STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Electric Service	**))))**	**Case 20-E-0380**
Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Gas Service	**))))**	**Case 20-G-0381**

DIRECT TESTIMONY
OF
ELISHEBA SPILLER
ON BEHALF OF
ENVIRONMENTAL DEFENSE FUND

Dated: November 25, 2020

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I. Introduction and Qualifications

Q. Please state your name, title, and business address.

A. My name is Elisheba "Beia" Spiller, and my title is Lead Senior Economist. My business address is Environmental Defense Fund, 257 Park Avenue South, New York, New York.

Q. Would you please summarize your educational background, professional experience, and current general responsibilities?

A. I have over a decade of experience in researching energy economic topics ranging from gasoline and vehicle demand to impacts of natural gas extraction. However, over the past seven years, I have primarily focused on electricity pricing and regulation, with a special focus during the past two years on medium- and heavy-duty vehicle electrification. I received a Bachelor of Arts in Environmental Policy from University of California, San Diego in 2003; a Master's in Public Policy from Universidad Torcuato di Tella in Buenos Aires, Argentina in 2005; a Master's in Economics from Duke University in 2008; and a PhD in Economics from Duke University in 2011. During my tenure at Environmental Defense Fund ("EDF"), I have engaged in the topic of electricity pricing through multiple efforts. For example, I have participated in rate cases in both New York and California, helping to provide analysis for testimony and comments describing the benefits and impacts of time-variant pricing. In March 2015, I led a forum on time-variant pricing in New York City developed in coordination with Department of Public Service Staff and the Institute for Policy Integrity at NYU School of Law ("IPI") to inform the

New York Public Service Commission (the "Commission")'s Reforming the Energy Vision ("REV") proceeding, inviting a number of practitioners from across the country to describe their experiences with time-variant pricing and how it could be implemented in New York. In May 2016, as part of Case 16-E-0060, I filed testimony regarding how best to structure a rate pilot in order to achieve measurable outcomes, and have continued to engage with Consolidated Edison over the years with regard to the roll out and implementation of their Innovative Pricing Pilot. Furthermore, for the past two years, I have focused on rate design for medium- and heavy-duty ("MHD") electric vehicles ("EVs"), specifically for internal work within EDF. My work has helped develop EDF's strategy for approaching rate design for these vehicles, resulting in a published document on this topic.[1] I have also been working with external parties to analyze the impact of a variety of tariffs on a set of MHD EV fleets (that is, fleets of trucks and buses), in order to identify the impact of the tariff on shifting behavior, load management, system costs, and bills.

Q. Have you previously filed testimony before the New York Public Service Commission?

A. Yes. As a witness for EDF in the Consolidated Edison Company of New York rate case brought in 2016 (Case 16-E-0060), I provided pre-filed testimony regarding the design of time-variant pricing pilots for residential customers.

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[1] *See* Exhibit __ (ES-2). This document is also available online at http://blogs.edf.org/energyexchange/files/2020/10/ChargingFactSheet.pdf

Q. On whose behalf are you testifying in this proceeding?

A. I am submitting testimony on behalf of EDF.

II. Purpose of Testimony and Recommendations

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to recommend modifications to Niagara Mohawk (the "Company")'s proposed approach to the electrification of MHD vehicles, including potential modifications to commercial tariffs that could help support a rapid, low-cost electrification of fleets of MHD vehicles in a manner that yields maximum benefits.

Q. Please provide a summary of your testimony and recommendations.

A. My testimony centers around two issues: managing charging patterns with technology, and shaping tariffs with MHD vehicles in mind. Specifically, I recommend developing cost-reflective tariff options that would be available for prospective MHD EV charging customers. The objective of these cost-reflective tariffs in the setting of MHD EV charging is to achieve optimal charging patterns that both benefit the electric system and the environment while also keeping customers' bills low. Furthermore, to enable the price-responsiveness necessary to achieve the alignment between private incentives (reduced electric bills) and public benefits (minimized system and environmental costs), I recommend that the Company take steps to ensure that enabling technology for managed charging is in place from the start for MHD EV fleets.

Q. Was your testimony prepared by you or under your supervision?

A Yes.

Q. Are you sponsoring any exhibits?

A. Yes, I am sponsoring the following exhibits:

Exhibit __ (ES-1): CV of Elisheba Spiller

Exhibit __ (ES-2): Smart Pricing Principles for Charging Electric Trucks and Buses

III. New York's Vehicle Electrification Goals and the Company's Proposal

Q. Please describe New York's goals with respect to vehicle electrification.

A. New York has a variety of goals regarding vehicle electrification. With respect to the electrification of light-duty ("LD") vehicles, New York has committed to have approximately 850,000 Zero Emissions Vehicles on the roads by 2025. This goal arises from New York's signing on to the Multi-State Zero Emissions Vehicle Memorandum of Understanding ("ZEV MOU") in 2013.[2] Under the ZEV MOU, New York is one of eight states with a collective target of at least 3.3 million Zero Emissions Vehicles[3] on the road by 2025; New York's 850,000 ZEV goal is its share of this total. In addition to agreeing to a particular level of ZEV deployment, ZEV MOU signatory states including New York have committed to work together

[2] *See* State Zero-Emission Vehicle Programs, Memorandum of Understanding (Oct. 24, 2013), https://www.nescaum.org/documents/zev-mou-8-governors-signed-20131024.pdf/

[3] Zero Emissions Vehicles include plug-in hybrid electric vehicles, battery electric vehicles, and hydrogen fuel cell vehicles.

to establish charging and fueling infrastructure that will adequately support this number of vehicles.[4]

MHD vehicles were not covered in the 2013 ZEV MOU. However, goals for that sector were adopted on July 14, 2020, when New York signed on to a new multi-state memorandum of understanding, this one concerning medium- and heavy-duty vehicles (the "MHD MOU").[5] In the MHD MOU, the signatory states, including New York, adopted an ultimate goal of 100% of new MHD vehicle sales being zero-emissions in 2050, as well as an interim goal of 30% of new MHD vehicle sales being zero-emissions in 2030.

