COSTS AND BENEFITS OF MAINE'S NET ENERGY BILLING PROGRAM

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PREPARED FOR

Coalition for Community Solar Access

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AESC	Avoided Energy Supply Components
BHE	Bangor Hydro District
BTM	behind the meter
CAGR	compound annual nominal wage growth rate
CELT	ISO-NE Capacity, Energy, Loads, and Transmission
CMP	Central Maine Power
CO_2	carbon dioxide
Coalition	Coalition for Community Solar Access
Commission	Maine Public Utilities Commission
CPI	Consumer Price Index
DRIPE	Demand Reduction Induced Price Effects
EMEC	Eastern Maine Electric Cooperative
FCA	Forward Capacity Auction
FCM	Forward Capacity Market
FTE	full-time equivalents
GW	gigawatt
GWh	gigawatt hour
ISO-NE	ISO New England
kW	kilowatt
kWh	kilowatt hour
MPD	Maine Public District
MW	megawatt
MWh	megawatt hour
NEB	Maine's Net Energy Billing Program
NMISA	Northern Maine Independent System Administrator
NO_X	nitrogen oxides
NREL	National Renewable Energy Lab
PUC	Maine Public Utilities Commission
RNS	Regional Network Services
RPS	renewable portfolio standard
SO_2	sulfur dioxide
T&D	transmission and distribution

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I. EXECUTIVE SUMMARY

The Coalition for Community Solar Access (CCSA or Coalition) contracted Daymark to conduct an independent cost benefit analysis of Maine's Net Energy Billing Program (NEB). This report will provide additional perspective and information to the Maine Legislature and Public Utilities Commission (PUC or Commission) to further the conversation about considerations in valuing solar in the NEB program in Maine.

On November 10, 2020, the Commission issued a report entitled, *Report on the Effectiveness of Net Energy Billing in Achieving State Policy Goals and Providing Benefits to Ratepayers.* The Commission Report provided an illustrative analysis of the net costs of Maine's NEB program but missed some significant considerations in their analysis, the most significant of which is that it confuses distribution utility revenue impacts with ratepayer impacts and fails to consider the full value of solar. It was not an economic analysis of whether the addition of solar facilities is the most cost-effective resource to be added within the State of Maine.

The approach that the Commission is using to evaluate the NEB program is different than the standard way energy efficiency programs are evaluated. The evaluation of these programs intentionally does not incorporate a shift in which customers have their share of fixed utility costs increased due to the energy efficiency lowering consumption. The standard tests used to evaluate energy efficiency programs are life-cycle economic analysis, incorporating the time-value of money. Their costs or benefits are often expressed as a Levelized Cost per kilowatt-hour to make comparisons easier to see, digest and discuss.

While we see great value in the life cycle approach that is used in energy efficiency program evaluation to make decisions about which resources are the most economic for the State of Maine, this report is designed to provide information to enhance the Commission analysis. One of our primary concerns about the Commission's method to determine NEB program impact is that it does not recognize the entire savings, or the benefits created, when NEB solar facilities are installed.

This report presents an analysis of the net benefit when the full the value of solar is taken into account for each of the NEB programs in Maine to be used by the Commission in its evaluation.

This report examines the benefits of solar from both a bulk power system and societal perspective. This report also presents an outlook on program costs and develops a net benefit assessment for four scenarios in the NEB program:

- Scenario 1 : 2021: Solar penetration of 10% of peak load
- Scenario 2: 2030: Solar penetration of 10% of peak load
- Scenario 3: 2030: Solar penetration of 25% of peak load
- Scenario 4: 2030: Solar penetration of 40% of peak load

The scenarios were selected in consultation with CCSA to reflect a range of NEB program outcomes.

Our key findings are:

- **For all of the Scenarios, the NEB program provides net benefits to Maine customers.**
- The kWh program provides net benefits, while the Tariff Rate program is more costly to non-participating customers. This is due to the structural difference between the two programs that the kWh projects serve as load reducers, while Tariff Rate project serve as generators in ISO-NE markets.
- **The Commission's analysis of the NEB program vastly overstated the costs**. Our analysis shows a net benefit.

A. Maine NEB Program

In 2019, the Commission issued an order to adopt changes in the NEB program that expanded the traditional netting program, or kWh program, already in place and added a new program known as the Tariff Rate program. These programs established a maximum size for project eligibility of 5 MW as part of the Commission's changes.

Projects in both programs connect at the distribution system level, but a big distinction between the two programs is that projects in the Tariff Rate Program operate as generators from ISO New England's perspective and projects in the kWh program serve to reduce load. This distinction is documented in the Commission's rules for the program. That document states that for kWh projects, "the transmission and distribution utility shall apply the facility output of the eligible facility against supplier load obligations", while Tariff Rate projects are meant to be registered in the ISO-NE or

NMISA Market and their output "monetized in a manner that maximizes the value of the output of the resource to ratepayers." [1]

Daymark concludes in this report that kWh program is providing net benefits to all Maine utility customers. The costs of the new Tariff Rate program exceed the benefits calculated in this report. This result corresponds to the projects in the kWh program reducing load requirements of the utilities while projects in the Tariff Rate program do not.

kWh Program. The traditional NEB or kWh program can be utilized by either residential or commercial and institutional customers. These participants receive kWh credits on their bill for the energy generated by their solar panels. The credit is equal to the full retail rate the customer otherwise would have paid for their energy usage. Projects in the kWh program no longer have to be "behind the meter" (BTM); community solar[2] can also qualify for the kWh program. The kWh program provides net benefits to Maine customers in both Central Maine Power and Bangor Hydro's territories.

Tariff Rate Program. The Tariff Rate program is only available to commercial and institutional customers. Tariff Rate customers receive a dollar credit on their bill for 75% of their T&D charge, as well as their applicable standard service rate. Tariff Rates are determined yearly by the PUC based on current T&D and standard service rates. We will discuss the costs and benefits of the Tariff Rate program in our report.

Under the current Tariff program portion construct, the Tariff program portion net cost exceeds the benefit of solar. There are program adjustments that should be considered to improve cost-effectiveness for Maine's customer while continuing to support a successful developer business model and maintain the import role for NEB stimulated solar in helping Maine met its decarbonization objectives.

[1] 65-407 Chapter 13, page 9 and 10. https://www.maine.gov/mpuc/electricity/renewables/documents/Chapter313NEB.pdf.

[2] Under the Maine NEB Community Solar Project, developers market and sell portions of the output of their projects to individual residential, commercial, and institutional kWh program participants; each participant's portion of the amount of energy generated by the community solar facility is credited to the customer thereby reducing the amount of energy charges from their utility since they are reducing the amount of consumption provided by their utility. Under the Tariff program, Community Solar Developers market and sell portions of the output of their facility to individual commercial and institutional Tariff program participants where their portion of the amount of energy generated by the community solar facility is used to calculate a dollar amount credited to the customer within their utility bill.

B. Update to Commission Report Analysis

Using the value of solar results from 2021 from Scenario 1, we updated the illustrative analysis presented by the Commission which is shown below in Table 1. This demonstrates that the Commission Report vastly overstated NEB program costs. In our analysis, the Commission report's figure of $161 million changes to a net benefit of $1.8 million. When just considering operational projects, the program provides $2.1 million in net benefits.

Table 1. Updated analysis from the Commission report

(NET COST) OR BENEFIT (in MM)	COMMISSION REPORT ASSUMPTIONS	VALUING PROJECTS AT VALUE OF SOLAR
All Projects per PUC Report	($160.8) [3]	$1.8
Operational Projects only[4]	($8.5)	$2.1
Operational Projects + 50% Attrition Remaining[5]	($84.7)	$2.0

C. Benefits of Net Energy Billing

Since the PUC report did not focus its review on the benefits of solar generation in its analysis of the NEB program, Daymark purposely studied the benefits of the program to Maine customers. To do this Daymark independently determined the benefits of the projects participating in the kWh and Tariff Rate Programs.

This analysis is built from the market components of benefits (or costs) that solar brings when interconnected with the system. Solar generation facilities participating in the Maine NEB program bring several types of market benefits to Maine customers:

- **Bulk power system benefits**. **The PUC Report included only a portion of the bulk power system benefits.** These benefits include the value of the individual energy market products the solar project provides to participants or allows the utility to avoid purchasing. Benefits here also include changes in the utilities cost to serve load due to the addition of certain resources, such as a reduced Renewable Portfolio Standard (RPS) obligation or a reduction in Maine's share

[3] This number comes directly from the Commission's November 10 report.

[4] The development of the impacts based upon operational projects was first established by Daymark in its initial review dated January 5, 2021 and filed on behalf of the CCSA on January 7, 2021.

[5] The development of the impacts based upon only operational and 50% of the projects proposed was first established by Daymark in its initial review dated January 5, 2021 and filed on behalf of the CCSA on January 7, 2021.

of the Regional Network Service (RNS) charges. Also, the addition of a zero marginal cost and/or load reducing resource will reduce the price for energy and capacity for all of Maine's retail customers energy consumption; this market price effect is referred to as Demand Reduction Induced Price Effects (DRIPE). **The DRIPE and RNS charge reduction benefits were not included in the Commission report of program impact.**

- **Societal Benefits.** Societal benefits include both environmental benefits and economic development benefits. These benefits include reduced emissions and job creation and local tax impacts resulting from local project development and investment. **Societal benefits were not included in the Commission report of program impact.**

It is important to note that we have not included transmission investment or distribution benefits in this analysis. Distribution benefits are generally local in nature, so are hard to quantify on a system wide basis. Both benefits could materially add to the net benefit presented in this report.

Figure 1 and Figure 2 show the benefits of the two program types. These figures show that the benefit is higher for the load reducing resources in the kWh program. By reducing load requirements on the local utility, these kWh program resources provide some benefits (like reducing the RPS requirements) that resources in the Tariff Rate program do not provide. Some benefits are greater in the kWh program because the retail value of market products like avoided energy and avoided capacity is higher than the corresponding wholesale value. For example, 2030 wholesale capacity and energy benefits contribute about $40/MWH to the total benefit of the Tariff Rate Program while at retail avoided capacity and energy contribute just over $55/MWH to the total benefit of the kWh program.

