STATE OF VERMONT
PUBLIC UTILITY COMMISSION

Petition of Green Mountain Power Corporation for a certificate of public good authorizing the purchase of electricity from Great River Hydro, LLC	))))	Case No. 21-____-PET

PREFILED TESTIMONY OF
ANDREW QUINT
ON BEHALF OF
GREEN MOUNTAIN POWER CORPORATION

March 4, 2021

Mr. Quint's testimony explains how GMP evaluated the PPA and its fit with GMP's short-term and long-term energy needs together with GMP's renewable goals. Mr. Quint also addresses how the proposed PPA helps to meet GMP's customer demand on a monthly and annual basis.

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1. <u>Introduction</u>

Q1. Please state your name, occupation, and business address?

A1. My name is Andrew Quint. I am a Power and Markets Analyst for Green Mountain Power Corporation ("GMP"). My business address is GMP, 66 Merchants Row, Rutland, VT 05701.

Q2. Please describe your professional background, qualifications and experience.

A2. I have a Bachelor of Business Administration degree from Southern Methodist University. I also have a Master of Business Administration and Master of Science in Finance degrees from Boston College. I am a Certified Public Accountant in the State of Texas. I have been with GMP for over 16 years and in the Power Supply group for the past 15 years. My primary focus is analysis of generation and resource opportunities; forecasting energy and capacity market prices; and overseeing and analyzing market interactions with ISO-NE. I have provided testimony and support on various topics including avoided costs, Rule 4.100, the Standard Offer Program, and renewable generation. Prior to joining GMP, I worked at Fidelity Investments for 12 years in a number of financial analysis roles including Director of Finance and Analysis.

Q3. Have you previously testified before the Public Utility Commission?

A3. Yes, I have testified in a number of Dockets including 8010 and 8684 on Rule 4.100 avoided costs; Dockets 8569 and 8586/8685 on petitions for Rule 4.100 PPAs; Docket 8827 relating to the purchase of hydroelectric generation facilities; Case No. 17-5003-PET (GMP Solar/Storage-Milton); Case No. 17-5236-PET (GMP Solar Storage-Ferrisburgh); and Case No. 18-2902-PET (GMP Solar/Storage-Essex).

Q4. What is your role in the proposed Power Purchase Agreement between GMP and Great River Hydro, LLC ("GRH"), and what is the purpose of your testimony?

A4. I have reviewed the proposed Purchase Power Agreement ("PPA") to determine its fit with GMP's short- and long-term energy needs. I have also reviewed its fit with GMP's requirements for renewable attributes over the life of the PPA based on Vermont's Renewable Energy Standard ("RES") and GMP's internal carbon free and renewable energy goals. Finally, I have reviewed the value of the energy output covered by this PPA. The purpose of my testimony is to address how the proposed PPA helps to meet GMP's demand on a monthly and annual basis; how it furthers GMP's renewable obligations and goals; and finally, how both of the energy products help to provide value for our customers.

2. <u>Overview of the PPA Products and their Value</u>

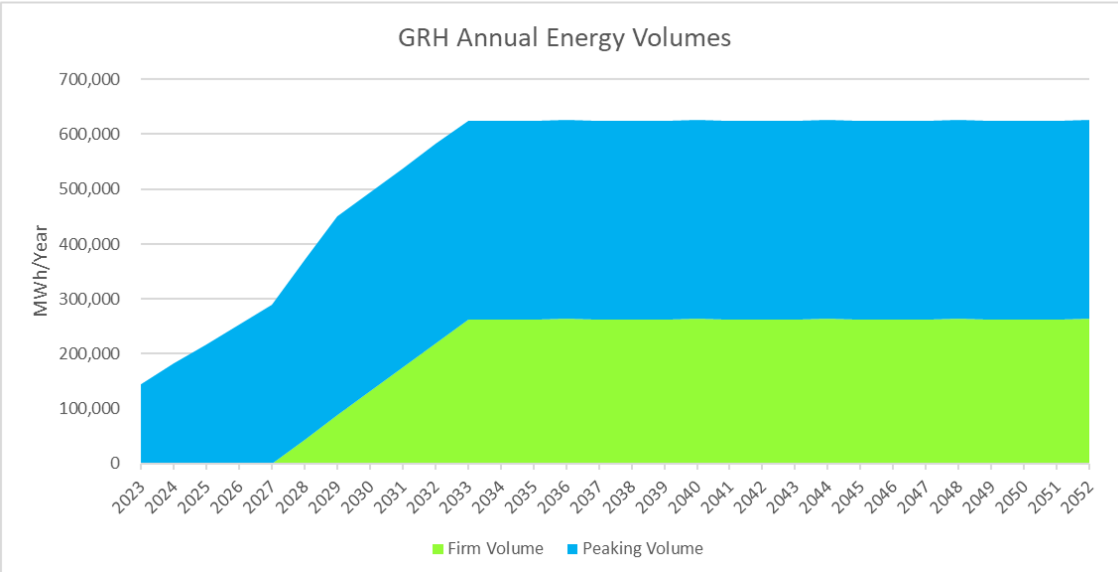
Q5. Please describe the products GMP will be buying under this PPA.

A5. The PPA between GMP and GRH is for energy associated with renewable attributes, which are broadly defined in the PPA to include renewable energy certificates ("RECs") tied to the output of GRH's generation facilities on the Connecticut and Deerfield Rivers. The PPA includes two distinct energy products, which are referred to as firm hydroelectric energy and peaking hydroelectric energy in the PPA. The firm energy deliveries will be for a fixed hourly volume across all hours of the year. The peaking energy deliveries are unit contingent and will vary based on the hourly operating characteristics of the Fifteen Mile Falls facilities (the "FMF Facilities")—subject to PPA requirements that obligate GRH to optimize performance in the energy markets.

In particular, the PPA requires GRH to begin making peaking energy deliveries on January 1, 2023, with GMP receiving twenty percent of the output of the FMF Facilities and, in addition, RECs equivalent to a total annual volume of 800,000 MWh of renewable generation. After the initial year, GMP's share of the peaking product's output increases by 5% of the total output of the FMF Facilities per year until GMP is purchasing 50% of the combined plants' total output in 2029. Although the energy output for the FMF Facilities will fluctuate on an annual basis, long-term historical average output indicates that at their maximum GMP's 50% share of the average peaking energy volumes should be between about 345,000 and 360,000 MWh per year.

Beginning in 2028, GMP will also receive a fixed hourly volume of firm energy and the associated RECs from GRH. This energy volume is supported by all of the GRH generation units on the Connecticut and Deerfield Rivers, including the FMF Facilities (collectively, the "GRH Facilities"). The firm energy volume starts at 5 MW per hour across the year and will grow by 5 MW per year until GMP receives 30 MW per hour in 2033, after which the volume will remain constant until the contract ends in 2052. This volume is firm and although there is a possibility of curtailments during extremely low hydrology periods, any such potential events would not be anticipated to affect volumes of energy delivered in a meaningful amount as GMP will be taking a relatively small share of the total output from GRH Facilities. This volume will generally not be affected by seasonal or annual variability in the plants' output. Once the contractual volumes have ramped up, GMP anticipates purchasing a total of approximately 625,000 MWh from GRH on an annual basis of combined peaking and firm energy. **Figure 1** below shows the anticipated annual volumes that GMP will purchase from GRH over the term of the PPA.