Q. How do the MHD MOU signatory states plan to achieve these goals?

A. In the MHD MOU, the states agreed to collaborate, through a process similar to the one established in the 2013 ZEV MOU, to "develop a multi-state action plan to identify barriers and propose solutions to support widespread electrification of medium- and heavy-duty vehicles (Zero Emission Medium- and Heavy-Duty Vehicle Action Plan)."[6] That process is currently underway and will culminate in individual state processes and policies to achieve the mutually agreed-on goal.

Q. What are the environmental ramifications of New York's vehicle electrification goals?

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[4] *See Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure,* Case No. 18-E-0138, Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs at 3-4 (July 16, 2020).

[5] *See* Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding (July 14, 2020), https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf [hereinafter MHD MOU].

[6] *Id.* Section 2.

A. Eliminating fossil fuel combustion in our vehicles is absolutely critical to New York meeting its climate goals. Unless all or most of the greenhouse gas ("GHG") emissions from the transportation sector are eliminated, New York's GHG emissions goals, now codified in the Climate Leadership and Community Protection Act ("CLCPA"), will probably be out of reach. The Department of Environmental Protection is still in the process of establishing the exact goals in tons based on CLCPA statutory requirements for the baseline, GHG-equivalence, upstream impacts, etc.,[7] but the ultimate goal of the law is for 2050 New York State greenhouse emissions economy-wide not to exceed 15% of their 1990 levels, and preferably to be eliminated entirely.[8] And, as of New York's most recent GHG inventory, released in 2019 and based on emissions through 2016, the transportation sector accounted for 36% of all GHG emissions.[9]

But the environmental imperative to eliminate the tailpipe emissions from MHD vehicles is not based solely on their greenhouse gas impact. The tailpipe emissions of diesel trucks and buses have serious public health ramifications; they are tied to

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[7] The Department of Conservation rulemaking, proposing a new 6 NYCRR Part 496 Statewide Emission Limits, is currently underway. Information about the status of the rulemaking can be found at https://www.dec.ny.gov/regulations/121052.html (last visited Nov. 24, 2020).

[8] The Proposed Part 496 that is currently the subject of the rulemaking would establish 401.38 million metric tons of carbon dioxide equivalent and would establish a 2030 limit of 240.83 million metric tons of carbon dioxide equivalent and a 2050 limit of 60.21 million metric tons of carbon dioxide equivalent. *See* Proposed Part 496, available at https://www.dec.ny.gov/regulations/121059.html (last visited Nov. 24, 2020).

[9] *See* New York State Energy Research and Development Authority, *New York State Greenhouse Gas Inventory: 1990-2016*, Table S-1, at page S-3 (July 2019), available at https://www.nyserda.ny.gov/-/media/Files/EDPPP/Energy-Prices/Energy-Statistics/greenhouse-gas-inventory.pdf (last visited Nov. 22, 2020).

various pulmonary and cardiac conditions, including asthma[10] and heart attacks,[11] and premature mortality.[12] Moreover, because disadvantaged communities tend to be exposed to more than their share of this pollution,[13] there are profound environmental justice ("EJ") implications of electrifying the transport sector. The need to reduce frontline communities' exposure to this pollution is all the more evident now, in the midst of the Covid-19 pandemic, as communities with greater concentrations of pollution have faced higher Covid-19 mortality rates.[14]

Q. Are the goals adopted in the MHD MOU sufficient to address the environmental harm associated with MHD vehicle emissions and achieve New York's emissions goals?

A. Although ambitious, the timetable is probably still too slow to support the achievement of New York's vision for GHG reductions, and action continues to be delayed, public health and environmental justice harms will continue to be substantial.

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[10] *See e.g.*, A. E. Nel, D. Diaz-Sanchez, D. Ng, T. Hiura, and A. Saxon, *Enhancement of Allergic Inflammation by the Interaction between Diesel Exhaust Particles and the Immune System*, 102 JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY 539 (Oct. 1998).
[11] *See e.g.*, B. J. Lee, B. Kim, and K. Lee, *Air Pollution Exposure and Cardiovascular Disease*, 30 TOXICOLOGICAL RESEARCH, 71 (2014).
[12] *See e.g.*, Q. Di *et al*., *Air Pollution and Mortality in the Medicare Population*. 376 N. ENGL. J. MED. 2513 (June 29, 2017).
[13] *See e.g.*, I. Mikati *et al*., *Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status*, 108 AM. J. PUBLIC HEALTH 480 (April 2018), and J. Richmond-Bryant *et al*., *Disparities in Distribution of Particulate Matter Emissions from US Coal-Fired Power Plants by Race and Poverty Status after Accounting for Reductions in Operations between 2015 and 2017,* 110 AM. J. PUBLIC HEALTH 655 (May 2020).
[14] *See* X. Wu, R. C. Nethery, M.B. Sabath, D. Braun, F. and Dominici, *Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis*, SCIENCE ADVANCES (Nov. 4, 2020).

