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 KIRK SHIELDS ON BEHALF OF GREEN MOUNTAIN POWER

April 13, 2018

Summary of Testimony

Mr. Shields describes the proposed JV Solar/Battery Storage projects currently under development, and GMP's goals of developing JV Solar/Battery Storage projects in order to primarily reduce peak loads and associated power costs on behalf of customers. Mr. Shields also describes how these projects are key to an energy future that is more reliable and cost-effective.

PREFILED TESTIMONY OF
KIRK SHIELDS
ON BEHALF OF GREEN MOUNTAIN POWER

Q1. What is your name and business affiliation?

A1. My name is Kirk Shields. I am employed by Green Mountain Power ("GMP") as Director of Development and Risk Management.

Q2. Please describe your business experience and educational background.

A2. During my twenty years in the electric utility industry, I have worked for Vermont Electric Power Company and Central Vermont Public Service and am now employed by GMP. My experience and background include renewable project development and construction, resource acquisitions and contract negotiations, risk mitigation structures, and other activities generally related to serving customers through the wholesale bulk power markets. I have also worked with teams to develop innovative products and services for GMP customers, assisted Rutland City in achieving the distinction of becoming the Solar Capital of New England, and most recently led development of several utility-scale solar projects on behalf of GMP customers. I earned a bachelor's degree in finance from Southern Connecticut State University and a Master of Business Administration degree from College of St. Joseph.

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

A3. Yes. I filed testimony in Dockets 7589 (Granite Reliable Wind Project) and 8098 (Stafford Hill Solar). I also provided testimony in the GMPSolar Williston, Richmond, Hartford, Panton, and Williamstown Projects (Dockets 8562, 8564, 8580, 8637, and 8682), the Panton Solar/Battery Storage Project (Case No. 17-2813-PET), the 2018 rate case (Case No. 17-3112-INV), the GMP JV Milton Project (Case No. 17-5003-PET), and the GMP JV Ferrisburgh Project (Case No. 17-5236-PET).

Q4. What is the purpose of your testimony?

A4. I discuss GMP's proposed Joint Venture Solar/Battery Storage ("JV Solar/Battery Storage") projects, along with describing and quantifying their costs and benefits for customers.

Q5. Please provide an overview of the JV Solar/Battery Storage projects.

A5. Green Mountain Power is focused on an energy future that is reliable, clean, and cost-effective. To achieve this, it is important that we find innovative ways to drive down costs to mitigate the otherwise increasing financial burden of a grid that has lower energy sales to support it. These JV Solar/Battery Storage projects are one example of energy tools and resources that can drive down the cost of the grid of the future. Included in the rate filing are three utility-scale solar/battery storage systems that GMP proposes to construct, co-own with a tax investor, and operate, with the batteries being charged primarily by the solar arrays with which they are each paired. The project sites are in

Milton, Ferrisburgh, and Essex, and will be known respectively as the "Milton Project," the "Ferrisburgh Project," and the "Essex Project."

Together, the projects' proposed nameplate capacity will provide 6 MW of battery storage capacity (24MWh of energy over a four-hour period) and add about 14.4 MW of solar energy to GMP's power supply portfolio. Each project will have a 2MW/8MWh Tesla Powerpack battery system and the Milton and Ferrisburgh projects will have a 4.9 MW AC solar array while the Essex Project will have a 4.5 MW AC solar array. Each battery system will be capable of providing its full electric output for up to four consecutive hours, and each complete project system will be able to provide both solar output and battery output simultaneously for reducing peak loads.

The combination of Solar/Battery Storage paired with solar will provide a number of benefits to customers, including:

- Enabling GMP to store energy and discharge during targeted peak load hours, saving customers money on transmission and capacity costs.
- Providing frequency regulation services to earn revenue for customers when not being used for peak load discharge.
- Creating potential opportunities for energy arbitrage.
- Opening up possibilities of other benefits such as "islanding" capability for customers around the project locations in the event of power outages.

