2011
Integrated Resource Plan for Electricity

GREEN MOUNTAIN POWER

On. Every Day.

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1. Executive Summary

Overview

Green Mountain Power presents the results of our 2011 Integrated Resource Planning (IRP) process. Through this process, we met three fundamental objectives.

The first — and most important — objective is that we thoughtfully examined the potential strategies that GMP could deploy to secure the resources necessary to meet the needs of our customers in a way that provides the most value to customers, based on current and anticipated regulatory policies, price projections, and risks. GMP evaluated the various strategic options from several perspectives: projected costs, air emissions, flexibility, financial feasibility, and flexibility to adapt to the changing environments in which our customers live and conduct their businesses.

A second objective is to form a basis for dialogue with the Vermont Public Service Board (PSB), the Department of Public Service (DPS), and other key stakeholders including the Vermont Legislature, the executive administration, other government agencies, and the public. GMP hopes that this report and other insights and information developed within the IRP analysis will provide insight into GMP's future resource needs, and the factors that GMP is using to determine how best to meet those needs. Finally, we comply with the requirement for all utilities in Vermont to periodically file an Integrated Resource Plan. Pursuant to 30 Vermont Statutes Annotated (V.S.A.) § 218c, each regulated electric company is required to prepare and implement a least-cost integrated plan for the provision of energy services to its Vermont customers. A "least-cost integrated plan" is defined as:

> . . . a plan for meeting the public's need for energy services, after safety concerns are addressed, at the lowest present value life cycle cost, including environmental and economic costs, through a strategy combining investments and expenditures on energy supply, transmission and distribution capacity, transmission and distribution efficiency, and comprehensive energy efficiency programs.

Changing Focus from 2007 IRP

The primary theme in GMP's 2007 IRP was assessing the emerging gap between projected load and long-term supply sources to meet that load (driven by the impending expiration of GMP's major long-term power purchase agreements (PPAs) with Vermont Yankee and Hydro-Québec) and identifying the priority resources for GMP to explore in rebuilding its power supply portfolio. In the past three years, GMP has actively pursued each of the resources identified as priorities in the 2007 IRP — including several types of new renewable generation; PPA opportunities with Hydro-Québec, Vermont Yankee, and other nuclear owners; natural gas combined cycle plants; and in-state peaking capacity.

As explained in this Executive Summary and discussed more fully throughout the IRP, GMP has acquired and proposed substantial new power supply sources that will fundamentally transform the our long-term power supply portfolio in favorable ways. GMP is pursuing a portfolio that maintains many of the strengths of its past portfolio (including a low emission profile and relatively stable electric rates) while reflecting Vermont preferences and our own Energy Plan in multiple ways (for example, greater diversity of sources, a ramp-down of reliance on nuclear sources, a substantial increase in power supply from new renewable power sources, and a somewhat greater portion of the portfolio that is responsive to market prices).

Organization of the IRP

This IRP consists of nine chapters and several supporting appendices.

Chapter 1: Executive Summary reviews the entire plan and presents its conclusions.

Chapter 2: Background Information address three themes that dominate the national, regional, and local electric industry.

Chapter 3: Demand summarizes GMP's recent long-term forecast of customer electricity requirements.

Chapter 4: Supply Resources summarizes GMP's owned generating plants and purchased power sources.

Chapter 5: Local Power Transmission and Delivery discusses how GMP plans, builds, upgrades, maintains, repairs, and monitors its delivery system. This section explains the current and planned projects that will help GMP provide reliable service to its customers.

Chapter 6: Smart Grid presents this emerging technology and the major project that it represents for GMP, explains how it benefits both GMP and its customers, and discusses how it is being implemented.

Chapter 7: Planning Energy Resources describes the analytical framework – including three alternate long-term scenarios of future outcomes for key uncertainties, and several stress tests - that GMP used to evaluate its power supply portfolio and to test potential future resource strategies.

Chapter 8: Evaluating Resource Portfolios analyzes, in depth, potential power supply strategies, presenting the results of the portfolio analysis. This section presents an illustrative preferred portfolio, and tests the performance of that portfolio in a number of ways.

Chapter 9: Action Plan outlines the proposed plan for implementing the conclusions presented in the core chapters of this IRP.

Changing Circumstances

GMP's portfolio planning in recent years has proceeded in a context of changing circumstances. Chapter 2 summarizes many developments in the electric industry (nationally and regionally in New England) that have affected GMP's power procurement strategy and activities. Some of the most notable developments follow.

First, a large decline in electricity market prices has greatly enhanced the prospects for purchasing power on a long-term basis. During 2008, energy market prices climbed to historic levels, with natural gas prices reaching well over $10 per MMBtu and crude oil prices briefly reaching $140 per barrel. The market price for electric energy procured in 2008 for delivery in New England in 2010 exceeded $100 per MWh (that is, 10 cents per kWh). Since 2008, however, energy market prices have fallen steadily to levels not seen in many years. Longer-term market price outlooks have also declined by tens of percentage points during this period. The primary driver of the short- and long-term price declines has been the emergence of shale gas production, which has fundamentally transformed the U.S. natural gas industry. Some of the price decline was also attributable to a sustained national slowdown of economic activity. A primary result of these market developments is that the past two years have increasingly represented a buying opportunity for GMP.

Second, the future of the Vermont Yankee plant has remained uncertain. While Vermont Yankee recently received Nuclear Regulatory Commission approval for its requested 20-year license extension, the Vermont legislature did not authorize the PSB to act on Entergy's license extension petition for Vermont. Governor Shumlin has also made it clear that in his view, the plant should be retired at the end of its license in March 2012. As a result, the plant's owner is now contesting (in federal court) the State of Vermont's jurisdiction over the plant's right to operate after its current license expires, and has sought an injunction enabling the plant to operate while the matter is litigated. At this time, it is not clear whether the plant will operate (in the near-term or the long-term), and it does not appear that this uncertainty will be resolved for some time.

Lastly, all planning initiatives in the electric power sector need to be cast against a backdrop of evolving climate change policy. At present, there is no comprehensive national policy to reduce the emission of CO_2, but components of such a policy are starting to emerge in both the national regulation of greenhouse gasses by the EPA and in the efforts of many states toward increased renewable energy development. In GMP's planning considerable weight is being given to addressing the electric sector's contribution to climate change because of the significant and supportive VT policy backdrop for addressing climate change, the financial risk that the carbon regulation poses to conventional fossil fired resources, and our customers' attention to and support for addressing this issue.

The New Supply

A Period of Extraordinary Power Supply Acquisition

Since GMP's last IRP in 2007, several factors — the approaching need for new power supplies, the decline in power market prices, and state policy guidance encouraging the acquisition of additional renewable power sources — have combined to lead GMP to conduct an extraordinary amount of power supply procurement activity. Specifically, GMP has acquired (or is in the process of acquiring) major new power sources that together can meet a large portion of GMP's future power supply needs. The highlights of these new acquisitions are the following:

- A new long-term PPA with Hydro-Québec's U.S. power marketing affiliate. This 26-year PPA begins in 2012, and features flat energy deliveries of energy during the 16 peak hours of every day and low-emission generation attributes associated with the Hydro-Québec system. GMP's share of annual energy volumes will be roughly 450,000 MWh for much of the contract period, representing about 21 percent of GMP's energy needs in 2016. The PSB recently granted a Certificate of Public Good (CPG) for this purchase.
- GMP has entered into a long-term agreement to purchase 32 MW of output from the Granite Reliable wind project that is presently under construction in New Hampshire. This contract is expected to deliver an average of about 96,000 MWh per year of energy and associated Renewable Energy Credits (RECs) to GMP, representing roughly 5 percent of GMP's annual energy needs. This contract will also deliver the associated capacity after 5 years.
- GMP has installed five solar plants throughout our territory, ranging in size from 3 kW to 200 kW, with the total capacity amounting to just under 500 kW. In addition, GMP's Solar Rate, which encourages customers to install their own solar devices, has received a substantial response; installed projects and applications currently exceed two percent of GMP's peak load.
- In December 2008, GMP began purchasing the electrical output — energy, RECs, and capacity — from an approximately 3 MW generator at the Moretown Landfill. Since this plant came online, it has provided about 25,000 MWh per year of baseload energy, or about one percent of GMP's annual energy supply.
- As the IRP portfolio evaluation was being finalized, GMP reached agreement with NextEra Seabrook, LLC on a new long-term PPA; GMP recently filed a petition seeking a Certificate of Public Good for the purchase. Beginning in March 2012, GMP will receive 15 MW of firm energy, increasing to 60 MW of unit-contingent baseload energy[1] in January 2015 and ending with 40 MW in December 2034. Because this PPA was not finalized during our work on the IRP, the portfolio evaluation presented herein does not represent the proposed PPA as a committed resource.
- Finally, as power market prices declined in 2009 and 2010, GMP entered into layered system energy purchases at fixed prices, with terms of up to five years. These sources do not provide capacity nor do they carry attributes (such as low-emissions and renewable) Vermonters prefer, but they serve their purpose by protecting GMP customers against potential market price increases starting in 2012 and by acting as a "bridge" to new, longer-term preferred resources (some of which are summarized above).

[1] The NextEra purchase features somewhat larger volumes of capacity.

Building and Owning Vermont Renewable Generation

The proposed Kingdom Community Wind project (KCW) is central to GMP's renewable power acquisition plan; it will provide about 8 percent of GMP's annual energy requirements. As an in-state wind plant, KCW is consistent with Vermont energy policy, and will help GMP and VEC achieve their proportions of Vermont's renewable energy goals at the lowest achievable cost. With a projected levelized cost of power of about 9.2 cents/kWh, KCW is the lowest-cost new renewable power source available to GMP — much less costly than the small renewable power projects from which GMP purchases today through the VEPPI program. As a utility-owned power source, KCW also has the potential to also provide longer-term benefits for GMP's customers, particularly if future electricity market prices turn out high or a policy premium is placed on limiting greenhouse gas emissions. The project will generate a great deal of local economic activity, including direct and indirect employment effects and payments to local entities (for the siting Town of Lowell, neighboring towns, landowners, and the State of Vermont).

Together, these committed and proposed new sources represent about 24 million MWh of estimated future energy deliveries for GMP. The collective spending on these proposed sources is several hundred million dollars in present worth terms, and well in excess of $1 billion in nominal terms. In short, the pace of supply acquisition in the past several years has been extraordinary for a utility of GMP's scale. As explained below, this pace of supply acquisition at GMP will not be repeated any time soon.

The State of the GMP Portfolio

For a number of years leading up to the 2007 IRP, GMP's "supply picture" — the outlook for GMP's long-term power sources relative to its projected power needs — was relatively static. The outlook showed a substantial and increasing gap between the power requirements and committed resources, beginning in 2012 with the expiration of the current Vermont Yankee PPA. By 2016, after the scheduled expiration of GMP's purchases under the current Hydro-Québec-Vermont Joint Owners (HQ/VJO) PPA, GMP's committed long-term sources were only sufficient to cover about 15% of our projected annual energy needs. GMP's projected need for new supply sources was large and encompassed a range of resource types (operating role, fuel type, and term).

Today, as a result of the substantial new power sources, both arranged and proposed, the picture is fundamentally different. We provide a flavor of this transition by showing GMP's projected energy supply for three illustrative years: 2011, 2013 (the first full year after the current Vermont Yankee PPA expires), and 2016 (the first year after the current Hydro-Québec contract expires).

- Figure 1 projects our 2011 energy mix[2]. This chart is dominated by our PPAs with Vermont Yankee nuclear and Hydro-Québec.

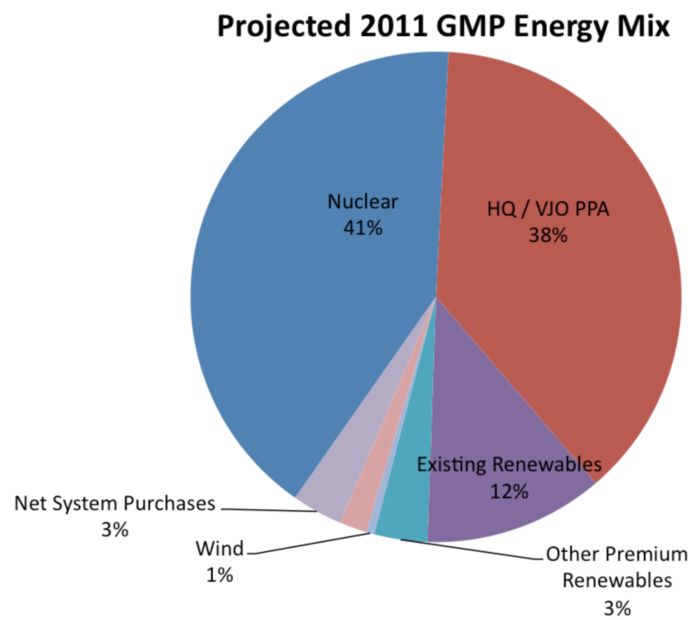

Figure 1: Projected 2011 GMP Energy Mix

- Figure 2 projects our 2013 energy mix[3], the first full year after the current Vermont Yankee PPA expires.

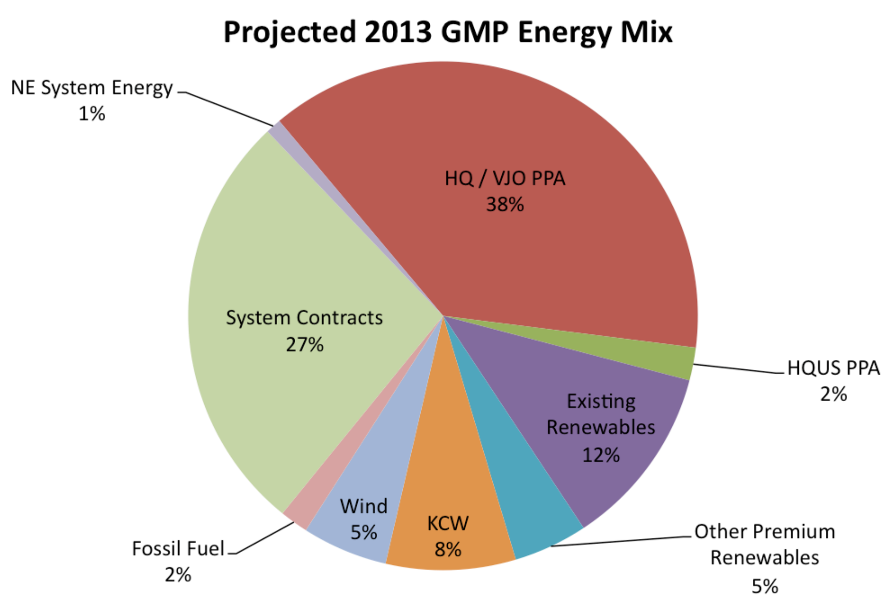

Figure 2: Projected 2013 GMP Energy Mix

[2] Net System Purchases" is the sum of bilateral forward energy purchases and spot (DA/RT) transactions.
[3] Figure 2 and Figure 3 do not include GMP's recently proposed NextEra PPA, which would provide an estimated 7% of GMP's supply in 2013 and 24% of GMP's supply in 2016.

- Figure 3 projects our 2016 energy mix, the first year after the current Hydro-Québec contract expires.

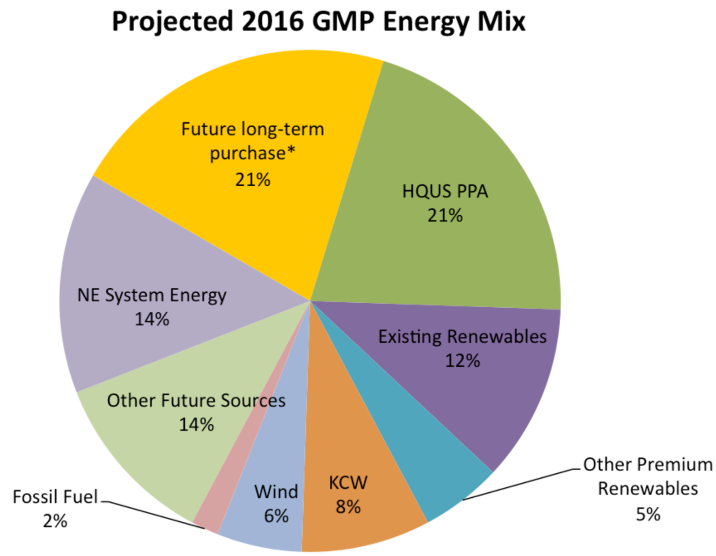

Figure 3: Projected 2016 GMP Energy Mix

These three figures show a clear transition from GMP's past supply (which was dominated by the Vermont Yankee and Hydro-Québec purchases) to a future supply that is less reliant on single sources, more reliant on renewable sources, and not fully committed to long-term purchases.

The Remaining Gap (Need)

Looking forward, GMP's committed and planned sources are sufficient to cover much of the previous "gap" between GMP's projected load requirements and its long-term power sources.

As Figure 4 illustrates, the annual energy output of GMP's committed and planned energy sources (including the committed sources described above) is sufficient to meet about 53% of the projected requirements of GMP's customers in the long-term. (Again, note that this figure does not include the capacity gained from the pending NextEra PPA.)

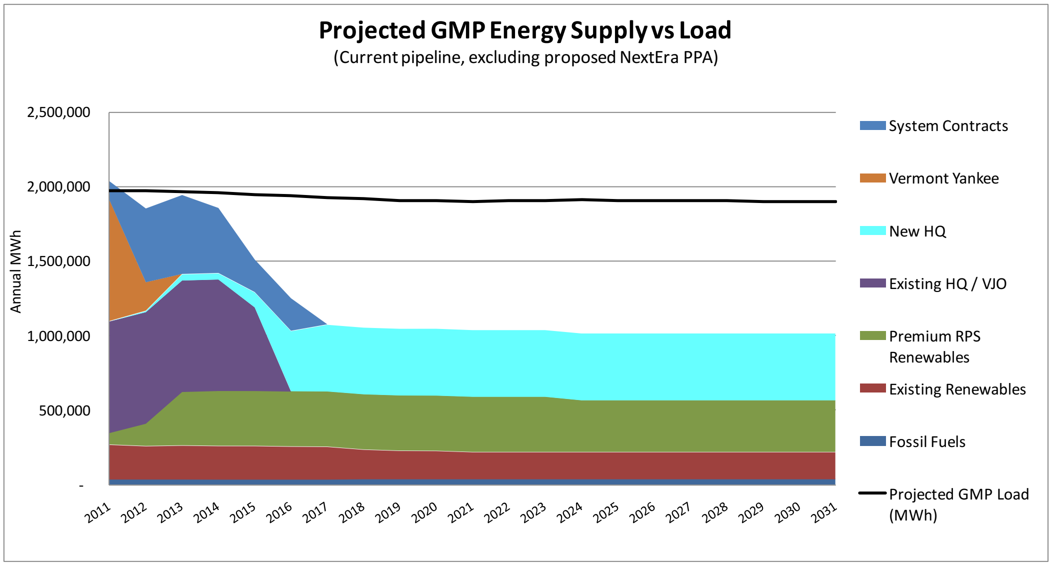

Figure 4: Projected GMP Energy Supply Versus Load

Thematically, the emerging GMP portfolio is consistent with the priorities outlined in GMP's 2007 IRP, and with GMP's subsequent Energy Plan (which emphasizes the touchstone attributes of low cost, low carbon, and high reliability), with Vermont legislative guidance, and with public preferences. GMP's planned sources, led by the proposed Kingdom Community Wind project, feature a substantial increase in new renewable power sources (those that are eligible to meet Vermont's SPEED program goals or the Class 1 renewable requirements of other New England states). Because most of GMP's new sources feature stable prices, the emerging portfolio features a substantial degree of long-term price stability. This is likely to make GMP's power supply costs (and therefore electric rates) much more stable than those of utilities in neighboring states, and positions GMP well against potential high future market price outcomes (which could arise from high natural gas prices, national regulation of greenhouse gas emissions, or other factors).

As GMP's portfolio takes shape, we observe that the primary needs to be obtained from future sources appear to be:

- Additional firm capacity sources, to hedge an increasing exposure in the ISO-New England Forward Capacity Market.
- Additional baseload power sources, to help meet GMP's round-the-clock power needs and to complement GMP's increasing reliance on intermittent renewable sources.
- Additional low-emission power sources, to help maintain the very low historical emission profile of GMP's power supply, and to replace the short- to mid-term system energy purchases noted above.

- Additional low-cost purchases that take advantage of the substantial decline in power market prices that has occurred in the past several years. Such purchases would complement the higher-cost renewables that GMP is acquiring, and enable GMP to continue offering electricity rates that are regionally competitive.

These features can potentially be obtained from multiple types of power sources, in various combinations. We note, however, that two types of sources — purchases from existing nuclear and large hydroelectric plants — have the potential to address all of these needs, and on a scale appropriate to GMP's portfolio.

Finding and Testing a Preferred Future Portfolio

In Chapter 8 we focus on identifying potential portfolio strategies, evaluating them, and identifying a preferred portfolio. This analysis includes the following steps: 1)Identifying GMP's resource needs, 2) Developing Alternative Portfolios, 3) Testing the Performance of the Alternative Portfolios and Determination of a Preferred Portfolio, 4) Testing the performance of the Preferred Portfolio, and 5) Key Findings and On-going Portfolio Management.

We began by evaluating the GMP's existing and committed resources against a resource gap based on expectations for future load. We then applied portfolio themes with differing levels of emphasis on market exposure, emissions reduction, renewable generation and in-state combined cycle generation to develop six potential alternative portfolio strategies. We tested each portfolio under each of our three scenarios from Chapter 7 against a series of metrics that included price stability, emissions, level of renewablness, and power costs. Based on a multi-attribute analysis of portfolio performance, we selected a preferred portfolio that mixed elements from the best-performing strategies. Next, we tested the preferred portfolio in our three scenarios, as well as additional sensitivity cases that suppose higher carbon allowance pricing, potential "shocks" such as the unexpected loss of significant load or reduced market prices as well as alternative resources choices, namely the addition of a combined cycle plant in Vermont. (See Figure 5 which illustrates this process)

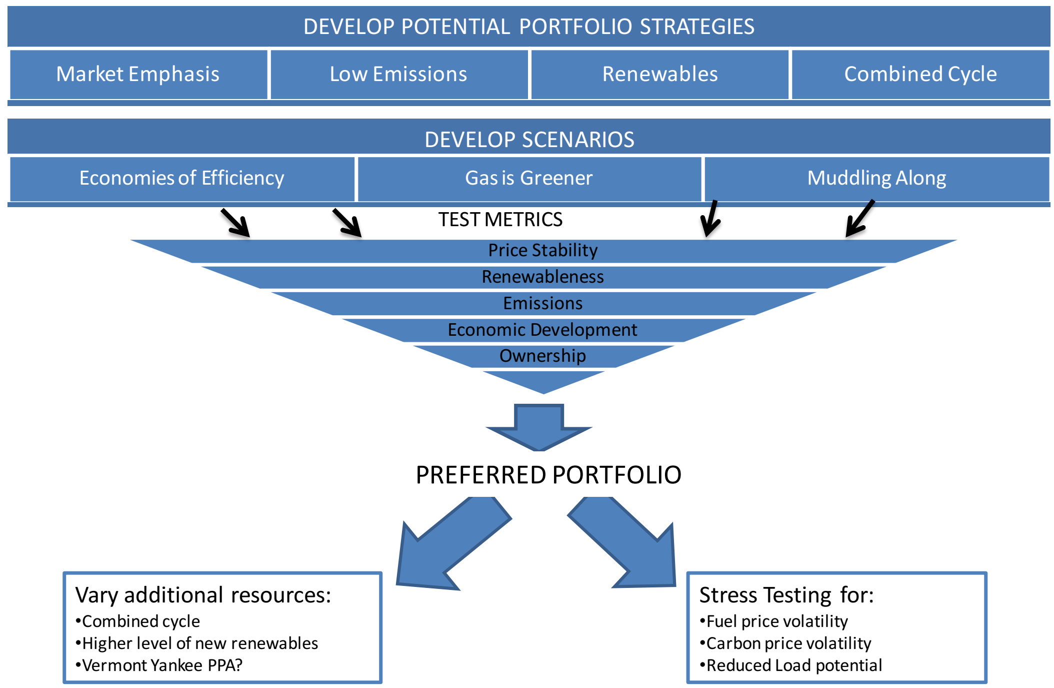

Figure 5: Method for Developing Potential Portfolio Strategies

GMP's preferred portfolio will maintain many of the strengths of its past portfolio (including a low emission profile and relatively stable electric rates), while reflecting Vermont preferences and our own Energy Plan in multiple ways (for example, greater diversity of sources, a ramp-down of reliance on nuclear sources, a substantial increase in power supply from new renewable power sources, and a somewhat greater portion of the portfolio that is responsive to market prices.

This analysis demonstrates that GMP has positioned itself to build a sustained portfolio that favorably balances financial, stability, environmental and other attributes in a wide variety of uncertain future conditions. Under the analysis conducted, our preferred portfolio performed well relative to GMP's key objectives.

An Illustrative Preferred Portfolio

The preferred portfolio is a specific combination of existing and future power resources, featuring specific types, amounts, and timing of future resource additions that appear appropriate, based on GMP's current evaluation, to serve the power needs of GMP's customers over the long-term. Of course, the number of potential specific future portfolios is essentially infinite, and the actual costs and prices at which future resources may be available could differ materially from those shown here. The illustrative preferred portfolio shown here does not commit GMP to specific resources, but it identifies the key themes that emerge from GMP's portfolio evaluation, and how they can be addressed with specific future resource choices.

Key elements of the preferred portfolio are as follows.

Retaining Existing Owned Generation

We expect all of our owned hydroelectric plants, and most of its oil-fired peaking plants, to continue to be available for many years.

A Meaningful New Long-term Power Purchase

This purchase is expected to be from a low-emission source that is not a "new" renewable under Vermont's SPEED program or a Class 1 renewable in neighboring states. The source would most likely be an existing nuclear or large hydro plant (or combination of plants). A primary goal of this purchase would be to add another low-emission source to the portfolio at relatively stable prices — thereby enabling GMP to take advantage of the substantial decline the electricity market price environment, greatly reducing the uncertainty of our long-term power costs and retail rate path. In the GMP portfolio analysis, the purchase is represented for illustration as a 50 MW purchase of unit-contingent power from a nuclear plant, for a term of 20 years. The price is assumed to start somewhat above near-term market prices, and to escalate at the rate of general price inflation (which is slower than we project future power market prices to increase).[4]

Increasing Amounts of Smaller Scale, In-state Renewable Generation

This represents a combination of community-scale generation projects (owned by GMP, or independently owned with output sold to GMP under PPAs), and customer-scale generation (which would likely participate in the net metering program). While small-scale renewable generation is, at present, typically much more costly on a long-term basis than utility-scale renewable sources, it has the potential to bring some unique local benefits (for example, local economic development, diversity of supply sources, and support of the local delivery system). We assume, for illustration, that much of this development will be solar photovoltaic, since this has been the primary small-scale renewable technology developed in GMP's territory in recent years. In addition, the technology's cost and performance characteristics are projected to continue to improve over time.

A Meaningful "Open" Position

In the preferred portfolio, a meaningful portion of the portfolio — starting at roughly 25 percent of projected load requirements in 2016 — is not "filled" with long-term, stable-priced supply commitments. This is a significant component of the preferred portfolio because it provides flexibility for several potential developments that could occur in the future. In particular, such developments include:

- Lower future electricity demand by GMP customers. This could be driven by one or more of lower economic growth in Vermont, greater energy efficiency savings, or a future decline in power needs by one of GMP's largest customers.
- Further declines in electricity market prices. Maintaining a meaningful portion of the portfolio open to future purchase will ensure that GMP customers benefit if power market prices turn out lower than today's expectations.
- Other future resource opportunities, such as preferred in-state renewable sources or output from a combined heat and power project.

Future Short and Mid-term Purchases

These purchases would be from existing low-emission sources (most likely hydroelectric) in the region with terms of one to five years. This type of purchase, if they can be obtained at competitive prices, would protect GMP customers from short-term market price volatility and enhance the portfolio's

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[4] As the IRP portfolio evaluation was being finalized, GMP reached agreement with NextEra Seabrook, LLC on a new long-term PPA, and GMP recently filed a petition seeking a Certificate of Public Good for the purchase. As a result, the portfolio evaluation presented herein does not include the proposed PPA as a committed resource.

emission profile and renewable content while maintaining flexibility to respond to longer-term developments and would not incur the significant price premium associated with many new renewable sources.

Consistent with these themes, GMP expects that if and when it implements a new stably-priced, long-term purchase, the central elements of its future portfolio will be in place. GMP would not expect to make new long-term commitments to stable-priced energy sources — at least on a large scale — for some time. In the preferred portfolio, it is likely that future purchases would be made primarily on an opportunistic basis (for example, when market conditions or particular transaction opportunities appear especially attractive) and would typically feature terms of 10 years or less.

Key Characteristics of the Preferred Portfolio

Building on the foundation of committed and planned sources described earlier, the preferred portfolio offers a number of attractive features:

- A high proportion of supply from renewable sources, approaching 20 percent within the next several years. This amount is sufficient for GMP to meet its share of Vermont's SPEED requirements (20% of supply from new renewable sources by 2017), well above requirements in the other New England states. The total fraction of supply from renewable sources including existing ones is projected to exceed 60 percent.
- An emission profile far below the regional average and consistent with GMP's very low historical levels.[5]
- A relatively high degree of long-term supply commitments with a fairly high degree of long-term price stability. This is due to GMP's substantial pipeline of renewable sources, its strategy to make significant long-term purchases to take advantage of recent market price declines, and an increase in the fraction of owned generation. As a result, GMP is relatively well protected against potential high future market price outcomes.
- A competitive expected price profile, reflecting a mix of market-based sources and new renewable sources that were procured at the lowest prices possible.
- An increasing diversity in the numbers of sources (thus, "fewer eggs in one basket"), their fuel types, and (in the case of long-term sources), their price structures.

The features of the preferred portfolio and its performance under potential future conditions are discussed in more detail in "Chapter 8. Evaluating Resource Portfolios".

Key Lessons Learned

The following are noteworthy lessons learned that GMP has identified from the IRP evaluation, along with its recent market experience.

First, utility ownership can be a way for GMP to obtain some types of generation resources at the lowest cost for customers. The KCW project is a primary example of this. In the future, utility

[5] As discussed below and in later chapters of the IRP, GMP's net power costs and the emission profile that it can claim for its power supply will depend significantly on the direction of Vermont's future policy with respect to the sale of RECs.

ownership could also be cost-effective for other local renewable projects (utility scale or smaller scale) and for other types of generation sources, including local peaking capacity.

Second, one of the most important determinants of GMP's retail rate path could be the evolution of Vermont's renewable energy policy — how much of the power supply should be obtained from new renewable sources, how rapidly, and what types of sources are preferred. One of the most important renewable policy choices for Vermont will be whether Vermont utilities should: (a) continue to sell the RECs associated with their new renewable sources or (b) retire the RECs and claim the key attributes of the renewable power (such as the renewable, low air emission profile) as part of Vermont's power supply. This will be one of the topics addressed in a PSB proceeding in Summer 2011. GMP's IRP scenario analysis indicates that the tradeoffs between these policy choices could be substantial, in terms of GMP's retail rates and the characteristics (for example, air emission profile, fuel mix) that GMP is able to claim for its supply portfolio. In particular, as the fraction of new renewable supplies held by GMP increases, we are at a decision point: while the sale of RECs could significantly enhance the regional competitiveness of GMP's retail rates; although selling the RECs would preclude GMP from claiming the renewable attributes of the associated sources (primarily wind), thereby significantly increasing the portfolio's projected emission profile.

GMP Infrastructure

Transmission and Distribution

GMP's delivery system is comprised of 260 miles of sub-transmission lines, 63 substations, and nearly 2,500 miles of distribution lines. We engage in a comprehensive system planning process to meet the reliability needs of our customers while attaining every cost-effective transmission and distribution system efficiency possible.

To meet the reliability needs of our customers, we have engaged in substantial capital investments since our last IRP filing. These investments have resulted in major upgrades to four substations, the construction of three new substations, and three new interconnections to the VELCO high-voltage supply system. Investments in distribution system upgrades are made annually to improve reliability to customers and to serve new load. Looking forward, we have numerous transmission and distribution projects in the study and planning stages designed to update aged equipment, enhance safety and efficiency, and improve reliability.

To ensure that we attain all cost-effective efficiency on the delivery system, GMP routinely implements measures including power factor correction, circuit balancing, circuit reconfiguration, voltage conversions, least-cost transformer acquisition, and conservation voltage regulation. GMP also engages in a number of on-going operations maintenance programs for the purpose of enhancing system reliability. These include vegetation management, pole inspections, aerial patrols, and infrared inspections. Analysis of outages occurs on both a weekly and annual basis. We take special pride in our ability to plan for weather events and perform storm-related restorations expeditiously.

Looking to the future, we intend to take full advantage of the emerging Smart Grid to improve the functionality and reliability of the transmission and distribution system. Through the use of the Smart Grid, we plan to enhance control of the system by our operators, to quickly detect the location of system problems and restore power to interrupted customers, and to enhance the efficiency of the delivery system.

Smart Grid Initiative

GMP's Smart Grid initiative — dubbed *GMPConnects* — is a combination of new meters, upgraded switching equipment, and state of the art software systems. For customers, advanced meters on homes and businesses will enable automatic meter reading, and provide new tools to monitor usage and manage consumption. In substations and on our feeders, new communications technology and automated switches will allow for remote control via GMP's SCADA system to minimize truck rolls. And, in the server room, GMPConnects is powered by a significant upgrade to our data processing systems, including a full replacement of our customer information system (CIS) to enhance customer interaction and to improve data handling through a meter data management system.

This new world of information will enable greater customer insight and control of electricity usage, as well as new rates to encourage off-peak consumption — key components for managing the costs of producing and delivering power. Using data from the Smart Grid, GMP will be able to reduce frequency and duration of outage times to improve the reliability, analyze grid data to optimize power flows, and allow for more small scale renewable generation.

GMP-Owned Generation

While GMP has historically obtained the vast majority of its power supply through purchased power contracts, utility-owned generation can, in some circumstances, be less costly for customers. This is particularly the case over a long-term horizon because properly maintained generating plants can often last longer than the term of a typical long-term PPA (generally 20 years). In addition, when original equipment reaches the end of its useful life, GMP has the option to replace or repower an existing generating plant. To the extent that the costs of replacement or repowering are below then-current market prices, GMP customers will reap the savings. In contrast, at the end of a long-term PPA, the buyer must typically negotiate an extension or future purchase based on then-current power market conditions. In many ways, this dynamic is similar to the "rent versus own" choice that homeowners face.

The clearest example of the benefits of owned generation is GMP's fleet of hydro plants — all of which were constructed decades ago and some of which were constructed over 100 years ago. The average all-in cost of power from GMP's hydro plants is presently between 3 and 4 cents per kWh, and is expected to be relatively stable in the long-term. This is more attractive than any market resources that GMP could purchase today.

As explained in Chapter 4, GMP has in recent years been actively upgrading its owned hydro and thermal generating plants. At several hydro plants, GMP has made generation and control upgrades that will extend the life of these facilities, and in some cases expand the output. While these projects are typically cost-effective sources of additional renewable energy, their scale is typically limited (on the order of hundreds of kW per project). GMP will continue to evaluate and implement improvements at the hydro plants (including an anticipated major overhaul of the Gorge Hydro plant (#18) which will almost double the plant's energy production.

GMP's 2007 IRP action plant discussed uncertainty as to whether some of GMP's existing peaking plants should be retired. Recent upgrades at the Berlin, Essex, and Vergennes facilities have put these facilities in a position to continue serving GMP customers for at least the next 5 to 10 years, and potentially much longer. GMP's Gorge (#17) peaking plant is in the late stages of its economic life, and is an attractive repowering candidate from several perspectives. GMP is considering filing a petition for a Certificate of Public Good in 2011 for repowering the Gorge plant, in case power market conditions or the ability to defer bulk transmission investments cause this project to be needed soon.

Implementation Timeline for Actions

Chapter 9 presents, in tabular form, an illustrative timeline of how the leading conclusions and actions identified in this IRP can be implemented. Of course, this outlook reflects GMP's internal assessment at a specific point in time, and future changes in key inputs like market conditions, customer demand, and industry regulation could alter this outlook.

2. Background Information

The Electric Industry

The electric industry continued to undergo significant changes over the four years since Green Mountain Power's last Integrated Resource Plan in 2007. In particular, two overriding themes emerged that have made the most significant impact on the industry and have altered the mix of resource generation employed to meet current and future demand, both regionally and nationally.

- Theme #1: Environmental Policy (see page 20)
- Theme # 2: New Natural Gas Supply from Shale (see page 23)

Evolving National Generation Mix

The evolution of the national generation mix has indeed been slow, but steady. These unhurried, but sure-footed transitions are largely due to two factors: 1. Any investment in new generation is capital intensive — it simply takes a lot of money; and 2. These investments are long lived, with replacement mainly occurring through attrition. As a result, most change in the national generation mix has come from the gradual influences of overall macroeconomic environment and related commodity pricing fluctuations applied to the normal expiration cycle of retiring assets.

As a result of this gradual process, national electrical generation continues to feature dominant percentages fueled by both coal and natural gas, followed closely by significant contributions from nuclear energy and large hydroelectric power. Recent change in the generation mix have been largely due to influences from the aforementioned themes and has resulted in a gradually increasing share of the nation's supply coming from natural gas.

Figure 6 depicts this gradual advancement, with the most evident shift ocurring from coal to natural gas.

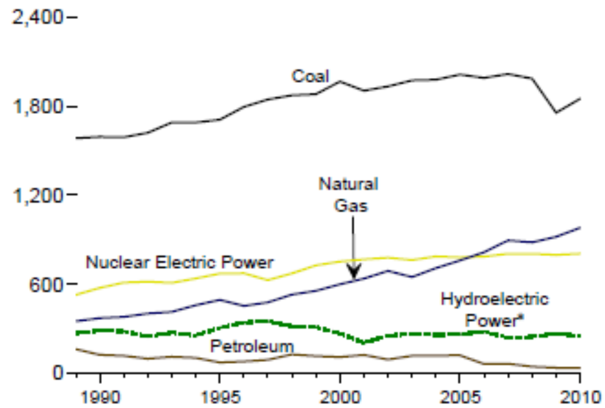

Figure 6: Major Electricity Sources (Billion Kilowatt Hours)[6]

Figure 7 depicts the current snapshot of power sources in the United States.

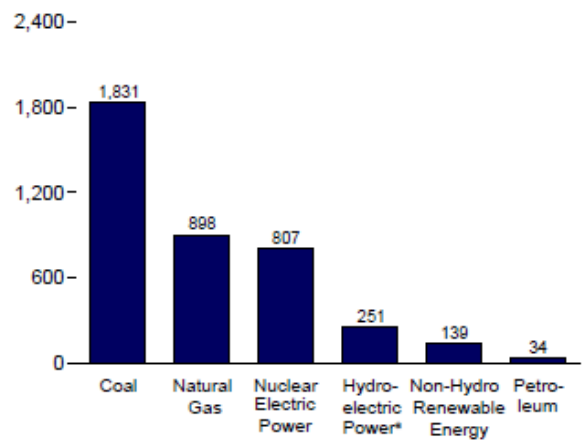

Figure 7: Major Electric Power Sources, 2010 (Billion Kilowatt Hours)[7]

In percentage terms as a source of power when compared with ten years ago:

- Coal and petroleum are both down about 10%.
- Nuclear power and hydroelectric power remain about the same.
- Natural gas is up about 15%.
- Non-hydroelectric renewables (especially wind) are up about 75%.

[6] In Figure 1, The label 'Hydroelectric Power' includes both conventional and pumped storage hydroelectric power.
[7] In Figure 2, The label 'Hydro-electric Power' includes both conventional and pumped storage hydroelectric power.

Evolving New England Generating Mix

In New England, the generation mix paints a bit of a different picture from the national scene. As Figure 8 demonstrates, New England relies heavily on natural gas and nuclear resources, easily outdistancing generation from coal-fired sources.

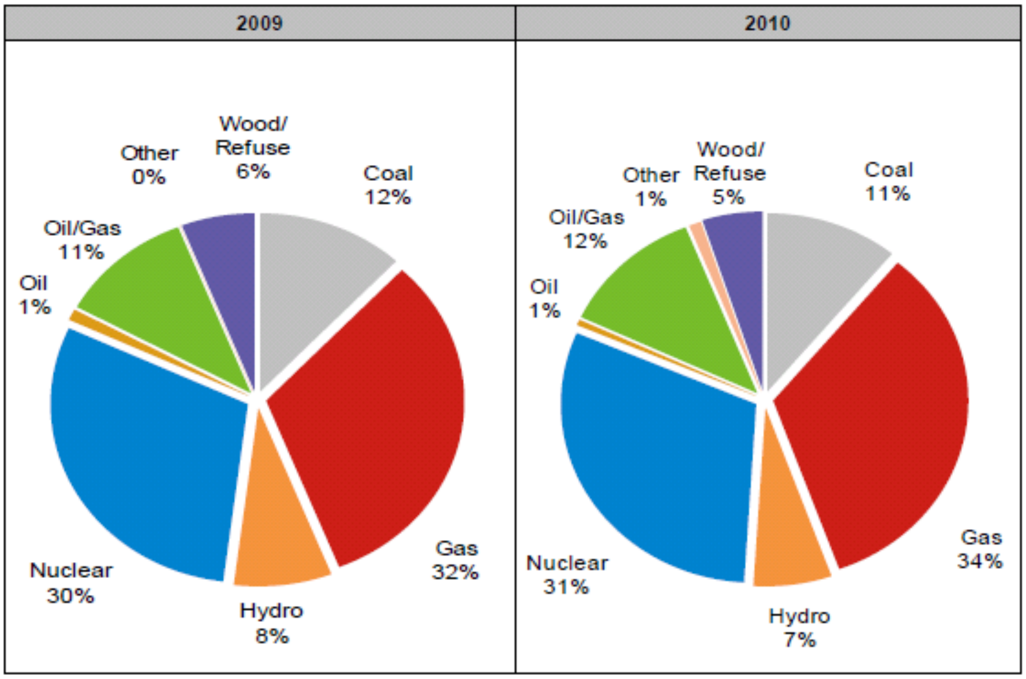

Figure 8: New England Generation by Fuel Type[8]

In the next few years, this picture will evolve more rapidly with contributions from renewable resources expected to increase as many of the states' renewable portfolio requirements begin to accelerate. As a result, ISO-New England renewable energy portion (new and existing) is expected to exceed 25% of the total by 2020.

[8] The 'Other' fuels label includes steam, wind, solar, and methane.

Theme #1: Environmental Policy

Climate Change and Greenhouse Gas Regulation

The Waxman-Markey legislation (passed by the U.S. House of Representatives in 2009), which outlined the country's climate change policy for reducing production of greenhouse gases in many economic sectors, has become the dominant theme in the electricity planning — even though the U.S. Senate rejected the bill. The recent economic downturn has eroded the bill's momentum. Nonetheless, this marked the first meaningful policy advancing the creation of a national RPS and efficiency requirements while simultaneously regulating carbon dioxide (CO_2) emissions from power plants under a cap-and-trade system.

Even without this comprehensive energy legislation, the EPA has regulated greenhouse gas emissions (now including CO_2) under the existing Clean Air Act. These new EPA standards create more stringent controls on new and existing large generation sources, making it more difficult to not only gain permits for large CO_2 emitting facilities, but also to access financing for this type of generation. These difficulties will likely accelerate the move, in many areas of the U.S., to smaller and cleaner natural gas fired generation.

These more stringent regulations are expected to have less of an effect on the energy market and new generation facilities in New England since the area's generation is already tilted to lower-carbon emissions. Nonetheless, New England does have a significant number of old oil-fired generation that contributes to the area's abundant capacity yet does not comply with the new emission standards. Even though these facilities run a limited number of hours, they do exist and will present a conundrum if they must be retrofitted with expensive emission controls.

Renewable Policy Incentives Drive Growth

The trends toward increasing renewable energy development have been driven by incentives and support through national and state policy. In particular, the continued offering of meaningful federal production tax credits (PTC) combined with a large increase in the number of states' RPS policies that require renewable generation to be purchased on behalf of customers has resulted in large fractions of the total overall additions of new electrical capacity in the country to be from wind, biomass, and even solar. Currently, there are 36 states with either mandatory or non-binding RPS policies, plus the District of Columbia, as depicted in Figure 9.

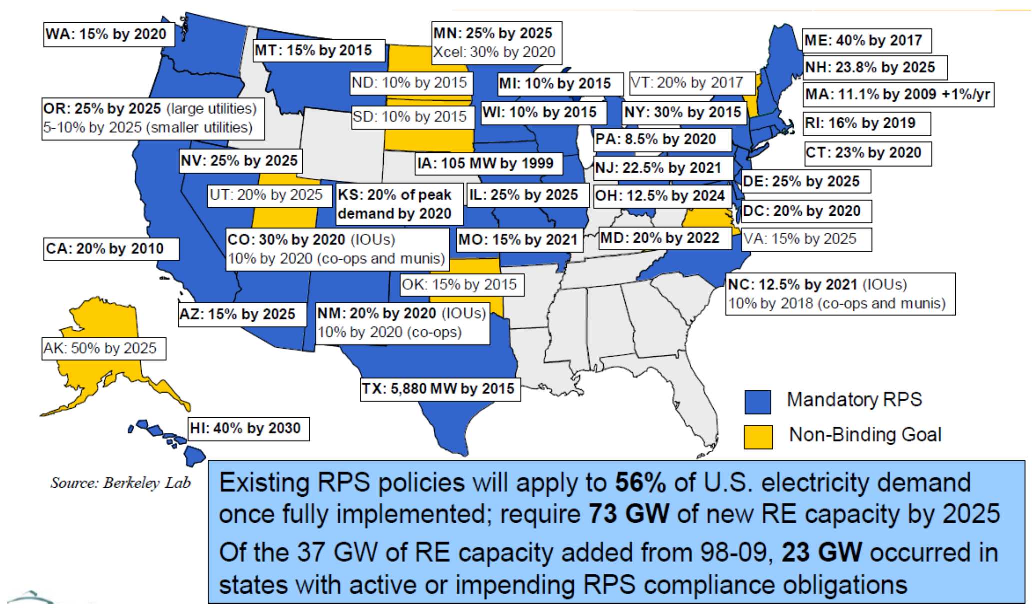

Figure 9: Twenty-nine State and District of Columbia RPS Policies[9]

[9] Seven additional states have non-binding goals (represented in yellow).

Within this development trend, wind generation has increased the most because of the combination of advances in production technology due to larger, more efficient turbine designs and favorable national and state incentives. Wind-generated electricity has increased nationally eight-fold over the last decade (Figure 10) with nearly 20,000 MW installed since GMP's last IRP in 2007.

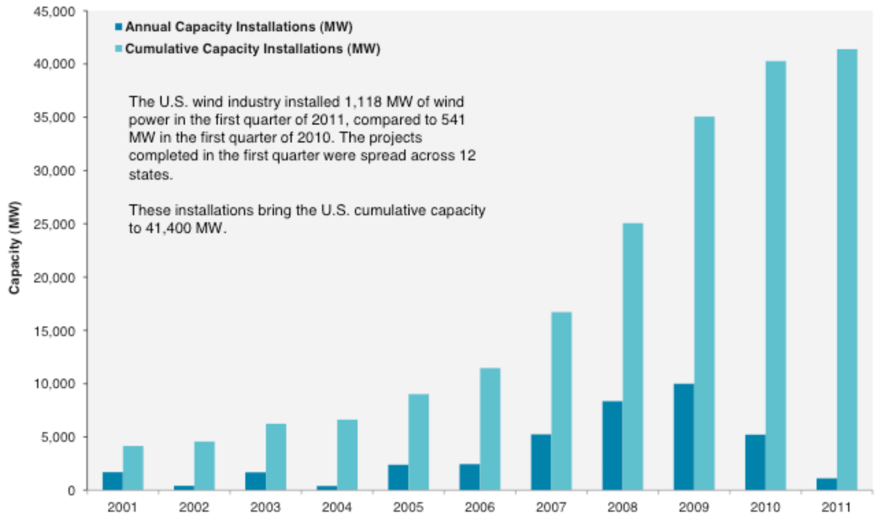

Figure 10: United States Annual and Cumulative Wind Power Capacity

New England Renewable Portfolio Standards

Five of the six New England states have adopted renewable portfolio standards (RPS) for the year 2020 (see Figure 11). Utilities and competitive suppliers must attain these percentages for the electricity they provide to customers from renewable sources, or make alternative compliance payments. Vermont has a separate program of incentives to promote renewable resources (see "Current Vermont Renewable Policy (SPEED)" on page 23). These standards will significantly alter the generation picture over the next decade, engendering an enormous shift toward investments in renewable sources, especially wind.

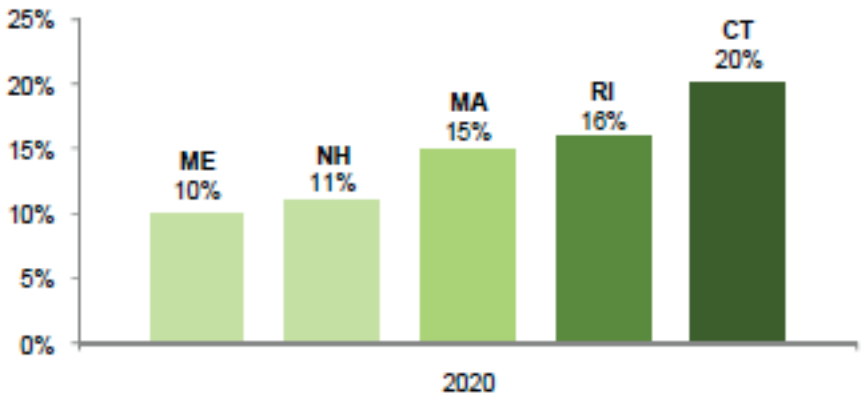

Figure 11: New England State Renewable Portfolio Standards

Current Vermont Renewable Policy (SPEED)

Vermont's renewable policy is in transition. While Vermont does not as yet feature a mandatory RPS, the SPEED statue (created by the Vermont Legislature in 2005 and implemented by the Public Service Board the following year) does establish targets for the purchase of energy from renewable electricity projects. Specifically, it established a minimum goal of 5% of Vermont's 2005 electric load or roughly 300,000 MWh to be acquired by all Vermont utilities by 2012. Further, it sets a target for 20% of Vermont's load to be generated from eligible renewable resources by 2017. Contrary to many RPS programs, the legislation allows credit toward the SPEED requirement even if the renewable energy credits (RECs) are retained by the developer or resold to other buyers in the region.

The legislation also directed that the program be evaluated and its progress toward the prescribed goals be assessed against the current renewable environment in 2012. Next steps hinge upon the recommendations by the Public Service Board (PSB). In the fall of 2011, the PSB is due to produce a progress report for the Vermont Legislature and, toward that goal, has begun a meaningful stakeholder process using consultants from the field of renewable procurement to determine the appropriateness of establishing a more formal RPS in Vermont.

In 2009, the Legislature added a 'feed-in-tariff' provision to the statute (H.446) to stimulate small renewable technologies (generators less than 2.2 MW in size) by requiring state utilities to purchase the output of these projects at established long-term costs. This provision was capped at 50 MW of installed generation with the contribution from any single technology type initially limited to 12.5 MW.

To date, both aspects of the SPEED legislation have been very successful in encouraging new renewable investment. Currently, there will be over 600,000 MWh of operational or proposed and eligible renewable resources available by the end of 2012 — far exceeding the minimum requirement of the statute. In the feed-in-tariff portion of the legislation, the response was so strong that a lottery had to be administered to award the program quantities of both solar and biomass generation. For solar in particular, over 180 MW of projects competed for the 12.5 MW available under the program.

Theme # 2: New Natural Gas Supply from Shale

While the Environmental Protection Agency's (EPA) new emission regulations and climate change policies and the growing incentives for renewable generation have significantly affected the electric industry, by far the largest single determinate of national changes in the price and planning for electricity in the past few years has come from the fluctuations in the prices for natural gas. These changes have been dramatic in both the upward price spikes (culminating in the 2008 peak) and the subsequent and continued downward trend toward levels that would have seemed implausible four years ago.

Driving these fluctuations have been the dramatic changes in the prospects for the supply of natural gas. In 2007 and 2008, natural gas was vulnerable due to its very short-term supply and demand balance based on older and conventional supplies mostly in the Gulf of Mexico. Currently the picture is quite different with supply markedly outpacing demand and much more secure over the long term mainly due to the emergence of shale gas. This introduction of a large new source of supply, compounded by a downturn in U.S. economic conditions, has caused a tremendous decrease in the price of natural gas at a time when most other commodities — especially oil-related products — have increased substantially.

For context on this new supply, domestic natural gas production has grown by approximately 25 percent since 2007 with much of the increase occurring in 2010 (after a modest pause in 2008 and 2009). This increase, largely due to increased shale gas production (23 percent of total U.S. supply by the end of 2010, up from 13 percent just two years earlier), has shown continued strength even as the price for gas has receded.

The United States Energy Information Agency (EIA) projects that shale gas will account for roughly 25 percent of all U.S. natural gas production by 2015 and as much as 46 percent of production by 2035. Figure 12 demonstrates the enormous influence that shale gas has had on natural gas production over the past decade and will continue to have over the next 25 years (in quantities of trillions of cubic feet per year).

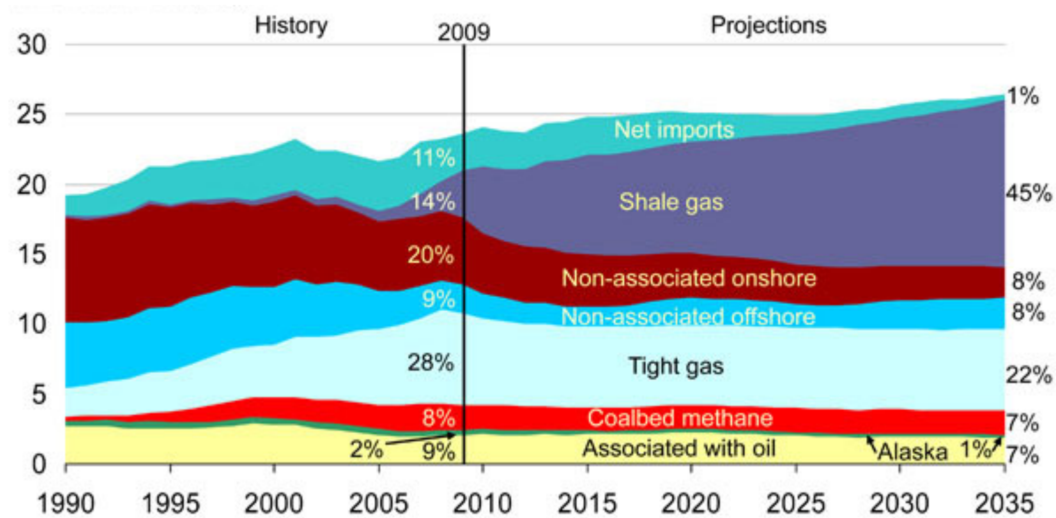

Figure 12: Natural Gas Generation, Historical and Projected

Total Shale Quantity and Environmental Concerns

According to a recent EIA energy outlook report, the United States has 2,552 trillion cubic feet (Tcf) of potential (irrespective of economics) natural gas resources. This is roughly enough to supply current demand for a period just over 100 years. Natural gas from shale resources, considered uneconomical just a few years ago, now accounts for 827 Tcf of this resource estimate, more than double the estimate published last year. Shale gas resource and production estimates increased significantly between the 2010 and 2011 estimates and are likely to increase further in the future as increased drilling activity provides new insights into the newly identified supply areas. However, just as the estimate of technically and economically recoverable shale gas resources has soared in recent years based on this early information, these increases include many assumptions that might prove to be incorrect over the long term.

