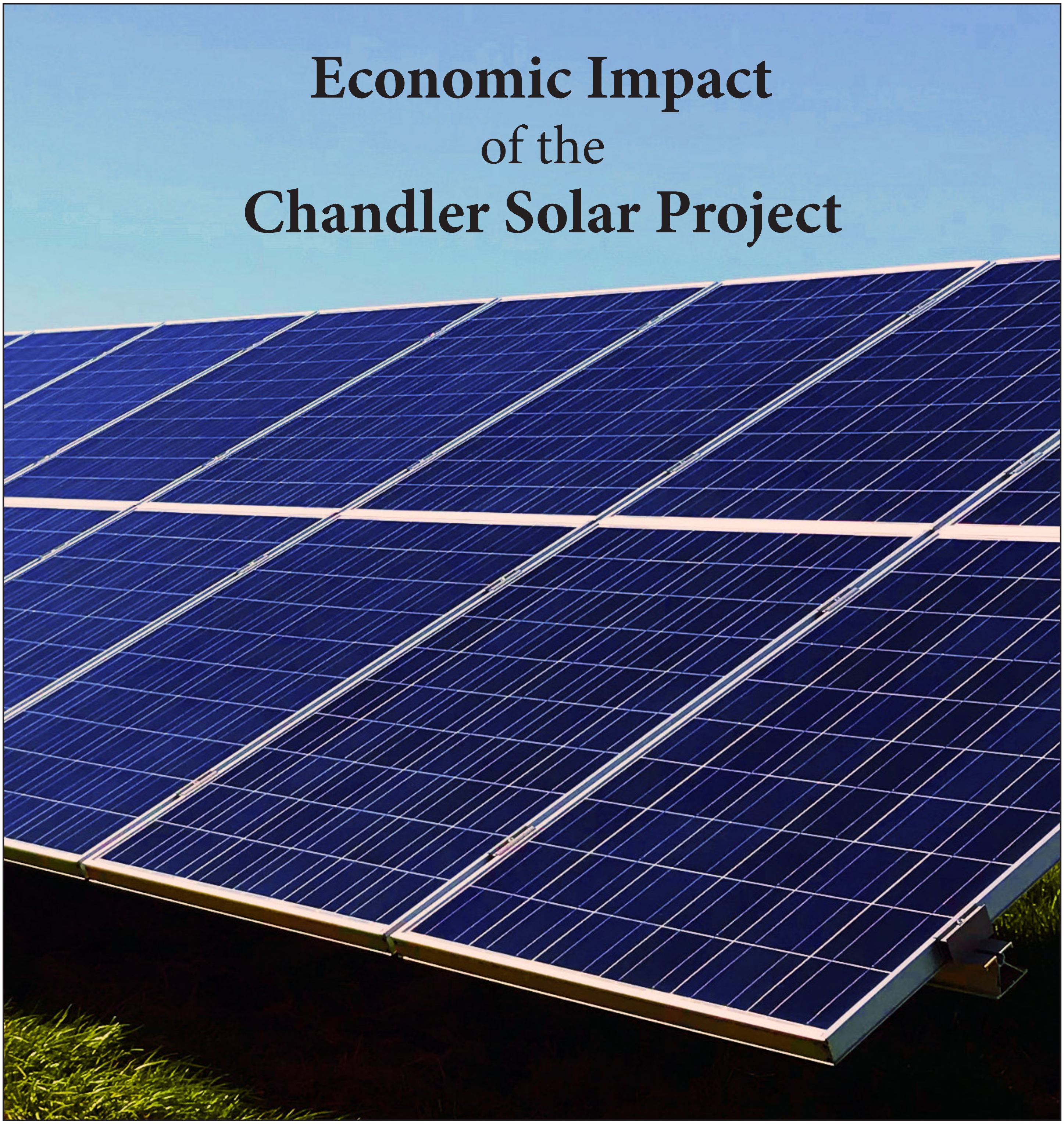
Economic Impact
of the
Chandler Solar Project



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About the Author

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I. Executive Summary

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

The Chandler Solar Project is a 125 MWac solar project using the next generation of single-axis tracking panels. The Project represents an investment in excess of $140 million. The total development is anticipated to result in the following:

<u>Jobs</u>

- 107 new local jobs during construction for Escanaba Township
- 263 new local jobs during construction for the State of Michigan
- 7.5 new local long-term jobs for Escanaba Township
- 18.1 new local long-term jobs for the State of Michigan

<u>Earnings</u>

- Over $7.3 million in new local earnings during construction for Escanaba Township
- Over $21 million in new local earnings during construction for the State of Michigan
- Over $282 thousand in new local long-term earnings for Escanaba Township annually
- Over $1.0 million in new local long-term earnings for the State of Michigan annually

<u>Output</u>

- Over $10.5 million in new local output during construction for Escanaba Township
- Over $32.9 million in new local output during construction for the State of Michigan
- Over $936 thousand in new local long-term output for Escanaba Township annually
- Over $2.7 million in new local long-term output for the State of Michigan annually

Property Taxes

- Over $217 thousand in total state education revenue over the life of the Project
- Over $469 thousand in total township property taxes over the life of the Project
- Over $2.9 million in total county property taxes for Delta County over the life of the Project
- Over $13.4 million in property taxes in total for all taxing districts over the life of the 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

- The price of corn would need to rise to $13.57 per bushel or yields for corn would need to rise to 314.3 bushels per acre by the year 2051 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 $37.35 per bushel or yields for soybeans would need to rise to 118.3 bushels per acre by the year 2051 for soybean farming to generate more income for the landowner and local community than the solar lease.
- At this time of this report, corn and soybean prices are $3.72 and $8.53 per bushel respectively and yields are 153 and 48 bushels per acre respectively.

II. Solar PV Industry Growth and Economic Development

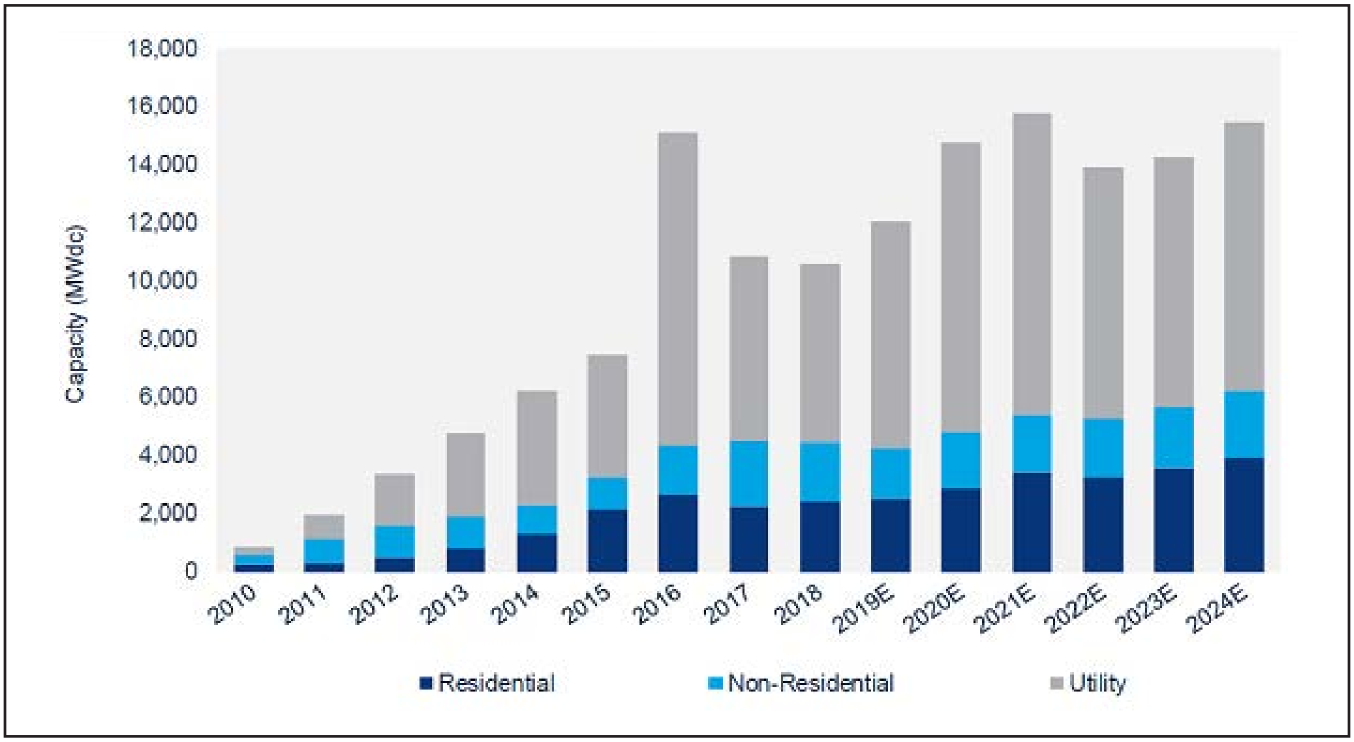
a. U.S. Solar PV Industry Growth

The U.S. solar industry is growing at a rapid but uneven pace. From 2013 to 2016, the amount of electricity generated from solar had more than doubled, increasing from 0.305 quadrillion Btu in 2013 to 0.624 quadrillion Btu in 2016 (EIA, 2018). The industry has continued to add increasing numbers of photovoltaic ("PV") systems to the grid. In 2016, the U.S. installed 15,128 megawatts DC ("MWdc") of solar PV driven mostly by utility-scale PV. In 2017 and 2018, the U.S. installed approximately 10,000 MWdc of solar PV each year, a 30% decrease from 2016.[1] Yet, as Figure 1 clearly shows, the capacity additions in 2017 and 2018 still outpaced any previous year except the record-breaking 2016. In addition, the forecast for 2019-2024 shows annual installations between 11,000 and 15,000 MWdc. The primary driver of this overall sharp pace of growth is large price declines. As seen in Figure 2, the price of solar PV has declined from about $7.50/watt DC in 2009 to almost $2.00/watt DC in 2015. Solar PV also benefits from the Federal Investment Tax Credit (ITC) which provides a 30% tax credit for residential and commercial properties. However, various federal tax reform measures and tariffs on imported solar panels by the Trump Administration may lessen the price declines in 2019 and beyond.

