COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Petition of Massachusetts Electric Company	**)**	
and Nantucket Electric Company each	**)**	**D.P.U. 21-91**
d/b/a National Grid for Approval of	**)**	
Phase III Electric Vehicle Market Development Program	**)**	

TRACK 1

DIRECT PANEL TESTIMONY OF

ELIZABETH A. STANTON

AND

JOSHUA R. CASTIGLIEGO

ON BEHALF OF

INTERVENOR GREEN ENERGY CONSUMERS ALLIANCE

D.P.U. 21-91 EXHIBIT GECA-ESJC-1

January 5, 2022

Table of Contents

I. INTRODUCTION

Q. Dr. Stanton, please state your full name, business name and address.

A. My name is Elizabeth A. Stanton. I am the Director and a Senior Economist at the Applied Economics Clinic. Our offices are located at 1012 Massachusetts Avenue, Arlington MA, 02476.

Q. What is your educational background?

A. I received a PhD in Economics from the University of Massachusetts-Amherst. Prior to that, I received my Master of Arts in Economics from New Mexico State University and a Bachelor of International Studies at the School for International Training in Brattleboro, Vermont.

Q. Please describe your professional experience.

A. I am the founder and Director of the Applied Economics Clinic ("AEC"), a non-profit consulting group. AEC provides expert testimony, analysis, modeling, policy briefs, and reports for municipalities and other public interest groups on the topics of energy, environment, consumer protection, and equity. AEC also provides training to the next generation of expert technical witnesses and analysts through applied, on-the-job experience for graduate students in related fields and works proactively to enhance diversity among the people who do our jobs today and in the future. As a researcher and analyst with two decades of professional experience as a political and environmental economist, I have authored more than 155 reports, policy studies, white papers, journal articles, and book chapters as well as more than 45 expert comments and oral and written testimony in public proceedings on topics related to energy, the economy, the environment, and equity. My articles have been published in Ecological Economics, Climatic Change, Environmental and Resource Economics, Environmental Science & Technology, and other journals. I have also published books, including Climate Change and Global Equity (Anthem Press, 2014) and Climate Economics: The State of the Art (Routledge, 2013), which I co-wrote with Frank Ackerman. I am also co-author of Environment for the People (Political Economy Research Institute, 2005, with James K. Boyce) and co-editor of Reclaiming Nature: Worldwide Strategies for Building Natural Assets (Anthem Press, 2007, with Boyce and Sunita Narain).

My recent work includes review and analysis of electric planning in several states, Integrated Resource Plan (IRP) and Demand-Side Management (DSM) planning review, analysis and testimony of state climate laws as they relate to proposed capacity additions, and other issues related to consumer and environmental protection in the electric sector. In my previous position as a Principal Economist at Synapse Energy Economics, I provided expert testimony in electric and gas sector dockets, and led studies examining environmental regulation, cost-benefit analyses, and the economics of energy efficiency and renewable energy. Prior to joining Synapse, I was a Senior Economist with the Stockholm Environment Institute's (SEI) Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory (CBEI) model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense

Fund, among others. My Curriculum Vitae is attached as D.P.U. 21-91 Exhibit GECA-ESJC-2.

Q. Have you ever testified before the Massachusetts Department of Public Utilities (DPU)?

A. Yes. I provided testimony in D.P.U. 14-86 (2014), D.P.U. 15-181 (2016), D.P.U. 16-05 (2016), D.P.U. 17-145 (2018), D.P.U. 17-172 (2018), D.P.U. 17-174 (2018), D.P.U. 17-175 (2018), D.P.U. 18-110 through D.P.U. 18-119 (2018), D.P.U. 18-150 (2019), D.P.U. 19-132 (2020) as well as in OADR 2011-025 & 026 before the Department of Environmental Protection.

Q. Have you testified in other jurisdictions?

A. Yes. I have submitted expert testimony and comments in public utility and other related dockets in District of Columbia, Florida, Illinois, Indiana, Louisiana, Michigan, Minnesota, New Hampshire, New York, Pennsylvania, Puerto Rico, South Carolina, and Vermont as well as several federal dockets, including in front of the U.S. EPA.

Q. Mr. Castigliego, please state your full name, business name and address.

A. My name is Joshua R. Castigliego. I am a Researcher at the Applied Economics Clinic. Our offices are located at 1012 Massachusetts Avenue, Arlington MA, 02476.

