Benefit-Cost Analysis of the Rhode Island Community Remote Net Metering Program

Prepared for the Rhode Island Division of Public Utilities and Carriers

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EXECUTIVE SUMMARY

Approach

The Rhode Island Division of Public Utilities and Carriers (the Division) engaged Synapse Energy Economics, Inc. (Synapse) to prepare this report to estimate the costs and benefits of the Community Remote Net Metering (CRNM) program, using the Rhode Island benefit-cost test (RI Test) that was developed as part of Docket 4600.

In this report we use methodologies and assumptions that have been used recently in other benefit-cost analyses (BCAs) in Rhode Island, especially in the BCA for the 2020 Energy Efficiency Plan (2020 EE Plan).

We apply a 25-year study period, consistent with the standard contract term for the CRNM subscribers. We analyze the costs and benefits of expanding the current CRNM program by 30 megawatts (MW). Examination of alternative levels of expansion would have similar results.[1]

The RI Test requires the assessment of macroeconomic impacts of utility resources and programs. Our analysis of macroeconomic impacts is presented in a companion report and integrated into this report.[2]

The CRNM program has many features similar to the Rhode Island Community Remote Distributed Generation (CRDG) program. We analyze the costs and benefits of the CRDG program for comparison with the CRNM program. We also analyze the costs and benefits of several modifications to the CRNM program, again for comparison purposes.

Community Remote Net Metering Program

The CRNM program allows electric customers to take advantage of distributed renewable generation without needing to site the resource at the point of the load or make any upfront investment. Through the program, residential customers can subscribe to a community solar project from which they receive electricity bill savings. The key elements of the program include the following:

- A renewable net metering (RNM) credit is used to compensate renewable project developers and provide bill savings for subscribers.
- The RNM credit is defined as the sum of the standard offer charge, the transmission charge, distribution charge, and transition charge of National Grid's small commercial customer electric rate (the C-06 rate). This rate determines the value of the RNM credits for all subscribers to the CRNM program.
- The RNM credit will change over time as the small commercial customer rate changes over time.

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1 For example, an expansion of 15 MW would result in roughly half the net benefits, and an expansion of 60 MW would result in roughly twice the net benefits, relative to the 30 MW expansion that we analyze here. The benefit-cost ratios would be essentially the same as the 30 MW expansion that we analyze, because the benefits would generally scale with the costs.

2 Synapse Energy Economics. November 2020. *Macroeconomic Impacts of the Rhode Island Community Remote Net Metering Program*, Prepared for the Rhode Island Division of Public Utilities and Carriers, (Synapse Macroeconomic Study).

- The CRNM subscription charge is set to equal 90 percent of the RNM credit and is used to compensate the renewable project developers. The remaining 10 percent of the RNM credit is used to provide bill savings for subscribers.
- Project developers are assigned rights to the renewable energy credits (REC) created by the remote renewable projects.
- Project developers are assigned rights to the generation capacity created by the remote renewable projects.
- The CRNM program has a statutory cap of 30 MW, which can be expanded by a petition by the Rhode Island Office of Energy Resources that shows that the expansion would be cost-effective.

For the purpose of this BCA, the costs of this program include the subscription charge plus the administration costs incurred by National Grid. The benefits of this program include avoided energy costs; avoided transmission costs; wholesale market price suppression effects; reliability benefits; reduced greenhouse gases (GHG); reduced NO_X, SO_X, and particulate matter (PM) emissions; and macroeconomic benefits. This BCA excludes benefits associated with avoided capacity or RECs, because these products are assigned to the project developers. This BCA also excludes benefits associated with avoided distribution costs because the facilities are located remotely from customer loads.

Table 1. Summary of BCA Base Case Results: Community Remote Net Metering (mil PV$)

Type of Impact	Impact	Result
Costs	Utility Administration Costs	0.2
	CRNM Subscription Costs	184
	Total Costs	**185**
Benefits	Energy Benefits	55
	Capacity Benefits	0
	Transmission Benefits	19
	Price suppression effects	18
	Reliability Benefits	0.01
	LI Benefits	0.02
	GHG Benefits	29
	SO_X, NO_X, PM Benefits	6
	Macroeconomic Benefits (GDP)	117
	Societal Benefits Internalized by RECs	-17.84
	Value of RECs to National Grid	0.00
	Total Benefits	**225**
Cost-Effectiveness	**Net Benefits**	**41**
	Benefit-Cost Ratio	**1.22**

Table 1 summarizes the results of the BCA of the CRNM program. In this case, we account for the macroeconomic impacts by adding the monetary value of GDP benefits to the other monetary benefits in the BCA. We refer to this as the Base Case because this is the way that macroeconomic impacts have been accounted for recently in the National Grid EE Plans. As described further below and in the

Synapse CRNM Macroeconomic Report, there are other options for accounting for macroeconomic impacts in BCAs.

As indicated, the costs of the CRNM program are estimated to be $185 million and the benefits are estimated to be $225 million in cumulative present value dollars. This results in $41 million in net benefits and a benefit-cost ratio of 1.22.

Table 2 summarizes the macroeconomic impacts of this program. It presents the expected jobs created by the program (in job-years) as well as four different macroeconomic indicators (in millions of present value dollars). Note that personal income, business income, and state taxes are all components of the state gross domestic product (GDP). Also, note that the state GDP impact presented here is included as one of the benefits in the BCA results presented in Table 1, consistent with the methodology used in National Grid's 2020 EE Plan.

Table 2. Macroeconomic Impacts: Community Remote Net Metering

Analysis	Impact	Result
Economic Impact Analysis	Jobs (job-years)	731
	Personal Income (mil PV$)	63
	Business Income (mil PV$)	29
	State Taxes (mil PV$)	10
	Gross Domestic Product (mil PV$)	117

Figure 1 presents the results of the BCA Base Case for the CRNM program in more detail. It shows the benefits, costs, and net benefits in cumulative present value dollars for the 25-year study period.

Figure 1. Benefits and Costs of the CRNM Program: Base Case

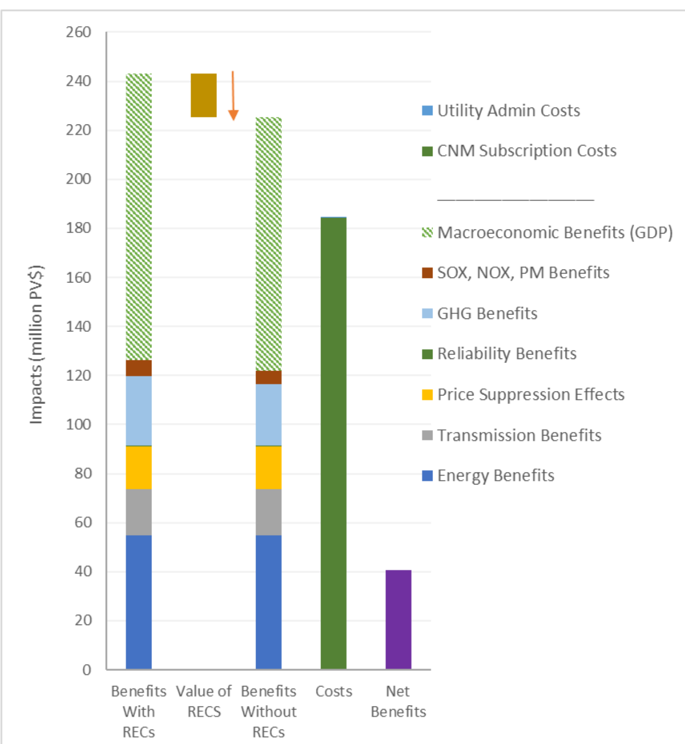


Figure 1 also shows how we subtract out the value of RECs from the benefits. This is necessary to account for the fact that the RECs generated by the CRNM solar projects are assigned to the project developers. This calculation is described further in Section 4.2.

Macroeconomic Impacts

As indicated in Figure 1, the macroeconomic benefits have a significant impact on the BCA results. In addition, there are several outstanding questions about the best way to account for macroeconomic impacts in a benefit-cost analysis. One of the most prominent outstanding questions is how to avoid double-counting between the macroeconomic impacts and the costs and benefits included in a BCA.

We therefore present BCA results using two different cases:

- Base Case: Monetary values of GDP are added to the monetary BCA results. This approach has been used to date in several recent filings before the PUC. The GDP values are adjusted to address double-counting concerns, consistent with the approach used in National Grid's 2020 EE Plan.
- Separate Impacts Case: All the macroeconomic indicators are presented separately from the BCA results to avoid double-counting. In this case, the macroeconomic impacts should be considered qualitatively as part of the benefits, but without adding them to the benefits. The GDP values are not adjusted to address double-counting concerns because they are not added into the BCA.

Table 3 presents the results for both cases. The Base Case data is the same data presented in Table 1 and Table 2. These macroeconomic results are discussed further in Section 8.4 and in the Synapse CRNM Macroeconomics Report.

Table 3. Macroeconomic Impacts: Two Cases

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	185	185
	Benefits (mil PV$)	225	108
	Net Benefits (mil PV$)	41	-76
	Benefit-Cost Ratio	1.22	0.59
Economic Impact Analysis	Jobs (job-years)	731	556
	Personal Income (mil PV$)	63	38
	Business Income (mil PV$)	29	18
	State Taxes (mil PV$)	10	7
	Gross Domestic Product (mil PV$)	117 Included in BCA above	84

Note that we have concerns about the treatment of macroeconomic impacts in several recent filings before the PUC. We believe that the monetary estimates of GDP benefits should not be added to the monetary benefits of the BCA, because this would lead to a significant amount of double-counting of benefits. In general, the macroeconomic impacts are a different representation of the impacts that are already included in the BCA and therefore the monetary value of the economic impacts should not be added to the monetary BCA results. Instead, the macroeconomic impacts should be considered alongside the BCA impacts, so they can be considered separately from those impacts. This recommendation is addressed in more detail in the Synapse CRNM Macroeconomic Report.

In this report, we add the macroeconomic results to the BCA results in the Base Case only because that is how these impacts have been accounted for in several recent filings before the PUC.

Modified Community Remote Net Metering Program

We analyze four Modified CRNM Programs to determine how different components of each program affect its cost-effectiveness. We also include a carve-out for low- to moderate-income (LMI) customers in each modified program.

Modified CRNM Program #1

The Modified CRNM Program #1 is the same as the CRNM program except that it includes the following features:

- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Table 4 summarizes the results of our analysis of the Modified CRNM Program #1. For this program, the benefits are slightly greater than for the CRNM program, resulting in greater net benefits and higher benefit-cost ratios.

Table 4. Summary of Results: Modified CRNM #1

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	185	185
	Benefits (mil PV$)	235	116
	Net Benefits (mil PV$)	50	-69
	Benefit-Cost Ratio	1.3	0.6
Economic Impact Analysis	Jobs (job-years)	758	595
	Gross Domestic Product (mil PV$)	119 Included in BCA above	88

Modified CRNM Program #2

The Modified CRNM Program #2 is the same as the CRNM program except that it includes the following features:

- The RECs created by the solar projects are assigned to National Grid.
- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Table 5 summarizes the results of our analysis of the Modified CRNM Program #2. For this program, the benefits are greater than for the CRNM program, resulting in greater net benefits and higher benefit-cost ratios.

Table 5. Summary of Results: Modified CRNM #2

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	185	185
	Benefits (mil PV$)	261	134
	Net Benefits (mil PV$)	77	-51
	Benefit-Cost Ratio	1.4	0.7
Economic Impact Analysis	Jobs (job-years)	834	699
	Gross Domestic Product (mil PV$)	127 Included in BCA above	102

Modified CRNM Program #3

The Modified CRNM Program #3 is the same as the CRNM program except that it includes the following features:

- The RECs created by the solar projects are assigned to National Grid.
- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.
- The RNM credit rate is fixed over the length of the contract to the small commercial customer rate in place at the time the customer signs up for the program.

Table 6 summarizes the results of our analysis of the Modified CRNM Program #3. Holding the RNM credit rate constant throughout the study period results in significantly lower costs than allowing it to increase with the small commercial customer rate. This modification makes this CRNM program much more cost-effective than the original CRNM program.

Table 6. Summary of Results: Modified CRNM #3

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	125	125
	Benefits (mil PV$)	226	134
	Net Benefits (mil PV$)	101	9
	Benefit-Cost Ratio	1.8	1.1
Economic Impact Analysis	Jobs (job-years)	673	637
	Gross Domestic Product (mil PV$)	92 Included in BCA above	85

Modified CRNM Program #4

The Modified CRNM Program #4 is the same as the CRNM program except that it includes the following features:

- The RECs created by the solar projects are assigned to National Grid.
- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.
- The subscribers sign up for a 20-year contract, instead of the 25-year contract in the CRNM program. Consequently, the BCA and the macroeconomic analysis use a 20-year study period.

Table 7 summarizes the results of our analysis of the Modified CRNM Program #4. Reducing the contract period and study period to 20 years reduces both the costs and the benefits of this program.

Table 7. Summary of Results: Modified CRNM #4

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	145	145
	Benefits (mil PV$)	204	112
	Net Benefits (mil PV$)	60	-33
	Benefit-Cost Ratio	1.4	0.8
Economic Impact Analysis	Jobs (job-years)	618	516
	Gross Domestic Product (mil PV$)	93 Included in BCA above	74

Community Remote Distributed Generation Program

The CRDG program has many features similar to the CRNM program. They both promote remote community solar facilities that are financed by National Grid electric customers who voluntarily subscribe to the program. Because of these similarities, we compare the costs and benefits of the CRNM program to those of the CRDG program.

There are also some important differences between these two programs. These differences are summarized in Section 2.4.

Table 8 summarizes the results of our analysis of the CRDG Program. The costs for this program are significantly lower than the costs for the CRNM program because they are based on competitive bids from project developers and the RNM credit is held constant over time.

Table 8. Summary of Results: CRDG Program

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	93	93
	Benefits (mil PV$)	178	112
	Net Benefits (mil PV$)	84	18
	Benefit-Cost Ratio	1.9	1.2
Economic Impact Analysis	Jobs (job-years)	510	500
	Gross Domestic Product (mil PV$)	66 Included in BCA above	64

Summary Across All Programs

Table 9 compares the different features of the six programs analyzed in this report.

Table 9. Features of Community Remote Solar Programs

Feature	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
RNM credit based on	C-06 rate	C-06 rate	C-06 rate	C-06 rate	C-06 rate	competitive bids
RNM credit over time	increases	increases	increases	fixed	increases	fixed
RECs assigned to	developers	developers	Nat. Grid	Nat. Grid	Nat. Grid	Nat. Grid
Capacity assigned to	developers	Nat. Grid	Nat. Grid	Nat. Grid	Nat. Grid	Nat. Grid
LMI customers	very few	20%	20%	20%	20%	very few[3]
Contract period	25 years	25 years	25 years	25 years	20 years	20 years

Table 10 summarizes the results of our analysis across all remote community solar programs.

[3] The 2021 CRDG filing before the PUC includes a ¢/kWh adder for projects that provide at least 20% of their output to LMI customers enrolled in the A-60 electric rate. National Grid, *2021 Renewable Energy Growth Program Tariff and Rule Changes*, Direct Testimony of Ian Springsteel and Meghan McGuinness, November 13, 2020. The impacts of this adder are not included in our monetary BCA results above because they are likely to be very small and they have not yet been approved by the PUC. Nonetheless, it is important to recognize the potential qualitative benefits of this modification.

Table 10. Summary of All Programs: Base Case

Analysis	Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Benefit-Cost Analysis	Costs (mil PV$)	185	185	185	125	145	93
	Benefits (mil PV$)	225	235	261	226	204	178
	Net Benefits (mil PV$)	41	50	77	101	60	84
	Benefit-Cost Ratio	1.22	1.3	1.4	1.8	1.4	1.9
Economic Impact Analysis	Jobs (job-years)	731	758	834	673	618	510
	GDP (mil PV$) Included in BCA above	117	119	127	92	93	66

Figure 2 compares the benefit-cost ratios across all the programs, including the Base Case and the Separate Impacts Case for each program.

Figure 2. Summary of All Programs: Benefit-Cost Ratios

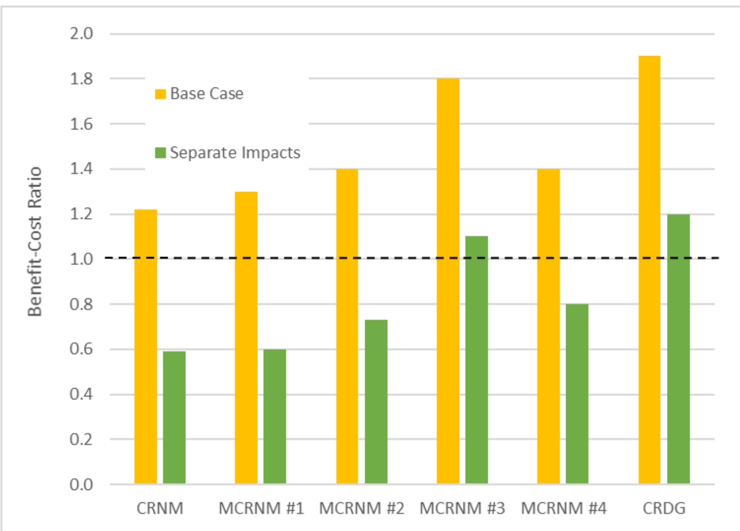
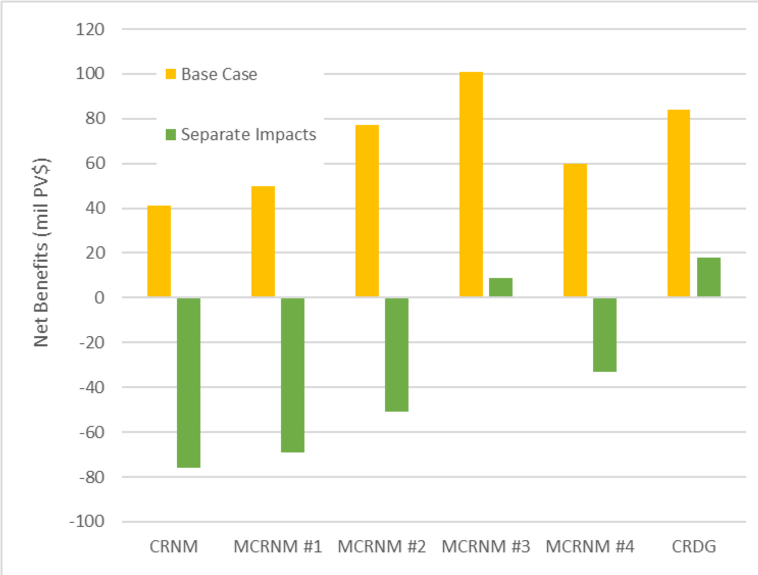


Figure 3 compares the net benefits across all the programs, including the Base Case and the Separate Impacts Case for each program. Note that Modified CRNM Program #4 and the CRDG program each have 20-year contract terms and study periods, while the others have 25-year contract terms and study periods. The net benefits of these two programs are less than they would be with a 25-year study period. This difference should be recognized when comparing these two programs with the others.

