The Economic Contributions of Building Out Community Solar in Wisconsin

Prepared For
Coalition for Community Solar Access

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June 2023

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Executive Summary

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In recent years, the state of Wisconsin has accelerated efforts to shift electric power generation from traditional fossil fuels toward renewable energy sources, including solar. This is most noticeable with the relatively large utility-scale solar installations constructed throughout the state.

In some states, utility-scale installations are accompanied by smaller community solar facilities. Community solar makes solar energy accessible to more people by allowing participants to invest in and benefit from small solar arrays in their communities. This study estimates the economic contributions to Wisconsin's economy from the construction and operation of 350 community solar installations, each with the capacity to provide 5 megawatts (MW) of electricity. Construction is assumed to take place over seven years with operation and maintenance for each facility lasting 25 years.

The economic activity measured in this study derives from three sources. First, during the construction phase, the state and local economy will be stimulated by money spent locally on the materials and labor need to build the facilities. Second, lease payments from solar facility owners to landowners add to household income and increase economic activity. Third, the operations and maintenance of the facilities, while not as labor intensive as construction, also infuse dollars into the economy. Although the annual impacts are less after the construction phase, they are felt for a much longer period–25 years compared to one year for construction.

To model the economic contributions, data from the National Renewable Energy Laboratory (NREL) database were combined with proprietary information provided by the Coalition for Community Solar Access (CCSA). The data was run through an input-output model developed by IMPLAN, which is the industry standard, to model all of these impacts.

The IMPLAN model measures the initial direct expenditures on labor, materials, and land leases, as well as the additional economic activity that occurs as these dollars move through the economy, generating what is often referred to as the multiplier effect. Spending in the local economy becomes revenue for other businesses, which is used to pay employees, who in turn purchase local goods and services. The cycle continues in smaller and smaller amounts. As such, the total economic impact can be much greater than the initial amount of spending.

TOPLINE ECONOMIC IMPACT

Based on the analysis here, construction and operation of the proposed solar facilities, which would generate 1.75 gigawatts of electricity per year when all facilities are operating, would contribute an estimated $2.49 billion of economic activity in Wisconsin.

While the lifetime of each facility is 25 years, most of the economic benefits will be realized in the first seven years as the facilities are built since the spending on materials and most labor costs will take place during the construction phase. During this construction phase, nearly two-thirds (62.9%), or $1.57 billion, of the economic benefits will be realized and an average of 2,713 full-time equivalent jobs will be created or supported.

INTRODUCTION

In the fall of 2022, representatives of the Coalition for Community Solar Access (CCSA) requested a Forward Analytics study of the potential economic impact of community solar in Wisconsin. After discussions about the scope of the project, Forward Analytics agreed to study the economic contributions that would result from the construction and operation of a series of community solar installations in the state.

The scope of this study is narrow, focusing on the contributions to Wisconsin's economy that can be expected from the construction of 350 community solar installations over a seven-year period at a rate of 50 per year. The study also measures the economic contributions resulting from the operation of each of these installations over an estimated 25-year life span. This includes the lease payments for the land on which the installations are built. The economic contributions are measured in terms of jobs, labor income, and Wisconsin gross domestic product (GDP).

This study is not a broad-based economic impact analysis. Those types of analyses are more expansive and might also account for how new community solar installations shift electricity production away from coal, natural gas, or other energy sources to solar. Often, an economic impact study would look at the **net** change in economic activity resulting from a widespread construction and use of these installations.

Finally, this report does not address the feasibility of the community solar model. That depends partially on business decisions and requires a different analysis.

WHAT IS COMMUNITY SOLAR?

Over the past 15 years, Wisconsin has embarked on a significant effort to move electricity production away from fossil fuels and toward renewable energy sources, such as wind and solar. The shift initially manifested itself with nine wind farms that came on line between 2008 and 2012, generating nearly 600 megawatts (MW) of electricity. A 10th wind farm with a capacity of 98MW began generating power in 2017.

Recently, the shift to renewable energy sources is becoming more visible with numerous utility-scale solar installations throughout the state. According to RENEW Wisconsin, 28 large solar farms are currently generating electricity for utility use or are in the process of being built.

