Strategic Economic Research, LLC

ECONOMIC IMPACT & LAND USE ANALYSIS OF THE TAMARACK SOLAR PROJECT

December 2023

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Dr. Loomis has published 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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Strategic Economic Research, LLC (SER) provides economic consulting for renewable energy projects across the U.S. We have produced over 250 economic impact reports in 31 states. Research Associates who performed work on this project include Ethan Loomis, Madison Schneider, Zoë Calio, Patrick Chen, Kathryn Keithley, Morgan Stong, Mandi Mitchell, Coryell Birchfield, Tim Roberts, Russell Piontek, Drew Kagel, Cedric Volkmer and Paige Afram.

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Table of Contents

Strategic Economic Research, LLC

Table of Contents - Figures

Table of Contents - Tables

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I. Executive Summary

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

The Tamarack Solar Project is a 150-megawatt alternating current (MWac) 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 $277 million. The total development is anticipated to result in the following:

Economic Impact

Jobs – all numbers are full-time equivalents

- 414 new local jobs during construction for Marshall County
- 1,383 new jobs during construction for the State of Indiana
- 33.9 new local long-term jobs for Marshall County
- 49.6 new long-term jobs for the State of Indiana

Output

- Over $56.4 million in new local output during construction for Marshall County
- Over $245 million in new output during construction for the State of Indiana
- Over $4.8 million in new local long-term output for Marshall County annually
- Over $7.2 million in new long-term output for the State of Indiana annually

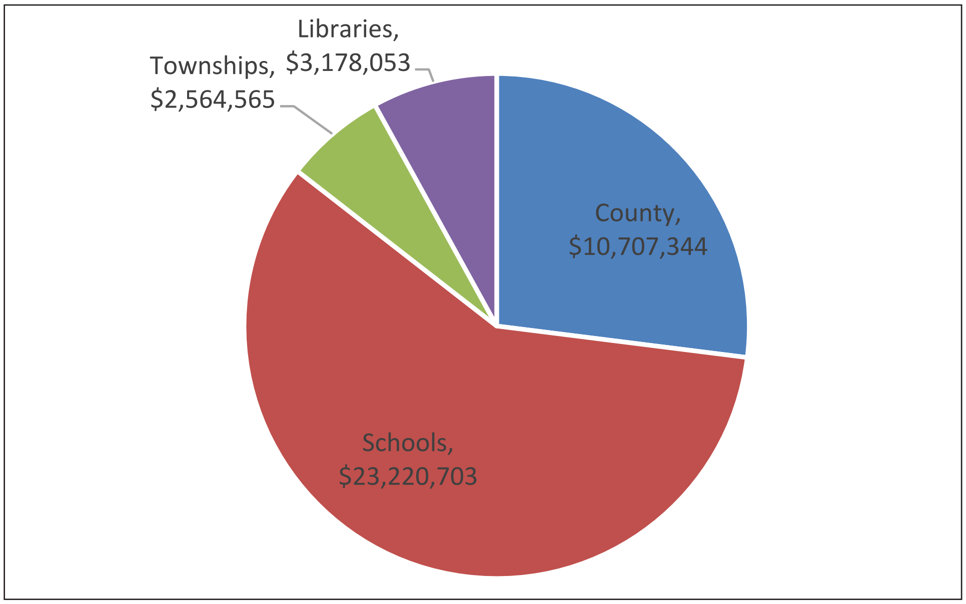
Earnings

- Over $20.8 million in new local earnings during construction for Marshall County
- Over $82.7 million in new earnings during construction for the State of Indiana
- Over $2.1 million in new local long-term earnings for Marshall County annually
- Over $2.9 million in new long-term earnings for the State of Indiana annually

Property Taxes

- Over $23.2 million taxes paid by the Project to the schools over the life of the Project
- Over $10.7 million taxes paid by the Project to Marshall County over the life of the Project
- Over $3.1 million taxes paid by the Project to libraries over the life of the Project
- Over $2.5 million taxes paid by the Project to townships over the life of the Project
- Over $39.6 million taxes paid by the Project in total to all taxing districts over the life of the Project

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



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:

Land Use

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

Marshall 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 $21.14 per bushel by the year 2061 or corn yields would need to rise to 313.9 bushels per acre by the year 2027.
- Alternatively, soybean prices would need to rise to $55.37 per bushel by the year 2061 or soybean yields would need to rise to 113.3 bushels per acre by the year 2027 for soybean farming to generate more income for the landowner and local community than the solar lease.
- At the time of this report, Indiana corn and soybean prices are $6.65 and $14.40 per bushel respectively and Marshall County yields are 193.6 and 57.8 bushels per acre respectively.[1]

[1] https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=INDIANA; and https://quickstats.nass.usda.gov/results/4F2819B9-DED5-35A3-B2C4-A0FED29CCC0B#0E8F68A9-8189-3852-9062-3D693EBA7F9D

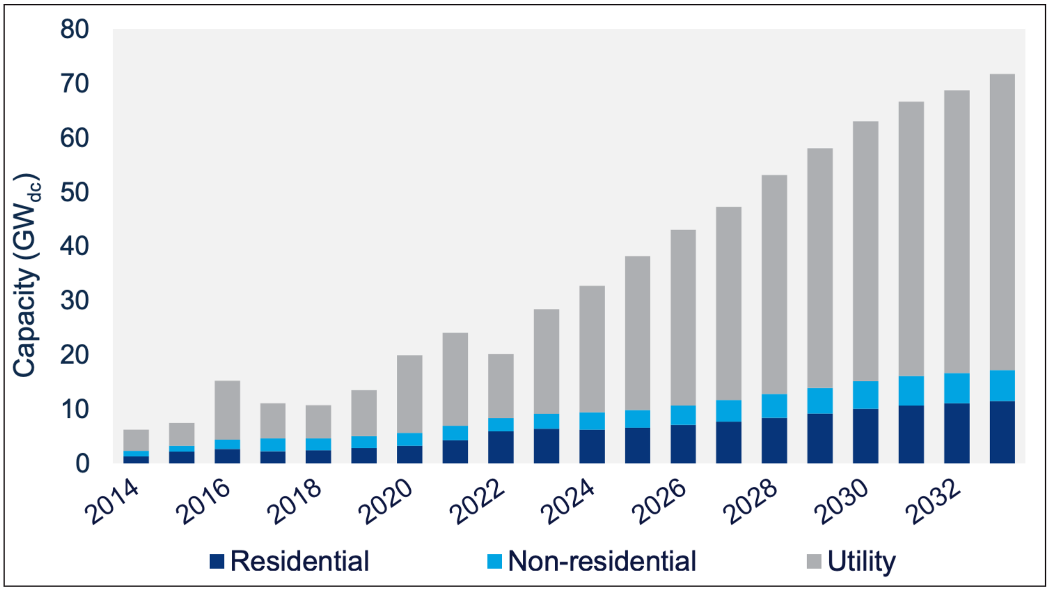
II. U.S. Solar PV Industry Growth and Economic Development

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. Tamarack 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. According to Figure 3, utility-scale solar fixed tilt and single-axis tracking have decreased from an average of $6/watt in 2010 to slightly more than $1/watt in 2022.

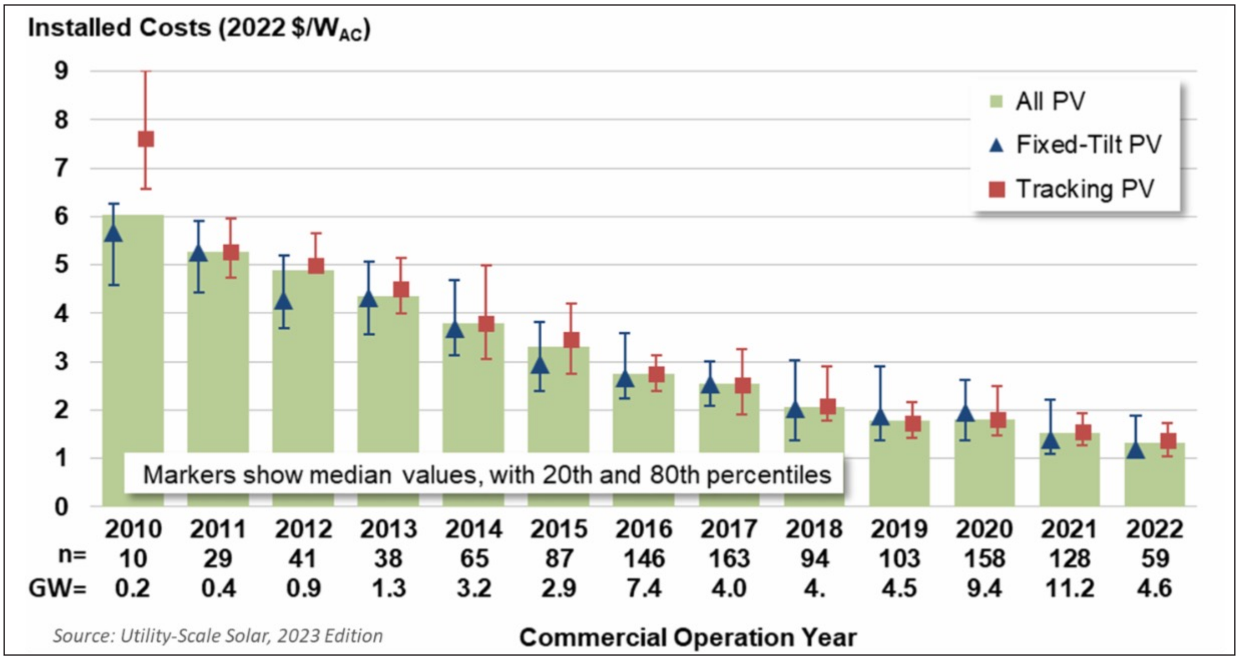
Utility-scale PV leads the installation growth in the U.S. Just under 12 GWdc of utility PV projects were completed in 2022. According to Figure 4, there are 90,300 MWdc of contracted utility-scale installations that have not been built yet.

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



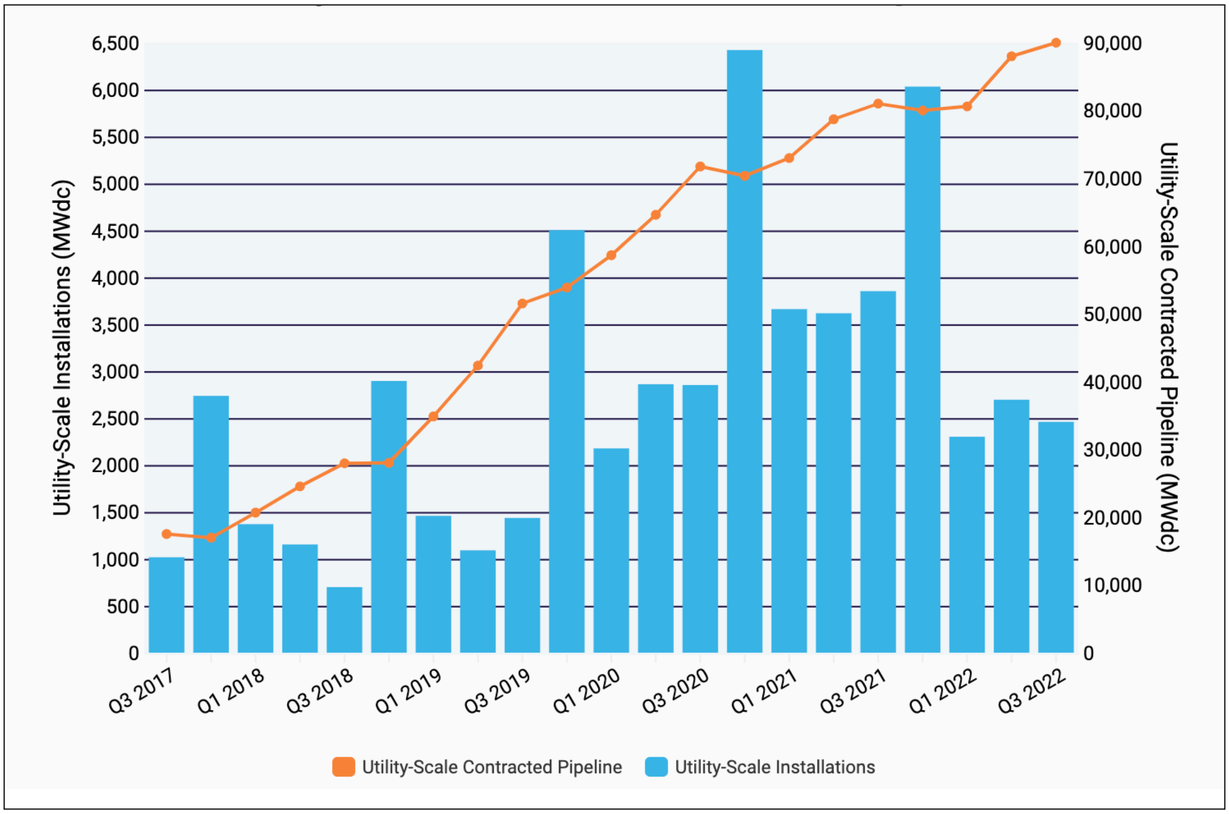
Source: Solar Energy Industries Association, Solar Market Insight Report 2022 Year in Review

Figure 3 – Installed Costs of Utility-Scale Solar from 2010 to 2022 (adjusted for inflation)



Source: Lawrence Berkeley National Laboratory, Utility-Scale Solar, 2023 Edition

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



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

b. Indiana Solar PV Industry

According to SEIA, Indiana is ranked 21stin 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, there are other states with similar solar irradiation to Indiana that rank highly, including New York (8th), New Jersey (9th), Virginia (10th), and Massachusetts (11th). In 2022, Indiana installed 280 MW of solar electric capacity bringing its cumulative capacity to 1,654 MW.