Q. What is your educational background?

A. I received a Master of Arts in Energy & Environment from Boston University and a Bachelor of Science in both Mathematics and Physics from Roger Williams University.

Q. Please describe your professional experience.

A. I have more than four years of professional experience in energy and climate research and analysis, with a focus on decarbonization and pollution mitigation. I have authored more than 15 reports, and have been published in *Waste Management*. Prior to joining the Applied Economics Clinic, I worked as a Research Fellow at Boston University's Institute for Sustainable Energy, where I led the analysis on the emissions impacts associated with Boston's waste management system to inform the City's decarbonization efforts as it works to achieve carbon neutrality by 2050 in the Carbon Free Boston report.

My recent work includes investigating the value of winter grid reliability, examining the net emissions savings benefit of a battery storage facility, and critiquing the over-procurement of PJM's capacity market. My Curriculum Vitae is attached as D.P.U. 21-91 Exhibit GECA-ESJC-3.

Q. Have you ever testified before the Massachusetts DPU?

A. No.

Q. On whose behalf are you submitting this testimony?

A. We are submitting this testimony on behalf of the Green Energy Consumers Alliance.

Q. Are you sponsoring any exhibits?

A. Yes. We are sponsoring the following exhibits:

- D.P.U. 21-91 GECA-ESJC-2 – Curriculum Vitae of Dr. Elizabeth A. Stanton
- D.P.U. 21-91 GECA-ESJC-3 – Curriculum Vitae of Mr. Joshua R. Castigliego
- D.P.U. 21-91 GECA-ESJC-4 – Workpaper A
- D.P.U. 21-91 GECA-ESJC-5 – Workpaper B

Q. What materials did you review in preparing this testimony?

A. Any document upon which we relied directly is cited in our testimony.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your joint testimony?

A. The purpose of our joint testimony is to review and critique National Grid's methods and assumptions in setting a 3 to 5 cent per kilowatt-hour (kWh) rebate for its Off-Peak Charging Program.

Q. Can you summarize your conclusions?

A. We find that National Grid's methodology and resulting rebate values omit important benefits of off-peak charging including avoided transmission and distribution costs, avoided emissions and emission costs, avoided reliability costs, avoided costs due to induced price effects, and non-energy benefits. We provide evidence that including these benefits in a value for off-peak charging could raise the rebate by 10 cents per kWh from 3 to 5 cents per kWh to 13 to 15 cents per kWh. We recommend that the DPU require National Grid (the "Company") to reexamine its methodology for setting these rebates, include a more complete set of benefits from this program, and raise rebate values accordingly.

III. OVERVIEW OF NATIONAL GRID'S OFF-PEAK CHARGING PROGRAM

Q. Please describe National Grid's Off-Peak Charging Program.

A. National Grid's Phase II Off-Peak Charging Program ("Program") was approved by the Massachusetts DPU in D.P.U. 18-150 for residential electric vehicles (EV) customers. The Program provides an incentive—in the form of per kWh charging rebates—to encourage customers to charge their EVs during off-peak hours. National Grid offers off-peak charging rebates of $0.03 per kWh for EV charging occurring during off-peak hours (9:00pm to 1:00pm) in Winter (October through May) and $0.05 per kWh for off-peak charging in Summer (June through September).

In its proposal for D.P.U. 18-150, National Grid noted that "residential customers receiving a rebate for a Level 2 charger in the EV Charging Program will be automatically enrolled in the Off-Peak Charging Rebate Program…"[1] with the option to opt out. Customers with existing Level 2 chargers can sign up to participate in the Program. National Grid stated that the Program's administrator will be in charge of "enrolling customers in the program, receiving and collecting charging session data from the charging and monitoring technology eligible for the program, managing a web portal for customers to view their activity and rebate amounts, both current and historical, and generating the rebate payments to customers. The Company anticipates offering customers payment options, which may include gift cards or credits on their electric bills."[2]

In D.P.U. 18-150, the Company stated that the Off-Peak Charging Program would be offered to a maximum of 11,000 participants.[3] National Grid launched the Program in October 2020[4] with an enrollment of over 500 residential customers.[5]

[1] D.P.U. 18-150, Exhibit NG-RS-1 at 25, lines 19-20.
[2] D.P.U. 18-150, Exhibit NG-RS-1 at 28, lines 1-5.
[3] D.P.U. 18-150, Exhibit NG-RS-1 at 28, lines 19-20.
[4] D.P.U. 21-91, National Grid's Response to Information Request GECA-NG-2-2(b)
[5] D.P.U. 21-91, Exhibit NG-EVPP-1 at 86, line 2.