Figure 1



Q6. Please summarize your understanding of the benefits this PPA will provide for GMP customers.

A6. As I will discuss below, there are several benefits of this PPA for GMP customers. This long-term PPA provides GMP's customers with a source of renewable and reliable energy that has a beneficial profile for meeting GMP's future load needs. The shape of the output, which combines peaking and firm volumes, is a good fit for a portion of GMP's open-portfolio positions and complements the shape of existing in-state renewables such as solar and wind across days and seasons. The PPA also allows GMP to lock in favorable, long-term pricing that is lower than any other renewable source currently in GMP's portfolio and will help to provide rate stability over its life. The current wholesale market price outlook is significantly lower than it has been in the past, and we think that the current market environment makes this a good time to lock in the purchase of a well-priced renewable resource. The volumes of energy and associated

RECs purchased over the life of the PPA will help GMP meet its obligations under Vermont's Renewable Energy Standard.

Q7. With respect to the peaking energy, please discuss how GRH operates the FMF Facilities and how this could provide value to GMP and its customers.

A7. The energy volume from the FMF Facilities is referred to as the peaking product in this PPA because the plants respond to periods of maximum system demand in the ISO-New England energy market. As Mr. Cole explains, the three developments that make up the FMF Facilities are Moore, Comerford, and McIndoes. These hydropower stations have meaningful ponding capabilities and are able to control hydro flows within the hours of a day and, within certain operational limitations, across days, allowing the GRH to schedule and dispatch the FMF Facilities to meet peak system demand, resulting in higher than average Locational Marginal Prices ("LMPs"). **Table 1** below, based on information provided by GRH, shows the long-term historical average hourly total output by month for the FMF Facilities in megawatts, including all generation.

Table 1

Hour Ending	January	February	March	April	May	June	July	August	September	October	November	December
1	46	50	50	126	96	36	22	22	22	44	50	50
2	46	50	50	126	96	36	22	22	22	44	50	50
3	46	50	50	126	96	36	22	22	22	44	50	50
4	46	50	50	126	96	36	22	22	22	44	50	50
5	46	50	50	126	96	36	22	22	22	44	50	50
6	44	50	50	126	106	36	22	22	22	44	50	50
7	56	56	56	166	146	48	24	24	24	56	56	56
8	76	76	76	166	146	48	28	28	28	66	76	76
9	86	86	86	166	146	48	30	30	30	66	96	96
10	96	96	96	166	146	48	32	32	32	66	96	96
11	96	96	96	166	146	48	36	36	36	66	96	96
12	86	86	86	166	146	50	40	40	40	66	86	86
13	76	76	76	166	146	50	44	44	44	70	72	72
14	72	72	72	146	136	70	64	64	64	70	72	72
15	68	68	68	146	136	88	84	84	84	66	68	68
16	66	66	66	146	136	88	84	84	84	64	66	66
17	86	86	86	146	136	88	84	84	84	84	86	86
18	146	146	146	176	166	78	74	74	74	134	146	146
19	146	146	146	176	166	64	52	52	52	146	146	146
20	146	146	146	176	166	48	42	42	42	146	146	146
21	146	146	146	176	166	44	38	38	38	146	146	146
22	146	146	146	176	166	40	32	32	32	136	146	146
23	76	76	76	156	146	38	28	28	28	76	76	76
24	56	56	56	136	126	36	24	22	22	56	56	36

The output shows a distinct pattern across all months, where output has generally been highest during the mid-morning and then again during the late afternoon and early evening hours. In general, these hours have tended to feature higher than average LMPs over the last six years as shown in **Table 2** below. **Table 2** shows the monthly average hourly LMP at the Vermont Load Zone (ISO-NE node 4003) as a percentage of the monthly average LMP at the Vermont Zone. Any hours where the average historical hourly LMP exceeds 100% is highlighted in yellow, with hours featuring average historical hourly LMP exceeding 125% being highlighted in pink. This data is based on ISO-New England's reported hourly Day-Ahead LMPs for the Vermont Load Zone.

Table 2

Analysis of Average Day-Ahead LMP at Node 4003 as a Percentage of Monthly Average LMP (January 2015 - December 2020)												
Hour Ending	January	February	March	April	May	June	July	August	September	October	November	December
1	84.5%	87.3%	85.1%	84.5%	84.3%	82.5%	74.9%	74.6%	76.5%	79.3%	81.7%	84.5%
2	80.5%	82.6%	80.0%	80.4%	76.7%	76.0%	69.2%	68.9%	70.4%	73.5%	76.1%	79.1%
3	76.4%	79.9%	77.7%	77.1%	70.2%	70.2%	64.3%	64.5%	65.2%	68.6%	72.4%	75.6%
4	76.0%	79.6%	77.3%	74.8%	67.6%	66.5%	60.7%	61.3%	62.4%	66.3%	71.5%	75.1%
5	79.3%	82.6%	79.7%	77.9%	69.9%	66.2%	60.4%	61.2%	63.6%	69.1%	74.4%	78.9%
6	88.8%	92.0%	90.5%	87.1%	78.8%	70.2%	62.3%	65.2%	71.1%	80.1%	85.1%	88.6%
7	109.6%	106.4%	110.9%	106.6%	90.1%	80.9%	68.4%	70.8%	87.2%	101.3%	103.1%	102.8%
8	112.4%	113.6%	119.6%	118.3%	100.0%	86.8%	75.4%	76.2%	90.7%	112.1%	113.1%	111.3%
9	109.7%	110.1%	114.7%	116.1%	101.6%	89.7%	83.1%	83.5%	93.0%	109.6%	110.0%	109.7%
10	108.5%	109.8%	113.8%	116.8%	106.1%	96.9%	92.0%	92.6%	98.7%	108.7%	107.2%	109.4%
11	107.1%	109.8%	111.1%	115.1%	109.0%	102.5%	100.2%	100.3%	101.3%	109.2%	105.8%	104.9%
12	102.5%	105.2%	106.9%	108.4%	109.9%	108.3%	110.2%	110.5%	108.5%	106.4%	102.8%	101.1%
13	97.0%	99.7%	99.6%	102.7%	108.9%	113.2%	119.4%	119.4%	112.9%	101.4%	98.0%	95.3%
14	93.5%	94.3%	93.6%	98.0%	110.3%	118.6%	129.3%	128.2%	119.8%	99.9%	94.4%	91.5%
15	90.8%	90.8%	89.3%	93.6%	110.1%	122.5%	136.4%	135.1%	123.1%	98.3%	93.4%	90.7%
16	93.2%	91.1%	88.0%	91.9%	112.9%	128.7%	143.9%	143.8%	129.0%	99.9%	98.9%	96.0%
17	112.1%	99.3%	93.6%	95.2%	118.0%	136.3%	151.5%	150.3%	135.3%	110.0%	126.6%	125.6%
18	143.5%	130.2%	109.4%	103.9%	122.1%	137.5%	151.3%	150.3%	137.5%	127.6%	153.7%	148.0%
19	132.6%	135.2%	127.1%	110.3%	117.7%	126.6%	138.1%	136.4%	133.5%	155.7%	139.1%	132.5%
20	118.5%	119.4%	135.3%	128.0%	119.1%	118.2%	124.0%	123.9%	138.3%	143.8%	122.3%	120.0%
21	108.6%	108.7%	120.5%	134.6%	132.4%	118.2%	117.1%	120.1%	121.3%	115.5%	108.2%	109.1%
22	99.1%	97.9%	103.3%	104.3%	107.6%	106.5%	102.2%	99.8%	97.8%	97.5%	96.2%	98.3%
23	90.1%	89.8%	89.9%	90.3%	91.3%	91.4%	85.8%	84.6%	83.8%	85.4%	85.7%	89.9%
24	85.6%	84.8%	82.4%	84.1%	85.7%	85.6%	79.9%	78.7%	78.9%	80.8%	81.7%	82.4%

