Economic Impact and Land Use Analysis of the Watertown Solar Project

Strategic Economic Research, LLC

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Dr. Loomis has published over 40 peer-reviewed articles in leading energy policy and economics journals. He has raised and managed over $7 million in grants and contracts from government, corporate and foundation sources. He received the 2011 Department of Energy's Midwestern Regional Wind Advocacy Award and the 2006 Best Wind Working Group Award. Dr. Loomis received his Ph.D. in economics from Temple University in 1995.

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Bryan Loomis has three years of experience in economic impact, property tax, and land use analysis at Strategic Economic Research. He has performed over 50 wind and solar analyses in the last three years. He improved the property tax analysis methodology by researching various state taxing laws and implementing depreciation, taxing jurisdiction millage rates, and other factors into the tax analysis tool. Before working for SER, Bryan mentored and worked with over 30 startups to help them grow their businesses as CEO and Founder of his own marketing agency. Bryan received his MBA in Marketing from Belmont University in 2016.

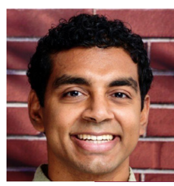

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Table of Contents

Table of Contents - Figures

Table of Contents - Tables

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I. Executive Summary of Findings

Samsung is developing the Watertown Solar Project in Sanilac County, Michigan. The purpose of this report is to aid decision makers in evaluating the economic impact of this project on Sanilac County and the State of Michigan. The basis of this analysis is to study the direct, indirect, and induced impacts on job creation, wages, and total economic output.

The Watertown Solar Project is a 182.56-megawatt direct current (MWdc) utility-scale solar powered-electric generation facility that will utilize photovoltaic (PV) panels installed on a single-axis tracking system. The total Project represents an investment in excess of $182 million. The total development is anticipated to result in the following:

Jobs – all numbers are full-time equivalents

- 100 new local jobs during construction for Watertown Township
- 128 new local jobs during construction for Sanilac County
- 245 new local jobs during construction for the State of Michigan
- 1.6 new local long-term jobs for Watertown Township
- 5.2 new local long-term jobs for Sanilac County
- 7.9 new local long-term jobs for the State of Michigan

Earnings

- Over $10.3 million in new local earnings during construction for Watertown Township
- Over $11.5 million in new local earnings during construction for Sanilac County
- Over $22.4 million in new local earnings during construction for the State of Michigan
- Over $76.8 thousand in new local long-term earnings for Watertown Township annually
- Over $213 thousand in new local long-term earnings for Sanilac County annually
- Over $479 thousand in new local long-term earnings for the State of Michigan annually

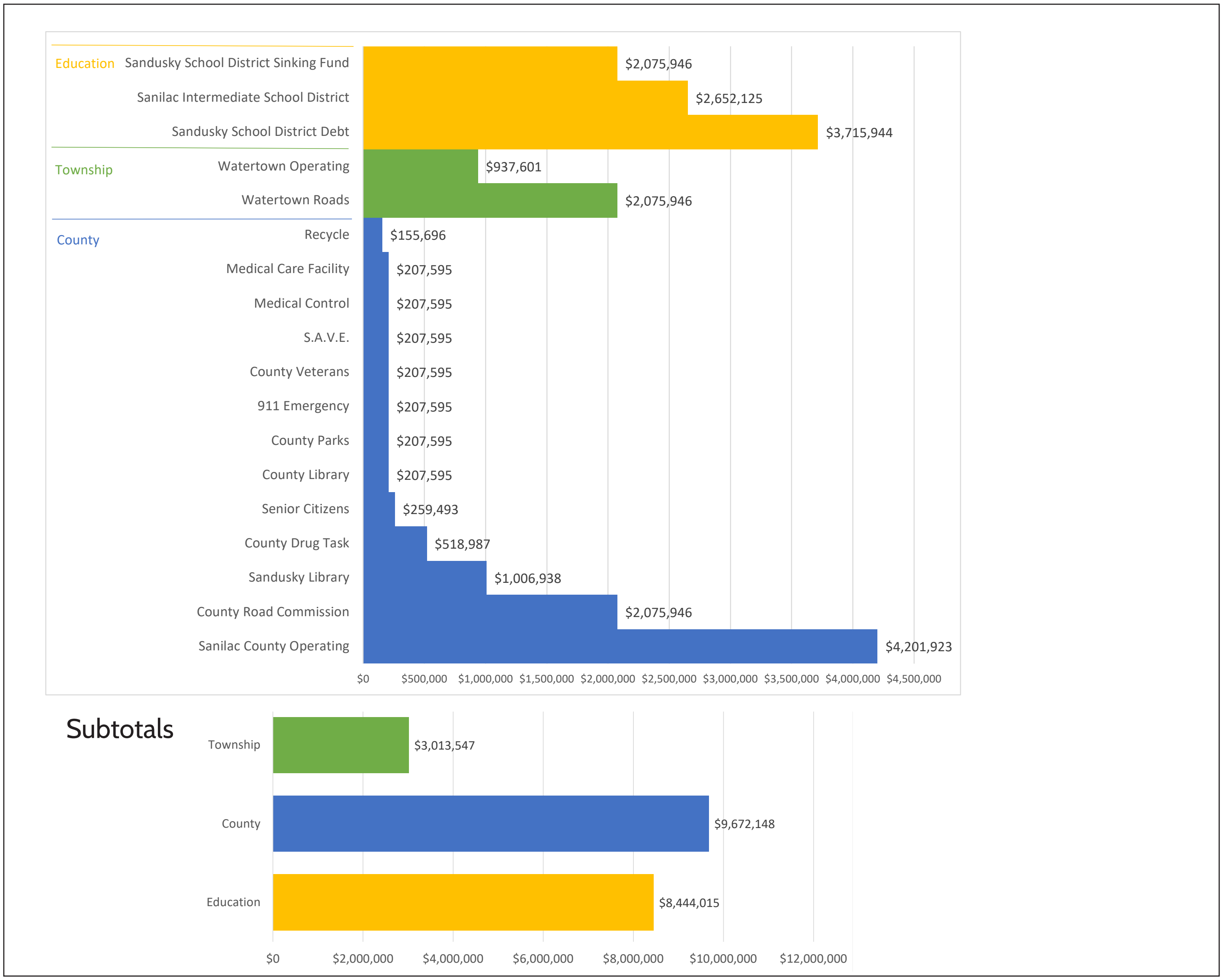
Output

- Over $10.9 million in new local output during construction for Watertown Township
- Over $14.8 million in new local output during construction for Sanilac County
- Over $33.1 million in new local output during construction for the State of Michigan
- Over $368 thousand in new local long-term output for Watertown Township annually
- Over $790 thousand in new local long-term output for Sanilac County annually
- Over $1.4 million in new local long-term output for the State of Michigan annually

Property Taxes

- Over $3.0 million in total property taxes for Watertown Township over the life of the Project
- Over $8.4 million in total school district revenue over the life of the Project
- Over $9.6 million in total county property taxes for Sanilac County over the life of the Project
- Over $21.1 million in property taxes in total for all taxing districts over the life of the Project

Figure 1 – Total Property Taxes Paid by the Watertown Solar Project



Land Use

This report also performs an economic land use analysis regarding the leasing of agricultural land for the new solar farm. That analysis yields the following results:

- Using a real-options analysis, the land use value of solar leasing far exceeds the value for agricultural use.

- Sanilac County:

    - For corn farming to generate more income for the landowner and local community than the solar lease, corn prices would need to rise to $20.05 per bushel by the year 2060 or corn yields would need to rise to 300.3 bushels per acre by the year 2026.
    - Alternatively, soybean prices would need to rise to $54.04 per bushel by the year 2060 or soybean yields would need to rise to 107.1 bushels per acre by the year 2026 for soybean farming to generate more income for the landowner and local community than the solar lease.
    - At the time of this report, corn and soybean prices are $6.13 and $13.90 per bushel respectively and yields are 180 and 54 bushels per acre respectively.

Although I am not a Property Value Expert, but as an economist who has studied renewable energy projects, I expect NO change in the value of the subject property and no additional costs to the township associated with the facility in the form of additional services.

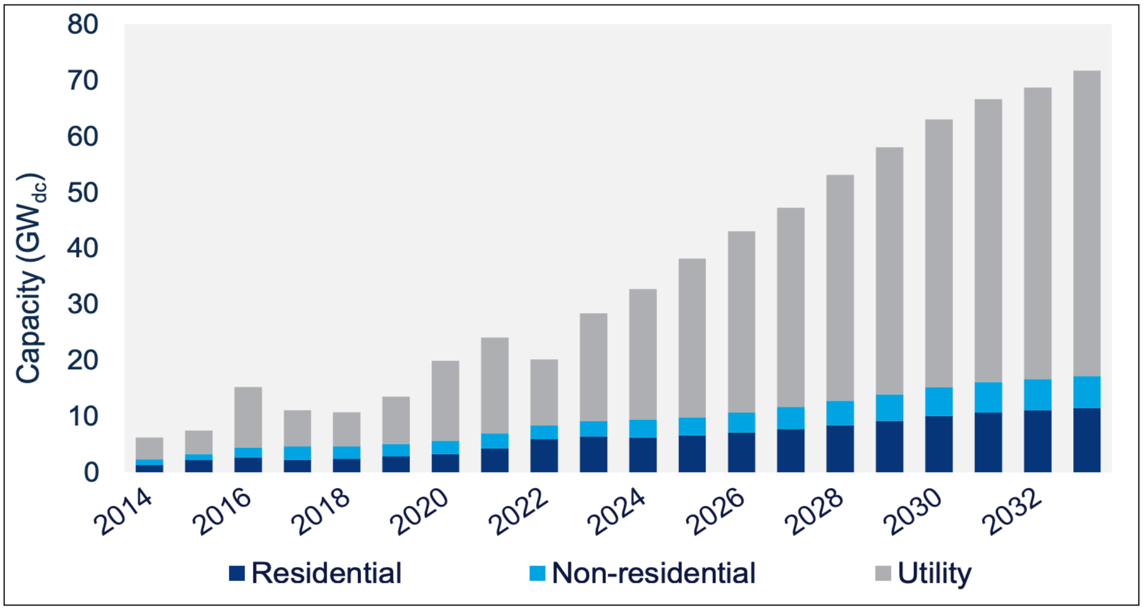
II. U.S. Solar PV Industry Growth and Economic Development

a. U.S. Solar PV Industry Growth

The U.S. solar industry is growing at a rapid but uneven pace. Solar energy systems are installed for onsite use, including residential, commercial and industrial properties, and utility-scale solar powered-electric generation facilities intended for wholesale distribution. Watertown Solar is a utility-scale solar PV project intended for wholesale markets through the transmission grid. From 2013 to 2018, the amount of electricity generated from solar had more than quadrupled, increasing 444% (SEIA, 2020). The industry has continued to add increasing numbers of PV systems to the grid. In the first half of 2021, the U.S. installed over 11,000 MW direct current (MWdc) of solar PV driven mostly by utility-scale PV which exceeds most of the annual installations in the last decade. Figure 2 shows the historical capacity additions as well as the forecasted additions into 2033. The primary driver of this overall sharp pace of growth is large price declines in solar equipment. The overall price of solar PV has declined from $5.79/watt in 2010 to $1.33/watt in 2020 (SEIA, 2020). According to Figure 3, utility-scale solar fixed tilt and single-axis tracking have increased slightly from $0.85/watt and $0.98/watt during the fourth quarter of 2021 to $0.91/watt and $1.01/watt by the fourth quarter of 2022. Solar PV also benefits from the Federal Investment Tax Credit (ITC) which provides a tax credit for residential and commercial properties.