Q. Has National Grid proposed changes to its Off-Peak Charging Program?

A. Yes. In its initial D.P.U. 21-91 filing, National Grid is seeking approval from DPU to expand the scope of its Off-Peak Charging Program by (1) extending the Program through 2025 and (2) expanding the Program to include up to 1,000 additional fleet EVs.[6] The Company also proposes to revise the Program to include automated, flexible scheduling with the goal of shifting more charging off-peak while avoiding the occurrence of timer peaks (i.e., spikes in demand at the beginning or end of off-peak hours).[7]

Q. Has National Grid revised its rebate amounts for the Off-Peak Charging Program since its 2018 DPU filing?

A. No. In its direct pre-filed testimony of the electric vehicle program panel, National Grid states that "The Company does not recommend any changes in how it offers off-peak rebates at this time as the off-peak rebate amounts, three or five-cents per kWh depending on the season, were based upon an analysis of ISO New England supply and capacity costs."[8]

Q. Does National Grid provide any justification for not revising its rebate amounts?

A. Yes. In its direct pre-filed testimony of the electric vehicle program panel, National Grid states that "Given the absence of evidence thus far on the impact of the approved rebate design, the Company does not see a need to conduct another version of this analysis at this time."[9] National Grid does plan to conduct a detailed analysis of the Program once a year

[6] D.P.U. 21-91, Exhibit NG-EVPP-1 at 87, lines 1-6.
[7] D.P.U. 21-91, Exhibit NG-EVPP-1 at 86, lines 15-19.
[8] D.P.U. 21-91, Exhibit NG-EVPP-1 at 92, lines 10-12.
[9] D.P.U. 21-91, National Grid's Response to Information Request GECA-NG-1-2(c)

with the next evaluation memo to be filed by May 15, 2022 as part of the 2021 Phase II EV Program cost recovery filing.[10] National Grid has confirmed that "[t]he Company will propose changes in the future as it gains experience in this area and as new evidence becomes available. The Company will use evidence available at the time to propose changes to the off-peak charging rebate design."[11]

IV. <u>REVIEW OF NATIONAL GRID'S CURRENT OFF-PEAK CHARGING REBATES</u>

Q. How did National Grid develop its off-peak charging rebates?

A. National Grid estimates its off-peak charging rebates as the difference between cost savings associated with charging off-peak versus on-peak (that is, on-peak costs less off-peak costs). Energy and capacity cost savings are summed together to calculate National Grid's off-peak rebates of $0.03 and $0.05 per kWh for Winter and Summer, respectively.[12] Importantly, for the purposes of calculating its off-peak charging rebate National Grid uses the assumption that in the absence of its Off-Peak Charging Program customers will charge their EVs on peak, and that with the Charging Program customers will charge their EVs off peak.

Q. Does National Grid consider any other costs or benefits of off-peak charging in setting its rebate values?

A. No. National Grid only includes energy and capacity cost savings in its off-peak charging rebates.

---

[10] D.P.U. 21-91, National Grid's Response to Information Request GECA-NG-2-2(c)
[11] D.P.U. 21-91, National Grid's Response to Information Request GECA-NG-2-2(e)
[12] D.P.U. 21-91, Exhibit NG-EVPP-1 at 92, line 11.

Q. How does National Grid estimate the energy cost savings component of its off-peak rebate?

A. To estimate the value of energy cost savings from off-peak charging, National Grid uses ISO-New England's hourly load and cost data[13] from January 1, 2016 through December 31, 2017 by load zone for Massachusetts (i.e., Northeast, Southeast, West/Central). National Grid calculates the weighted average across Massachusetts' load zones based on the Company's zonal load shares in 2017 (i.e., 32 percent for Northeast, 31 percent for Southeast, and 38 percent for West/Central).[14] The Company performs these calculations twice: once for real-time and once for day-ahead markets.

Using these weighted-averages for load and energy costs, National Grid calculates total energy demand and energy costs in the on-peak and off-peak periods, combining 2016-2017 data for each season. National Grid estimates the average energy price ($ per kWh) for each season and on-peak/off-peak period by dividing the total energy cost ($) by the total demand (MWh) and adjusted these values by a line loss factor of 1.7 percent.[15] As a final step, the Company averages together its real-time and day-ahead results to arrive at final on-peak and off-peak energy prices.