As this PPA covers hydroelectric output, it is important to note that there are seasonal characteristics to the output, with the highest volumes coming during the months of April and May, while volumes drop off significantly during the drier summer months. The spring volume may at times exceed our hourly needs, as occurs with other generation resources with a similar profile, but this potential can be mitigated as needed through forward resales and is balanced by lower summer flows during what is typically the predominant solar generation season. Overall, the PPA delivers a very favorable hourly output value throughout the year, as I explain in more detail below.

Q8. Please discuss your analysis of the value of energy delivered by the FMF Facilities, considering the shape of the peaking energy output.

A8. The screening that I undertook to understand the value of the peaking output used the historical shape shown in **Table 2** above that reflects long-term hourly average output levels by month and then applying the shape to the hourly Day-Ahead LMP at the Vermont Zone for the period of January 2013 through November of 2020. Based on this analysis, we calculated that the value of the historical average output shape was higher than the Around the Clock or All Hours Average ("ATC") Day-Ahead LMP by about 7% for the entire period as shown in **Table 3** below.

Table 3

Year	ATC DA-LMP	GRH Peaking Weighted LMP Value	Annual Premium
2013	$54.91	$59.21	7.8%
2014	$63.81	$70.04	9.8%
2015	$41.58	$45.00	8.2%
2016	$29.66	$30.99	4.5%
2017	$33.05	$35.75	8.2%
2018	$43.71	$46.73	6.9%
2019	$30.67	$32.54	6.1%
Average	$42.48	$45.75	7.7%

The ATC shape assumes that the same quantity of energy is delivered across all hours of the period being considered. In this case, the ATC average is calculated by taking the sum of the hourly LMPs and dividing by the number of hours being analyzed, which effectively assumes that one megawatt is being delivered for each hour. This is a meaningful and consistent premium over the ATC shape. Next, I compared the historical value of energy at the various pricing nodes where deliveries will be made for the FMF Facilities, which includes the following:

Node/Unit ID	Unit Name	Node Name
473	MCINDOES	UN.COMERFRD34.5MCIN
47366	COMERFORD 1	UN.COMERFRD13.8COM1
47367	COMERFORD 2	UN.COMERFRD13.8COM2
47368	COMERFORD 3	UN.COMERFRD13.8COM3
47369	COMERFORD 4	UN.COMERFRD13.8COM4
47370	MOORE 1	UN.MOORE 13.8MOR1
47371	MOORE 2	UN.MOORE 13.8MOR2
47372	MOORE 3	UN.MOORE 13.8MOR3
47373	MOORE 4	UN.MOORE 13.8MOR4

Based on an analysis covering both Day-Ahead and Real-Time LMPs for deliveries at these nodes, there was a small discount to energy delivered at the Vermont Load Zone (node 4003). This discount was approximately 1% for the Day-Ahead market and less than 2% for the Real-Time market based on ISO-New England pricing reports for the period of January 1, 2017 through August 31, 2020. This strong correlation between pricing for the Vermont Zone and the delivery nodes for the FMF Facilities indicates that the premium observed using historical average hourly output and the Vermont Zonal LMP should yield similar results when using the specific delivery nodes. Additionally, the small spread between the Vermont Zone and the peaking energy delivery nodes indicates there have not historically been any significant congestion or loss issues associated with the output of the FMF Facilities. The limited congestion and losses are reflective of well-established nodes with robust existing transmission that do not typically experience any significant constraints.

Finally, GRH provided historical hourly generation volumes for the period starting January 1, 2018 and ending May 31, 2020. By applying the hourly Day-Ahead and Real-

Time Energy Component of the LMPs we were able to determine that there is a persistent premium based on the actual hourly output of the peaking product as compared to the ATC average LMP in **Table 4** below.

Table 4

	Around the Clock		Achieved LMP		Premium	
Period	Day-Ahead LMP	Real-Time LMP	Day-Ahead	Real-Time	Day-Ahead	Real-Time
2018	$44.02	$43.21	$49.35	$48.09	112%	111%
2019	$31.17	$30.56	$33.00	$32.90	106%	108%
2020	$20.23	$19.79	$21.20	$20.78	105%	105%

By looking at various combinations of hourly LMPs, there is a strong likelihood that the FMF Facilities' significant dispatch capabilities will enable GRH to continue to realize a premium over the ATC energy prices. In general, the majority of generation is anticipated to settle in the Day-Ahead market with minor volumes being settled in the Real-Time market to reflect relatively minor deviations associated with changes in hydro volume and operational variations that help to maximize energy value when significant spreads occur between the Day-Ahead and Real-Time markets. Such operational variations would involve adjusting dispatch volumes during the course of a day in the event that the Real-Time LMPs varied significantly from the Day-Ahead LMPs, provided there were sufficient water volumes available in the reservoirs to adjust the output of the facilities. These adjustments to output in response to market signals would generally increase the value of the peaking product for GMP's customers relative to the profiles that are shown above. The premiums shown above change over time and reflect a low energy market environment in 2019 as well as a partial year of results in 2020, but they do indicate that there is a meaningful premium associated with how the FMF Facilities have historically been operated. Based on the ability to manage output across hours of the day and potentially between days, and the contractual terms designed to ensure GRH continues to operate the FMF Facilities to be responsive to the needs of the New England grid, there is a reasonable expectation that GRH will continue to operate in that way even if market changes develop during the PPA's term, as discussed below.

Q9. What potential market changes did GMP consider in evaluating the PPA?

