Economic Benefits of the Construction and Operation of Nonresidential Solar Photovoltaic Energy Generation in Maine, 2019-2027

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Contents

Summary of Findings

Maine's solar industry has become a key source of jobs and community benefits in recent years, and is poised to significantly expand its economic impact over the next five years. An estimated 370 MWac of nonresidential solar photovoltaic generation capacity (includes utility-scale, distributed generation, and commercial-scale greater than 2 MWac) will be installed and operational in Maine between 2019 and 2022, with an additional 860 MWac of capacity on track to be completed by the end of 2027. Industry stakeholders report that in addition to this 1,230 MWac of installed and planned capacity, an additional 960 MWac has the potential to be constructed by 2027, leading to a potential upper bound of 2,200 MWac of capacity coming online between 2019 and 2027. The capital investments related to the construction and development of this capacity as well as the ongoing operational expenditures will support thousands of jobs and millions in earnings and tax revenues in communities across the state of Maine.

Capital Investments for Development and Construction

The total capital spending by nonresidential solar developers in Maine (that is, on workers and businesses located in Maine) is estimated at $540 million for the period 2019 and 2027, with projects completed by the end of 2022 accounting for $160 million and an additional $380 million forecast for projects completed between 2023 and 2027. (This excludes capital spending on modules, racking, other materials not sourced in Maine, and imported specialized labor.) The potential for an additional 960 MWac to be constructed by 2027 would stimulate an additional $430 million in spending on Maine-based labor and vendors.[1]

Employment and Earnings Impacts

Spending on capital investments will create or support approximately 8,500 job years between 2019 and 2027, with 2,560 job years occurring between 2010 and 2022 and an additional 5,930 job years between 2023 and 2027. An additional 6,670 job years would be realized under the upper bound scenario where an additional 960 MWac is installed by 2027. Jobs will be concentrated in the construction and trade industries, but will extend to engineering, environmental, geophysical, and some manufacturing industries, as well as local consumer industries. Earnings from employment, including salaries, wages, and benefits, are estimated at $370 million, with $110 million earned between 2019 and 2022 and $260 million to be realized between 2023 and 2027 (in fixed 2022 dollars). An additional $290 million in earnings would be generated under the scenario of an additional 960 MWac coming online.

Ongoing Operational Impacts

Once solar projects are built, the operations of solar projects contribute ongoing employment, earnings, and tax revenues that accrue annually. The operation and maintenance of nonresidential solar facilities is estimated to support an average of 300 total jobs, $22 million in earnings, and $2 million in state and local tax revenues per year. Roughly 30% of these benefits are from installed capacity through 2022 and 70% are from planned capacity through 2027. Under the upper bound scenario where an additional 960 MWac comes online by 2027, the total operational impacts grow to 480 jobs, $33 million, and $3 million in state and local tax revenues per year.

[1] Per unit capital expenditure estimates and Maine-based labor and vendor spending shares are derived from a survey of industry stakeholders that are validated with construction cost data from the Energy Information Administration (EIA) and the National Renewable Energy Laboratory (NREL).

Tax Revenue Payments from Solar Developments

The potential value of property tax revenues is estimated at $121 million (in 2022 dollars) with a net present value of $174 million (NPV) over the 20-year period 2027-2046, assuming current municipal mill rates remain constant. (Ultimately municipalities may choose to provide tax relief to resident taxpayers rather than accrue additional revenue, which would also have modest economic impacts from increased disposable income that are not modeled here.) Property tax revenue impacts (20 year net present value) will be felt closest to where the projects are located, and will be concentrated in Kennebec County ($46 million), followed by Aroostook ($41 million), Somerset ($25 million), and Penobscot counties ($14 million), though every county will be impacted to some degree.

The economic impacts of development, construction, and operations and maintenance of solar projects stretch across the state affecting every Maine county, due to both the geographic spread of projects as well as the geographic reach of the industry and workforce.

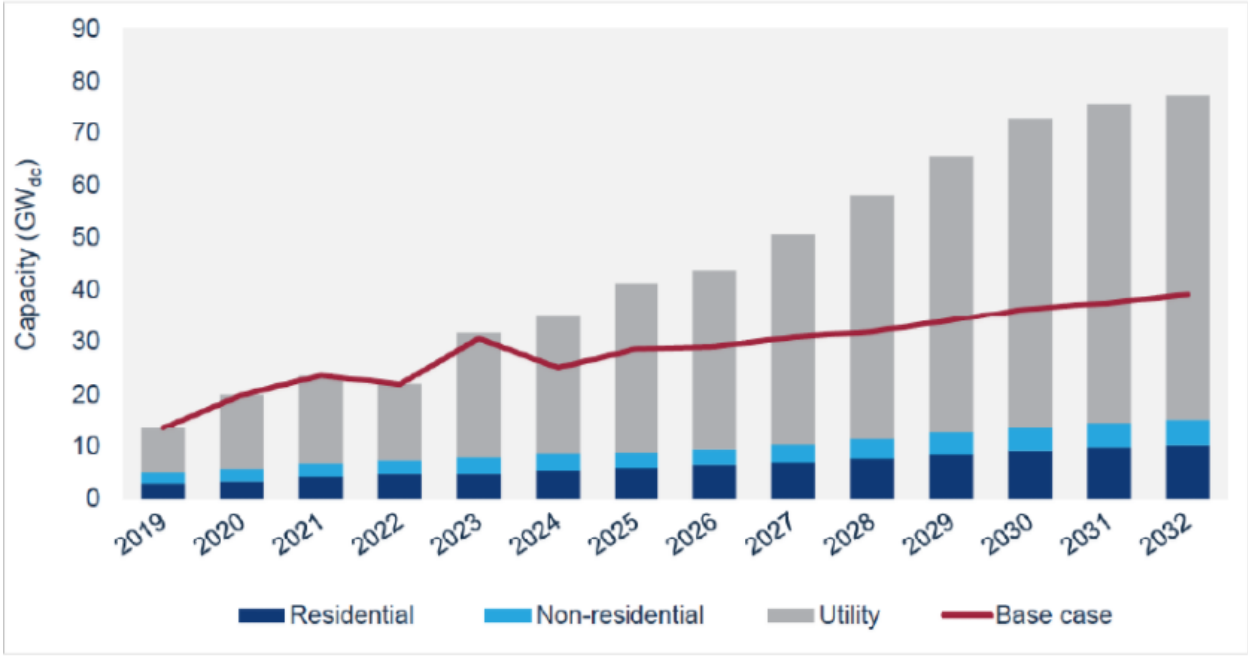
Constraints and Opportunities

There are several short-term risks to realizing this economic impact, including labor supply shortages, particularly in the construction and trade industries, supply chain challenges resulting from the pandemic and global shipping bottlenecks, the risk of legislative changes that may change or reduce the incentives for solar development, and issues and costs related to connecting solar projects to the existing electric grid. **However, if these challenges can be addressed, the solar industry will continue to be a significant source of career opportunities; good wages in construction, installation, engineering, and other trades; and local and state revenues to invest in local communities across the state.**