Figure 3. Summary of All Programs: Net Benefits



Qualitative Impacts

There are several benefits of the CRNM program that we are unable to put into monetary terms, so these are discussed qualitatively. These include risk benefits, market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

With the exception of low-income non-energy benefits, the impacts accounted for qualitatively are likely to be small to zero and therefore do not affect the BCA results for each program. They are also likely to be essentially the same across all six programs and therefore do not affect how the programs compare with each other.

However, the low-income non-energy benefits do make a difference in how the programs compare with each other. The CRNM program has a small number of subscribers that are low-income customers, and we expect that the same is true for the CRDG program.[4] The four Modified CRNM programs, on the other hand, include a requirement that at least 20 percent of the subscribers be LMI customers. Thus, the four Modified CRNM programs offer important benefits that the other two programs do not.

The Modified CRNM programs will create three types of low-income benefits:

- Utility system non-energy benefits in terms of reduced arrearages, reduced terminations and disconnections, reduced bad debt write-offs, reduced customer calls and collections, and reduced notices. These benefits are addressed quantitatively using assumptions from National Grid's 2020 EE Plan. See the section below on Utility Non-Energy Benefits.
- Low-income subscriber's non-energy benefits in terms of reduced energy burdens.

[4] The 2021 CRDG filing before the PUC includes a ¢/kWh adder for projects that provide at least 20% of their output to LMI customers enrolled in the A-60 electric rate. The impacts of this adder are not included in our BCA analysis above because they are likely to be small in monetary terms and they have not yet been approved by the PUC. Nonetheless, it is important to recognize the potential qualitative benefits of this modification.

- Societal low-income non-energy benefits in terms of poverty alleviation, environmental justice, reductions in the cost of low-income social services, and local economic benefits.

We are not aware of any information, in Rhode Island or elsewhere, that monetizes the low-income participant or societal non-energy benefits. Therefore, we address these benefits qualitatively.

The fact that the four Modified CRNM programs specifically seek to serve low-income subscribers distinguishes them from the CRNM and CRDG programs. Community solar programs are an important mechanism for allowing customers to benefit from solar facilities, regardless of where they live, whether they are renters, and whether they have a roof or ground space for a solar facility. Community solar programs can facilitate low-income customer participation as they require no up-front costs, they have few transaction costs, and they provide immediate electricity bill savings. Community solar programs offer an important opportunity for low-income customers to participate in and directly benefit from distributed energy resources.

In sum, the four Modified CRNM programs offer additional low-income benefits that are not accounted for in the BCA presented above. These additional benefits should be considered when comparing the Modified CRNM programs to the CRNM or CRDG programs.

1. INTRODUCTION

Background

The Rhode Island net metering statute establishes a Community Remote Net Metering (CRNM) program that allows customers to subscribe to solar facilities that are not located at their building or facility. The CRNM program was established as a pilot program, with a limit of 30 megawatt (MW) of aggregate capacity from all the participating solar projects. The net metering statute allows the Rhode Island Public Utilities Commission (PUC) to expand or modify the CRNM program after a public hearing upon petition by the Rhode Island Office of Energy Resources (OER). The statute further requires the PUC to determine "whether the benefits of the proposed expansion exceed the cost."[5]

The Rhode Island Division of Public Utilities and Carriers (the Division) tasked Synapse with estimating the costs and benefits of the CRNM program using the Rhode Island benefit-cost test (RI Test) that was developed as part of Docket 4600. This report describes the CRNM program, the RI Test, our methodologies and assumptions, and our findings on the costs and benefits of the CRNM program.

The OER assisted in collecting data for this report. National Grid also provided some of the data for this report. The findings and recommendations in this report, however, are those of the authors alone.

Overview of Methodology

This report relies upon the RI Test developed in Docket 4600 as the foundation for the benefit-cost analysis (BCA) of CRNM. The RI Test identifies all the costs and benefits to account for when evaluating the cost-effectiveness of any new energy resources in Rhode Island.[6] The test has been used in recent National Grid Energy Efficiency Plans (EE Plans), Power Sector Transformation proposals in the recent National Grid rate case, draft National Grid proposals for advanced metering functionality (AMF), draft National Grid proposals for grid modernization, and a recent docket evaluating the proposed Gravel Pit Solar Project.

This report relies upon inputs and assumptions used by National Grid and others in these recent applications of the RI Test in Rhode Island. In many cases, we rely upon the assumptions and inputs used in the 2020 EE Plan. In some cases, we rely upon more recent sources, and in other cases we develop new estimates reflecting the best data currently available. This report also relies upon the principles and concepts outlined in the *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources* (NSPM for DERs).[7]

We present the benefits and costs of CRNM in terms of present value dollars, which requires determining monetary values for each of the costs and benefits. Many of the CRNM costs and benefits are relatively easy to put into monetary terms, while some—especially benefits—are difficult to put into monetary terms at this time. For this reason, several of the costs and benefits in the RI Test have not

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5 R.I.G.L. Chapter 39-62.4-3(a)(1)(ii).

6 Public Utilities Commission's Guidance on Goals, Principles and Values for Matters Involving the Narragansett Electric Company d/b/a National Grid, October 27, 2017, Docket 4600.

7 National Energy Screening Project. 2020. *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources*. (NSPM for DERs). Available at www.nationalenergyscreeningproject.org/.

been used in any BCA in Rhode Island to date. For those hard-to-monetize impacts, we first determine whether the impact is likely to be applicable to CRNM and have a material effect on its BCA. For those impacts that are likely to be applicable and material, we provide a qualitative discussion of how those impacts might affect the BCA results.

The RI Test requires that BCAs account for the macroeconomic impacts of utility resources and programs. These macroeconomic impacts can have a significant effect on the CRNM benefit-cost analysis. Our analysis of macroeconomic impacts is presented in a companion report and integrated into this one.[8]

The CRNM program is similar to the Community Remote Distributed Generation program (CRDG). They both promote remotely sited PV facilities financed by National Grid customers who voluntarily subscribe to the program. Because of these similarities, we compare the costs and benefits of the CRNM program to those of the CRDG program. We also analyze the costs and benefits of several modifications to the CRNM program, again for comparison purposes.

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8 Synapse Energy Economics. November 2020. *Macroeconomic Impacts of the Rhode Island Community Net Metering Program*, Prepared for the Rhode Island Division of Public Utilities and Carriers.

2. RHODE ISLAND RENEWABLE INITIATIVES

2.1. Overview

Rhode Island has set targets for decarbonization of the state's energy sector and has implemented numerous programs to help meet the target. The Resilient Rhode Island Act set emissions reduction targets for the state of 45 percent below 1990 levels by 2035 and 80 percent below 1990 levels by 2050.[9] The law also established the Executive Climate Change Coordinating Council to direct the state's climate policies.

Many of the resulting policies aim to reduce carbon emissions in the electric power sector by increasing the supply of renewable generation. One policy to accomplish this goal is the Renewable Energy Standard (RES), which was enabled by the state's 2004 Renewable Energy Standard statute.[10] The RES requires the state's retail electricity providers to procure increasing amounts of renewable electricity relative to their total retail electricity sales. The RES requires that renewable resources account for 38.5 percent of all sales in 2035. Solar, wind, ocean movement and thermal, geothermal, small hydroelectric, biomass using renewable fuels, and fuel cells powered by renewables are all eligible for the RES. Furthermore, in January 2020, Governor Gina M. Raimondo signed an Executive Order to set Rhode Island on a path to meet 100 percent of its electricity demand with renewables by 2030. The OER is now leading an analytical process to help inform pathways toward achieving that goal.

The State has also implemented a number of specific policies to accelerate the growth of clean energy in Rhode Island. These programs include Net Metering, Renewable Energy Growth, and the Long-Term Contracting Standard. Table 11 provides an overview of the three renewable programs. Table 12 provides more detail on the components of these programs, including the community solar components.

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9 Rhode Island General Laws, Resilient Rhode Island Act of 2014, Title 42, Chapter 6.2. Available at:http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-6.2/INDEX.HTM.

10 Rhode Island General Laws, Renewable Energy Standard (RES), Title 39, Chapter 26. Available at: http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-26/INDEX.HTM.

Table 11. Rhode Island's Renewable Incentive Programs: By Three Main Programs

Program	History	Incentive	Eligibility	Treatment of RECs
Net Metering (NM)	Current implementing law passed in 2011; cap of 3% of utility's peak load was removed in 2014	Generation exported to the grid offsets cost of electricity consumed; projects not competitively bid but receive pre-determined payment set by statute	Customer-sited generation sized to meet on-site loads; virtual net metering for public/non-profit entities; CRNM pilot	The owner of the generation retains title to any RECs produced by the generation and has the exclusive right to sell them in the market for supplemental revenue
Renewable Energy Growth (REG)	Originally authorized by law in 2014; successor to the DG contracts program	Long-term fixed price contract; small-scale systems receive pre-determined payment; large-scale projects bid competitively	Generation cannot be net metered; residential systems must be sized at or smaller than historical consumption levels.	RECs are assigned to National Grid, who uses them to comply with standard offer RES obligation
Long-Term Contracts	Established in 2009	15-year contracts with projects selected through a competitive bid based on price and economic factors	Utility-connected renewable generation; originally included 40 MW carve-out for distributed generation (DG) contracts program, which was replaced with REG	RECs are assigned to National Grid, who uses them to comply with standard offer RES obligation

Table 12. Rhode Island's Renewable Incentive Programs: By Sub-Components

Program	Sub-Component	Size Category	Project Eligibility	Price Offered (¢/kWh)	Contract Term (years)
Net Metering (NM)	Standard	DG	DG	residential rate	Indefinite
	Virtual	Large	max 10 MW	small commercial rate	Indefinite
	Community (CRNM)	Large	multiple subscribers	small commercial rate	Indefinite
Renewable Energy Growth (REG)	Small-Scale	Small	1-10 kW	29.6	15
		Large	11-25 kW	23.4	20
	Large-Scale	Medium	26-250 kW	21.1	20
		Commercial	251-999 kW	18.2	20
		Large	1,000-5,000 kW	13.7	20
	Community (CRDG)	Commercial	251-999 kW	Competitive bid	20
		Large	1,000-5,000 kW	Competitive bid	20
Long-Term Contracts	Large-Scale	Large	Utility-scale	Competitive bid	15
	DG Standard Contracts	DG	DG	Closed	15

2.2. The Community Remote Net Metering Program

The Rhode Island net metering statute states that the purpose of the net metering program is:

> [T]o facilitate and promote installation of customer-sited, grid-connected generation of renewable energy; to support and encourage customer development of renewable generation systems; to reduce environmental impacts; to reduce carbon emissions that contribute to climate change by encouraging the local siting of renewable energy projects; to diversify the state's energy generation sources; to stimulate economic development; to improve distribution system resilience and reliability; and to reduce distribution system costs.[11]

The CRNM program allows residential electric customers to take advantage of net metered distributed renewable generation without needing to site the resource at the point of electric load or make any upfront investment. Subscribers to the CRNM program do not receive energy directly from the solar projects. Instead, they continue to receive electricity supply services from National Grid's standard offer service or from competitive generation suppliers. Subscribers continue to pay National Grid for all electricity consumed in their homes or businesses, with the same rates and rate designs they had before joining the program. Through the program, residential customers can subscribe to a community solar project from which they receive net metering credits.

Subscribers receive these credits, called renewable net metering (RNM) credits, from National Grid. They use 90 percent of the credit amount to pay the CRNM project developers and keep the remaining 10 percent as a reduction to their electricity bill.[12] RNM credits are defined as the sum of the standard offer charge, the transmission charge, distribution charge, and the transition charge of National Grid's small commercial customer electric rate (C-06). This rate determines the value of the RNM credits for all customers, including those who are not on the small commercial customer rate. The CRNM project developers are assigned (a) the rights to the RECs created by the output of the CRNM projects, and (b) the rights to bid the peak capacity contribution of the CRNM projects into the New England wholesale electric generation capacity market, referred to as the Forward Capacity Market (FCM).[13] The revenues generated from RECs and the FCM are used by the developers to help offset their costs of developing and operating the CRNM projects.

Figure 4 presents a diagram of how the CRNM programs affects project developers, participating customers, and electric customers as a whole. The left side of the diagram shows how the CRNM projects' energy is provided to National Grid while the RECs and capacity are assigned to the project developer. The right side of the diagram shows how participating customers receive RNM credits from National Grid; how those customers pay 90 percent of the value of the RNM credits to purchase the credits from the renewable developers; and how all National Grid customers reimburse National Grid for the RNM credit, minus the value of the energy that the utility receives from the CRNM projects.

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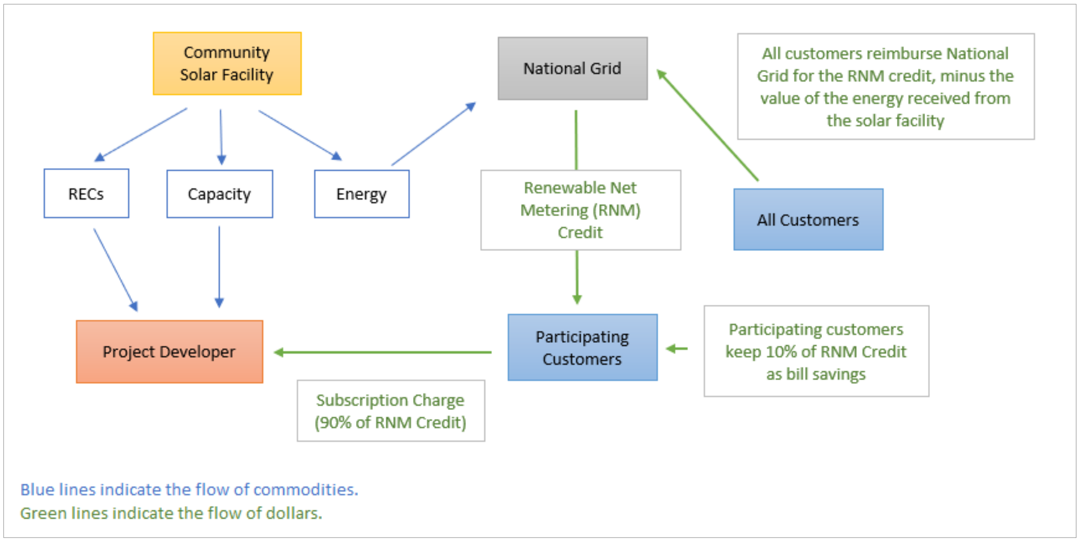
11 R.I.G.L. Chapter 39-62.4-1.

12 Arcadia. Accessed July 20, 2020. "How is My Bill Calculated with Community Solar In Rhode Island?" Available at: https://support.arcadia.com/hc/en-us/articles/360042837234-How-is-My-Bill-Calculated-with-Community-Solar-In-Rhode-Island-.

13 National Grid. June 18, 2020. *CRNM vs. CRDG RE Growth Net Cost Analysis.* Rhode Island Community Net Metering Stakeholder Meeting #6.

Figure 4. CRNM Design Features



A CRNM project can create excess credits if the electricity generated by a CRNM system during a billing period is greater than the sum of the usage of the subscribers during that same period. These excess credits can be generated up to an additional 25 percent beyond the sum of the CRNM project's subscribers' usage.[14]

No more than 50 percent of the net metering credits may go to one recipient, and at least 50 percent of the net metering credits must go to individual customers in amounts no greater than the annual kilowatt-hour (kWh) produced by a 25-kW AC system.[15]

Six solar projects have been accepted into the CRNM program and will provide the full 30 MW allowed under the pilot. According to National Grid, 28.42 MW of solar have been reserved and another 1.58 MW remain available to potential subscribers as of June 2020.[16] All of the six projects have started construction, and the last project broke ground in November 2019.[17] One project, equaling 2.54 MW, has interconnected to the electricity grid and has commenced commercial operation.

2.3. Modified Community Remote Net Metering Programs

We analyze four modified CRNM programs to determine how different components would affect the cost-effectiveness of these programs. We also include a carve-out for low- to moderate-income (LMI) customers in each modified program.

Modified CRNM Program #1 includes the following features:

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[14] R.I.G.L. Chapter 39-62.4-3(a)(4).

[15] R.I.G.L. Chapter 39-62.4-2(1).

[16] National Grid. March 2, 2020. "RI – Net Metering." Available at: https://ngus.force.com/s/article/Net-Metering-in-Rhode-Island.

[17] ecoRI News. November 14, 2019. "Ground Broken on Largest Community Solar Project." Available at: https://www.ecori.org/renewable-energy/2019/11/14/d4vcl1zd7zmqrjpdcbi75vpceyvnol.

- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Modified CRNM Program #2 includes the following features:

- The RECs created by the solar projects are assigned to National Grid.
- The generation capacity rights of the solar projects are assigned to National Grid.
- The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Modified CRNM Program #3 includes the same features as CRNM #2, plus the following:

- The RNM rate is fixed over the length of the contract to the small commercial customer rate in place at the time the customer signs up for the program.

Modified CRNM Program #4 includes the same features as CRNM #2, plus the following:

- The subscribers sign up for a 20-year contract, instead of the 25-year contract in the current CRNM program. Consequently, the BCA and the macroeconomic analysis use a 20-year study period for this modified program.

2.4. The Community Remote Distributed Generation Program

The CRDG program is one of the programs offered through the Rhode Island Renewable Energy Growth Program (see Table 11 and Table 12). This program is very similar to the CRNM program in that they both promote remotely sited PV facilities financed by National Grid customers who voluntarily subscribe to the program.

There are some important differences between the CRDG program and the CRNM program. Table 13 provides a comparison of the key differences.

Table 13. Comparison of CRNM and CRDG Program Components

	CRNM	CRDG
RECs	Retained by Developer	Assigned to National Grid
Generation Capacity Rights	Retained by Developer	Assigned to National Grid
Contract Length	25 years	20 years
Eligible Customers	Residential and LMI customers	Any customer, including commercial
Anchor Tenants Permitted	No	Yes - up to 50% of credits for any project
Compensation	RNM credit only. Based on sum of the standard offer charge, the transmission charge, distribution charge, and transition charge of National Grid's C-06 rate	Based on competitive solicitation, with a mix of cash and credits.
Compensation Rate	Variable based on changes to CO-6 rate over contract term	Fixed over contract term
RNM Crediting	Not to exceed the three year historical billings/use of customer	Net crediting permitted. Cap on the value of the credits. After cap reached, remaining value of the Performance Based Incentive (PBI) owed to customer is paid in cash.
Shareholder Incentive	No	Yes – 1.75% of gross value of the PBI

Our BCA of the CRDG program includes the same methodology and assumptions as the BCA of the CRNM program, except for the relevant differences listed above.

