Electricity 101
Public Service Department

BEFORE HOUSE ENERGY & ENVIRONMENT

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Topics Covered

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

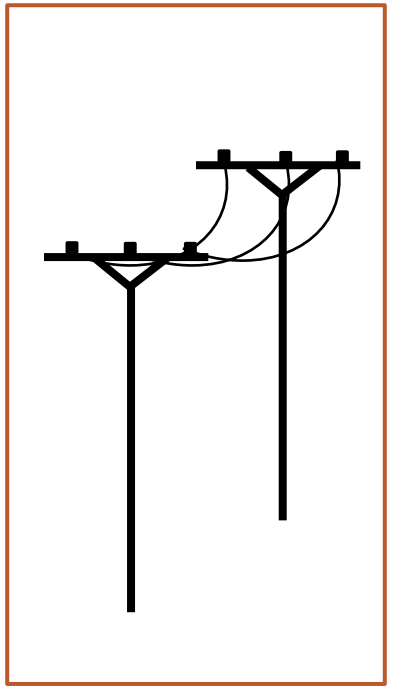
Part 2:

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

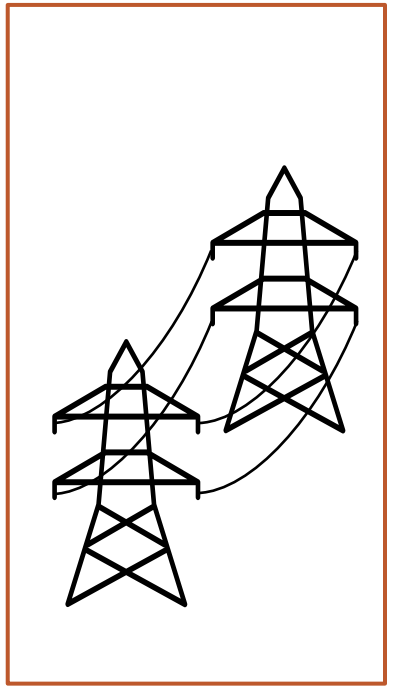
Appendices Included for Reference

Core Components of the Electric Grid

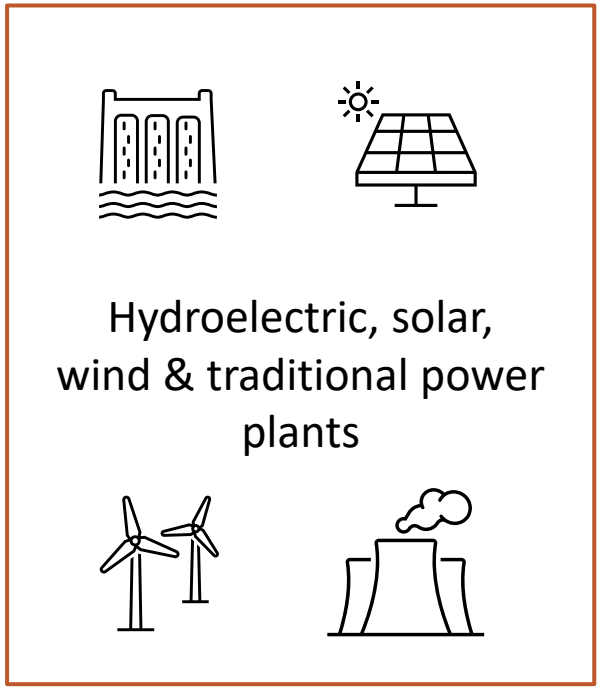
Electricity Consumers



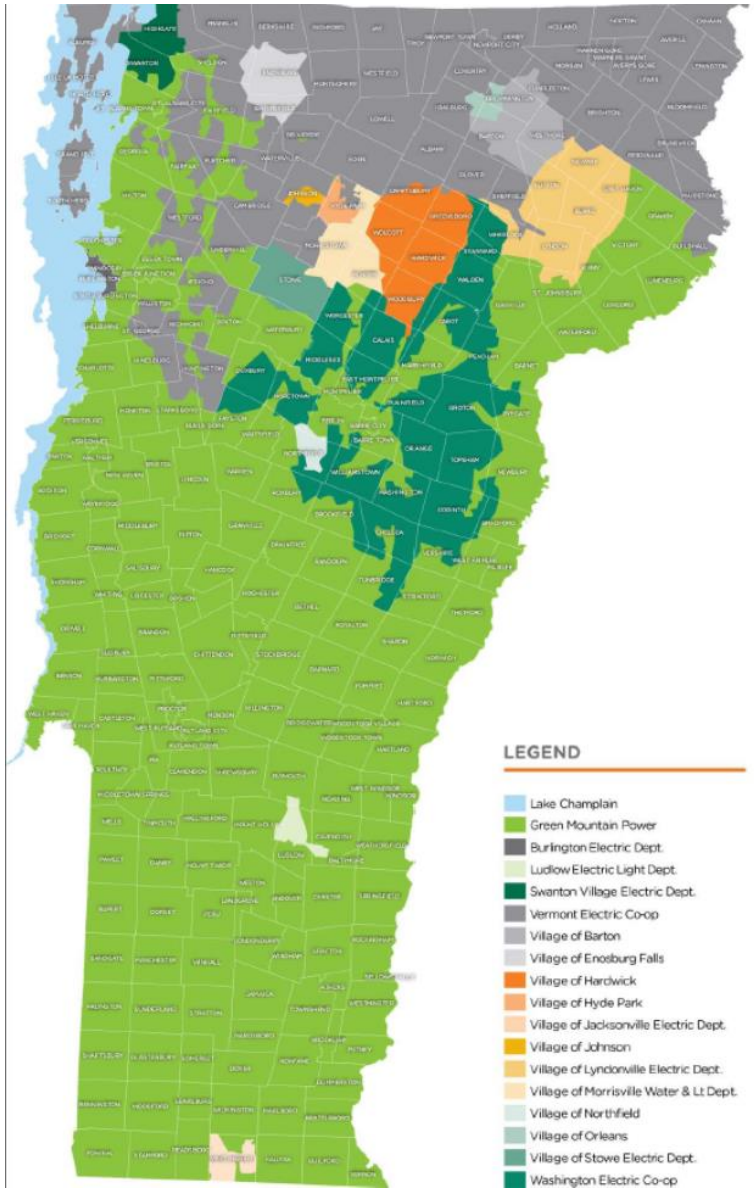
Distribution Lines



Transmission Lines



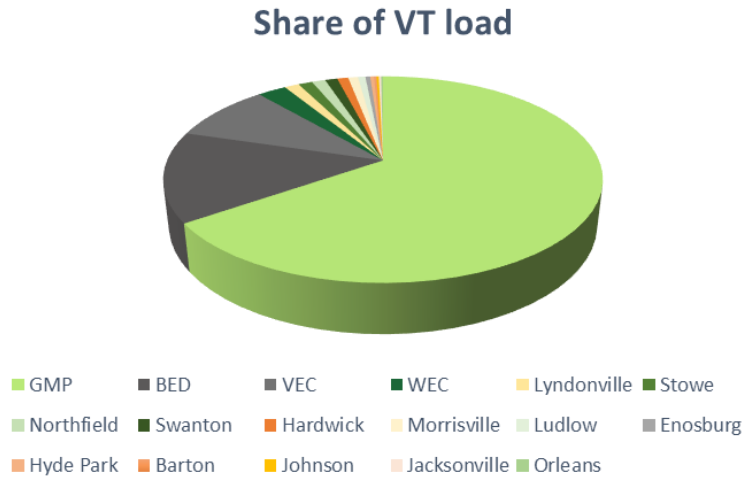
Generation



Vermont's Distribution Utilities

Vermont Electric Utilities

- 1 Investor Owned Utility (serving ¾ of VT demand ~ 260,000 customers)
- 2 Cooperative utilities
- 14 Municipal Utilities
- 1 transmission utility



1 Natural Gas Utility

- Investor Owned ~53,000 customers in 3 counties

Vermont's Energy Efficiency Utilities

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

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:

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

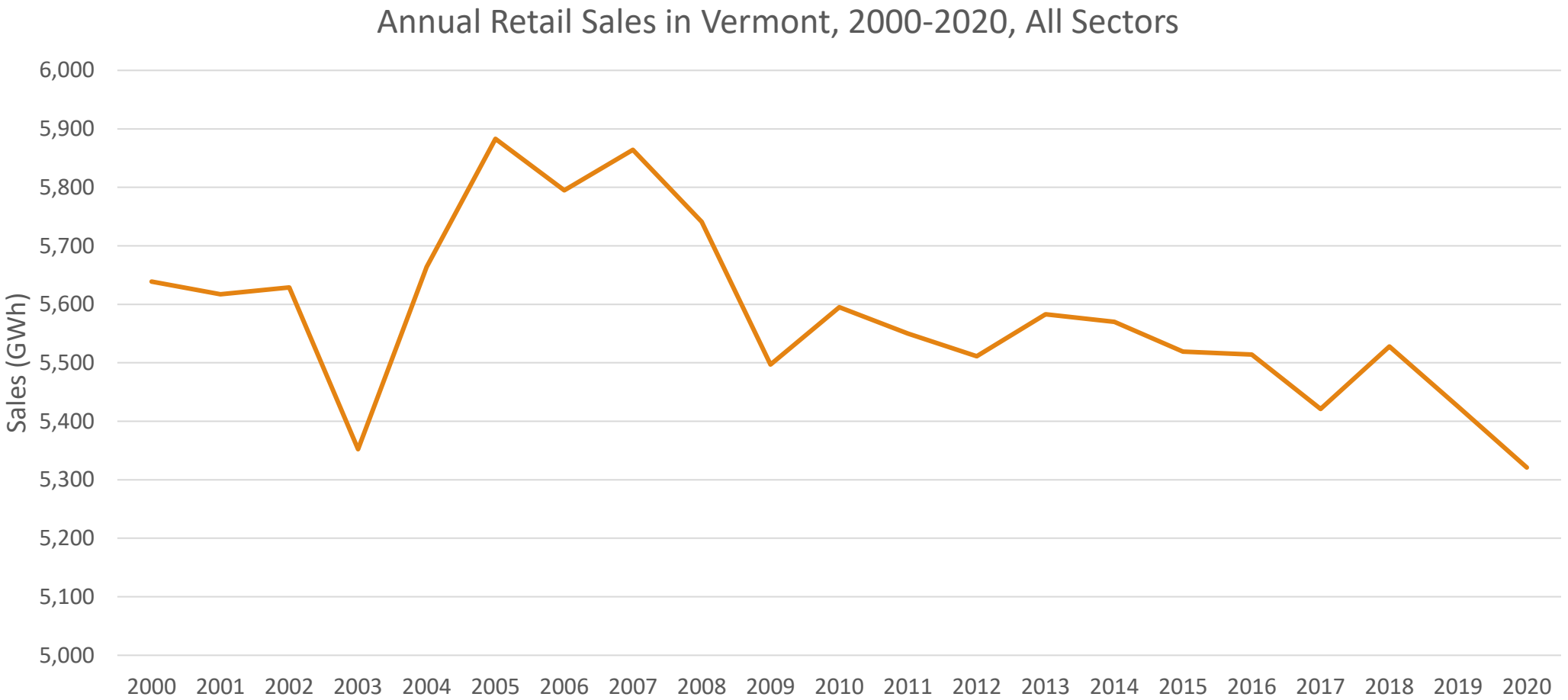
A hydropower plant with a capacity of **10 MW** could help **1 million** light bulbs turn on at the same time.

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 **1 million** light bulbs for that time.

EXAMPLES

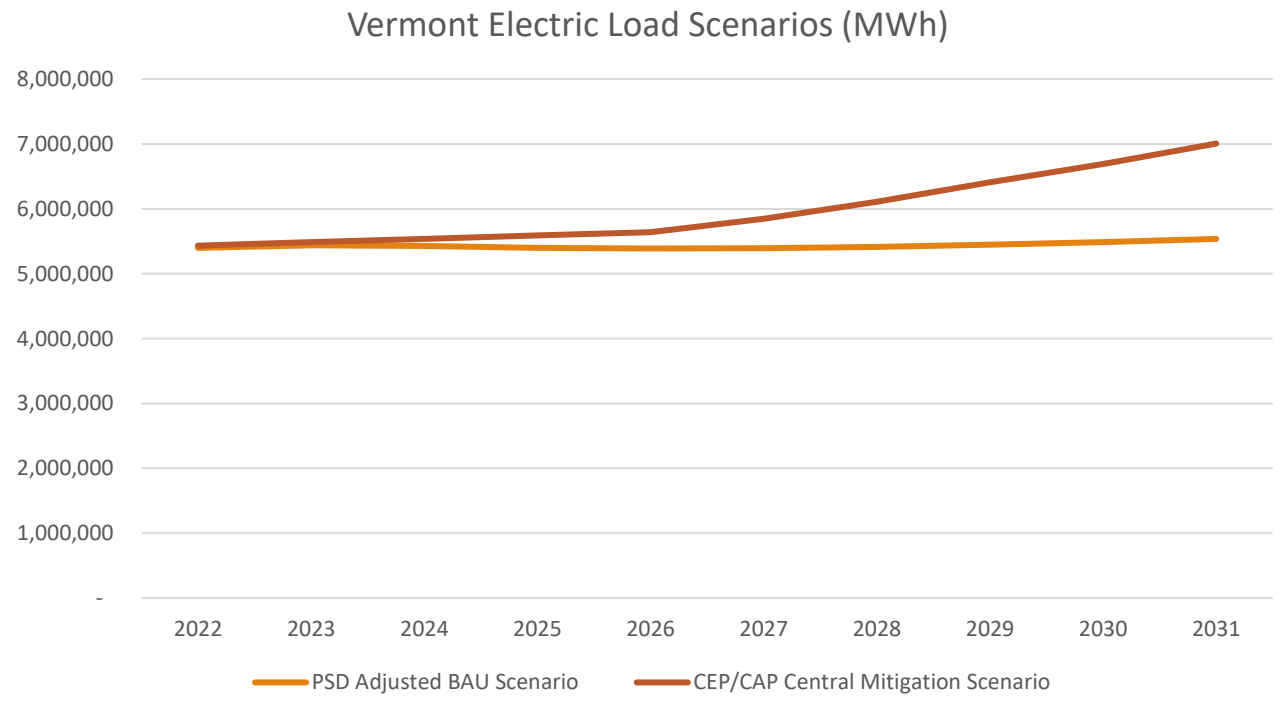
Retail Sales – Historical Trends



Retail Sales – Forecasted Trends

- **Business-As-Usual (Baseline) Forecast:** Based on 2021 VELCO Long-Range Transmission Plan, modified w/recent data

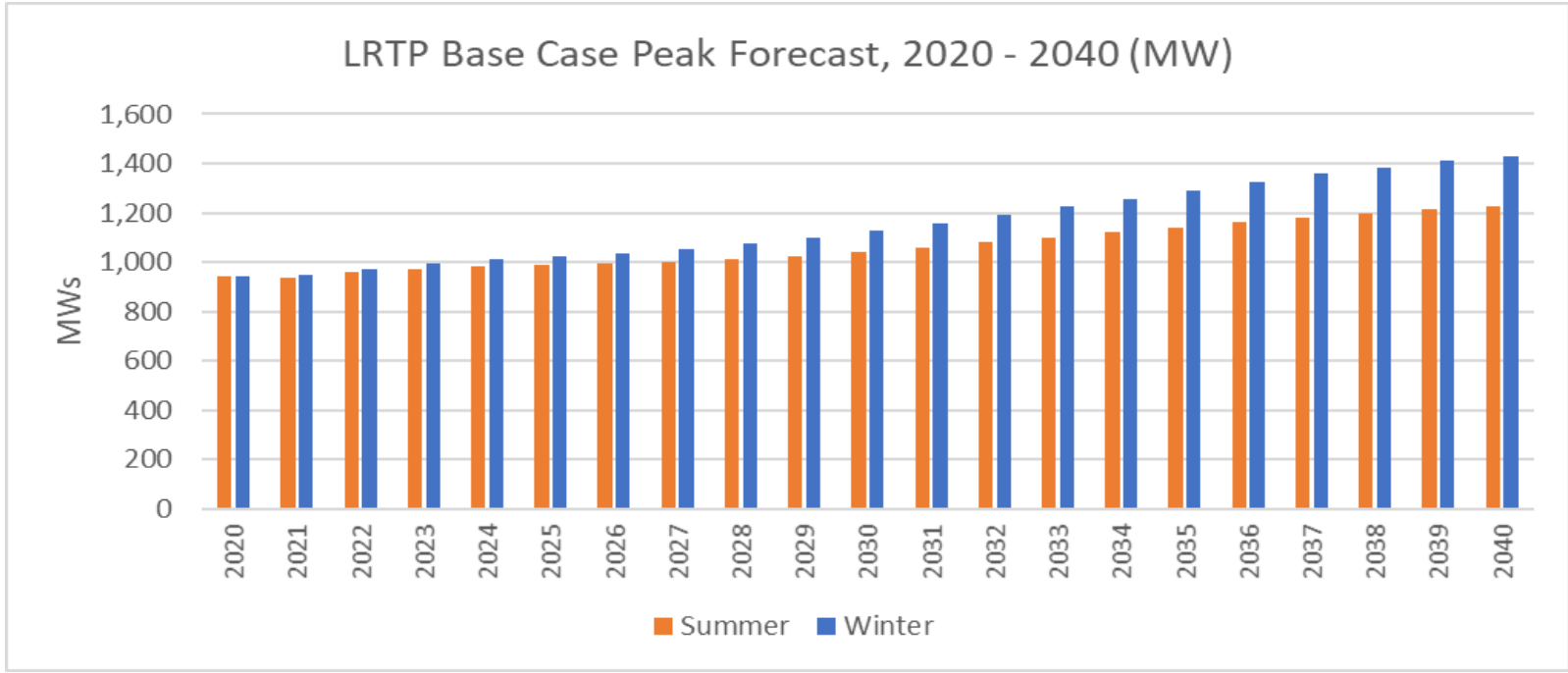
- **Central Mitigation Scenario:** Based on modeling conducted for the Comprehensive Energy Plan/Global Warming Solutions Act carbon reduction pathways

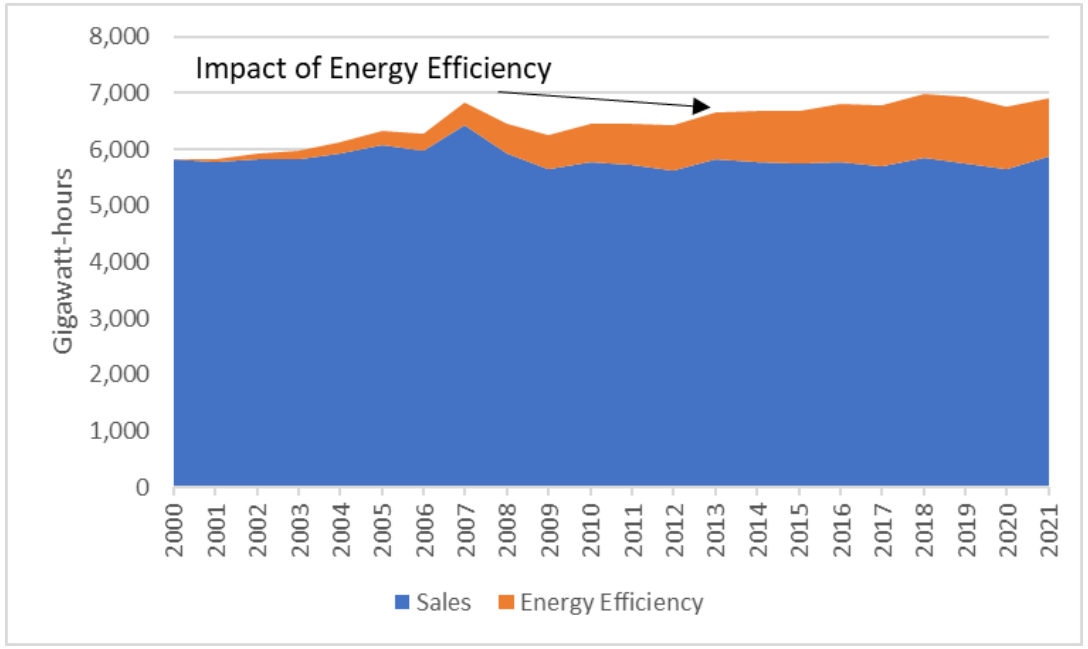


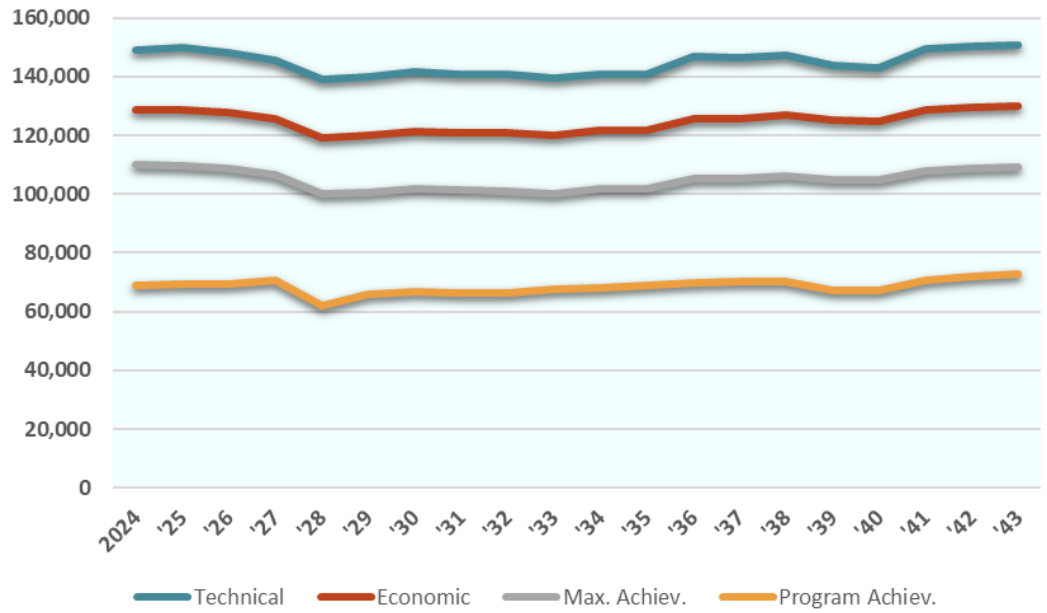
Vermont Peak Load Forecast

- 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	Syste 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*			