Introduction

The development and operation of solar photovoltaics (PV) installations has become a key source of jobs and community benefits in recent years, both in Maine and across the US. Despite challenges from global supply chain disruptions and uncertainty around public policies, solar PV contributed almost half (46%) of all US electricity generating capacity in 2021 and is positioned for continued growth over the next decade. Nonresidential solar PV installations (defined as installations greater than 2 MWac of electricity generating capacity, including utility-scale, distributed generation, and commercial-scale) provide significant power to the electric grid and contribute the largest share of capacity of all solar PV installations. The continuation of record growth of nonresidential solar PV will be highly dependent on federal and state policies, including the extension of the federal investment tax credit (ITC) (Figure 1).

Figure 1: U.S. PV Installations and Forecast Under an ITC Extension, 2018-2032

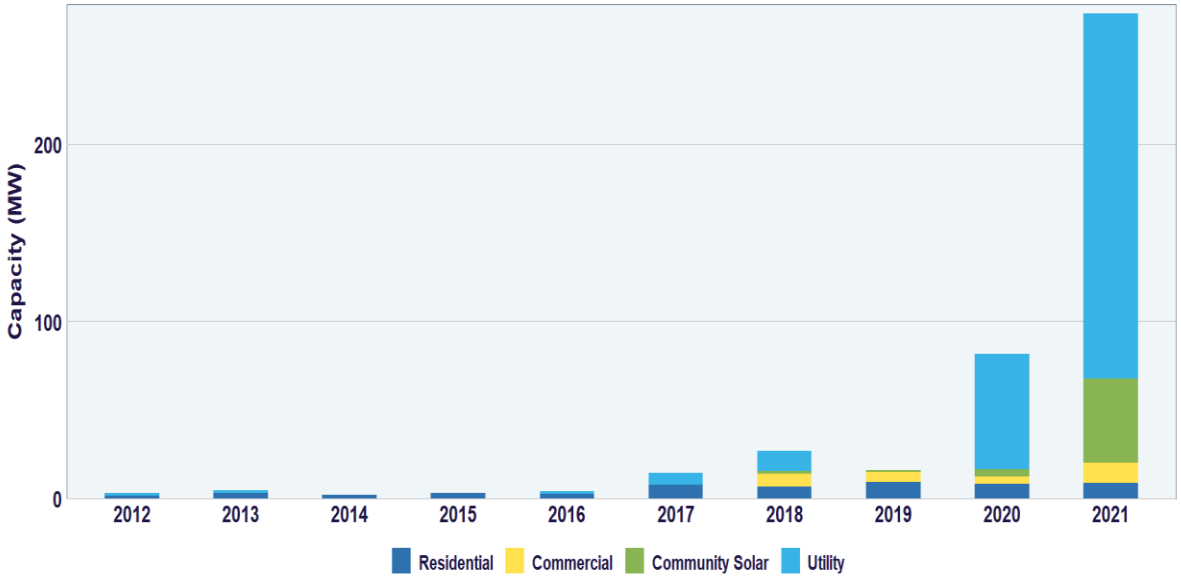


Reprinted from Wood Mackenzie via SEIA.org (Solar Energy Industries Association)

The growth of solar installations in Maine has been equally significant. Through the fourth quarter of 2021 approximately 440 MWac of photovoltaic solar has been installed and is operational today, with the vast majority of this increase coming online from nonresidential installations in 2020 and 2021 (Figure 2). Recent survey data collected from solar industry stakeholders suggests the industry is not slowing down: an additional 1 GW of capacity of nonresidential solar is expected to come online over the next 5 years.

These projects generate billions of dollars in capital investment during installation and millions more annually to operate, a significant portion of which support jobs and earnings in development and project management, construction, electrical trades, and engineering, among other supporting industries. The initial capital and operational spending ripples through the state and local economies through recurrent spending by supply chain businesses and from worker wages.

Figure 2: Historical Annual Solar Installation Capacity in Maine, 2012-2021



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The purpose of this report is to quantify the economic benefits from capital investments and operational spending on nonresidential solar PV projects installed or expected to come online in Maine between 2019 and 2027. The study uses information from a recent survey of industry stakeholders, as well as data from the National Renewable Energy Laboratory (NREL) and Energy Information Administration (EIA) to generate projected nonresidential installed solar capacity and capital and operational spending in Maine. Spending data is then used to simulate the associated economic impacts, including direct, indirect, and induced impacts (see appendix for definitions) to the state and communities in terms of jobs, worker earnings, and tax revenues.

Projected PV Solar Capacity and Capital Investments in Maine, 2019-2027

In March 2022, an electronic survey was sent to solar industry developers to estimate the pipeline of nonresidential solar PV projects that will be operational in Maine between 2019 and 2027. Respondents were asked to provide detailed information on specific projects, including the nameplate capacity, the expected date of completion, the geographic location, and other details for projects installed or expected to be installed between 2019 and 2027. In addition, respondents were asked to provide an estimate of the total capacity they expect to install and bring online for this period, which is assumed to include both capacity for specific projects in planning as well as anticipated capacity for projects that have not entered a formal planning process with an identified location. This data was used to construct three categories of solar capacity that are used in the analysis that follows. These are defined in Table 1.