Indiana has great potential to expand its solar installations. Indiana has several utility-scale solar farms in operation, including Dunns Bridge Solar (265 MW) in Jasper County; Indiana Crossroads Solar (200 MW) in White County; Riverstart Solar (200 MW) in Randolph County; Bellflower Solar (152.5 MW) in Henry County; and Troy Solar (50.4 MW) in Spencer County.[2] The 150 MW Tamarack Solar Project will be similar to other utility scale installations in Indiana to date.

There are 94 solar companies in Indiana including 25 manufacturers, 36 installers/developers, and 33 others.[3] Figure 5 shows the locations of solar companies in Indiana as of the time of this report. Currently, there are 3,946 solar jobs in the State of Indiana according to SEIA.

Figure 6 shows the Indiana 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 Indiana is projected to grow by 9,004 MW.

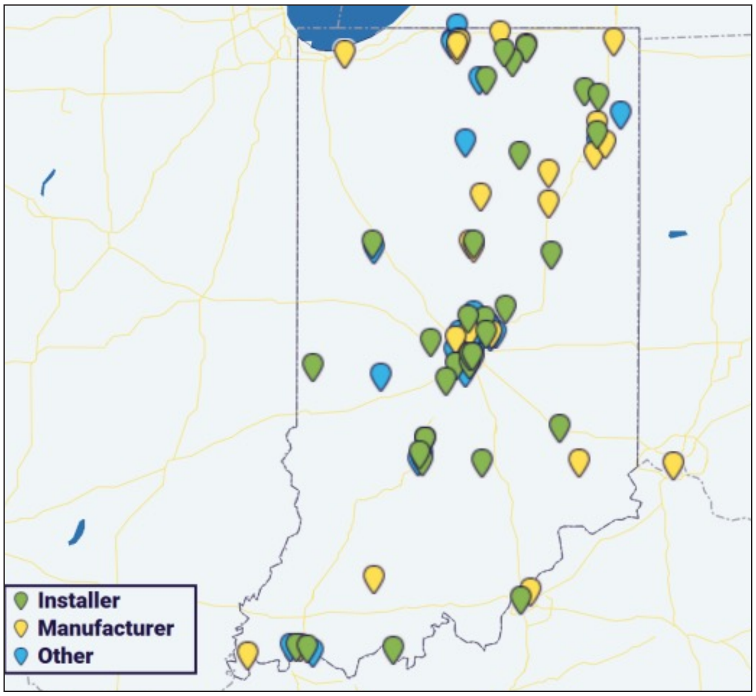
The Energy Information Administration (EIA) calculated the number of megawatt-hours generated from different energy sources in 2022. As shown in Figure 7, the greatest percentage of electricity generated in Indiana comes from coal with 52.6% followed by natural gas with 32.7% and wind with 10.0%. Approximately 1.2% of the total electricity power generated in Indiana 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 Indiana in the solar energy industry (4,066) falls behind wind electric generation (6,909) but is larger than coal generation (2,672) and natural gas generation (1,910).

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

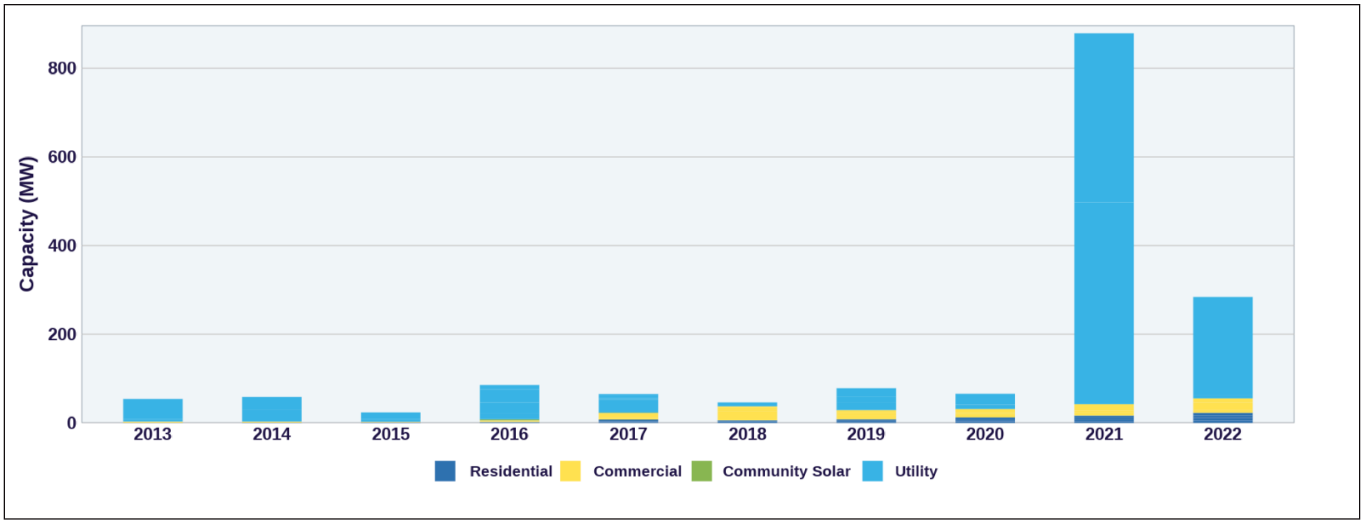
[3] "Other" includes Sales and Distribution, Project Management, and Engineering.

Figure 5 – Solar Company Locations in Indiana



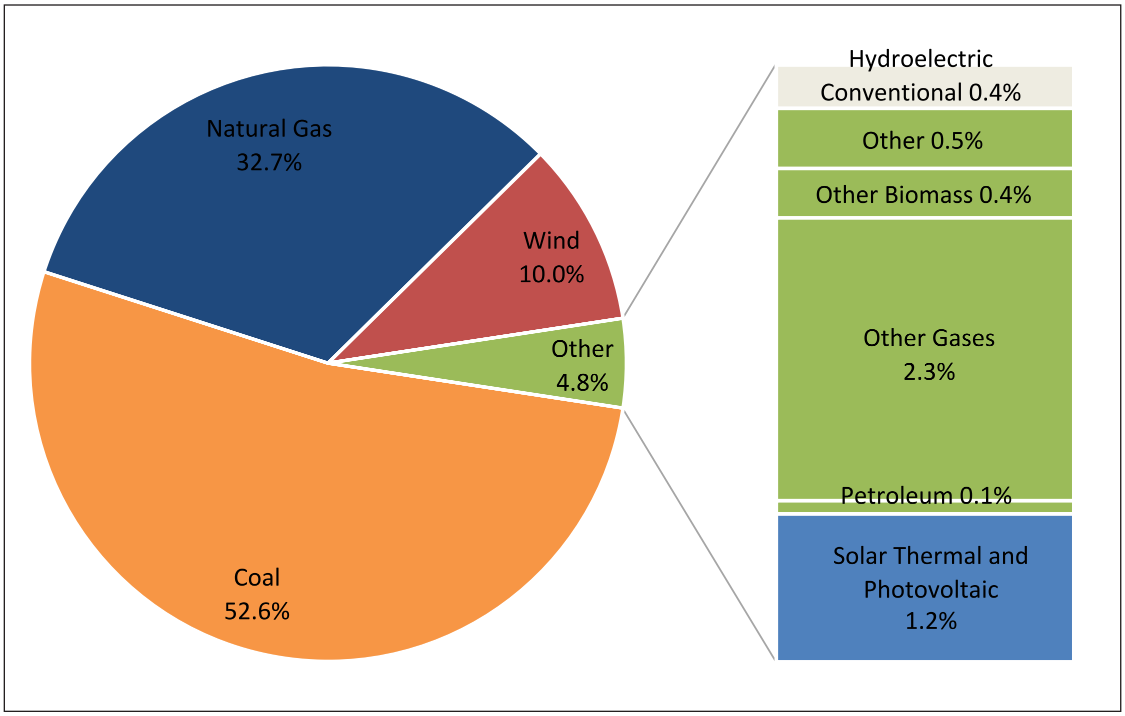
Source: Solar Energy Industries Association, Solar Spotlight: Indiana, Q2 2023

Figure 6 – Indiana Annual Solar Installations



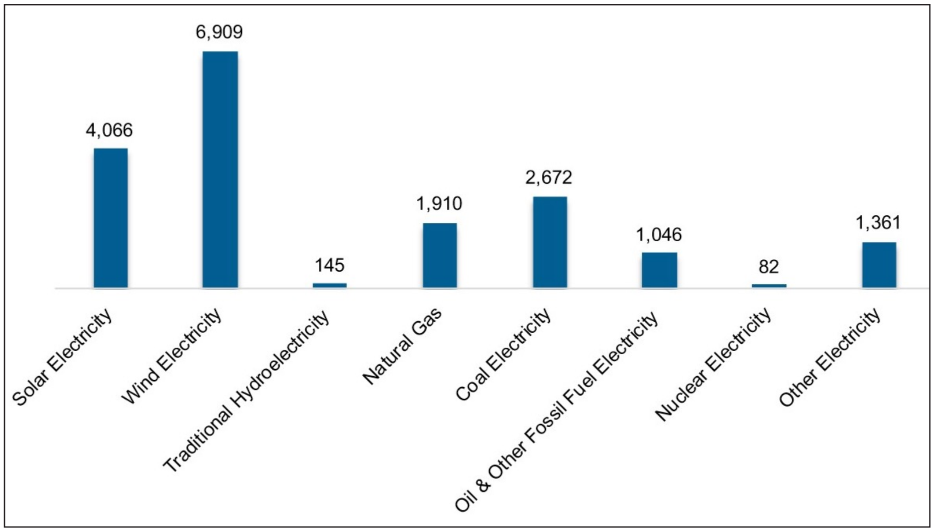
Source: Solar Energy Industries Association, Solar Spotlight: Indiana, Q2 2023

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



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

Figure 8 – Electric Generation Employment by Technology



Source: U.S. Energy and Employment Report 2023: Indiana

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 using the same methodology as this report. 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.

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.

In Indiana, Stantec (2020) estimated the impact of the Bellflower Solar Project in Henry and Rush counties. They find that this 152.5 MW project will create or support 250 jobs during construction and increase total economic output by over $330 million.