In some states, these wind and utility-scale solar installations are supplemented with community solar, aimed at making solar energy accessible to more people. Community solar allows multiple participants to invest in and benefit from a single, relatively small, solar array, sharing the energy generated from the solar panels.

A community solar program is started by an organization or individuals who invest in a small solar array sited on open land, large commercial properties, or other unused spaces. The energy generated by the community solar array is fed into the utility grid and subscribers (individuals or families) receive a credit for their portion of the project's production. Subscription rates are typically lower than the retail price of electricity charge by utilities.

RESEARCH APPROACH AND ASSUMPTIONS

The findings in this study are based on modeling the construction of 350 community solar facilities throughout the state of Wisconsin, each generating 5MW of electricity, which is a typical size for community solar. A 5MW facility can produce enough electricity to power between 1,000 and 1,300 homes in Wisconsin.

The study models 350 facilities built out over a seven-year period at a rate of 50 facilities per year. The lifespan of each facility is assumed to be 25 years. While the panels could be replaced at the end of their useful life to allow the site to continue to produce electricity, this study does not examine that possibility.

Economic Activity Generated

There are three paths through which economic activity is generated with these facilities. The first is via the construction of the solar installation, which requires spending on labor and materials. To the extent that the materials needed are produced in Wisconsin, these purchases generate economic activity in the state. Similarly, as labor income is spent within Wisconsin's borders, economic activity is created.

A second pathway comes from the leasing of the land on which these facilities are built. Owners of the facilities lease land from local landowners on which they build the installation. Those lease payments generate income for the landowners over the 26 years of the lease (one year for construction and 25 years of operation). Landowners spend those dollars, creating economic activity.

The third path by which economic activity is generated comes via the operation of the facility. While operating a community solar facility is not labor-intensive, there is some labor income associated with operating and maintaining the facility. Like the wages paid during the construction phase, as this labor income is spent, economic activity is created in the state.

These paths are straightforward and highlight the direct economic contributions of these facilities. That, however, is only part of the story. As these dollars are spent, they continue to move through the economy, multiplying the impact of the initial spending. Incomes spent at a local grocery or hardware store, for dinner out on the weekend, or for a vacation in northern Wisconsin help pay the wages and benefits of workers in those businesses. These workers then spend a portion of their incomes in the state and help to pay the wages of other workers, adding to the initial, direct impact. As this spending continues, the economic impact is increased even more. This "multiplier effect" means that the total economic impact of the initial spending can be as much as two or three times the direct impact.

> As spending by one party becomes revenue of another, the initial investment cycles through the economy, multiplying the total economic impact beyond the initial investment.

Modeling Economic Activity

An input-output model of the economy is used to measure the total impact of the construction and operation of these solar installations. This type of model simulates the economy by accounting for links between economic actors. Creators of these models collect and organize data that tracks the linkages across industries and between industries and households, corporations, and governments. The underlying basis of an input-output model is the recognition that the spending of one economic actor is the revenue of another.

For a solar installation, part of the construction spending becomes the income, or revenue, of laborers. When these workers spend their income, those expenditures become revenues of the businesses where the money is spent. A portion of that revenue is then used to pay the employees of these businesses.

This cycle continues to repeat itself in ever-smaller amounts, because some of the income is saved and some is spent outside the area of interest (in this case, the state of Wisconsin). Through the multiplier effect, these subsequent expenditures generate indirect and induced spending. The input-output model used here to track all these rounds of spending is from IMPLAN, widely regarded as one of the best models for this type of analysis.

Data

The IMPLAN model requires the input of expenditure data by detailed industry. For this study, the data comes from two sources. First, CCSA was able to provide proprietary expenditure data from solar operators. Because the number of operators providing expenditure data was relatively small, we supplemented those figures with information from the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). The laboratory collects and reports national data on solar installation costs for various installation sizes based on capacity measured in megawatts. We used the most recent figures for 2021 as a baseline, subject to relevant data provided by CCSA.