I discuss these benefits in more detail below. Furthermore, because of the unique structure of these projects, GMP has the ability to pursue them in a manner that lowers the overall cost of the projects for GMP customers. More specifically, the proposed joint

venture structure enables GMP to take advantage of Investment Tax Credits ("ITC") and to pass on to customers 100% of a developer fee earned by GMP and associated benefits that further lower the costs for customers. GMP originally proposed similar JV solar/storage projects in last year's rate case, but the projects were delayed and GMP agreed to remove the projects from that case and to have further discussions with the Department of Public Service ("Department" or "DPS") regarding the best method for returning these financial benefits to customers. As discussed further below, we have had productive discussions with DPS on this issue and continue to engage with them while we pursue development of these important projects on behalf of our customers.

Q6. How will the ownership of these projects be structured and does that structure provide any advantages for GMP customers?

A6. The ownership structure of these projects presents real benefits for GMP customers. Initially, GMP will co-own these projects through a partnership with a tax investor who will contribute capital to the project in return for tax benefits in the form of ITC and tax depreciation. After the ITC period expires in year six of the Projects' operations, the tax investor's ownership share of the Projects is reduced to just 5%. At that point, GMP will have the option of buying out the tax investor's small remaining share of the Projects. Once the purchase option is exercised, GMP will own 100% of the Projects.

As noted above, this tax financing structure benefits GMP customers directly in several ways. The ITC is a tax credit of 30% of eligible project costs ($11.4 million), which when combined with depreciation attributes that the tax investor will absorb, results in tax investor contributions that will significantly reduce the costs to customers.

Specifically, customers will avoid $14.3 million of capital contributed by the tax investor, which otherwise would increase ratebase and overall customer costs. Internal Revenue Service rules do not permit GMP to use the ITC on its own books for the benefit of customers on day one of the projects; however, a non-utility tax partner can immediately monetize tax attributes, including ITC and depreciation, in order to realize the full benefit of those tax savings. Through this structure, GMP's customers benefit because GMP needs to contribute fewer customer dollars toward the project costs, and the ratebase additions of the Projects are lower than they would be without this type of financing structure. In addition, the battery system becomes eligible for the ITC when paired with eligible solar property (which is the case for these projects), which results in further lowering the battery system capital costs by leveraging this paired solar/storage approach, which directly benefits customers. As noted above, this approach reduces total capital costs by approximately $14.3 million, or by about 33%.

In addition to taking advantage of the ITC, GMP customers benefit from GMP earning a developer fee for initiating and developing these projects on behalf of customers, as well as from earnings flowing back from the investment in the projects. The developer fee is a one-time benefit paid to GMP by the tax equity partnership once the projects are completed and appraised at a fair market value higher than the total sum cost of their parts. The difference between fair market value and cost is the value of the developer fee. This difference can be as high as 15% of the cost of the project. This fee flows directly to customers, reducing GMP's overall costs. GMP also earns a return on its share of the investment in the partnership and that return also flows back to customers. These earnings are recorded as an increase to GMP's investment in an affiliate (similar to

investments in VELCO) following completion of construction, when the book value of the projects is determined. These significant benefits are referred to as "day one gains" because of when the benefit is recognized, and together with the developer fee are expected to be in excess of $12 million. GMP proposes to return these benefits to customers immediately as that is the most favorable approach for our customers on a Net Present Value ("NPV") basis.

Q7. Following the Department of Public Service's comments in last year's rate case regarding these JV projects, has GMP done any further analysis of the most advantageous rate treatment for these projects for GMP's customers?

A7. Yes. Last year DPS raised the issue of potentially spreading out the developer fee and day one gain of these projects over the life of the project, rather than returning these benefits up front to customers, in the 2019 rate period. Because the projects were delayed, we agreed to take the projects out of the rate case and to continue discussion and analysis of this issue. Following those comments, GMP investigated the options for possible rate treatment for these projects, including evaluating the NPV associated with different approaches. We also discussed the results with the Department. The methodology we are recommending delivers more value to customers.

From a Generally Accepted Accounting Principles ("GAAP") accounting perspective, the benefits associated with the day one gain would typically be amortized over the life of the project. However, because GMP is a regulated utility, with the Commission's approval, returning the benefits to customers immediately after development is an appropriate alternative option. GMP also believes it is the most

favorable option, as it provides the greatest benefit for customers on an NPV basis. This is the rate-making approach we are therefore recommending and we request that the Commission approve this approach.