3. THE RHODE ISLAND BENEFIT-COST FRAMEWORK

As part of Docket 4600, the PUC approved the RI Test to create a consistent approach for assessing the costs and benefits across all types of utility investments. Appendix A provides a summary of the RI Test.

For inclusion in our analysis, we simplify the framework in three ways:

All costs and benefits are presented separately.

Overlapping costs and benefits are grouped together.

Impacts that can be both a cost and a benefit are combined into a net effect.

Table 14 and Table 15 present this simplified version of the RI Test. These tables also summarize how we treat the different costs and benefits for this study. In several cases, a cost or benefit is not applicable to the CRNM program and is therefore not further addressed in this study. In some cases, a cost or benefit might be applicable to the CRNM program but there is limited information or studies available to determine a reliable estimate. In such cases, we discuss these impacts qualitatively. The costs and benefits included in Table 14 and Table 15 are discussed further in Chapter 5.

Table 14. RI Test – Costs

Level	Cost	CRNM	Modified CRNMs	CRDG
Power Sector	Utility Administration Costs	Included. Source: National Grid		
	Utility Measure Costs	There are no utility measure costs.		
	Utility Shareholder Incentives	Not applicable	Not applicable	Included
	Increased Transmission Costs	Likely to be small to zero		
	Increased Distribution Costs	Likely to be small to zero		
Customer	Participant Measure Costs	Included as part of the subscription charge		
	Participant Non-Energy Costs	Likely to be small to zero		
Societal	Third-Party Developer Costs	Included as part of the subscription charge		

Table 15. RI Test - Benefits

Level of Impact	Benefit	CRNM	Modified CRNM	CRDG
Power Sector	Reduced Energy Costs	Included. Source: AESC 2018 (modified to reflect decreased gas prices since AESC 2018)		
	Reduced Generation Capacity Costs	Not applicable	Included. Source: CRNM Developers	
	Reduced Transmission Costs	Included. Source: National Grid 2020 EE Plan and AESC 2018		
	Reduced Distribution Costs	Likely to be small to zero		
	Reduced Ancillary Services Costs	Likely to be small to zero		
	Wholesale Market Price Suppression	Included. Source: National Grid 2020 EE Plan and AESC 2018		
	Reduced Costs of RES Compliance	These are zero. Remote PV does not reduce RES targets.		
	Renewable Energy Credits	Included. Source: Synapse estimate		
	Reduced GHG Compliance Costs	Included in the avoided energy costs		
	Reduced Environmental Compliance Costs	Included in the avoided energy costs		
	Improved Reliability	Included. Source: National Grid 2020 EE Plan and AESC 2018		
	Net Risk Benefits	Discussed qualitatively		
	Utility Non-Energy Benefits	Included. Source: National Grid 2020 EE Plan		
	Innovation and Market Transformation	Discussed qualitatively		
Customer	Participant Water and Other Fuels Impacts	Remote PV does not affect water or other fuel impacts		
	Participant Non-Energy Benefits (NEBs)	Discussed qualitatively		
	Low-Income Participant NEBs	Discussed qualitatively		
	Customer Empowerment	Likely to be small to zero		
Societal	Reduced GHG Emissions	Included. Source: National Grid 2020 EE Plan and AESC 2018		
	Reduced Environmental Impacts	Included. Source: Synapse AVERT and COBRA analysis		
	Economic Development Impacts	Included. Source: Synapse Macroeconomic Report		
	Societal Low-Income Benefits	Small to zero	Qualitative	Small to zero
	Public Health Benefits	Included in the reduced environmental impacts		
	Energy Security Benefits	Likely to be small to zero		

4. Results for the Community Remote Net Metering Program

4.1. Monetary and Macroeconomic Results

Table 16 summarizes the results of the BCA of the CRNM program. This BCA is referred to as the "base case" for the purpose of this analysis and includes the monetized benefits of macroeconomic impacts.

Table 16. Summary of BCA Base Case Results: CRNM Program (mil PV$)

Type of Impact	Impact	Result
Costs	Utility Administration Costs	0.2
	CRNM Subscription Costs	184
	Total Costs	**185**
Benefits	Energy Benefits	55
	Capacity Benefits	0
	Transmission Benefits	19
	Price suppression effects	18
	Reliability Benefits	0.01
	LI Benefits	0.02
	GHG Benefits	29
	SO_X, NO_X, PM Benefits	6
	Macroeconomic Benefits (GDP)	117
	Societal Benefits Internalized by RECs	-17.84
	Value of RECs to National Grid	0.00
	Total Benefits	**225**
Cost-Effectiveness	**Net Benefits**	**41**
	Benefit-Cost Ratio	**1.22**

As indicated, the cumulative costs of the program are estimated to be $185 million and the cumulative benefits are estimated to be $225 million in present value dollars. This results in $41 million in net benefits and a benefit-cost ratio of 1.22.

Table 17 presents the findings of our macroeconomic analysis. It presents the expected jobs created by the program (in job-years) as well as four different macroeconomic indicators (in millions of present value dollars). Note that personal income, business income, and state taxes are all components of the state gross domestic product (GDP) but they are not the only components.[18] Also, note that the state GDP impact we present here is included as one of the benefits in the BCA results shown in Table 16, consistent with the methodology used in National Grid's 2020 EE Plan.

[18] For detail on how personal income, busines income, and state tax components were calculated, see Synapse CRNM Macroeconomic Report.

Table 17. Macroeconomic Benefits: CRNM Program

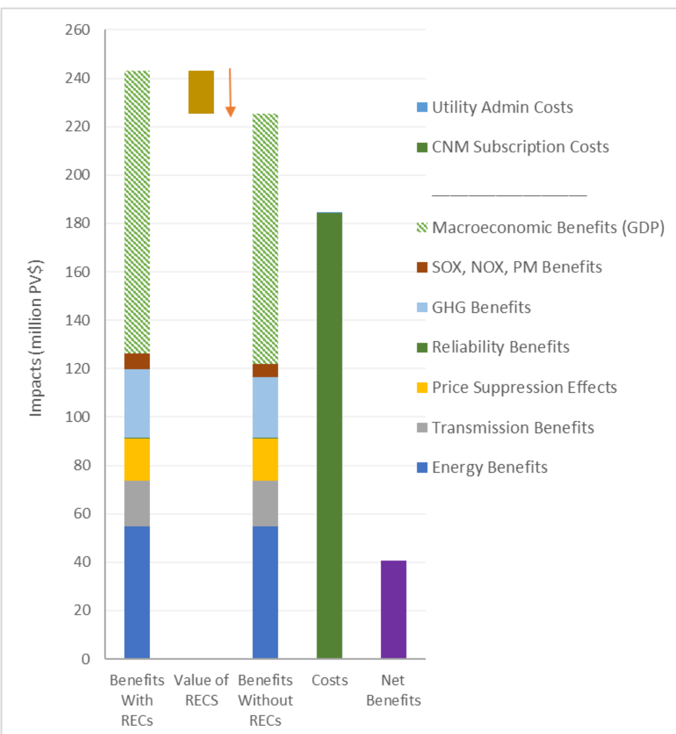
Analysis	Impact	Result
Economic Impact Analysis	Jobs (job-years)	731
	Personal Income (mil PV$)	63
	Business Income (mil PV$)	29
	State Taxes (mil PV$)	10
	Gross Domestic Product (mil PV$)	117

Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

Figure 5 presents the results of the BCA Base Case for the CRNM program in more detail. It shows the benefits, costs, and net benefits in cumulative present value dollars for the 25-year study period. The benefits include avoided energy, transmission, and wholesale market price suppression effects, environmental benefits, and macroeconomic benefits. The costs are dominated by the subscription costs that are paid to renewable project developers, and the costs also include a small cost incurred by National Grid for administering the program.

Figure 5 also shows how we subtract out the value of RECs from the benefits. This is necessary to account for the fact that the RECs generated by the CRNM solar projects are assigned to the project developers. This calculation is described further below in Section 4.2.

Figure 5. Benefits and Costs of the CRNM Program: Base Case



Macroeconomic Cases

As indicated in Figure 5, the macroeconomic benefits have a significant impact on the BCA results. In addition, there are several outstanding questions about the best way to account for macroeconomic impacts in a BCA. One of the most prominent outstanding questions is how to avoid double-counting between the macroeconomic impacts and the costs and benefits included in a BCA.

We therefore present BCA results using two different indicators:

- Base Case: Monetary values of GDP are added to monetary BCA results. We present this as the Base Case because this is the approach that has been used to date in several recent filings before the PUC.
- Separate Impacts Case: All the macroeconomic indicators are presented separately from the BCA results to avoid double-counting. In this case, the macroeconomic impacts should be considered qualitatively as part of the benefits, but without adding them to the benefits.

Table 18 presents the results for these cases. The Base Case data is the same data that is presented in Table 16. These results are discussed further in Section 8.4 and in the Synapse CRNM Macroeconomics Report.

Table 18. Macroeconomic Impacts: Two Cases

Analysis	Result	Base Case	Separate Impacts Case
Benefit-Cost Analysis	Costs (mil PV$)	185	185
	Benefits (mil PV$)	225	108
	Net Benefits (mil PV$)	41	-76
	Benefit-Cost Ratio	1.22	0.59
Economic Impact Analysis	Jobs (job-years)	731	556
	Personal Income (mil PV$)	63	38
	Business Income (mil PV$)	29	18
	State Taxes (mil PV$)	10	7
	Gross Domestic Product (mil PV$)	117 Included in BCA above	84

Note that we have concerns about the way that macroeconomic impacts have been accounted for in several recent filings before the PUC. We believe that the monetary estimates of GDP benefits should not be added to the monetary benefits of the BCA, because this would lead to a significant amount of double-counting of benefits. The macroeconomic impacts are a different manifestation of the impacts that are already included in the BCA and therefore should not be considered an additional benefit to those. (See Section 8.4 and the Synapse CRNM Macroeconomic Report.)

Instead, the macroeconomic impacts should be considered alongside the BCA impacts, as a different way to account for those impacts. Under the Separate Impacts Case, our results can be summarized as follows: The CRNM program has a benefit-cost ratio of 0.59, will result in net costs of $76 million, will create 556 job-years, and will increase the state GDP by $84 million.

4.2. Accounting for the Value of RECs

As indicated in Figure 5, we subtract the value of RECs from the total benefits of CRNM. RECs are intended to represent the above-market value of renewable generation (i.e., the societal benefits such as reduced greenhouse gas (GHG) emissions, reduced other environmental impacts, increased local jobs, and more). Therefore, there is some overlap between the value of RECs and the value of these societal benefits. To subtract the value of RECs from the total benefits, we reduce the societal benefits proportionally by the total value of the RECs. (See Section 8.3.)

Under the CRNM program, the RECs are assigned to the project developers (see Figure 4). If the RECs were instead assigned to National Grid, then the value of these RECs would be considered a benefit in the BCA because those RECs could be used by the Company to reduce its costs of complying with the Rhode Island RES.

4.3. Qualitative Impacts

Summary

There are five types of RI Test benefits that are likely created by the CRNM program but for which we do not have sufficient information to quantify and monetize. These include net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and certain environmental benefits. This analysis therefore only considers these benefits qualitatively. In all cases, we expect the benefits to be small and unlikely to change the outcome of the BCA.

Net Risk Benefits

All utility resource investments involve some form of risk. It is important that both increased and reduced risks of utility resources be accounted for in a BCA (i.e., that the BCA accounts for net risks).

In general, distributed energy resources (DERs) are less risky than utility-scale resources and investments because they are more modular, adaptable, and flexible, and they provide greater resource diversity. Fixed-price renewable resources offer a hedge against volatile generation commodity prices, increased optionality for responding to load growth, and improved generation reliability due to lower loads and higher reserve margins.

In the case of CRNM, the remote solar projects will likely result in a net reduction in risk. The project developers bear the risks associated with cost over-runs or project delays, and the solar projects will increase the diversity of Rhode Island electricity resources. Note that one of the purposes of the net metering law is to “diversify the state’s energy generation resources.”

A CRNM project will not necessarily reduce risk as much as other solar projects because it is not a fixed price resource. The RNM credit for the CRNM projects is based on National Grid’s small commercial electric rate (C-06), which can vary and increase over time.

Relative to the other benefits and costs in this analysis, we expect this benefit to be small. This benefit is unlikely to change the outcome of the BCA.

Innovation and Market Transformation Benefits

Innovation refers to the benefit of new methods, ideas, and products that lead to faster and broader adoption of energy technologies by customers and public, private, and governmental entities. This benefit can also be described as market transformation, which is sometimes one of the key reasons for utility policies and programs to promote emerging clean technologies.

In the case of CRNM, it is likely that the solar projects will contribute to the commercialization of remote solar technologies by increasing the demand for the solar technologies, supporting the business models of the renewable project developers, and educating customers about the values of solar technologies.

Relative to the other benefits and costs in this analysis, we expect this benefit to be material but small. This benefit is unlikely to change the outcome of the BCA.

Participant Non-Energy Benefits

Participant non-energy benefits include those participant benefits that are not related to energy consumed or produced. National Grid includes a variety of participant non-energy impacts in its 2020 EE Plan, including those related to property value; increased productivity; improved comfort, health, and safety; and more.[19]

For solar projects in general, participant non-energy benefits could potentially include satisfaction and pride, customer empowerment, and increased property value.[20] For remote solar projects, the main participant non-energy benefit is customer satisfaction and pride.

Relative to the other benefits and costs in this analysis, we expect this benefit to be material but small. This benefit is unlikely to change the outcome of the BCA.

Low-Income Non-Energy Benefits

Low-income non-energy benefits include those benefits that accrue from low-income customers participating in the community remote solar programs. In some cases, these are the same benefits that non-low-income customers experience. In other cases, there are additional benefits that low-income customers experience because of their energy burden, the buildings that they occupy, and other factors. National Grid includes a variety of low-income non-energy impacts in its 2020 EE Plan, including those related to improved health and safety, reduced arrearages, reduced terminations and disconnections, and more.[21]

Remote solar projects will not produce many of the low-income non-energy benefits that are created by energy efficiency programs because they will not improve the building occupied by low-income customers. They will, however, create three types of benefits from low-income customer participation:

- Utility system non-energy benefits in terms of reduced arrearages, reduced terminations and disconnections, reduced bad debt write-offs, reduced customer calls and collections, and reduced notices. These benefits are addressed quantitatively using assumptions from National Grid's 2020 EE Plan. See the section below on Utility Non-Energy Benefits.
- Low-income participant non-energy benefits in terms of reduced energy burden.
- Societal low-income benefits in terms of poverty alleviation, environmental justice, reductions in the cost of low-income social services, and local economic benefits.

[19] National Grid, 2020 EE Plan, Attachment 4, pages 10-11.

[20] NSPM for DERs, Section 8.4.

[21] National Grid 2020 EE Plan, Attachment 4, pages 10-11.

To date the CRNM projects have included a small number of low-income customers.[22] Because the low-income subscribers make up such a small portion of this program, we expect the low-income non-energy benefits to be small to zero. Therefore, this benefit is unlikely to change the outcome of the BCA.

Environmental Impacts

We have accounted for several environmental impacts using monetary values, including GHG, sulfur oxides (SO_X), nitrogen oxides (NO_X), and particulate matter (PM) emissions. However, there are other environmental costs and benefits of remote solar projects for which we have not accounted, including land use, water use, aesthetic impacts, and others.

We expect these additional environmental impacts to be small relative to the other costs and benefits in the CRNM BCA. The one possible exception is land use. The construction of remote solar facilities sometimes causes concern among neighbors and others about removing trees and taking up land that might otherwise remain pristine. While this is a real environmental cost created by remote solar facilities, it is important to also account for comparable environmental costs created by the electricity resources avoided by the solar facilities. The construction of power plants, transmission lines, and distribution lines also raise concerns about land use, removal of trees, and more. While we cannot determine the magnitude of the *net* land-use impact for the CRNM projects without further study, we can conclude that the net land-use impacts of the CRNM projects are likely to be small and potentially positive.[23] For this reason, we conclude that the land-use impacts of the CRNM projects are unlikely to change the outcome of the BCA.

[22] To date the CRNM projects have included [redacted] low-income income subscribers, which is [redacted] percent of the total [redacted] subscribers. This information was provided by the CRNM project developers and is confidential.

[23] Further, [redacted] This information was provided by the CRNM project developers and is confidential.

5. RESULTS FOR THE MODIFIED CRNM PROGRAMS

5.1. Modified CRNM Program #1

Description

The Modified CRNM Program #1 is identical to the CRNM program except that it includes the following features:

1. The generation capacity rights of the solar projects are assigned to National Grid.
2. The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Monetary and Macroeconomic Results

Table 19 presents the BCA and economic impact analysis results for the Modified CRNM Program #1. Results are presented in cumulative present value dollars for the 25-year study period.

Table 19. Benefits and Costs of the Modified CRNM Program #1

	Case:	Base Case	Separate Case
Costs (mil PV$)	Utility Administration Costs	0.2	0.2
	CRNM Subscription Costs	184	184
	Total Costs	**185**	**185**
Benefits (mil PV$)	Energy Benefits	55	55
	Capacity Benefits	7	7
	Transmission Benefits	19	19
	Wholesale Market Price Suppression	18	18
	Reliability Benefits	0.01	0.01
	LI Benefits (Utility NEBs)	0.13	0.13
	GHG Benefits	29	29
	SO_X, NO_X, PM Benefits	6	6
	Macroeconomic Benefits	119	qualitative
	Societal Benefits Internalized by RECs	-18	-18
	Value of RECs to National Grid	0	0
	Total Benefits	**235**	**116**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**50**	**-69**
	Benefit-Cost Ratio	**1.3**	**0.6**
Economic Impact Analysis	Jobs (job-years)	758	595
	Gross Domestic Product (mil PV$)	Included in BCA above	88

Economic Impact Analysis Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

Accounting for the Value of RECs

As indicated in Figure 5 in Section 4.1, we subtract the value of RECs from the total benefits of the Modified CRNM programs. RECs are intended to represent the above-market value of renewable generation (i.e., the societal benefits of reduced GHG emissions, reduced other environmental impacts, increased local jobs, and more). Therefore, there is some overlap between the value of RECs and the value of these societal benefits. To subtract the value of RECs from the total benefits, we reduce the societal benefits proportionally by the total value of the RECs. (See Section 8.3.)

Qualitative Impacts

We expect that the impacts addressed qualitatively for the CRNM program will also be created by Modified CRNM Program #1. This includes net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

Except for low-income non-energy benefits, which will increase with the proposed participation carve-out, we expect these impacts to be essentially the same as those for the CRNM program as described in

Section 4.3. Except for the low-income non-energy benefits, we expect these benefits to be small and unlikely to change the outcome of the BCA.

Low-Income Non-Energy Benefits

As described in Section 4.3, low-income non-energy benefits include those benefits that accrue from low-income customers participating in the community remote solar programs.

The Modified CRNM Program #1 requires that at least 20 percent of subscribers be low-income customers. This means that the program will create benefits for low-income subscribers and society. We are not aware of any information, in Rhode Island or elsewhere, that monetizes these benefits. Therefore, we address them qualitatively here.