National Grid estimates the energy cost savings component of its off-peak charging rebate by calculating the difference between the on-peak and off-peak energy prices. These

[13] ISO-New England. "Energy, Load, and Demand Reports." *SMD Hourly Data [Excel]*. Available at: https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/zone-info
[14] D.P.U. 21-91, National Grid's Response to Information Request, Attachment GECA-NG-1-2 [Excel]
[15] D.P.U. 21-91, National Grid's Response to Information Request, Attachment GECA-NG-1-2 [Excel]

differences (or "deltas") are $0.006 and $0.019 per kWh for Winter and Summer, respectively (see Table 1).[16]

Table 1. Replicated Energy Cost Results

Energy Cost Savings ($ per kWh)				
Season	**Peak/Off-Peak**	**Real Time**	**Day Ahead**	**Average**
Winter	On-Peak	$0.042	$0.040	$0.041
	Off-Peak	$0.035	$0.035	$0.035
	DELTA	**$0.007**	**$0.006**	**$0.006**
Summer	On-Peak	$0.047	$0.043	$0.045
	Off-Peak	$0.025	$0.026	$0.025
	DELTA	**$0.022**	**$0.017**	**$0.019**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. What does National Grid assume about annual EV electric usage and avoided EV demand from charging off-peak?

A. National Grid assumes that the average EV customer uses 3,000 kWh per year to charge their vehicle and that charging an EV off-peak versus on-peak results in an average avoided peak demand of 0.825 kW per vehicle.[17]

Q. How does National Grid estimate the capacity cost savings component of its off-peak rebate?

A. To estimate the value of capacity cost savings from off-peak charging, National Grid uses ISO-New England's 10th Forward Capacity Auction (FCA #10) clearing price for the 2019/2020 delivery years: $7.03 per kW-month.[18] National Grid first estimates the annual

[16] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.
[17] D.P.U. 21-91, National Grid's Response to Information Request, Attachment GECA-NG-1-2 [Excel]
[18] ISO-New England. February 2016. "Finalized Capacity Auction Results Confirm 10th FCA Procured Sufficient Resources at a Lower Prices, for 2019-2020." Available at: https://www.iso-ne.com/static-assets/documents/2016/02/20160229_fca10_finalresults.pdf

capacity payment ($ per kW-year) by multiplying the FCA #10 clearing price ($7.03 per kW-month) by 12 months (adjusting to account for a loss factor of 8 percent and a reserve margin of 19 percent) to yield $108 per kW-year.[19]

National Grid estimates annual avoided capacity costs by multiplying the annual capacity payment of $108 per kW-year by its assumed average avoided demand of 0.825 kW to yield $89 per year per vehicle. The annual avoided capacity cost is estimated on a per-kWh basis by dividing the $89 per year by 3,000 kWh—National Grid's assumed average annual usage for an electric vehicle—resulting in an avoided capacity cost of $0.030 per kWh.[20]

National Grid calculates its avoided capacity costs for the Winter and Summer periods using two different methodologies: (1) ratio of on-peak to off-peak hours in each period; and (2) the ratio of on-peak to off-peak energy costs in each period. These ratios are used as scaling factors to translate the annual avoided capacity cost of $0.030 per kWh into the average Winter and Summer values of $0.028 and $0.035 per kWh, respectively (see Table 2).[21]

---

[19] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.
[20] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.
[21] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Table 2. Replicated Capacity Cost Results

Capacity Cost Savings ($ per kWh)				
Season	**Weight Metric**	**Real Time**	**Day Ahead**	**Average**
Winter	Cost-Weighted	$0.026	$0.026	$0.026
	Hour-Weighted	$0.030	$0.030	$0.030
	AVERAGE	**$0.028**	**$0.028**	**$0.028**
Summer	Cost-Weighted	$0.040	$0.038	$0.039
	Hour-Weighted	$0.030	$0.030	$0.030
	AVERAGE	**$0.035**	**$0.034**	**$0.035**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. In your review of National Grid's off-peak charging rebates, did you find any calculation errors?

A. Yes. National Grid's off-peak charging rebates calculations appear to include two errors: (1) incorrect calculation of a weighted average line loss factor of 1.7 percent (the correct value is 5.0 percent),[22] and (2) the erroneous use of real-time demand data in day-ahead demand calculations.