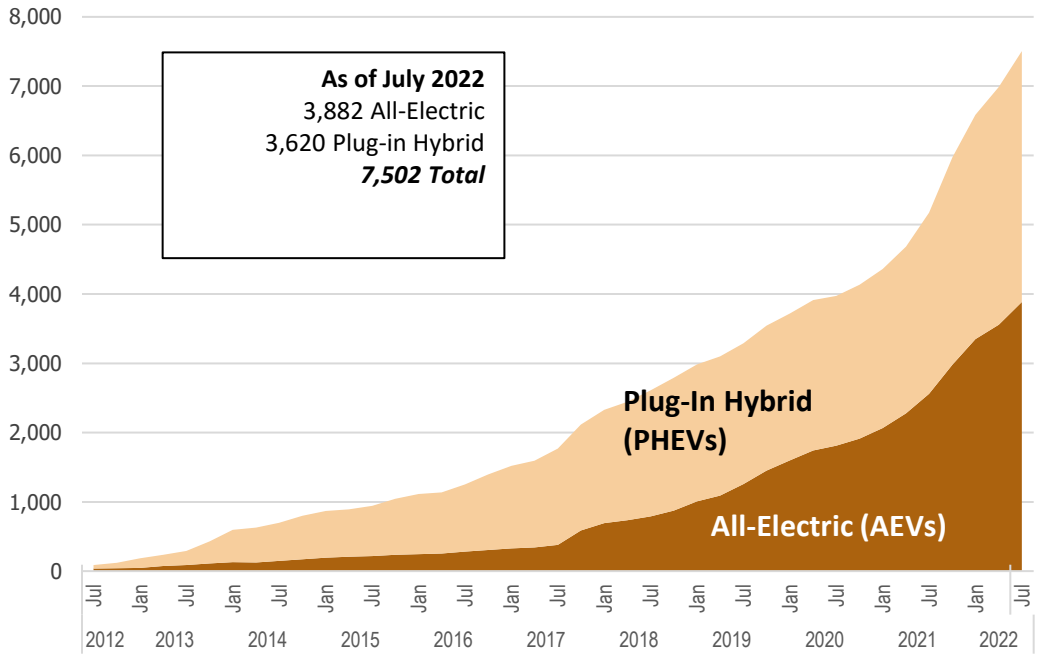


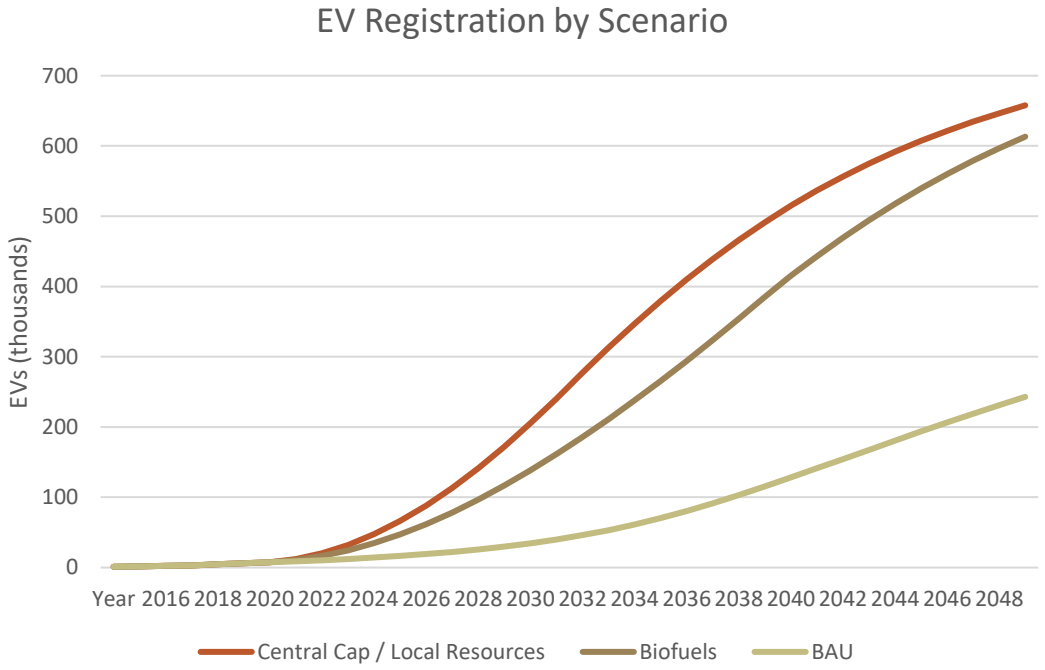




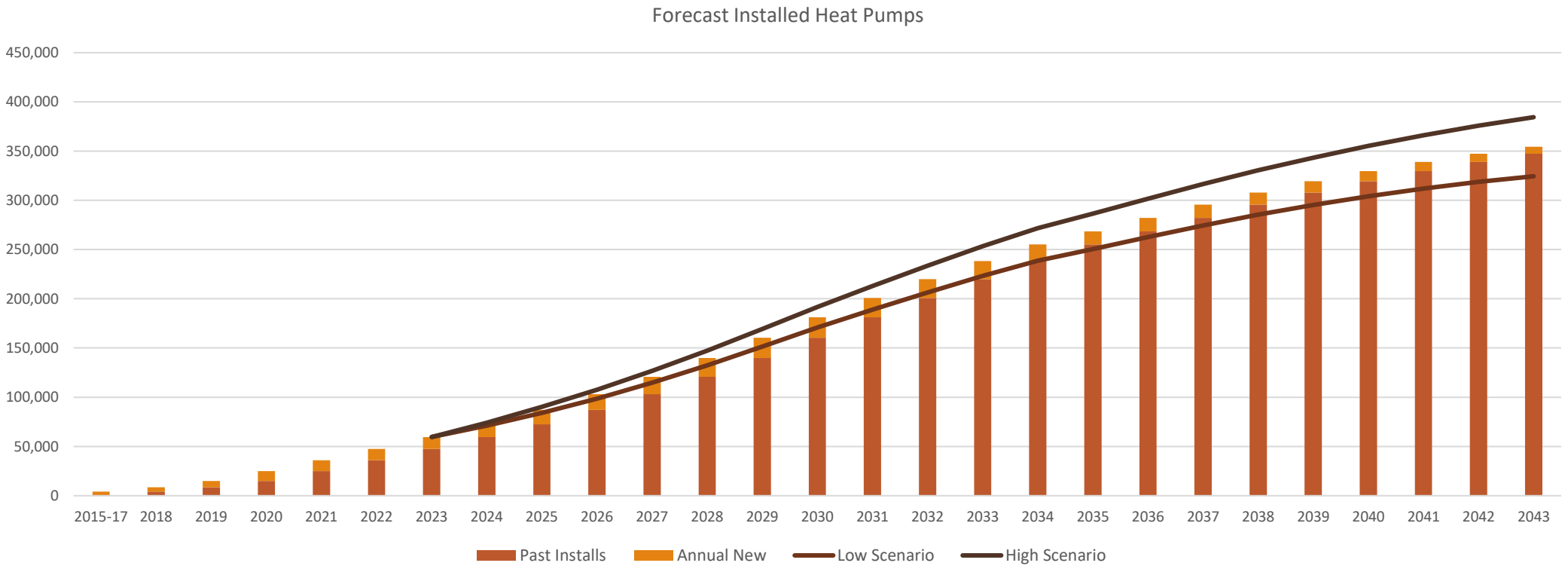
Traditional Electric Efficiency in forecast

Electric Vehicles





Heat Pumps


Forecast Installed Heat Pumps
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2015-17
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
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2035
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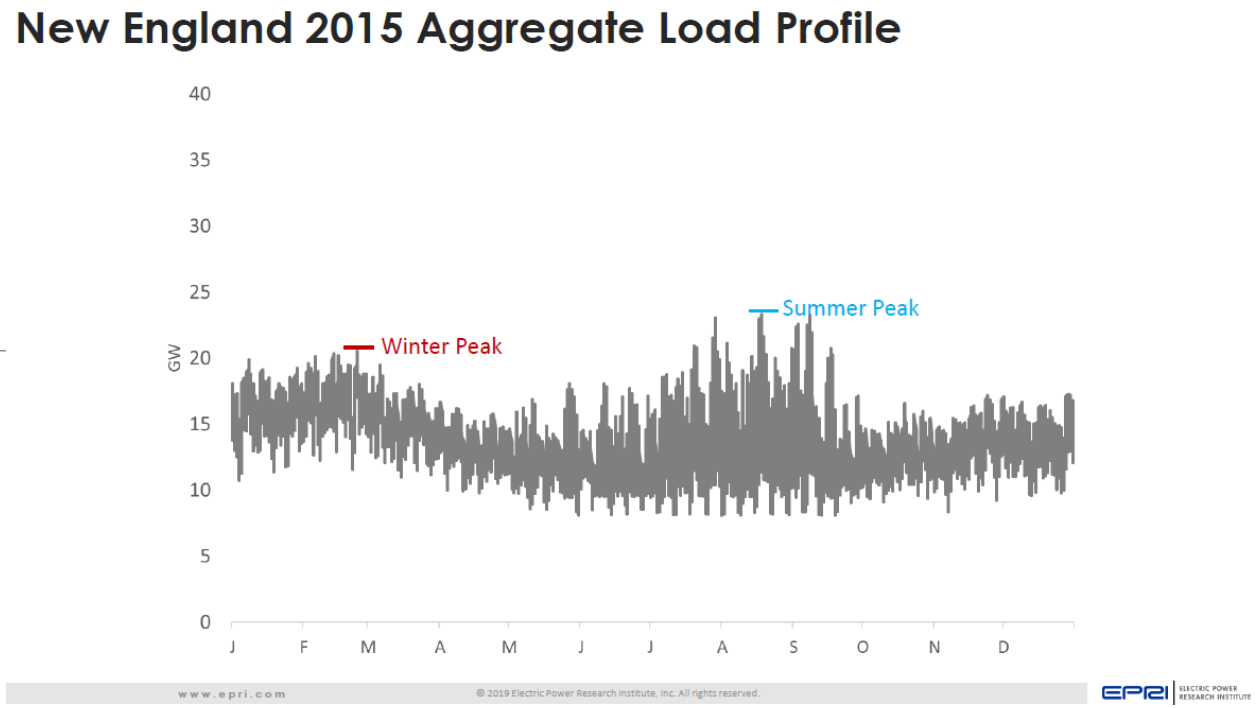
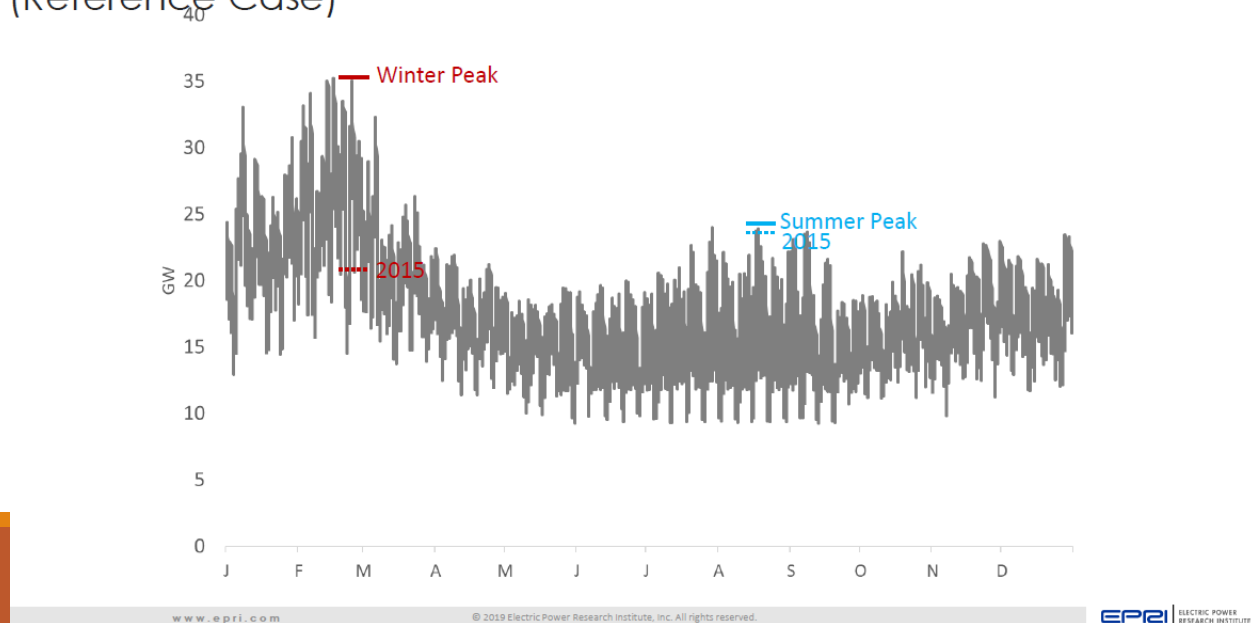
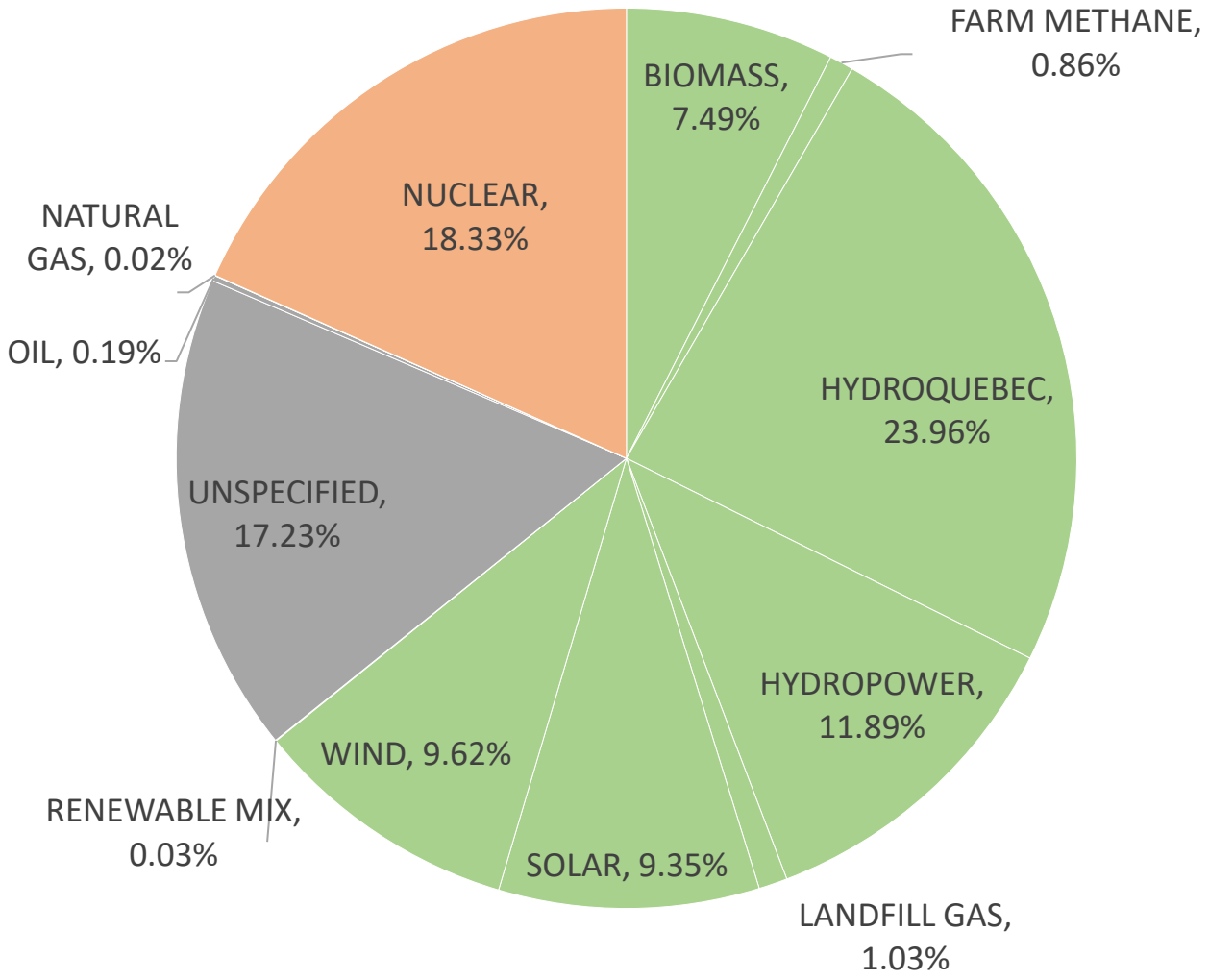
2038
2039
2040
2041
2042
2043
Past Installs
Annual New
Low Scenario
High Scenario

Electrification & seasonal demand patterns (N.E.)





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



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)

Components of Electric Rates

Power Supply and Transmission (approx. 61%)

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

Other Operations and Maintenance (approx. 16%)

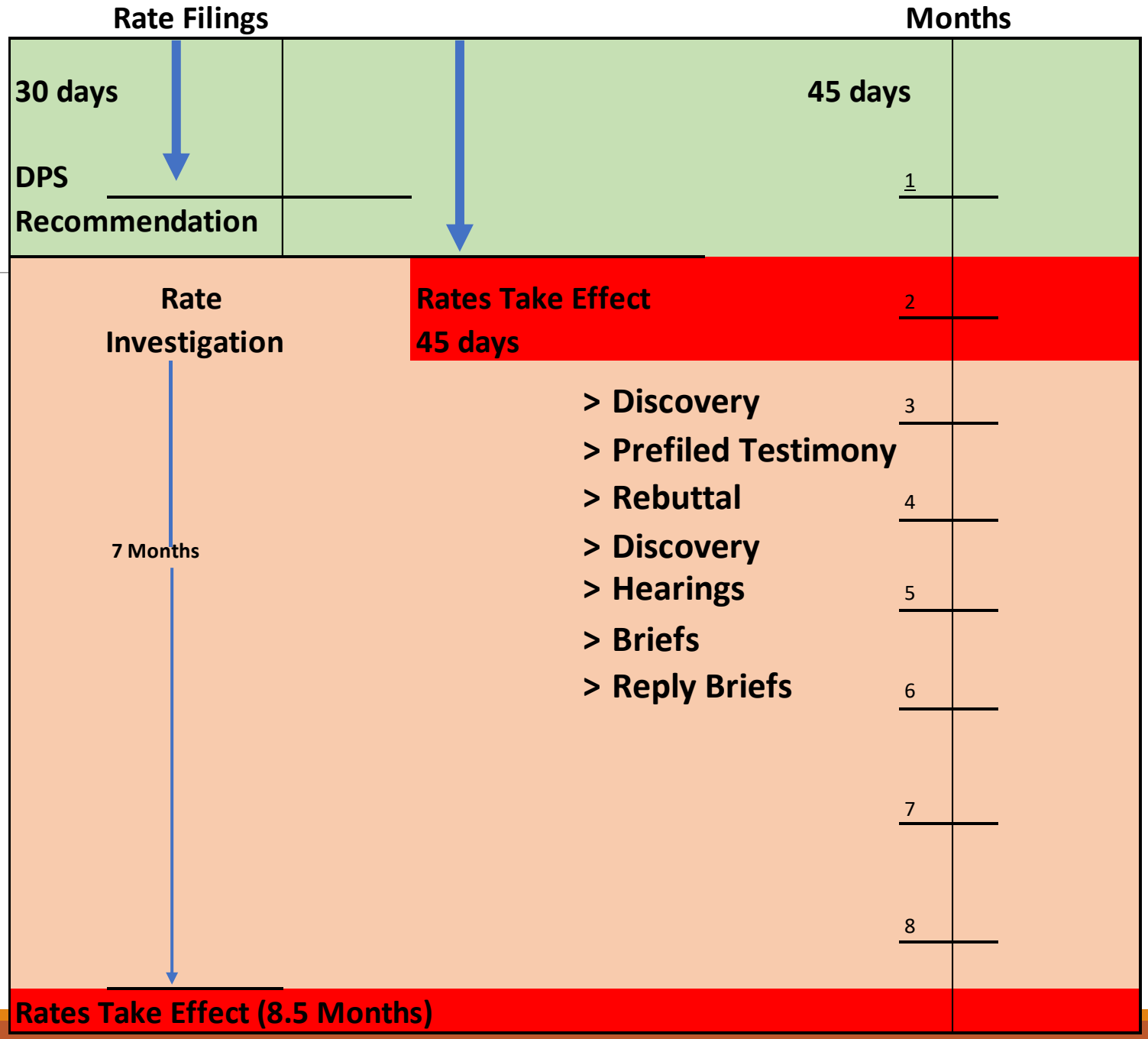
- Distribution
- Customer Accounts
- A&G expenses

Capital Costs (approx. 23 %)