Table 1: Capacity Categories Definitions use in Analysis

Scenario	Estimated Capacity	Description
Installed Capacity (2019-2022)	**374 MWac**	**Capacity tied to specific projects and locations that has been or will be completed by the end of 2022.**
Planned Capacity (2023-2027)	**857 MWac**	**Capacity tied to specific projects and locations that developers expect to install between 2023 and 2027.**
Potential Capacity (2023-2027)	**970 MWac**	**Additional capacity that is not tied to specific projects or locations but is reported by respondents as part of the total capacity they expect to install between 2019 and 2027. The value here is the difference between the reported total capacity and the capacity tied to specific projects (installed and planned). As such, it represents an aspirational potential capacity above and beyond existing installed and planned capacity.**

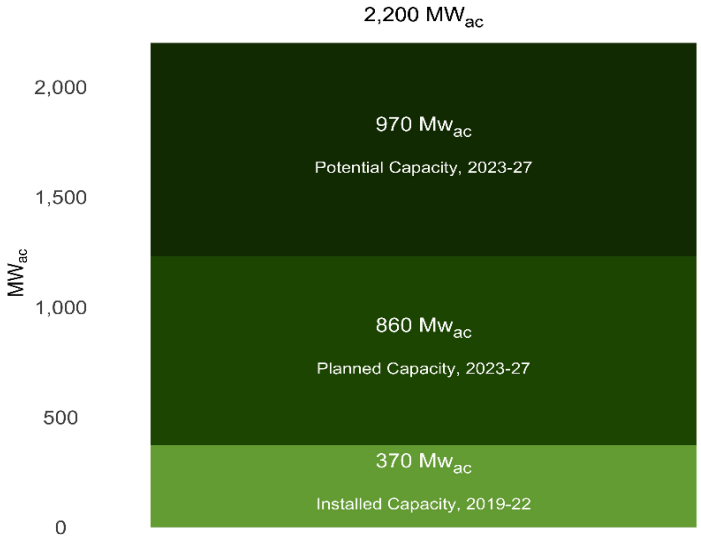
Source: Survey data, author's calculations.

Capacity

The Installed Capacity, representing projects that have either been installed or are expected to be completed by the end of 2022, is estimated at 374 MWac. The Planned Capacity, linked to specific projects and locations with completion anticipated to be between 2023 and 2027, is estimated at 857 MWac. In total, 1,230 MWac of capacity tied to specific projects and locations has been or is planned to be installed between 2019 and 2023. This estimate is closely aligned with other sources of capacity projections for Maine: for example, the Solar Energy Industries Association (SEIA) projects 1,260 MW of installed capacity in Maine over the next five years. In addition, survey developers estimate an estimated 970 MWac will be installed by 2027, although specific projects have not yet entered a formal planning process. This is represented by the Potential Capacity scenarios below.[2]

[2] For simplicity of this analysis, all installations are assumed fixed-array, though new capacity will likely include rotating axis installations and different materials, as well as battery storage capacity which are not accounted for here - all impacting total costs and spending.

Figure 3: Estimated Installed and Planned Capacity by Year and Scenario, 2019-2027



Cost per KW_{ac}

Developers reported an average cost of $1,694 per KWac of constructed or installed capacity. Although supply chain constraints have inflated costs over the last year by 18%, this estimate falls within the national benchmark estimates provided by NREL of $1,140 per KWac[3] and from EIA for the northeastern US which estimates an average weighted constructed cost of $2,544 per KW.[4]

Capital Spending Within Maine

Capital investments on installation materials and equipment include solar modules, racking, foundations, and electrical collection, as well as labor on development, geotechnical surveys and site preparation, installation, and testing and commissioning. Spending will go to workers, vendors, and suppliers both based in Maine and outside of the state. Based on project-level data from the survey, NREL data, and previously installed projects, an average of 26% of all capital spending is assumed to be sourced in Maine, with the vast majority of this spending on local labor and services. The majority of materials, including modules, are assumed to be imported into the state for installation.

Total Capital Spending, 2019-2027

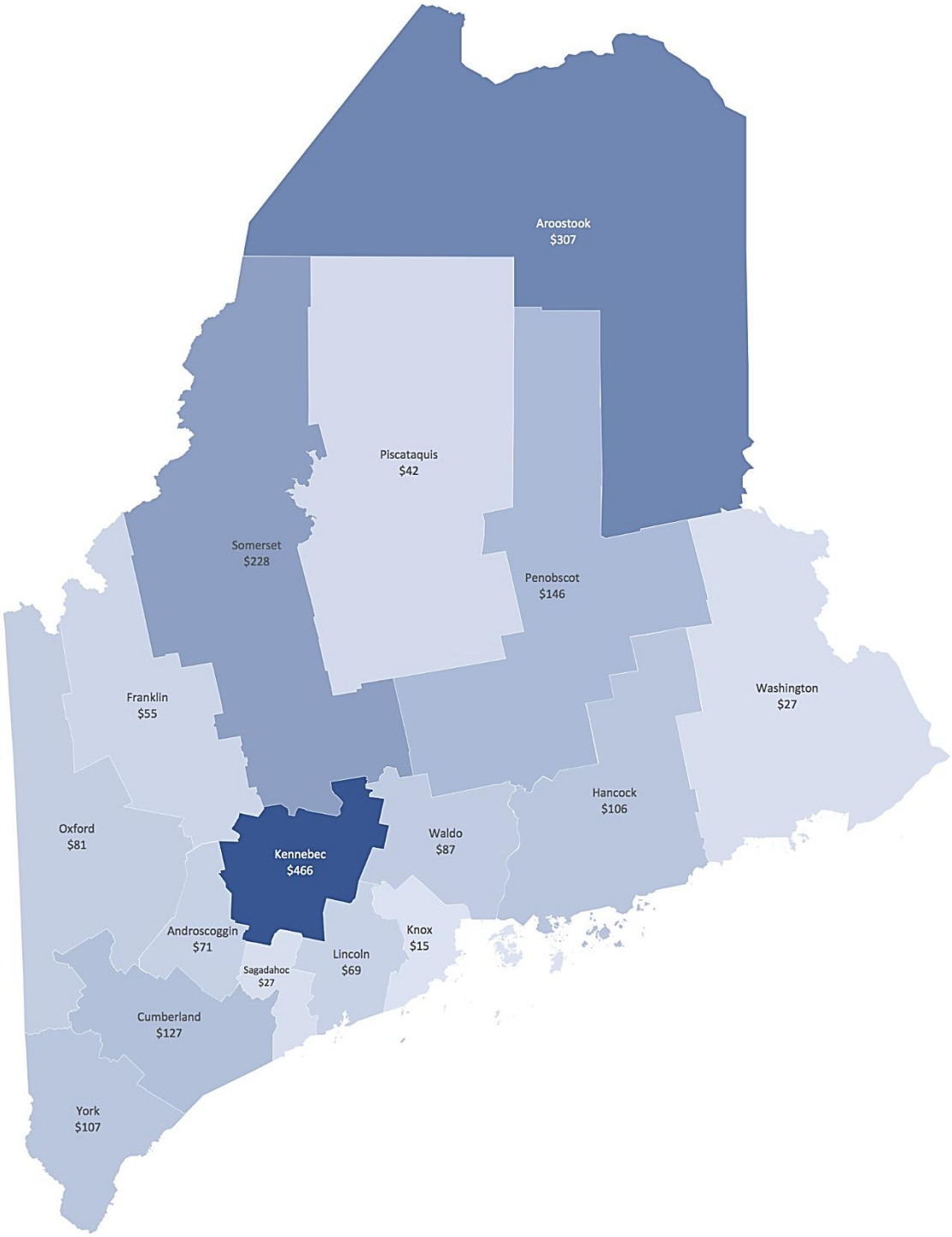
Applying the estimated cost per KWac to the capacity estimates and adjusting for the percent expected to be spent in Maine yields an estimate of $542 million in spending on Maine-based labor, services, materials, and equipment for Installed and Planned capacity. This includes $163 million that will be invested by the end of 2022 (Installed Capacity) and $379 million to be invested by 2027 (Planned Capacity). Spending is estimated