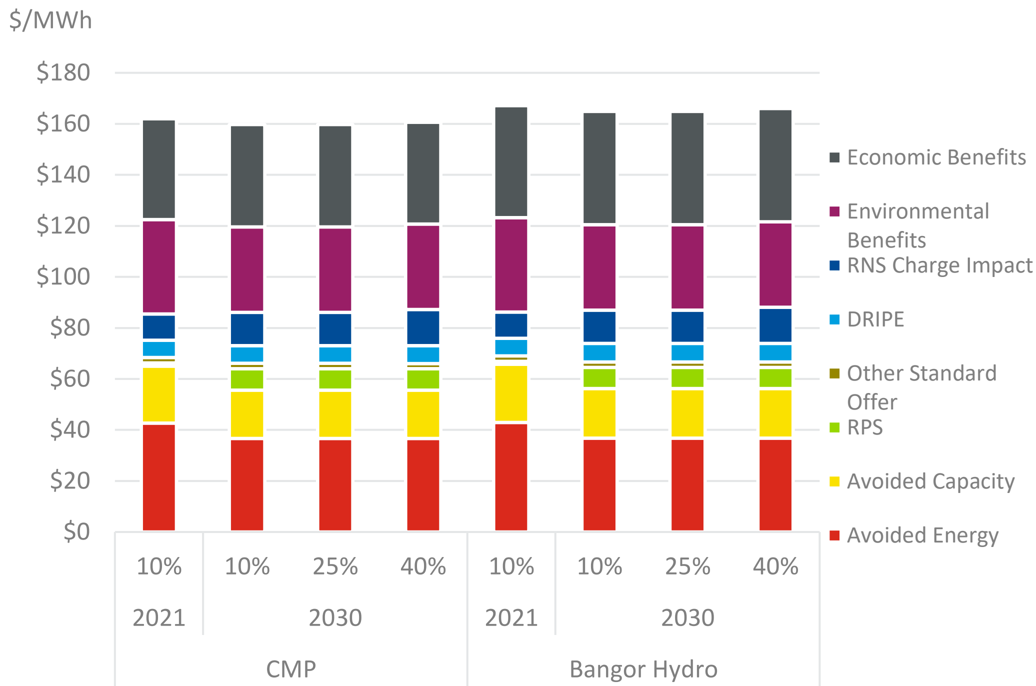

Figure 1. **Total benefit: kWh Program**

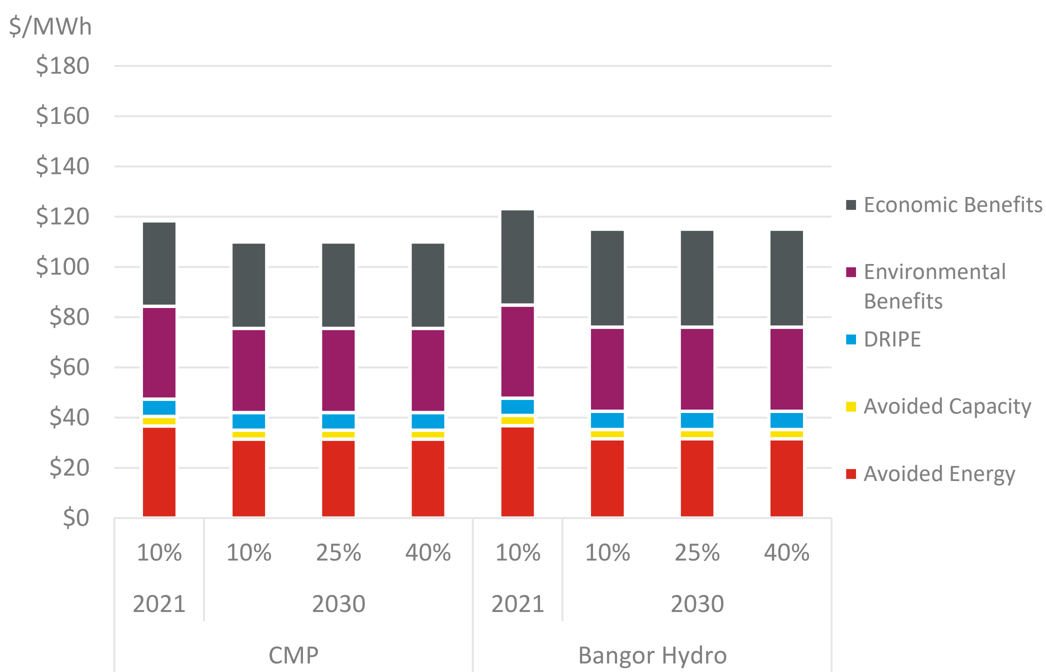

Figure 2. **Total benefit: Tariff Rate Program**

D. Net Benefit Analysis

In our assessment of program net benefits, we compared the appropriate value of solar components to the cost of the program for both the kWh and Tariff Rate programs. The results are shown in Table 2. Projects in the kWh Program provide benefits in all four scenarios and for each of the utilities studied. This result corresponds to projects in the kWh program reducing load requirements of the utilities while projects in the Tariff Rate program do not. By reducing load directly, the kWh projects reduce the standard offer obligation for the utilities and are credited with the full standard offer rate in the Commission's calculation of project cost-effectiveness.

Table 2. Net NEB Program benefit (cost) by scenario ($2021/MWh)

UTILITY	CMP				BANGOR HYDRO			
YEAR	2021			2030	2021	2030		
SCENARIO	10%	10%	25%	40%	10%	10%	25%	40%
kWh Program	$17.50	$34.68	$34.69	$35.61	$4.50	$9.18	$9.19	$10.28
Tariff Rate Program	$(7.25)	$(10.58)	$(10.58)	$(10.58)	$(19.38)	$(26.29)	$(26.29)	$(26.29)

When we applied the net benefit per MWh shown in Table 2 to the solar development scenarios, we found that there was a positive net benefit for all of the scenarios as shown below in Table 3.

Table 3. Scenario summary results: NEB utility impact versus value of solar

METRIC	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
Total (Millions)	$1.9	$5.1	$12.8	$21.0
¢/kWh Solar	$0.5	$1.2	$1.2	$1.2
$/MW Solar	$8.2	$19.8	$19.8	$20.4
$/ton of carbon avoided	$13.0	$31.3	$31.3	$32.2

II. INTRODUCTION

A. Background

The Coalition for Community Solar Access (CCSA or Coalition) contracted Daymark to conduct an independent cost benefit analysis of Maine's Net Energy Billing Program (NEB). The purpose of this cost benefit analysis is to provide information to the Maine Legislature and Public Utilities Commission (PUC or Commission) to further the conversation about the Value of Solar and NEB in Maine.

On November 10, 2020, the Commission issued a report entitled, *Report on the Effectiveness of Net Energy Billing in Achieving State Policy Goals and Providing Benefits to Ratepayer*s. The Commission Report addresses the requirement in Section A-6 of "An Act To Promote Solar Energy Projects and Distributed Generation Resources in Maine", which required the Commission to evaluate the net energy billing program "when the total amount of generation capacity involved in net energy billing in the State reaches 10% of the total maximum load of transmission and distribution utilities in the State or 3 years after the effective date of this Act, whichever comes first."[6] The Act instructs the Commission to evaluate the effectiveness of the program for 1) providing benefits to ratepayers and 2) meeting state policy goals and to submit a report to the Legislature on its findings.

In our review of the Commission's report, we found that the Commission's analysis made several errors, the most significant of which is that it confuses distribution utility revenue impacts with ratepayer impacts. The analysis simply calculated the revenue impact to the distribution utilities due to the NEB program and calls that ratepayer impacts; it does not assess the full benefit provided by the program to ratepayers. Additionally, the Commission Report's analysis overstates the revenue impact to distribution utilities.

This report presents an analysis of the benefits of solar participating projects, program costs, and the net benefit for each of the NEB programs in Maine to be used by the Commission in its evaluation.

[6] PUBLIC Law2019, Chapter 478, Section A-6, available at: http://legislature.maine.gov/legis/bills/bills_129th/chapters/PUBLIC478.asp.

1. Program Impact versus Life-cycle Value Solar Analyses

It is important to note that this report presents the net benefit of the NEB program for a single year for each scenario. This approach was taken to mirror the Commission's analysis, which also presented a single year, or snapshot of program costs and benefits. It is important to understand that the Commission report was focused on determining the impact of the program on Maine electric utility customers. It was not an economic analysis of whether the addition of solar facilities is the most cost-effective resource to be added within the State of Maine.

The approach that the Commission is using to evaluate the NEB program is different than the standard way energy efficiency programs are evaluated. The evaluation of these programs intentionally does not incorporate a shift in which customers have their share of fixed utility costs increased due to the energy efficiency lowering consumption. In energy efficiency analysis benefit-cost analysis there are two particular methods of testing the economics of that resource, the Revenue Requirements Test (Utility Cost Test) and the Total Resource Cost (TRC) Test that look only at the change in actual costs when these resources are added. These tests are also life-cycle economic analysis, incorporating the time-value of money. Their costs or benefits are often expressed as a Levelized Cost per kilowatt-hour to make comparisons easier to see, digest and discuss.

A non-emitting resource such as solar in Maine's NEB program is similar to energy efficiency resources. In addition to the non-emitting nature, both the NEB program participating solar facility resource and energy efficiency lower the amount of the electric bill paid to their utility by participating customers. There is a movement towards evaluating the value of solar using a life-cycle economic analysis, similar to the way energy efficiency programs have been evaluated.

While we see great value in the life cycle approach to make decisions about which resources are the most economic for the State of Maine, this report is designed to provide information to enhance the Commission analysis. An annualized or levelized Value of Solar is not something to compare to the Commission's metric. One of our primary concerns about the Commission's method to determine NEB program impact is that it does not recognize the entire savings, or the benefits created, when NEB solar facilities are installed. We have, therefore, designed this report to provide an annual snapshot of the benefits that solar projects in the NEB program provide to Maine for each of our scenarios.

This report presents an analysis of the net benefit when the full the value of solar is taken into account for each of the NEB programs in Maine to be used by the Commission in its evaluation.

B. Scope of Analysis

We developed the value of solar and net benefit analysis for four scenarios of solar penetration participating in the NEB program:

- 2021: Solar penetration of 10% of peak load
- 2030: Solar penetration of 10% of peak load
- 2030: Solar penetration of 25% of peak load
- 2030: Solar penetration of 40% of peak load

We included seven components in the net benefit analysis as shown in Table 4, below. It is important to note that the list studied is not an exhaustive list of benefits and that benefits are likely greater than captured in this analysis. For example, Community Scale solar project developers fund upgrades to the distribution grid that have benefits beyond the interconnection of an individual solar project. While not included in this analysis due to a lack of comprehensive information, these upgrades represent significant avoided capital costs that would otherwise be paid by ratepayers.

Table 4. Components included in analysis

COMPONENT	DESCRIPTION
Avoided Energy	Market energy purchases avoided due to distributed solar for kWh program or wholesale market value of solar for Tariff Rate program
DRIPE	Effects of solar on market prices for energy and capacity
Avoided Capacity	Market capacity purchases avoided due to distributed solar for kWh program or wholesale capacity market value of solar for Tariff Rate program
Avoided RNS Charges	Reductions in Maine’s share of ISO-NE’s Regional Network Services Charge
Renewable Portfolio Standard (RPS) Benefit	Reductions in an entity’s requirements to comply with RPS policies
Environmental Benefits	Value of reductions in air pollutant emissions
Economic Benefits	Benefits to Maine’s economy from NEB solar installation or construction

The cost of the NEB program is consistent with the Commission methodology. The cost of the NEB solar program was estimated in a similar manner as that developed by the PUC. The Commission methodology calculated a net utility revenue reduction from program participants and inferred that these impacts are or would become impacts on ratepayers. However, the exact timing and magnitude of how the impact on the utility revenue will be captured within utility rates to customers is uncertain and will be determined by the PUC.

It is important to also recognize that lost revenue is not actually a new cost that occurs to the utility or to Maine when solar facilities are installed under the NEB program. It is potentially a change in which ratepayers pay an increased share of embedded utility costs. The Commission's approach in representing net change in utility revenue as a cost has been debated as potentially irrelevant in the evaluation of energy efficiency programs. The NEB program's successful stimulus of significant solar generation capacity will result in a larger and quicker change in utility revenue than energy efficiency programs. A significant net loss in utility revenue will eventually require the PUC to address this in setting electric utility rates.

Thus, while it is reasonable to want to understand the net lost utility revenue it is somewhat confusing to label it as a cost. Nonetheless Daymark has chosen to compare a more accurate estimate of net reduction in utility revenue to the benefits that the NEB solar facilities bring to Maine. Daymark will continue in this report to refer to this net lost revenue using the Commission label as Net Program Costs.

Daymark's analysis addresses NEB for all three major utility districts. Central Maine Power (CMP) and Bangor Hydro District (BHE) are addressed on a quantitative basis. Because the Maine Public District (MPD) is not located within ISO New England (ISO-NE), we have addressed the benefits in that utility on a qualitative basis.

We have utilized publicly available data sources in order to make our analysis transparent. Sources included PV Watts the National Renewable Energy Lab (NREL) reports the 2018 Avoided Energy Supply Components (AESC) in New England report, ISO-NE's 2020 CELT Report and other ISO-NE publicly available data. Additionally, we used the IMPLAN software to assist in estimating the economic impact of developing solar in Maine.

C. Organization of this Report

The remainder of the report is organized into the following sections:

- Section III: Overview of Maine's NEB Program
- Section IV: Costs and Benefits of the NEB Program
- Section V: Value of Solar Methodology
- Section VI: Economic Development Benefits
- Section VII: NEB Program Costs

III. MAINE'S NET ENERGY BILLING PROGRAM

In 2019, the Commission passed an order to adopt changes in the NEB. These changes came from the Legislature's "Act to Promote Solar Energy Projects and Distributed Generation Resources in Maine", P.L. 2019, Chapter 478. These changes expanded the traditional netting program, or kWh program, already in place and added a new program known as the Tariff Rate program. These programs have now established a maximum size for projects eligibility of 5 MW.

The traditional NEB, or kWh, program can be utilized by either residential or commercial and institutional customers. These customers receive kWh credits on their bill for the energy generated by their solar panels. The credit is equal to the full retail rate the customer otherwise would have paid for their energy usage. kWh projects no longer have to be "behind the meter." Community solar[7] can also qualify for the kWh program. In our analysis, we separate the costs and benefits that are due to the traditional behind the meter kWh customers and the community solar kWh customers.

The Tariff Rate program is only for commercial and institutional customers. Tariff Rate customers receive a credit on their bill for 75% of their Transmission and Distribution (T&D) charge, as well as their applicable standard service rate. Tariff Rates are determined yearly by the PUC based on current T&D and standard service rates. We will discuss the costs and benefits of the Tariff Rate program later in our report.

Projects in both programs connect at the distribution system level, but a big distinction between the two programs is that projects in the Tariff Rate Program operate as generators from ISO New England's perspective and projects in the kWh program serve to reduce load. This distinction is documented in the Commission's rules for the program. That document states that for kWh projects, "the transmission and distribution utility shall apply the facility output of the eligible facility against supplier load obligations", while Tariff Rate projects are meant to be registered in the ISO-NE or

[7] Under the Maine NEB Community Solar Project developers market and sell portions of the output of their facility to individual residential, commercial, and institutional kWh program participants where their portion of the amount of energy generated by the community solar facility is credited to the customer reducing the amount of charges that they are billed by their utility. Under the Tariff Rate program developers market and sell portions of the output of their facility to individual commercial and institutional Tariff program participants where their portion of the amount of energy generated by the community solar facility is used to calculate a dollar amount credited to the customer on their utility bill.