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

Traditional Rate Case Filing

30 V.S.A. §225, 226, and 227



Elements of an Electric Bill

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

Residential Rates can vary widely

Ludlow

Customer Charge:	$8.56
First 100 kWh:	$0.0523
Above 100 kWh:	$0.1179

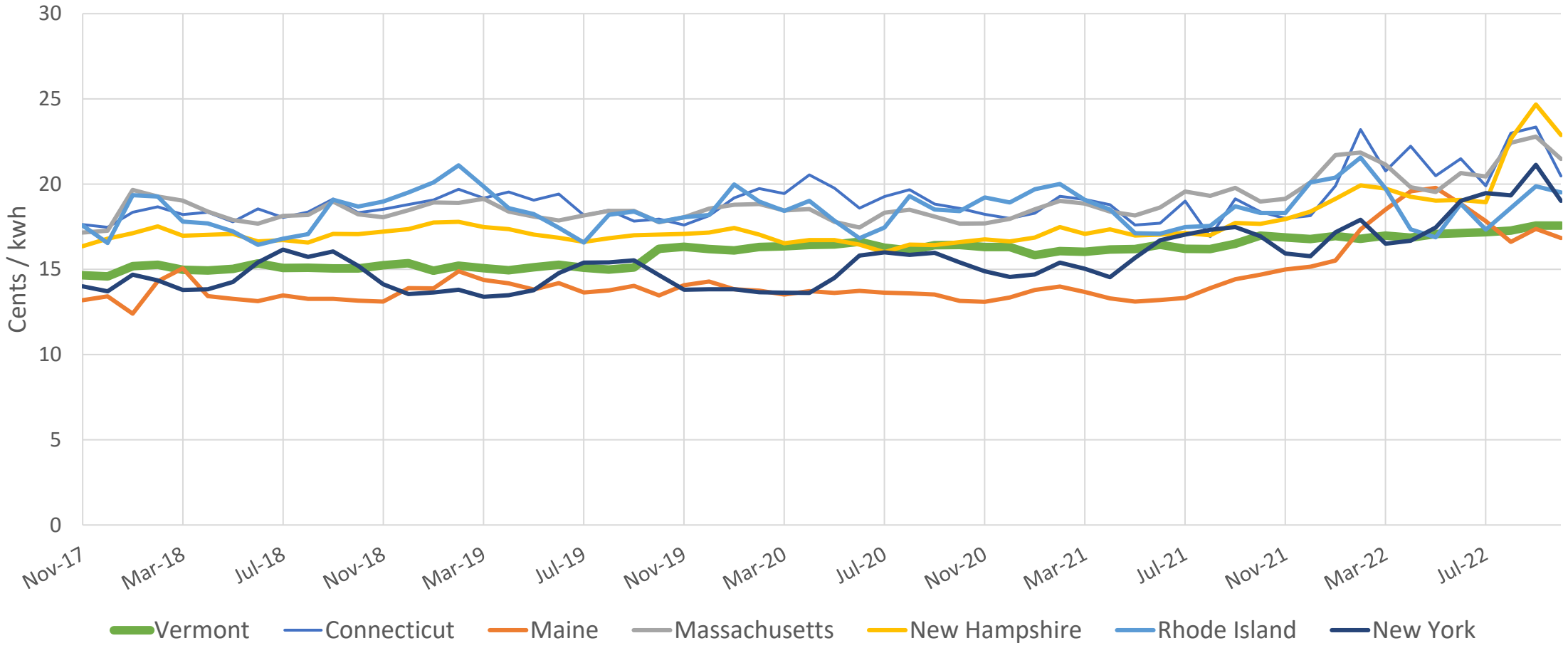
WEC

Customer Charge:	$26.49
First 100 kWh:	$0.08476
Above 100 kWh:	$0.21149

GMP

Customer Charge:	$16.31 (31 day mo)
Usage:	$0.18035

Average Monthly Retail Cost of Electricity (All Sectors)



Part 2

Core Renewable Energy Policies in VT

1998 – Start of Net-Metering

- Metering and billing arrangement designed to be an incentive to self-generate.
- First aimed at residential homes and farms, capped at a small percentage of utility overall demand.
- Modifications in 2008, 2011, 2014, 2017 to: **allow group net metering**, expand overall allowed amount per utility, increase allowable project size, adjust process for rate setting and treatment of renewable energy credits, preferred sites

2009 – Standard Offer Program

- Created a single, central procurement process for small (2.2 MW or less) renewable resources
- Initially 50 MW, expanded to 127.5 MW in 2012
- Initially, administratively determined price, moved to reverse bid process in 2012

2017- Renewable Energy Standard

- 3 Tiers of requirements that increase annually: Total Renewables, Distributed Generation, & Energy Transformation
- Net Metering and Standard Offer program now nested within Renewable Energy Standard (RES)

Renewable Energy Standard (RES)

- Enacted in 2015, compliance started 2017
- Three Tiers of Obligations:
  - Tier 1: Total renewable requirement
  - Tier 2: Distributed Generation (*A carve-out of Tier 1*)
  - Tier 3: Energy Transformation

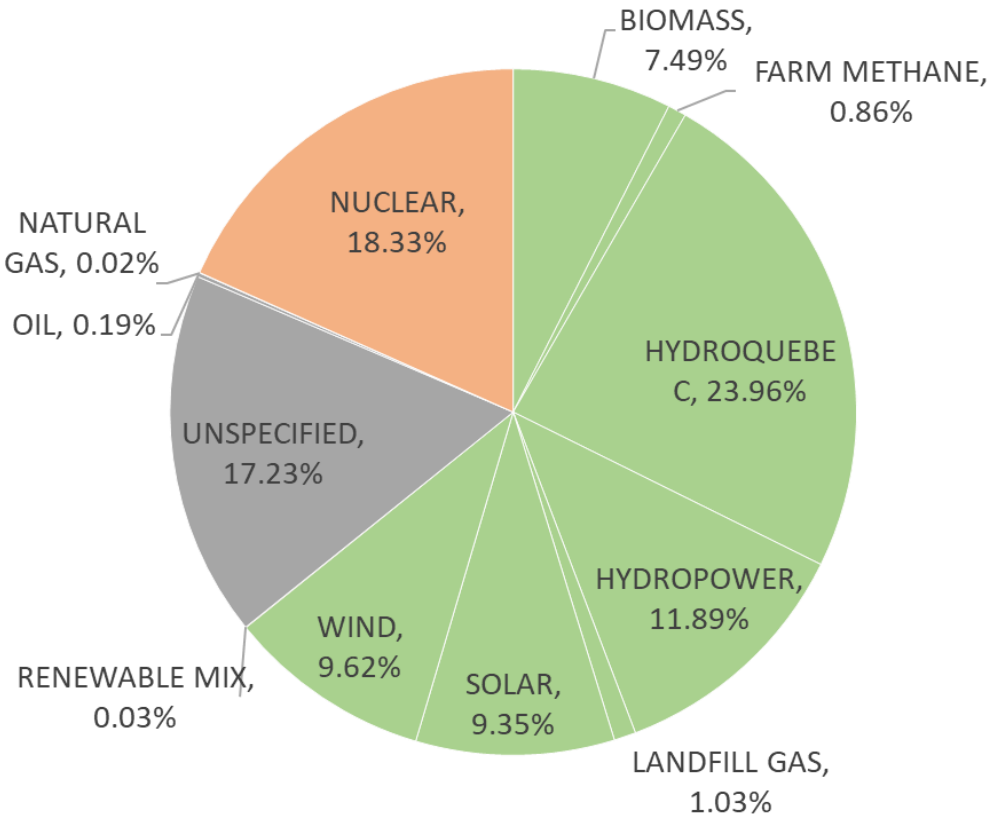
- Tiers 1 and 2 require retirement of renewable energy credits (RECs)

Renewable Energy Credits (RECs)

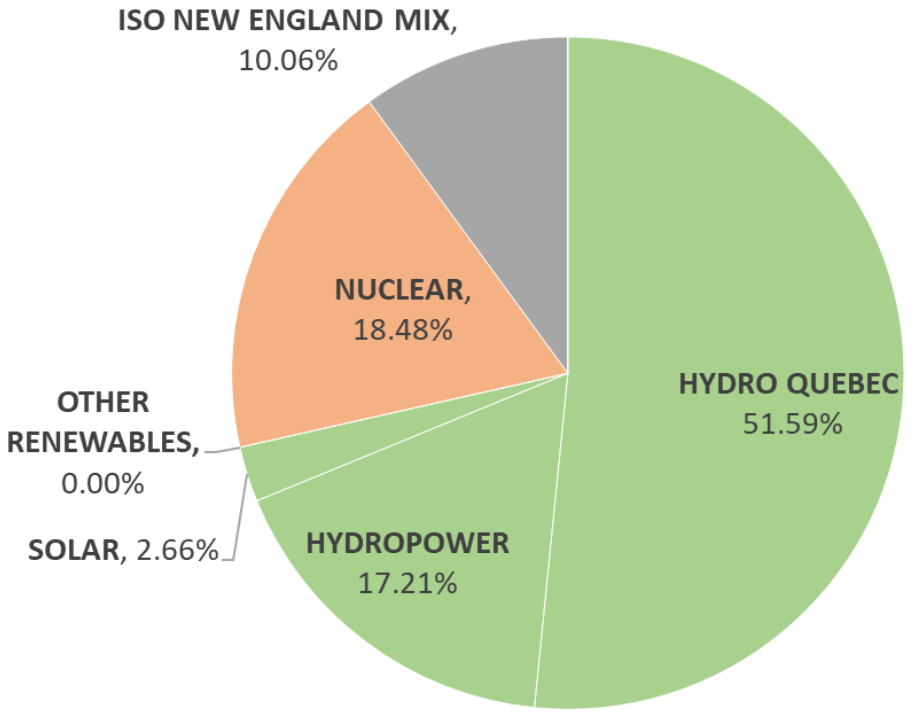
- RECs are the tool used for accounting, tracking and assigning ownership of environmental attributes.
- One MWh of renewable generation = one REC
- RECs are used throughout U.S. to track renewability
- Creates fungible commodity that can be traded; Renewable attributes can be separated from underlying generation
  - Attributes v RECs
- Creates uniform system for ensuring that there is no double counting
- Value of REC
  - Theory is that REC value should represent the difference between the revenues a resource receives from wholesale markets (e.g. energy, capacity, reserves, etc.) and the cost to build
  - Reality is that value is based on supply and demand
  - Different Tier/Class eligibility means different values

Vermont Electric Supply - 2021

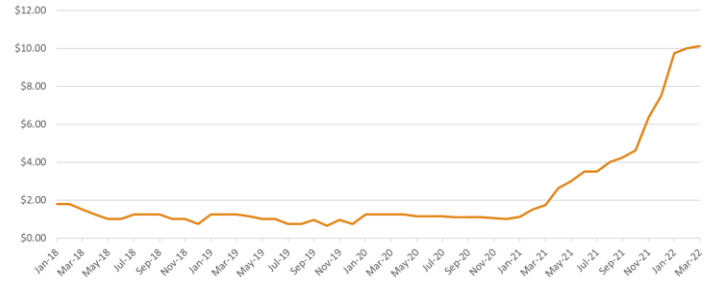
Physical Deliveries – Owned or Contracted



Based on REC Retirements



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)

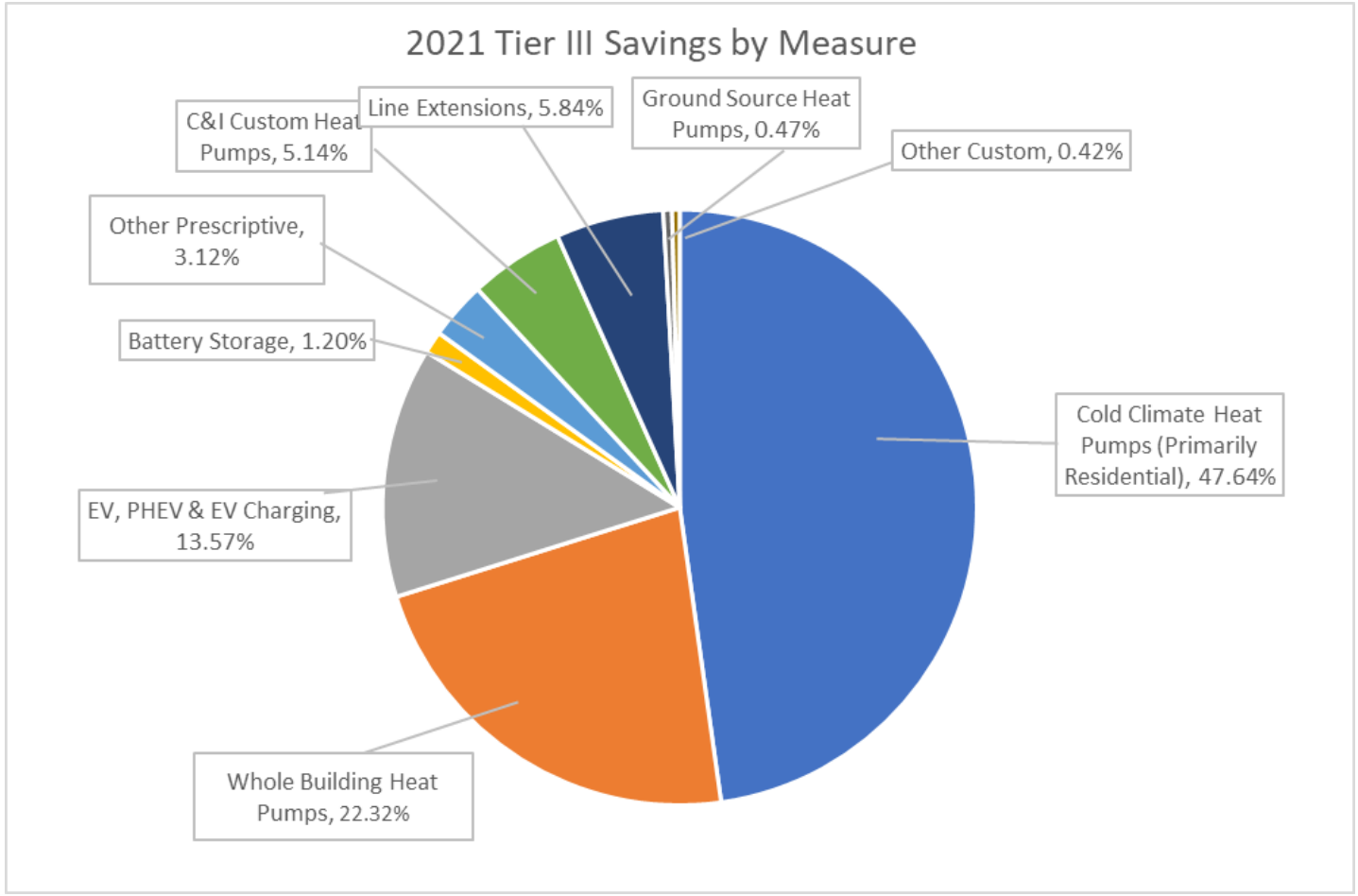
Tier 2 – Distributed Generation

- 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
  - Maintained at 10% thereafter
  - Current Requirements:
    - 2020: 2.8%
    - 2021: 3.4%
  - 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

Tier 3 – Energy Transformation

- 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/ MWhe in 2021 (gross cost)

Tier 3 – Energy Transformation

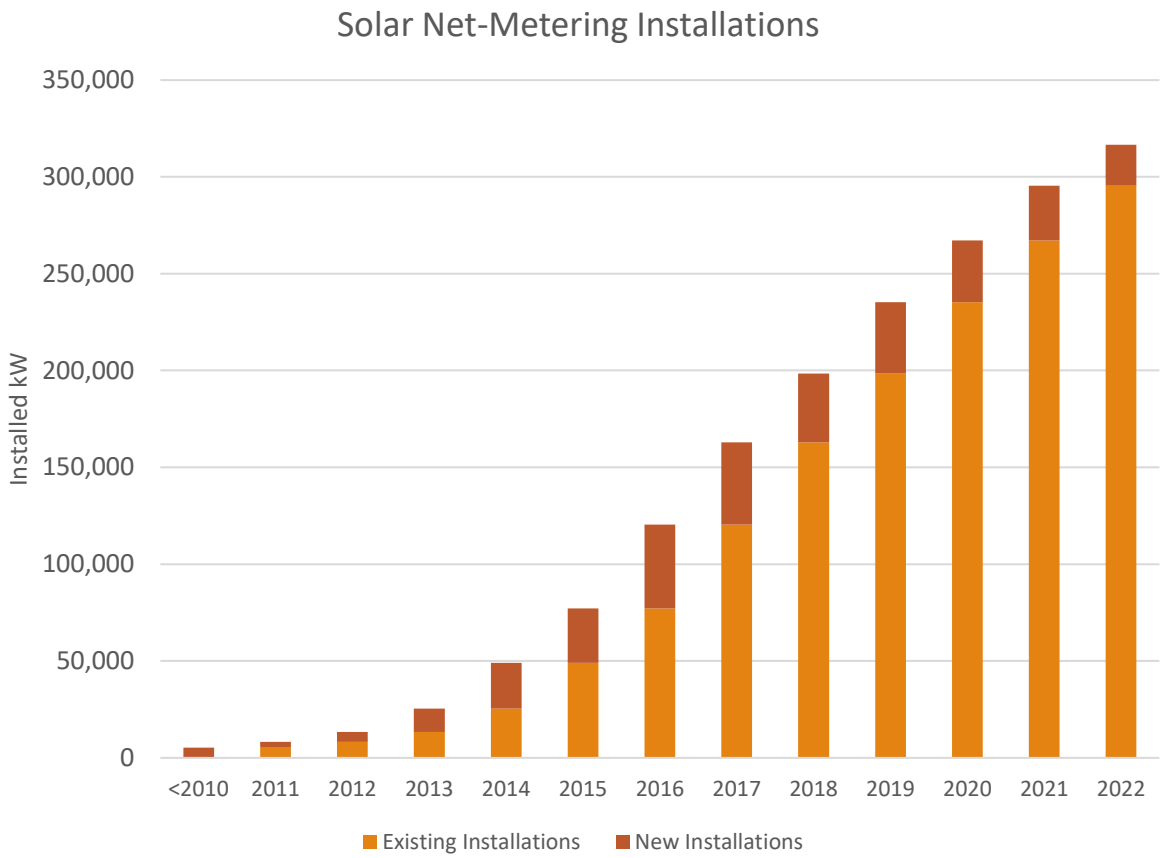


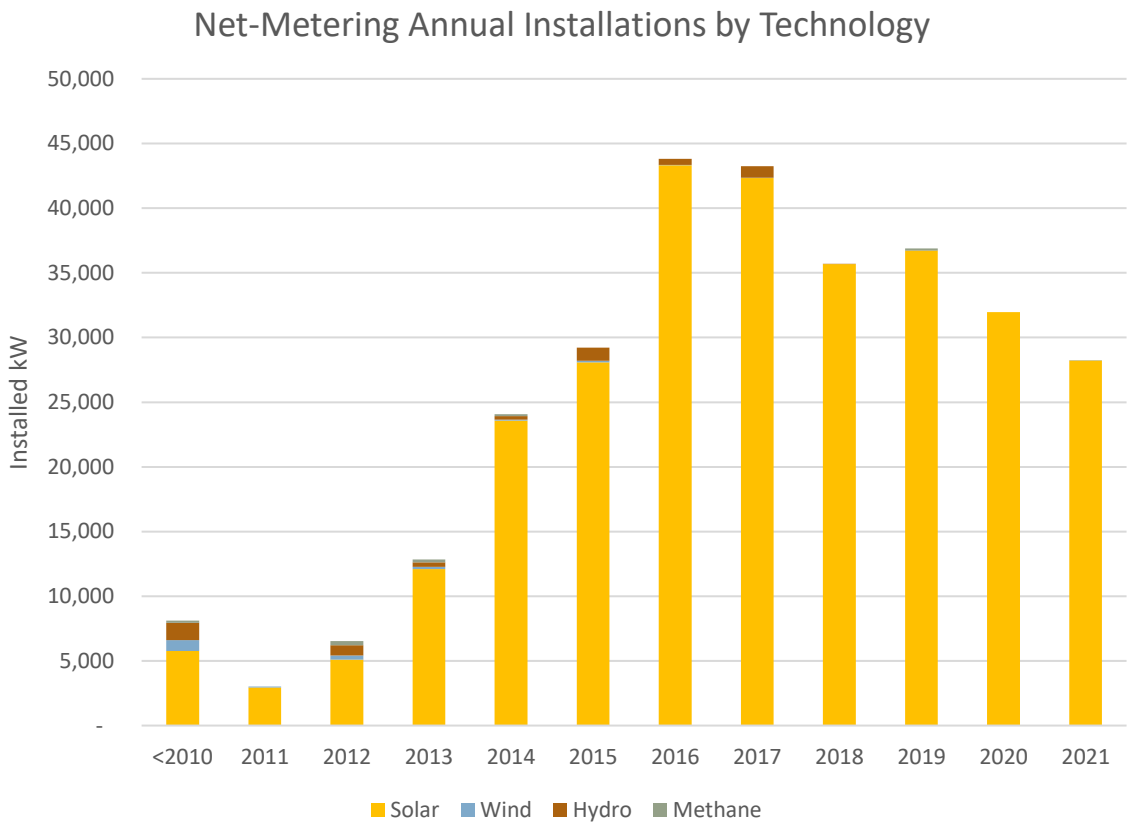
Net-Metering (30 V.S.A. § 8010 and PUC Rule 5.100)

- 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 Installations





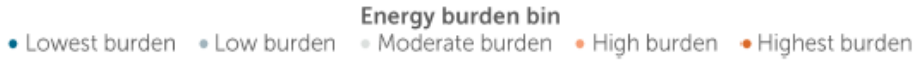
**Derived from utility monthly DG resource surveys to ISO-NE and includes data for GMP, VEC, and BED through Oct. 2022; WEC and VPPSA through Sept. 2022; Hyde Park though August 2022; and Stowe through Dec. 2021*

Net-Metering - Summary

- Net-metering has resulted in significant expansion of distributed renewable resources
  - Largest resource for Vermont in terms of nameplate, exceeding HydroQuebec
  - Supports jobs in Vermont
- Current net-metering system is substantially different from initial intent
  - 75% of net metered generation as of 2021 is exported to the grid (I.e., not used onsite)
  - Solar is a mature technology that can stand on its own
  - Substantial cost shift to non-participating customers
    - ~$0.17/kWh compared to $0.10/kWh or less
    - Overall cost shift increases as net metered customers add electric vehicles and heat pumps
- New compensation structure needed
  - Customers should be able to offset own usage and reduce electric bills; exported generation should be compensated closer to the value of generation
  - Historically, adoption of net-metering systems has not occurred in towns with the highest energy burden