3 Ramasamy Vignesh, David Feldman, Jal Desai, and Robert Margolis. 2021. U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks: Q1 2021. Golden, CO: National Renewable Energy Laboratory. NREL/TP-7A40-80694. https://www.nrel.gov/docs/fy22osti/80694.pdf

4 EIA capacity-weighted average construction costs for solar in the Northeastern US Census Region for 2019 https://www.eia.gov/electricity/generatorcosts/

to be concentrated in Kennebec (13%), Aroostook (11%), and Somerset (10%) counties, with the remainder distributed across the state (Figure 4). Under the Potential Capacity scenario, an additional $427 million of local spending would be procured by 2027. (This estimate is not included in Figure 4 because locations have not yet been identified).

Figure 4: Maine-based Spending for Installed and Planned Capacity by County in Millions $, (2019-2027)



Economic Impacts of Nonresidential Solar PV in Maine, 2019-2027

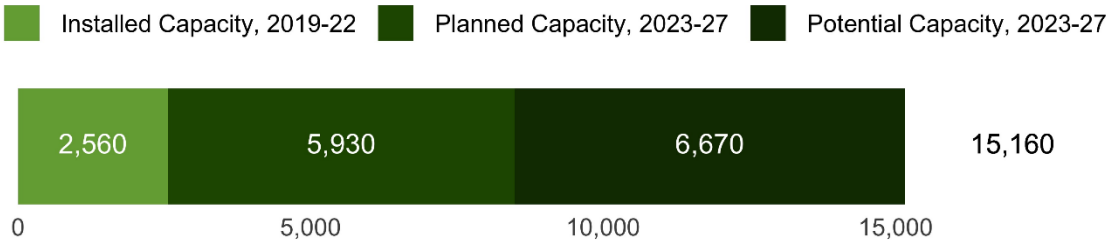
The economic impacts from capital spending are simulated using an economic model that utilizes industry level multiplier data from the US Bureau of Economic Analysis Regional Input-Output Modelling System (RIMS) and Economic Modeling Specialists, Inc. (EMSI) to estimate the direct, indirect, and induced effects on employment and earnings from recurring rounds of spending in the Maine economy. Direct effects refer to jobs and earnings stemming from the initial capital expenditures on engineering, procurement, and construction (EPC). Indirect effects, or "supply-chain effects," refer to the purchases that suppliers to the solar developers make on materials, equipment, supplies, and services in support of the goods and materials they provide to the solar industry. Induced effects, or "household effects," refer to the impacts from workers spending their wages locally on housing, health care, food, recreation, etc.

Impacts during Development and Installation

Employment impacts

The number of job years related to Installed Capacity through 2022 are estimated at 2,560, which includes 1,580 direct job years and 980 job years from indirect and induced spending. Planned Capacity spanning 2023 to 2027 will provide an estimated 5,930 total job years, including 3,660 direct job years and another 2,270 job years from indirect and induced spending. If the Potential Scenario came to fruition, an additional 6,670 job years would be supported, including 4,120 from direct spending and 2,550 from indirect and induced spending effects. Figure 5 shows the impact on employment by capacity scenario and detailed estimates are presented in Table 2.

Figure 5: Total Job Impacts by Scenario, 2019-2027

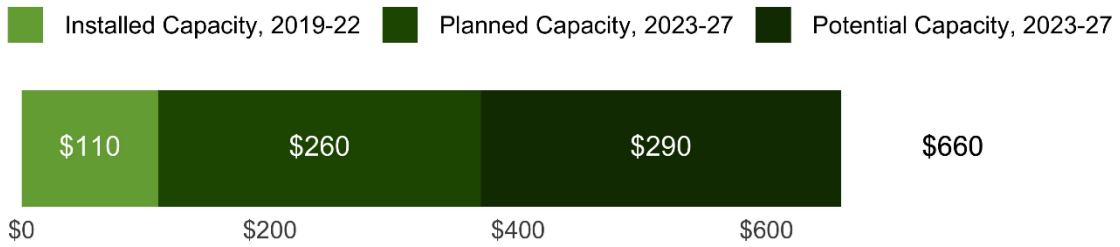


Note: Jobs reported as jobs per year and include both full- and part-time employment.

Earnings impacts

The total earnings related to Installed Capacity are estimated at $110 million, which includes $70 million direct earnings and $40 million from indirect and induced spending. Planned Capacity spanning 2023 to 2027 will provide an estimated $260 million in earnings, including $160 million in direct earnings and another $100 million in indirect and induced spending. If the Potential Scenario was realized, an additional $290 million in earnings would be supported, including $180 million from direct spending and $110 million from indirect and induced spending effects. Earnings include wages, salaries, and benefits. Figure 6 shows the impact on earnings by capacity scenario.

Figure 6: Earnings Impacts by Scenario in Millions, 2019-2027



Note: Dollar values in millions of fixed 2022 dollars and rounded to nearest 10 million.

Income, Sales, and Property Tax Impacts

Earnings generate state and local tax revenues through taxes on income, sales, and property taxes, among others. The state and local taxes associated with the total earnings described above are estimated at $9 million for the Installed Capacity scenario, $20 million for the Planned Capacity scenario, and $23 million for the Potential Capacity scenario.