A9. As Mr. Smith discusses in his testimony, we anticipate that the regional energy market will change as increasing volumes of renewable energy are added in New England, driven to a large degree by various state programs sponsoring the development of solar, offshore wind, and other renewable projects. Based on the anticipated growth of new renewables in the region and our current understanding of the energy market, GMP anticipates that LMPs will decline during spring and summer hours over time as significant new renewable generation comes online. There may also be a decline during winter hours to the extent offshore wind generation begins to offset a meaningful portion of the natural gas and other fossil fuel generation that typically drives high winter LMPs. These technologies have tended to impact winter LMPs as the region deals with fuel shifting during peak demand periods, when oil-fired units are called to operate as natural gas becomes scarce due to its use for heating of homes and businesses. This dynamic will change if these units retire, and as thermal loads are transferred to electric or other less carbon-intensive fuels over time. This decrease is expected to result from the anticipated suppression effect of significant volumes of zero-fuel-cost generators during certain hours, which will tend to lower ISO-New England's hourly requirements and effectively lead to the lowest priced portions of the bid stack being used to meet demand. The bid stack, in this case, would be the economic ordering of supply resources that have been offered into the market. The lowest priced units generally have low or no fuel costs, while the most expensive units have high fuel and operating costs and tend to run infrequently when the market experiences periods with significant or unexpected demand. The trends above should, over time, increase the number of hours where LMPs will be at or near zero, but will also feature hours when LMPs are significantly higher as these intermittent resources are ramping up or down or are not generating.

The terms of the PPA and flexibility of the FMF Facilities are important as they mitigate GMP's exposure to these market risks. The unique ability of the FMF Facilities to shift generation between hours in a day, and to some degree, between days, will allow these facilities to continue to respond to the needs of the New England grid and maximize the value of their output in a changing energy market, benefitting our customers. The PPA has terms that are meant to ensure that GRH operates the facilities to maximize, to the extent possible, its performance in the energy markets, which we anticipate will result in meaningful premiums over the ATC LMP for the foreseeable future. As the continued owner of half the output of the FMF Facilities, GRH will continue to be incentivized to operate the assets reliably and efficiently. The ability to pond and operate all three of the FMF Facilities in concert allows for GRH to effectively operate to be responsive to system needs and thus maximize the output during high energy price hours. For example, as LMPs drop during hours with peak solar generation, it will be natural to see higher LMPs during the early morning hours with relatively high customer demand and slowly ramping solar generation and then again in the hours after the sun sets and loads tend to peak. In such a scenario, we would expect to see the FMF Facilities have higher output during the early morning hours and after the sun sets, which would be when GMP most needs the energy and also when the energy has the most value to GMP's customers. Another potential value-maximization effect might occur when GRH is able to pond water during a sunny day and then increase output the following day if it was expected to be hazy, hot, and humid, which are conditions associated with significantly lower solar generation but higher energy prices, thus the PPA complements both existing and continued growth in solar generation. Overall, we believe that the highest LMPs will tend to occur during hours where GMP has higher loads and more need due to lower behind-the-meter solar generation during these hours, and when we would anticipate receiving deliveries of the peaking product from the FMF Facilities.

Q10. Please explain your analysis of whether the firm component of the PPA provides value to GMP's customers.

A10. The firm portion of the PPA provides GMP with a fixed volume of energy that helps to limit exposure to spot market prices as GMP's loads vary across the day. At the same time, the limited volume of firm energy helps to minimize the potential sale of excess energy during periods with significant solar or wind generation, when LMPs will tend to be lower than daily averages. The firm energy will also help to meet customer needs during higher demand hours that feature higher than average LMPs. More generally, the firm component of the PPA provides certainty to GMP's portfolio and helps to offset the "wobble" associated with intermittent resources that have characteristic daily and seasonal patterns of output and experience substantial short-term fluctuations in output based on availability of sun, water, and wind.

3. <u>The Pricing under the PPA.</u>

Q11. What is the approximate price of the products delivered under the PPA?

A11. The prices for energy and RECs begin at about $45/MWh for the peaking product in 2023 and at about $47/MWh in 2028 for the firm product; the REC price itself begins at $2.44 per REC.

Q12. Please explain how the pricing of this PPA compares to other renewable options.

A12. To help provide context around the pricing for this proposed transaction, it makes sense to examine the pricing for a number of different, but related products. There are two major classes of renewables that can be examined.

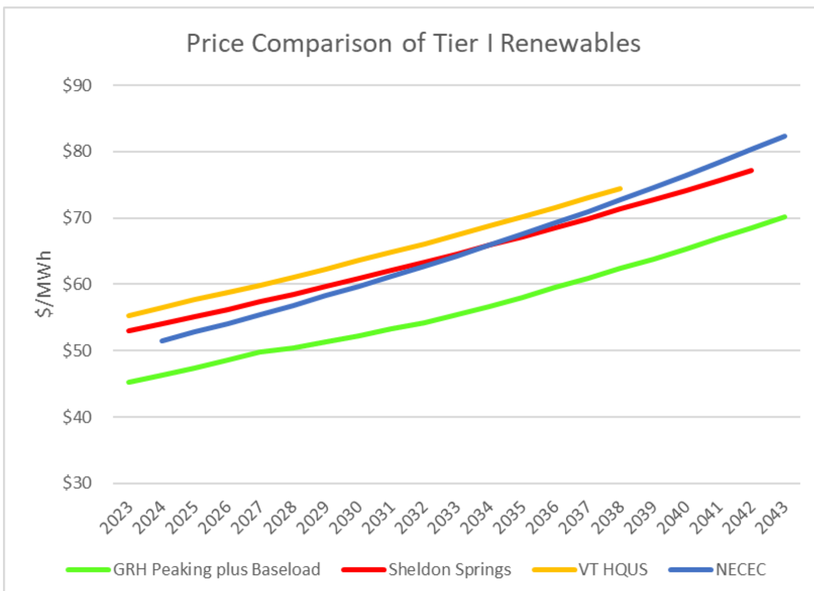
The first group is existing renewables that would qualify for Tier I of the RES. We would generally include some of our existing renewables such as HQUS and Sheldon Springs Hydro, which GMP purchases under long-term PPAs. It would also be reasonable to include something like the proposed New England Clean Energy Connect ("NECEC") project, which will bring existing hydroelectric generation from Québec to Massachusetts.

The second group of related products would be new renewables that qualify for Class I RECs in other New England states and would also qualify for Vermont Tier I due to location and size. This group would include large solar development on the scale of projects selected in recent Connecticut and Maine RFPs, with sizes ranging from 15 MW to over 50 MW, as well as new offshore wind projects that have been awarded PPAs under a number of state RFPs. These options obviously have different output profiles than the proposed hydroelectric-sourced PPA, but they provided guidance as we evaluated the PPA price terms.