Construction

Before 2021, community solar cost estimates from NREL were based on costs for utility-scale installations with a generating capacity of up to 100MW. In the more recent 2021 report, NREL provides cost estimates for smaller systems, including those with capacity of 5MW. These figures can be used when studying community solar installations.

Based on the NREL figures, each community solar array installation is estimated to cost $1.12 per Watt DC (a common unit of measurement for NREL data), which is equivalent to $5.6 million. Line item costs are shown in Table 1 below.

The data provided by CCSA, some of which is sourced to NREL, yields different totals for such a facility. The average cost for a 5MW solar facility using data provided by CCSA is $9.8 million. Cost differentials are due to several factors.

First, these projects will have federal dollars subsidizing them and thus, will pay prevailing wages. The NREL estimates are based on average wage and benefit packages that are less than prevailing wage.

Second, the estimated costs for modules, inverters, parts, and equipment are higher in the CCSA data. Land acquisition costs are higher as well.

Third, NREL does not include customer acquisition costs, which are somewhat unique to community solar. Although much of this work needs to be done locally, it is likely that some of these expenditures will be realized by out-of-state entities. As such, we assume 50% of these costs are realized within the state.

Finally, interconnection fees, transmission lines, permitting fees, and various taxes are all locally and regionally dependent and thus differ from NREL averages.

Table 1: Average Installation Costs

NREL 2021 National Benchmarks

	Benchmark Cost/ Watt DC	**Cost Per 5MW Facility**
Engineering, Procurement, & Construction	$0.08	$400,000
Contingency	$0.03	$150,000
Developer Overhead	$0.10	$500,000
Interconnection Fee	$0.02	$100,000
Permitting Fee	$0.04	$200,000
Sales Tax	$0.04	$200,000
Overhead	$0.08	$400,000
Install Labor & Equipment	$0.12	$600,000
Electrical Balance of System	$0.13	$650,000
Structural Balance of System	$0.11	$550,000
Inverter	$0.04	$200,000
Module	$0.33	$1,650,000
Total Construction & Installation Costs	$1.12	$5,600,000

> Construction of each 5MW facility will cost an estimated $9.8 million. Of that, $3.8 million will be spent in the state, creating economic activity.

CCSA expenditure estimates are applied to appropriate IMPLAN categories and events. IMPLAN suggests applying costs associated with engineering, procurement, construction overhead, and developer profits solely to the local economy. In other words, the IMPLAN model assumes these expenditures would be spent entirely in state. In this model, we instead assume a 50% local capture rate. While numerous local businesses will be involved, and indeed new, in-state businesses will be created, it is entirely reasonable to assume that a portion of developer profits may be realized at corporate offices out of state. Additionally, we assume that solar panels, modules, and inverters are purchased out of state and therefore, do not impact the local or state economy.

Of the $9.8 million total cost for each solar facility, we estimate 35.2% ($3.45 million) is spent in state contributing to Wisconsin's economy.

Land Acquisition

According to NREL, solar energy produced using photovoltaic technology requires an average of 6.1 acres per MW. Consequently, a 5MW solar farm would require, on average, just under 31 acres. Land used for community solar may be alternatively used for commercial ventures or residential development, however, typically in Wisconsin, solar farms are proposed and developed on land designated for agricultural use. As mentioned, this analysis does not account for other potential revenue sources for each 31-acre plot. However, this analysis does account for revenue that otherwise may have been earned by landowners through renting their land for agricultural production. To measure lost revenue, this analysis compares typical rental prices for farmland as published by the University of Wisconsin-Madison Division of Extension in 2022.

Various types of farmlands (irrigated, non-irrigated, and pasture) are rented at different rates in different regions of the state. For consistency, the analysis uses the statewide average rental rate for non-irrigated farmland. To smooth annual fluctuations when calculating a base year, this analysis uses an average of rental rates for 2019 ($137 per acre), 2020 ($138 per acre), and 2021 ($133 per acre). This yields an average rental rate of $136 per acre, or $4,216 annually, for the required 31 acres per solar farm.