One of the areas that could alter these estimates most directly is the new study of the environmental impacts of extracting this new shale resource. In 2010, environmental concerns arose regarding air and water quality problems associated with both the increased level and methods involved with natural gas extraction, specifically the hydraulic fracturing method used in shale-gas drilling. With Congressional direction, the EPA is undertaking “a study of this practice to better understand any potential impacts of hydraulic fracturing on drinking water and groundwater”.

The EPA recently submitted its draft study plan to its Science Advisory Board, with the goal of understanding the relationship between hydraulic fracturing and drinking water resources from the beginning to the end of the drilling cycle. The EPA anticipates initial research results by the end of 2012 and a final report in 2014.

Shale's Impact on New England Electricity Prices

The impact of shale gas on the New England region cannot be underestimated due to the preponderance of hours in the year that natural gas is determining the marginal or spot price for electricity (see Figure 13 and Figure 14).

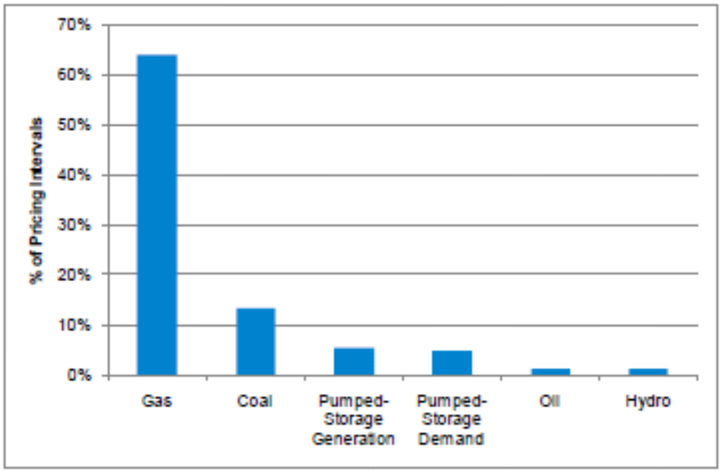

Figure 13: Marginal Fuel-Mix Percentages of Unconstrained Pricing Intervals (2010)

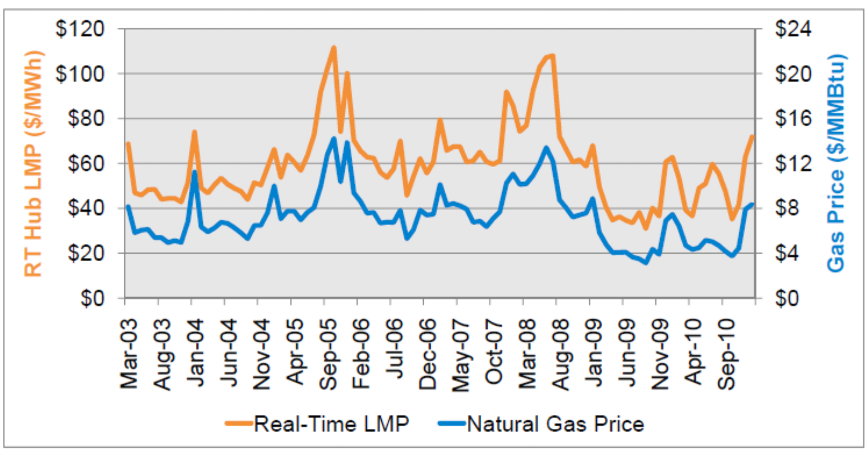

Figure 14: Real-Time Local Marginal Prices Versus Natural Gas Prices

This significant exposure of the region to this single fuel source caused great concern when the supply of the product was threatened in 2008 after the hurricane season greatly damaged the supply infrastructure in the Gulf of Mexico. Also, due to this high dependence in the region, the dramatic price fluctuations between 2005 and 2008 were directly being seen in the electricity prices to New England customers. Today, with the contribution of shale gas to the national supply (much of which is being produced in the Northeast from the massive Marcellus shale formation), many of the concerns that dominated the planning discussion in 2008 have moderated both concerns because of the significantly lower price (Figure 14) and the reduction in our region's exposure to events in the Gulf of Mexico.

2. Background Information

Theme # 2: New Natural Gas Supply from Shale

3. Demand

GMP Current and Projected Electricity Demand

Green Mountain Power (GMP), an investor-owned utility, provides electric services to approximately one-third of the population of Vermont and sells electricity in the wholesale market to other utilities. GMP's service area (Figure 15) is both economically and geographically diverse.

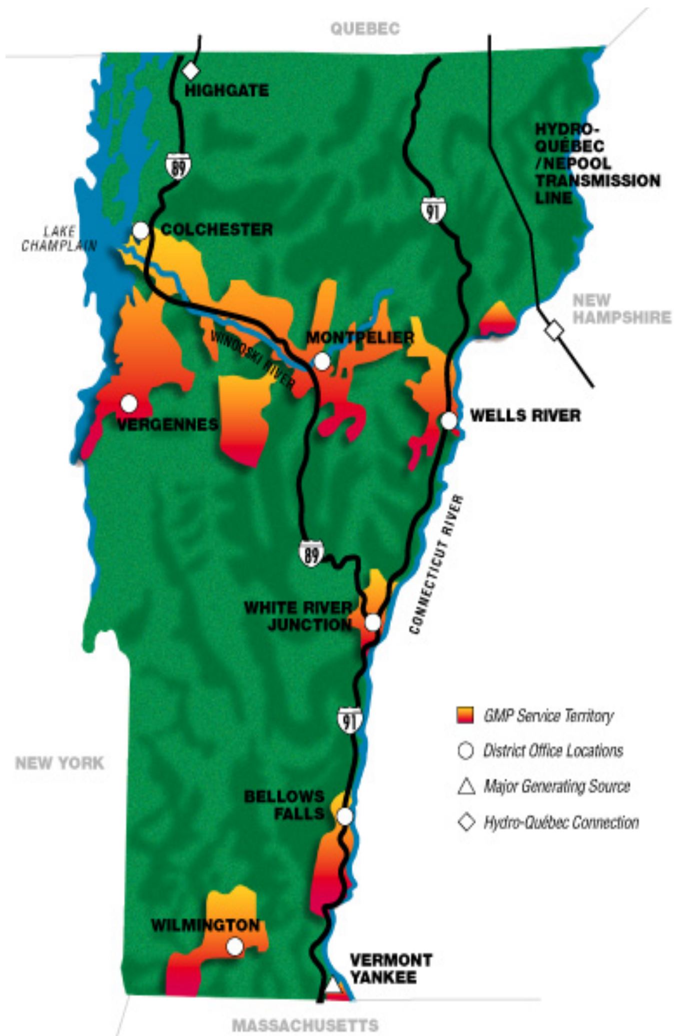

Figure 15: GMP's Service Area

Green Mountain Power serves roughly 95,000 customers in nine counties and 122 different communities. We serve three broad classes of customers:

- Residential 80,000
- Small commercial and industrial 14,000
- Large commercial and industrial 31

Table 1 outlines our customer growth, by class, over the previous five years.

Type of Customer	2006	2007	2008	2009	2010
Residential	78,856	79,461	79,757	80,146	80,697
Small Commercial & Industrial	14,151	14,383	14,500	14,508	14,606
Large Commercial & Industrial	26	29	29	28	31

Table 1: Growth Trend of GMP Customers by Class

These customers have been using somewhat less electricity in the last few years, as a result of energy efficiency initiatives and the downturn in economic conditions (depicted as retail sales in Figure 16).

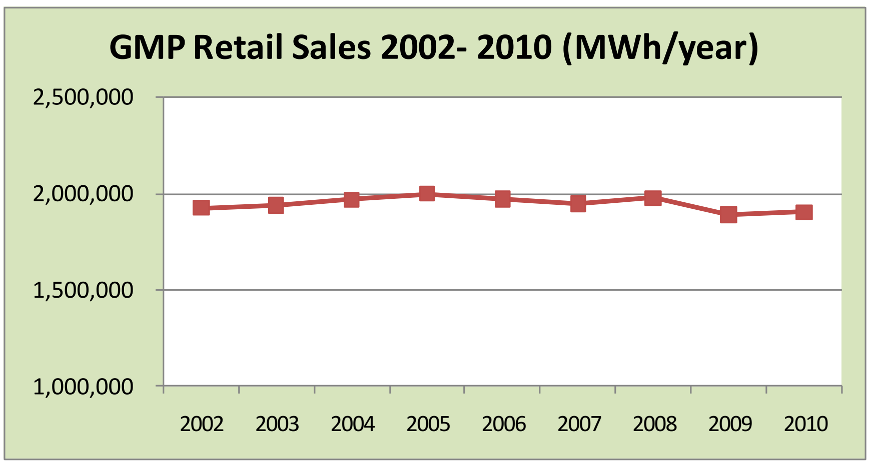

Figure 16: GMP Retails Sales Trend

Current Statewide Efficiency Initiative

Since the our last IRP in 2007, a meaningful change to the GMP's load obligations has come from accelerated spending in the statewide energy efficiency utility (EEU) programs. Since the enactment of a statewide funding program, Vermont has continued to be the leader in U.S. per capita spending on electric efficiency measures.

In 2010, Vermont spent over $54 per capita on efficiency programs outpacing the next largest state expenditure of $44 in Massachusetts by over 20% and far exceeding the national average of just over $16 per capita.[10] Looking forward, we expect the current state funding levels to continue to lead the country (although specific decisions regarding funding levels for the next several years are subject to an open proceeding before the PSB). As a result, planning for the affects of these programs will continue to be one of the most important features of our load forecasting efforts.

GMP Energy Efficiency Fund

In addition, since being acquired by Gaz Metro in 2008, GMP has managed its own energy efficiency fund (EEF). As a condition of the acquisition, GMP was required to demonstrate approximately $9 million in savings for customers, with undelivered savings growing each year at the our allowed rate of return. To provide these savings, GMP created an efficiency spending program and contracted with Efficiency Vermont to deliver this efficiency value to customers within GMP's service territory. This significant level of efficiency funding has resulted in meaningful annual load savings for customers. The EEF program is expected to continue for another two years before the fund commitment is achieved.

Figure 17 summarizes the annual energy savings by year attributable to the EEF program.

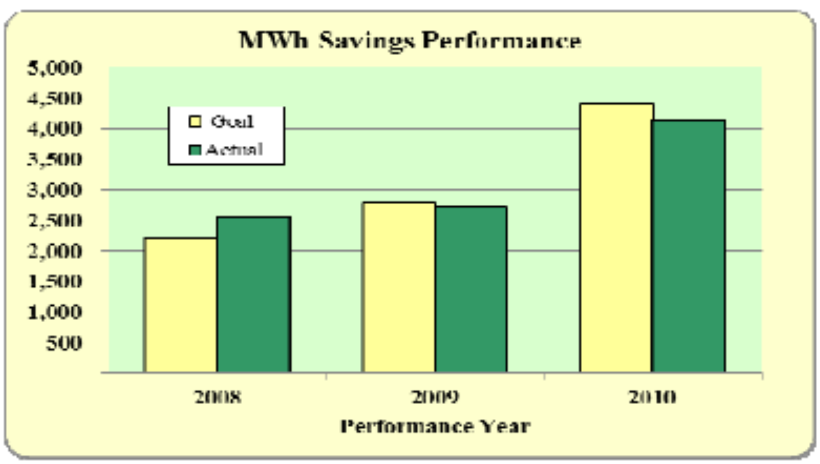

Figure 17: GMP EEF MWh Savings by Year

[10] See www.cee1.org/ee-pe/2010data.php3

Baseline Load Forecast Methodology

Itron, Inc. developed a baseline energy and demand forecast to use in GMP's 2011 IRP; this forecast was completed in January 2011. An updated sales forecast was completed in April 2011 to support GMP's budget and financial planning process. The updated forecast includes additional sales data (through March 2011) and updated (March 2011) economic forecast. ("Appendix A: 2012 Budget Forecast" on page 141 provides results of the updated forecast and detail description of the forecast methodology.) The updated sales forecast is modestly lower than the sales forecast used in the January IRP forecast, as it reflects updated assumptions on the impact of near-term economic conditions and higher real electricity price projections.

Itron has been providing forecast support to GMP and other Vermont utilities for the last decade. The most recent work includes the completion, in October 2010, of a state level long-term energy and demand forecast for VELCO. Itron worked closely with key stakeholders through the forecast development process that included state utilities, Efficiency Vermont, other consultants, and the Vermont DPS Staff. The VELCO forecast has recently been used by DPS and Efficiency Vermont for assessing future energy efficiency savings.

The GMP IRP forecast is developed using the same method as used in the VELCO long-term forecast. The long-term energy and demand forecast builds up from customer class and end-use sales forecasts. The objective is to capture the impact of changing end-use saturation and efficiency, as well as economic conditions on long-term energy requirements and peak demand. The forecast approach entails first developing monthly end-use (heating, cooling, and base use) and customer class sales forecasts using a Statistically Adjusted End-Use (SAE) modeling framework. Resulting class and end-use sales projections are combined with peak-day weather conditions to estimate monthly system peak demand model and forecast peak demand. Through this model structure, peak demand forecasts reflect changes in customer class and end-use sales trends that are, in turn, driven by long-term structural changes (such as changes in housing square footage, improvements in thermal shell efficiency, change in end-use saturation, and end-use efficiency trends).

Figure 18 depicts the forecast approach.

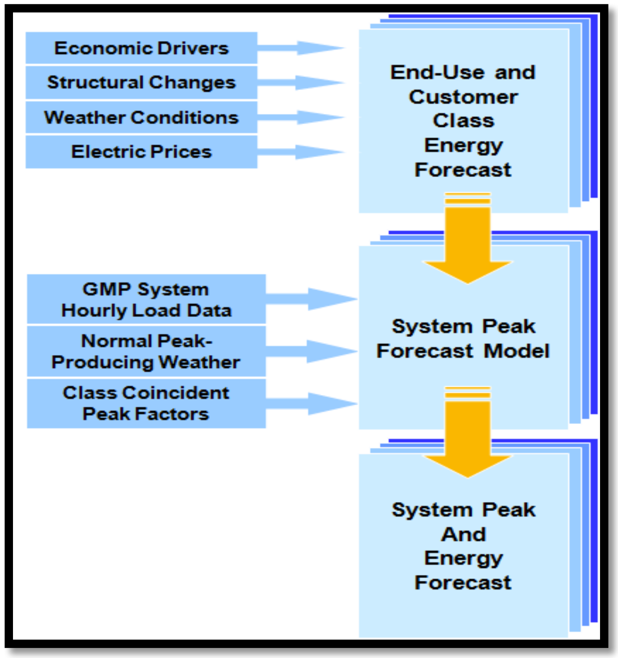

Figure 18: Load Forecasting Methodology

The long-term forecast incorporates the appliance efficiency standards established by the Energy Independence and Security Act (EISA) and the American Recovery and Reinvestment Act (ARRA). End-use saturations have been calibrated into recent Vermont statewide saturation studies; efficiency trends reflect the impact of projected statewide efficiency program savings. The economic drivers include state household projections, real household income, state manufacturing and non-manufacturing output, state manufacturing and non-manufacturing employment, and electric price projections. The IRP forecast is based on *Moody's Economy.com* October 2010 economic forecast; the updated GMP budget forecast incorporates *Moody's Economy.com* March 2011 economic forecast and higher real electricity price projections.

The forecasting methodology includes the following:

- Class sales forecasts (residential, commercial, and industrial) are estimated from historical monthly customer and sales data.
- The IRP forecast is based on billing data from January 2001 to December 2010. The updated budget sales forecast includes actual sales through April 2011.
- Separate monthly regression models are estimated for each revenue class.
- SAE models are estimated for the residential and commercial revenue classes; these models include constructed end-use variables (heating, cooling, other use) that incorporate economic, price, weather conditions, and long-term projections of end-use saturation and efficiency trends.
- Industrial sales are estimated using a more generalized regression model where the primary driver includes state-level output, manufacturing employment, and price. The forecast model excludes sales to IBM; a separate judgment-based IBM forecast is developed based on assumed future business activity and the effects of energy efficiency investments at IBM.

The class sales forecasts are used to generate monthly and annual energy forecasts by applying monthly energy-to-sales ratios to the monthly sales forecasts. The energy-to-sales ratios are based on historical energy (derived from historical system hourly load data) and sales data. The peak forecast is derived using a monthly peak regression model where peak demand is expressed as a function of estimated coincident end-use loads (calculated from the sales forecast models) and peak-day weather conditions. The peak forecast model uses the same model specification as used in the VELCO long-term demand forecast.

Itron developed both a baseline and a 'With Demand-Side Management (DSM)' forecast. The baseline forecast reflects EIA's Annual Energy Outlook 2010 end-use efficiency projections for New England. As the model is estimated with actual data through 2010, we assume that the model captures the impact of past state and utility efficiency activities. Each year, EIA updates the forecast and end-use efficiency projections. These efficiency projections have generally been increasing each year as the updated forecasts reflect recent end-use purchases. As a result, significant efficiency improvements are incorporated into the baseline forecast.

The 'With DSM' forecast incorporates the impact of Efficiency Vermont's program savings projections from their *Forecast 20* Report (December 2009) and GMP-initiated efficiency programs. These savings projections represent the most current end-use saving projections at the time the IRP forecast was completed. These future efficiency program impacts are incorporated into the forecast model by adjusting the end-use efficiency projections to account for expected future program impacts.

Adjusting the Baseline Forecast for IRP Scenario Analysis

In order to evaluate the performance of GMP's resource portfolio strategy under a range of potential future outcomes, GMP implemented a scenario analysis approach. The scenarios include alternative outcomes for the electricity requirements of GMP customers, driven by a range of future macroeconomic outcomes and future energy efficiency spending. "Chapter 7. Planning Energy Resources" (page 81) describes the development of those planning scenarios in more detail, and presents the specific scenarios of future GMP electricity requirements.

4. Supply Resources

GMP employs a number of sources to serve its customers' power requirements.

Historically, we have obtained the vast majority of our generation capacity from power purchase agreements (PPAs) where we purchase power from an external source, delivered at a specific price for a specific length of time. (For example, we purchase 103 MW of power, delivered annually, from Vermont Yankee at a fixed price, under a PPA that expires in March 2012.) GMP retains no profit from a PPA, simply passing on the cost to our customers through retail rates. Upwards of 70% of GMP's capacity derives from PPAs.

GMP also owns a number of generating plants feature several fuel types and technologies. These plants provide a smaller, but continually growing, share of our current capacity. Together with other joint owners, we operate and maintain these plants.

We continually make capital investments in these plants, especially the one that represent cost-effective opportunities to expand energy or capacity output. And we invest in new, owned generation (witness the Kingdom Community Wind project and the Gorge Gas Turbine repowering) when the opportunity for such generation benefits our overall resource supply and our customers.

GMP's Generating Resources

GMP's generation supply consists a number of facilities spread across New England and Québec.

Table 2 describes the basic make-up of each sources. These sources are broken out first the facilities in which GMP has ownership, and then by contacted power purchase agreements (PPAs). The H.446 Statute source is discussed in Chapter 2 (see "Current Vermont Renewable Policy (SPEED)" on page23), while each of the remaining sources is discussed in more detail in this chapter.

Source	Location	Primary Fuel	Ownership	Long-Term Price Stability
Berlin Gas	Vermont	Oil #1/ Kero	100%	Low
Essex Diesels	Vermont	Oil #2	100%	Low
GMP Hydro[11]	Vermont	Hydro	100%	High
Gorge Gas #17	Vermont	Oil #2	100%	Low
Kingdom Community Wind	Vermont	Wind	87%	High
McNeil Wood	Vermont	Wood	11%	Moderate–High
Searsburg Wind	Vermont	Wind	100%	High
Stony Brook	Massachusetts	Oil #2/ Gas	13%	Low
Vergennes Diesels	Vermont	Oil #2	100%	Low
Wyman	Maine	Oil #6	1%	Low

Table 2: GMP-Owned Generation Resource Descriptions

Source	Location	Term/Expiration	Primary Fuel	Long-Term Price Stability
Granite Reliable Wind	New Hampshire	2012–2031	Wind	High
H.446 Statute	Vermont	Various 20-year contracts	Renewables	High
Hydro-Québec (HQUS)	Québec	2012-2038	Hydro	Substantial
Hydro-Québec (HQ/VJO)	Québec	Until 2015	Hydro	High
JP Morgan	System	2012–2016	System	High
Macquarie	System	2012–2013	System	High
Moretown Landfill Gas	Vermont	Until 2023	Landfill Gas	High
Morgan Stanley	System	2011	System	High
NextEra System	System	2012–2015	System	High
Seabrook NextEra	New Hampshire	2012-2034	Nuclear	Substantial
VEPPI Hydros	Vermont	Various until 2020	Hydro	Yes
VEPPI Wood	Vermont	Until Nov 2012	Wood	Yes
Vermont Yankee	Vermont	Until Mar 2012	Nuclear	High

Table 3: Contracted PPA Generation Resource Descriptions

[11] GMP-owned hydroelectric plants include facilities in West Danville, Essex, Marshfield, Middlesex, Waterbury, Bolton Falls, Burlington (Gorge #18), and Vergennes.

Table 4 lists capacities for GMP's generation resources, together with other pertinent information about each source.

Source	GMP Approximate Max Capacity (MW)	Approximate MWh/year	Delivery Profile[12]	Renewable	CO_2 Emissions
GMP Owned					
Berlin Gas	50	3,100	Peaker	No	High
Essex Diesels	8	150	Peaker	No	High
GMP Hydro	35	122,304	Intermittent	Yes	None
Gorge Gas #17	10	800	Peaker	No	High
Kingdom Community Wind	55	161,885	Intermittent	Yes	None
McNeil Wood	6	31,507	7x16	Yes	Low
Searsburg Wind	6	10,500	Intermittent	Yes	None
Stony Brook	46	27,144	Peaker	No	High
Vergennes Diesels	4	150	Peaker	No	High
Wyman	6	1,692	Peaker	No	High
Contracted PPAs					
Granite Reliable Wind	32	96,000	Intermittent	Yes	None
H.446 Statute	17	50,000	Intermittent	Yes	Low
Hydro-Québec (HQUS)	77	450,000	7x16	Yes	Low
Hydro-Québec (HQ/VJO)	114	748,980	75% CF	Yes	Low
JP Morgan	25	219,000	ATC	No	High
Macquarie	20	94,000	Off-Peak	No	High
Moretown Landfill Gas	3.2	23,827	UC	Yes	Low
Morgan Stanley	25	128,400	ATC	No	High
NextEra System	25	219,000	ATC	No	High
Seabrook NextEra	60–40	394,200	Baseload	No	None
VEPPI Hydros	17	55,167	Intermittent	Yes	Low
VEPPI Wood	8	58,134	7x16	Yes	Low
Vermont Yankee	103	812,052	Baseload	No	None

Table 4: GMP Generation Resources Descriptions Capacities

[12] *Delivery Profile Legend:*

7x16:	Seven days a week, during peak hours
75% CF:	75% of annual capacity
ATC:	Around the clock
Baseload:	Constant power, every day all hours
Intermittent:	Conditionally available
Off-Peak:	Night-time hours
Peaker:	Runs only when demand is high, or peaks
UC:	Unit contingent

GMP Energy Mix

With the expiration of the Vermont Yankee PPA in 2012 and the Hydro-Québec-Vermont Joint Ownership PPA expiring in 2015, GMP energy mix will be undergoing significant changes over the upcoming five years. We have been planning for those potential supply gaps, and have made significant in-roads in filling those gaps.

The following three pie charts provide an overall picture (prior to REC sales) of our energy mix for these next five years:

- Figure 19 projects our 2011 energy mix[13]. This chart is dominated by our PPAs with Vermont Yankee nuclear and Hydro-Québec.

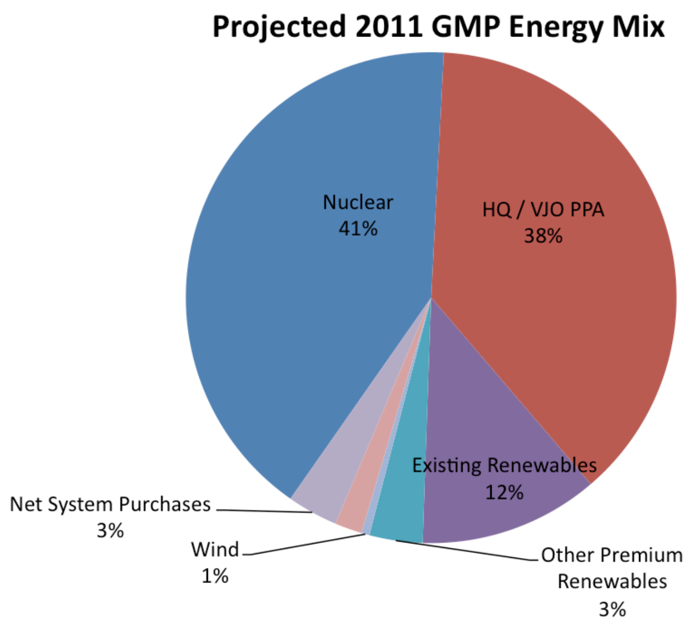

Figure 19: Projected 2011 GMP Energy Mix

[13] "Net System Purchases" is the sum of bilateral forward energy purchases and spot (DA/RT) transactions.

- Figure 20 projects our 2013 energy mix[14]. In this scenario, nuclear has been replaced by system purchases and wind power from the Kingdom Community Wind project, with renewables sources on the rise.

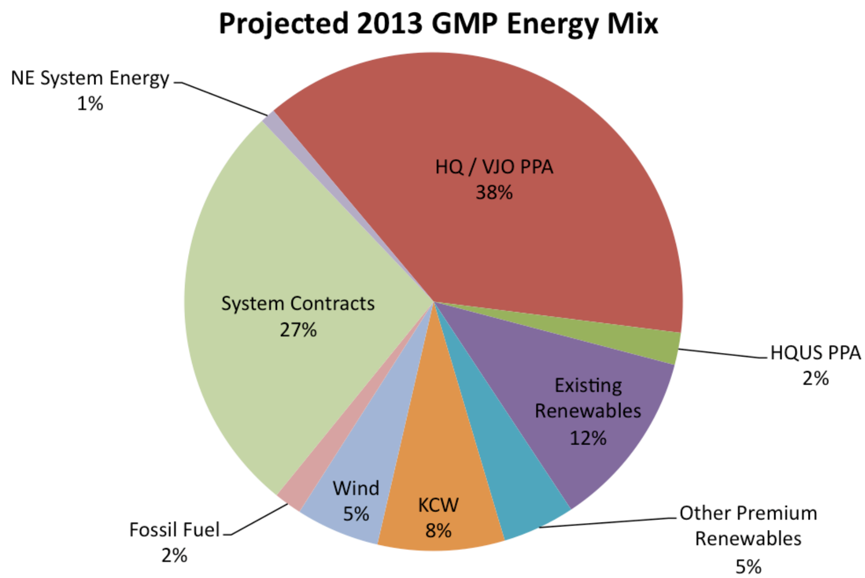

Figure 20: Projected 2013 GMP Energy Mix

- Figure 21 projects our 2016 energy mix[15]. One Hydro-Québec PPA has been partially replaced by another, plus another PPA. 'Other Future Sources' presents an opportunity for more renewable generation.

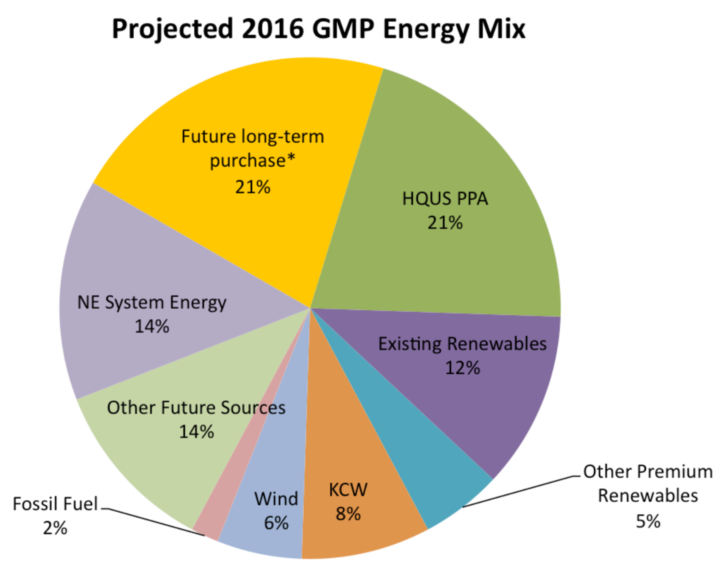

Figure 21: Projected 2016 GMP Energy Mix

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[14] *This pie chart does not include GMP's recently proposed NextEra PPA, which would provide an estimated 7% of GMP's supply in 2013.*
[15] *This pie chart does not include GMP's recently proposed NextEra PPA, which would provide an estimated 24% of GMP's supply in 2016.*

Investing in Existing Generation

Green Mountain Power continually invests in improving its existing generating capabilities and in new generating resources. Our goal is to continually provide low-cost, safe, and reliable power to our customers.

Utility-owned power plants can be the lowest-cost way to obtain some types of power generation, particularly for local renewable and peaking plants. GMP's fleet of existing hydroelectric plants is currently our lowest-cost power source, with an average cost of about 3 to 4 cents/kWh. Looking forward, one of GMP's power supply options is to construct owned generating plants (or to refurbish or expand existing ones) when it is cost-effective to do so relative to other potential power sources.

Peaking Plant Improvements

In 2008, GMP installed a direct line of communication from ISO to our control center so that we are notified immediately when a 10-minute start is issued by ISO.

Before this direct link, an ISO-issued start would first be sent to VELCO, who would then transmit the start command to GMP. Sometimes, this communication relay through VELCO took longer than the allotted time and GMP would miss its 10-minute requirement. Now that the new direct feed has been installed, we immediately receive any ISO start command and, as a result, have continually met our start-time requirement.

Berlin Gas Turbine

The Berlin Gas Turbine facility consists of a Pratt & Whitney Twin Pack gas turbine generator comprised of two Pratt & Whitney Simple Cycle FT4 engines. The unit has an approximate capacity of 50 MW at full output. Low sulfur kerosene fuels the engines from the two on-site fuel storage tanks.

In 2008, we upgraded the Berlin Gas Turbine facility, one of the largest peaking plants in Vermont. We overhauled and rebuild both Pratt & Whitney Jet Engines, and together with a complete rewind of the generator; and installed an additional air-assisted start pack enabling both engines to start simultaneously.

As a result of these upgrades, we have:

- Improved the life expectancy of the plant.
- Increased the reliability of continued starts and runs.
- Enabled both engines to start and get online to almost full load in about six minutes with the dual start packs. The single start pack could not start both engines, thus we could only claim about 20 MW of power in the ISO Forward Reserve market, or about half of the total plant size. Today, GMP is able to claim 40 MW in that market.

Essex Diesels Upgrade

The Essex plant includes 8.5 MW of hydroelectric generation and 8 MW of peaking diesel generation. The diesel generation consists of four 2 MW Caterpillar diesel reciprocating engines which operate on a 5% bio-diesel blend.

In 2007, GMP upgraded the Essex peaking facility. We:

- Replaced the60-year-old, 1.0 MW Electro-Motive Division (EMD) diesel engines with four new Caterpillar, 2-MW diesel engine/generator sets, totaling 8 MW of capacity.
- Upgraded all the associated switchgear and controls.

This upgrade greatly improved the facility's reliability, increased its efficiency, and lowered its air emissions.

Vergennes Diesels

The Vergennes peaking facility consists of two General Motors, 16-cylinder reciprocating engines, originally installed in 1964. They have a nameplate capacity of 2 MW with a total capacity of 4 MW. Both engines are fueled using ultra-low sulfur, blended #2 diesel oil.

Both Vergennes Diesel engines have been overhauled in the last decade, enabling this facility to be a reliable peaking source for many more years.

Complying with more restrictive air quality requirements caused us to review the plant's air emission controls and consider our options: replace the existing units or install more units. We chose the most cost effective solution; we added SCR post combustion controls to meet air quality requirements and thus enabled the facility to retain its operating permit. With the updated air emissions controls in place together with the overhauls, we expect these units to operate through the next decade.

Hydro Plant Improvements

GMP has made a number of substantial improvements to our current hydro generation to maintain consistent and reliable operation. Over the next few years, we will be making additional improvements as well as investigating the feasibility of other upgrades. Taken together, our hydro plants account for 35 MW of capacity.

West Danville

The West Danville generation facility consists of one 1.25 MW hydro unit originally installed in 1917. Since being installed, various work has occurred on the generator, the dam, and the penstock including adding a rubber bag to allow tighter control of pond levels on the reservoir known as Joe's Pond.

We are currently making two improvements to the West Danville plant; we are:

- Replacing a section of the wooden penstock that feeds the plant, and significantly stabilizing the area surrounding the penstock. Last summer, a GMP employee noticed a significant washout around the existing penstock following a heavy rain storm. The plant has been taken off-line until the penstock is repaired.
- Updating the remote control system. We do not have complete remote control from our Colchester offices over the West Danville hydro plant: we can only stop the plant, and raise or lower its output; we cannot start the plant. When a plant operator is not on-site or is off duty, many hours pass before we can put the unit online, costing valuable megawatt-hours. An updated remote control system — through an automatic pond level control system similar to what has recently been installed at Essex — enables us to fully automate the plant's operation.

Essex

The Essex facility was constructed in 1917. It consists of four main hydro units each capable of producing 1.8 MW maximum output. We recently added a minimum flow hydro generator capable of producing approximately 500 kW.

We have made a number of improvements to the Essex facility. We:

- Upgraded the fuel units.
- Replaced the water-driven exciters with a new minimum flow 500 kilowatt generator, which bore two major benefits: first, it enabled more generation during lower flow times; and second, it allows a minimum flow to continue to operate should the four main 2 MW generators trip offline, thus allowing our minimum river flow requirement to pass through and not violate our river flow requirements.
- Installed a new Pond Level Control system to automate control of the plant. Before this installation, the manual process required a dispatcher to watch the pond level and adjust the units as required, trying to hold a certain pond elevation. Now the process is fully automated, automatically holding the pond level within inches of the top, maximizing generation output.

Future improvements include connecting the plant control systems to augment run-of-river; and upgrading the bag controller, tying it into the plant control system, enabling a tighter, more flexible operation.

Marshfield

The Marshfield facility was constructed in 1927. It consists of a single, vertical hydro unit capable of producing 5 MW maximum output. The Marshfield plant utilizes a reservoir in conjunction with a long penstock to provide greater elevation differential (known as 'head') between the pond and the generator.

Over the past six years and ending this year, we have been replacing the existing wooden penstock (along Route 2 in Marshfield and Cabot), section by section. Through this gradual replacement, we have reduced many leaks throughout the penstock, enabled better flow which slightly improved the dam's performance, and improved safety of the area.

We also replaced the voltage regulator in order to maintain tighter controls and removed all asbestos from the plant.

In the near future, we will be installing wireless communication that will enable us to improve our control of the reservoir gate as well as monitor the pond level at the Peacham Pond reservoir, both so that we can improve generation. We are also exploring the feasibility of adding a minimum flow generator to the outlet of the Peacham pond (which currently drains into the Marshfield reservoir), again to improve generation.

Middlesex

The Middlesex facility, constructed in 1928, is a run-of-river plant consisting of two 1.6 MW hydro units.

Recently, we completely overhauled both generators at our Middlesex facility. This included brand new copper rewind of the generators, restacking the generator's core material, and replacing both voltage regulators. We installed new equipment that enables us to more tightly control the unit's generators, its voltage and its megawatt output.

We continue to resurface the dam face with new concrete, extending the life of the entire spillway.

In the next few years, GMP will be exploring the feasibility of installing a rubber bag system to the dam (similar to Essex) to allow better control of the pond level, thus increasing annual output and reducing maintenance needed to continuously replace wooden flashboards.

Waterbury

The Waterbury facility was originally constructed in 1938 to provide flood control for the Winooski River. In 1951, the generation facility was added; it consists of one hydro unit capable of producing approximately 5 MW maximum output.

Upgrading the Waterbury Hydro facility presented an enormous challenge to us, but we were dedicated to continuing with the existing structure, maximizing its megawatt capacity, all without altering the reservoir or river conditions. Toward this end, we:

- Replaced the existing hydro runner, increasing the turbine's efficiency by approximately 12 percent.
- Completely rebuilt the exciter.

In the future, we will review the feasibility of installing an additional minimum flow unit, allowing us to generate more power when the river flow is low.

Bolton Falls

Bolton Falls (also known as DeForge Hydro Plant) was originally constructed in 1899; it was completely rebuilt and re-powered in 1985. The plant consists of two 4.5 MW hydro units.

For years, Bolton Falls had the proclivity for collecting more than its share of river debris and trash. The intake structure would plug up, severely restricting flow. The process of removing this build-up, which required the generator be shut down, was both labor intensive and time consuming.

To alleviate this problem, we installed a new Rack raker crane. This enabled us to remove debris much quicker, allowing the unit to generate power for longer periods of time.

We will be evaluating the feasibility of installing a minimum flow generator and upgrading the pond level control system which enables us to automatically maintain a certain water level.

Gorge Hydro Plant #18

The Gorge Hydro plant (#18) was constructed in 1914 and rebuilt in 1928. Originally, there were two plants (the other one, #17), one on each side of the river. The great flood of 1927 significantly damaged both plants; only the plant on the South Burlington side — #18 — was reconstructed. This reconstructed plant consists of one 3 MW hydro unit.

In the coming years, this Gorge Hydro will undergo the largest overhaul of all our plants. Plans include:

- Installing a new rubber bag system.
- Replacing the runner.
- Rewinding the generator.
- Installing a new Pond Level Control system.
- Repair leaks to the dam.

- Upgrading the electrical arc flash bus work.
- Abating asbestos.

All this work will increase output by 90%, almost doubling the plant's output. This represents an enormous benefit for our customers because we are upgrading an existing GMP-owned generation facility with altering the characteristics of the river nor its flow.

Across the river from this Gorge Hydro plant is the defunct Gorge #17 plant, entirely washed out from the great flood of 1927. All that remains is a shell of a powerhouse and its dam. We are determining the feasibility and cost effectiveness of re-powering this facility (see "Gorge Gas Turbine #17 Repowering" of page 45 for details).

Vergennes

The Vergennes hydro plant is considered by some as the true beginning of Green Mountain Power. Originally constructed in the late 1800s, it supplied electricity to Burlington trolley cars. The site consists of two generation plants: the main facility consists of two 1 MW hydro units; the second (known as 9B) consists of one 1.25 MW hydro unit.

In 2011, GMP finished rebuilding the headworks and intake system — a $5 million project — at our Vergennes Hydro facility. The upgrade included:

- Installing a new concrete intake structure.
- Replacing a new high-pressure casing runner.
- Installing a new control system and protective relaying.
- Automating the sluice gate system (allowing employees to work more efficiently).
- Replacing the penstocks to relieve leaks.
- Installing a new air blast trash removal system, greatly improving trash removal from the racks.

This project came about mainly due to the safety of the existing dam and headworks. The facility is about 100 years old, and has served us well. Now that these issues have been addressed, we are looking forward to the next 100 years of continued operation.

Solar Plant Installations

GMP continues to lead in encouraging and developing solar generation projects statewide. Over the last four years, we have installed five solar plants ranging in size from 3 kilowatts up to 200 kilowatts in these towns: Berlin, Shelburne, Montpelier, Westminster, and Colchester. Our Berlin solar plant, commissioned last summer, was the largest plant in Vermont at that time. Our current, total installed solar capacity is just under 500 KW.

Our Solar Rate proposal encourages grass-roots growth. Residents who install their own solar devices are compensated for their output, above and beyond the savings through offsetting their own consumption.

Searsburg Wind Plant

The Searsburg Wind plant, first operated in 1987, consists of eleven 550 kW Zond Z40 turbines, for a total installed capacity of just over 6 MW. The plant continues to be a great generation source for GMP.

Recently, one of the plant's turbines failed catastrophically during a high-wind weather event. We took that opportunity to upgrade the plant. After locating replacement parts and turbine components, we replaced the damaged turbine and tower, upgraded the SCADA system, changed to form-wound generators, installed a new braking system, and replaced the wind sensing equipment for improved control and reliability.

Now that the upgrade is complete with the site only requiring ongoing maintenance, we expect the existing turbines to operate cost effectively and efficiently for years to come. Of course, as with all of our plants, GMP will continuously monitor the performance and condition of the Searsburg equipment, along with other factors (such as power market conditions, prices, and available wind generation technologies). In the long term, GMP expects that the Searsburg presents an opportunity for re-powering or expanding its production of wind energy.

Jointly Owned Generation

GMP owns an interest in the McNeil biomass plant, Stony Brook Station, and the Wyman plant. Together with other joint owners, we operate and maintain these facilities.

McNeil Station

Green Mountain Power owns an 11 percent share of the McNeil Station in Burlington, Vermont. The 50 MW plant has been in operation since 1984. The plant primarily burns woodchips, but can also burn natural gas, either alone or in combination with the wood. In recent years, the plant has operated at approximately 65% capacity, supplying GMP with roughly 31,500 MWh of renewable energy and about 6 MW of annual capacity.

Stony Brook Plant

Green Mountain Power owns an 8.8 percent share and has PPA for 4.4 percent of the output from the Stony Brook power plant in Ludlow, Massachusetts. The plant is a 354 MW intermediate combined-cycle power plant that entered into commercial operation in 1981. The unit's three gas turbines generate electricity using either No. 2 oil or natural gas, with additional electricity produced using a single steam turbine in the combined-cycle process. In recent years, Stony Brook has provided GMP with approximately 27,000 MWh of energy and 46 MW of annual capacity.

Wyman Station

Green Mountain Power owns a 1.14 percent share in the Wyman Unit No. 4 power plant in Yarmouth, Maine. The plant is a 610 MW No. 2 oil generating plant that began operating in 1978. In recent years, this plant has supplied GMP with less than 2,000 MWh annually and 6 Mw of annual capacity.

Potential Large Generation Sources

Presented here is a picture of the current and planned generation to meet projected demand. All projects described in this section are either owned or co-owned by GMP, a position we find economically advantageous to us and to our ratepayers.

Kingdom Community Wind (KCW)

The Kingdom Community Wind (KCW) project, located in the town of Lowell in Vermont's Northeast Kingdom and undertaken in conjunction with Vermont Electric Cooperative (VEC) demonstrates GMP's commitment to investing in in-state renewable generation. We anticipate starting on this project in July 2011, and completing it in the fall of 2012.

KCW will provide numerous benefits to GMP customers and VEC members, as well as to the region and stat, not the least of which is the locally produced, zero-emissions power it will generate.

With an estimated flat cost of roughly 9.2 cents per kWh, KCW represents the lowest cost means of enabling us to achieve Vermont's aggressive renewable goals. KCW's fuel type (wind) and technology will increase the diversity of GMPs power supply. Not only is KCW utility-owned, but it will also provide price stability within GMP's portfolio over the estimated 25-year life. In addition, KCW has the potential to provide future value through longer operation or repowering. VEC and its members will realize similar benefits through an agreement with GMP to purchase, at a cost-based rate, 8 MW annually over the project's life of the project.

As a zero-emission energy source, KCW can play an important role in limiting the carbon footprint in the GMP and VEC portfolios and, as such, will contribute to a healthier planet.

The Wind Turbines

KCW will have the capacity to generate up to 63 megawatts. With 8 MW being sold to VEC, GMP will gain 55 MW of capacity. The output from KWC will represent approximately 8 percent of GMP's annual energy requirement. The project will consist of 21 Vestas V112 three megawatt turbines; this turbine model was the most efficient turbine among those considered for the project.

We expect 180 million kilowatt hours of electricity will be generated annually by the facility. This is enough electricity to power about 24,000 Vermont homes (based on an average residential use of 600 kilowatt hours per month and considering that the turbines do not continually generate full power). By comparison, GMP's Searsburg wind facility has a 6 megawatt capacity, and last year generated about 14.7 kilowatt hours, enough for 2,000 Vermont homes.

Cost Factors

If KCW is operating by 31 December 2012, GMP will qualify for a federal production tax credit worth about $48 million over 10 years. Because GMP is a regulated utility, the entire tax credit will pass directly to GMP and VEC customers, thus lowering the cost they pay for electricity. (GMP's investors receive none of the tax credit.)

Local Economic Impact

We fully understand the impact that this project can have in the local siting area. GMP created and distributed a lot of information to residents of the host town, Lowell and to the surrounding communities: Albany, Eden, Westfield, Irasburg, and Craftsbury. For over a year, local residents considered the project. The PSB held public hearings, accepting testimony and exhibits from all participants, submitted under oath and subjected to cross-examination and rebuttal. Representatives from GMP, Albany, Craftsbury, and others actively participated in these hearings.

At their 2010 annual meetings, residents of Lowell and Albany both voted to support the project. GMP has no control over this ballot item. On May 31, 2011 the PSB issued a Certificate of Public Good for the project (subject to certain conditions). Given this situation, GMP and VEC are moving forward with the project.

KCW will contribute meaningfully to both the short-term and long-term economic vitality of the Northeast Kingdom. KCW will immediately bring about 700 direct and indirect jobs to the community. In addition, investment in Vermont continues as the project seeks goods and services from local businesses. Once online, KCW will contribute more than $500,000 annually in property taxes to the town of Lowell; this payment stream can be used to lower property taxes for Lowell residents or to invest in other town projects.

In addition, GMP will pay a similar amount in taxes to the Vermont education fund and approximately $180,000 annually for ten years through our Good Neighbor Fund to the neighboring towns of Albany, Eden, Westfield, Irasburg and Craftsbury.

Operation and Maintenance

When completed as planned, the KCW project will generate the largest capacity amount of an GMP-owned facility. Its average annual energy output will exceed that of GMP's entire fleet of existing hydroelectric plants. Considering the scale of the wind plant and that its performance will meaningfully affect GMP's power supply costs, the KCW project will become an important focus of GMP's generation operation and maintenance activities.

To manage the risks associated with operating KCW, GMP plans to take advantage of a long-term maintenance agreement and warranty program from Vestas, the manufacturer of the project's turbines. Under this plan, Vestas will be engaged in the plant's operation and maintenance regimen for an expected 15-year period; Vestas maintenance technicians will be deployed permanently on-site, along with GMP personnel. As part of this arrangement, Vestas will provide an equipment warranty that covers major component failures, along with an availability factor guarantee that would protect customers should equipment availability turn out to be meaningfully below expectations.

Gorge Gas Turbine #17 Repowering

A 1965 GE Frame 5 Gas Turbine occupies the Gorge Gas Turbine #17 peaking facility site. Originally rated with a nameplate capacity of approximately 22 MW, the unit has continually been de-rated over the years of its operation, and is now considered to have a capacity resource of approximately 10 MW.

This facility is uniquely positioned in a major load pocket for Vermont, Chittenden County and has the added benefit of being sited immediately off a major interstate highway and next to a railway line. The site also features natural gas transmission lines and excellent electric transmission interconnection facilities. All of these factors make Gorge an attractive location for siting peaking generation.

In 2008 as part of the Gorge Area Reinforcement Project, GMP reviewed the site to reconstruct it as a potential Non-Transmission Alternative (NTA) or repower its generation increasing capacity to approximately 40 MW. We determined that repowering the facility was not the preferred reliability solution, primarily due to low expected capacity market prices in the near-term. Thus, we are moving forward with detail design work and ISO-New England interconnection to create an NTA site, and are organizing the permitting requirements to submit a Certificate of Public Good (CPG) to the PSB.

Currently, we are compiling and planning to submit a Section 248 permit for the installation of three 15 MW dual-fuel gas turbines by the fall of 2011. GMP intends to provide a duel-fuel supply to these turbines from the natural gas located on site together with the existing liquid fuel tanks.

In addition, we are conducting bulk transmission planning studies at various levels (including VELCO and ISO-New England) to determine the reliability needs of the transmission grid through Vermont and New Hampshire. Although studies are not complete, there is the potential that siting additional generation at the Gorge location, perhaps in combination with other supply, or demand-side resources could defer significant bulk transmission upgrade projects which would otherwise be needed. If new generation at Gorge is part of the least-cost reliability solution for Northwest Vermont, it does not appear that current ISO-New England rules would allow for the costs of this option to be shared across users of the bulk transmission system in the way that bulk reliability solutions are shared. This means that the least-cost solution from a regional perspective may not be least-cost for Vermont.

In spite of the uncertainties regarding future market prices and transmission deferral benefits, obtaining a Certificate of Public Good in the near future could benefit GMP customers by establishing the Gorge site as a clear capacity option, thus shortening the required lead time to implement the project if and when it is determined that the project is needed.

Purchased Power Sources

GMP obtains most of it current power supply from long-term purchased power contracts (PPAs). We complement these agreement with a mix of owned plants and periodic purchases from the New England wholesale electricity market.

Hydro-Québec/Vermont Joint Owners

GMP currently has a 114 MW agreement in this stably-priced Hydro-Québec Vermont Joint Owners (HQ/VJO) contract. This PPA is structured with a target energy delivery equivalent to a 75% annual capacity factor, which represents approximately 750,000 MWh/year — about 37% of GMP's current energy requirements. Roughly two-thirds of the energy from this source is delivered during peak hours, with the remainder during off-peak hours. This contract expires in 2015.

Vermont Yankee Nuclear Power

Our current long-term PPA with Entergy Vermont Yankee provides GMP with approximately 103 MW on a unit-contingent basis at a fixed price (in other words, the energy is generated directly by the Vermont Yankee plant). In March 2012, the PPA expires, after which we will no longer receive energy and capacity from the plant.

There is some question as to whether the plant will continue to operate in the future. If the plant does continue to operate, however, GMP is eligible under provisions of a Revenue Sharing Agreement (RSA) for a share of any "Excess Revenue" beginning in 2012 for 10 years (up to 2022). The RSA defines Excess Revenue to exist if Entergy is able to sell the output of the facility at a price above a defined threshold value. For 2012, this threshold value (the "Strike Price") starts at $61 per MWh and escalates annually thereafter by an established mix of inflation and nuclear fuel pricing. The RSA calls for Entergy to make annual payments of this revenue sharing. This revenue is not dependant on the company having a new PPA with the facility.

Hydro-Québec–United States

In April 2011, GMP and a group of other Vermont distribution utilities received approval from the PSB for a 26-year PPA with Hydro-Québec–United States (HQUS) starting in November 2012. GMP's share of the purchase will be modest at first, increasing to about 77 MW by 2016.

The HQUS PPA provides annual energy volumes of approximately 450,000 MWh per year during much of the delivery term, in a flat schedule during the peak 16 hours of every day during the agreement. In addition to the energy delivered, the PPA also includes all environmental attributes of the power, at least 90% of which will be based on renewable hydroelectric resources, helping GMP to maintain our low emission energy profile at a relatively stable price. No capacity is included in this purchase.

VEPPI Hydro and Wood

GMP is required by statute to purchase on a long-term basis approximately 34% of the output from various qualified Vermont facilities. The PSB appointed Vermont Energy Power Producers Incorporated (VEPPI) as the agent to administer these resource transfers. The resources include 17 hydroelectric generating stations and one wood burning station.

For most recent years, GMP's purchases under these contracts have amounted to roughly 100,000 MWh per year, or roughly 5 percent of GMP's annual energy requirements. In the next few years, many of the existing VEPPI contracts begin to expire leaving GMP purchases of approximately 40,000 per year by 2013 with no meaningful volumes by 2020. However, the legislature has recommended that the Ryegate Plant continue to operate under a power agreement with Vermont utilities beyond the current contract. In this IRP, we have assumed that GMP will continue to get 60,000 MWh from Ryegate.

VEPPI has also been appointed as the SPEED Standard Contract (feed-in-tariff) facilitator for a new Vermont small renewable purchasing requirement (Section 8007 to Title 30). Under this program, GMP is required to purchase our load share of about 34% of up to 50 MW eligible new renewable resources under 2.2 MW in size are able to supply the Vermont utilities at set contract rates for a 20 year term. Presently, GMP estimates these resources to be supplying about 10,000 MWh per year to our portfolio; we expect this amount to grow to about 50,000 MWh per year when the program is fully implemented. The actual volumes will depend on the specific mix of renewable technologies that provide the contract.

Moretown Landfill Gas

In December 2008, GMP began receiving energy from Moretown Landfill Gas through a 15-year PPA. GMP receives 100 percent of the 3.2 MW plant output, which includes energy, capacity, and RECs. This plant operates in a baseload mode to provide GMP around 25,000 MWh of renewable energy annually at a stable price.

Granite Reliable Wind

GMP has entered into a 20-year contract with Granite Reliable Power beginning April 2012. GMP will purchase 32 percent of the output from a 99 MW wind plant to be built in central New Hampshire. This will supply just under 5 percent of our energy requirements at a fixed price. The output of the project includes unit contingent energy, capacity (after five years), and RECs.

Small Renewable PPAs

In order to help facilitate development of local small renewable projects across a broad range of technologies, GMP has entered into several PPAs with Vermont individuals and businesses for the output from their facilities. These purchases currently represent a small number of annual megawatt hours (less than 5,000 MWh per year), but may grow in future years to the extent that economics of smaller scale resources improves.

System Energy Purchases

Over the past several years, GMP has entered into a number of fixed-price system energy contracts to replace our current Vermont Yankee contract. These PPAs are with four sources: JP Morgan, Morgan Stanley, NextEra, and Macquarie. The terms and delivery profiles of these PPAs vary, with some providing around the clock energy and others off-peak energy. In the next few years, these purchases will represent approximately 27 percent of GMP's annual energy supply in 2013. The longest such system energy purchase expires at the end of 2016.

Seabrook NextEra

GMP has signed a proposed PPA with NextEra for energy from its Seabrook nuclear facility, and has filed a petition for a Certificate of Public Good with the PSB. The energy amounts in the PPA are provided under two separate schedules: one for 25 MW of firm baseload (7x24) energy beginning in March 2012 and ending December 2014; the other for unit contingent baseload energy beginning with 60 MW in January 2015 and ending (with periodic reductions in quantity) with 40 MW December 2034.