Table 8. Top ten towns by adoption of clean energy technology[11]

Cold Climate Heat Pumps	Solar PV	Electric Vehicles	Weatherized Homes
Searsburg	Cornwall	Plainfield	Winhall
Ripton	Waltham	Charlotte	Victory
St. George	West Windsor	Montpelier	Montpelier
Mendon	Lincoln	Norwich	Shrewsbury
Stratton	Strafford	Strafford	Landgrove
Killington	Charlotte	Waitsfield	Jamaica
Peru	New Haven	Putney	Mount Holly
Andover	Weybridge	Calais	Barton
West Windsor	Norwich	Searsburg	Rutland City
Waterbury	Thetford	Cornwall	St. Albans City



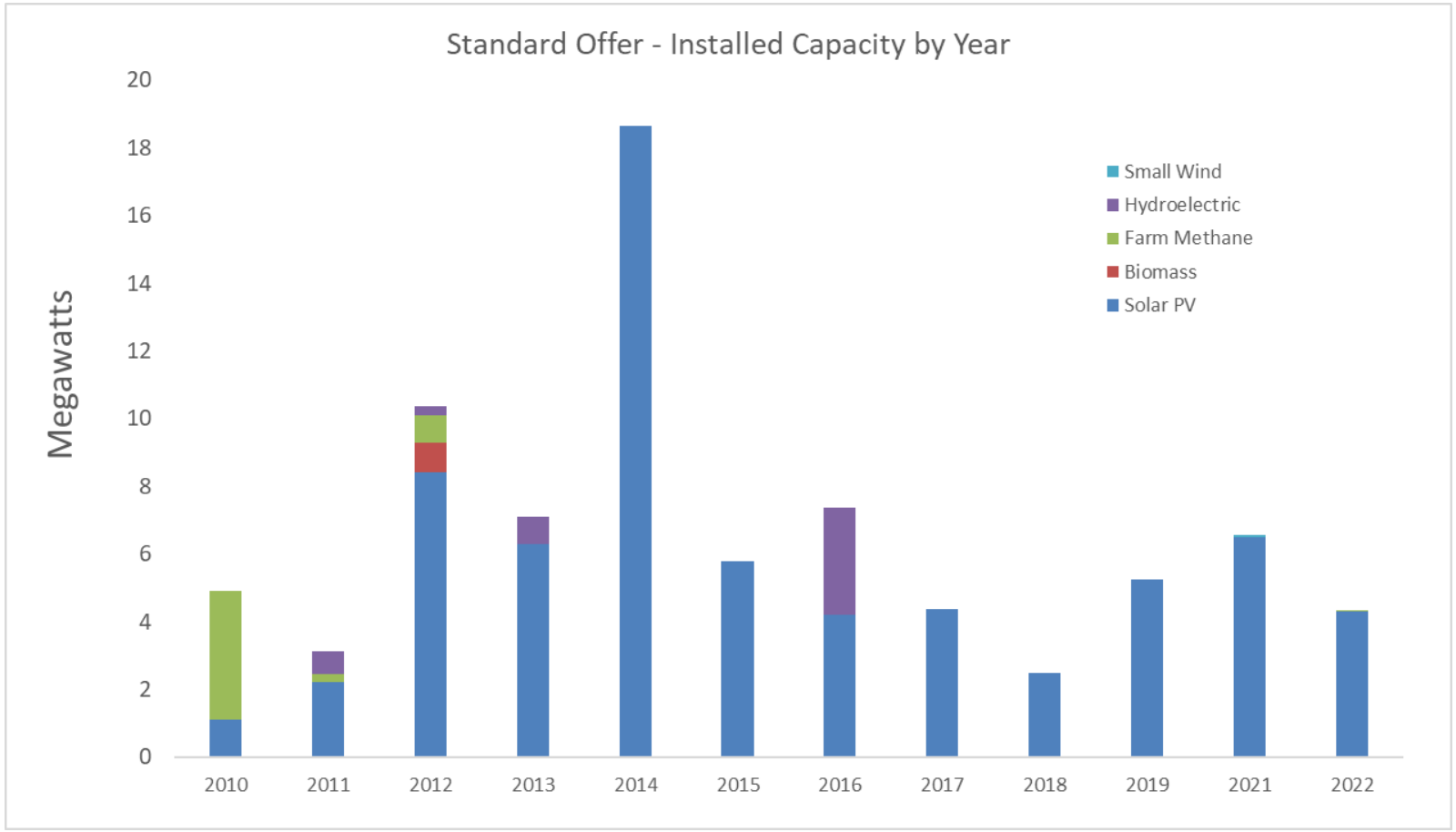
Source: 2019 EVT Energy Burden Report

Standard Offer Program

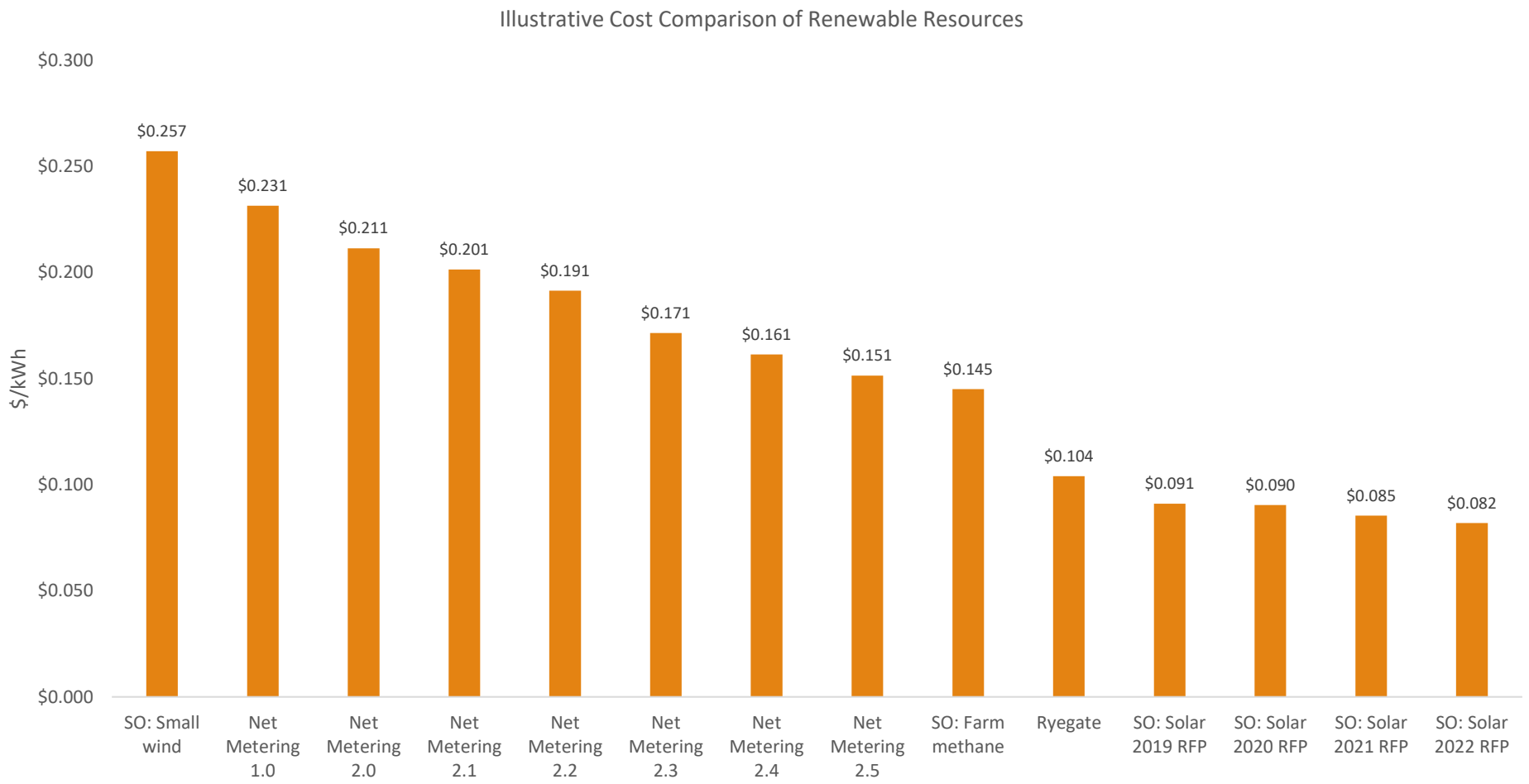
- Program was established in 2009 to stimulate small, in-state renewable energy development
- Total program capacity of 127.5 MW expected to be contracted by 2022
- Program is structured to encourage technology diversity, but has proved hard to achieve
- Currently, there are 80 MW online with a total of 129 MW that have been awarded contracts

- Includes a baseload renewable power portfolio requirement (Ryegate) that Act 155 of 2022 extended to 2026, and 2032 if meets certain efficiency benchmarks in the legislation. Not included in program summaries above

Standard Offer Installed by Year, Type



Example Renewable Resource Costs



2021 RES Costs

2021 RES Performance			
	REC Retirements		*Compliance Cost*
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			**$16,940,963**
Retail Sales	5,382,695	kWh	
Rate Impact of RES Compliance	1.9%		
		tons of	
CO2 Reduction from RES	717,019	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**
TOTAL Cost of RES	**$137,000,000**	**$159,000,000**	**$271,000,000**	**$325,000,000**
Rate Impact	1.01%	1.19%	4.29%	4.88%

Rate Pressure of RES

- No recent rate cases have been a direct result/soley 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

PSD Public Engagement Process

The Department proposes to review renewable electricity programs and policies through a process with three core phases:

Phase 1:
Awareness & Capacity Building

November 2022 – March 2023

Focus on broad outreach, especially to frontline & impacted communities, and create educational opportunities

Phase 2:
Policy & Program Review

April – August 2023

Focus on reviewing existing programs and policies through continued stakeholder engagement & technical analyses. This phase would begin to identify possible recommendations for policy and program changes

Phase 3:
Recommendations & Reporting

September – December 2023

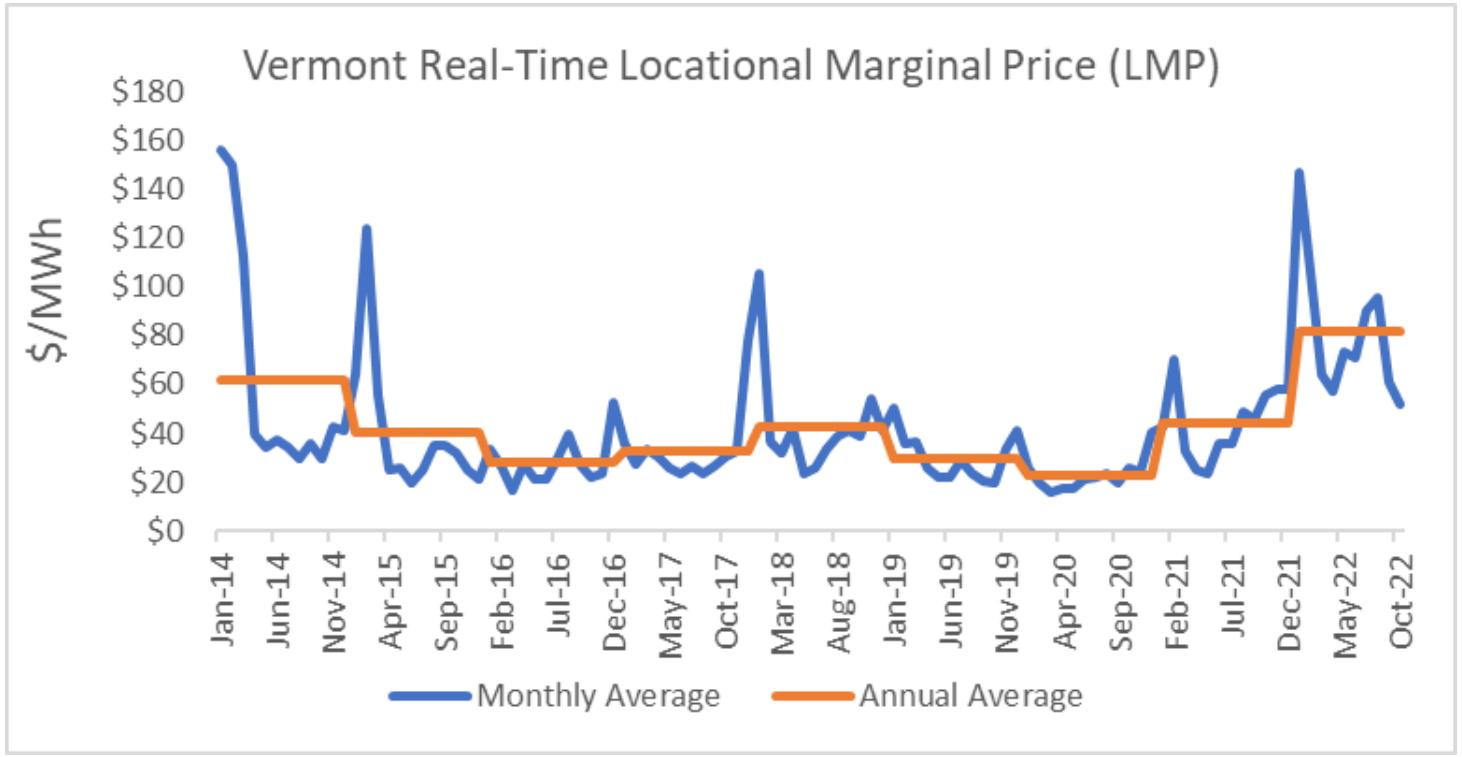
Focus on finalizing and drafting recommendations and produce summaries of the process. Drafts of those documents would be reviewed and revised through public comment periods

The Department expects the results of this process would be published in time to inform the 2024 legislative session.

Thank you!