Q. Would correcting the loss factor error in National Grid's calculations change the rebate?

A. Yes. National Grid incorrectly calculates the weighted average across Massachusetts' load zones by weighting and then averaging their components rather than, correctly, weighting and then summing them together. As a result, National Grid uses a loss factor of 1.7 percent instead of the correct weighted average of 5.0 percent (see Table 3).[23] Correcting this error would result in a slight increase in the rebate amounts.

[22] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.
[23] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Table 3. Line Loss Factors by Load Zone

Massachusetts Load Zone	Weights	Line Loss Factors
Northeast (NEMA)	31.8%	5.4%
Southeast (SEMA)	30.6%	5.1%
West Central (WCMA)	37.6%	4.5%
National Grid's Weighted Average		**1.7%**
Corrected Calculation		**5.0%**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. Would correcting the demand totals error in National Grid's calculations change the rebate?

A. Yes. National Grid incorrectly used real-time demand totals in its day-ahead calculations (see Table 4). Correcting this error would result in a slight increase in the rebate amounts.

Table 4. Real-Time and Day-Ahead Electric Demand

Peak/Off-Peak	Real-Time Demand (MWh)	Day-Ahead Demand (MWh)
On-Peak	11,004,511	10,864,213
Off-Peak	25,712,954	26,243,516
Total	**36,717,465**	**37,107,729**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. What rebates did you estimate by correcting these errors?

A. By correcting National Grid's calculations, we were able to identify minor differences in the Company's off-peak rebate amounts. Our corrections increased National Grid's off-peak charging rebates ($0.034 and $0.054 per kWh) by $0.001 per kWh, resulting in corrected rebates of $0.035 and $0.055 per kWh for Winter and Summer, respectively (see Table 5).[24]

[24] See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Table 5. Replicated and Corrected Off-Peak Rebates by Season

Season	National Grid's Off-Peak Rebates ($ per kWh)	Corrected Off-Peak Rebates ($ per kWh)	DELTA ($ per kWh)
Winter	$0.034	$0.035	**$0.001**
Summer	$0.054	$0.055	**$0.001**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A calculations.

Q. Aside from the mathematical errors associated with energy and capacity, do you agree with National Grid's method for calculating its off-peak charging rebates?

A. No. In our professional opinion, National Grid is underestimating its rebate by excluding important benefits of off-peak charging such as avoided transmission and distribution costs, avoided emissions and emission costs, avoided reliability costs, avoided costs due to induced price effects, and non-energy benefits.

V. OMITTED BENEFITS IN NATIONAL GRID'S OFF-PEAK CHARGING REBATES

Q. What are the benefits of off-peak charging?

A. Off-peak charging provides benefits that include, but are not limited to:

- **Avoided energy costs:** The difference between peak and off-peak energy costs.
- **Avoided capacity costs:** Charging EVs during off-peak hours reduces peak demand, which provides cost savings to the grid due to the reduced need to build and operate plants that serve peak load.
- **Avoided transmission and distribution costs:** The need for additional transmission and distribution investment is reduced as demand is shifted from peak to off-peak hours.
- **Avoided reliability costs:** Related to the avoided capacity benefit, shifting schedules to charge EVs during off-peak hours can improve grid reliability as more capacity will be made available when fewer EVs are charging during the peak. New England utilities estimate reliability using the value of non-energy

benefits of avoided outages to residences and businesses—i.e., the value of lost load, (VOLL)—as a proxy for the cost of system-wide outages (see AESC 2021).[25]

- **Avoided costs due to induced price effects or "Capacity DRIPE":** Avoided demand reduction induced price effects (DRIPE) is a measure of the value of efficiency in terms of a reduction in wholesale prices seen by all customers in a given timeframe.
- **Avoided emissions and emission costs:** As fewer EV charge during peak hours, less generation from high-emitting peaker plants is required—which results in reduced greenhouse gas emissions and air pollution, and reduced costs of emission abatement.
- **Non-energy benefits**: Additional non-energy benefits of charging off-peak include: avoided power outages and less land used for power plants as the need for peaker plants is reduced.

Q. Does National Grid include these benefits in its off-peak charging rebates?

A. National Grid only includes avoided energy and capacity costs in its off-peak charging rebates. It does not include avoided transmission and distribution costs, avoided reliability costs, avoided capacity DRIPE, avoided emissions and emission costs, or non-energy benefits.

