1. Executive Summary

INNOVATIVE PLANNING FOR CUSTOMER-BASED ENERGY DELIVERY

The story throughout our 2018 Integrated Resource Plan is one of innovation and change:

- Change from the old energy system of centralized, fossil fuel-based generation transmitted through traditional poles and wires to customers far away, toward lower carbon, renewable, distributed generation with new, complex local and regional grid management opportunities.
- Change from one-way electricity flowing from a central plant to a customer toward two-way energy information, storage, and delivery between customers and us to benefit all.
- Change from steady and increasing loads toward flat and declining loads, as customers choose self-generation and utilize beneficial energy efficiency programs.
- Change from separate fuels for and treatment of thermal, lighting, and transportation energy toward convergence through the strategic electrification of resources.

And our pace, while already rapid and dynamic with a bias toward action and innovation, absolutely must increase if we are to meet the threat of climate change. Given these changes, we must also change the way we think about traditional planning to meet the energy needs of our customers and help them cut carbon. We are in the midst of transforming integrated resource planning into meaningful innovation planning, covering the details of distribution, procurement, asset management, and financial planning within the context of the shift toward customer-centered distributed energy resources (DERs).

The Energy Future We Embrace With Customers

We are guided by one central principle:
We are obsessed with serving our customers—our customers are our North Star.

Our focus on customers facilitates and guides our decisions—some that are unique in our industry—so that every action we take distinctly benefits our customers. We are adopting new, clean, distributed-energy technologies on both sides of the meter and, together with our customers, changing the way energy is delivered.

We are investing in energy delivery models that seek transformation in the following ways:

- Reducing the distance between generation and consumption, to lower losses and reliance upon the bulk electrical delivery system. This will ultimately result in a lower cost and a dramatically more reliable local energy system that is greener and more resilient in the face of significant climate change impacts.
- Establishing communities of distributed energy resources that are communications-enabled to optimize the operating cost of the electrical system and the use of renewable and non-emitting generating sources.
- Offering a diverse portfolio of innovative energy programs that promote measures consistent with Vermont energy policy and appeal to the personal goals of each customer.

Our 2018 IRP demonstrates our deep commitment to providing reliable, cost-effective —and increasingly distributed and carbon free—energy solutions for our customers. This includes helping customers transition away from higher cost, carbon-laden resources for heating and transportation, the largest contributors to climate carbon pollution and climate change in Vermont. We are striving to maintain stable and cost-effective rates despite rapid changes and profound challenges in the energy landscape. Looking to the future, we see a continued transition to an even more localized energy economy, one that is home-, business-, and community based. Ensuring this transition happens rapidly and smoothly, and in a way Vermonters can afford, is important.

ABOUT GREEN MOUNTAIN POWER

Our mission statement reflects directly our deep commitment to our customers:

> We have a vision to use energy as a force for good that improves lives and transforms communities. We're focused on a new way of doing business to meet the needs of customers with integrated energy services that help people use less energy and save money, while continuing to generate clean, cost-effective, and reliable power in Vermont.

We seek to accelerate the transformation in energy by providing energy as a service to allow Vermonters to cut carbon and improve their lives. Our strategy is to work with our customers to save money by flattening the peaks with a network of controlled devices, deployed storage technologies, and customer-focused market solutions that help accelerate adoption and facilitate other energy market players. We are focused on building a resilient two-way power grid—moving electricity and data to dynamically and efficiently balance load and demand. On a broader scale, our work aligns with, and has often been a precursor of, statewide policies and statutes.

Regional and other cost pressures out of our control impact overall costs, so we proactively address issues within our control to help mitigate these risks for our customers. We focus on how to deploy technologies to control load, while accelerating a market platform that does the same thing around us so that, over time, we lower our share of cost for the broader regional grid.

Meanwhile, energy efficiency measures and net metering installations mean flat and declining demand for electricity. No part of our service area is experiencing growth in demand, even with the significant trend toward the increased electrification of heating and transportation. Instead, improvements and repair to our distribution grid will be a necessity to maintain reliability and enhance resiliency as we focus on delivering controllable, low carbon energy locally.

Background and History

Green Mountain Power was founded on August 29, 1928 following a series of consolidations that included our predecessor, the Vergennes Electric Company, an early pioneer in electricity delivery founded 35 years earlier in 1893. To give this some perspective, distributed electricity first became available to parts of urban Manhattan in 1882. By the mid-1920s, approximately 85% of urban America was electrified as compared to only about 3% of farms and rural areas.

The Rural Electrification Act of 1935 began to change all that, bringing electricity throughout Vermont and putting in place the bulk delivery model that we are now seeking to transform.

Throughout our recent history, we have created a culture of working solely for the benefit of our customers. In 2008, we introduced the solar incentive, which helped jumpstart the solar industry and customer energy independence in Vermont. In 2014, we become a B Corporation—the first utility in the world to do so—by meeting rigorous standards of performance, accountability, and transparency, and seeking to use the power of business to alleviate poverty, address climate change, and build strong local communities, while being a great place to work.

