STATE OF VERMONT
PUBLIC UTILITY COMMISSION

Case No. _____

Tariff filing of Green Mountain Power requesting an	)
increase in its base rates starting January 1, 2019, to be	)
fully offset by bill credits through September 30, 2019	)

PREFILED TESTIMONY OF JOSHUA CASTONGUAY ON BEHALF OF GREEN MOUNTAIN POWER

April 13, 2018

Summary of Testimony

Mr. Castonguay gives an overview of GMP's focus on energy transformation and innovation in partnership with customers to drive down costs, and provides details of the interim and rate year capital costs associated with those Energy Transformation projects.

EXHIBIT LIST

Exhibit GMP-JC-1	New Initiatives Capital Additions (2018-2019)
Exhibit GMP-JC-2	New Initiatives Department Capital Planning Philosophy
Exhibit GMP-JC-3	Innovative Pilots – Costs & Revenues

PREFILED TESTIMONY OF JOSHUA CASTONGUAY ON BEHALF OF GREEN MOUNTAIN POWER

Q1. What is your name and business affiliation?

A1. My name is Joshua Castonguay. I am employed by Green Mountain Power ("GMP") as Vice President, Chief Innovation Executive.

Q2. Please describe your educational background and business experience.

A2. I have been employed by GMP since 2003, working in engineering until 2009, and then moving into various leadership positions throughout the organization, including the control center, and the transmission and distribution line department, among other responsibilities. In 2017, I became Vice President, Chief Innovation Executive leading generation, engineering, and the team working on our innovative technology and service. I graduated from the University of Maine in 2003 with a Bachelor of Science in Electrical Engineering Technology.

Q3. Have you previously testified before the Vermont Public Utility Commission ("Commission")?

A3. Yes, I have previously testified before the Commission, including in Docket Nos. 7628 (Kingdom Community Wind), 7601 (Berlin Solar Project), 6860 (Northwest Reliability Project), and 8680 (Stafford Hill Project). I also submitted testimony in GMP's 2014 rate case in Docket 8190 and 2018 rate case in Case No. 17-3112-INV.

Q4. What is the purpose of your testimony?

A4. I give an overview of GMP's Energy Transformation projects (also called New Initiatives), including our work to partner with customers and our vision to leverage innovations like battery storage to benefit customers while continuing to deliver highly reliable power in a cost-effective way. In fact, the whole basis for the transformation work we are doing is to ensure an economically sustainable and reliable path for the Vermonters we serve. I explain how these innovations also help to meet state requirements to lower carbon emissions by achieving the Tier III goals of Vermont's Renewable Energy Standards ("RES"). I also provide details regarding the interim and rate year capital costs associated with these transformation projects.

Q5. What are Energy Transformation projects, and what is GMP's vision for these projects?

A5. GMP's vision for the future continues to be focused on partnering with customers and other stakeholders to leverage the latest in innovations, while moving away from a traditional centralized energy system to one that is home-, business-, and community-based. This means embracing new energy technologies and resources as they are developed to deliver cleaner, more reliable energy to customers in more cost-effective ways. Our transition to this new energy paradigm depends on our ability to embrace technological innovation and energy transformation tools that will allow for an increasingly distributed energy network and a system of developing new value streams for customers as sales on the traditional bulk system decline. Without business model innovation, it is clear that customers are headed toward a future of escalating costs. The

goal at GMP is to lower costs as much as possible while creating a dramatically more localized energy system that is more reliable and weather resilient.

These Energy Transformation projects will help achieve this vision. These projects focus on new, low-carbon, distributed energy technology that support Vermont's energy policy, reduce power costs, introduce new revenue streams to benefit customers, and provide customers with options to transition off of traditional fossil-fuel systems for heating or transportation. These projects are a critical part of GMP's proactive approach to the challenges of the current energy landscape, as we seek to find innovative solutions to combat rising costs and declining sales, and to offer new energy products and services that enhance our customers' experience.