Beginning the first of June 2015, the PPA will also include deliveries of unit contingent capacity to offset GMP's obligations in the ISO-New England Forward Capacity Market. Similar to the long-term energy schedule, the capacity quantity exhibits a declining volume profile, starting with deliveries of 85 MW per month in 2015, periodically reducing to an ending quantity of 65 MW in 2034.

Overall, the purchase represents reasonably-priced, low-emissions baseload energy and capacity provided at stable prices (with increases primarily with the influences of general inflation throughout the term).

Note: The analysis presented in this 2011 IRP was conducted before we finalized the NextEra PPA. As such, our portfolio analysis in Chapter 7. Planning Energy Resources does not consider this PPA to be a committed resource.

5. Local Power Transmission and Delivery

System Overview

Green Mountain Power's delivery system includes approximately 260 miles of sub-transmission lines. The predominant subtransmission voltage on the GMP system is 34.5 kV. GMP also owns and operates a limited amount of subtransmission at voltages of 13.8 kV, 46 kV, and 69 kV. The primary supply to GMP's subtransmission system is from Vermont Electric Power Company's (VELCO) 115 kV transmission system. The VELCO system, in turn, is interconnected to the bulk transmission systems administered by ISO-New England, New York ISO, and Hydro-Québec at voltages of 115 kV, 230 kV, and 345 kV.

GMP's subtransmission system also includes a limited number of neighboring utility subtransmission interconnections, internal generation, and non-utility generation.

GMP has 63 substations that supply its distribution system with a predominant distribution voltage of 12.47 kV. GMP also has a limited amount of distribution at voltages of 2.4 kV, 4.16 kV, 8.3 kV, and 34.5 kV. GMP owns and operates approximately 2,483 miles of overhead and 610 miles of underground distribution lines.

System Planning and Efficiency Initiatives

GMP engages in a comprehensive system planning process to meet the reliability needs of its customers and to attain every cost-effective transmission and distribution system efficiency possible. GMP's planning procedures and system efficiency initiatives are described in the following sections.

Transmission and Distribution Planning Criteria

GMP's standard transmission voltage for its Western and Central Divisions is 34.5 kilovolts, transmitting power from VELCO delivery points to GMP's distribution substations, wholesale customers, and large industrial customers. GMP predominantly uses 46 kV and 69 kV transmission in its Southern Division. We plan our transmission system to an N-1 standard which requires that there be no violations of thermal or voltage criteria, and no interruption of load to customers. This avoids the loss of any one transmission line or the loss of any one VELCO substation transformer supplying the GMP system.

Green Mountain Power allows a maximum 5 to 8 percent voltage drop on the transmission system during all lines in operation and a maximum 10 percent voltage drop following a first contingency. Each element in the power delivery system has a thermal design load limit reflecting the load at which an element begins to overheat and fail. GMP applies a 100% maximum load limit on all elements during normal operation. For specific cases for limited periods of time during first contingency operation, we allow overloading, but only when service must be maintained or restored.

GMP's standard distribution system voltage is 12.47/7.2 kV grounded wye[16]. We also employ a limited amount of 34.5/19.9 kV distribution system facilities in service, but because of operating challenges with 34.5 kV equipment, we restrict the expansion of this voltage to high growth and industrial areas. A limited amount of 2.4 kV, 4.16 kV, and 8.3 kV distribution remains on the system, however we are steadily converting these voltages to the standard 12.47 kV to improve voltage performance, reduce losses, accommodate load growth, and permit feeder back-up between substations. The voltage delivered to customers adheres to the standards prescribed by the American National Standards Institute (ANSI) Standard C84.1.

System Monitoring

GMP monitors its transmission and distribution system to identify areas that may require improvements. We gather data from a variety of sources which provides the rationale for making capital upgrades, improving operations, and maintaining the system. These sources include the following:

- Observations by line workers and substation technicians in the course of their daily duties.
- The VELCO Long Range Plan (updated every three years) which identifies portions of the GMP transmission system that might violate its N-1 planning criteria considering forecasted load growth over the proceeding 20 years.
- Line and equipment loading garnered from GMP's supervisory control and data acquisition (SCADA) database. This database contains real power, reactive power, and phase unbalance data for the majority of our transmission lines and distribution feeders.
- Additional monitoring equipment (including thermal demand ammeters and revenue meters) for those distribution feeders not on SCADA.
- Data loggers.
- Customer line extension requests.
- Act 250 letters.
- Customer complaints.
- Outage history and outage analysis, including the analysis of distribution feeders with the worst reliability performance.
- GMP's geographic information system (GIS) which assists in locating aged conductor and equipment.

Comprehensive Transmission and Distribution Efficiency Study

Beginning in 1998 following an agreement with the Department of Public Service, GMP conducted a comprehensive transmission and distribution system efficiency study. This study, performed over a period of several years, analyzed every circuit on GMP's system to identify opportunities for cost-effective efficiency improvements. The efficiency measures studied included reconductoring, capacitor installation, feeder balancing, phase balancing, voltage conversion, and equipment acquisition

[16] A wye is a three phase, four-wire electrical configuration where each of the individual phases is connected to a common point, the "center" of the Y. This common point normally is connected to an electrical ground.

strategies. During the time of this study, we implemented many cost-effective measures and reported them to the Department of Public Service. All cost-effective efficiency projects—consisting mainly of phase balancing, capacitor placement, and feeder balancing—were completed by 2007.

During the study, GMP discovered that a number of measures (including reconductoring, three-phase extensions, and voltage conversions) provided significant energy and demand savings on some parts of our system. Implementing these projects on their own cost more than they saved. Instead, we incorporated these projects into our required maintenance and reliability projects, which enabled us to cost-effectively implement them and realize their incumbent enhanced efficiencies and energy savings.

In addition, we continued to attain enhanced system efficiencies through programs that address:

- Conservation Voltage Regulation (page 51)
- Power Factor Correction (page 52)
- Circuit Balancing and Reconfiguration (page 52)
- Circuit Balancing and Reconfiguration (page 52)
- Voltage Conversion (page 53)
- Transformer Acquisition (page 53)
- Conductor Selection (page 54)

Conservation Voltage Regulation

Conservation Voltage Regulation (CVR) is an energy efficiency program applied to an electric utility's distribution system, involving measures and operating strategies designed to provide service at the lowest practicable voltage level in a cost-effective manner, while meeting all applicable voltage standards. Field studies have shown that, in general, a one percent reduction in the voltage delivered to customers results in a one percent reduction in energy consumption. The primary strategy for implementing CVR is the use of line drop compensation (LDC). LDC is a control device connected to tap-changing transformers and voltage regulators, that measures feeder load current and computes the resultant voltage drop. The value of the voltage drop is then used by the tap changer or regulator to raise or lower the feeder voltage.

Following consideration of its last Integrated Resource Plan in 2007, GMP and the Department of Public Service agreed that GMP would perform CVR on a trial basis on six of GMP's distribution circuits. CVR was implemented on these circuits in 2008. GMP learned a great deal about CVR through this implementation. We investigated methods for commissioning CVR through industry and manufacturing resources from which we developed a standard practice for creating the settings on each circuit. We researched and purchased new meters to monitor the voltage. GMP's Meter Technicians brought into the project installed and interrogated these new meters.

Our examination of the post CVR results for these circuits, however, indicated that it was difficult to achieve the desired end-of-line voltages. Nonetheless, GMP believed that about 10 more of its feeders could benefit from a cost-effective CVR implementation, We intend to complete our implementation of CVR on these circuits this summer (2011).

An emerging issue with CVR pertains to the significant installation of renewable distributed generation on GMP's distribution system (see "Distributed Generation Interconnections" on page 54). Large quantities of generation on a distribution feeder reduces the amount of current that LDC controls detect, thereby reducing the apparent voltage drop across the length of the feeder, and thus could cause low voltages delivered to customers at the ends of feeders. GMP will closely monitor circuits that have both CVR and significant generation to ensure that end-of-feeder voltages remain within the range specified by ANSI Standard C84.1.

GMP does not believe that any of its other circuits have the necessary characteristics that would make them candidates for conventional CVR. GMP, however, believes that CVR programs can be successful when implemented in conjunction with Smart Grid technologies. When Smart Grid[17] is in place, we will be able to measure voltages at the ends of feeders in real time. By communicating this information back to substations in a continuous manner, transformer load tap changers and regulators could adjust, in real time, to ensure with certainty that the voltages delivered to the last customers on a feeder are the lowest they can be consistent with applicable voltage standards. As our Smart Grid technologies develop, we will investigate merging these technologies with an advanced implementation of CVR.

Power Factor Correction

ISO-New England strictly limits reactive power flow between reliability regions. In turn, VELCO and other transmission companies strictly limit the power factors at GMP's delivery points. To help meet these limitations, enhance circuit performance, and decrease losses, GMP has set the minimum power factor required for customers to avoid a penalty under its commercial and industrial time-of-use tariff (Rate 63) to 95%. GMP has also conducted a power factor correction study and implemented a plan to add capacitors to the distribution system to help meet these objectives. Strategically adding capacitors (including placing capacitors as close to the load as possible) helps GMP to attain efficiency improvements while maintaining delivery point power factor requirements.

Over the past several years, GMP reviewed the power factors on all of its circuits with volt-ampere reactive (VAR) data to determine whether installing capacitors could cost-effectively improve power factors. We prioritized circuits by the magnitude of VARs consumed and analyzed for VAR demand. From this, GMP determined whether existing capacitor banks were operating properly and whether additional banks should be installed.

GMP is conducting a power factor correction study that analyzes 69 circuits in total. Based on the results of this study, GMP has installed 89 capacitors which provided an additional 55 MVAR of reactive capability to its system. We expect to complete this study and install the last capacitors by October 2011. Our future plans include leveraging Smart Grid software to alert Engineering staff when capacitor banks trip out of service and cause the circuit's power factor to fall below expected levels. GMP is also analyzing the feasibility of reviewing its distribution circuits again to identify additional opportunities to improve power factor.

Circuit Balancing and Reconfiguration

While conducting the comprehensive efficiency study, GMP performed a system-wide analysis of circuit phase balancing. We analyze load balance on circuits whenever large loads are added to the system, feeder back-up studies are performed, or protection issues call into question the balance among phases. Swapping loads from one phase to another to balance circuits has the added benefits of reducing losses and improving voltage performance. Likewise, GMP evaluates the relative loading

[17] For a complete discussion of GMP's Smart Grid initiative, please refer to "Chapter 6. Smart Grid" on page 75.

of adjacent circuits and optimizes the normally-open points between these circuits to lower losses, improve voltage performance, and extend the load capabilities of substation transformers.

Voltage Conversion

As previously explained, GMP's standard distribution system voltage is 12.47/7.2 kV grounded wye. While a limited amount of 2.4 kV, 4.16 kV, and 8.3 kV distribution remains on the system, GMP has been steadily converting these voltages to the standard 12.47 kV to accommodate load growth, permit feeder back up between substations, improve voltage performance, and reduce losses. In 2009, we converted the Ethan Allen Substation in Colchester (see "Ethan Allen Substation" on page 58) from 4.16 kV to 12.47 kV to accommodate load growth and permit back-up with 12.47 kV feeders from the GMP Essex Substation. We are converting the 8.32 kV feeders from the Westminster Substation to 12.47 kV to permit back-up with feeders from the Bellows Falls Bridge Street Substation. This conversion is scheduled for completion in summer 2011.

Voltage conversions in the planning stage include the following:

- In 2014, GMP plans to convert the Gorge Substation 4.16 kV circuits to 12.47 kV. This will permit unloading heavily loaded circuits from the Essex substations, balance the loads, and provide limited feeder back-up between these circuits.
- As part of the Waterbury Substation replacement (see "Waterbury Center Substation" on page 56), GMP plans to convert the 4.16 kV circuits to 12.47 kV to accommodate load growth and to permit feeder back-up with circuits from the Waterbury Center Substation.
- GMP has planning studies in the beginning stages that will analyze the costs and benefits of voltage conversions for circuits originating from the Berlin, Marshfield, and Barre area substations.

Transformer Acquisition

GMP adds and replaces distribution transformers on its system for a variety of reasons including unit failure, distribution circuit voltage conversion, load growth surpassing a transformer's capacity, and storm damage. GMP adds transformers to its inventory that are the lowest life-cycle cost based on both the first cost of a given unit and the expected cost of demand and energy losses over the unit's life. We determine the cost of life-cycle losses for a given transformer with an Excel®-based analytical tool developed in collaboration with the Department of Public Service. We provide the cost of losses to vendors who then bid transformers with specified first cost, no-load loss, and full-load loss characteristics. GMP evaluates these bids and selects the lowest life-cycle cost transformers available.

In 2011, for the first time in several years and due to the declining cost and increased availability of amorphous steel, GMP was able purchase low-loss amorphous core steel transformers. The advantage: Transformers with amorphous steel cores can have core losses one-third that of conventional steels.

Conductor Selection

GMP selected the following as the standard conductors for its distribution system: 1/0 AAAC, 4/0 AAAC, and 477 ACSR[18]. The size conductor selected for a given application depends on the anticipated maximum load current for the portion of the circuit for which the conductor would be used. The maximum load level assigned to each of these conductors has been established to ensure that the life cycle cost of that conductor (comprised of the up-front capital cost plus the cost of losses) is minimized.

In recent years, most of GMP's new transmission construction and reconductoring has used 795 ACSR conductor. We choose 795 ACSR as the transmission conductor for a number of reasons. 795 ASCR:

- Can carry the output of the typical VELCO 50 MVA, 115 kV to 34.5 kV transformer.
- Can carry transmission system post-contingency thermal loading.
- Results in low losses under normal operating conditions.
- Can be supported with single pole/cross-arm construction without the expense of excessively robust structures or short spans.
- Is a common conductor used in Vermont and New England for transmission purposes and is stocked by many utilities making it readily available in emergency conditions.

Distributed Generation Interconnections

GMP supports the interconnection of distributed generation on its distribution system. Over the past decade, federal and state legislation has created incentives for developing renewable distributed generation. Vermont offers incentives through its Net Metering and Sustainably Priced Energy Enterprise Development (SPEED) programs.

GMP itself offers financial incentives for residential and commercial customers to install photovoltaic solar generation through its SolarGMP rate. Each generator installation must receive a Certificate of Public Good (CPG) from the Public Service Board. As part of the CPG process, GMP ensures that the generator can be interconnected to its system in a safe and reliable manner, consistent with applicable interconnection standards.

Larger capacity interconnections generally require an interconnection study, conducted by GMP on behalf of the interconnecting customer. Most renewable generation installations to date have been photovoltaic solar and residential-sized wind.

Since its last IRP in 2007, GMP has interconnected over 7 MW of renewable generation to its distribution system.

LED Street Light Replacement

The Vermont Municipal Streetlight Initiative enables Green Mountain Power customers to improve lighting efficiency on streets and in public spaces by replacing less efficient streetlights with new LED technology streetlights. LED lighting enables a number of benefits; they:

- Significantly reduce energy use.

[18] AAAC are aluminum alloy conductors; ACSR are aluminum conductors steel reinforced.

- Last at least four times longer than mercury vapor fixtures, thus lowering maintenance costs.
- Improve the nighttime environment because they are dark-sky friendly: our LED fixtures are 100% full cut off, meaning that absolutely no light escapes from the top.

GMP is offering its customers incentives to install LED streetlights:

- GMP and Efficiency Vermont are offering significant financial incentives to offset all of the costs associated with converting to LED lighting. Customers need only determine where to install LED lighting and what size those LED lights should be.
- GMP is developing new tariffs for LED street lighting that offer financial savings when compared to current GMP tariffs.
- For a limited time, Efficiency Vermont is providing municipalities in GMP's service territory up to 12 hours of free technical assistance (through a local engineering firm) to help them undertake an LED upgrade project. With this assistance, municipalities can decide where to eliminate lighting, where to keep it, and what amount of light they need in specific areas.

Efficiency Vermont has prepared step-by-step "Guide to Improving Efficiency in Municipal Street and Public Space Lighting". In addition, Efficiency Vermont plans to holding workshops, both helping municipalities implement an LED street-lighting project.

Energy Demand and Consumption Savings

In the next few years, GMP hopes to replace up to 11,000 non-flood fixtures between GMP-owned fixtures and GMP's new customer-owned tariff fixtures. Changing eleven thousand 129-watt mercury vapor fixtures to 37-watt LED fixtures would cut demand from 1.416 megawatts down to 407 kilowatts, saving 12.14 megawatt hours per day, or 4,432.56 megawatt hours per year.

Planning Coordination with VELCO and Other Utilities

GMP regularly communicates with VELCO and other utilities in Vermont to review the need for transmission upgrades that can impact and benefit more than any single utility. The East Avenue Loop project (discussed in detail on page 59) is an example of coordinated planning between GMP, a neighboring distribution utility (Burlington Electric Department), and VELCO. Central to these efforts, VELCO maintains a base-case Positive Sequential Load Flow (PSLF) model of Vermont's bulk transmission and subtransmission systems. The model simulates load flows on the transmission and sub-transmission systems and is the basis for planning studies. All of Vermont's distribution utilities have access to the model and participate in its updating. GMP forecasts its own load for use with the model.

Vermont statutes and Public Service Board precedent require that transmission upgrades be compared to non-transmission alternatives (NTAs):, generation and demand-side alternatives. Once this comparison is done, the least-cost solution to a given transmission deficiency is implemented. The process for analyzing transmission deficiencies, determining the least-cost traditional transmission solution, and comparing this solution against NTAs is conducted through the Vermont System Planning Committee (VSPC). The VSPC and its procedures were approved by the Public Service Board in the context of Docket No. 7081 in 2007.

The VSPC and its planning process change the way GMP plans for transmission system upgrades. The approach used by the VSPC includes the following:

- Transmission planning is lead by VELCO with input from GMP and the other Vermont distribution utilities, and is performed on a three-year cycle that considers a planning horizon of 20 years.
- The planning process is transparent and includes access by the public and all VSPC participants.
- The Public Service Board formally appoints three public members to the VSPC to ensure their involvement.
- VSPC takes advisory votes to determine which utilities are responsible for projects that impact and benefit more than one utility. The projects include how costs are allocated for non-transmission alternatives.
- VSPC establishes a process for system analysis with explicit standards for evaluating NTAs to solve reliability deficiencies.
- The planning process encourages coordination among all utilities, public representatives, the Department of Public Service, the Energy Efficiency Utility (EEU), and the SPEED Facilitator.
- Consideration is given to market-based approaches to assessing NTAs.

GMP was involved in the creation of the VSPC and remains a full and active participant in all its functions.

Projects Completed or Under Construction

Following are the major transmission and distribution capital projects that have been completed since the filing of GMP's last IRP in 2007 or are presently under construction.

Lamoille County Loop

The Lamoille County Loop was upgraded because it was vulnerable to voltage collapse following numerous first contingencies.

The Lamoille County Loop serves approximately 70 MW of load; it is comprised of 34.5 kV subtransmission lines and connected distribution substations extending from Middlesex to Waterbury, Stowe, Hardwick, and Marshfield.

In 2006, GMP, VELCO, and the Stowe Electric Department obtained a certificate of public good from the Public Service Board. VELCO constructed a 115 kV transmission line from Duxbury to Stowe together with a 115-kV-to-34.5-kV substation in Stowe. The project removed vulnerability to first contingencies by providing a high voltage supply near the Loop's load center. Construction and commissioning was completed in 2009.

Waterbury Center Substation

The Waterbury Center Substation, located approximately 3.5 miles north of the Waterbury village, is supplied by the 34.5 kV Lamoille County Loop. In 2007, GMP obtained a certificate of public good from the Public Service Board to upgrade this substation, essentially to address issues of safety and reliability.

In upgrading the Waterbury Center Substation, GMP:

- Replaced obsolete equipment.
- Converted the single 12.47 kV distribution feeder supplied by this substation into two separate circuits to reduce customer exposure to contingencies.
- Replaced the 10.5 MVA transformer with a 14 MVA transformer. By replacing the transformer, two goals were met: 1. we enabled the substation to serve future load growth and 2. we enabled feeder back-up, in the future, between the Waterbury Center Substation and the Waterbury Substation. This will be possible after the Waterbury Substation and its associated feeders are upgraded to 12.47 kV. (For details, see "Waterbury Substation" under "Planned Projects" on page 62.)

GMP completed construction on this project and commissioned the substation in 2009.

Dover Substation

GMP's Dover Substation, located in the Town of Dover, contains a 69-kV-to-12.47 kV transformer. The substation serves customers in the Towns of Dover and Wilmington. The area's largest customer, Mount Snow, expanded its facilities (including more snow making equipment and new ski lifts) that required an additional 7 MW of delivered power.

To meet these needs while maintaining area reliability, GMP:

- Replaced the substation's 14 MVA transformer with a 22 MVA transformer.
- Installed a high-side circuit breaker with bus differential protection
- Reconfigured the substation to make room for a new recloser and feeder position.
- Constructed a new two-mile, 12.47 kV express feeder to Mount Snow.

GMP completed these upgrades in 2008.

Tafts Corner Substation

In 2009, GMP, the Vermont Electric Cooperative (VEC), and VELCO obtained a certificate of public good from the Public Service Board to upgrade the VELCO Tafts Corner Substation (Williston) for two main reasons:

- Load growth in the service area drove local distribution circuits above their normal operating capacity, which caused the nearby GMP Digital substation transformer to overload.
- Load growth in the neighboring Vermont Electric Cooperative (VEC) Hurricane Lane area of Williston exceeded VEC's capacity to supply this load from its Williston substation.

The Tafts Corner Substation upgrade was comprised of a 41.7 MVA, 115-kV-to-12.47-kV transformer, a transformer oil containment pit, three 115 kV circuit breakers, and switchgear which supplies distribution circuits to both GMP and VEC.

The upgrade provided immediate benefits. For GMP, this project:

- Placed two new distribution circuits into the Tafts Corner area, increasing area supply by 14 MVA.
- Unloaded the Chittenden County 34.5 kV subtransmission system, deferring needed system improvements on this network.
- Unloaded the GMP Digital substation transformer and circuits, allowing for anticipated load growth in South Burlington's Technology Park.

For VEC, this project provided two new distribution circuits into its Williston service territory and allowed its Williston substation to be retired.

The Tafts Corner Substation upgrade was complete in 2010.

Ethan Allen Substation

GMP's Ethan Allen Substation, located in Colchester, serves GMP customers in Colchester and Winooski. Because of its relatively small transformer size and 4.16 kV secondary voltage, this substation was unable to provide feeder back-up to nearby substations. The substation also lacked an oil containment pit.

To address these issues, GMP obtained a certificate of public good from the Public Service Board in 2007 to upgrade the substation. As a result, GMP:

- Upgraded the 7 MVA, 34.5-kV-to-4.16-kV transformer to a 14 MVA, 34.5-kV-to-12.47-kV transformer.
- Installed an oil containment pit.
- Converted the three 4.16 kV distribution feeders to 12.47 kV (while maintaining the single existing 34.5 kV distribution circuit). This conversion enabled the Ethan Allen Substation to back up the 12.47 kV feeders from GMP's Essex Substation. After converting the Gorge substation feeders from 4.16 kV to 12.47 kV (scheduled for 2014), feeder back-up between the Ethan Allen and Gorge substations will also be possible. (For more details, see "Gorge Area Reinforcement" on page 60.)

We completed this upgrade in 2009.

Bridge Street Substation

The former Bridge Street substation in downtown Bellows Falls (in the Town of Rockingham) was jointly owned by GMP and National Grid. The substation was characterized by numerous problems, including that it:

- Was supplied at 6.6 kV, which originated from the TransCanada Bellows Falls hydroelectric station. This non-standard supply voltage precluded the installation of a mobile transformer.
- Occupied a location in downtown Bellows Falls, a congested area. The Town of Rockingham wanted the substation relocated to a less visible location.
- Lacked safe working clearances.
- Lacked oil containment pits.
- Transmitted a mix of 8.32 kV and 2.4 kV distribution voltages.

- Made scheduling and coordinating maintenance difficult because of its joint ownership.

To address these shortcomings, GMP and National Grid obtained a certificate of public good from the Public Service Board in 2008 to upgrade the substation. Together, we:

- Rebuilt the Bridge Street Substation at a location ¼ mile east of the old substation.
- Designed safe working clearances into the rebuilt substation.
- Upgraded to a 14 MVA, 46-kV-to-12.47-kV transformer complete with an oil containment pit.
- Supplied by National Grid at 46 kV; enabling the use of a mobile transformer.
- Installed three 12.47 kV distribution circuits.
- Obtained exclusive ownership; GMP now wholly owns the substation.

The new Bridge Street Substation was completed in 2009. Replacing the Westminster Substation's transformers and converting the substation's distribution feeders (see "Westminster Substation" on page 61) will enable feeder back-up between the Westminster and Bridge Street Substations.

In 2011, we completed the load transfers to the new 12.47 kV circuits; in 2012, we will finish dismantling the former substation.

East Avenue Loop

The East Avenue Loop upgrade in Chittenden County enables us to address a number of reliability issues. Before we initiated this upgrade, supplies to the system were:

- 115-kV-to-34.5-kV transformers at VELCO's Essex, Queen City, and Tafts Corner substations together with the 50 MW McNeil generating station.
- 115-kV-to-13.8-kV transformers at VELCO's East Avenue and Queen City substations together with a 34.5-kV-to-13.8-kV transformer at Burlington Electric Department's (BED's) Lake Street substation.

These configurations presented two fundamental problems:

- The subtransmission system was vulnerable to overloads, low voltage, and voltage collapse under numerous transformer and transmission line contingencies.
- Nearly half of BED's load could be disconnected following the loss of either the East Avenue 115-kV-to-13.8-kV transformer or the loss of the radial 115 kV supply to this substation.

To address these issues, GMP together with BED and VELCO obtained a certificate of public good from the Public Service Board to construct the East Avenue Loop project. This construction comprises the following elements:

- Replacing the five-mile 115 kV line between the VELCO Essex and East Avenue substations with two new 115 kV lines.
- Expanding the East Avenue substation to accommodate two new 115-kV-to-13.8-kV transformers and one new 115-kV-to-34.5-kV transformer.
- Installing a new 1.5-mile 34.5 kV subtransmission line from the East Avenue substation to the GMP McNeil substation.
- Constructing a new BED McNeil substation adjacent to the GMP McNeil substation. This new substation accommodates the relocated Lake Street substation 34.5-kV-to-13.8-kV transformer and supplies four new distribution circuits.

For GMP, this project removes the vulnerability to numerous transformer and line contingencies, thus improving reliability to its customers served by the Chittenden County subtransmission system. For BED, this project removes the possibility that supply to nearly half of its customers could be lost following a single contingency, thus increasing reliability. This project also allowed for the Lake Street Substation on the Burlington waterfront to be removed.

Gorge Area Reinforcement

As load levels increased in 2009, GMP's subtransmission system in Chittenden County became more susceptible to poor voltage and thermal performance. Any number of factors could contribute to this performance reduction: the loss of either one of the VELCO Essex transformers, an outage of the 34.5 kV Essex to Gorge line, or an outage of the 34.5 kV Essex to McNeil line.

To address these performance issues, GMP together with VELCO obtained a certificate of public good from the Public Service Board to construct the Gorge Area Reinforcement. The Gorge Area Reinforcement project comprises the following elements:

New VELCO Lime Kiln Substation: Erected across the Winooski River from the GMP Gorge Substation in South Burlington, this substation is comprised of a 56 MVA, 115-kV-to-34.5-kV transformer connected to a 115 kV three-breaker ring bus.

New GMP Lime Kiln switching station: This 34.5 kV switching station, adjacent to the VELCO Lime Kiln Substation, is comprised of a five-breaker ring bus.

Upgraded GMP Gorge Substation: The existing substation in Colchester is being upgraded to:

- Increase the load and fault current capacity of the 34.5 kV bus.
- Add a new transformer to convert the existing 4.16 kV distribution feeders to 12.47 kV (expected in 2014).
- Install a new 34.5 kV feeder position to host a 34.5 kV distribution circuit into Winooski (expected in 2013).
- Reconstruct approximately 700 feet of GMP's 3307 and 3308 34.5 kV lines between GMP's Lime Kiln and Gorge substations.

VELCO and GMP have completed the VELCO Lime Kiln Substation and GMP Lime Kiln switching station; both have been commissioned. GMP is presently upgrading the GMP Gorge Substation.

After installing fault current limiting reactors on the 34.5 kV 46Y1 feeder in Winooski, GMP will permanently connect the VELCO Lime Kiln Substation to the 34.5 kV subtransmission system. This is expected to occur in 2011.

After completing the Gorge Area Reinforcement project, we will be removing approximately 4.2 miles of GMP's 34.5 kV lines (the so-called waterfront lines) between GMP's McNeil and Queen City substations later this year or early 2012.

Westminster Substation

GMP's Westminster Substation, located in the Town of Westminster, serves GMP customers in the Towns of Westminster and Rockingham. This substation was comprised of three, single-phase 2.147 MVA, 69-kV-to-8.32-kV transformers. Three years ago, GMP determined that one of these transformers was failing.

GMP obtained a certificate of public good from the Public Service Board to upgrade the facility. We replaced all three transformers with one, three-phase, 14 MVA transformer with dual-voltage secondary windings: 69 kV on the high side and both 8.32 kV and 12.47 kV on the low side.

We choose this design for the new transformer so that we could convert the Westminster distribution feeders from 8.32 kV to 12.47 kV. Replacing the Westminster Substation transformer and converting its distribution feeders enables feeder back-up with the Bridge Street Substation in Bellows Falls.

We replaced the transformers last year. We plan to finish converting the feeders in June of this year.

Planned Projects

Green Mountain Power continually conducts planning studies and upgrades facilities to meet load growth, maintain system reliability, and enhance safety. Listed here are the capital projects and planning studies projected for the next three years.

White River Junction Substation

The White River Junction Substation needs to be replaced.

Two substations operate in the GMP service area in and around White River Junction: the Wilder Substation and the White River Junction Substation. In recent years, GMP upgraded the White River Junction Substation and its associated distribution system from 4.16 kV to 12.47 kV for two main reasons: to accommodate load growth and to permit partial back-up with circuits originating from the Wilder Substation. Over time, this upgrade has proved inadequate.

A new White River Junction substation is necessary because of:

- Anticipated area load growth.
- Limitations on the 13.8 kV transmission supply to the White River Junction Substation.[19]
- Limited ability to perform feeder back-up.

[19] The White River Junction Substation is supplied at 13.8 kV directly from the National Grid Wilder Substation hydro generation bus. Limitations on this supply will likely require that a future supply to a new White River Junction Substation be from a nearby 46-kV source.

This new substation would likely be comprised of a 14 MVA, 46-kV-to-12.47-kV transformer; voltage regulators; SCADA control; and two or three 12.47 kV feeders.

There are at least two possible sites for the new substation: an expansion of the existing site on Lantern Lane in White River Junction and on land adjacent to the intersection of Vermont Route 4 and Interstate 91. Supply to the new substation can be by way of a new 2.5 mile 46 kV transmission line, overbuilt on distribution, located along Old River Road in Hartford that would tap onto the CVPS Hartford-to-Taftsville 46 kV line.

Due to limitations of the area 46 kV system, VELCO must install a second Hartford 115-kV-to-46-kV transformer (presently scheduled for 2015) before this project can be brought on-line.

Waterbury Substation

A new Waterbury Substation must be built to replace the existing substation.

GMP's existing Waterbury Substation is supplied at 34.5 kV and is comprised of a 10.5 MVA, 34.5-kV-to-4.16-kV transformer; regulators; and three 4.16 kV feeders. The Waterbury Center Substation (the other GMP substation servicing the Waterbury area) is supplied with a 14 MVA, 34.5-kV-to-12.47-kV transformer; regulators; and two 12.47 kV feeders.

Steady load growth and the impact of several large customers (including the State of Vermont and Vermont Coffee Roasters) characterize the Waterbury area. The Waterbury Substation's 4.16-kV feeders are nearing capacity; and these feeders cannot be backed up with the Waterbury Center Substation because the feeder voltages are dissimilar. This situation creates the need for a new Waterbury Substation to replace the existing substation. This new substation would be supplied with a 14 MVA, 34.5-kV-to-12.47-kV transformer; a voltage regulator; SCADA control; and two or three 12.47 kV feeders.

Currently, the best site for this new substation appears to be on GMP-owned land adjacent to the existing Waterbury Substation. This land, however, resides within the Winooski River's flood plain, thus obtaining a permit to construct at this site could prove challenging.

Third Winooski 34.5 kV Feeder

A third feeder into the City of Winooski is needed.

One 34.5 kV feeder, the 46Y1, currently serves the City of Winooski load. The adjacent 36Y5 feeder (originating at the Ethan Allen Substation in Colchester) backs up this feeder, albeit not at all hours of the year. This inability to provide full-time backup as well as continued load growth in Winooski creates the need for a third 34.5 kV feeder for the city.

This third feeder, the 16Y3, would originate at the Gorge Substation following the substation's renovation in 2012. To create the feeder, GMP must convert a half mile of existing 4.16 kV distribution that is underbuilt on the 3307 transmission line between the Gorge Substation and the Winooski redevelopment area. Because this half mile traverses a wetland area, the 3307 line would likely be reconductored at the same time to avoid having to perform construction in a wetland more than once.

Websterville Substation

The Websterville Substation, together with its relay building and transmission structure, is antiquated and needs to be upgraded.

Located in the Town of Orange, the existing Websterville Substation was constructed in the 1950s. It is comprised of a 34.5 kV transmission switching station and 12.47 kV distribution substation. The 34.5 kV wood pole transmission structure is badly deteriorated and much of the station equipment is outdated. GMP plans to:

- Replace the wood pole transmission structure with four 18-foot x 18-foot steel structure bays.
- Replace two old oil circuit breakers with new vacuum circuit breakers.
- Eliminate the breaker shunt switches.
- Add a bus-tie sectionalizing airbreak switch.
- Install capacitor and transformer high-side breakers with bus differential relaying.

GMP also plans to replace the relay building with relay replacements performed in concert with the GMP's Smart Grid initiative.

Hinesburg Substation

There will soon be a need for a new Hinesburg Substation. Currently, GMP's load in the Town of Hinesburg is served by a relatively long feeder, the 28G2, which originates at the GMP Charlotte Substation. Load growth in Hinesburg is placing large loads at the end of the 28G2; these loads will soon exceed this feeder's capacity.

The new substation's source would most likely be the Vermont Electric Cooperative (VEC) 34.5 kV subtransmission line from Richmond to the VEC Hinesburg Substation. GMP is exploring opportunities with VEC to upgrade this subtransmission line together with the possibility of constructing a jointly-owned substation that would provide service to both GMP and VEC customers in the area. A new Hinesburg substation would not only support growth in the area, but also could provide feeder backup for the 28G2 and a way to unload the 45G1 circuit out of GMP's North Ferrisburg Substation.

Planning Studies

We are conducting a number of planning studies to determine the parameters and timing of future projects required to meet the needs of GMP's customers.

Berlin Substation Transformer Upgrade

The Berlin substation in the Town of Berlin has a 10.5 MVA, 34.5-kV-to-4.16-kV transformer and a 10.5 MVA, 34.5-kV-to-12.47-kV transformer. Load growth requires increasing the substation's capacity. Our study will determine when this upgrade must happen.

We are considering two main alternatives:

- Upgrading the 34.5-kV-to-12.47-kV transformer to 22.5 MVA.
- Replacing the 10.5 MVA, 34.5-kV-to-4.16-kV transformer with a 14 MVA, 34.5-kV-to-12.47-kV transformer together with converting the existing 4.16 kV, 40J3 circuit (currently dedicated to Central Vermont Hospital) to 12.47 kV.

Barre Area Study

The Barre area is presently served by three substations, the North End Substation, Barre Substation, and South End substation. These substations, some of which contain aged equipment, supply distribution feeders in the area at 2.4 kV, 4.16 kV, and 12.47 kV, respectively.

In the long term, GMP intends to convert all area feeders to 12.47 kV to permit maximum flexibility in loading and enhance the back-up capability between feeders.

This study analyses the existing substations' equipment, system configurations, and area load. From that information, we will develop a plan for upgrading the substations' transformers and distribution feeders.

Dog River Switch to Mountain View Substation Reconductoring

The Mountain View Substation in Montpelier contains two transformers with a total capacity of 27 MVA. The 34.5 kV radial supply to this substation (originating at the Dog River Switch) is comprised of 1/0 conductor with a capacity of 18 MVA.

This study is evaluating the Mountain View Substation loading. From that information, we will determine a date for reconductoring the supply to the substation.

Marshfield Substation Rebuild

The Marshfield Substation, located in the Town of Marshfield, has a single 6.0 MVA, 34.5-kV-to-4.16-kV transformer that acts as both a hydro generator step-up transformer and a distribution transformer.

The substation is old, its equipment obsolete, its clearances too tight, and it cannot accept a mobile transformer installation. The transformer's ability to support load growth is limited, and the 4.16 kV distribution voltage does not permit back-up with the adjacent 12.47 kV feeders originating from the Plainfield Substation.

This study will detail a comprehensive plan to rebuild the substation, address safety and clearance issues, replace obsolete equipment, and convert the outgoing distribution voltage to 12.47 kV.

Graniteville Substation Rebuild

The Graniteville Substation in Williamstown has a 3.0 MVA, 34.5-kV-to-2.4-kV transformer that supplies two 2.4 kV feeders. A brick building at the substation encloses the transformer, switchgear, and an exposed low-side bus. The building is deteriorating, much of the equipment is obsolete, and clearances do not meet contemporary safety standards.

Out study will create comprehensive plan for dismantling the existing substation and to rebuilding it (on the same site) as an outdoor, open-air substation. This rebuild will address the safety and clearance issues and replace the obsolete equipment.

System Reliability

GMP pursues a number of initiatives that enhance the reliability of the service we provide to our customers. We perform these tasks:

- Vegetation Management
- Pole Inspections
- Aerial Patrols and Infrared Inspections
- Weather Event Planning and Response
- Power Quality Solutions
- Outage Management
- Smart Grid Opportunities

Vegetation Management

Trees that contact GMP's overhead transmission and distribution lines account for over one-third of all outages experienced by our customers. To reduce tree contact outages and improve operational efficiency, GMP employs a structured vegetative management program.

GMP selected Davey Tree Experts (through a competitive bidding process) to provide exclusive tree-trimming services in our service territory. Davey has assigned 40 of its employees and assembled 16 crews for GMP. These crews follow local and national standards, including the American National Standards Institute (ANSI) A300: Standards for Tree Care Operations and Public Service Board Rule 3.600: Maintenance of Electric Utility Rights of Way. Davey uses ground crews to cut vegetation under overhead lines as well as climbing and bucket crews to remove hazards to the sides and above the wires. A one-man aerial bucket crew answers customer concerns and trims around secondary wires. GMP does not use herbicides along its transmission and distribution rights-of-way to control vegetation.

GMP's distribution system is trimmed on a seven-year cycle. Every year, we clear approximately 420 miles and remove about 3,500 danger trees[20]. Urban areas are trimmed more frequently when seven years of clearance cannot be attained. The standard trimming requirements for our distribution system means maintaining 12.5 feet to each side and 15 to 20 feet above all wires[21]. All undergrowth is removed with the exception of low growing shrubs and trees (such as fruit trees). Crews working on the distribution system describe the work to be done to landowners and obtain permission from the landowner before beginning work on that property.

Our transmission system is maintained on a five-year cycle. Every year, we cut flat (by mowing or by hand cutting) approximately 3,500 acres plus remove 1,700 danger trees. Transmission right-of-way standards require a total cleared area 50 feet to each side of the wires. Crews working on the transmission system notify landowners of the intent to work on the rights-of-way and address their concerns before commencing work.

[20] Danger trees are those trees that are large, have a significant chance failure, and must be totally removed to avoid coming into contact with transmission or distribution wires.
[21] GMP has easements for less than 20% of its distribution lines located roadside. This can limit our ability to obtain the full 12.5 feet of side trimming.

Pole Inspections

GMP inspects all poles on its transmission and distribution system once every 10 years. Transmission poles are provided a full excavation inspection that entails a 360 degree excavation to 18 inches below the ground line. We then wrap the portion of the pole below grade and treat it with an antifungal compound.

We also check the integrity of the transmission poles. We visually inspect them to detect splits, holes, and abrasions; perform core boring; and perform sound tests for portions of the pole both above and below ground to detect soft spots or other internal imperfections. When decay is detected, we keep the pole in place by chemically treating it when its life can be reasonably extended. Otherwise, we replace it.

We partially excavate distribution poles by excavating to 8 inches on two sides of the pole. We visually inspect distribution poles to detect splits, holes, and abrasions; perform core boring; and perform sound tests for portions of the pole above the ground. Decayed distribution poles that fail our inspection are simply replaced because, by that time, they usually fail to meet the current specifications for height and class.

Aerial Patrols and Infrared Inspections

Every spring and fall, GMP flies helicopters to perform aerial patrols of its entire subtransmission system. During these patrols, we fly close to visually detect danger trees, broken cross arms, floating phases, cracked insulators, displaced cotter pins, and other problems that can negatively affect the performance of our transmission lines. We also conduct aerial patrols following major storms to assess possible damage.

During the peak load period of August, we fly an additional aerial patrol to conduct infrared scans. Infrared scans employ an infrared camera mounted directly to the helicopter to identify hot spots that can indicate a failing conductor, corroded splice, loose connection, or other problem area where a line is stressed and vulnerable to failure.

From the ground, GMP also performs infrared inspections in our substations using hand-held infrared cameras. We perform these inspections twice per year, near the summer and winter peak loads, when the thermal loading of components is at its highest.

Weather Event Planning and Response

Severe weather events pose a significant threat to GMP's system reliability. To exacerbate the situation, these events often occur with only 24 to 72 hours notice. To react quickly to an anticipated weather event, GMP has established a culture of immediate response in which all employees are trained in preparing for weather events and executing our reaction plan.

The GMP Storm Preparedness Planning Guidelines guides our response to severe weather events. This document describes how to prepare for and respond to an anticipated weather event. The Guidelines also establish guidelines for our post-event evaluations. GMP continuously incorporates "lessons learned" into the Guidelines, which then become part of future preparations for weather events.

From experience, certain types and severity of weather events predicate power outages. GMP subscribes to a weather monitoring service in which dispatchers receive weather alerts. The dispatchers then forward these alerts by email and storm pager to operations management. This early warning system enables our storm team, field assessors, and field crews to mobilize before an outage occurs. This proactive process has significantly minimized the duration of outages.

GMP's rotation of on-call storm directors has proved to be an important component of preparing for storms. The storm director on-call "owns" the successful handling of a storm, including:

- Calling pre-storm assessment and planning meetings.
- Securing resources.
- Assigning individuals to specific roles.
- Scheduling a succession of staff (if the restoration effort is forecasted to last more than 24 hours).
- Performing post-storm assessments.

Technology plays a significant role in managing weather events (see "Outage Management" on page 67 for details). GMP uses several interrelated systems to manage its restoration efforts, thereby allowing us to efficiently answer the high volumes of customer calls and to maximize our use of available resources. In the fall of 2011, GMP will begin installing its advanced metering infrastructure (AMI) meters (see "Advanced Metering Infrastructure" on page 74.) Among other features, these meters will alert operations personnel when an outage occurs allowing us to quickly and accurately pinpoint the extent of an outage.

Power Quality Solutions

Over the last few decades, the electric industry has paid increasing attention to the issue of power quality. Poor power quality adversely affects the reliability of the now ubiquitous computers and microprocessor-based equipment.

Power quality is the relative frequency and severity of deviations in the incoming power supplied to electrical equipment from the customary, steady, 60 Hertz sinusoidal voltage waveform. Examples of poor power quality include voltage impulses, high frequency noise, harmonic distortion, unbalanced phases, voltage swells and sags, and total power loss. Because the sensitivity to such deviations varies from one piece of equipment to another, what might be considered poor power quality to one device might be acceptable power quality to another.

The vast majority of power quality issues originate on the customer side of the meter, often due to inadequate wiring or grounding. Power quality issues, however, can and do originate on the transmission and distribution system. When poor power quality issues arise, GMP investigates its cause by using power quality recording devices installed at customers' premises. When poor power quality is the result of problems on our transmission or distribution system, GMP immediately develops and implements a solution.

Outage Management

GMP employs a device-driven, highly integrated outage management system (OMS) known as Responder. Responder accepts a variety of customer and system information and outputs information useful for analyzing and responding to outages.

Data input into Responder comes from a variety of sources:

- Customer service representatives take phone calls reporting outages and input this information into our customer service system (CSS). The CSS then automatically communicates pertinent outage data to Responder.

- In a similar fashion, GMP's integrated voice response (IVR) system uses prerecorded voice messages and subsequent customer responses to automatically obtain the caller's outage information, communicate this information to Responder, and if available provide customers with anticipated restoration times.
- Our geographic information system (GIS) holds the locations of customer data, line types, lines, and the interrupting devices (fuses or reclosers). The GIS is integrated into the OMS.
- Finally, GMP's fleet truck tracking system enables input into the OMS of line and tree crew locations.

Armed with this information, Responder predicts the discrete interrupting device that most likely operated for a given fault and provides to our operators this device's unique location. Operators can then dispatch line crews or outage assessors to confirm the operation of the device. Once confirmed, the line crew or outage assessor patrols downstream of the device to find the cause of the outage. Once the cause of an outage is known, we dispatch crews and equipment to repair the outage and estimate the restoration time.

Outage Analysis

GMP annually reviews and analyzes outage data.

Table 5 compares the number of 2010 outage events with the historical five-year average.

Outage Events	Average 2005–2009		2010	
Cause	Events	% of Total	Events	% of Total
Accidents	84	4%	121	3%
Animals	388	17%	546	15%
Equipment Failure	528	23%	680	19%
GMP Initiated	59	3%	58	2%
Operator Error	17	1%	7	0%
Power Suppliers	20	1%	21	1%
Trees	793	35%	1,841	52%
Weather	331	14%	276	8%
Other	6	0%	0	0%
Unknown	70	3%	10	0%
Totals	2,295	100%	3,560	100%

Table 5: Outage Events Analysis

Table 6 compares the number of 2010 customer hours-out (CHO) with the historical five-year average.

Customer Hours Out	Average 2005–2009		2010	
Cause	**Events**	**% of Total**	**Events**	**% of Total**
Accidents	14,521	4%	10,702	2%
Animals	15,948	5%	26,392	6%
Equipment Failure	36,475	11%	57,728	12%
GMP Initiated	10,163	3%	1,570	0%
Operator Error	1,051	0%	26	0%
Power Suppliers	39,641	12%	36,516	8%
Trees	171,087	53%	276,039	58%
Weather	32,250	10%	68,663	14%
Other	494	0%	0	0%
Unknown	3,735	1%	62	0%
Totals	325,364	100%	477,699	100%

Table 6: Customer Hours-Out Analysis

In addition to analyzing overall trends, each year GMP identifies its worst performing circuits, develops a priority list, and implements plans to improve the reliability of these circuits. GMP creates a priority list by ranking each circuit by the number of customers affected by outage events and by total customer hours out. This priority list allows us to focus our available resources on the least reliable areas of the power system thereby cost-effectively improving overall performance. Coupled with a system-wide focus on preparedness, technology, and a proactive vegetation management plan, this initiative creates a comprehensive approach to advancing the reliability of our power system.

The list of the 20 worst circuits represents the place where we first analyze and target improvements. Circuits making this list do not automatically result in a plan for capital improvements since we must consider other factors. For example, if the majority of the hours out on a given circuit was the result of a car pole accident, there might be no justification for undertaking additional improvements. Also, changing the operation or maintenance of a given circuit might be the best way to address an issue, as this requires no financial investment. For the 20 worst circuits identified in 2010, GMP has implemented improvements including road-side rebuild projects, SCADA upgrades, and reconstruction projects.

To further enhance its reliability analysis, GMP is developing a program in its GIS system that will consider parameters including outage data, wire type, circuit loading, and distance from the maintained road. By assigning various weights to these attributes, the program will be able to identify and recommend reliability upgrade projects.

GMP continues to make significant investments in the reliability of its electric system. Over the last several years, GMP has invested, on average, $16–20 million per year into its electric system, half of which has been earmarked for reliability enhancement projects. Examples of such projects include moving cross-country lines to the roadside, installing new protection devices, upgrading SCADA controls, and replacing end-of-life plants. All distribution rebuilds in which feeder back-up may be possible are performed with conductor large enough to support feeder back-up. These capital investments are in addition to the operation and maintenance expenses associated with vegetative management, pole inspections, aerial patrols, and infrared scanning.

Smart Grid Opportunities

The opportunities for Smart Grid[22] to improve the functionality of the transmission and distribution system comprise the following elements:

Enhanced Substation to Control Center Communications

The VELCO fiber network presently under construction will provide high bandwidth, secure, two-way communication from our 63 substations to our control center in Colchester. This enhanced, real-time communication will improve data acquisition and the ability of GMP operators to remotely control substation equipment. Microprocessor-based substation equipment installed over the past several decades is already compatible with the Smart Grid system; older electromechanical equipment will be upgraded to become compatible. Enhanced communication will also permit GMP engineering staff to more readily access substation data thereby allowing overloaded and failing equipment to be identified and enabling more accurate efficiency analyses.

Transmission Line Fault Indication

GMP has approximately 300 miles of transmission lines on its system. Some transmission lines can extend 20 miles or more and supply multiple substations. Faults on these lines will necessarily interrupt power to all of the connected substations. To address these areas of high exposure, GMP plans to install fault indication at about 25 sites, which will allow GMP operators to quickly identify the location of a fault. With this information, operators can dispatch crews to the problem location to remotely sectionalize the line and restore power to the effected substations and customers.

Distribution Automation

With present technology, a fault on a distribution line requires us to dispatch a crew, identify the fault location, and make repairs before restoring power to customers. With distribution automation under Smart Grid, remotely controlled switches will be installed on distribution lines. Once a fault occurs and the location of the problem identified, operators in our control center will be able to isolate the section of the line that requires repairs thereby restoring power to the balance of the interrupted customers.

In the future, GMP plans to add fault detection to the distribution system enabling fault location, isolation, and power restoration to be fully automated. Under this scenario, the restoration of power to unaffected sections of a distribution line would occur in a matter of seconds, without the need for an intervening operator.

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[22] See “Chapter 6. Smart Grid” on page 75 for a complete discussion of GMP’s smart grid initiatives and activities.

Distribution Management

Enhanced communications will permit the application of distribution management software systems. These systems create opportunities for real-time monitoring, control, and optimization of voltage and reactive power supply. As discussed above under the heading Conservation Voltage Regulation, optimizing the voltage to customers results in more efficient utilization of end-use equipment and energy savings to the customer. In a similar manner, more closely matching reactive power supply and demand can result in lower system losses.

6. Smart Grid

In the coming years, electric utilities, including Green Mountain Power, will be converting traditional utility operations and equipment into a smarter, more reliable, and more efficient electric grid — the so-called Smart Grid. At a basic level, the Smart Grid overlays digital communications technology on the existing system of poles, wires, and substations. This network of two-way communication collects and transmits data regarding usage, quality, and outages thus enabling a higher level of intelligence about grid activity.

This new world of information will enable greater customer insight and control of electricity usage, as well as new rates to encourage off-peak consumption — key components for managing the costs of producing and delivering power. Using Smart Grid data, utilities will be able to better understand the frequency and duration of outage times and use this data to improve reliability, analyze grid data to optimize power flows, and allow for more small scale renewable generation.

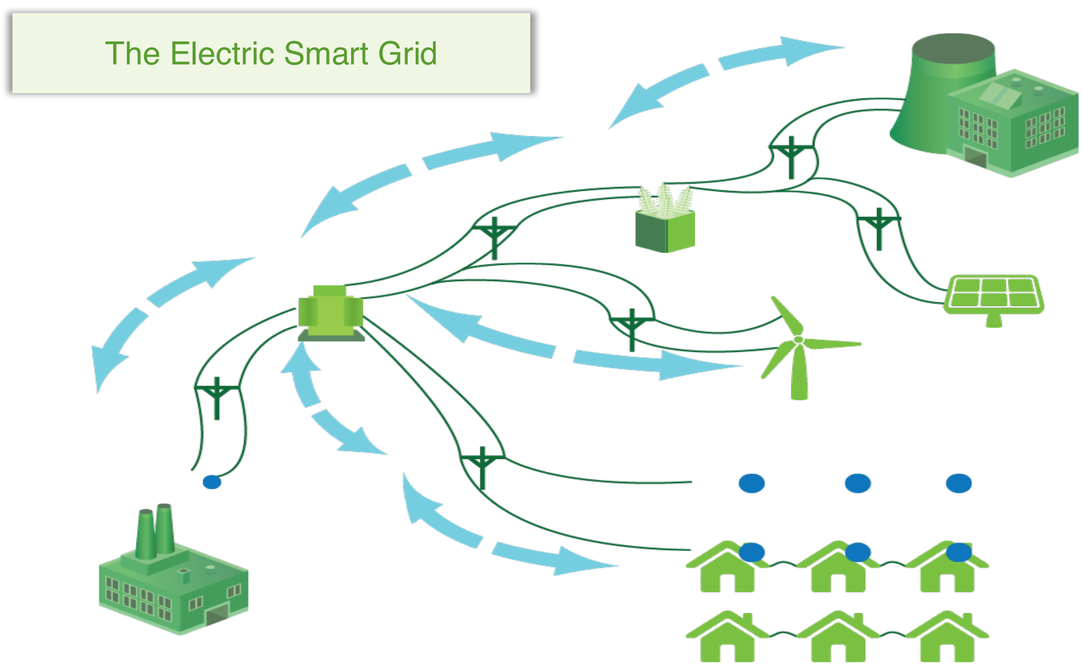

Figure 22: The Multi-Directional Information Exchange of a Smart Grid

The underlying technology for GMP's Smart Grid initiative — dubbed *GMPConnects* — is a combination of new meters, upgraded switching equipment, and state of the art software systems (represented in Figure 22). For customers, advanced meters on homes and businesses will enable automatic meter reading, sending data directly to us, thus allowing us to monitor and manage consumption patterns. In substations and on feeders, new communications technology and automated switches will allow for remote control via GMP's SCADA system to minimize truck rolls. And, in the server room, the project is powered by a significant upgrade to our data processing systems, including a full replacement of our customer information system (CIS) to enhance customer interaction.

Taken together, these advancements are expected to create customer savings, improve grid uptime, and allow for more renewable resources — in perfect concert with GMP's core principles of low cost, low carbon, and high reliability for our customers.