As noted above, the pricing for the proposed PPA starts at approximately $45/MWh for the peaking product in 2023 and $47/MWh for the firm product beginning in 2028. These prices are lower than the current prices GMP pays for energy and RECs under hydroelectric-sourced PPAs that do not feature the same beneficial mix of peaking and firm energy. For example, the Sheldon Springs PPA features deliveries of run-of-river hydroelectric generation with minimal ponding for a current price of $49.94 for energy and attributes. The HQUS PPA features a 7x16 shape – meaning that energy is delivered between hours ending 8 and 23 every day - and a current price of $50.66/MWh for energy and RECs, and a price formula that has a weighting of changes in market prices and an inflation factor. The NECEC PPA between Eversource and HQ features a first-year price of $51.51for energy and RECs or Clean Energy Certificates (“CEC”), with a price escalator of 2.5% per year and a Guaranteed Delivery Term Start Date of December 13, 2022 or approximately the same start date as this PPA.[1]

Figure 2 below demonstrates how the proposed PPA compares favorably to the various PPAs summarized above:

Figure 2

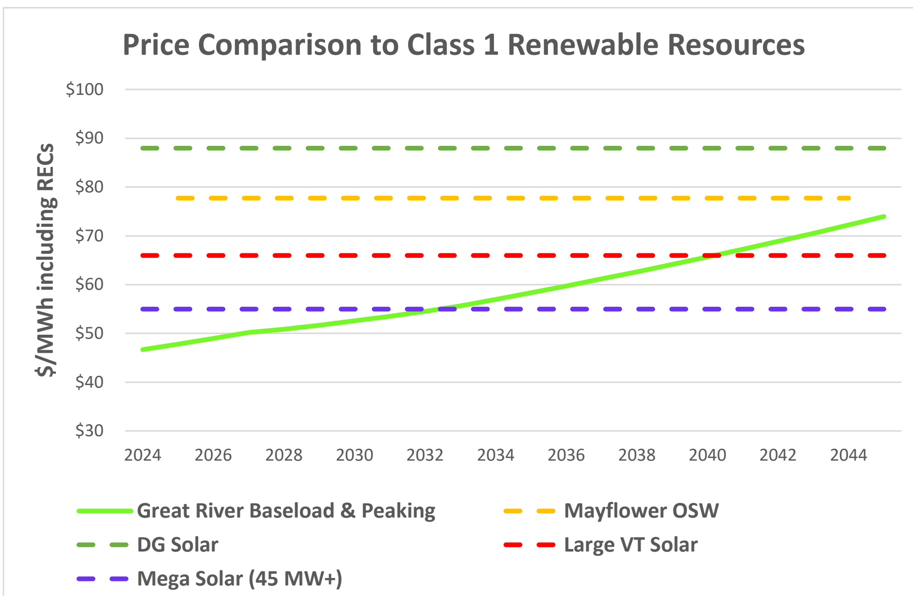


The favorable position is solidified when one considers that New Class I renewables feature a significant spread in prices and may not, in all cases, reflect all of the costs associated with delivering the energy to customers. For points of comparison when looking at prices for energy with RECs, we selected Mayflower Offshore Wind, with a levelized price of $77.76; a DG solar project eligible for Vermont Tier II featuring a Standard Offer program price of just under $90/MWh; a large solar project of up to

[1] https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/9636757 page 75.

20 MW located in Vermont featuring an estimated price of just under $70/MWh; and, finally a large solar project of over 45 MW with a price of about $55/MWh based on the Maine RPS Class 1A RFP. **Figure 3** below shows a comparison of the proposed PPA costs for each of these products, but does not address the relative value of the output of these projects to meeting the demand of GMP's customers or locational differences in the market value of their output:

Figure 3



As discussed below, the levelized cost for the purchase of energy and RECs from GRH is about $60/MWh, reflecting the impact of a slow phase in of energy volumes over ten years. If instead the full contractual volumes began deliveries at the beginning of the PPA term, the levelized cost would be several dollars lower, though the risk of resale would be higher. Regardless, the PPA price is below all of the options shown above with the exception of solar in excess of 45 MW. However, as I have discussed above, the shape of the products that we will be purchasing for our customers have a better fit with our portfolio needs than comparable products.

As we look at the different options available to GMP, we see significant other benefits associated with the GRH transaction as it features an energy profile that is complementary to the installed and growing base of solar generation in our territory. As I discussed earlier, having a carbon-free resource that helps to meet customer demand in hours when solar generation is not available makes this a valuable and complementary resource for hedging our energy needs. Additionally, as we anticipate that there will be continued growth of solar generation through programs such as net metering, there is a continued need to diversify our portfolio by adding other non-solar renewable generation to help ensure that we have sufficient resources to reliably meet customer demand on a daily, monthly, and annual basis.

4. The Ability of the PPA to Meet GMP's Energy Needs

Q13. Please describe how the PPA helps GMP meet its future load requirements.

A13. Mr. Smith's testimony provides an overview on this subject. In brief, GMP meets its load requirements through a mix of long- and short-term PPAs. The general goal is to provide price stability for our customers while also ensuring that our portfolio stays reasonably connected to the ISO-New England market. This is accomplished by having a meaningful portion of our portfolio filled with a variety of short-term market purchases that have maturities of between one and five years. These short-term PPAs have a higher proportion of non-renewable power than our longer-term commitments. We anticipate that our need for these short-term transactions will decrease in the near-term with the addition of the PPA as reach and then maintain a 100% renewable portfolio.

In addition, GMP has a number of significant renewable and carbon-free PPAs that will be ending in the early to mid-2030s. These include the Granite Reliable Wind PPA for approximately 82 MW of output on a unit contingent basis and the NextEra Seabrook PPA that currently supplies GMP with 60 MW of baseload energy. In addition, GMP's PPA with H.Q. Energy Services (U.S.) Inc. ("HQUS"), which now delivers approximately 180 MW of energy between hours ending eight and twenty-three on a daily basis, will wind down in the mid-2030s. The expiration of these PPAs opens up a significant future need and opportunity for GMP's portfolio.

As we look at ways to fill our portfolio with renewable resources, this PPA offers a number of appealing features: all the energy is from renewable resources located in New England; the PPA ramps up over time with the peaking component providing shaped output that is a good fit with our portfolio needs and complementary to the continued growth of solar resources in our portfolio; and the firm component of the PPA begins to deliver energy near the end of the decade as significant baseload and on-peak PPAs begin to phase out, providing limited volumes that will grow as GMP anticipates needing to add firm energy to help serve its load.

Q14. Please describe how the proposed PPA helps to meet GMP's load needs on an hourly basis.

A14. To better understand this PPA in the context of GMP's portfolio, we analyzed how the anticipated energy volumes would help to meet hourly short positions based on our settlement data for calendar year 2019. This approach provides meaningful insights because it reflects the actual combination of loads and generator output that occurred during each hour over the course of that year and does not rely on normalized figures that generally do not adequately capture the interaction between loads and generation.