Q. Is it possible to estimate the avoided transmission and distribution costs associated with off-peak EV charging?

A. Yes. In its proposed 2022-2024 Three-Year Energy Efficiency Plan, National Grid applies an avoided transmission cost of $99 per kW-year and an avoided distribution cost of $110

[25] AESC Study Group. May 2021. "Avoided Energy Supply Costs in New England 2021." Synapse Energy Economics. Available at: https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf

per kW-year to measures that reduce peak load.[26] (Note that we relied on the data contained in the "AESC" tab of National Grid's draft BCA workbook submitted to the Massachusetts Energy Efficiency Advisory Council in April 2021, which in turn relies upon values from the *2021 Avoided Energy Supply Cost* (AESC) study and therefore would not have changed in the Company's final 2022-2024 Three-Year Plan calculations as submitted in D.P.U. 21-128.)

Charging EVs during off-peak hours also reduces peak load, and the inclusion of these avoided costs would increase National Grid's off-peak charging rebates. Following National Grid's methodology for calculating its avoided capacity benefit, we estimate an avoided transmission benefit of $0.027 per kWh and an avoided distribution benefit of $0.030 per kWh for a total transmission and distribution cost savings of $0.058 per kWh (see Table 6).

Table 6. Avoided Transmission and Distribution Costs

	Avoided Cost ($ per kW)	Cost Savings ($ per kWh)
Transmission	$99	$0.027
Distribution	$110	$0.030
TOTAL	**$209**	**$0.058**

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

[26] National Grid. April 30, 2021. "Statewide Draft Energy Efficiency Plan." *2022-24 National Grid BC Model Electric [Excel].* Available at: https://ma-eeac.org/wp-content/uploads/2022-24-National-Grid-BC-Model-Electric-April.xlsb

Q. Is it possible to estimate the avoided reliability costs associated with off-peak EV charging?

A. Yes. In its draft 2022-2024 Three-Year Energy Efficiency Plan, National Grid applies a total avoided reliability cost of $31 per kW-year in 2022 to measures that reduce peak load.[27] Charging EVs during off-peak hours also reduces peak load, and the inclusion of this avoided cost would increase National Grid's off-peak charging rebates. Following National Grid's methodology for calculating its avoided capacity benefit, we estimate a reliability benefit of $0.008 per kWh (see Table 7).

Table 7. Avoided Reliability Costs

	Avoided Cost ($ per kW)	Cost Savings ($ per kWh)
Reliability	$31	$0.008

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. Is it possible to estimate the avoided capacity DRIPE costs associated with off-peak EV charging?

A. Yes. In its draft 2022-2024 Three-Year Energy Efficiency Plan, National Grid utilizes a total avoided capacity DRIPE cost of $50 per kW-year in 2022 for measures that reduce peak load.[28] Charging EVs during off-peak hours also reduces peak load, and the inclusion of this avoided cost would increase National Grid's off-peak charging rebates. Following National Grid's methodology for calculating its avoided capacity benefit, we estimate a capacity DRIPE benefit of $0.014 per kWh (see Table 8).

---

[27] National Grid. April 30, 2021. "Statewide Draft Energy Efficiency Plan." *2022-24 National Grid BC Model Electric [Excel].* Available at: https://ma-eeac.org/wp-content/uploads/2022-24-National-Grid-BC-Model-Electric-April.xlsb

[28] National Grid. April 30, 2021. "Statewide Draft Energy Efficiency Plan." *2022-24 National Grid BC Model Electric [Excel].* Available at: https://ma-eeac.org/wp-content/uploads/2022-24-National-Grid-BC-Model-Electric-April.xlsb

Table 8. Avoided Capacity DRIPE Costs

	Avoided Cost ($ per kW)	Cost Savings ($ per kWh)
Capacity DRIPE	$50	$0.014

Note: See D.P.U. 21-91 GECA-ESJC-4 Workpaper A for calculations.

Q. How does off-peak EV charging provide an emissions reduction and related cost benefit?

A. Off-peak EV charging shifts energy use from peak to off-peak times. Off-peak charging times have a lower grid emissions rate than on-peak charging rates per ISO-New England.[29] Shifting energy use from peak to off-peak times both lowers Massachusetts emissions and lowers the marginal abatement costs associated with those emissions.[30]

Q. Is it possible to estimate the emission reduction from off-peak EV charging?

A. Yes. Both ISO-New England[31] and AESC[32] provide estimates of peak and off-peak grid emissions. The on- and off-peak periods used by ISO-New England and AESC do not, however, align perfectly with expected EV charging or the rebate program as designed by National Grid. For this reason, we apply a different methodology—developed by AEC for use in battery storage permitting applications with the DPU—that allows for emission rate estimation for specific periods (e.g., charging and discharging, peak and off-peak, etc.).