Q6. What specific energy transformation projects are included in this rate filing?

A6. In this rate filing, we are including the following energy transformation programs and projects: Tesla Powerwall 2.0 home batteries, Cold Climate Heat Pumps, Heat Pump Water Heaters, residential battery storage, Level 2 home electric vehicle ("EV") chargers, the ePark project, and Behind the Meter ("BTM") controls. See **Exhibit GMP-JC-1.** The capital costs of these projects are as follows:

Category	Interim Year (10/1/17 – 12/31/18) ($000)	Rate Year (1/1/19 – 9/30/19) ($000)	Total ($000)
Tesla Powerwall 2.0	$9,671	$5,558	$15,229
Residential Battery Storage	$12	$0	$12
Cold Climate Heat Pumps	$1,173	$189	$1,362
Heat Pump Water Heaters	$278	$256	$534
Level 2 EV Home Chargers	$0	$84	$84
BTM Controls	$75	$0	$75
ePark	$155	$0	$155

GMP is developing a number of larger energy transformation projects as we continue our focus on utilizing battery storage as a new tool on the distribution system that can lower costs for customers, while providing additional resiliency benefits to the grid. The Panton Battery Storage Project, which has received a Certificate of Public Good, is included in the rate filing as a generation project and discussed in the testimony of Jason Lisai. In addition to the Panton Battery Project, three Joint Venture ("JV") Solar/Battery Storage projects are also included in this filing. Those projects are discussed in more detail in the testimony of Kirk Shields.

Finally, GMP has open access programs that support innovative uses of devices like home batteries through our recently launched "Bring Your Own Device" program. Innovations like these are important for driving market transformation but also speak to why key investments in areas like GMP's technology infrastructure are so critical.

Q7. You mentioned the challenges of the current energy landscape. What challenges are you referring to?

A7. As GMP continues to describe, both in last year's filing and this year, there are a number of significant challenges facing electric utilities and customers at this time. GMP is experiencing declining sales of traditional bulk delivery energy while demands of the system are actually increasing due to literally 1,000s of customers now acting as generators. In fact, we have lower kilowatt-hour ("kWh") sales today than we did at the end of 2003. This fact, combined with rising power costs and regional grid and transmission costs that are out of our control, point to a future that could entail double-digit increases. For example, ISO-New England and the transmission companies in New England project that they will spend over $2 billion on new transmission infrastructure over the next four years, all of which is paid for by New England customers. These uncontrollable cost pressures will continue to mount, while sales will more likely continue to decline further.

Meanwhile, even though we have lower overall kWh sales, there are *more* electrons flowing through the grid today, from thousands more sources and locations, than ever before. That is because of the tremendous growth of distributed generation, projects that connect directly to the distribution system, in particular those defined as "net metering" and standard offer projects. In fact, in just the past few years, net metering has grown from a total of about 5 MWs on the GMP system to over 150 MWs, with another 40 MWs proposed, and it continues to grow. This means that the work GMP does to balance, manage, and secure the grid has become much more complex. Additionally,

distributed solar has done a tremendous job at reducing what used to be a daytime peak, causing a new, lower peak, to show up later in the day, typically after daylight hours. This means that as additional solar is added, it has much less of a benefit against the peak, and also points to why energy storage is arising as an important tool to further reduce the costs of peaks as we will describe more below.

Even in this challenging environment, GMP remains customer-obsessed and committed to not just maintaining, but continually improving, its performance and reliability. As part of this, we are working on innovation that can drive down costs to meet our customers' increasingly individualized needs for electricity management in their homes and businesses and that can help balance and manage peak load on the grid for the benefit of all customers. Without this focus on innovation, customers will continue to bear increasing cost pressures because lower retail sales means there are fewer kilowatt-hours over which to spread the uncontrollable, required costs we face, resulting in upward rate pressure.

Q8. How is GMP addressing these challenges?