Unlike the other qualitative impacts, this impact could make a significant difference to the monetary results of the BCA for the Modified CRNM Program #1, in contrast to the CRNM program and the current CRDG program. Community solar programs are an important mechanism for allowing customers to benefit from solar facilities, regardless of where they live, whether they are renters, and whether they have a roof or ground space for a solar facility. Community solar programs can facilitate low-income customer participation as they require no up-front costs, they have few transaction costs, and they provide immediate electricity bill savings. Community solar programs offer an important opportunity for low-income customers to participate in and directly benefit from DERs.

As indicated in Table 19, the Modified CRNM Program #1 base case is cost-effective even without including monetary values for these low-income benefits. Therefore, accounting for these low-income benefits would only improve this program's BCR.

5.2. Modified CRNM Program #2

Description

The Modified CRNM Program #2 is identical to the CRNM program except that it includes the following features:

3. The RECs created by the solar projects are assigned to National Grid.
4. The generation capacity rights of the solar projects are assigned to National Grid.
5. The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.

Monetary and Macroeconomic Results

Table 20 presents the BCA and economic impact analysis results for the Modified CRNM Program #2. Results are presented in cumulative present value dollars for the 25-year study period.

Table 20. Benefits and Costs of the Modified CRNM Program #2

	Case:	Base Case	Separate Case
Costs (mil PV$)	Utility Administration Costs	0.2	0.2
	CRNM Subscription Costs	184	184
	Total Costs	**185**	**185**
Benefits (mil PV$)	Energy Benefits	55	55
	Capacity Benefits	7	7
	Transmission Benefits	19	19
	Wholesale Market Price Suppression	18	18
	Reliability Benefits	0.01	0.01
	LI Benefits (Utility NEBs)	0.13	0.13
	GHG Benefits	29	29
	SO_X, NO_X, PM Benefits	6	6
	Macroeconomic Benefits	127	qualitative
	Societal Benefits Internalized by RECs	-18	-18
	Value of RECs to National Grid	18	18
	Total Benefits	**261**	**134**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**77**	**-51**
	Benefit-Cost Ratio	**1.4**	**0.73**
Economic Impact Analysis	Jobs (job-years)	834	699
	Gross Domestic Product (mil PV$)	Included in BCA above	102

Economic Impact Analysis Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

Accounting for the Value of RECs

As indicated in Figure 5 in Section 4.1, we subtract the value of RECs from the total benefits of the Modified CRNM programs. RECs are intended to represent the above-market value of renewable generation (i.e., the societal benefits of reduced GHG emissions, reduced other environmental impacts, increased local jobs, and more). Therefore, there is some overlap between the value of RECs and the value of these societal benefits. To subtract the value of RECs from the total benefits, we reduce the societal benefits proportionally by the total value of the RECs. (See Section 8.3.)

In Modified CRNM Program #2, the RECs are assigned to National Grid. Therefore, the value of these RECs should be considered a benefit in the BCA, because those RECs would be used by National Grid to reduce its costs of complying with the Rhode Island RES. We therefore add the value of RECs back into the benefits to capture this benefit to National Grid and its customers.

Qualitative Impacts

We expect that the impacts addressed qualitatively for the CRNM program will also be created by Modified CRNM Program #2. This includes net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

Except for low-income non-energy benefits, which will increase with the proposed participation carve-out, we expect these impacts to be essentially the same as those for the CRNM program as described in Section 4.3. Except for the low-income non-energy benefits, we expect these benefits to be small and unlikely to change the outcome of the BCA.

Low-Income Non-Energy Benefits

As described in Section 4.3, low-income non-energy benefits include those benefits that accrue from low-income customers participating in the community remote solar programs.

The Modified CRNM Program #2 requires that at least 20 percent of subscribers be low-income customers. This means that the program will create benefits for low-income subscribers and society. We are not aware of any information, in Rhode Island or elsewhere, that monetizes these benefits. Therefore, we address them qualitatively here.

Unlike the other qualitative impacts, this impact could make a significant difference to the monetary results of the BCA for the Modified CRNM Program #2, in contrast to the CRNM and CRDG programs. Community solar programs are an important mechanism for allowing customers to benefit from solar facilities, regardless of where they live, whether they are renters, and whether they have a roof or ground space for a solar facility. Community solar programs can facilitate low-income customer participation as they require no up-front costs, they have few transaction costs, and they provide immediate electricity bill savings. Community solar programs offer an important opportunity for low-income customers to participate in and directly benefit from DERs.

As indicated in Table 20, the Modified CRNM Program #2 base case is cost-effective even without including monetary values for these low-income benefits. Therefore, accounting for these low-income benefits would only improve this program's BCR.

5.3. Modified CRNM Program #3

Description

The Modified CRNM Program #3 is identical to the CRNM program except that it includes the following features:

1. The RECs created by the solar projects are assigned to National Grid.
2. The generation capacity rights of the solar projects are assigned to National Grid.
3. The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.
4. The RNM rate is fixed to the small commercial customer rate in place at the time that the customer signs up for the program.

Monetary and Macroeconomic Results

Table 21 presents the BCA and economic impact analysis results for the Modified CRNM Program #3. Results are presented in cumulative present value dollars for the 25-year study period.

Table 21. Benefits and Costs of the Modified CRNM Program #3

	Case:	Base Case	Separate Case
Costs (mil PV$)	Utility Administration Costs	0.2	0.2
	CRNM Subscription Costs	124	124
	Total Costs	**125**	**125**
Benefits (mil PV$)	Energy Benefits	55	55
	Capacity Benefits	7	7
	Transmission Benefits	19	19
	Wholesale Market Price Suppression	18	18
	Reliability Benefits	0.01	0.01
	LI Benefits (Utility NEBs)	0.13	0.13
	GHG Benefits	29	29
	SO_X, NO_X, PM Benefits	6	6
	Macroeconomic Benefits	92	qualitative
	Societal Benefits Internalized by RECs	-18	-18
	Value of RECs to National Grid	18	18
	Total Benefits	**226**	**134**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**101**	**9**
	Benefit-Cost Ratio	**1.8**	**1.1**
Economic Impact Analysis	Jobs (job-years)	673	637
	Gross Domestic Product (mil PV$)	included in BCA above	85

Economic Impact Analysis Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

Accounting for the Value of RECs

Similar to Modified CRNM Program #2, in the Modified CRNM Program #3, the RECs are assigned to National Grid. Therefore, the value of these RECs should be considered a benefit in the BCA because those RECs would be used by National Grid to reduce its costs of complying with the Rhode Island RES. We therefore add the value of RECs back into the benefits to capture this benefit to National Grid and its customers.

Qualitative Impacts

We expect that the impacts addressed qualitatively for the CRNM program will also be created by the Modified CRNM Program #3. This includes net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

Except for low-income non-energy benefits, which will increase with the proposed participation carve-out, we expect these impacts to be essentially the same as those for the CRNM program as described in Section 4.3. Except for the low-income non-energy benefits, we expect these benefits to be small and unlikely to change the outcome of the BCA.

Low-Income Non-Energy Benefits

As with Modified CRNM Program #2, the Modified CRNM Program #3 requires that at least 20 percent of subscribers be low-income customers and will therefore create benefits for low-income subscribers and society. Unlike the other qualitative impacts, this impact could make a significant difference to the monetary results of the BCA for the Modified CRNM Program #3, in contrast to the CRNM and CRDG programs.

As indicated in Table 21, the Modified CRNM Program #3 base case is cost-effective even without including monetary values for these low-income benefits. Therefore, accounting for these low-income benefits would only improve this program's BCR.

5.4. Modified CRNM Program #4

Description

The Modified CRNM Program #4 is identical to the CRNM program except that it includes the following features:

1. The RECs created by the solar projects are assigned to National Grid.
2. The generation capacity rights of the solar projects are assigned to National Grid.
3. The developers solicit participation by LMI customers and commit to selling at least 20 percent of the output from each solar project to LMI customers.
4. The subscriber's contract is for 20-years instead of the current CRNM contract term of 25 years. Consequently, the BCA and the macroeconomic analysis use a 20-year study period.

Monetary and Macroeconomic Results

Table 22 presents the BCA and economic impact analysis results for the Modified CRNM Program #4. Results are presented in cumulative present value dollars for the 25-year study period.

Table 22. Benefits and Costs of the Modified CRNM Program #4

	Case:	Base Case	Separate Case
Costs (mil PV$)	Utility Administration Costs	0.1	0.1
	CRNM Subscription Costs	145	145
	Total Costs	**145**	**145**
Benefits (mil PV$)	Energy Benefits	42	42
	Capacity Benefits	6	6
	Transmission Benefits	16	16
	Wholesale Market Price Suppression	18	18
	Reliability Benefits	0.01	0.01
	LI Benefits (Utility NEBs)	0.11	0.11
	GHG Benefits	24	24
	SO_X, NO_X, PM Benefits	5	5
	Macroeconomic Benefits	93	qualitative
	Societal Benefits Internalized by RECs	-16	-16
	Value of RECs to National Grid	16	16
	Total Benefits	**204**	**112**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**60**	**-33**
	Benefit-Cost Ratio	**1.4**	**0.8**
Economic Impact Analysis	Jobs (job-years)	618	516
	Gross Domestic Product (mil PV$)	Included in BCA above	74

Economic Impact Analysis Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

Accounting for the Value of RECs

Similar to Modified CRNM programs #2 and #3, in Modified CRNM program #4, the RECs are assigned to National Grid. Therefore, the value of these RECs should be considered a benefit in the BCA because those RECs would be used by National Grid to reduce its costs of complying with the Rhode Island RES. We therefore add the value of RECs back into the benefits to capture this benefit to National Grid and its customers.

Qualitative Impacts

We expect that the impacts addressed qualitatively for the CRNM program will also be created by the Modified CRNM Program #4. This includes net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

Except for low-income non-energy benefits, which will increase with the proposed participation carve-out, we expect these impacts to be essentially the same as those for the CRNM program as described in Section 4.3. Except for the low-income non-energy benefits, we expect these benefits to be small and unlikely to change the outcome of the BCA.

Low-Income Non-Energy Benefits

As with the Modified CRNM Programs #1, #2 and #3, Modified CRNM Program #4 requires that at least 20 percent of subscribers be low-income customers and will therefore create benefits for low-income subscribers and society. Unlike the other qualitative impacts, this impact could make a significant difference to the monetary results of the BCA for Modified CRNM Program #4, in contrast to the CRNM and CRDG programs.

As indicated in Table 22, the Modified CRNM Program #4 is cost-effective even without including monetary values for these low-income benefits. Therefore, accounting for these low-income benefits would only improve this program's BCR.

6. RESULTS FOR THE COMMUNITY REMOTE DISTRIBUTED GENERATION PROGRAM

6.1. Monetary and Macroeconomic Results

Table 23 presents the BCA and economic impact analysis results for the CRDG program. Results are presented in cumulative present value dollars for the 25-year study period.

Table 23. Benefits and Costs of the CRDG Program

	Case:	Base Case	Separate Case
Costs (mil PV$)	Utility Administration Costs	3	3
	CRNM Subscription Costs	89	89
	Utility Incentive	2	2
	Total Costs	**93**	**93**
Benefits (mil PV$)	Energy Benefits	42	42
	Capacity Benefits	6	6
	Transmission Benefits	16	16
	Wholesale Market Price Suppression	18	18
	Reliability Benefits	0.01	0.01
	LI Benefits (Utility NEBs)	0	0
	GHG Benefits	24.1	24.1
	SO_X, NO_X, PM Benefits	5	5
	Macroeconomic Benefits (GDP)	66	qualitative
	Societal Benefits Internalized by RECs	-16	-16
	Value of RECs to National Grid	16	16
	Total Benefits	**178**	**112**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**84**	**18**
	Benefit-Cost Ratio	**1.9**	**1.2**
Economic Impact Analysis	Jobs (job-years)	510	500
	Gross Domestic Product (mil PV$)	Included in BCA above	64

Economic Impact Analysis Source: Synapse CRNM Macroeconomic Study. See also Section 8.4.

6.2. Accounting for the Value of RECs

As indicated in Figure 5, we subtract the value of RECs from the total benefits of the CRDG program. RECs are intended to represent the above-market value of renewable generation (i.e., the societal benefits of reduced GHG emissions, reduced other environmental impacts, increased local jobs, and more). Therefore, there is some overlap between the value of RECs and the value of these societal benefits. To subtract the value of RECs from the total benefits, we reduce the societal benefits proportionally by the total value of the RECs. (See Section 8.3.)

In the CRDG program, the RECs are assigned to National Grid. Therefore, the value of these RECs should be considered a benefit in the BCA, because those RECs would be used by National Grid to reduce its costs of complying with the Rhode Island RES. We therefore add the value of RECs back into the benefits to capture this benefit to National Grid and its customers.

6.3. Qualitative Impacts

We expect that the impacts addressed qualitatively for the CRNM program will also be created by the CRDG program. This includes net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and some environmental impacts.

In all cases, we expect these impacts to be essentially the same as those for the CRNM program as described in Section 4.3. These benefits are anticipated to be small and therefore unlikely to change the outcome of the BCA.

National Grid recently filed a proposal to the PUC where the CRDG program would be modified to include a ¢/kWh adder for projects that provide at least 20 percent of their output to LMI customers enrolled in the A-60 electric rate. This modification will likely increase the number of LMI customers participating in the CRDG program, thereby increasing the LMI benefits of the program.

7. Results Across All Programs

7.1. Monetary and Macroeconomic Impacts

Table 24 summarizes the results of the Base Case BCA across all the community remote solar programs. This case adds the monetary value of GDP to the monetary BCA results.

Table 24. Benefits and Costs Across All Programs: Base Case

Type of Impact	Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Costs (mil PV$)	Utility Administration Costs	0.2	0.2	0.2	0.2	0.1	3
	CRNM Subscription Costs	184	184	184	124	145	89
	Utility Incentive	0	0	0	0	0	2
	Total Costs	**185**	**185**	**185**	**125**	**145**	**93**
Benefits (mil PV$)	Energy Benefits	55	55	55	55	42	42
	Capacity Benefits	0	7	7	7	6	6
	Transmission Benefits	19	19	19	19	16	16
	Wholesale Market Price Suppression	18	18	18	18	18	18
	Reliability Benefits	0.01	0.01	0.01	0.01	0.01	0.01
	LI Benefits (utility NEBs)	0.02	0.13	0.13	0.13	0.11	0
	GHG Benefits	29	29	29	29	24	24.1
	SO_X, NO_X, PM Benefits	6	6	6	6	5	5
	Macroeconomic Benefits (GDP)	117	119	127	92	93	66
	Societal Benefits Internalized by RECs	-17.84	-18	-18	-18	-16	-16
	Value of RECs to National Grid	0.00	0	18	18	16	16
	Total Benefits	**225**	**235**	**261**	**226**	**204**	**178**
Cost-Effectiveness	**Net Benefits (mil PV$)**	**41**	**50**	**77**	**101**	**60**	**84**
	Benefit-Cost Ratio	**1.22**	**1.3**	**1.4**	**1.8**	**1.4**	**1.9**
Economic Impact Analysis	Jobs (job-years)	731	758	834	673	618	510
	Gross Domestic Product (mil PV$)	Included in BCA	Included in BCA	Included in BCA	Included in BCA	Included in BCA	Included in BCA

Table 25 summarizes the results of the Separate Impacts Case BCA across all the community remote solar programs. For this case, all the macroeconomic indicators are presented separately from the BCA results to avoid double-counting. For this case, the macroeconomic impacts should be considered qualitatively as part of the benefits, but without adding them to the benefits.

Table 25. Benefits and Costs Across All Program: Separate Impacts Case

Type of Impact	Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Costs (mil PV$)	Utility Administration Costs	0.2	0.2	0.2	0.2	0.1	3
	CRNM Subscription Costs	184	184	184	124	145	89
	Utility Incentive		0	0	0	0	2
	Total Costs	185	185	185	125	145	93
Benefits (mil PV$)	Energy Benefits	55	55	55	55	42	42
	Capacity Benefits	0	7	7	7	6	6
	Transmission Benefits	19	19	19	19	16	16
	Wholesale Market Price Suppression	18	18	18	18	18	18
	Reliability Benefits	0.01	0.01	0.01	0.01	0.01	0.01
	LI Benefits (utility NEBs)	0.02	0.13	0.13	0.13	0.11	0
	GHG Benefits	29	29	29	29	24	24.1
	SOX, NOX, PM Benefits	6	6	6	6	5	5
	Macroeconomic Benefits	qualitative	qualitative	qualitative	qualitative	qualitative	qualitative
	Societal Benefits Internalized by RECs	-17.84	-18	-18	-18	-16	-16
	Value of RECs to National Grid	0.00	0	18	18	16	16
	Total Benefits	108	116	134	134	112	112
Cost-Effectiveness	Net Benefits (mil PV$)	-76	-69	-51	9	-33	18
	Benefit-Cost Ratio	0.59	0.6	0.73	1.1	0.8	1.2
Economic Impact Analysis	Jobs (job-years)	556	595	699	637	516	500
	Gross Domestic Product (mil PV$)	84	88	102	85	74	64

Figure 6 compares the benefit-cost ratios across all the programs, including the Base Case and Separate Impacts Case for each program.

Figure 6. Summary of All Programs: Benefit-Cost Ratios

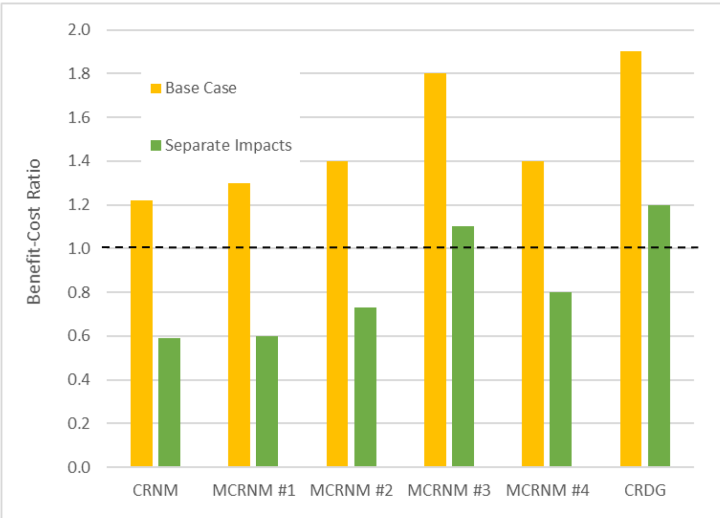
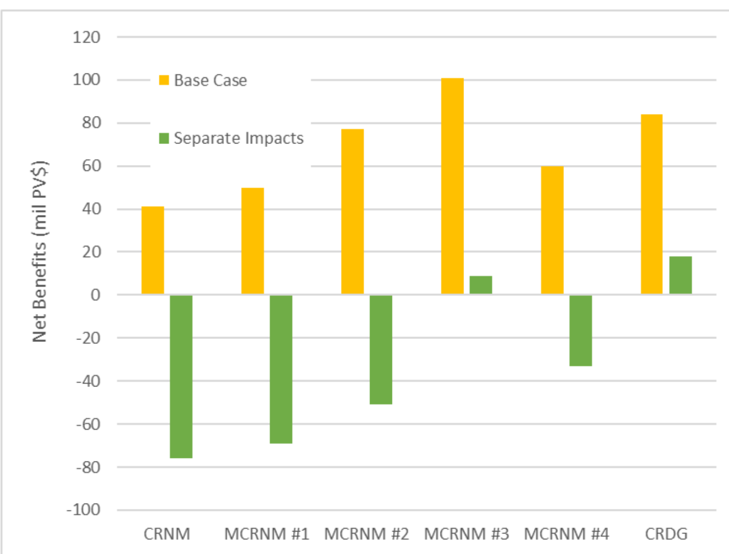


Figure 7 compares the net benefits across all the programs, including the Base Case and Separate Impacts Case for each program. Note that the Modified CRNM Program #4 and the CRDG programs each have 20-year contract terms and study periods, while the other programs have 25-year contract terms and study periods. This results in lower net benefits for these two programs than what would occur with a 25-year study period. This difference should be recognized when comparing across all programs.