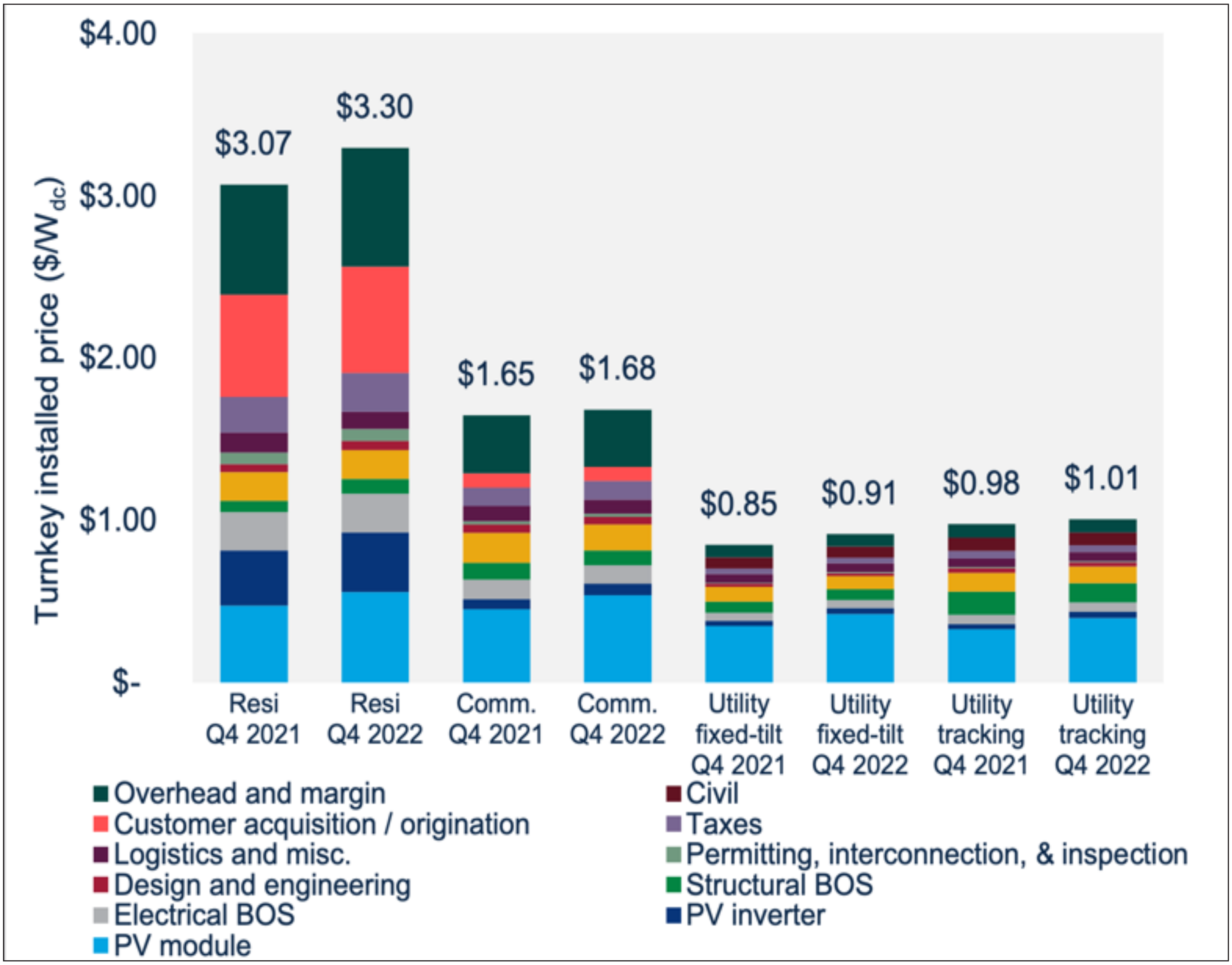
Utility-scale PV leads the installation growth in the U.S. Just under 12 GWdc of utility PV projects were completed in 2022. According to Figure 4, there are 90,300 MWdc of contracted utility-scale installations that have not been built yet.

Figure 2 – Annual U.S. Solar PV Installations, 2014-2033E



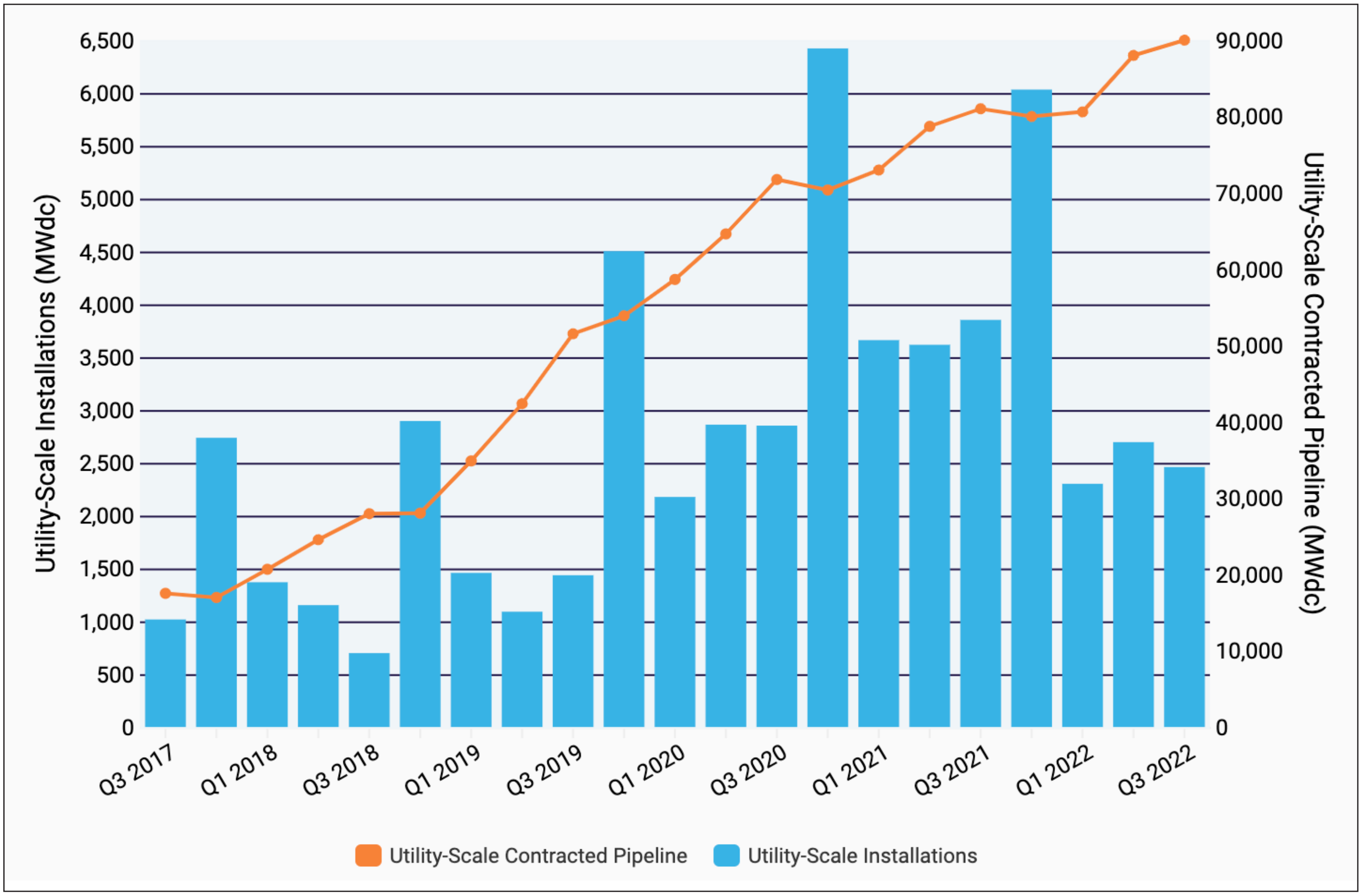
Source: Solar Energy Industries Association, Solar Market Insight Report 2022 Year in Review

Figure 3 – Modeled U.S. National Average System Prices by Market Segment, Q4 2021 and Q4 2022



Source: Solar Energy Industries Association, Solar Market Insight Report 2022 Year in Review

Figure 4 – U.S. Utility PV Installations vs. Contracted Pipeline



Source: Solar Energy Industries Association, Solar Market Insight Report Q4 2022

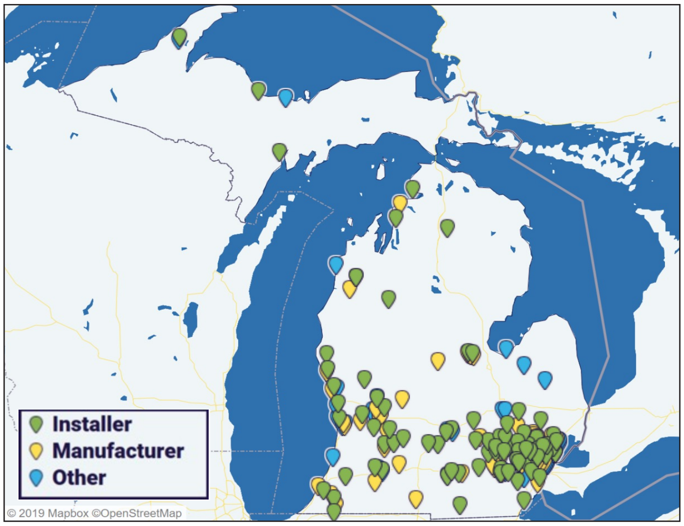
b. Michigan Solar PV Industry

According to SEIA, Michigan is ranked 25th in the U.S. in cumulative installations of solar PV. California, Texas, and Florida are the top 3 states for solar PV which may not be surprising because of the high solar irradiation that they receive. However, other states with similar solar irradiation to Michigan rank highly including New Jersey (8th), New York (9th), Virginia (10th), and Massachusetts (11th). In 2022, Michigan installed 245 MW of solar electric capacity bringing its cumulative capacity to 1,038 MW.

Michigan has great potential to expand its solar installations. Michigan has several utility-scale solar farms in operation: Assembly Solar (239 MW) in Shiawassee County; Demille Solar (28.56 MW) in Lapeer County; and Delta Solar (24 MW) in Eaton County[1]. The 182.56 MWdc Watertown Solar Project will be one of the largest installations in Michigan to date.

There are 216 solar companies in Michigan including 74 manufacturers, 80 installers/developers, and 62 others.[2] Figure 5 shows the locations of solar companies in Michigan as of the time of this report. Currently, there are 3,941 solar jobs in the State of Michigan according to SEIA.

Figure 5 – Solar Company Locations in Michigan

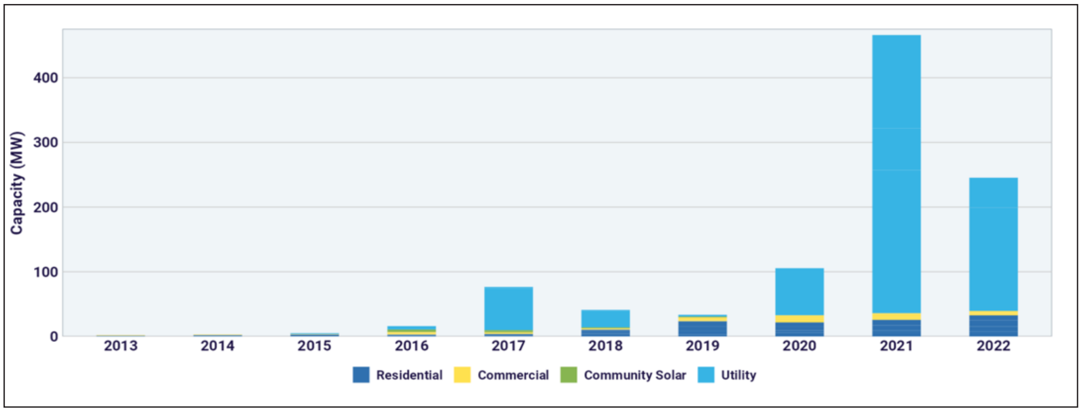


Source: Solar Energy Industries Association, Solar Spotlight: Michigan, Q1 2023

[1] The megawatts listed in this paragraph are MWac. To convert to MWdc, multiply the MWac by 1.3 to get the approximate MWdc capacity.