The first step in the analysis was to align the hourly quantities of GMP's load requirements and generation sources as reported to ISO-New England with the output of behind-the-meter resources that operate as load reducers to determine GMP's net hourly energy position in the market. This net position indicates the extent to which GMP was purchasing from or selling to ISO-New England, on an hourly basis. These net positions were adjusted to remove all short-term PPA transactions, which settled at the Massachusetts Hub (ISO-NE node 4000), to provide a more accurate view of GMP's needs as the PPA begins to ramp up when these short-term PPAs will have largely expired. The portfolio was also adjusted to account for the already assumed continued growth of solar generation from sources such as net metering at a pace of about 20 MW to 25 MW per year. To simplify the analysis, we assumed the same solar hourly output profile that GMP experienced in 2019, which covers a variety of solar generation with different sizes, both AC and DC, as well as orientations and ages. Based on this analysis, we estimated that between 60% and 65% of the output from GRH will help to meet GMP's short positions, depending on whether we used the 2019 actual FMF Facilities' output profile or the long-term average hourly historical peaking profile (see **Figures 4 and 5** below).

While we assumed a reasonable pace of solar growth based on historical trends, a significantly higher rate of solar deployment would not greatly change the volume of energy from this PPA that GMP would use to fill our short position. This is because the profile of the GRH peaking output is complementary to the profile of solar generation and often fills resource needs during hours when solar is either not generating or has limited output. Having the PPA's output meet load needs during hours when other intermittent or variable resources are not able to fill the needs is a positive reliability result and helps to support the value of the PPA as a key building block of our current and future portfolio.

One of the benefits to having a resource with GRH's output profile is that the PPA is a meaningful hedge for hours when GMP's portfolio is expected to have net-short positions. In particular, the PPA's deliveries will help limit the portfolio's exposure to spot prices that can fluctuate significantly over the course of a day, month, or year. A PPA that closely matches our load needs also has the advantage of reducing short-term or spot purchases that would otherwise come from system power and generally not be from renewable resources. Limiting the future purchases of system power will enhance

GMP's work to reach its carbon-free and renewable goals and more tightly match our load and resources.

Q15. Please describe how the output associated with the proposed PPA compares to alternative options for meeting GMP's hourly load needs.

A15. As part of our analysis, we compared the output profile of the PPA with similar volumes of output from other renewable resources that might be available in region at similar scale, specifically additional solar facilities and a combination of solar and wind facilities providing the same volume of energy on an annual basis. We first compared the historical FMF Facilities' volumes generated in calendar year 2019 assuming GMP was receiving the full 50% share of output, which resulted in about 402,000 MWh - a volume that significantly exceeded the historical average. When combined with the anticipated firm volume we arrived at a total volume of approximately 665,000 MWh as shown in **Figure 4** below.

Figure 4

	Base Case No Solar Growth	Scenario 2 Anticipated Solar Growth	Scenario 3 GRH PPA	Scenario 4 Solar Equal to GRH	Scenario 5 Solar and Wind Equal to GRH
GRH Peaking Profile Used			Actual 2019		
New Solar Volume in MW	0	240	240	730	485
New Wind Volume in MW	0	0	0	0	97
Great River Baseload MW	0	0	30	0	0
Peaking Volume as Percent of Total PPA Allocation	0%	0%	100%	0%	0%
Annual Estimated Settlement Position in MWh					
Long Position	70,882	287,202	554,856	870,513	680,652
Short Position	(1,133,251)	(1,022,959)	(625,723)	(939,869)	(750,764)
Net Position in MWh	(1,062,369)	(735,756)	(70,868)	(69,356)	(70,112)
Change in Long Position vs. Normal Growth	(216,320)		267,653	583,310	393,450
Change in Short Position vs. Normal Growth	(110,292)		397,235	83,090	272,194
Total Change vs. Normal Growth	(326,613)		664,889	666,400	665,644
Percent Filling Short Position			60%	12%	41%
Percent Sold as Long Position			40%	88%	59%
Peaking Volume			402,089		
Firm Volume			262,800		
Total GRH Volume			664,889		

We also ran the same comparison using the long-term historical average hourly profile provided by GRH, which totaled approximately 360,000 MWh of peaking volume, which, when combined with the firm volume would yield about 625,000 MWh of total volume as shown in **Figure 5** below.

Figure 5

	Base Case No Solar Growth	Scenario 2 Anticipated Solar Growth	Scenario 3 GRH PPA	Scenario 4 Solar Equal to GRH	Scenario 5 Solar and Wind Equal to GRH
GRH Peaking Profile Used			Average Profile		
New Solar Volume in MW	0	240	240	691	466
New Wind Volume in MW	0	0	0	0	89
Great River Baseload MW	0	0	30	0	0
Peaking Volume as Percent of Total PPA Allocation	0%	0%	100%	0%	0%
Annual Estimated Settlement Position in MWh					
Long Position	70,882	287,202	503,003	822,484	646,153
Short Position	(1,133,251)	(1,022,959)	(626,201)	(944,290)	(768,655)
Net Position in MWh	(1,062,369)	(735,756)	(123,198)	(121,806)	(122,502)
Change in Long Position vs. Normal Growth	(216,320)		215,801	535,282	358,951
Change in Short Position vs. Normal Growth	(110,292)		396,757	78,669	254,303
Total Change vs. Normal Growth	(326,613)		612,558	613,951	613,254
Percent Filling Short Position			65%	13%	41%
Percent Sold as Long Position			35%	87%	59%
Peaking Volume			349,758		
Firm Volume			262,800		
Total GRH Volume			612,558		

Based on each of these historical GRH profiles, a clear majority of GRH energy would have filled a net short position and effectively decreased GMP's market exposure. Alternatively, if GMP were to use one of these potential sources to obtain the same volume of annual energy, approximately 13% of the projected solar output and 41% of the projected solar and wind output would help to meet GMP's energy needs by filling short positions. Conversely, GMP would anticipate selling between 59% of the solar and wind output and 87% of the solar output to the market, which carries a greater risk that at least a portion of these sales would occur in hours when energy prices are at or near $0/MWh.

Selling these long positions would create meaningful risk for our customers because the shape of those positions would match times when GMP already would expect to have long positions where it sells excess energy to ISO-New England, due to the output of solar compared to customer load needs.

The benefit of the GRH portfolio becomes more pronounced over time as the Granite, NextEra Seabrook, and HQUS PPAs roll off and we see growing open positions in our portfolio. The proposed PPA will act as an anchor as we seek to balance the continued growth of solar-shaped energy with other resources that will help to meet customer demand both on a daily and seasonal basis.

5. PPA Effects on Net Power Costs.

Q16. How will the PPA affect GMP's net power costs?

A16. The structure of the PPA provides immediate value for our customers as it will provide a long-term source of energy and RECs for our portfolio at a cost that reflects current market prices and that grows slowly over time. The prices of the peaking and firm components are below many of our current portfolio contracts due to a lower current market outlook than existed when we entered into those other PPAs in the last decade. Additionally, a number of PPAs will be expiring at the beginning of the next decade, and this agreement will help to lock in lower-priced energy and environmental attributes over the long-term.

