Renewable Energy Growth Program Analysis

Economic, Jobs and Environmental Impacts for Program Years 2015 and 2016 and the Overall Program Years 2015 to 2019

PREPARED FOR

Rhode Island Office of Energy Resources

Rhode Island Distributed Generation Board

PREPARED BY

Mark Berkman

Jurgen Weiss

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This report was prepared for the Rhode Island Office of Energy Resources and the Distributed Generation Board. All results and any errors are the responsibility of the authors and do not represent the opinion of The Brattle Group, Inc. or its clients.

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Executive Summary

The Rhode Island Office of Energy Resources (OER) and Distributed Generation Board engaged *The Brattle Group* to conduct a study to assess the economic, jobs, and environmental impacts of the Renewable Energy Growth (REG) Program years 2015 and 2016 as well as to estimate, based on the experience with program years 2015 and 2016, the expected impacts of the overall REG program between 2015 and 2019. Since most REG tariffs remain in place between 2030 and 2040 (depending on the execution of the tariffs), we estimated the impacts over a 25 year period through 2040. In brief, we have determined that:

- The 49.4 megawatts (MW) of solar and wind projects supported by the REG program in 2015 and 2016 resulted in an investment of $126 million in 1046 projects.
- By the end of the current REG program in 2019, REG investments will account for 160 MW of renewable energy capacity reflecting additional investments totaling $264 million, bringing total investment to $390 million.
- This investment will contribute about $236 million on a present value basis to state GDP through 2040. On average 88 jobs will be added in each year (close to 500 per year 2016-2019 because of construction, but near zero on net per year 2020-2040 because while operations and maintenance jobs grow, they are offset by losses in service jobs resulting from modestly higher electricity prices until late in the period.
- The overall investments under the 2015-2019 REG program benefit from approximately $117 million in federal investment tax credits (ITC), about $38 million of which are benefitting program years 2015 and 2016. To reach REG program goals without the ITC, Rhode Island ratepayers would have to pay approximately the same amounts provided by the ITC through correspondingly higher tariffs.
- The REG investments will contribute to reducing carbon and criteria pollutant emissions. The social costs avoided by the carbon reductions total over $51 million between now and 2040 on a present value basis. The criteria pollutant (SO_2, NO_x and $PM_{2.5}$) reductions avoid social costs of about $4.9 million on a present value basis over the same period.

The net impacts highlighted above take into account the REG programmatic costs, including ratepayer costs to fund the above-market tariffs for energy, capacity and RECs of the REG program and are net of increased state tax revenues due to taxes paid by REG program participants.

Figures ES-1 and ES-2 summarize these impacts. Figure ES-1 shows the expected incremental impact of the REG program on state Gross Domestic Product (GDP). It shows that the REG program has a significantly positive initial impact during construction years, followed by a small incrementally positive impact during the duration of the tariffs over the 25 year period. Note that Figure ES-1 only shows the incremental contribution to Rhode Island's state GDP and does not reflect underlying changes that are not due to the REG program. Figure ES-2 shows the REG program's estimated Rhode Island jobs impact. All of our analyses are based on somewhat

simplified assumptions concerning the timing of construction of projects that have received tariffs. Figures ES-1 and ES-2 take into account the REG programmatic costs.

Figure ES-1: Expected Incremental Impact of REG Program on Net Present Value of State GDP

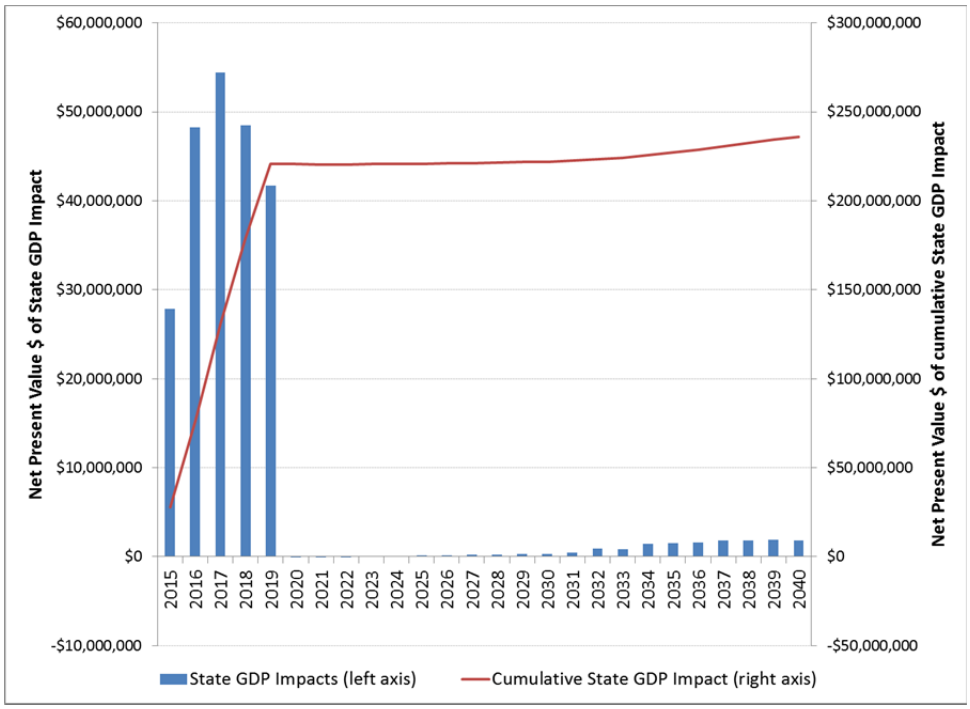
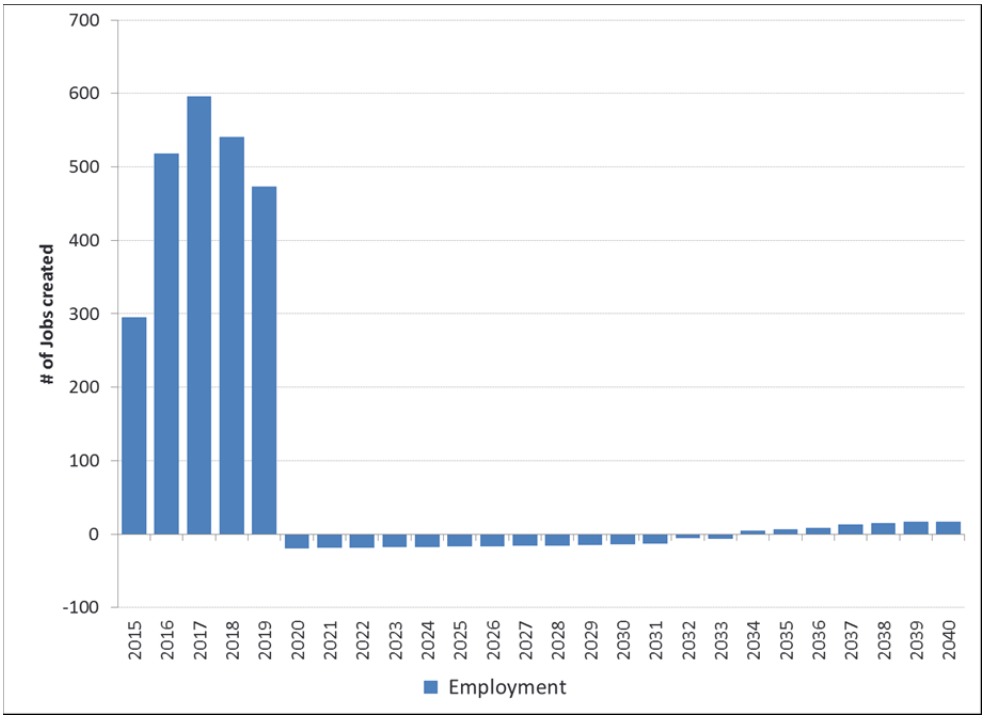


Figure ES-2: Expected Incremental Impact of REG Program on RI Employment



I. Introduction

A. Study Objective

In 2014, The Brattle Group released a study[1] analyzing the potential jobs, economic and environmental impacts of the distributed generation standard contract program (DGSC) on behalf of The Rhode Island Office of Energy Resources (OER) and Distributed Generation Board. The study examined potential impacts of the DGSC program under three alternative assumptions about how much capacity might be added under the program: 160 MW, 200 MW and 1,000MW.

Recently, OER and the Distributed Generation Board engaged *The Brattle Group* again to evaluate the actual economic, jobs, and environmental impacts of the Renewable Energy Growth (REG) Program based on actual REG program data for program years 2015 and 2016 as well as to estimate, based on the experience with program years 2015 and 2016, the expected impacts of the overall REG program, with the assumption that the targeted total 160 MW of renewable energy resources will be built under the entire REG program between 2015 and 2019. The analysis involves an assessment both of the immediate impacts on the Rhode Island economy related to the construction and other activities caused by participating projects as well as the longer term impacts through 2040 resulting from payments made and costs avoided under the REG program tariffs, including administrative costs, compensation payments made to National Grid, the program administrator, and various taxes being paid by program participants.

B. Structure of Report

This report is organized into six sections including the introduction. Section two provides a description of the REG programs. Section three reviews the methodology employed in the analysis. Section four describes the data and reviews key assumptions used in the analysis. Section five presents the results of the analysis. Section six provides our conclusions. Appendix A provides the detailed numerical results of our analysis.

II. Program Description

Rhode Island promotes renewable energy development in part through the Renewable Energy Growth (REG) program.[2] Under the REG Program, National Grid enters into fifteen or twenty year renewable energy tariffs with private landowners, homeowners, affordable housing, businesses, farmers and municipalities at a set and fixed price, not to exceed certain caps.

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1 Mark Berkman and Jürgen Weiss, Distributed Generation Standard Contracts and Renewable Energy Fund: Jobs, Economic and Environmental Impact Study, The Brattle Group, April 2014.

2 Net Metering and Virtual Net Metering are other existing means of encouraging renewable energy development. For more details on the REG program see https://www9.nationalgridus.com/narragansett/business/energyeff/4_dist_gen.asp

Anaerobic digestion, solar photovoltaic, small-scale hydro, and wind technology projects are eligible.

National Grid administers the annual program and receives administrative support and remuneration for operating the annual program. Payments made under the tariffs, administrative expenses and the incentive payment received by National Grid are recovered from ratepayers through a surcharge (per kWh) on electric rates.

Table 1 summarizes the projects that are under REG program tariffs by class and a capacity investment as of 2016. One thousand and forty six tariffs were executed for a total of 49.4 MW representing an investment of $126 million.[3]

Table 1 also summarizes the expected additional tariffs by class from 2017 through 2019. Over this period, another 110.5 MW of REG project capacity is expected to be awarded tariffs representing another $264 million investment. Thus, the REG program will be responsible for 160 MW of renewable capacity through the end of 2019.

Table 1: REG Total Capacity (kW installed) by REG Program Category

	Actuals		2015-2016	Projections			2015-2019
	2015	2016	**Total**	2017	2018	2019	**Total**
Small-Scale Solar	845	6,213	**7,059**	5,502	4,001	2,501	**19,063**
Medium-Scale Solar	2,705	4,496	**7,201**	4,001	4,001	4,001	**19,205**
Commercial-Scale Solar	4,147	7,559	**11,706**	5,002	5,002	5,002	**26,711**
Large-Scale Solar	6,644	7,854	**14,498**	19,840	19,840	19,840	**74,018**
Wind I	1,500	3,000	**4,500**	4,001	4,001	4,001	**16,504**
Wind II	4,500	0	**4,500**	0	0	0	**4,500**
Total	**20,341**	**29,122**	**49,464**	**38,346**	**36,845**	**35,345**	**160,000**

Sources and Notes:
1. Renewable Energy Growth Program Small-Scale Solar Projects, December 2016 Report for the Rhode Island Office of Energy Resources (RI-4536-N15). OER for capacity projections for 2017-2019.
2. National Grid 2016 Renewable Energy Growth Program enrollment results.
3. Assume kW = kW DC.
4. Program categories defined by type of technology and capacity.
   Small-scale solar: <25 kW DC
   Medium-scale solar: 26-250 kW DC
   Commercial-scale solar: 251-999 kW DC
   Large-scale solar: 1,000-1,500 kW DC
   Wind I: 1,500-2,999 kW
   Wind II: 3,000-5,000 kW

[3] Because we used tariff data through the end of November 2016, we likely slightly undercount the total number of tariffs under program years 2015 and 2016. Since we assume that over the entire 2015-2019 REG program the full 160 MW target capacity will be built, any shortfall in 2015-2016 is effectively captured in our assumed build-out in the remaining three REG program years.

Table 2 summarizes the capital investments by class associated with the REG program for the first two program years and for the entire REG program based on our assumptions about years 2017-2019. The first two years account for an investment of $126 million. Investments for the period 2017 through 2019 are expected to total $264 million for an overall 2015-2019 REG program investment total of approximately $390 million.

Table 2: REG Total Investment by Class ($ millions)

	Actuals		2015-2016	Projections			2015-2019
	2015	2016	**Total**	2017	2018	2019	**Total**
Small-Scale Solar	$3.66	$24.77	**$28.43**	$22.16	$16.12	$10.07	**$76.77**
Medium-Scale Solar	$6.74	$11.21	**$17.95**	$9.98	$9.98	$9.98	**$47.88**
Commercial-Scale Solar	$10.34	$18.84	**$29.18**	$12.47	$12.47	$12.47	**$66.59**
Large-Scale Solar	$13.45	$15.90	**$29.36**	$40.18	$40.18	$40.18	**$149.89**
Wind I	$3.52	$7.04	**$10.56**	$9.39	$9.39	$9.39	**$38.72**
Wind II	$10.56	$0.00	**$10.56**	$0.00	$0.00	$0.00	**$10.56**
Total	**$48.27**	**$77.77**	**$126.04**	**$94.17**	**$88.12**	**$82.08**	**$390.40**

Sources and Notes:

1. Renewable Energy Growth Program Small-Scale Solar Projects, December 2016 Report for the Rhode Island Office of Energy Resources (RI-4536-N15).

2. National Grid 2016 Renewable Energy Growth Program enrollment results.

3. Total investment approximated using mean installed cost from Table 1 of Distributed Generation Renewable Energy Estimate of Costs (National Renewable Energy Laboratory, February 2016), http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html, accessed April 27, 2016.