[2] "Other" includes Sales and Distribution, Project Management, and Engineering.

Figure 6 – Michigan Annual Solar Installations



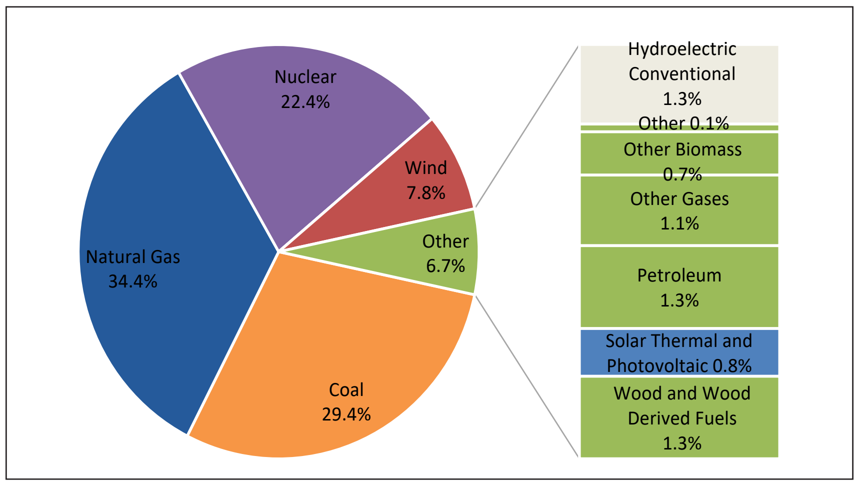
Source: Solar Energy Industries Association, Solar Spotlight: Michigan, Q1 2023

Figure 6 shows the Michigan historical installed capacity by year according to the SEIA. Huge growth was seen in 2021 and is forecasted to continue to grow in 2023 and beyond. Over the next five years, solar in Michigan is projected to grow by 2,610 MW.

The Energy Information Administration (EIA) calculated the number of megawatt-hours generated from different energy sources in 2022. As shown in Figure 7, the greatest percentage of electricity generated in Michigan comes from natural gas with 34.4% followed by coal with 29.4% and nuclear energy with 22.4%. Approximately 0.8% of the total electricity power generated in Michigan came from solar thermal and solar PV in 2022.

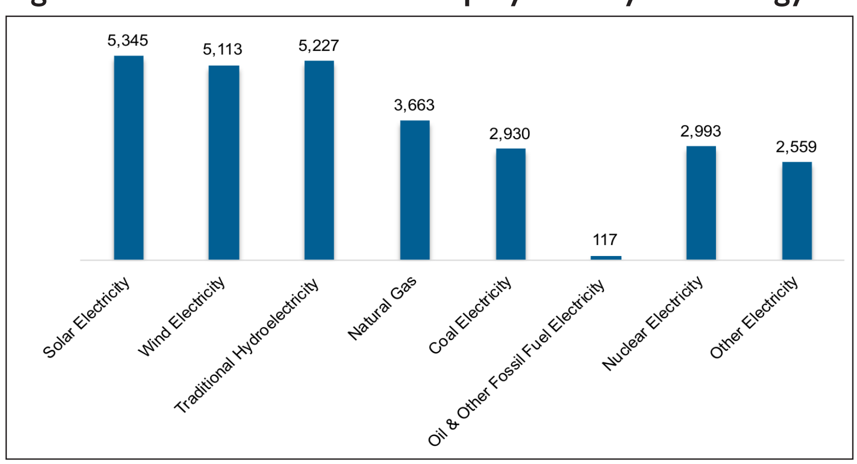
The U.S. Department of Energy sponsors the U.S. Energy and Employment Report each year. Electric Power Generation covers all utility and non-utility employment across electric generating technologies, including fossil fuels, nuclear, and renewable technologies. It also includes employees engaged in facility construction, turbine and other generation equipment manufacturing, operations and maintenance, and wholesale parts distribution for all electric generation technologies. According to Figure 8, employment in Michigan in the solar energy industry (5,345) is larger than traditional hydroelectric generation (5,227), wind generation (5,113), and natural gas generation (3,663).

Figure 7 – Electric Generation by Fuel Type for Michigan in 2022



Source: U.S. Energy Information Association (EIA): Michigan, 2022

Figure 8 – Electric Generation Employment by Technology



Source: US Energy and Employment Report 2023: Michigan

c. Economic Benefits of Utility-Scale Solar PV Energy

Utility-scale solar powered-electric generation facilities have numerous economic benefits. Solar PV installations create job opportunities in the local area during both the short-term construction phase and the long-term operational phase. In addition to the workers directly involved in the construction and maintenance of the solar energy project, numerous other jobs are supported through indirect supply chain purchases and the higher spending that is induced by these workers. Solar PV projects strengthen the local tax base and help improve county services, and local infrastructure, such as public roads.

Numerous studies have quantified the economic benefits of Solar PV projects across the United States and have been published in peer-reviewed academic journals. Some of these studies examine smaller-scale solar systems, and some examine utility-scale solar energy. Croucher (2012) uses NREL's Jobs and Economic Development Impacts ("JEDI") modeling methodology to find which state will receive the greatest economic impact from installing one hundred 2.5 kW residential systems. He shows that Pennsylvania ranked first supporting 28.98 jobs during installation and 0.20 jobs during operations. Illinois ranked second supporting 27.65 jobs during construction and 0.18 jobs during operations.

The Michigan Conservative Energy Forum (2018) commissioned a study by The Hill Group in 2018 to examine the economic impacts of different renewable portfolio standards for the State of Michigan. They found that "the 12.5 percent by 2019 scenario indicates that the selected activities as a whole could have a potential gross impact of nearly $3.8 billion on Michigan, including more than 20,100 job-years supported and nearly $1.4 billion in employee compensation."

More recently, Michaud et al. (2020) performed an analysis of the economic impact of utility-scale solar energy projects in the State of Ohio. They detail three scenarios: low (2.5 GW), moderate (5 GW) and high (7.5 GW). Using the JEDI model, they find that between 18,039 and 54,113 jobs would be supported during construction and between 207 and 618 jobs would be supported annually during operations. In addition, between $22.5 million and $67.5 million annually in tax revenues would come from these projects.

Loomis et al. (2016) estimates the economic impact for the State of Illinois if the state were to reach its maximum potential for solar PV. The study estimates the economic impact of three different scenarios for Illinois – building new solar installations of either 2,292 MW, 2,714 MW or 11,265 MW. The study assumes that 60% of the capacity is utility-scale solar, 30% of the capacity is commercial, and 10% of the capacity is residential. It was found that employment impacts vary from 26,753 to 131,779 job years during construction and from 1,223 to 6,010 job years during operating years.

Several other reports quantify the economic impact of solar energy. Bezdek (2006) estimates the economic impact for the State of Ohio and finds the potential for PV market in Ohio to be $25 million with 200 direct jobs and 460 total jobs. The Center for Competitive Florida (2009) estimates the impact if the state were to install 1,500 MW of solar and finds that 45,000 direct jobs and 50,000 indirect jobs could be created. The Solar Foundation (2013) uses the JEDI modeling methodology to show that Colorado's solar PV installation to date created 10,790 job-years. They also analyze what would happen if the state were to install 2,750 MW of solar PV from 2013 to 2030 and find that it would result in nearly 32,500 job years. Berkman et al. (2011) estimates the economic and fiscal impacts of the 550 MWac Desert Sunlight Solar Farm. The project creates approximately 440 construction jobs over a 26-month period, $15 million in new sales tax revenues, $12 million in new property revenues for Riverside County, CA, and $336 million in indirect benefits to local businesses in the county.

Finally, Jenniches (2018) performed a review of the literature assessing the regional economic impacts of renewable energy sources. After reviewing all of the different techniques for analyzing the economic impacts, he concludes "for assessment of current renewable energy developments, beyond employment in larger regions, IO [Input-Output] tables are the most suitable approach" (Jenniches, 2018, 48). Input-Output analysis is the basis for the methodology used in the economic impact analysis of this report.

III. Project Description and Location

a. Watertown Solar Project

Samsung is developing the Watertown Solar Project in Sanilac County, Michigan. The Project consists of an estimated 182.56-megawatt direct current (MWdc) utility-scale solar powered-electric generation facility that will utilize photovoltaic (PV) panels installed on a single-axis tracking system. The total Project represents an investment in excess of $182 million.

b. Sanilac County, Michigan

Sanilac County is located in the eastern part of Michigan (see Figure 9). It has a total area of 1,590 square miles and the U.S. Census estimates that the 2022 population was 40,657 with 21,775 housing units. The county has a population density of 45 (persons per square mile) compared to 174 for the State of Michigan (2020). Median household income in the county was $52,459 (U.S. Census Bureau, 2021).

Figure 9 – Location of Sanilac County, Michigan

As shown in Table 1, the largest industries in the county are "Manufacturing" followed by "Agriculture, Forestry, Fishing and Hunting," "Retail Trade" and "Administrative Government." These data for Table 1 come from IMPLAN covering the year 2021 (the latest year available).

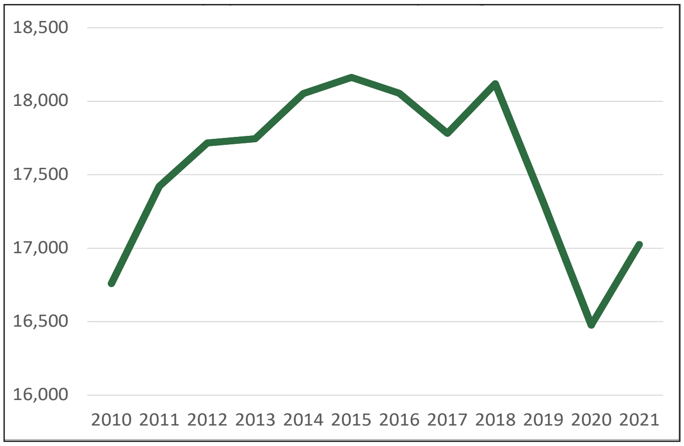
Table 1 – Employment by Industry in Sanilac County

Industry	Number	Percent
Manufacturing	2,640	16.4%
Agriculture, Forestry, Fishing and Hunting	1,967	12.2%
Retail Trade	1,630	10.1%
Administrative Government	1,315	8.2%
Health Care and Social Assistance	1,309	8.1%
Construction	1,131	7.0%
Accommodation and Food Services	993	6.2%
Other Services (except Public Administration)	845	5.2%
Transportation and Warehousing	728	4.5%
Real Estate and Rental and Leasing	682	4.2%
Finance and Insurance	671	4.2%
Wholesale Trade	538	3.3%
Administrative and Support and Waste Management and Remediation Services	498	3.1%
Professional, Scientific, and Technical Services	467	2.9%
Educational Services	292	1.8%
Arts, Entertainment, and Recreation	119	0.7%
Government Enterprises	116	0.7%
Mining, Quarrying, and Oil and Gas Extraction	75	0.5%
Information	69	0.4%
Utilities	27	0.2%
Management of Companies and Enterprises	0	0.0%

Source: Impact Analysis for Planning (IMPLAN), County Employment by Industry, 2021

Table 1 provides the most recent snapshot of total employment but does not examine the historical trends within the county. Figure 10 shows employment from 2010 to 2021. Total employment in Sanilac County was at its highest at 18,162 in 2015 and its lowest at 16,475 in 2020 (BEA, 2023).

