Langdon Mills Solar Project
Docket No: 9818-CE-100

APPENDIX R

Economic Impact Study

Economic Impact and Land Use Analysis of Langdon Mills Solar Project

September 2022

Strategic Economic Research, LLC

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Dr. David G. Loomis is Professor of Economics at Illinois State University and Co-Founder of the Center for Renewable Energy. He has over 20 years of experience in the renewable energy field. He has served as a consultant for 43 renewable energy development companies. He has testified on the economic impacts of energy projects before the Illinois Commerce Commission, Iowa Utilities Board, Missouri Public Service Commission, Illinois Senate Energy and Environment Committee, the Wisconsin Public Service Commission, Kentucky Public Service Commission, Ohio Public Siting Board, and numerous county boards. Dr. Loomis is a widely recognized expert and has been quoted in the Wall Street Journal, Forbes Magazine, Associated Press, and Chicago Tribune as well as appearing on CNN.

Dr. Loomis has published over 38 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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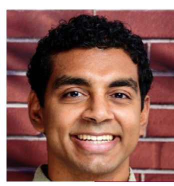
Bryan Loomis has three years of experience in economic impact, property tax, and land use analysis at Strategic Economic Research. He has performed over 50 wind and solar analyses in the last three years. He improved the property tax analysis methodology by researching various state taxing laws and implementing 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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Christopher Thankan assists with the production of the economic impact studies, including sourcing, analyzing, and graphing government data, and performing economic and property tax analysis for wind, solar and transmission projects. Thankan has a Bachelor of Science degree in Sustainable & Renewable Energy, and minored in economics.

Strategic Economic Research, LLC (SER) provides economic consulting for renewable energy projects across the US. We have produced over 150 economic impact reports in 28 states. Research Associates who performed work on this project include Ethan Loomis, Madison Schneider, Zoe Calio, Patrick Chen, Kathryn Keithley, Morgan Stong, Mandi Mitchell, and Paige Afram.

SER Strategic Economic Research, LLC

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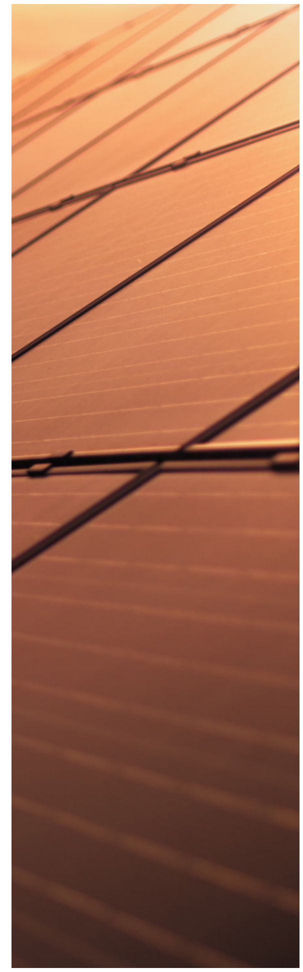

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I. Executive Summary

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

The Langdon Mills Solar Project is a 200-megawatt alternating current (MWac) utility-scale solar powered-electric generation facility that will utilize photovoltaic (PV) panels installed on a single-axis tracking system. Samsung may include a battery storage system in this project but the costs were not included in the modeling. Solar power electric generation facilities are commonly referred to as PV systems or solar PV. The Project represents an investment in excess of $448 million. The total development is anticipated to result in the following:

<u>Jobs – all jobs numbers are full-time equivalents</u>

- Approximately 146 new local jobs during construction for Columbia County
- Approximately 221 new local jobs during construction for the State of Wisconsin
- Approximately 14.5 new local long-term jobs for Columbia County
- Approximately 20.1 new local long-term jobs for the State of Wisconsin

<u>Earnings</u>

- Over $12.7 million in new local earnings during construction for Columbia County
- Over $19.1 million in new local earnings during construction for the State of Wisconsin
- Over $579 thousand in new local long-term earnings for Columbia County annually
- Over $1.1 million in new local long-term earnings for the State of Wisconsin annually

<u>Output</u>

- Over $16.4 million in new local output during construction for Columbia County
- Over $28.0 million in new local output during construction for the State of Wisconsin
- Over $2.3 million in new local long-term output for Columbia County annually
- Over $3.6 million in new local long-term output for the State of Wisconsin annually

<u>Tax Revenue</u>

- Approximately $333,400 annually in total township revenue
- Approximately $466,700 annually in total county tax revenue for Columbia County

Land Use

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

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

Columbia County:

- The price of corn would need to rise to $21.90 per bushel by the year 2064 or yields for corn would need to rise to 372.9 bushels per acre by the year 2025 for corn farming to generate more income for the landowner and local community than the solar lease.
- Alternatively, the price of soybeans would need to rise to $60.78 per bushel by the year 2064 or yields for soybeans would need to rise to 135.7 bushels per acre by the year 2025 for soybean farming to generate more income for the landowner and local community than the solar lease.
- At the time of this report, corn and soybean prices are $5.20 and $12.60 per bushel respectively and yields are 191.7 and 60.9 bushels per acre respectively.

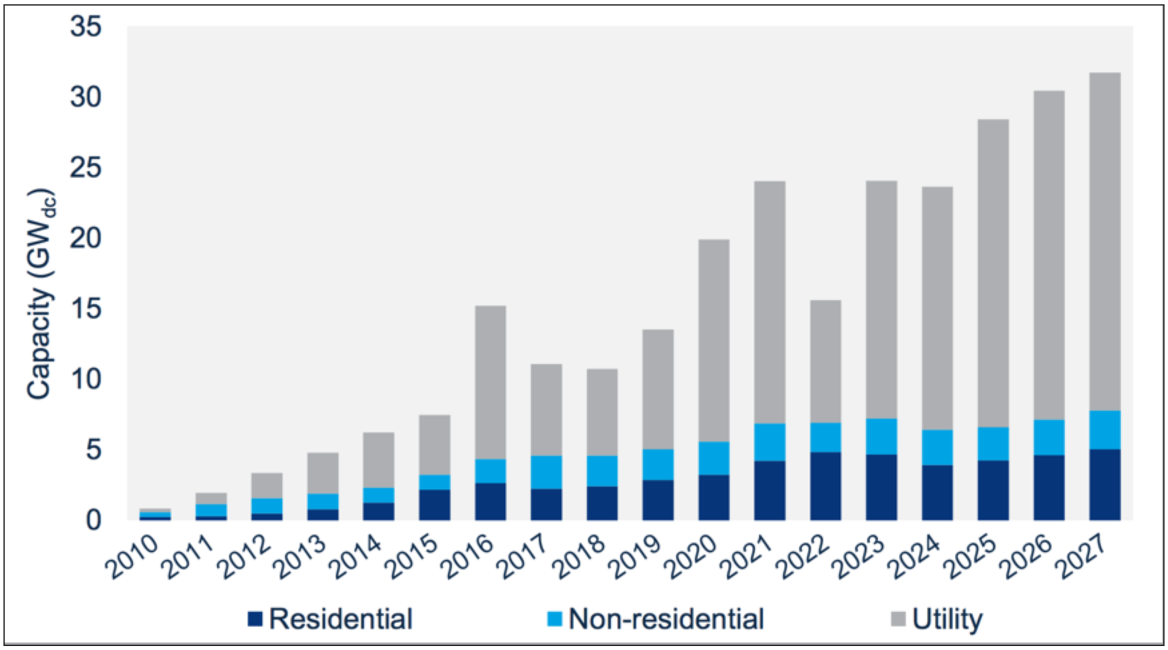
II. U.S. Solar PV Industry Growth and Economic Development

a. U.S. Solar PV Industry Growth

The U.S. solar industry is growing at a rapid but uneven pace, with systems installed for onsite use, including residential, commercial and industrial properties and with utility-scale solar powered-electric generation facilities intended for wholesale distribution, such as Langdon Mills Solar. 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 1 shows the historical capacity additions as well as the forecasted additions into 2026. The primary driver of this overall sharp pace of growth is large price declines in solar equipment. The overall price of solar PV has declined from $5.79/watt in 2010 to $1.33/watt in 2020 (SEIA, 2020). According to Figure 2, utility-scale solar fixed tilt and single-axis tracking have declined from $1.50/watt at the beginning of 2015 to near $1.00/watt by the first quarter of 2021. Solar PV also benefits from the Federal Investment Tax Credit (ITC) which provides a 26 percent tax credit for residential and commercial properties.