A8. A key part of solving these challenges is to innovate, and to offer energy transformation products and services to our customers that leverage new technologies and provide clean power more efficiently, more reliably, and at a lower cost. At the same time, these Energy Transformation projects create new value streams and allow us to develop tools for grid management for the benefit of all customers, while continuing to reduce our reliance on traditional electricity sales to keep costs low.

We have four goals for these projects:

1. Deliver increased resiliency in new ways to all customers, including through grid management and balancing.
2. Create new value streams, including revenues from new non-traditional sources, that flow back to all customers and reduce rates.
3. Deliver services and a platform that enable customers to reduce their carbon footprints while increasing their comfort and saving money on total energy consumption.
4. Strategically partner with customers as well as third parties to deliver more innovative program offerings in order to achieve GMP's goals, as well as Vermont's energy goals.

With these four goals in mind, we are implementing pilot programs, developing partnerships with innovators and suppliers, and offering alternative platforms that achieve all of this, while continually focusing on driving down costs for customers. **Exhibit GMP-JC-2** contains additional details about our capital planning philosophy with respect to these projects. This work is absolutely critical in order to help combat rising costs and rate pressures and provide for a much more reliable and resilient grid.

Q9. The first set of programs on your list of Energy Transformation projects involve the Tesla Powerwall and residential battery storage. Why has GMP pursued those projects?

A9. These programs offer customers new ways to create home resilience without a fossil-fuel-based backup generator, while allowing for load control and balancing for the benefit of all customers.

One of the most exciting Energy Transformation projects in this filing is our Grid Transformation/Tesla Powerwall 2.0 pilot program, which enables customers to get a home battery with a capacity of 13.5 kWh that can be used for backup power in the case of an outage. In exchange for sharing access to the battery with GMP, the cost of the battery unit is reduced to either a monthly charge of $15/month for ten years or a one-time charge of $1,500, making it more affordable for customers to participate while also creating a stored energy resource that can be strategically discharged to lower costs for all customers. The batteries thus provide benefits to both participating customers and non-participating customers, which is an important aspect of all the Energy Transformation programs we explore. For GMP, the batteries will help transform the grid as each one represents a dynamic resource that can be utilized to manage the complex distributed energy system and has the capacity to be discharged to lower peak load costs. For participating customers, the battery is an alternative to a fossil-fuel generator that can provide hours of backup power to a customer's residence in the event of an electricity outage. And for non-participating customers, in addition to savings on peak load costs, the sale of the batteries generates an additional revenue stream that flows back to all customers. While we currently have several hundred customers using the batteries, we

have customers signed up for delivery and installation throughout the rest of 2018 and expect to have nearly 2,000 customers participating in this program through early 2019. This will create nearly 10 MW of storage capacity to be used in these innovative ways. With this capacity, customers could see savings of over $2 million over the life of the program.

Q10. The next program on your list of Energy Transformation projects relates to cold climate heat pumps and heat pump hot water heaters. Can you give details regarding that project?

A10. Since 2015, GMP has offered cold climate heat pumps aimed at helping customers heat and cool their homes or businesses more efficiently, as well as heat pump water heaters for more efficient water heating. These programs have delivered over 1,200 systems into customers' homes and businesses, and when the number of customers who procured the technology in other ways after talking with us is added in, the total deployed is much higher.

These programs have had several benefits. First, we have delivered education and information to the market about the benefits of heating and cooling with highly efficient heat pump systems. Many customers that discussed heat pumps with the GMP team did not necessarily go with the GMP offering, but learned about the benefits of these systems and went on to purchase them through other means. We consider this a success for smart electrification and potential peak shavings. Our program has provided customers with a choice to transition away from fossil fuels for heating, without having to pay large up-front costs to do so. Second, customers have been able to access this emerging

technology efficiently by using GMP's expertise, with the added benefit of a full guarantee on the unit. Third, we have been able to pair many of these units (and all units going forward) with Sensibo smart controls. These smart controls enable customers to remotely access their heat pumps through their smart devices, even while they are out of the home. They also allow GMP to share access and adjust the heat pumps during the heaviest peak demand times, saving all customers money by reducing the peak energy consumption at that time.