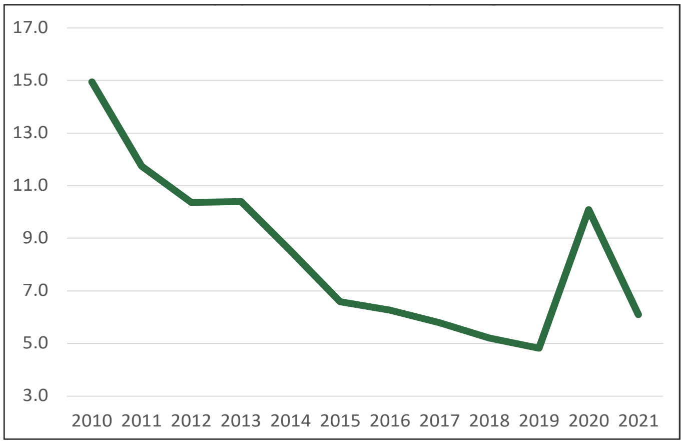
Figure 10 – Total Employment in Sanilac County from 2010 to 2021



Source: Bureau of Economic Analysis, Regional Data, GDP and Personal Income, 2010-2021

The unemployment rate signifies the percent of persons without employment in the county. Figure 11 shows the unemployment rates from 2010 to 2021. Unemployment in Sanilac County was at its highest at 15% in 2010 and its lowest at 4.8% in 2019 (FRED, 2023).

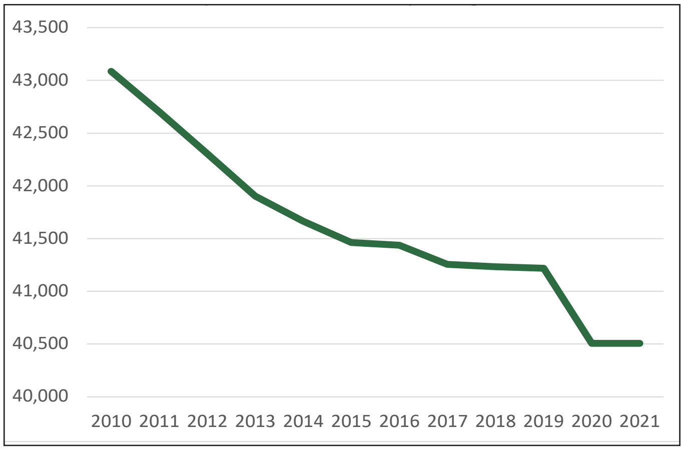
Figure 11 – Unemployment Rate in Sanilac County from 2010 to 2021



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census Bureau, Unemployment Rates, 2010-2021

The overall population in the county has been decreasing steadily, as shown in Figure 12. Sanilac County population was 43,087 in 2010 and 40,506 in 2021, a loss of 2,581 (FRED, 2023). The average annual population decrease over this time period was 235.

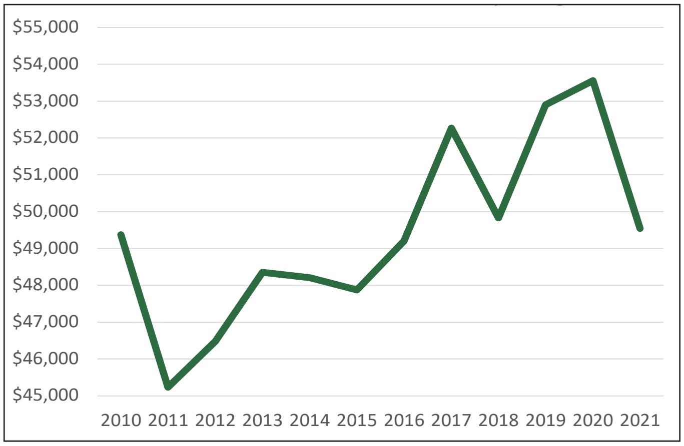
Figure 12 – Population in Sanilac County from 2010 to 2021



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census Bureau, Population Estimates, 2010-2021

Household income has fluctuated greatly in the county. Figure 13 shows the real median household income in Sanilac County from 2010 to 2021. Using the national Consumer Price Index (CPI), the nominal median household income for each year was adjusted to 2021 dollars. Household income was at its lowest at $45,230 in 2011 and its highest at $53,560 in 2020 (FRED, 2023).

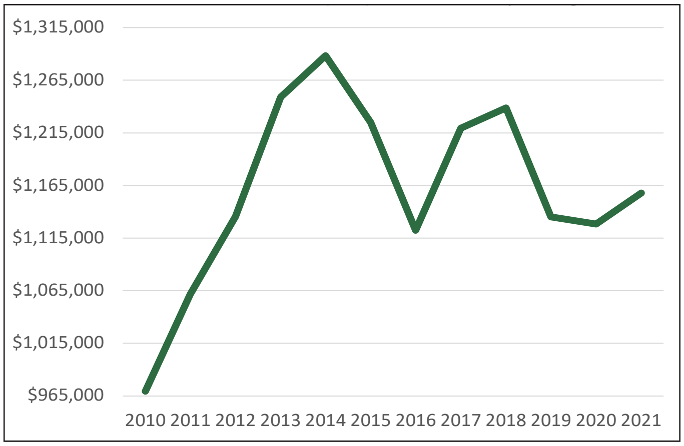
Figure 13 – Real Median Household Income in Sanilac County from 2010 to 2021



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census Bureau, Estimate of Median Household Income, 2010-2021

Real Gross Domestic Product (GDP) is a measure of the value of goods and services produced in an area and adjusted for inflation over time. The Real GDP for Sanilac County has been fluctuating since hitting a high in 2014, as shown in Figure 14 (BEA, 2023).

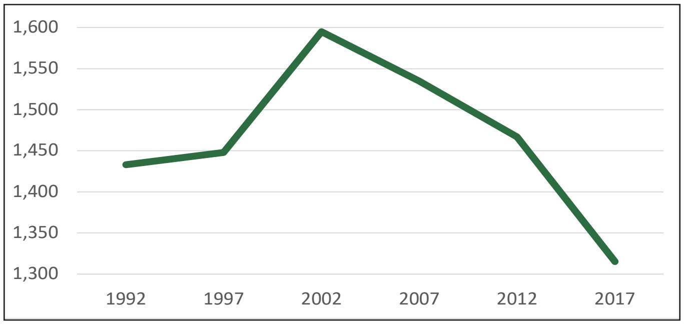
Figure 14 – Real Gross Domestic Product (GDP) in Sanilac County from 2010 to 2021



Source: Bureau of Economic Analysis, Regional Data, GDP and Personal Income, 2010-2021

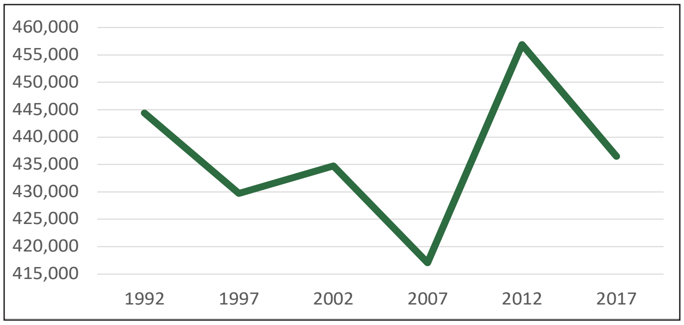
The farming industry has fluctuated in Sanilac County. As shown in Figure 15, the number of farms hit a high of 1,595 in 2002 and a low of 1,315 in 2017. The amount of land in farms has fluctuated greatly. The county farmland hit a low of 417,083 acres in 2007 and a high of 456,877 acres in 2012 according to Figure 16.

Figure 15 – Number of Farms in Sanilac County from 1992 to 2017



Source: USDA National Agricultural Statistics Service, Census of Agriculture, 1992-2017

Figure 16 – Land in Farms in Sanilac County from 1992 to 2017



Source: USDA National Agricultural Statistics Service, Census of Agriculture, 1992-2017

ii. Agricultural Statistics

Michigan is ranked eighteenth among U.S. states in total value of agricultural products sold (Census, 2017). It is ranked twenty-first in the value of livestock and fifteenth in the value of crops (Census, 2017). In 2022, Michigan had 44,300 farms and 9.2 million acres in operation with the average farm being 208 acres (State Agricultural Overview, 2022). Michigan had 428 thousand cattle and produced 11.7 billion pounds of milk (State Agricultural Overview, 2022). In 2022, Michigan yields averaged 168 bushels per acre for corn with a total market value of $2.11 billion (State Agricultural Overview, 2022). Soybeans yields averaged 47 bushels per acre with a total market value of $1.54 billion (State Agricultural Overview, 2022). The average net cash farm income per farm is $31,415 (Census, 2017).

In 2017, Sanilac County had 1,315 farms covering 436,511 acres for an average farm size of 332 acres (Census, 2017). The total market value of products sold was $357 million, with 46 percent coming from livestock sales and 54 percent coming from crop sales (Census, 2017). The average net cash farm income of operations was $68,512 (Census, 2017).

The 548 acres planned to be used by the Watertown Solar Project represents just 0.13% of the acres used for farming in Sanilac County. As we will show in the next section, solar farming is a better land use on a purely economic basis than livestock or crops for the particular land in this Project.

IV. Land Use Methodology

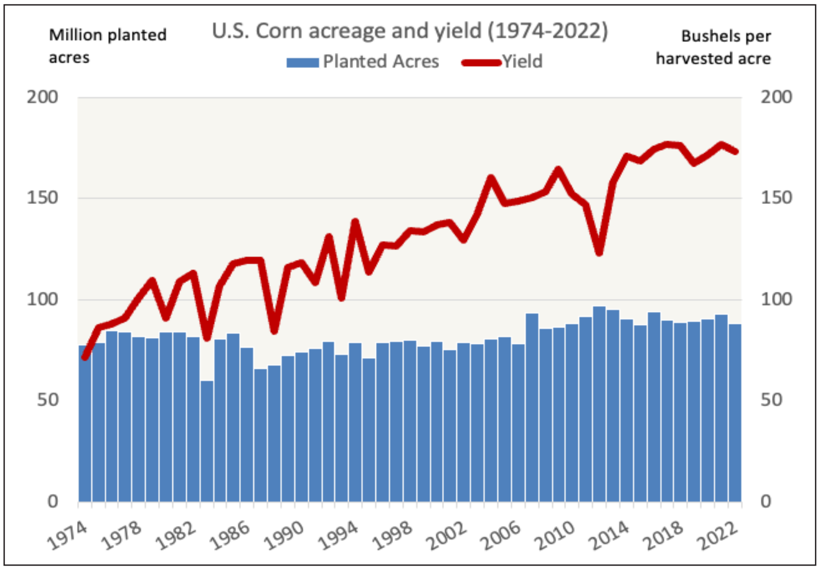
To analyze the specific economic land use decision for a solar energy facility, this section uses a methodology first proposed by Gazheli and Di Corato (2013). A "real options" model is used to look at the critical factors affecting the decision to lease agricultural land to a company installing a solar powered electric generating facility. According to their model, the landowner will look at his expected returns from the land that include the following: the price that they can get for the crop (typically corn or soybeans); the average yields from the land that will depend on amount and timing of rainfall, temperature and farming practices; and the cost of inputs including seed, fuel, herbicide, pesticide and fertilizer. Not considered is the fact that the landowner faces annual uncertainty on all these items and must be compensated for the risk involved in each of these parameters changing in the future. In a competitive world with perfect information, the returns to the land for its productivity should relate to the cash rent for the land.

