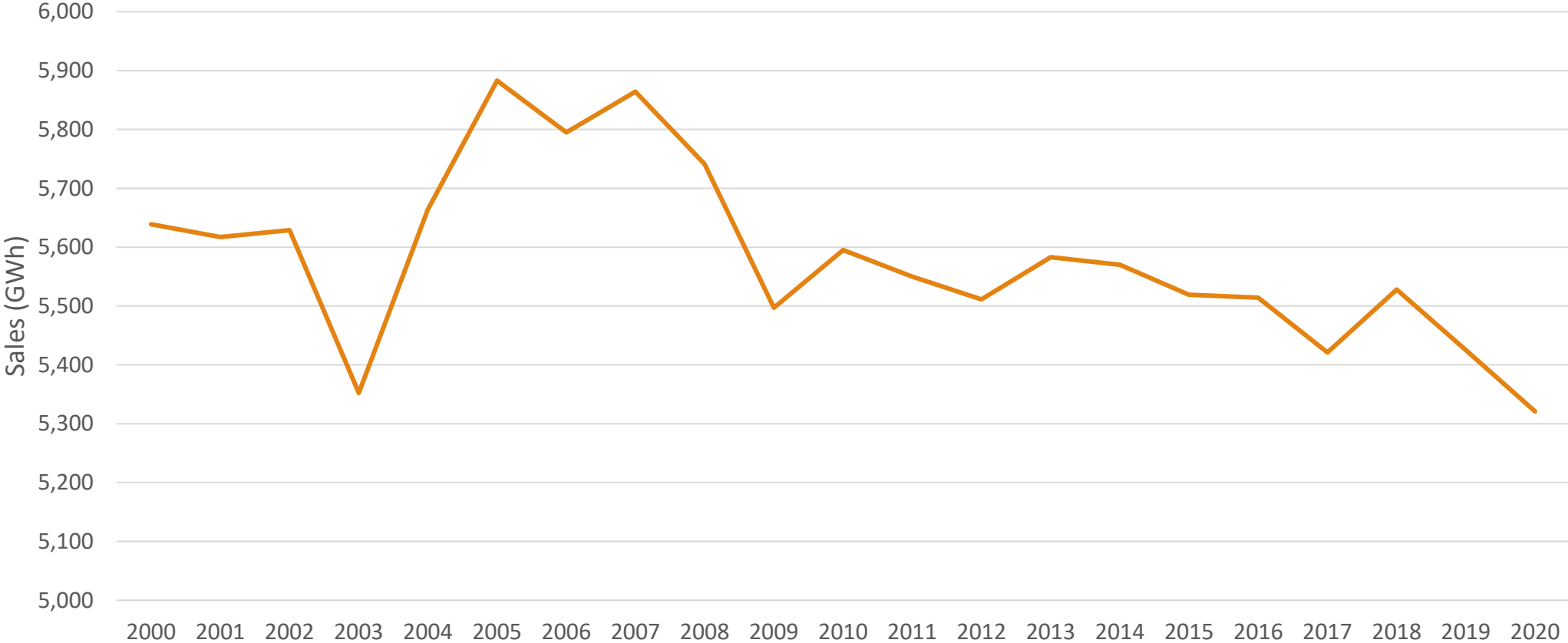


A hydropower plant with a capacity of **10 MW** that was on for **3 hours** at full capacity could power **10 million** light bulbs for that time.

## EXAMPLES

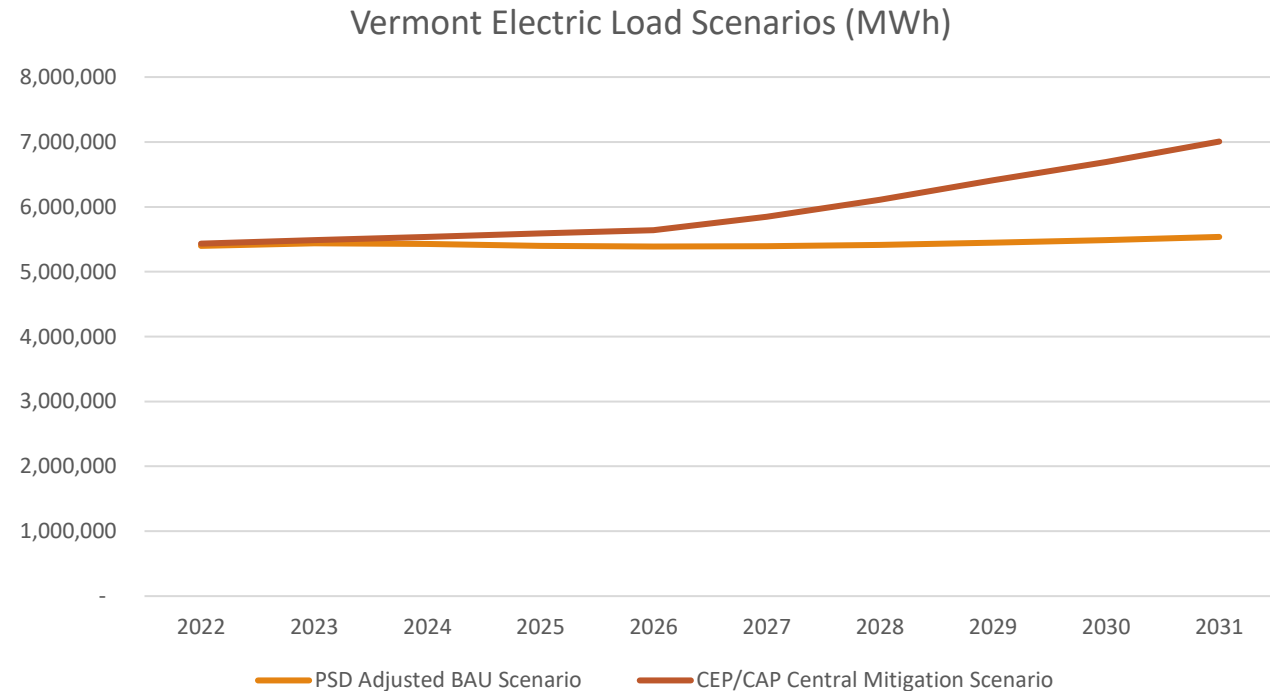
# Retail Sales – Historical Trends

Annual Retail Sales in Vermont, 2000-2020, All Sectors



# Retail Sales – Forecasted Trends

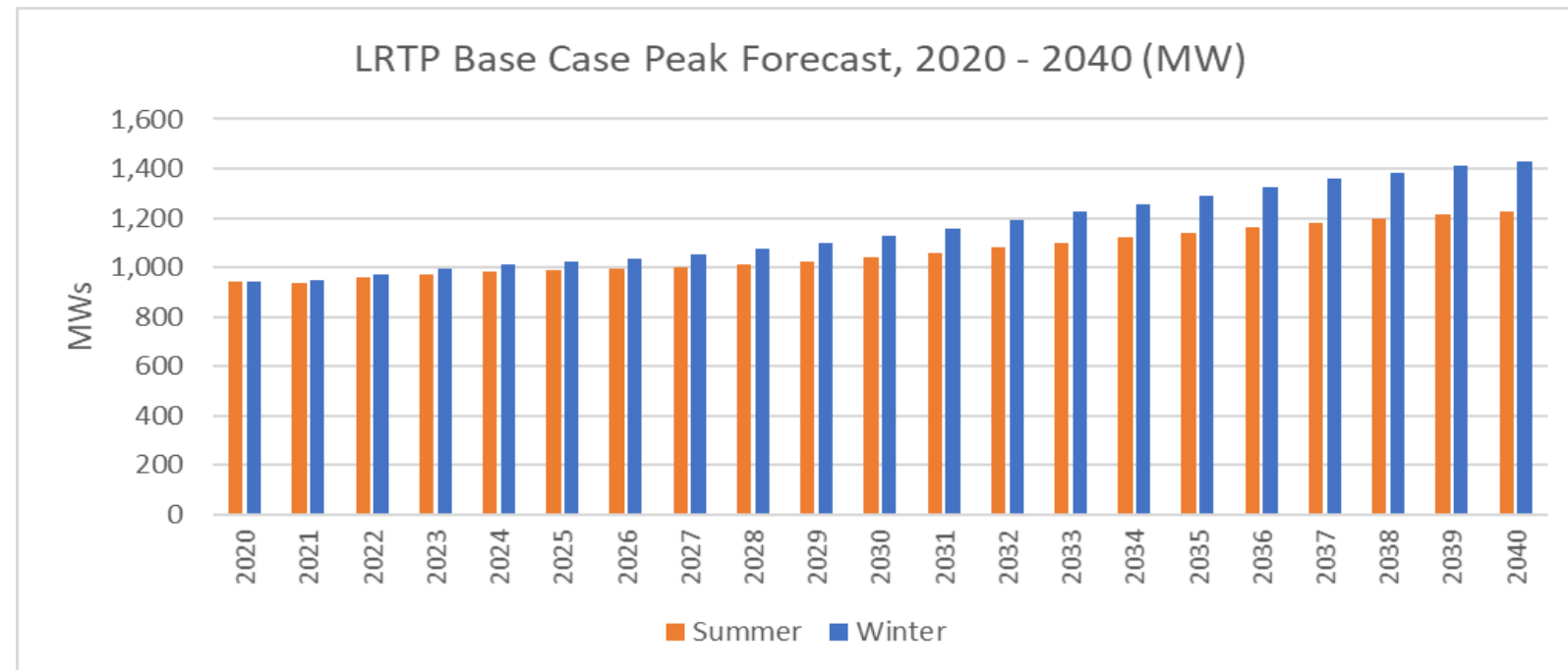
- **Business-As-Usual (Baseline)**  
Forecast: Based on 2021 VELCO Long-Range Transmission Plan, modified w/recent data
- **Central Mitigation Scenario:**  
Based on modeling conducted for the Comprehensive Energy Plan/Global Warming Solutions Act carbon reduction pathways

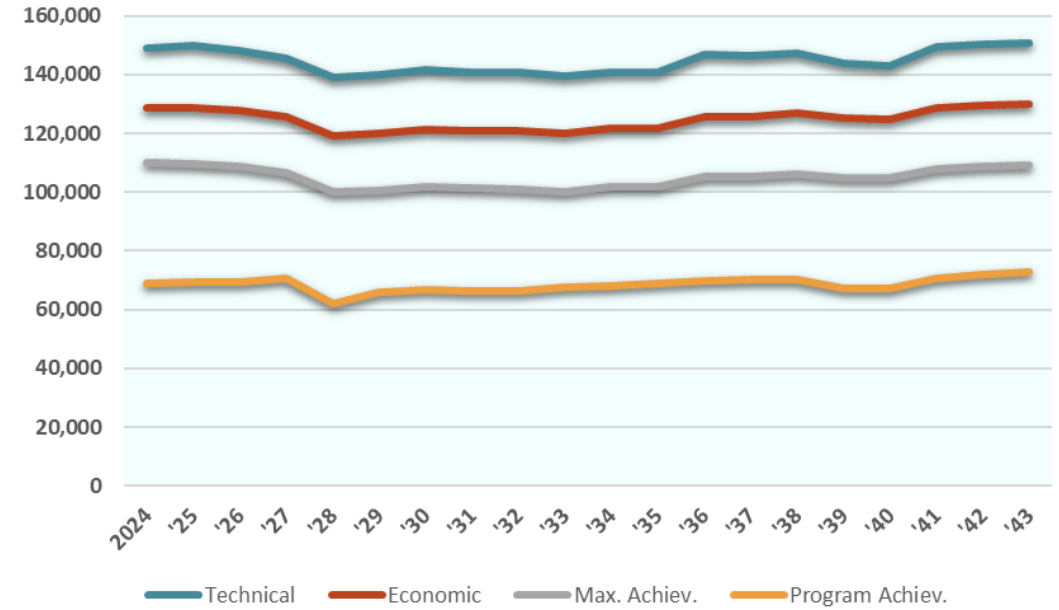
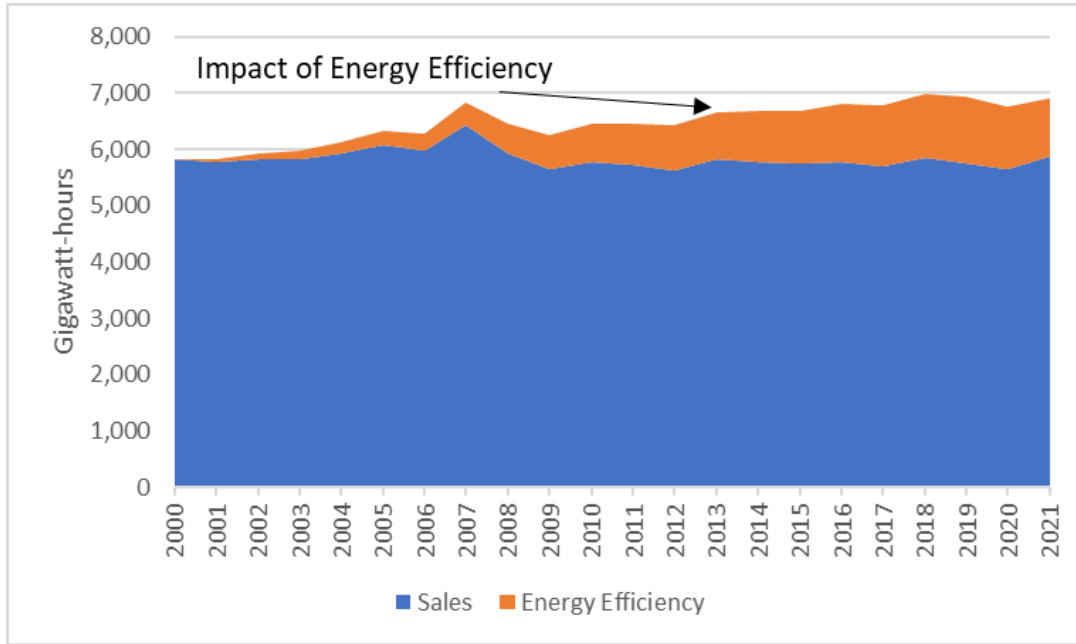