Summary Look at *GMPConnects*

The $787 billion American Recovery and Reinvestment Act of 2009 (ARRA) was signed into law on February 10, 2009. As part of the $65 billion allocated to energy spending and tax credits, $4.5 billion is aimed at modernizing the nation's transmission grid, including Smart Grid demonstration projects. The money is directed specifically at grants for projects that enable utilities and their customers to track and manage the flow of energy more effectively, curb peak demand, lower energy bills, reduce blackouts, and integrate renewable energy and storage (including electric and plug-in hybrid vehicle batteries) into the grid. The funds are intended to spur a wave of new energy investments and are not intended to replace the entire grid infrastructure.

GMP partnered with six other Vermont utilities to submit an application to the U.S. Department of Energy to obtain funding as part of the Smart Grid Investment Grant program. Vermont's application was selected and 50% matching funds were awarded to all six utilities. The entire project totaled $138 million, with $69 million from federal funds and the remaining half from Vermont utilities.

GMP's share of the overall smart grid project is $38 million, of which $19 million comes from federal funds. Federal stimulus funds are particularly important because they make the GMPConnects initiative cost-effective for customers enabling us to work through the project all at once; without federal matching funds, GMP would most likely be undertaking the project in a series of smaller projects stretched over many years.

The term of the grant is three years. It began in April 2010 and concludes in April 2013. All monies must be expended by April 2013 in order to be eligible for matching funds.

Advanced Metering Infrastructure

Advanced meters are the most visible change for customers in the GMPConnects initiative. Beginning in October 2011, with a target completion of January 2013, GMP will be replacing essentially all of its current 96,000 meters with new advanced meters from Elster. GMP's advanced metering infrastructure (AMI) system will consist of three components: an advanced meter located at the customer premise, a communications network between the meter and the utility, and a head-end system located at the utility office.

The advanced meter will record and store usage data at 15 minute intervals, register billing data for dynamic rates, register demand readings, report power supply status, and turn power on or off remotely using a built-in service disconnect switch. The advanced meter can relay price signals to and within the home via web presentment and in-home displays (IHD) — a key feature necessary the enables customers to reduce their electricity use during high price times using price signals sent from the utility. Although GMP's initial rollout of AMI will not provide IHDs, it will allow for customers to incorporate any commercial available IHDs. GMP will offer web presentment capability in its first phase.

The communications network has the ability to transmit prices and control signals to the meter, as well as information from the meter and, eventually, the Home Area Network (HAN), which will include devices within the home for usage control in response to price signals. In the initial rollout, GMP will utilize AT&T's 3G cellular network as its intermediate network to connect advanced meters to the utility. In future phases, GMP will use Vermont Telephone Company's (VTel) LTE network that VTel is building as part of the statewide *Connect Vermont* project.

The head-end system is the hardware and software used to process the collected usage data and to transmit data on the communication network to the meters. This is an Elster product that will incorporate with GMP's back office network.

Meter Data Management System

GMP will be implementing an meter data management system (MDMS) as part of its backbone upgrade. Due to the extreme volume of data that will be generated as part of the AMI project, the MDMS is vital to the proper functioning of other systems. To give a sense of the change in data volume, today, monthly meter reading generates 12 data entries per year per meter; with 95,000 meters, that is 1,140,000 data points annually. With new AMI technology reading usage data at 15 minute intervals all day, every day, the utility will receive 35,040 entries per year per meter; that's 3,328,800,000 data points annually — a nearly 300,000% increase in data volume.

The MDMS serves as the principal conduit and repository for meter information. MDMS is essentially a meter data warehouse, where meter data is collected, parsed, and translated before being made available to utility systems such as the customer information system, the outage management system, GIS, and other operations. GMP has not used an MDMS before and will be implementing meter data management as part of Oracle's utility bundle.

Customer Information System

In order to maximize the opportunity of the Smart Grid technology, GMP is undertaking a complete replacement of its existing customer information system (CIS). The current CIS is a legacy technology that lacks the functionality needed to fully integrate with AMI and MDMS. The new system will be built on the Customer Care and Billing (CC&B) module as part of Oracle's utility bundle, and is expected online by June 2012.

A major component of the new CIS system is how it improves functionality for customers. In addition to a range of web self-service features (bill pay, address change, and others), the CIS upgrade will allow for web presentment of meter data for customers — essential for empowering customer control and choice. These new services will allow customers to analyze electricity spending and usage, compare rate plans, and choose new rate options and other services.

Rates Policy

An important part of the GMPConnects initiative is developing and providing a variety of new rate options that encourage customers to save money by changing usage patterns to more closely match the cost that GMP incurs to purchase and deliver power during different seasons, times of day, and hours. GMP is proposing a phased approach for the new rates, beginning with relatively simple, voluntary designs and progressing to more innovative rates. The first "time-of-use" (TOU) rates are expected to be available in June 2012 for 500 customers.

With a phased rollout for a limited customer base, GMP is seeking to understand each new rate before opening it to the broader customer population. GMP plans to analyze usage patterns, revenue impact, and customer satisfaction, among other metrics, to measure the efficacy of the design to achieve desired goals. Table 7 is an indicative schedule of how GMP's rate design path may unfold.

Proposed Rate Design[23]	Limited Rollout	Full Rollout
Flat Rate – Existing Rate 01	n/a	n/a
Static Time-of-Use (TOU)	June 2012	January 2014
TOU with In-Home Display (IHD)	June 2013	October 2014
TOU with Day Ahead Variable Peak Pricing (VPP)	March 2014	June 2015
TOU with IHD and Day Ahead Peak Time Rebate (PTR)	June 2014	April 2016
TOU with IHD and Day Ahead Critical Peak Pricing (CPP)	June 2014	April 2016
TOU with IHD and Hour Ahead PTR	June 2015	June 2017
TOU with IHD and Hour Ahead CPP	June 2015	June 2017
Real-Time Hourly Rate	January 2016	January 2018

Table 7: Rollout Schedule for Proposed Rate Designs

Grid Automation

Although largely out of sight for customers, grid automation activities will have a direct and immediate impact in improving the reliability and efficiency of the grid. Beginning summer 2011, GMP will be upgrading its distribution substations, sub-transmission network, and distribution network with two-way communications systems.

The foundational improvement in substation automation will be a high bandwidth, secure, two-way communication between GMP's control center in Colchester and its 63 distribution substations around the state. The communication mode will be the VELCO fiber backbone currently under construction. This high-speed, low-latency link will allow a view inside the substation for both control center access (to operate the devices) and engineering access (to look at equipment ratings, configurations, and the like).

Along the 300 miles of its sub-transmission network, GMP will be adding fault indication technology to help diagnose grid problems as they arise. GMP will add fault indicators at approximately 25 different sites so that control centers operators will instantly receive data on faults, be able to isolate those faults, and bring the line up much more quickly.

[23] All rates and timelines are preliminary and draft only, and may not reflect final plans. This table indicates rates and timelines proposed to the Vermont Department of Public Service in Spring 2011.

Automation on the GMP distribution lines will improve reliability by giving the control center more options to bypass faulted circuits. Current practice is that when a fault occurs, the utility dispatches a crew, drives to the site of the fault, and remedies the fault. Distribution automation will add remote controlled switches that can be operated from the control center so that when a fault occurs, a system operator will have the ability to segment out that faulted section of line and bring up the balance of the customers more quickly. The utility will still need to send a crew to fix the fault, but fewer customers will be impacted.

Information Technology Infrastructure

With so much of GMPConnects' benefit derived from data transmission and analysis, it is important that GMP has a robust information technology (IT) infrastructure to match its array of new Smart Grid services.

The existing IT system is a collection of point-to-point interfaces that prevent easy data sharing between applications. Every system is, in a sense, a silo. These disparate systems are inefficient and limit using data in ways that enhance core functions. In addition, some current systems are past the end of their intended lifecycles and are becoming operational risks.

To support the new demands of the Smart Grid, GMP is implementing a new service-oriented architecture (SOA) upgrade for its IT infrastructure. The SOA framework uses a "build once, use often" model that provides better performance, quicker development, lower cost, and a high degree of flexibility. The framework allows for robust data sharing among various applications.

The new IT backbone is designed to evolve enterprise decision making from reactive (fixing things when they break) to proactive and predictive (anticipating customer needs) based on the connectedness of available information. The SOA architecture, coupled with robust tools, will turn data into information and allow sharing among applications. The new platform allows maximum flexibility for future opportunities to better serve evolving needs of customers, including a suite of new services to maximize web and mobile interfaces.

GMP is also focused on enhanced, enterprise-wide security with the new Smart Grid technology. In addition to building systems the comply with all Federal Energy Regulatory Commission (FERC), North American Electric Reliability Corporation (NERC), and National Institute for Standards and Technology (NIST) cyber-security standards, GMP and other Vermont utilities are working with Sandia National Laboratories to develop and implementation robust security measures for the new network.

Customer-Focused Benefits

GMPConnects is focused on delivering the greatest benefit for customers. From more reliable power to cost savings to greater level of customer control, the Smart Grid has potential to positively transform the customer experience.

One of the most anticipated benefits of the Smart Grid will be to make the grid even more reliable, to reduce the frequency of service interruptions, and shorten the duration of outages. In addition to the new substation and distribution control features (mentioned previously under "Grid Automation"), the advanced meters play an important role in alerting the utility when outages occur. When the power goes out, the new meter will send a "last gasp" signal to the utility. These signals will populate the outage management application and help isolate the fault on the line. For now, utilizes are encouraging customers to still call customer service when the lights go out, but, within a few years as the technology is tested and improved, it is expected that this "last gasp" feature will all but eliminate the need for a customer call.

With advanced meters capturing power data at more frequent intervals, there is an extraordinary opportunity to provide customers with new levels of information about their energy usage. Through web presentment (Figure 23) and in-home displays, customers will have the ability to make more informed decisions based on their individualized energy profile. When customers know that GMP's cost of delivering power is very high, they can save money by reducing consumption at those times. Time-differentiated rates will also allow customers to know when the cost of power is low, and to take advantage by shifting consumption to those times (such as charging electric vehicles during those times).

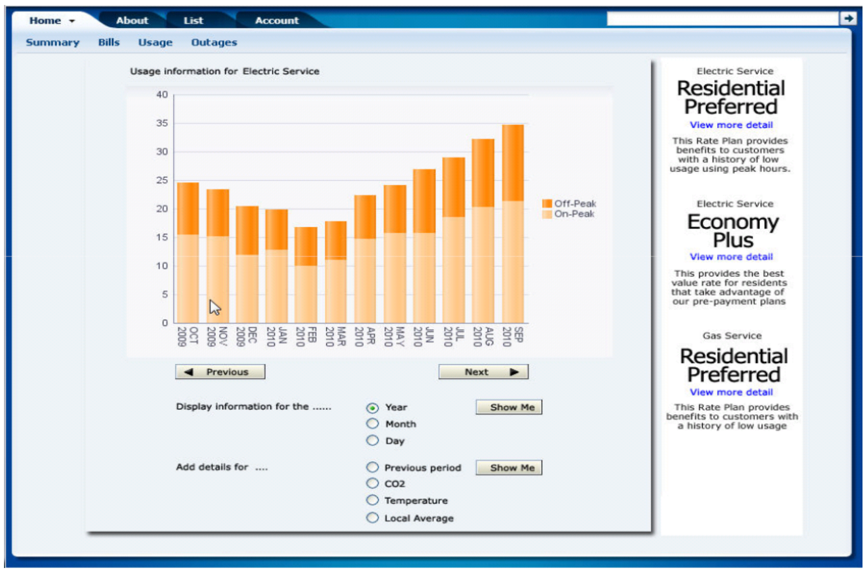

Figure 23: Usage Information Available to Customers Through Web Presentation

There are also utility-side savings that GMP expects to pass along to customers. As previously mentioned, there will be operational cost savings with improved grid intelligence by limiting field time by improved fault isolation, lowering the number of truck rolls for routine service, and reducing meter reading. Utilities have also reported reduced theft and tampering with the advanced meters, which leads to additional cost savings.

Another potential area for utility savings is fine-tuning line voltage to reduce system load. At present, because of line loss and peak demands, utilities send near maximum voltage from the substation to prevent voltage sags at the farthest premise on the circuit. New advanced meters will measure power quality, and by monitoring voltage at the last meter on a circuit, the control center can calibrate the substation flow, reducing the demand on the system. Reduced demand on the system translates into cost savings for power supply.

The Smart Grid will also help fit more small-scale renewable power into the grid. Currently, using schematics and limited field testing, engineers estimate the capacity of conductors and transformers to accommodate the power flow from backyard solar and small-scale wind turbines. This estimate can be a limiting factor for new renewables on a single circuit. However, with intelligence from advanced meters and grid automation upgrades, GMP will be able to more accurately model the capacity of a circuit. Engineers expect this will as much as double the capacity for distributed generation without having to make extensive capital investments. Using this data will also open the door for future opportunities, such as microgrids and more robust community net-metering.

With new data, new potential for increased savings, and new options for small-scale renewables, it is important that customers control their level of involvement. Many customers will be satisfied by simply accruing the benefits of system improvement and will not be interested in extra features through GMPConnects. A smaller segment of customers will be interested in enhanced benefits, including more granular usage information, time-of-use (TOU) rate options, and other features — provided that the tools to access these features are easy to use. There will also be a segment of very involved customers who are interested in more complex rate options for deeper savings, in-home devices (IHDs), and more active utility-directed savings (such as load control).

A final segment might not be interested in Smart Grid functionality at all. GMP is working with the Department of Public Service to develop an "out-opt" plan for customers who — for whatever reason — do not wish to receive an advanced meter or other Smart Grid benefits.

Customer Outreach and Involvement

The phase-in of advanced meters will require robust and regular communications with customers. Some utilities have found customer communications with Smart Grid challenging. With lessons learned from other initial forays, we created an outreach plan to connect with more focused information for the various customer involvement levels. GMP has a comprehensive customer outreach program, including traditional mail, bill inserts, targeted emails, updates on the GMP home page, community presentations throughout the GMP service territory, and earned media efforts through local press. Customers will also have a full range of information through social media outlets such as Twitter and Facebook.

GMP plans to educate customers about the new smart grid features — such as web presentment and new rates — so that customers can take advantage of these enhanced benefits. GMP customer service representatives (CSRs) will be trained to answer specific customer questions, as well as explain how to maximize Smart Grid benefits. GMP will be updating its web site and Facebook page as well as creating collateral materials to reflect the new information.

The frequency of customer interaction will likely increase: instead of a once monthly bill and the occasional call to the customer support for nearly all customers, some customers might be accessing their individual account daily or weekly to track energy usage and analyze rate options. GMP plans to enhance its web platform and allow customers to perform a broader range of transactions via the web — freeing CSRs to deal with more complex customer questions.

GMP understands the need for comprehensive and consistent cross-platform communication, including support available through the various media, both voice (phone, interactive voice response) and text (web site pages, paper bills, emails). GMP is mindful of customers with disabilities who might be hindered by non-traditional media and plans to implement appropriate alternatives. GMP is also considering partnerships with third-party vendors (such as Efficiency Vermont) to provide further education opportunities for customers.

Implementation

The breadth and complexity of Smart Grid and its impact on the GMP enterprise — in particular on information systems — continues to unfold. With the coming Smart Grid data explosion, many industry experts see utilities enhancing their business model to become significantly more similar to information technology companies. The transformative nature of GMPConnects will provide a new range of opportunities to enhance customer benefit, but will also create new risk factors that must be identified and managed. GMP has an established risk management strategy and employs that strategy in the GMPConnects initiative.

At just past a year into the three-year Smart Grid Investment Grant, GMPConnects is generally on-track with all major deliverables. GMP evaluates progress on a regular basis and, at this juncture, expects to finish the planned work by the April 2013 deadline. For a detailed tracking of the individual projects within GMPConnets, see Appendix “C: Smart Grid Implementation Plan” on page 181.

7. Planning Energy Resources

Green Mountain Power uses the information and recommendations in this IRP to implement a strategy and corresponding resource portfolio with the most value to us and our customers. We measure value from the following perspectives:

- Balancing a stable price environment for our customers with market flexibility.
- Maintaining a low emissions profile in the region.
- Implementing cost-effective energy efficiencies.
- Supporting Vermont's economy by investing in generation and by maintaining regional rate competitiveness.
- Maintaining low revenue requirements, both in procuring and delivering power.
- Continuing to strengthen our financial position, ensuring that we are able to implement the resource plan with minimal risk.

We employ a multi-step process to create a recommended course of action for our resource portfolio strategy. It can be pictorially represented as shown in Figure 24.

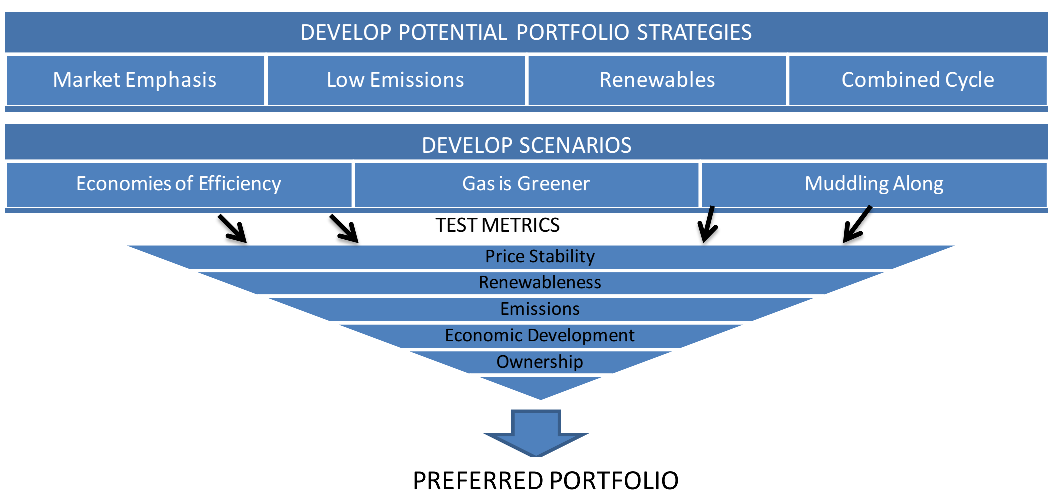

Figure 24: GMP's Multi-Step IRP Portfolio Evaluation Process

We examine our power system, demand, generation, transmission and distribution, and their future outlook together with a thorough understanding of the regional marketplace and its outlook. The IRP planning centers on developing and modeling various resource portfolios that reflect potential thematic directions. We evaluate these portfolios using three scenarios that illustrate future economic, political, and environmental variables for the local, regional, and global energy environments. We examine these scenarios against several key metrics and use a multi-attribute trade-off approach to choose a preferred portfolio to pursue. This portfolio is then further tested against potential market stresses such as reduced load or reduced fuel prices.

"Chapter 9. Action Plan" (on page 139) describes how we intend to implement the priorities identified in this plan.

Our Three Energy Scenarios

The exact future conditions in which this plan will unfold are unknowable. For planning purposes, we developed three scenarios based on divergent but realistic predictions of how economic, geopolitical, and energy policy factors play out during the study period. Testing our proposed action plan within these three scenarios provides a method for determining the robustness of our forecast results under varying future conditions.

Many different organizations have used scenarios as a planning tool for at least two decades. Scenarios are useful in that they help determine a viewpoint on the best course of action to take from a classic economic analysis perspective of a particular investment and also provide insight regarding the flexibility, robustness, and value of different organizational strategies.

The Factors Considered in Our Scenario Design

In order to better plan for the future, the scenarios represent three plausible but very different future worlds with parameters that affect the demand for electricity and the cost to provide reliable electric service. We based these scenarios on original analysis performed by La Capra Associates, and informed by the GMP Integrated Resource Planning team. They are meant to reflect dynamics that are relevant to today's power industry and the future.

The following sections describe the state of the world in which GMP is assumed to operate in each of our three scenarios:

- Muddling Along
- Economies of Efficiency
- Gas is Greener

Key factors described for each scenario include the: Geopolitical Climate, Economic Outlook, Carbon Policy, Renewable Energy and Energy Efficiency Policy, Baseload Generation, Transmission Buildout, Demand-Side Management (DSM), Gas Supply and Pricing, and Capacity Market Prices.

Muddling Along

Geopolitical Climate. The U.S. remains focused on two fronts — battling the spread of terrorism and nation-building abroad, and improving the economy at home. Politically, there is no consensus on any major initiative; as a result, policy development across the board, including a comprehensive energy or climate policy, remains stuck. Europe too is plagued by lack of a comprehensive approach to difficult issues and is drawn more inward to address economic challenges of certain member states like Greece. Asia continues to grow but not at levels that would provide an impetus to help the rest of the world. China increasingly faces difficulties resulting from demographic challenges, including the need to address an aging population.

Economic Outlook. The economy grinds and stumbles along with a slow and shallow recovery. Annual gross domestic product (GDP) growth remains below 2% until 2015, ultimately plateauing at 2.5% by 2020. Growth is also slow in the rest of the world, failing to provide a stimulus to overcome U.S. muddling.

This world is characterized by continued uncertainty in the power markets, in particular regulatory uncertainty. A patchwork of regulatory policies for regional markets, generation development, environmental issues, and transmission continue. It takes a long time to arrive at any political compromise and then any policy is watered down. This is a challenging environment in which companies need to develop robust long-term strategies and tend to be more risk adverse and focus on their core competencies.

In keeping with the theme, inflation and interest rates are expected to muddle along at moderate levels. Inflation hovers around an average rate of about 2% for the entire study period, while interest rates on Federal 10-year Treasury bonds climb from about 4.5% in 2012 to just below 6% by 2030.

Carbon Policy. There is some global support for policies to address global climate change, but lack of a uniform approach and required consensus to get anything meaningful done is lacking. The EPA administratively regulates carbon. By 2018, however, policymakers are able to pass a watered down national carbon policy and prices increase to moderate levels — roughly $18 a ton in 2020 — but nowhere near levels that would fundamentally change the composition of the U.S. generation fleet.

Renewable Energy and Energy Efficiency Policy. Development continues but in fits and starts as there is a lack of sustained policy incentives. Instead, a patchwork approach continues of different state renewable portfolio standard (RPS) policies with varying structures and definitions. Some states focus in on costs of RPS and revisit targets to either reduce requirements or loosen compliance eligibility standards. Vermont does not pass a mandatory RPS, but keeps the SPEED construct (in which the Vermont utilities are expected to sell the RECs associated with their new renewable sources) in place. No federal RPS is enacted.

The continued lack of clarity on biomass policy both at a state level and at the EPA limits its development. Massachusetts eliminates biomass from their RPS and Connecticut follows suit. Although biomass-rich states such as Maine continue to maintain biomass eligibility in their RPS, development is still limited by regulatory uncertainty. The PTC is renewed but with a lag. The inconsistent and unpredictable policy environment tends to mire projects in long development times.

Baseload Generation. No major changes in the makeup of New England baseload generation are assumed in this scenario. Concerns about the safety of nuclear prevent any significant new additions, but do not rise to the level that would cause the retirement of existing capacity. Coal generation also proves to be fairly "sticky". The lack of strong environmental control policies provide no financial incentive for plants to retire and the result is that all but one New England coal plant remains online over the planning horizon.

Transmission Buildout. This scenario assumes that bulk transmission projects continue to be implemented on a piecemeal basis, without any comprehensive regional build-out plan for a modern smart grid system. However, some local projects to alleviate congestion do move forward, including projects that better connect Vermont to the Massachusetts hub. As a result, LMP premiums decline. There is a lack of clarity on who will pay for transmission and the process to evaluate non-transmission alternatives (NTAs) is slow and cumbersome, resulting in higher than expected transmission additions by VELCO. There is increased interest in new fossil fuel generation in Vermont to address reliability concerns.

At the federal level, the final rule that results from the current FERC NOPR leads to more questions than answers for cost-sharing of interregional transmission projects. The transmission "superhighway" across the U.S. never materializes.

Demand-Side Management. This scenario assumes that DSM efforts will essentially continue along a "business as usual" trajectory. Although existing efforts continue, there is no major tax support for taking Smart Grid to the next level.

Community and micro-scale renewable generators are one exception, seeing increased attention that leads to 1.5% of load being offset by behind-the-meter renewable generation by 2030.

This scenario also sees the lowest amount of statewide funding for efficiency through the Efficiency Vermont (EVT) programs, although it is still assumed that investment will increase slightly ($5–10 million) from current levels.

Gas Supply and Pricing. Uncertainties surrounding development of shale gas remain unresolved in this scenario, resulting in a significant but smaller than expected influx of new domestic natural gas supply. Though some regions move forward with drilling, others such as New York ban or greatly limit the tapping of shale gas plays due to environmental concerns such as watershed contamination. Generally, the erratic and uncertain regulatory environment slows investment, making domestic shale gas a moderate infra-marginal supply source.

The see-saw policy approach also applies to gas transportation, as some planned pipeline projects are developed and others scrapped based on local dynamics. No coherent regional plan or policy emerges.

The result of this muddling is that gas prices are moderate in this scenario. There is enough gas supply to prevent any major price spikes, but the potential for a flood of domestic shale gas dramatically undercutting prices is never realized either.

Capacity Market Prices. At the New England system level, we see continued slow and muddled evolution of FCM markets. The lack of major retirements in this scenario results in a continued surplus of capacity bidding into the markets and a corresponding low price — under $5.00/kW-month through 2024. Only in 2025 is the capacity surplus finally eliminated allowing prices to reach levels that support new thermal entry.

Economies of Efficiency

Geopolitical Climate. U.S. hegemony continues to weaken politically and economically. China and India drive commodity prices through their increasing demand and oil prices rise as a result. The U.S. experiences sustained poor valuation of the dollar and has less weight in international circles. The U.S. makes efficiency job one. Politicians realize competitiveness gaps can only be closed by efficiency improvements or lifestyle changes.

Economic Outlook. Slow economic growth is expected as the U.S. recession continues, and its trade imbalance and deficit continue to grow. GDP growth is slow, peaking at 2.3% in 2020 before declining to just 2% by 2030. Asian countries enjoy modest to strong growth, led by China in double digits. U.S. inflation remains in check as high input prices are offset by low economic growth. The poor U.S. economy and focus on efficiency causes New England's load growth to dip even lower than expected in the current CELT.

Low economic growth implies low interest rates but a weak dollar leads to higher interest rates over time as the return on money needs to be higher to attract capital. An increased deficit also leads to higher interest rates.

Electricity remains expensive, driven primarily by increased costs of natural gas. While demand for natural gas is rising all around the world, growth is strongest in non-OECD countries, in particular, China. By 2030 China's demand for natural gas will be more than 6 times what it was in 2005. This demand fueled by the rise in China's GDP and high oil prices — which encourages switching -- leads to higher U.S. natural gas production costs as the U.S. must compete for limited drilling rigs and related services. China and India's skyrocketing demand for additional generation drives increases in commodity prices. This includes the price of coal as well as steel and other components of generators, resulting in increases in the capital costs of new generation and therefore an increase in the cost of new entry. A poor financing environment and aging physical infrastructure in need of investment put further upward pressure on costs of new entry as well as transmission and distribution expansion.

Carbon Policy. Weak. The political impetus to deal with climate change is severely hampered in a poor economic environment. The impetus for aggressive regulation is further undercut by natural CO_2 emissions declines in a low growth environment. Support for a carbon tax in this environment is negligible and even support for a cap and trade regime wanes as policymakers look to energy efficiency as the most cost effective means to reduce emissions. In addition, scandals with the emissions trading market in Europe erode confidence in a managed trading system for carbon emissions.

The U.S. lacks the political will to implement a comprehensive carbon policy at the federal level such as cap and trade. Instead, the EPA is grudgingly allowed to proceed with administrative regulations through the CAA. In order to prevent Congress from interceding and removing their regulatory authority over carbon, however, the EPA generally adopts lenient standards. Carbon prices reflect this and stay at low levels, similar to prices under RGGI.

Renewable Energy and Energy Efficiency Policy. Some development. High natural gas prices and support in some quarters for renewable power development enable development of the most cost effective renewable options. However, concern about the cost of renewable projects and financing pressure create a challenging environment for new investment. Lower cost renewables such as onshore wind and landfill gas go forward. There is a first mover advantage as the "good" projects with best sites get done earlier.

Some state renewable policies are scaled back and no federal RPS policy is implemented, as regulators and consumers grow increasingly intolerant of any additional cost premiums. Vermont, encouraged in part by a focus on transmission, passes an RPS of 25% by 2025.

The production tax credits for renewable energy projects are renewed, but at reduced levels.

Some biomass development occurs in the Northeast as biomass remains standard in RPS policies. The weak stance on carbon means that the carbon neutrality of biomass is not questioned. Biomass development focuses on lower cost applications like co-firing.

Baseload Generation. Fossil fuel increases as a percent of overall generation. Some new coal and nuclear is developed but not in New England where these are difficult to permit and build. Only Salem Harbor, which has already announced its planned retirement, retires in New England. Market heat rates are low, driven by lower loads, surplus capacity and imports from Hydro-Québec. Some older gas plants in New England are sold overseas for parts and some steam units are mothballed.

Transmission Buildout. This scenario assumes tax support for transmission investment, leading to the most robust build of transmission projects both within New England and between New England and neighboring regions.

Demand-Side Management. With high electricity prices and costs for new entry in the U.S. and expectation of continued economic constraints, there is a real premium put on the value of the "negawatt" and EE as the "5th fuel" catches on. It is also more prudent to invest in DSM and EE rather than in investing in new generation with the expectation of low load growth. Also, when the economy is down policymakers think of EE in terms similar to financial aid, and as a result they are inclined to spend more on EE as a social program. High oil prices also fuel interest in EE. VT increases DSM spending which it can recover through regulators and which costs less than the alternatives of capital investment or asset acquisition costs. Energy Efficiency programs and tax incentives (which help hold down required utility incentives) increase in this world. EE incentives fulfill the desire to be "green". There is also a large focus on CHP, as large CHP gets tax incentives to soothe the outcry from renewable energy advocates.

There is an increase in community scale renewable projects; especially CHP projects because they are promoted by environmental advocates.

Smart Grid, Electric Transportation and Transmission investments get tax support. Smart Grid investments go forward to enhance operational efficiency of the storm restoration and T&D systems allowing lower O&M costs. Smart Grid customer effects are surprisingly stronger than research has indicated, reducing non-space conditioning usage by 0.5% per year from 2016–2025, before leveling off. The public response during peak demand tight capacity periods through the smart metering component of smart grid kicks in with a 5% reduction in peak demand in 2016 and grows to 10% by 2030. There is a robust transmission buildout resulting in higher RNS rates due to higher interest rates despite the hope to lower costs via the tax credit. There is a strong push to expand the electricification of the transportation sector. Electric Vehicle initiatives go beyond cars to include buses, light trucks and even motorcycles. Regional and sub regional light rail projects come to fruition within Southern New England and in the greater Burlington region of Vermont. IBM stands out as a sponsor of its employees utilizing this efficiency and IBM Smart means of commuting. Some increase in off-peak loads due to charging vehicles is also accompanied by slight increases to both winter peak and peak period consumption year round due to light rail usage.

Gas Supply and Pricing. High prices. Higher global demand for energy led by China and India coupled with an anemic economic recovery in the U.S. and high world oil prices drive energy companies toward more oil exploration and production outside of the U.S.. This in turn raises the cost of production because domestic gas producers — including shale — must compete for limited drilling rigs and related services. U.S. producers are thus competing for inputs to production — including credit — and U.S. consumers are competing with other countries for LNG, which will, all else equal, tend to increase gas prices in New England which is more dependent on LNG to meet peak winter demand. This changes the seasonal profile for New England gas prices, sharply increasing January and February.

In addition, pipelines seek and are granted tariff increases in rate filings where they need to demonstrate how the gas will flow in response to Marcellus Shale. Further, environmental concerns related to shale gas extraction both at a local and state level put upward pressure on gas prices and constrain domestic supply for some Northeast markets such as New York and Pennsylvania. The Northeast must rely more on imports, which are expensive due to the weak dollar.

Even if environmental issues reduce demand for Marcellus and Gulf of Mexico drilling, international demand is up enough to support higher prices so domestic producers will have to pay more to lease rigs regardless.

Capacity Market Prices. New energy efficiency keeps the capacity price low as the cost of new entry for energy efficiency is low. Because of the increase in steel commodity costs the cost of new generation and therefore the capacity clearing price will jump suddenly.

Gas is Greener

Geopolitical Climate. This is a future shaped by increasing American energy independence in the electric sector driven largely by the new fuel revolution: shale gas. The abundance of inexpensive, moderate carbon-emitting gas provides the U.S. an answer to dependence on foreign fuels and the desire to reduce our national carbon footprint.

Oil and gas prices increasingly become delinked as technological advancements for gas extraction continue and gas supplies grow globally providing alternative options to oil importing nations.

Economic Outlook. In this scenario the economic outlook is measured but optimistic with GDP growth averaging 2.3% in 2015 and settling at 2.7% by 2020. This coupled with moderate interest rates results in more money for R&D investment in the energy sector, particularly in clean technology. This technological emphasis along with abundant inexpensive gas further drives the U.S. economy and reduces the U.S. trade deficit. Higher economic growth leads to higher interest rates, but this is mitigated by a reduction in the trade deficit.

The strong economy means stronger load growth in New England. GMP sees some of its highest load growth and lowest levels of energy efficiency in this scenario.

Carbon Policy. There is ongoing evidence of the harmful and wide-reaching impacts of growing green house gas emissions. There is a strong interest in "green" globally and in the U.S. but bipartisan support does not exist to enact a cap and trade or carbon tax policy approach. The opportunity for gas replacement of coal to reduce carbon emissions at a low cost is widely embraced, in particular in an increasingly difficult environment for nuclear plant development. Carbon is administratively handled by the EPA.

Renewable Energy and Energy Efficiency Policy. Gas is abundant and cheap which makes it difficult for renewable energy to compete. However, given the lack of a strong carbon policy and the stagnation of nuclear power development folks look to gas and renewables to help lower emissions. Some development of renewables occurs in particular to meet RPS standards and when based on economic impact justification/or at community level. The federal government does heavily back and promote mid-west and western U.S. 'cheap' wind, including the infrastructure to assure no RE congestion, but does not create the superhighway to the NE. This implies incentives to expand the NE transmission system to get northern Maine wind.

Solar PV- capital cost declines are achieved on the module and balance-of-system side, leading to a growth in solar PV, including building-integrated PV.

Although biomass is generally more costly than onshore wind projects, it remains one of the lowest cost and most abundant economic renewable resources in New England – particularly across Vermont, New Hampshire, and Maine. The Massachusetts DOER gets major blowback from their strict new proposed regulations on biomass RPS eligibility (and the Manomet study upon which it was based), resulting in revised standards that are more conducive to biomass development. Other states (including VT's new RPS policy) follow suit and allow or continue allowing most biomass to qualify for RPS eligibility. The opportunities for low cost co-firing are limited as many coal plants are replaced by gas generation.

RPS standards remain strong given general support of green. VT passes a "real" RPS of 20% by 2025. The PTC is renewed until a Federal RPS is in place in 2020 and then it is not renewed.

Baseload Generation. Global safety concerns regarding nuclear power in the wake of the Japan crisis trigger a number of cancellations of nuclear projects around the globe. What was once hailed as the "nuclear renaissance" which could greatly mitigate carbon is no more. This dynamic gives further impetus to both natural gas and renewables to help address rising GHG emissions.

New natural gas capacity follows power demand growth. A low or no transmission buildout gas favored world leads to generation buildout rather than transmission. Some extra CT's are built or D/R is added even with the regional surplus to account for the continuation of reliability concerns in some pockets and to get more LFMR capacity. Finally, a stronger focus on being green in this world and low gas prices combine to lead to a large amount of retirements.

Demand-Side Management. Some level of DSM. Vermont uses new technology such as smart grids to implement more distributed generation

Gas Supply and Pricing. Natural gas prices are low due to an abundant supply of inexpensive shale gas combined with high production, high storage levels and significant expansion of pipeline capacity. VT expands distribution system for gas dramatically (quantify) over 20 years, enabling it to triple the number of new customers compared to the current build out plan. This results in increased CHP potential.

There is stronger gas demand than in the other scenarios due to its low price. The U.S. becomes an LNG exporter.

Capacity Market Prices. This is the scenario of highest capacity market prices, led in part by electricity demand growth and the retirement of some existing generating capacity in the face of low energy market prices. A reformed Capacity market is established to get new gas fired generation built, characterized by a floor set for existing capacity resources and new CC's getting capacity prices that match cost of service rates through a secondary market or utility contracting.

Quantifying Key Components of the Scenarios

After establishing the scenarios in qualitative terms, we created future values for key components for each scenario to better evaluate alternative strategies through various resource portfolios on a quantitative basis. Table 8 and Table 10 below summarize the inputs for our three scenarios.

We derived the scenario inputs from a number of sources. The U.S. Department of Energy publishes an Annual Energy Outlook (AEO) that includes alternative cases for projecting economic activity. We based regional load growth on forecasts by ISO-New England; and GMP-specific load growth on internal projections modified to match scenario conditions. Finally, we based spot electricity price forecasts on the La Capra Northeast Market Model. This model uses a chronologic simulation tool, utilizing the Aurora software platform, that realistically approximates the formation of hourly energy market clearing prices on a zonal basis, the dispatch of various types of generating plants, and the net energy revenues associated with their operation.

Main Scenario Inputs: Cost Drivers for 2020 and 2030 in 2010 Dollars

These cost drivers include sample values for years 2020 and 2030.

Input	Muddling Along	Economies of Efficiency	Gas is Greener
U.S. GDP Growth	*Moderate* 2.5%/2.5%	*Low* 2.3%/2.0%	*High* 2.7%/2.9%
Inflation	*Moderate* 2.12%/2.23%	*High* 2.61%/2.67%	*Low* 1.44%/1.65%
Interest rates (Nominal 10 year Treasury)	*Moderate* 5.74%/5.90%	*High* 6.37%/6.58%	*Low* 5.10%/5.22%
Oil Prices (crude $/bbl)	*Moderate/High* $110.28/$125.70	*High* $154.52/$154.52	*Moderate* $103.02/$103.02
Natural Gas Prices (Henry Hub $/MMBtu)	*Moderate* $5.75/$6.68	*High* $6.90/$8.40	*Low* $4.64/$4.64
Coal Prices (Delivered to NE $/MMBtu)	*Moderate* $3.44/$3.52	*Moderate* $3.44/$3.52	*Moderate* $3.44/$3.52
Carbon Allowance Prices ($/ton CO_2e)	*Moderate – begins in 2018* $21.27/$36.68	*Low – no national program* $6.18/$8.24	*High – begins in 2018* $34.04/$55.44
VT Renewable Policy	No mandatory RPS – SPEED goal 20% by 2017	VT RPS – ramp to 20% by 2020	VT RPS – ramp to 20% by 2020
Regional Fossil Fuel Retirements	*Moderate*	*Low, including some gas*	*High – mostly coal*
Transmission Buildout	*Moderate*	*High*	*Low*
Transmission Costs (RNS rates and TBO): $/kWh	*Low* $.021/.0189	*Low* $.021/$.019	*Moderate* $.022/$.022

Table 8: Summary of Key Cost Driver Scenario Inputs

Natural Gas Prices

Natural gas prices are a key determinant in future electric power prices. Since the last IRP, a paradigm shift has occurred in natural gas markets with the advent of shale gas and the prospect for lower sustained natural gas prices. This outcome is not guaranteed however and there remains tremendous uncertainty regarding future gas prices, global demand for energy, gas infrastructure development as well as the environmental impacts of shale gas will influence future natural gas prices. Figure 25 depicts the range of natural gas prices delivered to New England for the three scenarios.

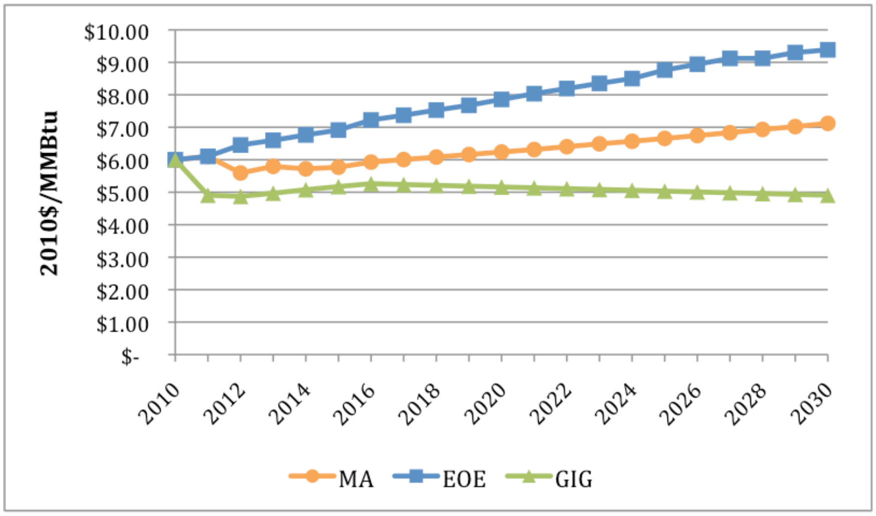

Figure 25: Natural Gas Prices, Delivered to New England (2010$/MMBtu)

Carbon Prices

Although the potential for carbon prices would have the greatest impact in regions with a large degree of coal generation in the mix, they would also meaningfully impact New England power prices. There has been and will continue to be significant uncertainty regarding the potential for pricing of carbon, making this variable one of the largest uncertainties regarding electricity prices in the long-term. Although the proposed Waxman-Markey legislation which outlined the country's climate change policy for reducing production of greenhouse gases in many economic sectors has died in the U.S. Senate, there is still the possibility that some form of greenhouse gas legislation that could include a cap and trade program (at least in the electric sector) or tax on carbon will be approved and implemented during the study period. Even without this comprehensive energy legislation, the EPA has regulated greenhouse gas emissions (including CO_2) under the existing Clean Air Act. It will be important to monitor what happens with the RGGI markets, EPA and national legislation.

Figure 26 shows the CO_2 emission price trajectory assumed for each of the three scenarios. Because none of these assume a Waxman Markey level of carbon pricing we thought it was important to also develop a high carbon price sensitivity which we apply to the scenarios in further analysis which is discussed in more detail in "Chapter 8. Evaluating Resource Portfolios" (page 103).

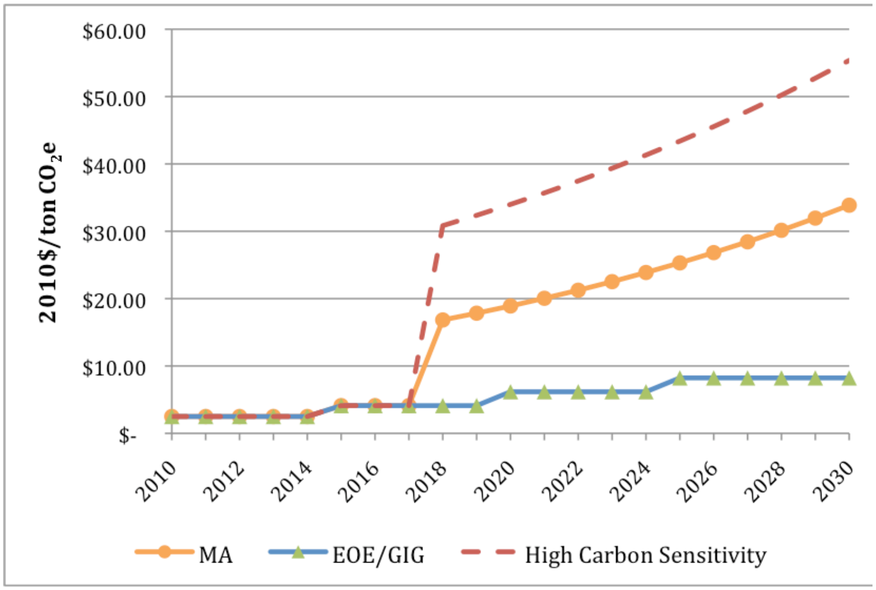

Figure 26: CO_2 Emissions Allowance Prices

Renewable Policy and Development

As mentioned in Chapter 2, renewable energy policy at the state and federal level can have a profound impact on the New England generation mix, and particularly GMP. Table 9 summarizes assumptions made about renewable policies enacted in each of our three scenarios.

Currently, state-level renewable portfolio standards (RPS) are one of the most important drivers of renewable development in the U.S. Vermont is the only New England state that does not have a mandatory RPS. In Muddling Along, we assume that this situation continues, with only a SPEED goal where it is assume 20% of supply is met by renewable energy sources by 2017. As a result, GMP in this scenario sells its RECs (representing the desirable attributes of renewable generation) to electric suppliers in other states. In Economies of Efficiency and Muddling Along, Vermont joins its fellow New England states in enacting a mandatory RPS that begins at 15% in 2015 and climbs linearly to 20% by 2025. As a result, GMP no longer sells its RECs, but rather retires them to fulfill its RPS requirements and voluntary green rate program. A federal RPS of 15% by 2020 is also assumed in EOE and GIG, but because it is lower than the standards already in place in New England it has little effect.

Input	Muddling Along	Economies of Efficiency	Gas is Greener
SPEED	Goal of 20% by 2020	None	None
VT RPS	None	15% Class I renewables by 2015; ramping up to 20% by 2025.	
Qualifying resources	Post-2004 Solar PV, Landfill gas, Wind, Biomass, Hydroelectric, Municipal Solid Waste, and Anaerobic Digestion resource. (Based on SPEED definitions.)		
Solar FIT	Yes		No
REC Sales	None. GMP RECs are retired to meet RPS and voluntary green rate program.	All RECs sold for compliance in other RPS markets.	
Federal RPS	None	15% by 2020	
Production Tax Credit	Renewed at ½ current levels in 2015		In place until 2020, then expires

Table 9: Renewable Policy Assumptions for the Scenarios

The other factor that plays a critical role in spurring renewable development is federal tax credits. The Federal Production Tax Credit (PTC) gives resource owners a tax credit for each unit of energy produced. The 2011 rates are 2.2 cents per kWh for wind, closed loop biomass and geothermal resources and 1.1 cents per kWh for other resources.[24] Historically, the PTC has applied to wind and some forms of biomass projects. In the Energy Policy Act 2005 (EPACT 2005), resources such as hydropower were added to the eligibility list, and the PTC for closed-loop biomass resources was extended to ten years from five. Open-loop biomass, including landfill-gas and anaerobic digestion projects, can now receive PTC at 50% of the full rate for ten years. The PTC is currently set to expire at the end of 2012 for wind projects and 2013 for other qualified resources. In Muddling Along as well as Economies of Efficiency, we assume that the current PTC is renewed at current levels until 2015, and then extended at 50% of current levels for the rest of the study period. In Gas is Greener, the original PTC is extended through 2020, but then is allowed to expire completely.

[24] The PTC is adjusted annually for inflation, to the nearest $0.001/kWh.

The varying renewable energy policy regimes contribute to a differential in regional renewable buildouts across the three scenarios. Figure 27[25] shows the annual generation from new (post-2011) renewable resources in model runs for the three scenarios. Gas is Greener sees the largest influx of new generation, led by wind power. The lower overall levels of renewable generation in Economies of Efficiency compared to Muddling Along highlights the fact that other factors besides direct renewable policies also drive renewable development and dispatch, such as carbon policy, commodity prices and the cost of non-renewable generation.

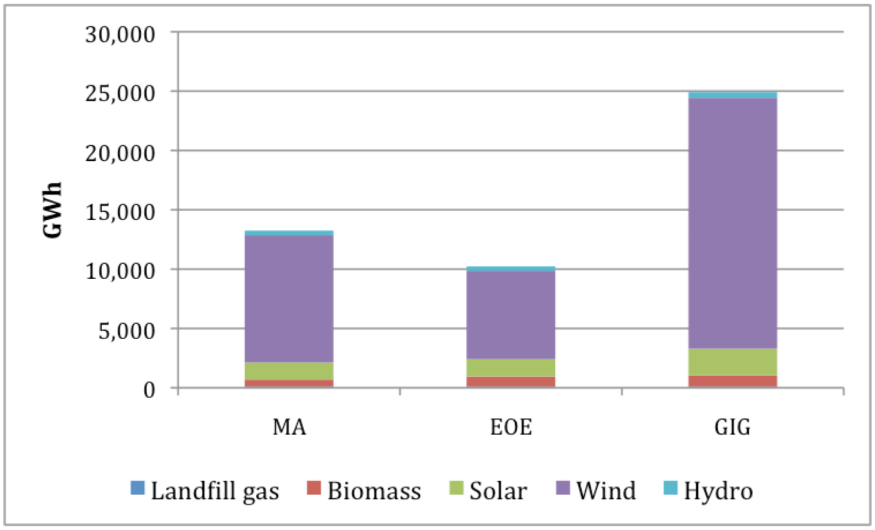

Figure 27: Generation from New Renewable Resources in New England: 2030

Regional Retirements

Regional retirements vary across the three scenarios with the largest level in Gas is Greener, due in part to relatively low natural gas prices and resulting low energy margins for many generators.

Muddling Along: 494 MW of coal units are retired by 2016, and then no more. More than 2,000 MW of oil units are retired by the end of 2020, and almost 3,000 MW by the end of the study period.

Gas is Greener: 878 MW of coal units are retired by the end of 2020 and 1274 MW by 2030. In terms of oil unit retirements 2,244 retire by the end of 2020 and over 5,000 MW retire by 2030.

Economies of Efficiency: 494 MW of coal is retired by 2016, and then no more. 437 MW of oil units retire by 2018, then no more. 678 MW of natural gas facilities retires by 2020 and 1,078 by 2030.

[25] Landfill gas in this figure is so small that it is not noticeable.

Total cumulative capacity lost to retirement during the study period is depicted in Figure 28.

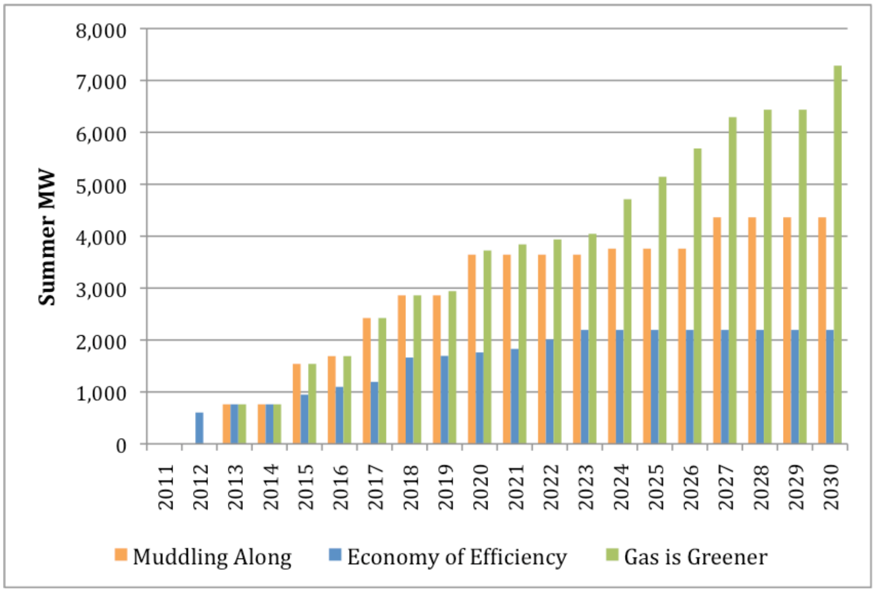

Figure 28: Cumulative Unit Retirements by Scenario

Transmission Buildout.

The Economies of Efficiency scenario includes tax support for transmission investment. As a result this scenario features the most robust build of transmission projects. The major transmission projects that are represented in the La Capra Market Model are the Maine Power Reliability Project (MPRP), New England East West Solution (NEEWS), Northern Pass, and a generic increase in the transfer capability between Northwest Vermont and Northern New York, near Plattsburg. The MPRP is modeled as increasing the transfer capability along the 345kV transmission system in Maine as well as an increase in the Maine — New Hampshire interface. NEEWS is modeled as an increase to the transfer capability between Massachusetts and Connecticut south of Springfield, MA as well as an increase in the transfer capability between Connecticut and Rhode Island. The Northern Pass is a new Merchant transmission project that adds a connection between Québec and New Hampshire.

In the Gas is Greener scenario, new gas fired generation is a very competitive resource which displaces some transmission investment. In this scenario the major transmission projects that are represented in the La Capra Market Model are the Maine Power Reliability Project (MPRP) and the Greater Springfield Reliability Project phase of NEEWS. The MPRP is currently under construction and the Greater Springfield phase has been approved by the Reliability Committee and is included in ISO-New England's Regional State Plan. The Northern Pass is a merchant transmission project and the less expensive gas generation makes the Northern Pass project uneconomic and the project is abandoned. The generic increase in transfer capability between Vermont and New York is deemed to be unnecessary due to the increase in generation development.

The Muddling Along scenario is closest to a business as usual scenario. In this scenario the major transmission projects that are represented in the La Capra Market Model are the Maine Power Reliability Project (MPRP), New England East West Solution (NEEWS), and Northern Pass. As was mentioned above, MPRP is under construction. All phases of the NEEWS project are being studied by ISO-New England with some phases of the project further along in the development process (that is, Greater Springfield Reliability Project). This project is assumed to be the best solution to meet the transfer constraints between western and eastern New England and it is assumed to be built.

Northern Pass is still proceeding through the development process at FERC and it is assumed that this project receives all necessary approvals and it gets built. In this scenario the generic increase to the transfer capability between Vermont and New York is not assumed to be built as it is a generic project and there is not a compelling reason in this scenario for its construction.

Main Scenario Inputs: Load and Energy Efficiency 2020 and 2030

Input	Muddling Along	Economies of Efficiency	Gas is Greener
GMP Energy Growth (2011–2013, pre-EE)	*Moderate* 0.13%	*Low* –0.07%	*High* 0.73%
Environment VT Funding	*High* $50M/$50M	*Moderate* $40M/$40M (2011$)	*Low Moderate* $40M/$40M (nominal $)
Regional Load Growth (Change in energy) (change in summer capacity)	*Moderate* 0.91%/0.91% 1.37%/1.37%	*Low* 0.24%/0.24% 1.10%/1.10%	*High* 1.59%/1.59% 1.65%/1.65%
Regional DSM (GWh saved)	*High* 12.8/12.8	*Highest* 14.1/14.4	*High* 12.8/12.8

Table 10: Summary Table of Key Demand and Energy-Related Scenario Inputs

Demand and Energy Outlook

Itron provided an updated base GMP load forecast through 2030 that assumed EVT funding continues at historical levels of $30 million annually. Forecasts were created for energy, summer peak, and winter peak annual load. IBM load was forecasted separately and assumed to be constant through the forecast period. This base forecast was adjusted to create the final load forecast for each of the three scenarios. The following adjustments were made in sequential order:

1. IBM load was removed from the Itron base forecast
2. Non-IBM load growth was adjusted for assumptions in economic growth
3. IBM load growth was adjusted such that it declined instead of remained constant and was added back to the load forecast
4. Energy efficiency levels were adjusted to reflect scenario-specific assumptions in EVT funding
5. Projected load to account for electric vehicle growth was added to the forecast

The final GMP load forecasts were calculated as the sum of three components: IBM load, electric vehicle load and other GMP load. The IBM load forecast remains constant across all three scenarios, and only the "Economies of Efficiency" scenario uses a different electric vehicle forecast, so the primary difference between scenarios lies in the Growth Rate Calculations and the Energy Efficiency calculations.