Service Territory and Resources

Our service territory spans 7,500 square miles, serves almost 264,000 customers in 202 municipalities, and delivers power to about 77% of Vermont. Table 1-1 alphabetically lists all 202 municipalities we serve.

Addison	Chittenden	Highgate	Northfield Town	Saxtons River	Waitsfield
Andover	Clarendon	Hinesburg	Northfield Village	Searsburg	Wallingford
Arlington	Colchester	Hubbardton	Norwich	Shaftsbury	Waltham
Athens	Concord	Huntington	Orange	Sharon	Wardsboro
Bakersfield	Corinth	Ira	Orwell	Shelburne	Warren
Baltimore	Cornwall	Jamaica	Panton	Sheldon	Washington
Barnard	Danby	Jeffersonville	Pawlet	Shoreham	Waterbury
Barnet	Danville	Jericho	Peacham	Shrewsbury	Waterford
Barre City	Dorset	Killington	Peru	South Burlington	Weathersfield
Barre Town	Dover	Kirby	Pittsfield	Springfield	Wells
Belvidere	Dummerston	Landgrove	Pittsford	St. Albans City	West Fairlee
Bennington	Duxbury	Leicester	Plainfield	St. Albans Town	West Haven
Benson	East Montpelier	Lincoln	Plymouth	St. Johnsbury	West Rutland
Berlin	Essex	Londonderry	Pomfret	Stamford	West Windsor
Bethel	Fair Haven	Ludlow	Poultney	Starksboro	Westford
Bolton	Fairfax	Lunenburg	Pownal	Stockbridge	Westminster
Bradford	Fairfield	Lyndon	Proctor	Stowe	Weston
Braintree	Fairlee	Manchester	Putney	Strafford	Weybridge
Brandon	Fayston	Marlboro	Quechee	Stratton	Wheelock
Brattleboro	Ferrisburgh	Marshield	Randolph	Sudbury	Whiting
Bridgewater	Fletcher	Mendon	Reading	Sunderland	Whitingham
Bridport	Georgia	Middlebury	Readsboro	Swanton	Wilder
Bristol	Glastenbury	Middlesex	Richmond	Thetford	Williamstown
Brookfield	Goshen	Middletown Springs	Ripton	Tinmouth	Williston
Brookline	Grafton	Milton	Rochester	Topsham	Wilmington
Buels Gore	Granby	Monkton	Rockingham	Townshend	Windam
Cabot	Granville	Montpelier	Roxbury	Tunbridge	Windsor
Calais	Groton	Moretown	Royalton	Underhill	Winhall
Cambridge	Guildhall	Mount Holly	Rupert	Vergennes	Winooski
Castleton	Guilford	Mount Tabor	Rutland City	Vernon	Woodford
Cavendish	Halifax	New Haven	Rutland Town	Vershire	Woodstock Town
Charlotte	Hancock	Newbury	Ryegate	Victory	Woodstock Village
Chelsea	Hartford	Newfane	Salisbury	Walden	Worcester
Chester	Hartland	North Hartland	Sandgate		

Table 1-1. Vermont Municipalities Served (Alphabetic)