# Vermont Peak Load Forecast

- Includes base forecast of EVs, Heat Pumps, Solar
- Assumes NO load control

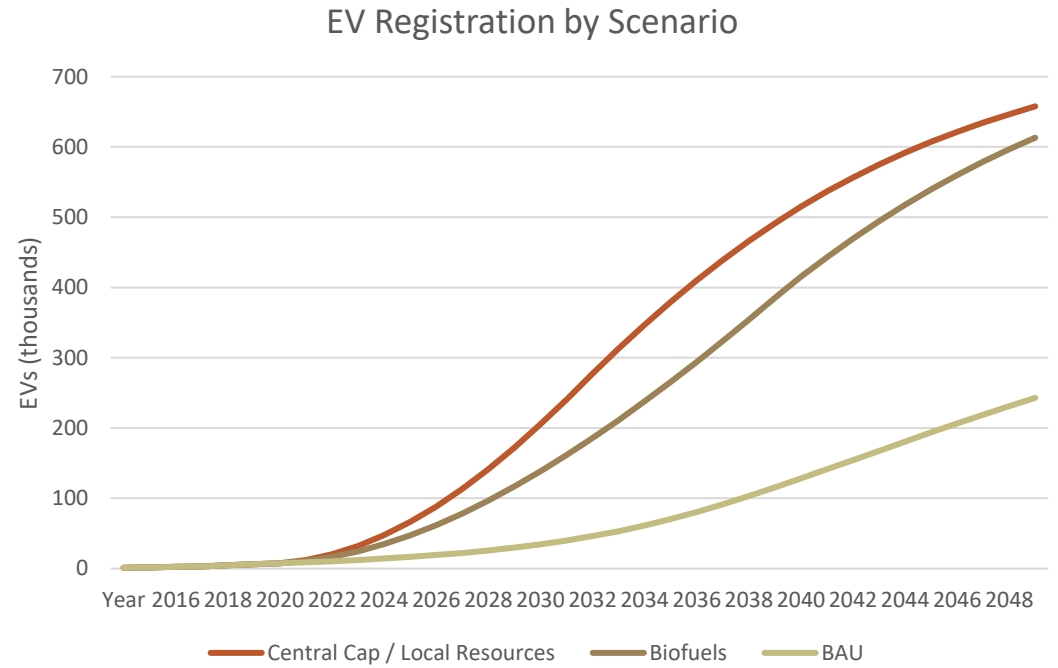
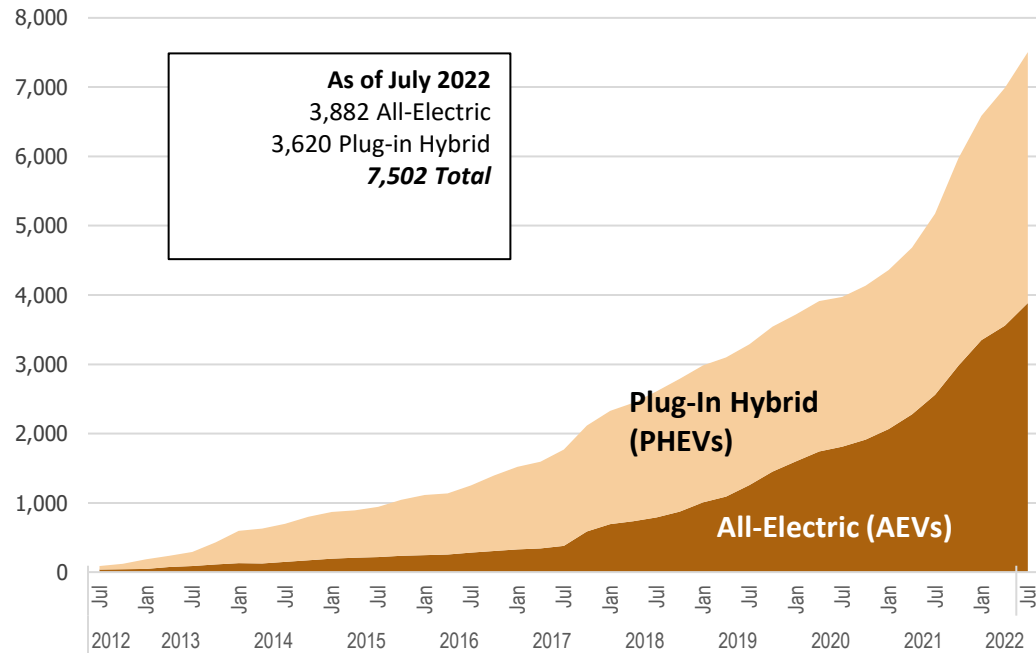
ISO-NE System					Vermont		
Year	Peak Date	Hour Ending	System Peak Load (MW)	Vermont Coincident Peak (MW)	Peak Date	Hour Ending	System Peak Load (MW)
2016	8/12/2016	15:00	25,111	868	1/4/2016	18	931
2017	6/13/2017	17:00	23,508	849	12/29/2017	18	942
2018	8/29/2018	17:00	25,559	726	7/2/2018	20	935
2019	7/30/2019	18:00	23,929	837	1/21/2019	18	892
2020	7/27/2020	18:00	24,727	792	7/27/2020	20	890
2021	6/29/2021	16:00	25,280	825	8/26/2021	20	962
2022*	8/4/2022	17:00	24,471	761			



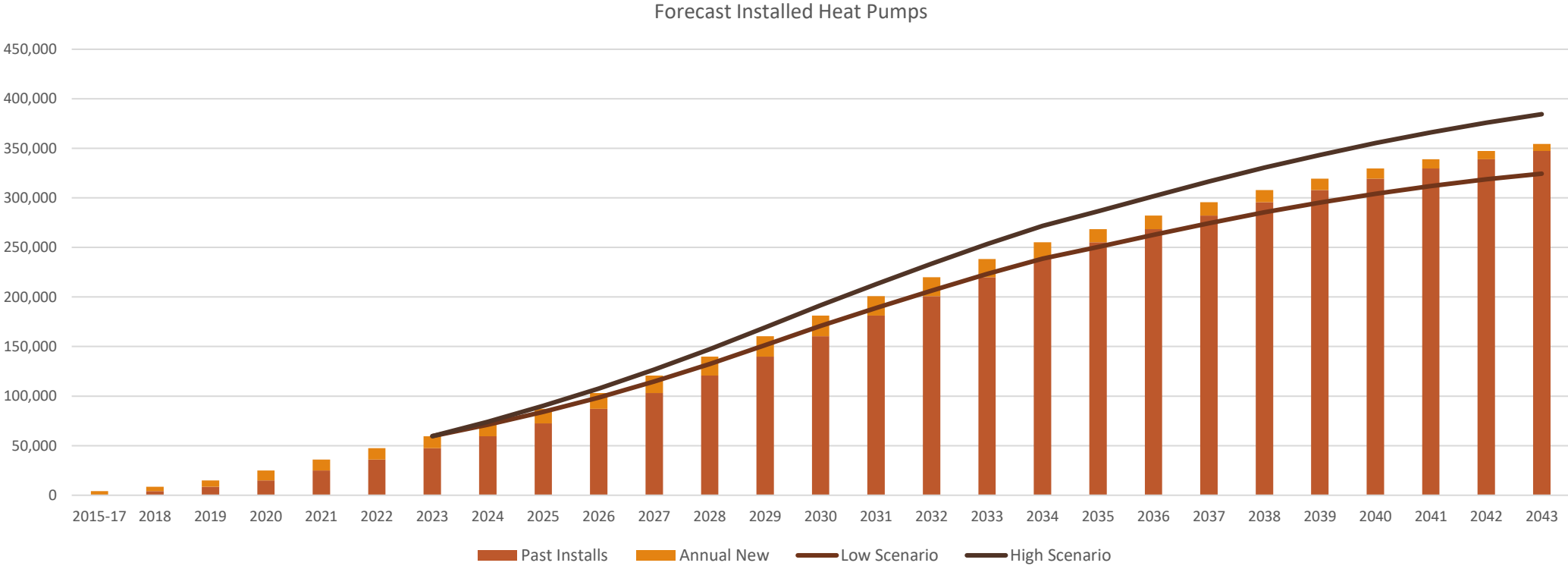


Traditional Electric Efficiency in forecast

# Electric Vehicles

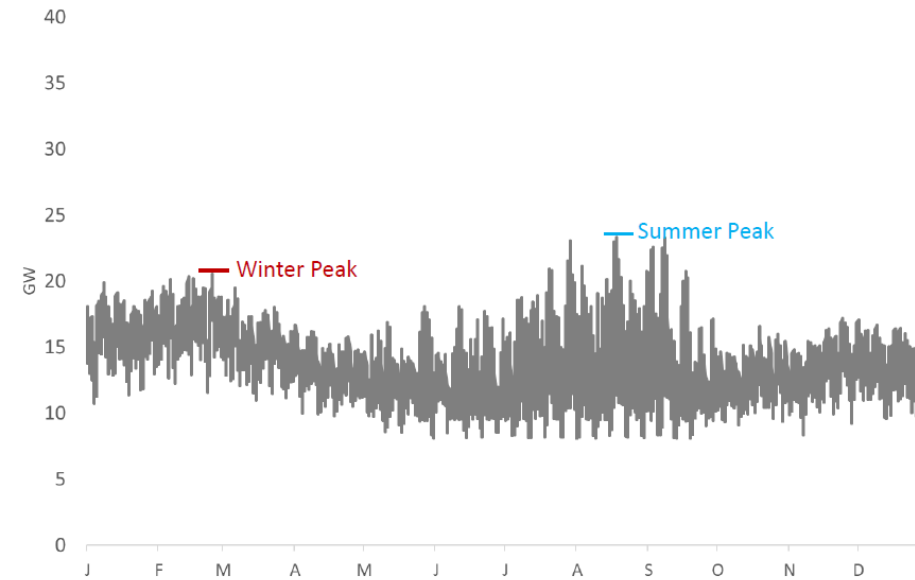


# Heat Pumps



# Electrification & seasonal demand patterns (N.E.)

## New England 2015 Aggregate Load Profile

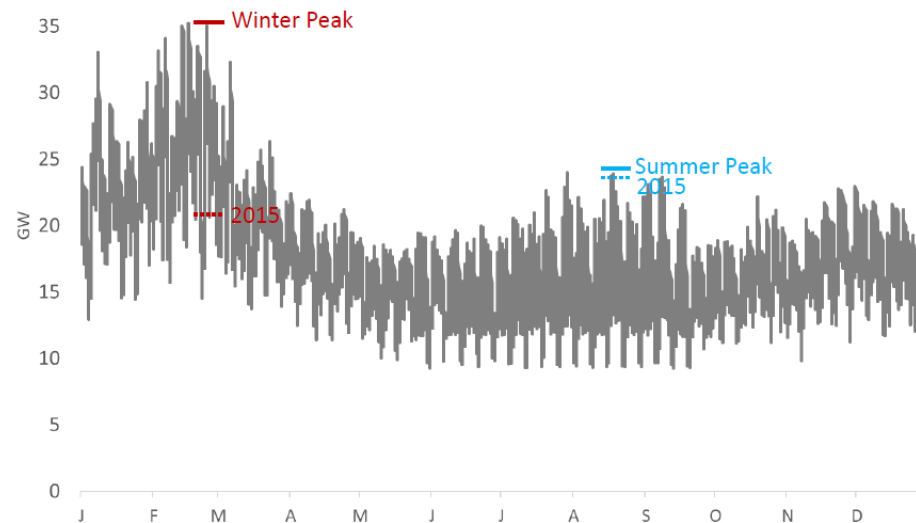


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## Potential New England 2050 Aggregate Load Profile (Reference Case)



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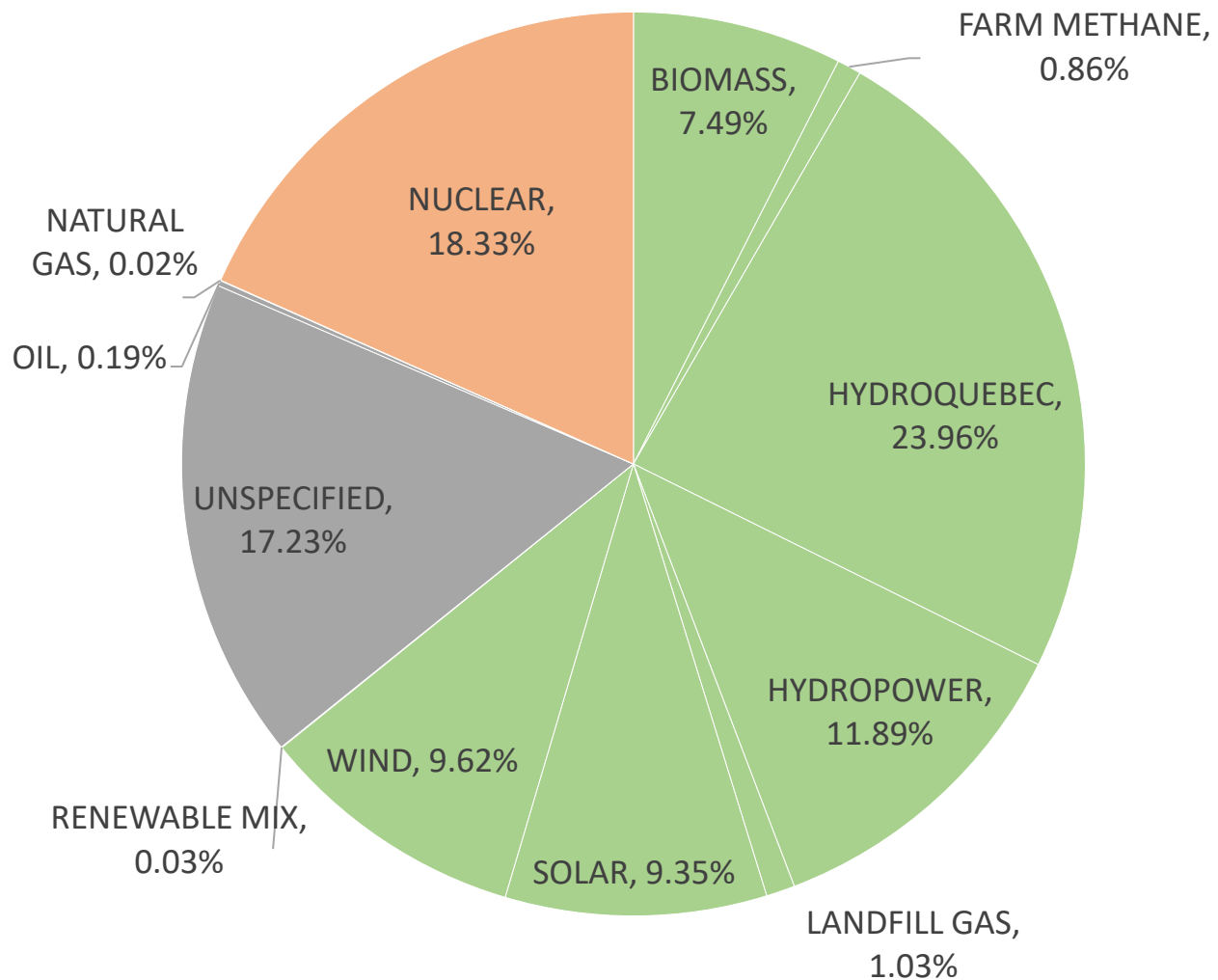
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Source: Aidan Tuohy, EPRI: ISO-NE Grid Transformation Day, May 23, 2019: [https://www.iso-ne.com/static-assets/documents/2019/05/a2\\_grid\\_transformation\\_solving\\_technical\\_challenges\\_tuohy\\_epri.pdf](https://www.iso-ne.com/static-assets/documents/2019/05/a2_grid_transformation_solving_technical_challenges_tuohy_epri.pdf)



# What electricity do Vermont utilities generate or buy?



In 2021, Vermont distribution utilities purchased **5,848,660 MWh** of electricity to meet the demand of their customers.

Of this:

**64%** came from **renewable resources**

**18%** came from **carbon-free resources** (Nuclear)

\*Prior to the disposition of Renewable Energy Credits (See Part 2)



Power Supply and  
Transmission (approx.  
61%)

Energy  
Capacity  
Renewable Energy Credits  
Regional & Local Network  
Service  
Ancillary Services



Other Operations and  
Maintenance (approx.  
16%)

Distribution  
Customer Accounts  
A&G expenses



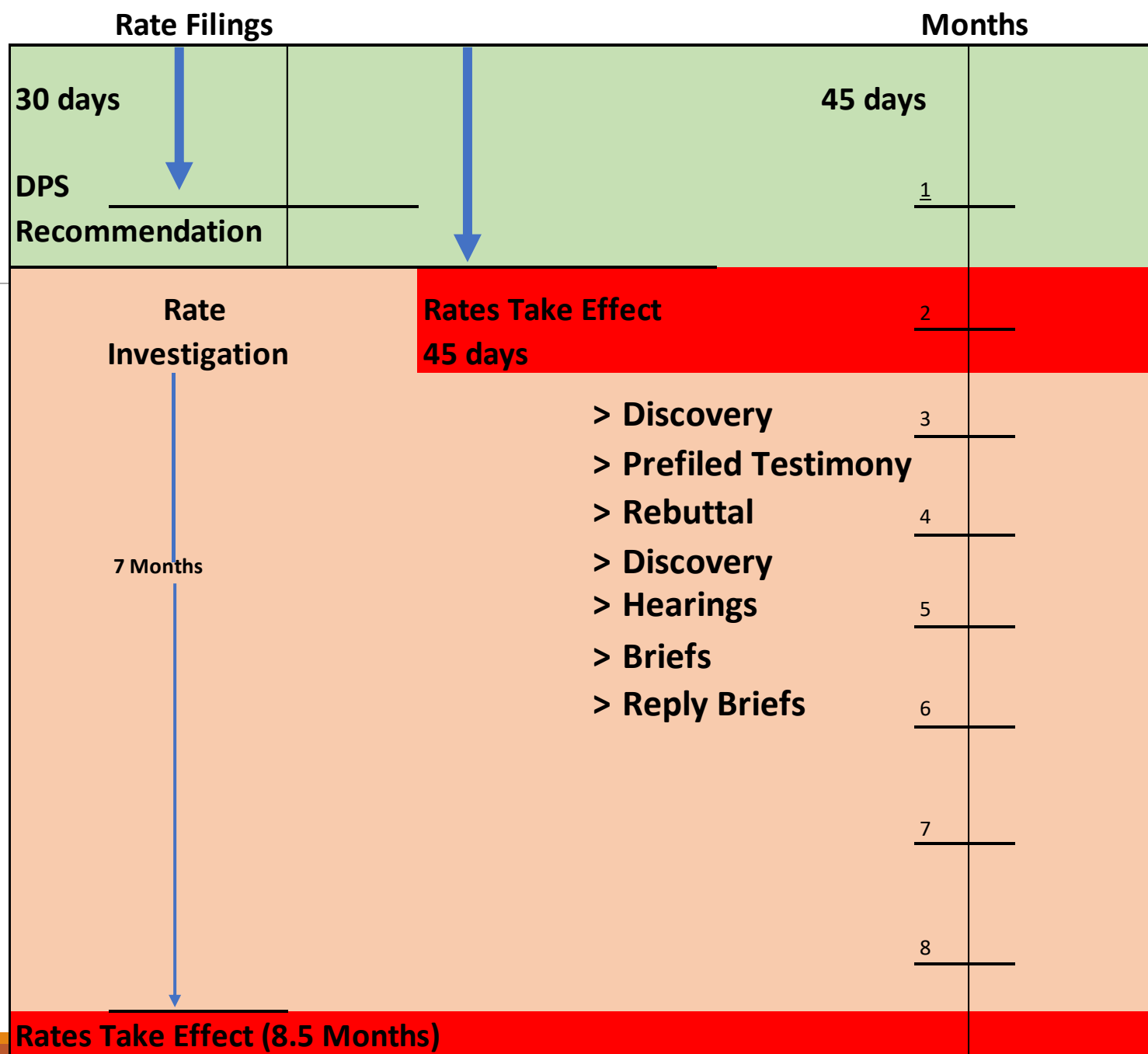
Capital Costs (approx.  
23 %)