The key inputs that were used to create the scenario load forecasts are summarized in Table 11 below. The derivation of these inputs and the methodology for forecasting the GMP scenario loads are described in more detail in "Appendix A: 2012 Budget Forecast" (page 141).

Scenario	EE Annual Funding (million 2010$)		Growth Adders		Electric Vehicle Case
	2011-2015	2016-2030	Energy	Peak	
Muddling Along	$40 (nominal $s)	$35	0.00%	0.00%	Low
Economies of Efficiency	$40	$50	–0.20%	–0.15%	Reference
Gas is Greener	$40	$40	0.60%	0.60%	Low

Table 11: Scenario Inputs for GMP Load Growth Adjustments

Figure 29 below shows the GMP load forecasts in each of the three scenarios. In keeping with recent historical trends, the load is expected to be flat or decline slightly in each of the three scenarios. This is largely due to energy efficiency measures, community scale renewable projects, and other DSM initiatives that are expected to be implemented over the course of the study period. Low expectations for economic growth also contribute to low load growth expectations in Muddling Along and Gas is Greener. Gas is Greener is the only scenario in which load growth does not decline

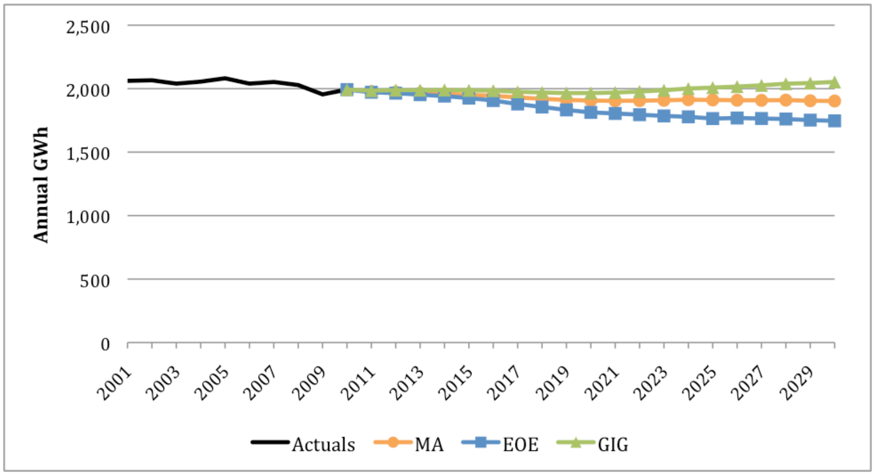

Figure 29. GMP Actual and Projected Annual Energy Growth for Each IRP Scenario

Energy Efficiency Funding Levels and Impact

Table 11 shows the levels of statewide investment in energy efficiency through the Efficiency Vermont (EVT) program assumed for each scenario. Current EVT funding levels are about $30 million. Economies of Efficiency has the highest funding level, while Muddling Along has the lowest, though all assume some increase over past levels of funding.

We assumed that energy efficiency impacts have a ten-year lifetime and that impacts are spread evenly across each of those ten years. A supply curve (see Appendix "A: 2012 Budget Forecast", page 141) was generated to convert funding dollars into GWh saved. For example, if energy efficiency funding in Vermont in 2011 is $30 million, this supply curve attributes about 1,300 GWh of lifetime impacts for the entire state to that level of funding, or 134 GWh a year for ten years.

Furthermore, we assumed that energy efficiency impacts are additive across years. For example, if energy efficiency funding is $30 million in 2011 and $30 million in 2012; total impacts will be 134 GWh in 2011 and 268 GWh in 2012. We then modeled the market-transformative effects of energy efficiency by assuming that 5% of the yearly impacts persist forever, even after the ten-year energy efficiency lifetime is reached.

Figure 30, Figure 31, and Figure 32 show the impacts of various levels of statewide Efficiency Vermont funding and electric vehicles on the forecasted load in 2030 for the Muddling Along, Economies of Efficiency, and Gas is Greener scenarios, respectively.

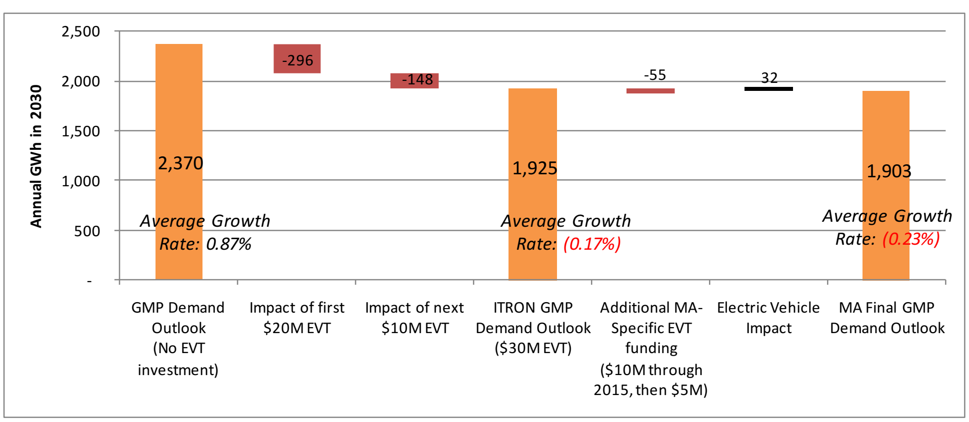

Figure 30: Impact on Forecasted 2030 GMP Demand in Muddling Along

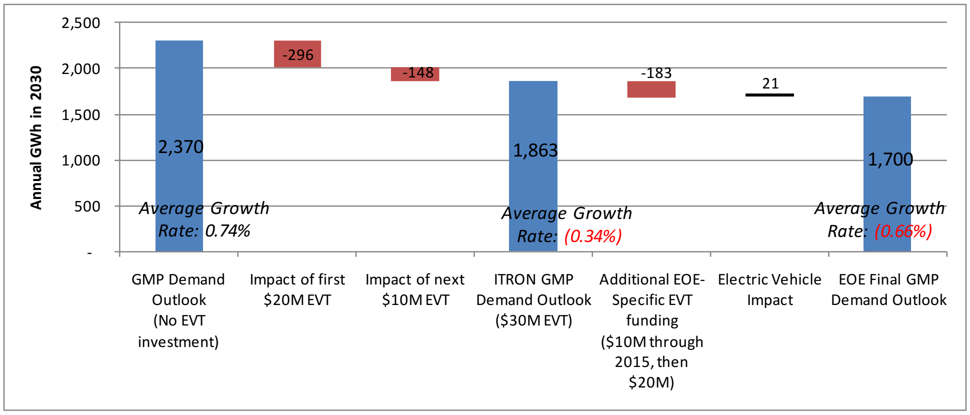

Figure 31: Impact Forecasted GMP Demand in Economies of Efficiency

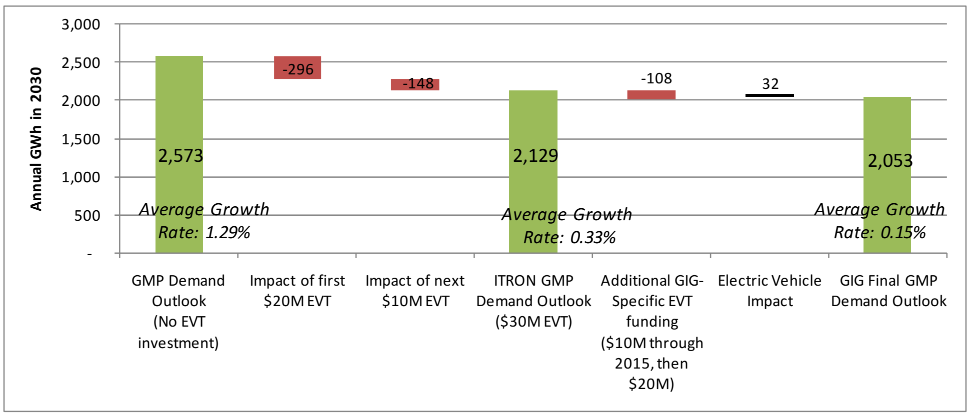

Figure 32: Impact on Forecasted GMP Demand in Gas is Greener

Scenario Outputs

Estimating Electric Energy Wholesale Prices

We began the process of forecasting electricity prices by using La Capra Associates Northeast Market Model. We based regional demands on ISO-New England's load forecast scenarios from the 2010 CELT Report. ISO-New England produces a reference high and low forecast for each of the New England states and in aggregate. We used these ISO-New England forecasts for all states with the exception of Vermont, which we based on a forecast developed for GMP by ITRON. Table 12 depicts regional load growth forecasts net of energy efficiency installations.

IRP Scenario	Regional Average Energy Load Growth 2010 to 2019
Muddling Along	0.20%
Economy of Efficiency	–0.60%
Gas is Greener	0.95%

Table 12: Regional Average Energy Load Growth

We then used these growth rates as a basis in the La Capra Northeast Market Model to develop market price forecasts for the three scenarios, two sensitivities, and four stress tests.

Figure 33 depicts long-term all-hours energy market prices under these cases. The growth trend within New England of market energy prices following natural gas prices continues; there is a similarity between these projections and the natural gas projections.

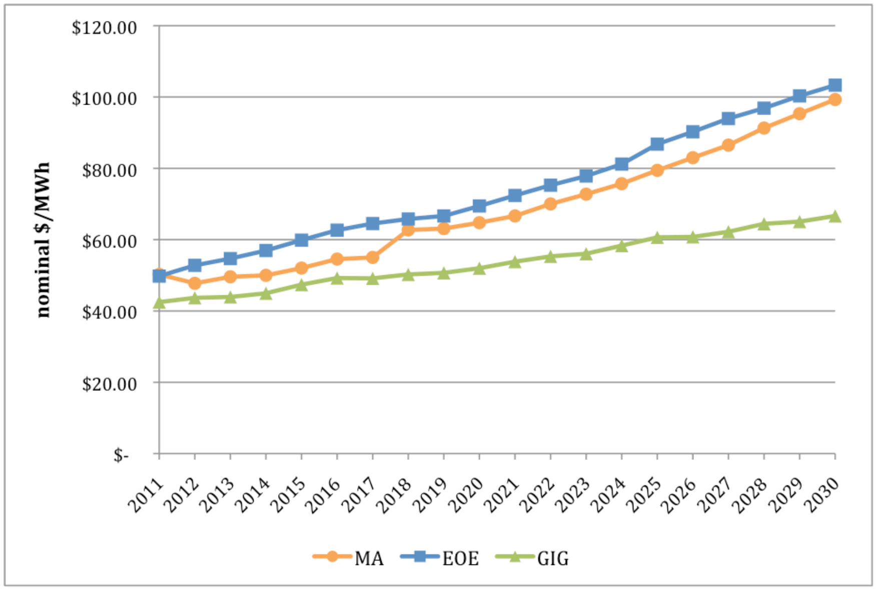

Figure 33: All-hours Market Energy Prices by Scenario

Electric Capacity Wholesale Price Estimates

The second major component of GMP's cost to serve the load in its service territory (after energy, the largest component) is that of maintaining adequate electric generation capacity. Figure 34 depicts capacity, market prices by scenario. ISO-New England determines the required amounts of capacity in the region, conducts annual auctions and interim reconfiguration auctions, and charges GMP and other load serving entities for the net cost of capacity procured. The capacity market is a relatively new market that is still undergoing structural transition.[26] In this market, ISO-New England is responsible for acquiring sufficient regional resources and not the individual utilities or other load serving entities. The utilities participate in this marketplace by owning or contracting for electric generating capacity as a cost savings or hedge against future capacity prices.

Annual Forward Capacity Auctions (FCAs) are conducted one year at a time, approximately three years in advance of the year of delivery. In the long-term, it is expected that the auction will clear at the price at which the total sources of capacity (including supply and demand side sources) willing to provide capacity in the ISO-NE market equals the amount needed to maintain system reliability. Conceptually, capacity market prices will be driven primarily by the supply of and demand for capacity resources (including supply- and demand-side ones). To date, four FCAs have been conducted; they have been dominated by a surplus of up to 5,000 MW of capacity relative to the minimum amount required, in combination with a significant floor price. As a result, the early auctions have not featured a true balancing of supply and demand. Looking forward, the Forward Capacity Market is in a period

[26] On June 15, 2006, the Forward Capacity Market (FCM) was approved by FERC as a settlement agreement to resolve New England's capacity issues. We based our estimates on the FCM rules as they existed at the beginning of 2011. The FCM rules are still undergoing revision through a stakeholder process at FERC.

of structural transition. The most recent step in this transition was a FERC order in April 2011 which adopted some (but not all) of the structural changes proposed by ISO-New England. Some of the major anticipated market structure changes include:

- An end to floor prices (the date for this is not yet certain). This can be expected to put downward pressure on prices in the near-term, as FCA prices will now need to go as low as it takes to balance supply and demand. In the longer term, however, this change can be expected to lead to attrition of some New England capacity sources (including existing power plants, demand resources, and imports), resulting in upward pressure on capacity market prices; and
- Adjustment of "out of market" or "OOM" bids — that is, low bids by capacity sources that are largely or entirely supported by revenue streams outside of the FCM — to higher levels that reflect the all-in cost of the resource in question. This bid "mitigation" appears likely, over time, to reduce the prospects of sustained low FCA clearing prices, and to increase the prospects of prices clearing at levels high enough to attract new thermal capacity (for example, $6 to $9 per kW-month).

The market prices assumed in this analysis are shown Figure 34.

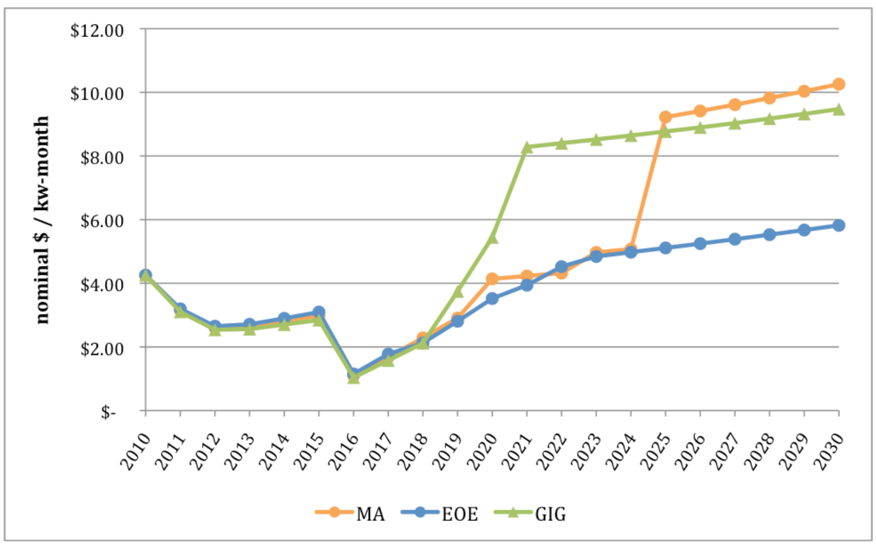

Figure 34: Forward Capacity Market Price Outlook (ISO-NE Rest of System)

Renewable Energy Credits (RECs)

To determine REC prices for the scenarios we first used the La Capra Associates New England REC model to estimate REC prices. The La Capra Associates model assumes that market REC prices would be set by the cost of the marginal resource. To determine the marginal renewable energy resource in each year, we developed a renewable energy supply curve and used New England renewable energy demand to "clear" the market each year.

The supply curve is comprised of our estimates of future renewable resources available in New England and their associated costs. Renewable resources in the supply curve are differentiated by state, performance characteristics and project size. The resource potential includes wind imports from New York, Québec, and New Brunswick.[27]

A key resource cost differentiator between the scenarios was the Production Tax Credit assumption. In the Muddling Along and Economy of Efficiency Scenarios we assumed that the PTC was renewed at half its current level in 2015. In the Gas is Greener scenario we assumed that the PTC remained at its current level through 2020, but was not available 2021 and beyond.

The total New England RPS demand was calculated for each scenario, by multiplying the required RPS percentage by the load forecast in that state. For states other than Vermont, we assumed that the current policies continued throughout the study period for all scenarios. For Vermont, we assumed that a mandatory RPS was enacted in Gas is Greener and Economy of Efficiency while the SPEED program remained in Muddling Along.

In order to calculate the incremental renewable resource supply required to meet the New England RPS in future years, the amount of currently online renewable supply was subtracted from the New England RPS demand discussed above. Energy and capacity prices from the appropriate scenario were used to model resource revenues. The renewable resource build-out and REC price in each future year was estimated by determining the highest cost resource on the supply curve which was required to meet that year's demand. (See Figure 35).

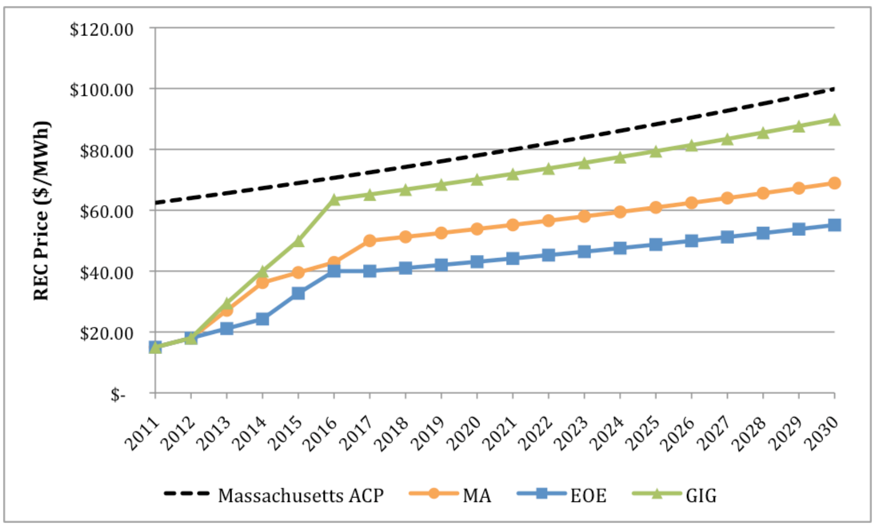

Figure 35: GMP's REC Price Forecast

However, at the completion of this modeling process, we were concerned that the high prices obtained were not realistic given states concerns about keeping rate payer costs low. We decided that in the face of very high REC market prices, other New England states would be likely to alter their policies to ease price pressure. Alternatively , it is possible that high prices would stimulate a meaningful additional amount of new renewable supply in the region. We adjusted the REC estimates downward to reflect this assumption, while maintaining a roughly proportional spread between the scenario prices. The relative levels of REC prices in the scenarios are consistent with the relative levels of key price drivers (for example, energy market prices, general inflation) in those scenarios.

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[27] The resources include the following: Wind — onshore (large scale), offshore (large-scale), imports (New York and Canada); Biomass — co-firing at existing generation facilities, Retrofits (existing facilities that retrofit with emissions controls, Repower (old or retired facilities that repower to burn biomass) and New Greenfield facilities; Hydropower -- upgrades to increase capacity at existing facilities and new small hydropower; Landfill gas and Tidal currents.

8. Evaluating Resource Portfolios

Resource Portfolio Selection

Introduction and Summary

The following discussion summarizes the analysis underlying GMP's evaluation of resource portfolios and of the selected preferred portfolio. Given the overall level of uncertainty in the National and New England electricity market, GMP seeks a strategy and corresponding portfolio approach that proves to be robust across differing potential scenarios of the energy future. In addition, and the portfolio seeks to take into account the many and diverse interests of stakeholders in GMP's service territory. Finally GMP sought to determine a strategy and corresponding portfolio consistent with GMP's last IRP, its Energy Plan and Vermont preferences. Underpinning this analysis are six planning objectives:

1. Balancing a stable portfolio cost with market flexibility;
2. Maintaining a relatively low emission profile relative to the region;
3. Implementing cost-effective energy efficiency;
4. Supporting Vermont's economy through investment and by maintaining electric rates that are competitive with other utilities in the region;
5. Maintaining low revenue requirements, both in procuring and delivering power;
6. Continuing strengthening the company's financial position.

Based on the portfolio selection process described below, achieving these objectives can be met by a portfolio that has the following key characteristics:

- A mix of key long-term non-carbon based purchases and supply agreements with short term rolling purchases, to provide substantial price stability with some flexibility to respond to future demand and market developments and to make opportunistic purchases in the future.
- Cost-effective renewable ownership and PPAs which will reduce the emissions profile and increase overall percentage of renewables in the portfolio;
- Energy efficiency through the Energy Efficiency Utility;

These portfolio elements maintain price stability, provide a hedge to GMP's cost to serve load, over time decrease GMP's greenhouse gas emissions footprint and increase its level of renewableness. This portfolio strategy should result in relatively stable revenue requirements relative to many utilities in the region, while not creating unmanageable (that is, harmful to our credit rating) levels of imputed debt in bond rating agency analyses.

In selecting a preferred portfolio we sought to identify a mix of resources that perform reasonably across all scenarios under criteria most important to GMP. This analysis includes the following steps:

1. Identifying GMP's Resource Needs. The analysis begins with an assessment of GMP's incremental resource needs over the planning period based on an analysis of expected loads and the characteristics of its existing and proposed supply and demand-side resources.

2. Developing Alternative Portfolios. The analysis next involves devising portfolios to test potential strategies related to the amount of market exposure, air emission levels, level of renewable generation and consideration of adding a new combined cycle plant. We also took into account generation technologies, energy efficiency programs, and contractual arrangements that are potentially available GMP.

3. Testing the Performance of the Alternative Portfolios and Determination of a Preferred Portfolio. We measured each of the alternative portfolios against key metrics most important to GMP. These include (1) Long-term price stability, 2) Emissions (CO_2 lbs/MWh), 3) Renewable fraction (new & existing), 4) Fraction of supply from in-state sources (as a proxy for in-state economic benefits, as well as effectiveness as a hedge against GMP's load requirements) , 5) Utility ownership (vs. purchases), 6) Intermittence, 7) Capacity position, 8) Collateral and 9) Consistency with Vermont public preferences. From this analysis and assessing tradeoffs between these metrics, we then determined an illustrative preferred portfolio to guide GMP's exploration of future resource options.

4. Testing the performance of the Preferred Portfolio. We then reviewed the preferred portfolio against high carbon price sensitivity and stress tests for reduced load and market prices, along with potential changes to the GMP resource mix. Based upon testing the performance of the preferred portfolio and in consideration of GMP's key goals and current portfolio composition, we refined GMP's resource strategy from its 2007 IRP.

5. Key Findings and On-going Portfolio Management. There are several key findings from its analysis that help inform current and future GMP strategy.

Identifying GMP's Resource Needs

To determine GMP's incremental resource needs over the planning period, in addition to taking into account the specific characteristics of its existing supply and demand-side resources which reflect significant portfolio changes - specifically the addition of substantial new power supply resources summarized in Chapter 4, we assessed expected Vermont load trends and expectations for pursuit of energy efficiency.

Load Forecast after Energy Efficiency

The following figures show the net effect of the expected trends in GMP system energy requirements within the three IRP planning scenarios, based on the underlying economy-driven demand and energy forecast and the impact of alternative scenarios of energy efficiency funding. Assumptions for GMP load across the scenarios are discussed in more detail in Chapter 7. This table illustrates that, in the scenarios, the GMP energy requirements are actually declining slightly through 2020 and in only one scenario, Gas is Greener, does the forecast increase modestly post 2020. As a result, the resource decisions that GMP will face over the next decade will likely not be driven by electricity demand growth, but primarily by the attrition of existing resources (particularly expiration of the Vermont Yankee and Hydro-Québec contracts).

GMP Demand Outlook	**Muddling Along**		**Economies of Efficiency**		**Gas is Greener**	
	2030 Level	2011–2030 Growth Rate	2030 Level	2030 Level	2030 Level	2011–2030 Growth Rate
Energy (GWh)	1,903	(0.23%)	1,746	(0.66%)	2,053	0.15%
Summer (MW)	335	(0.12%)	324	(0.28%)	363	0.28%
Winter (MW)	296	(0.19%)	276	(0.54%)	322	0.22%

Table 13: GMP Demand Outlook for 2030 after Adjusting for Assumed EE Investment

Committed Supply Forecast

The analysis of resource portfolios begins with an assessment of GMP's incremental resource needs over the planning period based on an analysis of expected loads and the characteristics of its existing supply and demand-side resources.

As discussed in Chapter 4, the majority of GMP's current energy requirements presently come from long-term purchased power contracts (PPAs), and a smaller share from owned generating plants. Currently, GMP's energy portfolio has sufficient resources to cover projected demand through approximately 2014, with an increasing open position in the longer-term.

The Company's two largest long-term PPAs, Vermont Yankee and Hydro-Quebec/ Vermont joint Owners Schedules B and C-3, will expire 2012 and 2015 respectively. These two contracts account for roughly half of GMP's annual energy requirements. In reducing our long-term open position, GMP has signed a 26 year PPA with HQUS, which will supply GMP with just under a quarter of our energy requirements. Additionally, GMP has entered into several shorter term PPAs for system power, all of which will expire by 2015.

GMP also gets a significant, share of our energy needs from renewable sources—both owned and PPAs. The portion of GMP's portfolio from renewable sources is expected increase substantially in the coming years. Existing renewables, which include GMP hydro facilities, VEPPI hydro and Ryegate biomass, account for about 11% of our mix. Premium renewables, which include McNeil, Moretown PPA, Searsburg, and GMP's share of Standard Offer Contracts through the SPEED program, represent about 4% of our mix. However, with the start Granite Reliable Wind PPA in 2012 and the proposed Kingdom Community Wind project to be built in 2013, premium renewables will represent an estimated 19% of our mix by 2014.

Finally, GMP owned peaking generation units will continue to contribute less than 2% to our energy requirements.

Renewable Energy Generation

While New England has experienced continued capacity development, particularly for wind and solar projects, the cost and practical availability of new renewable generation within the region remains uncertain. For example, there is much more uncertainty now then there was a few years ago regarding the future of biomass given lack of clarity regarding how its emissions should be viewed. Future renewable development can be supported by long-term output contracts or local utility participation -- both approaches of which GMP has utilized. Impediments to renewable project development include local siting approval, the potential for regulatory backlash in some states that may lead to reduced RPS goals, and the ability to finance these projects.

GMP has actively pursued renewable resources since its last IRP and has met its goals in a cost effective manner. See Table 14 below for GMP's committed premium renewable resources (that is., those which would qualify as Class 1 renewables in the RPS programs of one or more neighboring states), which total roughly 370,000 MWh per year in projected annual output.

GMP Premium Renewable Resources			
	Source	*Approximate Capacity (MW)*	*Approximate Annual Energy (MWh)*
Searsburg	Wind	6	10,500
Kingdom Community Wind	Wind	55	161,885
Granite	Wind	32	96,000
McNeil	Biomass	6	31,507
H.446	Various	17	46,256
Moretown	Landfill Gas	3	23,827
TOTAL		**119**	**369,975**

Table 14: GMP Premium Renewable Resources

GMP will continue to seek new renewable opportunities on an opportunistic basis, but if this pipeline of new renewable is completed will not need to continue to aggressively pursue renewables in the near term in order to meet Vermont's SPEED goals. GMP plans, however, to work to further enhance local generation in Vermont through an opportunistic approach to small renewable purchases, and by developing a strategy to facilitate customer-funded local renewable generation and to limit the cost of developing such generation.

GMP's Projected Energy Position

Figure 36 summarizes GMP's projected annual energy requirements over the long-term, along with the Company's committed and proposed supply sources as described in Chapter 4. The estimated gap is about 900,000 GWh in 2030, and is roughly constant over time.

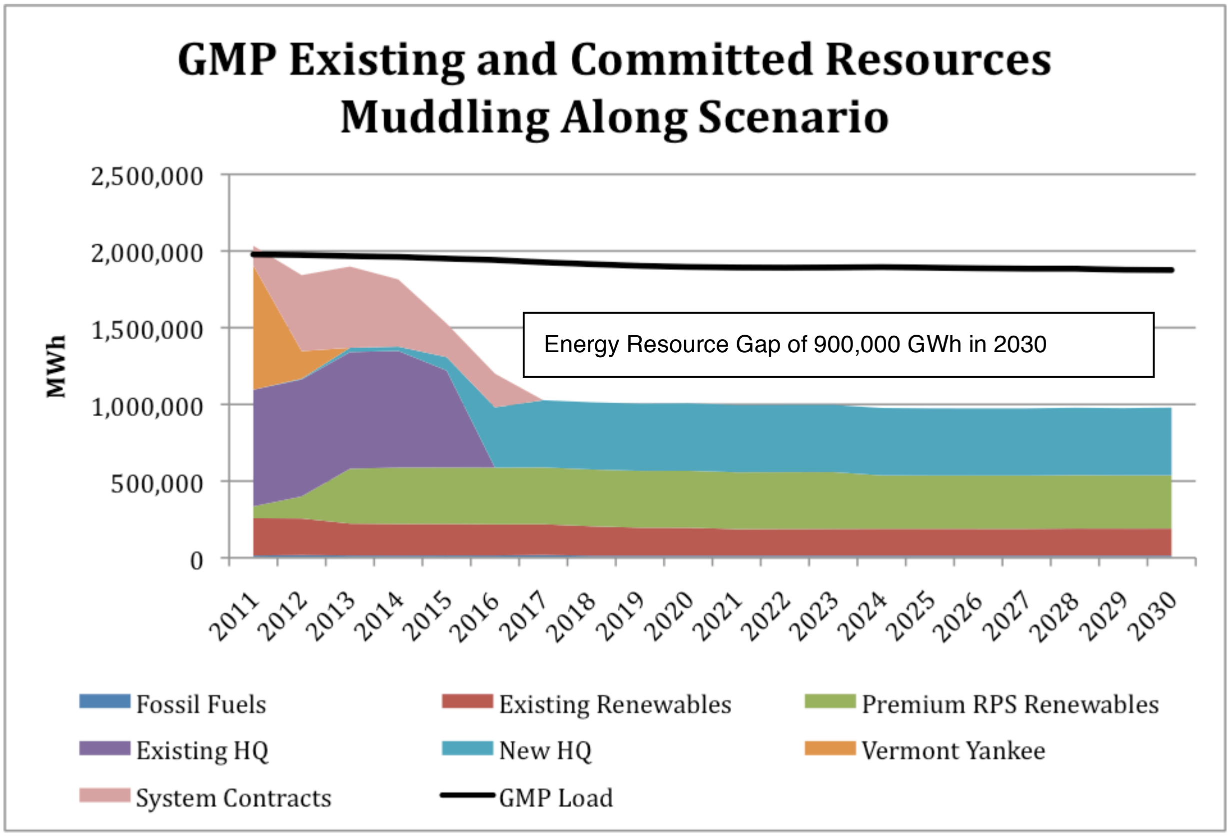

Figure 36: GMP Existing and Committed Resources

Table 15 below shows our current portfolio commitments for three snapshot years:

	2015	**2020**	**2030**
Vermont Yankee	-	-	-
Existing HQ/VJO	561,735	-	-
New HQ-US	99,996	450,672	450,672
Existing Renewables	225,664	190,332	182,304
Premium RPS Renewables	370,255	370,255	346,603
Fossil Fuels	34,828	37,159	37,159
System Contracts	219,000	-	-
Total Comitted Resources	**1,511,478**	**1,048,418**	**1,016,738**
Energy Requirements	1,950,975	1,906,109	1,902,770
Open Position	439,496	857,691	886,032
Open Position	*23%*	*45%*	*47%*

Table 15: GMP Premium Renewable Resources

As shown in the table above, GMP has undertaken an extraordinary amount of power supply procurement in the past three years to replace substantial portions of our expiring long-term contracts. There is still some room in our portfolio for new resources (although it is not necessary or desirable to fill the entire portfolio with long-term sources), which are explored in this portfolio analysis.

Potential Resources

Considering the characteristics of the committed and planned sources and GMP believes that its portfolio would benefit from the following:

a. Additional capacity sources, to hedge GMP's growing exposure in the Forward Capacity Market. This would likely be obtained via PPAs with existing generation owners, or potentially from new in-state capacity (most likely peaking);

b. Additional baseload (round-the-clock) power, to complement the committed and planned sources - which include substantial amounts of intermittent sources, as well as sources that are best utilized in intermediate or peaking roles;

c. Additional low-emission power sources, to replace the relatively high-emission system energy purchases that GMP has made to replace Vermont Yankee energy on a temporary basis and help GMP's portfolio emissions reach their historical low levels;

d. Low-cost power. We believe that in the current favorable power market price environment, it makes sense to lock in additional stable-priced power on a long-term basis. This could include favorably priced renewable resources.

GMP considered the following potential resources to meet the needs described above.

- Energy efficiency, as captured through the statewide Energy Efficiency Utility
- Utility-scale new renewables (wind, solar, biomass, LFG)
- Small-scale new renewables (wind, solar)
- PPA from existing nuclear plants
- PPA from large hydro (Canadian, or unit-contingent NE plants)
- Natural gas-fired combined cycle plants (existing NE, or new-build in Vermont)
- Market purchases (which are now available at prices lower than have been seen in many years)

Survey of Resource Options

For planning purposes, GMP focused on supply side resources, both long and short-term contracts as well as energy efficiency as future resource options. In terms of the supply side resources GMP looks at commercially available generation technology options, and includes few alternatives that are in developmental stages. Specifically we looked at renewable resources, in particular wind and solar and baseload resources which include large scale hydro, nuclear and combined cycle resources. More detailed descriptions of these resource options are outlined below.

Renewable Energy Technologies

The development of renewables in New England and their part in GMP's portfolio vary across scenarios. The biggest drivers of renewable development are the overall economy of the country, state Renewable Portfolio Standards ("RPS"), national carbon policy, varying assumptions on the PTC, and the relative price of gas compared to renewable development.

The cost of renewables that were assumed in the portfolio comparisons are based on estimated installed costs of real projects being proposed in New England, along with future fuel and operating costs. The installed cost for a biomass plant (stoker or fluidized bed) of 25–50 megawatts in size has increased over the past few years and is assumed at about $3,500 per kilowatt in 2011 dollars. The installed costs for new 2 MW solar PV plant are assumed to be 3,600 in 2010 dollars with the expectation that costs will decline at about 3% per year in real terms. The installed costs for new wind plants of 25–75 megawatts can cost between $1,800 to $2,500 per kilowatt in 2011 dollars and for purposes of this analysis we have assumed $2,300 per kilowatt in 2011 dollars. Under EPACT05 and an extension of the Production Tax Credit (PTC) in 2009, wind is eligible for a PTC of (approximately $0.022 per kilowatt hour in 2011) for ten years and biomass plants can now receive half of the PTC benefit (approximately $0.011 per kilowatt hour in 2011), also for ten years.

In addition to the PTC, both wind and biomass facilities are eligible to take a 30% Investment Tax Credit (ITC) instead of the PTC. The ITC and PTC are present scheduled to expire at the end of 2012 for wind and 2013 for biomass. Both wind and biomass are eligible to take a 30% cash grant for instead of investment tax credit for projects installed in 2011. PTC credits are treated differently across the scenarios. In Muddling Along and Economies of Efficiency, they are reduced by half in 2015. In Gas is Greener, they are assumed to disappear in 2020.

While the actual contract pricing can vary widely, we do estimate that under most scenarios, wind, solar and biomass-fueled electric power will cost materially more than the prevailing market prices for non-renewable energy and capacity combined, and thus cost more than the market priced long-term contracts. The potential decline or expiration of the PTC, as assumed in the scenario analysis, meaningfully increases the cost of new renewable power relative to non-renewable wholesale power.

For the development of renewables within Gas is Greener and Economies of Efficiency scenarios, we assumed that GMP meets 20% of the energy to serve load with new RPS-qualifying renewable generation by 2025. In the Muddling Along scenario we assume that the SPEED program remains in place, so that RECs associated with premium renewable sources held by GMP will continue to be sold to reduce retail rates. This supply could come from within Vermont or from outside, or a combination.

By the end of the study period, the resulting contributions from new renewable resources to GMP's portfolio are as follows:

	Nameplate Capacity (MW)			Energy (MWh)		
	Muddling Along	Economies of Efficiency	Gas is Greener	Muddling Along	Economies of Efficiency	Gas is Greener
Wind	35	30	35	88,914	76,212	88,914
Biomass	19	13	21	141,474	96,798	156,366
Solar	9	12	34	9,680	13,552	38,719
Landfill Gas	1	1	1	5,361	5,361	5,361
Total	64	56	91	245,429	191,923	289,360

Table 16: Generation Capacity Resource Mix

One big question is related to how RECs will be priced by merchant renewable projects in the future. Currently RPS-qualifying RECs trade in the short-term at less than $20 per megawatt hour from eligible renewable resources and will continue at these levels as long as there is a supply surplus relative to RPS requirements. With GMP as a buyer of a bundled product (energy, capacity, and RECs), this IRP analysis assumes the purchase price reflects the revenue requirement of a project to achieve appropriate returns on investment. However, it does not factor in the market value of the RECs and energy as part of the contract. In particular, the price of new renewables to GMP will depend, in part, on what state of equilibrium the regional RPS market achieves. We expect the regional supply surplus to disappear as the regional renewable demand increases and are expecting the REC prices to rise after the surplus disappears.

As an alternative to purchasing renewable output through a long-term PPA, GMP can explore owning and operating these facilities to better retain the total benefit associated with ownership including PTC. Considerations associated with ownership include the organizational capabilities associated with owning and operating such plants and the scale of capital outlay required and associated financial risk.

Baseload Technologies

Baseload sources are those that tend to operate in a steady, round-the-clock manner. Nuclear plants are an excellent example, because their variable costs of operation arevery low, and they tend to produce at or near their full capacity whenever they are available. Other types of plants which may operate in a baseload fashion (depending on factors that include market conditions and plant-specific contract terms) are efficient coal plants, and biomass plants. Some combined heat and power plants (featuring various fuels and technologies) also sometimes operate in a baseload mode, in order to provide a steady source of thermal energy. In the context of a utility's power portfolio, it makes sense to roughly match the collective output profile of a utility's supply sources with the profile of its customer load. In practice, this tends to mean baseload power sources to cover most or all of the minimum round-the-clock load level (for GMP, this is roughly 150 MW), peaking plants to cover the highest-load hours (and to provide reserves), and intermediate plants to cover the load levels in between. The primary benefit of this matching is to enhance the stability of the utility's net power supply costs, over short-term and long-term time frames.

Baseload resources are needed to improve GMP's supply sources in much better balance with the shape of its load requirements. GMP's committed and planned baseload sources (plus intermittent ones) will provide only about 40 percent of GMP's minimum load level, compared to a recent historical level of roughly 90 percent. The expiring PPA for output from Vermont Yankee is by far GMP' largest current baseload source, at about 100 MW. That PPA (along with the plant's license) expires in16 March 2012. In addition, many of GMP's committed and planned capacity sources (e.g., Stony Brook, GMP peaking units) operate in intermediate or peaking roles, and deliveries under our new HQUS purchase will be primarily during peak hours as well. Further, many existing and planned renewable sources (e.g., wind, GMP hydro, VEPPI hydro) are intermittent, so their output often fluctuates strongly on an hourly and daily basis, and noticeably over longer time frames.

In terms of the portfolio development, we looked at purchases from existing nuclear, large hydro and perhaps combined cycle natural gas. These are described in more detail below:

Nuclear Resource

The potential new nuclear resource that is tested as a component of GMP's portfolio is modeled as a long term purchase, beginning in 2015 with a term of 20 years. Depending on the scenario and strategy the resource is sized between 22.5 MW and 90 MW. The purchase is modeled as a unit-contingent contract tied to the output of an existing nuclear generating unit in New England. The contract price is modeled as a real-levelized price where the contract starts at the same price in all scenarios and escalates annually at the scenario-specific inflation rate. The contract price is derived from a current reference outlook of energy and capacity prices. The price reflects the unit contingent nature of the contract, through an assumed price reduction of 4 percent relative to a firm purchase. As a nuclear resource this contract is modeled as a zero emission resource.

Large Hydro

Another resource option tested in the portfolios is a purchase of output from existing large hydro facilities. This resource is modeled as a series of purchases with a term of 5 years starting in 2017. Depending on the portfolio and scenario, this resource is included in quantities up to 45 MW with some portfolios not containing any large hydro. These purchases are not tied to any particular hydro generating unit. As a hydro resource there are no emissions associated with including it in any portfolio. Consistent with the assumed shorter-term nature of this resource, the price of this large hydro resource follows the projected energy and capacity market prices in each scenario.

Vermont Combined Cycle

One of the portfolios tested contains a share of a Vermont sited combined cycle generating unit. The unit is modeled as a jointly owned 250 MW combined cycle with an online date of 2016. GMP's participation in this resource is modeled as 80 MW. The installed, fixed, and variable costs of the unit are estimated based on the costs to construct a unit with current technology. The emissions from this resource are also consistent with current technology. Our analysis did not assume any extraordinary capital costs associated with reinforcing the Vermont gas transmission system; to the extent that such costs are required they will make the Vermont combined cycle option more costly than shown here.

Long-Term Contracts

As mentioned above, the existing Vermont Yankee contract expires in 2012. In addition the current contract with Hydro-Québec ends in 2015. As was mentioned in Section 4, GMP has been successful in entering into long term power purchase agreements. These include agreements for a landfill gas resource, a wind resource, and a replacement contract with Hydro-Québec. GMP's experience shows that buyers that want long term power can find sellers to offer it and at competitive prices. These long term contracts were modeled in the analysis according to the terms of the contracts.

Short-Term Contracts

GMP also utilizes shorter term contracts to meet its needs that are not met through GMP's owned resources and long term commitments. Due to their flexibility, shorter term purchase contracts offer GMP the ability to closely match its resources to its load requirements. Because short-term purchases are negotiated a short time before delivery, they reflect then-current market conditions and therefore do not provide any meaningful protection against long-term market price trends.

At the time of our last IRP, opportunities for contracting in the energy market, both the contractual options and potential counterparties, were somewhat limited due to the poor credit standing and weak balance sheets of many of the sellers in the market. We had assumed, however, that over the planning period the wholesale energy market would improve in liquidity and product customization and that a significant market in bilateral contracts would return. This has indeed occurred. The market for short term contracts is now quite liquid. There are plenty of offers for standard block contracts, with terms of a few days to a few years available on two exchanges, Intercontinental Exchange and NYMEX as well as over the counter.

Our analysis did not explicitly model any short term hedging for GMP's open energy or capacity position. In developing and scoring the portfolios, the load that is met through "market purchases and sales" is assumed to occur hourly at the spot price. Similarly, GMP's capacity open position is priced at the forecasted FCM price. In actual practice GMP typically balances its loads and resources with short-term bilateral purchases so that its spot market exposure is limited to just a few percent on average. In the context of the IRP's long-term trend analysis (which lacks the daily and monthly volatility of the actual spot market), the pricing of short-term purchases/sales using simulated spot market price is a reasonable approximation.

Other pricing structures – such as options or collars – could also be available. However, such alternative pricing structures are not traded on a standard basis today despite the liquid market for standard products. It is not clear whether the market for them will become liquid and competitive as is the market for energy. As a result we have not explicitly analyzed them in this portfolio analysis. We note, however, that at some point in the future they could potentially be effective tools to help GMP manage price uncertainty.

Peak Demand Management

In recent years GMP has (first directly, and more recently in partnership with the firm EnerNOC) helped some of its customers to manage their consumption during peak demand events. In addition, some large GMP customers participate in curtailable and interruptible retail rate programs. Together, these activities can reduce capacity obligations, transmission costs, and the need for peaking power. GMP's efforts are complemented by region-wide demand response programs designed to allow large customers to reduce consumption in response to market prices. The regional demand response programs should temper the volatility of market prices, thereby reducing fixed price contract premiums. To the extent this occurs, GMP will benefit from lower contract prices.

Energy Efficiency

GMP will continue to pursue cost effective energy efficiency led through the State EEU process. Chapter 7 and Appendix B describe how energy efficiency savings were incorporated in GMP's 2011 IRP analysis.

Developing Alternative Portfolios

With GMP's incremental needs established, the next step in selecting a portfolio involves developing alternative resource portfolios designed to match our energy and capacity needs and core objectives. GMP's portfolio choices will, due to their limited size, probably not have a meaningful effect on resource adequacy or the mix of renewable generation for New England as a whole. Rather, regional resource adequacy will depend primarily on the effectiveness of the new Forward Capacity Market (FCM) process at stimulating needed supply- and demand-side resources in sufficient quantities. And regional renewable generation additions will depend primarily on future policy and incentives as well as the financing market. The key impacts of the future resource choices for GMP will be on the company's ability to effectively hedge against possible future market environments, the level of greenhouse gas emissions associated with GMP's portfolio, as well as the amount of renewables and energy efficiency in the portfolio.

The effect of GMP holding resources that are collectively either long or short relative to GMP's energy and capacity needs would be for GMP's net power supply costs to be exposed to movements in wholesale market prices. Thus for GMP, any supply resource commitments essentially serve as a financial hedge to stabilize GMP's net power supply costs. In this analysis, GMP has not designed portfolios intended to be either materially long or short of capacity and energy, in part because holding such a portfolio could be considered speculative. GMP's resource portfolios in this IRP analysis basically produce the same amounts of energy and capacity that GMP expects to be billed for by ISO New England to serve its load obligations.

The set of portfolios ultimately tested is designed to represent the range of resource strategies that GMP might reasonably pursue given the conditions arising under each scenario. The goal of developing alternative portfolios and then assessing them is to develop a preferred portfolio strategy rather than to define the precise set of resources that GMP *will acquire* to meet future needs.

Themes

Our portfolio development in the 2010 IRP demonstrates how GMP, given its own portfolio characteristics and vision of the kind of company it desires to be in Vermont and the region as a whole ,can best hedge against potential future market environments and position itself to be a leader providing reliable, low cost and environmentally attractive power.

We developed these portfolios by first looking at the kind of resource options available that best match GMP's needs. In a screening process we then developed several cases and associated resource portfolios for the three scenarios to meet GMP key objectives based on the following themes. (See Table 16 on page 110 which illustrates the specific resource types in these alternative portfolios across the three scenarios.)

1. Market Contracting Emphasis

This portfolio relies on layered market purchases for up to 5 for energy and capacity to stabilize costs and provide energy at regional emissions levels beyond RPS requirements. There are no new long-term commitments. This portfolio would be consistent with the ability of the ISO New England FCM and LFRM to bring sufficient capacity into the market and opportunities for GMP to be opportunistic in any resource purchases and have multiple sellers with whom to negotiate.

- Market contracts 1-, 3-, and 5-years for capacity and energy, and spot market for swing peaking energy.
- Moderate commitment to in-region renewables (20% of GMP energy requirements from a mix of unit ownership/entitlement and PPAs for renewables)
- Energy Efficiency as achieved by Efficiency Vermont.

2. Low Emissions

This portfolio relies on significant additional long-term purchases from large hydro and/or nuclear sources. In addition GMP seeks to secure new renewables through ownership or a PPA arrangement. Over the planning horizon, we targeted a portfolio with the following levels of CO_2 emissions:

- Average CO_2 emissions of about 100 lbs/MWh
- Average Co_2 emissions of 300 lbs/MWh
- In the past GMP was at 100 to 200 lbs/MWh but with the cessation of the VY contract it is expected that at least in the near term, this level will increase.

3. Renewable Emphasis

This portfolio is a major expansion of GMP's renewable energy-based supply mix well beyond the current SPEED goals. Major emphasis on base and intermediate energy comes from regional renewable resources (specifically wind solar) and a continuation of Hydro-Québec's imports. We looked at the following levels of emphasis:

- Strong commitment to in-region renewables (30% of GMP energy requirements from a mix of unit ownership/entitlement and PPAs for renewables)
- Higher emphasis on new renewables: 40% by 2030
- Maximum emphasis on new renewables with 50% by 2030, including significantly higher-cost renewable resources.

4. Unit Contracting – Nuclear and Combined Cycle

The fundamental building blocks of this portfolio are a unit-contingent purchase of output from an existing nuclear unit, and a natural gas combined cycle plant. The latter source could be obtained through ownership in existing or new combined cycles throughout New England. The ability to offer combined cycle owners and developers 15-year contracts rather than have them rely on the shorter term FCM market for their capacity revenues is posited to give GMP negotiating leverage.

- GMP is assumed to owns a share (about 80 MW) of a new in-state Vermont-scale combined cycle plant in 2018.
- Natural gas fueled combined cycles (existing and new) for capacity and energy, short-term market purchases for additional energy, and FCM price for peak capacity requirements.
- Moderate commitment to in-region renewables (20% of GMP energy requirements from a mix of unit ownership/entitlement and PPAs for renewables)
- DSM as prescribed by Efficiency Vermont.

Analysis

Figure 37 is an example of how the various portfolio strategies would vary the mix of generating resources in place in 2030, the end of this study period. As discussed in the prior section, these resources are used as proxies for actual resources and do not represent specific assets. In this Figure, the 20% renewables resources are made up of solar, in state wind, and in state biomass. The 30% renewables resources contain a combination of in state and out of state wind and in state biomass. The nuclear and Vermont combined cycle resources are generic resources that are not associated with specific power plants. They were included so as to evaluate the effect of these types of resources on GMP's power supply portfolio. Note that the figure below shows only future resources; GMP's existing and committed resources are represented elsewhere.

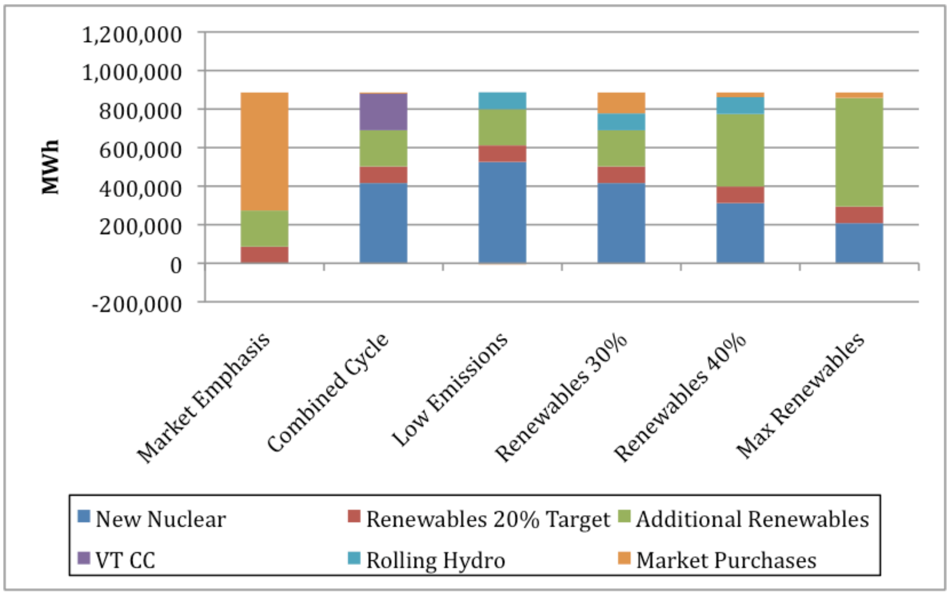

Figure 37: Resulting Resources by Portfolio 2030: Muddling Along

Resource Portfolios Additions Energy Output (MWh) Summary through 2030

Table 17 summarizes the projected additions (GMP's existing and committees resources are not included) to each of the six reference portfolios, for each of the three scenarios through the year 2030.

Portfolio Additions Summary - Energy Provided by Resource type in 2030						
Portfolio Theme	Market Emphasis	Combined Cycle	Low Emissions	Renewables 30%	Renewables 40%	Max Renewables
Muddling Along						
New Nuclear	0	416,100	525,600	416,100	312,075	208,050
Renewables 20% Target	86,068	86,068	86,068	86,068	86,068	86,068
Additional Renewables	187,902	187,902	187,902	187,902	375,804	563,706
VT CC	0	192,720	0	0	0	0
5 Year Hydro Purchases	0	0	87,600	87,600	87,600	0
Market Purchases	612,061	3,241	-1,139	108,361	24,484	28,207
Total	*886,032*	*886,032*	*886,032*	*886,032*	*886,032*	*886,032*
Gas is Greener						
New Nuclear	0	394,200	788,400	394,200	295,650	295,650
Renewables 20% Target	117,361	117,361	117,361	117,361	117,361	117,361
Additional Renewables	202,794	202,794	202,794	202,794	405,588	608,382
VT CC	0	192,720	0	0	0	0
5 Year Hydro Purchases	0	131,400	0	262,800	131,400	0
Market Purchases	716,077	-2,243	-72,323	59,077	86,233	14,839
Total	*1,036,232*	*1,036,232*	*1,036,232*	*1,036,232*	*1,036,232*	*1,036,232*
Economy of Efficiency						
New Nuclear	0	394,200	569,400	394,200	295,650	197,100
Renewables 20% Target	47,454	47,454	47,454	47,454	47,454	47,454
Additional Renewables	173,010	173,010	173,010	173,010	346,020	519,030
VT CC	0	192,720	0	0	0	0
5 Year Hydro Purchases	0	0	0	87,600	87,600	0
Market Purchases	509,213	-77,707	-60,187	27,413	-47,047	-33,907
Total	*729,677*	*729,677*	*729,677*	*729,677*	*729,677*	*729,677*

Table 17: Reference Resource Portfolios Additions Summary through 2030

Evaluation of Alternative Portfolios

Based on the themes described above, six portfolio strategies were initially developed. The evaluation of these portfolios was done using a multi-step process. The first step involved evaluating the initial portfolios under three different scenarios. This yielded eighteen initial cases that were evaluated. As was described in the previous section, these eighteen cases were evaluated against a number of metrics that measured various aspects of the portfolio performance. Based on the results of the initial evaluation, the preferred portfolio was developed. This portfolio was then evaluated under the three scenarios.

The second step involved evaluating the preferred portfolio for sensitivity to external market forces. These sensitivity tests involved evaluating the preferred portfolio under an environment that was similar to the Muddling Along and Gas is Greener scenarios except that a high price for carbon allowances was substituted for the scenario carbon allowance price.

The final step was to conduct a set of stress and robustness tests. Two stress tests were performed that evaluated the preferred portfolio under stress conditions. These stress conditions were based on the Gas is Greener scenario with two exceptions. The first stress test evaluated the preferred portfolio against a situation where GMP's load was lower than forecast due to a significant decline in the consumption of one of GMP's large customers. The second stress test added extremely low market prices to the effects of the first stress test. The robustness tests evaluate the performance of the preferred portfolio when it is subjected to a discrete change in its resource composition. The first robustness test replaced some of the preferred portfolio's resources with a combined cycle resource. This was tested under the Gas is Greener scenario. The second robustness test didn't change the composition of the preferred portfolio. Rather, it tested the world where Vermont Yankee is relicensed and GMPs power costs are potentially offset somewhat by the Revenue Sharing Agreement. This robustness test was conducted under the Economies of Efficiency scenario.