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

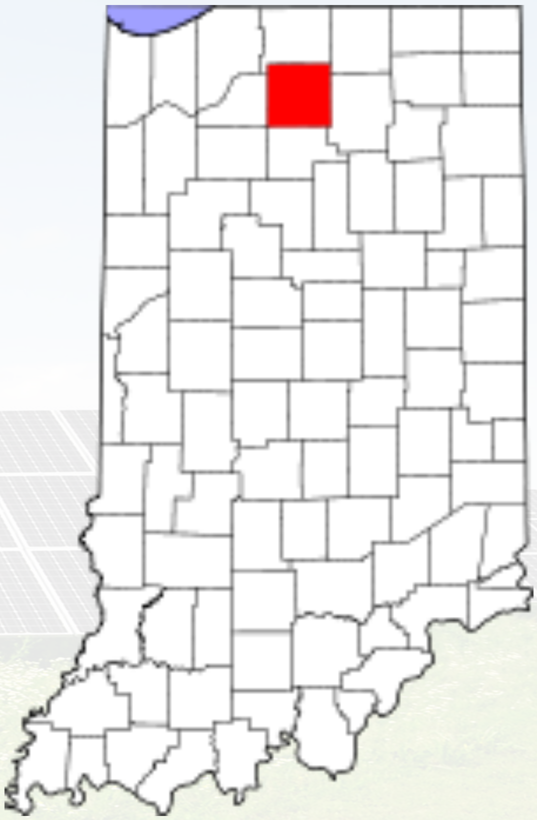
a. Tamarack Solar Project

Invenergy is developing the Tamarack Solar Project in Marshall County, Indiana. The Project consists of an estimated 150-megawatt alternative current (MWac) 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 $277 million.

b. Marshall County, Indiana

Marshall County is located in the northern part of Indiana (see Figure 9). It has a total area of 449.74 square miles, and the U.S. Census estimates that the 2022 population was 46,332 with 20,138 housing units. The county has a population density of 100 (persons per square mile) compared to 189 for the State of Indiana (2020). Median household income in the county was $66,016 compared to $67,173 for the State of Indiana (U.S. Census Bureau, 2022).

Figure 9 – Location of Marshall County, Indiana



i. Economic and Demographic Statistics

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

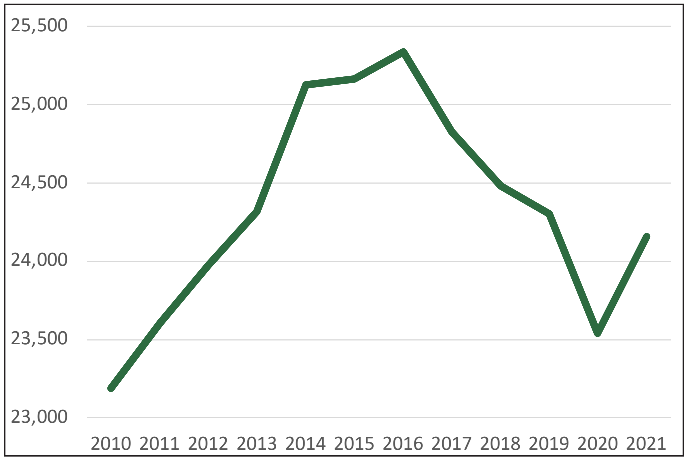
Table 1 provides the most recent snapshot of total employment but does not examine the historical trends within the county. Figure 10 shows employment from 2010 to 2021. Total employment in Marshall County was at its lowest at 23,189 in 2010 and its highest at 25,336 in 2016 (BEA, 2023). Since 2016, employment in the county has decreased significantly.

Table 1 – Employment by Industry in Marshall County

Industry	Number	Percent
Manufacturing	7,205	29.8%
Retail Trade	2,231	9.2%
Administrative Government	1,904	7.9%
Health Care and Social Assistance	1,763	7.3%
Accommodation and Food Services	1,530	6.3%
Other Services (except Public Administration)	1,204	5.0%
Agriculture, Forestry, Fishing and Hunting	1,204	5.0%
Construction	1,197	4.9%
Administrative and Support and Waste Management and Remediation Services	1,043	4.3%
Real Estate and Rental and Leasing	915	3.8%
Professional, Scientific, and Technical Services	782	3.2%
Finance and Insurance	752	3.1%
Educational Services	670	2.8%
Transportation and Warehousing	645	2.7%
Wholesale Trade	617	2.6%
Arts, Entertainment, and Recreation	195	0.8%
Government Enterprises	142	0.6%
Information	85	0.4%
Management of Companies and Enterprises	72	0.3%
Utilities	28	0.1%
Mining, Quarrying, and Oil and Gas Extraction	7	0.0%

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

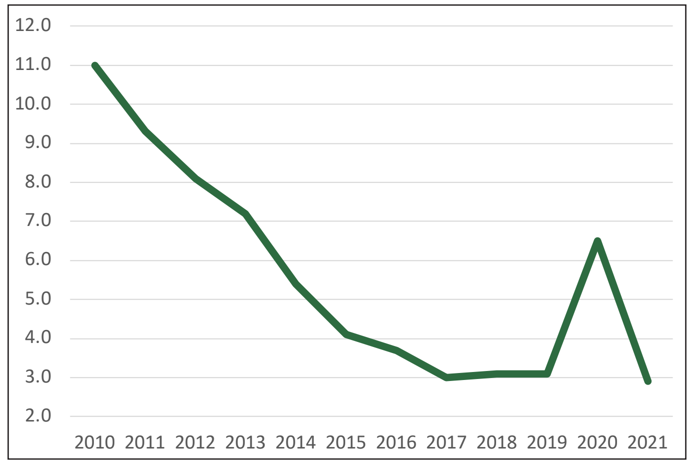
Figure 10 – Total Employment in Marshall County from 2010 to 2021



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

The unemployment rate signifies the percentage of the labor force without employment in the county. Figure 11 shows the unemployment rates from 2010 to 2021. Unemployment in Marshall County was at its highest at 11.0% in 2010 and at its lowest at 2.9% in 2021 (FRED, 2023).

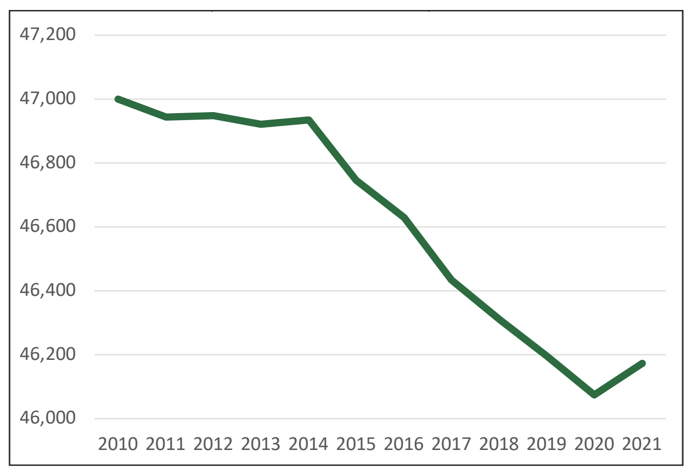
Figure 11 – Unemployment Rate in Marshall County from 2010 to 2021



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

The overall population in the county has decreased steadily, as shown in Figure 12. Marshall County's population hit a high of 47,000 in 2010 and a low of 46,076 in 2020, a loss of 924 people in 10 years (FRED, 2023). The population then increased to 46,175 in 2021.

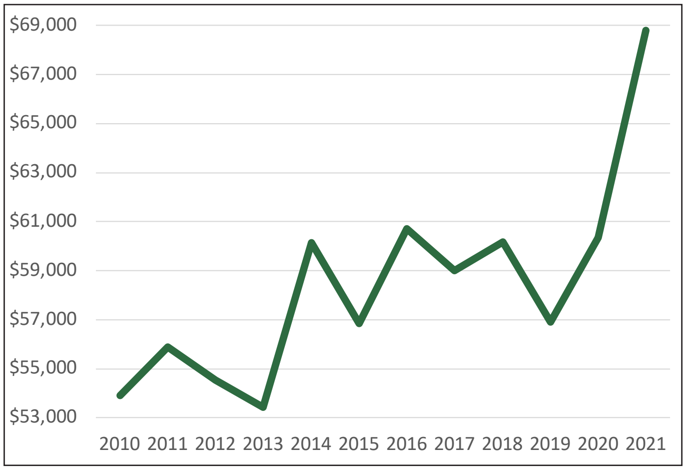
Figure 12 – Population in Marshall County from 2010 to 2021



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

The household income has fluctuated greatly in the county. Figure 13 shows the real median household income in Marshall 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 $53,419 in 2013 and its highest at $68,799 in 2021 (FRED, 2023).

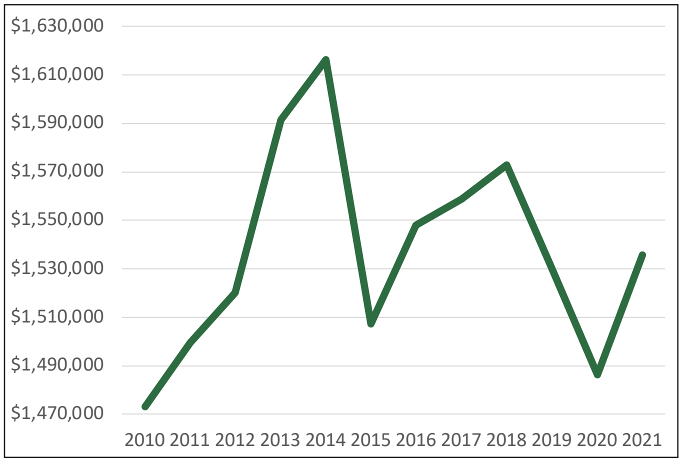
Figure 13 – Real Median Household Income in Marshall County from 2010 to 2021



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 Marshall County has fluctuated greatly since 2010, as shown in Figure 14 (BEA, 2023).

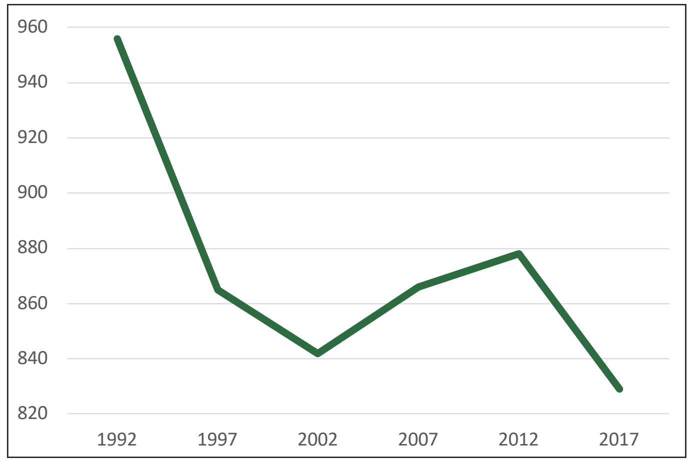
Figure 14 – Real Gross Domestic Product (GDP) in Marshall County from 2010 to 2021



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

The farming industry has decreased in Marshall County. As shown in Figure 15, the number of farms hit a high of 956 in 1992 and a low of 829 in 2017.

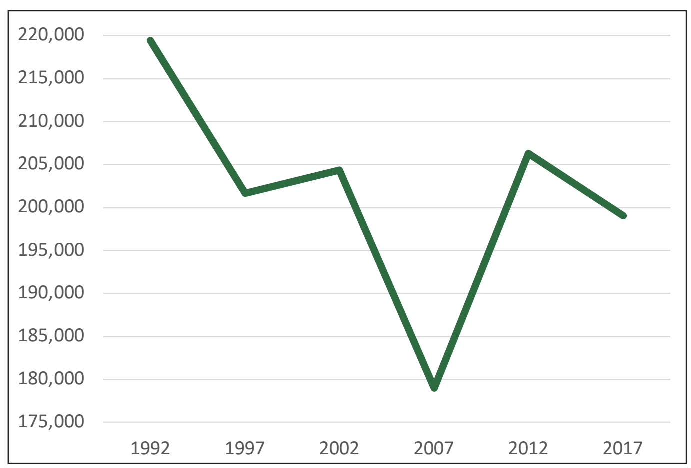
Figure 15 – Number of Farms in Marshall County from 1992 to 2017



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

The amount of land in farms has fluctuated greatly. The county farmland hit a high of 219,402 acres in 1992 and a low of 179,016 acres in 2007, according to Figure 16. Since 2007, the amount of land in farms in the county has increased significantly.