Utility-scale PV leads the installation growth in the U.S. A total of 6.2 gigawatts DC ("GWdc") of utility-scale PV projects were completed in both 2017 and 2018, accounting for 58-59% of the total installed capacity in those years. An additional 2.5 GWdc are under construction and expected to come on-line in 2019. As seen in Figure 3, there are 34,339 MWdc of utility-scale PV solar operating in the U.S. with an additional 23,872 MWdc contracted, and another 42,357 MWdc announced.

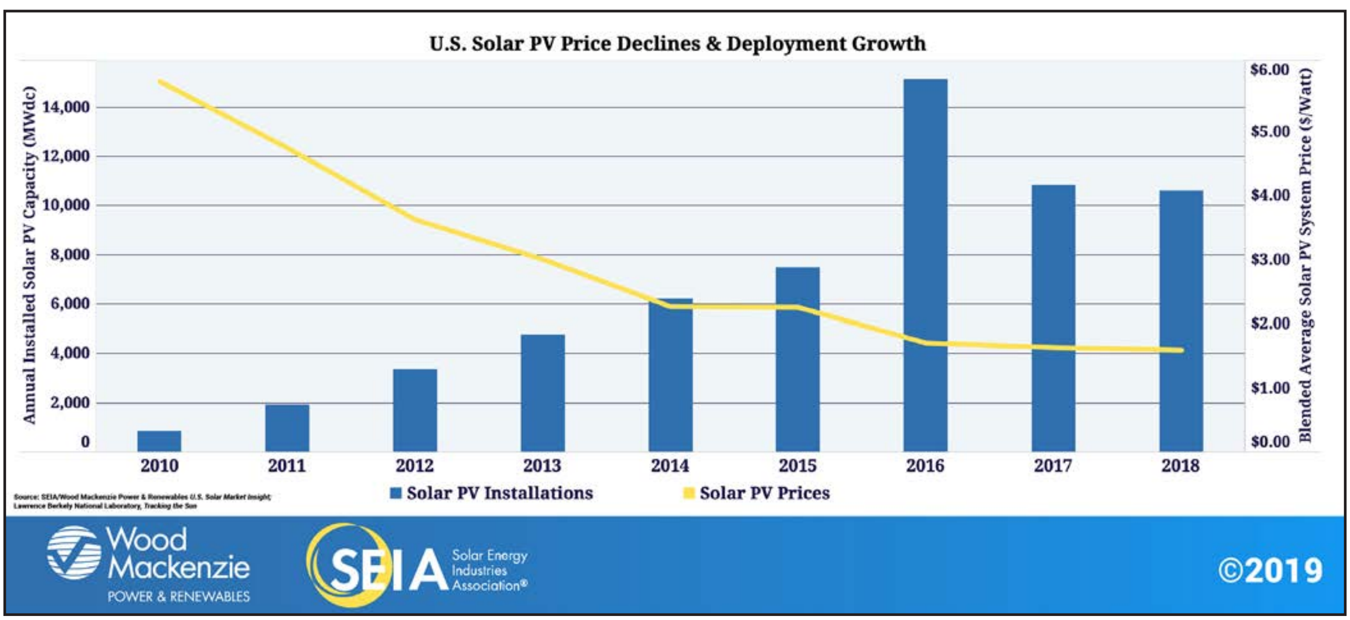
[1] Solar modules generate direct current (DC) electricity, which must be inverted to alternating current (AC) to connect to the grid. Projects typically have a DC/AC ratio of about 1.3. For example, the Chandler Solar Project is 162.5 MW DC but only 125 MW AC. The report uses DC measurement in this section because the trade organization, Solar Energy Industries Association, reports their statistics in this fashion. Elsewhere in the report, we will use AC measurement.

Figure 1.—U.S. Annual Solar PV Installations, 2010-2024E



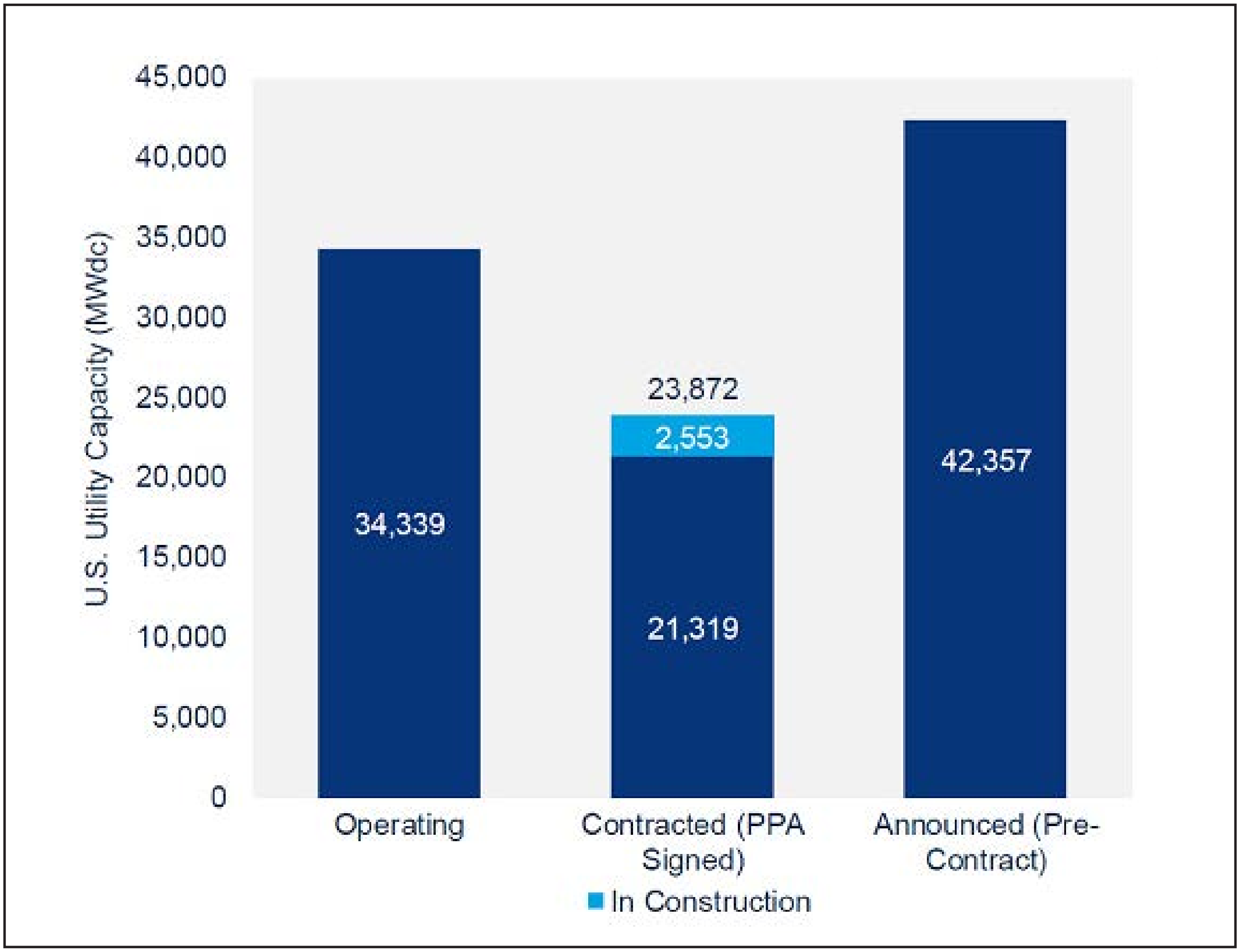
Source: Solar Energy Industries Association, Solar Market Insight Report 2018