NMISA Market and their output "monetized in a manner that maximizes the value of the output of the resource to ratepayers." [8]

This report will also show the costs and benefits for the full program of CMP and BHE which will be made up of kWh program participation and Tariff Rate program participation.

[8] 65-407 Chapter 13, page 9 and 10. https://www.maine.gov/mpuc/electricity/renewables/documents/Chapter313NEB.pdf.

IV. COSTS AND BENEFITS OF THE NEB PROGRAM

A. Overview

The Commission Report presented the net benefit of the NEB program without including the full value of solar that participating projects provide. In this report, we developed value of solar metrics for all of the project types eligible for the NEB program and calculated the net benefit of the NEB program. We updated the Commission Analysis and we also developed 4 scenarios showing the impact of varying participation levels in the NEB program in 2021 and 2030. This section discusses the net benefits analysis. The development of the Value of Solar and the future cost of the program are covered in Section V of this report.

This section will show the following

- For all of the Scenarios, the NEB program provides net benefits to Maine customers.
- The kWh program provides net benefits, while the Tariff Rate program is more costly to non-participating customers. This is due to the structural differences between the two programs.
- The Commission's analysis of the NEB program vastly overstated the costs. Our analysis shows a net benefit.

B. Solar Development Scenarios

1. Commission Report on NEB Program

The Commission Report based its analysis on the status of solar development in the Versant (including Bangor Hydro and Maine Public District) and CMP territories as of September 30, 2020. At that time about 65 MW was online and almost 900 MW of solar capacity was proposed in one of two categories (active non-operational or pending)[9]. Given that the 2020 Peak Load for Maine was almost 2300 MW, the proposed projects represent about 43% of peak load.

The majority of the capacity already online were Small BTM projects in CMP's territory, while the majority of proposed projects are the larger community scale projects. Figure 3 shows the capacity of solar installations cited in the Commission Report. It shows that

[9] Active Non-Operational projects are those with an executed Net Energy Billing Agreement, but that are not yet operational. Pending projects are those that have filed an application but have not yet executed a Net Energy Billing Agreement.

43% of the community scale projects (defined as projects greater than 500 kW) are in the kWh program and the remainder in the Tariff Rate program.

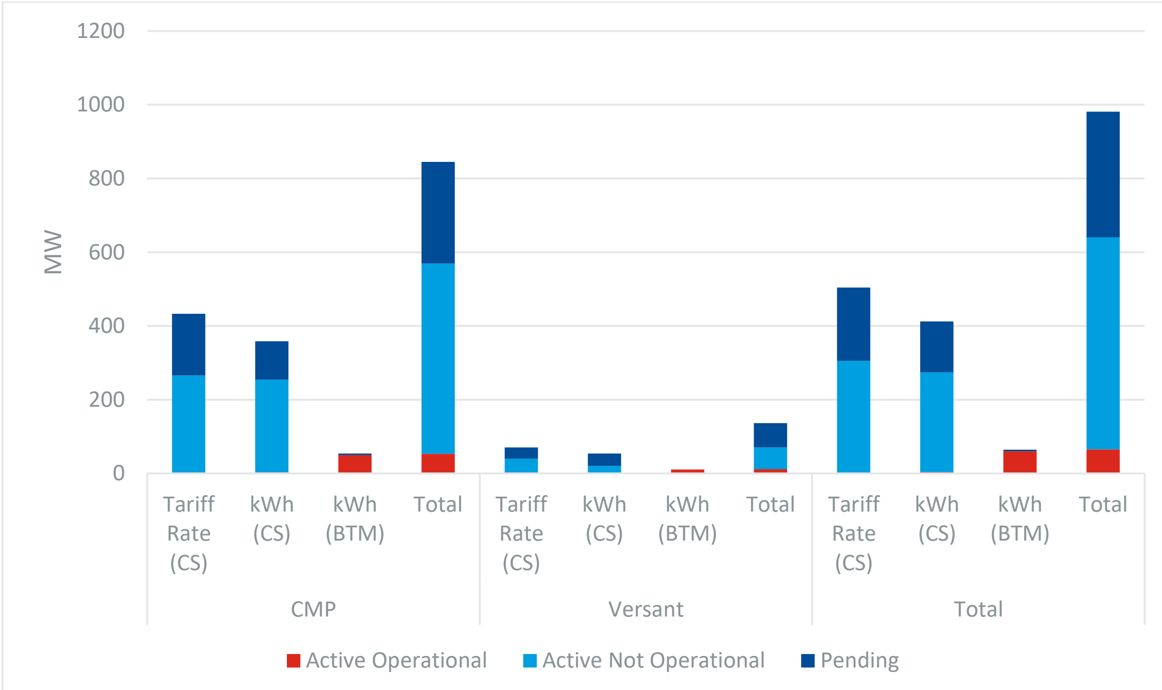

Figure 3. Capacity of solar cited in the Commission report

2. Daymark Study NEB Solar Development Cases

As mentioned above, we developed four different cases of solar capacity installation based on a percentage of CMP, BHE, and the Maine Public District (MPD)'s peak load estimates for 2021 and 2030:

- Scenario 1: 10% of 2021 peak load
- Scenario 2: 10% of 2030 peak load
- Scenario 3: 25% of 2030 peak load
- Scenario 4: 40% of 2030 peak load

We started by developing an estimate of peak load of each utility for 2021 and 2030. The peak load estimates of the three utilities are developed using the combination of forecast from ISO-NE's forecast[10] and Northern Maine Independent System

[10]ISO-NE 2020 Forecast Data, available at: https://www.iso-ne.com/static-assets/documents/2020/04/forecast_data_2020.xlsx, accessed: January 8, 2021.

Administrator (NMISA).[11] Because the Commission report was triggered in 2020 based on reaching 10% of 2020 peak load, we have used 2020 peak load for the 2021 scenario. The peak load for CMP and BHE is based on ISO-NE forecast, whereas MPD's peak load is based on a forecast from NMISA. The ISO-NE's 2020 load forecast included peak load for 2020-2029 period. The 2030 peak load is based on compound annual growth rate of 2020-2029 period. Similarly, NIMSA produces seven-year outlook forecast and the latest forecast included the outlook for 2020 – 2026 period.[12] The 2030 peak load estimate is based on the compound annual growth rate of 2020-2026 period.

We then applied the appropriate percentage to the peak load to get the total capacity addition. The peak load addressed by NEB is divided into small BTM and community solar by assuming a 30/70 breakdown, respectively.[13] We further break the community scale projects down into kWh projects and Tariff Rate projects assuming that 40% of community scale projects will participate in the kWh program based on the current operating and proposed projects in the NEB program. This results in 227, 257, 643, and 1029 MW of solar installed in scenarios 1, 2, 3, and 4, respectively.

Table 5 shows total solar capacity assumed in each scenario further broken down by project type. Solar capacity is given in MW AC as this is the way the Commission Analysis has represented it.

[11] Northern Maine Independent System Administrator, Inc., "*Seven-Year Outlook*," accessed on January 8, 2021, available at: https://www.nmisa.com/wp-content/uploads/2020/04/2020-Seven-Year-Outlook.pdf.

[12] We removed the peak load of Eastern Maine Electric Cooperative (EMEC) that is included in NMISA's seven-year outlook by using EMEC's latest, publicly available annual report that can be accessed here: https://www.emec.com/sites/emec/files/PDF/Annual%20Reports/EMEC2019.pdf.

[13] The maximum assumed residential PV capacity installation, combined for all utilities, for any given year is 300 MW.

Table 5. Total NEB solar capacity installation by scenario (MW_{AC})

SCENARIOS	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
CMP Small BTM - kWh	55	62	156	243
CMP Community Scale -kWh	51	58	146	236
CMP Community Scale -Tariff Rate	77	87	218	354
Total CMP	**184**	**208**	**520**	**832**
BHE Small BTM - kWh	10	11	27	44
BHE Community Scale - kWh	9	10	25	41
BHE Community Scale -Tariff Rate	14	15	38	61
Total BHE	**32**	**36**	**91**	**146**
MPD Small BTM – kWh	3	4	10	15
MPD Community Scale - kWh	3	4	9	14
MPD Community Scale -Tariff Rate	5	5	13	21
Total MPD	**11**	**13**	**32**	**51**
ME Small BTM - kWh	68	77	193	302
ME Community Scale - kWh	64	72	180	291
ME Community Scale -Tariff Rate	95	108	270	436
ME Total (MW)	**227**	**257**	**643**	**1029**

Capacity factors for the two project types and utility service territories were developed using NREL's PV Watts. We assumed that the BTM projects would be largely rooftop configurations and that half of the community scale projects would utilize single access tracking and half would utilize fixed tilt. The resulting capacity factors are shown in Table 6.

Table 6. AC capacity factor by project type

PROJECT TYPE	CAPACITY FACTOR
CMP – Small BTM	18.3%
CMP - Community Scale	20.5%
BHE and MPD – Small BTM	16.8%
BHE and MPD - Community Scale	18.1%

Based on the capacity factors shown in Table 6, the projected annual energy generation by scenario is shown in Table 7, below. The annual energy generation ranges from a total of 387 GWh in Scenario 1 to 1,754 GWh in Scenario 4. For Reference Maine's total energy demand is forecasted to be just over 16,000 GWH by 2029.

Table 7. Total annual NEB solar energy generation by scenario (MWh)

SCENARIOS	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
CMP Small BTM - kWh	88,444	100,238	250,595	389,662
CMP Community Scale -kWh	92,328	104,641	261,601	423,613
CMP Community Scale -Tariff Rate	138,493	156,961	392,402	635,420
Total CMP	**319,265**	**361,839**	**904,599**	**1,448,696**
BHE Small BTM - kWh	14,340	16,106	40,266	64,425
BHE Community Scale - kWh	14,420	16,196	40,490	64,785
BHE Community Scale -Tariff Rate	21,631	24,294	60,736	97,177
Total BHE	**50,391**	**56,597**	**141,492**	**226,387**
MPD Small BTM - kWh	5,033	5,652	14,131	22,609
MPD Community Scale - kWh	5,061	5,684	14,210	22,735
MPD Community Scale -Tariff Rate	7,591	8,526	21,314	34,103
Total MPD	**17,684**	**19,862**	**49,655**	**79,447**
ME Small BTM - kWh	107,817	121,997	304,991	476,696
ME Community Scale - kWh	111,809	126,521	316,301	511,134
ME Community Scale -Tariff Rate	167,714	189,781	474,452	766,700
ME Total	**387,341**	**438,298**	**1,095,745**	**1,754,530**

We also calculated the carbon emissions reduction for each scenario based on the load weighted marginal emissions rate in ISO-NE in 2018 of 745 lbs/MWh,[14] which is the most recent year that data was available. The carbon reduction is shown below in Table 8.

Table 8. Annual carbon reduction by scenario in that year (tons)

	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
CMP	118,926	134,785	336,963	539,639
BHE	25,358	28,481	71,202	113,994
MPD	6,587	7,399	18,496	29,594
Maine Total	144,284	163,266	408,165	653,633

[14] ISO New England, "*2018 ISO New England Electric Generator Air Emissions Report*," p. 5, available at: https://www.iso-ne.com/static-assets/documents/2020/05/2018_air_emissions_report.pdf.

C. NEB Program Type Cost-Benefit

1. Comparison to Commission Report

The Commission Report provided an "illustrative analysis of ratepayer impacts" in its report. The Commission analysis showed the cost of the NEB program to Maine customers to be over $160 million in one year. Three issues in the report's analysis overstate the potential utility revenue impact:

- **Treatment of capacity revenues for Tariff Rate projects.** The rules of the Tariff Rate NEB program give ownership of both energy and capacity revenues from the NEB projects to the distribution utilities for the Tariff Rate program.[15] The analysis presented in the Commission Report only credits the utilities for the value of the energy from the Tariff Rate program.
- **No attrition rate assumed for non-operational and pending projects**. Comments by Revision Energy, CES, MREA, and CCSA in Case 2020-00199 pointed to a range of attrition rates, from 25 to 70%. Due to this range, we assumed an attrition rate of 50 percent for the larger community scale projects which make up the bulk of active non-operational and pending projects.
- **Not considering the all the benefits that solar provides.** The Commission did not include the all the benefits that solar provides to Maine in its analysis. This report provides an expanded analysis of the benefits.

Using the results from 2021 from Scenario 1, we updated the illustrative analysis presented by the Commission which is shown below in Table 9. This demonstrates that the Commission Report vastly overstated NEB program costs. In our analysis, the widely quoted $161 Million net cost of the program becomes a net benefit of $1.8 million. When just considering operational projects, the program provides $2.1 million in net benefits.