As a pilot is intended to do, the heat pump and heat pump water heater programs have allowed us to evaluate the program's effectiveness and evolve our offerings over the course of the last few years, to determine how best to keep costs lower for all our customers. As part of this evolution, we will be proposing a transition this summer to a program financed through Vermont State Employees Credit Union. We expect this credit-union partnership will prove efficient and popular for customers, increase the number of units with smart controls, and reduce costs for all customers. Customers also may continue to purchase units on their own, and if they do, we will work with them to add control devices through a customer services agreement. Finally, for the smaller number of customers who may want to continue to utilize GMP's direct retail installment contract, we expect to file a tariff to take effect after the current pilots expire.

Q11. Provide the details on the Level 2 Electric Vehicle Home Chargers program.

A11. Electric vehicles ("EV") are clearly a growing segment of the market that are finally taking a firm hold. In markets with utilities that have a higher percentage of renewable energy like GMP's, they give consumers a chance to move away from fossil fuel while

also offering an affordable cost on a per-mile basis. We are offering customers with EVs creative, affordable options for recharging their vehicles at home, which will encourage the purchase and use of EVs while also providing GMP with a grid resource that can be managed during peak energy demand times.

The EV charger offered in this program can connect to the customer's Wi-Fi, which allows the charger to be managed by the customer through an App, and with the customer's agreement, by GMP. Those chargers that GMP has permission to share access and manage are aggregated through GMP's Virtual Peaker platform, meaning that they can be used to respond to peak load events and reduce peak energy costs. Additionally, like the other programs described above, a portion of these residential EV chargers also provide a revenue stream for nonparticipating customers. GMP currently has over 80 customers taking advantage of this program, and is at present engaged with 40 more customers to deploy systems later this year. As more and more customers enroll, the capacity for aggregated management and choreographing of these devices grows as well.

Q12. The next Energy Transformation project is the 'BTM' project. What is this project and how is it providing value to customers?

A12. Our Behind the Meter ("BTM") controls project may be one of our most important development projects as we look ahead to this new, distributed grid. The BTM project involves technology development work to build up the energy management software platform and test out various forms of shared access with customer devices. This includes developing the ability to test controls on everything from different battery

technologies, various EV car chargers, heat pump controls, and water heater controls to smart thermostats. This energy platform technology is critical to our energy transformation work and will allow us to unlock the value of distributed energy resources throughout the grid and provide us with alternatives to solving distribution system issues that do not necessarily involve traditional poles-and-wires solutions. While this project is not a standalone pilot program, it is the platform that is allowing us to roll out our Bring Your Own Device program, which we describe further below, in addition to providing the aggregation control that we need for most other pilot offerings. We are very excited about the work that has been done in this space to facilitate growth of a system of flexible and reliable resources.

Q13. The final program on your Energy Transformation list is the ePark project. Please provide details on that project.

A13. The ePark project is allowing GMP to demonstrate the benefits of using combined battery and solar technology to address reliability issues in existing grid infrastructure. In the ePark project, GMP installed a solar array and battery storage unit at the Emerald Lake State Park in Dorset, Vermont, which is located on a distribution line that was experiencing a high number of reliability issues. The line runs through a very dense section of woods, as well as through a swampland, which has created both a higher likelihood of outages, as well as a much more difficult time responding and restoring due to the fact that equipment that makes restoration easier, such as bucket trucks, could not be used to access the area. Over the last two years alone, this line experienced 23 reliability incidents, all which needed repair. Furthermore, the park closes in the winter