Summary of Impacts

A summary of the impacts from capital expenditures is reported in Table 2. In summary, capital investments in nonresidential solar installations in Maine between 2019 and 2027 have the potential to support over 15,000 job years statewide, support $660 million in earnings, and generate over $50 million in state and local tax revenue from earnings. As a gross metric of overall economic impacts, total capital expenditures could support over $1.5 billion in total output, of which $880 million would be attributable to value-added economic activity, referred to as gross domestic product (GDP).

Table 2: Summary Impacts by Scenario during Development and Installation, 2019-2027

Capacity Scenario	**Jobs**			**Earnings**			**State & Local Revenues**	**Value-Add (GDP)**	**Total Output**
	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total			
Installed, 2019-22	1,580	980	2,560	$70	$40	$110	$9	$150	$260
Planned, 2023-27	3,660	2,270	5,930	$160	$100	$260	$20	$340	$610
Total, 2019-27	**5,240**	**3,250**	**8,490**	**$230**	**$140**	**$370**	**$29**	**$490**	**$870**
Potential, 2023-27	4,120	2,550	6,670	$180	$110	$290	$23	$390	$680
Grand Total	**9,360**	**5,800**	**15,160**	**$410**	**$250**	**$660**	**$52**	**$880**	**$1,550**

Note: Dollar values in millions of fixed 2022 dollars and rounded to nearest 10 million. Jobs reported as jobs per year and include both full- and part-time employment.

Sensitivities to Regional Spending Share and Capital Costs

The economic impacts described above are sensitive to assumptions of the regional share of capital spending. Based on data from previous solar projects and information from NREL, a range of local spending estimates are estimated at between 19% and 33%. This range is applied to the estimates on capital spending and simulated in the economic model to generate impacts under a lower regional share (19%) of capital spending and an upper regional share (33%). Based on these scenarios, Table 3 indicates that the total impact on employment may range from 11,300 to 19,250 depending on the share of local procurement and the extent of capacity installed over the period 2019 to 2027. Similarly, Table 4 indicates that the total impact on earnings may range from $500 million to $840 million.

Table 3: Job Impacts Sensitive to Adjustments in Local Share of Expenditures, 2019-2027

	Lower range			Middle			Upper range		
Capacity Scenario	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total
Installed, 2019-22	1,200	740	1,940	1,580	980	2,550	2,000	1,240	3,240
Planned, 2023-27	2,790	1,730	4,510	3,660	2,270	5,930	4,650	2,880	7,530
Total, 2019-27	**3,990**	**2,470**	**6,460**	**5,240**	**3,250**	**8,490**	**6,650**	**4,120**	**10,770**
Potential	3,000	1,860	4,850	4,120	2,550	6,680	5,240	3,240	8,480
Grand Total	**6,990**	**4,330**	**11,320**	**9,360**	**5,800**	**15,160**	**11,890**	**7,360**	**19,250**

Note: Middle range values are equivalent to those reported above. Employment in job years. Dollars in fixed 2022.

Table 4: Earnings Impacts Sensitive to Adjustments in Local Share of Expenditures, 2019-2027

	Lower range			Middle			Upper range		
Capacity Scenario	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total
Installed, 2019-22	$50	$30	$80	$70	$40	$110	$90	$50	$140
Planned, 2023-27	$130	$80	$210	$160	$100	$260	$210	$120	$330
Total, 2019-27	**$180**	**$110**	**$290**	**$230**	**$140**	**$370**	**$300**	**$170**	**$470**
Potential	$130	$80	$210	$180	$110	$290	$230	$140	$370
Grand Total	**$310**	**$190**	**$500**	**$410**	**$250**	**$660**	**$530**	**$310**	**$840**

Note: Middle range values are those reported above. Dollar values in millions of fixed 2022 dollars and rounded to nearest 10 million. Jobs reported as jobs per year and include both full- and part-time employment.

Impacts during Operations

Operations and Maintenance Spending

The average annual spending per KW of installed capacity is estimated at $38 (in fixed 2022 dollars), of which 75% is assumed to be Maine-based spending for the operations and maintenance of solar facilities. The estimate of 75% is based on existing solar installations and survey responses. Table 5 presents the annual economic impacts stemming from operations and maintenance spending by capacity scenario. The impacts on employment are estimated at 90 jobs per year for Installed Capacity, 210 for Planned Capacity, and would support another 180 jobs under the Potential Capacity scenario. Likewise, earnings will average $6 million per year for Installed Capacity, $15 million per year for Planned Capacity, and an additional $11 million per year if the Potential Capacity scenario is realized.

Table 5: Annual Estimated Economic Impacts during Operations and Maintenance, 2019-2027

Capacity Scenario	Jobs			Earnings			State & Local Revenues	Value-Add (GDP)	Total Output
	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total			
Installed, 2019-22	60	30	90	$4	$2	$6	$1	$8	$19
Planned, 2023-27	130	80	210	$9	$6	$15	$1	$18	$44
Total, 2019-27	**190**	**110**	**300**	**$13**	**$8**	**$22**	**$2**	**$25**	**$63**
Potential, 2023-27	50	130	180	$5	$7	$11	$1	$30	$49
Grand Total	**240**	**240**	**480**	**$18**	**$15**	**$33**	**$3**	**$55**	**$112**

Note: Dollar values in millions of fixed 2022 dollars and rounded to nearest 10 million. Jobs reported as jobs per year and include both full- and part-time employment.