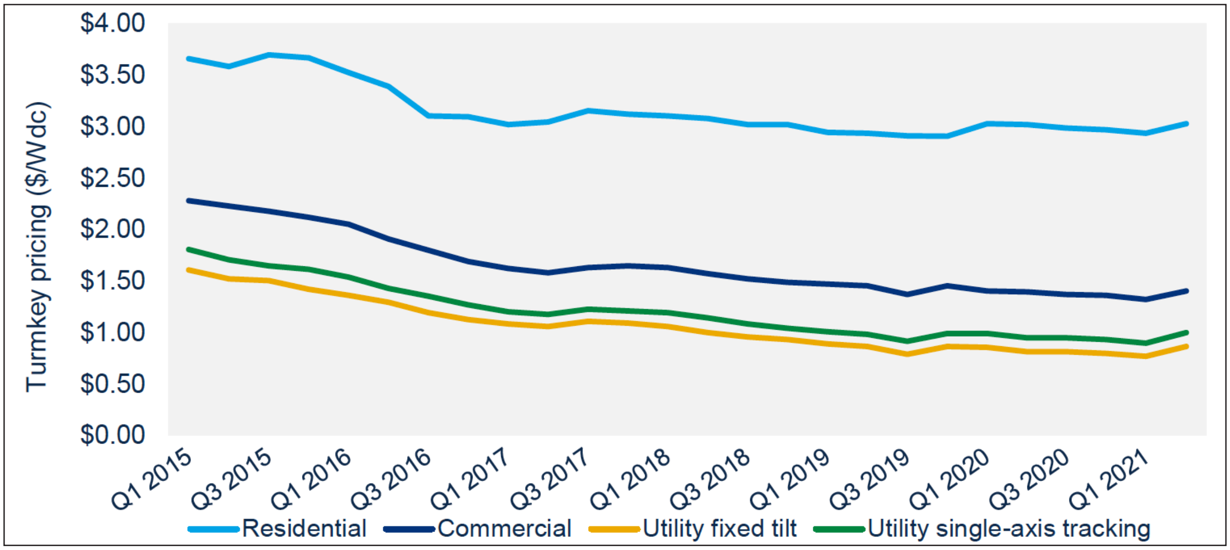
Utility-scale PV leads the installation growth in the U.S. Just under 14 GWdc of utility PV projects were completed in 2020. According to Figure 3, there are 85,000 MWdc of contracted utility-scale installations that have not been built yet.

Figure 1 – Annual U.S. Solar PV Installations, 2010-2027E



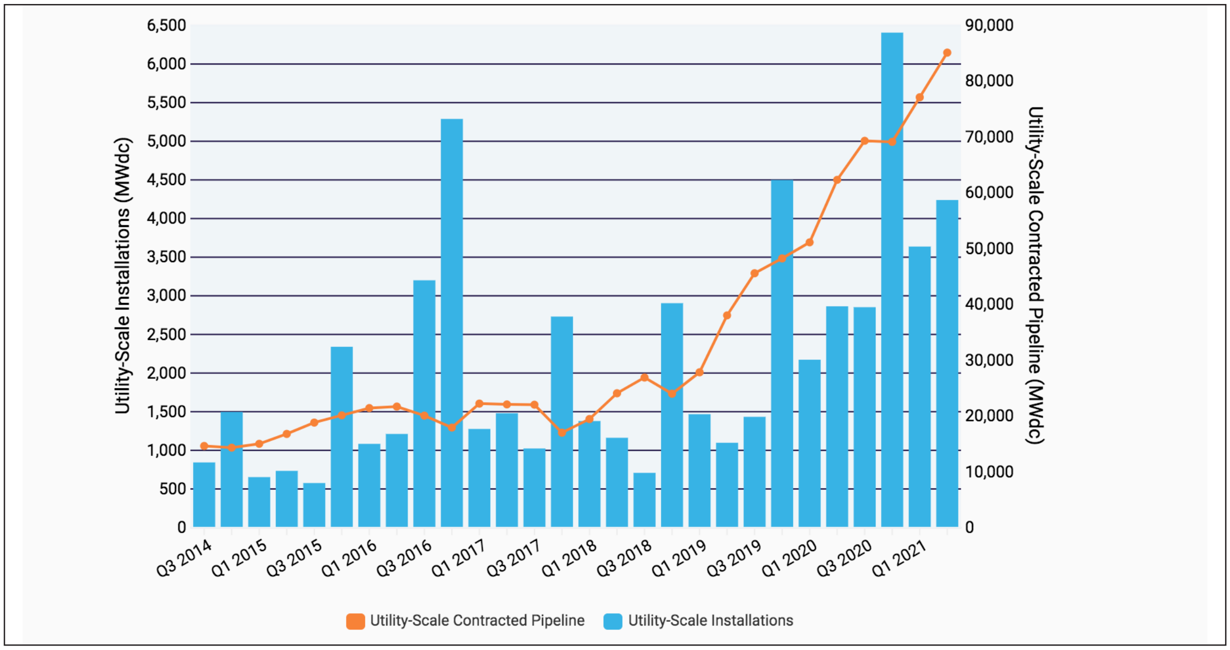
Source: Solar Energy Industries Association, Solar Market Insight Report Q2 2022

Figure 2 – U.S. Annual Solar PV Installed Price Trends Over Time



Source: Solar Energy Industries Association, Solar Market Insight Report Q3 2021

Figure 3 – U.S. Utility PV Installations vs. Contracted Pipeline

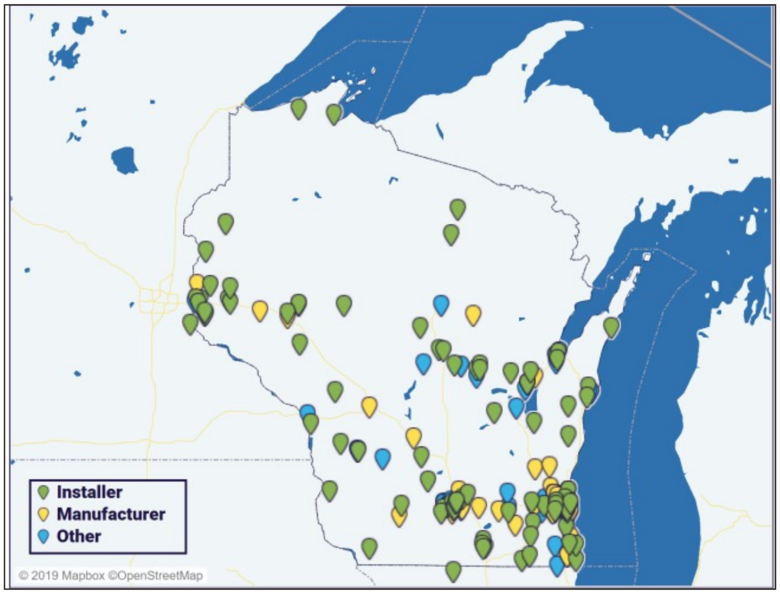


Source: Solar Energy Industries Association, Solar Market Insight Report Q2 2021

b. Wisconsin Solar PV Industry

According to SEIA, Wisconsin is ranked 26th in the U.S. in cumulative installations of solar PV. California, Texas, and Florida are the top 3 states for solar PV which may not be surprising because of the high solar irradiation that they receive. However, other states with similar solar irradiation to Wisconsin rank highly include New Jersey (8th), Massachusetts (9th), New York (11th), and Maryland (17th). In 2021, Wisconsin installed 395 MW of solar electric capacity bringing its cumulative capacity to 860.9 MW.