Q8. What analysis did you perform to reach this conclusion?

A8. GMP performed an analysis that compared the Project NPV outcomes for customers in three scenarios: 1) returning the day-one benefits to customers immediately and upfront; 2) returning the benefits to customers over 15 years; and 3) returning the benefits to customers over 25 years. Returning the benefit immediately upfront to customers yields a higher lifetime NPV by about $400,000 over the 25-year scenario, and by about $285,000 higher than a 15-year scenario. Thus, returning benefits on day one is the most beneficial for customers from a cost perspective.

This same rate-making methodology was adopted when the JV Solar projects were included in rates in FY2016 and FY2017, as approved by the Commission, and we are requesting that the PUC approve this same treatment here for the benefit of our customers. Changing the treatment to return these benefits in small annual increments over the life of the projects would have the negative impact of increasing the rate in the 2019 rate period by approximately 2.5% as discussed further in Mr. Ryan's testimony.

Q9. What is the current development status of these projects?

A9. Two of the projects are currently under review by the Commission for a Certificate of Public Good ("CPG"), and a CPG petition for the third project will be submitted in June. Specifically, CPG petitions under 30 V.S.A. § 248 and Public Utility Commission Rule

5.400 have been submitted for both the Milton and the Ferrisburgh projects. A 45-day notice will be issued for the Essex project in April, and the CPG petition will be filed at the end of the required notice period.

System Impact Studies have been conducted for both the Milton and Ferrisburgh projects. The Essex project has undergone initial interconnection review, which has not identified any significant obstacles to successful interconnection, and a System Impact Study will be commissioned by May. GMP has also selected construction contractors for each project, under fixed-price terms.

GMP expects these projects will continue through the CPG review process over the course of 2018 and, pending approval, will begin construction in Spring of 2019. This will allow for the projects to begin reducing summertime peak loads in 2019 and lowering costs for customers.

Q10. What are the goals of these JV Solar/Battery Storage projects?

A10. These projects are part of GMP's focus on innovation and energy transformation technology to benefit customers and drive down costs, as outlined in Mr. Castonguay's testimony. With these specific projects, GMP plans to harness energy storage technology to reduce peak loads and their associated costs for customers. The addition of energy storage to a solar project provides a highly flexible source of dispatchable energy on the circuit to target and lower GMP's peak loads during forecasted peak load hours—a tool known as "peak shaving"—which directly provides value for all GMP customers. In other words, one of the primary goals of these projects is to store energy generated by the

solar array in the battery and then discharge that stored energy during peak energy use periods to reduce GMP's system peak loads and associated costs to customers.

Q11. Why is peak shaving important?

A11. Lower power costs directly save customers money. Reducing peak loads reduces GMP's allocated share of transmission and capacity cost obligations within the New England region, which are significant cost drivers for GMP's rates. Peak shaving will be the primary, but not exclusive, use case of the battery storage systems, meaning that the system will primarily be used to achieve lower power costs.

Q12. How are GMP's regional cost obligations calculated?

A12. System peak loads are ISO-NE's basis for calculating GMP's annual Capacity Load Obligation and its monthly Regional Network Service ("RNS") transmission costs. RNS costs are all of the costs associated with maintaining the bulk high-voltage transmission system within the New England region, to which all distribution utilities connect. RNS transmission costs are allocated among load-serving entities, such as GMP, based on our load coincident with the Vermont system load at the time of VELCO's peak, meaning that GMP's transmission costs are a function of peak load. Lower loads, and lower peak loads, thus reduce cost obligations in regional markets that are allocated to load-serving entities like GMP so that GMP customers pay less.

Likewise, GMP's obligation in ISO-NE's Forward Capacity Market (FCM) of the Installed Capacity Requirement (ICR) is based on our coincident load during the previous year's ISO-NE summer annual peak. Reducing load coincident with the annual summer

peak reduces GMP's obligation in the FCM for the following year. This means that savings in these markets, which are achieved through load reductions, are credited back to customers through future rate adjustments.

Q13. In addition to peak shaving, what other benefits will the projects provide to customers?