The steps described above generated a great deal of information about the characteristics and performance of GMP's future portfolio. It would not be practical to present and describe all of the pertinent information; the remainder of this section summarizes and visually presents some of the key steps and observations that provided the greatest insights.

The following table illustrates the portfolio strategies developed and the conditions the portfolios were tested against.

After developing the alternative portfolios we tested their performance against various metrics, including stability, CO_2 emissions and level of renewableness. We then looked at the inherent tradeoffs between different metrics to hone in on a preferred portfolio.

Specifically, we reviewed the cases against the following Metrics:

Strategic Metrics

- Long-term price stability
- Emissions (CO_2 lbs/MWh)
- Renewable fraction (new & existing)
- In-state sources
- Utility ownership (vs. purchases)
- Intermittence
- Capacity position
- Public Preference

Financial Metrics

- GMP Power Costs
- GMP Power Costs vs. Regional Average Costs
- Cash Position
- Total Debt
- Financial Coverage Ratios

Table 18 below summarizes the portfolio strategies that were evaluated and key observations on their performance relative to the above metrics.

Portfolio Strategy	Description	Metrics Performance Observations
Market Emphasis	Focus on market purchases; also includes 30% premium renewables	Relatively high emissions profile; Relatively low long-term price stability (illustrated further below); Low rates of ownership, in-state, and public preference.
Unit Contracting – Nuclear and Combined Cycle	Includes new VT CCGT, as well as nuclear and 30% premium renewables.	Relatively low price stability; Moderately high emissions profile, in spite of a substantial nuclear component
Low Emissions	Highest nuclear and rolling hydro purchases; also 30% premium renewables.	Low to moderate on the public preference scale; Excessive levels of long-term commitment too early.
Renewables 30%	30% premium renewables; similar to Combined Cycle, but market and rolling hydro purchases replace VT CCGT.	Desirable level of renewables; High exposure to market price increases due to low hedging.
Renewables 40%	40% premium renewables; other renewables, nuclear, rolling hydro and market purchases to round out.	High price stability, but little portfolio flexibility to deal with potential low-load future; Relatively high cost, especially under a VT RPS High reliance on intermittent resources, leading to potential reliable capacity shortfalls.
Max (50%) Renewables	50% premium renewables. Some nuclear and market purchases.	Same observations as Renewables 40%, only more so. Price stability is illustrated further below.
	Multi-attribute Portfolio Analysis	
PREFERRED PORTFOLIO	30% Renewables with Nuclear and Rolling Hydro purchases	Low air emissions profile Appropriate level of long-term hedging Competitive cost No “fatal flaws”

Table 18: Summary of Portfolio Strategies Tested to Develop a Preferred Portfolio

Single Metric Performance

This section examines some indicative performances of select portfolios on key metrics. One of the challenges we discovered with the high premium renewables portfolios was that they tended to result in extreme long-term price stability. As Figure 38 shows, the Renewables 50% portfolio results in an almost completely inflexible (100% hedged long-term) GMP portfolio by the end of the planning period. Though a certain degree of stability is desirable, excessive flexibility leaves GMP unable to respond to unexpected downturns in load or market prices.

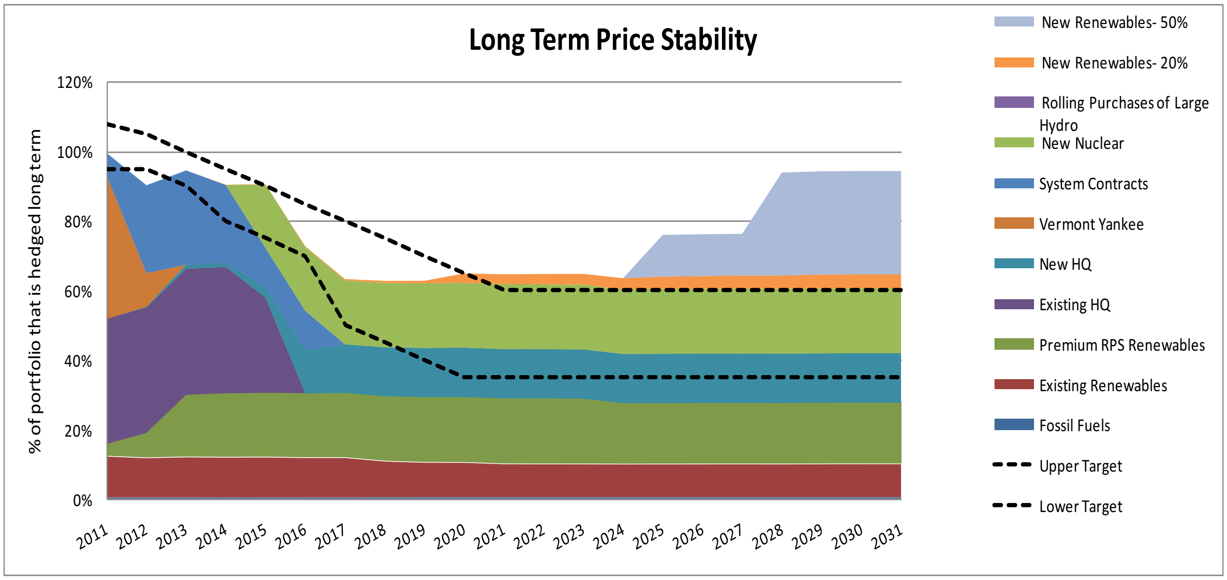

Figure 38: Long-Term Price Stability for the Renewables 50% Portfolio

The regional average emissions rate is currently much higher than the GMP portfolio emissions rate. A portfolio high in market purchases will result in significantly higher emissions per MWh than a similarly-priced portfolio that utilizes lower-emission sources such as large hydro, nuclear, or most renewables. The projected emissions levels from our Market Emphasis portfolio strategy are shown in Figure 39 below. Although still well below the regional average, the portfolio emissions in this strategy are significantly higher than GMP's historic levels between 100 to 150 pounds per MWh of GHG emissions.

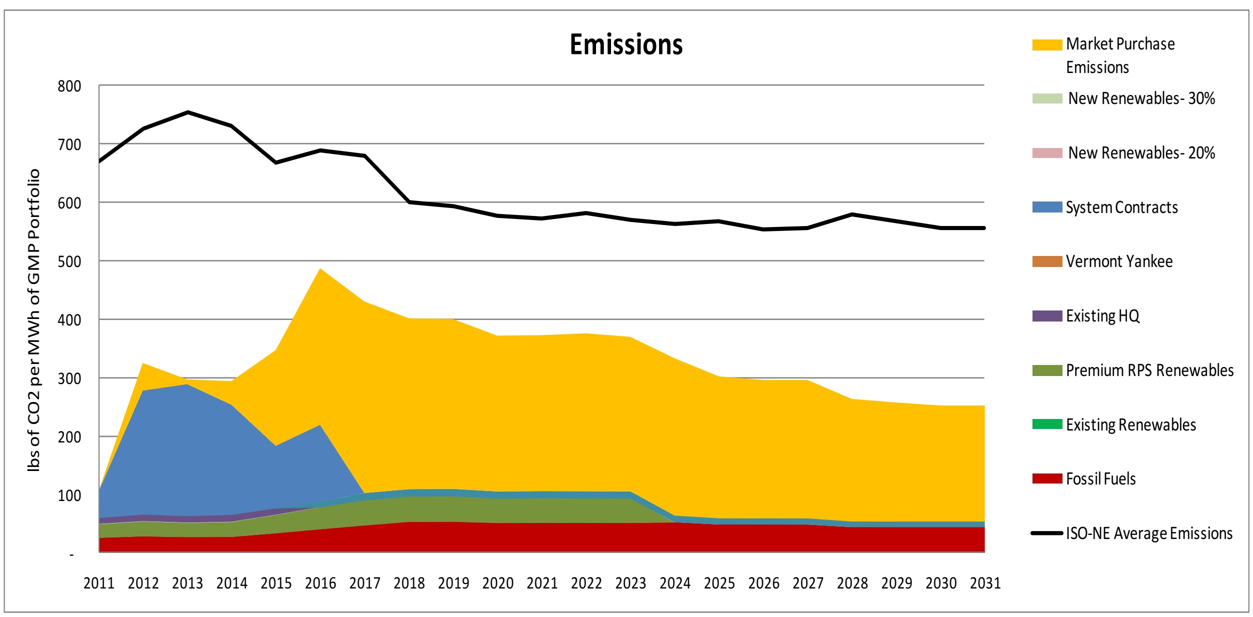

Figure 39: Emissions Profile of the Market Emphasis Portfolio

Multi-Attribute Trade-off Analysis Results

In this analysis, we examined several attributes across the three scenarios to help determine a preferred portfolio. The impact attributes that GMP felt were the most important with respect to evaluating the strategy that provided the most benefit to our customers are:

- Renewableness. This measures the percentage of GMP's portfolio over 20 years that is renewable. This is defined more broadly than the generation that produces renewable energy credits (RECs) in the regional markets. REC producing generation are referred to as Premium Renewables. Two prominent examples of generation that is included in our metric that does not qualify for creating RECs are purchases from large Canadian hydroelectric facilities such as Hydro Quebec and older hydroelectric facilities which predate the establishment of the REC marketplace and renewable portfolio standards.
- Stability. This measures the % of GMP's resource portfolio mix that is committed as opposed to the amount that is exposed to market prices through open positions.
- Emissions: tons of CO_2, (total over 20 years).

In evaluating a portfolio, it is useful to plot pairs of attributes against each other for all the strategies and all the scenarios. Shown below are three of these plots. Each plot includes 18 cases with the same portfolio strategy symbol. This represents the three variations within the strategy for each of the three scenarios. We examined each plot for clustering of points, which demonstrates a robustness of that portfolio strategy performance for that attribute across the three scenarios. Of course, the trends and clustering depicted in this analysis reflect, among other things, on the price assumptions used to derive them. While the shape of these results (and the relative attractiveness of the underlying portfolios) will probably evolve in the future as GMP obtains specific proposals from potential suppliers, the multi-attribute approach presented here can be adapted relatively easily to help GMP evaluate its options as conditions change.

The following charts highlight some comparative results of the alternative portfolios.

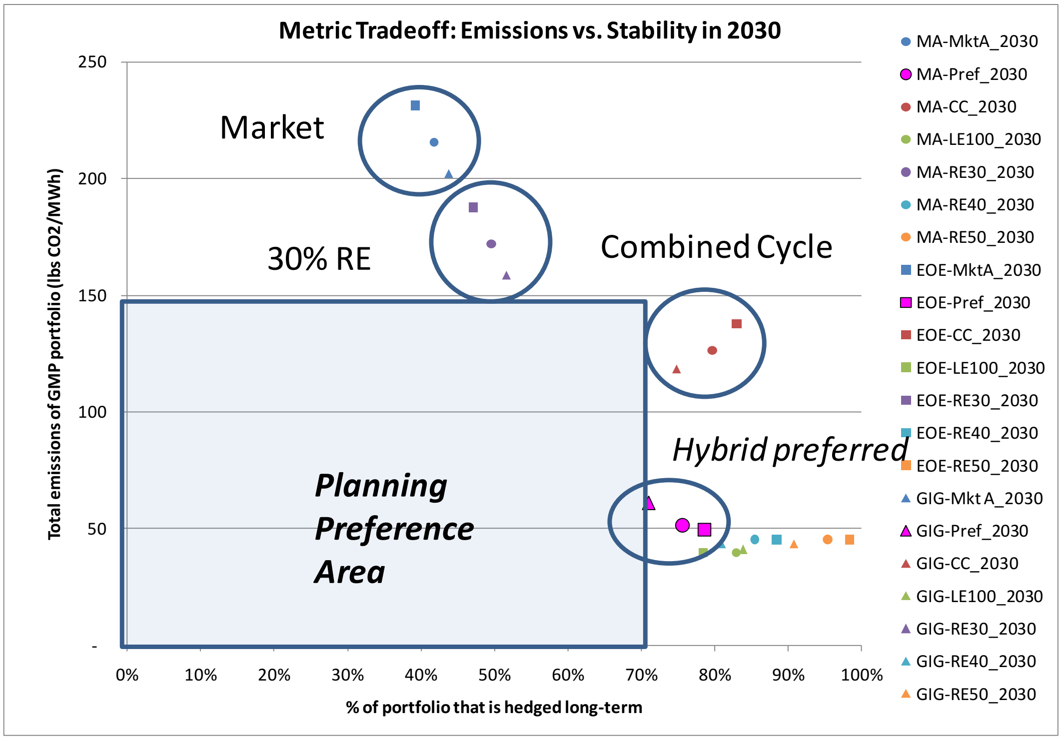

Figure 40: Trade-off Showing Market, Combined Cycle and 30% RE Portfolios as Configured Do Not Meet Emissions Level Targets

This chart is referred to as a trade-off chart in that it compares the relationship of two portfolio metrics rather than the prior charts that show a single metric over time. In this case we have the Stability metric, defined as the percentage of the portfolio that is hedged long-term, on the x-axis as compared with the Emissions metric, the amount of Carbon emitted by the GMP Portfolio per MWh that the portfolio provides. This chart provides these metrics in a snapshot for the year 2030, showing the results of the 6 original portfolios and the Preferred Portfolio developed after evaluating metrics of the original 6 portfolios. Each portfolio was modeled for each of the 3 scenarios, thus there are 21 points on this chart. The Trade-off chart also depict a Planning preference area where as implied , ideally GMP's plan would attempt to be developed such that its metrics fall in that area. In this chart the preference is to be 150 lbs/MWh or below for CO_2 emissions and not more than 70% of the portfolio should be hedged long term. For convenience we have highlighted the particular portfolios in circles. We see that the Market Emphasis portfolio, the 30% renewable portfolio both fit within the stability constraints but do not have emissions below 150 lbs/MWh. The Preferred Plan was created as a hybrid by combining elements of the 30% Renewable Energy plan and the contracting of the Low Emissions strategy to obtain low emissions without excessive stability metric values.

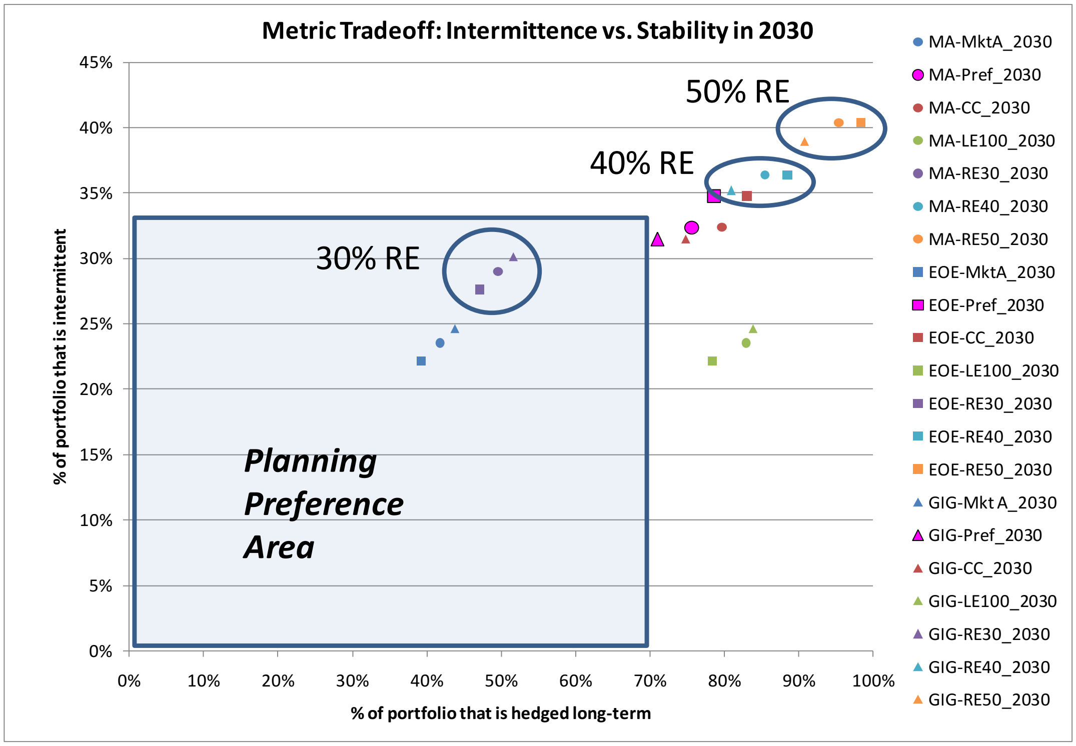

Figure 41: Trade-off Showing Concern About Too Much Dependence on Intermittent Resources with the Higher Emphasis of Premium Renewable Energy

This second trade-off chart is a comparison the relationship of the Price Stability on the x-axis (that is, percent of the portfolio that is hedged long-term) as compared with the Intermittence metric, the percentage of the portfolio that comes from generation resources that are intermittent in nature, such as wind, solar and certain hydroelectric configurations. This chart also provides these metrics in a snapshot for the year 2030, showing the results of the 6 original portfolios and the Preferred Portfolio developed after evaluating metrics of the original 6 portfolios. Each portfolio was modeled for each of the 3 scenarios, thus there are 21 points on this chart. The Trade-off chart also depict a Planning preference area where, as implied , ideally GMP's plan would attempt to be developed such that its metrics fall in that area. In this chart the preference is to be at $1/3^{rd}$ or less for intermittence and not more than 70% of the portfolio should be hedged long term. For convenience we have highlighted the particular portfolios in circles. The high renewable energy portfolios clearly fall outside of the preferred planning area, thus making them vulnerable to unsatisfactory levels of short term volatility, operation reliability concerns or hidden costs to maintain adequate operational reliability. This review of the trade-off here would steer the IRP away from portfolios with higher than 3o% intermittent renewable energy based generations.

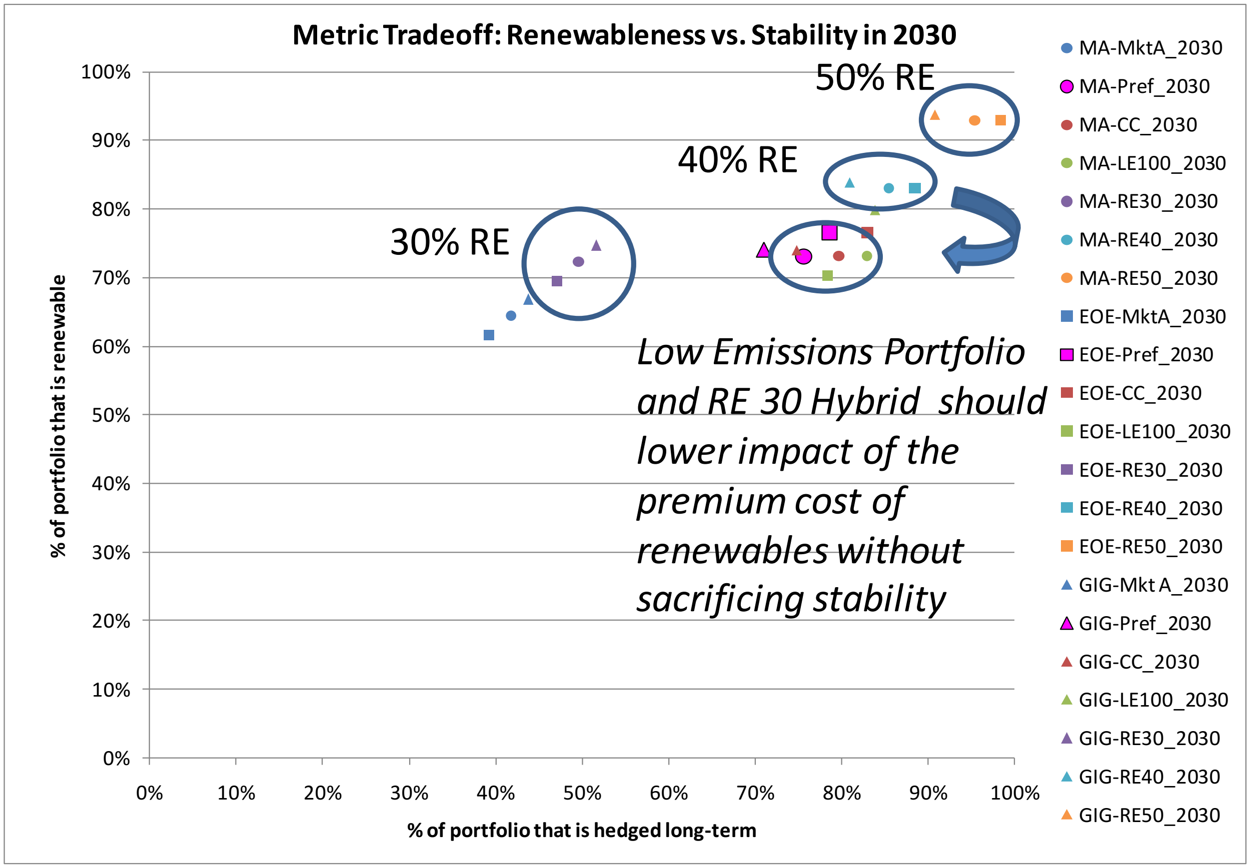

Figure 42: Trade-off Showing Concern About Too Much Stability at the Premium Renewable Costs

This final trade-off chart depicted in the report shows the relationship of the Stability on the x-axis as compared with the Renewableness metric, the of the portfolio that comes from generation resources that are renewable in nature even if they do not qualify as producing tradeable renewable energy credits, such as long established hydroelectric generation and purchases from Hydro Quebec. This chart also provides these metrics in a snapshot for the year 2030, showing the results of the 6 original portfolios and the Preferred Portfolio developed after evaluating metrics of the original 6 portfolios. Each portfolio was modeled for each of the 3 scenarios, thus there are 21 points on this chart. The Trade-off chart does not have a limitation on the amount of renewableness per se, however it does have concerns if more than 70% of the portfolio should be hedged long term. For convenience we have highlighted the particular portfolios in circles. The chart shows that there is little "renewableness" lost by moving to the Preferred Plan's use of rolling hydroelectric purchases in place of premium renewable. GMP's participation in the marketplace has shown that there is a much greater cost for the premium renewable based energy as compared to short term market purchases, and potentially relative to large hydroelectric PPAs. This review of the trade-off here would steer the IRP away from portfolios with higher than 30% renewable energy based generations.

Based on our assessment of these cases and inherent tradeoffs, we developed a Preferred Portfolio.

GMP's Preferred Portfolio

The preferred portfolio is a specific combination of existing and future power resources, featuring specific types, amounts, and timing of future resource additions that appear appropriate, based on GMP's current evaluation, to serve the power needs of GMP's customers over the long-term. Of course, the number of potential specific future portfolios is essentially infinite, and the actual costs/prices at which future resources may be available could differ materially from those shown here. The illustrative preferred portfolio shown here does not commit GMP to specific resources, but it identifies the key themes that emerge from GMP's portfolio evaluation, and how they may be addressed with specific future resource choices.

Key elements of the preferred portfolio are as follows:

- **Retention of existing owned generation.** All of GMP's owned hydroelectric plants, and most of its oil-fired peaking plants, are assumed to continue to be available for many years.
- **A meaningful new long-term power purchase.** This purchase is assumed to be from a low-emission source that is not a "new" renewable under Vermont's SPEED program or a Class 1 renewable in neighboring states. The source would most likely be an existing nuclear or large hydro plant (or combination of plants). A primary goal of this purchase would be to add another low-emission source to the portfolio at relatively stable prices – thereby enabling GMP to take advantage of the substantial decline the electricity market price environment, greatly reducing the uncertainty of our long-term power costs and retail rate path. In the GMP portfolio analysis, the purchase is represented for illustration as a 50 MW purchase of unit-contingent power from a nuclear plant, for a term of 20 years. The price is assumed to start somewhat above near-term market prices, and to escalate at the rate of general price inflation (which is slower than we project future power market prices to increase). [28]
- **Increasing amounts of smaller-scale, in-state renewable generation.** This represents a combination of community-scale generation projects (owned by GMP, or independently owned with output sold to GMP under PPAs), and customer-scale generation (which would likely participate in the net metering program. While small-scale renewable generation is, at present, typically much more costly on a long-term basis than utility-scale renewable sources, it has the potential to bring some unique local benefits (e.g., local economic development, diversity of supply sources, and support of the local delivery system). We assume for illustration that much of this development will be solar photovoltaic, since this has been the primary small-scale renewable technology developed in GMP's territory in recent years. In addition, the technology's cost and performance characteristics are projected to continue to improve over time.
- **A meaningful "open" position.** In the preferred portfolio, a meaningful portion of the portfolio is not "filled" with long-term, stable-priced supply commitments. This is a significant component of the preferred portfolio, because it provides flexibility for several potential developments that could occur in the future. In particular, such developments include:
  - Lower future electricity demand by GMP customers. This could be driven by one or more of: lower economic growth in Vermont; greater energy efficiency savings; or a future decline in power needs by one of GMP's largest customers.

[28] As the IRP portfolio evaluation was being finalized, GMP reached agreement with NextEra Seabrook, LLC on a new long-term PPA, and GMP recently filed a petition seeking a Certificate of Public Good for the purchase. As a result, the portfolio evaluation presented herein does not include the proposed PPA as a committed resource.

- Further declines in electricity market prices. Maintaining a meaningful portion of the portfolio to be purchased to be purchased in the future will ensure that GMP customers benefit if future power market prices turn out lower than today's expectations, and will help to limit the extent to which
- Other future resource opportunities, such as, for example, a preferred in-state renewable sources or output from a combined heat and power project.

- **Future short/mid-term purchases** from existing low-emission sources (most likely hydroelectric) in the region, with terms of one to five years. This type of purchase, if it can be obtained at a competitive price, would protect GMP customers from short-term market price volatility, and enhance the portfolio's emission profile and renewable content, while maintaining flexibility to respond to longer-term developments and not incurring the significant price premium associated with many new renewable sources.

Consistent with the themes above, GMP expects that if and when it implements a new stable-priced and long-term purchase, the central elements of its future portfolio will be in place. GMP would not expect to make new long-term commitments to stable-priced energy sources – at least on a large scale - for some time. In the preferred portfolio, it is likely that future purchases would be made primarily on an opportunistic basis (e.g., when market conditions or particular transaction opportunities appear especially attractive), and would typically feature terms of 10 years or less.

Some of the key features of the preferred portfolio include a nuclear resource, a strong presence of various types of renewable resources and additional shorter term purchases from existing large hydro facilities. The new nuclear resource is a 50 MW twenty year contract with a New England nuclear unit. The contract features a high level of long term price stability and the price is reflective of current long term market outlooks.

GMP's current renewable procurement has resulted in approximately 20% of its supply being derived from renewable resources. These include the resources currently under development such as Kingdom Community Wind and Granite Reliable Wind as well as some additional smaller scale local resources. Additionally, the preferred portfolio also contains future biomass and wind resources toward the end of the planning period.

From 2017 forward, the preferred portfolio features 30 MW of consecutive or rolling shorter term purchases (up to 5 years) from existing large hydro. The figure below illustrates the energy composition of the preferred portfolio by resource category.

Figure 43 shows the preferred portfolio by resource.

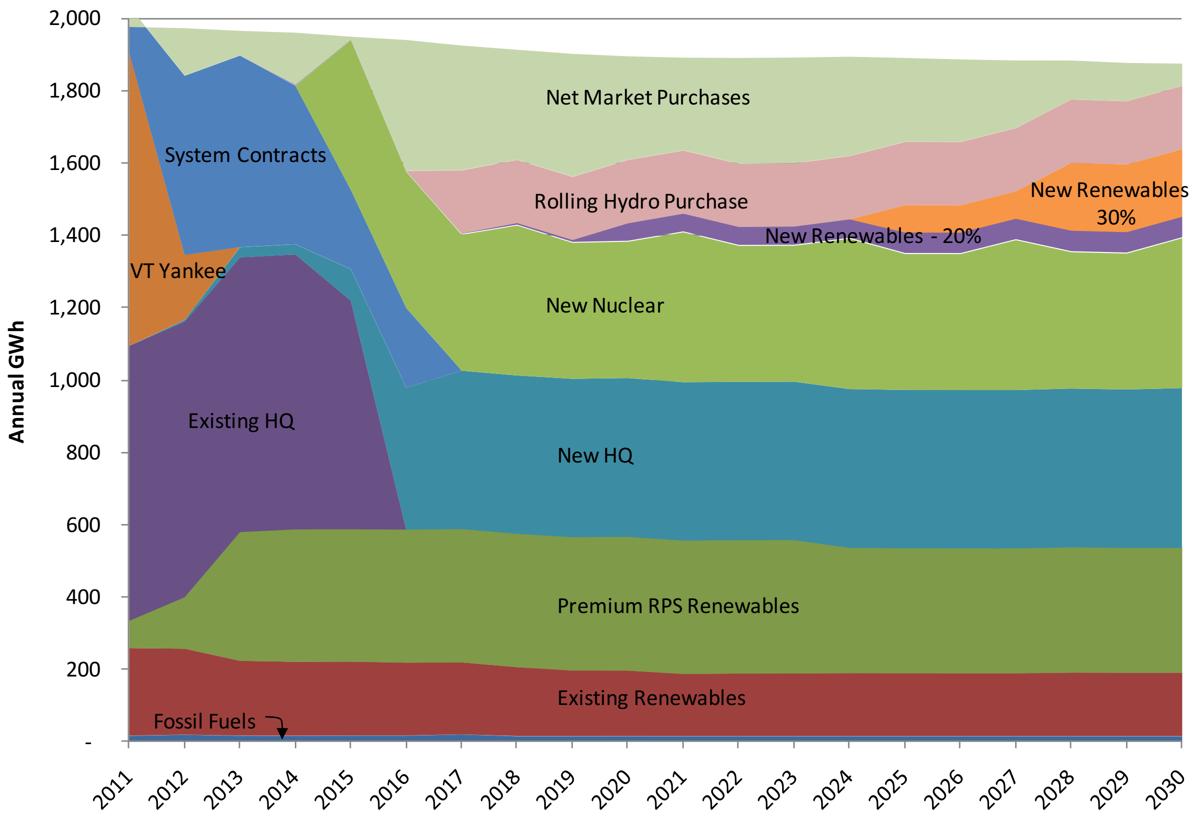

Figure 43: Portfolio Energy Supply by Resource – Muddling Along

Key Characteristics of the Preferred Portfolio

Building on the foundation of committed and planned sources described earlier, the preferred portfolio offers a number of attractive features:

- A high proportion of supply from renewable sources, approaching 20 percent within the next several years. This amount is sufficient for GMP to meet its share of Vermont's SPEED requirements (for example, 20% of supply from new renewable sources by 2017), and well above requirements in the other New England states. The total fraction of supply from renewable sources including existing ones) is projected to exceed 60 percent.
- An emission profile far below the regional average, and consistent with GMP's very low historical levels.[29]
- A relatively high degree of long-term supply commitments and a fairly high degree of long-term price stability. This is due to GMP's substantial pipeline of renewable sources, its strategy to make significant long-term purchases to take advantage of recent market price declines, and an increase

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[29] As discussed below and in later chapters of the IRP, GMP's net power costs and the emission profile that it can claim for its power supply will depend significantly on the direction of Vermont's future policy with respect to the sale of RECs.

in the fraction of owned generation. As a result, GMP is relatively well protected against potential high future market price outcomes.

- A competitive expected price profile, reflecting a mix of market-based sources and new renewable sources that were procured at the lowest prices possible.
- An increasing diversity of sources - in terms of the number of sources (i.e., "fewer eggs in one basket"), their fuel types, and (in the case of long-term sources), their price structures.

The preferred portfolio exhibits a very favorable emissions profile. As the figure below illustrates, under all scenarios tested the preferred portfolio's emissions are well below the average New England emission rate. It is important to note that under the current SPEED program GMP is allowed to sell the RECs it obtains from renewable resources. Selling the RECs does relieve the upward pressure on retail rates, however by selling the RECs GMP is no longer able to claim the desirable low emission and renewable attributes of the resources in its portfolio. The effect of selling the RECs on the emission profile of the preferred portfolio is illustrated in the figure below. The average emission rate of the preferred portfolio in the Muddling Along scenario is higher than the portfolio that contains a share of a combined cycle generating unit due to the sale of RECs. We also wanted to assess the emissions impact of adding an 80 MW share of a new CCGT plant in 2018 in Vermont (Stress D) and as you can see the addition of just this one resource in Vermont compared to the GIG and EOE scenarios where the RECs are not sold, does have a material impact on GMP's average emissions rate; however it still remains well below regional levels. (The various Stress cases are described in more detail below.)

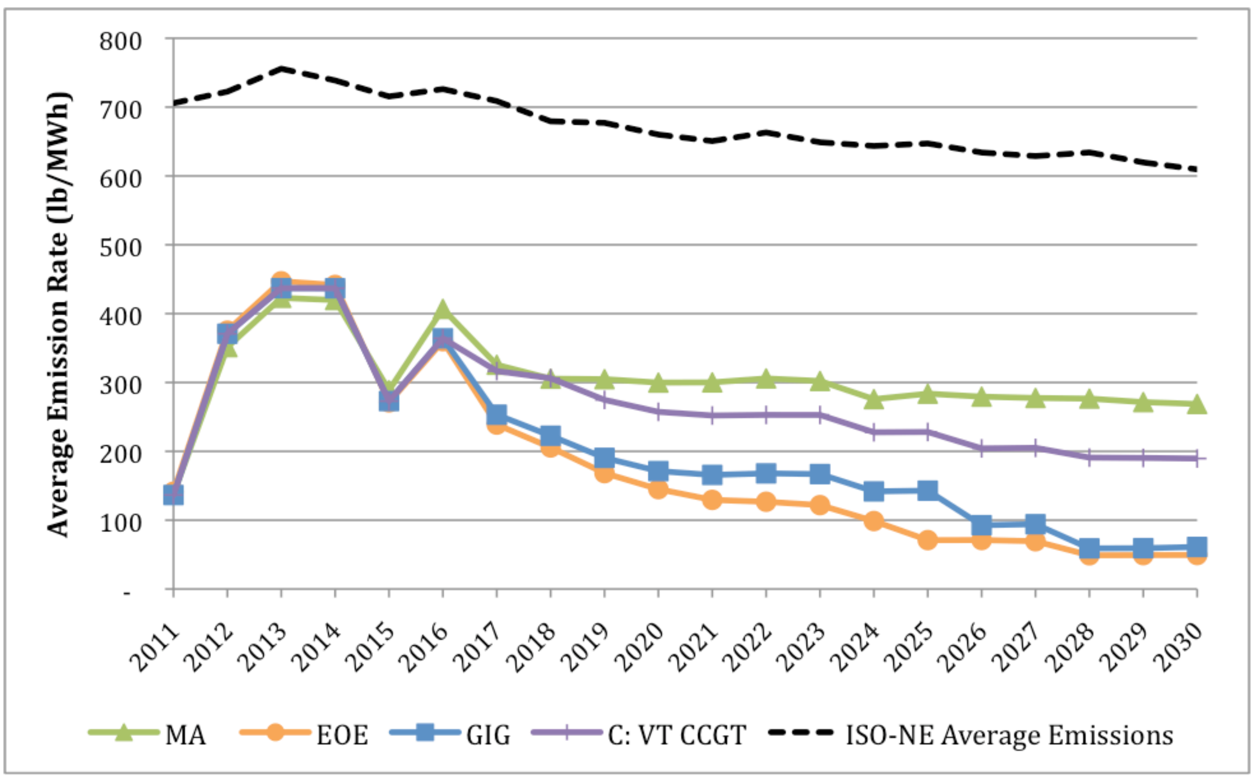

Figure 44: Adjusted Portfolio GHG Emissions

In terms of portfolio content, the Preferred Portfolio contains a considerable amount of renewable resources. Premium renewables quickly approach 20% of GMP's energy resources. This is well above the regional RPS requirements for many states and it also meets Vermont's SPEED requirement.

Furthermore, the preferred portfolio obtains over 60% of its energy from renewables resources that include not only the premium renewables but also existing hydro and biomass resources and future purchases from large hydro. In addition to the three scenarios, when we looked at the case of adding a new 80 MW CCGT in Vermont in 2018, not surprisingly this reduces the level of GMP's renewableness by more than 10% - from over 70% to roughly 60% in 2030.

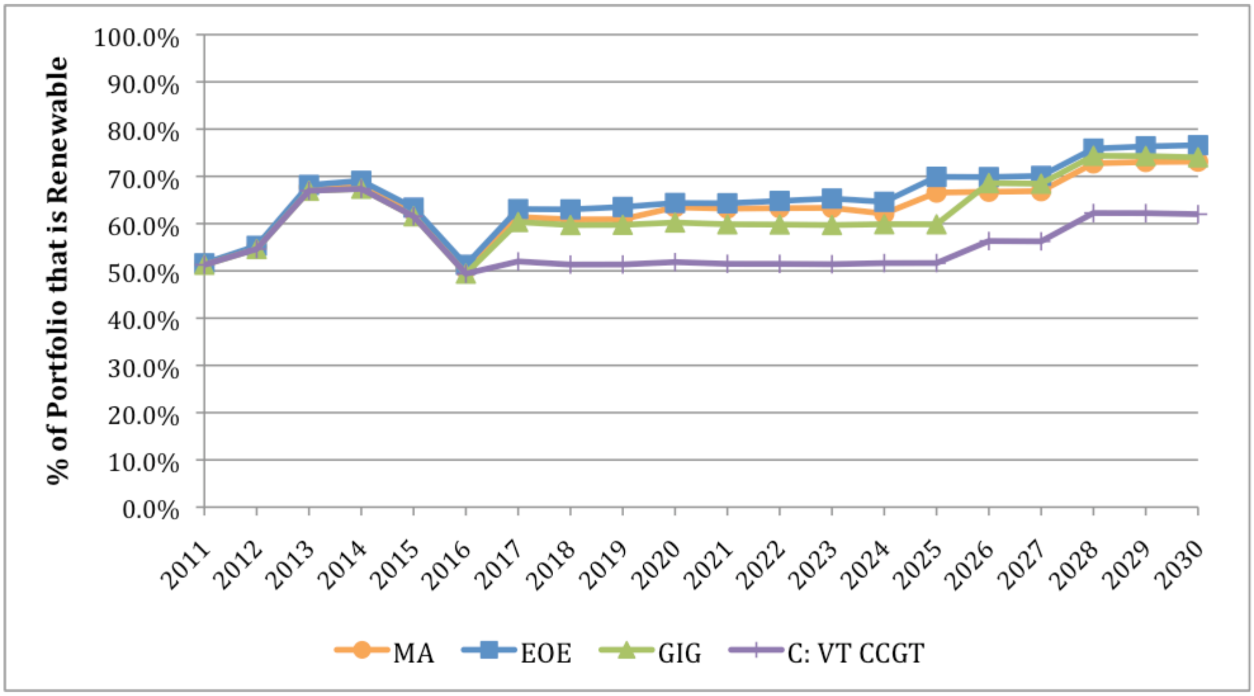

Figure 45: Portfolio Renewableness

The preferred portfolio also features a moderate to high degree of long term price stability. In the figure below, between 60% and 80% of GMP's portfolio is hedged long term. This level of hedging is results in portfolio costs that are significantly more stable than the power supply of most of Vermont's neighbors in New England. This is a slight departure from recent history where GMP was almost fully hedged. However, the larger open position enables customers to benefit to some degree from any future market price declines. We also opted to examine the impact of a lower GMP load paradigm on stability (Stress A). The lower load was assumed to be the unexpected loss of a large customer. As the figure shows, the lower load results in a much higher percentage of GMP's load being hedged earlier in the planning horizon.

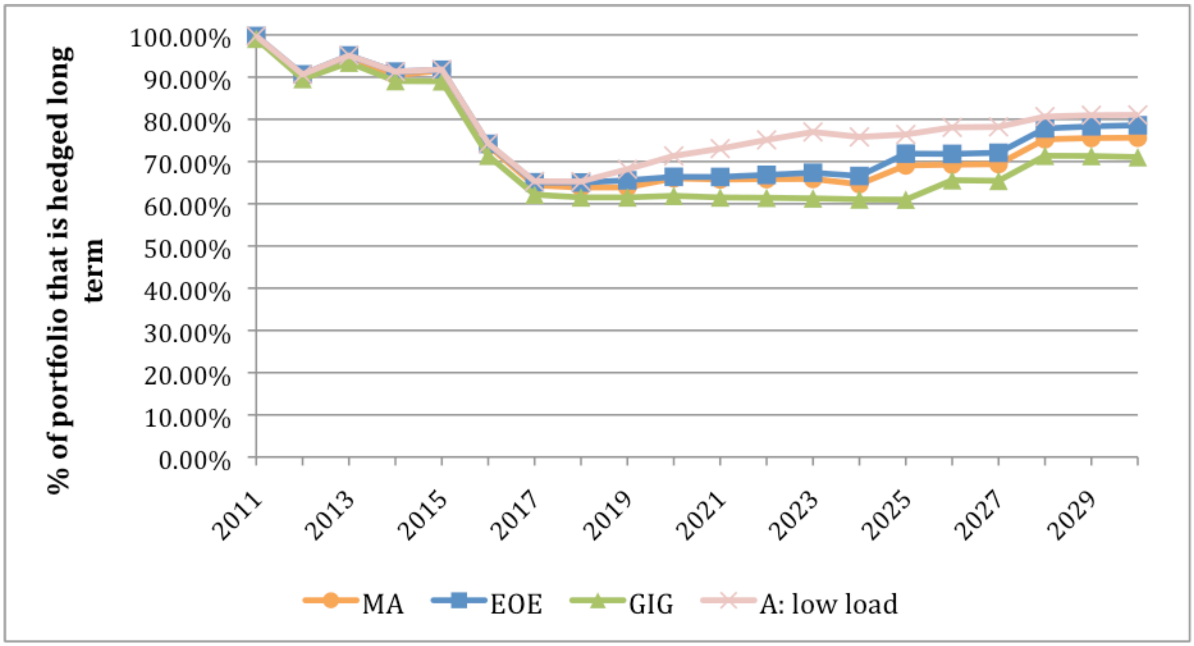

Figure 46: Portfolio Stability

The preferred portfolio scores well initially in terms of the public's preferred makeup (particularly increasing reliance on renewable sources, instate sources, and more diverse sources). Over time GMP continues to add resources that are consistent with the public preferences, balancing the pace of those additions against the relative cost of additional renewable and the need to maintain flexibility in our portfolio to respond to future events.

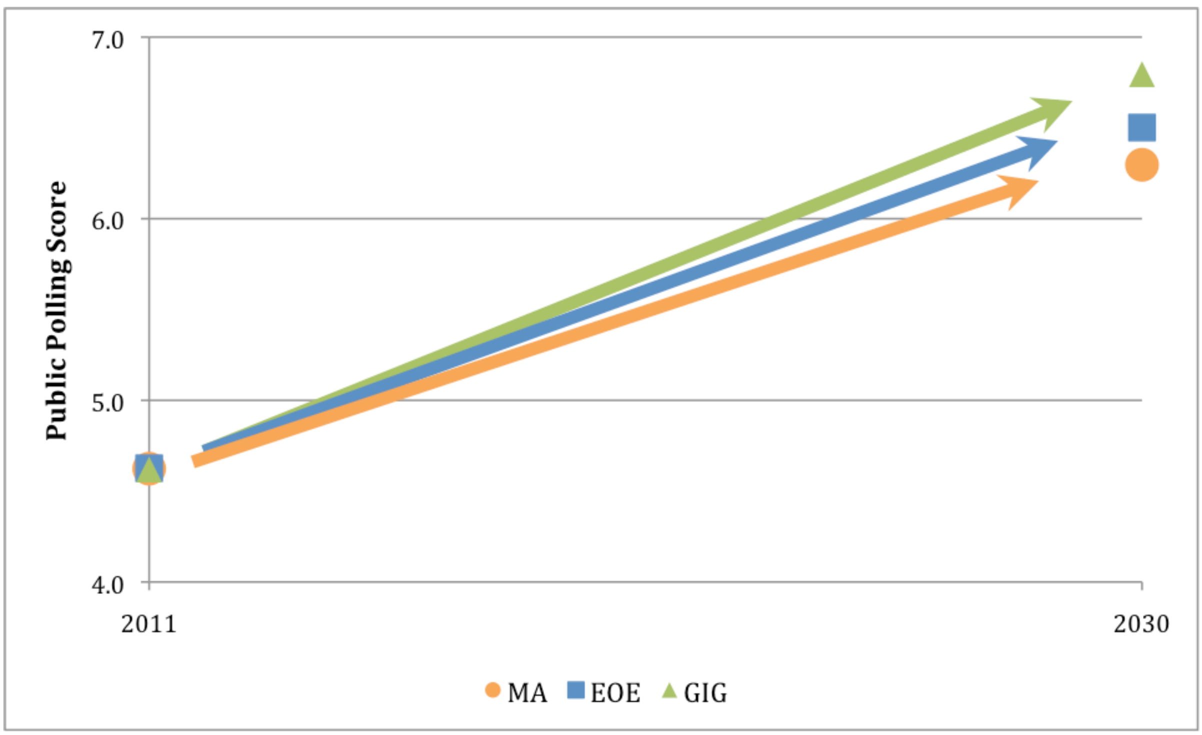

Figure 47: Public Preference Trends for Preferred Portfolio

Generation Rate Comparison

One key take away from the analysis of the preferred portfolio is that GMP's generation service rates are projected to remain competitive versus the regional average (Figure 48). As we discussed in the last IRP, approximately 90 percent of GMP's historic power supply resources - including Vermont Yankee, Hydro-Quebec, GMP-owned hydroelectric plants, VEPPI purchases, and GMP's joint ownership in the McNeil generating plant - involve prices that are either fixed price, relatively stable, or not tied closely to the wholesale market. The remaining 10 percent has been obtained primarily from periodic forward energy market purchases and from GMP's participation in the Stony Brook and Wyman plants. As a result, GMP's portfolio has been largely insulated from market price changes and has been much more stable than those of utilities in neighboring states (which generally purchase their power supplies on a much shorter-term basis). This has tended to make GMP's power supply costs and retail rates among the lowest in New England during periods of high market prices, and less competitive during periods when market prices are low. While there are many uncertainties in projections of this type, the IRP analysis suggests that GMP will be able to maintain the regional competitiveness of its power supply costs.

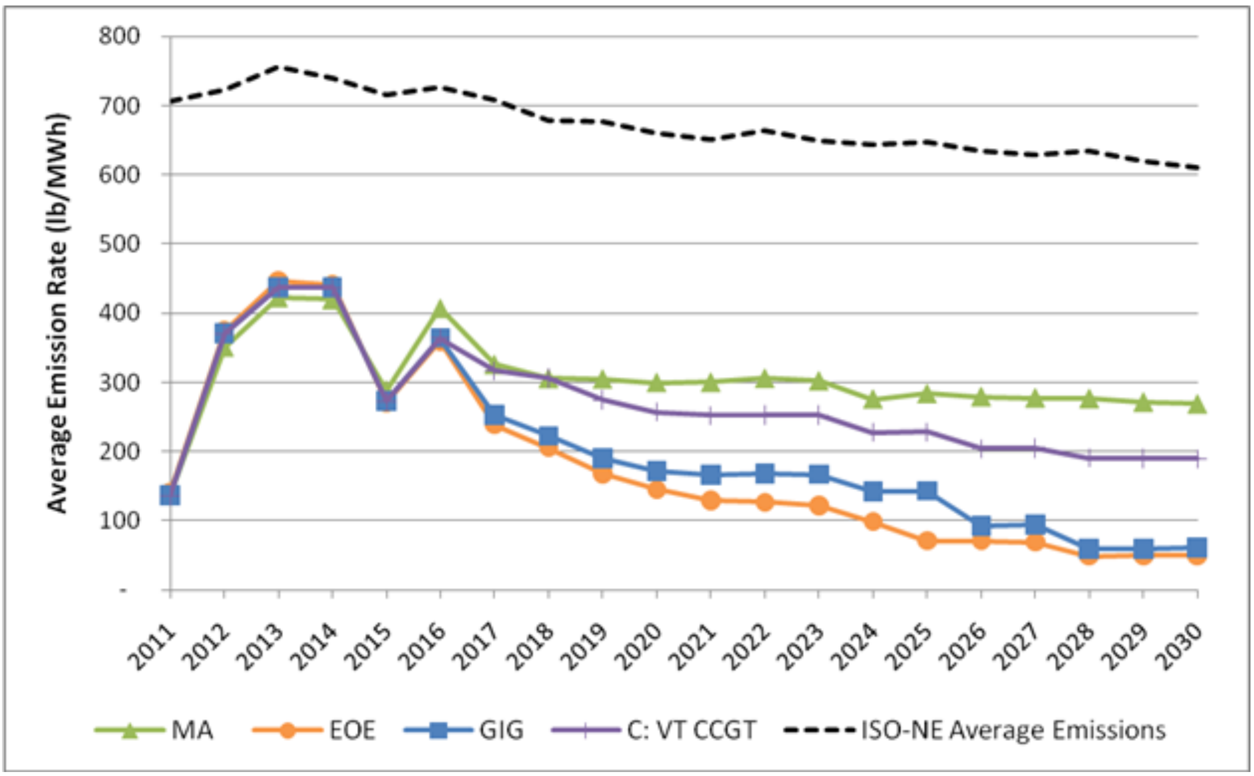

Figure 48: GMP Generation Service Rates vs. Regional Average

The Financial Implications of the Preferred Portfolio

Maintaining a strong credit rating is necessary for an electric utility to provide safe, reliable service to its customers. The key financial metrics reviewed by the credit rating agencies are: a cash flow interest coverage ratio, a measure of the relationship of cash flow to total debt and a measure of the relationship of cash flow to total debt including a measure for the implied liability of the company's pension plan. It is meaningful for the utility to show the ability to maintain a Funds from Operation interest coverage ratio of 4.0 (i.e., cash flow from operations is 4 times the interest obligation) and a cash flow to debt of greater than 20%. The key is not so much a one-time measurement at the end of a particular year, but a trend over time. It is important when doing long range planning to assure the utility will maintain these metrics to maintain a strong credit rating. This ensures lower borrowing costs and access to debt capital, which is essential to providing continuous service.

Investing in and constructing utility-owned generating plants such as hydro, large wind and other renewables that do not incur a fuel expense aids in generating positive cash flow after construction. This tends to lead to strengthening credit metrics, which strengthens the utility's financial stability. As a result, power portfolios that are balanced with both contracts and owned non-fuel units (assuming that those units are operated successfully) should lead to stronger credit ratings. In the IRP analysis of GMP's illustrative preferred portfolio, the company's projected FFO interest coverage increases to over 4.0 in 2014 (after the KCW project is completed), and remains over 4.0 for most of the planning horizon.

Of course, another strong consideration in evaluating a power supply portfolio is the prospective rate increases needed to allow the utility to recover their costs and maintain a strong financial position. If implementing a particular strategy entails the need to file high rate increases (for example, in the high single digits or greater) over a number of years, then the strategy may not be politically or economically sustainable. Therefore, a key element in evaluating a long term power supply strategy is a careful review of the rate increases needed to sustain the strategy. The core elements of GMP's preferred portfolio in the IRP analysis (i.e., the KCW project, a new long-term, stable-priced PPA) are consistent with maintaining GMP's financial health, because they will reduce GMP's exposure to volatile wholesale power market prices, thereby increasing the stability of GMP's power supply costs and retail rates.

Benchmarking the Performance of the GMP Preferred Portfolio

After determining the preferred portfolio we looked at the key components of the preferred portfolio against the three scenarios. Against these we performed three types of analysis;

- High Carbon Price Sensitivity Analysis
- Stress Testing
- Robustness Testing

The following table illustrates the portfolio strategies developed and the conditions the portfolios were tested against.

Portfolio Strategy	Muddling Along	Economies of Efficiency	Gas is Greener	Sensitivity 1 Muddling Along w/ High Carbon	Sensitivity 2 - Gas is Greener w/ High Carbon	Stress A - Low Load, Low Market	Stress B - Low Load, Extreme Low Market	Stress C - Combined Cycle	Stress D - Vermont Yankee Reprieve
Market Emphasis	X	X	X						
Combined Cycle	X	X	X						
Low Emissions	X	X	X						
Renewables 30%	X	X	X						
Renewables 40%	X	X	X						
Max (50%) Renewables	X	X	X						
Preferred Portfolio	X	X	X	X	X	X	X	X	X

Table 19: Summary Table of the Cases Analyzed

High Carbon Price Sensitivity Analysis

In developing the scenarios, the outlook for the regulation of greenhouse gasses, and in particular carbon dioxide, presented the single largest area of uncertainty. Action at the national level on climate change has been debated for a number of years with the likelihood of passage of any legislation following the political winds. Given the uncertainty regarding future carbon prices and the impact on power prices, and thus potentially GMP's power costs and the fact that none of GMP's three scenarios relied on a high scenario price, we thought it prudent to test the impacts of a higher priced carbon regime. We determined that especially in the GIG and MA scenarios, there could be a logical argument for higher carbon prices. The two sensitivity cases are described below.

Gas is Greener "with a High Carbon Emission Price

In GIG for instance, one could argue that a renewed interest in comprehensive climate change results in enacting US GHG policy. In addition, a stronger economy provides the impetus to do something about GHG emissions. The Gas is Greener scenario features low gas prices, strong U.S. economic growth, and low inflation. These factors provide a strong impetus for action on climate change. The low gas prices and resulting low energy prices help to offset the increases due to higher carbon dioxide emissions allowances. Further, strong economic growth is also better able to withstand and absorb the drag that higher costs from the regulation of greenhouse gas emissions causes. In this sensitivity, greenhouse gas regulation is assumed to occur through a cap and trade system that is put in place in 2018. In our GIG high carbon price sensitivity case then we assume carbon legislation is implemented in 2018 and that carbon is taxed along the lines of the Waxman Markey bill to regulate greenhouse gasses introduced in 2009, reaching 55.37 $/ton in 2010 dollars by 2030.

"Muddling Along" with a High Carbon Emission Price

The second sensitivity analysis was performed under the Muddling Along scenario with a carbon dioxide emission allowance price again consistent with the Waxman Markey bill. In our MA scenario, although currently cap and trade is dead in its tracks, it is conceivable that Congress will take on Energy Policy in the near term. The harmful and wide reaching impact of GHG emissions gains more attention in the public spotlight and public pressure results in action in Congress to address climate change. The result is that in 2018, carbon is taxed along the lines of Waxman/Markey.

Figure 49 and Figure 50 illustrate GMP Generation Service rates compared to Regional Average for both the Muddling Along scenario and Gas is Greener scenarios with high a high carbon price sensitivity. As the figures below show, the generation service rates for other utilities in the region respond quickly to the increase in market prices due to greenhouse gas regulation however GMP's generation rate does not exhibit the same step increase. These results show that GMP's Preferred Portfolio's long term purchase power strategy from hydroelectric and nuclear sources will create a hedge against the resulting higher market energy costs that will drive regional generation service costs up by $1.5-3 per MWH in 2030. The contracting for long term purchase will likely not even require that GMP being paying a premium if carbon emissions regulations are never enacted. As a result of the composition of the preferred portfolio GMP is well protected from the effects of any potential climate change legislation.