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



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

ii. Agricultural Statistics

Indiana is ranked tenth among U.S. states in total value of agricultural products sold (Census, 2017). It is ranked eighteenth in the value of livestock and sixth in the value of crops (Census, 2017). In 2022, Indiana had 54,800 farms and 14.8 million acres in operation with the average farm being 270 acres (State Agricultural Overview, 2022). Indiana had 186 thousand cattle and produced 4.41 billion pounds of milk (State Agricultural Overview, 2022). In 2022, Indiana yields averaged 190 bushels per acre for corn with a total market value of $6.48 billion (State Agricultural Overview, 2022). Soybean yields averaged 57.5 bushels per acre with a total market value of $4.86 billion (State Agricultural Overview, 2022). The average net cash farm income per farm is $50,171 (Census, 2017).

In 2017, Marshall County had 829 farms covering 199,083 acres for an average farm size of 240 acres (Census, 2017). The total market value of products sold was $145 million, with 35% coming from livestock sales and 65% coming from crop sales (Census, 2017). The average net cash farm income of operations was $48,651 (Census, 2017).

The 1,000 acres planned to be used by the Tamarack Solar Project represents just 0.5% of the acres used for farming in Marshall 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.

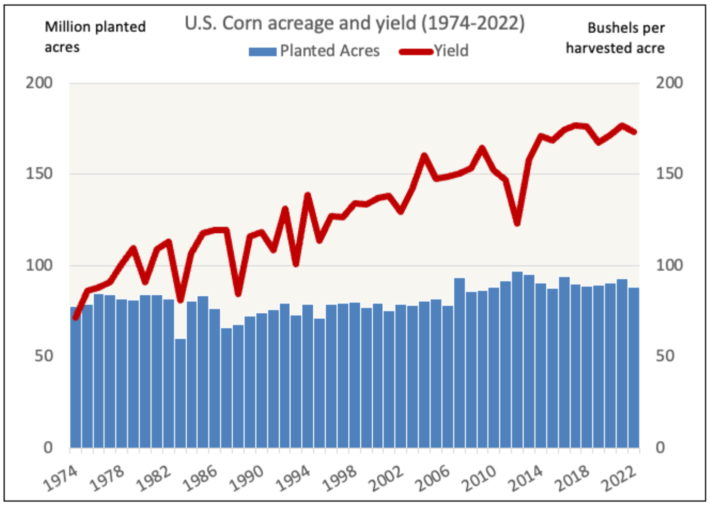
For the landowner, the key analysis will be comparing the net present value of the annual solar lease payments to expected profits from farming. The farmer will choose the solar farm lease if:

$$NPV\ (Solar\ Lease\ Payment_t) > NPV\ (P_t * Yield_t - Cost_t)$$

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).

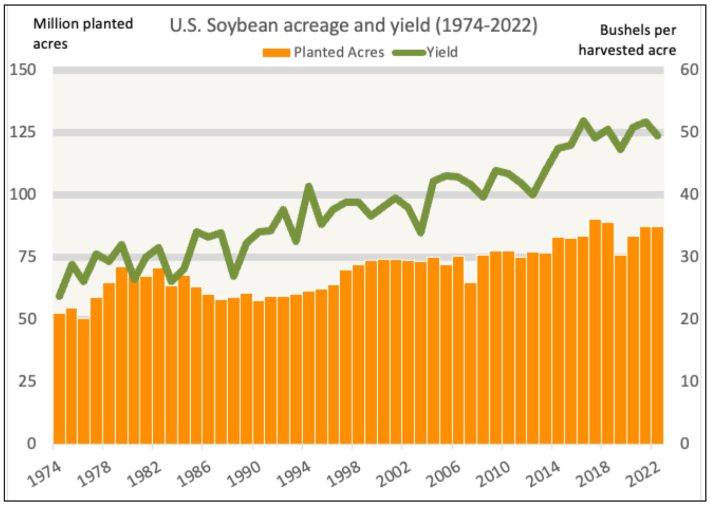
Figure 17 shows the dramatic increase in U.S. corn yields since 1974. Soybean yields have also increased though not as dramatically. Figure 18 displays the soybean yields in the U.S. since 1974.

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.

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

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.

V. Land Use Results

In order to analyze future returns from farming the land, we will use historical data from Marshall 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 Marshall County, Indiana

	1992	1997	2002	2007	2012	2017
Total Farm Income Per Farm	NA	$4,208	$5,227	$7,259	$20,724	$12,628
Total Farm Production Expenses (average/farm)	$46,673	$51,381	$72,472	$82,771	$143,642	$139,054
Average Farm Size (acres)	230	233	243	207	235	240
Net Cash Income per Farm[4]	$14,187	$17,799	$9,430	$35,465	$37,044	$48,651
Average Market Value of Machinery Per Farm	$55,557	$51,362	$68,526	$89,027	$140,648	$151,905

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.

[4] 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 Marshall County, Indiana

	1992	1997	2002	2007	2012	2017
Average Market Value Machinery Per Farm	$55,557	$51,362	$68,526	$89,027	$140,648	$151,905
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$1,852	$1,712	$2,284	$2,968	$4,688	$5,064
Mean Hourly Wage in IN for Farming (Bureau of Labor Statistics)	$6.64	$7.55	$9.50	$11.92	$10.88	$11.81
Annual Opportunity Cost of Farmer's Time (Wage times 16 weeks times 40 Hours/Week)	$4,251	$4,832	$6,080	$7,629	$6,963	$7,558

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).[5] These calculations and results are shown in Table 4.

Table 4 – Profit Per Farm Calculations for Marshall County, Indiana

	1992	1997	2002	2007	2012	2017
Net Cash Income per Farm	$14,187	$17,799	$9,430	$35,465	$37,044	$48,651
Machinery Depreciation	($1,852)	($1,712)	($2,284)	($2,968)	($4,688)	($5,064)
Opportunity Cost of Farmer's Time	($4,251)	($4,832)	($6,080)	($7,629)	($6,963)	($7,558)
Profit	$8,084	$11,255	$1,066	$24,869	$25,393	$36,029
Average Farm Size (Acres)	230	233	243	207	235	240
Profit Per Acre	$35.15	$48.30	$4.39	$120.14	$108.05	$150.12
CPI	141.9	161.3	180.9	210.036	229.601	246.524
Profit Per Acre in 2017 Dollars	$61.06	$73.83	$5.98	$141.01	$116.02	$150.12

[5] 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 $150.12 which adjusts to $187.43 after accounting for inflation in Marshall 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:

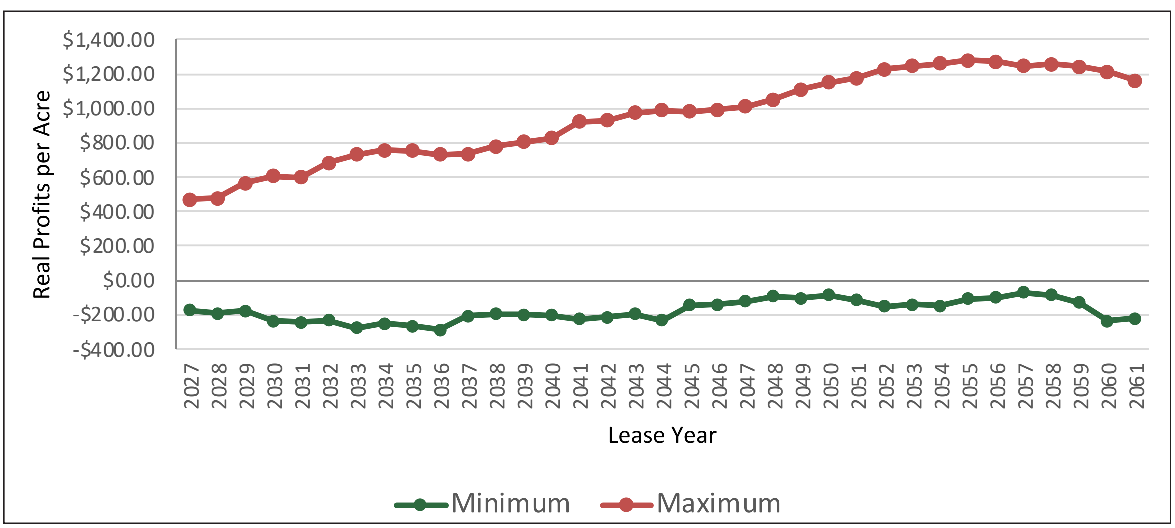
$$\pi_t = \propto + \beta * time$$

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 $36.80 with a standard error of $33.95. The time trend is $4.04 with a standard error of 2.13. This means that agriculture profits are expected to rise by $4.04. 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.

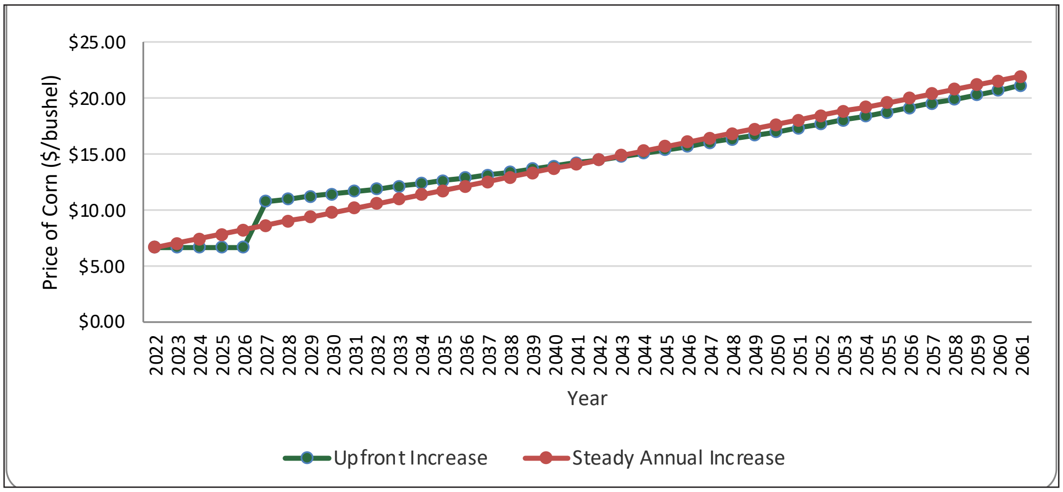
Over the period from 2017 to 2061, we assume that the profit per acre follows the equation above but allows for the random fluctuations. Because of this randomness, we can simulate multiple futures using a Monte Carlo simulation. We assume that the solar farm will begin operation in 2027 and operate through 2061. Using 500 different simulations, the real profit per acre never exceeds $1,279 in any single year. Overall, the maximum average annual profit over the 35 years is $1,002 and the maximum average annual loss is $181. 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 2061 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



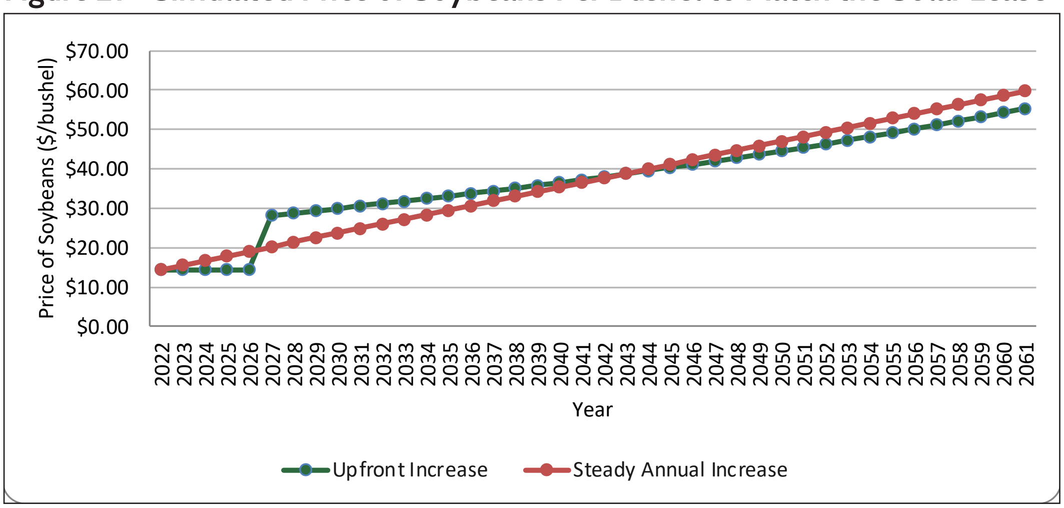
Another way to look at this problem would be to ask: How high would corn prices have to rise to make farming more profitable than the solar lease? Below we assume that the yields on the land and all other input costs stay the same. In this case, corn prices would have to rise from $6.65 per bushel in 2022 to $10.78 in 2027 and rise to $21.14 per bushel by 2061 as shown in Figure 20. Alternatively, corn prices would need to rise by $0.39 per bushel each year from 2022 to 2061 when it would reach $21.96 per bushel.