Figure 4 – Solar Company Locations in Wisconsin



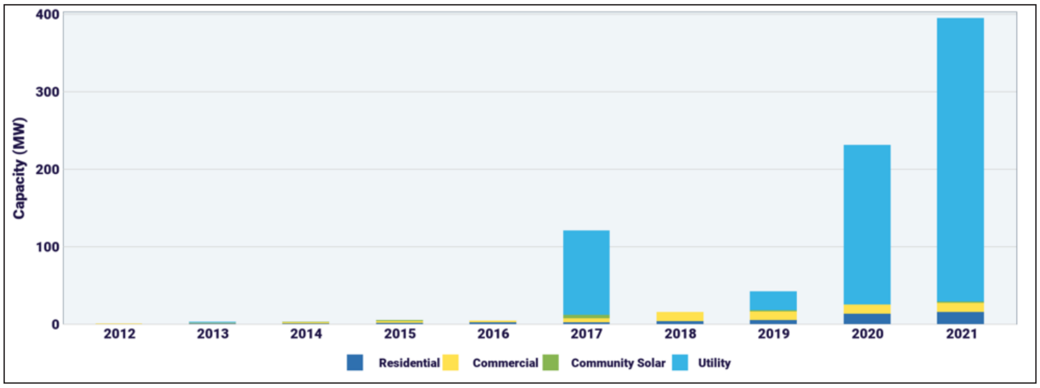
Source: Solar Energy Industries Association, Solar Spotlight: Wisconsin, September 2022

Wisconsin has great potential to expand its solar installations. Wisconsin has several utility-scale solar farms in operation: Badger Hollow Solar (150 MW) in Iowa County; Two Creeks Solar (150 MW) in Manitowoc County; Point Beach Solar (100 MW) in Manitowoc County; and O'Brien Solar (20 MW) in Dane County. The 200 MW Langdon Mills Solar Project will be one of the largest installations in Wisconsin to date.

There are more than 145 solar companies in Wisconsin including 40 manufacturers, 63 installers/developers, and 42 others.[1] Figure 4 shows the locations of solar companies in Wisconsin as of the time of this report. Currently, there are 2,942 solar jobs in the State of Wisconsin according to SEIA.

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

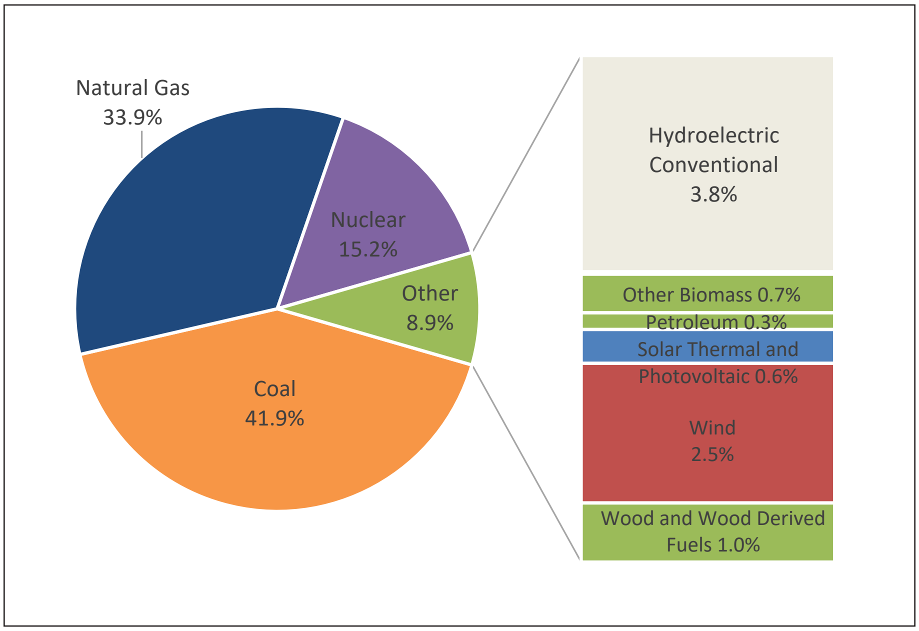
Figure 5 – Wisconsin Annual Solar Installations



Source: Solar Energy Industries Association, Solar Spotlight: Wisconsin, September 2022

Figure 5 shows the Wisconsin historical installed capacity by year according to the SEIA. Huge growth was seen in 2021 and is forecasted to continue to grow in 2022 and beyond. Over the next five years, solar in Wisconsin is projected to grow by 4,932 MW.