III. Methodology

Determining the jobs, economic and environmental impacts of Rhode Island's REG program requires a comparison of electric capacity, generation and REC costs, transmission and distribution costs, and emissions in the absence of these programs to those same costs and emissions with the programs in place. The observed differences between these scenarios measure the program's impacts. Given the relatively small size of the REG program in relation to the New England electricity market, it is reasonable to assume that market prices (representing the costs of marginal generation and emissions) reasonably represent these costs. We therefore use observed and projected market prices for energy, capacity and RECs to approximate the costs avoided by generation, capacity and renewable attributes provided by REG program facilities.[4] Differences in the costs under the REG program tariffs and the costs of alternatively procuring

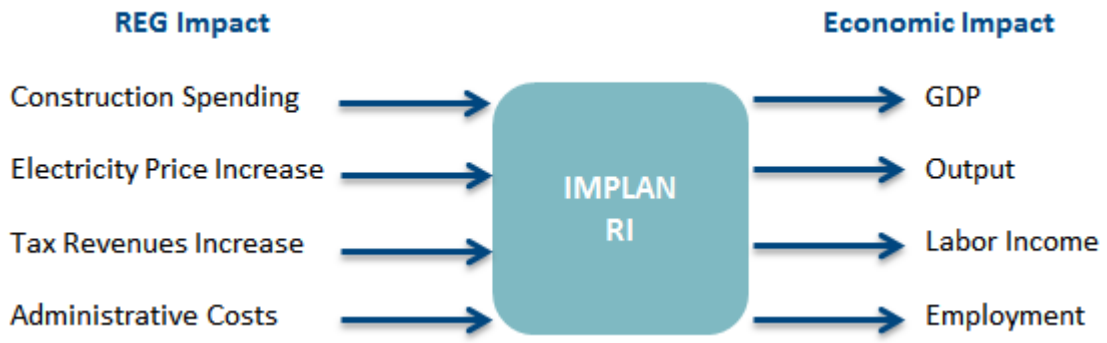
[4] In our 2014 report we modeled explicitly the change in production costs, capacity costs, etc., due to the fact that one of the cases analyzed, the addition of 1,000 MW of renewable capacity under the DGSC and REF programs, was as sizable enough addition to potentially lead to changes in the New England system that go beyond changes at the margin.

energy, capacity and RECs have consequences for electricity rates and employment. These consequences, in turn, affect economic development and government tax revenues.

To estimate the impact of the REG program on electricity generation and air quality we rely on information about the New England electricity market in general and on information provided by National Grid about how it will use the energy, capacity and renewable attributes from the facilities participating in the REG program.

We estimate economic impacts using IMPLAN, which is a commercial input-output model. IMPLAN is widely used by federal, state, and local agencies to measure the impacts of regulatory changes and major infrastructure investments.[5] IMPLAN measures changes in economic activity including Gross Domestic Product (GDP), output, jobs, and tax revenues resulting from these changes or investments. The necessary inputs to this model are taken from information provided by National Grid about participating projects, the New England ISO, interviews with program participants and other stakeholders, and general publicly available information. Figure 1 summarizes how Implan is implemented.

Figure 1: Implan Methodology



Investments in renewable plants encouraged by the REG program and any associated changes in electricity prices result in changes to final demand for goods and services by the residential, commercial, industrial, finance, and utility sectors. Electricity price changes are determined by payments made by National Grid under the tariff agreements entered under the REG program, associated incentive payments to National Grid and administrative expenses, net of the avoided costs for energy, capacity and renewable attributes. Final demands are also influenced by various taxes paid by program participants (tangible tax, sales tax, income tax paid on the sale of electricity under some of the tariffs),[6] some of which flow back to various participants in the

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5 For more information go to www.implan.com.

6 The equipment for the renewable energy facilities installed under the REG program is exempt from Rhode Island sales tax. As mentioned, the projects also benefit from the availability of the federal investment tax credit (ITC). These credits flow back to project owners and lower the tariffs necessary to make REG projects economically viable. We assume that the tariff ceilings and actual tariffs signed reflect the revenue levels needed to make REG projects economically viable with the ITC. Hence, the

Continued on next page

Rhode Island economy, and potentially changes in income to renewable energy participants (investors, private landowners, municipalities, affordable housing, farmers, businesses, and households) and payments to the participating utility (National Grid) through the REG program. IMPLAN produces estimates of economic output, employment and state tax revenues at the state level. Economic output is a measure of economic activity, and here represents a state level GDP reflecting the market value of all goods and services produced in one year by labor and property supplied by residents of the state. Employment impacts are comprised of direct employees associated with manufacturing a good or providing a service (installing solar equipment for example), indirect employees associated with providing goods and services to the manufacturer or primary service provider, and induced employees associated with the demand for goods and services from households who generate additional income as direct or indirect workers.

IV. Data and Assumptions

Analyzing the jobs, economic and environmental impact of the REG program requires data and assumptions about the capacity participating in the REG program year by program category as well as the average tariff received by REG projects in each program year. It also requires an estimate of the administrative costs as well as remuneration for National Grid, avoided costs of energy, capacity and RECs, tax revenues generated by REG projects, as well as construction costs and the Rhode Island share of construction expenditures. We describe how we account for each of the program influences identified below.

A. Program Participation and Tariffs

To assess the impact of the REG program, we first collected and assembled a list of actual projects awarded tariffs in the 2015 and 2016 REG program years. Table 3 below summarizes program participation (and average tariff) by program year and category.

Continued from previous page

benefits of the ITC to Rhode Island are already reflected in the (lower) tariff levels relative to tariffs without the ITC.

Table 3: 2015/2016 Program Year REG Tariffs by Category

	2015		2016	
Capacity	kW	Avg. Tariff	kW	Avg. Tariff
Small Scale Solar 15 yr	764	41.35	4,866	37.65
Small Scale Solar 20 yr	81	37.75	1,347	33.45
Medium Scale Solar	2,705	24.40	4,496	22.55
Commercial Scale Solar	4,147	18.86	7,559	17.77
Large Scale Solar	6,644	16.27	7,854	13.03
Wind I	1,500	22.75	3,000	18.75
WindII	4,500	22.35	-	18.00
Total	**20,341**		**29,122**	

Source: National Grid, OER.

Small scale solar projects, primarily rooftop solar PV installations of less than 10kW capacity, can choose to receive either 15 or 20 year tariffs, with 15 years tariffs resulting in somewhat higher tariff payments because of the shorter duration of those tariff payments.[7] All other participating (larger) facilities with capacities ranging from 25kW to 5MW receive tariff payments for 20 years.

Analyzing the anticipated activity during the remaining three REG program years to assess the overall impact of the REG program from 2015 to 2019 requires a projection of program participation by category in each of the next three program years. It also requires an estimate of average tariffs for each program category. To estimate the capacity installed under the REG program, we used assumptions provided to us by the OER related to the pattern of program participation by category and year for the remaining three program years. In essence, we assumed that about one third of the unfilled program capacity (a bit over 110MW out of 160MW total) would be installed in each of the next three years. To estimate the tariff for small scale solar projects, which receive the set-fixed tariff price, we used the tariff price for program year 2017 and estimated the tariff price for 2018 and 2019 by reducing the tariff price in each year by the average annual tariff price decrease between 2015 and 2017. The actual average tariffs paid for all other REG program categories depend on the bids received for such projects. To estimate the average tariff received by medium scale solar projects, we assumed that the average annual percentage decline in tariffs received during 2015-2017 would continue to lower prices in the next three program years. For commercial solar projects we assumed that the average percentage change of the rate between 2015 and 2016 would determine the average tariffs received in 2017, 2018 and 2019. Since using this approach for large scale solar projects would result in unrealistically low tariff prices by 2019 (under 7 cents/kWh), we assumed that the tariff decline rate would be cut in half in each of the next three program years, which results in a more realistic projection of tariff prices for large scale solar projects, a bit above 10 cents/kWh by

[7] Tariff levels reflect the required revenues to pay for the upfront investment.

2019.[8] For wind projects, we assumed that the tariff received would equal the tariff price in 2017 and would equal the average of the tariff received in 2016 and 2017 for the remaining two program years, in part to reflect the fact that the tariff price for wind increased from 2016 to 2017. Table 4 below shows the assumed capacity by project category and associated average tariffs received for the remaining three program years.

Table 4: Forecast Program Year 2017-19 REG Tariffs by Category

	2017		2018		2019	
Capacity	kW	Avg. Tariff	kW	Avg. Tariff	kW	Avg. Tariff
Small Scale Solar 15 yr	4,388	34.75	3,192	31.86	1,995	29.20
Small Scale Solar 20 yr	1,113	30.85	810	27.89	506	25.22
Medium Scale Solar	4,001	22.75	4,001	21.99	4,001	21.25
Commercial Scale Solar	5,002	16.74	5,002	15.77	5,002	14.86
Large Scale Solar	19,840	11.73	19,840	11.14	19,840	10.87
Wind I	4,001	19.45	4,001	19.10	4,001	19.10
WindII	-	18.25	-	18.13	-	18.13
Total	**38,346**		**36,845**		**35,345**	

Source: OER, Brattle Projections.

The capacity by program type, tariff length, and average tariff received are critical assumptions to determine the short and long-term impacts on the Rhode Island economy from building the facilities. These assumptions are also critical to determine the REG programs impact on electricity costs through tariff payments made by National Grid and ultimately recovered from ratepayers, inclusive of administrative costs and remuneration for National Grid, net of avoided spending on energy, capacity and RECs.

B. Administrative Costs and Remuneration

Administration of the REG program results in costs of the annual program. We used National Grid's estimate of the cost of administering the REG program. These include approximately $900,000 for program year 2015 and $800,000 for program year 2016 to-date, plus an estimated

[8] These projections remain highly uncertain, given the dynamic developments in the solar industry. Prices for utility scale solar projects, expressed in $/MWh, the equivalent of the tariffs under the REG program, have been falling steadily. At present, utility scale solar projects in the best US locations receive prices as low as $50/MWh. There is however very significant variation in prices, depending on the site and size of projects. In general, current solar projects in the Northeast receive prices between $75 and $242/MWh (See Lazard, Lazard's Levelized Cost of Energy Analysis – Version 10.0, page 9), approximately 50% higher than in the Southwestern United States. Given that even large scale solar PV projects in Rhode Island remain at the low end of the size of utility-scale projects, we expect prices around $100/MWh (equal to a tariff of 10 cents/kWh) to be a reasonable forecast.

$625,000 per year going forward.[9] We also assumed that National Grid's administrative costs for bidding capacity from some of the REG projects into the capacity market would be $3,930,240, spread over 25 years, or $157,210 per year.[10] Finally, National Grid is entitled to 1.75% remuneration for administering the REC program.[11]

C. Avoided Costs of Energy, Capacity and RECs

To assess the value of avoided energy, capacity and REC related costs requires assumptions about the wholesale energy, capacity and REC prices between now and 2040. Since each of these prices is determined through a complex process involving multiple uncertain factors, forecasting the value of each is, by definition, both difficult and relatively uncertain. National Grid has provided us with its own assumptions about the forecast value of energy and REC prices and we use National Grid's assumptions for both, but below describe how it relates to our own assessment. We also discuss our assumed value of capacity from REG projects National Grid is planning to sell into the New England capacity market.

1. Avoided Energy Costs

To model the avoided energy cost of the REG program requires an assessment of how energy production from REG facilities will impact customer energy bills over time. In theory, these impacts can take two forms. First, energy produced from REG facilities displaces energy that would have to be procured otherwise and hence the value of the energy procured under REG tariffs is equal to the value of avoided energy purchases.[12] Our analysis focuses on this direct impact of REG program participant facilities on customer energy bills. A theoretical secondary impact could be related to REG program facilities having a material impact on energy and/or capacity prices over time. Given the small amount of energy produced by the REG program facilities relative to the overall size of the New England market, we did not separately consider this potential impact on customer energy costs, but discuss it in our section about other potential benefits.

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[9] See Attachment PUC 1-3_Update to RR1 - COMM 3-11_to_2040_ETx_v4.xls, provided to us by National Grid.

[10] See Direct Testimony of Richard S. Hahn, In The Matter of National Grid's Proposal To Bid Capacity of Customer-Owned DG Facilities Into The Forward Capacity Market, Rhode Island Public Utilities Commission, Docket No. 4676, Table 1.

[11] See Joint Pre-filed Direct Testimony of Jeanne A. Lloyd and Adam S. Crary, RE Growth Factor Filing, June 30, 2016, Page 16 of 23.

[12] Note that to the extent the avoided energy would have been produced by Rhode Island power plants, there would be a partially offsetting effect of reduced energy margins to those facilities. The impact could be significant if the lower energy margins lead to the retirement (and associated loss of jobs and local tax revenues) of a Rhode Island facility, but are likely much smaller if they do not result in retirement. Given the relatively small amount of energy produced by the REG program facilities when compared to the New England market and given that we are not aware of any Rhode Island plants currently in danger of retirement, we did not consider this potentially offsetting effect.

In its own calculations of the anticipated costs of the REG program, National Grid assumed an avoided wholesale energy price of $55/MWh.[13] The 2016 all-hours average locational marginal price for the RI zone was $28.91/MWh[14] (or a little under 3 cents/kWh). National Grid's estimate of the avoided cost of energy from REG program is therefore above recent wholesale market prices. This difference can be due to several factors. First, the energy value of REG facilities could be higher than the all-hours average Locational Marginal Price (LMP)[15] if such facilities produce more energy during hours with higher than average LMPs than they do in hours with below average LMPs. We used a standard model provided by the federal National Renewable Energy laboratory (NREL) to simulate the hourly production profile of both rooftop and open field solar PV facilities located in Rhode Island to test to what extent the all-hour average LMP well represents the value of output from solar PV facilities in Rhode Island and concluded that, using 2016 real time LMPs, the value of solar PV output would have been 105% of the real-time LMP.[16] Since the REG program facilities will produce electricity for decades and since this impact analysis requires estimates through at least 2040, it is important to assess how the relationship between all-hour average LMPs and REG facility output LMPs may evolve over time. It is unlikely that as more solar photovoltaic (PV) facilities get added to the New England system, any premium value of solar PV output will increase. This is because additional solar production reduces the net demand that needs to be met by non-solar (and dispatchable) facilities setting market prices. This in turn means that average hourly prices during hours of solar production will likely decline as solar facilities are added to the system. The magnitude of this effect depends on what other changes occur to the system over time. We have therefore made the simplifying assumption – like National Grid – that the relationship of the price received by solar PV production relative to the all-hours average price of electricity remains constant across time on a per kWh basis.