A13. With these projects, GMP's strategy is to "stack" benefits to reduce net power costs for customers. When not in use for peak shaving, the projects will also provide frequency regulation services and earn revenue for providing these services in the regional market, which are returned 100% to customers. Here's how it works: in this market, the battery responds to signals from ISO-NE to charge or discharge in four-second intervals. The battery's fast response helps regional grid balance generation and loads in real time. When eligible resources, such as the proposed battery storage systems, respond to the dispatch signals and provide frequency regulation services to the grid, GMP is paid for providing that service. As a result, providing frequency regulation services to the region is a value stream that the battery can monetize for customers and contribute to lower power costs.

In addition to peak shaving and frequency regulation, there is some limited opportunity for energy arbitrage where the battery is charged during low-priced hours and discharged during higher-priced hours. However, energy arbitration is not expected to be a major contributor to the overall value proposition since peak shaving and frequency regulation will constitute the bulk of battery operations.

In addition, as illustrated in Table 1 in the following response, the projects will likely have a useful life longer than the 25 years over which the costs will be depreciated. This means that after the projects are fully depreciated, they will continue to serve customers at low cost (operation and maintenance only) for a number of years.

Finally, GMP engineering is currently analyzing how solar/storage projects such as these can enhance customer service reliability through maintaining electric service to customers during extended outage events when service is disrupted on the circuit. This kind of "islanding" capability is already an existing feature of the battery system, and GMP's analysis will evaluate which loads can safely and reliably be carried on a circuit and how system protection will protect the circuit when disconnected from the rest of the distribution grid. The analysis is expected to be completed in June 2018. Thus islanding capabilities will very likely be another very important benefit of these projects for customers at some point in the future. Serious climatic events and changing weather patterns make improvements to system reliability and resiliency for customers even more important.

GMP will employ the different use cases discussed above (peak shaving, frequency regulation, energy arbitrage, and islanding) at different times to optimize financial benefits for customers. Since the battery system cannot simultaneously provide frequency regulation services and perform peak reduction functions, the services will be discretely managed with sophisticated battery management controls. The battery control system allows for scheduling the services to optimize the value for the battery services performed. GMP's cost-benefit modeling takes into account those operational values in determining the value to customers.

Q14. Please summarize the cost to customers for the JV Solar/Battery Storage projects.

A14. In summary, the effective 35-year levelized unit cost that customers will pay for these projects is 8.0 cents per kWh for the solar component and 5.5 cents per kWh for the Solar/Battery Storage component. GMP is not aware of any other solar project operating in Vermont whose unit cost is this low. By comparison, the lowest-cost operating solar project contracted through the Standard Offer program is $0.1096/kWh. Table 1 below shows the total levelized cost breakdown for the 3 projects.

Table 1

	cents/kWh
Solar PPA	0.099
Solar Share of Rate Base Savings	(0.010)
Value of Operation Past 25 Years	(0.008)
Levelized Solar Cost to Customers	**0.080**
Battery PPA	0.061
Battery Share of Rate Base Savings	(0.006)
Levelized Battery Cost to Customers	**0.055**
Levelized Project Cost to Customers	**0.135**

As shown above, customers realize additional benefits from GMP ownership of the projects by providing at least 10 years of service beyond the 25-year assumed life of a typical power purchase agreement. Although production output will have degraded below its original production capacity at 25 years, the solar arrays will still have sufficient life in them to operate beyond their assumed life, with inverter replacements assumed and budgeted during years 15-20.

In addition, there will be no added maintenance cost for the batteries for the first 20 years of the project life, as GMP will execute a Capacity Maintenance Agreement under which the manufacturer will ensure the batteries maintain their full rated capacity for this period. The cost of the Capacity Maintenance Agreement is incorporated into the project cost.

Q15. Please provide some additional detail about the capital cost for the JV Solar/Battery Storage projects and explain how these costs were developed.

A15. GMP has worked closely with its vendor and developer partners to estimate costs for equipment, materials, and labor for each of the proposed projects. GMP has awarded fixed-price Engineer, Procure and Construct ("EPC") contracts for the solar and battery storage components for each Project. EPC contracts create contractual obligations to construct and deliver operating systems for a fixed price, significantly reducing procurement and construction cost risk. Total projected project capital costs are summarized below in Table 2, however GMP's share of those costs are shown separately in Table 3 below.