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



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 $14.40 per bushel in 2022 to $28.24 per bushel in 2027 and rise to $55.37 by 2061 as shown in Figure 21. For a linear increase, soybean prices would need to rise by $1.16 per bushel each year from 2022 to 2061 when it would reach $59.79 per bushel.

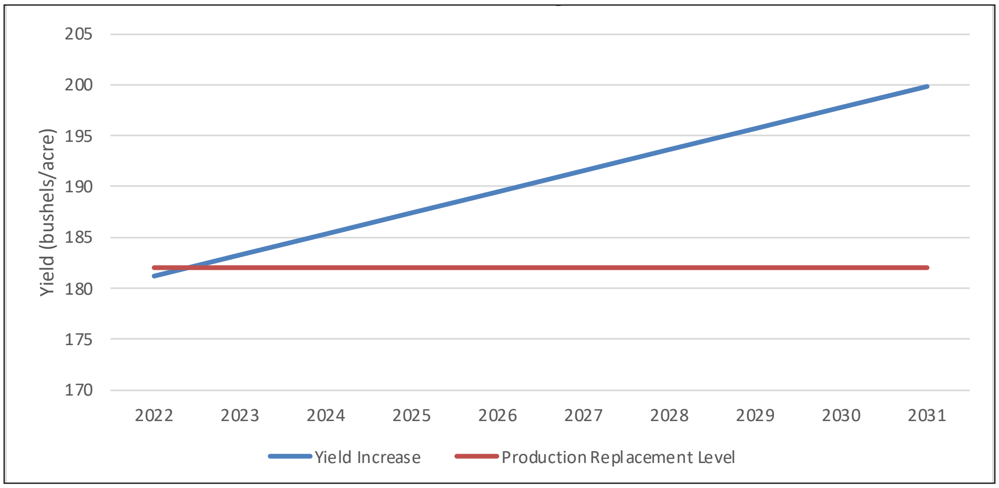
Figure 21 - Simulated Price of Soybeans Per Bushel to Match the Solar Lease



If we assume that the price of corn stays the same, the yields for corn would need to increase from 193.6 bushels per acre in 2022 to 313.9 bushels per acre in 2027 and stay at that level until 2061. The soybean yields would need to rise from 57.8 bushels per acre in 2022 to 113.3 bushels per acre in 2027 and stay there until 2061.

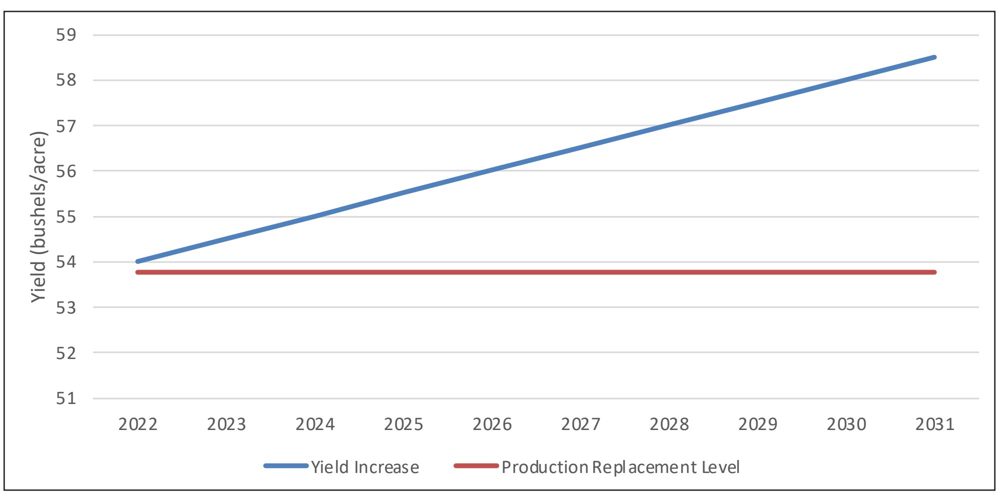
At 1,000 acres, the Project would take 0.5% of the county's agricultural land out of production, thus reducing the total agricultural output for the county. However, it is possible to offset this loss as yields for corn have been increasing by 2.07 bushels per acre every year. Therefore, less land will be needed to produce the same amount of corn. Our analysis shows that yields would need to reach 182.08 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 0.47 years.

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



Likewise, yields for soybeans have been increasing by 0.5 bushels per acre every year. Our analysis shows that yields would need to reach 53.78 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 0.53 years.

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 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. IMPLAN is a leading provider of economic development software that is widely used by economists and economic development professionals. More information about IMPLAN can be found at http:/implan.com.

IMPLAN 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, IMPLAN 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 IMPLAN model utilizes county-specific and state-specific industry multipliers in the analysis. 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.

The majority of the jobs during construction are construction workers but there are other occupations involved as well. In addition, during operations, there are other occupations involved besides solar technicians. A sample of those occupations, the education/training needed and wages percentiles, is contained in Table 11 in the Appendix. A larger description of those occupations, their work environment, and future job growth is found in Table 12 in the Appendix.

VII. Economic Impact Results

The economic impact results were derived from detailed project cost estimates supplied by Tamarack Solar. In addition, Tamarack Solar estimated the percentages of project materials and labor that will be coming from within Marshall County and the State of Indiana.

Two sets of models were produced to show the economic impact of the Tamarack Solar Project. The first set of models examines the construction costs and the second set of models examines the operating expenses. The first model uses the capital expenditures and the 2021 IMPLAN Marshall County dataset. The second model uses the 2021 IMPLAN dataset for the State of Indiana and the same project costs. The third model uses the operating expenditures and the 2021 IMPLAN Marshall County dataset. The fourth model uses the 2021 IMPLAN dataset for the State of Indiana and the same project costs. The latest dataset from IMPLAN and specific project cost data from the Tamarack Solar Project are used and SER translated 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 Tamarack Solar Project for Marshall County and the State of Indiana. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

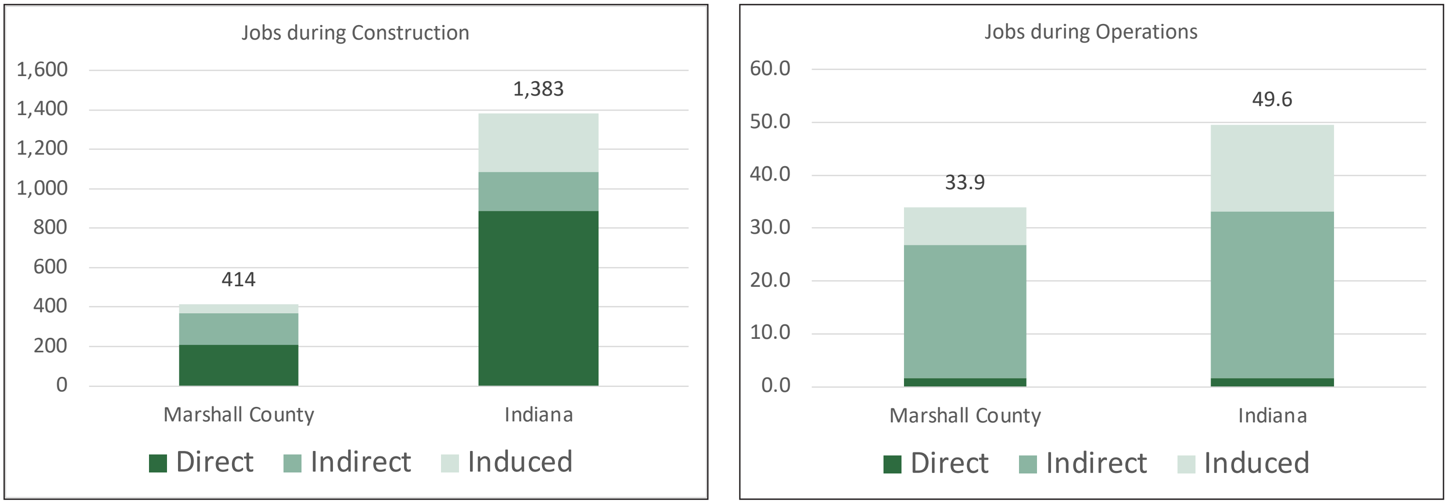
Table 5 – Total Employment Impact from the Tamarack Solar Project

	Marshall County Jobs	State of Indiana Jobs
Construction		
Direct Impacts	207	890
Indirect Impacts	163	194
Induced Impacts	44	299
Local Jobs during Construction	414	1,383
Operations (Annual/Ongoing)		
Onsite Direct Impacts	1.6	1.6
Indirect Impacts	25.2	31.6
Induced Impacts	7.1	16.4
Local Long-Term Jobs	33.9	49.6

The results from the IMPLAN model show significant employment impacts from the Tamarack 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 IMPLAN 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 model. For example, the IMPLAN model results show 207 new direct jobs during construction in Marshall County, though the construction of the solar center could involve closer to 414 workers working half-time for a year. Thus, due to the short-term nature of construction projects, IMPLAN 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 414 for Marshall County and 1,383 for the State of Indiana. New local long-term jobs created from the Tamarack Solar Project total 33.9 for Marshall County and 49.6 for the State of Indiana.

Figure 24 – Total Employment Impact from the Tamarack Solar Project



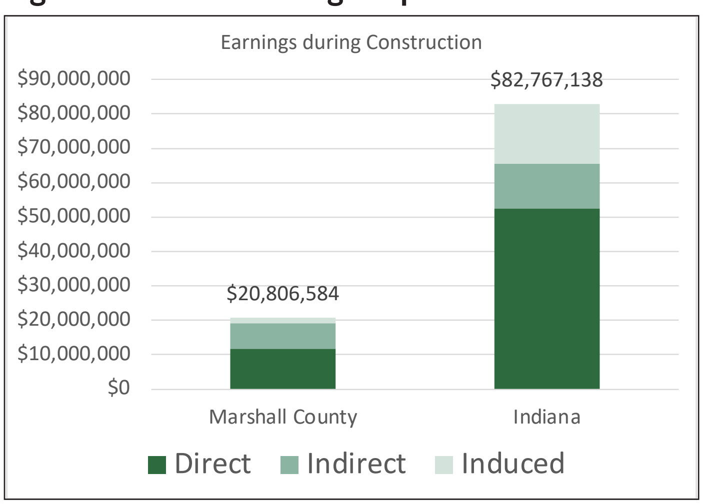
Direct jobs created during the operational phase last the life of the solar PV project, typically 20-30 years. Both direct construction jobs and operations and maintenance jobs require highly-skilled workers in the fields of construction, management, and engineering. For a list of occupations expected to be employed, their wages, benefits, total compensation, and hours worked, please see Tables 13 to 15 in the Appendix.

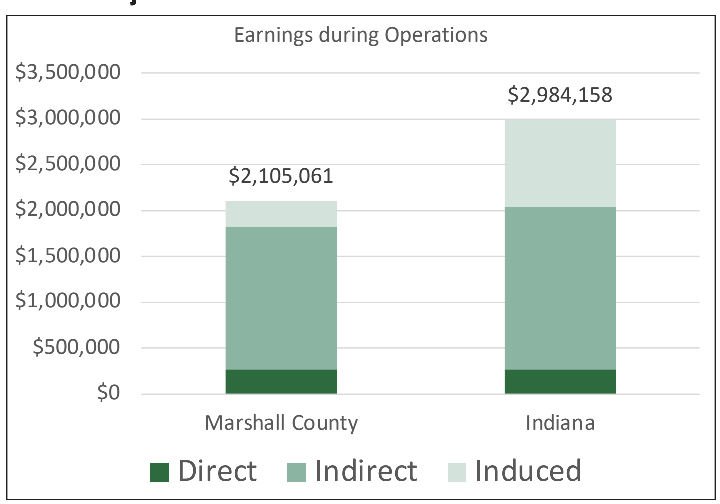
Accordingly, it is important to not just look at the number of jobs but also the earnings that they produce. Table 6 shows the earnings impacts from the Tamarack Solar Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction totals over $20.8 million for Marshall County and over $82.7 million for the State of Indiana. The new local long-term earnings totals over $2.1 million for Marshall County and over $2.9 million for the State of Indiana.