Property Tax Revenues

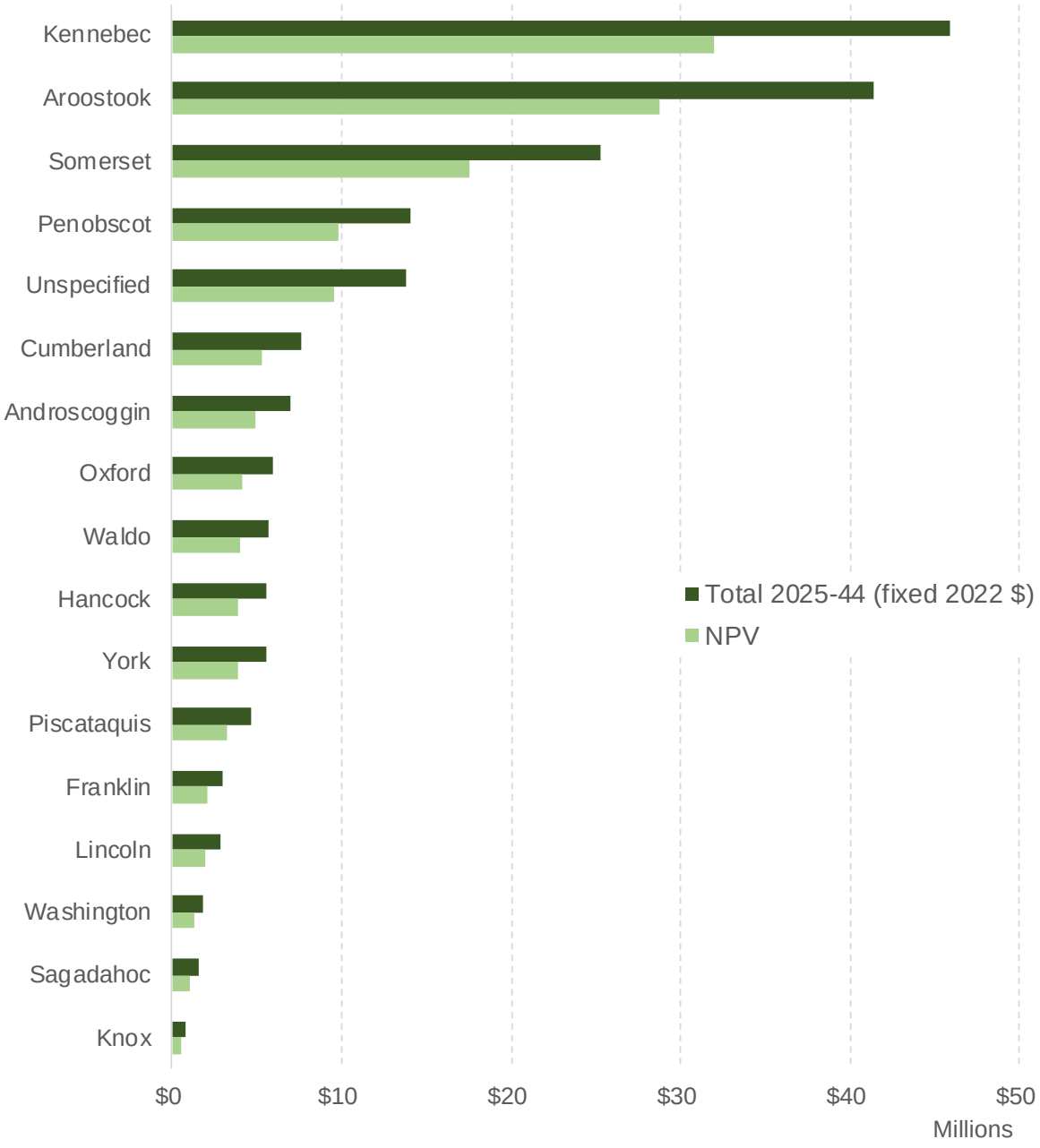
The assets related to the development, installation, and ongoing operations of solar PV will contribute to local property tax assessments and revenues. Based on current mill rates and the location of installed and planned projects, an estimated $121 million (in fixed 2022 dollars) in total property tax revenue (net present value (NPV) of $174 million) will be accrued over a 20 year period. Figures 6 and 7 show the estimated county level property tax revenues for installed and planned projects including the total amount (in fixed 2022 dollars) and the net present value of these revenues. If the Potential Capacity scenario were to be realized, an additional $95 million in local property tax revenues, with an NPV of $137 million, would be generated over a 20-year period.

Limitations of Economic Impact Analysis and Scope

The scope of this analysis is focused on the economic benefits associated with spending from the development, installation, and operations of nonresidential solar photovoltaic projects in Maine during the period 2019 through 2027. The analysis does not address potential costs or attempt to estimate the net benefits or costs from the loss of other sources of generation displaced by new solar capacity or the value of highest and best use of land used for solar development. Nor does the analysis attempt to estimate any

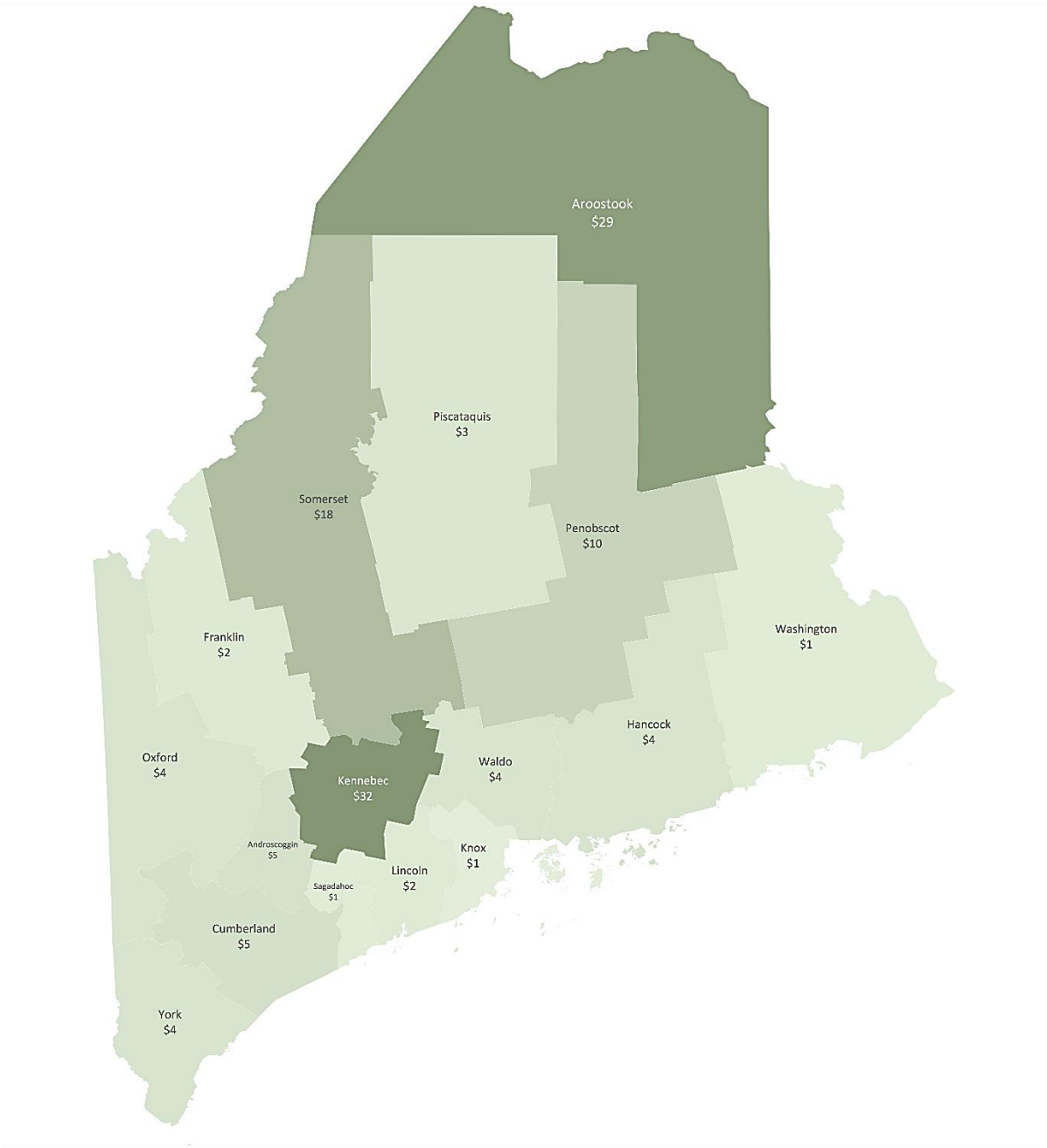
impacts on electricity ratepayers, whether positive or negative. In addition, the estimated project capacity is based in part on the responses to the survey, which are primarily composed of the MREA membership base. As such, the capacity reported by respondents does not necessarily reflect all of the potential installed capacity over the period as non-MREA members may also be planning projects. The analysis also does not consider the value of greenhouse gas emission reductions or the potential inclusion of battery storage capacity accompanying solar projects, especially in later years as technology and capacity matures.