The CLCPA, in addition to its requirements of economy-wide GHG emissions reductions to specified levels by 2030 and 2050, sets an aspirational goal of *all* anthropogenic GHG emissions being eliminated by 2050.[15] However, the MHD MOU sets 2050 as the year by which all vehicle sales should be zero emissions – which means that for years after that deadline, one would expect older diesel trucks and buses to remain on New York's roads, belching a wide variety of pollutants. Meanwhile, the people who are being made sick and dying from diesel pollution simply cannot wait. To their credit, the states that adopted the MHD MOU agreed to prioritize these public health and environmental justice needs, specifically agreeing to "seek to accelerate the deployment of zero-emission medium- and heavy-duty trucks and buses to benefit disadvantaged communities that have been historically burdened with higher levels of air pollution."[16] Every day that high-emitting diesel vehicles continue to pollute the air in disadvantaged communities is a day when more irreversible health harm occurs.

Q. Has the Public Service Commission taken note of New York's EV goals?

A. The Commission has taken note of the obligations established in the ZEV MOU in its Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs (the "Order").[17] However, that Order does not take note of the goal

[15] *See* Climate Leadership and Community Protection Act, Section 1(4) ("It shall therefore be a goal of the state of New York to reduce greenhouse gas emissions from all anthropogenic sources 100% over 1990 levels by the year 2050").
[16] *See* MHD MOU at Section 3.
[17] *Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure*, Case No. 18-E-0138, Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs at 3-4 (July 16, 2020).

for MHD vehicles arising from the MHD MOU, which had been entered into only two days before the issuance of the Order.

Q. Has the Public Service Commission taken steps to ensure that the electric grid throughout the state can support achievement of the goals contained in the MHD MOU?

A. Not yet. As noted, the MHD MOU was entered into only two days before the issuance of the Order, and many months after the Staff Whitepaper[18] that provided the basis for much of the Order. The Order does not note the existence of the MHD MOU or its goals. Despite its silence on these subjects, the Order includes discrete program elements that seek to accelerate MHD EV adoption; however, these are discrete efforts that do not consider the system-wide implications of MHD vehicle electrification.

Q. Does the Company's proposal lay the groundwork for successful electrification of the MHD vehicle sector?

A. No. There is much in the proposal that can help lay the groundwork for accelerated MHD EV adoption, such as the Fleet Assessment Program, the School Bus initiative, and the Make Ready program, all of which are expected to enable MHD EVs. The Company's proposed Fleet Assessment Program, in particular, is more comprehensive than what the Commission has required in its recent Order, as it includes a range of services likely to be of considerable use to fleet customers in its

[18] *See Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure,* Case No. 18-E-0138, Department of Public Service Staff Whitepaper Regarding Electric Vehicle Supply Equipment and Infrastructure Deployment (Jan. 13, 2020).

service territory, including "a comprehensive assessment of the customer's entire fleet of vehicles, a full roadmap to electrification… available charger and vehicle funding, estimated greenhouse gas reduction, total cost of ownership analysis, and guidance for future fleet vehicle procurement."[19]

However, two key elements of a sound foundation for electrification are missing. These include 1) any proposals to enable and encourage effective vehicle-grid integration ("VGI") for MHD EV fleets, and 2) tariff designs that are appropriate for MHD EV fleets.

Q. Why are these elements so important?

A. VGI, which can be enabled by well-designed time-variant price signals coupled with technology, is important for ensuring that new EV loads do not burden the electric grid more than necessary, and even makes it possible for EV loads to function as a grid asset by providing useful services. Because the availability of these capabilities will determine how high future electric demand is and how costly it is to serve, it is of core importance to bringing down the total cost of electrification.

Appropriate tariff design for MHD EVs is also a key factor when considering accelerating the adoption of these large vehicles. Tariffs that are well calibrated to the charging capabilities of MHD EVs and the needs of their owners can be structured to ensure that the adoption of these vehicles and their subsequent charging does not place too much strain on the system. Though managed charging

[19] *See* Corrections and Updates Testimony of the Electric Vehicle Panel at 9-10.

(a central aspect of VGI, as further discussed in the next section of my testimony) is a key factor in ensuring that charging load doesn't overly burden the system (burdens which could ultimately lead to higher-than necessary new infrastructure costs), fleet owners are unlikely to invest in managed charging technologies unless they face price signals that would allow them to benefit from managing their charging. And because managed charging should (with efficient pricing) result in lower bills for customers than unmanaged charging of the same vehicles, the availability of suitable pricing that enables EV customers to benefit from optimized charging will improve the attractiveness of EVs relative to fossil-fueled vehicles, which in turn could help speed customers' embrace of vehicle electrification. Thus, tariff design and successful VGI go hand in hand, and should be key pillars in the process of accelerating adoption of MHD EVs.