Projecting the value of avoided energy purchases through 2040 also requires an estimate of energy market prices over the same time period. Deriving our own independent forecast of energy prices was beyond the scope of this report. Given the currently very low price of natural gas and the fact that natural gas prices are the primary determinant of energy market prices in New England, it is likely that energy prices in the future will increase, given that projections of the natural gas price such as those made in the Annual Energy Outlook by the Energy Information Administration project real increases in natural gas prices going forward. Figure 2

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[13] See Attachment PUC 1-3_Update to RR1 - COMM 3-11_to_2040_ETx_v4.xls, provided to us by National Grid.

[14] See ISO New England (www.iso-ne.com). We use real-time hourly LMPs to calculate the all-hours average.

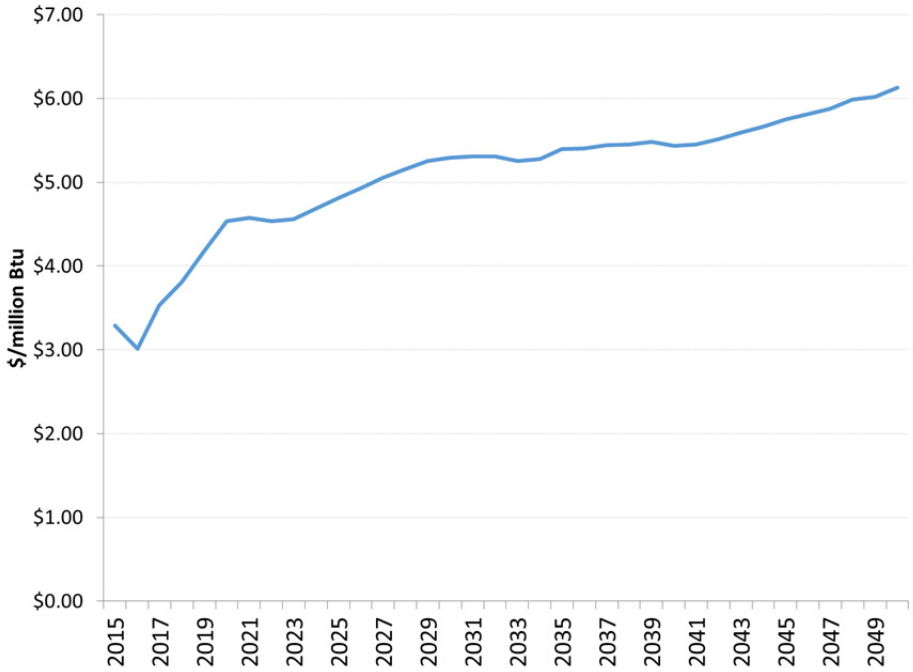
[15] The LMP represents the wholesale value of electricity at a given location in the New England wholesale electricity market administered by ISO New England.

[16] See pvwatts.nrel.gov, which is freely available online. We assumed a 50/50 mix of residential and open field installations and used a TMY3 weather station at TF Green State Airport as the reference location.

below shows the EIA's projection of natural gas prices for electricity production from 2015 to 2050.

As Figure 2 shows, natural gas prices in general are expected to approximately double in real terms between today and 2050. Since natural gas prices are the primary driver of energy market prices in New England (the other important variables being variable O&M costs and changes to which plant sets the market price in each hour), this projection, if true, would suggest a likely increase of energy market prices by a similar but somewhat lower percentage over the same time horizon. This would imply an approximate increase of wholesale energy prices from 3 cents/kWh to 6 cents/kWh (in real terms, with a correspondingly larger increase in nominal terms).[17]

Figure 2: AEO 2017 Natural Gas Price Projection (for Electricity Production)



Source: Energy Administration, Annual Energy Outlook 2017, Reference Case ($2016).

National Grid's estimate, which based on statements by National Grid is based on a recent forward energy price estimate, is therefore broadly consistent with a long-run average expected

[17] In reality, the relationship between natural gas and wholesale energy prices is of course more complex. Energy prices are set by the most expensive generating unit called upon by ISO-NE to produce energy. At present, natural gas fired generation sources are setting the price in most hours. However, depending on the overall level of demand, natural gas fired generation sources of different efficiency are doing so. As existing units retire and new generation gets added and demand changes, the types of generation sources setting market prices and the frequency with which they do so will change. As the region continues to decarbonize, it is possible that different types of resources will increasingly be price setting. Nonetheless, it is likely that through 2040 natural gas will continue to play a significant role in setting wholesale prices.

wholesale market price, potentially including some diversity value related to the uncertainty of future wholesale electricity prices due to potential deviations of the natural gas price from long-term forecast prices. For these reasons, we use National Grid's assumed avoided energy price of 5.5 cents/kWh in our analysis.

2. Avoided REC Costs

Under the REG program, participants receive a tariff payment in exchange not only for energy and capacity, but also for environmental attributes. In particular, the REG program was at least in part designed to create some of the supply of renewable energy necessary to meet Rhode Island's Renewable Energy Standard (RES) and associated renewable energy certificates (RECs).[18] The production of renewable energy from REG program facilities therefore has value equal to the avoided cost of procuring RECs outside the REG program, i.e., from other qualifying facilities. Under the Rhode Island RES rules, renewable energy from a variety of resources including wind, solar, small hydro, ocean energy, fuel cells using renewable fuel, and certain biomass facilities can be used as long as they generate electricity in the markets[19] administered by ISO-NE. The avoided costs of RECs to meet the RI RES is therefore directly linked to the cost of renewable energy (and the related cost of generating RECs) in New England overall.

Because the actual construction costs of renewable projects are private information and not typically made public, the cost of procuring renewable energy (and RECs derived from such renewable energy) in New England in the absence of the REG program needs to be estimated. There are several indicators of the costs of building new renewable energy resources in New England. They include the spot prices for RECs as well as observed prices of long-term contracts for bundles of energy, capacity and RECs in several New England states, most importantly long-term contracts signed in Massachusetts under Sections 83 and 83A of the Green Communities Act.

While a potential indicator of the cost of renewable energy (more precisely of the cost above the market value of energy and capacity from renewable resources), spot prices for RECs by themselves can be somewhat misleading since they also reflect shorter term mismatches between the supply of and demand for RECs. Figure 3 below shows the evolution of spot REC prices in New England.

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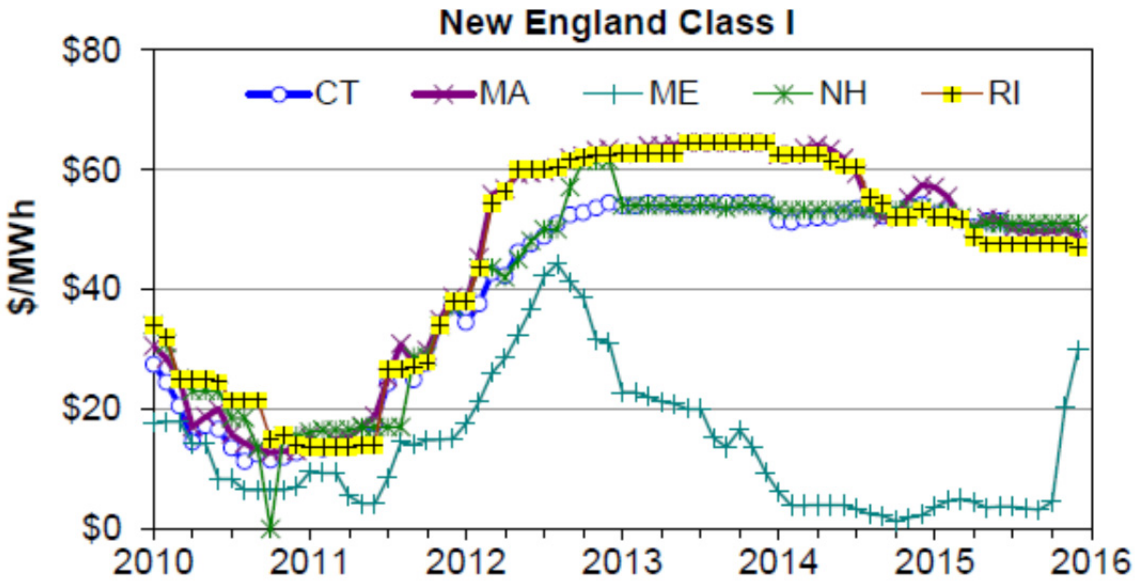
[18] See http://programs.dsireusa.org/system/program/detail/1095 for details on the Rhode Island RES, which requires a 10% share of renewable energy by 2016 and then grows by 1.5% per year until it reaches 38.5% by 2035.

[19] See State of Rhode Island and Providence Plantations Public Utilities Commission, Rules and Regulations Governing the Implementation of a Renewable Energy Standard, July 25, 2007, Section 5.

Figure 3: New England Class I Spot REC Prices

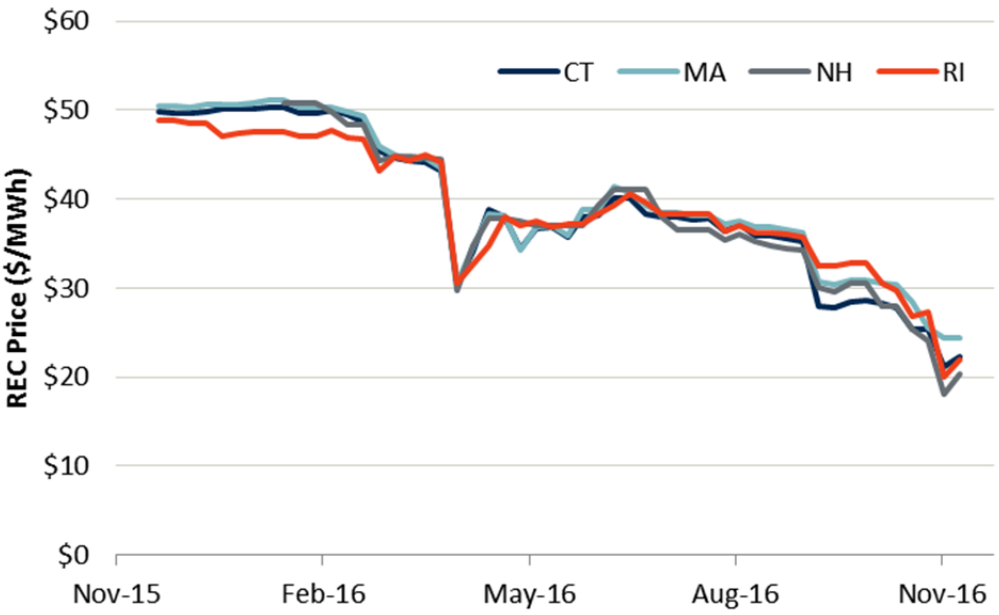


Source: reproduced from Galen Barbose, U.S. Renewables Portfolio Standards: 2016 Annual Status Report, Lawrence Berkeley National Laboratory, April 2016, p.28.

As can be seen from Figure 3, spot REC prices in most of the New England states have been at or near the Alternative Compliance Payment (ACP) levels[20] over the past several years and more recently around $55/MWh, with the exception of Maine due to different eligibility for biomass resources. More recently, however, spot REC prices have declined substantially to levels below $25/MWh, as indicated in Figure 4.

[20] The ACP sets an upper bound to REC prices. Companies can choose to comply with their requirements under a RES by making a payment equal to the ACP instead of surrendering REC.

Figure 4: Recent Development of New England REC Prices



Source: Reproduced with permission from Figure 15, Sam Newell and Jurgen Weiss, Electricity Market Impacts of the Proposed Northern Pass Transmission Project, prepared for the New Hampshire Counsel for the Public, December 30, 2016, based on SNL Financial data.

There is some evidence from recently signed long-term contracts for renewable resources that the longer-term REC value needed to fund new renewable projects may be even lower. For example, a relatively recent wind project PPA signed in Connecticut suggests a required long-term REC price of $12/MWh.[21]

The evolution of REC price levels required to support future development of renewable energy resources to meet current and future renewable energy obligations in New England is of course highly uncertain. RES[22] targets in several New England states will continue to increase over time and may be further increased in light of longer term GHG emissions reductions mandates or targets in excess of what is achievable under current RES targets. At the same time, it is likely that there will be continued cost declines for various renewable energy technologies. It seems reasonable to expect the value of avoided REC purchases to meet the Rhode Island RES to be between approximately $12/MWh and $55/MWh.

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[21] See Power Purchase Agreement between The United Illuminating Company and Number Nine Wind Farm, LLC as of September 19, 2013, Exhibit D, Connecticut Public Utilities Regulatory Authority, Docket No. 13-09-19.

[22] Different states use different names for their renewable energy programs, such as RES and RPS. For convenience and to avoid confusion with the REG program, we use RES for all state level renewable energy programs resulting in overall renewable energy targets, i.e. for both RES and RPS.

We note that National Grid, in its REG Program Factor filing, has assumed a REC value of $41/MWh, which is somewhat below recent (but above the most recent, as shown in Figure 4) spot REC price levels. Nevertheless this value is in the range of reasonable REC prices. We therefore use National Grid's estimated REC price of $41/MWh for our analysis.

3. Avoided Capacity Costs

Renewable energy projects participating in the REG program help meet overall capacity needs in two potential ways. First, smaller behind the meter systems are currently not allowed to participate in the New England ISO forward capacity market (FCM), but can still have a beneficial impact by reducing the installed capacity requirement (ICR) that forms the basis for procuring capacity on the FCM. However, given the relatively modest size of these types of installations, the fact that even in the near-term the impact of small scale and behind the meter solar PV generation on the ICR is likely relatively modest and given that this impact will likely continue to decline as more solar PV capacity is added to the New England system, we have not attempted to estimate the magnitude of this contribution, making our estimates somewhat conservative.

Second, separately metered solar PV (and other renewables) projects can in theory provide capacity value through their participation in the ISO New England's capacity market. At present, participation is limited to resources above 100 kW in size.[23] National Grid has stated that it plans to sell capacity from non-residential REG projects of 250kW and larger into the FCM.[24] The ISO qualifies approximately 35% of the nameplate capacity of solar PV resources in the forward capacity auctions (FCA).[25] We estimate, based on National Grid's proposal, that REG capacity of 250kW and above will be bid into the FCM beginning with FCM#12 for the summer period, i.e.