Return on equity or Times  
Interest Earned Ratio,  
Depreciation, Income Tax,  
Interest

# Components of Electric Rates

# Traditional Rate Case Filing

30 V.S.A. §225, 226, and 227



# Elements of an Electric Bill

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## Customer Service Charge

- Designed to recover the costs including meter, and line drop

## Energy (per kWh) Charge

- Typically, the majority of the electric bill; designed to recover costs not covered by customer service charge
- Many municipal and cooperative utilities include Inclining Block Rates, with initial block of kWh that is relatively inexpensive and next block is significantly more expensive

## Energy Efficiency Charge

- Funds the Energy Efficiency Utilities, designed to acquire “all reasonably available cost-effective efficiency” resources

## Demand Charge

- Does not apply to most customers; designed to recover costs associated with high peak loads

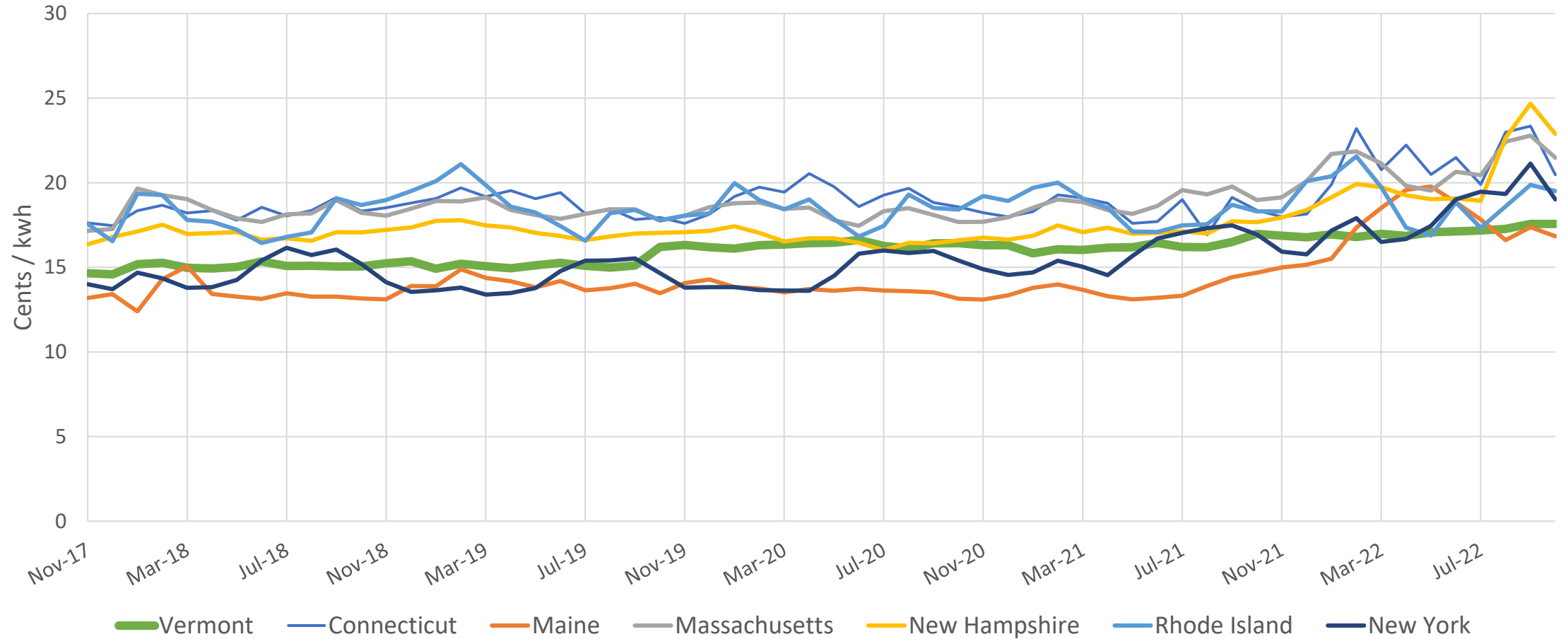
# Distribution Utility Electric Rates

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Residential Rates can vary widely

<b>Ludlow</b>	<b>WEC</b>	<b>GMP</b>
Customer Charge: \$8.56	Customer Charge: \$26.49	Customer Charge: \$16.31 (31 day mo)
First 100 kWh: \$0.0523	First 100 kWh: \$0.08476	Usage: \$0.18035
Above 100 kWh: \$0.1179	Above 100 kWh: \$0.21149	

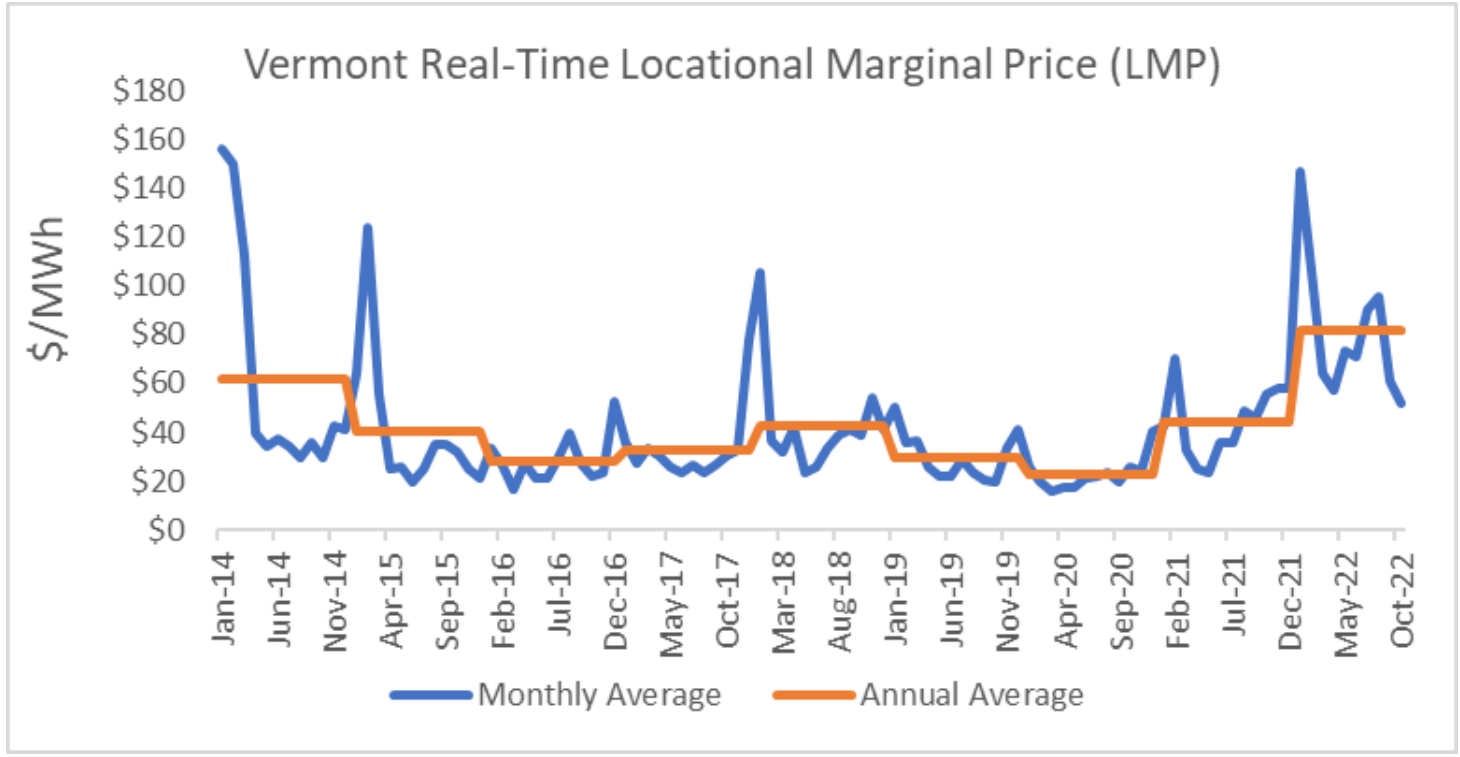
# Average Monthly Retail Cost of Electricity (All Sectors)



# Price components

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# New England Wholesale Electricity Prices

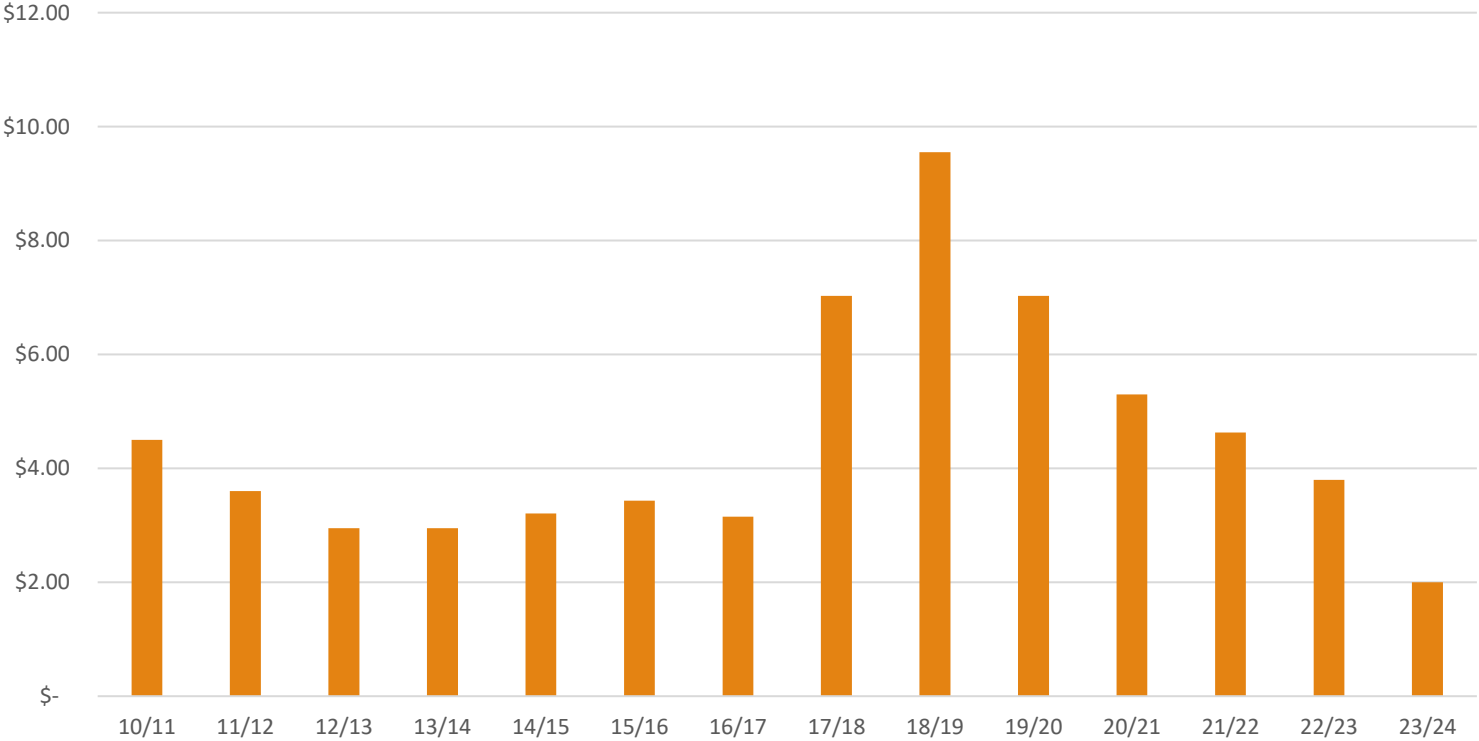




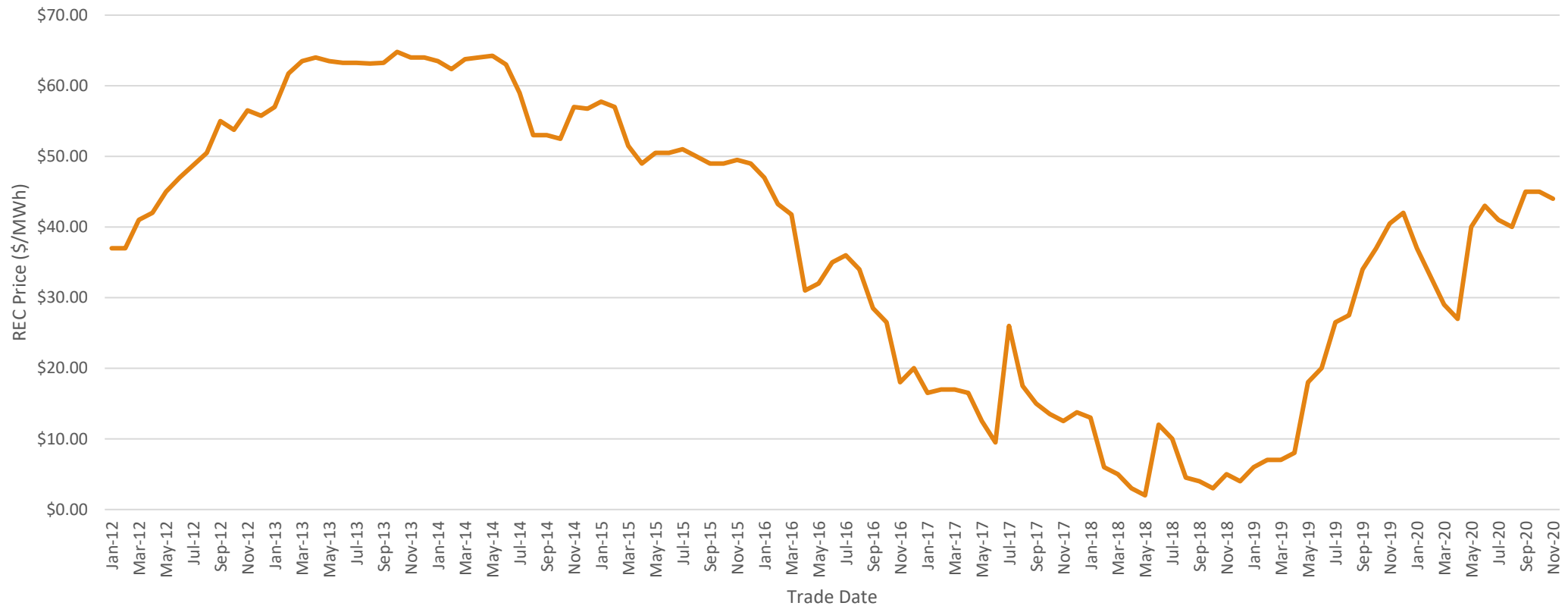
# New England Capacity Prices

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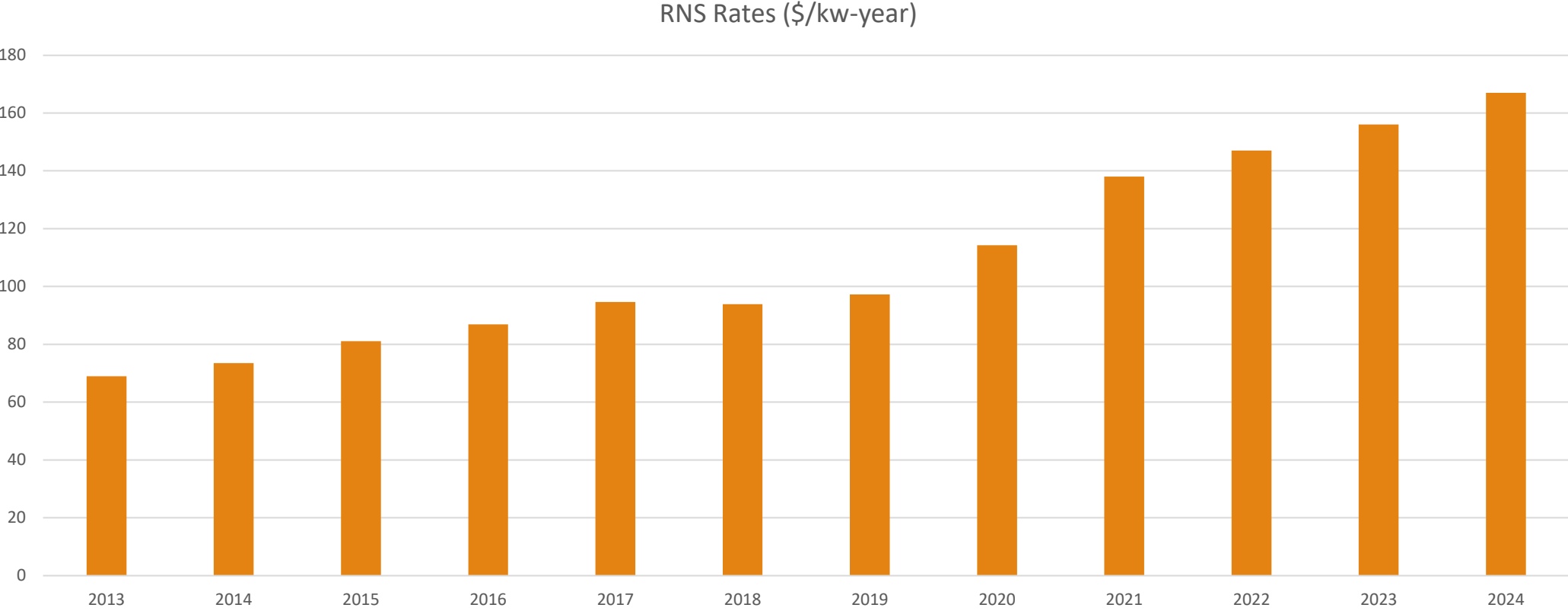
FCA Prices (\$/kW-month)