Figure 2.—U.S. Annual Solar PV Installations and Prices



Source: Solar Energy Industries Association, Solar Market Insight Report 2018

Figure 3.—U.S. Utility PV Pipeline



Source: Solar Energy Industries Association, Solar Market Insight Report 2018

b. Michigan Solar PV Industry

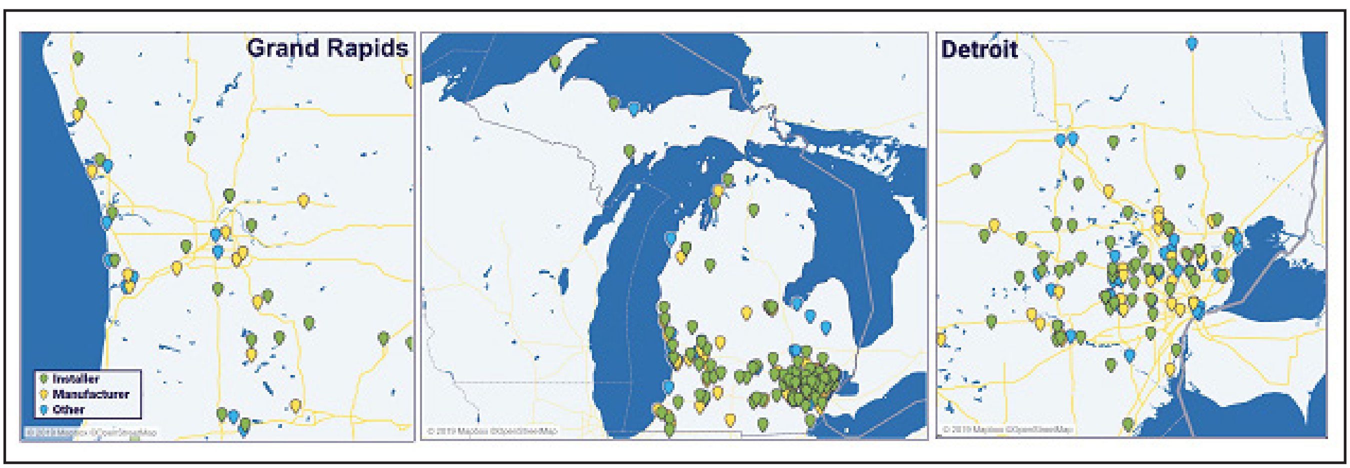
According to SEIA, Michigan is ranked 32nd among the states in cumulative installations of solar PV. California, North Carolina, and Arizona are the top 3 states for solar PV which may not be surprising because of the high solar radiation that they receive. However, other states with similar or lower solar potential rank highly including New Jersey (6th), Massachusetts (7th), New York (10th), and Maryland (14th). In 2018, Michigan installed 41 MW of solar electric capacity bringing its cumulative capacity to 176 MW.

There are more than 288 solar companies in Michigan including 90 manufacturers, 122 installers/developers and 76 others.[2] Figure 4 is a map showing the locations of solar companies in Michigan. Currently, there are 4,196 solar jobs in the State of Michigan according to SEIA.

Michigan has several sizeable solar projects. Demille Solar Farm is a 28.4 MW installation and Turrill Solar Farm in Lapeer is a 19 MW installation. Both were developed by DTE Electric Company. In addition, IKEA has a 1.22 MW project in Canton.

Figure 5 shows the Michigan historical installed capacity by year according to the SEIA. 2017 saw the most utility-scale capacity additions in Michigan's history. The Chandler Solar Project would be the largest single project in Michigan with its 125 MW size.

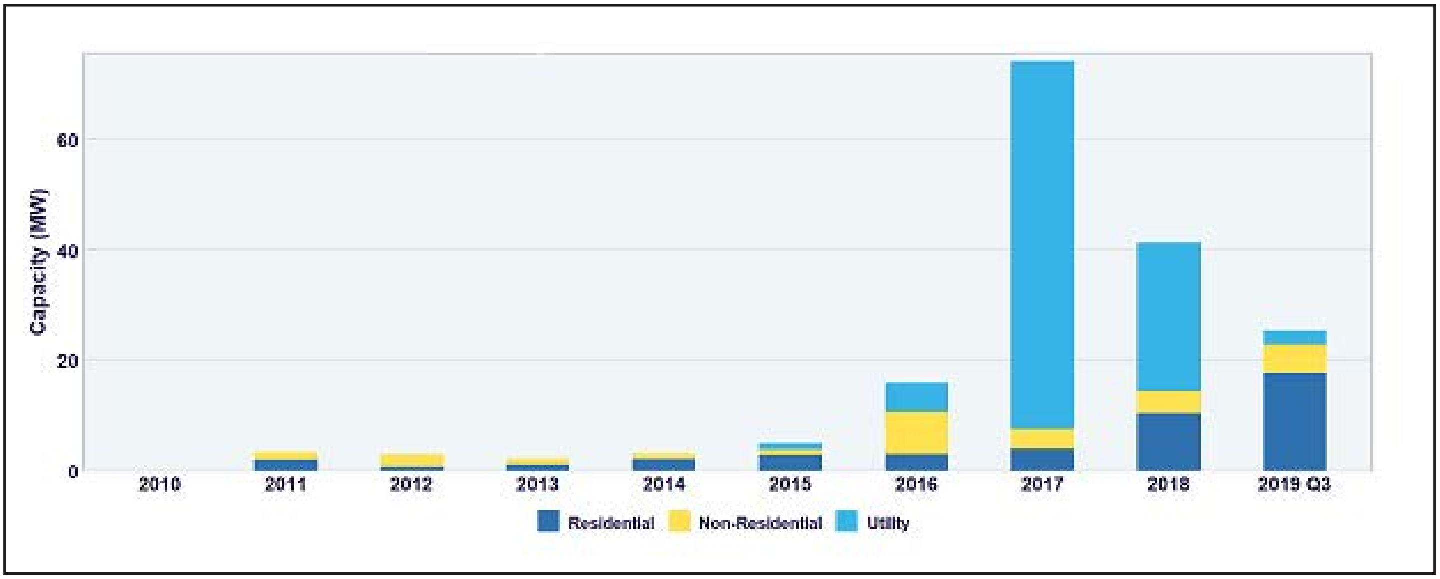
Figure 4.—Solar Companies in Michigan



Solar Energy Industries Association, State Solar Spotlight: Michigan, 2019

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

Figure 5.—Michigan Annual Solar Installations



Solar Energy Industries Association, State Solar Spotlight: Michigan, 2019

c. Economic Benefits of Utility-Scale Solar PV Energy

Utility-scale solar energy projects have numerous economic benefits. Solar installations create job opportunities in the local area during both the short-term construction phase and the long-term operational phase. Solar projects strengthen the local tax base helping to improve local services, schools, police and fire departments and infrastructure improvements, such as public roads.

Numerous studies have quantified the economic benefits of Solar PV projects across the United States in peer-reviewed academic journals using the same methodology used in this report. Some of the studies examine smaller-scale solar systems and some studies utility-scale solar energy. Croucher (2012) uses JEDI modeling methodology to find which state will receive the greatest economic impact from installing one hundred 2.5 kW systems which are smaller residential systems. He shows that Pennsylvania ranked first supporting 28.98 jobs during installation and 0.20 jobs during operations. Michigan ranked twenty-first supporting 26.02 jobs during construction and 0.03 jobs during operations.

Jo (2016) analyzes the financing options and economic impact of solar photovoltaic 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.

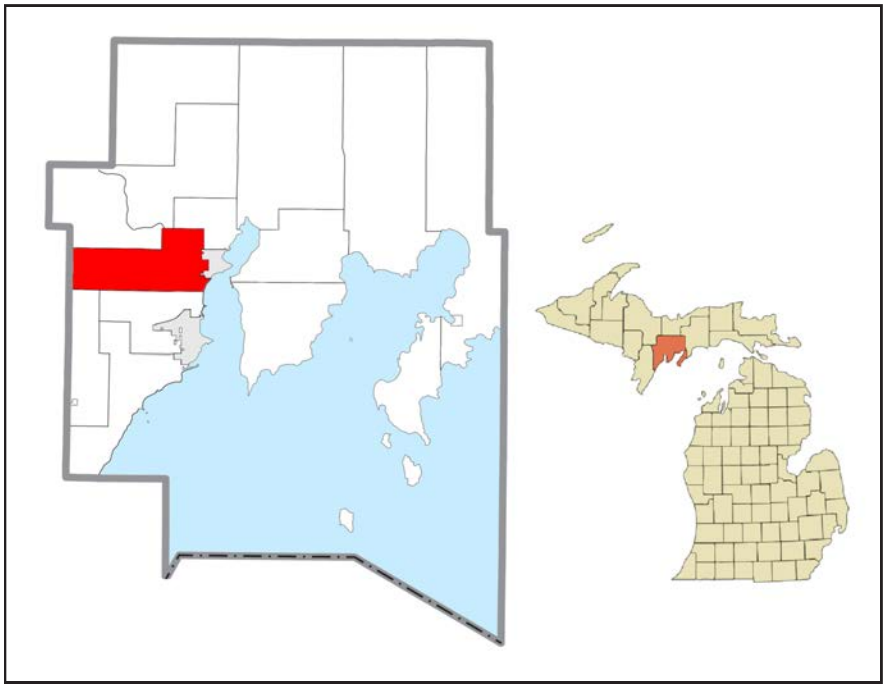
Loomis (2016) estimates the economic impact for the State of Illinois if the state were to reach its maximum potential for solar PV. They estimate the economic impact of three different scenarios for Illinois – building new solar installations of 2,292 MW, 2,714 MW or 11,265 MW. They assume the 60% of the capacity is utility-scale solar, 30% of the capacity is commercial, and 10% of the capacity of the systems are residential. They find the 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) estimated the economic impact for the State of Ohio. He estimated the PV market in Ohio to be $25 million with 200 direct jobs and 460 total jobs. The Center for Competitive Florida (2009) estimated the impact if the state were to install 1,500 MW of solar. They found that 45,000 direct jobs and 50,000 indirect jobs could be created. The Solar Foundation (2013) used the JEDI modeling methodology to show that Colorado's solar PV installation to date created 10,790 job-years. They also analyzed what would happen if the state were to install 2,750 MW of solar PV from 2013 to 2030 and found that it would result in almost 32,500 job years. Berkman et. al (2011) estimate the economic and fiscal impacts of the Desert Sunlight Solar Farm. The project created approximately 440 construction jobs over a 26-month period, $15 million in new sales tax revenues and $12 million in new property revenues for Riverside County and $336 million in indirect benefits to local businesses in the county.