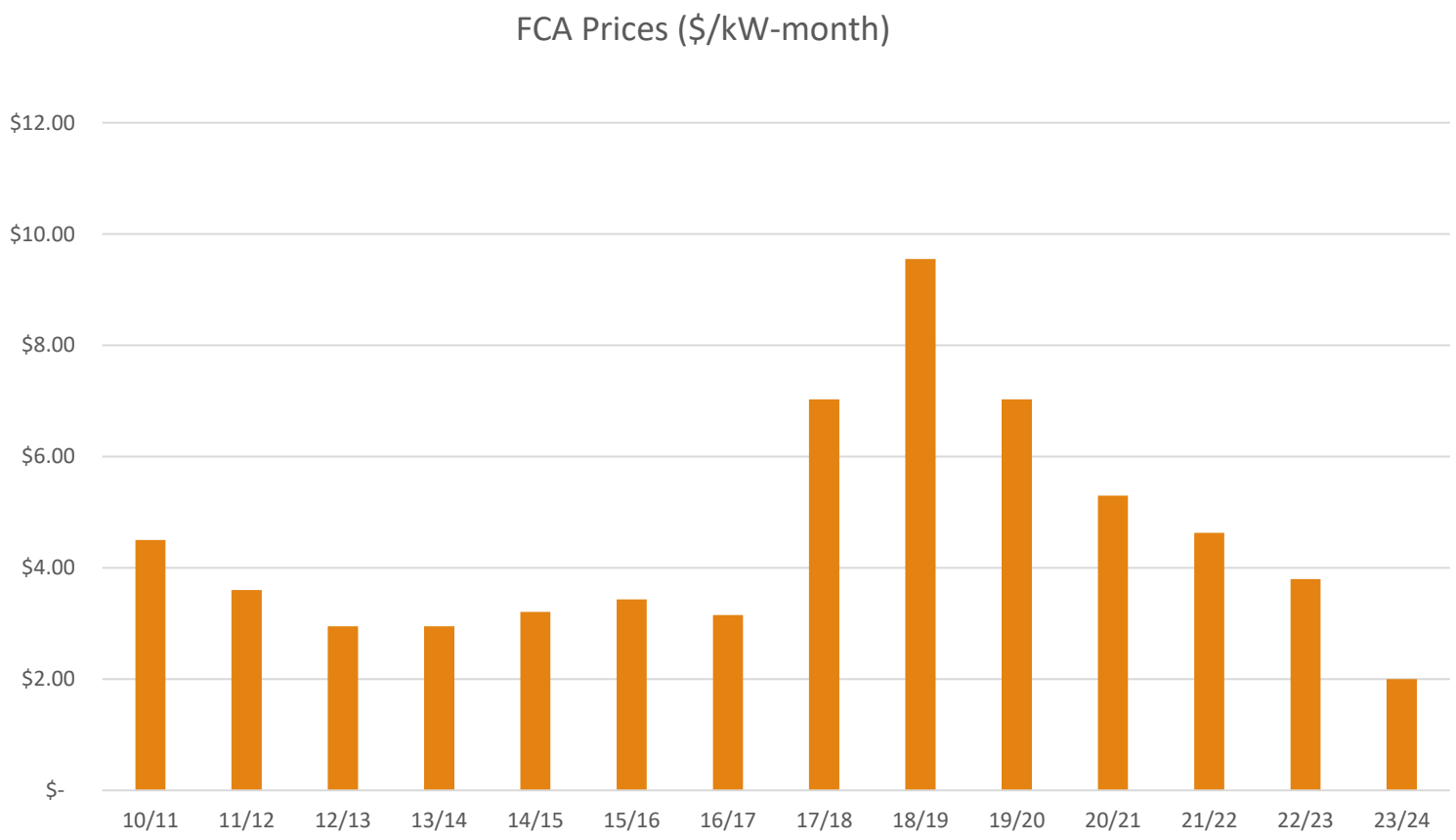
Appendix

Price components

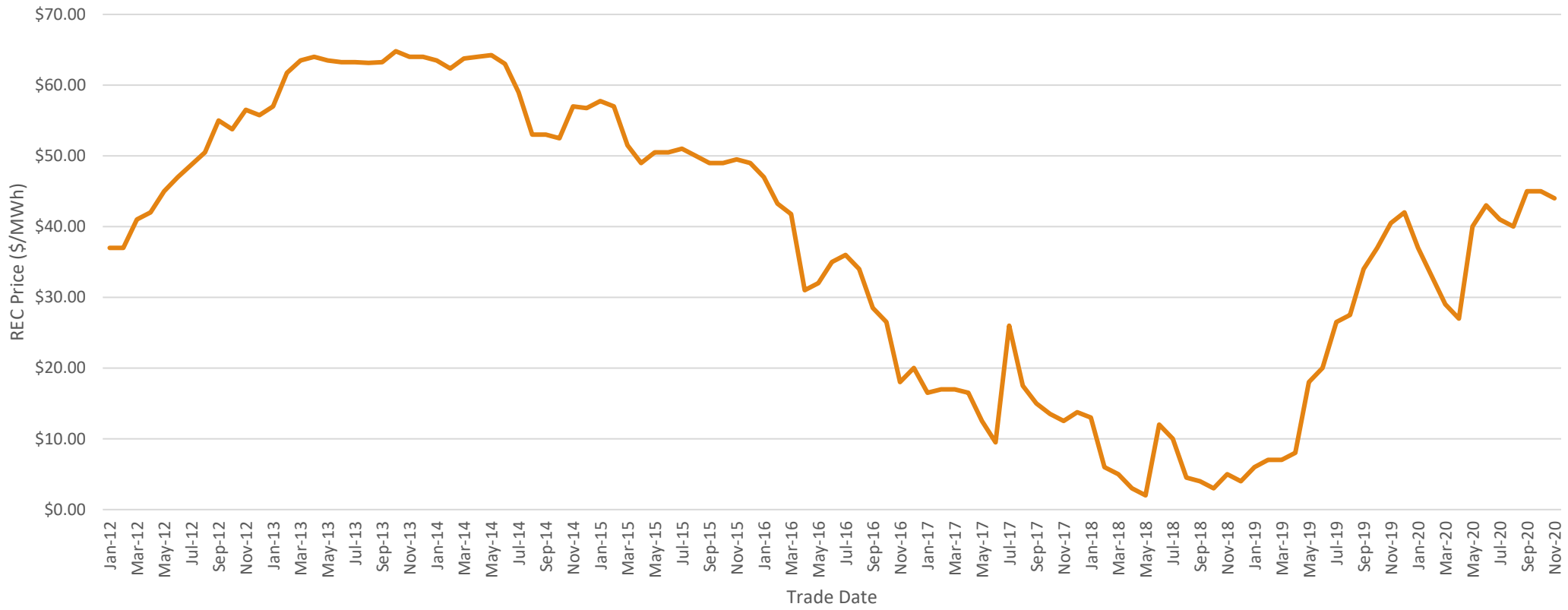


New England Wholesale Electricity Prices

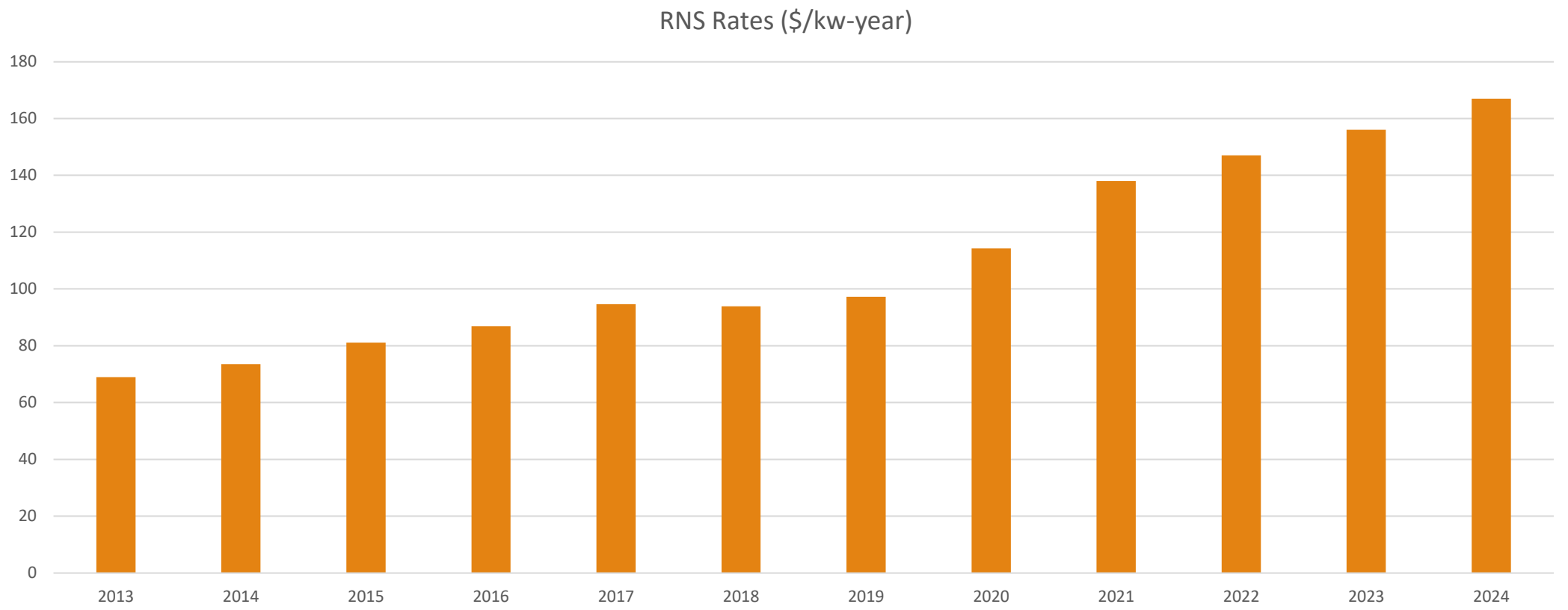
New England Capacity Prices



MA Regional Class I REC Prices



Regional Transmission Costs



RPS in Other NE States

Connecticut

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

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

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

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

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

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

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

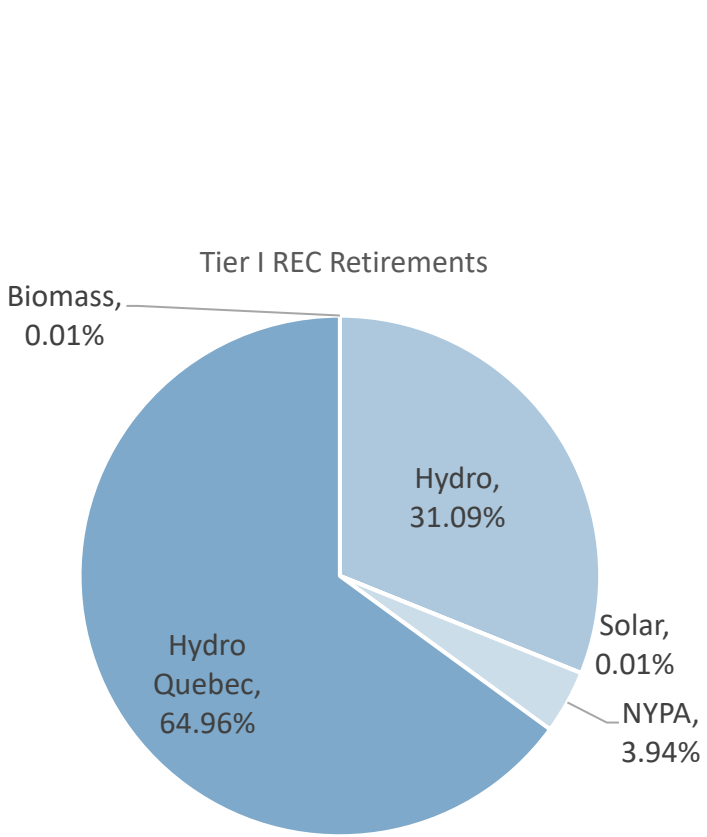
Vermont

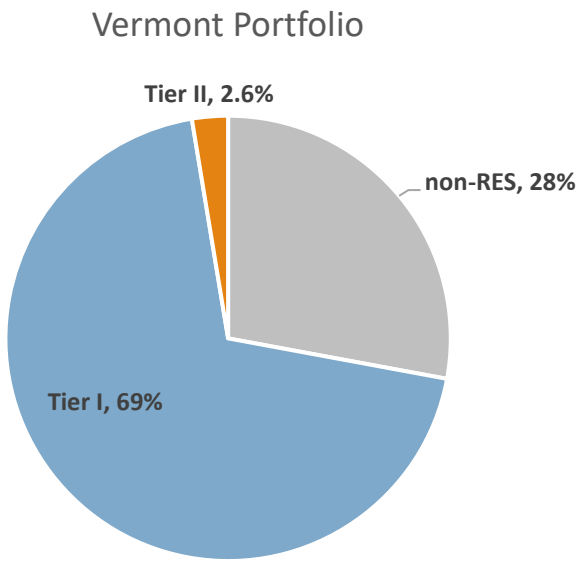
- **Title:** Renewable Energy Standard.
- **Established:** 2005 (voluntary target); 2015 (standard).
- **Requirement:** 55% by 2017; 75% by 2032.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** Approximately 6%**.**
- **Details:** 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.

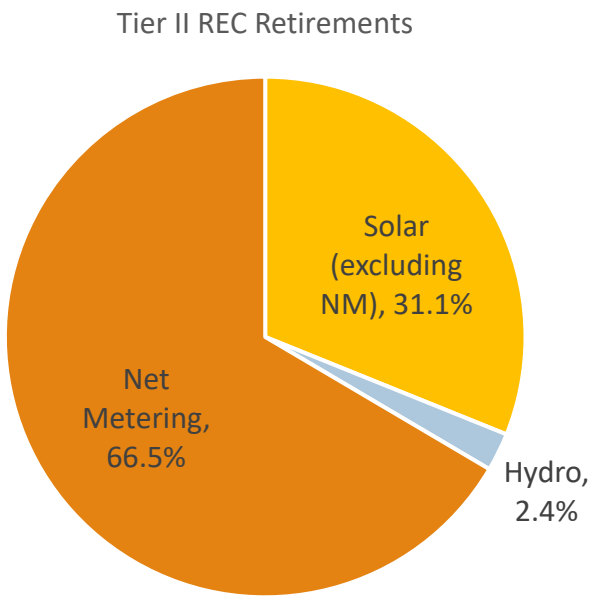
Source: https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx and https://programs.dsireusa.org/system/program/detail/5786/renewable-energy-standard

RES Compliance

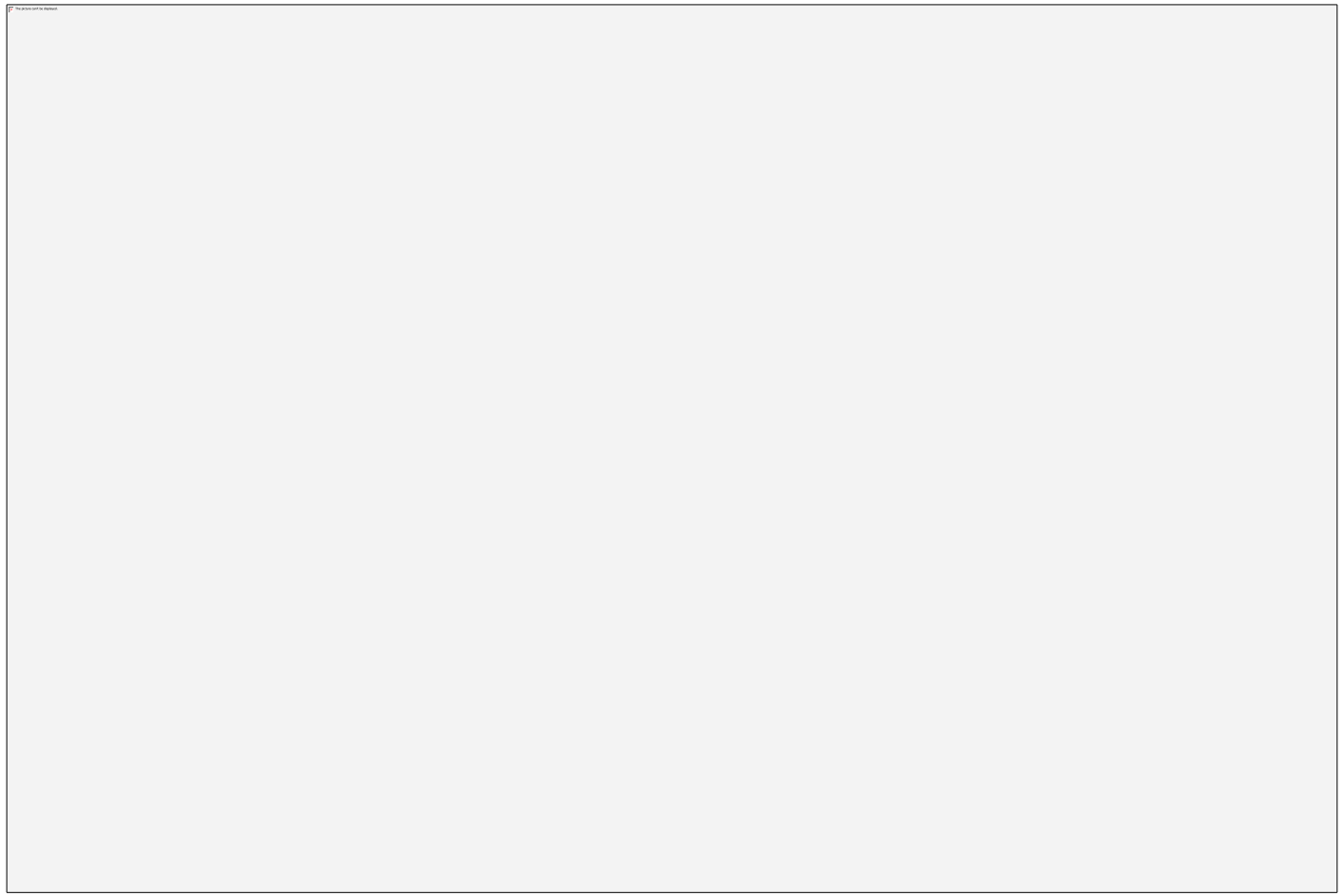
2020 Tiers 1 & 2 Compliance



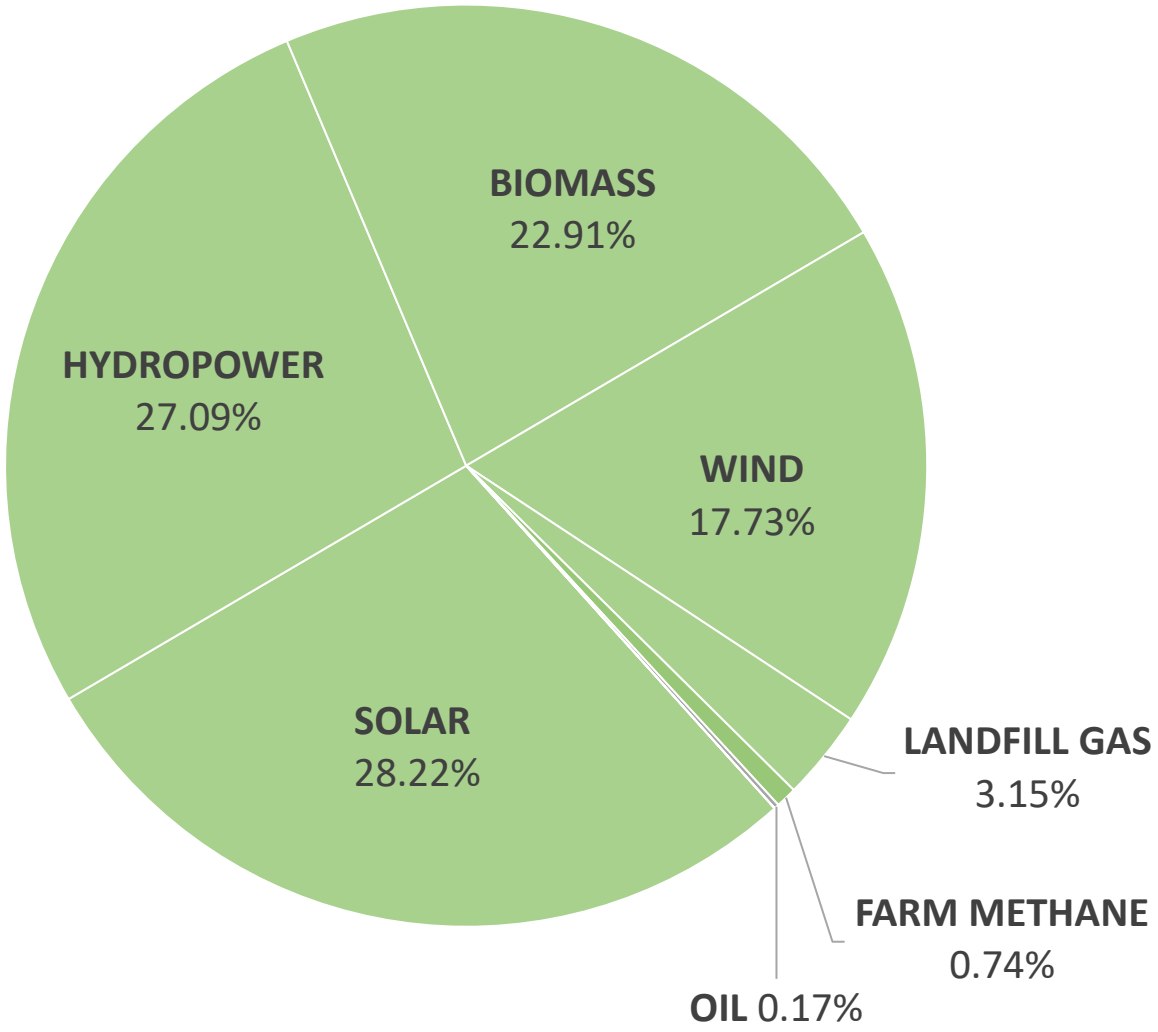




2020 Tier 3 Compliance



In State and Regional Generation



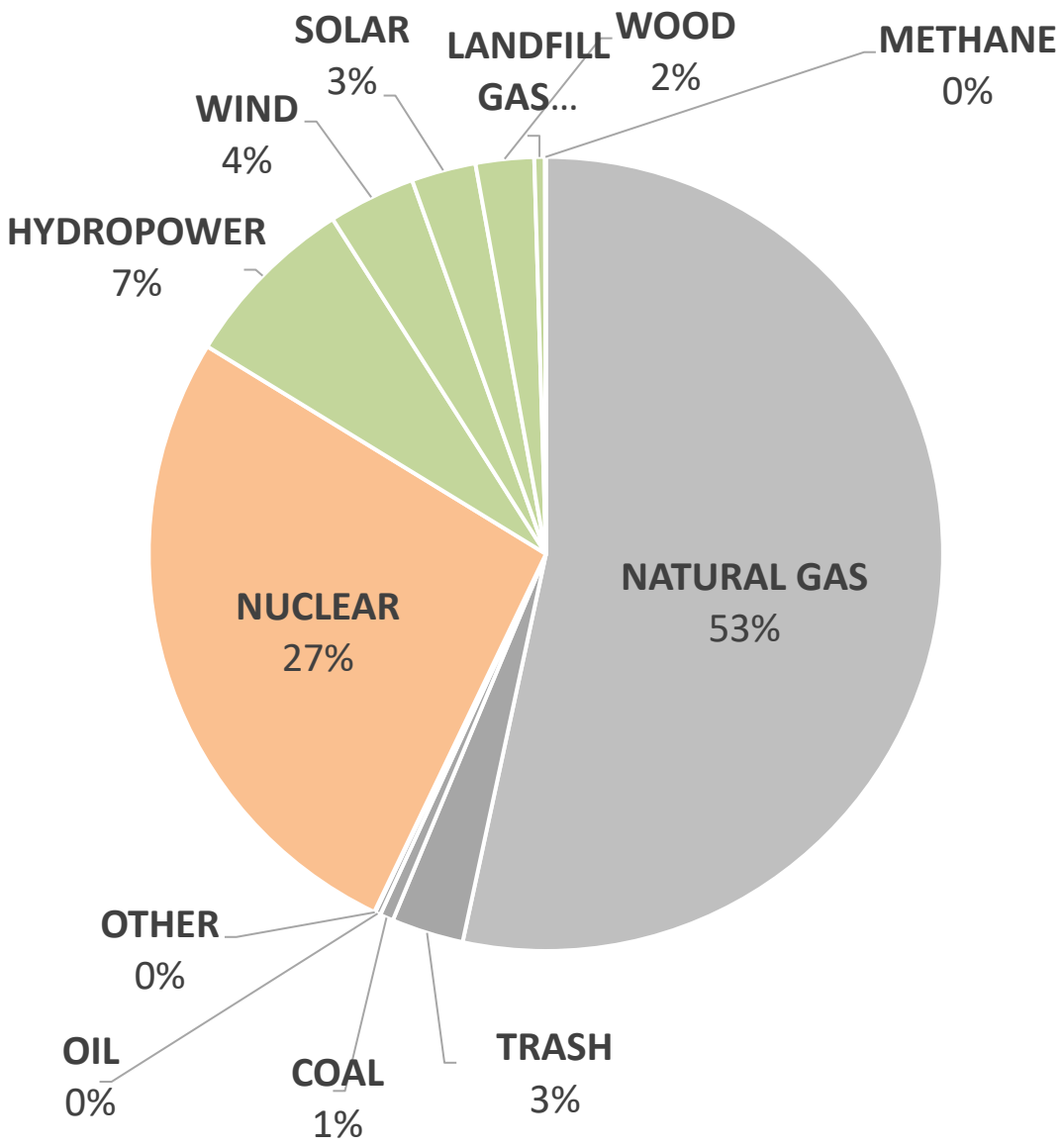
What does Vermont generate in-state?

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?

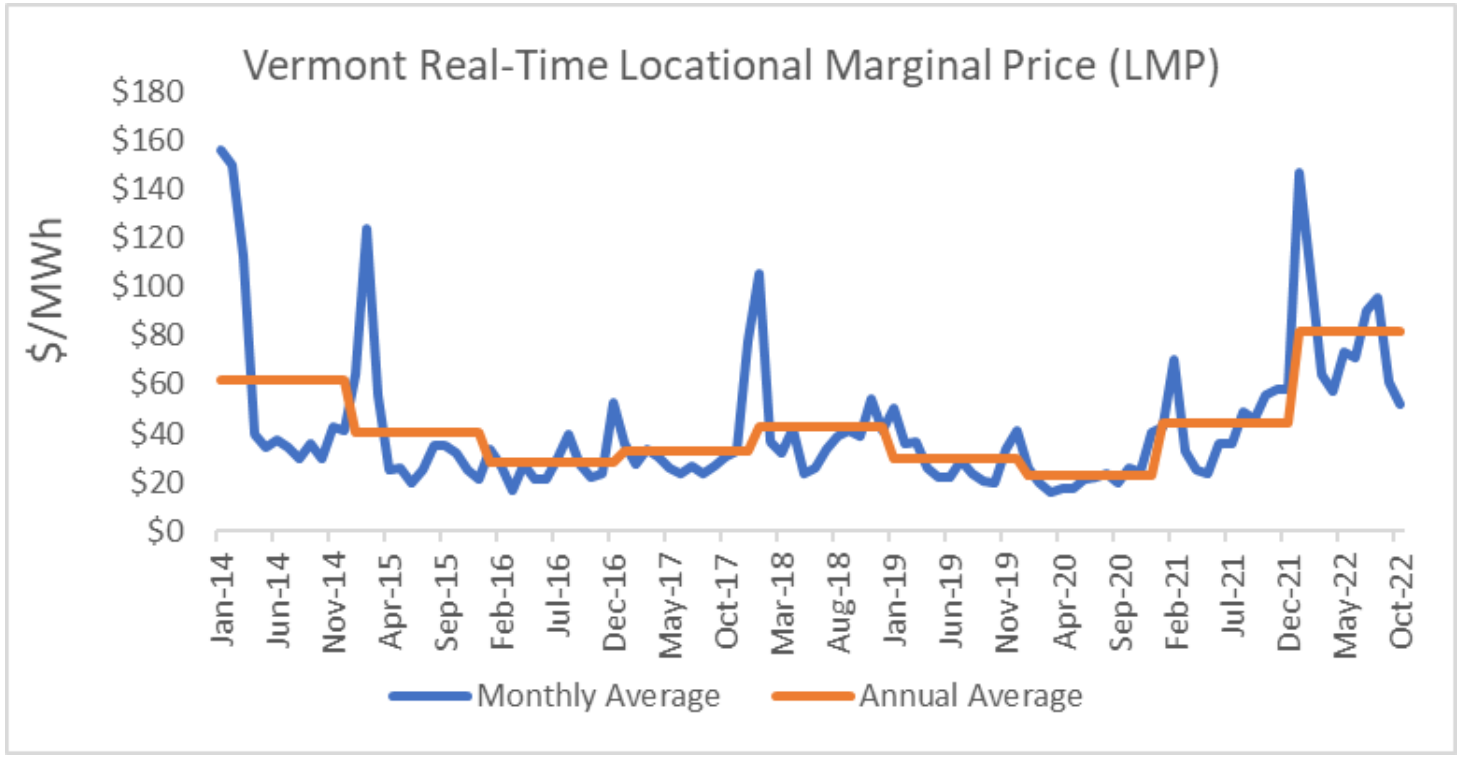
In 2021, generators in the New England region (including those in Vermont) produced roughly **101,692,000 MWh** of electricity.