The firm energy pricing is reflective of the ATC energy prices for ISO-New England, while the peaking product features a meaningful and consistent premium over ATC pricing. As I discussed earlier, the peaking product has provided a consistent premium to the value of ATC energy, and the ability of GRH to manage the timing and volume of output through ponding in both the Day-Ahead and Real-Time markets should allow it to adapt and continue to provide this same sort of premium over time even as we anticipate changes to the ISO-New England energy market.

Overall, since the pricing is similar to what we have identified as our market outlook in our current forecast, and since the PPA is set to phase in over the next twelve years as our open position expands, we do not anticipate a material impact on our net-power costs through the rest of this decade. Additionally, as we will be replacing expiring PPAs that feature higher prices with the volume from this contract, we anticipate seeing a benefit for our customers over a longer time horizon. By entering into a long-term PPA at a time with moderate energy price expectations we expect the PPA will provide a benefit to our customers across the term of the agreement.

Q17. How do these prices compare to the estimated value of the PPA to GMP's customers?

A17. The PPA is well priced based on our current market outlook and helps to lock in long-term stability for the portfolio while also limiting the initial volumes that GMP will purchase to help match volumes with the timing of portfolio needs. The Net Present Value of the expected PPA for purchasing the energy products and environmental attributes is slightly under $400 million or about $60/MWh on a levelized basis[2] over the thirty-year term of the agreement. The levelized cost of the PPA could have been lowered somewhat by either increasing the overall energy volumes purchased in the early years or by selecting a shorter contract term. However, as GMP evaluated the PPA we determined that the ramp-up of the energy volumes delivered to generally match our portfolio need as well as the longer duration of the deliveries to lock in well-priced energy and attributes would be most beneficial for our customers. As Mr. Smith discusses, the limited volumes of existing renewable generation in New England and the steadily growing demand for clean energy options in the region helped GMP determine that now was the appropriate time to enter into a PPA with substantial volumes of renewable energy to ensure the renewability of our portfolio over the long term. The prices featured in the PPA are reflective of current energy prices based on broker quotes and our estimated value of Vermont Tier I eligible RECs. The prices grow over time based on an escalation factor that is roughly equivalent to anticipated inflation and that helps to contain any long-term impact on GMP's portfolio.

Q18. Please explain how market uncertainty affected GMP's analysis of the PPA.

A18. As Mr. Smith discusses, there is significant uncertainty about future energy prices in the region. Looking at the future, many of the current energy forecasts do not adequately account for the total cost of bringing new renewables to market, or fully factor in the impact that long-term PPAs through state programs will have on their development. To

[2] The levelized price for this PPA takes into account the PPA's 30 year term, which is generally longer than many alternatives, and the ramp up of deliveries over time to fit GMP's needs.

the extent that the current ISO-New England markets do not fully support the economics of this new generation, the remainder of the required value will likely be driven by the environmental attributes of the projects that customers pay for through other mechanisms. There is also a strong possibility that ISO-New England's energy market will either become a balancing market, allowing participants to efficiently manage any imbalances created by intermittency in their resource mix, or that it will be restructured to support the future needs of ISO-New England participants in ways that provide a more direct incentive for the deployment of renewable sources.

In light of this future market uncertainty, we have reviewed a variety of valuations, where a mix of energy and REC value supports the PPA pricing and yields a long-term benefit for our customers. In general, we are seeing indications that energy market prices will tend to moderate in the 2030s (relative to natural gas prices) as significant zero-fuel-cost resources start to drive meaningful stretches of hours with low or zero LMPs. As Mr. Smith discusses, we are also expecting that the growing renewable- and clean-energy requirements across New England will tend to increase the value of RECs from existing resources due to increased demand and will consequently drive the value of Vermont's RES Tier I eligible RECs closer to the alternative compliance price ("ACP").

Q19. Please discuss the price scenarios that GMP has developed to analyze this PPA and explain how you developed the price outlooks.

A19. GMP has developed three energy and REC price scenarios that assume different growth rates for the anticipated significant renewable generation around New England. The first, or high scenario, is consistent with a future in which the complete build out of new renewable sources such as large offshore wind projects is slower to reach completion than present state goals indicate, with final units reaching commercial operation late in the next decade. In this path, energy prices remain somewhat connected to natural gas through 2040, and Tier I REC prices remain moderate throughout the analysis period. The second, or base scenario, assumes that the completion of the build out of significant new renewables occurs by the mid-2030s with energy prices falling substantially relative to natural gas prices in the middle of the decade and thereafter featuring moderate growth while Tier I REC prices grow at a slightly faster pace than the high scenario. The last, or low scenario, assumes that the build out of large-scale renewables of the magnitude required to meet the region's aggressive decarbonization goals is accomplished by the end of this decade and continues through the next several decades, leading to significantly lower energy prices by the beginning of the next decade as prices become disconnected from natural gas, which is displaced as the leading hourly marginal fuel for the region.

The three energy price scenarios were developed based on a review of subscription-based consultant materials and discussions with our consultants who specialize in providing analysis of the New England energy market. These analyses are somewhat different from our previous energy outlooks reflecting a rapidly evolving energy marketplace. In the past we have relied on strong correlation between natural gas prices and New England energy prices as the basis of our forecasts and have focused on how natural gas prices will evolve over time as new pipeline capacity is built. At the same time, we reviewed planned generation capacity retirements and proposed additions to understand changes to underlying market heat rates, which have been a key driver of our price forecasts.

Our fundamental assumptions to forecasting energy prices have changed based on continued efforts within the New England states to dramatically reduce carbon emissions through a variety of state renewable policies and the growing volume of renewable generators forecast to come online over the rest of this decade. We have determined that, over the next decade, the high correlation between natural gas and ISO-NE energy prices will gradually diminish as we see zero-fuel-cost generation grow rapidly. Consequently, we anticipate that there may be a large number of spring and summer hours where prices will be at or near $0/MWh as solar output surges, while we also expect that offshore wind, which features strong winter capacity factors, may help to reduce demand for fossil fuel generation during the winter months when we have historically seen some of the least efficient units running (due to the use of natural gas for home heating purposes during the winter, which as noted above is also anticipated to shift more over time as carbon goals are attained).

As discussed above, many of the large new renewable projects under development in New England are being supported by long-term PPAs that balance tradeoffs between state objectives with the markets for energy and renewable attributes in the region. To model this dynamic GMP looked at the value of the energy being delivered for the firm and peaking products as well as the implied value of the associated renewable attributes that would, over the term of the PPA, be required to break even with the PPA prices for the products on a net present worth basis. By using renewable attribute values expressed as a percent of the alternative compliance price for Vermont Tier I RECs to bridge the gap between the PPA purchase prices and the value of the energy delivered, we were able to determine whether the required future REC prices were reasonable. The PPA price for energy and RECs in each of the scenarios that we present exceeds the value of the energy purchased by significantly less than the Vermont Tier I ACP – with the discount being on the order of between 30% and 70%. We based this judgement of the reasonableness of the required attribute values on our understanding of the current REC markets as informed by GMP's consultants and our knowledge of current prices for the various REC classes and tiers.