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[23] ISO New England, Distributed Generation/PV in the Forward Capacity Market, September 15, 2014

[24] National Grid, PROPOSAL TO BID CAPACITY OF CUSTOMER-OWNED DG FACILITIES INTO THE FORWARD CAPACITY MARKET, Joint pre-filed testimony and schedules of Stefan Nagy and Scott McCabe, November 18, 2016, p. 13 of 34. Even though about two thirds of medium scale solar PV projects installed in program years 2015-2016 meet the minimum threshold set by National Grid (they are exactly 250kW in size), we have assumed that National Grid would only bid commercial and large scale solar PV systems into the forward capacity markets. It is possible that the administrative effort associated with bidding smaller projects (between 100kW and 249kW) into the market may exceed the capacity market revenues that would be generated from selling such capacity. However, even in the absence of formally bidding the capacity into the forward capacity market, REG program facilities may have some (small) capacity value. To the extent they provide energy during peak demand periods, they may reduce the amount of capacity needed to be procured through the forward capacity market. For the portion of the 160 MW of REG program capacity not bid into the New England forward capacity market, this effect is likely small.

[25] Ibid.

the months of June, July, August and September.[26] We also use National Grid's assumed capacity contribution of 34.7%, which is based on the actual performance of four large solar PV facilities owned by Massachusetts Electric Company, which in turn is owned by National Grid, between 2012 and 2015.[27] Even though wind facilities can provide capacity in the New England market, based on the National Grid proposal to bid only solar REG capacity in the capacity market, we did not assume that wind project capacity under the REG program will generate capacity market revenues, again making our estimates somewhat conservative.[28]

Evaluating the REG capacity benefit in the New England Forward Capacity Market requires not only an assessment of the participating quantity, but also of the prices obtained. The correct price to use for estimating the value of REG capacity is the estimated price of future capacity auctions. Forecasting this value is a complex task and well beyond the scope of our analysis. However, given the dynamics of the FCM, it is possible to place reasonable bounds on future capacity prices. Notably, recent capacity prices in situations of surplus capacity likely provide an estimate of the lower bound of prices. On the other hand, ISO New England's estimate of Net CONE (Net Cost of New Entry) provides an estimate of the upper bound of capacity prices. ISO New England has recently proposed a change of Net Cone for FCA#12. The recently concluded FCA#11 resulted in a market-clearing price of $5.297/kW-month.[29] The ISO NE also recently proposed a Net Cone value of $8.04/kW-month for FCA#12.[30] Given the uncertainty of capacity prices over time, we have assumed a capacity value equal to the average of the most recent (FCA#11) clearing price and ISO New England's proposed Net Cone for FCA#12, equal to $6.685/kW-month to estimate the capacity value of REG projects installed during REG program.

We have also used National Grid's estimate of administrative costs for selling REG facility capacity into the market between 2017 and 2040, equal to $3,930,240. For simplicity, we have assumed this cost to occur in equal annual installments over 25 years.

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[26] Direct Testimony of Richard S. Hahn IN THE MATTER OF NATIONAL GRID'S PROPOSAL TO BID CAPACITY OF CUSTOMER-OWNED DG FACILITIES INTO THE FORWARD CAPACITY MARKET, Rhode Island Public Utilities Commission Docket Nr. 4676, January 20, 2017, p. 6

[27] Ibid, p.9.

[28] The percentage of wind generators' nameplate capacity qualifying as capacity in the New England ISO's forward capacity market depends on individual facilities' (historic) performance during winter and summer peak. For wind facilities with nameplate capacity above 20 MW currently having a capacity supply obligation, the average capacity qualifying for the forward capacity market is 33% in the winter and 11% in the summer, resulting in a simple average of 22% (see ISO New England, 2016 CELT Report). Hence, to the extent National Grid will decide, as it has stated, on a case by case basis on whether or not to bid capacity from REG projects into the capacity market, wind projects could provide additional value not captured in our analysis.

[29] ISO New England, Forward Capacity Auction #11 Results Summary.

[30] ISO New England, Cost of New Entry and Offer Review Trigger Prices, Revisions to Market Rule 1, December 6, 2016, p.4.

Finally, a recent decision by the Rhode Island Public Utility Commission awards National Grid 10% of annual revenues generated by the sale of REC capacity into the New England capacity market. The remaining 90% of revenues generated annually are used to offset the program costs.

4. Summary of Avoided Energy, Capacity and REC Assumptions

In its most recent REG Program Factor Filing and associated testimony[31] National Grid assumed that the energy value of electricity produced from REG Program facilities would be equal to 5.5 cents/kWh for all facilities other than the residential program facilities in all future years. Separately, National Grid includes an assumed REC value of 4.1 cents/kWh.

National Grid's assumptions regarding the avoided energy and REC costs due to the REG program therefore seem at the high end of the range of reasonable assumptions.

We have made one significant change to National Grid's calculations with respect to the energy and REC value of REG Program facilities. We have assumed that energy produced by host owned small-scale solar PV facilities will also avoid energy purchases with a value of 5.5 cents/kWh.[32]

In addition to the benefits assumed by National Grid (with the addition of the energy and REC value of owner-owned residential solar PV systems) used in its factor filing to calculate the net cost of the REG Program costs, we have also added the estimated capacity value benefit, net of administrative costs, for facilities of 250kW or greater.[33]

D. TAXES

A number of REG program participants may be subject to various taxes. The (state) taxes paid by REG program facilities will flow back to Rhode Island entities and therefore ultimately benefit Rhode Island residents.

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31 Joint Pre-filed Direct Testimony of Jeanne A. Lloyd and Adam S. Crary, RE Growth Factor Filing, June 30, 2016

32 National Grid treated these systems as purely load-reducing. Ultimately, however, any kWh produced by a REG program facility makes it unnecessary to produce such a kWh of electricity by some alternative means, assuming overall end-use demand remains unchanged.

33 In its proposal, National Grid proposes to sell capacity from non-residential projects of 250kW or more. (National Grid, PROPOSAL TO BID CAPACITY OF CUSTOMER-OWNED DG FACILITIES INTO THE FORWARD CAPACITY MARKET, Joint pre-filed testimony and schedules of Stefan Nagy and Scott McCabe, November 18, 2016, p.13). However, other exhibits in National Grid's testimony suggest that at least initially only commercial and large scale projects (with capacity of 251kW or greater) may be bid into the capacity market (Ibid, Schedule NG-2). We therefore use this assumption, which results in a qualified capacity of just below 35 MW of solar facilities, very similar to National Grid's assumptions (Ibid, Schedule NG-3).

Specifically, based on recent regulations, commercial renewable projects are subject to a tangible tax of $5/kW per annum, effective January 1, 2017.[34] By the regulation, residential and projects on manufacturing properties are exempt from the tax, as are projects having concluded interconnection agreements on or before December 31, 2016.[35] Since we were unable to verify which of the non-residential REG projects were (or will be) on manufacturing sites, we have assumed that the $5/kW-year tangible tax will apply to all non-residential projects under the program.

The sale of energy, capacity and RECs under the REG program tariffs is also potentially subject to gross earnings and sales and income taxes.[36] Residential systems are exempt since they are not deemed to be selling electricity to National Grid, but rather use the renewable systems to offset a portion of the electricity they otherwise purchase from the grid. All customers (except exempt manufacturing sites) under the REG program are subject to a gross earnings tax of 4%. Non-residential customers are also subject to a 7% sales tax.[37]

In addition, the earnings stemming from the sales under the REG program by commercial program participants are subject to federal and Rhode Island income taxes. Since federal taxes are flowing out of Rhode Island, we have assumed they have no impact on the State.[38] The Rhode Island state income tax varies from 3.75% for income below $60,500 per year to 5.99% for income above $137,500.[39] Given that residential systems are exempt from the tax and since REG sales revenues would be incremental, we have assumed that income from the sale of electricity under the REG tariff will incur state income tax at a rate of 5.99% on the sales (minus tangible, gross earnings and sales taxes) under REG program tariffs.

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34 State of Rhode Island and Providence Plantations, Department of Administration, Office of Energy Resources, Rules and Regulations for Commercial Renewable Energy Systems Tangible Tax Value, Effective Date: January 1, 2017.

35 Ibid, pages 4-5.

36 The renewable equipment itself is exempt from Rhode Island sales tax, but revenues from selling electricity by non-residential customers under REG tariffs is not.

37 National Grid, National Grid Policies Regarding Taxation and the Rhode Island Renewable Energy Growth Program.

38 As explained above, the REG program is also benefitting from the existence of the ITC. However, our analysis already captures the effect of the ITC in that we assume that tariff ceilings and actual tariffs signed under the REG program are set to make REG project economically viable, recognizing that REG projects have received and/or will receive the ITC. Absent the ITC, the tariffs required to make REG projects economically viable would be higher as would be the rate increase needed to pay for the above-market cost under the REG tariffs.

39 See Rhode Island Department of Revenue Division of Taxation, Inflation-adjusted amounts set for tax year 2016, December 11, 2015.

V. Results

In this section, we present the results of our analysis of the jobs, economic and environmental impacts of the REG program. The impact period extends through 2040 because the tariffs associated with the program extend through 2040.[40]

We first present the economic impacts between 2015 and 2019 stemming primarily from the construction of renewable facilities under the REG program, with only a small amount of impacts from tariffs and ongoing operations and maintenance for projects already producing electricity during this time period. We then present impacts during the "tariff phase" of the REG program, composed of tariff costs (tariff payments, administrative costs and remuneration, net of avoided energy, capacity and REC costs), operations and maintenance expenses and various taxes paid by program participants. Next we present the net jobs and economic impacts accounting for both effects. We conclude with a discussion of the estimated environmental benefits of the REG program. Details on our calculations are presented in Appendix A.

A. Impact of The REG Program During Construction Phase

Renewable facilities constructed as a result of REG program participation have positive economic impacts on Rhode Island especially during the period 2015-2019 when most of the renewable projects will be constructed.[41] Since a small portion of REG program facilities will already be operational in this time period, the economic impacts we present also include the effect of tariffs, operations and maintenance costs and taxes resulting from these operating facilities. Direct effects include employment, labor income and changes to gross domestic product (GDP). IMPLAN enables us to estimate economic impacts measured in terms of employment, labor income, GDP and output. We can also distinguish impacts as direct, indirect, and induced. Direct effects include impacts directly associated with the construction and operation of the investments made as a result of the REG program. Indirect impacts account for good and services associated with the construction and operations provided by third parties. Induced impacts

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[40] Since REG program participants have 24 months from the date of obtaining a tariff to entering commercial operation, a small portion of the program impacts could extend to 2041 since some of the tariffs under the 2019 program year with terms of 20 years may not come into force into until late 2020. Since the effect of these additional benefits is small (due to discounting), we conservatively omit these small benefits from our analysis.

[41] Since REG program participants have 24 months from obtaining a tariff to beginning commercial operation, we had to make assumptions about the timing pattern of entry. For the purpose of estimating the economic impact of the construction phase, we assumed construction would be completed entirely in the program year in which a project obtained a tariff. This is in part due to the difficulty of estimating which portions of project investment would take place when. For the tariff payments portion of the program, we assumed that projects would begin generating electricity over the first 24 months – spanning up to three calendar years – following and including the program award year. We assumed a timing of entry that approximately results in the tariff payments made by National Grid for program years 2015 and 2016.

reflect spending by workers associated with direct and indirect activities, employment, and labor income.

Below we summarize the impacts related to initial investments in renewable facilities related to the 2015 through 2019 program years on a present value basis reflecting a 4.9 percent discount rate.[42] As shown in Table 5, the fulltime equivalent of on average 484 jobs per year will result in accounting for labor income of approximately $140 million on a present value basis. Gross domestic product (GDP), a standard measure of economic activity, totals almost $221 million over the period on a present value basis. We also measure output, which captures both final and intermediate sales and as a consequence is less useful as an aggregate measure since it double counts. However, it is useful as a measure of individual industry activity and as an indicator of the relative contributions to the economy of individual industries or sectors.[43]

Table 5: Economic Impacts—Construction Phase
2015 - 2019

	Employment	Labor Income	GDP	Output
Direct Effect	312	$93,600,000	$140,500,000	$230,200,000
Indirect Effect	48	$14,800,000	$23,900,000	$40,600,000
Induced Effect	124	$31,400,000	$56,300,000	$92,300,000
Total Effect	484	$139,800,000	$220,700,000	$363,100,000

Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

B. TARIFF PHASE IMPACTS

The investment related impacts of the REG program are not the only elements of the REG program that have economic impacts. Rhode Island ratepayers will bear the cost of these programs through very small rate increases[44] to cover National Grid's costs for entering tariffs above market rates, administration and remuneration. These costs, however, are partially offset over the study period by avoided costs for energy, capacity, and RECs.

In a typical program year and based on the assumed project build-out during the REG program, the sum of tariff payments, administrative costs and remuneration results in a cost of about $18

[42] The 4.8 discount rate reflects a long-run average 3% real interest rate and 1.8% inflation.

[43] U.S. Bureau of Economic Analysis, www.bea.gov/faq/index.cfm?faq_id=1034.

[44] National Grid's most recent estimate is for bills for typical residential customers to increase by $0.05 per month, or 60 cents per year. See Joint Pre-filed Direct Testimony of Jeanne A. Lloyd and Adam S. Crary, RE Growth Factor Filing, June 30, 2016, Schedule NG-5.

million in excess of the avoided energy, capacity, and REC payments from the REG projects. Program participants also pay approximately $6 million in various Rhode Island taxes (tangible tax, gross earnings tax, sales tax, and RI income tax). Once these additional RI government revenues in the form of various taxes are factored in, the total net cost to Rhode Island of the REG program is about $12 million in a typical year. Net costs are lower in early and later years as tariff payments are not made to the full set of REG projects. The higher rates affect residential, commercial and industrial electricity customers. We have used information by National Grid to allocate the REG program costs to various customer classes (including government).[45] The government sector is also assumed to pay higher electricity rates, but also receives higher direct tax revenues from REG program participants. The additional payments and revenues are used as inputs to our economic model to estimate the economic impacts associated with these payments and revenues. Table 6 illustrates the calculation of costs and offsets for a typical year in this phase.