time, yet the distribution line must be maintained throughout the year to assure public safety at all times, even though it only feeds a few restrooms and ranger station at the park. Rather than continuing to maintain or improve this troubled line, the installation of solar generation and battery storage infrastructure allows the park to go off-grid, which will both improve reliability for the park and reduce maintenance costs for all customers. This is a great example of using energy transformation and innovation to solve issues with traditional grid infrastructure. Note that the ePark project was not a pilot, but a GMP capital project in replacement of what would have been a traditional distribution line rebuild. The customer will continue to be billed under existing tariffed electric rates. We will continue to explore opportunities like ePark, in order to reduce operating costs of the traditional system while converting customers to a more reliable energy delivery model. This could include exploring other similar parks and campgrounds, remote sites like cell towers and pump stations, and other harder-to-serve locations.

Q14. How were these customer-facing programs developed? In other words, how does GMP determine what energy transformation products to offer customers?

A14. It starts with investigating ways to bring benefits to all customers by offering products and services that help lower costs, lower carbon, increase reliability, and help load management. We are continuously evaluating ideas that can arise from anywhere: front-line employees, customers, stakeholders, and even other energy companies around the world. From there, we determine if a project is the right fit for our vision and whether it is the right thing to do for the Vermonters we serve. As with everything we do, our north star is the customer. If a project offers customer benefit and fits our vision, we begin to

put together the structure of the program or service, including a financial model, technology roadmap, and any other requirements necessary to run it as a pilot offering.

The pilot program structure provides the opportunity to determine if a given product or service delivers on the expected benefits and whether it should be expanded into a fully-tariffed offering. Once a pilot program has been initiated for a given product or service, GMP then provides a series of status reports under its regulation plan on the progress of the program for 18 months, including sales and performance, at the end of which GMP decides whether to end the program or propose to transition it into a full-fledged Energy Transformation offering. This provides additional time to see if a product or service is providing the right benefits for GMP customers. Most of the customer-facing programs in this filing are current pilot programs or will soon be transitioned to a tariffed customer offering.

Q15. Are these programs all developed by GMP or has GMP partnered with any third parties?

A15. An important part of this energy transformation is providing value to customers, while also looking for ways to strategically partner with third parties. GMP is creating new platforms where multiple parties can independently participate in helping to lower the cost of energy in Vermont.

Although not included in this filing because there are no capital costs, a great example of this is the Bring Your Own Device (BYOD) pilot, which allows GMP customers to procure their own backup battery, and to then participate in GMP's grid transformation capabilities to manage peak costs. We look forward to the deployment of

this program with multiple partners throughout Vermont, and to expanding the number of customers with participating residential storage capacity, which will in turn reduce peak costs and provide benefits to all customers.

We also contract out the installation and maintenance of the products offered to customers (heat pumps, heat pump water heaters, EV chargers, and Powerwall units) to Vermont-based third parties. In this way, GMP benefits from the expertise and training of local installers for the installation of any behind the meter energy transformation products, and these companies are important partners to the success of our customer programs.

It is important to note that GMP is ultimately responsible to guarantee the safe and reliable delivery of energy across our distribution system. It is for this reason that we find it imperative to be able to continue to pilot and test, in real-world scenarios, the various innovative tools and technologies, which then allow us to scale up and offer more broadly as warranted. We want to ensure that while we are delivering innovative solutions to lower cost, we are doing so in a way that has a positive impact on system stability and reliability, not the other way around. Our BYOD program is a great example of how we have been able to test various battery systems, gain comfort with their performance, and offer them out to the marketplace as a way for third parties to sell products directly to customers, leveraging our platforms to extract value.

Q16. In addition to customer-facing programs, you also mentioned larger-scale Energy Transformation projects. Can you please provide details of these projects?