- This is the equivalent of XX

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

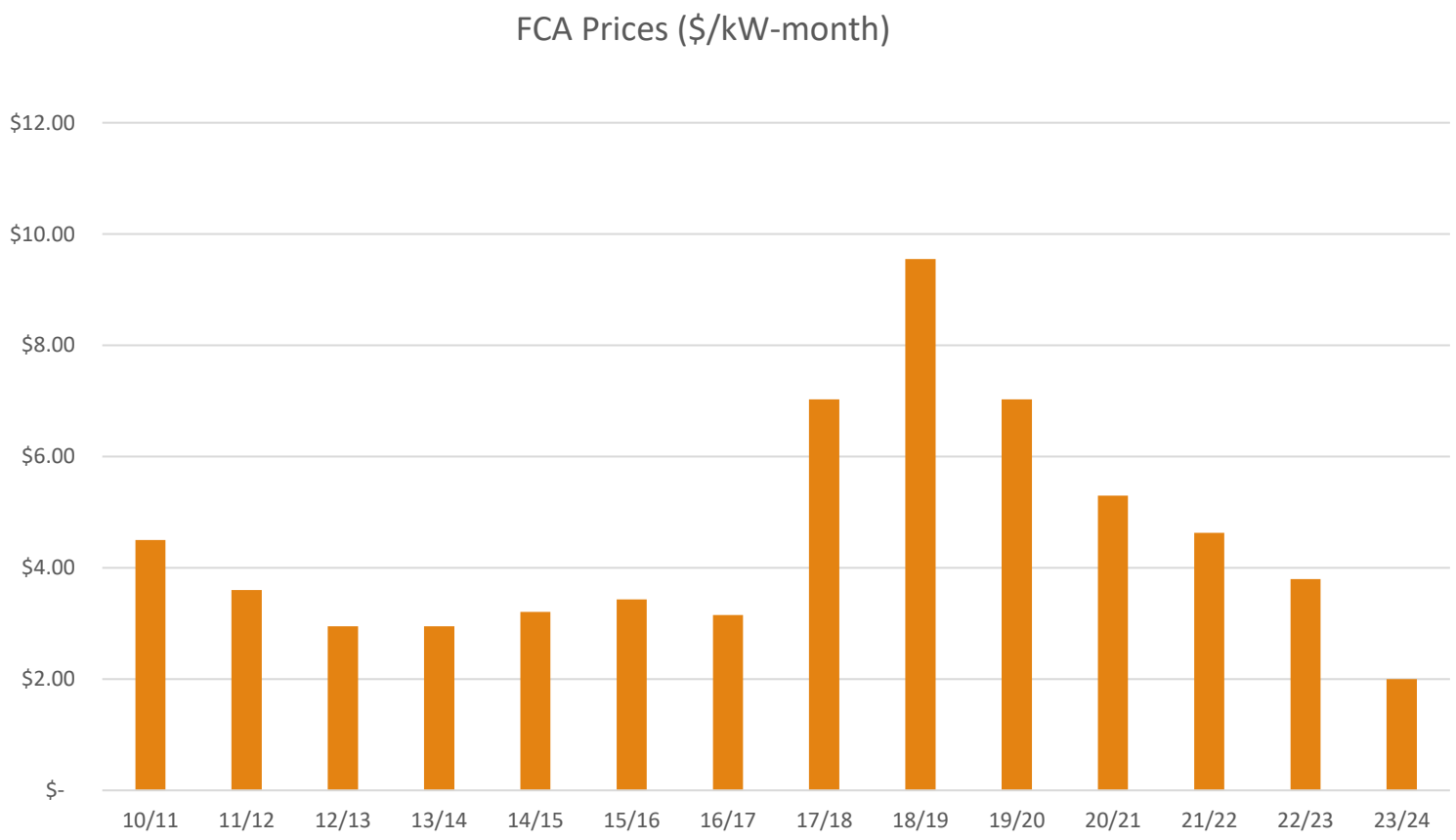
27% of this electricity came from nuclear, which is not considered renewable but is **considered carbon free**.

Price components

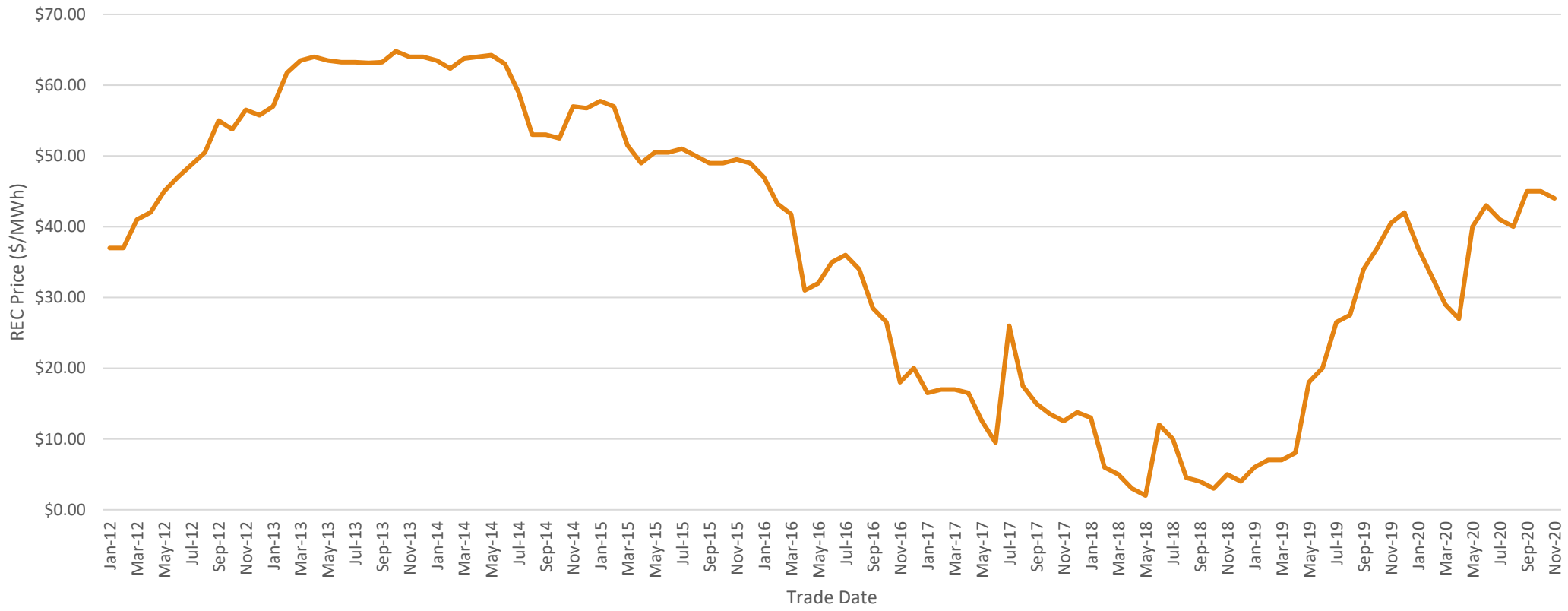


New England Wholesale Energy Prices

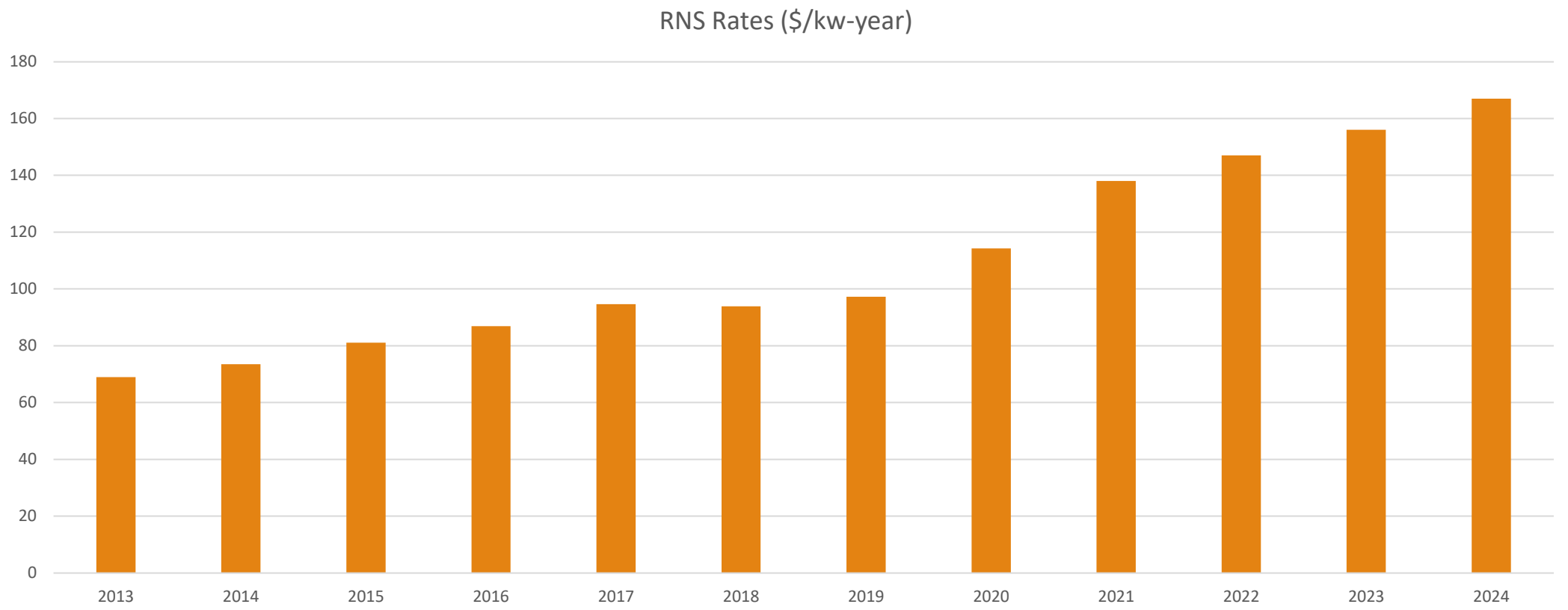
New England Capacity Prices



MA Regional Class I REC Prices



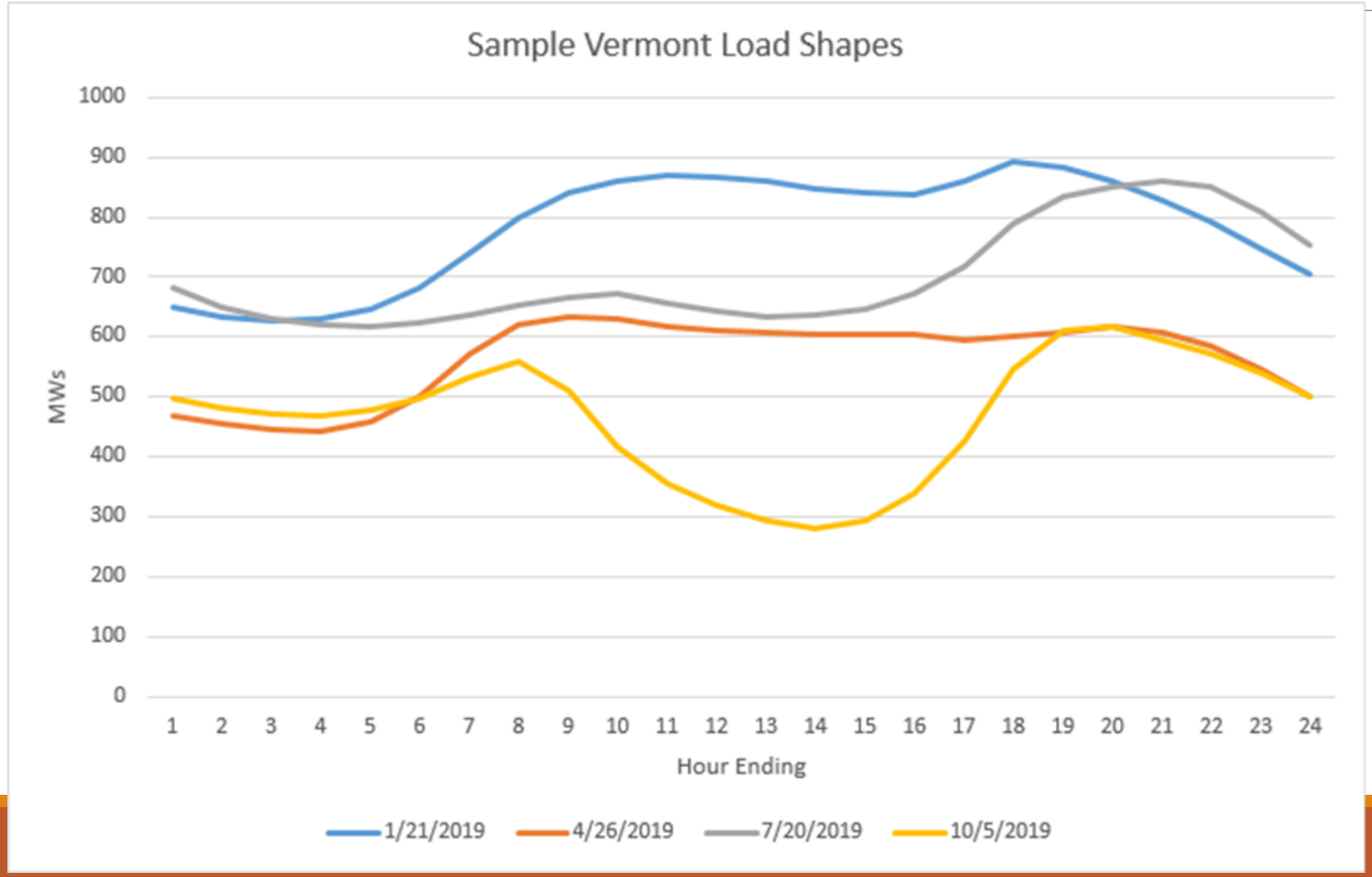
Regional Transmission Costs



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)			

Electric Vehicle Rate Structures

Vermont Seasonal Load Profiles



Net Metering

NM Compensation Rates

			RECs		CATEGORY				
Program	CPG Application Date	Statewide Blended Rate	Transfer to Utility	Retain Ownership	I	II	III	IV	Hydro
NM 1.0	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

[1] After 2011, and before NM 2.0 (beginning January 1, 2017), systems received overall compensation of $0.19/kWh - $0.20/kWh and retained the RECs. Additionally, other up-front capacity-based incentives were also available.

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

Total Solar Generated
147
kWh

Total Energy Used
583
kWh

75 kWh used by your home
72 kWh Solar to the grid

508 kWh delivered to your home
75 kWh from generation

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
New Actual Charges	**$92.92**

*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

Your Share of Generation
225
kWh

Your Energy Used
997
kWh

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
New Actual Charges	**$173.19**

Adjustments

Transfer Credit To/From Net Meter Bank	-$137.78
Total Adjustments	**-$137.78**

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

Grid Modernization

Grid Modernization

"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

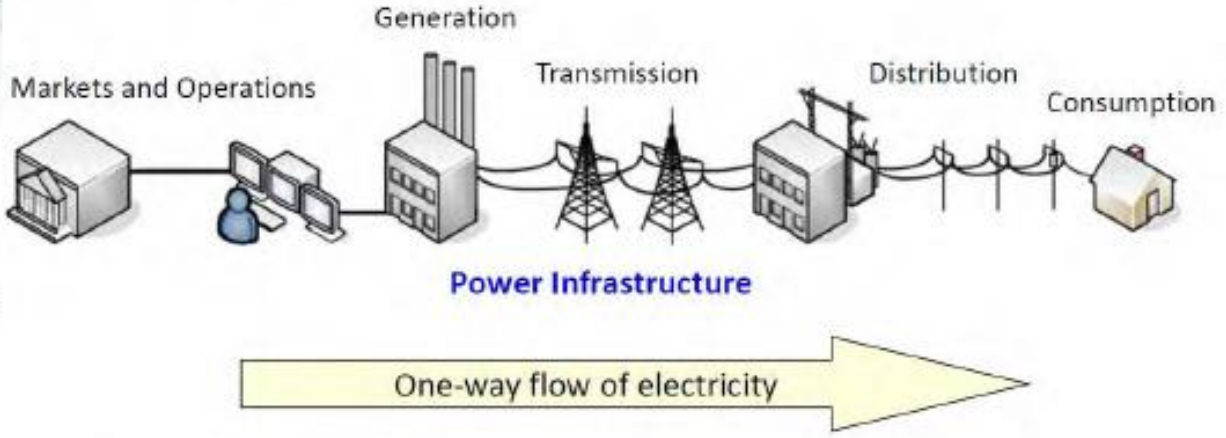
"'Grid modernization' and 'distribution system planning' are understood to refer to the process of identifying how to build the distribution system and integrate non-wires solutions to integrate and optimize distributed energy resources and other aspects of a rapidly evolving energy ecosystem while maintaining 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)

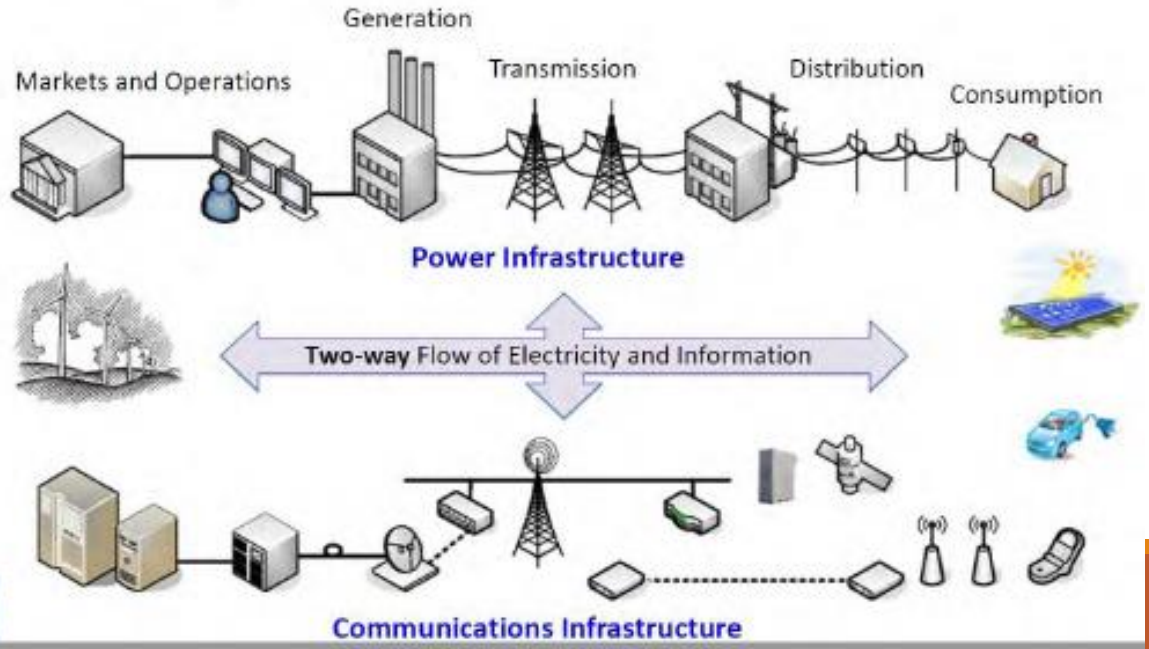
Grid Modernization and a Vision for the Future

- 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:



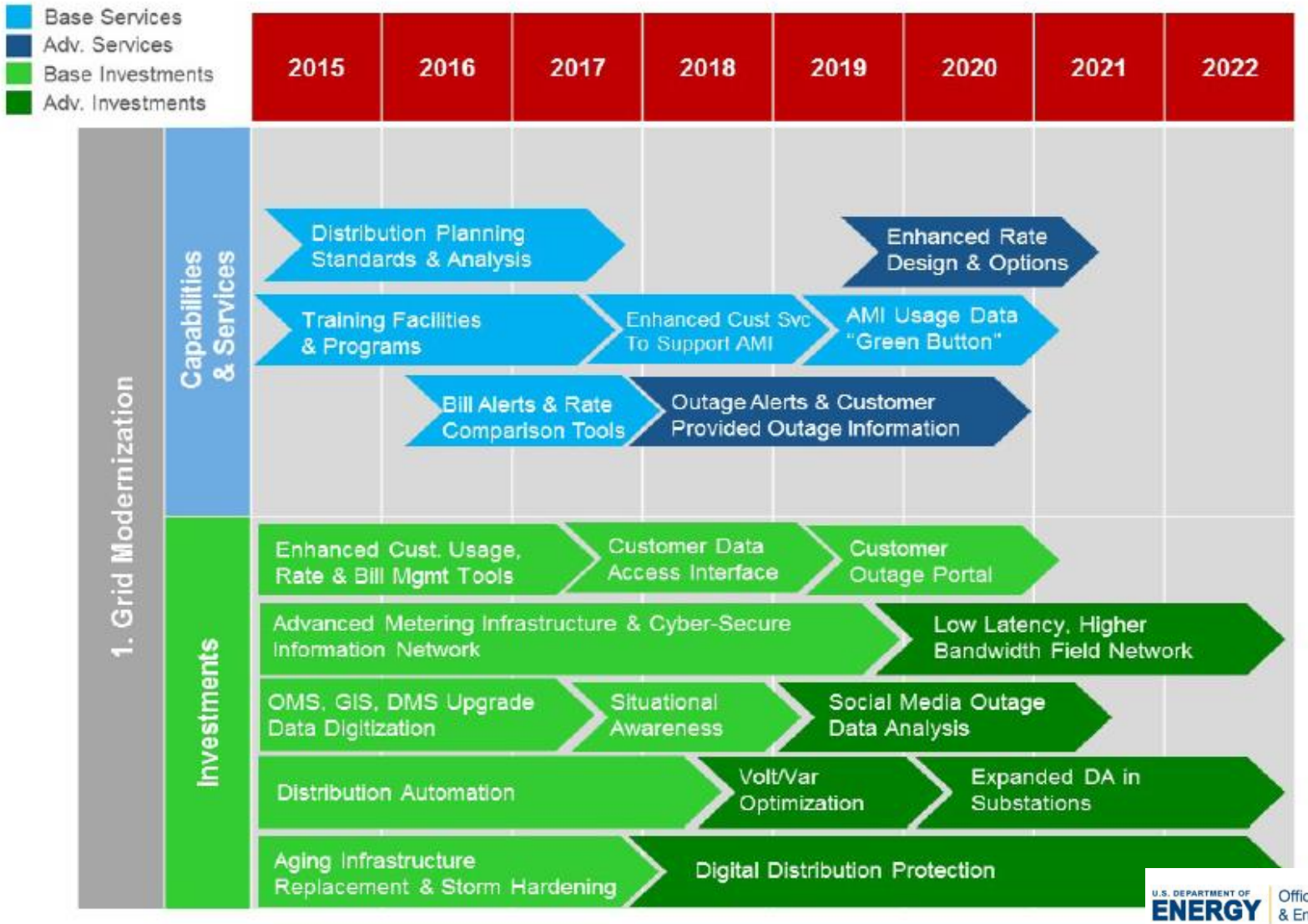
Future Smart Grid:



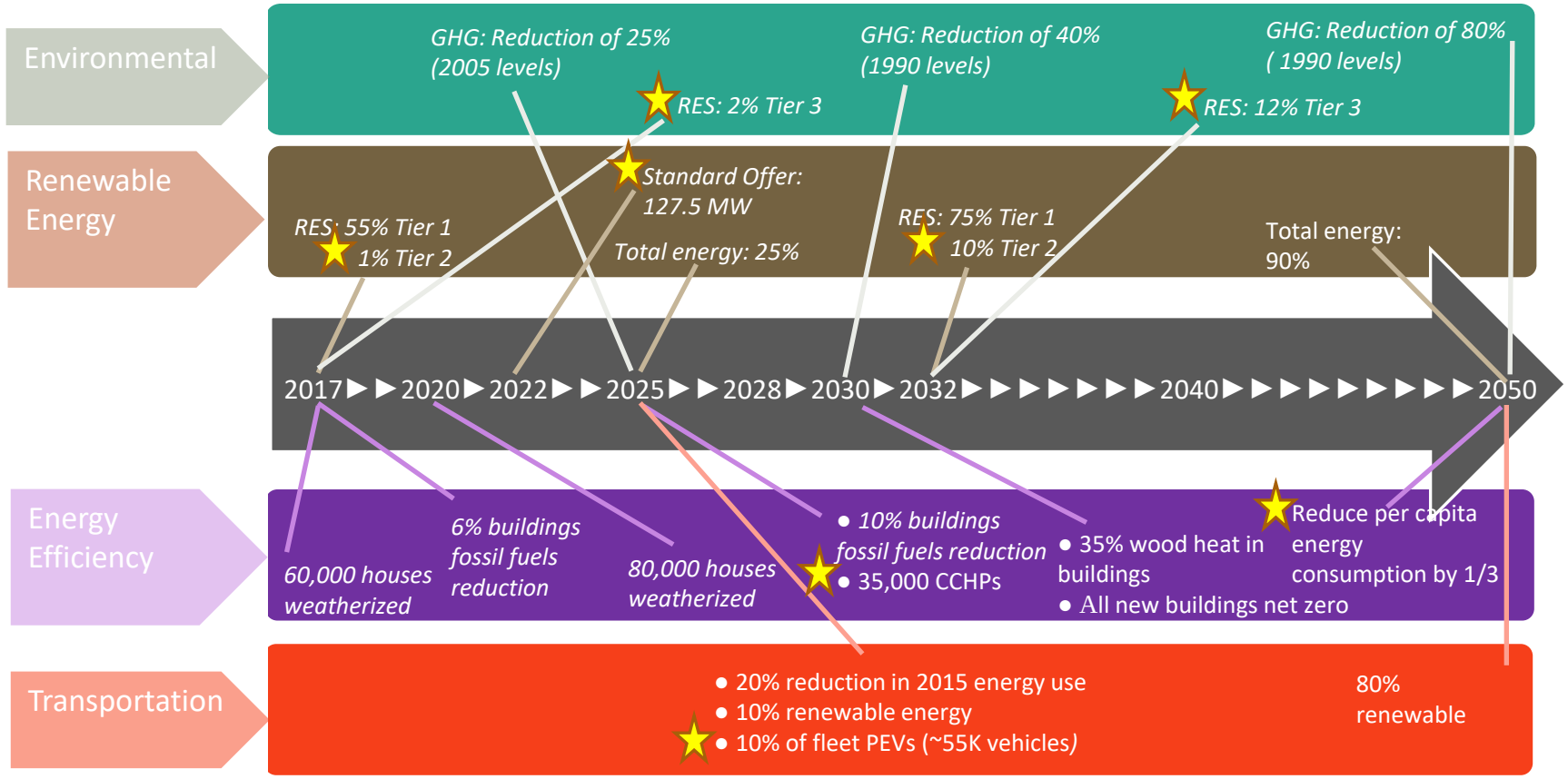
- Centralized + distributed generation
- Variable resources
- Consumers become producers
- Multi-directional power flow
- Flexible load

Source: ABB 2009; Texas Tech 2012

Generic Grid Mod Roadmap – post AMI

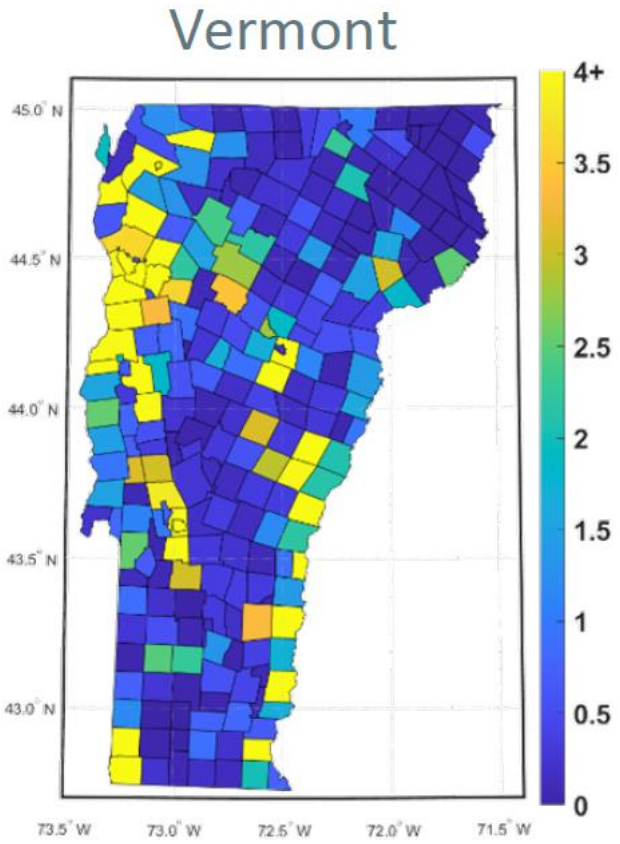


VT Policy Drivers w/Distribution System Implications

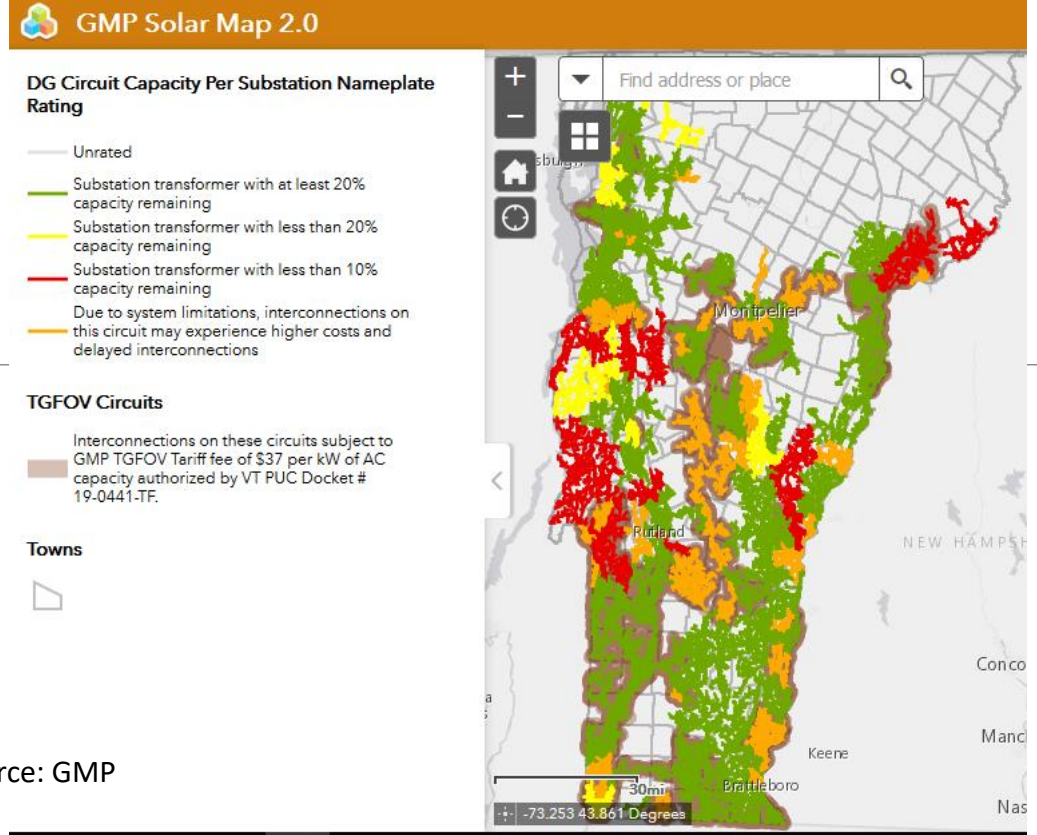


Italics indicate statutory requirements/goals

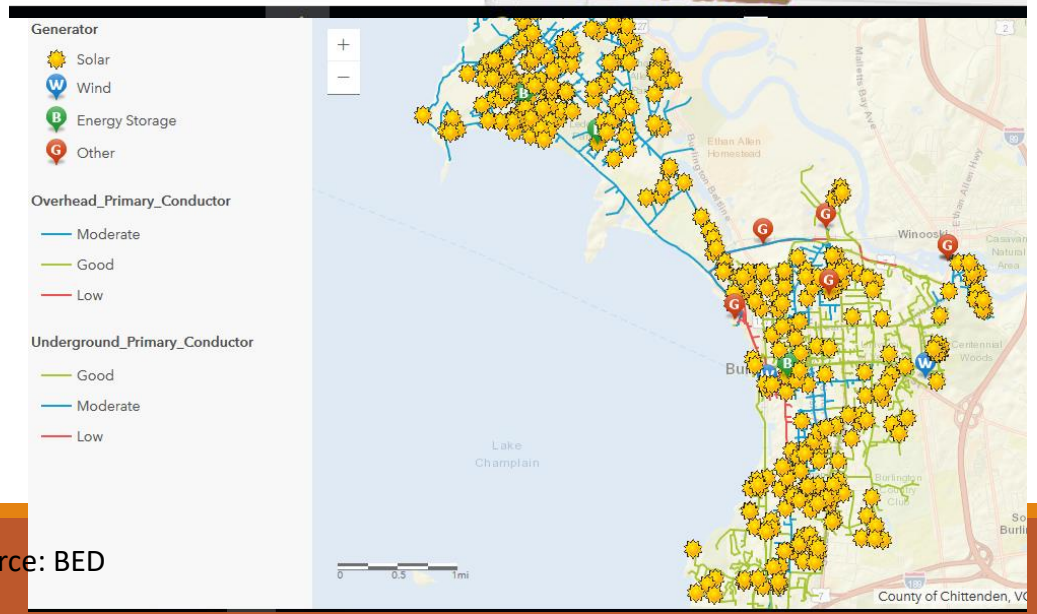
Solar: hosting capacity & D-system constraints



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

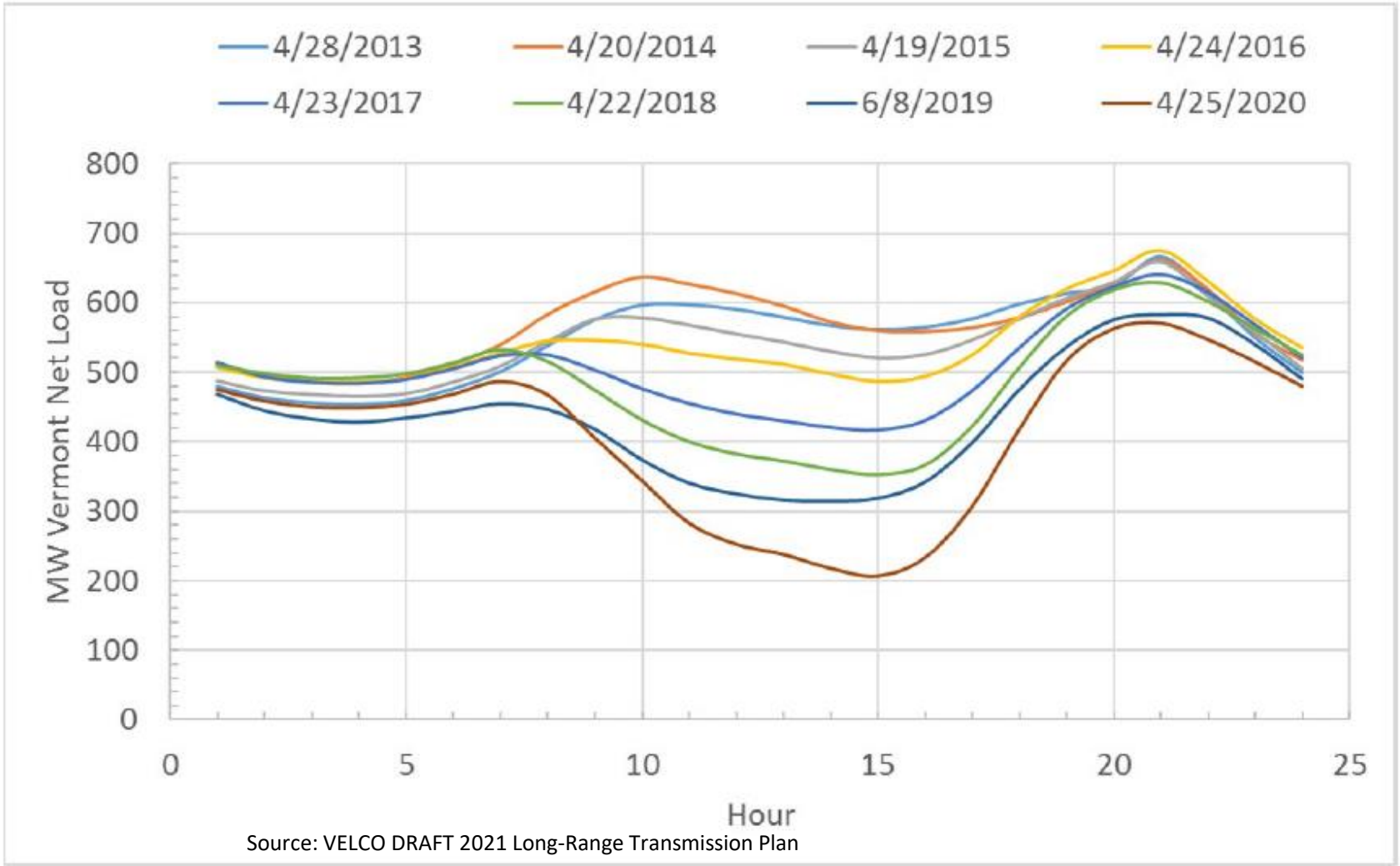


Source: GMP



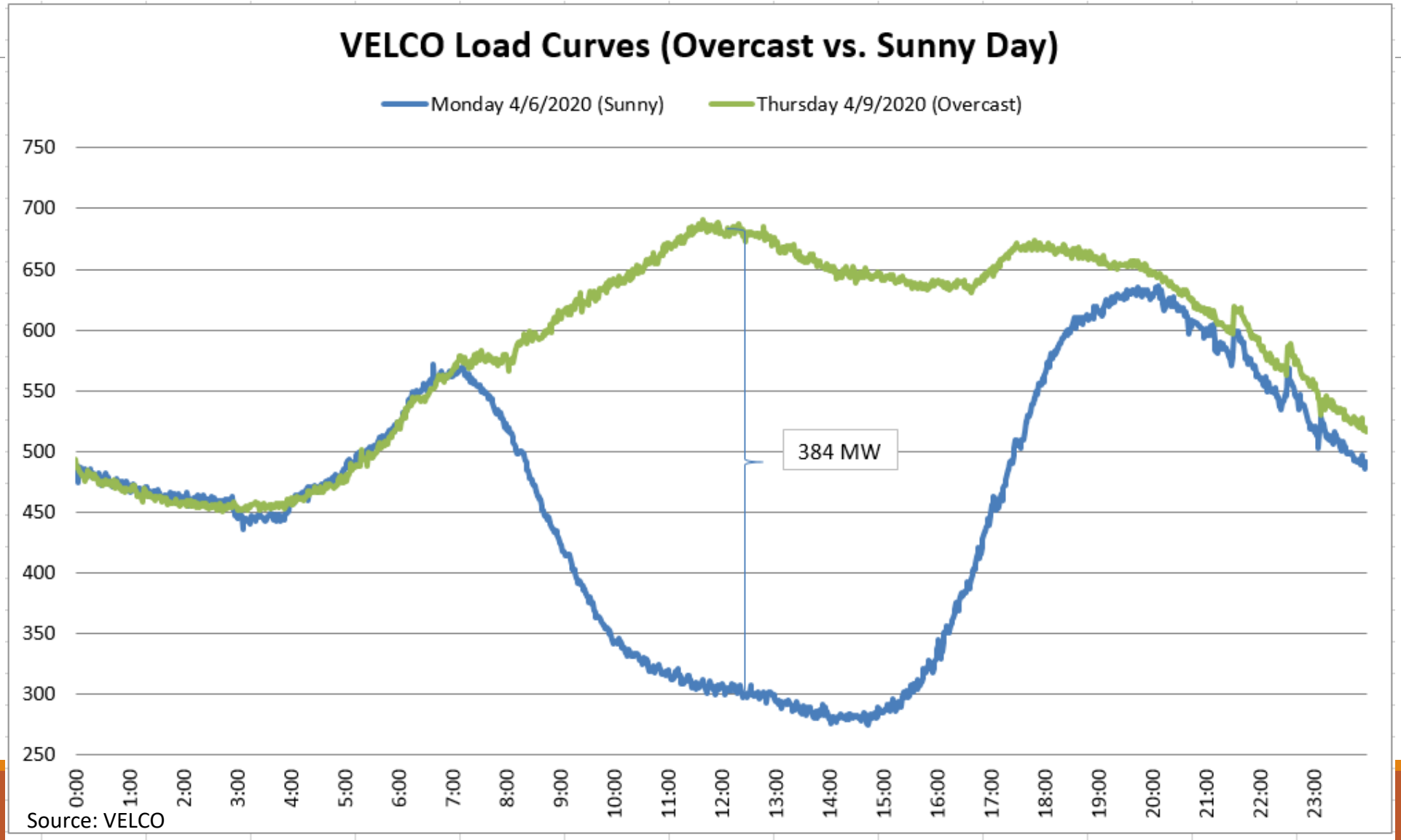
Source: BED

Solar: lowering & shifting peak demand



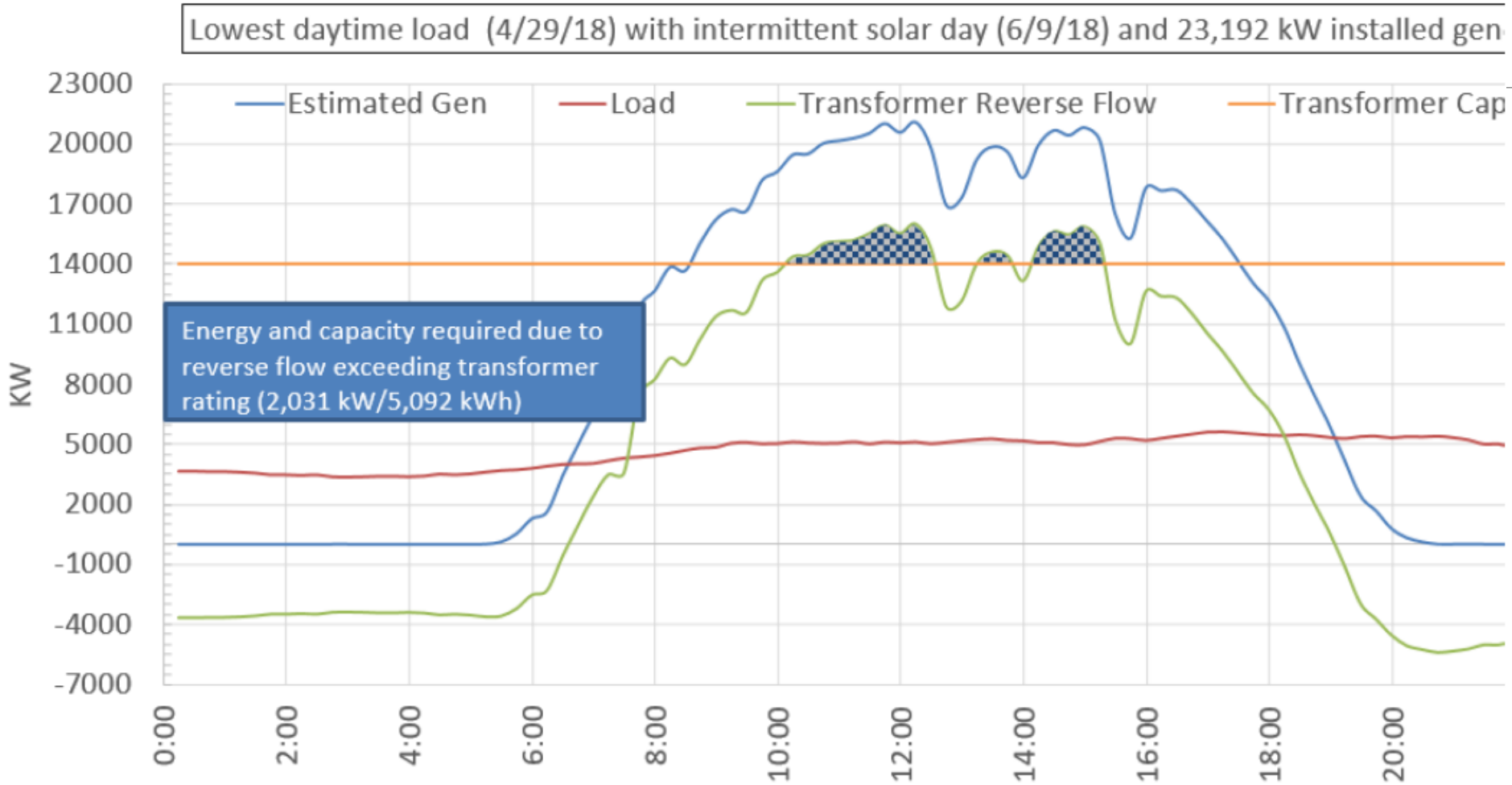
Source: VELCO DRAFT 2021 Long-Range Transmission Plan