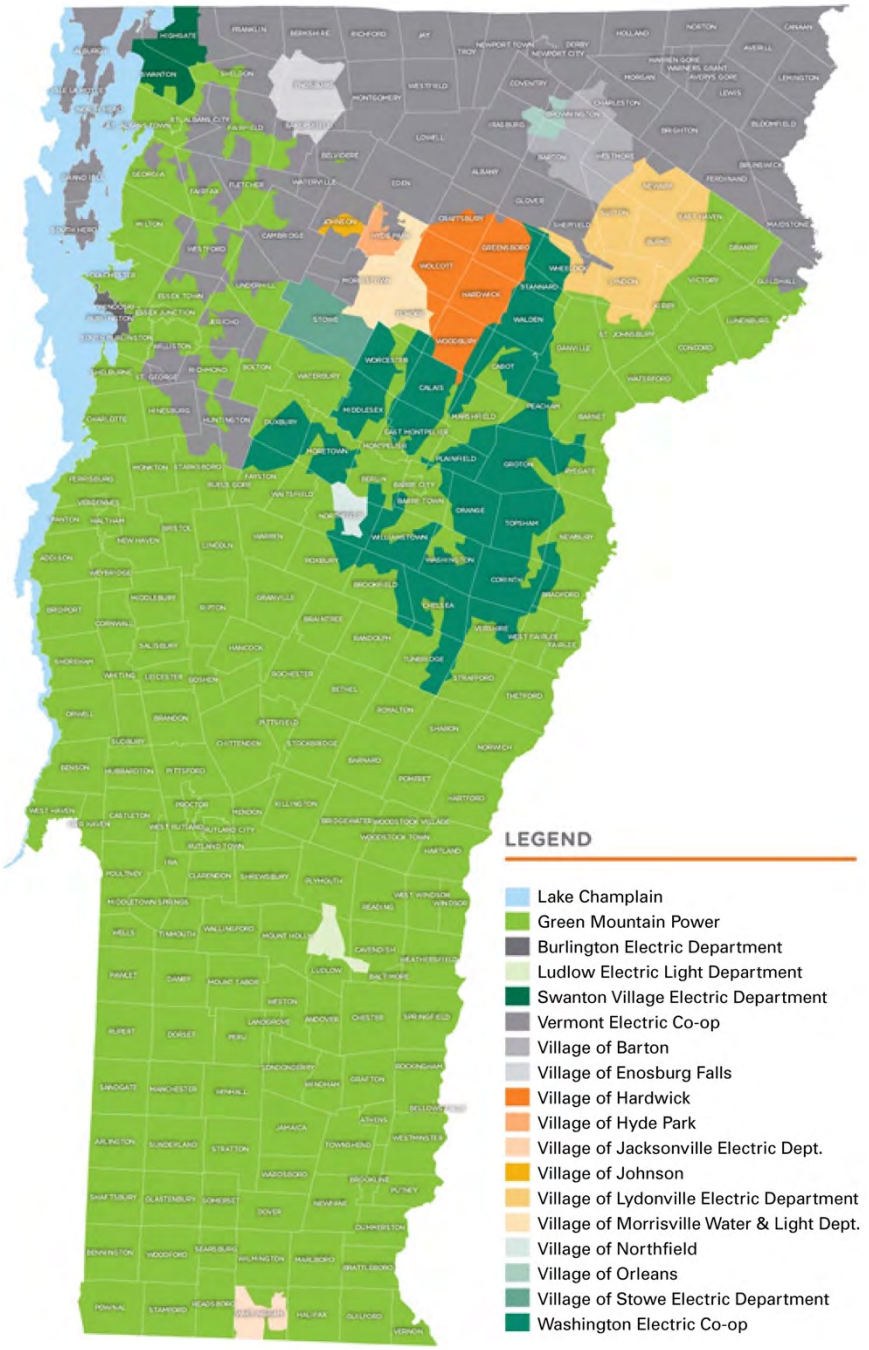

Figure 1-1. Service Territories of Vermont Electric Utilities

Figure 1-1 depicts a color-coded map of the service territories of all Vermont electric utilities. Our services area focuses mainly on the 200-plus cities and towns in the central and southern parts of the state, and includes Montpelier, Rutland, Bennington, and Brattleboro.

We own a portfolio of cost-effective generation resources, including 46 hydroelectric units, two wind plants, six oil-fired peaking plants, and 10 solar power facilities. We also co-own a wood-fired plant, a portion of a nuclear unit in Connecticut, a combined-cycle unit, and an oil-fired unit. Over time, we have significantly limited the use of carbon-intensive resources. (For a complete breakdown of this generation, our independent power purchase agreements (PPAs), and our statutory

PPAs, see Appendix C: Current Power Supply".)

Customers and Costs

Figure 1-2 illustrates the number of commercial, industrial, and residential customers we serve, and the amount of energy each group consumes.

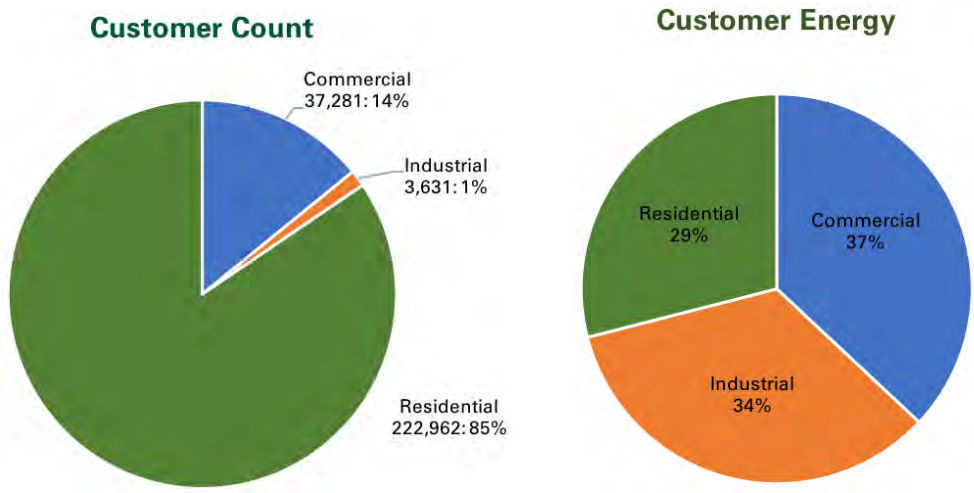

Figure 1-2. Customer Count and Energy Comparison

We are proud to have rates that are low when compared to investor-owned utilities in New England and are lower than compared with many other utilities serving Vermonters.

Figure 1-3 compares the 2017 retail rates of Green Mountain Power with the independently owned electric utilities in the five other New England states.

Figure 1-3. Retail Rates of Investor Electric Utilities In New England: 2017

LOAD AND T&D SYSTEM SUMMARY

Load Forecast

We are facing declining load as our customers look to personal energy systems as well as take advantage of continued improvements in efficiency, such as improved appliance standards. Table 1-2 provides a summary of our load forecast view provided in our last IRP compared to our current load forecast. In fact we are using less energy now than we have since the end of 2003. Regional cost pressures, however, continue to rise and with fewer kilowatts to spread these costs over, will lead to further rate cost pressures on customers. It is our focus to counter these cost pressures through transformative customer offerings, strategic partnerships with third-party providers, and development of a power supply resource mix that is incredibly low carbon and low cost.