[45] Joint Pre-filed Direct Testimony of Jeanne A. Lloyd and Adam S. Crary, RE Growth Factor Filing, June 30, 2016, Schedule NG-3 (page 1 of 3). We have assumed rate classes A16/A-60 to be residential, C-06 and have the sales under G02 to be commercial, S10/S14 and X-01 to be government and all other rate classes industrial.

Table 6: Revenues and Costs Associated with the REG Program in Year 8

[1]	**Total MWh**	209,311
[2]	**Total Tariff Costs**	**$37,236,720**
	Avoided Costs	
	Total Energy Value REG program	-$11,512,126
	Total REC Value REG program	-$8,581,766
	Total Capacity Value REG program	-$841,174
[3]	**Total Avoided Costs**	**-$20,935,066**
	Administrative Costs	
	Remuneration for NG	$651,643
	REG Program Admin Costs	$625,000
	Capacity Market Admin Costs	$157,210
[4]	**Total Administrative Costs**	**$1,433,852**
[5]	**Total Net Market Cost of REG Program**	**$17,735,506**
[6]	**Total Offsetting Tax Revenues**	**-$5,768,122**
[7]	**Total Net Program Cost**	**$11,967,385**

[1]: Estimated total MWh generated by REG projects.
[2]: Total ratepayer REG program tariff payments.
[3]: Estimated total costs avoided due to REG program.
[4]: Estimated REG program administrative costs.
[5]: [2] + [3] + [4].
[6]: Estimated additional tax revenue due to REG program.
[7]: [5] + [6].

It is important to recognize that the results presented here are sensitive to several key assumptions. First, the estimated impacts of program years 2017-2019 rely on our assumptions, highlighted above, about the renewable capacity built in each of the REG program categories and the evolution of average tariff prices for those program categories. Second, the study assumes average avoided energy costs of $55/MWh, based on National Grid's assumption reflecting relatively recent forward prices for electricity. Recent wholesale market prices have been somewhat lower than $55/MWh. If current low prices persist, the benefits of avoided energy costs could be correspondingly lower. If on the other hand wholesale electricity prices increase substantially, for example as a consequence of natural gas prices increasing more than forward markets are assuming or as a consequence of prolonged periods of unexpectedly cold winter or hot summer days, the benefits of avoided energy purchases could be larger. Similarly, future capacity and REC prices are uncertain and could be higher or lower than we assume, resulting in

correspondingly higher or lower benefits from avoided capacity and REC purchases. The annual costs and offsets for each year between 2015 and 2040 are provided in Appendix A.

Finally, adding renewable capacity may provide additional benefits including T+D savings and protection against natural gas price spikes, which the state and New England have experienced in recent years. At the same time, these additions may also result in higher grid costs. More definitive calculations of these benefits are beyond the scope of this report.

Table 7 provides our estimate of impacts for the Tariff phase, 2020 and 2040, the period when the REG tariffs are assumed to be in force.[46] The economic impacts during this period are more modest than the initial period because very little construction is expected and the impact of higher electricity rates has some modest negative impacts. Much of the latter is offset by the increase in economic activity associated with operations and maintenance of the renewable investments. The impact net on employment is actually small but negative— approximately 6 jobs lost annually on average. Labor income on a present value basis, however, is modestly higher because by the end of the period higher paying operations and maintenance (O&M) jobs and the decline in tariff payments result in a net gain. GDP gains are small and positive on a present value basis for the same reason. Overall, the net impacts are, as noted above, very modest. They are certainly within the uncertainty band that surrounds these estimates suggesting that actual employment impacts in this phase could also be zero.

Table 7: Economic Impacts—Tariff Phase
2020 - 2040

	Employment	Labor Income	GDP	Output
Direct Effect	2	$15,200,000	$35,800,000	$36,400,000
Indirect Effect	-9	-$13,200,000	-$21,500,000	-$36,500,000
Induced Effect	1	$600,000	$1,000,000	$1,700,000
Total Effect	-6	$2,600,000	$15,300,000	$1,600,000

Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

[46] We estimate the economic impacts between 2020 and 2040 even though tariff payments will be staggered beginning in 2015 and are reflected in our impact results for 2015-2019. As described earlier, the discrepancy is likely immaterial and will depend on the unknown timing pattern of when REG program facilities will commence commercial operation. At present, the vast majority of non-residential program participants have not reached commercial operation.

C. REG Program Net Economic Impacts

In this section, we present the net impact of the REG program, namely the combined effect of upfront investments in renewable facilities and of higher rates (and tax revenues) for electricity consumers and the government during the time period when REG program participants receive payments (or bill credits) under the REG program. A detailed presentation of our calculations is shown in Appendix A. Table 8 presents the PV of the REG program for the entire period through 2040. Eighty-eight annual jobs are associated with the program on average over the entire program period, although as discussed above, the largest number of jobs are accounted for during the construction period. The present value of the program's impact on labor income over the entire period is over $142 million. The contribution to GDP over the period also on a present value basis is about $236 million. The present value of output is over $365 million.

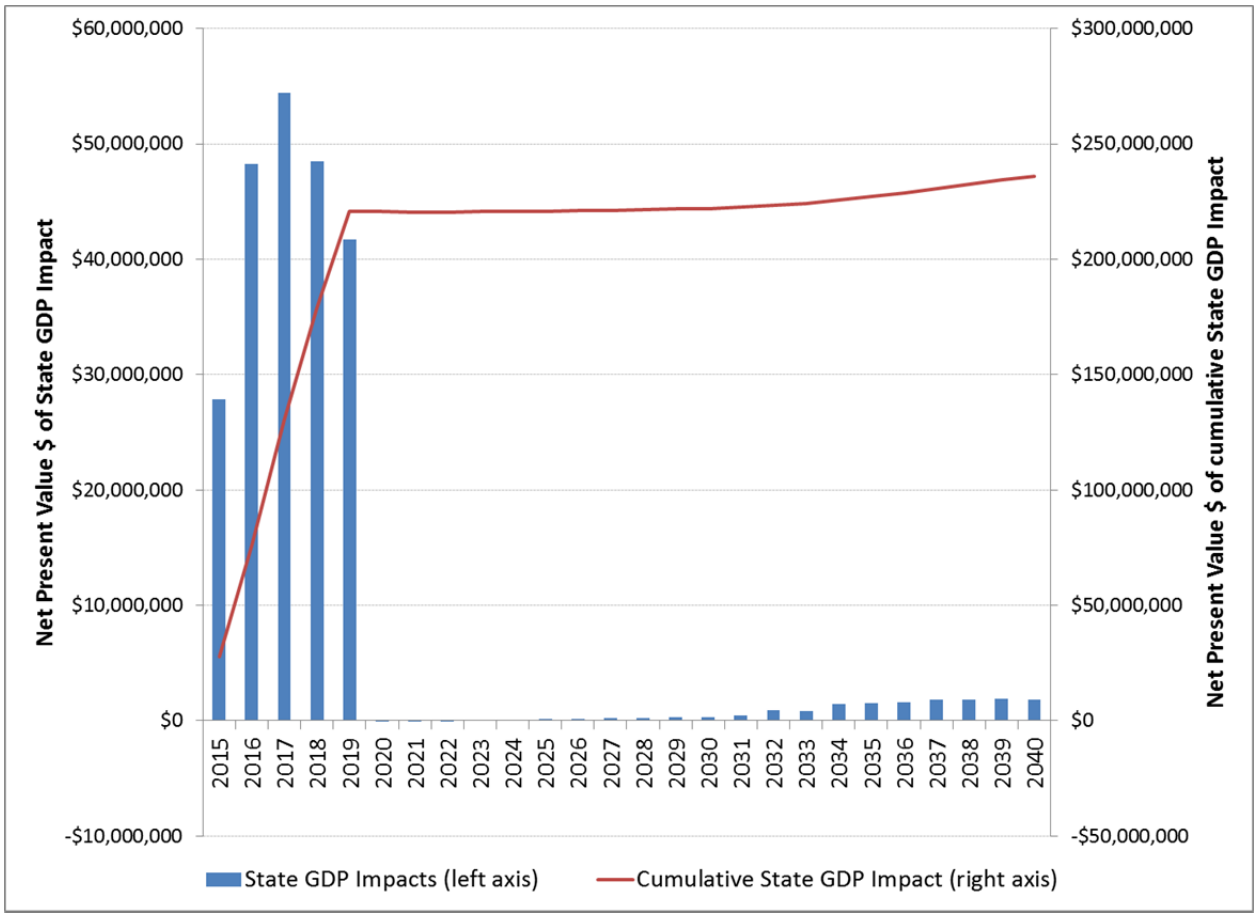
Table 8: Economic Impacts—Program Life
2015 - 2040

	Employment	Labor Income	GDP	Output
Direct Effect	62	$108,800,000	$176,300,000	$266,500,000
Indirect Effect	2	$1,600,000	$2,400,000	$4,100,000
Induced Effect	25	$32,000,000	$57,300,000	$94,000,000
Total Effect	88	$142,400,000	$236,000,000	$364,700,000

Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

Figure 5 shows the estimated net impact of the REG program (for all program years) on RI state GDP, presented in present value terms, both on a year by year and on a cumulative basis.

Figure 5: Expected Incremental Impact of REG Program on Net Present Value of State GDP



As can be seen in Figure 5, the impact of the REG program on state GDP is expected to be strongly positive during the construction phase of the program, i.e., in the years 2015-2019,[47] followed by very small negative impacts on state GDP, primarily driven by the reduction in consumer spending in Rhode Island due to payments under the REG tariffs in excess of the avoided payments for energy, capacity, and RECs through 2031. The increases in tariffs are small enough to have a trivially negative impact on state GDP so that overall the REG program is estimated to have substantially positive impacts on Rhode Island state GDP.

[47] We capture the benefits from 2015 representing the first year under the program.

Figure 6 shows the estimated net impact of the REG program on Rhode Island jobs.

Figure 6: Expected Incremental Impact of REG Program on RI jobs

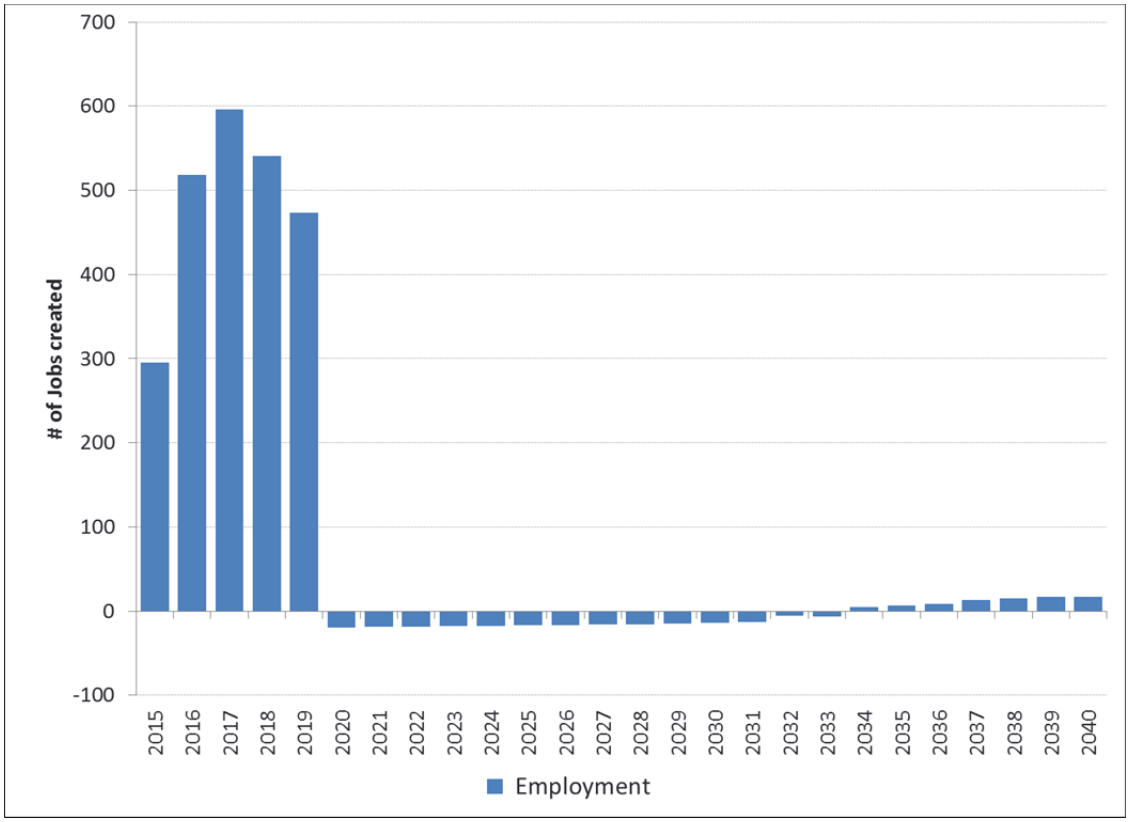


Figure 6 shows that consistent with GDP, employment impacts are greatest during the construction phase of the program (these jobs are not permanent), followed by a small negative employment effect after the projects are completed. The small incremental loss of further jobs after construction is the result of two (partially offsetting) factors: on the positive side, the REG program facilities are estimated to require on average approximately 12 maintenance jobs. Additionally, spending on new administrative services at National Grid creates approximately 9 direct and indirect jobs annually on average. On the other hand, the slightly higher rates paid by Rhode Island electric customers to finance the costs of the REG program (tariffs, administration, remuneration) reduce disposable income, which in turn results in an expected loss of approximately 26 jobs per year, resulting in a net loss of about 6 jobs in each year of the program post construction through 2034. Job impacts become positive in 2034 as tariffs and the associated electricity rate impact decrease.