Variability and uncertainty: daily



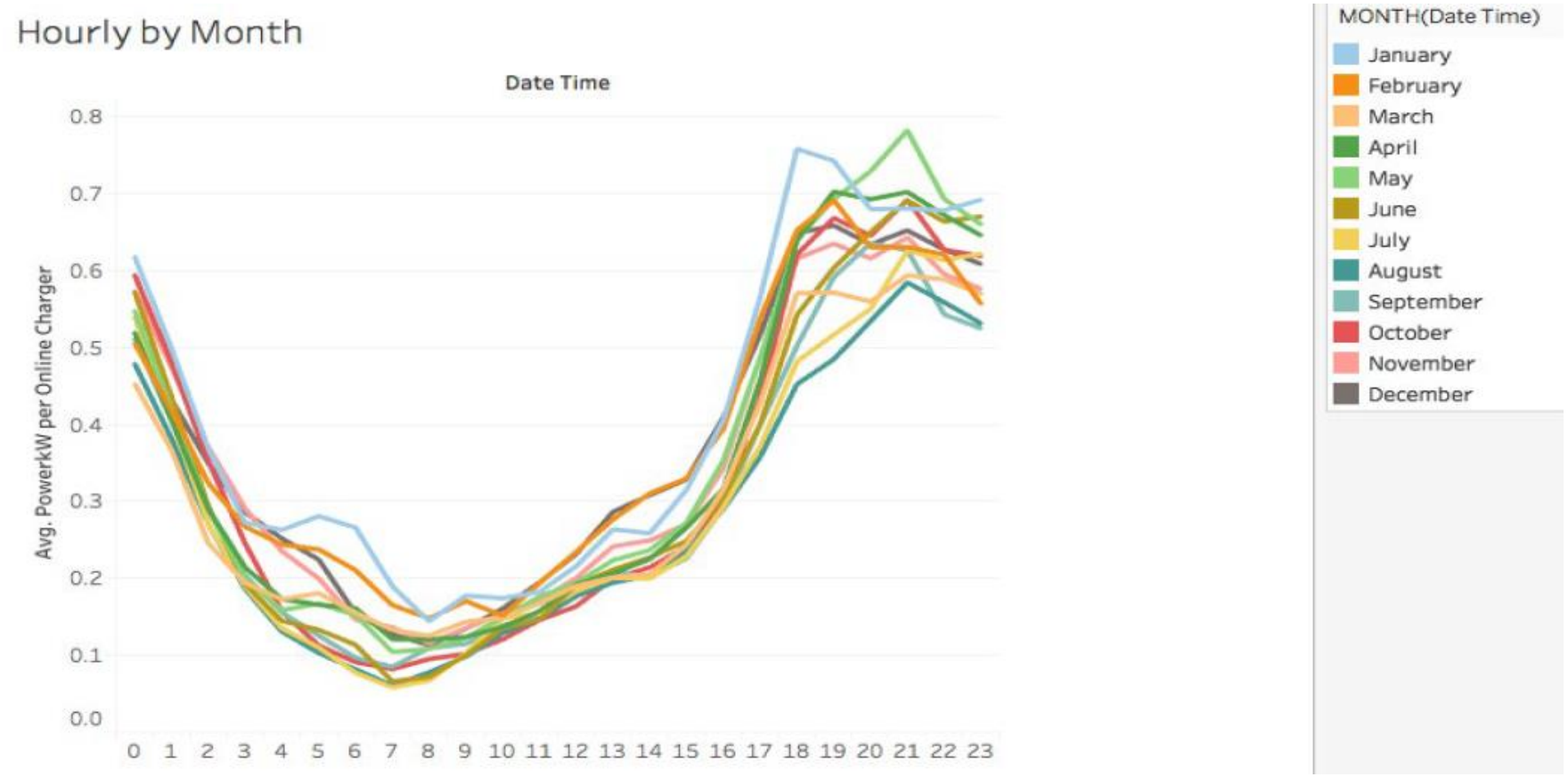
Source: VELCO

Variability and uncertainty: hourly



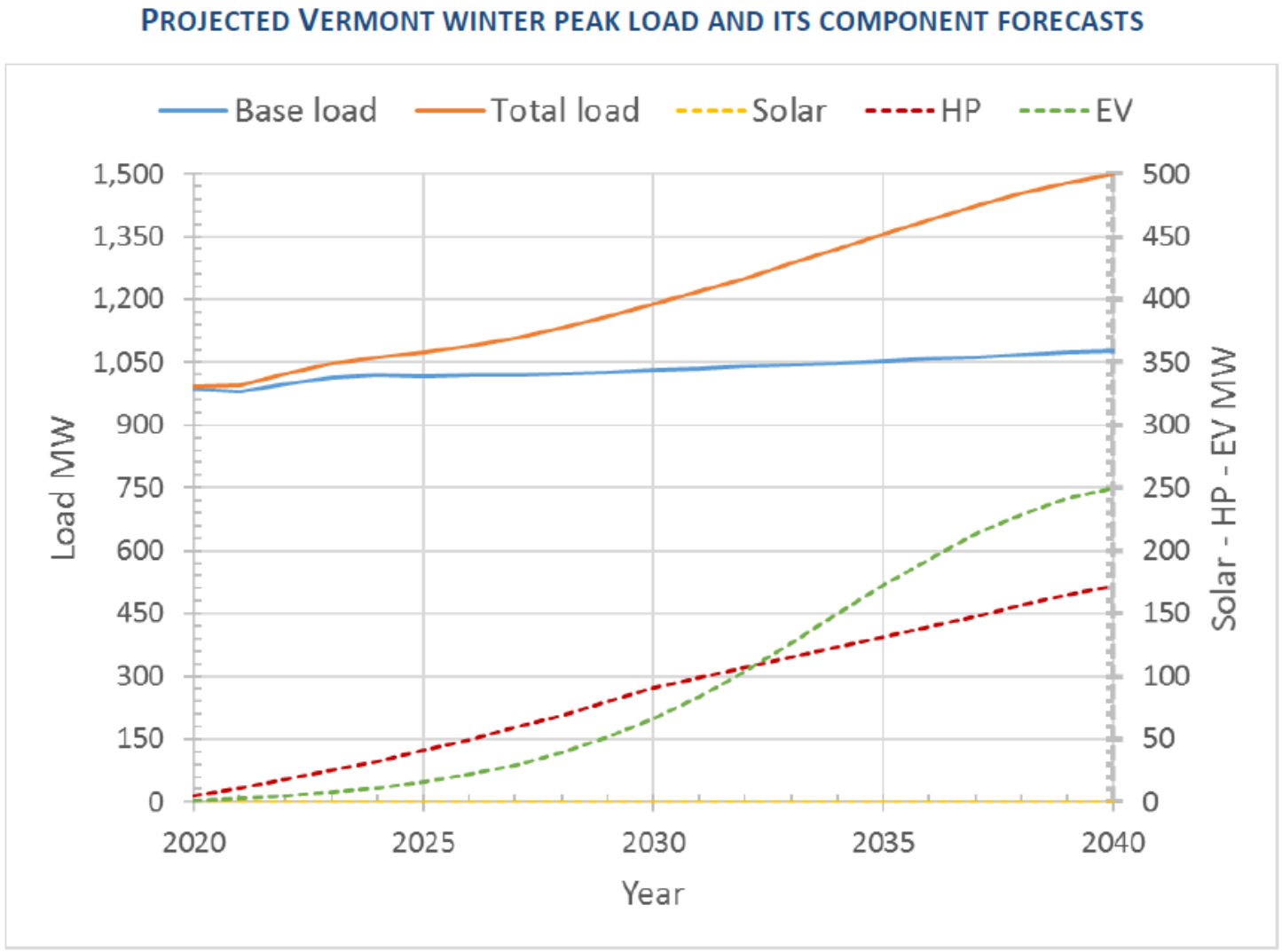
Source: GMP presentation to VSPC Generation Constraint Subcommittee 9/9/20

Electric vehicles: charging profiles



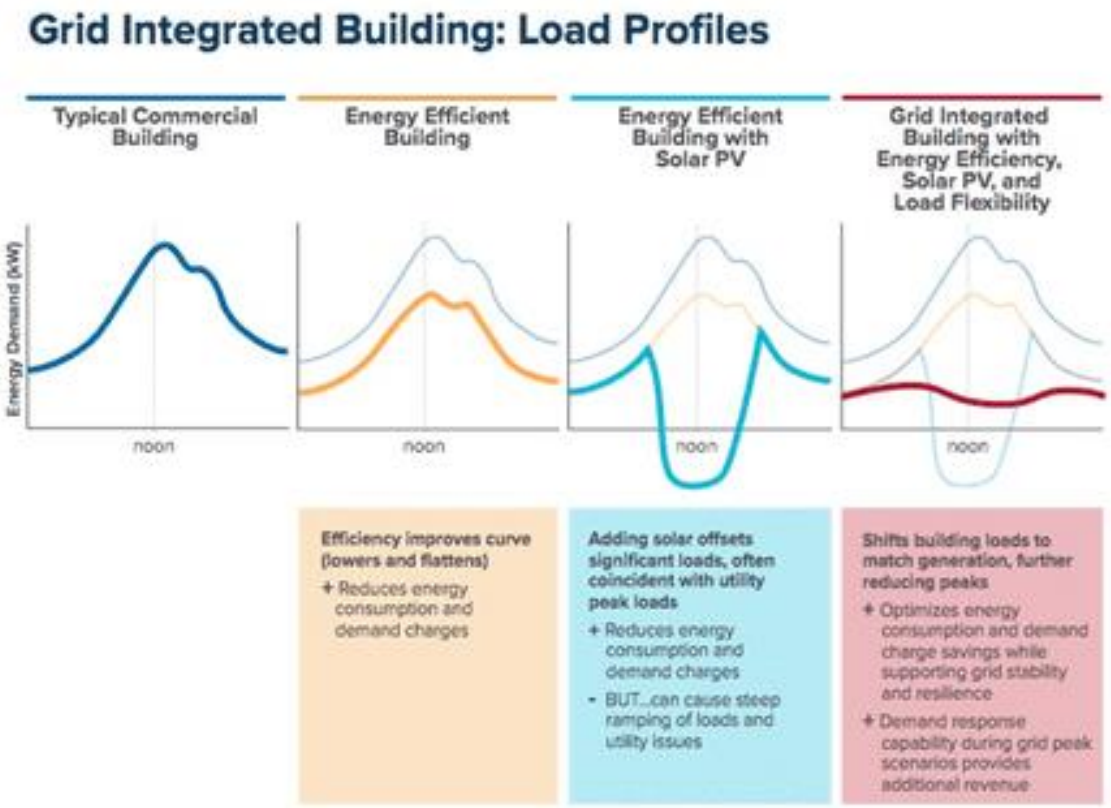
Source: GMP

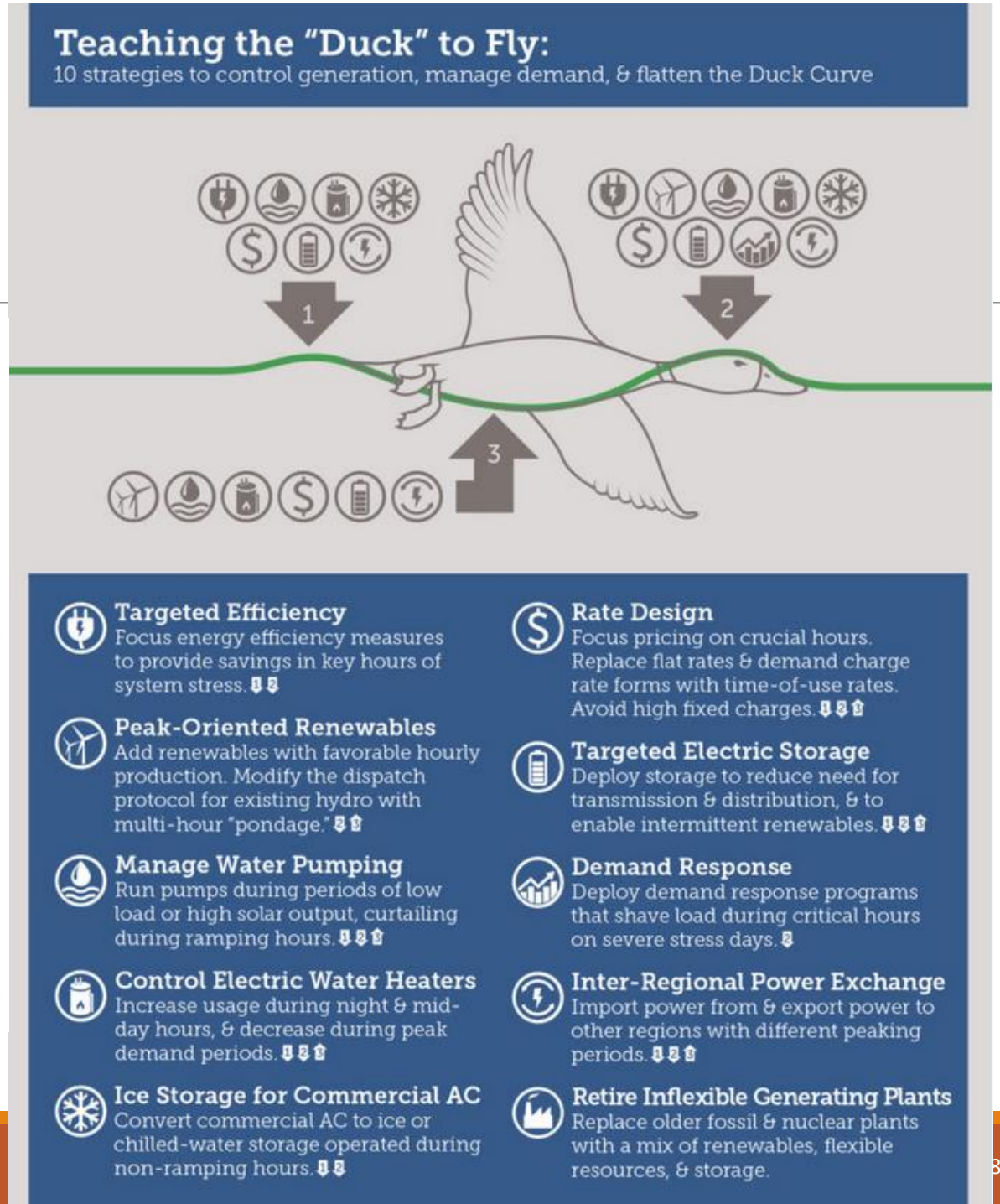
Electrification & seasonal demand patterns (VT)



Source: VELCO DRAFT 2021 Long-Range Transmission Plan

Optimizing demand & supply in real time

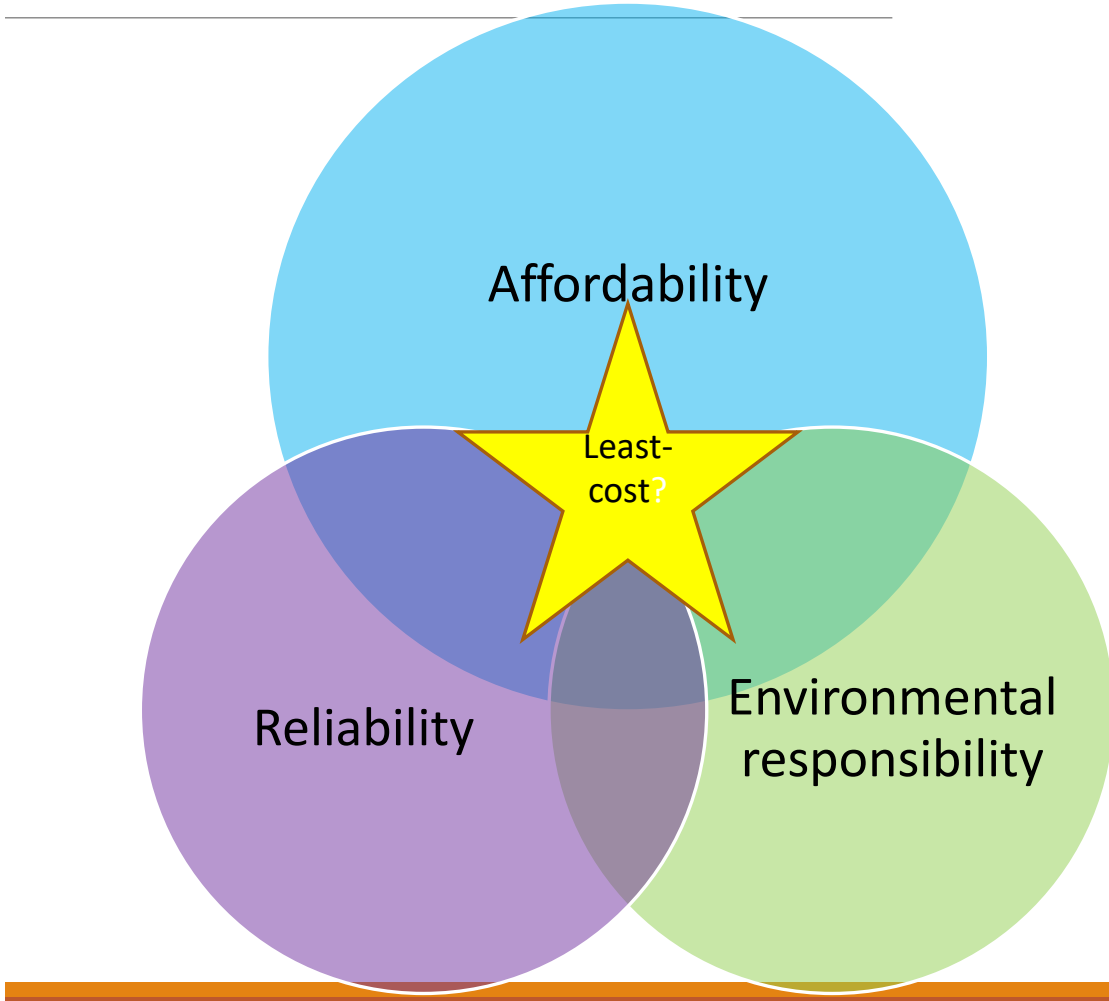




Sources: RMI (above), RAP (right)

Big picture questions

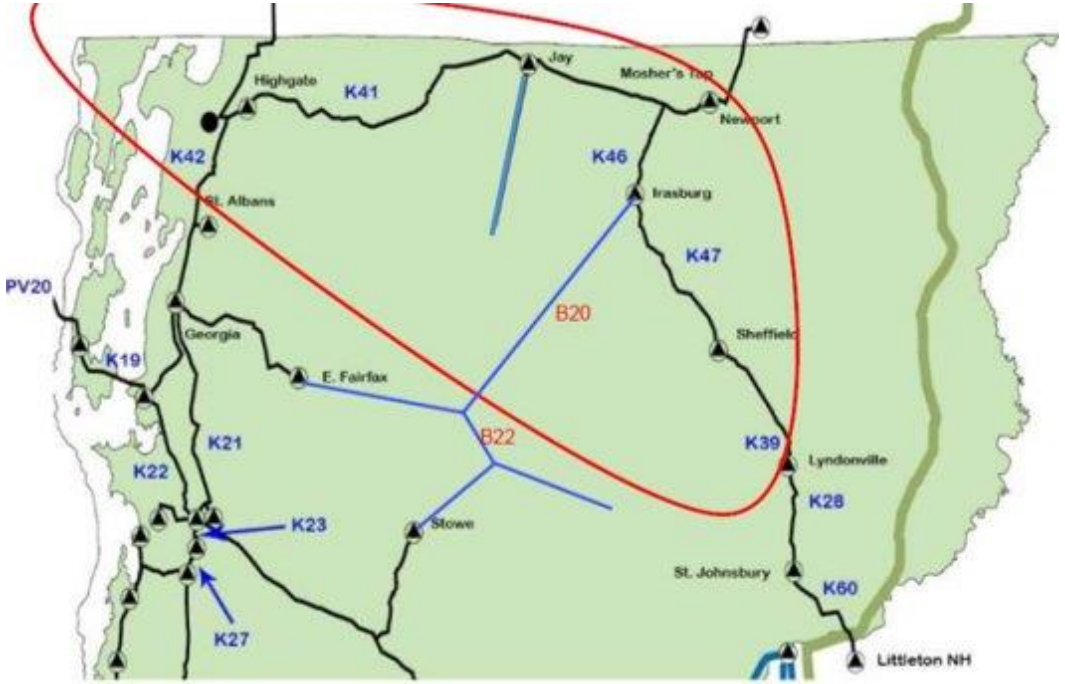
- What are the objectives of grid modernization?
- Who can and will participate, and how?
- What is necessary to reach goals (planning, programs, rate design, regulation)
- Where & when do investments need to be made
- Why?
  - Utility activities
    - Pilots & investments (RES Tier III, AMI, storage, 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

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

- 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