Table 6 – Total Earnings Impact from the Tamarack Solar Project

	Marshall County	State of Indiana
Construction		
Direct Impacts	$11,672,500	$52,440,000
Indirect Impacts	$7,359,331	$12,979,342
Induced Impacts	$1,774,753	$17,347,796
Local Earnings during Construction	$20,806,584	$82,767,138
Operations (Annual/Ongoing)		
Onsite Direct Impacts	$262,500	$262,500
Indirect Impacts	$1,560,340	$1,777,126
Induced Impacts	$282,221	$944,532
Local Long-Term Earnings	$2,105,061	$2,984,158

Figure 25 – Total Earnings Impact from the Tamarack Solar Project



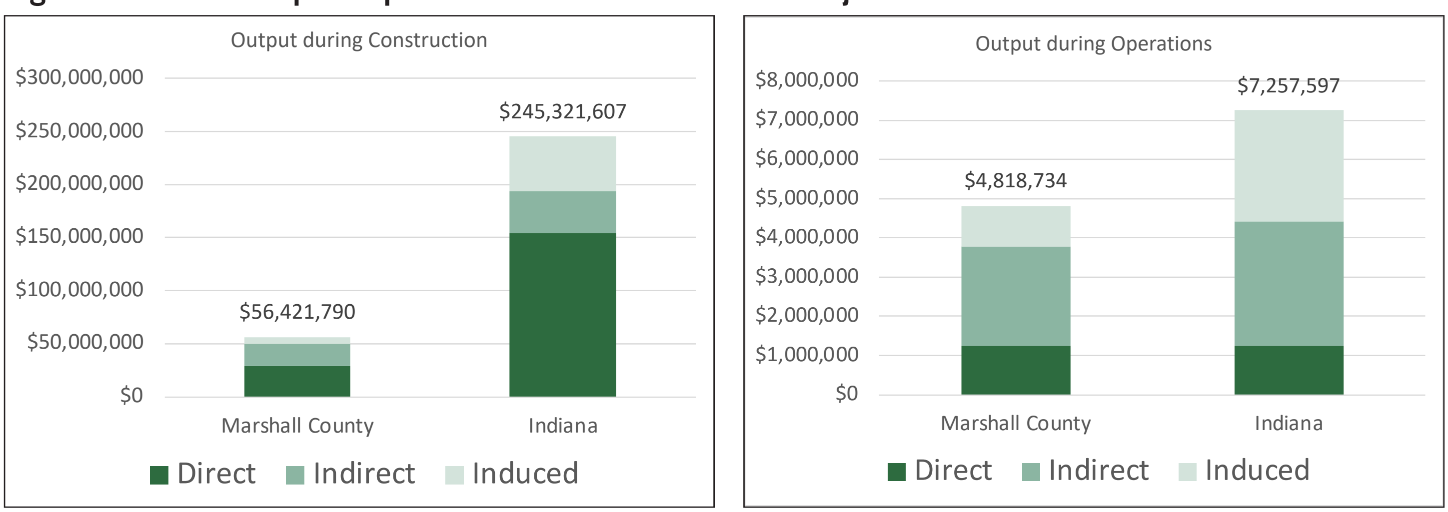


Output refers to economic activity or the value of production in the state or local economy. It is an equivalent measure to the Gross Domestic Product, which measures output on a national basis. According to Table 7, the new local output during construction totals over $56.4 million for Marshall County and over $245 million for the State of Indiana. The new local long-term output totals over $4.8 million for Marshall County and over $7.2 million for the State of Indiana.

Table 7 – Total Output Impact from the Tamarack Solar Project

	Marshall County	State of Indiana
Construction		
Direct Impacts	$28,665,772	$154,033,616
Indirect Impacts	$21,271,728	$39,364,199
Induced Impacts	$6,484,290	$51,923,792
Local Output during Construction	$56,421,790	$245,321,607
Operations (Annual/Ongoing)		
Onsite Direct Impacts	$1,245,284	$1,245,284
Indirect Impacts	$2,541,193	$3,174,118
Induced Impacts	$1,032,257	$2,838,195
Local Long-Term Output	$4,818,734	$7,257,597

Figure 26 – Total Output Impact from the Tamarack Solar Project



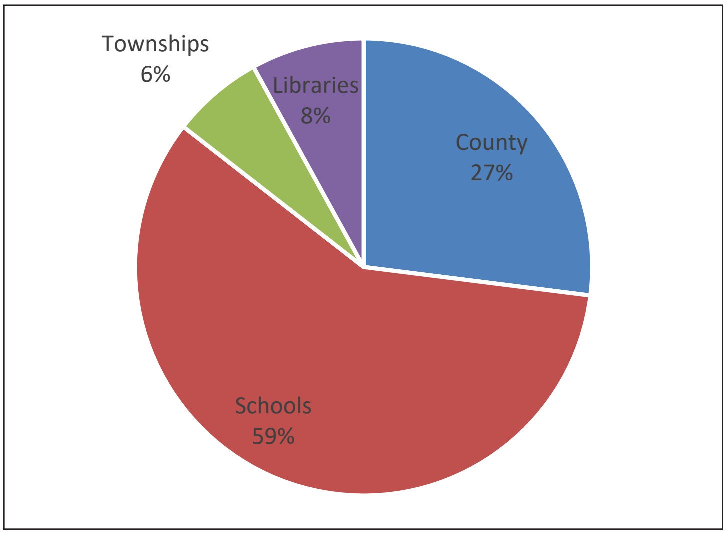
VIII. Tax Revenue

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. Estimates of the taxable value of each type of property were obtained from the client.

Tables 8 to 10 detail the tax implications of the Tamarack Solar Project. There are several important assumptions built into the analysis in these tables.

- First, the analysis assumes that the taxable personal property at the start of the Project will be $225 million of costs depreciable in 5 years and $51 million of costs depreciable in 15 years.
- Second, the depreciation of the personal property uses MACRS depreciation schedules with a maximum depreciation of 70%.
- Third, for modeling purposes all tax rates are assumed to stay constant at their 2023 (2022 tax year) tax rates. For example, the Marshall County general fund tax rate will remain at 0.3425%.
- Fourth, the names of the taxing bodies used in this section come from the county and state tax websites.
- Fifth, a 100% tax abatement was assumed for the first ten years of the Project. If a different agreement is reached, the property tax numbers presented will change.
- Sixth, a total economic development payment of $7,347,460 was assumed to be paid over the first four years of the Project. This payment was assumed to be apportioned to the taxing jurisdictions by the percent of the Project within the taxing jurisdiction and their relative tax rates. However, this payment would go to the county and the county would have the authority to allocate the funds to the other taxing jurisdiction as it sees fit.
- Seventh, no comprehensive tax payment was calculated, and these calculations are only to be used to illustrate the economic impact of the Project.

Figure 27 – Percentages of Property Taxes Paid to Taxing Jurisdictions



As shown in Table 8, a conservative estimate of the total personal property taxes paid by the Project starts out at over $1.9 million due to the economic development payment, and then drops to over $145 thousand for the remainder of the abatement. After the 10 year abatement, the estimated total taxes paid will remain at over $1.2 million annually. The expected total property taxes paid over the 35-year lifetime of the Project are over $39.6 million, and the average annual property taxes paid will be over $2.2 million.

Table 8 – Total Personal Property Taxes Paid by the Tamarack Solar Project

Year	Total Property Taxes
2027-2030	$1,981,916
2031-2036	$145,051
2037-2061	$1,234,908
TOTAL	**$39,670,665**
AVG ANNUAL	**$2,203,926**

Table 9 shows an estimate of the likely taxes paid to the Marshall County General Fund, Marshall County Special Unit, West Township, Union Township, Plymouth Public Library, and Culver Public Library.

According to Table 9, the total amounts paid by the Project over 35 years are over $10.3 million for Marshall County General Fund, over $356 thousand for Marshall County Special Unit, over $1.2 million for West Township, over $1.3 million for Union Township, over $1.6 million for Plymouth Public Library, and over $1.5 million for Culver Public Library over the life of the Project.

Table 9 – Tax Revenue from the Tamarack Solar Project for the County, Townships, and Libaries[6]

Year	Marshall County General Fund	Marshall County Special Unit	West Township	Union Township	Plymouth Public Library	Culver Public Library
2027-2030	$517,115	$17,816	$61,722	$66,402	$82,859	$75,914
2031-2036	$37,846	$1,304	$4,517	$4,860	$6,064	$5,556
2037-2061	$322,208	$11,101	$38,458	$41,374	$51,629	$47,301
TOTAL	**$10,350,735**	**$356,609**	**$1,235,440**	**$1,329,125**	**$1,658,535**	**$1,519,518**
AVG ANNUAL	**$575,041**	**$19,812**	**$68,636**	**$73,840**	**$92,141**	**$84,418**

[6] The assumed tax rates are 0.3425% for Marshall County General Fund, 0.0118% for Marshall County Special Unit, 0.1022% for West Township, 0.0733% for Union Township, 0.1372% for Plymouth Public Library, and 0.0838% for Culver Public Library.

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 10 shows the direct property tax revenue coming from the Project to the Plymouth Community School Corporation and Culver Community School Corporation. This tax revenue uses the assumptions outlined earlier to calculate the other tax revenue and assumes that 40% of the project area is in the Plymouth Community School Corporation and 60% is in the Culver Community School Corporation. Over the 35-year life of the Project, the school districts are expected to receive over $23.2 million in tax revenue.

Table 10 – Tax Revenue from the Tamarack Solar Project for the School Districts[7]

Year	Plymouth Community School Corporation	Culver Community School Corporation
2027-2030	$607,493	$552,596
2031-2036	$44,461	$40,443
2037-2061	$378,521	$344,316
TOTAL	**$12,159,771**	**$11,060,931**
AVG ANNUAL	**$675,543**	**$614,496**

[7] The assumed tax rates are 1.0059% for Plymouth Community School Corporation and 0.61% for Culver Community School Corporation.

IX. Appendix

Table 11 – Local and Statewide Compensation by Occupation

BLS Occupation Code	Job Type	Education/Training Required	Indiana 10th Percentile of Wages	Indiana 90th Percentile of Wages	Indiana Mean Wages	South Bend-Mishawaka, IN-MI 10th Percentile of Wages	South Bend-Mishawaka, IN-MI 90th Percentile of Wages	South Bend-Mishawaka, IN-MI Mean Wages	US Fringe Benefits Median	Total Compensation Local mean wages plus US Fringe
	Jobs during Construction									
47-2231	Solar Photovoltaic Installers	High school diploma or equivalent	$46,300	$55,880	$49,750	#N/A	#N/A	#N/A	$27,394	#N/A
47-3013	Helpers – Electricians	High school diploma or equivalent	$28,940	$48,210	$37,700	#N/A	#N/A	#N/A	$27,394	#N/A
47-2111	Electricians	High school diploma or equivalent	$38,670	$90,540	$66,630	$36,810	$90,240	$67,370	$27,394	$94,764
47-2061	Construction Laborers	No formal educational credential	$30,860	$65,610	$47,850	$30,080	$62,550	$46,710	$27,394	$74,104
47-2073	Operating Engineers and Other Construction Equipment Operators	High school diploma or equivalent	$39,360	$83,460	$63,180	$41,080	$99,890	$69,610	$27,394	$97,004
47-1011	First-Line Supervisors of Construction Trades	High school diploma or equivalent	$47,220	$102,300	$74,450	$50,600	$98,630	$77,740	$27,394	$105,134
13-1082	Project Management Specialists and Business Operations Specialists		$48,880	$131,130	$84,070	$49,930	$124,030	$81,050	$27,394	$108,444
49-9071	Maintenance and Repair Workers, General (Operations)	High school diploma or equivalent	$29,620	$66,660	$47,240	$29,570	$62,660	$44,620	$27,394	$72,014
13-1111	Management Analysts	Bachelor's degree	$46,970	$134,170	$88,770	$42,610	$128,520	$80,710	$27,394	$108,104
11-1021	General and Operations Managers	Bachelor's degree	$41,620	$217,300	$120,780	$41,030	$208,690	$115,040	$27,394	$142,434
17-2071	Electrican Engineers		$60,540	$132,920	$96,450	$62,460	$134,800	$92,100	$27,394	$119,494
41-3091	Sales Representatives of Services		$33,810	$123,880	$69,820	$32,500	$115,570	$68,100	$27,394	$95,494
53-7062	Laborers and Freight, Stock and Material Movers	No formal educational credential	$28,990	$46,780	$37,660	$27,900	$46,440	$36,360	$27,394	$63,754
43-3031	Bookkeeping, Accounting and Auditing	Some college, no degree	$27,250	$58,940	$42,620	$30,380	$56,420	$42,260	$27,394	$69,654
	Jobs during Operations									
51-8013	Power Plant Operators	High school diploma or equivalent	$64,830	$107,350	$90,270	#N/A	#N/A	#N/A	$27,394	#N/A
37-3011	Landscaping and Grounds-keeping	No formal educational credential	$22,970	$45,100	$34,530	$23,190	$42,760	$33,780	$27,394	$61,174
51-1011	First-Line Supervisors of Production and Operating Workers	High school diploma or equivalent	$43,370	$96,780	$67,300	$40,010	$89,480	$64,160	$27,394	$91,554