[15] Note that the calculations for the kWh program do not have this issue because they are correctly given credit for the full value of avoided standard offer service in the analysis.

Table 9. Updated analysis from the Commission report

(NET COST) OR BENEFIT	COMMISSION REPORT ASSUMPTIONS	VALUING PROJECTS AT VALUE OF SOLAR
All Projects per PUC Report	($160.8) [16]	$1.8
Operational Projects only[17]	($8.5)	$2.1
Operational Projects + 50% Attrition Remaining[18]	($84.7)	$2.0

2. Daymark Study Cases

Daymark studied the benefits for each program for both CMP and BHE. Because the MPD is outside ISO-NE we have not developed a full net benefits analysis for that district. Benefits accrue since the additional solar stimulated by the NEB program has the following impacts:

- Reduces ISO-NE's generation through a wholesaler bulk market transaction or through a reduction in the amount of retail standard offer power.
- Reduces the charges to Maine by ISO-NE to support the regional transmission system.
- Reduces the ISO-NE wholesale energy and capacity market prices.
- Reduces the cost to Maine for compliance with its RPS.
- Reduces the emissions of CO_2, NO_X and SO_2.
- Creates activity within the Maine economy from the marketing, sales, construction and service expenditures for the NEB solar facilities.

For each of the scenarios studied, we calculated the net benefit which is the benefits just described above minus the cost of the program provided in Section V. Each of the scenarios includes an analysis of both.

The cost to other customers of the Tariff Rate program is the Tariff Rate determined by the PUC and the cost of the kWh program to other customers is the T&D rate for the applicable utility. The benefits include components of the value of solar. We have not calculated the full costs and benefits of projects in the Maine Public District. For that reason, our costs and benefits calculations only include CMP and BHE service territories.

[16] This number comes directly from the Commission's November 10 report.

[17] The development of the impacts based upon operational projects was first established by Daymark in its initial review dated January 5, 2021 and filed on behalf of the CCSA on January 7, 2021.

[18] The development of the impacts based upon only operational and 50% of the projects proposed was first established by Daymark in its initial review dated January 5, 2021 and filed on behalf of the CCSA on January 7, 2021.

As shown in Table 7, about 5 percent of the capacity in the scenarios we analyzed was in the Maine Public District.

Table 10, below, shows the total net benefit (cost) of the Net Energy Billing program to customers by utility and project type. It demonstrates that kWh projects are providing net benefits and that the community scale projects in the Tariff Rate program are driving the program's net costs. Overall, the NEB program provides Maine customers $1.9 Million of benefits in Scenario 1, and benefits between $5.1 and $21 Million for Scenarios 2 through 4.

Table 10. Annual benefit (cost) of NEB Program in the scenario year ($2021 Millions)

SCENARIOS	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
CMP - kWh	$3.2	$7.1	$17.8	$29.0
CMP -Tariff Rate	($1.0)	($1.7)	($4.2)	($6.7)
Total CMP	$2.2	$5.4	$13.6	$22.2
BHE - kWh	$0.1	$0.3	$0.7	$1.3
BHE -Tariff Rate	($0.4)	($0.6)	($1.6)	($2.6)
Total BHE	($0.3)	($0.3)	($0.9)	($1.2)
ME - kWh	$3.3	$7.4	$18.5	$30.3
ME -Tariff Rate	($1.4)	($2.3)	($5.7)	($9.3)
ME Total	$1.9	$5.1	$12.8	$21.0

It is helpful to look at these numbers on a unitized basis to answer such questions as: What is the impact for each kWh of solar energy provided on average? Or for each MW? Or how much is the net cost for each ton of carbon we reduce from the NEB solar? The last question is most interesting. Our analysis shows that there is a net program benefit in 2030 so there is no cost to obtain the carbon reduction when one accounts for all the benefits. We provide the answers to these questions, calculating the net benefit of the NEB program in terms of cents per kWh, dollars per MW, and dollars per ton of carbon avoided. These metrics are shown below in Table 11.

Table 11. Benefit (cost) of Net Energy Billing Program

METRIC	SCENARIO 1 10% BY 2021	SCENARIO 2 10% BY 2030	SCENARIO 3 25% BY 2030	SCENARIO 4 40% BY 2030
Total (Millions)	$1.9	$5.1	$12.8	$21.0
¢/kWh Solar	$0.5	$1.2	$1.2	$1.2
$/MW Solar	$8.2	$19.8	$19.8	$20.4
$/ton of carbon avoided	$13.0	$31.3	$31.3	$32.2

D. Benefits Not Included in this Analysis

There are several components of utility cost savings that would add materially to the benefits side of the equation. These benefits are highly location dependent and are not possible to include within the scope of this study during the time limitations. These include:

- **Avoiding Distribution System Investments.** These benefits are locational which means the savings benefits would be realized on that circuit or feeder experiencing the savings but not throughout the entire distribution system uniformly. Benefits would be created when the addition of solar on a circuit allows the utility to avoid or defer an upgrade. The locational nature of this benefit makes it challenging to develop a system wide estimate of this benefit.
- **Avoiding Transmission Network Investment.** This report and the majority of reports, including Maine's 2015 Value of Solar report, include the benefit of reduced transmission charges due to peak load reduction. In New England, these charges are the avoided RNS charges. Very few reports calculate the reduced transmission investment required due to added solar. Where calculated we found avoided transmission investment estimates ranging from $1-$15/MWh in $2021.[19]

There are benefits to the NEB program which we have not included in this analysis because they do not evenly accrue to all Maine utility customers. These were not included because the focus of this analysis was on impacts to customers as a whole rather than individual customers. These include:

[19] We found 3 reports estimating avoided transmission investment : An Arkansas Report (http://www.apscservices.info/pdf/16/16-027-R_228_1.pdf, page 65); a Mississippi report (https://www.psc.state.ms.us/InSiteConnect/InSiteView.aspx?model=INSITE_CONNECT&queue=CTS_ARCHIVEQ&docid=565391, p ES-4-ES-5), and a previous Daymark report to the Maryland PSC, entitled, Benefits and Costs of Utility Scale and Behind the Meter Solar Resources in Maryland, November 2, 2018, page 110.

- **Benefits to customers who participate in the NEB program**. Project owners offer customers the output of the community scale projects at a discount to the retail rate. This means that the participating customers save money on their electric bills, allowing them to invest that money in other areas of the Maine economy. A participating industrial customer may be able to offer more competitive pricing for its products in the market due to the NEB program or a municipality customer may be able to reduce taxes for residents or invest the savings in the town.
- **Benefits from grid upgrades**. Developers of solar projects pay for updates to the grid through the interconnection process. These upgrades obviously benefit the developer, who can now interconnect their project, but they also create a more robust grid that can accommodate other users. For example, upgrades funded through the interconnection process improve local grid reliability and resilience and may allow new load sources such as electric vehicle charging to be more easily incorporated and at no additional cost.

E. Comparison of Results for Different of Solar Installations

1. Overview

We calculated the net benefit for each type of solar installation by scenario and by utility. The net benefit analysis uses the Commission methodology to determine the cost of each NEB program. The benefits of each program are made up of different components of the value of solar for each program. For the kWh program, the benefits include the Wholesale Market Price Impact (DRIPE) benefit, the RNS Change Impact (BTM only), the Environmental Benefits, and the Economic Impact. For the Tariff Rate program the whole value of solar is included.

Table 12, below, shows the net benefit by project and program type. Projects in the kWh program provide benefits in all four scenarios, while Tariff rate program have a net cost. This result corresponds to projects in the kWh program reducing load requirements of the utilities while projects in the Tariff Rate program do not. By reducing load directly, the kWh projects reduce the standard offer obligation for the utilities and are credited with the full standard offer rate in the Commission's calculation of project cost-effectiveness.

Table 12. Net benefit (cost) by scenario ($2021/MWh)

UTILITY	CMP				BANGOR HYDRO			
YEAR	**2021**	**2030**			**2021**	**2030**		
SCENARIO	10%	10%	25%	40%	10%	10%	25%	40%
kWh Program	$17.50	$34.68	$34.69	$35.61	$4.50	$9.18	$9.19	$10.28
Tariff Rate Program	$(7.25)	$(10.58)	$(10.58)	$(10.58)	$(19.38)	$(26.29)	$(26.29)	$(26.29)

2. Detailed Net Benefit Results

Figure 4 and Figure 5, below, show the detailed results of the net benefit analysis. Each figure shows the benefit components compared to the program costs.

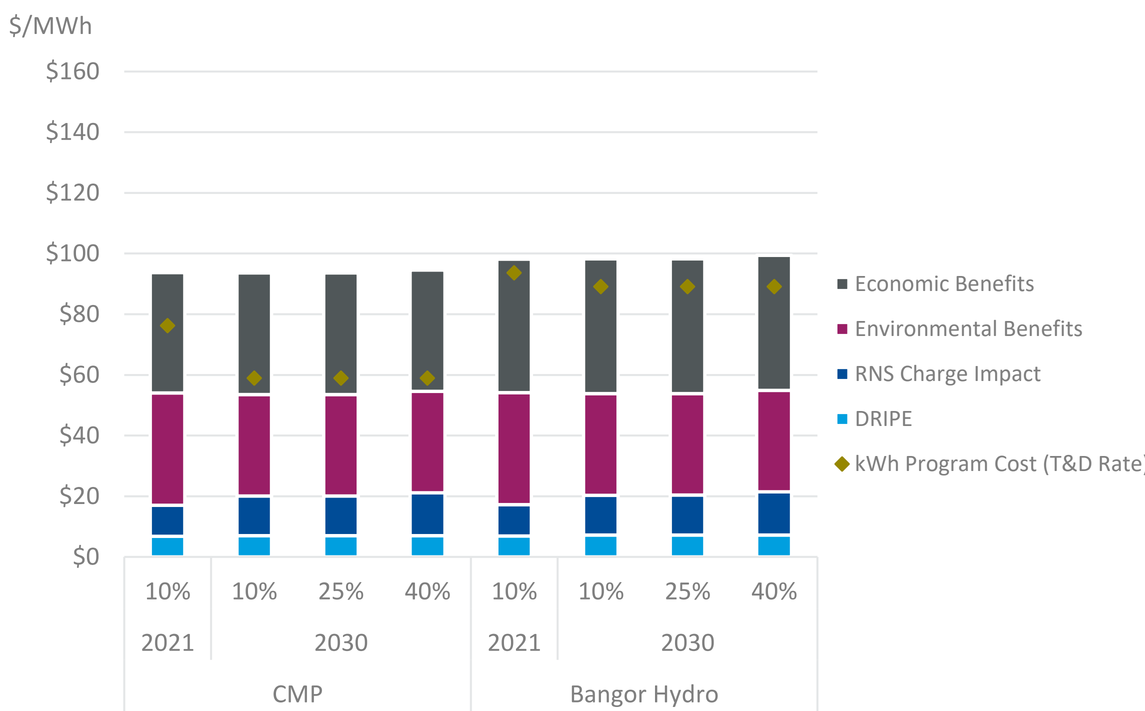

Figure 4. Cost and benefit: kWh Program

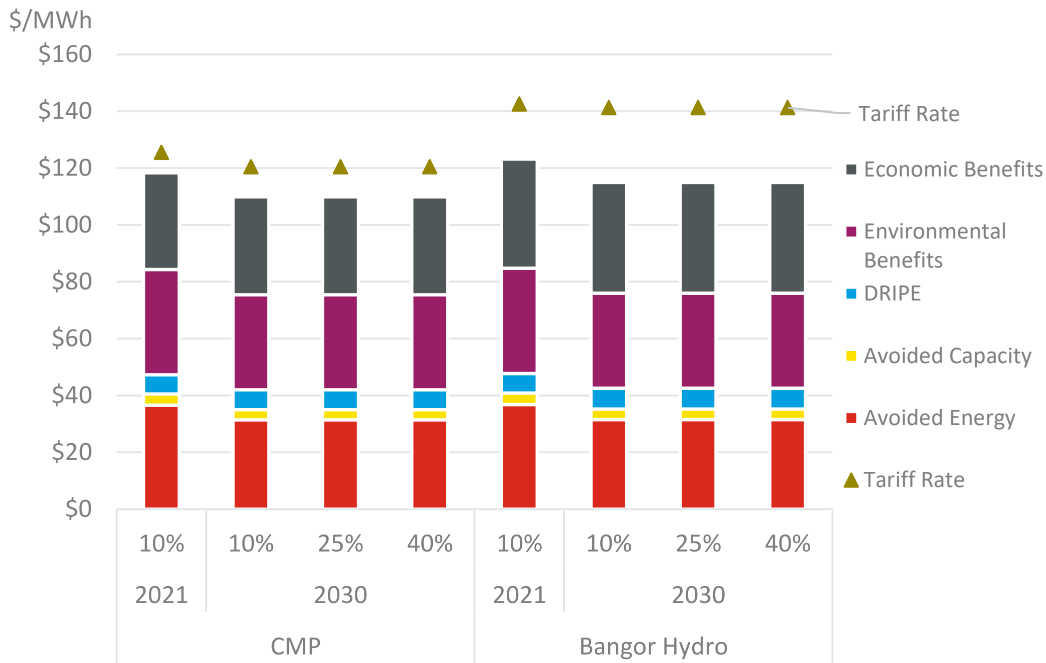

Figure 5. Cost and benefit: Tariff Rate Program Resources

V. BENEFITS OF SOLAR METHODOLOGY

A. Overview

The benefit of solar generation is determined by giving careful to consideration to all the attributes that come with developing and operating solar facilities under the NEB program. This chapter of the report provides Daymarks methodology for monetizing the value of the attributes of the solar projects within the NEB program context.