For the landowner, the key analysis will be comparing the net present value of the annual solar lease payments to expected profits from farming. The farmer will choose the solar farm lease if:

$$NPV\ (\text{Solar Lease Payment}_t) > NPV\ (P_t * \text{Yield}_t - \text{Cost}_t)$$

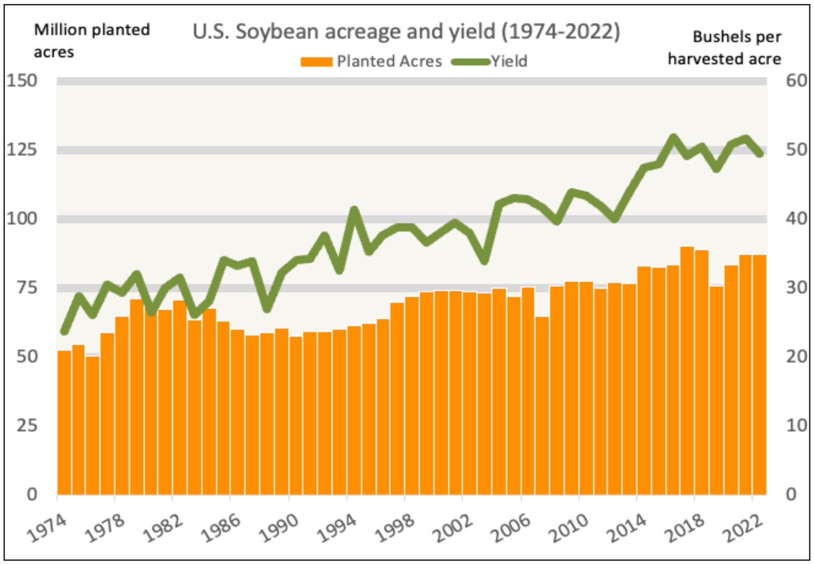
Where NPV is the net present value; Solar Lease Payment_t is the lease payment the owner receives in year t; P_t is the price that the farmer receives for the crop (corn or soybeans) in year t; Yield_t is the yield based on the number of acres and historical average of county-specific productivity in year t; Cost_t is the total cost of farming in year t and will include (the cost of seed, fertilizer, the opportunity cost of the farmer's time. Farming profit is the difference between revenue (price times yield) and cost. The model will use historical agricultural data from the county (or state when the county data is not available). Figure 17 shows the dramatic increase in U.S. corn yields since 1974. Soybean yields have also increased though not as dramatically. Figure 18 displays the soybean yields in the U.S. since 1974.

Figure 17 – U.S. Corn Acreage and Yield



Source: USDA National Agricultural Statistics Service, Quick Stats, 2023

Figure 18 – U.S. Soybean Acreage and Yield



Source: USDA National Agricultural Statistics Service, Quick Stats, 2023

The standard net present value calculation presented above, uses the expected value of many of the variables that are stochastic (have some randomness to them). In order to forecast returns from agriculture in future years, we use a linear regression using an intercept and time trend on historical data to predict future profits.

$$\pi_t = \alpha + \beta * time$$

Where π_t is the farming profit in year t; α is intercept; β is the trend and time is a simple time trend starting at 1 and increasing by 1 each time period.

V. Land Use Results

In order to analyze future returns from farming the land, we will use historical data from Sanilac County to examine the local context for this analysis. The United States Department of Agriculture's National Agricultural Statistics Service publishes county-level statistics every five years. Table 2 shows the historical data from 1992 to 2017 for total farm income, production expenses, average farm size, net cash income, and average market value of machinery per farm.

Table 2 – Agricultural Statistics for Sanilac County, Michigan

	1992	1997	2002	2007	2012	2017
Total Farm Income Per Farm	NA	NA	$5,536	$10,155	$15,621	$15,588
Total Farm Production Expenses (average/farm)	$66,044	$71,061	$70,373	$112,606	$207,498	$218,351
Average Farm Size (acres)	310	297	273	272	311	332
Net Cash Income per Farm[3]	$15,723	$18,571	$24,837	$36,251	$92,095	$68,512
Average Market Value of Machinery Per Farm	$74,240	$92,024	$128,298	$140,989	$217,288	$274,204

Source: USDA National Agricultural Statistics Service, Census of Agriculture, 1992-2017

The production expenses listed in Table 2 include all direct expenses like seed, fertilizer, fuel, etc. but do not include the depreciation of equipment and the opportunity cost of the farmer's own time in farming. To estimate these last two items, we can use the average market value of machinery per farm and use straight-line depreciation for 30 years with no salvage value. This is a very conservative estimate of the depreciation since the machinery will likely qualify for a shorter life and accelerated or bonus depreciation. To calculate the opportunity cost of the farmers time, we obtained the mean hourly wage for farming in each of these years from the Bureau of Labor Statistics. Again, to be conservative, we estimate that the farmer spends a total of 16 weeks @ 40 hours/week farming in a year. It seems quite likely that a farmer spends many more hours than this including direct and administrative time on the farm. These statistics and calculations are shown in Table 3.

[3] Net Cash Income per farm is reported by the NASS and does not exactly equal income minus expenses. NASS definition for this item is, "Net cash farm income of the operators. This value is the operators' total revenue (fees for producing under a production contract, total sales not under a production contract, government payments, and farm-related income) minus total expenses paid by the operators. Net cash farm income of the operator includes the payments received for producing under a production contract and does not include value of commodities produced under production contract by the contract growers. Depreciation is not used in the calculation of net cash farm income."

Table 3 – Machinery Depreciation and Opportunity Cost of Farmer's Time for Sanilac County, Michigan

	1992	1997	2002	2007	2012	2017
Average Market Value Machinery Per Farm	$74,240	$92,024	$128,298	$140,989	$217,288	$274,204
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$2,475	$3,067	$4,277	$4,700	$7,243	$9,140
Mean Hourly Wage in MI for Farming (Bureau of Labor Statistics)	$5.73	$6.52	$7.31	$10.05	$10.60	$11.71
Annual Opportunity Cost of Farmer's Time (Wage times 16 weeks times 40 Hours/Week)	$3,670	$4,172	$4,678	$6,432	$6,784	$7,494

To get the total profitability of the land, we take the net cash income per farm and subtract depreciation expenses and the opportunity cost of the farmer's time. To get the profit per acre, we divide by the average farm size. Finally, to account for inflation, we use the Consumer Price Index (CPI) to convert all profit into 2017 dollars (i.e. current dollars).[4] These calculations and results are shown in Table 4.

Table 4 – Profit Per Farm Calculations for Sanilac County, Michigan

	1992	1997	2002	2007	2012	2017
Net Cash Income per Farm	$15,723	$18,571	$24,837	$36,251	$92,095	$68,512
Machinery Depreciation	($2,475)	($3,067)	($4,277)	($4,700)	($7,243)	($9,140)
Opportunity Cost of Farmer's Time	($3,670)	($4,172)	($4,678)	($6,432)	($6,784)	($7,494)
Profit	$9,579	$11,332	$15,882	$25,119	$78,068	$51,877
Average Farm Size (Acres)	310	297	273	272	311	332
Profit Per Acre	$30.90	$38.15	$58.18	$92.35	$251.02	$156.26
CPI	141.9	161.3	180.9	210.036	229.601	246.524
Profit Per Acre in 2017 Dollars	$53.68	$58.31	$79.28	$108.39	$269.52	$156.26

[4] We will use the Consumer Price Index for All Urban Consumers (CPI-U) which is the most common CPI used in calculations. For simplicity, we will just use the CPI abbreviation.

Using an unsophisticated static analysis, the farmer would be better off using his land for solar if the solar lease rental per acre exceeds the 2017 profit per acre of $156.26 which adjusts to $188.12 after accounting for inflation in Sanilac County. Yet this static analysis fails to capture the dynamics of the agricultural market and the farmer's hope for future prices and crop yields to exceed the current level. To account for this dynamic, we use the real options model discussed in the previous section. Recall that the net returns from agriculture fluctuates according to the following equation:

$$\pi_t = \propto + \beta * time$$

Where π_t is the farming profit in year t; α is intercept; β is the trend and time is a simple time trend starting at 1 and increasing by 1 each time period.

Using the Census of Agriculture data from 1992 to the present, the intercept is $50.12 with a standard error of $45.62. The time trend is $5.76 with a standard error of 2.86. This means that agriculture profits are expected to rise by $5.76. Both the intercept and the coefficient on the time trend have a wide variation as measured by the standard error. The wide variation means that there will be a lot of variability in agricultural profits from year to year.

Over the period from 2017 to 2060, we assume that the profit per acre follows the equation above but allows for the random fluctuations. Because of this randomness, we can simulate multiple futures using a Monte Carlo simulation. We assume that the solar farm will begin operation in 2026 and operate through 2060. Using 500 different simulations, the real profit per acre never exceeds $1,509 in any single year. Overall, the maximum average annual profit over the 35 years is $1,127 and the minimum average annual profit is $-73. Figure 19 is a graph of the highest and lowest real profit per acre simulations. When comparing the average annual payment projected in the maximum simulation by 2060 to the solar lease per acre payment, the solar lease provides higher returns than farming in all of the 500 simulations. This means the farmer is financially better off under the solar lease in 100% of the 500 scenarios analyzed.

Figure 19 – Simulations of Real Profits Per Acre Based on Data from 1992

Another way to look at this problem would be to ask: How high would corn prices have to rise to make farming more profitable than the solar lease? Below we assume that the yields on the land and all other input costs stay the same. In this case, corn prices would have to rise from $6.13 per bushel in 2022 to $10.23 in 2026 and rise to $20.05 per bushel by 2060 as shown in Figure 20. Alternatively, corn prices would need to rise by $0.40 per bushel each year from 2022 to 2060 when it would reach $21.35 per bushel.

Now let's turn our attention to soybean prices. If we assume the yields and input costs stay the same, soybean prices would have to rise from $13.90 per bushel in 2022 to $27.56 per bushel in 2026 and rise to $54.04 by 2060 as shown in Figure 21. For a linear increase, soybean prices would need to rise by $1.20 per bushel each year from 2022 to 2060 when it would reach $59.62 per bushel.

If we assume that the price of corn stays the same, the yields for corn would need to increase from 180 bushels per acre in 2022 to 300.3 bushels per acre in 2026 and stay at that level until 2060. The yields for soybeans would need to rise from 54 bushels per acre in 2022 to 107.1 bushels per acre in 2026 and stay there until 2060.

Figure 20 – Simulated Price of Corn Per Bushel to Match the Solar Lease

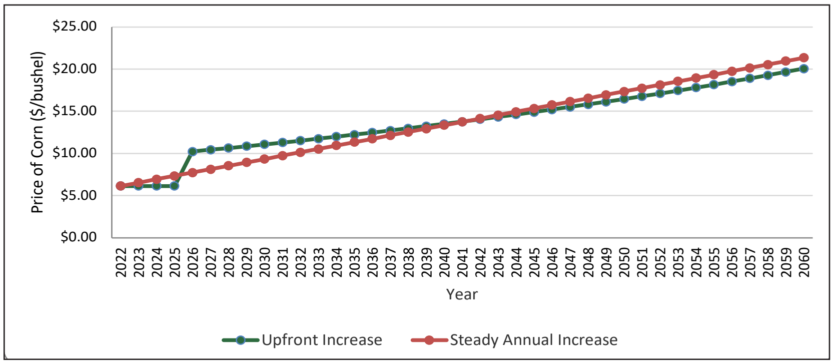
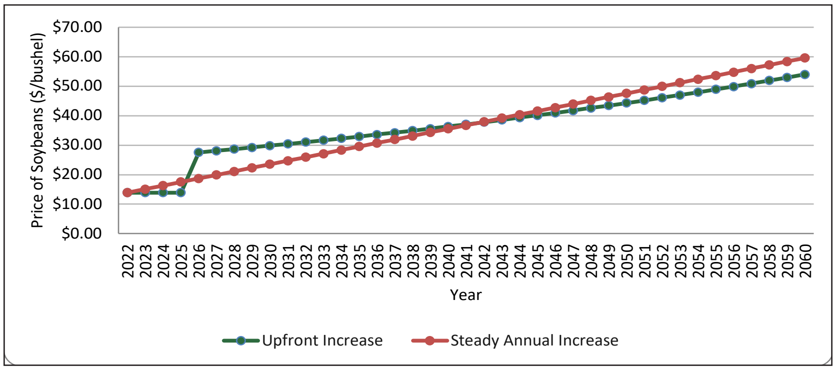


Figure 21 – Simulated Price of Soybeans Per Bushel to Match the Solar Lease



At 548 acres, the Project would take 0.13% of the county's agricultural land out of production, thus reducing the total agricultural output for the county. However, it is possible to offset this loss as yields for corn have been increasing by 1.52 bushels per acre every year. Therefore, less land will be needed to produce the same amount of corn. Our analysis shows that yields would need to reach 192.47 bushels per acre to compensate for the land taken out of production. If yields continue to increase according to their historical trends, this would happen in just 0.17 years.