Table 12 – Occupational Description and Future Outlook

Occupation Code	Occupation Title	Description	Work Environment	Current Employment	Job Growth, 2021-2031 (percent)
11-1021	General and Operations Managers	Plan, direct, or coordinate the operations of public or private sector organizations, overseeing multiple departments or locations. Duties and responsibilities include formulating policies, managing daily operations, and planning the use of materials and human resources, but are too diverse and general in nature to be classified in any one functional area of management or administration, such as personnel, purchasing, or administrative services. Usually manage through subordinate supervisors. Excludes First-Line Supervisors.	Top executives work in nearly every industry, for both small and large organizations. They often have irregular schedules, which may include working evenings and weekends. Travel is common, particularly for chief executives.	3,328,200	209,800 (7%)
13-1082	Project Management Specialists and Business Operations Specialists	Analyze and coordinate the schedule, timeline, procurement, staffing, and budget of a product or service on a per project basis. Lead and guide the work of technical staff. May serve as a point of contact for the client or customer. Excludes "Management Occupations" (11-0000), "Logisticians" (13-1081), "Meeting, Convention, and Event Planners" (13-1121), and "Production, Planning, and Expediting Clerks" (43-5061).	Project management specialists usually work in an office setting. Although project management specialists may collaborate on teams, some work independently. Project management specialists also may travel to their clients' places of business.	781,400	56,300 (7%)
13-1111	Management Analysts	Conduct organizational studies and evaluations, design systems and procedures, conduct work simplification and measurement studies, and prepare operations and procedures manuals to assist management in operating more efficiently and effectively. Includes program analysts and management consultants. Excludes "Computer Systems Analysts" (15-1211) and "Operations Research Analysts" (15-2031).	Management analysts may travel frequently to meet with clients. Some work more than 40 hours per week.	950,600	108,400 (11%)
17-2071	Electrican Engineers	Research, design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use. Excludes "Computer Hardware Engineers" (17-2061).	Electrical and electronics engineers work in industries including research and development, engineering services, manufacturing, telecommunications, and the federal government. Electrical and electronics engineers generally work indoors in offices. However, they may have to visit sites to observe a problem or a piece of complex equipment.	303,800	9,800 (3%)
37-3011	Landscaping and Groundskeeping	Landscape or maintain grounds of property using hand or power tools or equipment. Workers typically perform a variety of tasks, which may include any combination of the following: sod laying, mowing, trimming, planting, watering, fertilizing, digging, raking, sprinkler installation, and installation of mortarless segmental concrete masonry wall units. Excludes "Farmworkers and Laborers, Crop, Nursery, and Greenhouse" (45-2092).	Most grounds maintenance work is done outdoors in all weather conditions. Some work is seasonal, available mainly in the spring, summer, and fall. The work may be repetitive and physically demanding, requiring frequent bending, kneeling, lifting, or shoveling.	1,299,000	61,300 (5%)
41-3091	Sales Representatives of Services	Sell services to individuals or businesses. May describe options or resolve client problems. Excludes "Advertising Sales Agents" (41-3011), "Insurance Sales Agents" (41-3021), "Securities, Commodities, and Financial Services Sales Agents" (41-3031), "Travel Agents" (41-3041), "Sales Representatives, Wholesale and Manufacturing" (41-4010), and "Telemarketers" (41-9041).	Wholesale and manufacturing sales representatives work under pressure because their income and job security depend on the amount of merchandise they sell. Some sales representatives travel frequently.	1,597,600	63,300 (4%)
43-3031	Bookkeeping, Accounting and Auditing	Compute, classify, and record numerical data to keep financial records complete. Perform any combination of routine calculating, posting, and verifying duties to obtain primary financial data for use in maintaining accounting records. May also check the accuracy of figures, calculations, and postings pertaining to business transactions recorded by other workers. Excludes "Payroll and Timekeeping Clerks" (43-3051).	Most accountants and auditors work full time. Overtime hours are typical at certain periods of the year, such as for quarterly audits or during tax season.	1,449,800	81,800 (6%)
47-1011	First-Line Supervisors of Construction Trades	Directly supervise and coordinate activities of construction or extraction workers.	N/A	735,500	29,900 (4%)

Table 12 – Occupational Description and Future Outlook (Cont.)

47-2061	Construction Laborers	Perform tasks involving physical labor at construction sites. May operate hand and power tools of all types: air hammers, earth tampers, cement mixers, small mechanical hoists, surveying and measuring equipment, and a variety of other equipment and instruments. May clean and prepare sites, dig trenches, set braces to support the sides of excavations, erect scaffolding, and clean up rubble, debris, and other waste materials. May assist other craft workers. Construction laborers who primarily assist a particular craft worker are classified under “Helpers, Construction Trades” (47-3010). Excludes “Hazardous Materials Removal Workers” (47-4041).	Most construction laborers and helpers typically work full time and do physically demanding work. Some work at great heights or outdoors in all weather conditions. Construction laborers have one of the highest rates of injuries and illnesses of all occupations.	1,572,200	69,500 (4%)
47-2073	Operating Engineers and Other Construction Equipment Operators	Operate one or several types of power construction equipment, such as motor graders, bulldozers, scrapers, compressors, pumps, derricks, shovels, tractors, or front-end loaders to excavate, move, and grade earth, erect structures, or pour concrete or other hard surface pavement. May repair and maintain equipment in addition to other duties. Excludes “Extraction Workers” (47-5000) and “Crane and Tower Operators” (53-7021).	Construction equipment operators may work even in unpleasant weather. Most operators work full time, and some have irregular work schedules that include nights.	466,900	22,000 (5%)
47-2111	Electricians	Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems, or electrical control systems. Excludes “Security and Fire Alarm Systems Installers” (49-2098).	Almost all electricians work full time. Work schedules may include evenings and weekends. Overtime is common.	711,200	50,200 (7%)
47-2231	Solar Photovoltaic Installers	Assemble, install, or maintain solar photovoltaic (PV) systems on roofs or other structures in compliance with site assessment and schematics. May include measuring, cutting, assembling, and bolting structural framing and solar modules. May perform minor electrical work such as current checks. Excludes solar PV electricians who are included in “Electricians” (47-2111) and solar thermal installers who are included in “Plumbers, Pipefitters, and Steamfitters” (47-2152).	Most solar panel installations are done outdoors, but PV installers sometimes work in attics and crawl spaces to connect panels to the electrical grid. Installers also must travel to jobsites.	17,100	4,600 (27%)
47-3013	Helpers – Electricians	Help electricians by performing duties requiring less skill. Duties include using, supplying, or holding materials or tools, and cleaning work area and equipment. Construction laborers who do not primarily assist electricians are classified under “Construction Laborers” (47-2061). Apprentice workers are classified with the appropriate skilled construction trade occupation (47-2011 through 47-2231).	Most construction laborers and helpers typically work full time and do physically demanding work. Some work at great heights or outdoors in all weather conditions. Construction laborers have one of the highest rates of injuries and illnesses of all occupations.	1,572,200	69,500 (4%)
49-9071	Maintenance and Repair Workers, General (Operations)	Perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of a building in repair. Duties may involve pipe fitting; HVAC maintenance; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs. Excludes “Facilities Managers” (11-3013) and “Maintenance Workers, Machinery” (49-9043).	General maintenance and repair workers often carry out many different tasks in a single day. They could work at any number of indoor or outdoor locations. They may work inside a single building, such as a hotel or hospital, or be responsible for the maintenance of many buildings, such as those in an apartment complex or on a college campus.	1,539,100	76,300 (5%)
51-1011	First-Line Supervisors of Production and Operating Workers	Directly supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators, and plant and system operators. Excludes team or work leaders.	N/A	646,800	12,200 (2%)
51-8013	Power Plant Operators	Control, operate, or maintain machinery to generate electric power. Includes auxiliary equipment operators. Excludes “Nuclear Power Reactor Operators” (51-8011).	Most power plant operators, distributors, and dispatchers work full time. Many work rotating 8- or 12-hour shifts.	43,700	(6,500) (-15%)
53-7062	Laborers and Freight, Stock and Material Movers	Manually move freight, stock, luggage, or other materials, or perform other general labor. Includes all manual laborers not elsewhere classified. Excludes “Construction Laborers” (47-2061) and “Helpers, Construction Trades” (47-3011 through 47-3019). Excludes “Material Moving Workers” (53-7011 through 53-7199) who use power equipment.	Most hand laborers and material movers work full time. Because materials are shipped around the clock, some workers, especially those in warehousing, work overnight shifts.	6,473,000	358,300 (6%)

Table 13 – Occupational Output from IMPLAN Construction Model, Direct Jobs, Employment Greater than 1.0

Occ Code	Occupation	Wage and Salary Employment	Wage and Salary Income	Supplements to Wages and Salaries	Employee Compensation	Hours Worked
47-2000	Construction Trades Workers	100.55	$4,276,211.70	$789,074.50	$5,065,286.20	189,275.98
47-1000	Supervisors of Construction and Extraction Workers	14.48	$846,464.98	$156,195.24	$1,002,660.23	30,972.37
49-9000	Other Installation, Maintenance, and Repair Occupations	13.70	$566,811.67	$104,591.79	$671,403.46	26,576.70
13-1000	Business Operations Specialists	9.78	$624,085.76	$115,160.38	$739,246.14	19,681.41
11-9000	Other Management Occupations	7.31	$608,324.63	$112,252.03	$720,576.67	15,662.36
43-9000	Other Office and Administrative Support Workers	7.18	$211,525.15	$39,032.00	$250,557.15	11,523.39
11-1000	Top Executives	6.45	$585,513.90	$108,042.85	$693,556.75	14,421.88
47-3000	Helpers, Construction Trades	5.37	$155,721.43	$28,734.73	$184,456.16	9,185.91
43-3000	Financial Clerks	4.06	$151,293.06	$27,917.58	$179,210.64	7,140.22
43-6000	Secretaries and Administrative Assistants	3.90	$132,984.17	$24,539.11	$157,523.27	6,834.53
53-3000	Motor Vehicle Operators	3.85	$140,036.36	$25,840.42	$165,876.79	7,831.52
41-3000	Sales Representatives, Services	2.76	$144,462.54	$26,657.17	$171,119.71	5,489.48
53-7000	Material Moving Workers	2.42	$88,055.69	$16,248.61	$104,304.30	4,336.62
47-4000	Other Construction and Related Workers	2.31	$102,625.57	$18,937.14	$121,562.71	4,503.06
49-2000	Electrical and Electronic Equipment Mechanics, Installers, and Repairers	1.69	$70,488.81	$13,007.05	$83,495.86	3,379.50
49-1000	Supervisors of Installation, Maintenance, and Repair Workers	1.64	$98,694.18	$18,211.69	$116,905.88	3,571.99
17-2000	Engineers	1.62	$106,798.25	$19,707.11	$126,505.36	3,289.18
51-4000	Metal Workers and Plastic Workers	1.55	$66,675.71	$12,303.44	$78,979.15	3,054.04
43-4000	Information and Record Clerks	1.50	$45,197.26	$8,340.09	$53,537.35	2,472.40
13-2000	Financial Specialists	1.43	$91,292.63	$16,845.91	$108,138.55	2,862.37
49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	1.39	$61,116.46	$11,277.61	$72,394.07	2,914.82
43-1000	Supervisors of Office and Administrative Support Workers	1.25	$63,674.21	$11,749.58	$75,423.79	2,449.20
43-5000	Material Recording, Scheduling, Dispatching, and Distributing Workers	1.24	$46,949.44	$8,663.42	$55,612.86	2,394.28