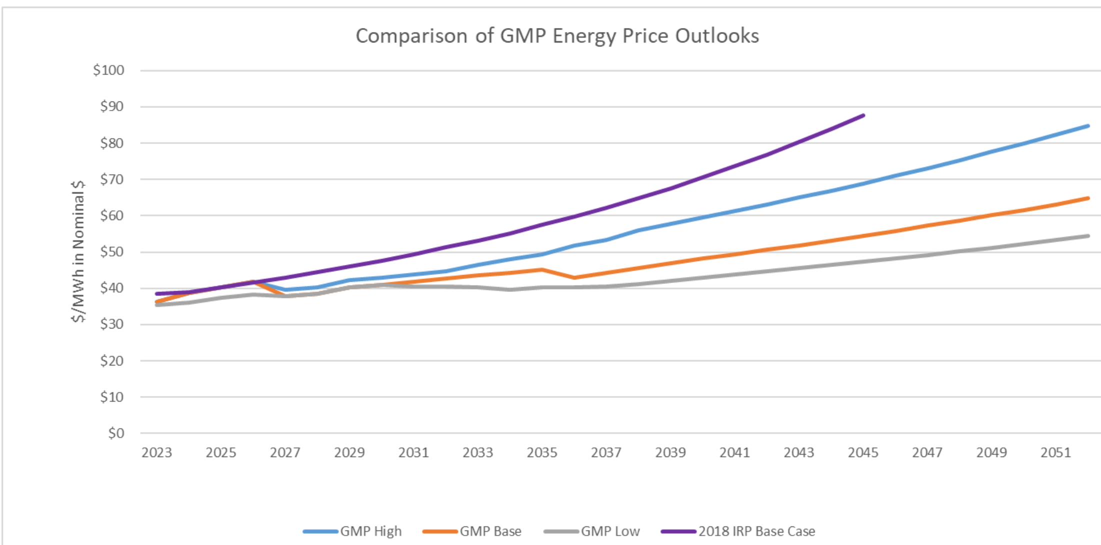
In general, GMP's low scenario anticipates that significant new renewables such as large scale solar and offshore wind will be in the market by the end of this decade. The scenario also assumes that market disruptions will be moderated by the continued need for additional generation to support loads in hours where there is limited output from these resources, effectively creating a large number of low-priced LMP hours and a large number of meaningfully higher LMP hours required to ensure adequate generation to support the market. Our belief is that moderate capacity prices and low energy prices will be insufficient to ensure an adequate energy supply during all hours, requiring the market to evolve to help balance the countervailing trends. Through the mid-2030s, GMP's low case slowly increases at a pace of about 2% per year (approximately the long-term inflation rate), meaning that the energy value will remain flat in real terms. Using this low scenario, the renewable attributes would need to be about 75% of the Vermont Tier I ACP for the customer value from the underlying PPA products to be equal to the PPA purchase price. This is a reasonable assumption, as under this scenario the rapid growth of demand for renewables as New England decarbonizes will drive up the value of renewable attributes from both new and existing resources.

GMP's base scenario assumes that the pace of the renewable buildout is somewhat slower due to permitting and construction issues and is completed in the mid-2030s. Energy prices are forecast to follow current broker prices for the next several years before moderating in 2027—the end of the broker strip—and then growing slowly through 2035, after which prices sag as significant renewable volumes are absorbed by the market. The energy prices never get as low as those featured in our low scenario but grow at a rate that is slightly higher than inflation. This trend reflects the continued need for generation to fill hours where load requirements exceed the output of renewable generation and some portion of that generation is fossil based, which is encumbered with moderate internalized carbon costs. In the context of the PPA price, we assume that attributes would only need to be valued at about 60% of the Vermont Tier I ACP to balance the cost of the products with the spot market value of the energy. The relative value of Vermont Tier I eligible RECs under this scenario would also be driven up by tightening supplies across New England as other states continue their drive to decarbonize with new and existing renewable generation.

Finally, in the high scenario we assume that the build out of renewables takes until the late 2030s and that the correlation between natural gas and energy prices does not decrease as significantly due to the longer-term need for fossil fuel generation to support New England's energy needs. This scenario also assumes that the energy market evolves as ISO-NE works to provide stability for the various market participants. Under this scenario attributes would only need to be somewhat under 30% of the Vermont Tier I ACP to balance the cost of the products with the spot market value of the energy. This would be only a modest increase from current low prices seen for existing renewables and would be driven by increasing requirements for renewable and carbon-free generation across the region.

Each of the energy price scenarios is a credible long-term energy price path reflecting the fundamental transition of the region's energy mix to meet aggressive renewable energy goals. As Mr. Smith notes we believe that these are conservative energy price outlooks that do not rely on potential structural changes that might tend to enhance the value of the energy being purchased under the PPA. In each of these scenarios, we are assuming a significantly lower energy price environment than we had used in GMP's 2018 Integrated Resource Plan ("IRP"). This reflects the changing market conditions since the 2018 IRP was prepared, with prices and expectations that have moderated over time and that now anticipate a meaningfully lower energy price environment for the foreseeable future. This environment has largely emerged at the same time that the New England states have started to significantly strengthen their environment goals and press a number of large renewable projects toward commercial operation. These trends have led to rapidly evolving consultant outlooks that have tried to deal with significant uncertainty. This has also reflected the continued policy of decarbonizing through the use of environmental attributes and RFPs in New England instead of reliance of carbon pricing directly in the energy market that had widely been anticipated in various studies over the past decade. See **Figure 6** below:

Figure 6



The PPA prices generally follow GMP's Base outlook for energy but are somewhat higher than the ATC prices shown in the graph above. This reflects that the purchase price includes the value of environmental attributes and a premium for the shaped output of the peaking product. Regardless, there are a number of factors that make this PPA a good option to supply GMP's customers with a well-priced renewable source of energy over the long-term. These factors include the strong fit of the energy volumes with

GMP's open position; the value that both the firm and peaking products provide to our customers; the fact that the products being purchased provide a complementary shape to solar output; and reasonableness of the PPA prices based on our current market outlook. Additionally, based on the growing renewable requirements in the New England states, locking in a meaningful volume of output from a well-priced renewable resource helps to provide certainty for meeting our customers' future needs in light of the limited supply of existing renewables currently available in New England. We anticipate that this will help to insulate our customers from potential price competition in the future as various utilities work to meet increasing renewable and carbon-free requirements in their states.

6. Conclusion

Q20. Does this conclude your testimony?

A20. Yes.