D. REG Environmental Impacts

As discussed in Section III, environmental impacts are measured by determining the reduction in emissions of CO_2 and the criteria pollutants compared to the emission levels absent the REG program.[48] We calculate the avoided cost of emission allowances resulting from the programs by multiplying emission reductions induced by the program by estimated emissions allowance costs, which in New England are currently equal to the allowance prices under the Regional Greenhouse Gas Initiative (RGGI).[49] As an alternative measure of the value of reduced emissions, we also translate these emissions reductions into dollar damages avoided reflecting the harm to human, health, and the environment avoided by the renewable capacity added under the REG program. We use the current marginal emissions rates in New England to estimate avoided emissions. By itself, this likely overstates expected emissions reductions since, based on existing policy goals in New England, marginal emissions rates are expected to decline over the coming decades. However, we also note that even though REG program facilities will roll-off REG tariffs between 2035 and 2040, the emissions benefits from REG facilities are expected to continue since typical REG program facilities have a life span in excess of the 15-20 year tariff terms, which leads to our approach likely understating emissions reductions.[50]

1. Emissions

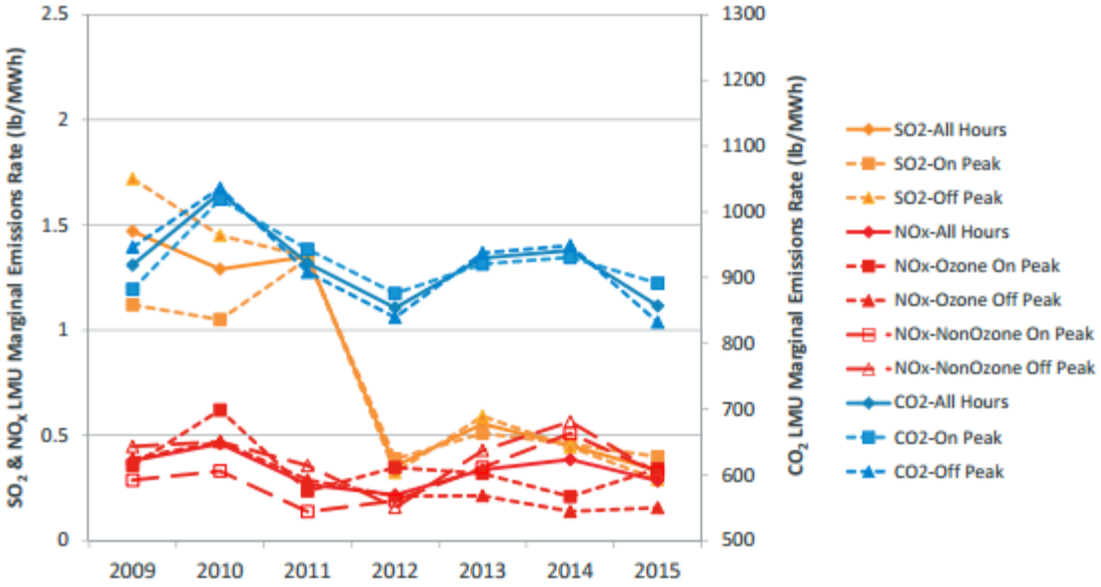
Figure 7 shows the evolution of marginal emissions rates for CO_2 and criteria pollutants in the New England market over the past several years.

[48] We recognize that absent the REG program similar emissions reductions may be achieved with alternative programs/incentives.

[49] In doing so, we assume that the emissions reductions due to the REG program will not have a material impact on RGGI prices, which, given the relative small size of the program, is reasonable.

[50] Solar PV facilities, which represent the largest share of REG program facilities, have an expected life span of 30 years or longer. Wind facilities may not have a life span significantly above 20 years, but represent a very small fraction of the REG program capacity.

Figure 7: Marginal Emissions Rates for All Generation Sources 2009-2015



Source: Reproduced from Figure 5-9, 2015 ISO New England Electric Generator Air Emissions Report, ISO New England, January 2017.

To calculate the impact of the REG program on CO_2 and other criteria pollutants requires estimating the emissions rates of the generation sources displaced by electricity production from REG facilities. Given the relatively small overall volume of electricity produced by the REG program (compared to total electricity produced in the New England market), the most recent marginal emissions rates in New England are reasonable indicators of how many emissions will be avoided by REG facility generation going forward.[51] In 2015, the marginal emissions rate for CO_2 in the NE-ISO market was 857 lb/MWh. The marginal all-hours average emissions rate for SO_2 was 0.33 lb/MWh and the marginal emissions rate for NO_x was 0.28 lb/MWh.[52] We note that these emissions rates are lower than those used in our 2014 report. This is due to the fact that we now have access to ISO NE specific marginal emissions rates and that marginal emission rates in New England have been decreasing (and, as we just noted, will likely continue to decrease). Given the uncertainty about the rate of decline of marginal emissions rate and about the ultimate useful life of REG program facilities beyond the tariff terms, we use these marginal emissions rates to estimate the total amounts of emissions reductions from the REG Program. Based on this simple approach, total CO_2 emissions reductions due to the REG program are expected to be 1.5

[51] Given the overall regional goal towards electric sector carbon reductions, marginal emissions rate may decrease over time. However, the change in marginal emissions rates over the coming decades is highly uncertain and its estimation beyond the scope of our analysis.

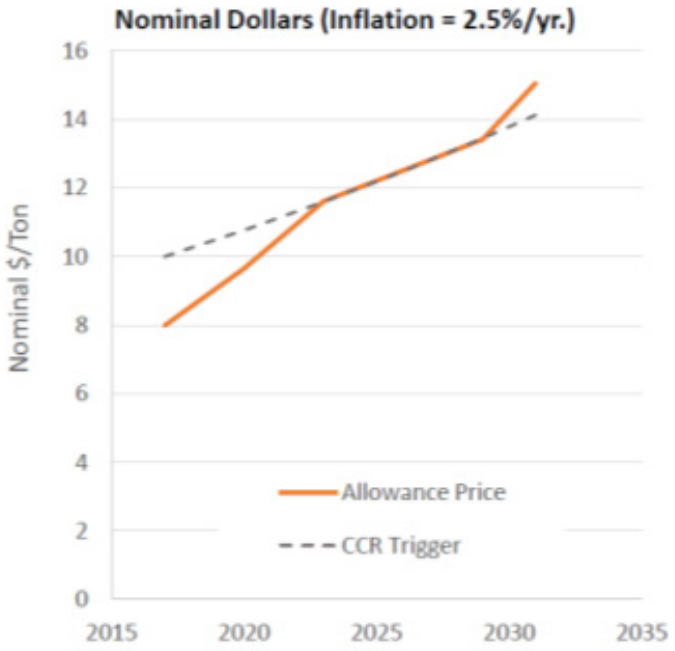
[52] ISO New England Electric Generator Air Emissions Report, ISO New England, January 2017, Table 5-3, page 24.

million tons. Reductions for the criteria pollutants SO_x, NO_x, and $PM_{2.5}$ are 582, 494, and 53 tons respectively.[53]

2. Allowance Costs

Figure 8 shows recent values of RGGI allowance prices, which are the appropriate allowance prices for estimating the value of avoided allowance costs as a result of the REG program.

Figure 8: RGGI Allowance Prices



Source: Draft 2016 RGGI Program Review Reference Case Results, RGGI, February 2, 2016, page 9.

RGGI prices going forward are highly uncertain since they not only depend on the evolution of the New England power system over time but also on potential further changes to the RGGI program itself. With this caveat, under current RGGI rules, RGGI prices are projected to increase over time from current levels around $3/allowance based on the most recent auction[54] to approximately $15/allowance in nominal terms by 2030 as shown in Figure 8.

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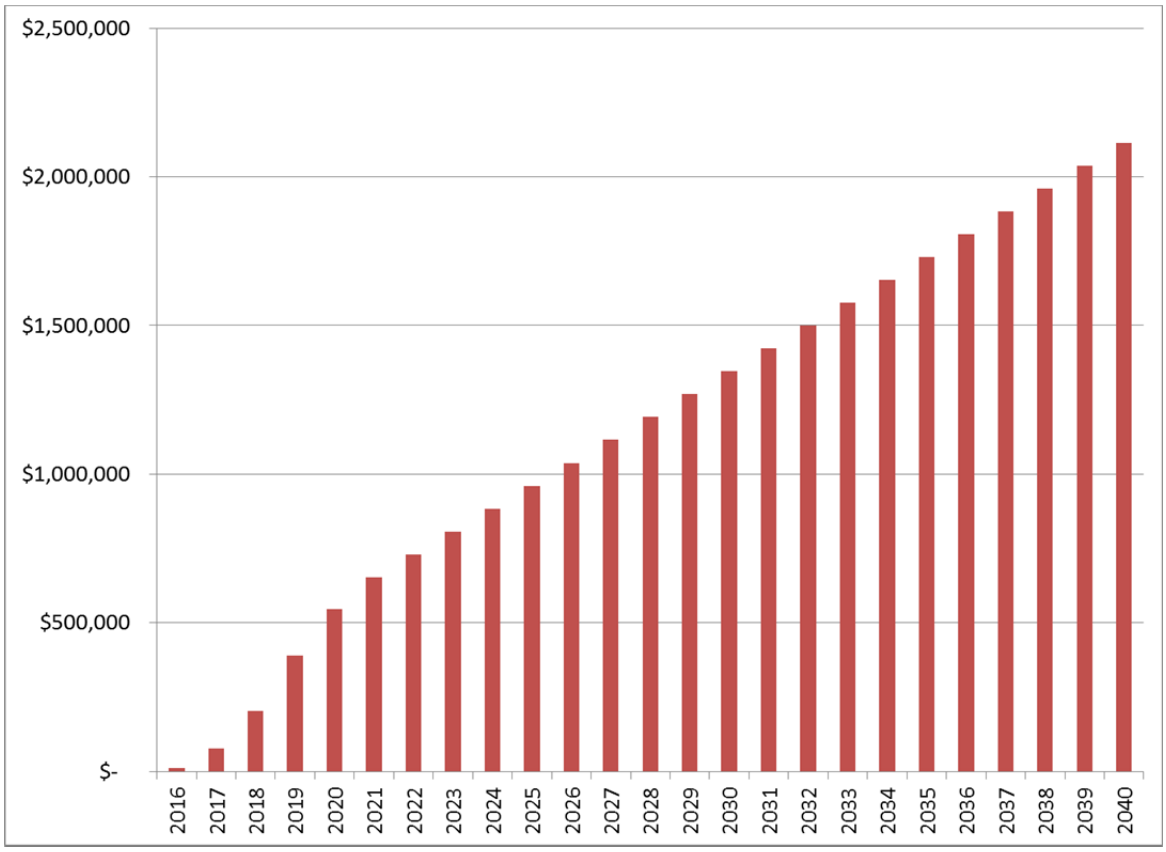
[53] These estimates represent emissions reductions relative to emissions under the current New England market. We do not attempt to estimate what emissions reductions would have occurred through other programs in the absence of the REG program.

[54] The clearing price for the last RGGI auction, auction #35, was $3 (Potomac Economics, Market Monitor Report for Auction 35, March 10, 2017, page 8.

Assuming that, in nominal terms, RGGI allowance prices will increase steadily from today to 2030 and then continue to grow by the same annual amount[55] would result in the emissions reductions having the value outlined in Figure 9 below.

Figure 9: Value of CO_2 Emissions Allowance Reductions (Nominal) for Year Ending March 31



Discounted at 4.9% per annum,[56] these allowance values sum approximately $13 million over the entire life of the REG program.

3. Damages Costs of Pollutants

Alternatively, we also present the potential value of reduced emissions using estimated damages caused by emissions of CO_2, SO_x, NO_x and $PM_{2.5}$.

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[55] The evolution of RGGI prices is highly uncertain. Given that our analysis time frame extends beyond the time frame examined by RGGI, the projection of RGGI prices beyond 2030 is particularly uncertain and will substantially depend on the evolution of the New England electricity supply mix as well as potential changes to RGGI itself.

[56] We use 4.9% as the discount rate, based on an estimate of the nominal risk-free rate and the nominal discount rate we used in our 2014 report. See also *Blue Chip Economic Indicators*, Volume 39, No. 3. March 10, 2014.

The Social Cost of Carbon (SCC) is a frequently used measure of the damages caused by CO_2 emissions. There are multiple measures of the social cost of carbon, depending on the choice of discount rate, the year of assumed emissions, and whether or not average or 95th percentile damages resulting from an incremental ton of CO_2 emissions are estimated. The SCC ranges from $10/ton to $212/ton.[57] Given the wide range of estimates and typical values of the SCC often used, we use the 2020 SCC value assuming a 3% discount rate, equal to $42/ton, for our analysis.[58]

The expected PV of avoided damages from CO_2 using the Social Cost of Carbon is $51 million for the entire REG program. We also estimated the net present value of criteria pollutant reductions. Table 9 below shows the assumed damages caused per ton of criteria pollutant.

Table 9: Estimated Damages per Ton of Criteria Pollutant

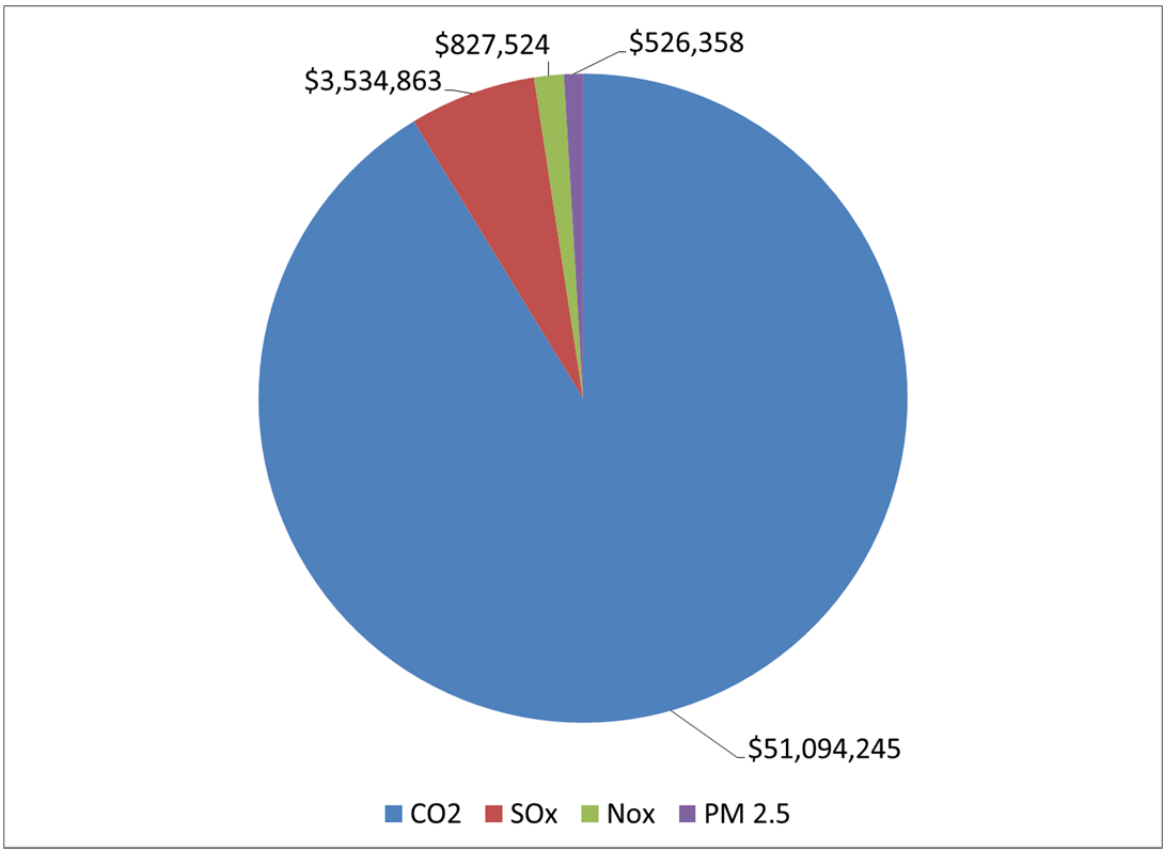
	Damages ($/ton)
SO2	$ 7,500
Nox	$ 2,000
PM2.5	$ 12,400

Using these damage estimates, Figure 10 shows the net present value of criteria pollutant damage cost reductions. For comparison purposes, we also include avoided damages related to CO_2 in the figure. The net present value of all avoided pollutants (including CO_2) is about $56 million.