Table 14 – Occupational Output from IMPLAN Construction Model, Indirect Jobs, Employment Greater than 1.0

Occ Code	Occupation	Wage and Salary Employment	Wage and Salary Income	Supplements to Wages and Salaries	Employee Compensation	Hours Worked
37-3000	Grounds Maintenance Workers	47.82	1,763,500.32	278,057.73	2,041,558.06	81,110.27
47-2000	Construction Trades Workers	16.31	667,791.32	121,895.60	789,686.93	30,726.17
37-1000	Supervisors of Building and Grounds Cleaning and Maintenance Workers	6.31	327,498.85	51,683.77	379,182.62	13,154.09
11-1000	Top Executives	3.87	340,837.02	57,350.80	398,187.82	8,685.83
43-9000	Other Office and Administrative Support Workers	3.35	111,136.19	18,704.52	129,840.71	5,443.50
13-1000	Business Operations Specialists	3.02	190,920.25	33,147.65	224,067.89	6,041.12
49-9000	Other Installation, Maintenance, and Repair Occupations	2.95	131,435.18	24,273.08	155,708.26	5,754.38
41-2000	Retail Sales Workers	2.49	67,270.77	12,081.12	79,351.89	3,447.08
53-7000	Material Moving Workers	2.43	80,133.18	14,002.82	94,136.00	3,964.93
41-3000	Sales Representatives, Services	2.37	127,039.01	20,772.32	147,811.33	4,746.90
47-1000	Supervisors of Construction and Extraction Workers	2.34	131,171.22	24,020.74	155,191.95	5,008.77
43-3000	Financial Clerks	2.15	84,933.86	14,402.02	99,335.89	3,790.57
53-3000	Motor Vehicle Operators	2.06	86,692.60	15,779.62	102,472.22	4,169.04
43-6000	Secretaries and Administrative Assistants	1.81	66,374.10	11,250.74	77,624.83	3,176.36
49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	1.54	87,846.94	14,139.09	101,986.02	3,006.10
43-4000	Information and Record Clerks	1.50	51,381.44	8,844.66	60,226.11	2,488.42
11-9000	Other Management Occupations	1.32	110,388.69	20,392.07	130,780.77	2,792.74
13-2000	Financial Specialists	1.23	77,126.21	12,358.02	89,484.24	2,397.25

Table 15 – Occupational Output from IMPLAN Construction Model, Induced Jobs, Employment Greater than 1.0

Occ Code	Occupation	Wage and Salary Employment	Wage and Salary Income	Supplements to Wages and Salaries	Employee Compensation	Hours Worked
41-2000	Retail Sales Workers	4.08	88,551.03	16,650.97	105,202.00	5,218.68
35-3000	Food and Beverage Serving Workers	3.69	58,070.21	8,665.19	66,735.40	3,776.58
29-1000	Healthcare Diagnosing or Treating Practitioners	2.29	197,195.21	42,719.95	239,915.16	4,200.19
31-1100	Home Health and Personal Care Aides; and Nursing Assistants, Orderlies, and Psychiatric Aides	2.11	44,677.82	10,883.37	55,561.18	3,353.59
53-7000	Material Moving Workers	2.10	59,925.51	11,242.79	71,168.29	3,175.53
35-2000	Cooks and Food Preparation Workers	2.02	39,000.94	6,118.45	45,119.39	2,646.75
43-4000	Information and Record Clerks	1.20	35,029.27	6,484.22	41,513.49	1,914.06
29-2000	Health Technologists and Technicians	1.14	47,580.83	10,532.98	58,113.81	2,011.92

X. Glossary

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.

XI. References

Berkman, M., Tran, M., and Ahlgren, W. (2011). "Economic and Fiscal Impacts of the Desert Sunlight Solar Farm." Prepared for First Solar, Tempe, AZ (US)

Bezdek, R. H. (2007, July). Economic and Jobs Impacts of the Renewable Energy and Energy Efficiency Industries: U.S. and Ohio [PowerPoint Slides]. Presented at SOLAR 2007, Cleveland, Ohio. https://www.utoledo.edu/centers/urban-affairs/publications/jobs_report.pdf

BRE. (2014). Biodiversity Guidance for Solar Developments. BRE National Solar Centre https://www.bre.co.uk/filelibrary/nsc/Documents%20Library/NSC%20Publications/National-Solar-Centre---Biodiversity-Guidance-for-Solar-Developments--2014-.pdf

Bureau of Economic Analysis (BEA). (2023). Regional Data. GDP and Personal Income [Data set]. https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1

Center for Competitive Florida. (2009, April). The Positive Economic Impact of Solar Energy on the Sunshine State. Florida TaxWatch. https://floridataxwatch.org/Research/Blog/ArtMID/34888/ArticleID/15997/The-Positive-Economic-Impact-of-Solar-Energy-on-the-Sunshine-State

Croucher, M. (2012). Which state is Yoda? Energy Policy, 42(C), 613-615

Cusimano, J., Megdal, S.B., McLain, J.E., & Silvertooth, J.E. (2014). Study Finds Land Fallowing Improves Soil Quality in PVID. Arizona Water Resource, 22(1). https://wrrc.arizona.edu/land-fallowing-soil

de O. Milfont, M., Rocha, E.E.M., Lima, A.O.N. & Freitas, B.M. (2013). Higher soybean production using honeybee and wild pollinators, a sustainable alternative to pesticides and autopollination. Environmental Chemisty Letters. 11, 335–341. https://doi.org/10.1007/s10311-013-0412-8

Federal Reserve Bank of St. Louis Economic Data (FRED). (2023). Median Household Income. https://fred.stlouisfed.org/searchresults/?st=Median%20household%20income

Federal Reserve Bank of St. Louis Economic Data (FRED). (2023). Population Estimates. https://fred.stlouisfed.org/searchresults/?st=population

Federal Reserve Bank of St. Louis Economic Data (FRED). (2023). Unemployment Rate. https://fred.stlouisfed.org/searchresults/?st=unemployment&t=il&rt=il&ob=sr

Garibaldi, L.A., Schulte, L.A., Nabaes Jodar, D.N., Gomez Carella, D. S., & Kremen, C. (2021). Time to Integrate Pollinator Science into Soybean Production. Trends in Ecology & Evolution. 36(7) 573-575. https://doi.org/10.1016/j.tree.2021.03.013

Graham, M., Ates, S., Melathopoulos, A.P., Moldenke, A.R., DeBano, S.J., Best, L.R., & Higgins, C.W. (2021). Partial shading by solar panels delays bloom, increases floral abundance during the late-season for pollinators in a dryland, agrivoltaic ecosystem. Scientific Reports, 11, 7452. https://doi.org/10.1038/s41598-021-86756-4

IMPLAN Group LLC. (2023). Huntersville, NC. implan.com

Jenniches, S. (2018). Assessing the Regional Economic Impacts of Renewable Energy Sources. Renewable and Sustainable Energy Reviews, Elsevier, 93, 35-51. https://www.sciencedirect.com/science/article/pii/S1364032118303447

Jo, J.H., Cross, J., Rose, Z., Daebel, E., Verderber, A., and Loomis, D. G. (2016). Financing options and economic impact: distributed generation using solar photovoltaic systems in Normal, Illinois, AIMS Energy, 4(3): 504-516

Kozak, M., & Pudełko, R. (2021). Impact Assessment of the Long-Term Fallowed Land on Agricultural Soils and the Possibility of Their Return to Agriculture. Agriculture, 11(2), 148. https://doi.org/10.3390/agriculture11020148

Lawrence Berkeley National Laboratory. (2023). Utility-Scale Solar, 2023 Edition. Empirical trends in deployment, technology, cost, performance, PPA pricing, and value in the United States. https://emp.lbl.gov/sites/default/files/utility_scale_solar_2023_edition_slides.pdf

Loomis, D.G., Jo, J.H., & Aldeman, M.R. (2016). Economic impact potential of solar photovoltiacs in Illinois Renewable Energy, 87(1), 253-258. https://doi.org/10.1016/j.renene.2015.10.021

Michaud, G., Khalaf, C., Zimmer, M. & Jenkins, D. (2020). Measuring the economic impacts of utility-scale solar in Ohio. Developed for the Utility Scale Solar Energy Coalition of Ohio (USSEC). https://www.ohio.edu/voinovich-school/news-resources/reports-publications/utility-scale-solar

Solar Energy Industries Association (SEIA). (2021). Solar Market Insight Report 2021 Q3. https://www.seia.org/research-resources/solar-market-insight-report-2021-q3

Solar Energy Industries Association (SEIA). (2023). Solar State By State [Interactive Map]. https://www.seia.org/states-map

Solar Energy Industries Association (SEIA). (2023). Solar Market Insight Report 2022 Q4. https://www.seia.org/research-resources/solar-market-insight-report-2022-q4

Solar Energy Industries Association (SEIA). (2023). Solar Market Insight Report 2022 Year in Review. https://www.seia.org/research-resources/solar-market-insight-report-2022-year-review

Solar Foundation. (2013). An Assessment of the Economic, Revenue, and Societal Impacts of Colorado's Solar Industry. Denver Business Journal. https://www.bizjournals.com/denver/blog/earth_to_power/2013/10/solar-power-industry-says-economic.html

Stantec. (2020). Economic Benefit and Property Value Study. Bellflower Solar Project, Henry and Rush Counties, Indiana. Prepared or Lightsource Renewable Energy North America. http://henryco.net/attachments/Bellflower%20Economic%20Benefit_Property%20Value%20Review.pdf

United States Census Bureau. (2023). QuickFacts. https://www.census.gov/

USDA National Agricultural Statistics Service. (1994). 1992 Census of Agriculture. https://agcensus.library.cornell.edu/census_year/1992-census/

USDA National Agricultural Statistics Service. (1999). 1997 Census of Agriculture. https://agcensus.library.cornell.edu/census_year/1997-census/

USDA National Agricultural Statistics Service. (2004). 2002 Census of Agriculture. https://agcensus.library.cornell.edu/census_year/2002-census/

USDA National Agricultural Statistics Service. (2009). 2007 Census of Agriculture. https://agcensus.library.cornell.edu/census_year/2007-census/

USDA National Agricultural Statistics Service. (2014). 2012 Census of Agriculture. https://agcensus.library.cornell.edu/census_year/2012-census/

USDA National Agricultural Statistics Service. (2019). 2017 Census of Agriculture. https://www.nass.usda.gov/Publications/AgCensus/2017/index.php

USDA National Agricultural Statistics Service. (2023). Quick Stats [Data Set]. https://quickstats.nass.usda.gov/

United States Department of Agriculture. (2023). Statistics by State [Interactive Map]. National Agricultural Statistics Service. https://www.nass.usda.gov/Statistics_by_State/index.php

U.S. Department of Energy. (2022). Farmer's Guide to Going Solar. Office of Energy Efficiency & Renewable Energy. https://www.energy.gov/eere/solar/farmers-guide-going-solar

U.S. Department of Energy. (2023). United States Energy & Employment Report: Energy Employment by State 2023. https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20States%20Complete.pdf

U.S. Energy Information Administration (EIA). (2022). Monthly Generation Data by State, Producer Sector and Energy Source [Data set]. Form EIA-923. https://www.eia.gov/electricity/data/eia923/

Walston, L. J., Mishra, S. K., Hartmann, H. M., Hlohowskyj, I., McCall, J., & Macknick, J. (2018). Examining the Potential for Agricultural Benefits from Pollinator Habitat at Solar Facilities in the United States. Environmental Science & Technology. 52(13). 7566-7576

XII. Curriculum Vitae (Abbreviated)

David G. Loomis
Strategic Economic Research, LLC
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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.S.), 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

Strategic Economic Research, LLC

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