Data from CCSA indicates an annual lease payment will be made to each landowner. Because of the proprietary nature of this data, we do not publish the actual proposed payment but instead discuss how the payment is treated within the parameters of this analysis. We assume that all lease payments remain static through the life of the project even though average rental rates for non-irrigated farmland typically fluctuate based on market conditions, such as real estate prices, interest rates, and demand for agriculture commodities.

The annual lease payment is included during the construction phase. However, it is not treated the same as other expenditures. First, we subtract the opportunity cost ($4,216) of leasing the farmland for agricultural purposes. Then, the net lease payment is treated as household income for the lessor. This allows the household expenditures resulting from the payment to be more accurately traced throughout the state economy. These payments are accounted for in both the construction and operation phases of the project.

Operation

While construction of solar farms requires various materials and personnel during the staggered, seven-year construction phase, annual maintenance and operations require significantly fewer employees and the expenses are spread over a longer period. Annual costs are comprised of worker compensation, materials and equipment costs, lease payments, state and local taxes and fees, and the annual cost of customer enrollment. Like lease payments, these amounts are not disclosed here due to their proprietary nature.

Annual costs, such as worker compensation, materials and equipment costs, and local taxes and fees are applied to the appropriate IMPLAN categories. The annual cost of customer enrollment is not captured by the NREL model. These costs include direct marketing, advertising, and customer retention. Like the costs associated with customer acquisition in the construction phase, we attribute estimates provided by CCSA to a separate type of analysis within the IMPLAN model. We assign 50% of these costs to specific fields related to advertising, public relations, and other related services. We assume the other half of the expenditures are realized out of state.

Compiling all data provided by CCSA, coupled with standardized data from NREL, the estimated annual cost of operating a 5MW solar facility is $430,353.

Timeline

In this section, we detail the timeline for the construction and operations phases, as well as the customer acquisition, customer enrollment, and land-lease events associated with the entire project. We assume that in each of years one through seven, 50 5MW solar farms will be constructed, adding 250MW electricity generation to the state each year. After year seven, these projects will provide an additional 1,750 MW of electricity compared to the year prior to the initial installations. Assuming current (2021) power generation remains constant, this increase will bring the share of electric power generated by all solar facilities–utility-scale, community, commercial, and other independent producers–to 13.7% of total electric generation, up from 3.1% currently. During years one through seven, construction, land-lease, and customer acquisition costs are applied to the model for each solar farm.

Each facility is assumed to have a 25-year life span, which means in years one through seven, the number of facilities on line will be staggered in the same way as in years 26 through 32 of the project life cycle.

Beginning in year two of the project, operations, maintenance, customer enrollment, and land-lease costs are applied to the model for each solar facility. These costs will be staggered throughout the construction phase as more facilities come on line and again staggered as each facility reaches its 25-year life span.

Discounting and Deflators

When calculating future economic contributions of any proposed project, two important factors need to be considered: the preference for current dollars over future dollars and the predicted impact of inflation on cost estimates.

Inflation is estimated through deflators in the IMPLAN model. Each industry event is tied to relative spending categories, which in turn, are tied to specific economic deflators. These deflators are applied to each spending category in each year following year one.

To account for the preference for current spending compared to future spending, we apply a 5% discount rate to each year of construction, operation and maintenance, land-lease, customer acquisition, and customer enrollment expenditures.

ECONOMIC IMPACT

Construction Phase

As mentioned above, each 5MW installation will cost an estimated $9.84 million. Of that, $3.45 million will be spent in the state. These dollars are expected to directly create or support 30 full-time equivalent jobs in Wisconsin, mostly in the construction industry. These jobs will generate just over $2.1 million in labor income.

The true impact, however, will be much larger due to the multiplicative impact of dollars spent in the local economy on items such as housing, food, and fuel for transportation. This direct spending ripples through the region to create indirect and induced effects.

Indirect effects stem from the initial purchases and expenditures captured by the direct effects. As businesses spend money with other businesses, money travels through the local economy. For example, a construction company may purchase lumber from a local business, which in turn uses the income earned from the construction company to purchase machine parts for its sawmill. As local businesses spend their income from the initial, direct expenditure, the realized impact ripples through the economy.