[29] ISO-New England. March 2021. "2019 ISO New England Electric Generator Air Emissions Report." *System Planning.* Available at: https://www.iso-ne.com/static-assets/documents/2021/03/2019_air_emissions_report.pdf, Table 5-3
[30] AESC Study Group. May 2021. "Avoided Energy Supply Costs in New England 2021." Synapse Energy Economics. Available at: https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf, Chapter 8
[31] ISO-New England. March 2021. "2019 ISO New England Electric Generator Air Emissions Report." *System Planning.* Available at: https://www.iso-ne.com/static-assets/documents/2021/03/2019_air_emissions_report.pdf
[32] AESC Study Group. May 2021. "Avoided Energy Supply Costs in New England 2021." Synapse Energy Economics. Available at: https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf

In essence, our method estimates a difference in the emission rates associated with EV charging under two different scenarios:

(1) **No planning**: In this counterfactual, National Grid does not plan for EV charging and charging occurs on peak (per National Grid's own assumption). In this scenario, the addition to peak load from charging is served by marginal generating resources (that is, the next least expensive resource available to run in the event of higher load) and the relevant emissions rate is the on-peak marginal emissions rate.

(2) **Planning**: In this scenario, National Grid plans for EV charging by means of its Off-Peak Charging Program. EV load is expected and National Grid is ready to meet that load with generation that is compliant with Massachusetts climate regulations (e.g., Renewable Portfolio Standard, Clean Energy Standard, Clean Peak Standard). The relevant emissions rate is the off-peak average emissions rate.

Thus, charging during on-peak hours adds unplanned marginal generation and emissions, while charging during off-peak hours adds planned average generation and emissions. We estimate the difference in emissions rates using hourly generation data by resource type from ISO-New England's *Operations Reports for Dispatch Fuel Mix*[33] for the 2020 calendar year to estimate marginal and average emission rates for specific time periods and seasons.

[33] ISO-New England. 2020. *Operations Reports: Dispatch Fuel Mix*. Available at: https://www.isone.com/isoexpress/web/reports/operations/-/tree/gen-fuel-mix

Using this period-specific method we find a difference in on-peak versus off-peak emission rates of 89.7 and 83.8 kg CO_2 per MWh for Winter and Summer, respectively (see Table 9).[34]

Table 9. On- and Off-Peak Emissions Rates and Avoided Emissions Values by Season

Season	On-Peak Emissions Rate (kg CO_2 per MWh)	Off-Peak Emissions Rate (kg CO_2 per MWh)	Emission Savings (kg CO_2 per MWh)
Winter	404.2	314.5	89.7
Summer	423.4	339.6	83.8
Average	**413.8**	**327.1**	**86.7**

Note: See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations.

Q. Is it possible to estimate the avoided costs associated with the emissions reduction from off-peak EV charging?

A. Yes. AESC 2021 develops avoided greenhouse gas emission values that are applied in the Massachusetts energy efficiency program administrators draft 2022-2024 plan. Table 10 below shows the 2021 Winter and Summer peak and off-peak avoided greenhouse gas emission values used in the draft 2022-2024 plan,[35] the emission rates assumed in AESC 2021,[36] and the inferred $184 per short ton CO_2 (or $203 per metric ton CO_2).[37] (This value, when calculated using AESC's illustrative 15-year levelized average emission cost is $125 per short ton.)

---

[34] See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations.

[35] National Grid. April 30, 2021. "Statewide Draft Energy Efficiency Plan." *2022-24 National Grid BC Model Electric [Excel].* Available at: https://ma-eeac.org/wp-content/uploads/2022-24-National-Grid-BC-Model-Electric-April.xlsb

[36] AESC Study Group. May 2021. "Avoided Energy Supply Costs in New England 2021." Synapse Energy Economics. Available at: https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf, Table 80

[37] See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations.