Figure 7. Summary of All Programs: Net Benefits



7.2. Qualitative Impacts

The qualitative impacts across these six programs will differ and should be considered in any comparison. As described in Section 4.3, there are several benefits of community remote solar programs that we are not able to put into monetary terms, so these are discussed qualitatively. These include net risk benefits, innovation and market transformation benefits, participant non-energy benefits, low-income non-energy benefits, and certain environmental impacts.

These qualitative benefits are anticipated to be small to zero and similar across all programs except for low-income non-energy benefits. The four Modified CRNM programs include a participation requirement that at least 20 percent of the subscribers be LMI customers. Therefore, it is anticipated that the Modified CRNM programs will create additional LMI benefits to those of the CRNM and CRDG programs that currently have limited participation from this population.

7.3. Impacts on All Customers

Community remote solar programs will have impacts on all utility customers, even those that do not subscribe to the programs. These impacts occur as a result of three factors:

- Utility system costs avoided by the solar projects will create downward pressure on electricity rates.
- Utility system costs created by the solar projects will create upward pressure on electricity rates.
- Costs created as a result of the RNM credit will create upward pressure on electricity rates. As indicated in Figure 4, National Grid collects the costs associated with the RNM credit from all utility customers.

The combined effect of these three factors will create changes to electricity rates. The direction and magnitude of those changes will depend upon the specific features of the community remote solar program.

Table 26 summarizes our estimates of the ways that the six programs are likely to affect electricity rates. The top portion of the table shows costs avoided, costs created, and total effects in terms of millions of cumulative present value dollars over the study period. It shows that the CRNM program is likely to increase costs to all customers by $114 million, Modified CRNM Program #1 by $106 million, Modified CRNM Program #2 by $88 million, Modified CRNM Program #3 by $22 million, Modified CRNM Program #4 by $63 million, and the CRDG program by $5.7 million.

The bottom two rows of the table show the long-term average change in rates from the six programs, in terms of ¢/kWh and percent of rates. These rate impact estimates are for all customer rate classes combined, since the increased and reduced costs of these programs are experienced by all customers. These estimates are in levelized terms, which represents the impact per year. Note that these rate impacts represent the difference between one scenario with the relevant program and one without that program. Therefore, customers will see their rates increase (relative to current rates) only in the first year of the program, but these impacts do not compound year over year.

Our analysis indicates that the CRNM program will increase rates by roughly 0.24 percent, the Modified CRNM programs will increase rates within a range of 0.06 percent to 0.23 percent, and the CRDG programs will increase rates by roughly 0.02 percent.

Table 26. Impacts on All Customers

Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Costs avoided (mil PV$):	---	---	---	---	---	---
Avoided costs (energy, etc.)	-90.5	-98.1	-98.1	-98.1	-81.7	-81.6
Avoided REC costs	0	0	-17.7	-17.7	-15.6	-15.6
Costs created (mil PV$):	---	---	---	---	---	---
Administration costs	0.2	0.2	0.2	0.2	0.1	2.5
Utility Incentive	0	0	0	0	0	2.1
Subscription charge	204.0	204.0	204.0	137.6	160.2	98.4
Total effect on rates (mil PV$)	113.6	106.1	88.4	22.0	63.0	5.7
Change in rates (¢/kWh)	0.054	0.050	0.042	0.012	0.038	0.005
Change in rates (% of bill)	0.24%	0.23%	0.19%	0.06%	0.18%	0.02%

8. METHODOLOGY AND ASSUMPTIONS

8.1. Overview: All Programs

Many of the costs and benefits inputs and assumptions are the same for the CRNM program, the four Modified CRNM programs, and the CRDG program. The sections below describe the inputs and assumptions for all six programs. Any inputs or assumptions that differ across these programs are noted as such.

8.2. Costs

Utility Administration Costs

CRNM Program

National Grid expects that the administration costs of the CRNM program in its current configuration are roughly $5,000 to $10,000 per year.[24] We assume these costs will be $7,500 per year throughout the study period. This results in a cost of $0.17 million in cumulative present value dollars over the course of the study period.

Modified CRNM Programs

We assume that the utility administration costs for the Modified CRNM programs will be the same as the CRNM program.

CRDG Program

We use the average utility administration costs incurred in 2017, 2018, and 2019 to represent the future administration costs for the study period. The average cost over these three years was 5.1 ¢/kWh.[25]

Subscription Costs

CRNM Program

The CRNM subscription cost is equal to 90 percent of the RNM credit costs (see Figure 4). First, we estimate the RNM credit costs, then we estimate the CRNM subscription costs.

<u>The RNM Credit Costs</u>

The RNM credit is set to equal the sum of the standard offer charge, the delivery charge, and the transition charge of National Grid's small commercial customer electric rate (C-06). The 12-month

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[24] National Grid Response to Division Informal Data Request 6-1.

[25] Program administration costs are taken from the Renewable Energy Growth Program 2017, 2018, and 2019 Growth Factor Filings. The administration cost for CRDG on a $/kWh basis is assumed to be similar to the REG program. We assume that the administration cost applies to each incremental kWh of generation added to the program. The average cost of $0.051/kWh is per kWh of first year generation and not per kWh of lifetime generation.

average value of this portion of the C-06 rate is currently 15.0 ¢/kWh. We took an annual average to account for the seasonal variation in wholesale energy prices.

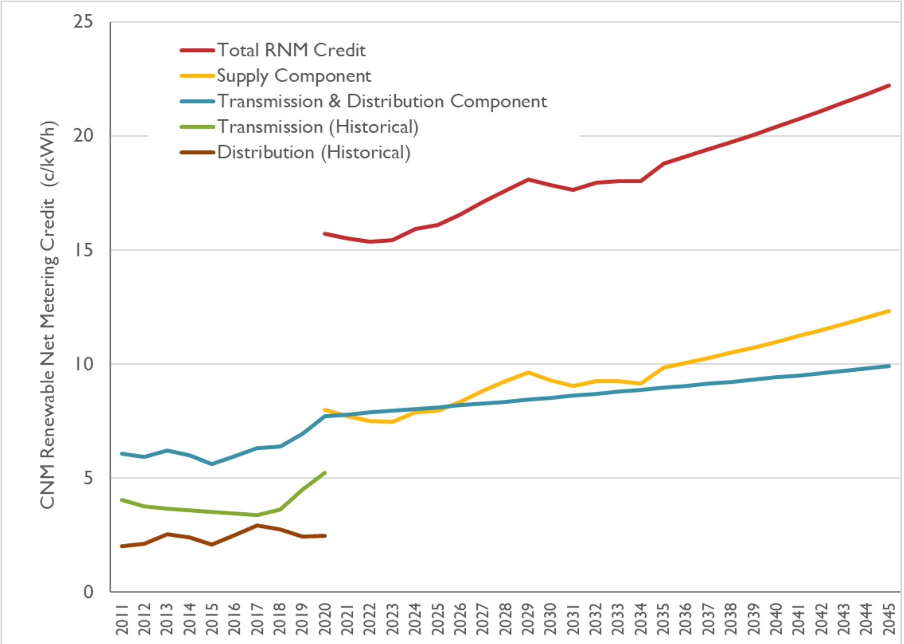
The C-06 rate is likely to increase over the course of the CRNM study period. We therefore estimate the future rates by separately forecasting the supply and delivery components of rates.

- We assume that the supply component of rates will increase each year at the same annual growth rate as the wholesale energy and capacity market prices over the study period.
- We assume that the transmission and distribution components of rates will increase throughout the study period at a compound average annual growth rate of 3.0 percent nominal and 1.0 percent real. This assumption is based on our review of several factors.
    - The compound annual growth rate of National Grid's transmission and distribution prices from 2011 through 2020 was 4.8 percent nominal and 2.8 percent real.
    - The Handy-Whitman Index of utility construction cost inflators for the North Atlantic region indicates that transmission and distribution input costs have increased at 2.4 percent nominal and 0.4 percent real over the past 10 years.[26]
    - We expect DERs being deployed in Rhode Island will help create downward pressure on transmission and distribution prices.
    - We expect that infrastructure replacement needs and one-time investments, such as in advanced metering functionality, will create upward pressure on distribution rates.

Figure 8 presents the results of our C-06 rate forecast. It shows the historical trends of transmission and distribution prices, as well as the forecasts of the price components based on the methodology described above.

[26] Whitman, Requardt & Associates, *The Handy-Whitman Index of Public Utility Construction Costs: Trends of Construction Costs*, North Atlantic Region, Bulletin No. 191, 2020.

Figure 8. CRNM Renewable Net Metering Credit Forecast, Real 2019 dollars



<u>CRNM Subscription Costs</u>

The CRNM subscription charge is set at 90 percent of the RNM credit by developers. This subscription charge is paid to the project developers and is expected to cover the cost associated with the CRNM projects. The developers can also cover a portion of their costs with revenues from selling RECs and from selling the capacity of their projects in the New England FCM.

For the purposes of this BCA, the subscription charge represents the cost of implementing the CRNM program. Note that the project developers will receive revenues from the sale of the RECs and the capacity of the solar projects, and these revenues will help offset their project costs. Consequently, the total cost of the remote solar projects might be higher than the subscription charge. However, since the revenues from the sale of the RECs and the capacity of the solar projects are assigned to the solar developers, those impacts are outside the scope of the CRNM program and therefore are not considered part of this BCA.

We calculate the CRNM subscription costs by taking 90 percent of the RNM credit costs. This turns out to be 13.8 ¢/kWh for 2021.

Participating customers pay the CRNM subscription charge to the project developers, so this charge is essentially a participant measure cost.

Modified CRNM Program #1

The Modified CRNM Program #1 has a subscription charge equal to the CRNM program subscription charge.

Modified CRNM Program #2

The Modified CRNM Program #2 has a subscription charge equal to the CRNM program subscription charge.

Modified CRNM Program #3

The Modified CRNM Program #3 has a subscription charge equal to the CRNM program subscription charge, except that it is set at a fixed amount based on National Grid's small commercial customer electric rate that exists at the time a customer subscribes to the program.

Modified CRNM Program #4

The Modified CRNM Program #4 has a subscription charge equal to the CRNM program subscription charge.

CRDG Program

One of the most significant differences between the CRNM program and the CRDG program is the way that the compensation rate is set. For the CRDG program, the compensation rate is set based on competitive bids provided by the solar project developers. Further, the compensation rate is fixed at the charge in place when customers subscribe to the program. It does not increase over time in the way that the CRNM subscription charge does.

We estimate the future compensation rate for the CRDG project using the compensation rates paid to date to project developers. The weighted average compensation rate for projects selected in 2019 and first 2020 enrollment was 12.9 ¢/kWh.[27] The subscription charge is set at 90 percent of this rate, which is 11.6 ¢/kWh.

We find this to be a reasonable estimate given the draft proposed 2021 CRDG ceiling price recommendations to the Rhode Island Distributed Generation Board in the range of 12.94 to 13.63 ¢/kWh.[28] While the 2021 ceiling price had not been approved by the PUC at the time of this report, we find that this price range supports our current long-term price estimates.

Utility Measure Costs

The costs of installing and operating the CRNM program, the four Modified CRNM programs, and the CRDG program are borne entirely by the developers and recovered from the subscribers. Therefore, these costs are equal to zero in this BCA.

Utility Shareholder Incentives

CRNM Program

National Grid does not earn any financial incentives for the CRNM program. Therefore, these costs are equal to zero in this BCA.

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[27] The CRDG compensation rate is based on historical data submitted as part of the 2019 and 2020 Open Enrollment Reports submitted as part of RI PUC Docket Nos. 4892 and 4893. The compensation rate is based on the pricing information submitted by the subscribers selected to the CRDG program.

[28] Sustainable Energy Advantage, LLC and Mondre Energy, Inc., "Rhode Island Renewable Energy Growth Program: 2021 Ceiling Price Recommendations to the DG Board". October 26, 2020.

Modified CRNM Programs

National Grid does not earn any financial incentives for the four Modified CRNM programs. Therefore, these costs are equal to zero in this BCA.

CRDG Program

National Grid is entitled to earn 1.75 percent of payments to developers as a shareholder incentive for promoting the CRDG program.[29] The CRDG subscription charge represents the payments to developers, so we multiply this percentage by that charge to get the shareholder incentives for the CRDG program.

Increased Transmission Costs

We do not have information suggesting that the CRNM program, the four Modified CRNM programs, or the CRDG program are expected to increase transmission costs. Therefore, these costs are equal to zero in this BCA.

Increased Distribution Costs

Any increased distribution costs are covered by the developers and thus are included as part of the subscription charge. Therefore, these costs are equal to zero in this BCA.

Participant Non-Energy Costs

To the best of our knowledge, the CRNM program, the four Modified CRNM programs, and the CRDG program do not create any participant non-energy costs. The participants might experience some transaction costs associated with signing up for the program, but these costs are likely to be small to zero. Therefore, these costs are assumed to be zero for this BCA.

Third-Party Developer Costs

Any third-party developer costs are included in the CRNM program, the four Modified CRNM programs, and the CRDG program subscription charge. As noted above, the subscription charge is paid for by participating customers and therefore is essentially a participant measure cost.

8.3. Benefits

Reduced Energy Costs

We used the AESC 2018 wholesale energy price forecast to represent the avoided costs of the CRNM program, the four Modified CRNM programs, and the CRDG program. We began with the AESC 2018 wholesale energy price forecast, and then updated it to reflect lower gas prices that have occurred since 2018. Based on publicly available AEO 2020 data, regional gas price forecasts have fallen by roughly 30

[29] R.I. Gen. Laws § 39-26.6-12(j)(3).

percent since the AESC 2018 energy price forecast was conducted.[30] Therefore, we reduced the AESC 2018 energy prices by 30 percent.

Figure 9 presents three forecasts of New England energy prices. It includes the AESC 2018 forecast, our modified AESC price forecast, and a forecast from a recent draft study of the value of DERs in Connecticut.[31] Table 27 presents the three energy price forecasts in levelized terms, for comparison purposes.

Figure 9. Comparison of Forecasts of New England Energy Prices

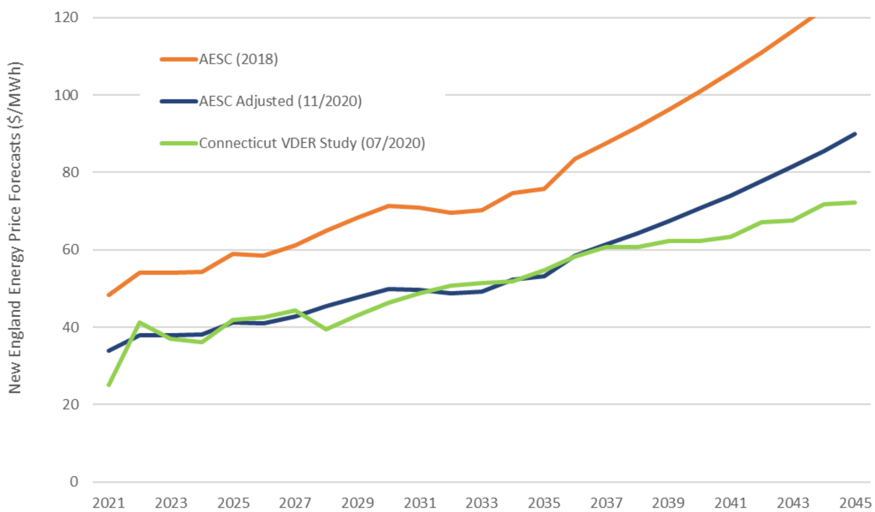

Table 27. Comparison of Energy Price Forecasts

Energy Price forecast	Levelized Value ($/MWh)
AESC 2018	69.6
Adjusted AESC 2018	48.7
Connecticut VDER Study	44.8

Reduced Generation Capacity Costs

CRNM Program

The renewable developers retain the rights to bid the capacity of their solar projects into the New England wholesale electricity markets. Therefore, the generation capacity benefits of these projects

[30] This is based on a comparison of the latest AEO natural gas price forecast (dated 2020) and the AEO natural gas price forecast used in the 2018 AESC (dated 2017). Because of the heavy reliance upon natural gas for the marginal units in ISO-New England, the wholesale energy prices are very much dependent upon natural gas prices.

[31] Connecticut Department of Energy and Environmental Protection and Connecticut Public Utility Regulatory Authority, *Distributed Energy Resources in Connecticut*, Draft, July 2020.

cannot be attributed to the BCA for these projects. Consequently, we assume these benefits are zero in this BCA.

Modified CRNM Programs

In the four Modified CRNM programs, the rights to bid the capacity of the solar projects into the New England wholesale electricity markets are assigned to National Grid. This means that the revenues from those capacity rights will benefit National Grid customers and therefore should be included as part of each Modified CRNM programs' BCAs.

We estimate the value of the avoided capacity for the four Modified CRNM programs using the forecast of New England wholesale capacity prices from National Grid's 2020 EE Plan, which uses values from the 2018 AESC study.

Solar resources that bid into the New England wholesale capacity market are assigned a capacity credit that reflects the portion of a solar resource's nameplate capacity that is expected to be operating during the ISO-New England peak hours. The capacity credits vary for each month. We apply the annual average capacity credit to estimate that amount of revenues available from bidding the solar project capacity into the New England capacity market.[32]

CRDG Program

In the CRDG program, the rights to bid the capacity of the solar projects into the New England wholesale electricity markets are assigned to National Grid. Therefore, we use the same capacity price and capacity credit assumptions to calculate the avoided capacity costs that we use for the Modified CRNM program.

The only reason the CRDG result differs from the result for the Modified CRNM program is that the former has a 20-year study period while the latter has a 25-year study period.