Although not specific to Solar PV, Hill Group (2018) quantified the economic impact of different renewable portfolio standards (RPS) for the state beyond the current 15% by 2021. They show that the state could see gross economic impact of $10.3 billion, over 68,500 job-years and $4.5 billion in employee compensation if it increases its RPS to 30% by 2027.

III. Chandler Solar Project Description and Location

Figure 6.—Location of Escanaba Township, Delta County, Michigan



Source: https://en.wikipedia.org/wiki/Escanaba_Township,_Michigan#/media/File:Escanaba_Township,_MI_location2.png, public domain

a. Chandler Solar Project Description

Chandler Solar is a 125 MW project located in the Escanaba Township of Delta County, Michigan approximately five miles northwest of the town of Escanaba. The Chandler Solar project land agreements are with 12 farmer landowners representing approximately 1,800 acres total. The project will cover a smaller land area of roughly 810 acres.

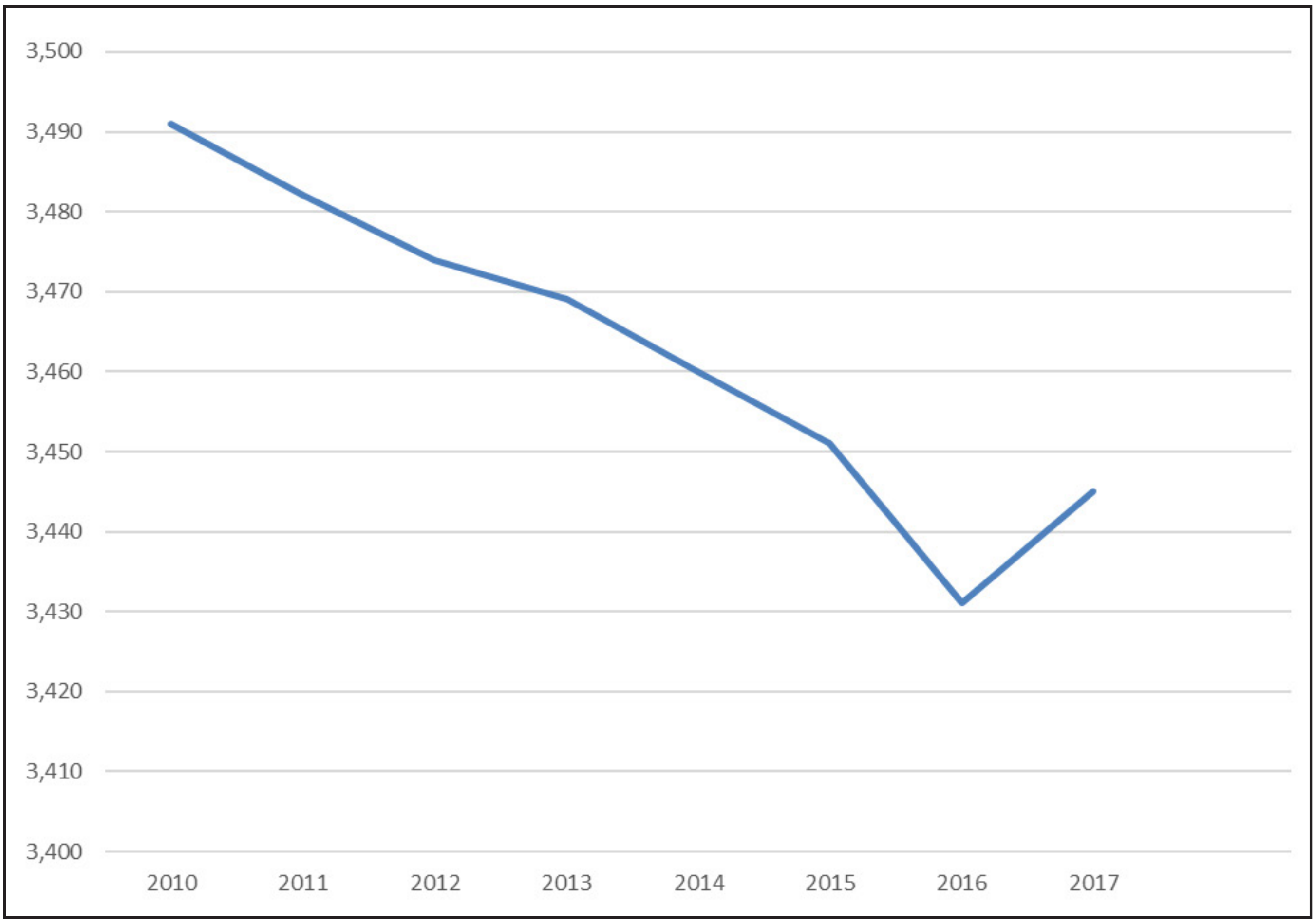
Chandler Solar has executed a transmission interconnection agreement with ATC, and a power purchase agreement with UPPCo for the full 125 MW. According to those agreements construction on the project will start in late 2021, it will become fully operational by end of 2022.

b. Escanaba Township, Michigan

Escanaba Township is located in the Western part of Delta County, which is in the Southern part of the Upper Peninsula of Michigan (see Figure 6). It has a total area of 60.3 square miles and the U.S. Census estimates that the 2010 population was 3,482 with 1,520 housing units. The county has a population density of 58.4 (persons per square mile) compared to 174 for the State of Michigan. Median household income in the county was $58,720 (2017). "The economic activity of Escanaba Township has historically been closely related to agriculture and forestry. Approximately 64% of the township is forested, and 16% is used for agricultural purposes" (Escacaba, 2018).

The overall population trend in the county has been decreasing steadily, as shown in Figure 7. Escanaba Township population was 3,491 in 2010 and 3,445 in 2017, a loss of 46. The average annual population decrease over this time period was 7.

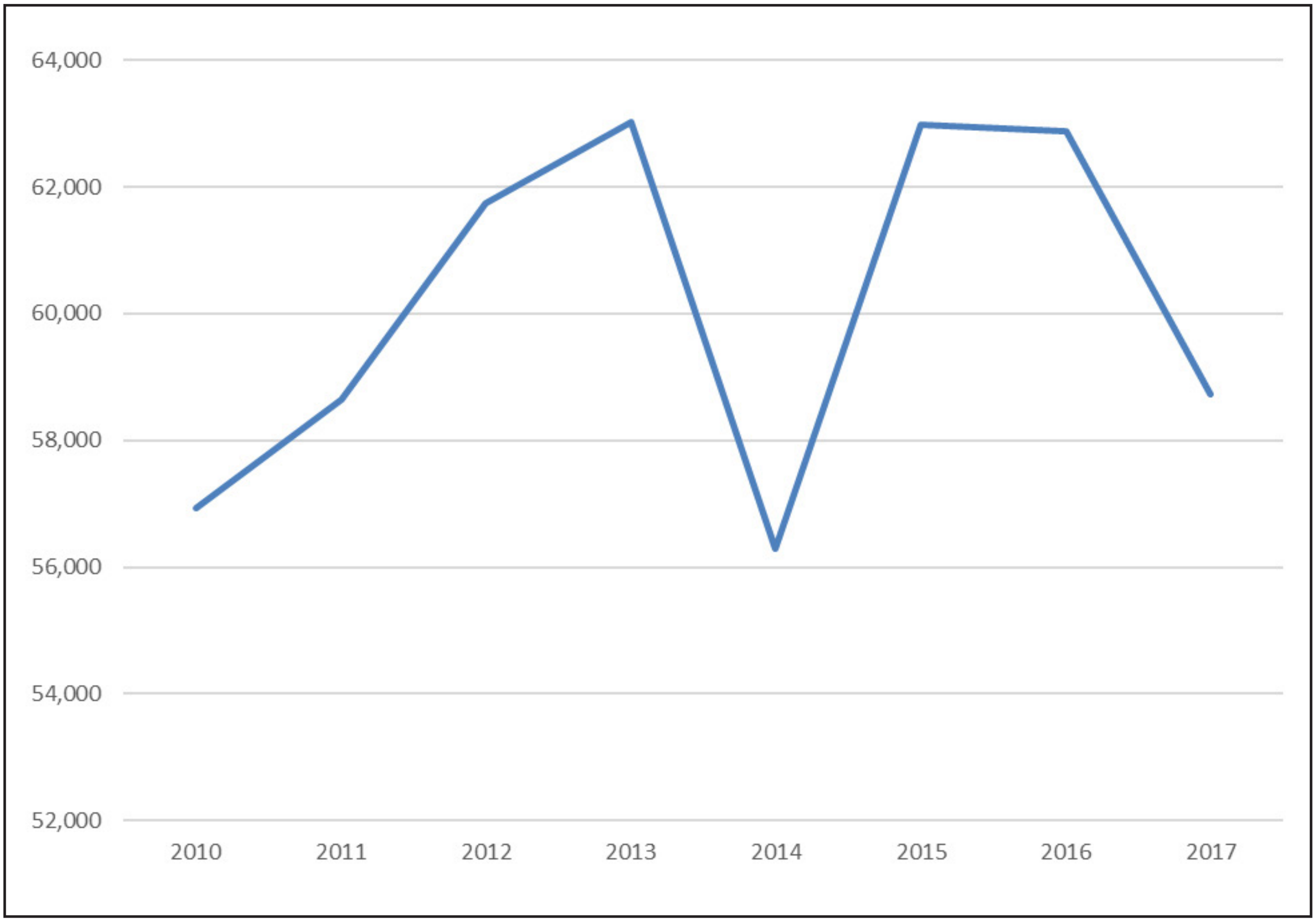
Figure 7.—Population in Escanaba Township 2010-2017



Source: 2018 Population Estimates Program, Annual Population Estimates, U.S. Census

Unlike the population trends, household income has fluctuated greatly in Escanaba Township. Figure 8 shows the median household income in Escanaba Township from 2010 to 2017. Household income was at its highest at $63,015 in 2013 and its lowest at $56,298 in 2014.