Figure 6: Property Tax Revenue Benefit Estimates for Total Payments and Net Present Value, 2019-2027



Note: Estimated for Installed and Planned Capacity scenarios for a twenty year period. NPV uses 4% discount rate on fixed 2022 dollars.

Figure 7: Net Present Value of Property Tax Revenue Benefits by County, 2019-2027 (in millions)



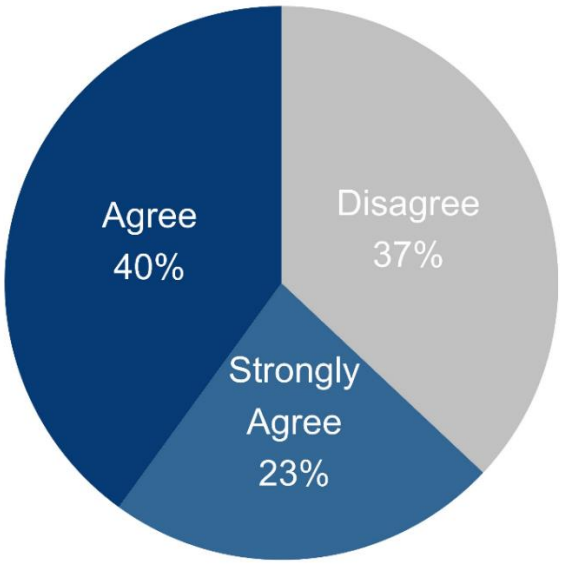
Constraints or risks to realizing this impact

There are several risks to realizing this economic impact, including labor supply shortages, particularly in the construction and trade industries, the risk of legislative changes that may change or reduce the incentives for solar development, and issues and costs related to connecting solar projects to the electric grid. The economic impact estimates described above will depend greatly on the ability to address these challenges. Put another way, if these challenges can be addressed, the solar industry will be a significant source of career opportunities; above-average wages in well-paying industries construction, installation, engineering, and other trades; and local and state revenues across the state in the years to come.

Labor supply challenges

Labor market conditions in Maine have been and will continue to be challenging. Aging demographics and strong economic conditions have kept unemployment rates low. Worker shortages are particularly acute in construction and trade industries especially in rural areas of the state. Almost two-thirds of developers who responded to the survey agreed or strongly agreed with the statement: "**A lack of qualified workers is preventing my business from growing.**"

Figure 6: Responses to "A lack of qualified workers is preventing my business from growing."



In addition, one-quarter of respondents cited labor issues as their company's biggest challenge. Two specific responses represent the sentiment of a number of respondents.

"[W]e intend to spend as much as possible on Maine labor and contractors, and will be reliant on availability of both."

"[A] lack of qualified licensed contractors….presented a number of challenges to project development."

Public Policy

Solar developers respond to both changes in public policy and the possibility of changes in public policy. In other words, uncertainty related to permitting, financial incentives, taxes, environmental and labor laws, and other policies that affect the feasibility of solar projects have the potential to curb development. Sixty percent of survey respondents cited public policy uncertainty as their biggest challenge. Representative responses are below:

"If the legislature wants to implement changes to the NEB program then it should do so ONLY ON PROJECTS NOT YET IN DEVELOPMENT!" (emphasis in original response)

"Perceived (and actual) market uncertainty prevents my clients (and potential clients) from developing more solar projects in Maine."

"[R]etroactive policy makes it extremely difficult to plan."

Interconnection

Just under half of respondents cited interconnection issues as their primary challenge, including a number of respondents who specifically mentioned Central Maine Power in their response. Representative responses are below:

"CMP creates issues at every turn and are [sic] the #1 roadblock to Maine reaching their ambitious clean energy goals."

"CMPs exorbitant costs along with unpredictable and slow approach to interconnecting solar [is my company's biggest challenge].

Technical Appendices

Survey

An online survey was sent to 82 solar development companies and 23 companies who support the solar industry through a variety of services and products. All respondents are members of the Maine Renewable Energy Association. The survey included logic that routed respondents to different questions based on whether their company was a developer or supporting company. The survey was implemented following best practices to achieve a valid and representative response rate, including introductory emails and/or phone calls by the MREW Executive Director and three follow-up invitations to non-respondents, also preceded by emails or phone calls from MREW. The survey was open for approximately two weeks. Forty-seven responses were received, including 40 responses from developers (49%) and 7 responses from supporting companies (30%). For the purposes of the economic analysis in this report, survey responses from developers were primarily used. For developers, the survey first asked for the total solar capacity expected to be completed between 2019 and 2027:

What is the total KWac of utility-scale, commercial, or distributed generation solar projects you have completed or plan to complete in Maine between 2019 and 2027?