Likewise, yields for soybeans have been increasing by 0.67 bushels per acre every year. Our analysis shows that yields would need to reach 55.4 bushels per acre to compensate for the land taken out of production. If yields continue to increase according to their historical trends, this would happen in just 0.1 years.

Figure 22 – Expected Annual Increase in Production Due to Higher Yields from Corn Versus Expected Decrease in Production from Acreage

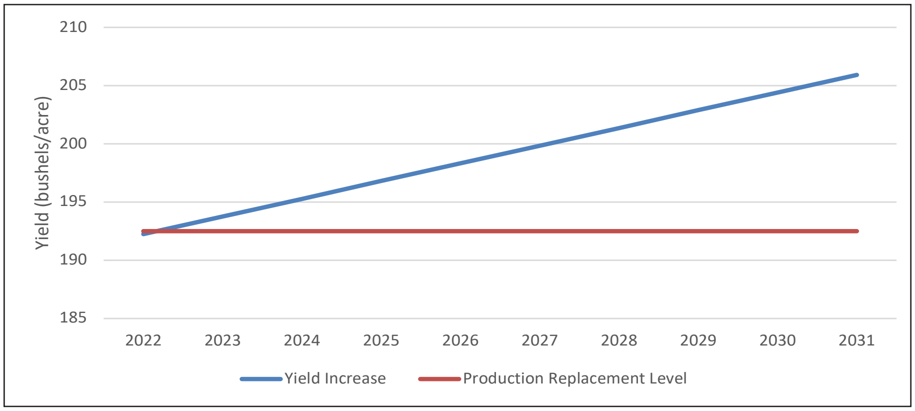
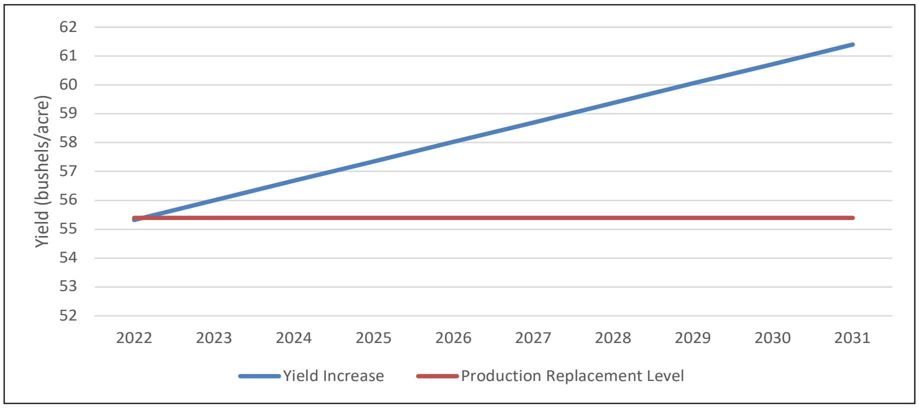


Figure 23 – Expected Annual Increase in Production Due to Higher Yields from Soybeans Versus Expected Decrease in Production from Acreage



Solar energy projects are compatible with agricultural land use by benefiting the land while solar farms are in operation. Some of these benefits include increased pollination, improved soil quality, and increased future production from soil fallowing.

Recent research has shown that pollinating insects can help soybean yields and improvement in pollinator habitats has been shown to boost soybean production (Garibaldi et. al. 2021; de O. Milfant, 2013). Walston, et al. (2018) shows the potential for agricultural benefits from pollinator habitats in the United States. Using native plant species in the land around solar projects can improve pollinator habitats which leads to increased yields, and the partial shading caused by solar panels can be quite beneficial to pollinators (Graham, et. al. 2021). Additionally, BRE (2014) shows that utility-scale solar can increase biodiversity.

Solar energy projects built on agricultural lands will allow the soil to rest for around 30 years. The U.S. Department of Energy (2022) states that "land can be reverted back to agricultural uses at the end of the operational life for solar installations. A life of a solar installation is roughly 20-25 years and can provide a recovery period, increasing the value of that land for agriculture in the future. Giving soil rest can also maintain soil quality and contribute to the biodiversity of agricultural land. Planting crops such as legumes underneath the solar installation can increase nutrient levels in the soil."

Several studies have shown that leaving the soil fallow for an extended period of time increases the productivity of the land when it is returned to crop production. Cusimano et al. (2014) found that the use of land fallowing can induce significant improvements to soil quality and crop production in California. Kozak and Pudelko (2021) studied abandoned land in Poland and showed that fallowed land could be restored to agricultural production.

VI. Economic Impact Methodology

The economic analysis of the solar PV project presented uses NREL's Jobs and Economic Development Impacts (JEDI) PV Model (PV12.23.16). The JEDI PV Model is an input-output model that measures the spending patterns and location-specific economic structures that reflect expenditures supporting varying levels of employment, income, and output. That is, the JEDI Model takes into account that the output of one industry can be used as an input for another. For example, when a PV system is installed, there are both soft costs consisting of permitting, installation and customer acquisition costs, and hardware costs, of which the PV module is the largest component. The purchase of a module not only increases demand for manufactured components and raw materials, but also supports labor to build and install a module. When a module is purchased from a manufacturing facility, the manufacturer uses some of that money to pay employees. The employees use a portion of their compensation to purchase goods and services within their community. Likewise, when a developer pays workers to install the systems, those workers spend money in the local economy that boosts economic activity and employment in other sectors. The goal of economic impact analysis is to quantify all of those reverberations throughout the local and state economy.

The first JEDI Model was developed in 2002 to demonstrate the economic benefits associated with developing wind farms in the United States. Since then, JEDI models have been developed for biofuels, natural gas, coal, transmission lines and many other forms of energy. These models were created by Marshall Goldberg of MRG & Associates under contract with the National Renewable Energy Laboratory. The JEDI model utilizes state-specific industry multipliers obtained from IMPLAN (IMpact analysis for PLANning). IMPLAN software and data are managed and updated by the Minnesota IMPLAN Group, Inc. using data collected at federal, state, and local levels. This study analyzes the gross jobs that the new solar energy project development supports and does not analyze the potential loss of jobs due to declines in other forms of electric generation.

The total economic impact can be broken down into three distinct types: direct impacts, indirect impacts, and induced impacts. **Direct impacts** during the construction period refer to the changes that occur in the onsite construction industries in which the direct final demand (i.e., spending on construction labor and services) change is made. Onsite construction-related services include installation labor, engineering, design, and other professional services. Direct impacts during operating years refer to the final demand changes that occur in the onsite spending for the solar operations and maintenance workers.

The initial spending on the construction and operation of the solar PV installation will create a second layer of impacts, referred to as "supply chain impacts" or "indirect impacts." **Indirect impacts** during the construction period consist of changes in inter-industry purchases resulting from the direct final demand changes and include construction spending on materials and PV equipment, as well as other purchases of goods and offsite services. Utility-scale solar PV indirect impacts include PV modules, invertors, tracking systems, cabling, and foundations.

Induced impacts during construction refer to the changes that occur in household spending as household income increases or decreases as a result of the direct and indirect effects of final demand changes. Local spending by employees working directly or indirectly on the Project that receive their paychecks and then spend money in the community is included. The model includes additional local jobs and economic activity that are supported by the purchases of these goods and services.

VII. Economic Impact Results

The economic impact results were derived from detailed project cost estimates supplied by Samsung. In addition, Samsung also estimated the percentages of project materials and labor that will be coming from within Watertown Township, Sanilac County, and the State of Michigan.

Three separate JEDI models were produced to show the economic impact of Watertown Solar Project. The first JEDI model used the 2021 Watertown Township multipliers from IMPLAN, and the second JEDI model used the 2021 Sanilac County multipliers from IMPLAN. The third JEDI model used the 2021 IMPLAN multipliers for the State of Michigan and the same project costs. Because all new multipliers from IMPLAN and specific project cost data from the Watertown Solar Project are used, the JEDI model serves only to translate the project costs into IMPLAN sectors.

Tables 5 to 7 show the output from these models. Table 5 lists the total employment impact from the Watertown Solar Project for Watertown Township, Sanilac County, and the State of Michigan. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

Table 5 – Total Employment Impact from the Watertown Solar Project

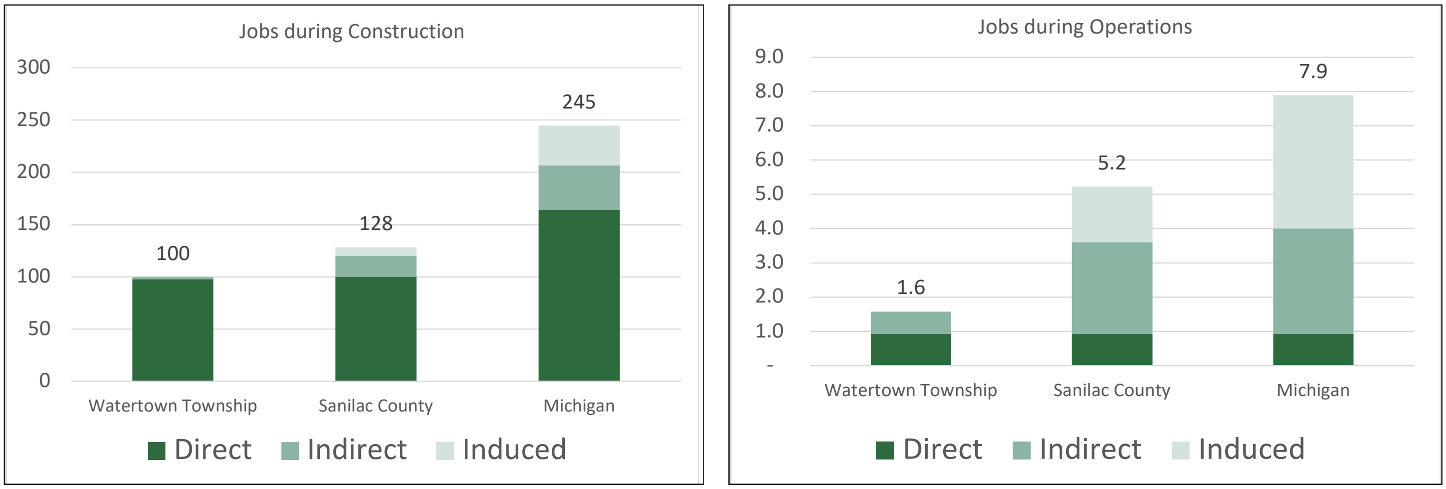
	Watertown Township Jobs	Sanilac County Jobs	Total State of Michigan Jobs[5]
Construction			
Project Development and Onsite Labor Impacts (direct)	98	100	164
Module and Supply Chain Impacts (indirect)	2	20	43
Induced Impacts	0	8	38
New Local Jobs during Construction	100	128	245
Operations (Annual)			
Onsite Labor Impacts (direct)	0.9	0.9	0.9
Local Revenue and Supply Chain Impacts (indirect)	0.7	2.7	3.1
Induced Impacts	0.0	1.6	3.9
New Local Long-Term Jobs	1.6	5.2	7.9

[5] The Total State of Michigan columns in Tables 5-7 cover Sanilac County so the two columns should NOT be added together.

The results from the JEDI model show significant employment impacts from the Watertown Solar Project. Employment impacts can be broken down into several different components. Direct jobs created during the construction phase typically last anywhere from 12 to 18 months depending on the size of the project; however, the direct job numbers present in Table 5 from the JEDI model are based on a full time equivalent (FTE) basis for a year. In other words, 1 job = 1 FTE = 2,080 hours worked in a year. A part time or temporary job would constitute only a fraction of a job according to the JEDI model. For example, the JEDI model results show 100 new direct jobs during construction in Sanilac County, though the construction of the solar center could involve closer to 200 workers working half-time for a year. Thus, due to the short-term nature of construction projects, the JEDI model often significantly understates the actual number of people hired to work on the project. It is important to keep this fact in mind when looking at the numbers or when reporting the numbers.