IV. Vehicle-Grid Integration

Q. What is VGI?

A. Gridworks, a California-based entity whose mission is "to convene, educate and empower stakeholders working to decarbonize electricity grids,"[20] defines electric vehicle-grid integration as follows:

> 'Electric vehicle grid integration' means any method of altering the time, charging level, or location at which grid-connected electric vehicles charge or discharge, in a manner that optimizes plug-in electric vehicle interaction with the electrical grid and provides net benefits to ratepayers by doing any of the following: (A) Increasing electrical grid asset utilization; (B) Avoiding otherwise necessary distribution infrastructure upgrades; (C) Integrating renewable energy resources; (D) Reducing the cost of electric supply; (E) Offering reliability services [that can

[20] Gridworks Frequently Asked Questions, Question 1, available at https://gridworks.org/wp-content/uploads/2020/09/Gridworks-FAQ.docx.pdf (last visited Nov. 24, 2020)

be deliverable to locations and at times necessary to maintain system and local reliability, and flexibility].[21]

The inherent flexibility of EV charging means customers can provide highly time-sensitive services through optimal VGI, which can help utilities manage demand in a way that avoids the need to add unnecessary grid infrastructure. It also enables the integration of greater amounts of renewable generation and reduced curtailment of those resources, thereby assisting the State in achieving its EV adoption and environmental goals in a cost-effective manner.[22]

The term VGI encompasses two different types of services: unidirectional charging services ("V1G"), as described in more detail below, and bidirectional vehicle-to-grid ("V2G")/vehicle-to-building ("V2B") capabilities. In the near term, however, it is likely that most VGI activities, particularly for MHD vehicles other than school buses, would fall under the general umbrella of V1G, which is also known as managed charging.

Q. What do you mean by managed charging?

A. I am using the phrase "managed charging" (also known as "smart charging" or "V1G") to refer to the manner in which the charging cycle of EVs is altered to respond to the condition of the electric system while simultaneously managing the

[21] Gridworks, *Evaluating California's Vehicle-Grid Integration Opportunities: A Framing Document* at 4-5 (Aug. 2019), http://gridworks.org/wp-content/uploads/2019/08/Gridworks-VGI-Initiative-Framing-Document.pdf.

[22] *See, e.g.*, C. Zhang *et al*., *Quantifying the Benefits of Electric Vehicles on the Future Electricity Grid in the Midwestern United States*, APPLIED ENERGY (July 15, 2020), *available at* https://www.sciencedirect.com/science/article/abs/pii/S0306261920306863 *and* J. Coignard *et al*., *Clean Vehicles as an Enabler for a Clean Electricity Grid*, ENVIRONMENTAL RESEARCH LETTERS (2018), *available at* https://iopscience.iop.org/article/10.1088/1748-9326/aabe97/pdf.

needs of vehicle users (both in terms of price responsiveness and charging requirements). This helps facilitate the integration of EVs onto the grid and improve grid functionality, while also meeting mobility needs.[23]

Q. Why is it important for managed charging to be part of any grid-buildout to support MHD EVs?

A. From the perspective of the grid, individual MHD EVs represent significant charging load, and entire fleets of them, even more so. Therefore, the new demand associated with truck and bus fleet electrification has the potential to be very taxing on the system. However, if the timing and shape of this new demand can be designed intentionally with an eye towards lowering total costs to the extent possible (given the fleet's duty cycle and dwell times), the burden posed by the new demand can be reduced. This can reduce the need for new infrastructure to serve new EV charging demand. With EV charging poised to become one of the primary categories of demand in future years, containing this need will be critical to avoiding excessive costs to ratepayers.

In addition to the grid benefits it provides, managed charging – provided it has the opportunity to participate on equal footing with other storage resources – can also play an important role in ensuring that New York meets its clean energy goals,

[23] *See* International Renewable Energy Agency, *Electric Vehicle Smart Charging: Innovation Landscape Brief* (2019), *available at* https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_EV_Smart_Charging_2019.pdf?la=en&hash=E77FAB7422226D29931E8469698C709EFC13EDB2

including its renewable energy goals[24] and its energy storage goal,[25] and that the State realizes the greatest possible environmental benefits available from vehicle electrification. Indeed, managed charging of electric vehicles has been found to be capable of shaping load to the extent needed to integrate intermittent renewable generation for a small fraction of the cost of stationary grid storage.[26]

Q. What are the environmental ramifications of managed charging?

A. Because the environmental attributes of electric generation vary dramatically over the course of a day, managing the timing of electricity consumption can yield significant environmental benefits. First, it can reduce environmental harm, by avoiding excessive reliance on some of the most polluting generation resources. For example, an analysis by E3[27] (based on data from a Brattle/New York Independent System Operator ("NYISO") study) found that the statewide[28] hourly

[24] The CLCPA sets goals of 70% of New York's electric generation being from renewable sources by 2030 and 100% of all New York electric demand being served by zero-emissions generation by 2040. CLCPA Section 4; N.Y. Pub. Serv. Law Section 66-p(2). It also sets goals for specific types of renewable energy including procurement of 9 gigawatts of offshore wind generation by 2035 and 6 gigawatts of photovoltaic solar generation by 2025. CLCPA Section 4; N.Y. Pub. Serv. Law Section 66-p(5).
[25] The CLCPA sets a statewide energy storage goal of 3 gigawatts by 2030. CLCPA Section 4; N.Y. Pub. Serv. Law Section 66-p(5).
[26] J. Coignard *et al.*, *Clean Vehicles as an Enabler for a Clean Electricity Grid*, ENVIRONMENTAL RESEARCH LETTERS (2018), *available at* https://iopscience.iop.org/article/10.1088/1748-9326/aabe97/pdf
[27] *See presentation by* Stefanie Tanenhaus (Energy + Environmental Economic), *Shaped E Value* (July 11, 2018), available as a link from N.Y. Department of Public Service's homepage for Case 15-E-0751, Value of Distributed Energy Resources, https://www3.dps.ny.gov/W/PSCWeb.nsf/All/8A5F3592472A270C8525808800517BDD?OpenDocument
[28] Statewide MERs may very well deviate from zone-specific rates; however, I do not have access to zone-specific MERs. This is therefore descriptive of how rates can vary over time in NY, though not an exact identification of upstate MERs.