Induced effects are the economic contributions from households spending earned income locally. Using the example above, as the construction company, local lumber mill employees, and the workers who manufactured the sawmill machine parts spend their income, the impacts will be measured as induced effects.

Once all these effects are considered–direct, indirect, and induced–we estimate that construction of each 5MW facility supports an average of about 48 Wisconsin jobs each year with total labor income of just over $3.1 million. Additionally, we show that the total value added, that is the total economic output including labor income and additional impacts throughout the region, is $4.6 million annually.

Construction of each 5MW community solar facility would directly or indirectly support 48 full-time equivalent jobs in Wisconsin.

Operations Phase

The operations and maintenance phase requires fewer materials and less labor and annual spending compared to the construction phase. However, since the operations phase lasts for 25 years instead of a single year of construction, the economic impacts are still quite significant. We estimate that the operation of each 5MW solar facility creates enough demand for 0.5 full-time equivalent positions. This demand will be divided amongst various vendors and industries.

Additional demand is created by spending associated with customer enrollment. This demand will support an additional 0.5 full-time equivalent jobs. While the lease payments do not support direct job creation, they create induced economic activity.

After accounting for all direct, indirect, and induced spending associated with annual operations and maintenance activities, we estimate that about two Wisconsin jobs will be supported by each 5MW capacity facility. Each facility will contribute approximately $123,000 in annual labor income and about $302,000 in total value to the state's economy.

Aggregate Contributions

The previous two sections detailed the economic contributions for the construction and operation of one facility in current dollars. We now turn to the aggregate economic contributions resulting from the construction and operation of 350 facilities built out over seven years (50 per year). All dollar values beginning in year two are discounted at 5%.

Over the 33-year period studied, construction and operation of the 350 community solar facilities are expected to generate $2.5 billion of economic activity in the state. These facilities would create or support 34,700 full-time equivalent jobs and $1.4 billion of labor income.

The bulk of the economic activity will be generated in the first seven years, during the construction phase. This period also encompasses six years of operation: 50 facilities operating in year two ramping up to 300 facilities in year seven. Still, the majority of the economic activity in this phase is related to construction.

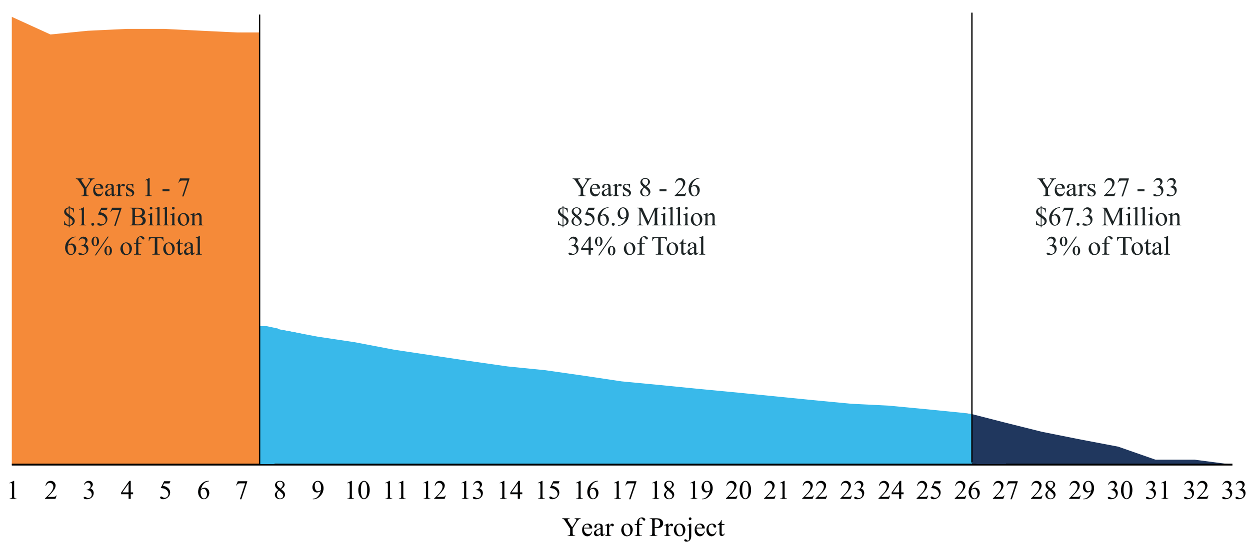
During this period, $1.57 billion in discounted total benefits, or 63% of the total, will occur (see Figure 1). Construction and operation will create or support a total of 18,991 full-time equivalent jobs and $1.01 billion in labor income. Annual detail can be found in Table 2 on page 12.