Reduced Transmission Costs

We use National Grid's estimates of avoided transmission costs from the 2020 EE Plan, which uses values from the 2018 AESC Study. The 2018 AESC values include costs associated with pool transmission facilities only.

The amount of reduced transmission costs will depend upon the capacity that the PV resource will provide during peak transmission periods. We use the New England wholesale capacity market capacity credit to estimate the portion of the solar projects' capacity that is likely to reduce transmission costs during peak periods.[33]

The only reason the CRDG result differs from the result for the CRNM programs is that the former has a 20-year study period while the latter has a 25-year study period.

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[32] The capacity credit is currently estimated to be [redacted] percent for the summer peak months, resulting in an annual average capacity credit of roughly [redacted] percent. This information was provided by the CRNM project developers and is confidential.

[33] The capacity credit is currently estimated to be [redacted] percent for the summer peak months, resulting in an annual average capacity credit of roughly [redacted] percent. This information was provided by the CRNM project developers and is confidential.

Reduced Distribution Costs

The community remote solar projects are not located at the site of customer load. Therefore, we assume that they do not provide any benefits in terms of reduced distribution costs.

Reduced Ancillary Services Costs

We assume that reduced ancillary services costs are likely to be small to zero for all six community remote solar programs.

Wholesale Market Price Suppression Effects

We use National Grid's estimates of wholesale market price suppression effects from the 2020 EE Plan, which uses values from the 2018 AESC.

This includes values for energy, capacity, and cross-fuels (i.e., gas) market price suppression. Table 28 presents a summary of results of these wholesale market price effects.

Table 28. Wholesale Market Price Suppression Effects: Million Cumulative PV Dollars

Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Energy	15.1	15.1	15.1	15.1	15.1	15.1
Capacity	2.0	2.0	2.0	2.0	2.0	2.0
Cross-Fuel	0.43	0.43	0.43	0.43	0.41	0.41
Total	17.5	17.5	17.5	17.5	17.5	17.5

Benefits Associated with Reducing the Rhode Island Renewable Energy Standard Target

Unlike energy efficiency resources and distributed PV projects, community remote solar projects do not reduce customer demand and therefore do not reduce the amount of National Grid sales used to set the Rhode Island RES. Therefore, this benefit is zero for this BCA.

Benefits Associated with the Creation of RECs

Treatment of RECs

RECs represent a portion of the above-market value of renewable generation. In other words, RECs are associated with several societal benefits of renewable resources, including GHG benefits, other environmental benefits, job benefits, and more. Therefore, there is some overlap between RECs and these societal benefits.

However, the value of RECs is not based on the societal benefits that renewable resources offer. RECs are created as a market mechanism to support the Rhode Island RES. The value of RECs is based upon the supply and demand for renewable resources, where the demand is created by the RES target plus customer demand for clean energy products. The societal benefits represented in RECs are valued in an entirely different way. For example, the environmental benefits are typically estimated using the cost of abating the pollutant of concern, and job benefits are typically estimated using a model of how different resource investments will flow through the local economy.

In sum, RECs represent a portion of the societal benefits of renewable resources, but not all of those benefits. For this reason, we subtract out the value of REC revenues from the total societal benefits to identify the *net* societal benefits that would occur from the remote solar projects after accounting for the societal benefits represented by the RECs. (See Figure 5.)

<u>CRNM Program</u>

Under the CRNM program, the RECs are assigned to the project developers (see Figure 4). This means that the value of these RECs cannot be included as a benefit of the CRNM program. Therefore the BCA for the CRNM program includes the set of benefits with the value of RECs subtracted out, as indicated in Figure 5 and Table 16. We estimate the value of RECs using a REC price forecast, described below, multiplied by the energy output from the remote solar projects.

Additionally, because the developers retain ownership of the RECs, the GHG benefits associated with CRNM do not help achieve the Resilient RI emissions reduction targets. For crediting emissions reductions in Rhode Island's GHG emissions inventory, RECs are counted in the state in which they are settled (*i.e.,* retired) and not where they are minted (*i.e.,* generated).[34]

<u>Modified CRNM Programs</u>

In three of the four Modified CRNM programs, the RECs are assigned to National Grid. Therefore, the value of these RECs should be considered a benefit in the BCA, because those RECs would be used by National Grid to reduce its costs of complying with the Rhode Island RES. We estimate the value of RECs using a REC price forecast, described below, multiplied by the energy output from the remote solar projects.

<u>CRDG Program</u>

In the CRDG program, the RECs are assigned to National Grid, similar to the three Modified CRNM programs. Therefore, we use the same assumptions to calculate the value of RECs for both the three Modified CRNM programs and the CRDG program.

REC Price Forecast

Figure 10 presents several recent forecasts of REC prices. The AESC 2018 REC price forecast is the oldest one presented and stands out as the lowest forecast by far. The National Grid REG REC price forecast was prepared recently for the purpose of reporting on the REG program.[35] The Nodal Exchange Forward REC prices are from a forward market for selling RECs prepared in July 2020, and therefore represent a reasonable estimate of likely REC prices over the next five years. Note that as of July 2020, the regional REC prices were roughly $40/MWh.

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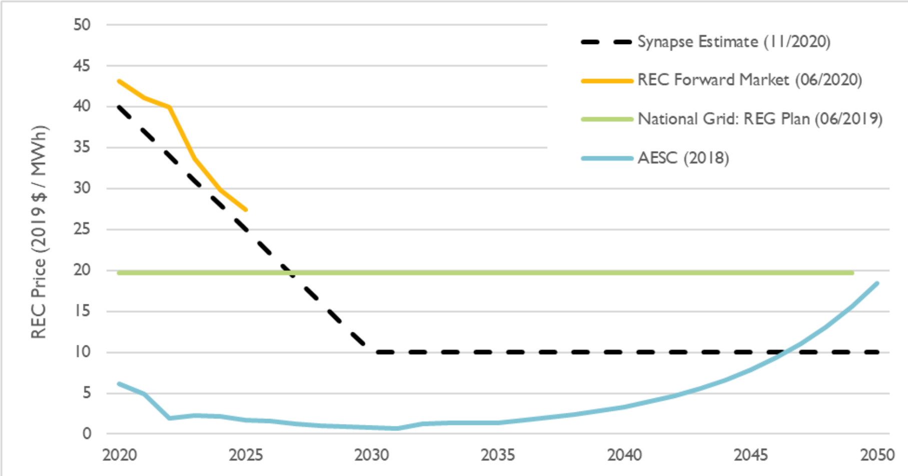
[34] Regional Greenhouse Gas Initiative. *Electricity Consumption Sector Methodology*, 2nd paragraph, 2016 RI Greenhouse Gas Emissions Inventory, page 11: http://www.dem.ri.gov/programs/air/documents/ghg-emissions-inventory-16.pdf.

[35] National Grid. June 28, 2019. 2019 Renewable Energy Growth Program Factor Filing. Schedule NG-2 page 4 of 6.

Figure 10. Comparison of REC Price Forecasts



We created our own REC price forecast for the purpose of this study for the following reasons: (1) there are substantial differences between these REC price forecasts; (2) REC prices were recently roughly $40/MWh; and (3) the Nodal Exchange Forward price forecast is very different from the Gravel Pit forecast. The dotted line in Figure 10 represents our estimate of REC prices for this study period.

We start in 2020 with the current REC prices of $40/MWh. We then assume that this price will decline linearly from 2020 through 2030. This assumption is consistent with the REC price trend from the Nodal Exchange Forward. We then assume that the REC prices level off at $10/MWh for the remainder of the study period, consistent with National Grid's assumptions for this time period.

This REC price forecast indicates that the CRNM program will create REC benefits of $17.8 million in cumulative present value dollars over the course of the study period.

Reduced GHG Compliance Costs

The Regional Greenhouse Gas Initiative (RGGI) requires power generators to meet GHG emission caps, purchase GHG allowances, and demonstrate compliance with that cap. The RGGI allowances are incorporated within the New England energy price forecast described above. Therefore, we do not assume any additional reduced GHG compliance costs.

At some point in the near future, as Rhode Island begins to make firm commitments to the GHG requirements of the Resilient Rhode Island Act, National Grid will begin to incur GHG compliance costs that extend beyond the RGGI allowance costs. We have not included these future reduced GHG compliance costs in this BCA due to the uncertainty of what they will be. However, we *do* include non-embedded GHG costs as part of the RI Test, and these capture what otherwise might become GHG compliance costs in the future.

Reduced Environmental Compliance Costs

New England generators are required to purchase SO_X and NO_X allowances. The costs of these allowances are incorporated within the New England energy price forecast described above. Therefore, we do not assume any additional environmental compliance cost reductions.

Improved Reliability

We assume that the reliability benefits from the community remote solar programs are comparable to those from energy efficiency programs. We use the reliability benefit assumptions from National Grid's 2020 EE Plan, which are based on the findings from the 2018 AESC Study.

This assumption indicates that the CRNM program will create reliability benefits of $0.01 million in cumulative present value dollars over the course of the study period.

Net Risk Benefits

We are not aware of studies showing the net risk benefits of remote solar facilities in Rhode Island and we do not have an independent estimate of the monetary value of this benefit. Therefore, we address this benefit qualitatively.

Utility Non-Energy Benefits

Utility non-energy benefits typically arise from lower utility costs from reduced arrearages and reduced disconnections and reconnections for non-payment. Most of those benefits are created by low-income customers reducing their bills through energy efficiency and other programs, making it easier for them to pay their bills and reduce arrearages.

Table 29 presents the assumptions used in the 2020 EE Plan for utility non-energy benefits resulting from low-income customer bill savings.[36] The utility non-energy benefits total $7.70 per participant per year. These benefits are then multiplied by the number of low-income customers served by the community remote solar program.

Table 29. Utility Non-Energy Benefits Resulting from Low-Income Customer Bill Savings (Annual Per Participant)

Category	Benefit	Description
Arrearages	$2.61	Reduced arrearage carrying costs as a result of customers being more able to pay their lower bills.
Bad Debt Write-offs	$3.74	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills.
Terminations and Reconnections	$0.43	Reduced costs to utility for terminations and reconnections due to nonpayment as a result of customers being more able to pay lower bills.
Customer Calls and Collections	$0.58	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments.
Notices	$0.34	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations.
Total	$7.70	

[36] National Grid's 2020 Energy Efficiency Program Plan Technical Reference Manual (TRM) filed as part of Docket No. 4979 (2019). Appendix B. Available at: http://www.ripuc.ri.gov/eventsactions/docket/4979-NGrid%20TRM%202020/TRM%20Documents/PY2020%20RI%20TRM.pdf.

CRNM Program

To date the CRNM projects have included a small number of low-income customers.[37] We multiply this number of low-income subscribers by the non-energy benefits of $7.70 per participant per year to determine the low-income non-energy benefits for this program.

Modified CRNM Programs

The four Modified CRNM programs require that at least 20 percent of subscribers will be LMI customers. We multiply this figure by the non-energy benefits of $7.70 per participant per year to determine the low-income non-energy benefits for these programs.

CRDG Program

We assume, for the sake of simplicity, that the number of low-income subscribers in this program is very low, and therefore the utility non-energy benefits will be low to zero.

Innovation and Market Transformation

Innovation refers to the benefit of new methods, ideas, and products that lead to faster and broader adoption of energy technologies by customers and public, private, and governmental entities. This benefit can also be described as market transformation and is sometimes one of the key reasons for utility policies and programs to promote emerging clean technologies.

In the case of community remote solar programs, it is likely that the solar projects will contribute to the commercialization of remote solar technologies by increasing the demand for the solar technologies, supporting the business models of the renewable project developers, and educating customers about the values of solar technologies.

We are not aware of any studies to estimate the value of this benefit in monetary terms. Relative to the other benefits and costs in this analysis, we expect this benefit to be small.

Participant Water and Other Fuels Impacts

There are no participant water or other fuel impacts for remote solar facilities.

Participant Non-Energy Benefits

Participant non-energy benefits include those participant benefits that are not related to energy consumed or produced. National Grid includes a variety of participant non-energy impacts in its 2020 EE Plan, including those related to asset value; increased productivity; improved comfort, health, and safety; and more.[38]

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[37] To date the CRNM projects have included [redacted] low-income income subscribers, which is [redacted] percent of the total [redacted] subscribers. This information was provided by the CRNM project developers and is confidential.

[38] National Grid, 2020 EE Plan, Attachment 4, pages 10-11.

For solar projects in general, participant non-energy benefits could potentially include satisfaction and pride, customer empowerment, and increased asset value.[39] For remote solar projects, the main participant non-energy benefit is customer satisfaction and pride.

We are not aware of any studies to estimate the value of this benefit in monetary terms. Relative to the other benefits and costs in this analysis, we expect this benefit to be material but small.

Low-Income Participant Non-Energy Benefits

Low-income participant non-energy benefits are defined as those benefits that accrue to low-income customers that are not related to energy consumed or produced. In some cases, these are the same benefits that non-low-income customers experience, while in other cases there are additional benefits that low-income customers experience because of their energy burden, the buildings that they occupy, and other factors. National Grid includes a variety of low-income participant non-energy impacts in its 2020 EE Plan, including those related to improved health and safety, fewer terminations and disconnections, fewer moves, reduced foreclosures, and more.[40]

Remote solar projects will not create many of the low-income non-energy benefits that are created by energy efficiency programs because they will not improve the building occupied by low-income customers. They will, however, help reduce the energy burden of low-income customers. As low-income customers experience reduced electricity bills, they are more likely to pay those bills—resulting in utility system benefits associated with reduced arrearages, reduced terminations and reconnections, and more. These utility system benefits will accrue to all customers because they reduce utility system costs. These utility system non-energy benefits are included in the BCA and described in the section above on Utility Non-Energy Benefits.

As low-income customers experience reduced energy bills, there will be another type of non-energy benefit in terms of reduced energy burden. The energy burden is defined as the portion of a customer's total income that is dedicated to paying energy bills. For most low-income customers, the energy burden is significantly higher than other customers, which leads to several challenges for those customers.

Therefore, community remote solar programs can help reduce the energy burden for low-income subscribers. However, we are not aware of any quantitative value for this non-energy benefit, either in Rhode Island or elsewhere. Therefore, we discuss this benefit qualitatively.

CRNM Program

As described in the section above on Utility Non-Energy Benefits, low-income subscribers make up a very small portion of the total subscribers. Therefore, we assume that any benefit associated with reduced energy burdens is small to zero.

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[39] NSPM for DERs, Section 8.4.

[40] National Grid, *2020 EE Plan*, Attachment 4, pages 10-11.

Modified CRNM Programs

The four Modified CRNM programs require that at least 20 percent of subscribers be LMI customers. This means that there will be some benefit associated with reducing the energy burden for those customers. These are addressed qualitatively in Section 5.2.

CRDG Program

We assume for the sake of simplicity that the number of low-income subscribers in this program is very low, and therefore the any benefit associated with reduced energy burdens is small to zero. National Grid recently filed a proposal for the 2021 program year that includes a ¢/kWh adder for projects that provide at least 20 percent of their output to LMI customers enrolled in the A-60 electric rate. This will likely increase the number of LMI customer participating in the CRDG program. This modification was not included in our monetary BCA because it is not likely to have a large impact on the BCA results, and it has not yet been approved by the PUC.

Customer Empowerment

In general, customer empowerment refers to the benefits of greater customer choice, greater customer control over energy bills, greater access to information on customer consumption patterns, and the ability to procure an increasing array of electricity services from third-party vendors.

Remote solar projects are not likely to create significant customer empowerment benefits. They do not provide a significant amount of customer flexibility or control: they primarily provide a way to reduce customer bills using clean technologies. For this reason, we assume that the customer empowerment benefits of the CRNM projects are likely to be immaterial.

Reduced GHG Emissions

These include the impacts associated with the non-embedded GHG emissions, *i.e.*, the environmental and public health impacts of reducing GHG emissions beyond those captured in the embedded GHG costs included in New England RGGI allowances.

We estimate monetary values of GHG emissions using the same methodology and assumptions used in National Grid's 2020 EE Plan, which are based on results of the 2018 AESC Study. The 2020 EE Plan uses the value of $68 per short ton of carbon emissions for this purpose, which is intended to represent the long-term value of the cost to achieve the Resilient Rhode Island Act's carbon emission reduction goal of 80 percent below 1990 levels by 2050.[41]

The RGGI allowance costs are already embedded in the energy price forecasts used in our analysis. The reduced non-embedded GHG emissions are equal to this $68/ton value minus the value of the RGGI prices.

The CRDG result differs from the result for the CRNM program because the former has a 20-year study period while the latter has a 25-year study period.

We note that, since these costs represent the costs of achieving the Resilient Rhode Island Act's carbon emission reductions, they will at some point in the future become embedded costs. That is, they will be

[41] National Grid, *2020 EE Plan*, Attachment 4, page 12.

internalized into the costs incurred by National Grid and passed on to customers in terms of increased revenue requirements. This distinction between GHG costs that are embedded versus non-embedded is not relevant to this BCA because they are both included in the costs of the community remote solar programs. However, this distinction will make a significant difference in the results of any rate impact analysis of these programs. Embedded emission costs affect the rate impacts of any resource, but non-embedded emission costs do not because these costs do not flow through rates. Avoiding GHG compliance costs will help to significantly reduce any rate impacts associated with the CRNM program.

Reduced SO_X, NO_X, and PM Emissions

We used two models to estimate the dollar values of the non-embedded costs of SO_X, NO_X, and PM. First, we use the AVERT model to estimate the likely emissions avoided by the community remote solar programs, then we use the COBRA model to estimate the dollar values of the environmental and health impacts from these emissions.

AVERT is an open-access tool built for the U.S. Environmental Protection Agency (EPA) by Synapse to estimate the hourly emissions and generation benefits of energy efficiency and renewable energy policies and programs. AVERT allows users to measure displaced emissions of CO_2, SO_2, and NO_X, and avoided generation mitigated by state or multi-state programs. The tool tracks each fossil unit's generation, heat input, and emissions, and it is able to identify likely changes in regional emissions when units are retired, replaced, or retrofitted with pollution controls. AVERT uses public data reported to the EPA by power plants in the United States.[42]

COBRA by the EPA is a health impacts screening and mapping tool. It uses county-level inputs on changes in criteria pollutants to estimate impacts on public health, including morbidity and monetized health effects. COBRA measures the impacts of emission change on air quality and translates them into health and monetary effects.[43]

Table 30 presents a summary of the non-embedded SO_X, NO_X, and PM emission benefits for the six community remote solar programs. The only reason the Modified CRNM Program #4 and the CRDG program results differ from the other programs is that they have a 20-year study period while the others have a 25-year study period.

Table 30. Reduced SO_X, NO_X, and PM Emissions (Cumulative PV$)

Pollutant	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
SO_X	0.37	0.37	0.37	0.37	.30	.30
NO_X	1.12	1.12	1.12	1.12	.92	.92
PM	4.85	4.85	4.85	4.85	3.96	3.96
Total	**6.35**	**6.35**	**6.35**	**6.35**	**5.18**	**5.18**

42 For more information about AVERT, see https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert.

43 For more information about COBRA, see https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool.

Reduced Environmental Impacts

We have accounted for several environmental impacts using monetary values, including values for GHG, SO_X, NO_X, and PM emissions. However, there are other environmental costs and benefits of remote solar projects that we have not quantified, including land use, water use, aesthetic impacts, and more.