[57] See Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under, Executive Order 12866, August 2016, Table ES-1. For a broader discussion of the application of the SCC at the federal level, see Executive Office of the President, Council on Environmental Quality, Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews, August 1, 2016.

[58] Note that since the SCC is expected to rise over time that this value is relatively conservative.

Figure 10: Net Present Value of Pollutant Damage Cost Reductions (Entire REG Program)



E. Other Benefits And Costs

The REG program induced renewable capacity may provide other benefits not directly captured by the price and environmental benefits described in the report. These include avoided transmission and distribution (T+D) costs, and reduced exposure to fuel price spikes (diversity) and reliability. There may also be some additional costs. These costs could include higher grid integration and management costs, which may partially offset the T+D and diversity benefits.

1. Diversity

Diversity savings capture the value of avoiding high power prices that may be caused by reliance on power plants dependent on volatile fuel prices. Measuring the benefits of diversity requires an understanding of the potential volatility of gas prices and their impact on wholesale electricity prices. Since, for this evaluation, we used National Grid's estimate of the wholesale value of energy of $55/MWh and since this value is somewhat above current wholesale market prices, this value likely captures at least some benefit of reduced reliance on gas-fired power generation.

Consequently, we do not separately assess a diversity value, which we had estimated at up to $5 million on a present value basis in our 2014 study.[59]

2. Reliability

Although improved reliability is often cited as a benefit of increased reliance on renewable energy, this is difficult to measure in part because it is very site specific. The location of a renewable plant may help avoid a widespread outage (or may increase its chances), but without a very detailed grid study, it is not easy to identify. Further, the modest addition of capacity added by the REG program makes it unlikely that they offer a large benefit. Consequently, no reliability value (or cost) is estimated for the REG program, even though individual projects, in the right places, may provide some reliability benefits.

3. Avoided Costs of Transmission & Distribution

Transmission and Distribution (T+D) costs tend to be very site specific and therefore are difficult to estimate at the level of analysis presented here. The models employed did not simulate National Grid or ISO New England grid operations. At the time of our 2014 Report, National Grid had reported to the Rhode Island Public Utility Commission that no T+D savings had occurred as result of the first 23.5 MW of renewable investments under the DGSC program.[60] A pilot program by National Grid and the OER to assess T&D delay or avoidance savings resulting from solar investment in Tiverton will not be installed until June or July 2017. Hence, at this point, no reliable conclusions from this pilot project are available. A review of other studies indicates that these savings could be substantial, but that the benefits are highly location specific. For example, a national review by the National Renewable Energy Laboratory (NREL) found that these savings ranged from $4.28 to $26.26/MWh. The "most common" was $4.84/MWh.

4. Grid Integration Costs

In addition to the savings that may be attributable to adding renewable energy capacity to the grid, there are costs. The same NREL study cited above found that integration costs associated with renewable energy because of the lack of centralized control, weather, and time of day variations were not trivial. NREL reported that these costs for solar PV ranged between $2.50 and $10.90/MWh.

5. Impact on Wholesale Prices

Our 2014 Report also estimated the potential impact of additional renewable capacity under the three program levels studied, 160MW, 200MW and 1,000MW, on wholesale electricity prices,

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[59] Mark Berkman and Jürgen Weiss, Distributed Generation Standard Contracts and Renewable Energy Fund: Jobs, Economic and Environmental Impact Study, The Brattle Group, April 2014, p.26.

[60] National Grid response to Records Request by the RI Public Utility Commission February 26, 2014, on March 11, 2014. (letter from T. Teehan to L. Massaro, Commission Clerk).

so-called wholesale price suppression. At the level relevant for the evaluation of the REG program (160 MW), the effect on wholesale prices was expected to be quite small ($0.75 million per year). While the REG program may lead to small and temporary declines in wholesale prices, given the small size of the REG program relative to the New England electricity market, we have not separately assessed the impact of the REG program on wholesale prices, but would expect the impact to be comparable to our original estimate.[61]

6. Potential Benefits to Program Participants

We have estimated the impact of the REG program on electric customers through slightly higher retail tariffs that would have to be paid to cover the total costs of the REG program in excess of realized market values for the REG facility products, notably energy, capacity and RECs. However, this does not capture potentially positive impacts of the REG program on program participants. Since participation in the REG program is voluntary, program participants must benefit from participating in the REG program. Whether those benefits are sufficient to result in additional economic benefits to Rhode Island depends on the level of the REG program tariffs relative to program participants' costs, including the return they would have counted on for making similarly risky investments in the absence of the REG program.[62]

Since all non-residential tariffs are the result of bids accepted by National Grid, it is reasonable to assume that the non-residential REG program will be relatively competitive, i.e., that the selected tariffs will be close to what is needed to just provide program participants with the financial returns they could expect for similarly risky alternative investments. As a result, we assume that non-residential program participants would not end up having additional disposable income as a result of the REG program, which could be the basis of additional benefits to the Rhode Island economy.

Residential program participants automatically receive the applicable tariff ceiling price for the program year for 15 or 20 years. Tariff ceiling prices applicable to projects in a given program year have been falling and are expected to continue to fall to reflect the assumption that the cost of installing residential solar-PV systems will continue to decline. It is possible that the rate of cost declines for small scale solar projects is somewhat quicker than the rate for tariff costs. It is

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61 We also note that while lower wholesale prices represent a benefit to ratepayers in the short run, they represent corresponding revenue losses to power generation facilities. In that sense they represent a transfer rather than an efficiency gain. In the longer run, lower wholesale market revenues may result in generation retirement. Also, the effect is likely temporary since wholesale prices would need to increase to the levels required to make investment in new generating capacity economically viable.

62 Program participants would only have additional disposable income as a consequence of participating in the REG program if the financial return for their REG project, i.e. the tariff revenue after accounting for all expenses including tax payments, exceeded the expected return from making an equally sized and similarly risky alternative investment. A portion of such additional disposable income would then be assumed to be spent in Rhode Island and result in economic benefits to the State.

therefore possible that in some of the program years, tariff ceiling prices would be higher than they have to be for some program participants to make investing in a residential solar PV system beneficial.[63] Such residential REG program participants may in fact find that their disposable income increases as a result of participation in the program and they would be expected to spend some portion of this increased income in ways that benefit the Rhode Island economy. However, given the small aggregate size of the residential program, the uncertainty about the actual economics of individual residential projects, and their impact on program participants' disposable income, we have not included this potential effect in our analysis. Our results are therefore conservatively low with respect to this potential benefit from the REG program.

It should also be noted that there is some evidence that solar rooftops have a positive impact on the value of homes.[64] Since there is little evidence of the impact of this higher value on spending – i.e. we don't know whether "feeling" wealthier as a result of having a solar roof translates into higher spending and there is no empirical basis for estimating the number of solar homes being sold per year – we have not estimated the impact of higher home values on the RI economy. As with tariff payments for program participants being a potential source of additional income, this assumption also makes our impact estimates conservative.[65]

VI. Conclusions

We were asked to analyze the expected jobs, economic and environmental impact of the Rhode Island REG program, based on actual results from the 2015 and 2016 program years and estimated participation over the remaining three program years, resulting in a total of 160 MW of renewable generation capacity in Rhode Island. In brief, we find that the REG program promotes economic activity, employment, and reduces greenhouse gases and several of EPA's s criteria pollutant emissions.[66]

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[63] It is also true that installed costs for residential solar PV systems vary significantly by installer and specific installation. Since tariff ceilings will typically reflect the expected costs of installing a typical solar rooftop system, some residential program participants may be able to have a more attractive project if they obtain a lower than average installation cost.

[64] See for example, Sandra K. Adomatis and Ben Hoen, "An Analysis of Solar Home Paired Sales across Six States," *The Appraisal Journal*, Winter, 2016. www.appraisalinstitute.org and Samuel Dastrup, Joshua GraffZiven, Dora Costa, and Matthew Kahn, "Understanding the Solar Home Price Premium: Electricity Generation and "Green" Social Status, National Bureau of Economic Research, Working Paper 17200, July 2011. www.nber.org/papers/w17200 .

[65] It is our understanding that solar rooftops are generally exempt from property tax (https://blog.pickmysolar.com/going-solar-in-rhode-island), so that solar installations on private homes do not lead to higher tax payments.

[66] While our results regarding the REG program are net positive, they do not by themselves indicate that the program is necessarily the most cost-effective means to reach Rhode Island's renewables targets. It is possible that other approaches could be either more or less cost effective although we are unaware of any alternatives to the REG Program being proposed or under consideration.

Given the overall size of the program relative to the size of the Rhode Island economy as well as the New England electricity market, it is not surprising that we estimate the overall impact of the REG program to be modest. However, given that renewable technologies are capital intensive and that in particular solar projects require a significant amount of installation labor, we estimate that the REG program will lead to approximately 484 additional jobs per year during the construction period, followed by a small net decrease in employment (about 6 jobs annually) during the 15-20 year period when all projects are constructed and producing electricity under the REG tariffs The decrease is explained by the modest number of jobs required for plant operations offset by a modest decrease in demand for goods and services that results from the modest increase in electricity rates effect on disposable income. The annual employment impact averaged over the entire 2015 through 2040 period will be to add almost 90 jobs.

We also estimate the expected impact of the REG program on economic activity as measured by state GDP to total almost $221 million during the construction phase in present value terms. Over the tariff period, 2020-2040, GDP will increase by over $15 million on a present value basis. The GDP impact over the entire period 2015-2040 will be about $236 million on a present value basis.

In addition, the REG program will contribute to reducing emissions by avoiding 1.5 million tons of CO_2, 582 tons of SO_2, 494 tons of NO_x and 53 tons of $PM_{2.5}$.[67] One way to value the avoided CO_2 emissions is to look at avoided purchase of RGGI allowances. Using current and reasonably expected future RGGI prices leads to estimated avoided RGGI allowance purchases of $13 million in present value terms. An alternative way to value avoided emissions is to look at damages that would occur if those same emissions were not avoided by the REG program. Using the range of estimates for damages from the various pollutants the estimated value of avoided emissions is $56 million in present value terms. Of this total, avoided damages from carbon dioxide emissions reductions represent a social benefit of $51 million on a PV basis. Reductions in criteria pollutants can also be attributed to the program. The combined damages avoided by reducing SO_2, NO_X, PM_{10}, and $PM_{2.5}$ emissions are $4.9 million on a PV basis.

All of these impacts are relative to a scenario without the REG program and incorporate both the positive and negative impacts of the REG program. Since these emissions reductions are mostly from the reduced generation of power plants located outside of Rhode Island, not all of the benefits will be captured by Rhode Island residents. Tracing the actual exposure paths and associated damages from pollution from these plants to determine precisely who benefits, however, is beyond the scope of this study. Some pollution emissions are most harmful in close proximity to the source, while other emissions do more harm downwind (or occur at the global level).

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[67] We recognize similarly that, absent the REG program, existing RES mandates may require that similar amounts of renewable resources be built and that those resources would reduce emissions by essentially the same amounts. We therefore describe the REG Program as contributing to such emissions reductions (mandated under RES).

VII. Appendix A

The following tables provide details of the previously described analysis.

	Year 1 Y/E 3/31/2016	Year 2 Y/E 3/31/2017	Year 3 Y/E 3/31/2018	Year 4 Y/E 3/31/2019	Year 5 Y/E 3/31/2020
TOTAL MWh	62	8,063	47,165	100,839	162,917
Total Tariff Payments	$25,378	$1,821,337	***$ 10,108,420***	***$ 18,595,362***	***$ 30,151,273***
Total Market Benefits REG Program	$ -	$ 176,723	$ 4,679,462	$ 10,074,610	$ 16,273,803
Total Admin Costs	$ 914,215	$ 834,014	$ 959,107	$ 1,107,628	$ 1,309,857
Total Net Market Cost of REG Program	$ 939,593	$ 2,478,628	$ 6,388,065	$ 9,628,381	$ 15,187,327
Total Offsetting Tax Revenues	$ 1,015	$ 267,192	$ 1,409,946	$ 3,017,763	$ 4,584,138
Total Net Program Cost	$ 938,578	$ 2,211,436	$ 4,978,119	$ 6,610,618	$ 10,603,189
Total Cost Shares					
Residential	$ 495,917	$ 1,308,220	$ 3,371,621	$ 5,081,859	$ 8,015,871
Commercial	$ 160,201	$ 422,606	$ 1,089,165	$ 1,641,639	$ 2,589,439
Industrial	$ 231,516	$ 610,734	$ 1,574,019	$ 2,372,433	$ 3,742,157
Government	$ 50,850	$ (130,372)	$ (1,057,324)	$ (2,486,276)	$ (3,745,798)
Total	$ 938,484	$ 2,211,188	$ 4,977,480	$ 6,609,655	$ 10,601,670
Tariff & Admin Impacts					
Employment	7.1	-1.0	-12.3	-13.9	-29.4
Labor Income	$ (176,843)	$ (538,453)	$ (1,018,674)	$ (861,118)	$ (1,587,756)
GDP	$ (92,741)	$ (798,317)	$ (1,908,309)	$ (2,053,149)	$ (3,684,223)
Output	$ 528,840	$ (791,470)	$ (2,997,737)	$ (3,777,386)	$ (6,959,393)
O&M					
Employment	1.7	4.1	7.0	9.7	12.0
Labor Income	$ 145,051	$ 367,117	$ 639,061	$ 892,885	$ 1,128,911
GDP	$ 471,814	$ 1,194,133	$ 2,078,693	$ 2,904,315	$ 3,672,046
Output	$ 683,098	$ 1,728,881	$ 3,009,559	$ 4,204,906	$ 5,316,437
Net Impacts					
Employment	295.0	517.8	596.1	540.4	473.2
Labor Income	$ 15,995,398	$ 29,157,119	$ 34,499,325	$ 32,191,827	$ 29,030,629
GDP	$ 25,306,015	$ 46,010,091	$ 54,417,276	$ 50,869,412	$ 45,852,531
Output	$ 42,418,778	$ 76,342,577	$ 89,687,603	$ 83,112,908	$ 74,176,202

All dollars are nominal.