Understanding and valuing solar generation's contribution to the electricity system is a widely discussed topic across the country. This analysis is built from the components of potential benefits (or costs) that solar brings when interconnected with the system. Solar generation facilities that are participating in the Maine NEB program bring several types of benefits to Maine customers:

- **Bulk power system benefits**. These benefits include the value of the products the solar project provides or allows the utility to avoid purchasing including energy and capacity. It also includes changes in the cost to serve load due to the addition of certain resources, such as a reduced RPS obligation or a reduction in Maine's share of the RNS charges. Also, the addition of a zero marginal cost and/or load reducing resource will reduce the price for energy and capacity for all of Maine's retail customers' energy consumption. This market price effect is referred to as Demand Reduction Induced Price Effects (DRIPE).
- **Societal benefits.** Societal benefits include both environmental benefits and economic development benefits. Whether the solar generation is serving customers through wholesale or retail markets it reduces the amount of generation in ISO-NE that is emitting CO2, NOx and SO2. These zero emissions attributes of the solar generation have significant environmental value. The activity created through the construction of solar facilities as well as sales, marketing and service of the retail customers to incent their participation in Maine's NEB program provide additional amounts of benefits to the economy of Maine.

The components included in the analysis are shown below in Table 13. It is important to understand that not all potential components were within the scope of this analysis.

There are several other potential ways that solar benefits the electric system and society including:

- **Distribution System Benefits.** Adding solar to the distribution system has the potential to eliminate or delay required investment in the distribution system infrastructure. The benefits would vary by circuit.
- **Avoided Transmission Investment.** We have calculated the reduction of Maine's share of the Regional Network Services charge from ISO-NE, but we have not calculated the potential savings from reducing the required investment from adding solar capacity to the Maine grid. Previous studies, such as the previous Maine Value of Solar Study have found value here.
- **Fuel Price Hedge Savings.** The cost structure of solar creates essentially a fixed cost resource. Therefore, adding solar leads to a reduction in reductions in exposure to volatile fuel prices.

Table 13. Components included in analysis

COMPONENT	DESCRIPTION
Avoided Energy	Market energy purchases avoided due to distributed solar for kWh program or wholesale market value of solar for Tariff Rate program
DRIPE	Indirect effects of solar on market prices for energy and capacity
Avoided Capacity	Market capacity purchases avoided due to distributed solar for kWh program or wholesale capacity market value of solar for Tariff Rate program
Avoided RNS Charges	Reductions in Maine's share of ISO-NE's Regional Network Services Charge
RPS Benefit	Reductions in an entity's requirements to comply with RPS policies
Environmental Benefits	Value of reductions in air pollutant emissions
Economic Benefits	Benefits to Maine's economy from solar development

B. Bulk Power Market Benefits

1. Overview

The facilities that are part of the Tariff Rate Program will reduce provide wholesale energy and capacity into the ISO-NE market. Daymark has evaluated the impact that the

Community Solar facilities will have in the years 2021 and 2030 as part of this study and the benefits that are created by these facilities.

2. Avoided Energy Benefits

Daymark adopted an approach to determining the avoided energy benefits associated with increased solar penetration by modifying the methodology used by the AESC 2018 report. Since the AESC report primarily deals with energy efficiency, the avoided wholesale energy costs had to be adjusted to the generation profile of the solar facilities to account how solar operates only during specific hours.

Daymark used the AURORA energy market model to develop a reference ISO-NE energy market simulation to get an outlook for hourly prices in southern and central Maine for 2021 through 2030. This outlook is primarily based on assumptions for loads and resources contained in the 2020 ISO-NE Capacity, Energy, Loads, and Transmission (CELT) Report[20] and the natural gas price outlook produced by EIA[21]. Generally electric wholesale market energy prices, driven by declining natural gas prices, are expected to decline over the next few years on a real dollar basis for before rebounding with slight real price growth in the second half of the next decade, resulting in prices in 2030 that are lower than 2021 on a real dollar basis.

Solar generation profiles were developed for facilities using Daymark generated solar shapes derived in Portland and Bangor (to represent CMP and BHE respectively) from the NREL PV Watts tool. These solar generation profiles were used to develop weighted average energy cost savings for solar facilities at those locations.

For both 2021 and 2030, the value of wholesale energy was scaled up to retail using the methodology in the AESC report. The Wholesale Avoided Energy Value of each project type are shown below in Table 14. The continued decline in natural gas prices over the last five years has resulted in dramatic reductions in the energy value of solar generation from the Maine 2015 Value of Solar Study[22].

Table 14. Avoided energy value by project type ($2021/MWh)

CMP		BHE	
2021	2030	2021	2030
$36.64	$31.40	$36.80	$31.53

[20] https://www.iso-ne.com/system-planning/system-plans-studies/celt/

[21] 2020 EIA Forecast.

[22] 2015 Maine VOS reference.

3. Avoided Capacity Benefits

According to NEB tariff language, the utilities are allowed to sell Tariff Rate resources into the ISO-NE capacity market. It does not appear that CMP or BHE are currently doing this. We verified that solar should qualify for the Forward Capacity Market (FCM) and in fact, there is evidence that solar has cleared the capacity market recently. ISO-NE publishes a spreadsheet of all qualified and cleared generators for each Forward Capacity Auction (FCA) and in the most recent auction, FCA 14, 383 MW of solar cleared. If a generator does not clear the FCA, they have the option to participate in any of the three reconfiguration auctions (ARAs) that occur. ARA 1 occurs two years before the corresponding FCA, ARA 2 occurs one year before, and ARA occurs a few months before. All four of these capacity auctions give the utilities a strong likelihood to earn revenues from NEB.

The wholesale capacity value of solar is determined by its generation during the period of 2-6 PM in the summer and 5-7 PM in the winter. We used the solar profiles for Portland and Bangor mentioned above to determine the capacity value of Community Scale resources in the Tariff Rate Program. Table 15 shows the wholesale capacity value of solar for both utility service territories.

Daymark advises clients on the ISO-NE capacity market rules and price outlook for upcoming Forward Capacity Auctions (FCAs). ISO NE has already conducted auctions for pricing through FCA 14, which governs the period 6/1/2023 through 5/31/2024. Daymark has developed a proprietary model to produce an outlook for the capacity market prices beyond the period of FCA 14. We utilized the actual capacity price for 2021 and the Daymark forecast price for 2030.

Table 15. Wholesale capacity value of solar

	CAPACITY VALUE	CAPACITY PRICE ($2021/KW-MONTH)		WHOLESALE CAPACITY BENEFIT ($2021/MWH)	
		2021	2030	2021	2030
CMP	38%	$4.63	$4.32	$3.87	$3.61
BHE	35%	$4.63	$4.32	$4.03	$3.76

C. Retail Generation Service Benefits

1. Overview

In the kWh program solar generation will reduce the amount of energy that is transacted on a retail basis. This reduction in load will reduce charges to Maine for use of the regional transmission service, reduce the cost of RPS compliance and reduce certain fees and changes for additional ISO-NE services.

2. Retail Avoided Energy

The wholesale energy values of solar described above were grossed up according to the methodology in the AESC report. The retail avoided energy values for CMP and BHE service territories are included in

Table 16: Retail avoided energy ($2021/MWh)

CMP		BHE	
2021	2030	2021	2030
$42.73	$36.63	$42.93	$36.77

3. Retail Avoided Capacity

The value of capacity from the kWh program is based on the reduction in load from solar generation at the time coincident to ISO-NE's annual system peak. ISO NE's forecasted system peak hour for 2021 and 2030 were used with the solar facility load shape to determine the projected output of Small BTM and Community Scale Projects during those times to determine the capacity equivalence that the solar facility would receive. We then multiplied the capacity equivalence by the forecasted FCA price. Table 17 shows the results of this analysis.

Table 17. Avoided capacity for kWh projects ($2021/MWh)

CMP		BHE	
2021	2030	2021	2030
$22.35	$19.04	$22.83	$19.45

4. Avoided Transmission Charges (RNS)

As the state of Maine increases its BTM solar capacity, Maine's overall load will be reduced. This will decrease the amount Maine utilities pay ISO-NE for RNS. RNS is the transmission service that transmission customers purchase to service their network load in the New England Control Area. The avoided RNS costs depends on the amount of load reduction from BTM solar that occurs during the ISO-NE monthly peak.

To determine the annual avoided RNS costs, Daymark performed the following:

- The hourly rooftop solar capacity factors for each month in Maine determined the hourly load reductions by month driven by BTM solar.
- The hourly load reductions in the hours corresponding with each monthly ISO-NE peak to get a monthly load reduction.
- The monthly load reductions are multiplied by Daymark projections of future RNS charges for 2021 and 2030.[23]
- The reduced the Maine's allocation of RNS charges that results, increases the RNS charge, slightly offsetting savings from avoided RNS charges.

Table 18. Avoided RNS charges ($2021)

	SCENARIO 1 - 10% BY 2021	SCENARIO 2 - 10% BY 2030	SCENARIO 3 - 25% BY 2030	SCENARIO 4 - 40% BY 2030
Avoided RNS Allocation	$2,245,915	$3,262,973	$8,158,525	$12,958,888
Savings Offset by Increased RNS rates	($181,719)	($288,838)	($718,066)	($1,134,137)
Total Net Savings	$2,064,196	$2,974,134	$7,440,459	$11,824,751
Net Savings/MWh	$10.28	$13.09	$13.09	$14.16

5. Reduced RPS Compliance Costs

Load serving entities in Maine are required to provide a certain percentage of renewable energy to customers to comply with Maine's RPS. The RPS requirements are divided into three classes, Class 1, Class 1A, and Class 2. The requirements for 2021 and 2030 are shown below in Table 19.

[23] New RNS rates are effective June 1 of each year so each calendar year will have an RNS charge for January 1 through May 31 and then a different one for June 1 through December 31.

Table 19. Maine RPS requirements a percent of load

YEAR	2021	2030
Class 1	10.0%	10.0%
Class 1A	5.00%	40.0%
Class 2	30.0%	30.0%
Total RPS	42.5%	80.0%

Both the kWh and Tariff rate NEB programs are constructed in a way such that the Maine utilities or generation service providers do not get to take credit for the RECs created by the facilities in the NEB program. The solar facilities within the kWh program create a savings related to the Maine RPS since they reduce the Maine load. The benefit to Maine customers of kWh program resources is the avoided RPS compliance that would have been required but for each kWh of solar generated under the NEB kWh program. For each unit of kWh program solar that is generated, the avoided RPS compliance costs are the percentage requirement of each tier times the REC cost for that tier. For example, in 2021 the avoided RPS compliance cost would be 10% times the Class 1 REC price plus 5% times the Class 1A REC price plus 30% times the Class 2 REC price.

Community solar projects participating in the Tariff programs of NEB do not produce an RPS savings.

Daymark forecasted a REC price for each class. The REC price for Class 1 and Class 2 resources was expected to remain constant in real terms between 2021 and 2030 since the Maine Class 1 REC price has been below the Class 1 REC price of other New England states. This is due to the more permissive rules around biomass and hydro qualification in Maine.

The increasing requirements of Class 1A will result in Class 1A REC prices to converge with Class 1 REC prices in the other New England states. The 2030 REC price for Class 1A resources was estimated to be the cost of entry of the marginal renewable resource, in 2030, an offshore wind farm in Southern New England. We calculated a required REC price for that resource using assumptions about the cost of offshore wind from the National Renewable Energy Laboratory Annual Technology Baseline[24] and the expected levelized energy and capacity revenues from the same sources described above in the avoided energy and avoided capacity sections.

The calculated benefit for kWh and Tariff program resources are shown below in Table 20. The benefits are the same for all utility territories in the state.

[24] https://atb.nrel.gov/electricity/2020/data.php

Table 20. RPS benefit ($2021/MWh)

	2021	2030
kWh program	$1.18	$8.32
Tariff Program	$0	$0

6. Avoided Standard Offer

The facilities in the kWh program avoid the purchase of generation services from either standard service provider or from an individual competitive provider either of whom would serve as the LSE. In a manner like that used within the analysis in the Commission report, Daymark is assuming that the generation services avoided would be that of the standard offer provider.