# MA Regional Class I REC Prices



# Regional Transmission Costs



# RPS in Other NE States

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# Connecticut

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## Connecticut

- **Title:** Renewables Portfolio Standard.
- **Established:** 1998.
- **Requirement:** 48% by 2030.
- **Applicable Sectors:** Investor-owned utility, local government, retail supplier.
- **Cost Cap:** Approximately 6%.
- **Details:** Class I renewable energy sources (including distributed generation): 40% by 2030. Class I or II (biomass, waste-to-energy and certain hydropower projects): 4% by 2018. Class III (combined heat and power, waste heat recovery and conservation): 4% by 2010. *If Class I contracts fall short of goal, large-scale hydro may fill the gap up to 5 percentage points, but it may not be traded in NEPOOL GIS.*
- **Enabling Statute, Code or Order:** [Conn. Gen. Stat. §16-245a et seq.](#); [Conn. Gen. Stat. §16-1](#); [Senate Bill 9](#) (2018).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/195/renewables-portfolio-standard>

# Maine

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## Maine

- **Title:** Renewables Portfolio Standard.
- **Established:** 1999.
- **Requirement:** 80% by 2030; statewide target of 100% renewables by 2050.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** Approximately 15%.
- **Details:** Maine updated its RPS requirements in 2019 to include an additional 40% requirement for certain renewable sources (Class IA) in addition to a 10% requirement by 2022 and each year thereafter for Class I (new) sources and 30% requirement for Class II resources. The state also has separate goals for wind energy: 2,000 MW of installed capacity by 2015; 3,000 MW of installed capacity by 2020, including offshore and coastal; and 8,000 MW of installed capacity by 2030, including 5,000 MW from offshore and coastal. The state has a credit multiplier for community-based renewable energy.
- **Enabling Statute, Code or Order:** [Me. Rev. Stat. Ann. 35-A §3210 et seq.](#); [Me. Rev. Stat. Ann. 35-A §3401 et seq.](#) (wind energy); [Senate File 457](#) (2019).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/452/renewable-portfolio-standard>

# Massachusetts - RPS

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## Massachusetts

- **Title:** Renewable Portfolio Standard.
- **Established:** 1997.
- **Requirement:** Class I: 35% by 2030 and an additional 1% each year after, until 55% in 2050. Class II: 6.7% by 2020.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** Approximately 16%.
- **Details:** Photovoltaic: 1,600 MW required by 2020. Class I resources are new sources. Class II (resources in operation by 1997) requirement includes 2.69% renewable energy and 3.5% waste-to-energy.
- **Enabling Statute, Code or Order:** [Mass. Gen. Laws Ann. ch. 25A §11F](#); [House Bill 4857](#) (2018).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/479/renewable-portfolio-standard>

# Massachusetts - CPS

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[The Clean Peak Energy Standard](#) is designed to provide incentives to clean energy technologies that can supply electricity or reduce demand during seasonal peak demand periods established by DOER. The Clean Peak Energy Standard (CPS) was part of [An Act to Advance Clean Energy](#), which was signed into law in August 2018. Clean Peak Resources include new Class I Renewable Energy Resources, Existing Class I / Class II resources that are paired with an Energy Storage System, Energy Storage Systems, and Demand Response Resources. Any qualified resource that generates, dispatches or discharges energy to the electric grid during a Seasonal Peak Period will generate Clean Peak Certificates. Clean Peak Certificates can be sold to retail electricity suppliers, which are required to meet a baseline minimum percentage of sales each year. DOER is charged with establishing four Seasonal Peak Periods in which resources must operate, determine a metering and verification protocol to ensure that all data is collected, reviewed and reported in a consistent manner, set the Alternative Compliance Payment rate and procurement process, and establish annual compliance requirements.

<https://www.mass.gov/service-details/program-summaries>



# Massachusetts - CES

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Beginning in 2018, the Clean Energy Standard (CES) sets a minimum percentage of electricity sales that utilities and competitive retail suppliers must procure from clean energy sources. The minimum percentage begins at 16% in 2018, and increases 2% annually to 80% in 2050. The CES is met through acquisition of Clean Energy Credits (CECs) or by making an Alternative Compliance Payment (75% of RPS ACP from 2018 to 2020, and 50% of the RPS ACP thereafter).

- RPS Class I compliance (13% in 2018) counts toward compliance with the CES (16% in 2018). Thus, the net incremental CES requirement for 2018 is 3%.
- Any RPS Class I qualified generation attributes will also qualify for CECs.
- Technologies that meet the emissions and vintage requirement will qualify for CECs, as well as energy procured under the 2016 Energy Diversity Act (e.g., 83d). *These include nuclear, large hydro imports, and fossil generators with carbon capture and sequestration.*
- Existing customer contracts on or before August 11, 2017, will be exempt only for incremental CES obligation over and above the RPS obligation in any year.
- Banking will not be allowed until 2021

<https://www.mass.gov/service-details/program-summaries>

# New Hampshire

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## New Hampshire

- **Title:** Electric Renewable Portfolio Standard.
- **Established:** 2007.
- **Requirement:** 25.2% by 2025.
- **Applicable Sectors:** Investor-owned utility, cooperative utilities, retail supplier.
- **Cost Cap:** Approximately 7%.
- **Details:** Solar: 0.7% new solar in 2020 and after. Requires at least 15% of requirement to be met with new renewables.
- **Enabling Statute, Code or Order:** [N.H. Rev. Stat. Ann. §362-F](#).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/2523/renewable-portfolio-standard>

# Rhode Island

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## Rhode Island

- **Title:** Renewable Energy Standard.
- **Established:** 2004.
- **Requirement:** 14.5% by 2019, with increases of 1.5% each year until 38.5% by 2035.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** Approximately 13%.
- **Details:** The state has a separate long-term contracting standard for renewable energy, which requires electric distribution companies to establish long-term contracts with new renewable energy facilities.
- **Enabling Statute, Code or Order:** [R.I. Gen. Laws §39-26-1 et seq.](#); [R.I. Gen. Laws §39-26.1 et seq.](#) (contracting standard); [House Bill 7413a](#) (2016).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/1095/renewable-energy-standard>

# Vermont

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## Vermont

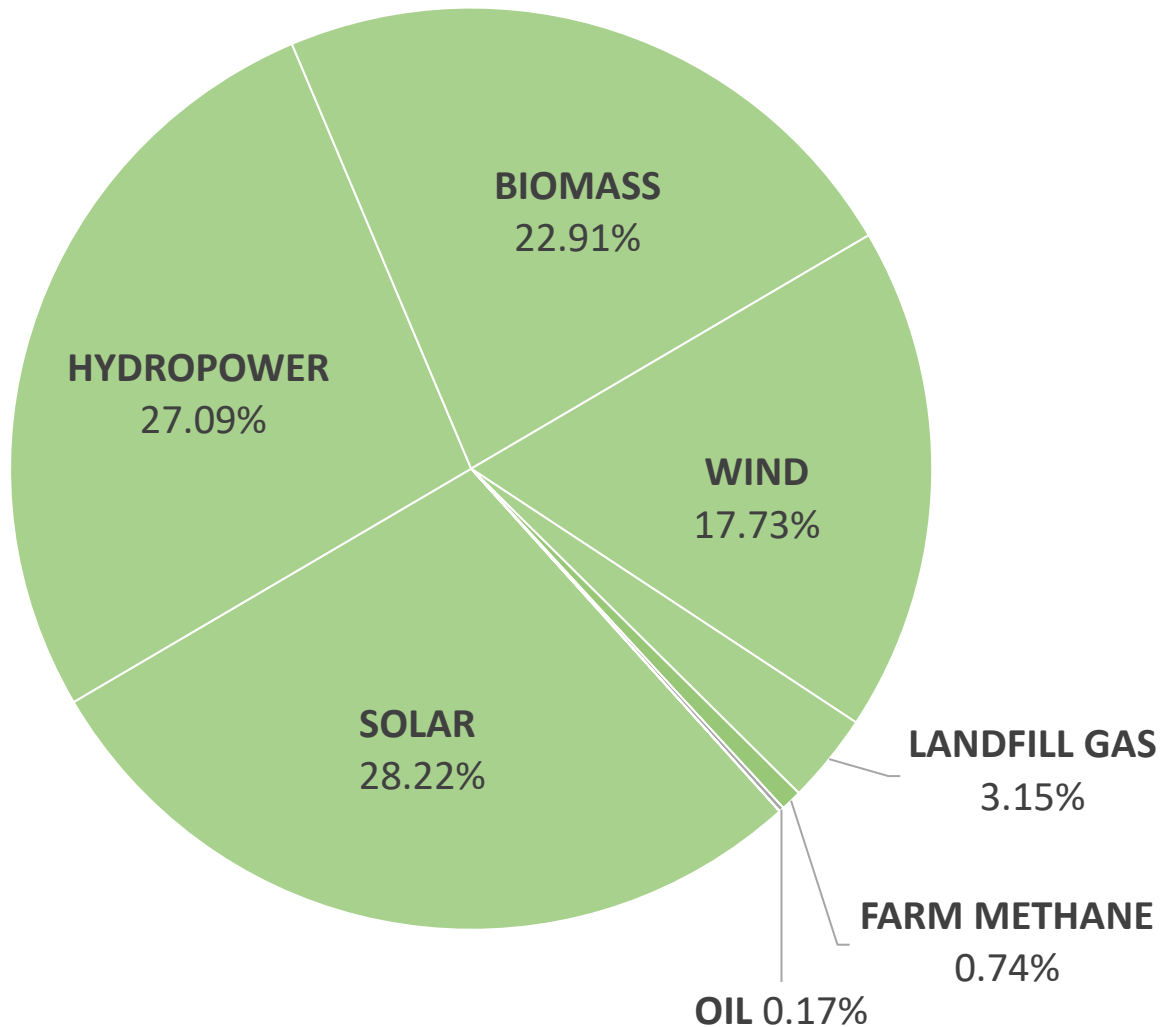
- **Title:** Renewable Energy Standard.
- **Established:** 2005 (voluntary target); 2015 (standard).
- **Requirement:** 55% by 2017; 75% by 2032.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** Approximately 6%.
- **Details:** Distributed Generation: 10% by 2032. Energy Transformation: 12% by 2032 (includes weatherization, thermal energy efficiency and heat pumps).
- **Enabling Statute, Code or Order:** [Vt. Stat. Ann. tit. 30 §8001 et seq.](#); [Standard: House Bill 40](#).

Source: <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx> and <https://programs.dsireusa.org/system/program/detail/5786/renewable-energy-standard>

# In State and Regional Generation

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# What does Vermont generate in-state?

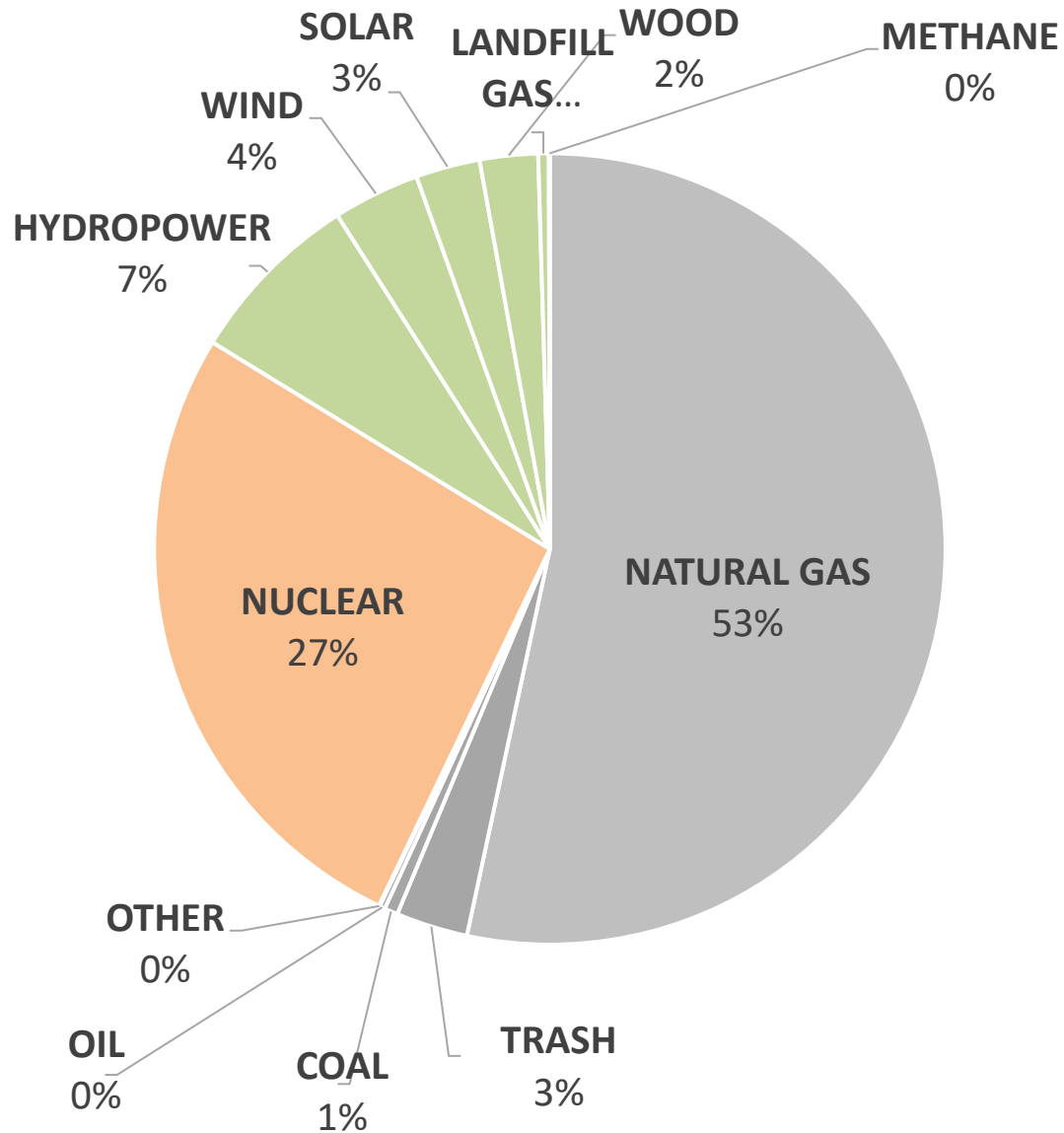


In 2021, generators based in Vermont produced roughly **1,932,194 MWh** of electricity.

- By contrast, in 2021 Vermont utilities purchased or generated **5,848,660 MWh** of electricity to meet customer needs.
- That's **203%** more electricity than was generated by resources in Vermont.

**99.8%** of this electricity came from resources that Vermont considers renewable. These resources are **highlighted in green**.

Not all the electricity generated in Vermont is used by or sold to Vermont utilities.