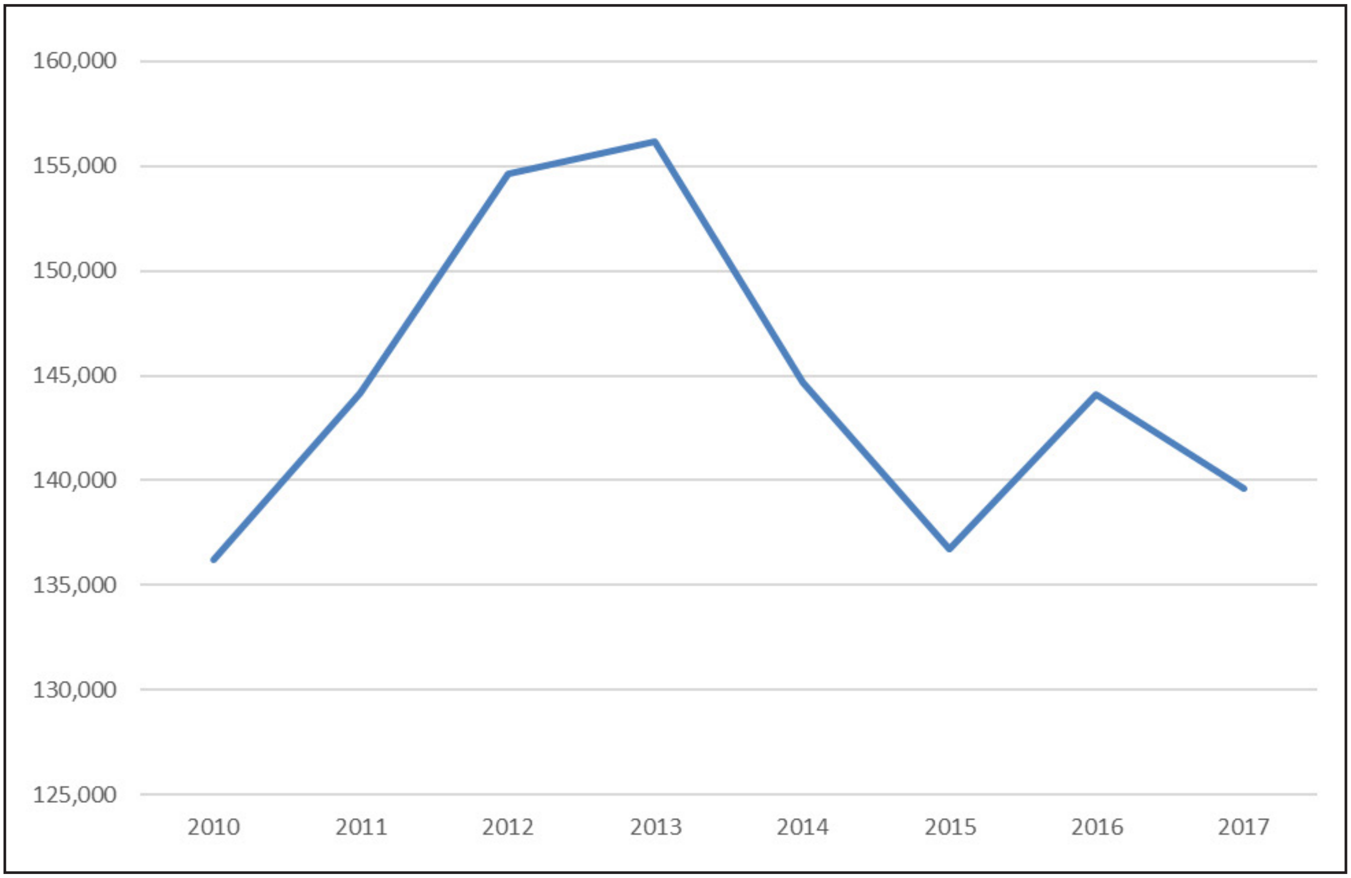
Figure 8.—Median Household Income in Escanaba Township from 2010 to 2017



Source: American Community Survey 5-year Estimates 2010-2017, U.S. Census

Owner-occupied housing values have been trending downward in Escanaba Township. The county was at its lowest at $136,200 in 2010 as shown in Figure 9. The housing values quickly rose to the highest value of $156,200 in 2013. Since then, housing values have been in decline.

Figure 9.—Median Owner-Occupied Property Values in Escanaba Township from 2010-2017



Source: American Community Survey 5-year Estimates 2010-2017, U.S. Census

c. Delta County, Michigan

Delta County is located in the Southern part of the Upper Peninsula of Michigan (see Figure 10). It has a total area of 1,991 square miles and the U.S. Census estimates that the 2010 population was 37,069 with 20,214 housing units. The county has a population density of 31.7 (persons per square mile) compared to 174 for the State of Michigan. Median household income in the county was $40,967.

Figure 10.—Location of Delta County, Michigan

Source: https://en.wikipedia.org/wiki/Delta_County,_Michigan#/media/File:Map_of_Michigan_highlighting_Delta_County.svg, public domain

Economic and Demographic Statistics

As shown in Table 1, the largest industry is "Retail Trade" followed by "Manufacturing," "Health Care" and "Accommodation." These data for Table 1 come from the U.S. Census' County Business Patterns. County Business Patterns "covers most of the country's economic activity. The series excludes data on self-employed individuals, employees of private households, railroad employees, agricultural production employees, and most government employees." Thus, the employment in Agriculture listed in Table 1 only counts individuals employed by a company. To get a more accurate picture of the agriculture sector in the county, the 2012 Census of Agriculture lists 165 principal operators with farming as their primary occupation and another 118 principal operators having another occupation as their primary occupation. These principal operators would put the agriculture sector at around 2% of the county's private workforce.

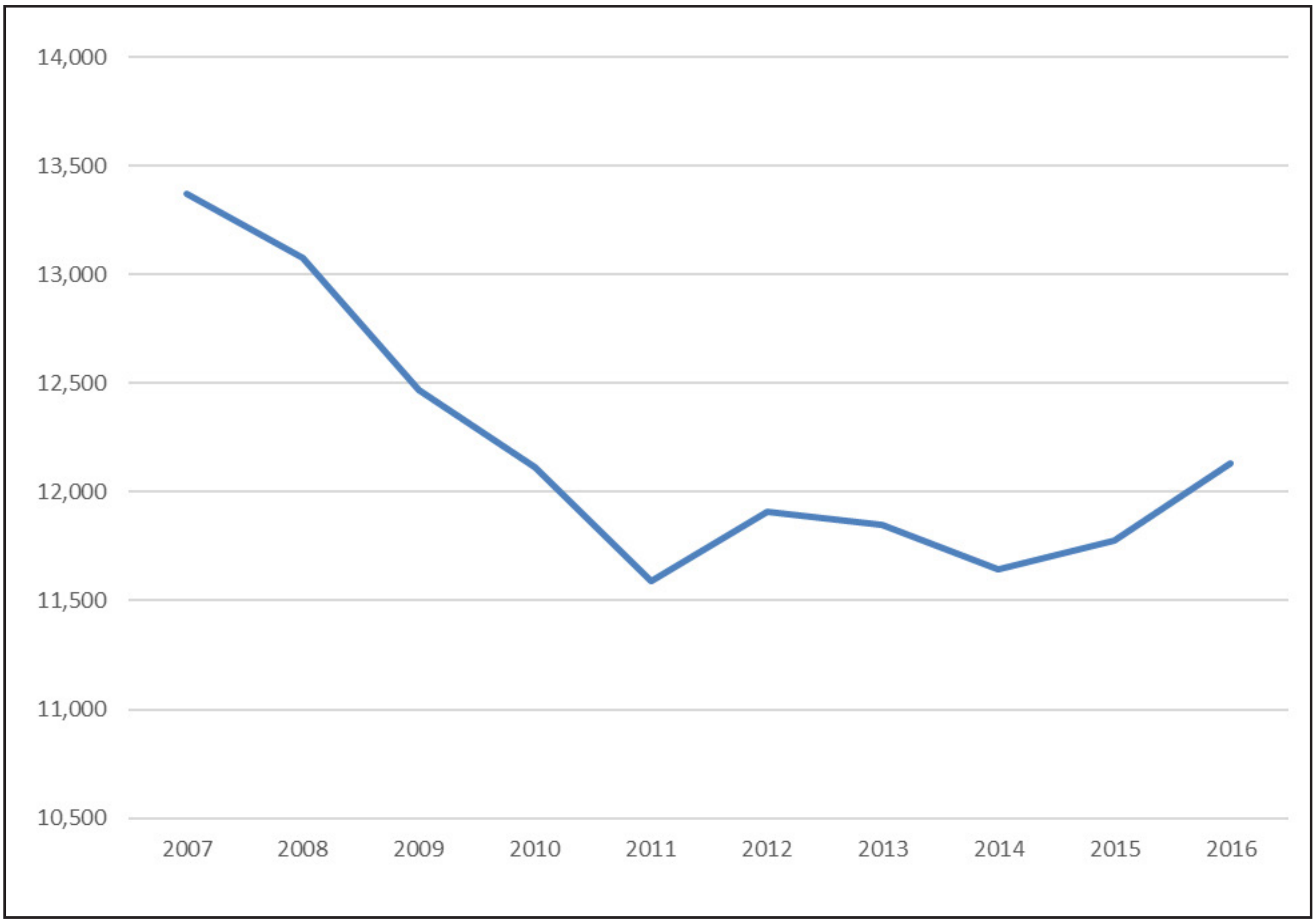
Table 1.—Employment by Industry in Delta County