marginal emissions rate ("MER")[29] can vary significantly[30] depending on the relative hour, with nighttime MERs consistently lower than mid-day emissions rates. This is shown graphically in the figure below, which averaged 2015 and 2016 NYISO hourly MERs; the MER by hour is presented in each column, with each row representing the month of the year. As can be seen in Figure 1 below, the majority of the high marginal emissions occur between 10am and 8 or 9pm. Overnight and early morning charging would therefore be much better for the environment than mid-day charging.

Figure 1: GHG Marginal Emissions Rates for NYISO, 2015/2016 Average

GHG Marginal Emission Rates Heatmap for Zone: Max (NYS)

Short Tons CO2/MWh	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	0.47	0.47	0.48	0.46	0.47	0.49	0.49	0.49	0.51	0.50	0.54	0.54	0.56	0.57	0.55	0.54	0.52	0.52	0.54	0.54	0.54	0.54	0.50	0.50
February	0.54	0.53	0.53	0.52	0.47	0.51	0.55	0.56	0.55	0.57	0.64	0.65	0.63	0.61	0.62	0.63	0.60	0.64	0.63	0.62	0.62	0.60	0.55	0.51
March	0.46	0.45	0.45	0.45	0.43	0.44	0.48	0.49	0.50	0.50	0.51	0.51	0.50	0.50	0.49	0.48	0.49	0.49	0.49	0.51	0.52	0.49	0.47	0.44
April	0.46	0.45	0.44	0.44	0.44	0.44	0.46	0.48	0.50	0.51	0.52	0.53	0.52	0.52	0.51	0.52	0.51	0.54	0.52	0.52	0.53	0.52	0.49	0.48
May	0.45	0.46	0.45	0.43	0.43	0.44	0.46	0.45	0.48	0.46	0.51	0.54	0.53	0.52	0.52	0.52	0.51	0.50	0.50	0.50	0.51	0.51	0.48	0.45
June	0.44	0.40	0.38	0.37	0.40	0.42	0.43	0.44	0.44	0.47	0.51	0.54	0.55	0.56	0.55	0.57	0.53	0.52	0.53	0.51	0.51	0.52	0.50	0.46
July	0.50	0.48	0.43	0.42	0.45	0.43	0.42	0.44	0.45	0.47	0.51	0.55	0.58	0.59	0.60	0.59	0.60	0.60	0.59	0.55	0.54	0.52	0.53	0.53
August	0.56	0.52	0.50	0.47	0.48	0.47	0.48	0.47	0.49	0.51	0.57	0.60	0.63	0.64	0.65	0.64	0.67	0.67	0.66	0.65	0.61	0.60	0.58	0.59
September	0.49	0.48	0.45	0.43	0.45	0.46	0.49	0.50	0.52	0.52	0.54	0.56	0.56	0.56	0.57	0.60	0.61	0.61	0.58	0.58	0.57	0.56	0.54	0.51
October	0.44	0.44	0.42	0.41	0.44	0.44	0.44	0.49	0.48	0.48	0.51	0.54	0.55	0.52	0.53	0.50	0.51	0.52	0.54	0.54	0.53	0.51	0.48	0.46
November	0.39	0.39	0.38	0.36	0.38	0.41	0.44	0.47	0.49	0.48	0.54	0.53	0.52	0.50	0.53	0.52	0.50	0.55	0.56	0.54	0.52	0.50	0.44	0.40
December	0.44	0.42	0.41	0.38	0.38	0.44	0.46	0.47	0.48	0.49	0.50	0.51	0.50	0.51	0.51	0.50	0.51	0.58	0.57	0.54	0.54	0.50	0.47	0.44

In addition to reducing environmental harm by reducing reliance on the most polluting resources, managed charging can also yield affirmative environmental benefits, if it is used to increase the uptake of intermittent renewable generation that might otherwise be curtailed. According to NYISO, 67 GWh of wind generation was curtailed in 2018 due to economic factors, in some months even reaching above 5% of wind generation.[31] Intentionally shaping charging patterns to as to maximize

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[29] Marginal emissions rate describes the emissions that are produced by a marginal unit – that is, the next unit to be turned on in a wholesale market – in a given hour; essentially, if demand increases by a marginal unit, the MER describes how emissions change with this change in demand.
[30] As shown in Figure 1, the highest MER within a specific month can be as high as 1.5 times the lowest MER within a specific month (see for example December 5pm vs 3am).
[31] Presentation by Cameron McPherson, NY Renewables – Overview and YTD Operation (presentation) (Feb. 20, 2019),

the uptake and minimize the waste of intermittent renewable generation makes EVs even cleaner in the present, while simultaneously improving the economics of intermittent renewable generation – making the future development of more clean energy resources more affordable. Given New York's goals of relying on renewable electric generation to meet 70% of demand by 2030 and its specific goals for offshore wind and solar generation,[32] the ability of managed charging to help reduce the cost of clean energy resources has the potential to contribute substantially to the State's ability to achieve these goals at low cost.