As shown in Table 5, new local jobs created or retained during construction total 100 for Watertown Township, 128 for Sanilac County, and 245 for the State of Michigan. New local long-term jobs created from the Watertown Solar Project total 1.6 for Watertown Township, 5.2 for Sanilac County, and 7.9 for the State of Michigan.

Figure 24 – Total Employment Impact for the Watertown Solar Project



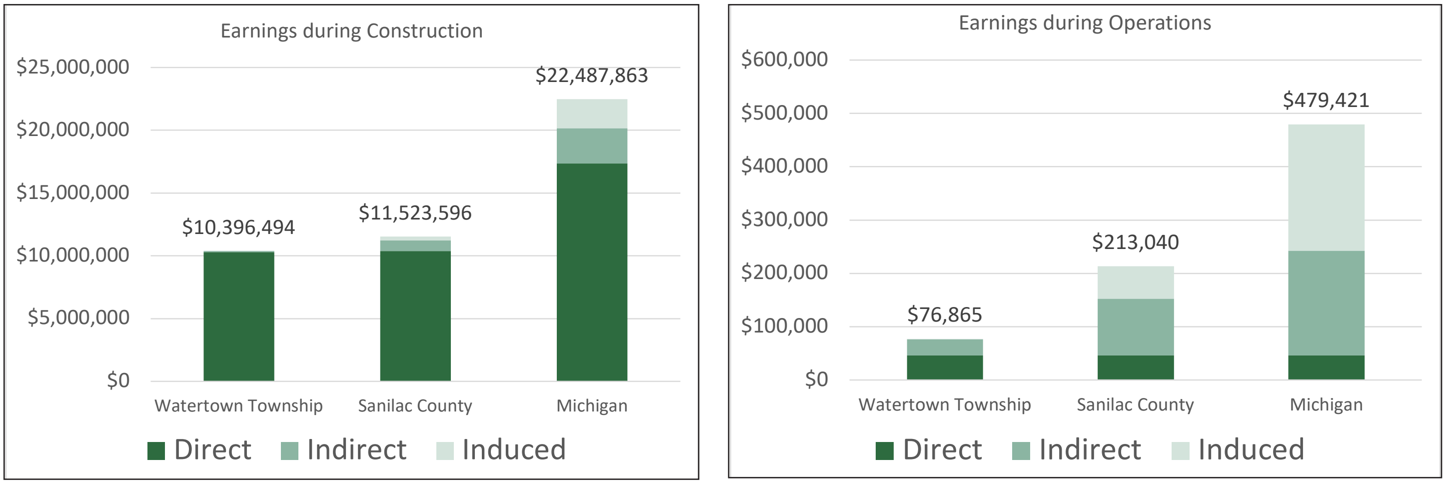
Direct jobs created during the operational phase last the life of the solar PV project, typically 20-30 years. Both direct construction jobs and operations and maintenance jobs require highly-skilled workers in the fields of construction, management, and engineering.

Accordingly, it is important to not just look at the number of jobs but also the earnings that they produce. Table 6 shows the earnings impacts from the Watertown Solar Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction totals over $10.3 million for Watertown Township, over $11.5 million for Sanilac County, and over $22.4 million for the State of Michigan. The new local long-term earnings totals over $76.8 thousand for Watertown Township, over $213 thousand for Sanilac County, and over $479 thousand for the State of Michigan.

Table 6 – Total Earnings Impact from the Watertown Solar Project

	Watertown Township	Sanilac County	Total State of Michigan
Construction			
Project Development and Onsite Earnings Impacts	$10,301,755	$10,378,429	$17,348,428
Module and Supply Chain Impacts	$86,745	$843,400	$2,819,218
Induced Impacts	$7,994	$301,767	$2,320,217
New Local Earnings during Construction	$10,396,494	$11,523,596	$22,487,863
Operations (Annual)			
Onsite Labor Impacts	$45,826	$45,826	$45,826
Local Revenue and Supply Chain Impacts	$30,737	$106,583	$196,852
Induced Impacts	$302	$60,631	$236,743
New Local Long-Term Earnings	$76,865	$213,040	$479,421

Figure 25 – Total Earnings Impact for the Watertown Solar Project

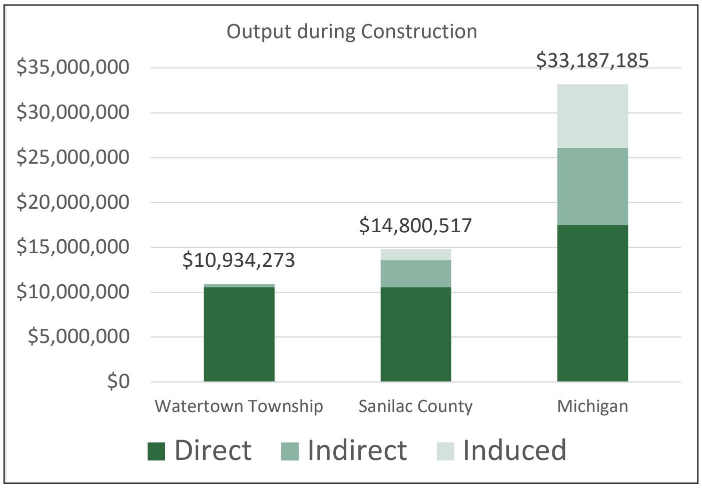


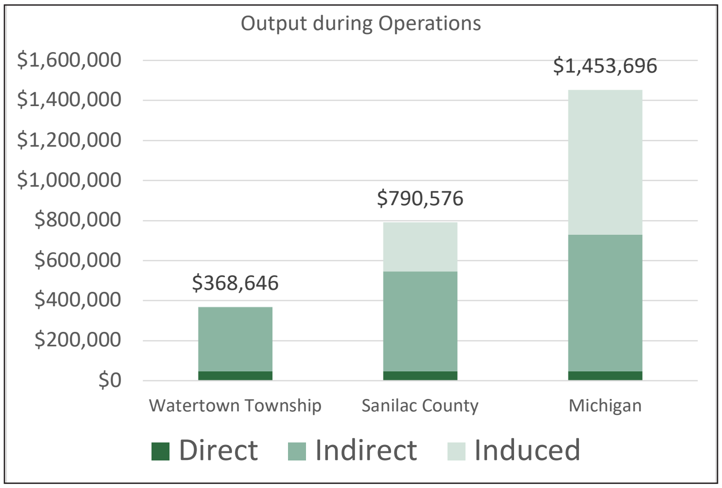
Output refers to economic activity or the value of production in the state or local economy. It is an equivalent measure to the Gross Domestic Product, which measures output on a national basis. According to Table 7, the new local output during construction totals over $10.9 million for Watertown Township, over $14.8 million for Sanilac County, and over $33.1 million for the State of Michigan. The new local long-term output totals over $368 thousand for Watertown Township, over $790 thousand for Sanilac County, and over $1.4 million for the State of Michigan.

Table 7 – Total Output Impact from the Watertown Solar Project

	Watertown Township	Sanilac County	Total State of Michigan
Construction			
Project Development and Onsite Jobs Impacts on Output	$10,570,548	$10,570,548	$17,517,577
Module and Supply Chain Impacts	$333,145	$3,010,199	$8,555,304
Induced Impacts	$30,580	$1,219,770	$7,114,304
New Local Output during Construction	$10,934,273	$14,800,517	$33,187,185
Operations (Annual)			
Onsite Labor Impacts	$45,826	$45,826	$45,826
Local Revenue and Supply Chain Impacts	$321,610	$500,345	$683,522
Induced Impacts	$1,210	$244,405	$724,348
New Local Long-Term Output	$368,646	$790,576	$1,453,696

Figure 26 – Total Output Impact for the Watertown Solar Project





VIII. Tax Revenue

Solar energy projects increase the property tax base of a county, creating a new revenue source for education and other local government services, such as fire protection, parks, health, and safety. The Watertown Solar Project would be subject to both personal property and real property taxes. Estimates of the taxable value of each type of property were obtained from the client.

Tables 8 to 12 detail the tax implications of the Watertown Solar Project. There are several important assumptions built into the analysis in these tables.

- The analysis assumes that the Project qualifies for the Solar Energy Facilities Tax of $7,000/MW for the first 20 years of operations and is otherwise exempt from personal property tax.
- It assumes that the capacity for the Project is 182.56 MWdc.
- It assumes that the Solar Energy Facilities Tax is allocated to the taxing jurisdictions according to their relative millage rates.
- The analysis assumes that after the 20 years of eligibility, ordinary industrial personal property taxes will be paid and that the total taxable industrial personal property will be $182.8 million.
- The tables assume that once the Project is eligible for ordinary property taxes, it has depreciated to the minimum depreciable value of 12% based on the 2022 Solar Energy System Report Form 5762. It will be assessed at the 50% assessment ratio.
- All tax rates are assumed to stay constant at their 2022 (2021 tax year) millage rates. For example, the Sanilac County operating tax rate will remain at 4.0482.
- The Project is assumed to be exempted from school operating fund taxes and the state education fund taxes, both under the Solar Energy Facilities Tax and Industrial Personal Property tax.
- No comprehensive tax payment was calculated, and these calculations are only to be used to illustrate the economic impact of the Project.

Table 8 – Total Property Taxes Paid by the Watertown Solar Project

Year	Total Property Taxes
2026-2045	$889,000
2046-2060	$223,314
TOTAL	$21,129,707
AVG ANNUAL	$603,706

As shown in Table 8, a conservative estimate of the total property taxes paid by the Project starts out at over $889 thousand and remains at that level due to the exemption for the first 20 years until 2046 when ordinary taxes resume. The expected total property taxes paid over the 35-year lifetime of the Project are over $21.1 million, and the average annual property taxes paid will be over $603 thousand.

Table 9 shows an estimate of the likely taxes paid to Sanilac County Operating, County Road Commission, County Library, Senior Citizens, Medical Control, County Drug Task, and County Parks.

According to Table 9, the total amounts paid over 35 years are over $4.2 million for Sanilac County Operating, over $2.0 million for the County Road Commission, over $207 thousand for the County Library, over $259 thousand for Senior Citizens, over $207 thousand for Medical Control, over $518 thousand for the County Drug Task, and over $207 thousand for County Parks over the life of the Project.

Table 9 – Tax Revenue from the Watertown Solar Project for the County[6]

Year	Sanilac County Operating	County Road Commission	County Library	Senior Citizens	Medical Control	County Drug Task	County Parks
2026-2045	$176,789	$87,342	$8,734	$10,918	$8,734	$21,836	$8,734
2046-2060	$44,409	$21,940	$2,194	$2,743	$2,194	$5,485	$2,194
TOTAL	$4,201,923	$2,075,946	$207,595	$259,493	$207,595	$518,987	$207,595
AVG ANNUAL	$120,055	$59,313	$5,931	$7,414	$5,931	$14,828	$5,931

[6] The assumed millage rates are 4.0482 for Sanilac County Operating, 2 for the County Road Commission, 0.2 for the County Library, 0.25 for Senior Citizens, 0.2 for Medical Control, 0.5 for the County Drug Task, and 0.2 for County Parks.

Table 10 shows an estimate of the likely taxes paid to the Medical Care Facility, Sandusky Library, Recycle, S.A.V.E., County Veterans, and 911 Emergency.

As shown in Table 10, the total amounts paid are over $207 thousand for the Medical Care Facility, over $1.0 million for Sandusky Library, over $155 thousand for Recycle, over $207 thousand for S.A.V.E., over $207 thousand for County Veterans, and over $207 thousand for 911 Emergency over the life of the Project.