Year	2015 Forecasted Retail Sales (MWh)	2019 Forecasted Retail Sales (MWh)	Annual Change (%)
2017	4,283,851	4,157,098	–3.1%
2018	4,287,010	4,166,119	–2.9%
2019	4,287,332	4,146,271	–3.4%
2020	4,280,655	4,132,091	–3.6%
2021	4,265,783	4,113,442	–3.7%
2022	4,272,630	4,102,733	–4.1%
2023	4,283,191	4,091,212	–4.7%
2024	4,300,610	4,083,897	–5.3%
2025	4,305,751	4,073,410	–5.7%
2026	4,319,724	4,065,796	–6.3%
2027	4,336,678	4,062,941	–6.7%
2028	4,363,099	4,065,519	–7.3%

Table 1-2. Forecasted Retail Sales: 2015 versus 2019

The Future T&D System

The theme throughout the IRP will be a focus on transitioning the energy delivery system to a highly distributed system, while continuing to strategically electrify transportation, heating and other fossil fuel processes. With the introduction of cost effective energy storage, we now have a new tool along with a software platform and distributed energy resources, to manage and choreograph the distributed grid. Our focus will be on how we seamlessly integrate intermittent distributed generation onto the grid. Chapter 7: Financial Assessments show how data has become an integral part of our planning and visibility into the distribution system.

2018 INTEGRATED RESOURCE PLANNING GOALS

As distributed energy resources have increasingly proliferated on the power grid, so has the challenge of integrated resource planning. The transition from last century's power grid where electricity flowed in one direction from a few central generating plants to customers, is accelerating. Net-metered solar installations together with small wind and solar plants distributed abundantly and randomly through the power grid, necessitated a bi-directional flow of power; the promise of storage now demands it.

This distributed energy future requires a new approach to integrated resource planning that is more nimble, flexible, and incorporates distribution planning down to the circuit level. We have carefully cultivated the integration of resource and distribution planning to ensure our 2018 IRP meets not only the statutory requirements, but also the needs of our customers now and in the future.

The larger purpose of our 2018 IRP is to meet Vermont's energy policy:

> (1) To assure, to the greatest extent practicable, that Vermont can meet its energy service needs in a manner that is adequate, reliable, secure, and sustainable; that assures affordability and encourages the State's economic vitality, the efficient use of energy resources, and cost-effective demand-side management; and that is environmentally sound.
>
> (2) To identify and evaluate, on an ongoing basis, resources that will meet Vermont's energy service needs in accordance with the principles of least-cost integrated planning; including efficiency, conservation, and load management alternatives, wise use of renewable resources, and environmentally sound energy supply.[1]

Vermont statute requires us to develop a "least-cost integrated plan" for a safe, reliable, lowest-cost, environmentally friendly power grid that meets the energy service needs of our customers. The plan must combine prudent investments and expenditures in energy supply, transmission and distribution capacity and efficiency, and comprehensive energy efficiency programs.[2]

We have not only endeavored to create our 2018 IRP to meet these two overarching statutes, but have also developed this IRP to fulfill three additional commitments and statutory goals:

- Conditions we agreed to meet in a memorandum of understanding (MOU) jointly filed with the Vermont Department of Public Service and Vermont Energy Investment Corporation following the submission of our 2014 IRP.
- Statutory goals for greenhouse gas emission reductions, a broad-based renewable energy obligation, and Renewable Energy Standard (RES) requirements.
- Expanded goals and guidance described in detail in the 2016 Vermont Comprehensive Energy Plan (CEP).

The following sections detail these goals and requirements.

1 30 V.S.A. § 202a.

2 30 V.S.A. § 218c.

Our Memorandum of Understanding Commitments

On July 29, 2015, the Vermont Public Utility Commission (PUC) approved the Memorandum of Understanding (MOU) that we presented together with the Vermont Department of Public Service (DPS) and Vermont Energy Investment Corporation (VEIC) regarding our 2014 IRP reviewed in Docket No. 8397.

In that MOU, we agreed to several methodological improvements to incorporate into the development of our 2018 IRP. All parties in the MOU agreed that the energy landscape in Vermont is complex and shifting, as evidenced by this paragraph:

> The Parties agree that there are many forces at work on the Vermont energy system including, but not limited to, winter peak pricing spikes; escalating regional transmission costs; the Vermont Comprehensive Energy Plan; the Total Energy Study; proposed legislation that would significantly change requirements for utilities to own renewable energy as a part of their portfolio, and potentially to deliver innovative energy resources; and significant opportunities for strategic electrification in the thermal energy and transportation energy sectors. The dynamics of these discussions and related potential regulatory obligations require ongoing assessment and strategic planning to meet Vermont's energy service needs in a manner that is consistent with State Energy Policy. GMP, the PSD, and VEIC agree that they will work collaboratively to develop innovative responses to these emerging challenges in a way that maximizes the unique resources and capabilities of the individual Parties.[3]

More specifically, we agreed to incorporate new efforts in six areas:

Collaboration. The MOU underscores the importance of continuing to collaborate with the DPS and VEIC in planning the delivery of energy services. This includes incorporating common assumptions and scenarios from the Demand Resource Plan and other relevant proceedings, adopting and quantifying common assumptions and scenarios for our Innovation Pilots, and collectively seeking opportunities to deliver least-cost energy services for our customers. We also agreed to quantify and integrate plans to incorporate DERs at the lowest cost, develop improved metrics (especially to measure financial impacts), and refine our load forecasting methodology.[4]

Distributed Energy Resources (DERs). Broadly defined, DERs are connected to the distribution system and can either generate electricity or reduce the demand for electricity. For this MOU, DERs include (but are not limited to): conservation, demand response, load management, energy efficiency, fuel switching, energy storage, distributed generation that is generally less than 5 MW, and any combination of resources intended

[3] *Memorandum of Understanding between Green Mountain Power Corporation, the Vermont Department of Public Service, and Vermont Energy Investment Corporation*, filed in Docket No. 8397 on March 11, 2015; #16, page 5–6.

[4] *Ibid.*; #14a, page 3.

to provide energy services at least cost. Thus, we agreed to consult with the DPS and VEIC to:

- Identify opportunities where DERs can be quantified and integrated into the IRP, emphasizing responsive demand resources and our innovation pilots and programs.
- Develop and implement DERs at the lowest cost, consistent with statutory and regulatory requirements. For our 2018 IRP, we also agreed to complete and report on our efforts to make web-based, location-specific technical grid information available to DER developers before they decided on the location, size, and electrical details of a project.
- Integrate the expected volume and cost of our innovation pilots that make a meaningful impact on the load or operation of the power grid.[5]

Integration. Because of the complex nature of integrated resource planning, we agreed to continue to involve several internal departments in the development of our IRP, including Power Supply, T&D Planning, Engineering, Rates and Finance, and Innovation. In addition, we agreed to collaborate with DPS and VEIC to develop common metrics for measuring our current and future energy planning processes, and to use the same tools, methods, metrics, and report formats employed in developing our annual cost of service filings to estimate the expected revenue requirement impacts of the expected and preferred outcomes by year.[6]

Load Forecast. Accurate load forecasting is fundamental to developing an impactful IRP. As such, we agreed to continue collaborating with Vermont Electric Power Company, Vermont Transco (VELCO), the Vermont System Planning Committee (VSPC), and VEIC to adopt multiple common assumptions into our load forecasts, including the major elements of the Demand Resource Plan and the expected penetration of DER. In addition, we agreed to depict the IRP load forecast before and after incorporating energy efficiency measures, consider using heating and cooling degree-day trends instead of flat multi-year averages, and consider and quantify the magnitude and timing of DER on our peak and total energy requirements.[7]

Public Notification. Once filed, we agreed to post our 2018 IRP on a separate, dedicated website page, and notify customers of our IRP through both a bill stuffer and a press release.[8] While our IRPs were publicly available previously, these steps help ensure higher customer engagement around these important issues.

5 *Ibid.;* #14b, page 3–4.

6 *Ibid.;* #14c, page 4–5.

7 *Ibid.;* #14d, page 5.

8 *Ibid.;* #13, page 3.

Our Ongoing Commitments. Finally, after the IRP is filed, we agreed to continue to monitor key uncertainties and the continued accuracy of input assumptions and data; to reevaluate the merits of our decision-making processes and analytic methods; and to adapt them to new techniques or information.[9]

Greenhouse Gas Reduction Goals

Vermont is dedicated to reducing greenhouse gas (GHG) emissions, both within state boundaries and from outside the state caused by energy use in Vermont, so that we can make an appropriate contribution to achieving regional emission reduction goals. Vermont targets to reduce GHG emission from the 1990 baseline by:

- 25% by January 1, 2012;
- 50% by January 1, 2028; and
- 75% by January 1, 2050 if practicable using reasonable efforts.[10]

The 2016 Vermont CEP expanded on these goals. See "2016 Comprehensive Energy Plan Guidance" on page 1-16 for details.

We embrace these GHG emission reduction goals and have factored those reductions into our resource planning efforts. We are partnering with customers to cut carbon in this era of climate change impacts.

Renewable Energy Goals

On a broader scale, Vermont is committed to producing 25% of the energy consumed within the state through renewable energy sources, particularly from Vermont's farms and forests.[11]

The 2016 Vermont CEP expanded on these goals by broadly seeking to move the state to 90% renewable energy by 2050 across all energy sectors, including heating and transportation. See "2016 Comprehensive Energy Plan Guidance" on page 1-16 for further details.

9 *Ibid.;* #17, page 6.

10 10 V.S.A. § 578.

11 10 V.S.A. § 580a.

Act 56: Renewable Energy Standard Requirements

Act 56, enacted on June 11, 2015, established Renewable Energy Standard (RES) requirements for Vermont electric distribution utilities to procure specific percentages of their total retail electric sales from renewable energy as defined under three categories, or Tiers.[12] Meeting RES requirements will not only increase renewable generation in the state, but also reduce GHG emissions by approximately 15 million tons by 2032, thus attaining one-quarter of the state's emission reduction goal by 2050.