Q. Is managed charging enough to ensure that vehicles are optimally integrated with the grid?

A. Over the long term, no. It is widely agreed that the future electric system will require a great deal of storage. Because EVs are in effect batteries on wheels, they in fact are storage devices, and merely managing their charging does not make full use of the range of capabilities that storage can provide; using bidirectional capabilities to allow vehicle batteries to discharge onto the grid or into a building (V2G/V2B) will be important. V2G can be leveraged to provide grid services such as frequency balancing in even greater quantities than is available from managed charging alone; this capability has been demonstrated at the Los Angeles Air Force Base, where a fleet of EVs were successfully able to offer reliable V2G frequency

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https://www.nyiso.com/documents/20142/5073363/2018%20NYCA%20Renewables%20Presentation%20FINAL%200222019.pdf/d6e684f3-0fce-1f00-86d5-c27a480f33f3.

[32] *See* CLCPA Section 4; Pub. Serv. Law Sections 66-p(2) and 66-p(5).

balancing services.[33] In the context of an emergency, EVs with V2G/V2B capability can be a resiliency asset if they can provide emergency power when the grid is out.[34]

Q. Does the Company's proposal employ managed charging as part of proposed vehicle electrification programs?

A. The Company's Smart Charging Rate for LD vehicles requires managed charging software. However, the other proposed programs do not leverage managed charging. This misses a key opportunity to ensure that the benefits of the programs are maximized, and it is an especially unfortunate oversight with respect to MHD EV fleets, given the potential for their unmanaged charging to place significant loads on the system and create large charging bills for the fleets.

For example, the Company proposes three projects with some relevance to MHD vehicle electrification: A Make Ready Infrastructure Project, which provides free infrastructure to 100 sites (for both LD and MHD EVs); a School Bus program for customers in low and moderate income ("LMI") and EJ communities, providing 25

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[33] See California Energy Commission, Los Angeles Air Force Base Vehicle-to-Grid Demonstration (October 2018), available at https://ww2.energy.ca.gov/2018publications/CEC-500-2018-025/CEC-500-2018-025.pdf. Other capabilities including demand charge management, integration of intermittent renewables, and peak load reduction are being explored by Nuvve Corporation and American Honda Motor Co., Inc. See Nuvve Press Release, Nuvve Corporation and Honda are Collaborating to Demonstrate the Benefits of Vehicle Grid Integration (VGI) (April 25, 2019), available at https://nuvve.com/wpcontent/uploads/2019/04/honda-nuvve-announcement-final-4.25.19.pdf.

[34] Nissan already offers this service for cars. *See* Nissan Motor Corporation, *EVs as Power Source for Living*, *available at* https://www.nissan-global.com/EN/TECHNOLOGY/OVERVIEW/vehicle_to_home.html. Proterra, a manufacturer of electric buses, now offers a bidirectional charger with V2G capability. *See* Proterra, "Proterra Introduces New High Power Interoperable EV Charging Technology," (May 7, 2018), *available at* https://www.proterra.com/press-release/proterra-introduces-new-high-power-interoperable-ev-charging-technology/.

free school buses; and a Fleet Assessment program, providing input to LD and MHD fleets to help them plan their electrification strategy. None of these program proposals requires participants to deploy managed charging (either by providing the technology for free or requiring them to purchase it) or takes note of the importance of incorporating technology and communication standards that will enable seamless, stakeholder-neutral managed charging programs. Thus, these programs are missing a key opportunity to ensure that the incremental vehicles they enable charge in a way that is favorable to the electric system, keeps costs low, and helps the fleet owners lower their charging costs. Charging costs are a major concern to fleet owners, as the difference between electricity and diesel costs defines a large part of the operational benefits the fleet achieves by electrifying its vehicles.[35] Because managed charging can help keep bills down, this will help reduce a barrier to electrification of these vehicles.

Furthermore, the Company's proposed marketing and education plan does not include a focus on educating customers about how to respond to prices, or the importance and benefits of deploying managed charging to reduce both system costs and electric bills.

Q. Do these omissions matter?

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[35] A report recently released by Environmental Defense Fund, M.J. Bradley & Associates and Vivid Economics, based on interviews with representatives and experts in the medium and heavy duty transport sector across the country, found that uncertain fuel cost savings was one of the priority barriers creating risk and uncertainty around the adoption of MHD EVs. *See* V. Rojas *et al*, Financing the Transition: Unlocking Capital to Electrify Truck and Bus Fleets (2020), https://www.edf.org/sites/default/files/documents/EDF_Financing_The_Transition.pdf

A. Although the current programs are unlikely to result in electrification of a sufficient number of MHD vehicles to become a significant source of demand on the overall grid, the omission of managed charging and tariffs that encourage that behavior from these early deployments is nonetheless a serious oversight that should be corrected. The Company and fleets will both face a learning curve as the MHD sector is electrified, and by failing to bake in MHD EV load management for the benefit of the system and the customer from the start, these programs will miss an opportunity to generate early learnings. Furthermore, not requiring managed charging could potentially result in negative experiences or elevated bills that will make the next phase of electrification that much harder.

Thus, the programs proposed by the Company that enable adoption of MHD EVs, and the marketing and education plan, should intentionally include or require managed charging in order to ensure the long-term lowest cost of and greatest benefits from MHD vehicle electrification.

V. Price Responsiveness and Rate Design

Q. How can electric tariffs be designed in order to ensure loads are managed in a cost-effective manner?

A. Electricity rates send price signals to the electric customer regarding how the customer could behave, so as to minimize their electric bill. Optimally, these price signals reflect the cost that the consumption places on the system and show how shifting away from high-priced times would also help reduce total costs (including generation and distribution system costs).