## What electricity is generated in the New England region?

In 2021, generators in the New England region (including those in Vermont) produced roughly **101,692,000 MWh** of electricity.

**16.3%** of this electricity came from resources that Vermont considers renewable. These resources are **highlighted in green**.

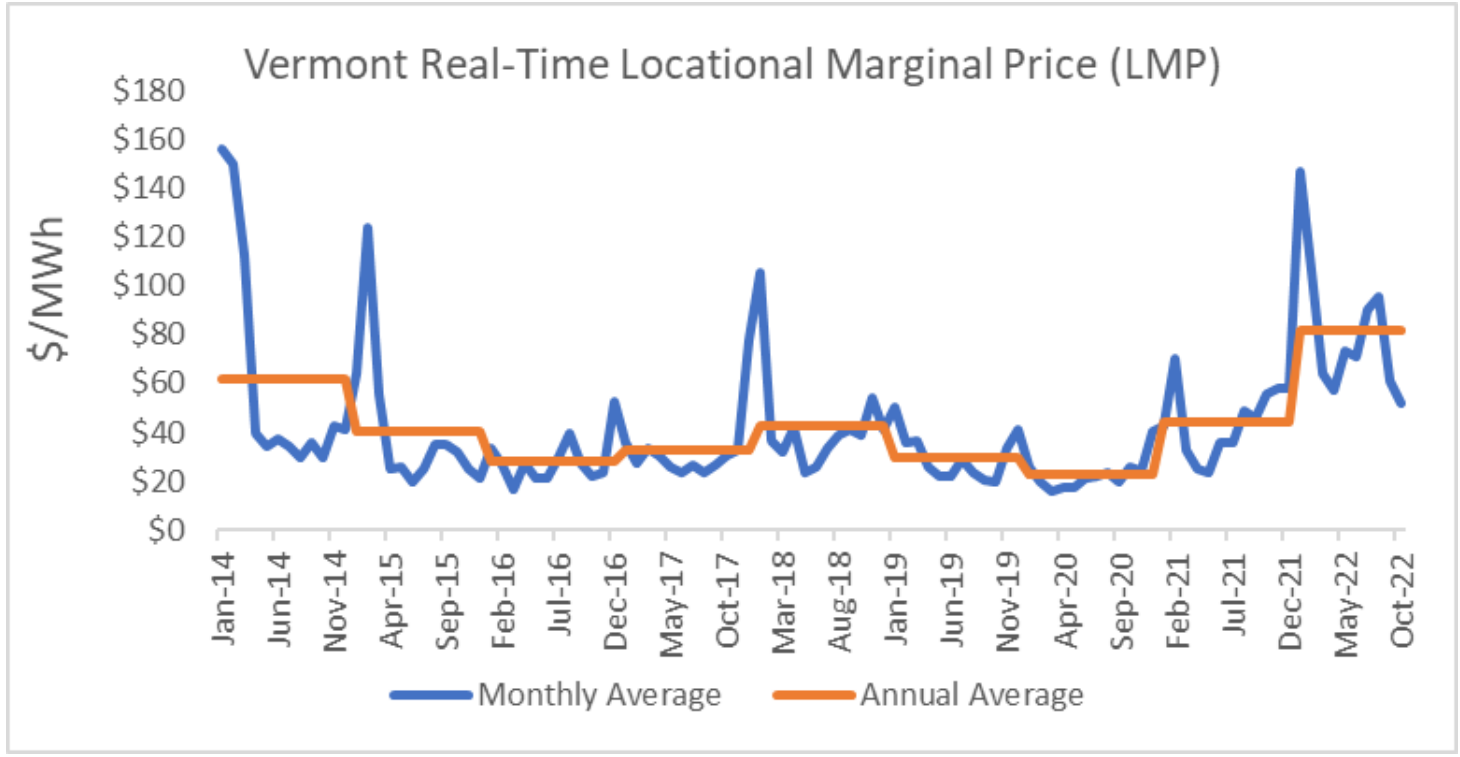
**27%** of this electricity came from nuclear, which is not considered renewable but is **considered carbon free**.

# Price components

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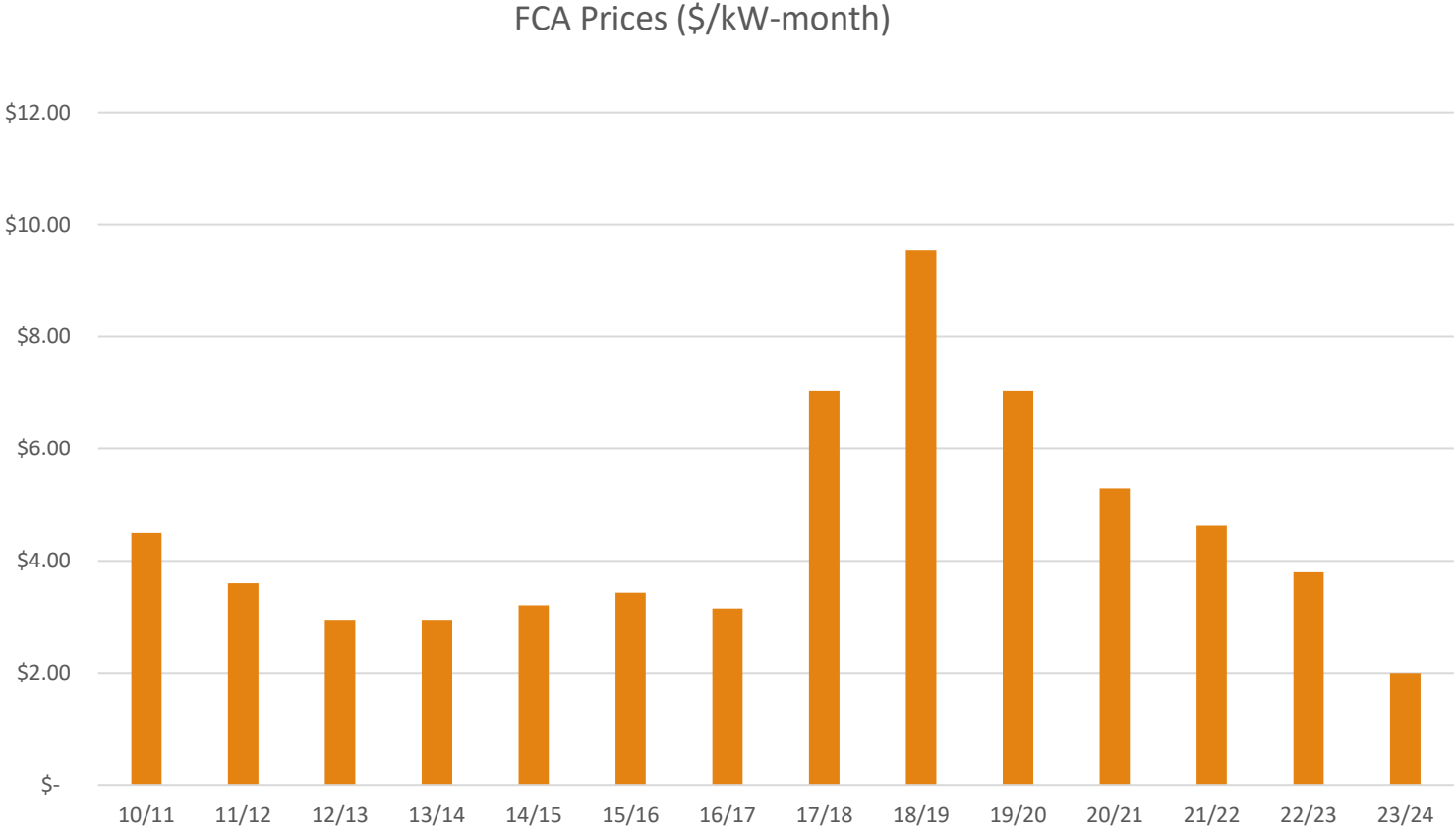


# New England Wholesale Energy Prices

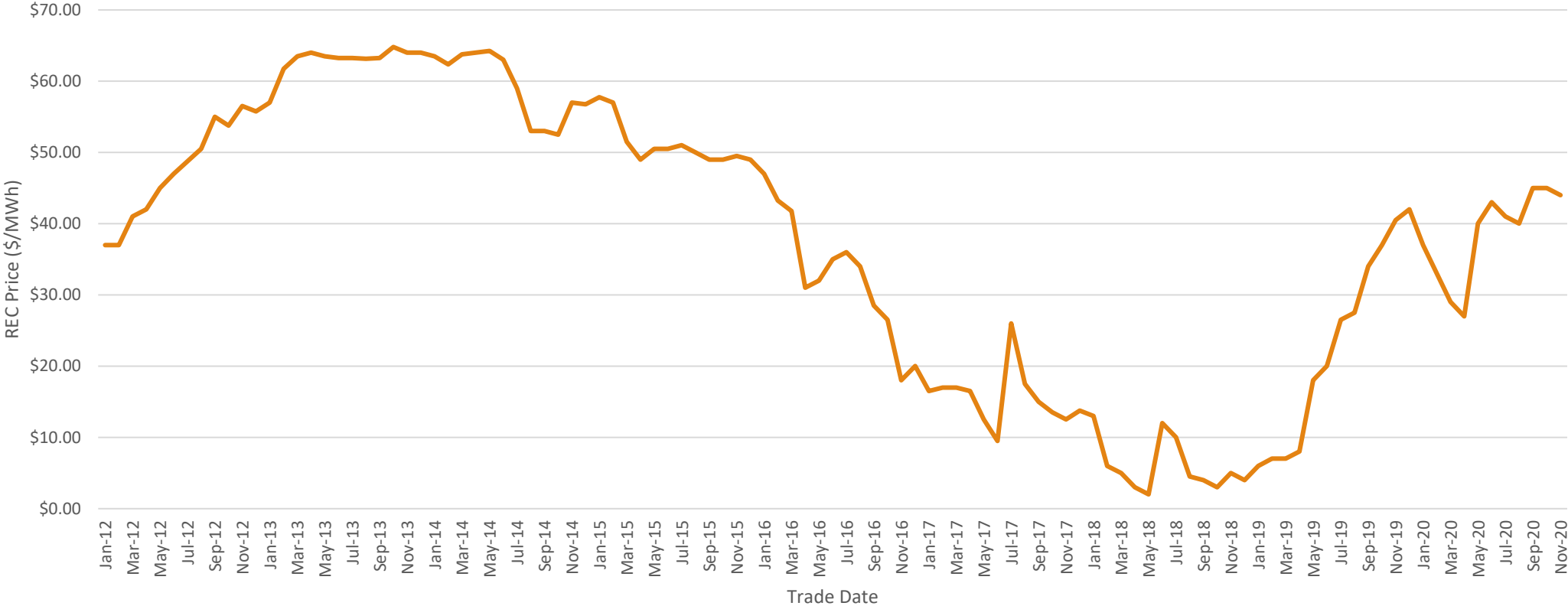


# New England Capacity Prices

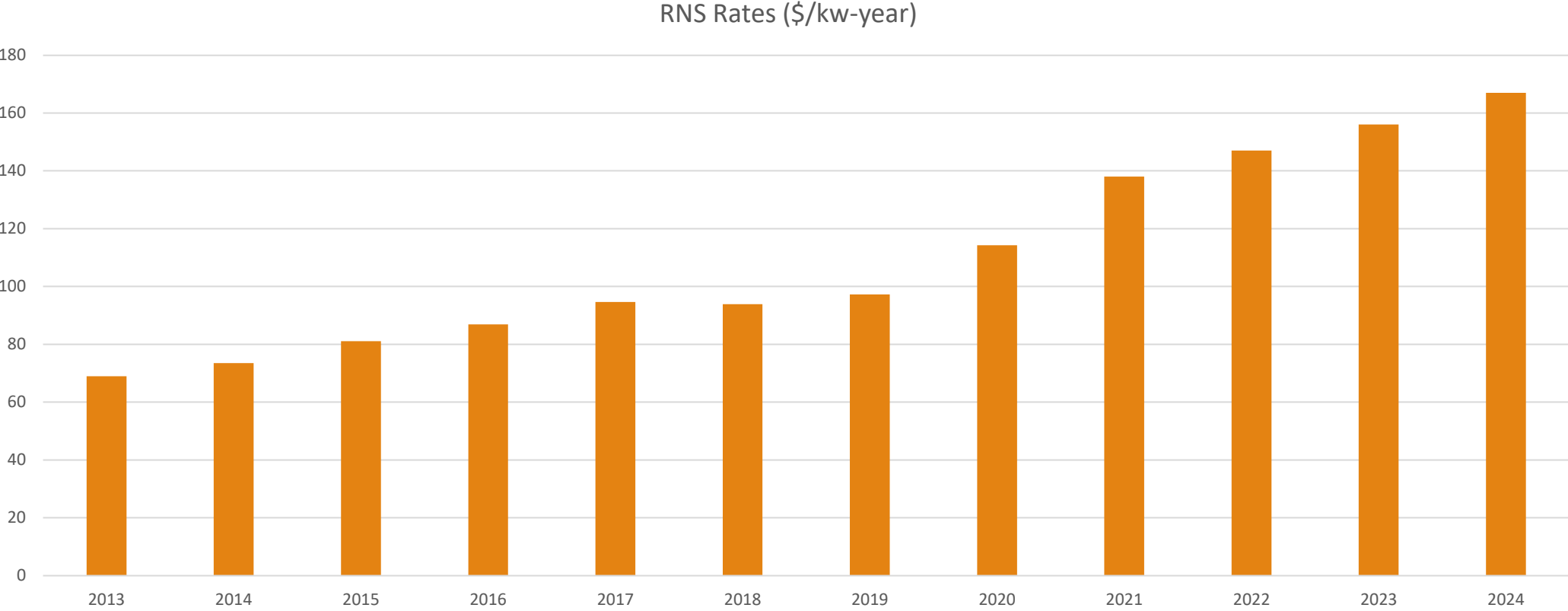
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# MA Regional Class I REC Prices



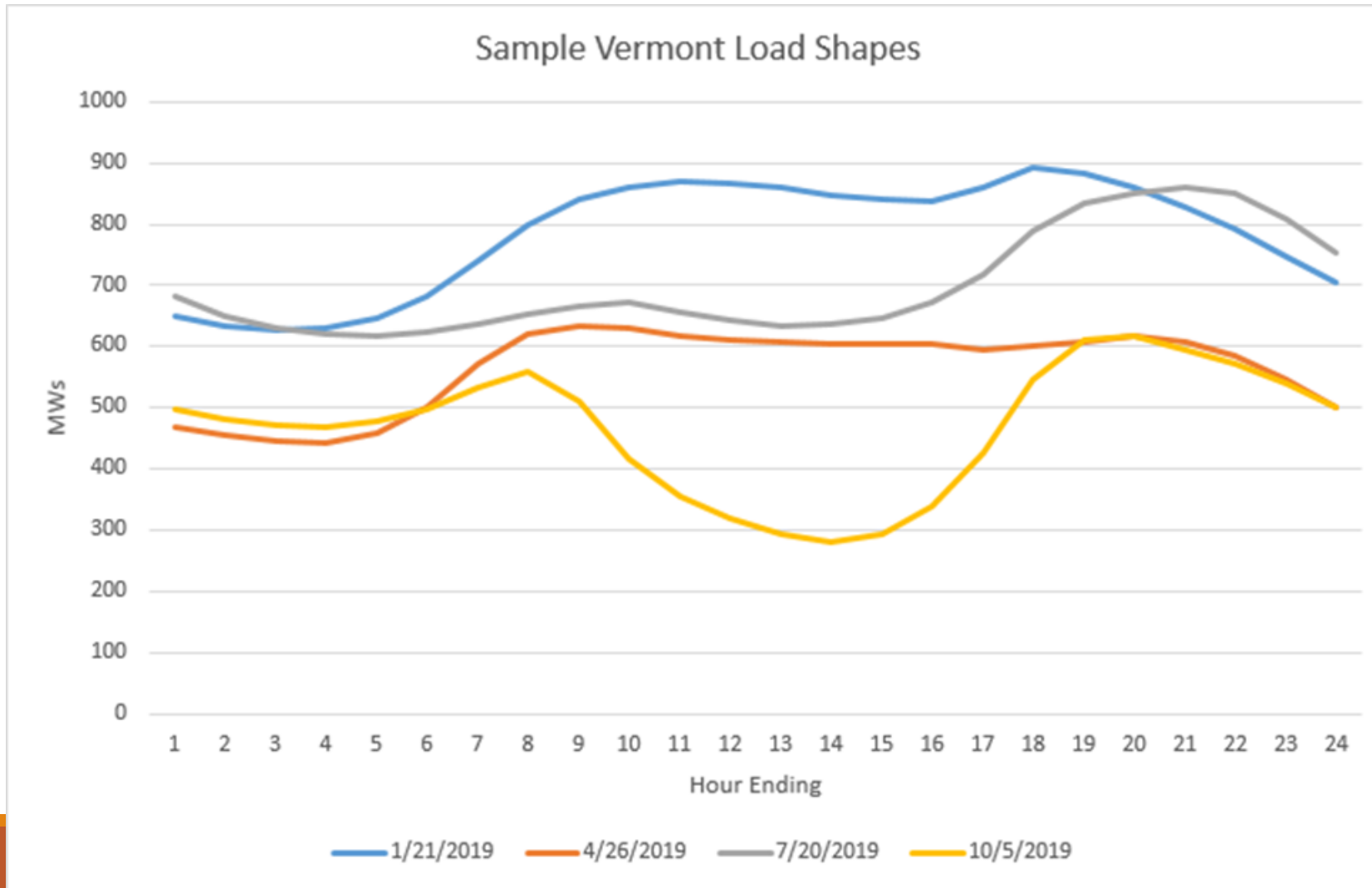
# Regional Transmission Costs



# Electric Vehicle Rate Structures

Utility	Standard Rate Above Base Block	Off-Peak Effective EV Rate	Savings	Comment
Burlington Electric Dept.	\$0.158815/kWh	\$0.086/kWh	46%	Prohibits charging 12 noon to 10 pm to realize lower charging rate each month
Green Mountain Power Rate 72	\$0.18035/kWh	\$0.14274/kWh	21%	Event-based on-peak charging penalty rate of \$0.73388/kWh
Green Mountain Power Rate 74	\$0.18035/kWh	\$0.13726/kWh	24%	Off-peak occurs outside weekdays, 1 pm to 9 pm
Vermont Electric Coop	\$250 one-time bill credit for avoiding on-peak charging (event-based or schedule-based options)			
Vermont Public Power Supply Authority	Free charger and \$500 one-time rebate for avoiding on-peak charging (schedule-based)			