Table 10. Avoided CO_2 Emissions Costs by Season

	Winter		Summer	
	On-Peak	Off-Peak	On-Peak	Off-Peak
Non-Embedded CO_2 Costs (2021$ per kWh)	$0.0695	$0.0728	$0.0717	$0.0735
CO_2 Marginal Emissions Rates (lb per MWh)	756	791	779	799
Avoided CO_2 Emissions Cost ($ per short ton)	**$184**	**$184**	**$184**	**$184**
Avoided CO_2 Emissions Cost ($ per metric ton)	**$203**	**$203**	**$203**	**$203**

Note: See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations.

Multiplied by the average emission reduction of 86.7 kg CO_2 per MWh as calculated above, the result is an average avoided greenhouse gas emissions cost savings of $0.018 per kWh (see Table 11).[38]

Table 11. Avoided Emissions Costs

Season	Emission Savings (kg CO_2 per MWh)	Avoided Emissions Cost ($ per metric ton CO_2)	Cost Savings ($ per kWh)
Winter	89.7	$203	$0.018
Summer	83.8	$203	$0.017
Average	**86.7**	**$203**	**$0.018**

Note: See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations

Q. How would including these omitted benefits change National Grid's off-peak charging rebate?

A. National Grid includes energy and capacity cost reductions in its valuation of its Off-Peak Charging Program rebate:

[38] See D.P.U. 21-91 GECA-ESJC-5 Workpaper B for calculations.

- **Energy cost reduction:** 0.6 and 1.9 cents per kWh for Winter and Summer, respectively
- **Capacity cost reduction:** 2.8 and 3.5 cents per kWh for Winter and Summer, respectively

Our testimony identifies several additional benefits of off-peak charging omitted by National Grid and provides preliminary valuations as a demonstration that it is possible to assign values to these benefits:

- **Transmission cost reduction:** 2.7 cents per kWh
- **Distribution cost reduction:** 3.0 cents per kWh
- **Reliability cost reduction:** 0.8 cents per kWh
- **Capacity DRIPE cost reduction:**1.4 cents per kWh
- **Emissions cost reduction:** 1.8 cents per kWh

Summing these estimates together provides illustrative Winter and Summer rebate values of 13.1 and 15.1 cents per kWh, respectively.

VI. POTENTIAL REVENUE SOURCE FOR FUNDING CHARGING REBATES

Q. What potential revenue sources could National Grid leverage to fund its Off-Peak Charging Program?

A. All National Grid customers are charged a System Benefit Charge, or energy efficiency fee, on their bills of $0.00250 per kWh[39] to fund the utility's energy efficiency programs. In addition, National Grid collects an energy efficiency reconciling factor (EERF) charge,

[39] National Grid. September 2021. "Summary of Electric Delivery Service Rates." *Residential R-1.* Available at: https://www.nationalgridus.com/media/pdfs/billing-payments/tariffs/mae/meco_delivery.pdf

which is designed to cover the estimated incremental costs of the Company's proposed energy efficiency programs for the year. The EERF charge is updated every year and varies by customer group. The current EERF charge for National Grid's residential customers is $0.01479 per kWh.[40] Together these two fees amount to $0.01729 per kWh. Charging of electric vehicles, therefore, contributes $0.01729 per kWh to fund energy efficiency programs in Massachusetts. At an average usage of 3,000 kWh per year, each electric car is generating $51.87 per year that may be one potential revenue source for funding charging rebates.

VII. RECOMMENDATIONS

Q. Are you recommending a specific off-peak charging rebate for National Grid?

A. No. The calculations we present in this testimony are illustrative and meant to demonstrate that (1) National Grid's off-peak charging rebates omit important benefits of off-peak charging, and (2) quantification of these omitted benefits is feasible.

Q. What is your recommendation with regard to National Grid's off-peak charging rebates?

A. National Grid should revisit its off-peak rebate calculations by rerunning its analysis to correct the errors that we have identified as well as to include the omitted benefits that we have described above. Our review indicates that doing so would result in much larger values than the off-peak charging rebates that National Grid is currently offering, which would more accurately compensate customers for the service that they provide by

---

[40] National Grid. September 2021. "Summary of Electric Delivery Service Rates." *Residential R-1.* Available at: https://www.nationalgridus.com/media/pdfs/billing-payments/tariffs/mae/meco_delivery.pdf

charging their EVs during off-peak hours. EV owners are currently being overcharged for the energy used to charge their vehicles; correcting the rebate value would eliminate a cross-subsidy from EV owners to non-EV owners while at the same time providing an incentive to adopt critical emission reductions in the transportation sector.

VIII. CONCLUSION

Q. Does this conclude your testimony?

A. Yes.