Figure 6 – Electric Generation by Fuel Type for Wisconsin

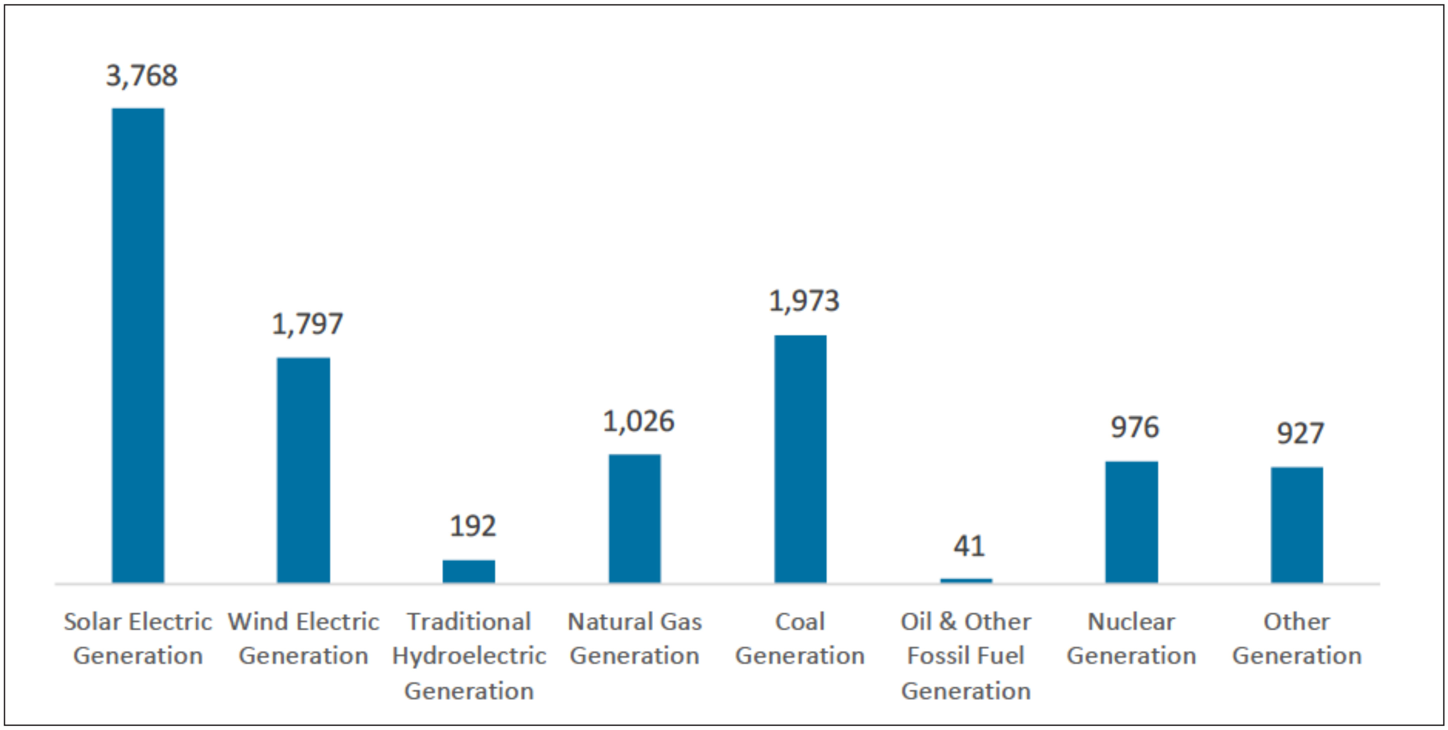


Source: U.S. Energy Information Association (EIA): Wisconsin, 2021

The Energy Information Administration (EIA) calculated the number of megawatts generated from different energy sources in 2021. As shown in Figure 6, the greatest percentage of electricity generated in Wisconsin comes from coal with 41.9% followed by natural gas with 33.9% and nuclear energy with 15.2%. Approximately 0.6% of the total electricity power generated in Wisconsin came from solar thermal and solar PV in 2021.

The U.S. Department of Energy (DOE) 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 DOE, and as shown in Figure 7, employment in the solar energy industry (3,768) is larger than coal generation (1,973) and wind electric generation (1,797).

Figure 7 – Electric Generation Employment by Technology



Source: US Energy and Employment Report 2021: Wisconsin

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.

Jo et. al. (2016) analyzes the financing options and economic impact of solar PV systems in Normal, IL and uses the JEDI model to determine the county and state economic impact. The study examines the effect of 100 residential retrofit fixed-mount crystalline-silicone systems having a nameplate capacity of 5kW. Eight JEDI models estimated the economic impacts using different input assumptions. They found that county employment impacts varied from 377 to 1,059 job-years during construction and 18.8 to 40.5 job-years during the operating years. Each job-year is a full-time equivalent job of 2,080 hours for a year.

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

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

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

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

III. Project Description and Location

a. Langdon Mills Solar Project

Samsung is developing the Langdon Mills Solar Project in Columbia County, Wisconsin. The Project consists of an estimated 200 MWac utility-scale solar powered-electric generation facility that will utilize PV panels installed on a single-axis tracking system. The Project represents an investment in excess of $448 million.

b. Columbia County, Wisconsin

Columbia County is located in the Southern part of Wisconsin (see Figure 8). It has a total area of 796 square miles and the U.S. Census estimates that the 2020 population was 58,490 with 24,336 housing units. The county has a population density of 76.4 (persons per square mile) compared to 108.8 for the State of Wisconsin. Median household income in the county was $69,262.

Figure 8 – Location of Columbia County, Wisconsin

i. Economic and Demographic Statistics

As shown in Table 1, the largest industry in the county is "Manufacturing" followed by "Administrative Government," "Health Care and Social Assistance" and "Retail Trade." These data for Table 1 come from IMPLAN covering the year 2020 (the latest year available).

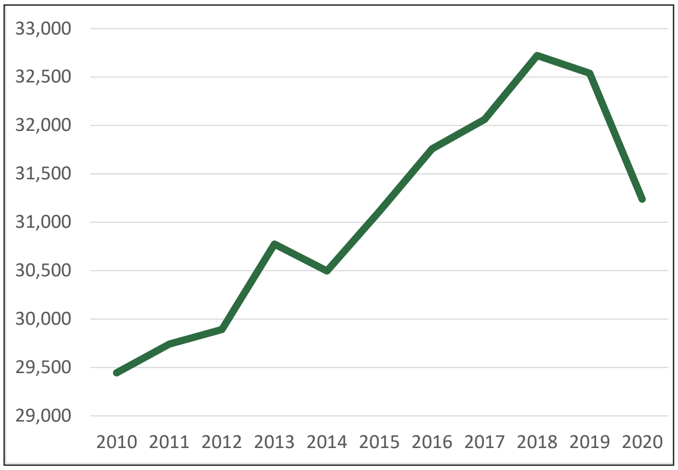
Table 1 provides the most recent snapshot of total employment but does not examine the historical trends within the county. Figure 9 shows employment from 2010 to 2020. Total employment in Columbia County was at its lowest at 29,445 in 2010 and its highest at 32,722 in 2018 (BEA, 2022).

Table 1 – Employment by Industry in Columbia County

Industry	Number	Percent
Manufacturing	6,346	19.6%
Administrative Government	3,423	10.6%
Health Care and Social Assistance	3,267	10.1%
Retail Trade	3,217	9.9%
Accommodation and Food Services	2,238	6.9%
Other Services (except Public Administration)	2,193	6.8%
Construction	1,956	6.0%
Agriculture, Forestry, Fishing and Hunting	1,887	5.8%
Wholesale Trade	1,244	3.8%
Real Estate and Rental and Leasing	1,222	3.8%
Transportation and Warehousing	1,049	3.2%
Administrative and Support and Waste Management and Remediation Services	1,036	3.2%
Finance and Insurance	1,016	3.1%
Professional, Scientific, and Technical Services	987	3.0%
Arts, Entertainment, and Recreation	509	1.6%
Utilities	226	0.7%
Government Enterprises	188	0.6%
Information	137	0.4%
Management of Companies and Enterprises	86	0.3%
Mining, Quarrying, and Oil and Gas Extraction	86	0.3%
Educational Services	38	0.1%

Source: Impact Analysis for Planning (IMPLAN), County Employment by Industry, 2020

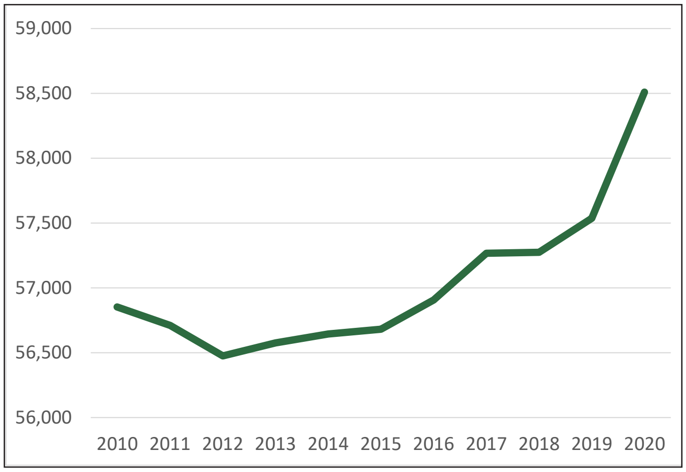
Figure 9 – Total Employment in Columbia County from 2010 to 2020



Source: Bureau of Economic Analysis, Regional Data, GDP and Personal Income, 2010-2020

Similar to the upward trend of employment, the overall population in the county has been increasing steadily, as shown in Figure 10. Columbia County population was 56,854 in 2010 and 58,510 in 2020, a gain of 1,656 (FRED, 2022). The average annual population increase over this time period was 166.