# Vermont Seasonal Load Profiles



# Net Metering

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# Adjustors: Siting and RECs

## REC adjustors:

- Currently +1 cent/kWh credit for ten years if RECs go to utility; decreasing to 0 cents/kWh 2/2/21
- Currently -3 cents/kWh (debit) for the life of the system if RECs are held by the customer; decreasing to -4 cents/kWh 2/2/21

## Siting:

- By Category
  - I and II: currently +1 cent/kWh for 10 years; 0 cents/kWh starting 2/2/21 and -1 cent/kWh starting 9/1/21
  - III: currently -2 cents/kWh (debit) for lifetime; -3 cents/kWh starting 2/2/21 and -4 cents/kWh starting 9/1/21
  - IV: currently -3 cents/kWh (debit) for lifetime; -4 cents/kWh starting 2/2/21 and -5 cents/kWh starting 9/1/21
  - Hydro: 0 cents/kWh

## Biennial proceeding to revisit adjustors, category definitions, and levels of compensation

- Last biennial review occurred in 2020 (see Case No. 20-0097-INV and Order issued 11/12/20 for details)

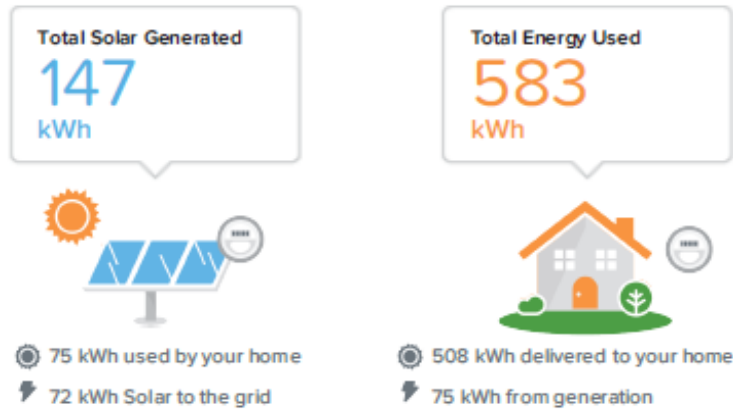
After 10 years, NM 1.0 systems will come under the contemporaneous net-metering rules and corollary tariffs



# Net-metering bill example

## My Energy Use Snap Shot

Learn how your renewable generation has contributed towards a sustainable energy future. For more details visit your account at [greenmountainpower.com](http://greenmountainpower.com)



## Bill Details

163 ACORN LN

### New Charges

508 Total KWH Consumed	
72 Total KWH Generated	
436 Total KWH Net Billed @ \$0.16859	\$73.51
Customer Charge: 30 Days @ \$0.492	\$14.76
Energy Efficiency Charge 436 x \$0.01188	\$5.18
Electric Assistance Program Fee	\$1.00
Past Storm & Power Fixed Charge	\$1.24
Emerald Ash Borer Charge	\$0.17
147 Total KWH Generation	
147 Solar Siting Incentive KWH @ \$-0.01	-\$1.47
147 Renewable Energy Certificate Incentive KWH @ \$-0.01	-\$1.47
<b>New Actual Charges</b>	<b>\$92.92</b>

\*Please note that non-bypassable charges cannot be paid with net metering credits.

NM 2.0  
behind-the-meter system

NM 2.0  
standalone group system

## My Energy Use Snap Shot

Learn how your renewable generation has contributed towards a sustainable energy future. For more details visit your account at [greenmountainpower.com](http://greenmountainpower.com)



## Bill Details

163 ACORN LN

**Rate:** General (Small) Commercial Net Metering non bypassable charges  
Group Rate 06  
Group Solar Incentive

### New Charges

Customer Charge: 33 Days @ \$0.618	\$20.39
Energy Efficiency Charge 997 x \$0.01024	\$10.21
Electric Assistance Program Fee	\$1.67
Past Storm & Power Fixed Charge	\$2.76
Emerald Ash Borer Charge	\$0.38
Total 997 KWH Consumed	
Total 225 KWH Generated	
Group Excess Shared 21,800 KWH	
997 Total KWH Consumed Billed @ \$0.17754	\$177.01
225 Total KWH Excess Credit @ \$-0.15417	-\$34.69
Total Gross 22000 KWH Generated	
Total Group Excess Shared 22,000 KWH	
227 Solar Siting Charge KWH @ \$0.01	\$2.27
227 Renewable Energy Certificate Incentive KWH @ \$-0.03	-\$6.81
<b>New Actual Charges</b>	<b>\$173.19</b>

<b>Adjustments</b>	
Transfer Credit To/From Net Meter Bank	-\$137.78
<b>Total Adjustments</b>	<b>-\$137.78</b>

\*Please note that non-bypassable charges cannot be paid with net metering credits.

# Grid Modernization

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# Grid Modernization

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*“Grid modernization is a broad term, lacking a universally accepted definition. In this report, the authors use the term grid modernization broadly to refer to actions making the electricity system more resilient, responsive, and interactive. Specifically, in this report grid modernization includes legislative and regulatory actions addressing: (1) smart grid and advanced metering infrastructure, (2) utility business model reform, (3) regulatory reform, (4) utility rate reform, (5) energy storage, (6) microgrids, and (7) demand response.”*

*-50 States of Grid Modernization, NC Clean Energy Technology Center*

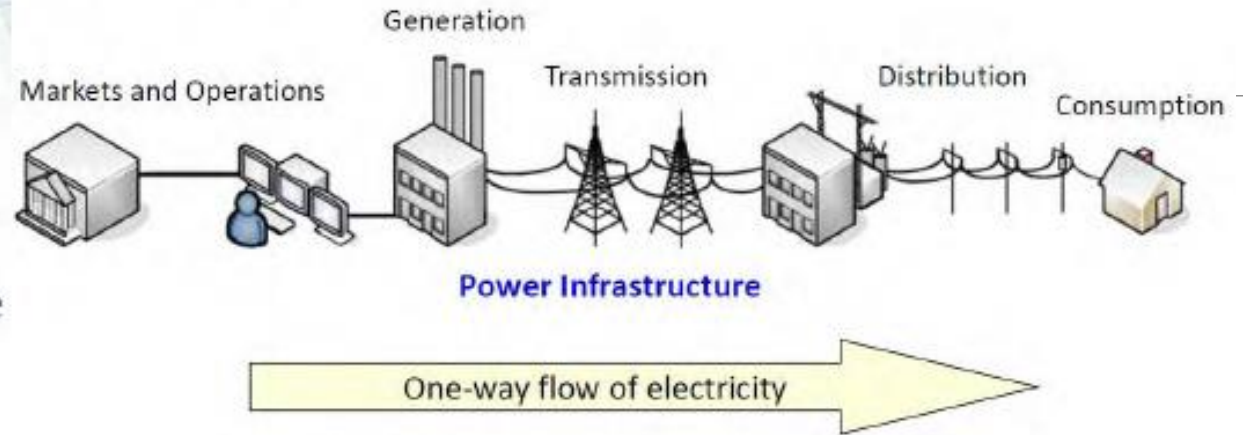
*“‘Grid modernization’ and ‘distribution system planning’ are understood to refer to the process of identifying how to build the distribution system and integrate non-wires solutions to integrate and optimize distributed energy resources and other aspects of a rapidly evolving energy ecosystem while maintaining and improving safety and reliability, consistent with the state’s energy policies, goals, and longstanding least-cost planning principles.*

*-Memorandum of Understanding in Case No. 18-4166-PET (GMP 2018 IRP)*

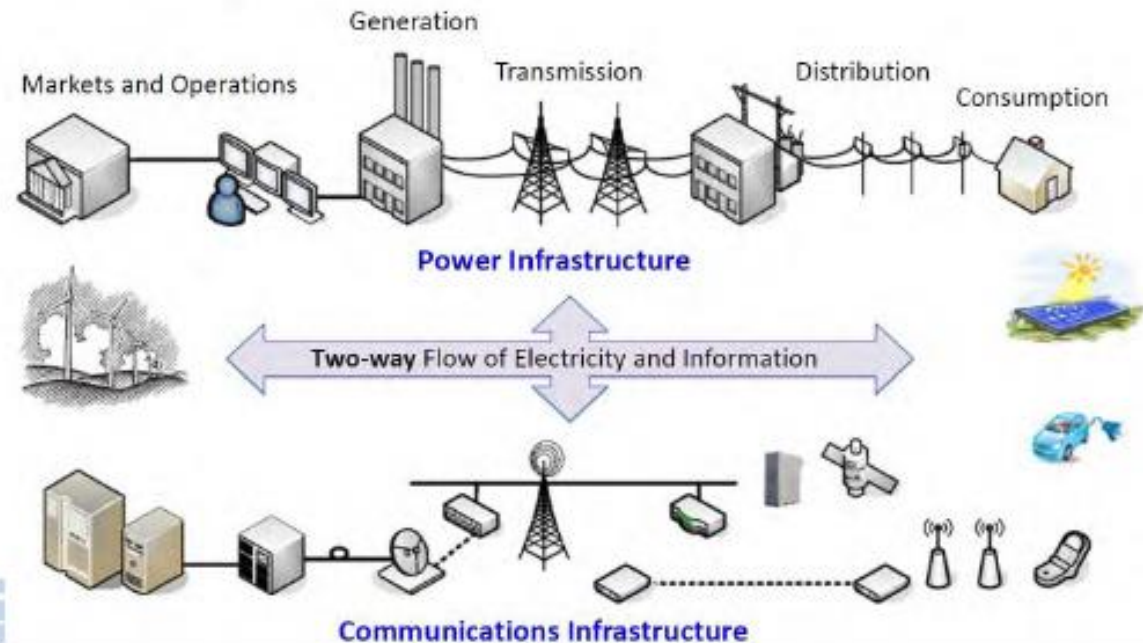
# Grid Modernization and a Vision for the Future

- Centralized generation
- Generation follows load
- One-directional power flow
- Limited automation
- Limited situational awareness
- Consumers lack data to manage use
- Limited accessibility for new producers

Traditional Power Grid:



Future Smart Grid:

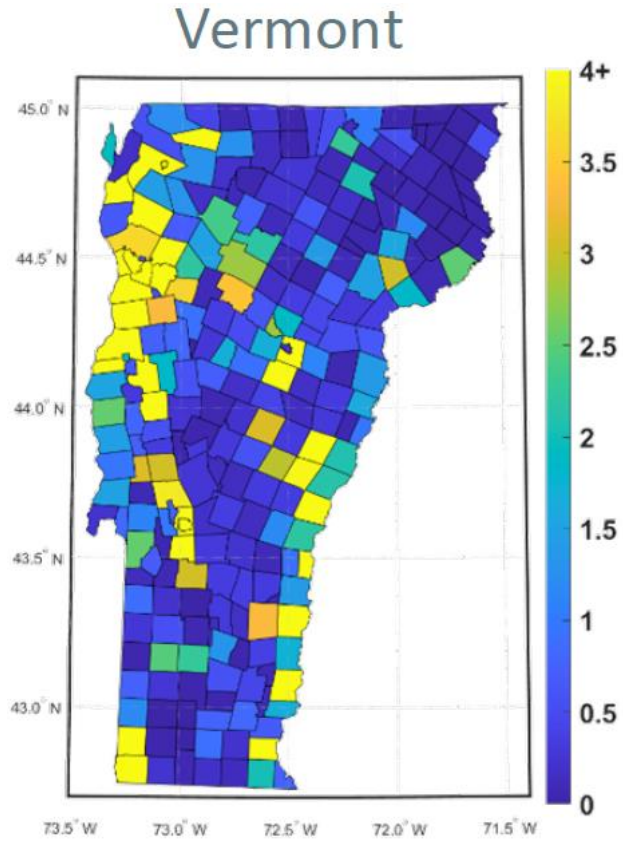


- Centralized + distributed generation
- Variable resources
- Consumers become producers
- Multi-directional power flow
- Flexible load





# Solar: hosting capacity & D-system constraints



Source: ISO-NE. Scale indicates MW/town as of August 2020

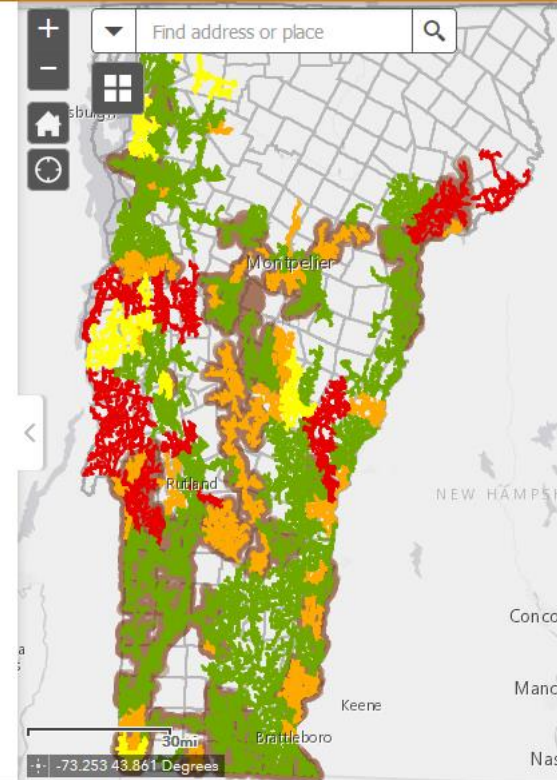
## DG Circuit Capacity Per Substation Nameplate Rating

- Unrated
- Substation transformer with at least 20% capacity remaining
- Substation transformer with less than 20% capacity remaining
- Substation transformer with less than 10% capacity remaining
- Due to system limitations, interconnections on this circuit may experience higher costs and delayed interconnections

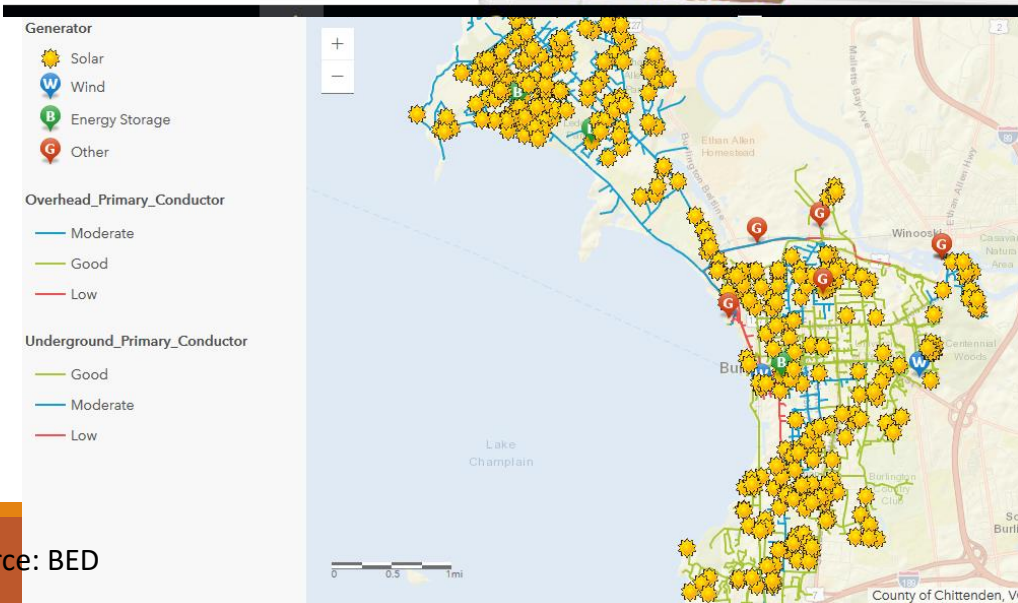
## TGFOV Circuits

Interconnections on these circuits subject to GMP TGFOV Tariff fee of \$37 per kW of AC capacity authorized by VT PUC Docket # 19-0441-TF.