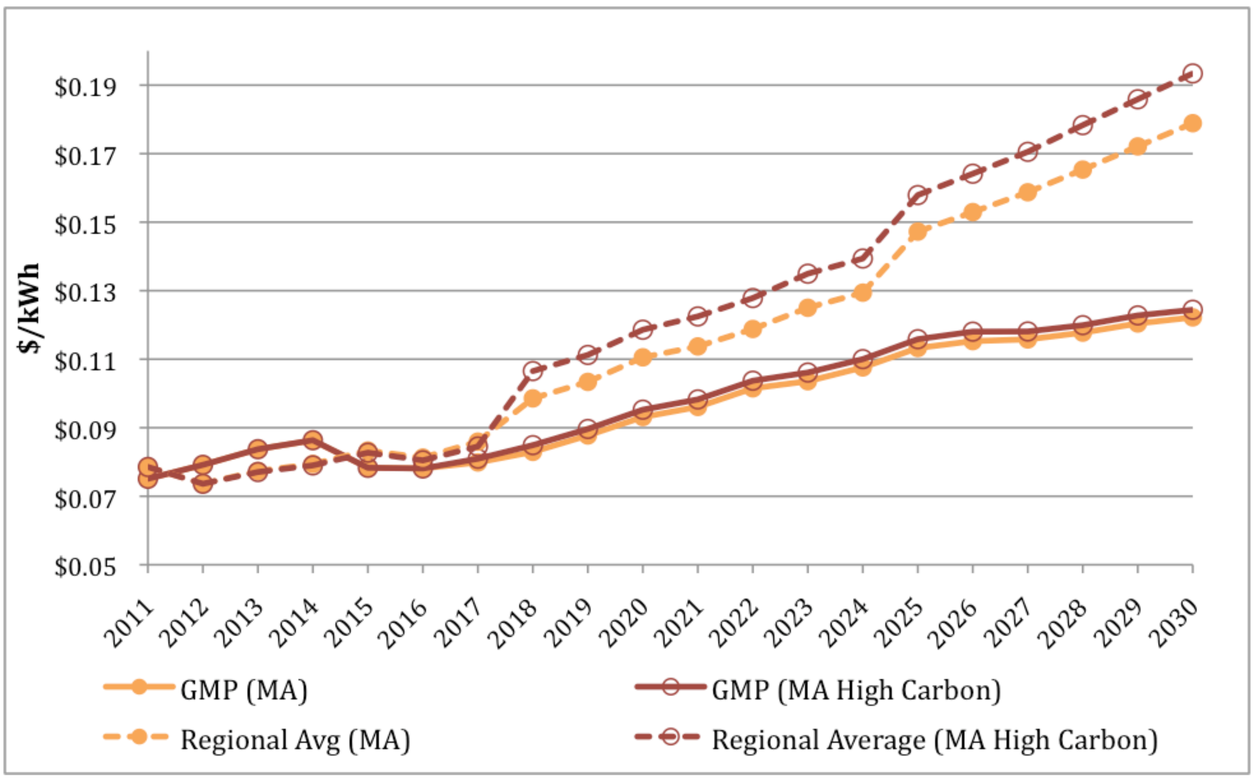

Figure 49: GMP Generation Service Rates Compared to Regional Average, Muddling Along Scenario and High Carbon Sensitivity

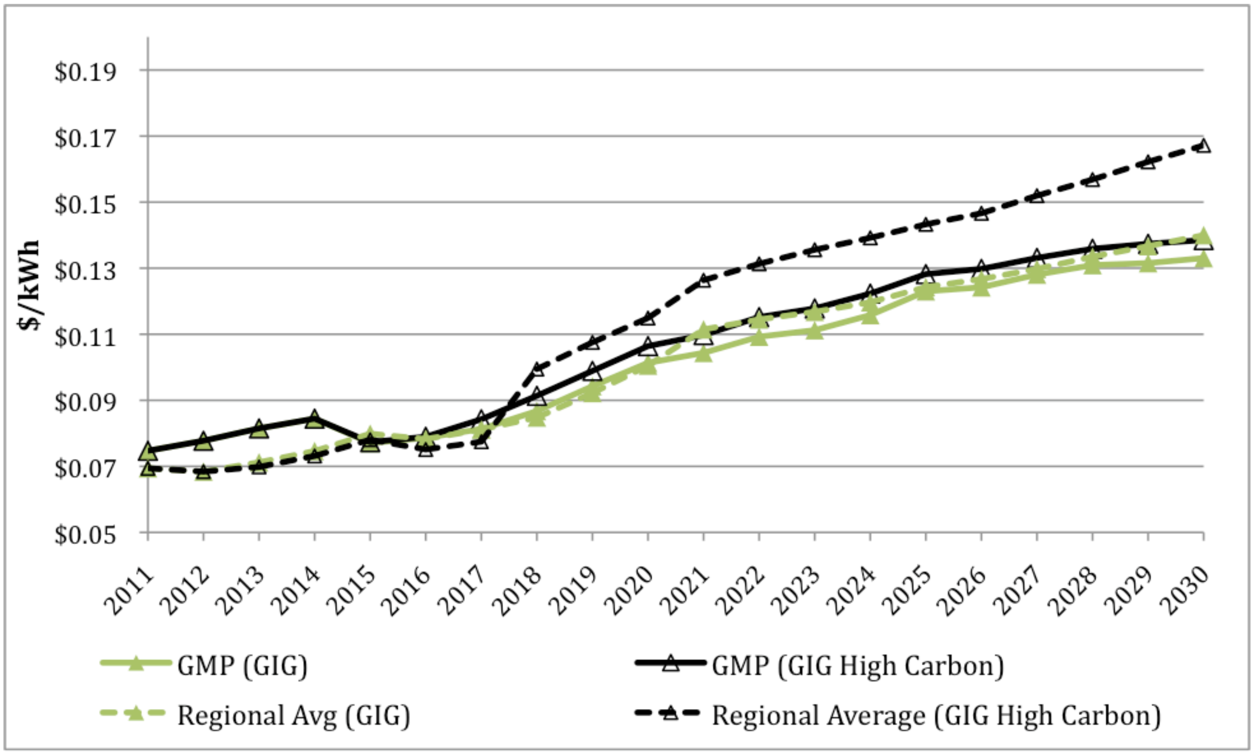

Figure 50: GMP Generation Service Rates Compared to Regional Average, Gas is Greener Scenario and High Carbon Sensitivity

Stress Testing

The second additional type of analysis that we performed was Stress Testing. Stress testing focuses more directly on GMP's portfolio and how it performs under one or two hypothesized shocks. In this analysis the shocks that were tested were chosen based on their perceived impact on GMP's power costs. The two stress cases that were tested involve a low market price environment and lower GMP load due to the loss of a large customer.

Gas is Greener with Low GMP load

The first stress case was based on the Gas is Greener scenario which features low gas and therefore low electric prices. The preferred portfolio was tested assuming significantly lower GMP load due to the loss of a large customer. The unexpected reduction in load results in GMP having a higher percentage of their load met through long term agreements and less open to market prices.

Gas is Greener with Low GMP Load and Extreme Low Prices

This stress test builds on the previous stress test and adds the dynamic of extremely low gas, and therefore electric prices. The lower load results in GMP's portfolio being hedged to a higher degree and therefore not able to benefit in the reduction in market prices. This case was constructed to test this situation.

Robustness Testing

The final type of analysis that was performed on the preferred portfolio was robustness testing. Robustness testing is designed to test how GMP's portfolio responds to changes in the resource composition. In this analysis we tested two cases; one where GMP acquired a share of a Vermont sited combined cycle unit and the other where Vermont Yankee was assumed to be relicensed. The combined cycle case was constructed on the Gas is Greener scenario with the inclusion of an 80 MW share of a joint owned combined cycle unit that begins operation in 2018. The second robustness case involved the continued operation of Vermont Yankee. It did not involve any changes in the resource composition of the preferred portfolio. Rather, this case tested the effect of the Revenue Sharing Agreement on GMP's power costs.

Key Findings and On-going Portfolio Management

This subsection describes several key findings with respect to GMP's emerging power supply portfolio and future needs.

- GMP has pursued essentially all of the priority supply resources identified in the 2007 IRP as ones for which GMP could have unique leverage or opportunities. These resources include PPAs from Hydro-Quebec or other import opportunities; PPAs from Vermont Yankee and other nuclear owners; new renewable generation (via PPAs and GMP ownership); natural gas combined cycle participation; and in-state generating capacity.
- Through an extraordinary period of resource acquisition, GMP has acquired and proposed substantial new power supply sources that will fundamentally transform our long-term power supply portfolio in favorable ways. GMP's future portfolio will maintain many of the strengths of its past portfolio (including a low emission profile and relatively stable electric rates), while reflecting Vermont preferences and our own Energy Plan in multiple ways (for example, greater diversity of sources, a ramp-down of reliance on nuclear sources, a substantial increase in power supply from new renewable power sources, and a somewhat greater portion of the portfolio that is responsive to market prices.
- GMP's recently completed NextEra Seabrook PPA addresses one of the key resource needs identified in this IRP analysis: a new long-term, low-emission purchase that takes advantage of the large decline in market prices that has occurred in recent years, and delivers both baseload power and stable-priced capacity. Together, the relatively stable-priced elements of GMP's portfolio will position GMP well against the factors (e.g., natural gas price increases, a national program to "cap" or tax greenhouse gas emissions, attrition of existing power plants in the region) that could drive future electricity prices meaningfully higher.
- GMP's committed and planned long-term resources (including the proposed NextEra PPA) are fairly well balanced with our customers' projected future load requirements. This balance includes a meaningful portion of our portfolio and costs that is not committed to stable-priced long-term resources. This "open" portion of the portfolio, for which our cost of power will be affected by future electricity market price trends, is beneficial because it helps to ensure that GMP customers will benefit in the event that future market prices turn out meaningfully lower than today's projections. The "open" portion of the portfolio also provides flexibility for GMP to adjust to future events (e.g., lower than expected customer load requirements, due to additional energy efficiency savings or other reasons) that could reduce GMP's future power needs.
- Looking forward, in order to maintain the flexibility discussed above, GMP would not expect to make new large, long-term commitments to stable-priced energy sources in the near future. It is likely that our future purchases will increasingly be made on an opportunistic basis (for example, when market conditions or particular transaction opportunities appear especially attractive) and would typically feature terms of 10 years or less.

- The projections of GMP's future generation costs per kWh indicate that GMP can achieve a cost structure that is competitive with other utilities in the region (and potentially meaningfully lower in the long-term), while also being much more stable. GMP expects to monitor these metrics further in the future.
- An important determinant of GMP's future power costs and retail rate path will be the evolution of Vermont's renewable energy policy and requirements. Because most new renewable resources presently are significantly more costly than non-renewable market options and are projected to remain so for some time, key questions here include how much of the power supply should be obtained from new renewable sources, how rapidly, and what types of sources are preferred. In addition, one of the most important renewable policy choices for Vermont will be whether Vermont utilities should continue to sell the RECs associated with their new renewable sources (as they do today under the SPEED program) or retire the RECs and claim the key attributes of the renewable power (such as the renewable, low air emission profile) as part of Vermont's power supply. This choice, which can be addressed in many forms and specific degrees, will be one of the topics addressed in a PSB proceeding in summer 2011. GMP's IRP scenario analysis indicates that the tradeoffs between these policy choices could be substantial, in terms of GMP's retail rates and the characteristics (for example, air emission profile, fuel mix) that GMP is able to claim for its supply portfolio. In particular, as the fraction of new renewable supplies held by GMP increases, whether RECs are sold or not could meaningfully affect the regional competitiveness of GMP's retail rates, along with the attributes (particularly air emission profile and fuel mix) that GMP can claim are associated with its power portfolio.
- GMP's portfolio has a significant remaining need for firm capacity, to complement the renewable and intermittent sources which GMP has recently acquired and to manage GMP's exposure to future increases in ISO-NE FCM prices. GMP's customers have benefitted greatly as GMP has been a net purchaser in the FCM in recent years – a period of regional capacity surplus and low clearing prices. Looking forward, we expect that management of our position in the FCM (through bilateral purchases, in-state capacity, or other means) will be an increasing focus of GMP's planning activities.
- GMP's current plans would enable the company to achieve about a 20 percent reliance on new renewable sources within the next several years, in as cost-effective a manner as possible. This is a substantial achievement, and is consistent with our own energy plan and with Vermont preferences. This level of new renewable does, however, exceed the levels that are required by RPS programs in most neighboring states. Because most new renewable sources are much more costly than wholesale market prices in the near term, GMP's plans to acquire new renewable sources will need to increasingly monitor the competitiveness of GMP's retail rates, and the degree of portfolio flexibility as discussed above.

- GMP expects to facilitate additional smaller-scale local renewables. This represents a combination of community-scale generation projects (owned by GMP, or independently owned with output sold to GMP under PPAs), and customer-scale generation (which would likely participate in the net metering program). While small-scale renewable generation is, at present, typically much more costly on a long-term basis than utility-scale renewable sources, it has the potential to bring some unique local benefits (for example, local economic development, diversity of supply sources, and support of the local delivery system). We assume, for illustration, that much of this development will be solar photovoltaic, since this has been the primary small-scale renewable technology developed in GMP's territory in recent years. In addition, the technology's cost and performance characteristics are projected to continue to improve over time. In the near future GMP plans to develop a small-scale generation strategy to help facilitate customer-funded development of local renewable sources, and where possible to limit the cost of such sources.

Finally, GMP will need to refine and reconfigure its preferred plan over time as appropriate, based on insights gained from these steps and from the "signpost" observations (regarding electricity supply, demand, market factors, and regulation) that indicate the type of future that is actually unfolding in the coming years.

9. Action Plan

This Action Plan presents an illustrative timeline of how the leading conclusions and actions identified in this IRP can be implemented. Of course, this outlook reflects GMP's internal assessment at a specific point in time, and future changes in key inputs like market conditions, customer demand, and industry regulation could alter this outlook.

Timeline for Implementing Major GMP Initiatives

Table 20 presents the timeline for implementing these activities.

Date	Initiative	Activity
2013	GMPConnects	Advanced meters, new customer information system, meter data management system, and service-oriented architecture IT backbone are fully implemented.
2013 and Ongoing	GMPConnects	Make at least one time-differentiated retail rate available to customers on a voluntary basis. Roll-out additional dynamic rates with increasing variability in succeeding years.
2013 and ongoing	GMPConnects	Implementation of GMP subtransmission and distribution systems automation controls and monitoring program.
2011 to 2012	Generation	Focus on strong **execution of the KCW project**, to achieve commercial on budget and on time (that is, by late 2012).
2011 forward	Generation	**Request permits for Gorge GT Replacement**: Monitor ISO-New England market conditions, and the extent to which repowering the Gorge plant would provide bulk transmission deferral benefits.
2011	Generation	Actively participate in the PSB's progress report in assessing the SPEED goals, and determining the appropriateness of establishing a more formal RPS in Vermont.
2011 to 2012	Generation	Develop a micro-renewable strategy, to facilitate customer-funded development of local renewable sources and to limit the cost of such sources.
2012	Generation	Complete the planned upgrade of GMP's Gorge hydro plant.
2014 to 2015	Generation	**Construct Gorge GT Replacement project** if economically viable (see above).
Ongoing	Generation	Study potential upgrades to GMP-owned hydro facilities; implement projects that are cost-effective and/or required for safety or reliability reasons.

Date	Initiative	Activity
2011	Power Purchases	**Develop and sign a new long-term, low-emission PPA** with a regional producer. Note: in recent weeks, GMP accomplished this goal by signing a new long-term PPA with NextEra Seabrook, LLC.
2011	Power Purchases	Obtain a Certificate of Public Good for the proposed NextEra Seabrook PPA by the end of December 2012.
Ongoing	Power Purchases	Manage GMP's future position in the Forward Capacity Market (FCM). Monitor the ISO-New England capacity market structure, including the emerging zonal component. Seek reasonably-priced, bilateral capacity purchases as appropriate, to reduce GMP's exposure to fluctuations in FCA clearing price results.
2013 to 2015	Power Purchases	Arrange future short- to medium-term market purchases, as needed. The appropriate types, amounts, and timing of purchases will depend on market conditions, GMP load trends, and status of GMP's proposed supply sources.

Table 20: Implementation Timeline

A: 2012 Budget Forecast

Forecast Summary

Itron, Inc. recently completed the 2012 budget-year forecast for Green Mountain Power (GMP). The forecast is based on actual sales through March 2011 and Moody's Economy.com's March 2011 Vermont economic outlook. The forecast uses an end-use modeling approach, incorporating end-use and efficiency trends that reflect new federal appliance standards as well as the impact of Efficiency Vermont statewide and direct company funded efficiency programs.

Table 21 summarizes the 2012 Budget forecast. The forecast is on a fiscal-year basis with the fiscal-year running from October to September. Fiscal year 2011 thus includes six months of actual sales (October 2010 through March 2011) and six months of forecasted sales (April 2011 – September 2011).

Year	Residential	Chg	Commercial	Chg	Transmission Class	Chg	St Lighting & PA	Chg	Total	Chg
2002	546.2		872.5		502.5		5.0		1,926.2	
2003	583.0	6.7%	883.1	1.2%	469.0	-6.7%	4.5	-9.0%	1,939.6	0.7%
2004	591.9	1.5%	902.7	2.2%	470.7	0.4%	4.4	-4.1%	1,969.7	1.6%
2005	596.2	0.7%	924.2	2.4%	475.9	1.1%	4.4	0.6%	2,000.7	1.6%
2006	586.5	-1.6%	923.9	0.0%	456.5	-4.1%	4.1	-5.7%	1,971.1	-1.5%
2007	579.1	-1.3%	914.4	-1.0%	450.1	-1.4%	4.4	6.1%	1,948.0	-1.2%
2008	578.4	-0.1%	940.0	2.8%	454.2	0.9%	4.4	0.2%	1,977.0	1.5%
2009	573.4	-0.9%	897.3	-4.5%	414.9	-8.7%	4.4	0.0%	1,890.1	-4.4%
2010	573.1	-0.1%	897.5	0.0%	429.9	3.6%	4.5	1.4%	1,904.9	0.8%
2011	582.0	1.6%	901.7	0.5%	426.8	-0.7%	5.1	15.0%	1,915.7	0.6%
2012	582.8	0.1%	915.3	1.5%	418.7	-1.9%	5.8	13.0%	1,922.7	0.4%
2013	583.0	0.0%	920.7	0.6%	412.5	-1.5%	5.8	0.0%	1,922.0	0.0%
2014	583.6	0.1%	929.8	1.0%	406.3	-1.5%	5.8	0.0%	1,925.5	0.2%
2015	585.6	0.3%	936.0	0.7%	400.2	-1.5%	5.8	0.0%	1,927.6	0.1%
Chg										
02-10		0.6%		0.4%		-1.9%		-1.3%		-0.1%
10-15		0.4%		0.8%		-1.4%		5.6%		0.2%

Table 21: 2012 Budget-Year Sales Forecast (GWh)

We expect fiscal year 2011sales to reach 1,915.7 GWh (up 0.6%) and fiscal year 2012 sales to be 1,922.7 GWh (up 0.4%) in. The increase in 2012 sales is largely attributable to expected growth in the commercial sector, reflecting Economy.com's relatively strong economic recovery projection. After 2012, sales increase due to customer and economic growth, but gains are largely mitigated by strong GMP and statewide efficiency programs, new residential lighting standards, and expected declining energy requirements from GMP's largest transmission customer.

Residential Sales

Table 22 shows the residential sales and customer forecast. The forecast is the aggregated result of the non-electric heat (NEH), electric heat (EH), and water heat (WtHt) revenue class forecasts. The revenue class forecasts are derived by multiplying the average use and customer forecasts.

Year	GWh	Chg	Customers	Chg	Avg kWh	Chg
2002	546.2		73,693		7,411	
2003	583.0	6.7%	74,563	1.2%	7,819	5.5%
2004	591.9	1.5%	75,297	1.0%	7,861	0.5%
2005	596.2	0.7%	76,212	1.2%	7,823	-0.5%
2006	586.5	-1.6%	77,912	2.2%	7,527	-3.8%
2007	579.1	-1.3%	78,980	1.4%	7,332	-2.6%
2008	578.4	-0.1%	79,579	0.8%	7,269	-0.9%
2009	573.4	-0.9%	80,051	0.6%	7,163	-1.4%
2010	573.1	-0.1%	80,411	0.4%	7,127	-0.5%
2011	582.0	1.6%	80,899	0.6%	7,194	0.9%
2012	582.8	0.1%	81,808	1.1%	7,124	-1.0%
2013	583.0	0.0%	82,732	1.1%	7,047	-1.1%
2014	583.6	0.1%	83,608	1.1%	6,980	-1.0%
2015	585.6	0.3%	84,465	1.0%	6,933	-0.7%
Chg						
02-10		0.6%		1.1%		-0.5%
10-15		0.4%		1.0%		-0.5%

Table 22: Fiscal-Year Residential Sales and Customer Forecast

Despite the deteriorating economy, GMP has continued to add customers. Average use, however, has been declining faster than customer growth, resulting in declining residential sales. The long-term decline in average use is largely attributed to declines in electric heating as well as strong GMP and statewide residential efficiency programs. This trend is expected to continue through the forecast period with declining average use mitigating increases in customer growth, resulting in virtually no residential sales growth. Projected fiscal-year 2012 sales are 582.8 GWh with little change over expected year-end 2011 sales.

CIS Sales

CIS includes small general service customers (GS) and medium to large commercial and industrial customers on the time-of-use rate (TOU). CIS accounts for over one-third of GMP retail sales. The GS class forecast is derived using separate customer and average use models; the forecast is then calculated as a product of the two components. TOU sales forecast is based on a total monthly sales model. Table 23 shows the CIS sales and customer forecasts.

Year	GWh	Chg	Customers	Chg	Avg kWh	Chg
2002	720.0		13,218		54,468	
2003	718.7	-0.2%	13,376	1.2%	53,733	-1.3%
2004	717.4	-0.2%	13,461	0.6%	53,296	-0.8%
2005	725.0	1.1%	13,696	1.7%	52,933	-0.7%
2006	709.6	-2.1%	13,951	1.9%	50,866	-3.9%
2007	704.6	-0.7%	14,182	1.7%	49,688	-2.3%
2008	713.7	1.3%	14,378	1.4%	49,639	-0.1%
2009	694.3	-2.7%	14,483	0.7%	47,941	-3.4%
2010	691.3	-0.4%	14,538	0.4%	47,552	-0.8%
2011	697.0	0.8%	14,619	0.6%	47,678	0.3%
2012	705.5	1.2%	14,806	1.3%	47,649	-0.1%
2013	711.7	0.9%	15,012	1.4%	47,408	-0.5%
2014	719.4	1.1%	15,220	1.4%	47,263	-0.3%
2015	725.1	0.8%	15,418	1.3%	47,030	-0.5%
Chg						
02-10		-0.5%		1.2%		-1.7%
10-15		1.0%		1.2%		-0.2%

Table 23: Fiscal-Year CIS Sales and Customer Forecast

Commercial sector sales have slowly been recovering form the long recession. Sales are projected to show relatively strong growth beginning in the second-half of 2011 through 2012 reflecting Economy.com's strong near-term economic growth projections. Forecasted CIS sales for 2012 are 705.5 GWh (up 1.2%).

General Service

The General Service customer class accounts for the majority of GMP's commercial customer base. These are primarily small commercial customers with average use less than 14,000 kWh per year. Table 24 summarizes the annual GS sales and customer forecast.

Year	GWh	Chg	Customers	Chg	Avg kWh	Chg
2002	174.2		11,619		14,992	
2003	173.2	-0.6%	11,701	0.7%	14,802	-1.3%
2004	179.3	3.5%	11,865	1.4%	15,115	2.1%
2005	184.6	2.9%	12,115	2.1%	15,235	0.8%
2006	181.4	-1.7%	12,344	1.9%	14,698	-3.5%
2007	178.5	-1.6%	12,541	1.6%	14,232	-3.2%
2008	176.4	-1.2%	12,706	1.3%	13,880	-2.5%
2009	171.3	-2.8%	12,815	0.9%	13,371	-3.7%
2010	171.9	0.3%	12,896	0.6%	13,333	-0.3%
2011	173.5	0.9%	12,970	0.6%	13,376	0.3%
2012	174.3	0.5%	13,150	1.4%	13,252	-0.9%
2013	175.5	0.7%	13,335	1.4%	13,164	-0.7%
2014	176.7	0.7%	13,510	1.3%	13,080	-0.6%
2015	177.8	0.6%	13,681	1.3%	12,998	-0.6%
Chg						
02-10		-0.1%		1.3%		-1.4%
10-15		0.7%		1.2%		-0.5%

Table 24: General Services Sales and Customer Forecast

As with residential sector, GMP continued to add small commercial customers through the recession. Average use however, has declined significantly, resulting in a fiscal-year sales decline of 2.8% in 2009 before a slight recovery in 2010. We have seen this trend since 1995 – strong customer growth coupled with strong declining average use. While efficiency programs and declining business activity explain some of this drop, we believe the GS sales trend also reflects a changing customer mix – GMP is adding more business customers, but these customers are much smaller in terms of energy use.

Time-Of-Use (TOU)

TOU customer's average over 300,000 kWh per year usage; these customers account for over 75% of CIS sales. TOU sales fell sharply in fiscal-year 2009 in line with the economy and fell again in fiscal-year 2010. Sales are expected to recover in 2011 and show positive growth of 1.5% in fiscal-year 2012. Table 25 summarizes the TOU sales and customer forecasts.

Year	GWh	Chg	Customers	Chg	Avg kWh	Chg
2002	545.8		1,599		341,271	
2003	545.5	0.0%	1,675	4.7%	325,702	-4.6%
2004	538.1	-1.4%	1,596	-4.7%	337,074	3.5%
2005	540.4	0.4%	1,581	-1.0%	341,856	1.4%
2006	528.2	-2.3%	1,607	1.6%	328,774	-3.8%
2007	526.2	-0.4%	1,641	2.1%	320,658	-2.5%
2008	537.3	2.1%	1,672	1.9%	321,411	0.2%
2009	523.0	-2.7%	1,669	-0.2%	313,446	-2.5%
2010	519.4	-0.7%	1,642	-1.6%	316,234	0.9%
2011	523.5	0.8%	1,648	0.4%	317,580	0.4%
2012	531.2	1.5%	1,656	0.5%	320,765	1.0%
2013	536.1	0.9%	1,677	1.2%	319,749	-0.3%
2014	542.7	1.2%	1,711	2.0%	317,199	-0.8%
2015	547.3	0.8%	1,737	1.5%	315,075	-0.7%
Chg						
02-10		-0.6%		0.4%		-0.9%
10-15		1.1%		1.1%		-0.1%

Table 25: TOU Sales and Customer Forecast

Large Commercial and Industrial Sales

The large commercial and industrial revenue class (CIL) includes GMP's 29 largest accounts, excluding Transmission Class and Station Service loads. Table 26 presents the CIL sales forecast. Historically, GMP has experienced relatively strong CIL sales growth. Sales however crashed in 2009 due to the recession and the loss of one of GMP's largest customers, before recovering some ground in 2010. Sales have been strongly correlated with state level GDP. Given GDP projections, we expect to see positive sales growth for these customers for fiscal-years 2011 and 2012, but off of a much lower base.

Year	GWh	Chg
2002	152.0	
2003	163.5	7.5%
2004	179.7	9.9%
2005	195.8	9.0%
2006	209.7	7.1%
2007	204.0	-2.7%
2008	223.7	9.6%
2009	197.9	-11.5%
2010	204.1	3.1%
2011	204.2	0.1%
2012	207.4	1.5%
2013	209.0	0.8%
2014	210.4	0.7%
2015	210.9	0.2%
Chg		
02-10		4.0%
10-15		0.7%

Table 26: CIL Sales Forecast (MWh)

Transmission Class, Station Service, and Street Lighting

The transmission class accounts for approximately 23% of GMP's electricity sales; the forecast is based on expected business activity provided by the customer. Transmission Class sales are expected to decline 0.7% in 2011 and a further 1.9% in 2012. Sales are expected to decline at a 1.5% annual rate after 2012.

Station Service electric requirements are largely driven by the Vermont Yankee refueling schedule. Small amounts of energy for Station Service "spike" during the refueling periods. The next refueling is expected in October 2011.

Street lighting energy use has been effectively flat for the last five years. Street lighting sales are forecasted with a simple trend model. Street lighting sales are projected to remain flat over the long-term.

Forecast Assumptions

The 2012 sales forecast is based on Moody's Economy.com's March 2011 economic outlook for Vermont. Price projections are provided by GMP. The forecast also incorporates the Energy Information Administration's (EIA) long-term saturation and efficiency trends for the New England Census Division. Residential end-use saturations are modified to better reflect the GMP service area based on a recent state-wide appliance saturation survey, as well as saturation survey work conducted by Burlington Electric. End-use efficiency projections are adjusted upwards to capture state-wide and utility-specific efficiency program activity.

Economic Projections

Moody's Economy.com projects strong near-term economic growth with 2012 Vermont real GDP growth of 3.9% and real personal income growth of 3.1%. The economy continues to show strong economic growth through 2013 before settling down into long-term real output growth of roughly 2.0% per year

Residential Economic Drivers

The state household projection drives the GMP residential customer forecast, and real income (on a per household basis) is a key economic variable in the residential average use models.

The number of households increased 0.4% in 2010 and is expected to show another 0.4% gain in 2011. Household growth accelerates with annual household growth reaching 0.7% by 2012; this is stronger growth than in any of the last ten years. Economy.com also projects relatively strong real income growth with real income growth of 3.1% in 2011 and 2012 and reaching 4.3% growth by 2013.

Table 27 shows Economy.com's household and income projections.

Year	Households (thousands)	Chg	Real Personal Income (mil $)	Chg	Income per Household (thousands of $)	Chg
2002	243.1		19,906		81.9	
2003	243.8	0.3%	20,216	1.6%	82.9	1.3%
2004	244.4	0.3%	20,837	3.1%	85.3	2.8%
2005	244.8	0.1%	20,695	-0.7%	84.6	-0.8%
2006	245.1	0.1%	21,744	5.1%	88.7	4.9%
2007	245.4	0.1%	22,341	2.7%	91.1	2.7%
2008	245.6	0.1%	22,345	0.0%	91.0	-0.1%
2009	246.0	0.2%	22,204	-0.6%	90.3	-0.8%
2010	246.9	0.4%	22,605	1.8%	91.6	1.4%
2011	248.0	0.4%	23,303	3.1%	94.0	2.6%
2012	249.7	0.7%	24,031	3.1%	96.2	2.4%
2013	251.4	0.7%	25,056	4.3%	99.7	3.6%
2014	253.1	0.7%	25,656	2.4%	101.4	1.7%
2015	254.8	0.7%	26,161	2.0%	102.7	1.3%
Chg						
02-10		0.2%		1.6%		1.4%
10-15		0.6%		3.0%		2.3%

Table 27: Residential Economic Drivers

Commercial Economic Drivers

Gross State Product (GSP) and employment are used to drive commercial sales forecast. Total GSP is used in the commercial TOU and CIL forecast models, while non-manufacturing output is used in estimating the general service average use model. Economy.com projects strong 2011 and 2012 output growth.

As Table 28 shows, Economy.com projects relatively robust economic activity with real GSP growth of 3.9% in 2012 and 3.5% in 2013. As employment growth generally lags output growth, the full impact on employment is not seen until 2014. Employment increases 1.2% in 2012 and ramps up to 2.2% annual growth by 2014.

Year	Total Output	Chg	Non-Manufactuiring Output	Chg
2002	20,989		18,149	
2003	21,618	3.0%	18,909	4.2%
2004	22,470	3.9%	19,731	4.3%
2005	22,772	1.3%	20,029	1.5%
2006	23,041	1.2%	20,329	1.5%
2007	23,069	0.1%	20,382	0.3%
2008	23,533	2.0%	20,848	2.3%
2009	23,364	-0.7%	20,914	0.3%
2010	24,410	4.5%	21,882	4.6%
2011	25,160	3.1%	22,549	3.0%
2012	26,131	3.9%	23,431	3.9%
2013	27,058	3.5%	24,288	3.7%
2014	27,796	2.7%	24,987	2.9%
2015	28,334	1.9%	25,507	2.1%
Chg				
02-10		1.9%		2.4%
10-15		3.0%		3.1%

Table 28: State Output (Million $)

Table 29 summarizes state employment projections.

Year	Total Employment	Chg	Non-Manufactuiring Employment	Chg
2002	300		259	
2003	299	-0.1%	262	1.2%
2004	303	1.3%	266	1.5%
2005	306	0.8%	269	1.1%
2006	308	0.8%	272	1.1%
2007	308	0.2%	272	0.0%
2008	307	-0.4%	272	0.0%
2009	297	-3.3%	266	-2.2%
2010	297	0.1%	267	0.4%
2011	300	0.7%	268	0.4%
2012	303	1.2%	272	1.5%
2013	308	1.7%	277	1.8%
2014	315	2.2%	283	2.2%
2015	319	1.2%	287	1.4%
Chg				
02-10		-0.1%		0.4%
10-15		1.4%		1.5%

Table 29: State Employment Projections (Thousands)

Price Projections

Electric price projections are also incorporated into the constructed average use model variables in the residential and general service models and in the total sales model variables in the TOU and CIL commercial customer class models. The price series is calculated as a 12-month rolling average of the real monthly average rate. We assume that the response to a rate-increase is not immediate, but rather, customers respond over the year as energy costs change. The price series is deflated using the Consumer Price Index for Vermont. GMP provides expected price increases. These increases are translated into real price and applied to starting actual real prices.

Figure 51shows the residential (NEH, WtHt, and EH) price and nonresidential (GS and TOU) price projections.

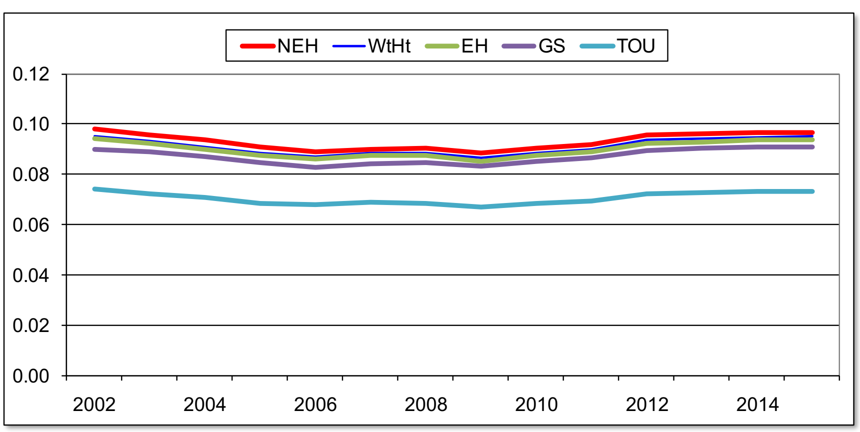

Figure 51: Non-Electric Heat Price Forecast ($/kWh)

GMP expects real price increases of 1.5% in 2011 and 3.8% in 2012. Real prices increase less than 1% in 2013 and 2014.

End-Use Saturation and Efficiency Trends

Residential Sector

Over the long-term, changes in end-use saturation and efficiency trends will have a significant impact on electricity sales. Residential and commercial end-use saturation and efficiency trends are explicitly incorporated into the forecast models. Initial end-use saturation and efficiency projections are based on the Energy Information Administration's (EIA) *2010 Annual Energy Outlook* (AEO 2010) for the New England Census Division. End-use efficiency trends reflect the impact of new end-use efficiency standards and tax credits resulting from the Energy Independence and Security Act (EISA) passed in 2007 and the American Recovery and Reinvestment Act (ARRA) passed last year.

Residential end-use saturation trends are modified to better reflect Vermont end-use saturation levels and ownership trends. End-use saturations are calibrated into a recent state-wide appliance saturation survey conducted by KEMA for the Vermont Department of Public Service. Saturation trends are further adjusted (particularly air conditioning saturation trends) based on saturation projections provided by Burlington Electric Department (BED).

Vermont has experienced relatively strong growth in room air conditioning saturation. The increase in ownership outweighs efficiency gains, resulting in increasing per household air conditioning load. Heating intensities include resistant electric heat, secondary electric heat (such as portable room heaters), and furnace fans. Electric heating use is projected to decline with improvement in furnace fan efficiency and decline in share of homes with electric resistance heat.

Figure 52 shows residential cooling and heating end-use index projections.

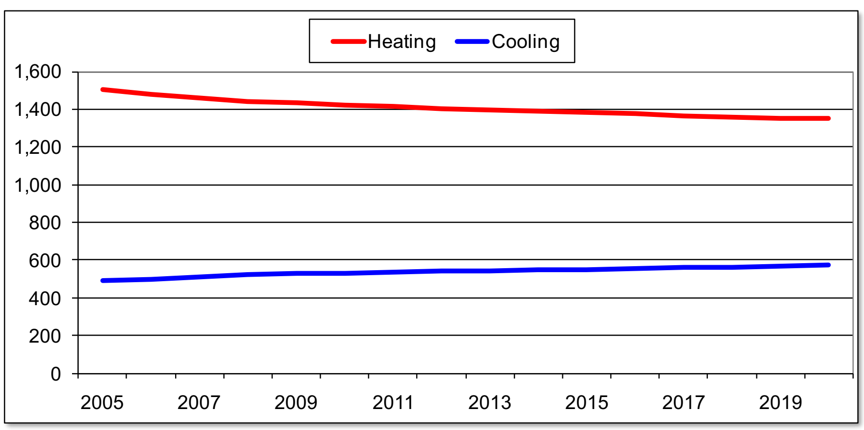

Figure 52: Cooling and Heating Index Projections (kWh per Household)

For the other appliances, saturations are similar to that of New England. Non-weather sensitive usage has been declining over the last five years partly as a result of strong GMP and State efficiency program activity. This trend is expected to continue through the forecast period. The efficiency trends reflect the impact of new standards, natural occurring efficiency gains, and the impact of future efficiency programs. Expected impacts of future efficiency programs mitigate positive growth from television, electronics and other miscellaneous usage.

Figure 53 shows projected annual energy intensity for all other uses.

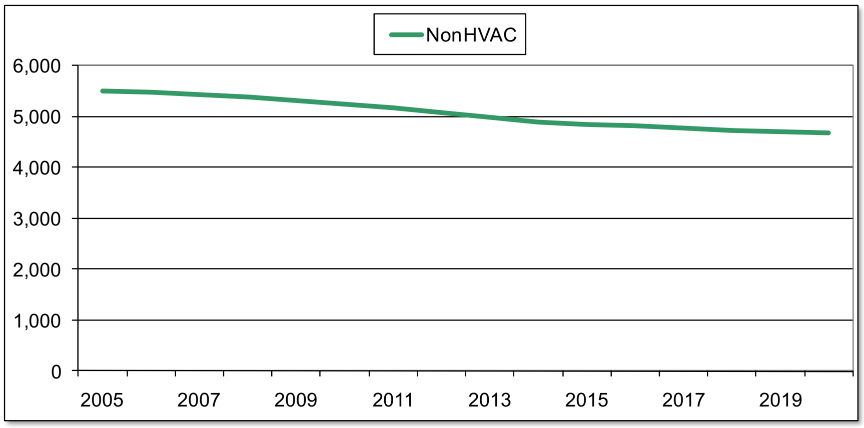

Figure 53: Other Use Intensity Projection (kWh per Household)

Commercial Sector

End-use intensity projections are also incorporated into the non-residential models. The commercial indices are based on the EIA's *2010 Annual Energy Outlook* for the New England Census Division. Overall, EIA projects commercial energy intensity (measured in kWh per square feet) to average 0.2% growth over the next ten years. When adjusted for future efficiency program impacts, average intensity declines 0.6% per year. Figure 54 and Figure 55 show the adjusted commercial end-use energy intensity projections.

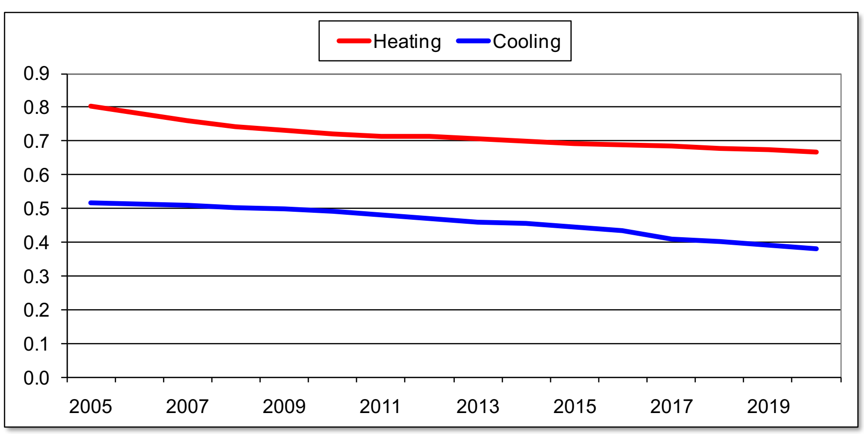

Figure 54: Commercial Cooling and Heating Intensity Trends (kWh/sq ft)

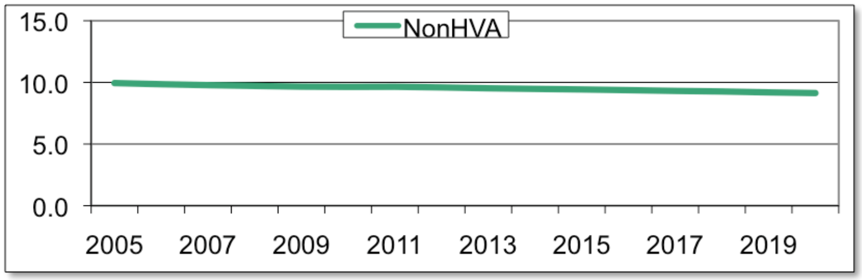

Figure 55: Commercial Non-HVAC Intensity Trends (kWh/sq ft)

End-Use Efficiency Adjustments

Over the last five years, Efficiency Vermont has had a significant impact on electricity sales through aggressive state-wide energy efficiency programs and additional efficiency programs funded directly by GMP. Actual sales reflect the impact of these programs with residential and CIS average use down 1.6% over the last five years. The estimated forecast models capture the downward usage trend and, as a result, account for a significant share of energy savings due to this program activity. Further, the models' specifications explicitly capture changes in end-use efficiency trends. The end-use efficiency trends are driven by end-use purchase decisions that are partly influenced by utility and state sponsored efficiency programs.

The end-use efficiency projections are adjusted further to reflect future GMP and state efficiency projections. A new set of efficiency projections were developed working with Efficiency Vermont as part of the VELCO load forecast completed last fall. These efficiency trends were developed by calibrating the end-use efficiency trends into specific end-use savings estimates from the Efficiency Vermont *Forecast 20 Report*. The higher efficiency projections are then used in the constructed model variables that drive the class average use and sales forecasts.

Weather Drivers

Cycle-weighted heating degree-days (HDD) and cooling degree-days (CDD) are calculated from historical daily weather data for the Burlington Airport and historical meter-reading schedules. HDD and CDD are calculated from a base 65 degree average temperature. In general, temperatures have been warming. To capture the warming trend, the forecast is based on 10-year monthly normal degree-days. Figure 56 shows historical and normal heating degree days.

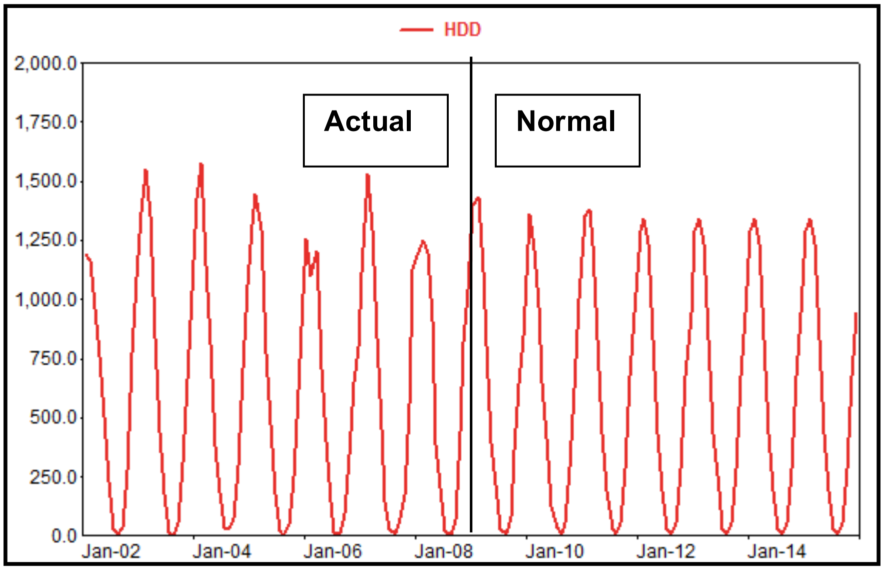

Figure 56: Heating Degree Days

Figure 57 shows historical and normal cooling degree days.

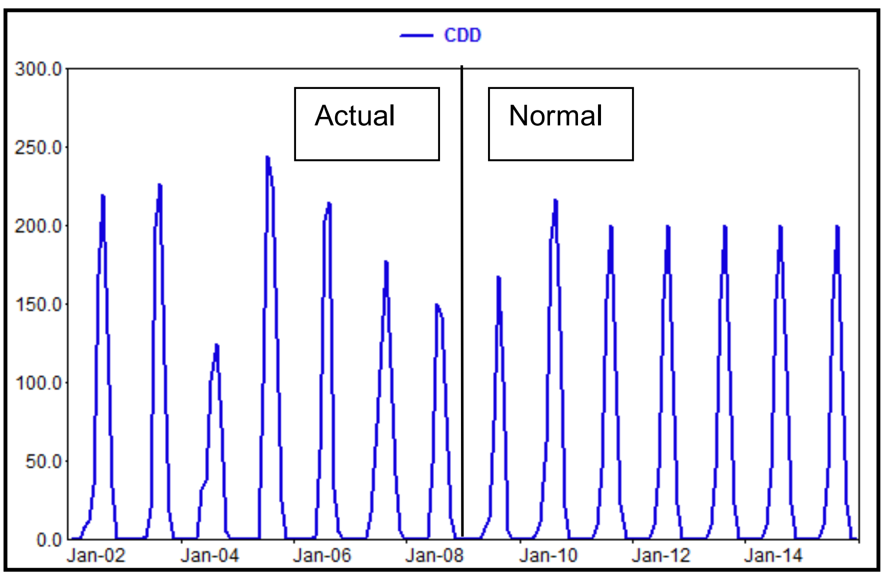

Figure 57: Cooling Degree Days

Methodology

Separate forecast models are estimated for the primary revenue classes. Models are estimated for:

- Residential Non-Electric Heat
- Residential Electric and Water Heat
- General Service
- TOU
- Large CIL
- Street Lighting and Public Authority

Residential, General Service, and TOU models are constructed using a Statistically Adjusted End-Use (SAE) modeling framework. This approach entails constructing generalized end-use variables (Heating, Cooling, and Other Use) that incorporate the long-term end-use saturation and efficiency projections as well as price, economic drivers, and weather. The SAE specification allows us to directly capture the impact of improving end-use efficiency and end-use saturation trends on class sales due to changing market conditions and efficiency program activity.

Estimated models are provided in "Model Statistics and Coefficients" beginning on page 163.

Residential Sector

The residential forecast is generated using separate average use and customer forecast models. The average use model is estimated using an SAE specification where monthly average use is estimated as function of a heating variable (*XHeat*), cooling variable (*XCool*) and other use variable (*XOther*) as shown below:

$$AvgUse_m \times a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m$$

XHeat is calculated as the product of a variable that captures changes in heating end-use saturation and efficiency (HeatIndex), economic, and other factors that impact stock utilization (HDD, household size, household income, and price). *XHeat* is calculated as:

$$XHeat_{y,m} = HeatIndex_y \times HeatUse_{y,m}$$

Where:

$$HeatUse_{y,m} = \left(\frac{HDD_{y,m}}{HDD_{05}}\right) \times \left(\frac{HHSize_y}{HHSize_{05}}\right)^{0.20} \times \left(\frac{Income_y}{Income_{05}}\right)^{0.20} \times \left(\frac{Price_{y,m}}{Price_{05}}\right)^{-0.15}$$

The heat index is a variable that captures heating end-use efficiency and saturation trends, thermal shell improvement trends, and housing square footage trends. The index reflects heating saturation trends in Vermont. The economic and price drivers are incorporated into the *HeatUse* variable. By construction, the $HeatUse_{y,m}$ variable sums close to 1.0 in the base year (2005). This index value changes through time and across months in response to changes in weather conditions, prices, household size, and household income.

The heat index (*HeatIndex*) and heat use variable (*HeatUse*) are combined to generate the monthly heating variable *XHeat*. Figure 58 shows the calculated *XHeat* variable.

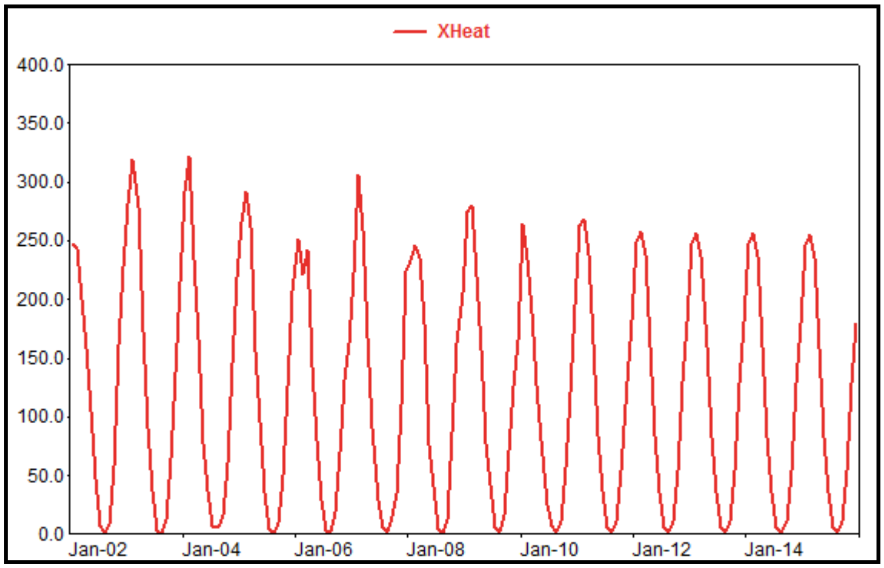

Figure 58: XHeat Variable (kWh per Household)

Similar variables are constructed for cooling (*XCool*) and other end-uses (*XOther*). Figure 59 and Figure 60 show XCool and XOther.

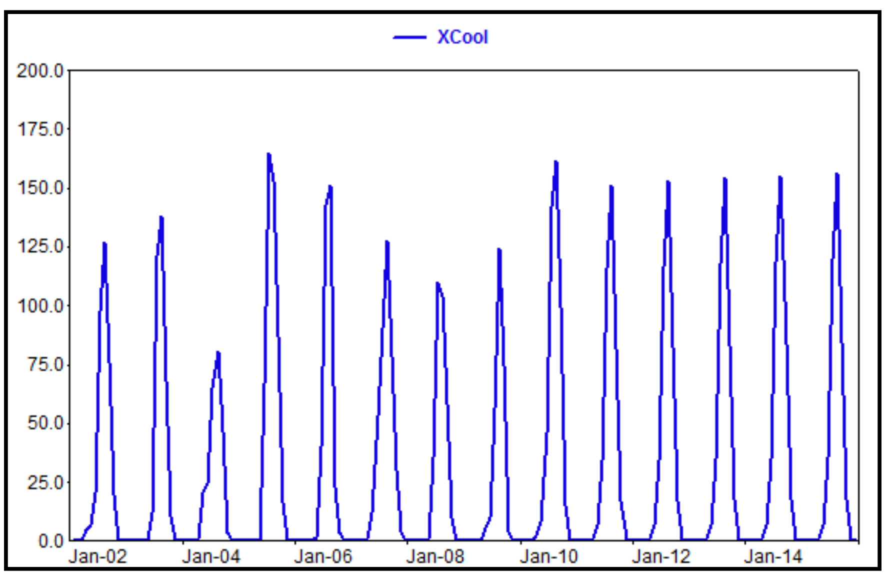

Figure 59: XCool Variable (kWh per Household)

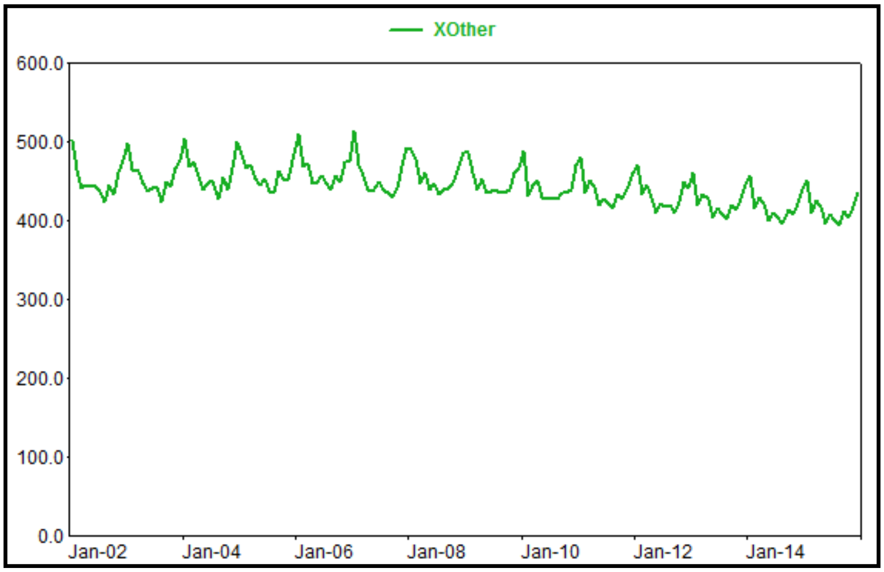

Figure 60: XOther Variable (kWh per Household)

The monthly variation in the XOther variable is a result of the variation in the number of monthly billing days, lighting requirements, and monthly water heater usage.

The end-use variables are used to estimate an average use model for each residential class. Figure 61 shows actual and predicted average use for the NEH revenue class.