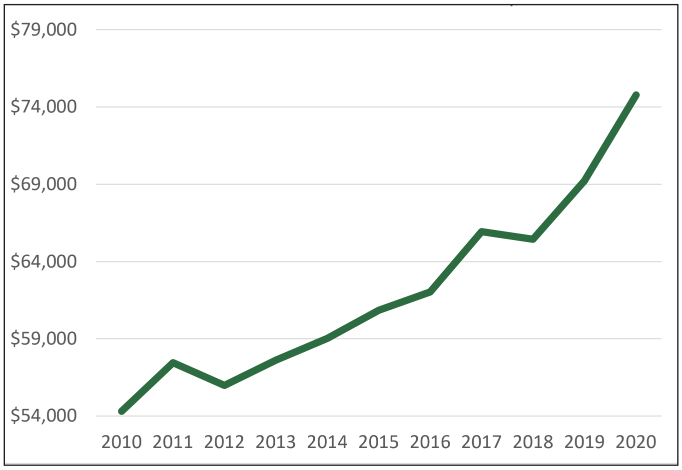
Figure 10 – Population in Columbia County from 2010 to 2020



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census Bureau, Population Estimates, 2010-2020

Like the population trend, household income has been trending upward in Columbia County. Figure 11 shows the median household income in Columbia County from 2010 to 2020. Household income was at its lowest at $54,304 in 2010 and its highest at $74,776 in 2020 (FRED, 2022).

Figure 11 – Median Household Income in Columbia County from 2010 to 2020

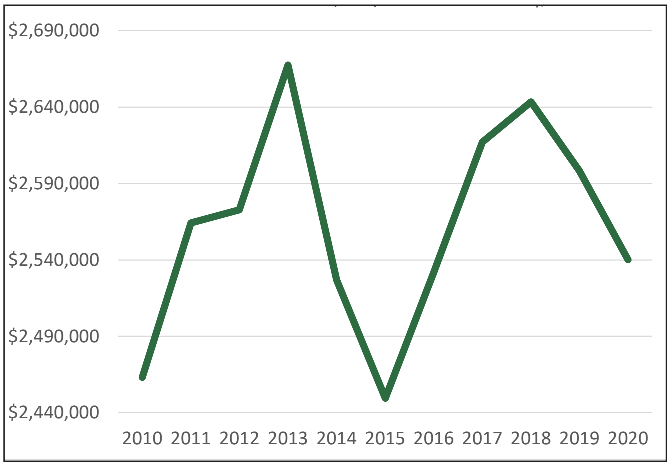


Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census Bureau, Estimate of Median Household Income, 2010-2020

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 Columbia County has fluctuated since 2010, as shown in Figure 12 (BEA, 2022).

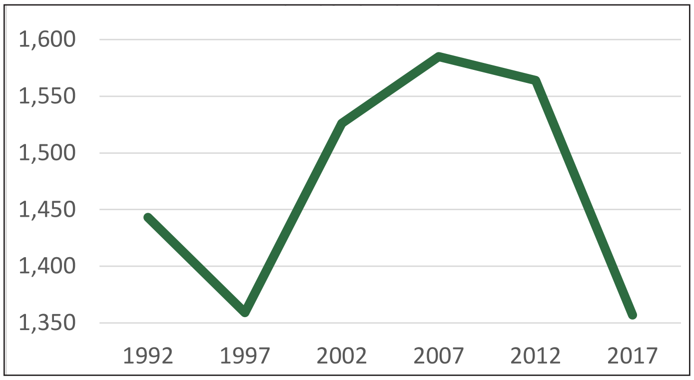
The farming industry has fluctuated in Columbia County. As shown in Figure 13, the number of farms hit a high of 1,585 in 2007 and a low of 1,357 in 2017. The amount of land in farms has decreased greatly. The county farmland hit a high of 348,369 acres in 2002 and a low of 304,058 acres in 2017 according to Figure 14.

Figure 12 – Real Gross Domestic Product (GDP) in Columbia County from 2010 to 2020



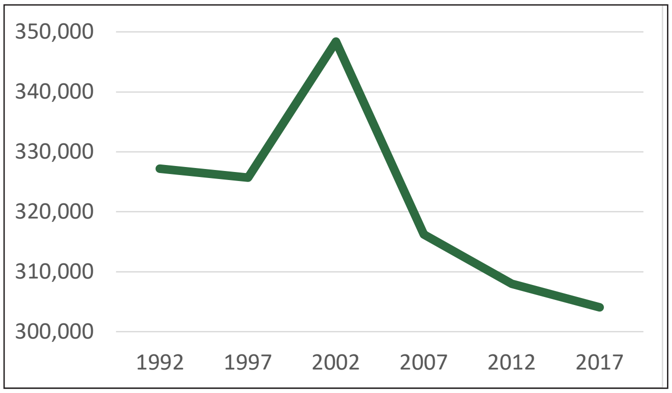
Source: Bureau of Economic Analysis, Regional Data, GDP and Personal Income, 2010-2020

Figure 13 – Number of Farms in Columbia County from 1992 to 2017



Source: Census of Agriculture, 1992-2017

Figure 14 – Land in Farms in Columbia County from 1992 to 2017



Source: Census of Agriculture, 1992-2017

ii. Agricultural Statistics

Wisconsin is ranked ninth among U. S. states in total value of agricultural products sold (Census, 2017). It is ranked eighth in the value of livestock, and sixteenth in the value of crops (Census, 2017). In 2021, Wisconsin had 64,100 thousand farms and 14.2 million acres in operation with the average farm being 222 acres (State Agricultural Overview, 2021). Wisconsin had 1.27 million cattle and produced 31.7 billion pounds of milk (State Agricultural Overview, 2021). In 2021, Wisconsin yields averaged 180 bushels per acre for corn with a total market value of $2.84 billion (State Agricultural Overview, 2021). Hay yields averaged 3.47 tons per acre with a total market value of $1.3 billion (State Agricultural Overview, 2021). The average net cash farm income per farm is $36,842 (Census, 2017).

In 2017, Columbia County had 1,357 farms covering 304,058 acres for an average farm size of 224 acres (Census, 2017). The total market value of products sold was $222 million, with 49 percent coming from livestock sales and 51 percent coming from crop sales (Census, 2017). The average net cash farm income of operations was $37,413 (Census, 2017).

The approximately 2,311 acres planned to be used by the Langdon Mills Solar Project represents just 0.7% of the acres used for farming in Columbia County. As we will show in the next section, solar farming is a better land use on a purely economic basis than livestock or crops for the particular land in this Project.

IV. Land Use Methodology

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

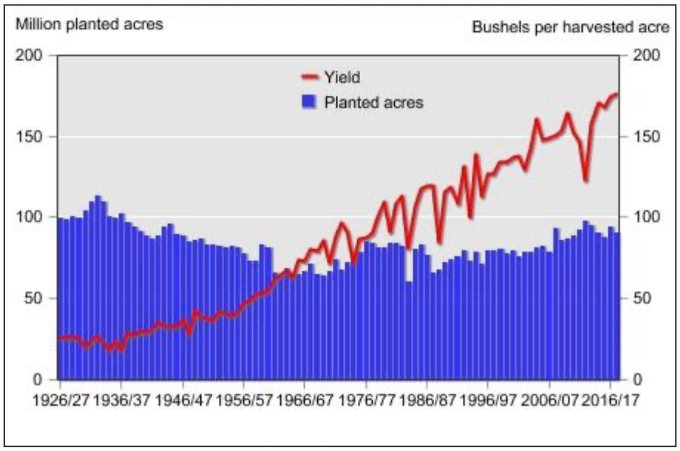
For the landowner, the key analysis will be comparing the net present value of the annual solar lease payments to expected profits from farming. The farmer will choose the solar farm lease if:

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

Where NPV is the net present value; Solar Lease Payment_t is the lease payment the owner receives in year t; P_t is the price that the farmer receives for the crop (corn or soybeans) in year t; Yield_t is the yield based on the number of acres and historical average of county-specific productivity in year t; Cost_t is the total cost of farming in year t and will include the cost of seed, fertilizer, the opportunity cost of the farmer's time. Farming profit is the difference between revenue (price times yield) and cost. The model will use historical agricultural data from the county (or state when the county data is not available).