The sum of answers to this question formed the basis of the Potential Capacity scenario. The survey then asked for specific information by solar project.

For your company's utility-scale, commercial, or distributed generation solar projects located in Maine and operational since 2019 or anticipated to be operational before the end of 2027, please tell us the following:

- *Location of Project - Town, County, or Unorganized Territory (if known)*
- *Total Capacity in KWac*
- *Expected Total Capital Expenditure Cost Per KWac*
- *Expected Operational Cost Per KWac (if known)*
- *Anticipated Year of Completion*

The responses to this question formed the basis for the Installed and Planned capacity scenarios.

Another question was asked about regional spending:

For all of the projects listed above, on average what percentage of labor and materials do you anticipate purchasing within Maine? Please provide separate estimates for each of the general categories in the table below.

- *For project development support, incl. environmental, engineering, permitting, interconnection, real estate, and legal consulting services*
- *For site work, preparation, and excavation*
- *For construction, installation, concrete work, electrical work, and related labor*
- *For materials and equipment like solar racking (non-electrical) and panels*

- *For transportation and logistics*
- *For balance of plant*
- *For operational services*

Additional question asked about specific challenges to the industry including labor market challenges.

Estimation methods

Capital and operational spending accounts

The analysis uses a top-down approach to allocate project spending by project component. Total capital expenditures based on average per KW of capacity and total estimated installed capacities reported by survey respondents is used to calculate total capital expenditures. These costs are then allocated by spending components based on data from NREL and recent project installations (Table 6). Local spending share estimates are applied to each industry summing to 26% (19% and 33% for sensitivity analysis).

Table 6: Project Component Spending Category Allocation

Spending Category	Percentage Total Cost (example project)
Site Preparation & Improvements	4.4%
Engineering & Design	1.8%
Installation (Foundations, Modules, Racking)	1.6%
Testing, Inspection, & Commissioning	0.7%
Electrical Infrastructure	4.1%
General Requirements & Other	4.7%
Modules	37.8%
Racking & Foundations	12.0%
Collection & Transmission	25.2%
Transport	0.2%
Other Costs	7.4%

These estimates implicitly assume capital and operating costs are similar across projects and that allocation of costs and spending for various categories of projects are consistent from project to project. Lease or land acquisition costs are excluded from the analysis as they typically represent transfers of assets. The analysis also does not account for community benefits packages or payments that often accompany projects made to local host communities.

Estimating direct, indirect, and induced effects

Economic benefits are estimated using multipliers from the US Bureau of Economic Analysis Regional Input-Output Modelling System (RIMS) and Economic Modeling Specialists Inc. (EMSI). This analysis utilizes and reports on Type II multipliers. Capital and operating and maintenance expenditures are applied to respective

industry multipliers to generate estimates of the economic impacts in terms of jobs, earnings, output, and value-add. As is similar in other static I-O models, the benefits reported in this analysis are estimates of the employment and economic activity typically associated with levels of spending during development, construction, and operations.

There are several underlying assumptions that form the foundation, and limitations of I-O models. First, the model assumes employment in industries affected will be at wage and earnings levels based on past industry employment data, which may or may not be at prevailing wage rates once Project procurement and construction begins. The model assumes industry homogeneity, meaning businesses in an industry use the same production process requiring the same levels of capital and labor based on national I-O accounts. Likewise, the model assumes fixed purchase patterns and that firms do not substitute inputs. For example, if a firm can substitute an input for labor, the model is not able to account for this and may result in estimates of employment that are inflated. The model also assumes no supply constraints assuming fixed prices. Businesses can add more inputs without affecting or without price. However, economies are dynamic and any number of factors can affect the state of economy in the future. Despite the limitations some of these assumptions create, the underlying estimates reported here are consistent in magnitude with comparable spending levels of past solar projects and with large scale development projects completed both in- and outside of Maine. The implications are that the estimates provided in this analysis are but a snapshot in time. Therefore, while the estimates from this model are representative, the benefits or impacts may differ in the future as a result of the dynamism of regional economies.

Reporting metrics

Direct employment impacts include those resulting from initial rounds of spending on project capital investments and direct operations and maintenance.

Indirect employment result from additional rounds of spending that occur by businesses on purchases of materials, supplies, and services from other businesses that support production and operations activities.

Induced employment results from local consumption demand spending by (direct and indirect employment) workers in the local economy on goods and services, such as food, housing, and other goods and services, which in turn support jobs economic activity in the local economy. Like most economic models that rely on US BEA and related data sources, employment is reported as inclusive of both the number of full-time (FT) and part-time jobs (PT). Both FT and PT jobs are counted with equal weight and are not distinguished by the model.

Total earnings include all pre-taxed wage and salary related earning, employee supplements (benefits), and proprietor income resulting from direct, indirect, and induced employment. Total earnings are not additive to total output, but rather are accounted for in those measures and can be understood as the associated labor income.

Estimating state and local tax revenues

Earnings are used to estimate the estimated state and local tax revenues from income, sales, and property taxes based on effective personal/household tax rates reported by Maine Revenue Service for 2019, the most recent year available.[5]

5 https://www.maine.gov/revenue/sites/maine.gov.revenue/files/inline-files/tax_expenditure_21_0.pdf

Estimating local property tax revenues

Property tax payments are estimated using a replacement cost accounting approach that uses capital expenditures of solar project components as an approximate measure of assessed valuation and contribution to a parcel's value. Initial assessed values are based on hard cost capital expenditures, which we assume as approximately 80% of total project level capex. Commercial projects (less than 5 MW) are assumed to receive net energy billing credit or will have the energy consumed on site. We also assume that approximately 50% of assumed valuation for these projects accounts for solar equipment qualifying for property tax exemption under 36 M.R.S. §§ 655(1)(U) and 656(1)(K). Total assessed valuations are depreciated at 5% annually (50% floor).County mill rates using the average of the most recent five year and held constant are used to estimate the potential tax revenue value of additional assessed valuation from solar projects each year and aggregated over a 20-year period. Total estimated tax revenue payments over the 20 year period are reported as net present value (NPV) using a 4% discount rate. Projects without a geography identified in the survey are applied to the statewide five-year average mill rate. The estimation of property tax revenues do not account for any potential adjustments resulting from tax-increment financing or other incentives. Property tax estimates do not factor in the complexities and characteristics of each individual project and are intended to provide a high level overview of the potential approximate property tax revenues nonresidential solar projects may provide communities in Maine over the study period.