## Towns



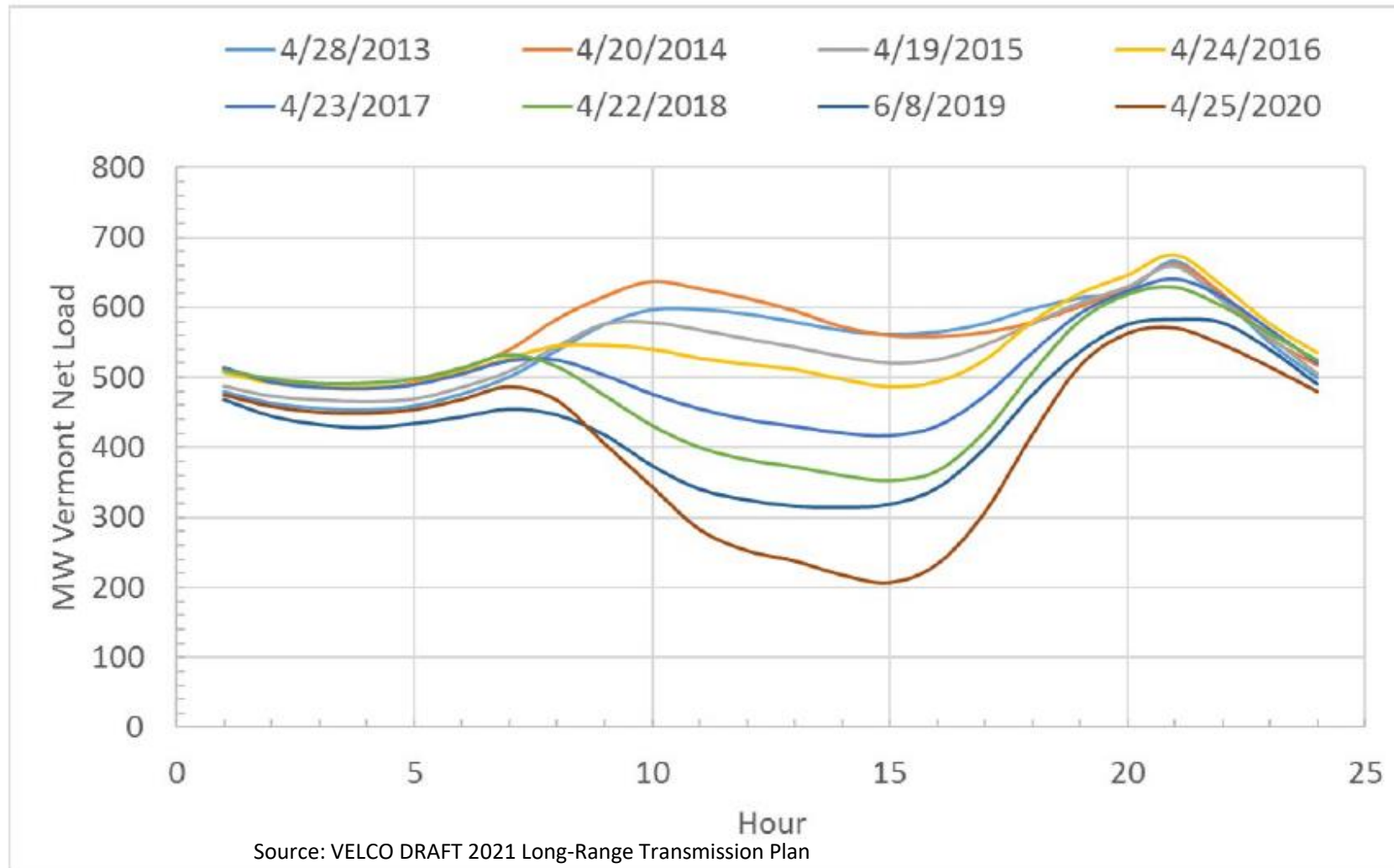
Source: GMP



Source: BED

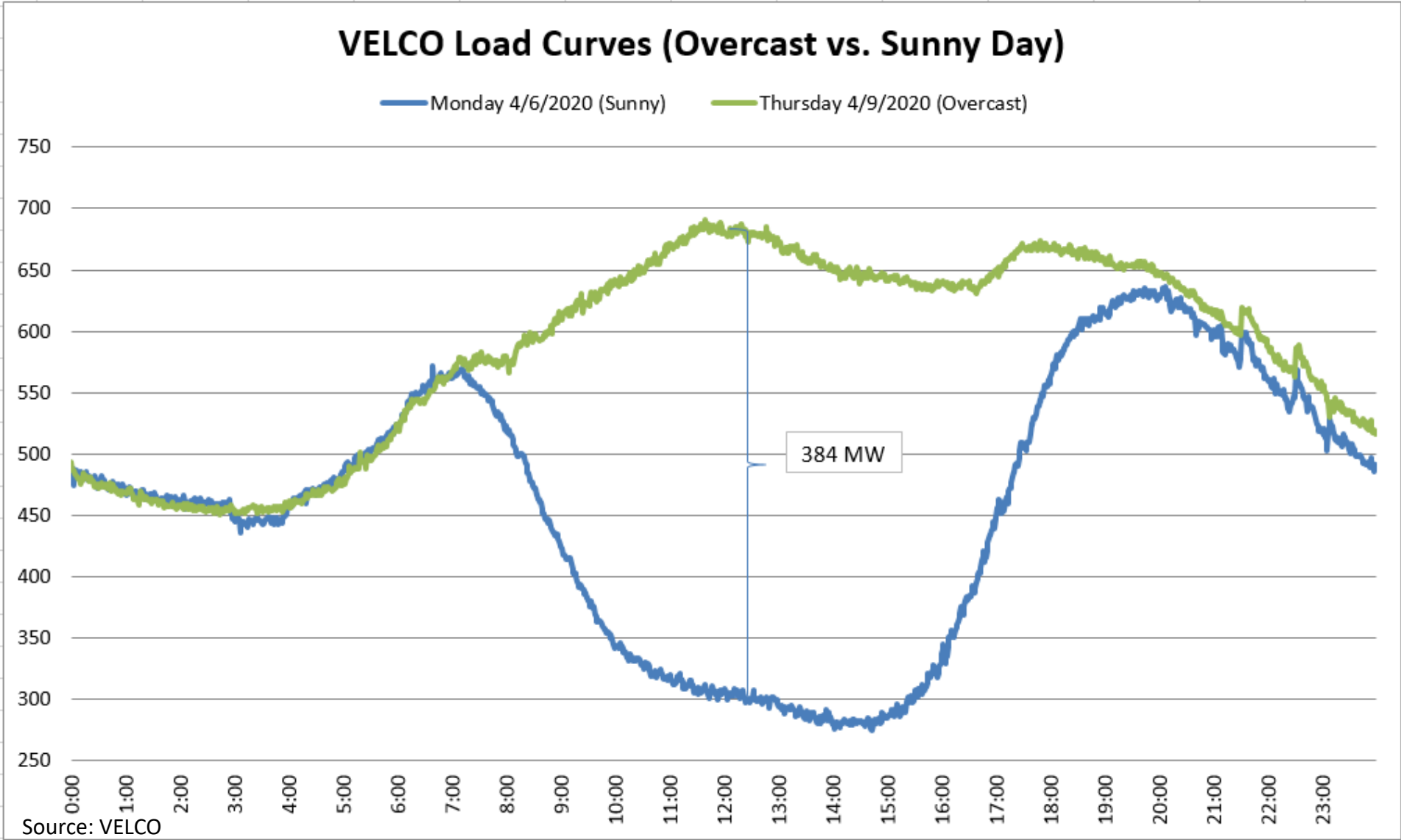
# Solar: lowering & shifting peak demand