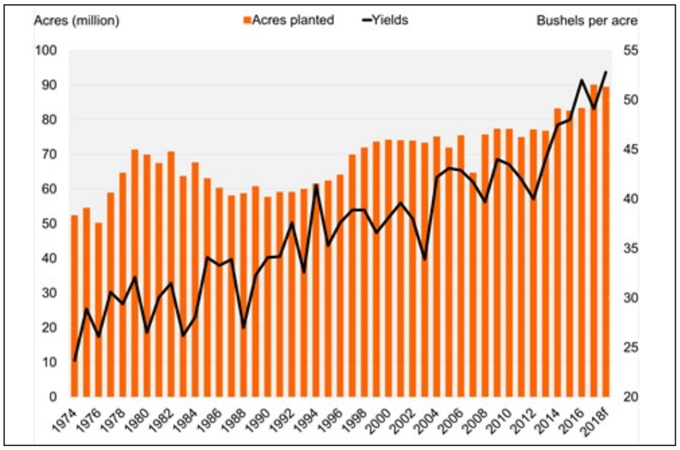
Figure 15 shows the dramatic increase in U.S. corn yields since 1926. Soybean yields have also increased though not as dramatically. Figure 16 displays the soybean yields in the U.S. since 1980.

Figure 15 – U.S. Corn Acreage and Yield



Source: USDA, Economic Research Service, https://www.ers.usda.gov/topics/crops/soybeans-oil-crops/oil-crops-sector-at-a-glance/

Figure 16 – U.S. Soybean Acreage and Yield



Source: USDA National Agricultural Statistics Service, Crop Production, November, 2018

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 Columbia 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 Columbia County, Wisconsin

	1992	1997	2002	2007	2012	2017
Total Farm Income Per Farm	NA	NA	$5,596	$8,851	$14,988	$11,415
Total Farm Production Expenses (average/farm)	$60,139	$64,844	$63,173	$84,561	$114,843	$134,828
Average Farm Size (acres)	227	240	228	199	197	224
Net Cash Income per Farm[2]	$12,422	$10,312	$13,410	$29,100	$34,490	$37,413
Average Market Value of Machinery Per Farm	$72,011	$70,787	$80,777	$101,916	$129,485	$158,741

Source: United States Department of Agriculture's National Agricultural Statistics Service (NASS), Census of Agriculture

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 farmer's 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.

[2] 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 Columbia County, Wisconsin

	1992	1997	2002	2007	2012	2017
Average Market Value Machinery Per Farm	$72,011	$70,787	$80,777	$101,916	$129,485	$158,741
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$2,400	$2,360	$2,693	$3,397	$4,316	$5,291
Mean Hourly Wage in WI for Farming (Bureau of Labor Statistics)	$6.14	$6.98	$8.79	$9.65	$10.81	$12.55
Annual Opportunity Cost of Farmer's Time (Wage times 16 weeks times 40 Hours/Week)	$3,930	$4,467	$5,626	$6,176	$6,918	$8,032

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

Table 4 – Profit Per Farm Calculations for Columbia County, Wisconsin

	1992	1997	2002	2007	2012	2017
Net Cash Income per Farm	$12,422	$10,312	$13,410	$29,100	$34,490	$37,413
Machinery Depreciation	($2,400)	($2,360)	($2,693)	($3,397)	($4,316)	($5,291)
Opportunity Cost of Farmer's Time	($3,930)	($4,467)	($5,626)	($6,176)	($6,918)	($8,032)
Profit	$6,092	$3,485	$5,092	$19,527	$23,255	$24,090
Average Farm Size (Acres)	227	240	228	199	197	224
Profit Per Acre	$26.84	$14.52	$22.33	$98.12	$118.05	$107.54
CPI	141.9	161.3	180.9	210.036	229.601	246.524
Profit Per Acre in 2017 Dollars	$46.62	$22.19	$30.43	$115.17	$126.75	$107.54

[3] 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 $107.54 which adjusts to $129.20 after counting for inflation in Columbia 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.

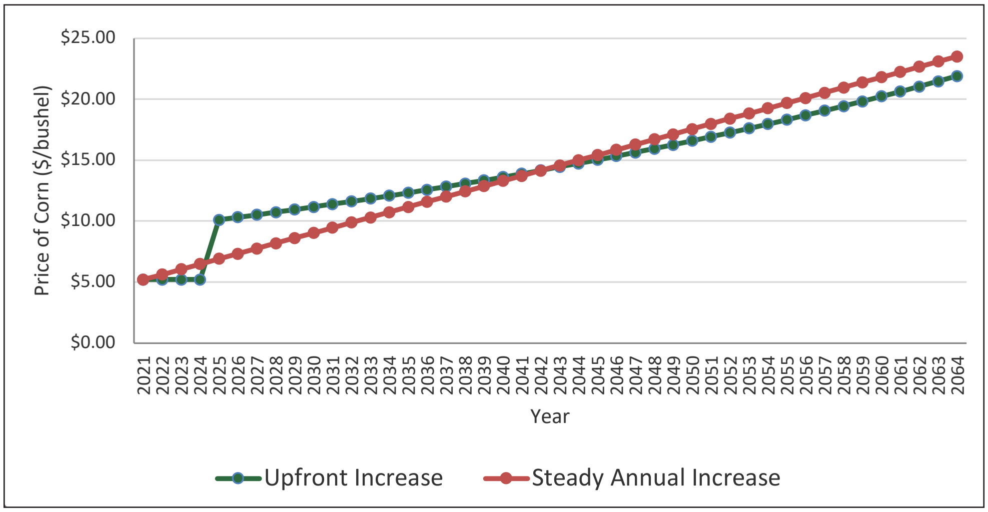
Using the Census of Agriculture data from 1992 to the present, the intercept is $20.55 with a standard error of $23.75. The time trend is $4.02 with a standard error of 1.49. This means that agriculture profits are expected to rise by $4.02. Both the intercept and the coefficient on the time trend have 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 2064, we assume that the profit per acre for farming follows the equation above but allows for the random fluctuations. Because of this randomness, we can simulate multiple futures using Monte Carlo simulation. We assume that the solar farm will begin operation in 2025 and operate through 2064. Using 500 different simulations, the real profit per acre never exceeds $967 in any single year. Overall, the maximum average annual profit over the 40 years is $348 and the minimum average annual profit is $232. Figure 17 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 2064 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 17 – Simulations of Real Profits Per Acre Based on Data from 1992