The structure of the prices, that is, the tariff, and not just the prices alone, will also affect the charging decisions. For example, tariffs that do not have time variation send a signal to the customer that shifting consumption across hours is unimportant; the customer facing a non-time-variant price will not attempt to shift consumption because they receive no benefit from doing so. Tariffs that have some time variation thus signal when consumption should be reduced (during high-priced times) or when would be an appropriate time to consume (during low-priced times).

This holds true whether the price signal is on demand (kW) or consumption (kWh). Indeed, tariffs can have time-variant demand-based charges, and/or time-variant volumetric charges; however, depending on which type of charge is levied, the response will also vary because the signal sent to the customer is different.

A time-variant *volumetric* rate sends the customer a signal to reduce consumption (or kWh) during high priced times. A time-variant *demand*-based rate, on the other hand, sends the customer a signal to reduce maximum demands (kW) during high-priced times. Though similar, the resulting effect and impacts on the distribution system can be quite different, especially when very large batteries (or fleets of batteries) are being charged. Essentially, under a time-variant *demand*-based rate the fleet owner will attempt to mitigate demand by charging over longer time periods at a lower rate of charge (managed charging software can help enable this reduction in maximum demands). However, under a time-variant *volumetric* rate, the fleet owner could simply shift the charging into the off-peak period without attempting to reduce the maximum demand caused by the vehicles charging.

Overall, both of these types of time-variant pricing mechanisms provide the customer with an incentive to reduce charging during peak times; however, a time-variant *demand* charge would also be more likely to reduce maximum demands during off-peak times. This will be especially important for very large fleets of EVs, whose maximum demands could become a significant concern for the distribution system, even if they occur during off-peak hours. As New York moves towards greater adoption of large EVs, this concern will attain greater importance. However, in the near term, when individual fleet customers are unlikely to pose very high demand during off-peak periods, incentivizing fleet customers to manage their off-peak demand will be less important.

Q: Should there be time variation in both the distribution and supply portions of the bill?

A: Yes. Because high demand peaks have a large impact on delivery system upgrade requirements, ensuring that there is some time variation in the delivery portion of the bill is essential to shifting charging away from high demand moments, thereby reducing the need to further expand the system. This can be implemented through simplified coincident demand charges, whereby the customer faces a coincident peak demand charge to recover the shared infrastructure and a cheaper demand charge in pre-determined off-peak periods (a "TOU" demand charge), or TOU volumetric charges (whereby the distribution charge is structured volumetrically, in a TOU manner).[36]

[36] *See* Exhibit __ (ES-2) for further discussion of these types of tariffs.

Time variation of the supply component of the bill is also necessary for the tariff to be cost-reflective, as generation costs vary over the course of the day, and generally peak during high-demand times. Furthermore, it is especially important to have time variation on supply due to the time-varying environmental costs of charging (see Figure 1 presented earlier in this testimony). Because many intermittent renewables are particularly cheap (they may bid zero or less in the wholesale market, and may be available at times when clearing prices are low), granular time-variant pricing can achieve cost and emissions reductions. Moreover, where the wholesale price of emitting generation reflects a price on carbon (whether as a consequence of the cost of acquiring Regional Greenhouse Gas Emission allowances or otherwise), and that price is passed through to retail customers on a dynamic basis, the retail price differentiation among resources based on their emissions profiles could be even more pronounced. And because supply is procured in a market hour by hour, only marginal costs are reflected in the wholesale generation price; to the extent that the market can consistently rely on the cheapest resources and avoid the most expensive ones, immediate savings to all customers can be unlocked.

Q. Is the right tariff design alone sufficient to ensure that VGI is optimized?

A. No. Although the details are beyond the scope of this testimony, price signals alone will not suffice – technology will be needed. Moreover, technology will need to be deployed to ensure that price signals reach customers and their charging stations, in order to ensure some automated amount of price responsiveness. Marketing, education and outreach will also be critical to ensuring that customers are aware of the price signals and how to respond to them. This is in addition to whatever metering, billing, and other technology utilities themselves will require in order to provide granular time-variant price signals to customers in the first place.

VI. Other Rate Design Considerations

Q. Should tariffs and rates be designed specifically for medium- and heavy-duty EVs, and what is the effect of not doing so?

A. Depending on the tariffs already in place and the usage patterns of emerging fleet customers, it is theoretically possible for broadly applicable tariffs and rates to help successfully manage demand from MHD EVs. In other words, if existing commercial tariffs are adequately cost-reflective and provide price signals that encourage reductions in demand and consumption especially during peak hours, these may be sufficient for encouraging charging behavior that can help to reduce system costs. However, that is certainly not a foregone conclusion based on currently existing rates. Where rapid electrification is an express goal, ensuring that tariffs are not merely workable but affirmatively appealing to potential MHD fleet owners becomes an important consideration, especially in the short term.