The major portion of the cost of generation services is the cost of the power itself. LSEs are responsible for the full requirements of the customers that they acquire. This means that their ISO-NE services and charges extend beyond the energy and capacity of the wholesale market value. The LSE's cost of capacity would need to account for capacity reserve savings in addition to the maximum load reduction for example.

The cost to serve load which is the basis of the standard offer rate includes the following components:

- Energy
- Capacity
- Ancillary Services
- Net Commitment Period Compensation
- Wholesale market services charges
- Miscellaneous Credits/Charges
- Renewable Portfolio Standard Charge

Daymark adjusted the outlook for the costs of energy, capacity, and RPS charges based on our analysis described above. The costs for the other components were estimated based on ISO-New England data and assumed that those components would stay constant in real terms between 2019, the last full year available, and 2030. Table 21 shows our standard offer price estimated for 2030. It is important to note that the avoided energy and capacity numbers in this forecast are based on the same underlying outlook for ISO-NE market clearing prices for energy and capacity used in the wholesale and retail energy and capacity sections discussed above.

Because the kWh program is reducing load, it is also avoiding the ancillary services, NCPC, Wholesale Market Charges, and Miscellaneous Credit/Charges shown in Table 21. These charges add up to just over $2/MWh.

Table 21. Standard offer components: 2030 ($2021/MWh)

	CMP	BHE
Energy	$ 33.18	$ 33.18
Capacity	$ 10.07	$ 9.95
RPS	$ 8.32	$ 8.32
Ancillary Services	$ 0.60	$ 0.60
NCPC	$ 0.85	$ 0.85
Wholesale Market Charges	$ 0.73	$ 0.73
Miscellaneous Credits/Charges	$ (0.08)	$ (0.08)
Total Standard Offer[25]	$ 57.96	$ 57.84

7. Market Price Reduction Benefits (DRIPE)

Demand Reduction Induced Price Effects, or DRIPE, is the amount of price reduction in the wholesale capacity and energy market resulting from either reduced load or new capacity added. The Avoided Energy Supply Cost (AESC) report compiled by Synapse every two years estimates DRIPE resulting from energy efficiency measures. The analysis of DRIPE is a very detailed statistical exercise examining the hourly energy market and yearly capacity market supply curves either with actual market data or in hourly energy market simulations. Daymark's DRIPE analysis builds off the AESC DRIPE results for energy efficiency. Two examples of aspects of the AESC methodology that were preserved in the Daymark study would be that the AESC methodology accounts for the temporal effects of the market price suppression and the estimates for the portion of load in Maine and ISO-NE whose prices do not vary directly with changes in ISO-NE market clearing prices. There were three primary adjustments required to build off the 2018 AESC DRIPE analysis.

1. Capture the impact of the difference in energy, peak demand and capacity characteristics of behind the meter solar as compared to energy efficiency,
2. Extend the analysis reflecting installations of solar facilities over ten years rather than two years of energy efficiency which was the focus of the 2018 AESC, and

[25] The total standard offer is marked up by 8%.

3. Update the DRIPE findings to account for the more current outlooks Daymark developed for the ISO-NE energy and capacity markets.

The energy market price reduction resulting from the NEB kWh program's facilities reduces the cost of generation services and thus lowers the price of standard offer service for all the utility's customers in Maine. Similarly, the capacity price reductions lower the price of standard offer service to all the utilities in Maine. The savings in total for all customers is a benefit that is ascribed to the value of BTM NEB program solar facilities.

The Tariff Rate program projects create a similar market price reduction by increasing supply of zero cost resources. They act to reduce the cost of wholesale energy and capacity prices and therefore reduce costs to all Maine load.

Table 22. Intrastate DRIPE ($/MWh)

YEAR	PENETRATION	INTRA-ZONE ENERGY	INTRA-ZONE CAPACITY	TOTAL
CMP				
2021	10%	4.76	2.03	6.79
2030	10%	4.12	2.84	6.96
2030	25%	4.12	2.84	6.96
2030	40%	4.12	2.84	6.96
BHE				
2021	10%	4.90	2.03	6.93
2030	10%	4.42	2.84	7.25
2030	25%	4.42	2.84	7.25
2030	40%	4.42	2.84	7.25

The 2018 AESC identified not only the DRIPE effects utilizing the Maine savings described above, referred to as Intrastate DRIPE, but also calculated the savings that demand reductions in Maine would have if one looked beyond the state border for the savings in the entire ISO-NE market, referred to as Rest-of-Pool DRIPE. Since this study wished to see the impact of the Maine NEB program as compared to the Value of Solar to Maine, Daymark utilized only the Intrastate DRIPE effects in the results shown earlier in this report. However, since the 2018 AESC notes that it provides the Rest-of-Pool DRIPE since some New England states utilize the benefits that accrue to all New England from their state energy efficiency programs, we have calculated the Rest-of-Pool DRIPE values for the BTM solar as well. The values provided in Table 23 below would be additive to the value of behind the meter NEB kWh program facilities.

Table 23. Rest of Pool DRIPE ($/MWh)

YEAR	PENETRATION	INTER-ZONE ENERGY	INTER-ZONE CAPACITY	TOTAL
CMP				
2021	10%	33.77	23.13	56.90
2030	10%	24.49	32.54	57.03
2030	25%	24.49	32.54	57.03
2030	40%	24.49	32.54	57.03
BHE				
2021	10%	34.75	23.13	57.88
2030	10%	31.91	32.54	64.45
2030	25%	31.91	32.54	64.45
2030	40%	31.91	32.54	64.45

D. Environmental Benefits

Adding solar generation to Maine's electric grid has the impact of displacing emitting resources on the grid. In calculating the emissions reductions benefit of solar for this study, we have followed the general methodology taken in the AESC report but updated the analysis for changes in the emissions profile of marginal resources in ISO NE and the cost of emissions mitigation. These values apply to all project types.

1. Avoided Carbon Emissions Benefit

The AESC report discussed two methods of calculating the benefits of avoiding carbon emissions: a cost based on the damage that carbon emissions cause or the marginal abatement cost. The AESC report used the marginal abatement cost method in its 2018 report. It based the carbon emissions benefit on the local marginal abatement cost, which in New England was found to be the above market cost of developing new offshore wind resources.[26]

We used both recent public power purchase agreement pricing in New England and NREL's Annual Technology Baseline forecast of offshore wind levelized costs to develop an estimate of 20-year levelized costs for offshore wind in the region and subtracted our

[26] https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-Oct-ReRelease.pdf, pp. 140-144.

levelized outlook of energy and capacity revenues to determine the above market cost of offshore wind resources in New England. The result of this analysis was an avoided carbon benefit of $32/MWh in 2021 and 2030. Despite the predicted decline in offshore wind costs, we have kept the avoided carbon emissions constant in real terms to reflect the potential for increased grid integration costs by 2030 and the upward pressure to find more sites for renewable generation what with Maine and other New England States having aggressive decarbonization plans.

2. Avoided NO_x Emissions Reduction Benefit

We have utilized the NO_x emission benefit as calculated in the 2018 AESC report. That benefit was $1.65/MWh in $2018.[27] We have assumed that this benefit stays constant in real terms and have assumed a value of $1.78/MWh in $2021.

3. Avoided SO_2 Emissions Reduction Benefit

The AESC report does not provide a value for avoided SO_2 emissions. This appears to be because they are assuming that energy efficiency will replace a natural gas generator, which does not emit SO_2. The most recent marginal emission study from ISO-NE shows that there is still some SO_2 emissions in the marginal unit (.11 lbs/MWh in 2018)[28] Based on this, we have developed a SO_2 emissions benefit for 2021, with the assumption that the generation mix will have moved to a zero SO_2 emitting mix by 2030. We used analysis by the EPA, *Regulatory Impact Analysis for the Clean Power Plan Final Rule*, which showed the 2021 benefit per ton of SO_2 avoided in the Eastern United States to range from $33,000 to $75,000 per ton in $2011.[29] We took the midpoint of this range, which yielded a 2021 emission benefit of $3.52 per MWh.

The emission benefits are shown below in Table 24. They are the same for all solar resource types and for resources in all of Maine.

[27] *Ibid*, pp. 144-145.

[28] ISO New England, "*2018 ISO New England Electric Generator Air Emissions Report*," p. 5, available at: https://www.iso-ne.com/static-assets/documents/2020/05/2018_air_emissions_report.pdf.

[29] US EPA. Regulatory Impact Analysis for the Clean Power Plan Final Rule. EPA-452/R-15-003. Table 4-7. October 2015.

Table 24. **Emissions benefit ($2021/MWh)**

	2021	2030
Carbon Benefit	$31.70	$31.70
NO_x Benefit	$1.78	$1.78
SO_2 Benefit	$3.52	$0.00
Total Emissions Benefit	$36.99	$33.48

E. Maine Public District

The Maine Public District (MPD) service territory of Versant Power falls outside the ISO-NE marketplace, instead participating in the Northern Maine Independent System Administrator (NMISA). NMISA is a much smaller marketplace than ISO-NE, having a forecasted peak of 118.9 MW and 680 GWh in 2020[30]. The smaller system operator can only reach the rest of Maine and ISO-NE through facilities owned by New Brunswick Power Corporation[31]. In 2020, the Houlton Water Company, a municipal utility servicing Houlton and portions of surrounding towns, is leaving the NMISA to interconnect with the New Brunswick Transmission and System Operator[32].

Evaluating the value of solar in the MPD is challenging because it is not part of ISO-NE. Certain benefits like RPS are the same statewide, while others like RNS charge impacts are not applicable outside of ISO-NE. We have included a qualitative assessment of avoided energy and capacity below.

1. Avoided Energy

Given MPD's already low-cost retail standard offer retail rate (1.5 cents/kWh lower than the Bangor Hydro and 0.5 cents/kWh lower than CMP)[33], and supported a significant amount of near-zero marginal cost resources servicing load in NMISA, it is not unreasonable to suggest the value of avoided retail energy of solar in MPD would be lower than that in the rest of the state.

[30] Northern Maine Independent System Administrator, "*Seven-Year Outlook*," April 2020, p. 2, available at: https://www.nmisa.com/wp-content/uploads/2020/04/2020-Seven-Year-Outlook.pdf.

[31] *Ibid*, p. 1.

[32] *Ibid*, p. 2.

[33] Maine Public Utilities Commission website, "*Delivery Rates*," available at: https://www.maine.gov/mpuc/electricity/delivery_rates.shtml.

2. Avoided Capacity

NMISA seems to have a firm capacity contract with NB Power of 131 MW, as reflected in their 2020 Seven Year Outlook[34]. Unless the contract is amended to reduce the amount of needed capacity obligation to NMISA, it is unlikely that solar will provide any avoided costs of capacity.

[34] Northern Maine Independent System Administrator, "*Seven-Year Outlook*," April 2020, p. 5, available at: https://www.nmisa.com/wp-content/uploads/2020/04/2020-Seven-Year-Outlook.pdf.

VI. ECONOMIC DEVELOPMENT BENEFITS

A. Overview

The NEB program has the potential to make a material impact on Maine's economy as solar development takes off in the state. To quantify that impact, we have conducted an analysis of the benefits to Maine's economy from the NEB program. We have utilized the IMPLAN model for this analysis. IMPLAN is an input-output model that combines a set of databases of economic factors, multipliers, and demographic statistics to measure the economic impacts caused by investment or other actions that cause an increase in sales to local industries. Like other input-output models, IMPLAN relies on supporting data and general assumptions.

B. Economic Impact

1. Inputs of the Analysis

Cost assumptions

The economic impact analysis considers the capital investment and operating expenses occurring within the state of Maine relative to the solar programs. For our cost input assumptions, we relied on data from the National Renewable Energy Laboratory's (NREL) most recent U.S. Solar Photovoltaic System Cost Benchmark.[35] We used the Residential PV data to model residential roof installations and the Utility-Scale PV data to model community solar.[36] NREL provided average costs for each key component of the development and installation or construction. The NREL data was in 2018 dollars, so we converted to 2020 dollars by using Northeast Consumer Price Index (CPI) data to adjust for inflation.[37]

The cost information was then shared with the solar developers that are CCSA members to verify independently gathered cost information and capture any Maine specific costs that the national average cost did not include. We adjusted the construction labor cost component of community solar to a higher value to reflect higher average wages in the Northeast.[38] With feedback from the CCSA members, we also added a category in

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[35] National Renewable Energy Laboratory, "*U.S. Solar Photovoltaic System Cost Benchmark,*" accessed on December 15, 2020, available at: https://www.nrel.gov/docs/fy19osti/72399.pdf.

[36] For community solar costs, we added civil cost and customer acquisition cost to the data collected from NREL. This is discussed further in the report.

[37] The economic results generated are in $2021.