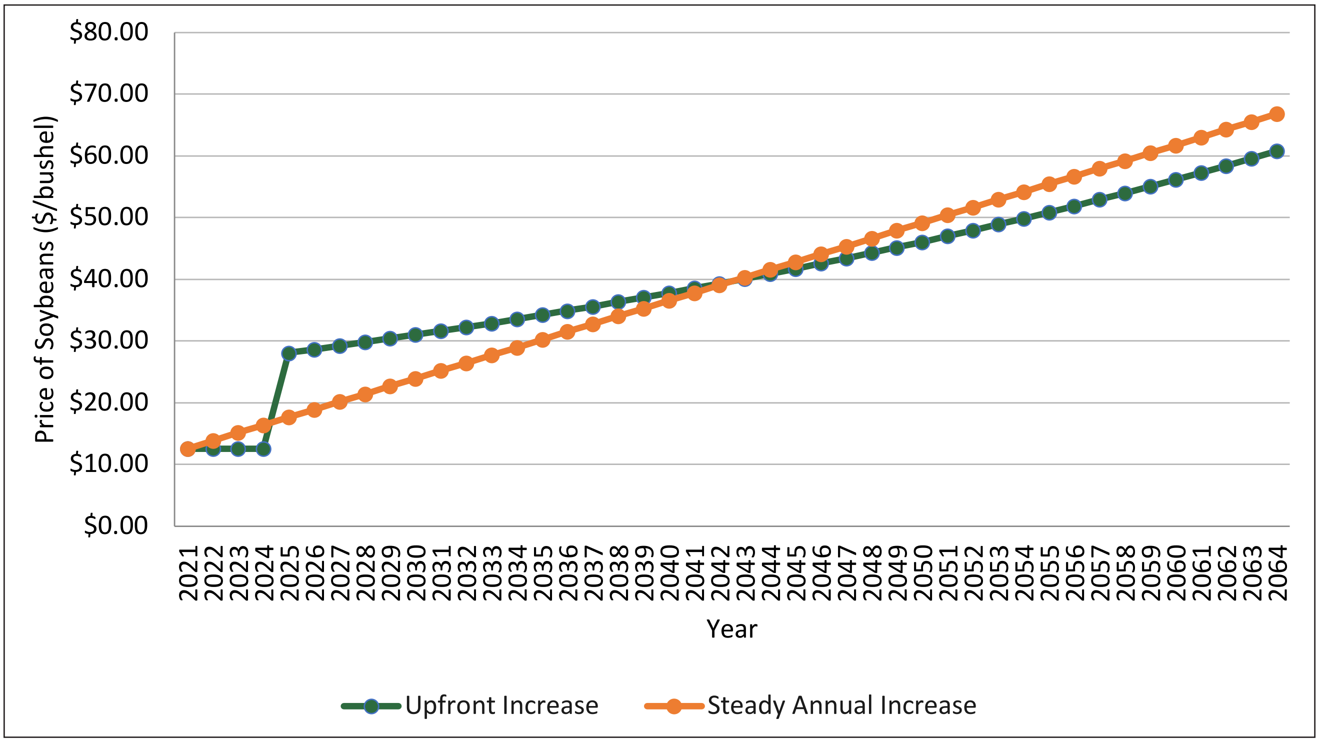
Another way to look at this problem would be to ask: How high would the price of corn have to rise to make farming more profitable than the solar lease? Below we assume that the yields on the land and all other input costs stay the same. In this case, the price of corn would have to rise from $5.20 per bushel in 2021 to $10.12 in 2025 and rise to $21.90 per bushel by 2064 as shown in Figure 18. Alternatively, the price of corn would need to rise by $0.43 per bushel each year from 2021 to 2064 when it would reach $23.52 per bushel.

Figure 18 – Simulated Price of Corn Per Bushel to Match the Solar Lease



Now let's turn our attention to soybeans. If we assume the yields and input costs stay the same, the price of soybeans would have to rise from $12.60 per bushel in 2021 to $28.08 per bushel in 2025 and rise to $60.78 by 2064 as shown in Figure 19. For a linear increase, the price of soybeans would need to rise by $1.26 per bushel each year from 2021 to 2064 when it would reach $66.77 per bushel.

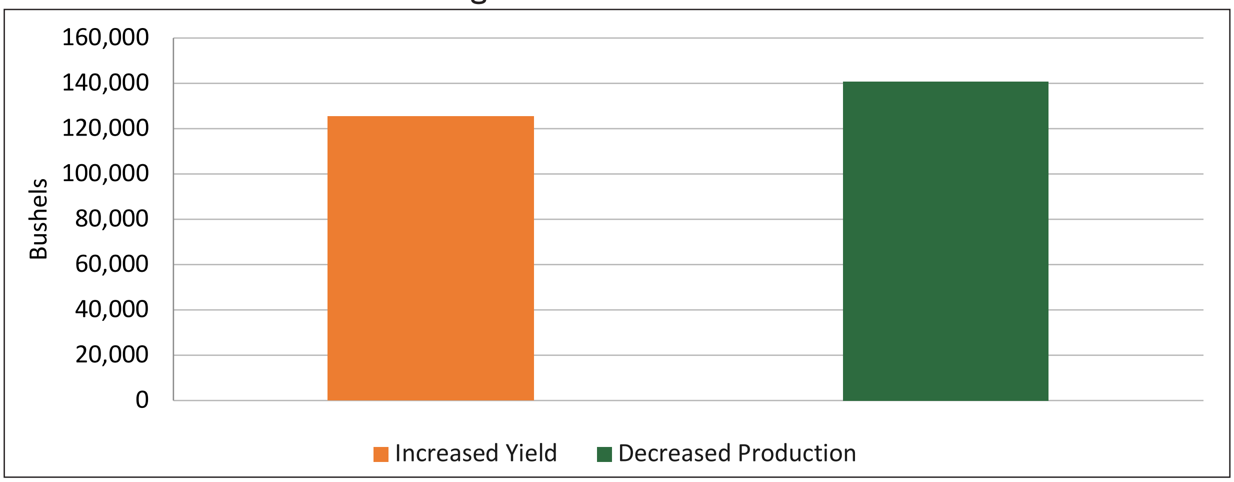
Figure 19 – Simulated Price of Soybeans Per Bushel to Match the Solar Lease



If we assume that the price of corn stays the same, the yields for corn would need to increase from 191.7 bushels per acre in 2021 to 372.9 bushels per acre in 2025 and stay at that level until 2064. The yields for soybeans would need to rise from 60.9 bushels per acre in 2021 to 135.7 bushels per acre in 2025 and stay there until 2064.

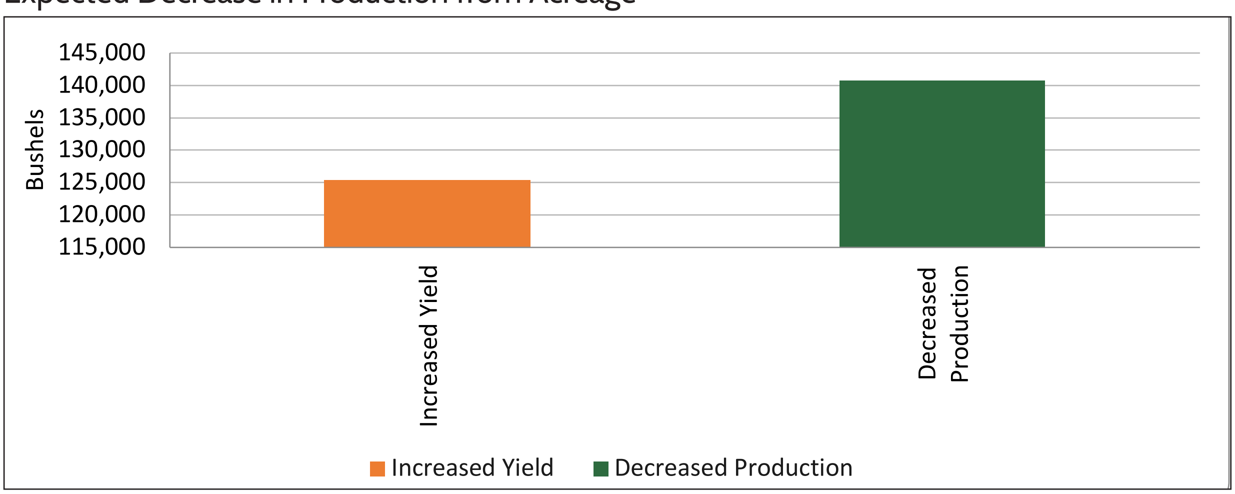
Likewise, over the past 20 years, corn yields have increased by 2.11 bushels per year. If 2,311 acres are taken out of production of the county's 304,058, the remaining 301,747 acres would be expected to produce 635,615 bushels more annually just by being more productive on-trend. At 181.2 bushels per year (2021 State Agriculture Overview yield), the 2,311 acres would reduce production by 443,019 bushels. Thus, the increased yields would take just 0.65 years to make up for the acreage taken out of production from the solar project.