	Year 6 Y/E 3/31/2021	Year 7 Y/E 3/31/2022	Year 8 Y/E 3/31/2023	Year 9 Y/E 3/31/2024	Year 10 Y/E 3/31/2025
TOTAL MWh	197,828	209,311	209,311	209,311	209,311
Total Tariff Payments	***$ 35,516,095***	***$ 37,236,720***	***$ 37,236,720***	***$ 37,236,720***	***$ 37,236,720***
Total Market Benefits REG Program	$ 19,780,791	$ 20,935,066	$ 20,935,066	$ 20,935,066	$ 20,935,066
Total Admin Costs	$ 1,403,741	$ 1,433,852	$ 1,433,852	$ 1,433,852	$ 1,433,852
Total Net Market Cost of REG Program	$ 17,139,045	$ 17,735,506	$ 17,735,506	$ 17,735,506	$ 17,735,506
Total Offsetting Tax Revenues	$ 5,475,380	$ 5,768,122	$ 5,768,122	$ 5,768,122	$ 5,768,122
Total Net Program Cost	$ 11,663,665	$ 11,967,385	$ 11,967,385	$ 11,967,385	$ 11,967,385
Total Cost Shares					
Residential	$ 9,045,988	$ 9,360,800	$ 9,360,800	$ 9,360,800	$ 9,360,800
Commercial	$ 2,922,207	$ 3,023,904	$ 3,023,904	$ 3,023,904	$ 3,023,904
Industrial	$ 4,223,061	$ 4,370,029	$ 4,370,029	$ 4,370,029	$ 4,370,029
Government	$ (4,529,304)	$ (4,789,122)	$ (4,789,122)	$ (4,789,122)	$ (4,789,122)
Total	$ 11,661,951	$ 11,965,611	$ 11,965,611	$ 11,965,611	$ 11,965,611
Tariff & Admin Impacts					
Employment	-30.7	-30.5	-30.0	-29.5	-28.9
Labor Income	$ (1,557,414)	$ (1,531,103)	$ (1,531,103)	$ (1,531,103)	$ (1,531,103)
GDP	$ (3,860,995)	$ (3,891,387)	$ (3,891,387)	$ (3,891,387)	$ (3,891,387)
Output	$ (7,548,435)	$ (7,696,927)	$ (7,696,927)	$ (7,696,927)	$ (7,696,927)
O&M					
Employment	12.0	12.0	12.0	12.0	12.0
Labor Income	$ 1,149,232	$ 1,169,918	$ 1,190,976	$ 1,212,414	$ 1,234,237
GDP	$ 3,738,143	$ 3,805,430	$ 3,873,927	$ 3,943,658	$ 4,014,644
Output	$ 5,412,133	$ 5,509,552	$ 5,608,724	$ 5,709,681	$ 5,812,455
Net Impacts					
Employment	(18.7)	(18.5)	(18.0)	(17.4)	(16.9)
Labor Income	$ (408,183)	$ (361,185)	$ (340,126)	$ (318,689)	$ (296,865)
GDP	$ (122,852)	$ (85,958)	$ (17,460)	$ 52,271	$ 123,257
Output	$ (2,136,301)	$ (2,187,375)	$ (2,088,203)	$ (1,987,246)	$ (1,884,472)

All dollars are nominal.

	Year 11 Y/E 3/31/2026	Year 12 Y/E 3/31/2027	Year 13 Y/E 3/31/2028	Year 14 Y/E 3/31/2029	Year 15 Y/E 3/31/2030
TOTAL MWh	209,311	209,311	209,311	209,311	209,311
Total Tariff Payments	***$ 37,236,720***	***$ 37,236,720***	***$ 37,236,720***	***$ 37,236,720***	***$ 37,236,720***
Total Market Benefits REG Program	$ 20,935,066	$ 20,935,066	$ 20,935,066	$ 20,935,066	$ 20,935,066
Total Admin Costs	$ 1,433,852	$ 1,433,852	$ 1,433,852	$ 1,433,852	$ 1,433,852
Total Net Market Cost of REG Program	$ 17,735,506	$ 17,735,506	$ 17,735,506	$ 17,735,506	$ 17,735,506
Total Offsetting Tax Revenues	$ 5,768,122	$ 5,768,122	$ 5,768,122	$ 5,768,122	$ 5,768,122
Total Net Program Cost	$ 11,967,385	$ 11,967,385	$ 11,967,385	$ 11,967,385	$ 11,967,385
Total Cost Shares					
Residential	$ 9,360,800	$ 9,360,800	$ 9,360,800	$ 9,360,800	$ 9,360,800
Commercial	$ 3,023,904	$ 3,023,904	$ 3,023,904	$ 3,023,904	$ 3,023,904
Industrial	$ 4,370,029	$ 4,370,029	$ 4,370,029	$ 4,370,029	$ 4,370,029
Government	$ (4,789,122)	$ (4,789,122)	$ (4,789,122)	$ (4,789,122)	$ (4,789,122)
Total	$ 11,965,611	$ 11,965,611	$ 11,965,611	$ 11,965,611	$ 11,965,611
Tariff & Admin Impacts					
Employment	-28.4	-27.9	-27.4	-26.9	-26.5
Labor Income	$ (1,531,103)	$ (1,531,103)	$ (1,531,103)	$ (1,531,103)	$ (1,531,103)
GDP	$ (3,891,387)	$ (3,891,387)	$ (3,891,387)	$ (3,891,387)	$ (3,891,387)
Output	$ (7,696,927)	$ (7,696,927)	$ (7,696,927)	$ (7,696,927)	$ (7,696,927)
O&M					
Employment	12.0	12.0	12.0	12.0	12.0
Labor Income	$ 1,256,454	$ 1,279,070	$ 1,302,093	$ 1,325,531	$ 1,349,390
GDP	$ 4,086,907	$ 4,160,472	$ 4,235,360	$ 4,311,597	$ 4,389,206
Output	$ 5,917,079	$ 6,023,587	$ 6,132,011	$ 6,242,387	$ 6,354,750
Net Impacts					
Employment	(16.4)	(15.9)	(15.4)	(14.9)	(14.4)
Labor Income	$ (274,649)	$ (252,033)	$ (229,010)	$ (205,572)	$ (181,712)
GDP	$ 195,520	$ 269,084	$ 343,973	$ 420,209	$ 497,818
Output	$ (1,779,848)	$ (1,673,340)	$ (1,564,916)	$ (1,454,539)	$ (1,342,176)

All dollars are nominal.

	Year 16 Y/E 3/31/2031	Year 17 Y/E 3/31/2032	Year 18 Y/E 3/31/2033	Year 19 Y/E 3/31/2034	Year 20 Y/E 3/31/2035
TOTAL MWh	209,255	208,340	202,686	202,762	193,477
Total Tariff Payments	***$ 37,213,464***	***$ 36,857,004***	***$ 34,762,434***	***$ 34,910,045***	***$ 31,618,306***
Total Market Benefits REG Program	$ 20,929,667	$ 20,841,783	$ 20,298,998	$ 20,306,352	$ 19,414,997
Total Admin Costs	$ 1,433,445	$ 1,427,207	$ 1,390,552	$ 1,393,135	$ 1,335,530
Total Net Market Cost of REG Program	$ 17,717,243	$ 17,442,428	$ 15,853,988	$ 15,996,829	$ 13,538,838
Total Offsetting Tax Revenues	$ 5,767,192	$ 5,752,933	$ 5,669,150	$ 5,675,055	$ 5,543,385
Total Net Program Cost	$ 11,950,051	$ 11,689,495	$ 10,184,837	$ 10,321,774	$ 7,995,453
Total Cost Shares					
Residential	$ 9,351,161	$ 9,206,113	$ 8,367,735	$ 8,443,126	$ 7,145,799
Commercial	$ 3,020,790	$ 2,973,934	$ 2,703,105	$ 2,727,459	$ 2,308,372
Industrial	$ 4,365,529	$ 4,297,814	$ 3,906,423	$ 3,941,619	$ 3,335,970
Government	$ (4,789,200)	$ (4,790,111)	$ (4,794,010)	$ (4,792,030)	$ (4,796,041)
Total	$ 11,948,280	$ 11,687,750	$ 10,183,252	$ 10,320,174	$ 7,994,099
Tariff & Admin Impacts					
Employment	-25.9	-24.3	-17.3	-17.6	-7.4
Labor Income	$ (1,525,189)	$ (1,436,424)	$ (924,506)	$ (971,904)	$ (181,440)
GDP	$ (3,881,138)	$ (3,727,220)	$ (2,839,152)	$ (2,920,902)	$ (1,549,030)
Output	$ (7,679,948)	$ (7,424,875)	$ (5,952,661)	$ (6,087,572)	$ (3,812,562)
O&M					
Employment	12.0	12.0	12.0	12.0	12.0
Labor Income	$ 1,373,679	$ 1,398,406	$ 1,423,577	$ 1,449,201	$ 1,475,287
GDP	$ 4,468,211	$ 4,548,639	$ 4,630,515	$ 4,713,864	$ 4,798,713
Output	$ 6,469,136	$ 6,585,580	$ 6,704,121	$ 6,824,795	$ 6,947,641
Net Impacts					
Employment	(13.9)	(12.3)	(5.2)	(5.5)	4.6
Labor Income	$ (151,510)	$ (38,019)	$ 499,071	$ 477,298	$ 1,293,846
GDP	$ 587,073	$ 821,420	$ 1,791,363	$ 1,792,962	$ 3,249,683
Output	$ (1,210,813)	$ (839,295)	$ 751,460	$ 737,223	$ 3,135,079

All dollars are nominal.

	Year 21 Y/E 3/31/2036	Year 22 Y/E 3/31/2037	Year 23 Y/E 3/31/2038	Year 24 Y/E 3/31/2039	Year 25 Y/E 3/31/2040	Year 26 Y/E 3/31/2040
TOTAL MWh	191,270	183,573	150,125	96,374	43,581	10,872
Total Tariff Payments	***$ 30,947,094***	***$ 29,310,224***	***$ 23,136,603***	***$ 14,502,050***	***$ 6,237,879***	***$ 1,542,013***
Total Market Benefits REG Program	$ 19,203,060	$ 18,441,630	$ 15,101,527	$ 9,699,025	$ 4,391,187	$ 1,095,562
Total Admin Costs	$ 1,323,784	$ 1,295,139	$ 1,187,100	$ 1,035,995	$ 891,372	$ 809,195
Total Net Market Cost of REG Program	$ 13,067,818	$ 12,163,733	$ 9,222,177	$ 5,839,020	$ 2,738,064	$ 1,255,645
Total Offsetting Tax Revenues	$ 5,516,537	$ 5,256,724	$ 4,198,508	$ 2,584,787	$ 1,150,081	$ 285,598
Total Net Program Cost	$ 7,551,281	$ 6,907,010	$ 5,023,669	$ 3,254,233	$ 1,587,983	$ 970,048
Total Cost Shares						
Residential	$ 6,897,194	$ 6,420,018	$ 4,867,465	$ 3,081,835	$ 1,445,150	$ 662,730
Commercial	$ 2,228,063	$ 2,073,916	$ 1,572,381	$ 995,553	$ 466,840	$ 214,088
Industrial	$ 3,219,910	$ 2,997,144	$ 2,272,344	$ 1,438,735	$ 674,659	$ 309,391
Government	$ (4,795,193)	$ (4,585,285)	$ (3,689,444)	$ (2,262,473)	$ (998,940)	$ (216,286)
Total	$ 7,549,974	$ 6,905,793	$ 5,022,746	$ 3,253,649	$ 1,587,709	$ 969,922
Tariff & Admin Impacts						
Employment	-5.4	-3.5	0.8	2.7	4.6	4.2
Labor Income	$ (31,318)	$ 82,624	$ 275,295	$ 165,137	$ 101,312	$ (78,598)
GDP	$ (1,288,017)	$ (1,028,620)	$ (431,571)	$ (204,981)	$ 54,222	$ (29,058)
Output	$ (3,379,108)	$ (2,869,436)	$ (1,540,577)	$ (626,016)	$ 280,980	$ 438,164
O&M						
Employment	12.0	12.0	12.0	12.0	12.0	12.0
Labor Income	$ 1,501,842	$ 1,528,875	$ 1,556,395	$ 1,584,410	$ 1,612,929	$ 1,641,962
GDP	$ 4,885,090	$ 4,973,022	$ 5,062,536	$ 5,153,662	$ 5,246,428	$ 5,340,863
Output	$ 7,072,699	$ 7,200,007	$ 7,329,607	$ 7,461,540	$ 7,595,848	$ 7,732,573
Net Impacts						
Employment	6.6	8.5	12.9	14.7	16.6	16.2
Labor Income	$ 1,470,524	$ 1,611,499	$ 1,831,690	$ 1,749,547	$ 1,714,241	$ 1,563,364
GDP	$ 3,597,073	$ 3,944,402	$ 4,630,966	$ 4,948,681	$ 5,300,650	$ 5,311,806
Output	$ 3,693,591	$ 4,330,572	$ 5,789,031	$ 6,835,524	$ 7,876,828	$ 8,170,737

All dollars are nominal.