Here are the requirements for each of the three Tiers (as itemized in Table 1-3).

Tier I requires a defined percentage of retail electric sales from any renewable energy source.

Tier II requires a defined percentage of retail electric sales from new DER generation. For RES, DERs must be either (1) electric generation facilities of 5 MW or less capacity directly connected to a subtransmission or distribution system, (2) identified plants that defer transmission upgrades, or (3) net-metered systems whose environmental attributes are owned by the distribution utility; and (4) must have started operations after June 30, 2015.

Tier III requirements can be met either through additional new DERs (as specified in Tier II) or through energy transformation projects with a net reduction in fossil fuel consumption. Examples include building weatherization; air source or geothermal heat pumps and high-efficiency heating systems; industrial-process fuel efficiency improvements; increased biofuels use; biomass heating systems; electric vehicles or related infrastructure; and renewable energy storage infrastructure on the electric grid.

Tier I and Tier II require utilities to hold Renewable Energy Certificates (RECs) to satisfy their requirements (like the five other New England states). RECs (equivalent to 1 MWh renewable generation) are created when a renewable unit generates electricity and can be sold separately from the electricity generated by the unit. Both utilities and generators can buy and sell RECs on an open market in the region. For example, a solar facility could sell electricity to one utility and RECs to another utility or to a private party.

[12] 30 V.S.A. § 8002–8005.

Table 1-3 lists the RES Tier I, Tier II, and Tier III retail sales requirements over the subsequent 14 years.

Year	Tier I	Tier II	Tier III
2017	55%	1.0%	2.00%
2018	–	1.6%	2.67%
2019	–	2.2%	3.33%
2020	59%	2.8%	4.00%
2021	–	3.4%	4.67%
2022	–	4.0%	5.33%
2023	63%	4.6%	6.00%
2024	–	5.2%	6.67%
2025	–	5.8%	7.33%
2026	67%	6.4%	8.00%
2027	–	7.0%	8.67%
2028	–	7.6%	9.33%
2029	71%	8.2%	10.00%
2030	–	8.8%	10.67%
2031	–	9.4%	11.33%
2032	75%	10.0%	12.00%

Table 1-3. Renewable Energy Standard Tier I, Tier II, and Tier III Requirements

Note: Tier I requirements encompass those of Tier II; in other words, the total Tier I and Tier II requirement for 2032 is 75% of retail sales.

Act 56: Standard Offer Program

Act 56 also repealed the Sustainably Priced Energy Enterprise Development (SPEED) program, except for its Standard Offer component with a goal is to promote a rapid increase in renewable generation facilities contracted with Vermont with a nameplate capacity of 2.2 MW or less. The Standard Offer program has a statutory cap of 127.5 MW.

The RECs and energy from Standard Offer projects, as well as their associated costs, are allotted to the Vermont utilities based on their pro-rata share of load. As of 2015, our share of the Standard Offer program is 76.67%. Thus, through Standard Offer projects we would have up to approximately 97.5 MW to use as RECs to satisfy either RES Tier I and Tier II requirements, depending on the date the project started operations.

2016 Comprehensive Energy Plan Guidance

The Vermont Department of Public Service published an updated CEP in 2016, which expanded and altered two key statutory goals, and provided detailed guidance for state electric utilities to develop their individual IRPs.

Expanded and Altered Statutory Goals

The 2016 CEP expanded on the statutory goal (10 V.S.A. § 580a) of attaining 25% renewable energy from farms and forests by establishing the following goals:

- Reduce total energy consumption per capita by 15% by 2025, and by more than one third by 2050.
- Meet 25% of the remaining energy need from renewable sources by 2025, 40% by 2035, and 90% by 2050.
- Three end-use sector goals for 2025: 10% renewable transportation, 30% renewable buildings, and 67% renewable electric power.[13]

In addition, the 2016 CEP altered the statutory goal (10 V.S.A. § 578) for reducing GHG emissions from the 1990 baseline by softening the short-term goal and strengthening the long-term goal. Targets now in the CEP:

- 40% reduction by 2030.
- 80% to 95% reduction by 2050.[14]

[13] *2016 Vermont Comprehensive Energy Plan; page 2*

[14] *Ibid.*; page 4.

IRP Development Guidance

The 2016 CEP suggests utilities use the IRP process to develop methods to evaluate competing investment and purchase decisions to meet customer demand, and to develop a set of specific tools for evaluating options of balancing supply and demand at the lowest present value life cycle cost.[15]

The 2016 CEP presented guidance in six main areas. That guidance is summarized here:

1. **Forecasts and Scenarios.** Analyze load forecasts against several future scenarios, considering several demand forecasting factors, then analyze alternative sensitivities to these scenarios employing historical data as appropriate.
2. **Assessment of Resources.** Assess existing resources and available supply options, including PPAs and REC purchases, for several generation-specific factors as well as a number of financial factors including rate structures for various customer classes.
3. **Financial Assessment.** Present a strategic direction based on a "simple five-year financial projection" that includes numerous cost and risk considerations as well as 20-year metrics and ratios for testing the financial projection.
4. **T&D System Assessment.** Develop a thorough transmission and distribution plan for improving efficiency (employing 14 T&D measures), including a detailed plan for modernization, together with an implementation plan that minimizes faults and outages and maximizes safety and reliability.
5. **Environmental Impact Assessment.** Demonstrate an understanding of GHG and other toxic emissions, and assess costs related to meeting relevant environmental statutes.
6. **Integrated Analysis and Action Plan.** Through an analysis of cost, generation, environmental impact, and finances that are documented, develop an optimal portfolio of supply and distribution options and a preferred least-cost plan together with a complete implementation and action plan for the short-term (three years) and long-term (starting three years out).