Figure 20 – Expected Annual Increase in Production Due to Higher Yields from Corn Versus Expected Decrease in Production from Acreage



Statewide, over the past 20 years, soybean yields have increased by 0.42 bushels per year. If 2,311 acres are taken out of production of the county's 304,058, the remaining 301,747 acres would be expected to produce 125,394 bushels more annually just by being more productive on-trend. At 50.3 bushels per year (2021 State Agriculture Overview yield), the 2,311 acres would reduce production by 140,740 bushels. Thus, the increased yields would take just 0.92 years to make up for the acreage taken out of production from the solar project.

Figure 21 – Expected Annual Increase in Production Due to Higher Yields from Soybeans Versus Expected Decrease in Production from Acreage



VI. Economic Impact Methodology

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

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

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

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

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

VII. Economic Impact Results

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

Two separate JEDI models were produced to show the economic impact of the Langdon Mills Solar Project. The first JEDI model used the 2020 Columbia County multipliers from IMPLAN. The second JEDI model used the 2020 IMPLAN multipliers for the State of Wisconsin and the same project costs. Because all new multipliers from IMPLAN and specific project cost data from Langdon Mills Solar Project are used, the JEDI model serves only to translate the project costs into IMPLAN sectors.

Tables 5 through 7 show the output from these models. Table 5 lists the total employment impact from Langdon Mills Solar Project for Columbia County and the State of Wisconsin. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

Table 5 – Total Employment Impact from Langdon Mills Solar Project

	Columbia County Jobs	State of Wisconsin Jobs
Construction		
Project Development and Onsite Labor Impacts (direct)	108	140
Module and Supply Chain Impacts (indirect)	28	44
Induced Impacts	10	37
New Local Jobs during Construction	146	221
Operations		
Onsite Labor Impacts (direct)	0.8	0.8
Local Revenue and Supply Chain Impacts (indirect)	11.0	11.8
Induced Impacts	2.7	7.5
New Local Long-Term Jobs	14.5	20.1

The results from the JEDI model show significant employment impacts from the Langdon Mills Solar Project. Employment impacts can be broken down into several different components. Direct jobs created during the construction phase typically last anywhere from 12 to 18 months depending on the size of the project; however, the direct job numbers present in Table 5 from the JEDI model are based on a full time equivalent (FTE) basis for a year. In other words, 1 job = 1 FTE = 2,080 hours worked in a year. A part time or temporary job would constitute only a fraction of a job according to the JEDI model. For example, the JEDI model results show 108 new direct jobs during construction in Columbia County, though the construction of the solar center could involve closer to 216 workers working half-time for a year. Thus, due to the short-term nature of construction projects, the JEDI model often significantly understates the number of people actually 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 146 for Columbia County and 221 for the State of Wisconsin. New local long-term jobs created from Langdon Mills Solar Project total 14.5 for Columbia County and 20.1 for the State of Wisconsin.

Direct jobs created during the operational phase last the life of the solar PV project, typically 20-30 years. Direct construction jobs and operations and maintenance jobs both require highly-skilled workers in the fields of construction, management, and engineering. These well-paid professionals boost economic development in rural communities where new employment opportunities are often welcome due to economic downturns. 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 Langdon Mills Solar Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction total over $12.7 million for Columbia County and over $19.1 million for the State of Wisconsin. The new local long-term earnings totals over $579 thousand for Columbia County and over $1.1 million for the State of Wisconsin.

Table 6 – Total Earnings Impact from Langdon Mills Solar Project

	Columbia County	State of Wisconsin
Construction		
Project Development and Onsite Earnings Impacts	$11,018,318	$14,618,397
Module and Supply Chain Impacts	$1,239,481	$2,497,303
Induced Impacts	$445,857	$2,007,724
New Local Earnings during Construction	$12,703,656	$19,123,424
Operations (Annual)		
Onsite Labor Impacts	$38,185	$76,176
Local Revenue and Supply Chain Impacts	$425,034	$650,840
Induced Impacts	$116,554	$403,357
New Local Long-Term Earnings	$579,773	$1,130,373

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 $16.4 million for Columbia County and over $28.0 million for the State of Wisconsin. The new local long-term output totals over $2.3 million for Columbia County and over $3.6 million for the State of Wisconsin.

Table 7 – Total Output Impact from Langdon Mills Solar Project

	Columbia County	**State of Wisconsin**
Construction		
Project Development and Onsite Jobs Impacts on Output	$11,311,749	$14,885,605
Module and Supply Chain Impacts	$3,641,619	$7,265,583
Induced Impacts	$1,448,399	$5,891,886
New Local Output during Construction	$16,401,767	$28,043,074
Operations (Annual)		
Onsite Labor Impacts	$38,185	$76,176
Local Revenue and Supply Chain Impacts	$1,923,877	$2,418,362
Induced Impacts	$374,381	$1,177,948
New Local Long-Term Output	$2,336,443	$3,672,486

VIII. Tax Revenue

Utility-scale solar PV projects, like other utility-scale energy generating facilities in Wisconsin, are exempt from property taxes. However, the county and township in which the projects are located will receive increased revenue through the shared revenue utility aid fund. This funding creates a new revenue source for county and township government services and is intended to reimburse the communities for the lost property tax revenue due to the tax exemption. Additionally, other sources of revenue may be available from the State of Wisconsin.

Table 8 details the shared revenue utility aid tax implications of Langdon Mills Solar. There are two important assumptions built into the analysis in this table. First, the analysis assumes that the Project has a capacity of 200 MW for taxing purposes. Second, the projections use the MW based payment and incentive payment formulas in the "Wisconsin Shared Revenue Utility Aid Summary" developed by the Wisconsin Department of Revenue.

The host townships will split approximately $333,400 annually and Columbia County will receive approximately $466,700 annually.

Table 8 – Illustration of "Utility Aid" Paid

	Total	Townships	County
MW based Payment	$400,000	$133,400	$266,700
Incentive Payment	$400,000	$200,000	$200,000
Total	$800,000	$333,400	$466,700

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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

1996-present Illinois State University, Normal, IL
Full Professor – Department of Economics (2010-present)
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-present Institute for Regulatory Policy Studies, Normal, IL
Executive Director (2005-present)
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.

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.

- Published 38 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 57 times in formal proceedings regarding wind, solar and transmission projects
- Raised over $7.7 million in grants
- Raised over $2.7 million in external funding

Bryan A. Loomis
Strategic Economic Research, LLC
Vice President

Education

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

Experience

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

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

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

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

Christopher Thankan
Strategic Economic Research, LLC
Economic Analyst

Education

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

Experience

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

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

Strategic Economic Research, LLC

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