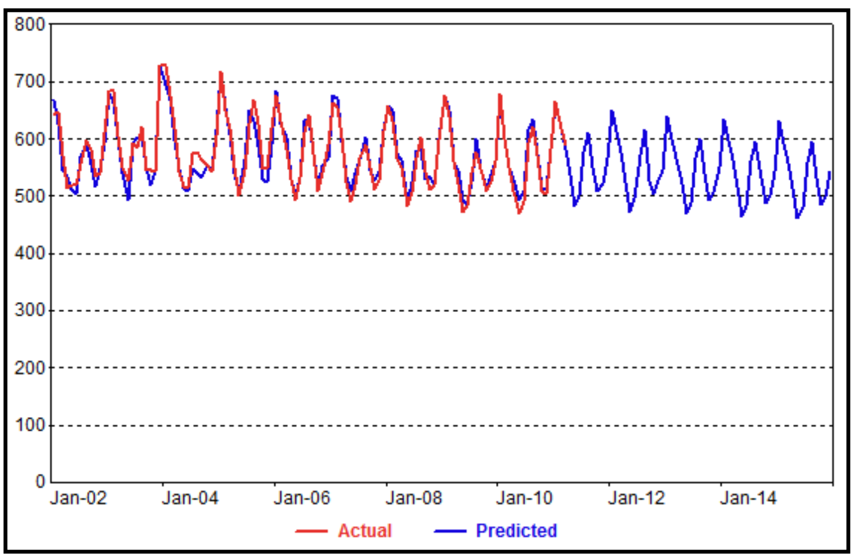

Figure 61: Non-Electric Heat Average Use Model (kWh)

The model explains historical data well. Model is estimated using monthly billed sales data covering the period January 2002 to March 2011. The adjusted R^2 is 0.92 with a MAPE of 2.3%. A similar specification is used for the space and electric water heating revenue classes. The Adjusted R^2 for the water heating model is 0.93 with a MAPE of 2.1% while electric space heating model had Adjusted R^2 of 0.95 and a MAPE of 5.3%.

Over the last ten years, there has been a relatively strong correlation with state households growth and GMP customer growth. Customers are forecasted using a simple regression model that relates customers to number of households. The elasticity with respect to state households is 1.09. This implies that customers in the GMP service area are growing at a slightly faster rate than total state households; a 1% increase in the number of state households translates into a 1.1% increase in the number of new customers. The model Adjusted R^2 is 0.99 with a MAPE of 0.1%. Figure 62 shows actual and predicted customers.

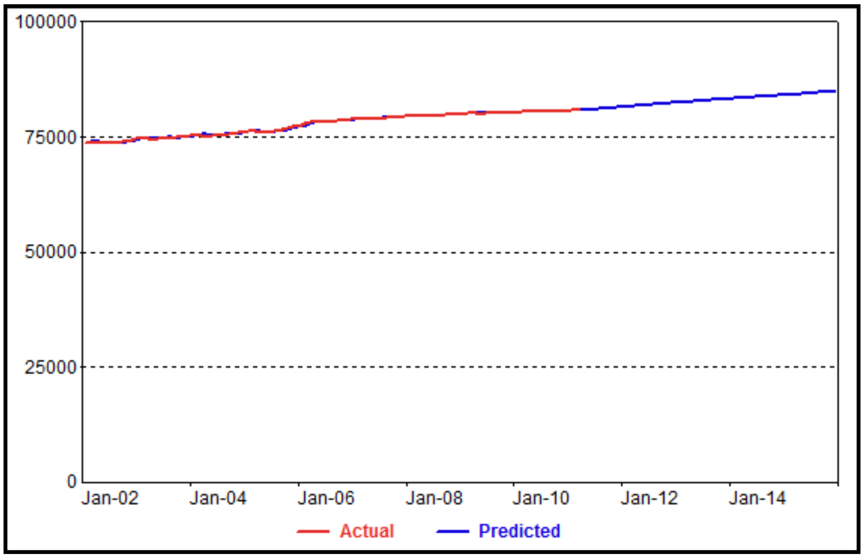

Figure 62: Residential Customer Forecast

Electric heat and water heating customers are forecasted as a share of total customers. The share of homes in the electric heat class is projected to continue to decline while the number of customers in the water heating revenue class is flat. All the customer growth falls with the non-electric heat revenue class.

Customer and average use forecasts are combined to generate monthly billed sales forecast (*Sales = AvgUse * Customers*). Figure 63 shows the monthly residential sales forecast.

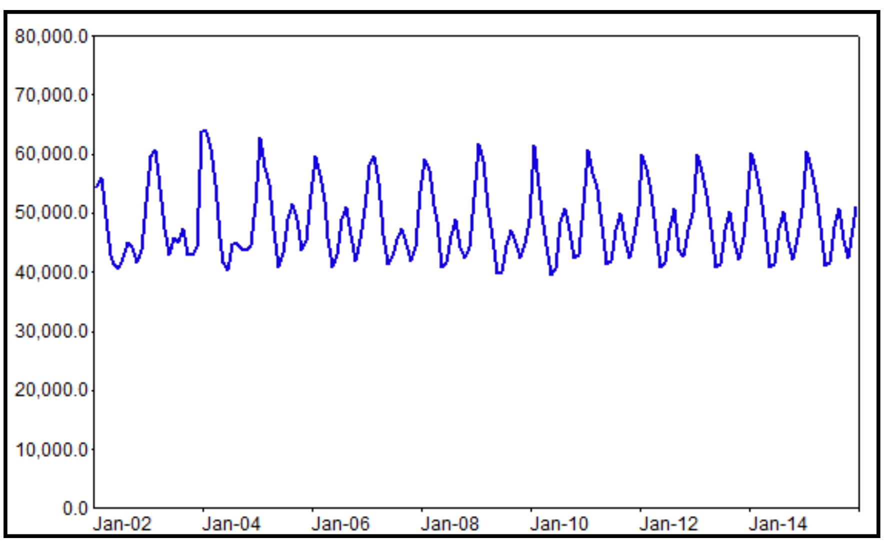

Figure 63: Monthly Residential Sales Forecast (MWh)

Commercial Sector

The commercial sector includes three classifications:

- General Service Customers (GS)
- Time-of-Use Customers (TOU)
- Commercial and Industrial Large (CIL)

Separate monthly sales and customer forecast models are estimated for each class.

General Service

The SAE approach is used to forecast GS and TOU revenue classes. The GS sales are modeled by combining an average use forecast with a customer forecast. As in the residential model, end-use variables XHeat, XCool, and XOther are constructed from end-use saturation and efficiency trends, regional output, price, and weather conditions. XCool for example is defined as:

$$XCool_{y,m} = CoolIndex_y \times CoolUse_{y,m}$$

Where:

$$\text{CoolUse}_{y,m} = \left(\frac{\text{CDD}_{y,m}}{\text{CDD}_{01}}\right) \times \left(\frac{\text{Output}_y}{\text{Output}_{01}}\right)^{0.20} \times \left(\frac{\text{Price}_{y,m}}{\text{Price}_{01}}\right)^{-0.10}$$

CoolIndex captures the long-term annual heating intensity projections and is measured in kWh per square foot. Monthly price, heating degree-days, and state non-manufacturing output drive the forecast through the CoolUse component. Output elasticities are calculated by estimating preliminary models with output as an explicit variable and then evaluating in-sample and out-of-sample performance with the initial elasticity estimate. Similar variables are constructed for XHeat and XOther. The constructed variables are then used to drive the average use forecast model. Figure 64 shows the resulting GS model results.

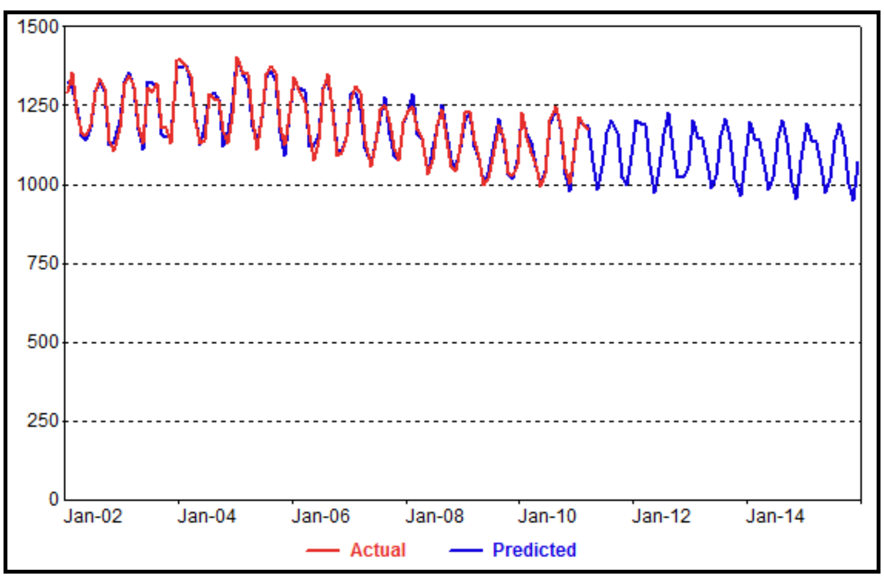

Figure 64: Actual and Predicted General Service Average Use (kWh)

The GS average use model performs well with an Adjusted R-Squared of 0.95 and a MAPE of 1.4%. The model is estimated with monthly billed sales data from January 2002 to March 2011. Since 2006, average GS usage has been trending downward with even a sharper decline beginning in 2008. This drop reflects a number of factors including decline in economic activity, an aggressive efficiency program, and increasing real prices since 2007.

The GS customer growth has been strongly correlated with residential customer growth. Residential customer projections are thus used to forecast GS customers. Figure 65 shows actual and predicted GS customers.

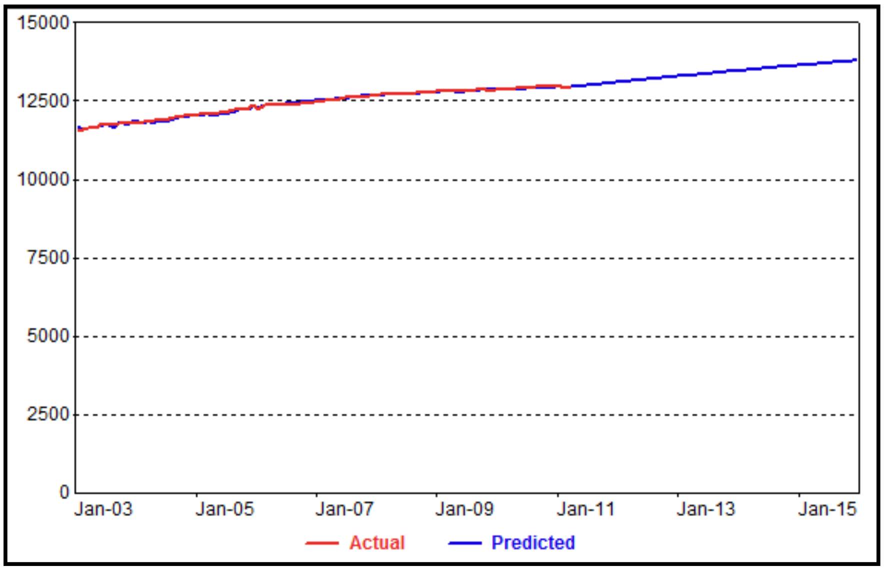

Figure 65: General Service Customer Forecast

The average use forecast is combined with the customer forecast to generate a monthly sales forecast. Figure 66 shows resulting sales forecast. The forecast includes the impact of expected efficiency program activity.

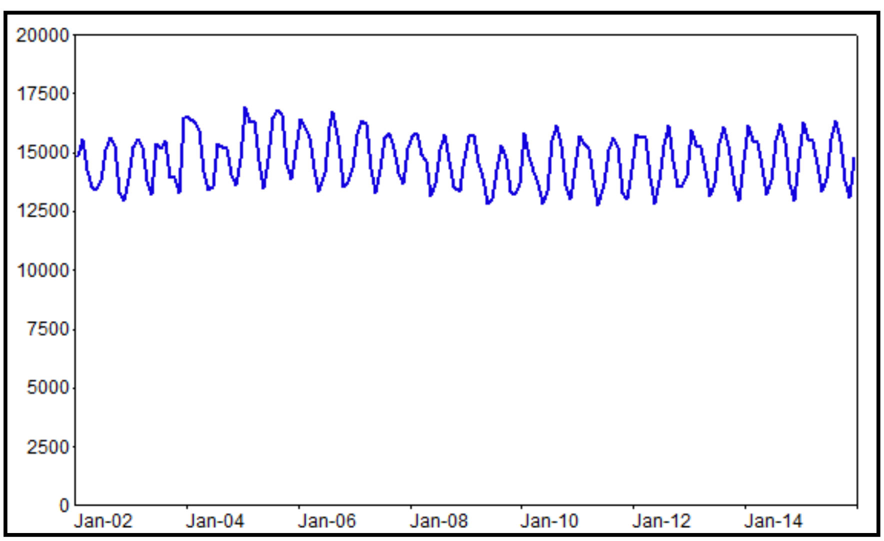

Figure 66: General Service Sales Forecast (MWh)

Time-of-Use (TOU)

The TOU model is structured similarly to the GS model, with two key differences. First, the TOU model is constructed using total sales, rather than average use. Second, the primary economic driver is a weighted employment and output variable. Heating (XHeat), cooling (XCool), and other use (XOther) variables are constructed from end-use intensity projections adjusted for expected efficiency program impacts, weather conditions, price, and economic driver. The constructed end-use variables are then used in a monthly sales regression model. Figure 67 shows the model results.

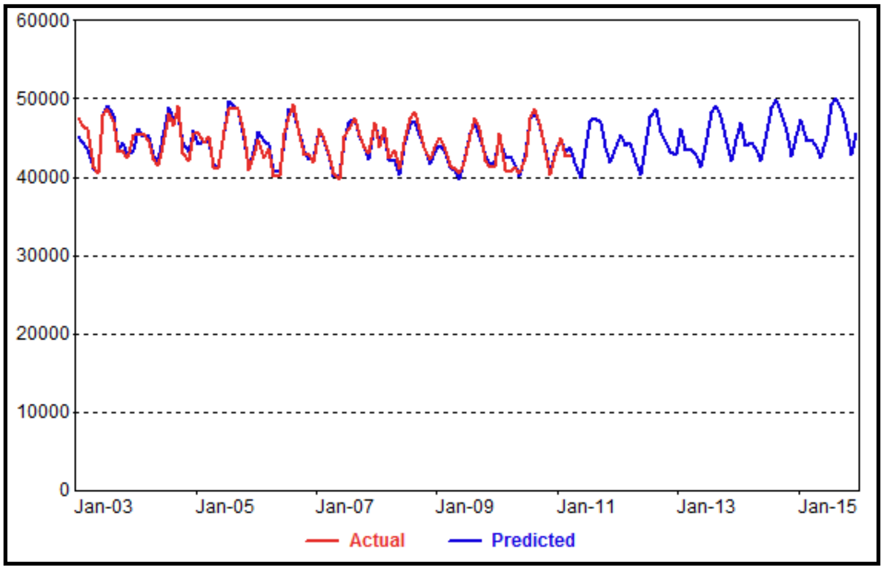

Figure 67: Time-of-Use Sales Forecast (MWh)

The model is estimated with monthly billed sales data from January 2003 to March 2011. The model Adjusted R-Squared is 0.88 with a MAPE of 1.5 %. Customers are forecasted separately using a regression model that relates TOU customers to non-manufacturing employment.

TOU weighted economic variable. Past TOU models have been estimated using state-level real output projections. This year, the model incorporates both output and employment as the near-term output projections were too strong. Figure 68 compares historical and forecasted employment and output. Both variables are indexed to a common year (2004) so that they can be compared on the same graph.

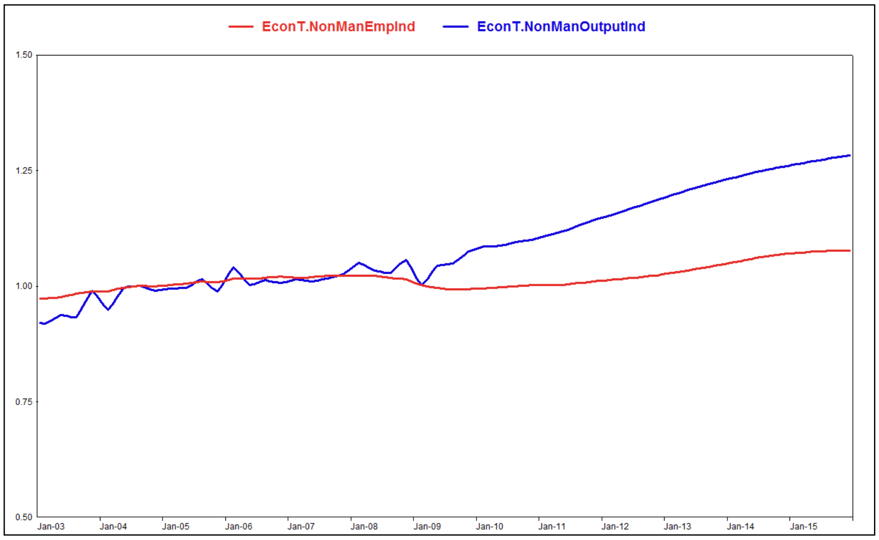

Figure 68: Nonmanufacturing Employment and Output Comparisons

Employment and output tracked each other relatively well until 2009. Since 2009 and into the forecast period, this relationship appears to change – state output shows strong growth while employment declines and then increases at a much slower rate. Given the divergence, a better approach is to incorporate both employment and output into the TOU model. To incorporate both variables, we developed a weighted economic variable where the weights are determined by evaluating the model fit statistics for different weightings. The variable that best fits the historical data has a 0.7 employment weight and a 0.3 output weight.

Large Commercial and Industrial Customers

The Large Commercial and Industrial class (CIL) includes GMP's 29 largest customers. While there is a seasonal pattern, there is no identifiable weather-sensitive component. The forecast is derived from an econometric model that relates monthly sales to a composite variable that incorporates price and manufacturing activity as measured by manufacturing employment and output projections. Employment and output are weighted based on in-sample model performance; this resulted in optimum weighting of 0.5 (equal weighting) on each concept. Monthly binary variables are used to capture non-weather-related seasonal variation. Binary variables are also used to capture shifts in usage as a result of changes in the CIL customer mix.

Figure 69 shows the model fit and forecasted sales. In 2008, there was a large drop in load due to the loss of a major customer. The forecast reflects this loss of load.

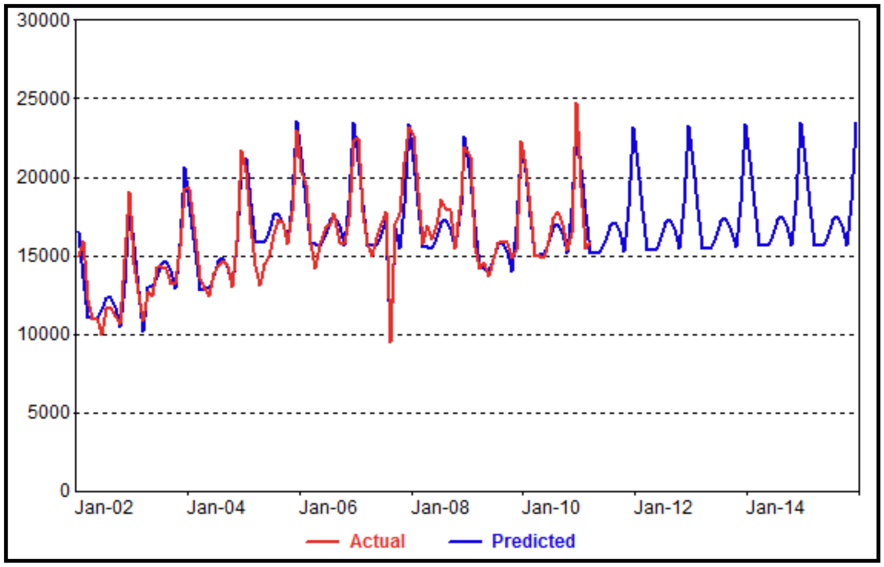

Figure 69: Large Commercial and Industrial Class Sales Forecast (MWh)

The model is estimated using monthly billed sales data from January 2002 to March 2011. The model Adjusted R^2 is 0.89 and the MAPE is 4.5%.

Other Classes

Separate regression models are estimated for station power and street lighting/public authority. Forecasts are based on simple trend variables with binaries added to capture large outliers. Sales for both station power and street lighting have been flat over the last five years and are expected to show little growth over the forecast period.

Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
NEH_RevVars.XHeat	1.086	0.08	13.533	0.00%
NEH_RevVars.XCool	1.176	0.056	21.025	0.00%
NEH_RevVars.XOther	1.034	0.012	83.528	0.00%
BinT.Jan01	-65.237	18.272	-3.57	0.05%
BinT.Jun03	105.603	17.698	5.967	0.00%
BinT.Dec03	140.605	17.532	8.02	0.00%
BinT.Oct04	45.78	18.223	2.512	1.34%
BinT.Jan05	56.369	18.216	3.094	0.25%
BinT.Sep06	66.828	17.733	3.769	0.03%
BinT.Nov08	-35.383	17.447	-2.028	4.50%
BinT.Jan	39.956	7.102	5.626	0.00%
BinT.Feb	42.243	7.057	5.986	0.00%
BinT.Oct	20.333	6.531	3.113	0.24%

Regression Statistics	
Iterations	1
Adjusted Observations	123
Deg. of Freedom for Error	110
R-Squared	0.923
Adjusted R-Squared	0.915
AIC	5.799
BIC	6.096
Log-Likelihood	-518.15
Model Sum of Squares	393,992.54
Sum of Squared Errors	32,843.89
Mean Squared Error	298.58
Std. Error of Regression	17.28
Mean Abs. Dev. (MAD)	13.15
Mean Abs. % Err. (MAPE)	2.32%
Durbin-Watson Statistic	1.668
Ljung-Box Statistic	61.5
Prob (Ljung-Box)	0
Skewness	0.491
Kurtosis	2.453
Jarque-Bera	6.483
Prob (Jarque-Bera)	0.0391

Table 30: Non-Electric Heat Average Use Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
H2O_RevVars.XHeat	1.033	0.085	12.134	0.00%
H2O_RevVars.XCool	1.193	0.058	20.623	0.00%
H2O_RevVars.XOther	1.116	0.011	100.718	0.00%
BinT.Jun03	84.529	19.847	4.259	0.00%
BinT.Dec03	144.01	19.763	7.287	0.00%
BinT.Oct04	48.773	19.784	2.465	1.52%
BinT.Sep06	69.024	19.865	3.475	0.07%
BinT.Jan	39.737	7.512	5.29	0.00%
BinT.Feb	52.614	7.849	6.703	0.00%
BinT.Yr06Plus	-35.604	3.544	-10.048	0.00%

Regression Statistics	
Iterations	1
Adjusted Observations	123
Deg. of Freedom for Error	113
R-Squared	0.931
Adjusted R-Squared	0.925
AIC	6.008
BIC	6.236
Log-Likelihood	-534
Model Sum of Squares	570,059.42
Sum of Squared Errors	42,500.92
Mean Squared Error	376.11
Std. Error of Regression	19.39
Mean Abs. Dev. (MAD)	14.12
Mean Abs. % Err. (MAPE)	2.05%
Durbin-Watson Statistic	2.255
Ljung-Box Statistic	56.12
Prob (Ljung-Box)	0.0002
Skewness	-0.142
Kurtosis	3.589
Jarque-Bera	2.189
Prob (Jarque-Bera)	0.3347

Table 31: H_20 Average Use Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
EH_RevVars.XHeat	0.583	0.024	24.063	0.00%
EH_RevVars.XCool	1.475	0.159	9.285	0.00%
EH_RevVars.XOther	0.815	0.028	28.828	0.00%
BinT.Dec03	356.329	55.68	6.4	0.00%
BinT.Nov08	-173.566	55.359	-3.135	0.22%
BinT.Jan	58.269	21.246	2.743	0.71%
BinT.Feb	93.834	22.141	4.238	0.00%

Regression Statistics	
Iterations	1
Adjusted Observations	123
Deg. of Freedom for Error	116
R-Squared	0.954
Adjusted R-Squared	0.952
AIC	8.065
BIC	8.225
Log-Likelihood	-663.53
Model Sum of Squares	7,324,369.33
Sum of Squared Errors	349,225.62
Mean Squared Error	3,010.57
Std. Error of Regression	54.87
Mean Abs. Dev. (MAD)	41.87
Mean Abs. % Err. (MAPE)	5.29%
Durbin-Watson Statistic	1.393
Ljung-Box Statistic	176.93
Prob (Ljung-Box)	0
Skewness	0.581
Kurtosis	3.308
Jarque-Bera	7.407
Prob (Jarque-Bera)	0.0246

Table 32: Electric Heat Average Use Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
Economics.Households	345.905	32.827	10.537	0.00%
AR(1)	0.994	0.007	146.257	0.00%

Regression Statistics	
Iterations	8
Adjusted Observations	122
Deg. of Freedom for Error	120
R-Squared	0.996
Adjusted R-Squared	0.996
AIC	10.208
BIC	10.254
Log-Likelihood	-793.79
Model Sum of Squares	827,498,536.73
Sum of Squared Errors	3,201,157.80
Mean Squared Error	26,676.32
Std. Error of Regression	163.33
Mean Abs. Dev. (MAD)	103.19
Mean Abs. % Err. (MAPE)	0.14%
Durbin-Watson Statistic	2.454
Ljung-Box Statistic	69.61
Prob (Ljung-Box)	0
Skewness	0.277
Kurtosis	6.887
Jarque-Bera	78.358
Prob (Jarque-Bera)	0

Table 33: Residential Customer Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
Economics.Households	270.859	35.168	7.702	0.00%
AR(1)	0.995	0.004	263.145	0.00%

Regression Statistics	
Iterations	11
Adjusted Observations	122
Deg. of Freedom for Error	120
R-Squared	0.999
Adjusted R-Squared	0.999
AIC	9.325
BIC	9.371
Log-Likelihood	-739.95
Model Sum of Squares	986,112,955.54
Sum of Squared Errors	1,324,414.49
Mean Squared Error	11,036.79
Std. Error of Regression	105.06
Mean Abs. Dev. (MAD)	72.69
Mean Abs. % Err. (MAPE)	0.14%
Durbin-Watson Statistic	2.297
Ljung-Box Statistic	36.71
Prob (Ljung-Box)	0.0468
Skewness	0.979
Kurtosis	6.179
Jarque-Bera	70.839
Prob (Jarque-Bera)	0

Table 34: Non-Electric Heat Customer Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	12208.301	361.147	33.804	0.00%
Res_Custs.Predicted	-0.023	0.005	-4.74	0.00%
AR(1)	0.937	0.033	28.473	0.00%

Regression Statistics	
Iterations	16
Adjusted Observations	122
Deg. of Freedom for Error	119
R-Squared	0.885
Adjusted R-Squared	0.883
AIC	5.848
BIC	5.917
F-Statistic	458.671
Prob (F-Statistic)	0
Log-Likelihood	-526.82
Model Sum of Squares	310,153.04
Sum of Squared Errors	40,233.89
Mean Squared Error	338.1
Std. Error of Regression	18.39
Mean Abs. Dev. (MAD)	12.67
Mean Abs. % Err. (MAPE)	0.12%
Durbin-Watson Statistic	1.94
Ljung-Box Statistic	103.4
Prob (Ljung-Box)	0
Skewness	0.772
Kurtosis	6.651
Jarque-Bera	79.886
Prob (Jarque-Bera)	0

Table 35: H_20 Customer Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
RevVars.GenServ_XOther	1162.766	14.302	81.3	0.00%
RevVars.GenServ_XHeat	845.145	128.105	6.597	0.00%
RevVars.GenServ_XCool	832.722	171.129	4.866	0.00%
Bin.Jan	54.158	11.098	4.88	0.00%
Bin.Feb	119.203	13.741	8.675	0.00%
Bin.Mar	79.822	10.529	7.581	0.00%
Bin.May	-24.063	7.781	-3.093	0.26%
Bin.Jul	58.183	16.469	3.533	0.07%
Bin.Aug	92.374	21.183	4.361	0.00%
Bin.Sep	68.672	12.425	5.527	0.00%
Bin.Nov	-52.981	7.483	-7.08	0.00%
Bin.Yr07Plus	-35.123	13.02	-2.698	0.83%
Bin.Yr09Plus	-40.438	11.479	-3.523	0.07%
Bin.Jun03	161.856	21.692	7.462	0.00%
Bin.Sep03	-133.653	21.962	-6.086	0.00%
Bin.Dec03	173.245	21.694	7.986	0.00%
Bin.Jan05	129.325	21.407	6.041	0.00%
Bin.TrendVar	-4.751	2.89	-1.644	10.36%
MA(1)	0.512	0.095	5.365	0.00%

Regression Statistics	
Iterations	19
Adjusted Observations	111
Deg. of Freedom for Error	92
R-Squared	0.957
Adjusted R-Squared	0.948
AIC	6.465
BIC	6.929
Log-Likelihood	-497.33
Model Sum of Squares	1,116,243.56
Sum of Squared Errors	50,645.33
Mean Squared Error	550.49
Std. Error of Regression	23.46
Mean Abs. Dev. (MAD)	17.09
Mean Abs. % Err. (MAPE)	1.44%
Durbin-Watson Statistic	2.024
Ljung-Box Statistic	32.42
Prob (Ljung-Box)	0.1169
Skewness	0.012
Kurtosis	2.979
Jarque-Bera	0.005
Prob (Jarque-Bera)	0.9975

Table 36: General Services Average Use Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-3177.868	294.974	-10.77	0.00%
ResCustFcst.Res_Custs	0.2	0.004	52.838	0.00%
MA(1)	0.736	0.082	8.987	0.00%
MA(2)	0.604	0.083	7.321	0.00%

Regression Statistics	
Iterations	17
Adjusted Observations	99
Deg. of Freedom for Error	95
R-Squared	0.993
Adjusted R-Squared	0.993
AIC	7.204
BIC	7.309
F-Statistic	4453.515
Prob (F-Statistic)	0
Log-Likelihood	-493.06
Model Sum of Squares	17,266,985.98
Sum of Squared Errors	122,776.71
Mean Squared Error	1,292.39
Std. Error of Regression	35.95
Mean Abs. Dev. (MAD)	26.2
Mean Abs. % Err. (MAPE)	0.21%
Durbin-Watson Statistic	1.354
Ljung-Box Statistic	83.18
Prob (Ljung-Box)	0
Skewness	-0.021
Kurtosis	4.593
Jarque-Bera	10.476
Prob (Jarque-Bera)	0.0053

Table 37: General Service Customers Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	9510.961	3849.175	2.471	1.55%
RevVars.TOU_XCool	26680.624	2211.801	12.063	0.00%
RevVars.TOU_XOther	36551.475	3958.049	9.235	0.00%
Bin.Yr05	-953.631	329.784	-2.892	0.49%
Bin.Aft06	-1362.488	225.303	-6.047	0.00%
Bin.Jun03	4469.235	990.563	4.512	0.00%
Bin.Sep03	-4213.677	929.874	-4.531	0.00%
Bin.Dec07	2789.945	978.389	2.852	0.55%
Bin.Feb	1139.617	365.959	3.114	0.25%
Bin.Apr	-2117.503	369.645	-5.728	0.00%
Bin.May	-2879.722	371.094	-7.76	0.00%
Bin.Jun	-1389.651	368.621	-3.77	0.03%
Bin.Nov	-2038.465	363.225	-5.612	0.00%
Bin.Dec	-1057.108	383.149	-2.759	0.71%

Regression Statistics	
Iterations	1
Adjusted Observations	99
Deg. of Freedom for Error	85
R-Squared	0.895
Adjusted R-Squared	0.878
AIC	13.741
BIC	14.108
F-Statistic	55.501
Prob (F-Statistic)	0
Log-Likelihood	-806.65
Model Sum of Squares	587,859,017.71
Sum of Squared Errors	69,254,027.49
Mean Squared Error	814,753.26
Std. Error of Regression	902.64
Mean Abs. Dev. (MAD)	647.5
Mean Abs. % Err. (MAPE)	1.46%
Durbin-Watson Statistic	1.415
Ljung-Box Statistic	24.94
Prob (Ljung-Box)	0.4093
Skewness	0.518
Kurtosis	3.802
Jarque-Bera	7.084
Prob (Jarque-Bera)	0.029

Table 38: Time-of-Use Sales Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
EconT.NonManEmp	5.939	0.112	53.013	0.00%
Bin.Jul_Dec02Trend	103.102	4.733	21.784	0.00%
Bin.Yr04Plus	-80.431	14.826	-5.425	0.00%
Bin.AftFeb02	113.602	10.77	10.548	0.00%
Bin.July02	-41.033	7.659	-5.357	0.00%
Bin.Dec03	-81.934	10.487	-7.813	0.00%
Bin.Jan06	-39.402	7.422	-5.309	0.00%
AR(1)	0.956	0.03	31.528	0.00%

Regression Statistics	
Iterations	11
Adjusted Observations	110
Deg. of Freedom for Error	102
R-Squared	0.959
Adjusted R-Squared	0.956
AIC	4.734
BIC	4.931
Log-Likelihood	-408.46
Model Sum of Squares	250,530.16
Sum of Squared Errors	10,820.60
Mean Squared Error	106.08
Std. Error of Regression	10.3
Mean Abs. Dev. (MAD)	6.67
Mean Abs. % Err. (MAPE)	0.41%
Durbin-Watson Statistic	1.668
Ljung-Box Statistic	39.43
Prob (Ljung-Box)	0.0246
Skewness	-1.108
Kurtosis	6.161
Jarque-Bera	68.305
Prob (Jarque-Bera)	0

Table 39: Time-of-Use Customers Model Statistics and Coefficients

Variable	Coefficient	StdErr	T-Stat	P-Value
RevVars.CIL_OtherUse	31.802	0.898	35.426	0.00%
Bin.Jan	5403.944	368.436	14.667	0.00%
Bin.Feb	2565.07	368.174	6.967	0.00%
Bin.Jun	714.77	382.399	1.869	6.46%
Bin.Jul	1711.788	382.167	4.479	0.00%
Bin.Aug	1886.563	400.979	4.705	0.00%
Bin.Sep	1315.405	381.963	3.444	0.09%
Bin.Nov	2817.049	381.972	7.375	0.00%
Bin.Dec	7829.341	384.292	20.373	0.00%
Bin.AftApr03	2803.399	341.031	8.22	0.00%
Bin.Yr05Plus	2855.223	272.032	10.496	0.00%
Bin.Yr09Plus	-408.465	326.482	-1.251	21.39%
Bin.Aft10	905.974	391.936	2.312	2.29%
Bin.Aug07	-7919.333	1098.24	-7.211	0.00%

Regression Statistics	
Iterations	1
Adjusted Observations	111
Deg. of Freedom for Error	97
R-Squared	0.903
Adjusted R-Squared	0.89
AIC	13.989
BIC	14.331
Log-Likelihood	-919.91
Model Sum of Squares	952,489,449.11
Sum of Squared Errors	102,631,186.04
Mean Squared Error	1,058,053.46
Std. Error of Regression	1,028.62
Mean Abs. Dev. (MAD)	737.37
Mean Abs. % Err. (MAPE)	4.54%
Durbin-Watson Statistic	1.623
Ljung-Box Statistic	35.14
Prob (Ljung-Box)	0.0663
Skewness	-0.012
Kurtosis	3.215
Jarque-Bera	0.216
Prob (Jarque-Bera)	0.8976

Table 40: Large Commercial & Industrial Sales Model Statistics

B: Scenario Load Forecasting Methodology

GMP Scenario Load Forecast

Itron provided an updated base GMP load forecast through 2030 that assumed historical levels of EVT funding at $30 million annually continue. Forecasts were created for energy, summer peak, and winter peak annual load. IBM load was forecasted separately and assumed to be constant through the forecast period. This base forecast was adjusted to create the final load forecast for each of the three scenarios. The following adjustments were made in sequential order:

1. IBM load was removed from the Itron base forecast
2. Non-IBM load growth was adjusted for assumptions in economic growth
3. IBM load growth was adjusted such that it declined instead of remained constant and was added back to the load forecast
4. Energy efficiency levels were adjusted to reflect assumptions in EVT funding
5. Projected load to account for electric vehicle growth was added to the forecast

Table 41 below summarizes the inputs used for each scenario in order to make the adjustments listed above. Each of these inputs is described in more detail below.

Scenario	EE Funding Case ($M)	Growth Adders		IBM Case	Electric Vehicle Case
		Energy	Peak		
Economies of Efficiency	40/50 Real	-0.20%	-0.15%	Reference	Reference
Gas is Greener	40 Real	0.60%	0.60%	Reference	Low
Muddling Along	40 Nominal/ 35 Real	0.00%	0.00%	Reference	Low

Table 41: Scenario Inputs for GMP Load Growth Adjustments

Energy Efficiency

In adjusting the Itron budget forecast which included $30 million in annual, statewide efficiency spending, a curve was created to establish the affect of various annual spending levels on GMP load. This curve is defined by three anchoring assumptions (cited below) which when connected inform expected levels of savings at many possible fund levels:

1. VEIC "unconstrained forecast"[30]
2. The 2008 report on historical funding and energy savings for Efficiency Vermont
3. The assumption that zero funding creates zero energy efficiency

This supply curve (Figure 70) assumes a non-linear relationship between efficiency spending and realized energy efficiency, that is, as funding is increased, the incremental benefit of an extra dollar of funding decreases.

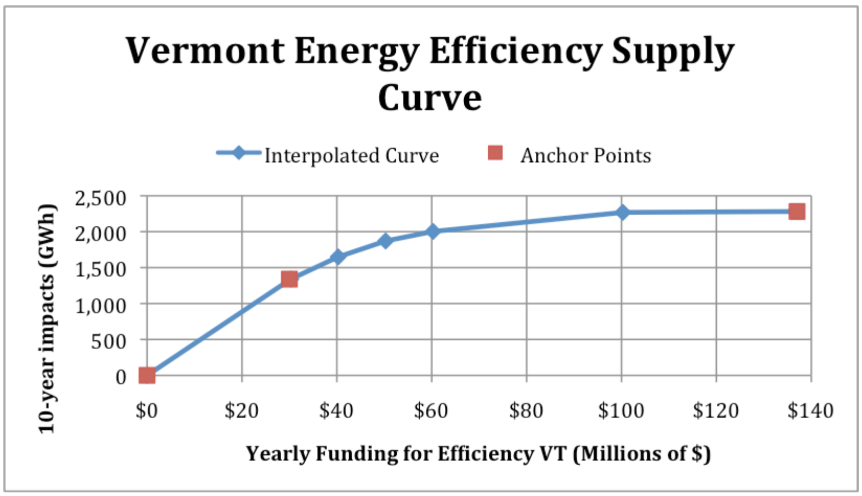

Figure 70: Vermont Energy Efficiency Supply Curve

We assumed that energy efficiency impacts have a ten-year lifetime and that impacts are spread evenly across each of those ten years. For example, if energy efficiency funding in Vermont in 2011 is $30 million, this supply curve attributes ~1340 GWh of lifetime impacts for the entire state to that level of funding, or 134 GWh a year for ten years.

Furthermore, we assumed that energy efficiency impacts are additive across years. For example, If energy efficiency funding is $30 million in 2011 and $30 million in 2012; total impacts will be 134 GWh in 2011 and 268 GWh in 2012. We then modeled the market-transformative effects of energy efficiency by assuming that 5% of the yearly impacts persist forever, even after the ten-year energy efficiency lifetime is reached.

[30] "Maximum Economically Achievable Electricity Savings from Unconstrained Investment in Energy Efficiency 2012–2031." Revised Analysis. January 19, 2011.

Table 41 above shows the EVT funding levels assumed for each scenario. Economies of Efficiency has the highest assumed funding level, while Muddling Along has the lowest, though all assume some increase from past levels of funding.

To convert GWh savings into peak load reductions, we assumed a load factor of 0.68, which we calculated using historical data on GMP's annual loads and annual peak. Finally, to convert the savings from statewide Vermont numbers to only those occurring in GMP's territory we used the scaling factors in Table 42. These were calculated by averaging ten years of historical data and were the same for each scenario.

VT-GMP Energy Scalar	Summer Peak Scalar	Winter Peak Scalar
33.18%	34.23%	31.95%

Table 42: Energy Efficiency Scaling Factors Converting State Efficiencies to GMP-only

Growth Adders

Growth adders were added to the Itron non-IBM load compound annual growth rates to account for different assumptions in economic growth in the different scenarios. Economies of Efficiency was assumed to have lower economic growth and hence lower load growth while Gas is Greener had higher economic growth and higher load growth. Muddling Along was assumed to have the same load growth as the Itron base forecast. The growth adders are shown in Table 34. Separate adders were developed for energy and peak load. (The peak load adder was applied to both summer and winter peak forecasts.) The same adder was applied for each year of the forecast. These growth adders derived as part of th 2007 GMP IRP analysis and incorporated into the scenarios in that report.

IBM Forecast Adjustment

Itron's budget forecast assumed a constant IBM energy load for the entire forecast period. In order to approximate a future of continued efficiency improvements at this site and better match the overall funding levels in the scenarios this load was subtracted from the Itron GMP forecast, adjusted separately, and added back. The adjusted IBM forecast was then used for all three scenarios. Specifically, the adjustment increased the IBM load 1.3% from 2010 to 2011 and then established decline of 1.5% per year thereafter. This decline is consistent with the recent history of declines in IBM's load in a robust efficiency funding environment..

The same procedure was done to the peak load forecasts. In order to translate the energy load into peak load, a constant load factor was used based on an average of historical annual load factors from 2006 to August 2010. Figure 71 shows both the Itron base IBM energy forecast and the adjusted energy forecast used in the IRP.

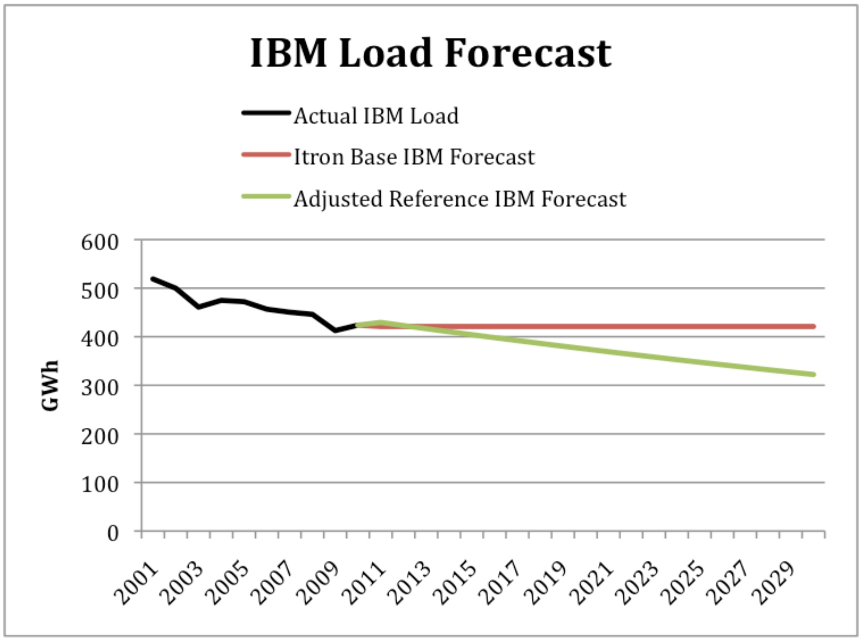

Figure 71: IBM Load Forecast Comparison

Electric Vehicle Load Forecast

Given the current plans to introduce plug-in hybrid and electric vehicles to the market, some additional energy and peak load was included in the GMP forecast to account for this. The forecast of electric vehicle load was based on work done by the University of Vermont Transportation Center[31] as well as work done specifically for GMP by Steven Letendre, one of the authors of the Vermont study.

The Vermont study created three electric vehicle load forecasts: a low, base, and high. The high case was considered to be a theoretical maximum that could be added to the grid without any need for added capacity. This was, therefore, not used in this IRP. Instead, the base forecast was assumed to be a reasonable maximum penetration level, also in line with other forecasts of electric vehicles.[32] This case, termed the Reference case, was assumed for the Economies of Efficiency scenario, which was assumed to have aggressive additions of electric vehicles. The other two scenarios used the low forecast.

Steven Letendre provided GMP with an annual energy load forecast due to the addition of electric vehicles for both the Reference and Low scenarios, which was used for the IRP. Forecasting peak load effects is much more challenging because it depends on what time of day the cars are plugged in. The Vermont study examined various charging scenarios. The electric vehicle peak load forecast for the IRP was based on the Uncontrolled Nighttime Charging scenario, which assumes no mitigation of peak load increases from off-peak electricity rates. The low case had minimal impacts on peak load in this scenario. There was a small increase in winter peak. The reference case had more pronounced effects. To translate the peak load effect for the entire state of Vermont to GMP, it was assumed that

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[31] Letendre, Steven; Watts, Richard; Cross, Michael. *Plug-In Hybrid Vehicles and the Vermont Grid: A Scoping Analysis.* February 2008. http://www.uvm.edu/~transctr/devsite/pdf/Final_PHEV.pdf

[32] This includes work done by Oak Ridge National Laboratory: Hadley, Stanton; Tsvetkova, Alexandra. *Potential Impacts of Electric Vehicles on Regional Power Generation.* January 2008.

the ratio of peak load increase to annual energy increase would remain constant. Figure 72 and Figure 73 show the electric vehicle forecasts for GMP used in this IRP.

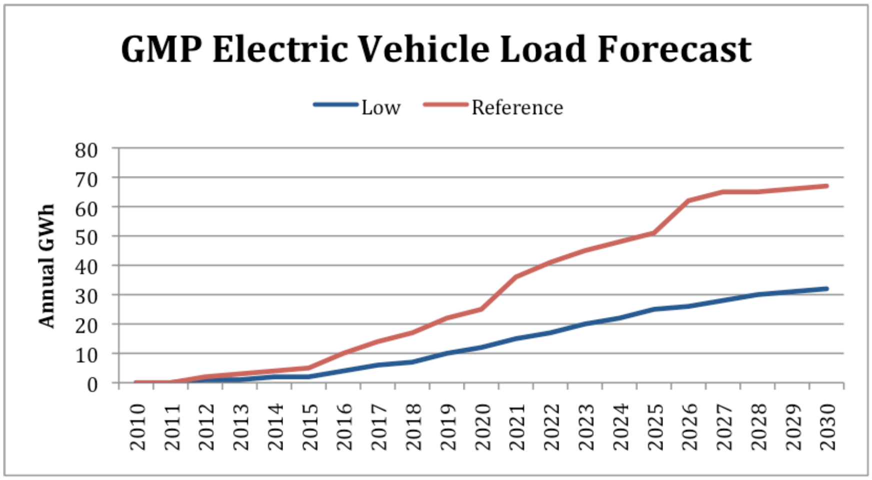

Figure 72: Projected Increase in GMP Annual Energy Load Due to Electric Vehicles

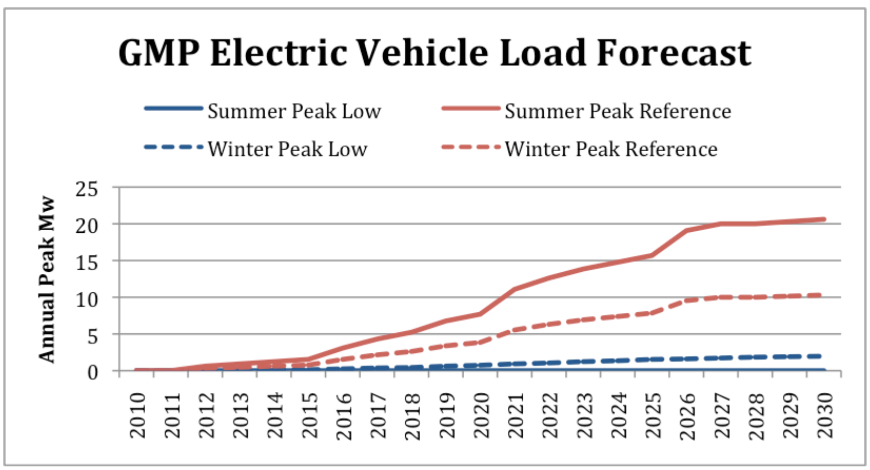

Figure 73: Projected Increase in GMP Annual Peak Load Due to Electric Vehicles

Final Results

The load forecasts for each scenario are shown in Figure 74, Figure 75, and Figure 76. Muddling along has relatively flat but slightly negative load growth. Gas is Greener has the strongest load growth due to assumptions of higher economic growth. Finally, Economies of Efficiency has negative load growth over the twenty-year planning horizon due the combination of low economic growth and high energy efficiency.

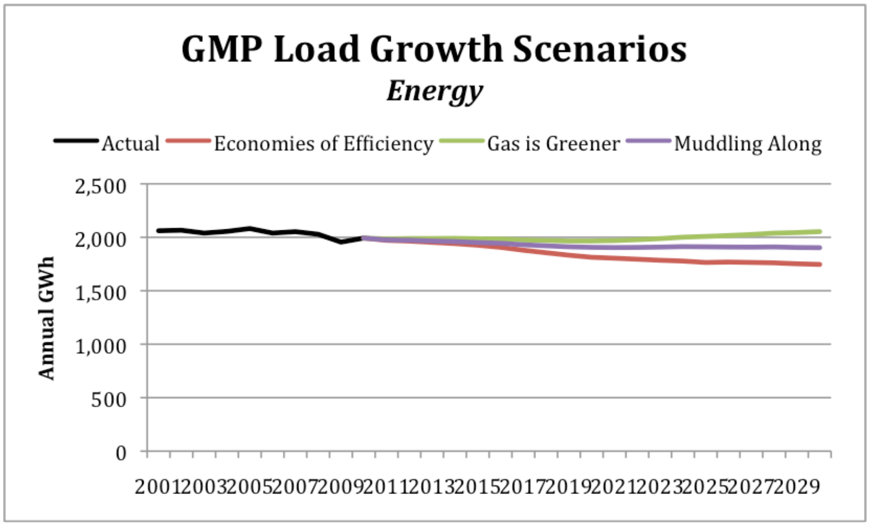

Figure 74: GMP Projected Annual Energy Growth for Each IRP Scenario

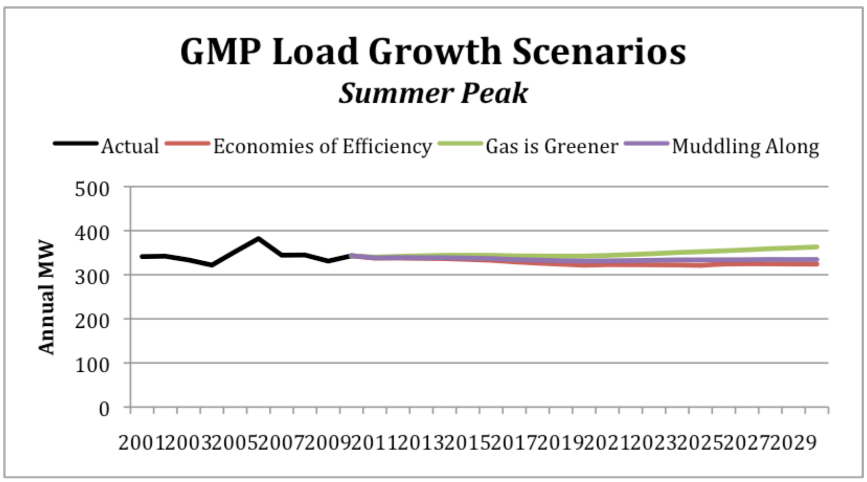

Figure 75: GMP Projected Annual Summer Peak Load Growth for Each IRP Scenario

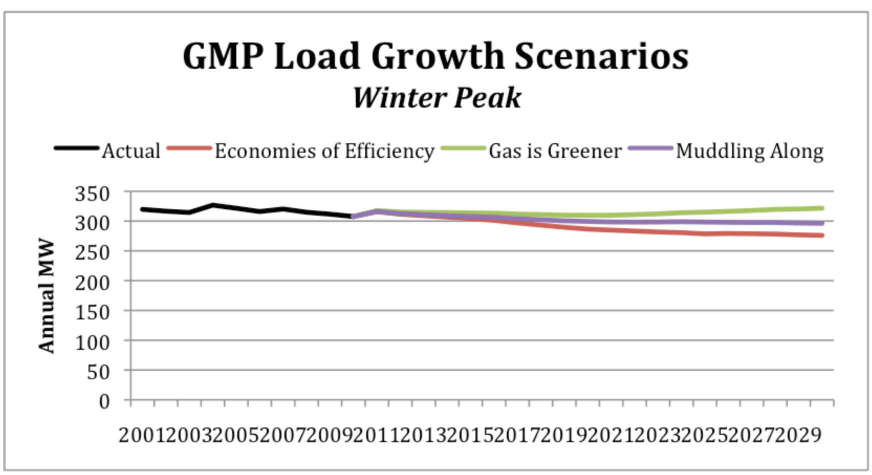

Figure 76: GMP Projected Annual Winter Peak Load Growth for Each IRP Scenario

C: Smart Grid Implementation Plan

Table 43 (next page) shows the status of our implementation of our Smart Grid plan, GMPConnects, as of June 2011. We are on track to complete this project by April 2013, the deadline for receiving matching federal funds.

C: Smart Grid Implementation Plan

Project	Requirements	Technology Research	Technology Selection	Contract	Implementation Plan Design	Deployment	Conversion	Testing	Live Date	Quality Certification
Customer Information System	Complete	Complete	Complete	Complete	Complete	In process	In process	On-going 9/11–5/12	June 2012	Aug 2012
Meter Data Management System	Complete	Complete	Complete	Complete (Oracle Utility Bundle)	By July 2011	In process	Phase I: 5–11/11 Phase II: 12/11–3/12	Phase I: 8–9/11 Phase II: 3–5/12	Phase I: 9/11–2/12 Phase II: June 2012	Aug 2012
Customer Web Portal	Complete	Complete	Complete	Complete (Oracle Utility Bundle)	By July 2011	TBD	TBD	TBD	By Summer 2012	TBD
Advanced Metering	Complete	Complete	Complete	Complete	By June 2011	Pilot: 7–9/11 Full: Oct 2011	n/a	Pilot: 9/11 Full: monthly	Ongoing Sept 2011	Jan 2013 [full system acceptance]
Grid Automation	Complete	Complete	Complete	In process	In process	In process	n/a	On-going/ substation	Rolling by substation 6/11–12/12	On-going by substation
Rates Policy	In process [working w/DPS]	n/a	n/a	n/a	Roadmap: June 2011	Design begins July 2011	n/a	Intro (500): Jun 2012	Full TOU: Jan 2013	n/a
Customer Outreach	Complete	Complete	Complete	Complete	Near complete	In process	n/a	On-going	Regular events thru 2012	n/a
Systems Integration	Complete	Complete	Complete	Complete (Oracle Utility Bundle)	In process	In process [pilot complete Feb 2011]	n/a	On-going	Integration rolled out thru 2012	On-going
Regulatory Approvals	Complete	Complete	Complete	In process	n/a	n/a	n/a	n/a	By May 2011	On-going 2011–2013

Table 43: GMPConnect Project Workstream Implementation Plan