Table 2

Project	**Rate Year ($ millions)**
Milton	$13.58
Ferrisburgh	$15.17
Essex	$14.26
Total Capital Costs	**$43.01**

Because GMP expects to own these facilities for up to 35 years, GMP's capital investment is accounted for in ratebase as an investment in an affiliate (similar to how investments are made in VELCO). The total capital investment included in ratebase is also lower than the total project costs shown in Table 2 with the inclusion of a tax equity partner who will contribute capital in exchange for investment tax credits and depreciation from the Projects. As noted above, the capital contributed by the partner will directly reduce GMP's required investment in the projects, resulting in a lower addition to GMP's ratebase. Table 3 below shows GMP's expected capital contribution to the partnership, net of the partner's capital contribution, which is the amount of capital added to ratebase (through investments in affiliates). The reduction in ratebase, relative to a structure in which GMP does not take on a tax partner, is approximately $14.3M. This is further discussed in the testimony of Eddie Ryan.

Table 3

Project	**GMP Share of Capital Costs ($ millions)**	**Equity Partner Share of Capital Costs ($ millions)**
Milton	$9.06	$4.52
Ferrisburgh	$10.12	$5.05
Essex	$9.52	$4.74
Total	**$28.70**	**$14.31**

Q16. What alternatives have you considered for these Projects?

A16. GMP has various load management tools to use for pursuing similar load reduction benefits for customers. None of the load management methods, including the intended uses of these proposed Projects, are mutually exclusive, meaning that GMP pursues multiple strategies simultaneously in order to reduce power costs for customers. Alternative load management strategies currently being deployed by GMP include the Curtailable Load Rider, Pilot Load Response Rider, Critical Peak Rider, Water Heater program, and Tesla Powerwall program. All of these programs are cooperatively managed to achieve the highest load reductions for customers to lower power costs. In addition, GMP is currently evaluating another potential pilot for testing flexible demand resources such as ice storage by partnering with customers who have this equipment already installed but are not using it with an eye toward peak load management.

Q17. Have you performed a cost-benefit analysis for these projects?

A17. Yes. The results of the cost benefit analysis show that the projects have a positive NPV of about $5.4 million. The positive NPV indicates that customers are financially better off with the projects than without them. NPV results are summarized in Table 4 below.

Table 4

	Project NPV $
Avoided Utility Costs	
Solar	26,475,442
Battery	20,213,879
	46,689,321
Levelized $/kWh	**$0.163**
Project Costs	
Solar	25,459,279
Battery	15,673,542
	41,132,822
$/kWh	**$0.144**
Net (Cost)/Benefit	
Solar	1,025,102
Battery	4,406,516
	5,431,618

Q18. Is GMP requesting to include the full project capital cost in GMP's ratebase?

A18. No. GMP's use of a tax equity partnership lowers ratebased capital and makes efficient use of the available federal tax credits to deliver cost-effective energy for customers. The ITC is a tax credit of 30% of eligible project costs, and when combined with depreciation, reduces the capital costs borne by customers by about $14.3 million as illustrated in Table 3.

The reason for using tax equity financing is because FERC accounting rules otherwise specify that GMP amortize the benefits to customers over the life of the Projects rather than upfront; however, a tax partner can help monetize tax attributes for customers *immediately*, including ITC and depreciation, in order to harvest those tax savings for customers faster than otherwise would be allowed. As illustrated above, those combined tax attributes significantly reduce total capital costs to customers and also directly reduce the amount added to GMP ratebase. Only GMP's share of the total

capital investment will be included in ratebase using this tax financing structure. GMP most recently employed this tax partnership strategy for the GMPSolar projects that were successfully completed in 2016 (GMPSolar Richmond, Williston, Hartford, Panton, and Williamstown).

Additional discussion regarding the proposed ratemaking approach to these projects is provided in Mr. Ryan's testimony.

Q19. Does this conclude your testimony?

A19. Yes.