Although existing commercial rates in some service territories may work reasonably well for some MHD EV fleet customers, they are not necessarily cost-reflective for MHD EV fleet customers considered as a class. Current commercial rates in the Niagara Mohawk service territory are based on an Embedded Cost of Service Study ("ECOSS"), which relies upon observed and historical patterns of demand and contributions to embedded costs by class. The ECOSS study allocates costs based on class contributions, among other aspects, such as "non-coincident peak demand ("NCP"), class contributions to system peak ("1CP"), annual kWh deliveries and historic bad debt experience."[37] The problem here is that a MHD EV fleet will not have similar load patterns to the commercial customers for whom the ECOSS was conducted based on two factors:

First, MHD EV fleets can incorporate managed charging software into their charging stations in order to help themselves level out their demands. This is very different from a commercial building, whose load profiles may be more set due to commercial requirements (e.g., open hours of operation) or less controllable due to the aggregation of many different individual actions (such as in a commercial building with several tenants).

Second, given that many fleets have demands that peak overnight (by charging overnight as their vehicles sit in the depot), their impact on the system would be much lower than a commercial building, whose peak generally would happen in the middle of the day, coincident with aggregate peak demands.

Thus, because a MHD EV fleet will not have load patterns similar to the aggregate load patterns produced by customers for whom the ECOSS was conducted (based on the factors listed above), it is likely that the tariff they face will not be cost-reflective for MHD EV fleets and may possibly over-allocate costs to them. If these customers are overpaying relative to their contribution to embedded costs, it may

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[37] Direct Testimony of Electric Rate Design Panel at 29, lines 1-3.

very well hinder adoption of the vehicles that the state has agreed to push forward by making the costs of charging prohibitively high.

Q. Are Niagara Mohawk's existing commercial tariffs structured in a way that would send adequate price signals to fleet owners to reduce demands, especially during peak hours?

Not entirely. Based on my review of Niagara Mohawk's Tariff Schedule,[38] I have identified four different existing commercial tariffs that may be applicable to a MHD EV fleet: Small General SC2 (Non Demand); Small General SC2 (Demand); Large General SC3; and Large General TOU, SC3-A. The table below lists the tariffs along with the eligibility criteria (based on size), and the type of tariff:

Tariff Name	Applicable kWh Range	Applicable kW Range	Demand Charge?	Time Variant?
Small General SC2, Non Demand	<2,000kWh	<100kW	No	Optional time-of-use rate on supply
Small General SC2, Demand	>2,000kWh	<100kW	Yes, not time-variant	Optional Hourly pricing on supply
Large General SC3	-	100-250kW	Yes, not time-variant	Optional Hourly pricing on supply
Large General SC3	-	250-2,000kW	Yes, not time-variant	Mandatory hourly pricing on supply
Large General, TOU SC3-A	-	>2,000kW	Yes, not time-variant	Mandatory hourly pricing on supply

[38] P.S.C. No. 220 Schedule for Electric Service. Specifically, Tariff Leaves 370 for Small General Service; 378 for Large General Service; and 390 for Large General Service Time-of-Use. https://www2.dps.ny.gov/ETS/jobs/display/download/6655958.pdf

As shown in the table above, none of the tariffs that would be applicable to an electric fleet have time-variant demand charges, or time-variant charges to recover distribution costs. As noted earlier in my testimony, ensuring that distribution costs are recovered in a time-variant manner is essential to reducing the potential burdens on the distribution system caused by large charging demands from MHD EV fleets. Tariffs with demand charges that do not vary over time send the wrong signals to the fleet owner regarding when and how they should focus on reducing peak demands, and may not reward (through bill reductions) the fleet owner for shifting demands into the off-peak hours. For large fleets whose peak demands, if unmanaged, may in fact be very large, ensuring that they shift their demands into the low aggregate demand periods (while still managing demand in those hours) will be key to keeping system costs down. Thus, the tariffs the fleet owners face should reflect this added system benefit by having a time-variant demand charge, rather than one that does not vary over time.

It is important to note that all tariffs do provide some form of time variation on supply for customers who take their supply from the Company, either mandatory or optional, and any such hourly pricing can send important granular time signals to fleet owners who are charged on such a basis. However, electric customers have the option to choose their own electricity supplier, which means they may in effect opt out of this sort of granular time variation in supply charges included in the Company's tariff. Because the Company is unable to ensure that the supply charges of their customers will reflect time-variant costs of generation, focusing on providing time-variant price signals for distribution costs will be of the utmost importance in keeping the system costs of vehicle electrification down in the long run.

Q. Has Niagara Mohawk developed tariffs that are specific to EVs?

A. In the proposal, Niagara Mohawk developed a smart charging tariff for LD EVs, which includes a volumetric subscription charge paired with managed charging. However, the Company has not developed a similarly-tailored tariff for charging larger EVs, although the imperative to do so is especially important given the fact that the existing commercial rates do not allow fleet owners who have inherently beneficial load profiles for the system (given their comparatively low demands during high system peak periods) to see lower bills.

Given the unique load characteristics of MHD fleet customers as a class and emerging goals for rapid electrification, such tariffs may be desirable. The approach taken by the Company for LD EVs could be similarly developed for MHD EVs. Subscription tariffs, particularly those based on demand, are being developed by utilities in CA. The fleet owner chooses a subscription level of demand and is billed based on that maximum demand. If the customer exceeds the maximum demand, there is either a penalty or, if the problem persists, the customer is ratcheted into a higher tranche of demand. This allows the customer to face stability in their bills, while also sending a price signal that encourages management of peak demands to a pre-determined level. Pairing this type of subscription charge with a requirement for managed charging software would further increase the potential benefit to the system. Because the customer is able to benefit from bill stability, ensuring that they also have managed charging software will simultaneously provide a benefit to the grid while helping the customer limit their peak demands to the pre-defined subscription level.

Q. Does this conclude your testimony?

A. Yes.