[15] *Op. cit.*; *Appendix B: Guidance for Integrated Resource Plans and 202(f) Determination Requests*; page 5.

SUMMARY OF FINDINGS

We describe in the individual chapters of the 2018 IRP the plans we have for innovative services, transmission & distribution maintenance, and power resource acquisitions to support our goals of a cleaner, more distributed energy system. A key component of any IRP is the "preferred portfolio" to meet future needs at the lowest present value life cycle costs, taking both economic and environmental costs into account as required by 30 V.S.A. § 218c. In Chapter 8, we analyze portfolio choices to arrive at an illustrative future portfolio based upon what we judge to be the most appropriate choices for our customers with the information we have available today.

The notable incremental resource components of this portfolio are:

Acquisition of additional distributed renewables over time, as needed to meet Tier II requirements including appropriate allowance for uncertainty of forecasted supply growth.

A limited mix of hydro (plant-contingent, or firmed) and offshore wind during the 2020s. The hydro resources could lock in a portion of our forecasted Tier I needs; the offshore wind could offer an attractive seasonal output profile and diversity from our other renewable resources. All three resources would have the potential to provide long-term portfolio cost stability after the expiration of major PPAs in the mid-2030s.

Acquisition of additional storage and flexible load resources. This IRP assumes that 50 MW to 100 MW of these resources will be deployed in our territory over the next decade, to address a mix of the potential use cases discussed in Chapter 5: Our Increasingly Renewable Energy Supply and Chapter 8: Portfolio Evaluation.

Ongoing operation of GMP's existing generation plants. We operate a fleet of both peaking and mid-base load generation facilities. Ongoing optimization of these facilities is key to keeping the overall portfolio costs low. Specifically, for peaking plants we recognize the fairly advanced age of our fleet and are assuming retirements of about 30 MW of our peaking capacity during the planning horizon in the mid-2020s and early 2030s.

Manage short-term market price volatility through layered forward purchases. Consistent with the approach discussed in Chapter 5: Our Increasingly Renewable Energy Supply, we plan to continue managing our forecasted open positions through a series of layered short-term purchases of energy and capacity, typically for terms of less than five years.

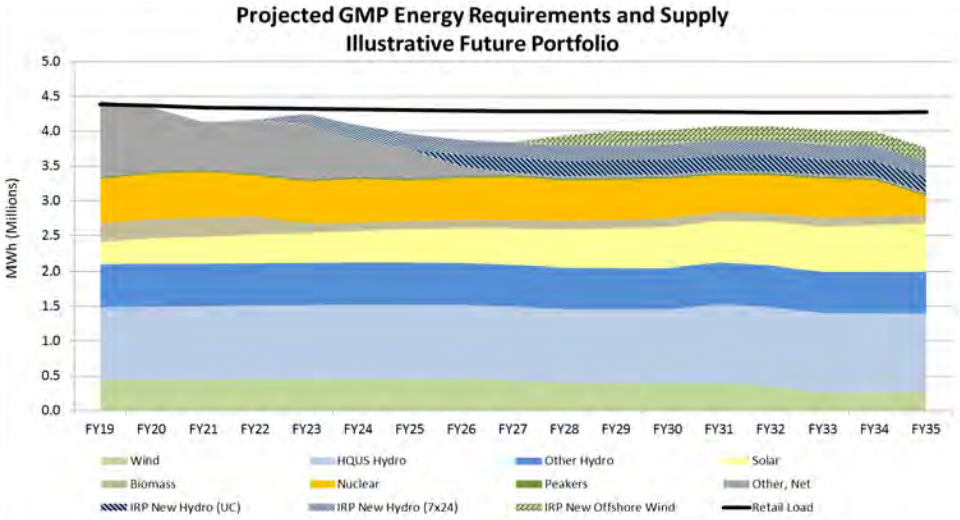

Figure 1-4. Projected Energy Requirements and Supply: Illustrative Future Portfolio

We discuss in Chapter 8: Portfolio Evaluation our preferred choices for capacity resources, as well as how we expect to meet Vermont RES requirements during the planning period. We also analyze the cost sensitivities of these choices, finding that under base case assumptions, our estimated power and transmission costs through 2035 are on the order of $4.86 Billion, with limited opportunity for significant change given our hedged position in the first few years, and substantial long-term and stable-priced resources that protect against potential movements in energy and capacity market prices in later years.

Implementation and Action Plan

Table 1-4 summarizes the action steps we expect will be needed within the planning period to achieve the outcomes we seek for customers through the 2018 IRP.