We expect these additional environmental impacts to be small relative to the other costs and benefits in this BCA. The one possible exception is land use. The construction of remote solar facilities sometimes causes concern among neighbors and others about removing trees and taking up land that might otherwise remain pristine. While this is a real environmental cost created by remote solar facilities, it is important to also account for comparable environmental costs created by the electricity resources avoided by the solar facilities. The construction of power plants, transmission lines, and distribution lines also raise concerns about land use, removal of trees, aesthetics, and more.

We are not aware of any studies to estimate the monetary value of land-use impacts of remote solar facilities. We conclude that the net land-use impacts of the community remote solar programs are likely to be material, small, and perhaps positive.[44]

Societal Low-Income Benefits

Societal low-income benefits include poverty alleviation, environmental justice benefits, reductions in the cost of low-income social services, and local economic benefits. However, we are not aware of any quantitative value for this non-energy benefit, either in Rhode Island or elsewhere. Therefore, we discuss this benefit qualitatively where applicable.

CRNM Program

As described in the section above on Utility Non-Energy Benefits, low-income subscribers make up a very small portion of the total CRNM subscribers. Therefore, we assume that any societal low-income benefit is small to zero for this program.

Modified CRNM Programs

The four Modified CRNM programs require that at least 20 percent of subscribers be low-income customers. This means that there will be some societal low-income benefits for this program. These are addressed qualitatively in Section 5.2.

CRDG Program

We assume for the sake of simplicity that the number of low-income subscribers in this program is very low, and therefore that any societal low-income benefit is small to zero for this program.

Public Health Benefits

Some energy resources create public health impacts for populations impacted by fuel extraction, combustion, and transportation. These health impacts have implications for (a) the health and well-

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[44] Further, [redacted] This information was provided by the CRNM solar project developers and is confidential.

being of the affected populations, (b) the societal investment required in medical facility infrastructure, and (c) the economic productivity of the affected populations.

The public health benefits of remote solar facilities overlap considerably with the benefits of reduced GHG, SO_X, NO_X, and PM emissions, which are accounted for elsewhere in our analysis. We assume that there are no additional public health benefits beyond those accounted for in the GHG and other environmental benefits.

Energy Security Benefits

Energy security refers to the ability to reduce imports of fuels from other states and even other countries. Reduced imports can make a state less at risk of supply disruptions or volatility in the costs of imported fuels.

The community remote solar programs will clearly reduce the use of fuels imported into Rhode Island. This includes reductions in the use of imported fossil fuels to generate electricity in New England, particularly natural gas imported from outside New England. It also includes reduction in the electricity that National Grid has to purchase from New England's wholesale energy market through contracts for standard offer services.

We note that neither AESC 2018 nor National Grid's 2020 EE Plan includes any energy security benefits. We are not aware of any study estimating monetary values of energy security benefits in Rhode Island. We assume this benefit is small to zero for community remote solar programs.

8.4. Macroeconomic Impacts

The macroeconomic impacts used in this analysis were developed in the Synapse CRNM Macroeconomic Report. Here we summarize some of the key points from that report.

Background: Docket 4600

Interest in assessing the macroeconomic impacts of energy investments in Rhode Island is relatively recent. In 2017 the PUC established the RI Test as part of Docket 4600, which requires that BCAs of energy resources account for macroeconomic impacts of those resources.[45]

The macroeconomic impacts are described as: "impacts on state product or employment, effects of land use change on property tax revenue." The candidate methodologies for accounting for these impacts include: "qualitative assessment or economic modeling (e.g. input / output life-cycle analysis, property tax base studies)."[46] Beyond this, the Docket 4600 materials do not provide guidance on how to account for macroeconomic impacts.

In Docket 4600 the PUC was clear that decisions regarding energy investments should not necessarily be limited to the monetary values included in the RI Test, and that there may be instances where it is appropriate to consider additional impacts, including state energy goals. In particular:

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45 Public Utilities Commission's Guidance on Goals, Principles and Values for Matters Involving the Narragansett Electric Company d/b/a National Grid, October 27, 2017, Docket 4600.

46 Docket 4600 Facilitation (Mediation)/Consulting Team, *Docket 4600: Stakeholder Working Group Process Report to the Rhode Island Public Utilities Commission,* April 5, 2017, Appendix B.

> The PUC holds that the Framework should be relied upon, but also that it should not be the exclusive measure of whether a specific proposal should be approved. Rather, the Framework should serve as a starting point in making a business case for a proposal. For example, there may be outside factors that need to be considered by the PUC regardless of whether a specific proposal was determined to be cost-effectiveness or not. This may include statutory mandates or qualitative considerations.[47]
>
> [I]f persuasive evidence is presented where a proposal that does not pass the screening is nonetheless found to be beneficial to the system and/or furthers state energy goals, it may be approved. Conversely, if a proposal passes the cost-effectiveness test, it will not automatically be approved, and can be rejected if persuasive evidence is presented that the proposal is costly to the system and/or hinders state energy goals. [48]

In the context of the National Grid EE Plans, National Grid proposed using state GDP as the indicator of macroeconomic benefits of energy efficiency programs and applied monetary estimates of GDP impacts to the monetary results of the EE BCA.[49] This proposal was included in several recent EE Plans, which were settled among the relevant stakeholders and approved by the PUC.[50] Because of the EE Plan settlements, and because the energy efficiency programs were very cost-effective in the absence of the macroeconomic impacts, the decisions regarding (a) which macroeconomic indicator is most appropriate and (b) how to account for that indicator in the BCA were not discussed or vetted before the PUC.

In the case of the community remote solar programs, the macroeconomic impacts will have a dramatic effect on the BCA and the decision as to whether the programs are cost-effective. For the CRNM program in particular, the BCA benefit-cost ratio is well below one without including macroeconomic impacts, but above one when the monetary GDP impacts are factored in. Consequently, we address macroeconomic impacts in detail in the Synapse CRNM Macroeconomic Impacts Report, to inform this BCA of the CRNM program.

Macroeconomic Indicators

There are several indicators that can be used to identify the macroeconomic impacts of investments in energy resources. The most useful indicators include:

- *Job creation*. This refers to all jobs created by the activity. It is best represented in terms of job-years. A job-year is equivalent to a full-time employment opportunity for one person for one year (e.g., five job-years could be five jobs for one year or one job for five years).

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[47] Public Utilities Commission's Guidance on Goals, Principles and Values for Matters Involving the Narragansett Electric Company d/b/a National Grid, October 27, 2017, Docket 4600, page 23.

[48] Public Utilities Commission's Guidance on Goals, Principles and Values for Matters Involving the Narragansett Electric Company d/b/a National Grid, October 27, 2017, Docket 4600, page 24.

[49] The Brattle Group. 2019. *Macroeconomic multipliers for the economic growth and job creation benefits of investing in cost-effective energy efficiency from "Review of RI Test and Proposed Methodology*. Prepared for National Grid.

[50] The Narragansett Electric Co. d/b/a National Grid - 2020 Energy Efficiency Plan (Docket No. 4979).

- *Personal Income*. Personal income refers to all income collectively received by all individuals or households in a country (or state). Personal income includes compensation from several sources including salaries, wages, and bonuses received from employment or self-employment.
- *Business Income*. Business income reflects earnings taken by businesses and is equivalent to income earned less costs. Note that business income is not equivalent to profits but is rather a broader metric that also includes depreciation of fixed assets and more.
- *State Tax Revenue*. State tax revenues increase in the form of property taxes, sales and gross receipts taxes, and individual income tax due to increased economic activity and employment within the state
- *State Gross Domestic Product*. State GDP is the total monetary or market value of all the finished goods and services produced within a state's borders in a specific time period. GDP is a very broad indicator and does not directly translate to financial health of individuals in the specified region. Furthermore, GDP calculations do not include environmental, health, or other external impacts of investment that may have important impacts on the economy in the long run.

It is important to understand what they each represent and how they should be used in making resource decisions. For example, it is important to note that personal income plus business income plus state tax revenue are all a part of GDP. The studies conducted recently to estimate the macroeconomic impacts of energy resources in Rhode Island have tended to focus on GDP as the primary macroeconomic indicator of interest.

Direct, Indirect, and Induced Economic Activity

There are three different ways in which an investment will create economic activity, including:

- *Direct impacts* consist of the economic activity created from the direct investment in the project, including activity from the design and engineering, construction, operation, and maintenance of the project.
- *Indirect impacts* consist of the economic activity from the supply chain that is necessary to support the direct investment in the project.
- *Induced impacts* consist of the economic activity from employees in newly created direct and indirect jobs spending their paychecks locally on goods and services.

Accounting for Macroeconomic Impacts in a BCA

Since the RI Test was established in Docket 4600, several studies have estimated the macroeconomic impacts of different energy resources proposed in Rhode Island. This includes studies assessing the National Grid EE Plans, the Revolution Wind Energy Project, the Renewable Energy Growth Program, and the Gravel Pit solar project. However, to our knowledge the questions of how to account for macroeconomic impacts and how to incorporate them into BCAs of energy resources have not been fully vetted before the PUC.

A report prepared for National Grid to estimate the macroeconomic impacts of energy efficiency programs recognized that there is some double-counting of benefits in the BCA results.[51] This report recommends that double-counting can be avoided by estimating the "net incremental" macroeconomic benefits, by subtracting out the direct macroeconomic benefits created by customer respending of bill savings as a result of the energy resource being analyzed. The rationale for this adjustment is that bill savings are already accounted for in the BCA, in the form of net benefits, and therefore they should not be included twice in the BCA.

In our view, this approach does not eliminate double-counting. It is true that bill savings are already captured in the BCA result, and therefore adding the macroeconomic impacts from them would be double-counting. However, it is also true that the BCA includes the costs of implementing the energy resource, which is what increases the macroeconomic activity associated with the resource. It is also true that the BCA includes the costs avoided by the energy resource, which is what reduces the macroeconomic activity associated with the resource. Since the three sources of macroeconomic impacts—increased spending on energy resources, reduced spending on energy resources, and customer respending effects—are already included in the BCA, then adding any of these macroeconomic impacts to the BCA would result in double-counting.

Further, the logic about subtracting direct impacts should apply to indirect impacts as well. If the goal is to completely eliminate double-counting, then both the direct and indirect impacts should be excluded from the economic impact analysis results.

Therefore, we recommend that none of the monetary macroeconomic results be added to the monetary BCA results. Instead, the macroeconomic benefits should be presented alongside the BCA benefits, and they should be considered separately from the BCA impacts.

Nonetheless, in this report we present a case that adds the monetary values of GDP onto the monetary impacts in the BCA because this is the approach used in several recent filings before the PUC. In developing monetary values of GDP, we estimate the "net incremental" macroeconomic impacts because that is the methodology used by National Grid in its recent EE Plans. We also present a case where the macroeconomic impacts are accounted for separately from the BCA results. This results in two cases:

- <u>Base Case</u>: Monetary values of GDP are added to the monetary BCA results. This approach has been used to date in several recent filings before the PUC. The GDP values are adjusted to address double-counting concerns, consistent with the approach used in National Grid's 2020 EE Plan.
- <u>Separate Impacts Case</u>: All the macroeconomic indicators are presented separately from the BCA results to avoid double-counting. In this case, the macroeconomic impacts should be considered qualitatively as part of the benefits, but without adding them to the benefits. The GDP values are not adjusted to address double-counting concerns because they are not added into the BCA.

The Separate Impacts Case requires making a judgment call about how to use the macroeconomic results to inform the cost-effectiveness decision. For example:

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[51] The Brattle Group, *Review of RI Test and Proposed Methodology,* M. Berkman and J. Weiss, prepared for National Grid, January 2019.

- If the BCA results indicate that the investment is clearly cost-effective without macroeconomic impacts, then the macroeconomic impacts do not change the BCA conclusion; they simply indicate that the benefits are greater than what is found in the BCA. This was the general outcome for the National Grid 2020 EE Plan.
- If the BCA results indicate that the investment is not cost-effective, then:
    - The investment might be considered cost-effective if the macroeconomic benefits are deemed to be sufficient to overcome the net costs identified in the BCA.
    - The investment might be considered *not* cost-effective if the macroeconomic benefits are *not* deemed to be sufficient to overcome the net costs identified in the BCA.

Macroeconomic Impacts of Community Solar Programs in Rhode Island

Table 31 summarizes the results of the Synapse CRNM Macroeconomic Study.

Table 31. Base Case Macroeconomic Impacts of Community Remote Solar Programs

Analysis	Impact	CRNM	Modified CRNM #1	Modified CRNM #2	Modified CRNM #3	Modified CRNM #4	CRDG
Economic Impact Analysis	Jobs (job-years)	731	758	834	673	618	510
	GDP (mil PV$)	117	119	127	92	93	66

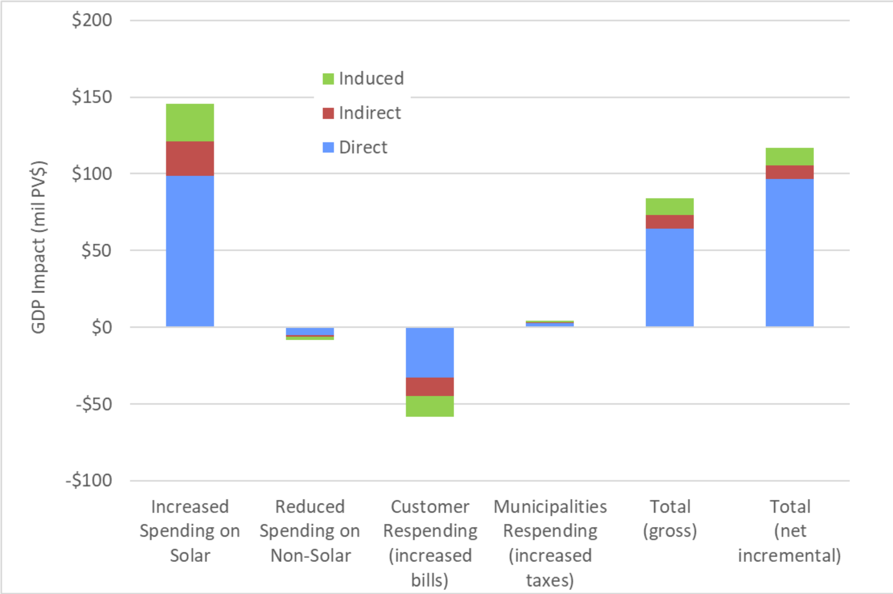
Note that the macroeconomic results in Table 31 and for every base case presented elsewhere in this report are based on the "net incremental" macroeconomic benefits approach, which subtracts out the direct macroeconomic benefits created by customer respending of bill savings in order to address concerns about double-counting of benefits in the macroeconomic analysis and the BCA.

Figure 11 presents the GDP impacts of the CRNM program. It also shows how the "net incremental" impacts are calculated:

- The total "gross" impacts are estimated to be $84 million.[52]
- The direct impacts of the customer respending are -$33 million. These impacts are negative for this program because average customer bills are increased by this program resulting in reduced economic activity.
- The "net incremental" impacts are determined by subtracting this -$33 million from the "gross" impacts, resulting in $117 million.

[52] We refer to these as "gross" impacts to distinguish them from the "net incremental" impacts. These "gross" impacts reflect the total effect of both the increase in economic activity spurred by the CRNM solar projects and the reduction in economic activity associated with avoided spending on other utility system resources as a result of these projects. The macroeconomic results provided for the "separate impacts" cases for each program are gross impacts, while the results provided for the base case for each program are net impacts.

Figure 11. GDP Impacts by Spending Category and Impact Type



Source: Synapse CRNM Macroeconomic Report.

8.5. General Study Assumptions

Expansion of the CRNM Program

In this study we conduct a BCA of expanding the CRNM program by 30 MW. We assume a hypothetical set of new CRNM projects that are allowed to subscribe customers and commence operation in 2021. We recognize that, if the PUC were to approve the expansion of the CRNM program, it would not be possible to construct all the solar projects and subscribe all the customers in a single year. Nonetheless, we assume for simplicity purposes that the full 30 MW commences operation in 2021. We do not expect this simplification to significantly affect our results.

In order to use solar project assumptions that are as realistic as possible, several of the inputs to our analysis are based on the actual projects that have participated in the CRNM program to date. For confidentiality purposes we are not able to present the details of those assumptions.

We only analyze the costs and benefits of expanding the current CRNM program by 30 MW because differences in the expansion of the program would be roughly linear, with comparable results. For example, an expansion of 15 MW would result in roughly half the net benefits, and an expansion of 60 MW would result in roughly twice the net benefits, as the 30 MW expansion that we analyze here. The benefit-cost ratios would be essentially the same as the 30 MW expansion that we analyze, because the benefits would scale with the costs.

Study Period

We use a study period of 25 years, which is equal to the standard contract term for customers subscribing to the CRNM program. This study period is long enough to capture the full lifetime benefits of the CRNM projects.[53] Our study period begins in January 2021 and continues through December 2045.

Discount Rate

We use the same discount rate used by National Grid in the 2020 EE Plan, which uses a discount rate of 0.84 percent in real terms.[54]

National Grid used a 7.0 percent discount rate to analyze the costs of the CRNM program. [55] We do not agree that this is the appropriate discount rate to use for a BCA of this program.

The Rhode Island Least-Cost Procurement Standards describes the discount rate that should be used to analyze the cost-effectiveness of energy efficiency programs:

> Benefits and costs that are projected to occur over the term of the Least-Cost Procurement investment shall be stated in present value terms in the RI Test calculation using a discount rate that appropriately reflects the risks of the investment of customer funds in Least-Cost Procurement. Energy efficiency is a low-risk resource in terms of cost of capital risk, project risk, and portfolio risk. [56]

The CRNM program has at least as low a risk as the National Grid energy efficiency programs. The project risk and the capital risk are borne by the project developers. As a company, National Grid bears little to no risk from the CRNM program. The CRNM program subscribers bear no risk at all. Therefore, the logic behind the energy efficiency discount rate supports using the same discount rate for the CRNM program.

In addition, this discount rate is consistent with the recommendations of the NSPM for DERs. That manual explains that all DERs should be evaluated using the consistent assumptions and methodologies, including the discount rate.[57] Thus, the discount rate used to assess energy efficiency should also be used for projects such as CRNM. Further, the NSPM explains that the discount rate used to evaluate DERs should not necessarily be based on the utility investors' perspective, as represented by the utility weighted average cost of capital, but instead should be based on the regulatory perspective.[58] The regulatory perspective represents a broad perspective that accounts for many factors, especially the applicable policy goals in the state, the interests of utility customers, inter-generational equity, and the value of long-term impacts relative to short-term impacts.[59] These factors suggest that the utility

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[53] According to the NSPM for DERs, a BCA study period should be long enough to capture the full costs and benefits experienced over the life of the resource being analyzed.