Table 10 – Tax Revenue from the Watertown Solar Project for the County (Cont.)[7]

Year	Medical Care Facility	Sandusky Library	Recycle	S.A.V.E.	County Veterans	911 Emergency
2026-2045	$8,734	$42,365	$6,551	$8,734	$8,734	$8,734
2046-2060	$2,194	$10,642	$1,646	$2,194	$2,194	$2,194
TOTAL	$207,595	$1,006,938	$155,696	$207,595	$207,595	$207,595
AVG ANNUAL	$5,931	$28,770	$4,448	$5,931	$5,931	$5,931

Table 11 shows an estimate of the likely taxes paid to Watertown Township Roads and Watertown Township Operating.

As shown in Table 11, the total amounts paid are over $2.0 million for Watertown Township Roads and over $937 thousand for Watertown Township Operating over the life of the Project.

Table 11 – Tax Revenue from Watertown Solar Project for the Township[8]

Year	Watertown Township Roads	Watertown Township Operating
2026-2045	$87,342	$39,448
2046-2060	$21,940	$9,909
TOTAL	$2,075,946	$937,601
AVG ANNUAL	$59,313	$26,789

[7] The assumed millage rates are 0.2 for the Medical Care Facility, 0.9701 for Sandusky Library, 0.15 for Recycle, 0.2 for S.A.V.E., 0.2 for County Veterans, and 0.2 for 911 Emergency.

[8] The assumed millage rates are 2 for Watertown Township Roads and 0.9033 for Watertown Township Operating.

The largest taxing jurisdictions for property taxes are local school districts. However, the tax implications for school districts are more complicated than for other taxing bodies. School districts receive state aid based on the assessed value of the taxable property within its district. As assessed value increases, the state aid to the school district is decreased.

Although the exact amount of the reduction in state aid to the school districts is uncertain, local project tax revenue is superior to relying on state aid for the following reasons: (1) the solar project can't relocate – it is a permanent structure that will be within the school district's footprint for the life of the Project; (2) the school district can raise the tax rate and increase its revenues as needed; (3) the school district does not have to deal with the year-to-year uncertainty of state aid amounts; (4) the school district does not have to wait for months (or even into the next Fiscal Year!) for payment; (5) the Project does not increase the overall cost of education in the way that a new residential development would.

Table 12 shows the direct property tax revenue coming from the Project to Sanilac Intermediate School District, Sandusky School District Sinking Fund, and Sandusky School District Debt. This tax revenue uses the assumptions outlined earlier to calculate the other tax revenue and assumes that 100% of the project area is in the school districts. Over the 35-year life of the Project, the school districts are expected to receive over $8.4 million in tax revenue.

Table 12 – Tax Revenue from the Watertown Solar Project for the School Districts[9]

Year	Sanilac Intermediate School District	Sandusky School District Sinking Fund	Sandusky School District Debt
2026-2045	$111,584	$87,342	$156,343
2046-2060	$28,030	$21,940	$39,273
TOTAL	$2,652,125	$2,075,946	$3,715,944
AVG ANNUAL	$75,775	$59,313	$106,170

[9] The assumed millage rates are 2.5551 for Sanilac Intermediate School District, 2 for Sandusky School District Sinking Fund, and 3.58 for Sandusky School District Debt.

IX. Glossary

Bb

Battery Energy Storage Systems (BESS)

An array of hundreds or thousands of small batteries that enable energy from renewables, like solar and wind, to be stored and released at a later time.

Cc

Consumer Price Index (CPI)

An index of the changes in the cost of goods and services to a typical consumer, based on the costs of the same goods and services at a base period.

Dd

Direct impacts

During the construction period: the changes that occur in the onsite construction industries in which the direct final demand change is made.

During operating years: the final demand changes that occur in the onsite spending for the solar operations and maintenance workers.

Ee

Equalized Assessed Value (EAV)

The product of the assessed value of property and the state equalization factor. This is typically used as the basis for the value of property in a property tax calculation.

Ff

Farming profit

The difference between total revenue (price multiplied by yield) and total cost regarding farmland.

Full-time equivalent (FTE)

A unit that indicates the workload of an employed person. One FTE is equivalent to one worker working 2,080 hours in a year. One half FTE is equivalent to a half-time worker or someone working 1,040 hours in a year.

Hh

HV line extension

High-voltage electric power transmission links used to connect generators to the electric transmission grid.

Ii

IMPLAN (IMpact analysis for PLANning)

A business who is the leading provider of economic impact data and analytic applications. IMPLAN data is collected at the federal, state, and local levels and used to create state-specific and county-specific industry multipliers.

Indirect impacts

Impacts that occur in industries that make up the supply chain for that industry.

During the construction period: the changes in inter- industry purchases resulting from the direct final demand changes, including construction spending on materials and wind farm equipment and other purchases of good and offsite services.

During operating years: the changes in inter-industry purchases resulting from the direct final demand changes.

Induced impacts

The changes that occur in household spending as household income increases or decreases as a result of the direct and indirect effects of final demand changes.

Inflation

A persistent rise in the general level of prices related to an increase in the volume of money and resulting in the loss of value of currency. Inflation is typically measured by the CPI.

Mm

Median Household Income (MHI)

The income amount that divides a population into two equal groups, half having an income above that amount, and half having an income below that amount.

Millage rate

The tax rate, as for property, assessed in mills per dollar.

Multiplier

A factor of proportionality that measures how much a variable changes in response to a change in another variable.

MW

A unit of power, equal to one million watts or one thousand kilowatts.

MWac (megawatt alternating current)

The power capacity of a utility-scale solar PV system after its direct current output has been fed through an inverter to create an alternating current (AC). A solar system's rated MWac will always be lower than its rated MWdc due to inverter losses. AC is the form in which electric energy is delivered to businesses and residences and that consumers typically use when plugging electric appliances into a wall socket.

MWdc (megawatt direct current)

The power capacity of a utility-scale solar PV system before its direct current output has been fed through an inverter to create an alternating current. A solar system's rated MWdc will always be higher than its rated MWac.

Nn

Net economic impact

Total change in economic activity in a specific region, caused by a specific economic event.

Net Present Value (NPV)

Cash flow determined by calculating the costs and benefits for each period of investment.

NREL's Jobs and Economic Development Impacts (JEDI) Model

An input-output model that measures the spending patterns and location-specific economic structures that reflect expenditures supporting varying levels of employment, income, and output.

Oo

Output

Economic output measures the value of goods and services produced in a given area. Gross Domestic Product is the economic output of the United States as a whole.

Pp

PV (photovoltaic) system

Solar modules, each comprising a number of solar cells, which generate electrical power.

Rr

Real Gross Domestic Product (GDP)

A measure of the value of goods and services produced in an area and adjusted for inflation over time.

Real-options analysis

A model used to look at the critical factors affecting the decision to lease agricultural land to a company installing a solar powered electric generating facility.

Ss

Stochastic

To have some randomness.

Tt

Tax rate

The percentage (or millage) of the value of a property to be paid as a tax.

Total economic output

The quantity of goods or services produced in a given time period by a firm, industry, county, or country.

Uu

Utility-scale solar

Solar powered-electric generation facilities intended for wholesale distribution typically over 5MW in capacity.

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XI. Curriculum Vitae (Abbreviated)

David G. Loomis
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Education

Doctor of Philosophy, Economics, Temple University, Philadelphia, Pennsylvania, May 1995.

Bachelor of Arts, Mathematics and Honors Economics, Temple University, Magna Cum Laude, May 1985.

Experience

2011-present Strategic Economic Research, LLC
President

- Performed economic impact analyses on policy initiatives and energy projects such as wind energy, solar energy, natural gas plants and transmission lines at the county and state level.
- Provided expert testimony before state legislative bodies, state public utility commissions, and county boards.
- Wrote telecommunications policy impact report comparing Illinois to other Midwestern states.

1996-2023 Illinois State University, Normal, IL
Professor Emeritus – Department of Economics (2023 - present)
Full Professor – Department of Economics (2010-2023)
Associate Professor - Department of Economics (2002-2009)
Assistant Professor - Department of Economics (1996-2002)

- Taught Regulatory Economics, Telecommunications Economics and Public Policy, Industrial Organization and Pricing, Individual and Social Choice, Economics of Energy and Public Policy and a Graduate Seminar Course in Electricity, Natural Gas and Telecommunications Issues.
- Supervised as many as 5 graduate students in research projects each semester.
- Served on numerous departmental committees.

1997-2023 Institute for Regulatory Policy Studies, Normal, IL
Executive Director (2005-2023)
Co-Director (1997-2005)

- Grew contributing membership from 5 companies to 16 organizations.
- Doubled the number of workshop/training events annually.
- Supervised 2 Directors, Administrative Staff and internship program.
- Developed and implemented state-level workshops concerning regulatory issues related to the electric, natural gas, and telecommunications industries.

2006-2018 Illinois Wind Working Group, Normal, IL
Director

- Founded the organization and grew the organizing committee to over 200 key wind stakeholders
- Organized annual wind energy conference with over 400 attendees
- Organized strategic conferences to address critical wind energy issues
- Initiated monthly conference calls to stakeholders
- Devised organizational structure and bylaws

2007-2018 Center for Renewable Energy, Normal, IL
Director

- Created founding document approved by the Illinois State University Board of Trustees and Illinois Board of Higher Education.
- Secured over $150,000 in funding from private companies.
- Hired and supervised 4 professional staff members and supervised 3 faculty members as Associate Directors.
- Reviewed renewable energy manufacturing grant applications for Illinois Department of Commerce and Economic Opportunity for a $30 million program.
- Created technical "Due Diligence" documents for the Illinois Finance Authority loan program for wind farm projects in Illinois.

- Published 40 articles in leading journals such as AIMS Energy, Renewable Energy, National Renewable Energy Laboratory Technical Report, Electricity Journal, Energy Economics, Energy Policy, and many others

- Testified over 80 times in formal proceedings regarding wind, solar and transmission projects

- Raised over $7.7 million in grants

- Raised over $2.7 million in external funding

Bryan A. Loomis
Strategic Economic Research, LLC
Vice President

Education

Master of Business Administration (M.B.A.), Marketing and Healthcare, Belmont University, Nashville, Tennessee, 2017.

Experience

2019-present Strategic Economic Research, LLC, Bloomington, IL
Vice President
(2021-present)
Property Tax Analysis and Land Use Director
(2019-2021)

- Directed the property tax analysis by training other associates on the methodology and overseeing the process for over twenty states
- Improved the property tax analysis methodology by researching various state taxing laws and implementing depreciation, taxing jurisdiction millage rates, and other factors into the tax analysis tool
- Executed land use analyses by running Monte Carlo simulations of expected future profits from farming and comparing that to the solar lease
- Performed economic impact modeling using JEDI and IMPLAN tools
- Improved workflow processes by capturing all tasks associated with economic modeling and report-writing, and created automated templates in Asana workplace management software

2019-2021 Viral Healthcare Founders LLC, Nashville, TN
CEO and Founder

- Founded and directed marketing agency for healthcare startups
- Managed three employees
- Mentored and worked with over 30 startups to help them grow their businesses
- Grew an email list to more than 2,000 and LinkedIn following to 3,500
- Created a Slack community and grew to 450 members
- Created weekly video content for distribution on Slack, LinkedIn and Email

Christopher Thankan
Strategic Economic Research, LLC
Economic Analyst

Education

Bachelor of Science in Sustainable & Renewable Energy (B.A.), Minor in Economics, Illinois State University, Normal, IL, 2021

Experience

2021-present Strategic Economic Research, LLC, Bloomington, IL
Economic Analyst

- Create economic impact results on numerous renewable energy projects Feb 2021-Present
- Utilize IMPLAN multipliers along with NREL's JEDI model for analyses
- Review project cost Excel sheets
- Conduct property tax analysis for different US states
- Research taxation in states outside research portfolio
- Complete ad hoc research requests given by the president
- Hosted a webinar on how to run successful permitting hearings
- Research school funding and the impact of renewable energy on state aid to school districts
- Quality check coworkers JEDI models
- Started more accurate methodology for determining property taxes that became the main process used

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