Industry	Number	Percent
Retail trade	2,310	19.0%
Manufacturing	2,140	17.6%
Health care and social assistance	1,903	15.7%
Accommodation and food services	1,323	10.9%
Finance and insurance	734	6.0%
Other services (except public administration)	682	5.6%
Administrative and support and waste management and remediation services	652	5.4%
Construction	497	4.1%
Transportation and warehousing	456	3.8%
Wholesale trade	372	3.1%
Professional, scientific, and technical services	367	3.0%
Information	210	1.7%
Arts, entertainment, and recreation	175	1.4%
Educational services	132	1.1%
Agriculture, forestry, fishing and hunting	94	0.8%
Real estate and rental and leasing	52	0.4%
Utilities	32	0.3%
Mining, quarrying, and oil and gas extraction	0-19	0.0%-0.2%
Management of companies and enterprises	0-19	0.0%-0.2%
Industries not classified	0-19	0.0%-0.2%

Source: U.S Census Bureau, 2016 County Business Patterns

Table 1 provides the most recent snapshot of non-governmental employment but does not examine the historical trends within the county. Figure 11 shows the total non-governmental employment from 2007 to 2016. Private employment in Delta County was at its highest at 13,373 in 2010 and its lowest at 11,593 in 2011. Since then, private employment has slowly trended upward.

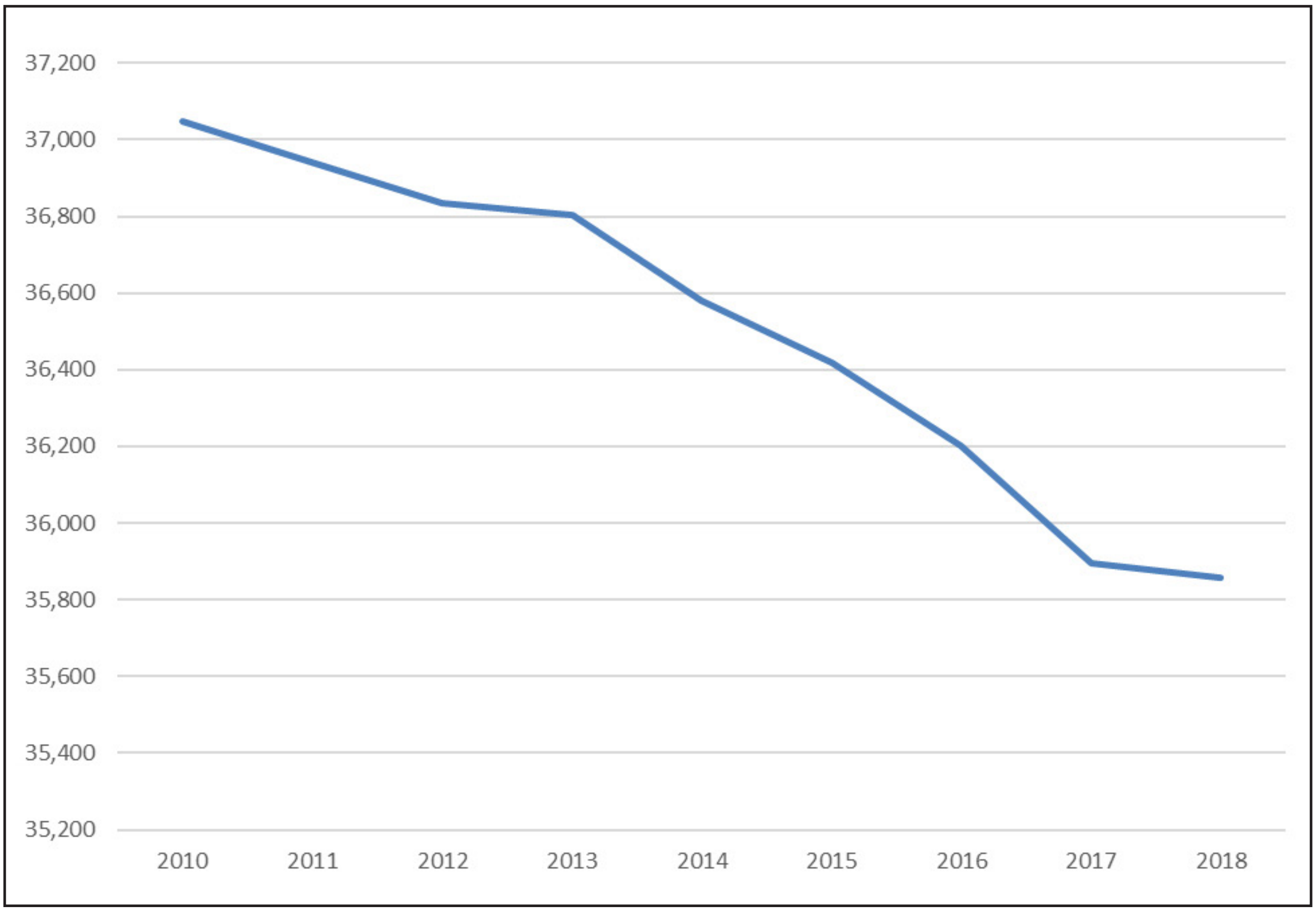
Figure 11.—Non-Governmental Employment in Delta County from 2007 to 2016



Source: 2007-2016 County Business Patterns, U.S. Census

Unlike the trend of private employment, the overall population trend in the county has been decreasing steadily, as shown in Figure 12. Delta County population was 37,049 in 2010 and 35,857 in 2018, a loss of 1,192. The average annual population decrease over this time period was 149. “According to state population projections, Delta County is projected to reduce in population by 2045 to 35,290. This would be a 3.7% increase from 1940’s population of 34,037 but a 3.9% decrease from 2015’s estimated population of 35,712” (Escanaba, 2018, 20).

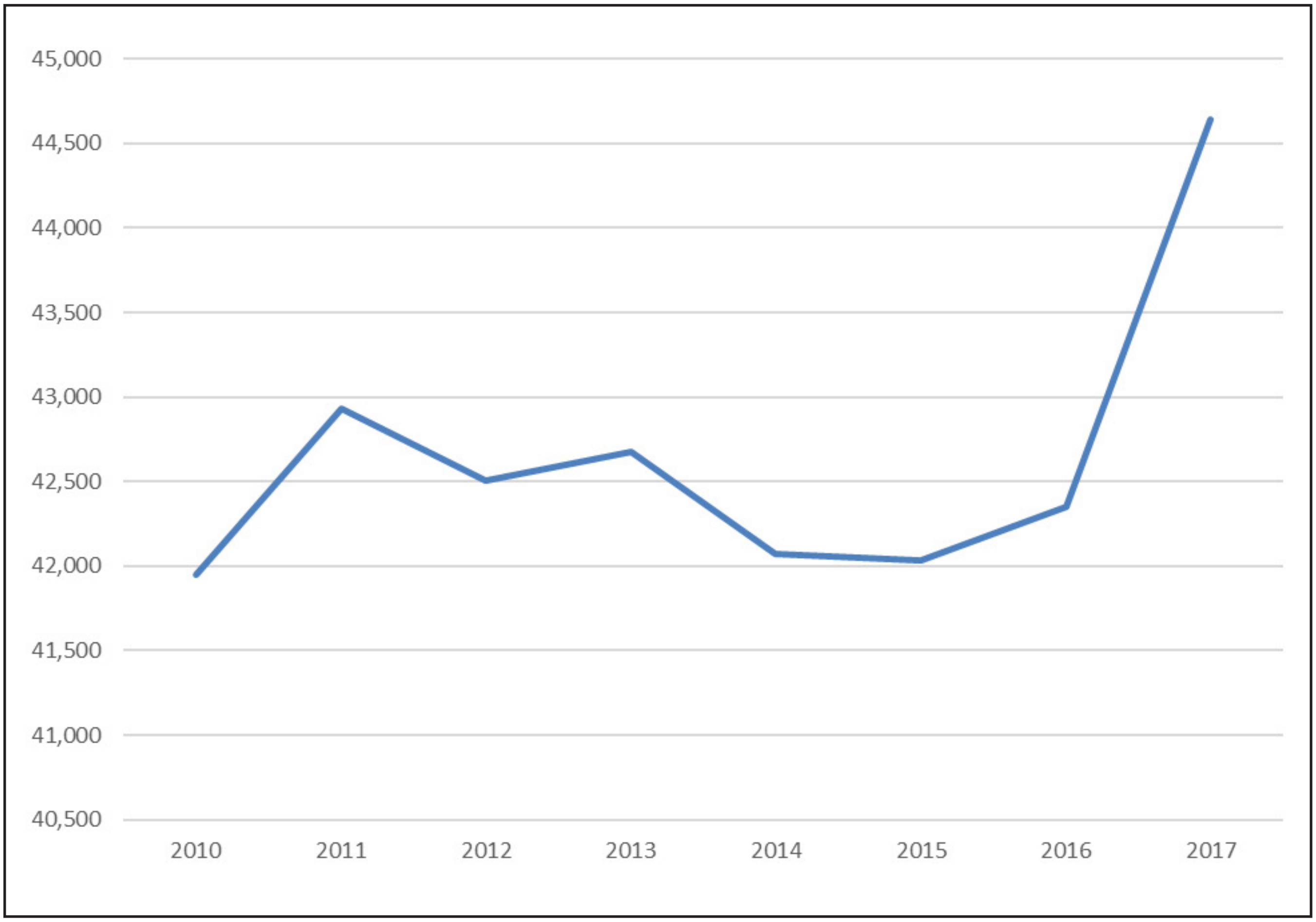
Figure 12.— Population in Delta County 2010-2018



Source: 2018 Population Estimates Program, Annual Population Estimates, U.S. Census

Unlike the steady population trend, household income has fluctuated in Delta County. Figure 13 shows the median household income in Delta County from 2010 to 2017. Household income was at its lowest at $41,951 in 2010 and its highest at $44,639 in 2017.