Construction and operation of 350 community solar facilities would create an estimated $2.5 billion of economic activity in Wisconsin.

Beginning in year eight, the project shifts from construction to operations, and therefore the total spending and economic contribution significantly decreases. During years eight through 26, we expect the total impact of the installed solar facilities to be $856.9 million. Because operations and maintenance are much less intensive than construction, the total number of jobs created and supported through this spending is significantly less than what occurs during the construction phase. During the maintenance and operation period, we estimate an average of 714 jobs per year will be created or supported and $346 million in labor income.

In year 27, the first batch of installed solar panels will start to outlive their projected life span. We do not model for the impacts of decommissioning, recycling, or disposal of panels. Nor do we model for any replacement or refurbishing of these panels. Instead, this analysis only considers the projected 25-year life span and the economic contributions of each group of panels. As solar

Figure 1: Total Economic Contribution to Wisconsin's Economy
350 Community Solar Facilities Built Over Seven Years; Each Operating 25 Years



panels are taken off line, maintenance and operations requirements will decrease as well. From years 27 through 32, economic contributions will total $67.3 million. The facilities will support 2,142 full-time equivalent jobs and $27 million in labor income.

CONCLUSION

This study explored the economic contributions deriving from the construction and operation of 350 community solar installations. Each installation has an estimated life span of 25 years. Using data from CCSA and NREL and the input-output model from IMPLAN, we estimate that the total discounted economic contribution would be $2.49 billion. Construction and operation would create or support nearly 35,000 full-time equivalent jobs and create $1.4 billion in labor income.

While construction and operation would occur over more than 30 years, the bulk of the benefits are generated early. We estimate that 63% of the total impact is generated in the first seven years.

Table 2: Economic Contributions From Community Solar

Construction and Operation of 350 Installations, Each With 25-Year Life Span; Labor Income and Value Added in $Millions

Project Year	Units Built	Units in Service	Employ-ment	Labor Income	Value Added
1	50	0	2,407	$157.80	$230.26
2	50	50	2,509	$148.08	$221.63
3	50	100	2,611	$145.70	$223.15
4	50	150	2,713	$143.18	$223.91
5	50	200	2,815	$140.52	$224.00
6	50	250	2,917	$137.76	$223.48
7	50	300	3,019	$134.92	$222.42
8	0	350	714	$28.36	$69.66
9	0	350	714	$26.90	$66.07
10	0	350	714	$25.52	$62.67
11	0	350	714	$24.21	$59.43
12	0	350	714	$22.96	$56.37
13	0	350	714	$21.78	$53.46
14	0	350	714	$20.66	$50.71
15	0	350	714	$19.60	$48.09
16	0	350	714	$18.59	$45.61
17	0	350	714	$17.64	$43.26
18	0	350	714	$16.73	$41.03
19	0	350	714	$15.87	$38.92
20	0	350	714	$15.06	$36.91
21	0	350	714	$14.28	$35.01
22	0	350	714	$13.55	$33.20
23	0	350	714	$12.85	$31.49
24	0	350	714	$12.19	$29.87
25	0	350	714	$11.56	$28.33
26	0	350	714	$10.97	$26.87
27	-50	300	612	$8.92	$21.84
28	-50	250	510	$7.05	$17.27
29	-50	200	408	$5.35	$13.10
30	-50	150	306	$3.81	$9.32
31	-50	100	204	$1.20	$2.95
32	-50	50	102	$1.14	$2.79
33	-50	0	0	$0.00	$0.00
Total	**0**	**0**	**34,699**	**$1,384.73**	**$2,493.10**