A16. Yes. As part of our focus on transforming the grid and changing the status quo, which creates greater and greater cost pressures for our customers, GMP has and is continuing to develop a number of distribution-scale, community-based energy transformation projects. For example, our Panton Battery Storage project, discussed in Mr. Lisai's testimony, is a 1MW/4MWh lithium-ion battery storage project that will be constructed in 2018 and located adjacent to our existing 4.9MW solar facility in Panton. In addition to providing power supply benefits through reduced peak demand costs and revenue from the frequency regulation market, this battery storage system is being designed to create a distribution island in the event of a substation or transmission system outage. GMP's engineering team is currently working through the details of system stability and protection while operating in an islanded mode with only solar and battery storage. Once fully functional, this detailed engineering will also be carried forward into new solar and storage projects, so that other energy storage projects can also take advantage of islanding benefits.

In addition to the Panton project, our team is focused on delivering solar/storage benefits to customers through three joint venture solar and storage facilities, known as the JV Solar/Battery Storage Projects. Together these projects will have a capacity of just under 14.5 MW AC of solar power, and will each have a battery storage system with a capacity of 2MW/8MWh that will be capable of providing full rating output of 2MWs for up to 4 consecutive hours. These projects are focused on delivering all the same benefits to customers as the Panton project, but will also be able to take advantage of the

Investment Tax Credit while it is still available through a joint venture tax equity partnership to directly provide more value to customers. Mr. Shields provides more detail on these projects in his testimony.

Q17. You discuss a number of different benefits from all the specific projects above. Can you please summarize how GMP approaches and evaluates the benefits of these projects for customers?

A17. With every new initiative program that we offer, we look at how we can stack as many benefits as possible — meaning that we evaluate how the program will benefit not just the participating customer, but equally important, how it will introduce a new tool or resource to drive down costs for all non-participating customers. Projects and programs like these deliver value in multiple ways, including reduced power supply costs through peak demand reductions, energy arbitrage, or providing other ancillary services in the ISO-NE market, such as frequency regulation. They also provide new revenues that flow back to all customers, such as the monthly or one-time fee that we collect from participating customers in our Powerwall pilot program.

An important aspect of stacking benefits is the flexibility of shared access in the programs we are developing. This allows GMP to be able to strategically control resources during peak times to realize some of the benefits mentioned above (reduced power costs through reduced peak load costs, energy arbitrage, and frequency regulation services). As described in Question 12 above relating to the BTM program, over the last year we have developed the ability to control every resource that we deploy to customers.

This includes control of Heat Pumps, Heat Pump Water Heaters, Resistive Water Heaters, Batteries and EV Chargers. This is incredibly important given the increasingly complex job of managing the grid connected to more and more distributed resources.

Q18. Do these programs also advance GMP's compliance with Vermont's Renewable Energy Standards?

A18. Yes, in both direct and indirect ways. First, these platforms and technologies will provide GMP with new tools to manage the distribution system as we move toward our Tier II goals under the Renewable Energy Standard. This is important as we have the ultimate responsibility of maintaining a safe and reliable grid as we make this transformation. Another significant benefit of many of these projects is their contribution towards GMP's Tier III obligations under Vermont's Renewable Energy Standards and advancement of the Comprehensive Energy Plan, which are discussed in the testimony of Brian Otley. The Energy Transformation projects are a critical part of GMP's ability to meet these significant requirements and the overall state goals for Vermont's energy future.

Q19. How have sales and revenues from the customer programs been incorporated into this filing?

A19. The sales and revenues from the customer programs appear in several different places in this filing. First, Itron, as part of their sales forecast, incorporates the incremental load due to the total number of heat pumps and heat pump water heaters installed in GMP's service territory, and the number of units from the customer program are contained as a

subset of that total. Second, GMP will receive either ongoing revenue from the monthly payment for these products or a positive margin from the sale of these units. Both the monthly income payments and the margin on sales may be found in "Other Operating Revenue" in this filing.

We have included in this filing the total impact of the costs and revenues for these pilot programs on the Cost of Service. See **Exhibit GMP-JC-3**. As indicated in this exhibit, the net impact of the pilot programs is a decrease to the Cost of Service, which will provide benefits to all customers, participating and non-participating.

Q20. Does this conclude your testimony?

A20. Yes.