[38] Increased from $0.12/ W_{DC} to $0.20/ W_{DC} in $2020.

community solar to account for the civil works[39] - the clearing and grading of the site – and customer acquisition cost.[40] Since Maine is heavily forested, many sites must be cleared before any installation work can begin.

Maine-specific investments

The next step in the process was to estimate the Maine specific investments of total capital and operational cost of the solar investments to consider for the economic benefit analysis. For each of the cost components, we estimated the percentage of its cost to incur within the state of Maine based on research of the solar industry in Maine and inputs from CCSA members.[41] The cost categories considered for Maine specific investments are primarily labor related. We assumed none of the PV hardware, both module and inverter, was being manufactured in Maine. We assumed 50% of overhead costs were spent in Maine, as some developers are not located in the state. In total, the economic impact analysis assumed about 37% of total Community Scale capital cost and 33% of total small BTM capital costs to be incurred within Maine. We modeled 100% of O&M to be incurred in Maine.

Cost and labor productivity projections

The solar investments are assumed to take place in 2021 for that 10% of peak load scenario and in every year between 2021 – 2030 for the 2030 scenarios. The next step in the analysis was to estimate how the Maine specific investment cost categories are projected to change in future years. As discussed above, most of the estimated Maine specific economic benefits for solar investment is labor related, mostly construction and marketing services. Although the total capital cost of solar investment is expected to decrease considerably over the next decade,[42] the labor related cost may not follow similar trends. To test this hypothesis, we compared the historical wage growth rates of construction and professional services in Maine.

We used the construction sector as a proxy for construction and installation labor, and the business and professional services sector as a proxy for the marketing, administration and business management functions. We looked at the historical Maine-

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[39] The cost assumed from civil works is $0.12/W_{DC}$ for the community scale projects.

[40] The customer acquisition cost for community solar is $0.07/W_{DC}$.

[41] Some of the resources utilized for research are Solar Energy Industries & Association, The Solar Foundation, and National Association of Manufacturers.

[42] The Annual Technology Baseline survey from NREL assumes that, in its Moderate scenario, the capital cost of utility scale solar is expected to decrease by 38% in 2030 as compared to 2020 value.

specific data from the Bureau of Labor Statistics for the 2010 – 2020 period.[43] The compound annual nominal wage growth rate (CAGR) for both sectors in the period from 2010 to 2020 was around 2%. Inflation during the same period, based on IMPLAN's data, is 2.2%. This suggests that in real-terms, the wage rate has barely increased during the 2010 – 2020 period. We assume this trend to continue during the 2021 – 2030 period.[44] As a result, we expect the income benefits associated with labor to stay same through the decade.

Similarly, we assessed the labor productivity to determine if the labor required to install solar projects could change in the future years. Based on the historical trends and research, it appears that the labor productivity in construction is not going to improve significantly during the 2020 – 2030 period. A recent report from McKinsey & Company finds that construction labor productivity has remained sluggish with a productivity growth of 1 percent annually for the past two decades.[45] At the same time, the productivity growth of the global economy has increased approximately 2.8 percent a year.[46] Similarly, for the specific construction sector that is closely related with the labor required for small BTM and Community Scale, the historical data from U.S. Bureau of Labor Statistics shows that the labor productivity has stayed the same or decreased in the recent years.[47] As a result, we expect the effort necessary to install same size solar projects to remain the same during the 2021 – 2030 period.

2. Analysis Method

IMPLAN analysis

Daymark uses the IMPLAN model,[48] an input/output model developed by the IMPLAN Group to estimate the direct economic impacts to Maine at the utility service territory

43 U.S Bureau of Labor Statistics, "*New England Information Office,*" accessed January 20, 2021, available at: https://www.bls.gov/regions/new-england/maine.htm#eag.

44 The inflation rate for 2021-2020 period is estimated to be around 1.8%.

45 McKinsey & Company, "*The next normal in construction*," June 2020, available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/The%20next%20normal%20in%20construction/The-next-normal-in-construction.pdf.

46 *Ibid.*

47 U.S. Bureau of Labor Statistics, "*Labor Productivity for Construction*," accessed January 15, 2021, available at: https://www.bls.gov/lpc/construction.htm.

48 IMPLAN, "*What is IMPLAN?,*" August 13, 2018, accessed September 18, 2020, available at: https://blog.implan.com/what-is-implan#:~:text=IMPLAN%20is%20a%20platform%20that,system%20that%20is%20fully%20customizable.

level for each scenario resulting from the investment in, and operation of, rooftop and Community Scale solar projects.

Impacts from the analysis are broken into two categories: 1) direct benefits and 2) indirect benefits. Direct benefits are realized directly from investment into solar PV systems, such as parts and labor produced in Maine. Indirect benefits arise from the business-to-business transactions that are inherent within an industry's supply chain (for example, should a solar developer hire a contractor, and the contractor in turn leases a crane that lease would be considered an indirect benefit). IMPLAN also reports induced benefits, which are household spending resulting from the direct investment. As induced benefits are harder to track, measure, and verify, they are not included as part of this report. Both direct and indirect benefits are further broken down by category shown in Figure 6.

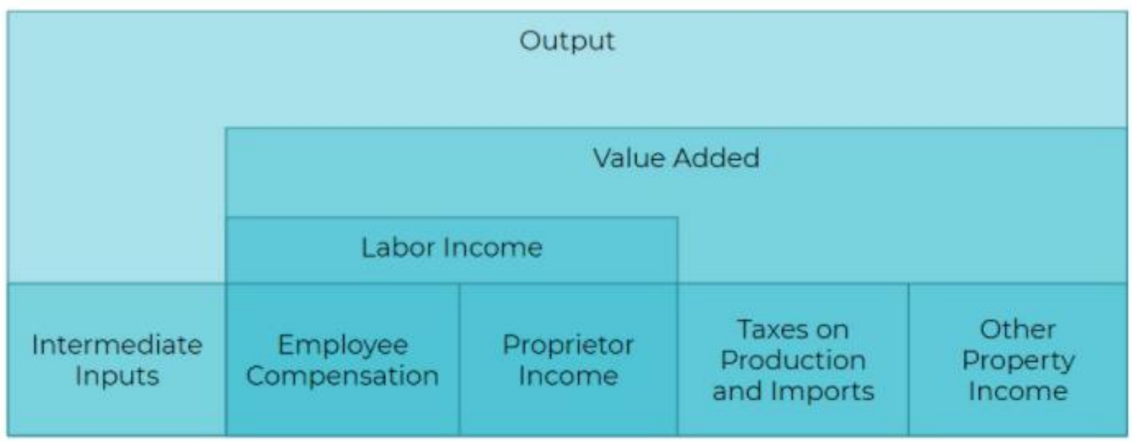

Figure 6. Components of output for a given industry[49]

Employment results can be difficult to interpret in an economic benefits analysis. The IMPLAN model reports employment output in two ways: "job years" and "employment compensation." If a worker is employed by a company in one position for 12 months, that is considered one job-year. If the same employee holds the same position for 24 months, this is considered two job-years. Additionally, if one employee holds two positions for the same 12 months, this is considered two job-years. IMPLAN provides ratios to determine full-time equivalents (FTEs) based on these job-years. The use of FTEs makes understanding employment figures easier – a person working one year for

[49] IMPLAN, "*Understanding Output*," accessed September 17, 2020, available at: https://implanhelp.zendesk.com/hc/en-us/articles/360035998833-Understanding-Output.

35 hours a week or more is considered one FTE, while a second individual working part-time for the same year would be considered 0.5 FTEs, depending on exact hours worked.

Employment compensation is simpler to understand, as it is the dollar value of the labor supported by the investment project.

IMPLAN, like any input/output model, considers gross benefits only, not net benefits. This complicates interpretation of results. It is difficult to determine exactly how much of the gross results are "new" jobs for example, and how much the project can be supported by any existing margins or "slack" in the industry. This holds truer for indirect and induced benefits and employment, where the jobs and industries impacted are best described as "supported" rather than "created."[50]

Finally, IMPLAN returns the output results in the current year dollars based on changes in inflation within each industry.

For this analysis, results generated by IMPLAN are in 2021 dollars. In order to estimate present value, Daymark applied the time value of money concept to the results, discounting future years at the real discount rates of 1.34%, used by the AESC 2018 report.[51]

NEB Projects Modeled

Daymark modeled the investment necessary for residential PV and utility scale solar in IMPLAN, using an analysis-by-parts method to determine more exact benefits than the generic "energy generation facility" category provided by IMPLAN. Analysis-by-parts identifies the industry category associated with individual aspects of the project, such as the inverters and the office space needed by a developer, and returns results based on these inputs.

IMPLAN results were then cross referenced outside the IMPLAN model with the relevant capacity addition in each scenario and cost and labor productivity projections to determine the overall economic benefits associated with the various scenarios.

[50] IMPLAN, "*Employment Data Details*," available at: https://implanhelp.zendesk.com/hc/en-us/articles/115009510967-Employment-Data-Details.

[51] "*Avoided Energy Supply Components in New England: 2018 Report, Appendix A,*" p. 251, accessed on January 19, 2021, available at: https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-June-Release.pdf.

3. Economic Impact Results

Each scenario produced significant economic benefits as shown in Figure 7. Detailed results are presented in Figure 8. Scenario 1 measured benefits associated with solar capacity installment reaching 10% of 2020 peak load in 2021. This equals o 161 MW of solar installation in 2021. Scenario 1 produced a total of 1,178 job years and $132 million of direct economic benefit. Indirect benefits included 554 job years and almost $41 million of total output across the state.

Scenario 2 modeled total solar installation reaching 10% of 2030 peak load by 2030. This translates to 191 MW of solar installation between 2021 and 2030. Over this period, Scenario 2 produced direct benefits 1,401 job years and $147 million of total output state-wide. Indirect benefits totaled 656 job years and $46 million of total output.

Scenario 3 measured economic benefits associated with solar installation reaching 25% of 2030 peak load by 2030. This equals total solar installation of 577 MW between 2021 and 2030. Across this period, direct benefits included 4,287 job years and $449 million of output. Indirect benefits include 2,014 job years and $140 million of output.

Scenario 4 was the most aggressive goal, with solar reaching 40% of 2030 peak load by 2030. This translates to total of 962 MW of additional solar installation in Maine during 2021 – 2030 period. Total direct benefits over the period include 7,157 job years and $750 million of economic output. Indirect benefits include 3,361 job years and $234 million of output.

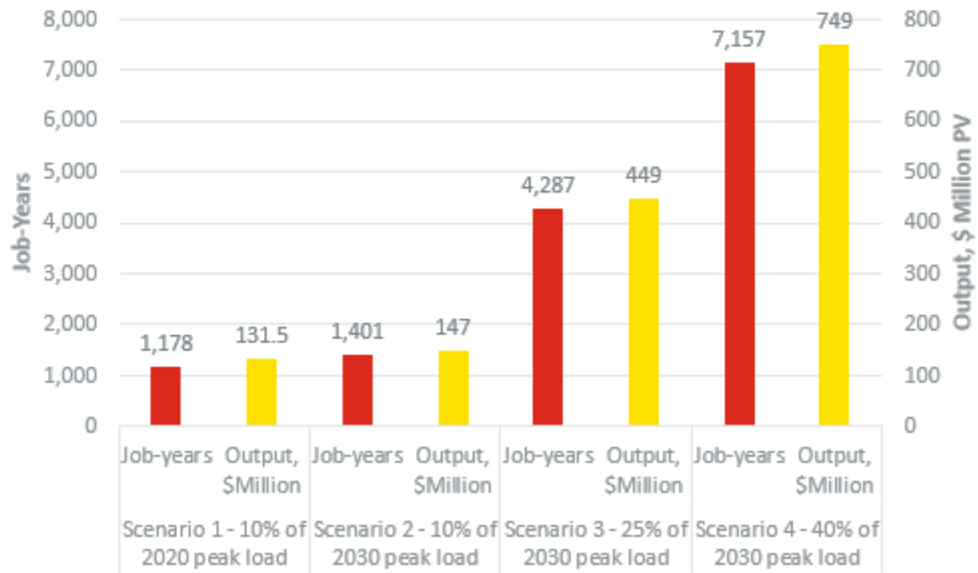

Figure 7. Total employment and economic output benefits under different scenarios

The solar investments also benefit Maine and local regions in terms of taxes. Daymark calculated tax benefits associated with each investment scenario, which is further broken into state, county, and municipal tax benefits. Solar development under the NEB program has municipal property full tax exemption for the developers with the state paying half of the accrued tax to the municipals. Thus, municipal tax has negative tax benefits.

Scenario 1 included a total of almost $2.7 million direct tax impacts to all three jurisdictions, while indirect taxes again totaled almost $1.8 million. Scenario 2 counted directed tax benefits of around $3 million, and indirect taxes of almost $2 million. Scenario 3 ramped up tax benefits as a result of the more aggressive solar investment scenario, with direct taxes of $9.2 million, and indirect taxes of $6.0 million. Scenario 4 was yet again the most aggressive, with $15.3 million in direct tax benefits, and $10 in indirect tax benefits.