SOLAR PV IMPACT ON VERMONT NET LOADS

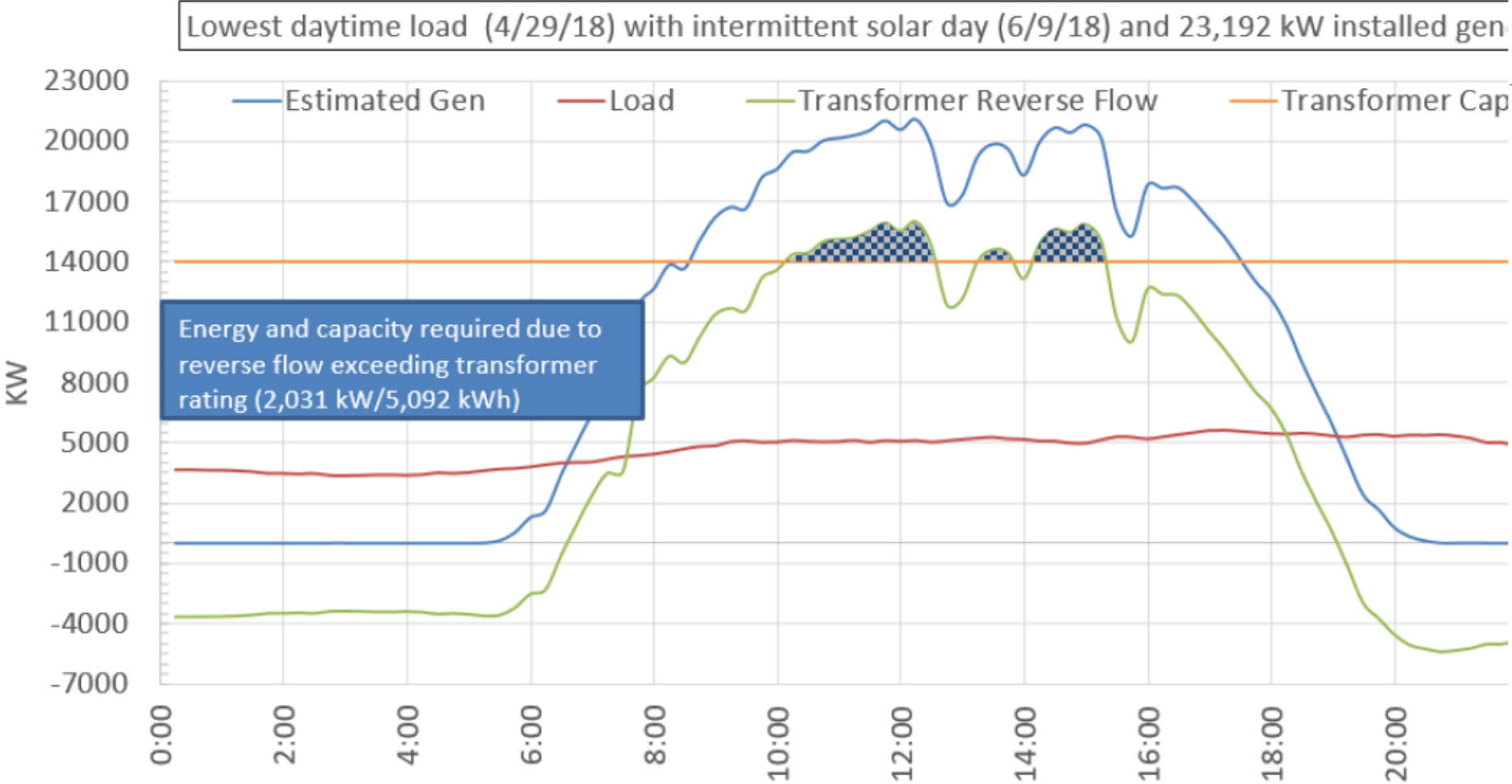


Source: VELCO DRAFT 2021 Long-Range Transmission Plan

# Variability and uncertainty: daily



# Variability and uncertainty: hourly

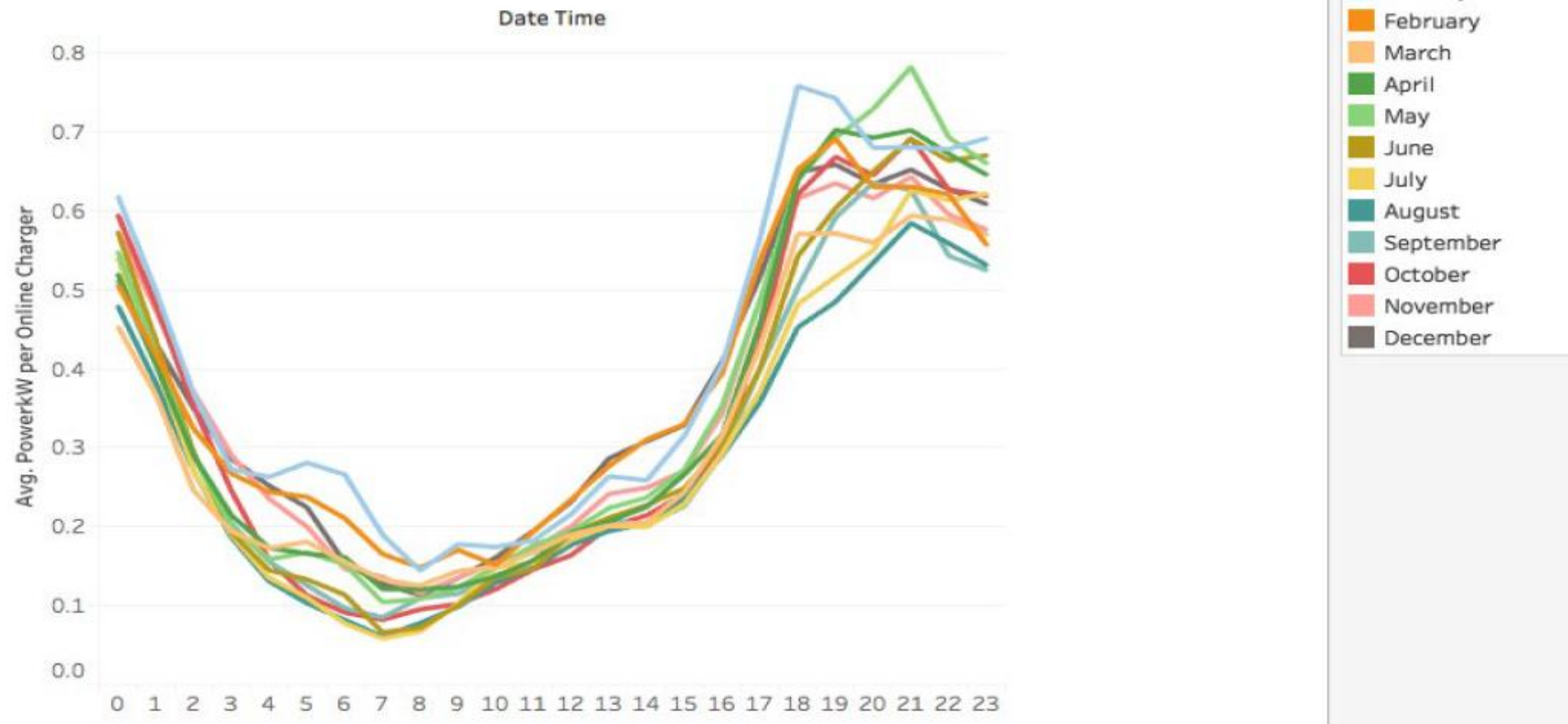


Source: GMP presentation to VSPC Generation Constraint Subcommittee 9/9/20



# Electric vehicles: charging profiles

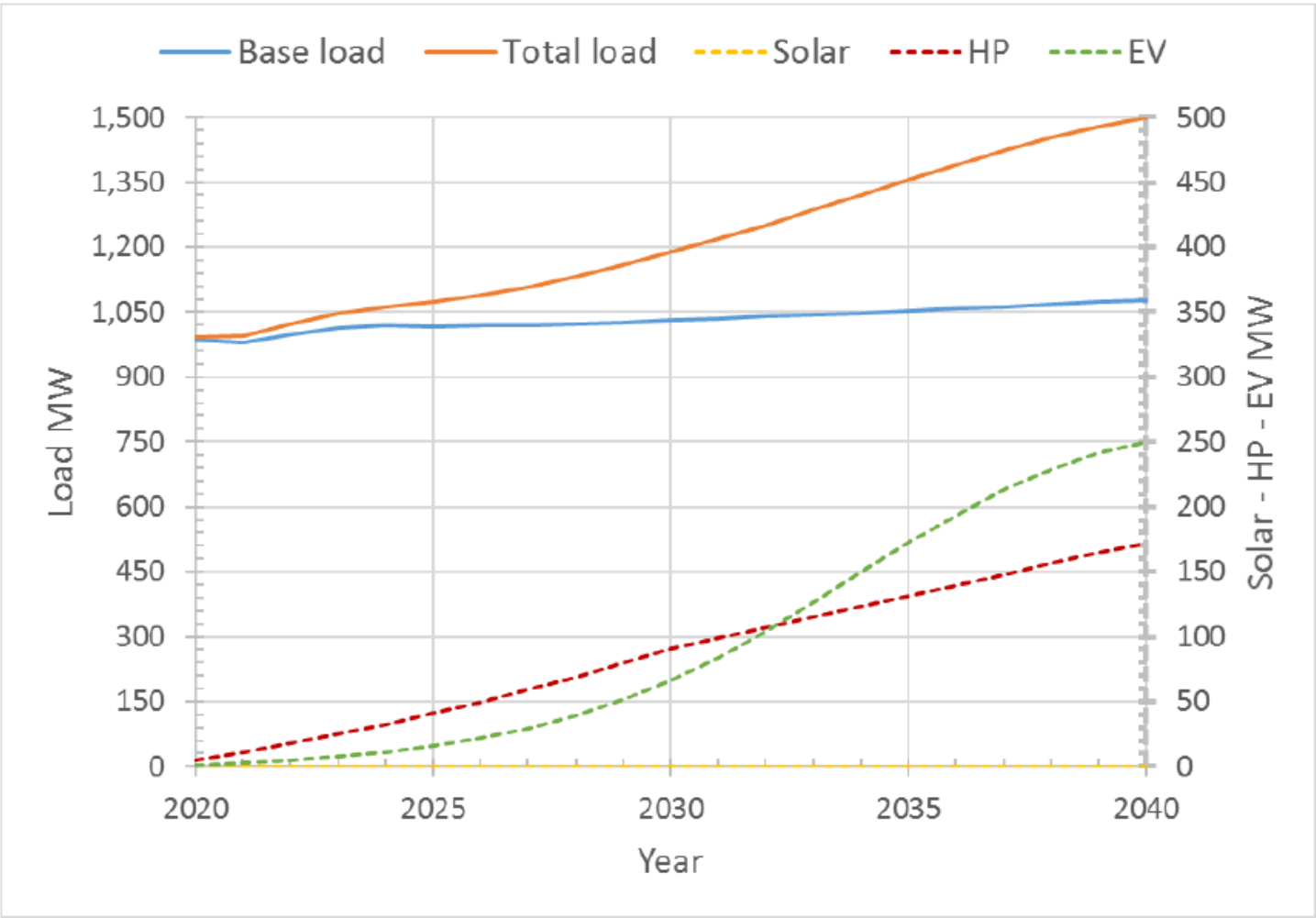
Hourly by Month



Source: GMP

# Electrification & seasonal demand patterns (VT)

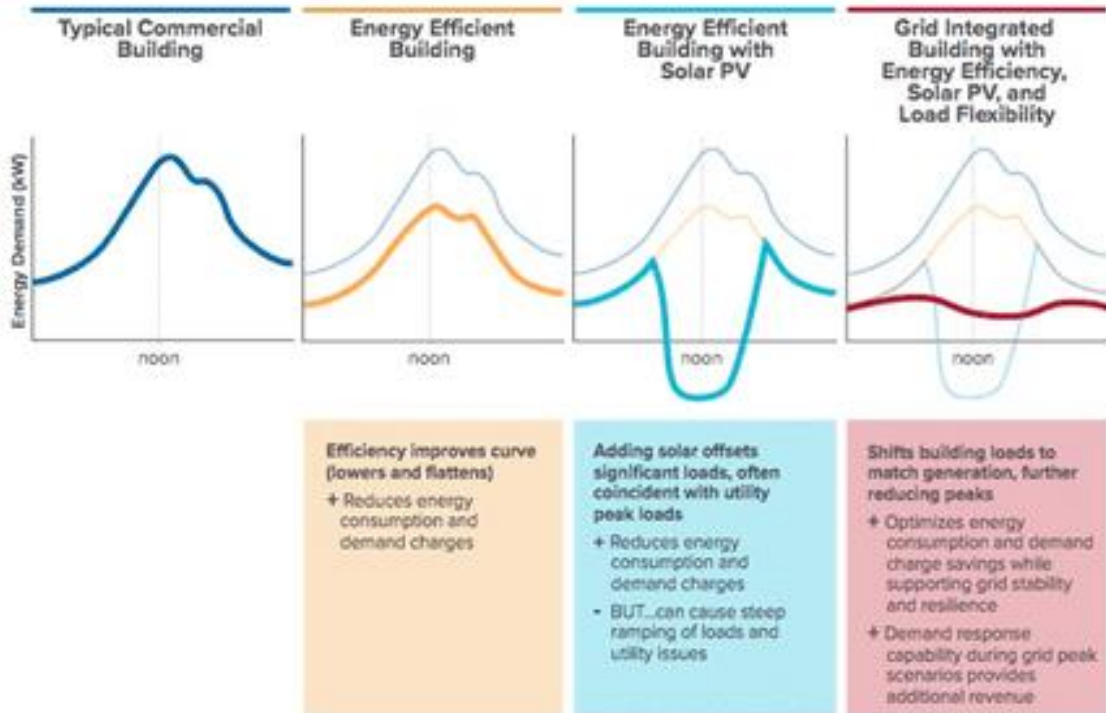
PROJECTED VERMONT WINTER PEAK LOAD AND ITS COMPONENT FORECASTS



Source: VELCO DRAFT 2021 Long-Range Transmission Plan

# Optimizing demand & supply in real time

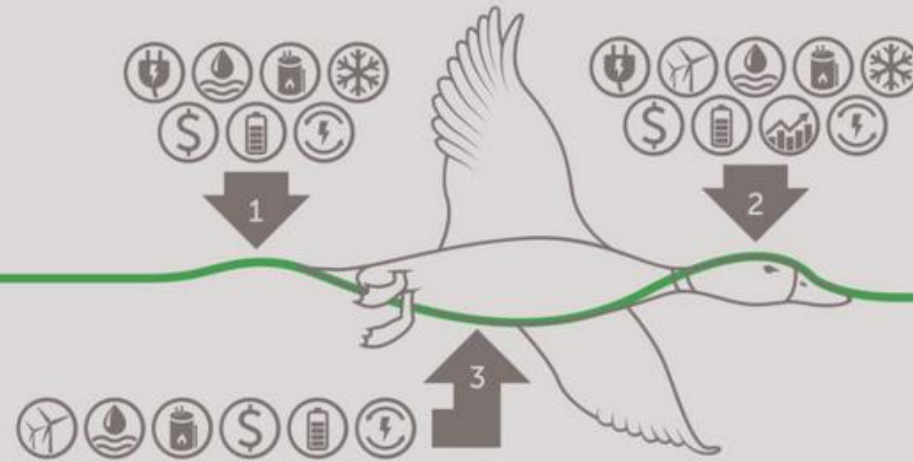
## Grid Integrated Building: Load Profiles



Sources: RMI (above), RAP (right)

## Teaching the "Duck" to Fly:

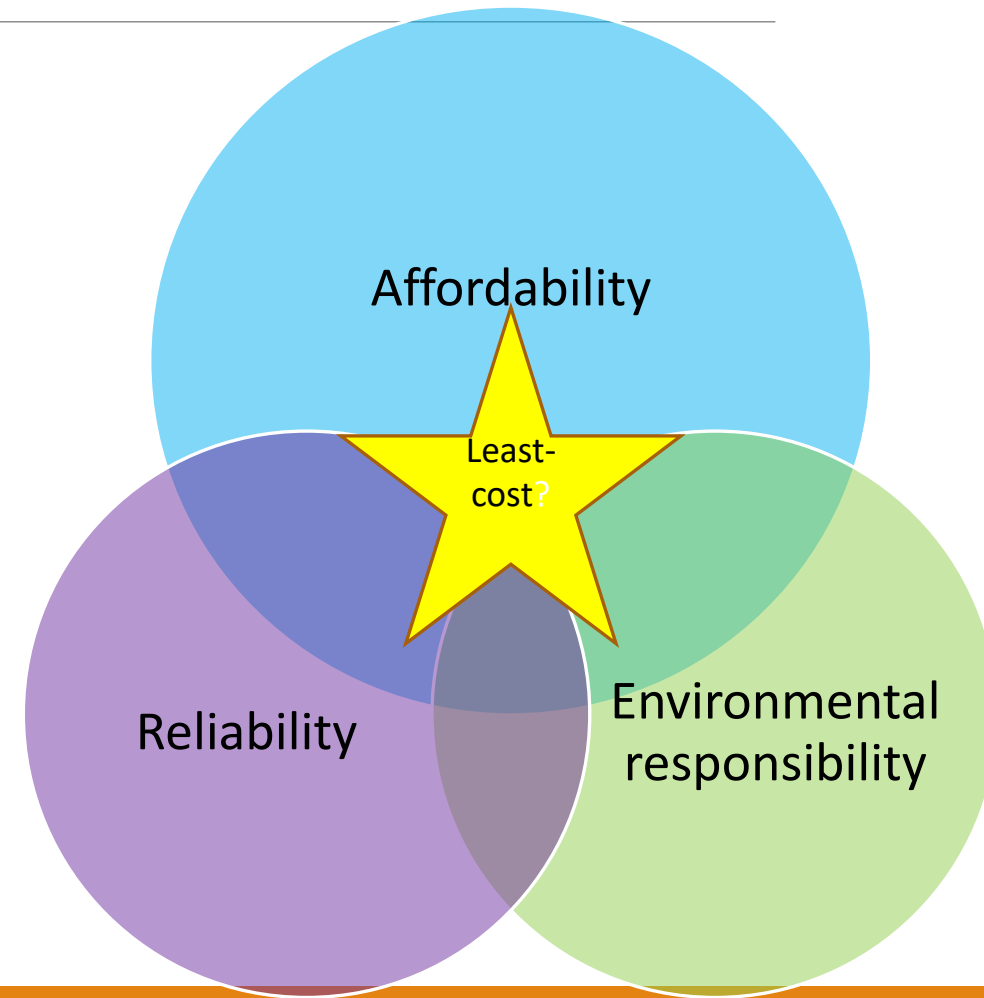
10 strategies to control generation, manage demand, & flatten the Duck Curve



- ⚡ Targeted Efficiency**  
Focus energy efficiency measures to provide savings in key hours of system stress. 📉📉
- 🌳 Peak-Oriented Renewables**  
Add renewables with favorable hourly production. Modify the dispatch protocol for existing hydro with multi-hour "pondage." 📉📉
- 💧 Manage Water Pumping**  
Run pumps during periods of low load or high solar output, curtailing during ramping hours. 📉📉📉
- 🔥 Control Electric Water Heaters**  
Increase usage during night & mid-day hours, & decrease during peak demand periods. 📉📉📉
- ❄️ Ice Storage for Commercial AC**  
Convert commercial AC to ice or chilled-water storage operated during non-ramping hours. 📉📉
- 💰 Rate Design**  
Focus pricing on crucial hours. Replace flat rates & demand charge rate forms with time-of-use rates. Avoid high fixed charges. 📉📉📉
- 🔋 Targeted Electric Storage**  
Deploy storage to reduce need for transmission & distribution, & to enable intermittent renewables. 📉📉📉
- 📊 Demand Response**  
Deploy demand response programs that shave load during critical hours on severe stress days. 📉
- ⚡ Inter-Regional Power Exchange**  
Import power from & export power to other regions with different peaking periods. 📉📉📉
- 🏭 Retire Inflexible Generating Plants**  
Replace older fossil & nuclear plants with a mix of renewables, flexible resources, & storage.

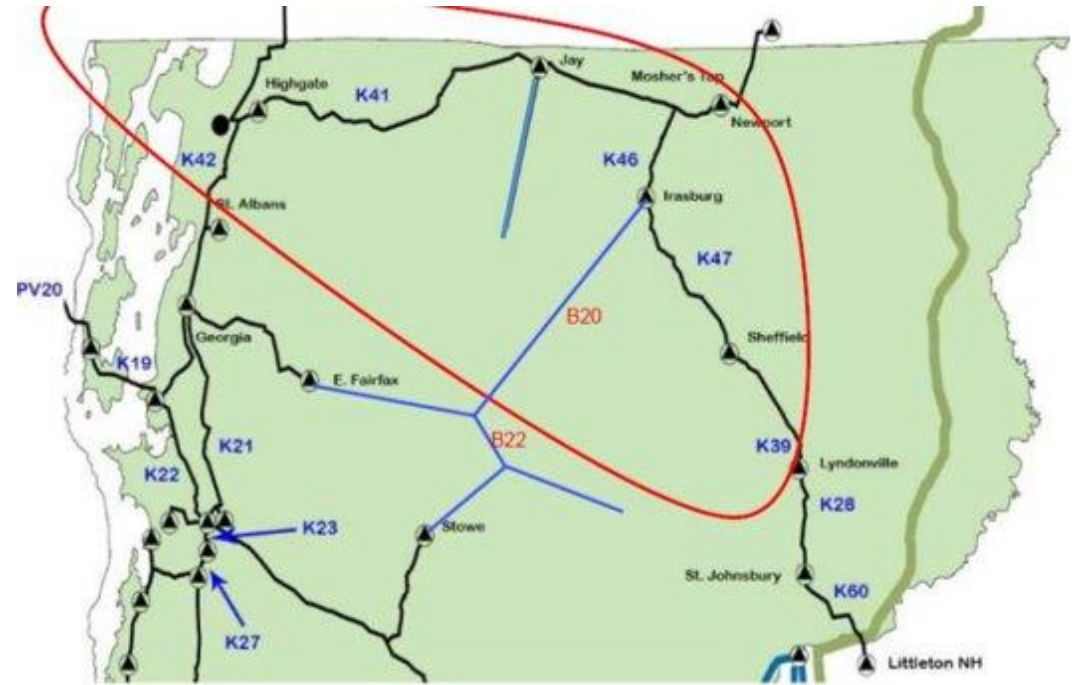
# Big picture questions

- What are the objectives of grid modernization?
- Who can and will participate, and how?
- What is necessary to reach goals (planning, programs, rate design, regulation)
- Where & when do investments need to be made
- Why?
  - Utility activities
    - Pilots & investments (RES Tier III, AMI, storage, charging stations, rate design, flex load management....)
  - PUC investigations
    - EVs
    - Act 62
  - Legislative reports
    - Demand charges
    - SHEI
    - Storage
- How do we...
  - Value integration of DERs?
  - Value reliability & resiliency?
  - Achieve no- or low-regrets least-cost outcomes



# Sheffield Highgate Export Interface

- SHEI is a region in northern Vermont with transmission constraints– the boundaries may shift as additional generation is added.
- Renewable electric generation (385 MW) almost always exceeds demand (20-60 MW), and at times the transmission system does not have the capacity to transport the energy elsewhere.





# Costs of SHEI

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## CURTAILMENTS

ISO-NE manages the interface by limiting generation through curtailments to ensure system capacity is not exceeded.

The result is existing renewable resources (typically Kingdom Community Wind) must reduce their output

These resources are owned by or under contract with Vermont utilities. With less output, revenue is lost from energy, RECs and ITC.

## CONGESTION

When the system is constrained, congestion costs increase which reduce the financial value for ALL generation in the region participating in the markets (almost all generation in the area is owned by or under contract to a VT utility)

Congestion is a component of Locational Marginal Prices (LMPs), which is the rate that generators are compensated. More congestion = lower revenues for generators

# Proposed Mitigation Grid Adjustor

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- Fee to be applied to solar net-metering projects smaller than 500 kW
- Larger projects would require an individualized analysis
- Fee intended to offset the incremental cost caused by additional solar
- Collected fees would be distributed to affected utilities
- PSD projected the incremental cost over 25 years of new DG solar
  - based on an assessment performed by GMP and VEC that 10 MW of additional DG in SHEI would have increased costs by about \$163,000 over the previous 2 years
  - additional costs due to increased congestion and curtailments
  - Projection accounts for existing mitigation actions including Lowell-to-Morrisville line upgrade

--> PSD recommended one-time upfront collection of \$75/kw-installed