Functional Area	Activity
Energy Transformation	Develop and deploy an integrated suite of customer offerings that drive carbon out of our total energy consumption, reduce costs for all customers, and improve comfort and reliability: ♦ Expand the Bring Your Own Device program to include more devices and more options for third parties and aggregators. ♦ Deploy energy storage into customer homes and businesses to improve resiliency and reduce cost and carbon for the entire system. Focus on customer options that include third-party integration of resources and additional value for locational benefits. ♦ Transition commercial customers from fossil-fuel-based processes to electricity where feasible and cost-effective to cut carbon. ♦ Develop innovative pricing and rate strategies to encourage and accurately price resources transitioning from fossil fuel to electricity, in a seamless way to benefit customers.
Generation	Invest and maintain our existing fleet of generation while looking for opportunities for acquisition and construction of new facilities to produce long-term value to customers: ♦ Explore acquisition of hydro facilities with a focus on peaking and wintertime capability. ♦ Pair energy storage with existing renewable facilities, or construct new storage-paired systems directly or through other procurement methods.
Power Supply	Maintain a cost-effective, very low-emission supply portfolio that incorporates a large share of long-term distributed renewable resources while retaining the flexibility to address changes in the evolving regional energy market: ♦ Adapt the short-term energy plan to hedge GMP-forecasted energy positions by season using layered, competitive supply solicitations. ♦ Explore the addition of diverse long-term renewable resources to achieve future RES program targets, while reducing reliance on REC-only purchases. ♦ Seek competitive short-term capacity purchases to hedge forecasted capacity requirements in advance of the delivery period. ♦ Evaluate the addition of long-term peak reduction and storage resources to address growing capacity shortfalls and in response to increasing energy volatility.
Transmission & Distribution	Plan the energy delivery system to allow the transition to a distributed, home-, business-, and community-based energy model while preparing the grid for harsher storm conditions: ♦ Leverage the vast data produced by our AMI and distributed energy resources to evaluate our circuits for highest locational value. ♦ Prepare system for the influx of strategic electrification, such as electric vehicles and heat pumps. ♦ Continue to invest in vegetation management programs and innovative solutions to address reliability.
Financial Strength	♦ Maintain strong financial measures and results to ensure strong operational support for customers. ♦ Maintain capital planning focus and discipline in each core area of spending to provide reliable power in this time of climate change.

Table 1-4. Implementation and Action Plan

ORGANIZATION OF THIS IRP

Our 2018 IRP is designed to be accessible and readable to a wide audience, even though its subject can be technical.

IRP Chapters

Chapter 1. Executive Summary describes our company, the statutory and self-imposed goals of our IRP, and our energy mix at a high level, especially from DERs and net-metered generation. It highlights the summary findings of our IRP. It also includes an overview description of our power grid together with specific details regarding our customers, our load, and transmission and distribution system. We wrote the Executive Summary to be a stand-alone document.

Chapter 2. Innovative Customer Programs demonstrates how we continue to empower our customers with a number of innovative energy programs, the multiple ways we communicate with our customers and meet them where they are, and the commitment we have to delivering excellent service.

Chapter 3. Regional and Environmental Evolution discusses regional supply, demand, and transmission developments; environmental impacts, and regional energy markets, prices, and constraints; and how they affect our resource portfolio.

Chapter 4. Declining Electricity Demand forecasts how energy demand will slowly decline in the next decade, despite electrification in heating and transportation, because of the cumulative effect of DERs, net-metered generation, energy efficiencies, and demand response measures.

Chapter 5. Our Increasingly Renewable Energy Supply presents specifics on the evolution of our resource mix away from thermal generation toward a renewable portfolio that meets statutory requirements.

Chapter 6. Transmission and Distribution evaluates our T&D system, discusses our innovative management practices, and outlines our grid modernization and vegetation management strategies.

Chapter 7. Financial Assessments provides information on our overall costs and electricity rates, our financial forecasts, and how we diligently maintain reasonable prices.

Chapter 8. Portfolio Evaluation describes the methods we employed to model and analyze our options to develop a preferred generation portfolio, and the results and conclusions of our analysis, along with our portfolio preferences in the planning period.

Chapter 9. Integration and Action Plan describes the specific action steps for implementing our IRP that considers demand, supply, finances, and transmission and distribution.

IRP Appendices

Included are a number of appendices that support our 2018 IRP:

Appendix A. Glossary and Acronyms defines and describes terms used throughout the IRP.

Appendix B. 2019 Budget Forecast Report presents the actual budget and demand forecast report created by Itron for our use in developing this IRP.

Appendix C. Transmission and Distribution Projects describes all of the completed and in-progress T&D projects that upgrade our system, deliver energy reliably, reduce the potential for faults and outages, and plan for the future.

Appendix D. Vegetation Management includes our *Transmission Right-Of-Way Management Plan*, our *Distribution Integrated Vegetation Management Plan*, and the emerging planning regarding the Emerald Ash Borer infestation.

Appendix E. Substations lists the 13 (out of 185) substations that lie in FEMA-designated 100-year or 500-year floodplains.