Description	Scenario 1 - 10% of 2020 peak load	Scenario 2 - 10% of 2030 peak load	Scenario 3 - 25% of 2030 peak load	Scenario 4 - 40% of 2030 peak load
Total Solar Installed Capacity (MW)	161	191	577	962
Economic Benefits				
Direct Impact				
Employment (Job Years)	1,178	1,401	4,287	7,157
Labor Income, PV $ Millions	$77.9	$87.2	$266.6	$445.2
Output, PV $ Millions	$131.5	$146.9	$448.7	$749.3
Indirect Impact				
Employment (Job Years)	554	656	2,014	3,361
Labor Income, PV $ Millions	$28.3	$31.8	$96.4	$160.9
Output, PV $ Millions	$41.4	$45.9	$139.9	$234.2
Tax Benefits				
Direct Impact				
State Tax	$3.34	$3.73	$11.4	$19.1
County Tax	$0.09	$0.10	$0.30	$0.50
Municipal Tax	-$0.75	-$0.83	-$2.57	-$4.30
Total Direct Tax, PV $ Millions	$2.68	$2.99	$9.2	$15.3
Indirect Impact				
State Tax	$2.72	$3.02	$9.06	$15.11
County Tax	$0.12	$0.14	$0.41	$0.68
Municipal Tax	-$1.06	-$1.17	-$3.48	-$5.8
Total Indirect Tax, PV $ Millions	$1.79	$1.98	$6.0	$10.0

Figure 8. Detailed economic benefits by modeled Scenarios

As discussed earlier, the analysis assumes solar investments between Small BTM and Community Solar for both CMP and Versant. Daymark estimated economic benefits associated with these different investment types for each scenario.

The detailed results for each scenario are presented in Figure 9 (Scenario 1), Figure 10 (Scenario 2), Figure 11 (Scenario 3), and Figure 12 (Scenario 4).

Description	Total	CMP - Small BTM	CMP - Community Solar	Versant - Small BTM	Versant - Community Solar
Total Solar Installed Capacity (MW)	161	24	104	8	24
Economic Benefits					
Direct Impact					
Employment (Job Years)	1,178	207	732	68	171
Labor Income, PV $ Millions	$77.9	$13.59	$48.54	$4.46	$11.32
Output, PV $ Millions	$131.5	$22.75	$82.14	$7.46	$19.15
Indirect Impact					
Employment (Job Years)	554	96	346	31	81
Labor Income, PV $ Millions	$28.3	$4.73	$17.84	$1.55	$4.16
Output, PV $ Millions	$41.4	$6.88	$26.04	$2.26	$6.23
	69%	67%	69%	67%	69%
Tax Benefits					
Direct Impact					
State Tax	$3.34	$0.62	$2.05	$0.20	$0.48
County Tax	$0.09	$0.02	$0.05	$0.01	$0.01
Municipal Tax	-$0.75	-$0.15	-$0.45	-$0.05	-$0.11
Total Direct Tax, PV $ Millions	*$2.68*	*$0.49*	*$1.65*	*$0.16*	*$0.38*
Indirect Impact					
State Tax	$2.72	$0.36	$1.82	$0.12	$0.42
County Tax	$0.12	$0.01	$0.08	$0.00	$0.02
Municipal Tax	-$1.06	-$0.12	-$0.72	-$0.04	-$0.17
Total Indirect Tax, PV $ Millions	*$1.79*	*$0.25*	*$1.18*	*$0.08*	*$0.28*

Figure 9. Economic benefits of solar investments under scenario 1 (10% of 2021 peak load)

Description	Total	CMP - Small BTM	CMP - Community Solar	Versant - Small BTM	Versant - Community Solar
Total Solar Installed Capacity (MW)	191	32	121	10	28
Economic Benefits					
Direct Impact					
Employment (Job Years)	1,401	270	852	82	197
Labor Income, PV $ Millions	$87.2	$16.66	$53.19	$5.05	$12.30
Output, PV $ Millions	$146.9	$27.81	$89.87	$8.42	$20.79
Indirect Impact					
Employment (Job Years)	656	125	400	38	93
Labor Income, PV $ Millions	$31.8	$5.80	$19.76	$1.76	$4.52
Output, PV $ Millions	$45.9	$8.38	$28.43	$2.54	$6.58
Tax Benefits					
Direct Impact					
State Tax	$3.73	$0.75	$2.23	$0.23	$0.52
County Tax	$0.10	$0.02	$0.06	$0.01	$0.01
Municipal Tax	-$0.83	-$0.18	-$0.49	-$0.05	-$0.11
Total Direct Tax, PV $ Millions	*$2.99*	*$0.59*	*$1.80*	*$0.18*	*$0.42*
Indirect Impact					
State Tax	$3.02	$0.44	$1.99	$0.13	$0.46
County Tax	$0.14	$0.02	$0.09	$0.01	$0.02
Municipal Tax	-$1.17	-$0.16	-$0.79	-$0.05	-$0.18
Total Indirect Tax, PV $ Millions	*$1.98*	*$0.30*	*$1.29*	*$0.09*	*$0.30*

Figure 10. Economic benefits of solar investments under scenario 2 (10% of 2030 peak load)

Description	Total	CMP - Small BTM	CMP - Community Solar	Versant - Small BTM	Versant - Community Solar
Total Solar Installed Capacity (MW)	577	125	340	32	80
Economic Benefits					
Direct Impact					
Employment (Job Years)	4,287	1072	2385	271	559
Labor Income, PV $ Millions	$266.6	$66.08	$148.86	$16.72	$34.91
Output, PV $ Millions	$448.7	$110.31	$251.52	$27.91	$58.98
Indirect Impact					
Employment (Job Years)	2,014	496	1,127	125	267
Labor Income, PV $ Millions	$96.4	$23.01	$54.72	$5.82	$12.83
Output, PV $ Millions	$139.9	$33.24	$79.57	$8.41	$18.66
Tax Benefits					
Direct Impact					
State Tax	$11.44	$2.97	$6.25	$0.75	$1.47
County Tax	$0.30	$0.08	$0.16	$0.02	$0.04
Municipal Tax	-$2.57	-$0.70	-$1.37	-$0.18	-$0.32
Total Direct Tax, PV $ Millions	*$9.17*	*$2.36*	*$5.03*	*$0.60*	*$1.18*
Indirect Impact					
State Tax	$9.06	$1.74	$5.57	$0.44	$1.31
County Tax	$0.41	$0.07	$0.26	$0.02	$0.06
Municipal Tax	-$3.48	-$0.60	-$2.21	-$0.15	-$0.52
Total Indirect Tax, PV $ Millions	*$5.98*	*$1.20*	*$3.62*	*$0.30*	*$0.85*

Figure 11. Economic benefits of solar investments under scenario 3 (25% of 2030 peak load)

Description	Total	CMP - Small BTM	CMP - Community Solar	Versant - Small BTM	Versant - Community Solar
Total Solar Installed Capacity (MW)	962	212	565	52	133
Economic Benefits					
Direct Impact					
Employment (Job Years)	7,157	1814	3967	447	930
Labor Income, PV $ Millions	$445.2	$111.80	$247.62	$27.52	$58.24
Output, PV $ Millions	$749.3	$186.62	$418.38	$45.94	$98.40
Indirect Impact					
Employment (Job Years)	3,361	838	1,874	206	442
Labor Income, PV $ Millions	$160.9	$38.92	$91.02	$9.58	$21.41
Output, PV $ Millions	$234.2	$56.24	$132.35	$13.84	$31.80
Tax Benefits					
Direct Impact					
State Tax	$19.11	$5.03	$10.39	$1.24	$2.44
County Tax	$0.50	$0.14	$0.27	$0.03	$0.06
Municipal Tax	-$4.30	-$1.18	-$2.29	-$0.29	-$0.54
Total Direct Tax, PV $ Millions	*$15.31*	*$3.99*	*$8.37*	*$0.98*	*$1.97*
Indirect Impact					
State Tax	$15.11	$2.94	$9.27	$0.72	$2.18
County Tax	$0.68	$0.12	$0.43	$0.03	$0.10
Municipal Tax	-$5.81	-$1.02	-$3.68	-$0.25	-$0.86
Total Indirect Tax, PV $ Millions	*$9.98*	*$2.04*	*$6.02*	*$0.50*	*$1.42*

Figure 12. Economic benefits of solar investments under scenario 4 (40% of 2030 peak load)

C. Attributing Economic Benefits to Solar

The prior section described the derivation of the economic impact benefits of the solar development scenarios in terms of present value dollars. The electric power and environmental benefits of the prior section developed benefits in the manner most often displayed on Value of Solar analyses: a value per kWh of solar energy produced. Each of the other benefits can be isolated as the specific value for either 2021 or 2030 as described in the introduction to show the value like the results presented in the PUC Report.

The NEB program is designed such that participants can receive the benefits of the program, full net-metering, including transmission and distribution charge credits, to calculate bill reductions for 15 years. After those 15 years the participants will have the bill savings determined by the electric generation value only. Thus after 15 years the method of estimating a cost of the NEB program should yield a cost of the program equal to or close to zero for each year thereafter. Daymark decided it was most appropriate to levelize[52] the economic impact benefits over 15 years for all the solar energy generated under the NEB programs. We have only included the direct economic benefits in this levelized benefit. The value of solar from the economic impact benefits are shown below.

Table 25. Levelized economic benefit

UTILITY	CMP				BANGOR HYDRO AND MPD			
YEAR	2021	2030			2021	2030		
SCENARIO	10%	10%	25%	40%	10%	10%	25%	40%
KWh Program	$39.62	$40.08	$40.08	$39.96	$43.95	$44.45	$44.45	$44.45
Tariff Rate Program	$34.03	$34.45	$34.45	$34.45	$38.45	$38.93	$38.93	$38.93

[52] Levelization is a standard financial analysis technique used widely for decades in the utility industry. It takes into account the timing of expenditures and benefits utilizing monetary discount rates to obtain an annuitized value of benefits and costs.

VII. COST OF NET ENERGY BILLING PROGRAM

A. Overview

The Commission concept of the cost of the NEB program is to estimate the revenue reduction that is seen by the utilities and subject any utility cost savings such as the sale of power or avoiding the purchase of power. The effects on utility revenue and the amount of savings that the utilities differ between the kwh program and the Tariff program.

B. kWh Program

While the kWh program customers are credited the full retail rate for their generation, the revenue impact to the utility is simply the cost of the Transmission and Distribution (T&D) rate as the generation from the kWh program serves to reduce load. For the 2021 analysis we used the actual 2021 T&D rate for each utility. We calculated a simple estimation of T&D rates in 2030 using a variety of publicly available information. For CMP, we calculated the compound annual growth rate in rates from 2010-2020 and applied this escalation rate for 2021-2030. For Versant, we looked at the very recent rate case filings from docket 2020-00316. It appears that all but their distribution capital investments typically go up with inflation. We note that Versant is asking for a 25% rate increase in an open rate case, but we did not include this specifically in our estimations, as it is very early in the proceeding and this increase could change. The 2030 outlook does include a constant escalation each year through 2030 and given the lack of political appetite for large rate increases, the 2030 outlook is reasonable even if the current rate case yields a significant increase.

Table 26. Program costs: kWh Program, estimated T&D rates ($2021)

	2021	2030
BHE	$0.0960	$0.1028
MPD	$0.0923	$0.1053
CMP	$0.0725	$0.0812

C. Tariff Rate Program

The cost of the Tariff Rate program is set by the Commission each year and ist based on the standard offer rate plus 75 percent of the T&D rate. As discussed earlier in this report, we have developed a forecast of the standard offer rate for 2030 based upon the same forecast we used to develop the value of solar. Our 2030 estimate for standard offer is shown below in Table 27.

Table 27. Standard offer components: 2030 ($2021/MWh)

	CMP	BHE
Energy	$33.18	$33.18
Capacity	$10.07	$9.95
RPS	$8.32	$8.32
Ancillary Services	$0.60	$0.60
NCPC	$0.85	$0.85
Wholesale Market Charges	$0.73	$0.73
Miscellaneous Credits/Charges	$(0.08)	$(0.08)
Total Standard Offer	$57.96	$57.84

The total tariff rate for 2030 was then calculated by multiplying the forecasted T&D rate by .75 and adding the forecasted standard offer rate. We used the actual Tariff Rate for 2021 in the net benefit analysis. This 2021 and 2030 Tariff Rates are shown below in Table 28.

Table 28. Program costs: Tariff Rate for 2021 and 2030 ($2021)

2021		**2030**	
CMP	BANGOR HYDRO	CMP	BANGOR HYDRO
$125.28	$145.88	$121.67	$138.53