[54] This is based on the interest rate on 10-year US Treasury Bills for the calendar year 2018. National Grid 2020 EE Plan, Attachment 4, pages 12-13.

[55] National Grid, *CRNM Versus CRDG RE Growth Net Cost Analysis*, slide deck presented at the Rhode Island Community Net Metering Stakeholder Meeting #5, May 2020. This is presumably based on the Company's weighted average cost of capital.

[56] Rhode Island Public Utility Commission, *Draft Rhode Island LCP Standards*, Docket 5015, May 29, 2020, Section 1.3(C)(iv).

[57] NSPM for DERs, Section 2.3.

[58] NSPM for DERs, Sections 3.2.2 and 5.11, and Appendix G.

[59] NSPM for DERs, Section 5.11 and Appendix G.

weighted average cost of capital is too high a discount rate, and that a low-risk discount rate, such as the one used for energy efficiency, is more appropriate.

9. Sensitivity Analyses

As with any BCA, several of the key assumptions used in this study are subject to significant uncertainty. Sensitivity analyses provide a useful way to test how these uncertainties might affect the results of the BCA. Below we present sensitivities for five of our most critical assumptions in this BCA.

Energy Price Forecasts

As indicated in Figure 9, energy price forecasts are volatile and can vary considerably over time. Further, energy benefits make up a large portion of the benefits of the CRNM program. For these reasons, we conduct a sensitivity for a High Energy Prices and a sensitivity for Low Energy Prices.

The High Energy Price Case assumes that the energy prices are 10 percent higher than those used in the Base Case, for each year of the study period. Similarly, the Low Energy Price Case assumes that the energy prices are 10 percent lower than those used in the Base Case, for each year of the study period. Table 32 presents the assumptions used.

Table 32. Energy Price Forecast Sensitivity: Assumptions

Scenario	Levelized Values ($/MWh)	Difference from Base Case
Base Case	48.7	0%
Low Case	43.8	10% lower
High Case	53.6	10% higher

Table 33 and Table 34 present the results of the energy price sensitivities.

Table 33. Energy Price Forecast Sensitivity: Base Case Results

Result	Base Case	Energy Prices	
		Low	High
Costs (mil PV$)	185	185	185
Benefits (mil PV$)	225	220	231
Net Benefits (mil PV$)	41	35	46
Benefit-Cost Ratio	1.22	1.25	1.19

Table 34. Energy Price Forecast Sensitivity: Separate Impacts Case Results

Result	Separate Impacts Case	Energy Prices	
		Low	High
Costs (mil PV$)	185	185	185
Benefits (mil PV$)	108	103	114
Net Benefits (mil PV$)	-76	-82	-71
Benefit-Cost Ratio	0.59	0.56	0.62

Renewable Energy Credit Prices

As indicated in Figure 10, REC price forecasts are volatile and can vary considerably over time. Further, REC prices have important implications regarding the benefits of the CRNM program. For these reasons, we conduct a sensitivity for a High REC Prices and a sensitivity for Low REC Prices.

The High REC Price Case assumes that the REC prices are 20 percent higher than those used in the Base Case, for each year of the study period. Similarly, the Low REC Price Case assumes that the REC prices are 20 percent lower than those used in the Base Case, for each year of the study period. Table 35 presents the assumptions used.

Table 35. REC Price Forecast Sensitivity: Assumptions

Scenario	Levelized Values ($/MWh)	Difference from Base Case
Base Case	15.8	0%
Low Case	12.7	20% lower
High Case	19.0	20% higher

Table 36 and Table 37 present the results of the REC price sensitivities.

Table 36. REC Price Forecast Sensitivity: Base Case Results

Result	Base Case	REC Prices	
		Low	High
Costs (mil PV$)	185	185	185
Benefits (mil PV$)	225	229	222
Net Benefits (mil PV$)	41	44	37
Benefit-Cost Ratio	1.22	1.24	1.20

Table 37. REC Price Forecast Sensitivity: Separate Impacts Case Results

Result	Separate Impacts Case	REC Prices	
		Low	High
Costs (mil PV$)	185	185	185
Benefits (mil PV$)	108	112	105
Net Benefits (mil PV$)	-76	-72	-80
Benefit-Cost Ratio	0.59	0.61	0.57

Discount Rates

As described above in Section 8.4, National Grid has assumed a discount rate of 7.0 percent for its analysis of the costs of the CRNM program. We use a sensitivity case to test how the discount rate affects the results of the BCA.

We assume that the discount rate used by National Grid is in nominal terms. In real terms, this is equal to a rate of 4.64 percent.[60]

Table 38 and Table 39 present the results of the discount rate sensitivity.

Table 38. High Discount Rate Sensitivity: Base Case Results

Result	Base Case	High Discount Rate
Costs (mil PV$)	185	116
Benefits (mil PV$)	225	190
Net Benefits (mil PV$)	41	74
Benefit-Cost Ratio	1.22	1.64

Table 39. High Discount Rate Sensitivity: Separate Impacts Case Results

Result	Separate Impacts Case	High Discount Rate
Costs (mil PV$)	185	116
Benefits (mil PV$)	108	73
Net Benefits (mil PV$)	-76	-43
Benefit-Cost Ratio	0.59	0.63

Distribution Benefits Included

As described above in Section 8.4, National Grid assumed that there are no distribution benefits for its analysis of the costs of the CRNM program. We use a sensitivity case to test how inclusion of distribution benefits affects the results of the BCA.

For this sensitivity, we assume distribution benefits from the CRNM program based on the assumption used by National Grid in it 2020 EE Plan.

Table 40 and Table 41 present the results of the distribution benefits sensitivity.

Table 40. Distribution Benefits Sensitivity: Base Case Results

Result	Base Case	Distribution Benefits Included
Costs (mil PV$)	185	185
Benefits (mil PV$)	225	242
Net Benefits (mil PV$)	41	57
Benefit-Cost Ratio	1.22	1.31

60 The 2020 EE Plan assumes an inflation rate of 2.06 percent. The real discount rate is equal to [(1 + nominal discount rate) / (1 + inflation rate)] – 1.

Table 41. Distribution Benefits Sensitivity: Separate Impact Case Results

Result	Separate Impacts Case	Distribution Benefits Included
Costs (mil PV$)	185	185
Benefits (mil PV$)	108	125
Net Benefits (mil PV$)	-76	-60
Benefit-Cost Ratio	0.59	0.68

The CRNM Subscription Charge

The CRNM subscription charge determines the cost of the CRNM program. This charge is equal to 90 percent of the relevant portions of the C-06 rate. This rate is based on a 25-year forecast that, like all rate forecasts, is highly uncertain. Therefore, we conduct a sensitivity of this forecast to assess the impact it has on the BCA results.

The High Subscription Charge Case assumes that the C-06 rate is 10 percent higher than those used in the Base Case, for each year of the study period. Similarly, the Low Subscription Charge Case assumes that the C-06 rate is 10 percent lower than those used in the Base Case, for each year of the study period.

Table 42 and Table 43 present the results of the subscription charge sensitivity.

Table 42. CRNM Subscription Charge Sensitivity: Base Case Results

Result	Base Case	Rates	
		Low	High
Costs (mil PV$)	185	166	203
Benefits (mil PV$)	225	225	225
Net Benefits (mil PV$)	41	59	22
Benefit-Cost Ratio	1.22	1.36	1.11

Table 43. CRNM Subscription Charge Sensitivity: Separate Impacts Case Results

Result	Separate Impacts Case	Rates	
		Low	High
Costs (mil PV$)	185	166	203
Benefits (mil PV$)	108	108	108
Net Benefits (mil PV$)	-76	-58	-95
Benefit-Cost Ratio	0.59	0.65	0.53

Appendix A. THE RHODE ISLAND COST-EFFECTIVENESS TEST

Table A-1. Power Sector Level

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Energy supply and transmission operating value of energy provided or saved (time- and location-specific LMP)	Bids, offers, marginal losses, constraints, and scarcity in time and location specific LMP (+ reactive power requirements and impacts on distribution assets in DLMP)	AESC seasonal on- and off-peak energy price forecasts	
		Expected time- and location-specific bulk power LMP for forecast period of resource operation	Requires interval or advanced metering functionality and Tracking of ISO Nodal Prices
		Expected time-, location-, and product-specific distribution LMP for forecast period of resource operation	Requires interval or advanced metering functionality and analysis of actual power flows
Renewable Energy Credit cost / value	Cost of REC obligation or REC revenue received	AESC forecast of REC prices	
Retail supplier risk premium	Differential between retail prices and ISO market prices times retail purchases	Absent AMI + dynamic retail pricing, AESC estimate or risk-adjusted observed differentials	Quantitative estimation requires detailed economic modeling
Forward commitment: capacity value	Whether an FCM-qualified resource and, if so, FCA bid and provision of qualified capacity	Estimate of likely FCA auction bid capacity from FCM-qualified resources	Quantitative estimation requires detailed economic modeling
	Change in demand reflected (4 yr. later) in a revision of FCM forecast capacity requirements	Review of FCM capacity requirements and estimate of likely future impacts (same as capacity DRIPE below)	Quantitative estimation requires detailed economic modeling
Forward commitment: avoided ancillary services value	Whether it is a qualified ancillary service resource and, if so, qualified capacity	Forecasts of AS requirements / provision of AS net of energy supplied times forecast AS prices	
Utility / third-party developer renewable energy, efficiency, or DER costs	Direct cost of new non-customer resources (capital and operating costs of resources) + customer program costs (participant recruitment, administrative, incentive and EM&V costs)	Cost estimates	

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Electric transmission capacity costs / value	Change in transmission capacity requirements associated in change in resource mix	Annualized statewide transmission capacity value associated with load growth times change in net demand (ICF)	
		Forecast impacts of specific resources on transmission planning requirements	Requires detailed planning studies
Electric transmission infrastructure costs for site-specific resources	Cost to develop new transmission (for peak output + any contingency requirement)	Direct cost estimates for remotely sited resources (e.g. offshore wind)	Requires detailed planning studies
Net risk benefits to utility system operations (generation, transmission, distribution) from (1) ability of flexible resources to adapt, and (2) resource diversity that limits impacts, taking into account that DER need to be studied to determine if they reduce or increase utility system risk based on their locational, resource, and performance diversity	Flexible DERs (storage, flexible demand) can reduce risk by enabling the system to respond to disruptive events	Use proxy value for ability of system to respond to disruptive events	
		Model system with additional flexible resources	Quantitative estimation requires detailed economic modeling
	DERs need to be studied to determine if they reduce or increase utility system risk based on their locational, resource, and performance diversity.	Use proxy values for size and locational and resource diversity	
		Portfolio analysis with risk assessment technique	Quantitative estimation requires detailed economic modeling
Option value of individual resources	Impacts of individual resources on the cost of other potential resources	Estimates of impacts of one resource on the costs of others	Quantitative estimation requires detailed economic modeling
		Option value calculation based on scenario analysis of potential future resource choices	Quantitative estimation requires detailed economic modeling
		Portfolio analysis - comparison of alternative portfolios	Quantitative estimation requires detailed economic modeling
Investment under uncertainty: real options cost / value	Impacts of reduced flexibility / discovery of new information	Scenario analysis: calculation of real option value associated with different decision times and resources	Quantitative estimation requires detailed economic modeling
Energy demand reduction induced price effect	Change in energy price, net of any capacity cost change from Net CONE	AESC Estimate of DRIPE (need to clarify whether accounts for impact on Net CONE)	
		Estimate of energy price change with an adjustment of impacts on Net CONE in ISO FCM	Quantitative estimation requires detailed economic modeling

Mixed Cost-Benefit, Cost, or Benefit Category	**System Attribute Benefit/Cost Driver**	**Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)**	**Potential Visibility Requirements**
Greenhouse gas compliance costs	Forecast prices under RGGI and other market-based regulations (e.g. Clean Power Plan) + changes other compliance costs under likely environmental regulations Forecast compliance costs associated with meeting the GHG emission targets in the Resilient Rhode Island Act Net marginal emissions or emissions avoided from changes in resource use	Forecasts of RGGI and CPP prices + estimates of likely compliance costs under any other GHG regulation. Estimates of likely compliance costs under RI GHG regulation. Forecast of net emissions impacts from change in regional dispatch and resource mix.	Quantitative estimation requires detailed economic modeling Quantitative estimation requires detailed economic modeling Quantitative estimation requires detailed economic modeling
Criteria air pollutant and other environmental compliance costs	Changes in forecast compliance costs under air pollution or other environmental regulations Net marginal emissions or emissions avoided from changes in resource use	Forecasts of the costs of compliance under affected environmental regulations Forecast of net environmental impacts from change in regional dispatch and resource mix	Quantitative estimation requires detailed economic modeling Quantitative estimation requires detailed economic modeling
Innovation and learning by doing	Experimentation Costs	Direct costs of innovation / demonstration programs	
Distribution capacity costs	Change in distribution capacity requirements generally with change in resources Forecasted change peak distribution circuit requirements Location-specific DER hosting capacity Impacts on system performance, thermal and reactive power constraints, and associated investment and operating costs	Annualized statewide distribution capacity value associated with load growth times change in net demand (ICF) Distribution planning studies Analysis of capability to host DER with existing and already planned facilities Distribution planning studies	Requires detailed planning studies
Distribution delivery costs	Location-specific distribution constraints, losses, equipment cycling, DLMP	Dynamic, multi-layered forecasts as a basis for circuit-specific DER and distribution system plans analysis of time-, location-, and product-specific DLMP value, potentially leading toward DLMP markets	Requires interval or advanced metering functionality, modeling, and planning studies Requires interval or advanced metering functionality and analysis of actual power flows
Distribution system safety loss/gain	Changes in risks, real-time information on system conditions, and training	Qualitative assessment, tracking, and assessment of safety metrics	Distribution system safety loss/gain

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Distribution system performance	Performance metrics include: voltage stability and equalization, conservation voltage reduction, operational flexibility, fault current / arc flash avoidance, and effective asset management	Distribution planning and benchmarking to best practices	Requires advanced metering functionality and / or distribution sensors
Utility low-income	Energy efficiency impacts on reducing utility arrearage carrying costs, uncollectibles, customer service and collection costs Incremental utility costs for low-income efficiency programs net of system energy cost savings Expected impacts on customer voltages and power quality	Marginal impacts on arrearages, uncollectibles, and other utility costs Direct costs net of system general system benefits Voltage and power quality measurement and assessments	Requires advanced metering functionality and / or distribution sensors
Distribution system and customer reliability / resilience impacts	Customer-specific and critical facility outage costs and value of uninterrupted service Expected impacts on the probability of outage Expected impacts on the duration of outages Expected impacts on customer voltages and power quality Costs of distribution improvements and microgrids	US DOE Interruption Cost Estimator Customer value of uninterrupted service studies Distribution system risk assessment studies Distribution system / microgrid resilience studies Voltage and power quality measurement and assessments Distribution planning and costing	Requires customer surveys Requires detailed planning studies Requires detailed planning studies Requires advanced metering functionality and / or distribution sensors Requires detailed planning studies
Distribution system safety loss/gain	Changes in risks, real-time information on system conditions, and training	Qualitative assessment, tracking and assessment of safety metrics	

Table A-2. Customer Sector Level

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Program participant / prosumer benefits / costs	Direct participant / prosumer cost of technology, investment, and/or program participation costs Participant indirect costs (includes required behavioral changes and inconvenience costs) Participant non-energy impacts (includes value of improvements in quality of life)	Estimates of net direct costs Qualitative assessment Willingness to accept / pay estimates (observation or surveys) Qualitative value Deemed benefits not reflected in other categories - Efficiency Technical Reference Manual willingness to pay estimates (observation or surveys)	Requires customer surveys
Participant non-energy costs/benefits: oil, gas, water, wastewater	Value of energy and water savings / requirements	AESC estimate of avoided natural gas, oil, and other fuel costs	
		Estimate of net costs or cost savings	Requires customer surveys
Low-income participant benefits	Improved comfort, reduced noise, increased property value, increased property durability, lower maintenance costs, improved health, and reduced tenant complaints.	Begin with values from Rhode Island EE cost-effectiveness analyses	May require interval or advanced metering functionality
Consumer empowerment & choice	Retail competition, facilitation of flexible demand, integration of commodity and energy services, development of platform market, and third-party DER development	Qualitative assessment	
Non-participant (equity) rate and bill impacts	Utility revenue requirements, cost allocation and rate design	Long-term rate and bill analysis	
		Analysis of non-participant usage, price elasticity, and income patterns	May require interval or advanced metering functionality

Table A-3. Societal Level

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Greenhouse gas externality costs	GHG externality value net of RGGI costs	Customer willingness to pay for reductions in excess of compliance levels (observation or WTP surveys)	Requires customer surveys
		Societal cost estimates	
	Net marginal emissions or emissions avoided from changes in the use of resources	Forecast of net emissions impacts from change in regional dispatch and resource mix	Quantitative estimation requires detailed economic modeling
Criteria air pollutant and other environmental externality costs	Criteria pollutant (e.g. fine particulates) and other environmental externality value net of any emission allowance / emission credit value	Customer willingness to pay for reductions in excess of compliance levels (observation or WTP surveys)	Requires customer surveys
		Societal cost estimates	
	Net marginal emissions or emissions avoided from changes in the use of resources	Forecast of net environmental impacts from change in regional dispatch and resource mix	Quantitative estimation requires detailed economic modeling
Conservation and community benefits	Land-use impacts (net of property costs for resource deployments): loss of sink, habitat, historic value, sense of place	Value of GHG sink per acre	
		Environmental and historic conservation easement cost	
	Equity in distribution of harmful or nuisance infrastructure	Qualitative assessment	
		MW of infrastructure per acre, $ of infrastructure per value of property	
Non-energy costs/benefits: economic development	Estimate of impacts on state product or employment, effects of land-use change on property tax revenue	Qualitative assessment	
		Economic modeling (e.g. input / output life-cycle analysis, property tax base studies)	Quantitative estimation requires detailed economic modeling
Innovation and knowledge spillover (Related to demonstration projects and other RD&D preceding larger scale deployment)	RD&D, strength of innovation eco-system, knowledge capture and sharing from public- / utility-/private sector-funded initiatives	Qualitative assessment	
Societal low-income impacts	Poverty alleviation, reduced energy burden, reduced involuntary disconnections from service, reductions in the cost of other social services, local economic benefits, etc.	Qualitative assessment or adder	
		Direct estimate of cost savings	
		Alternate input factor in modeling of local economic impacts	Quantitative estimation requires detailed economic modeling

Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
Public health	Indoor air quality, heating, cooling, and noise impacts of efficiency programs (additional environmental and economic impacts on vulnerable customers addressed elsewhere)	Qualitative assessment	
National security and U.S. international influence	Impacts on oil imports	Analysis of oil imports into Rhode Island and the region	