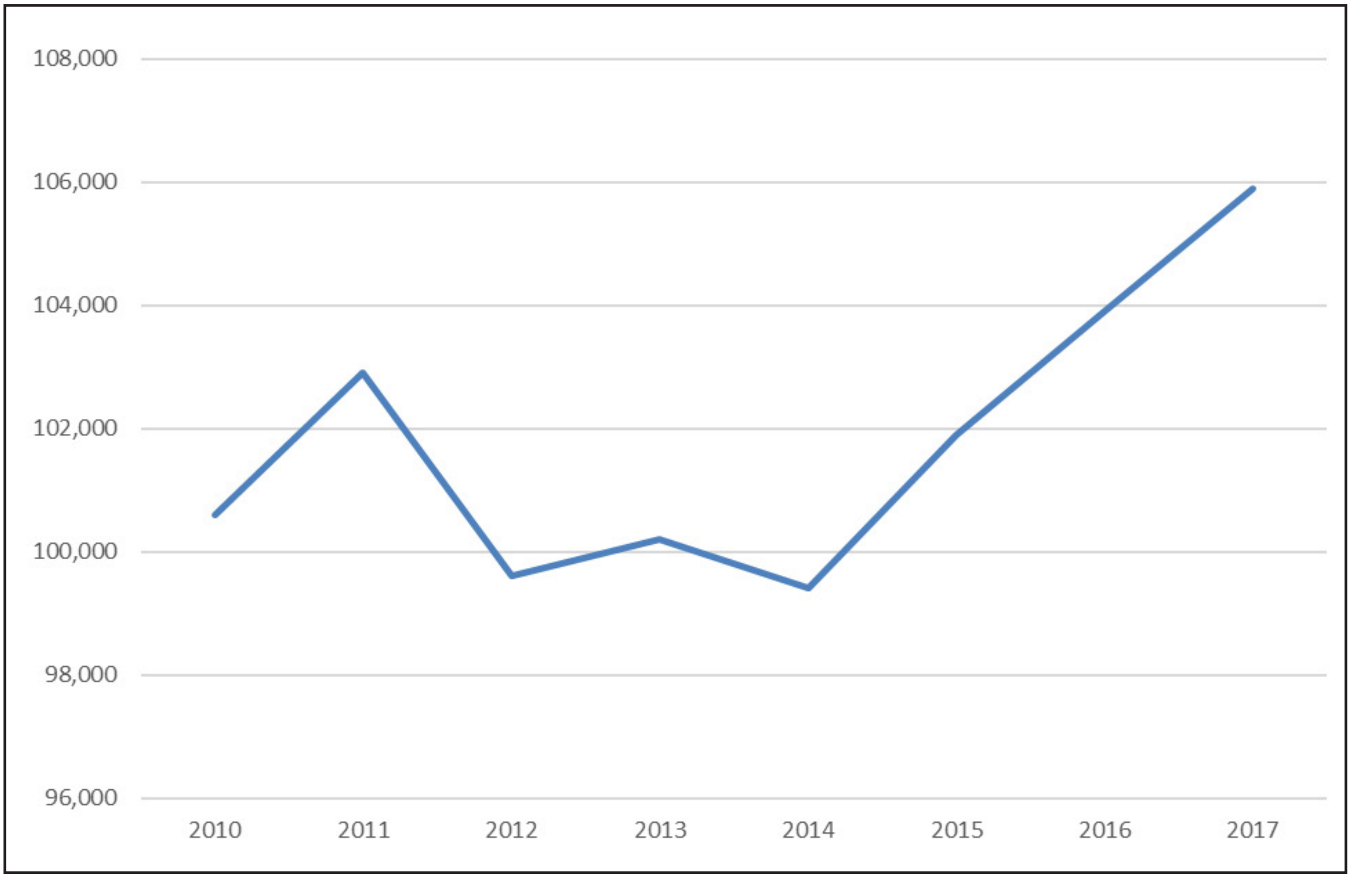
Figure 13.—Median Household Income in Delta County from 2010 to 2017



Source: American Community Survey 5-year Estimates 2010-2017, U.S. Census

Owner-occupied housing values have been trending upward in Delta County for the last few years. The county was at its lowest at $99,400 in 2014 as shown in Figure 14. The highest that the median housing value reached was $105,900 in 2017.

Figure 14.— Median Owner-Occupied Property Values in Delta County from 2010-2017

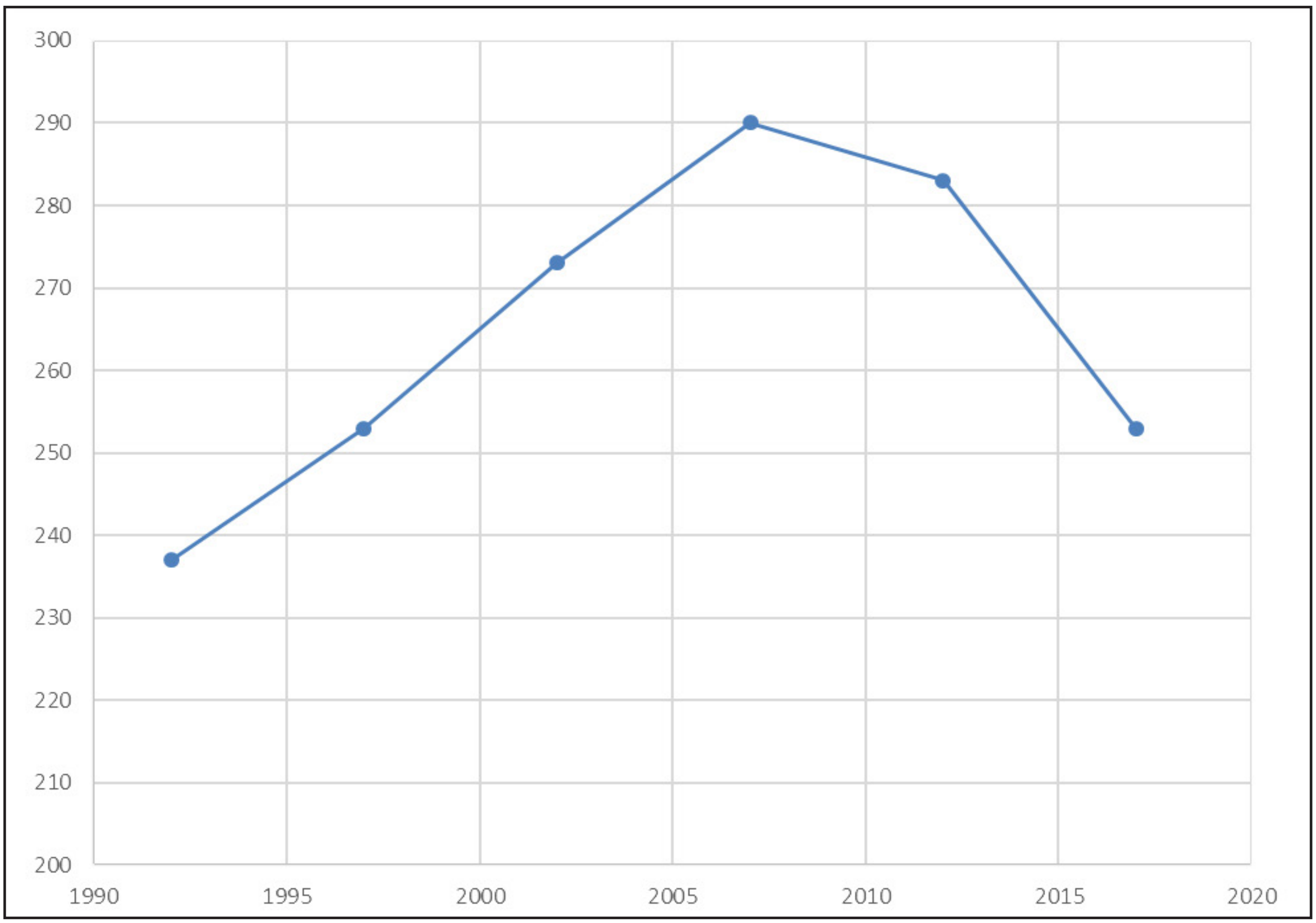


Source: American Community Survey 5-year Estimates 2010-2017, U.S. Census

Agricultural Statistics

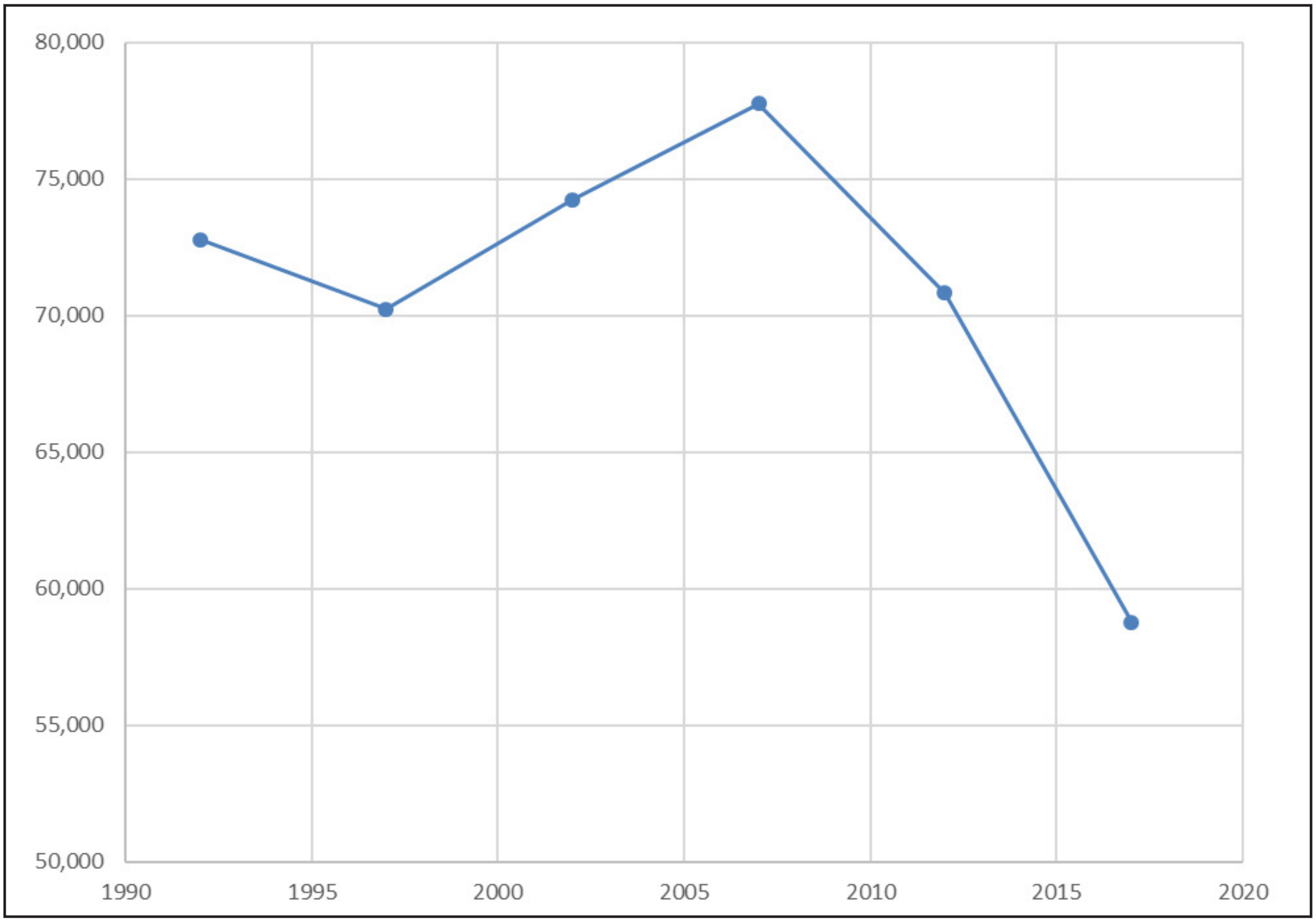
The farming industry has been declining in Delta County. As shown in Figure 15, the number of farms has decreased from 290 in 2007 to 253 in 2017. The amount of land in farms has decreased drastically in recent years as well. The County farmland hit a high of 77,762 acres in 2007 and a low of 58,764 acres in 2017 according to Figure 16. "Family farms which once dominated the landscape were the area's principal economic activities. Market forces, escalating operating costs, improved technology and farming practices and lifestyle preferences have contributed to the decline in the number of farms and persons engaged in farming as a principal occupation" (Escanaba, 2018, 21).

Figure 15.—Number of Farms in Delta County from 1992 to 2017



Source: Census of Agriculture, 1992-2017

Figure 16.—Land in Farms in Delta County from 1992 to 2017



Source: Census of Agriculture, 1992-2017

IV. Land Use Methodology

a. Agricultural Land Use

Many are concerned about the conversion of farmland to residential, commercial and industrial uses. In his article, "Is America Running out of Farmland?" Paul Gottlieb shows that in the Continental United States, prime farmland has declined 1.6% from 1982-2010. Conversion of farmland to other uses "has a number of direct and indirect consequences, including loss of food production, increases in the cost of inputs needed when lower quality land is used to replace higher quality land, greater transportation costs of products to more distant markets, and loss of ecosystem services. Reduced production must be replaced by increasing productivity on remaining land or by farming new lands" (Franscis et. al., 2012).

On the other side of the debate, Dwight Lee considers the reduction in farmland as good news. In his article, "Running Out of Agricultural Land," he writes, "farmland has been paved over for shopping centers and highways, converted into suburban housing tracts, covered with amusement parks, developed into golf courses, and otherwise converted because consumers have communicated through market prices that development is more valuable than the food that could have been grown on the land" (Lee, 2000).

Total U.S. cropland has remained steady over the past five years. In 2012, 257.4 million acres in the U.S. were cropland while in 2017, 249.8 million acres were cropland. In 2012, just over 40% of all U.S. land was farmland (Census of Agriculture, 2012). According to the World Bank, the percentage of agricultural land has increased worldwide from 36.0 in 1961 to 37.3 in 2015. The Arab World, Caribbean Small States, East Asia, South Asia and Sub-Sahara Africa have all experienced growth in the percentage of agricultural land. Thus, from a global perspective, it is simply not true that we are running out of farmland. Even in the U.S., large quantities of farmland are not disappearing.

One valid criticism of the "market forces" arguments is that flow of land only goes from agricultural to non-agricultural uses. In theory, land should move in a costless way back and forth between urban and rural uses in response to new market information. Since agricultural land seldom goes back to agricultural use once it is converted to residential or commercial development, one needs to account for this in the analysis of farmland. The common assumption then is that urban development is irreversible and leads to an "option value" argument (Gottlieb, 2015).

In finance, an option is a contract which gives the holder the right but not the obligation to buy or sell an underlying asset. A real option value is a choice made with business investment opportunities, referred to as "real" because it typically references a tangible asset instead of financial instrument. In the case of agricultural land, the owner retains the right to sell the land in future years if they don't sell in the current year. From a finance viewpoint, this "option" to sell in the future has value to the owner and since it is a tangible asset rather than a financial instrument, we call it a "real option."

b. Agricultural Land and Solar Farms

The present case of leasing agricultural land for a solar energy generating facility rises above this debate in several important ways.

First, the use of agricultural land for a solar energy center is only temporary, and certainly not irreversible. This reversibility stands in contrast to residential or commercial developments where farmland seldom reverts back to its original use. The term of the solar leases for this Project is thirty years with possible extensions of two 10-year terms, then the leases would expire. At the end of the leases, the land will be restored to its original condition and will likely return to agricultural use. Typical solar project life is roughly thirty to thirty-five years. Site restoration is ensured by lease terms and conditions as well as likely permit conditions. This is far different from residential or commercial development where the land is often owned in full and there are no decommissioning requirements or surety.

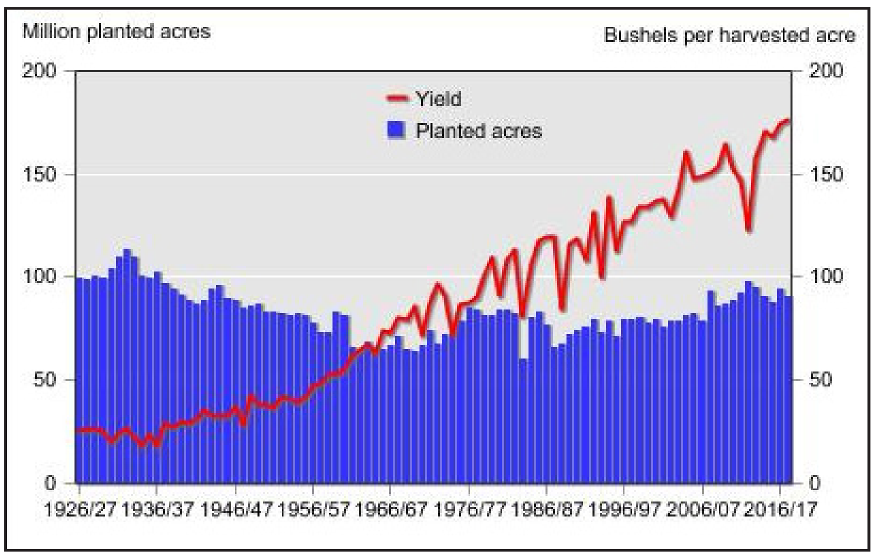
Second, the total amount of agricultural land being used for solar energy is miniscule compared to the conversion of agricultural land permanently to residential housing and commercial development. Chandler Solar would occupy roughly 2.1% of all land in Escanaba Township, and about 3.6% of total prime agriculture land.

Third, the ongoing annual lease payments will continue to go to the landowner who will retain ownership of the land both during and after the lease. At the end of the lease and when the project is responsibly decommissioned, the landowner could resume farming the land. In other conversions, the land is sold by the farmer to another party – usually a housing developer or commercial real estate broker. In this case, the values and goals of the new landowner differ significantly from the original landowner.

Fourth, the free market economic forces are working properly because solar farms present landowners with an opportunity for a higher value use on their land. This also allows the landowner to diversify their income away from agricultural products alone, better weather economic downturns, and keep the land in the family.

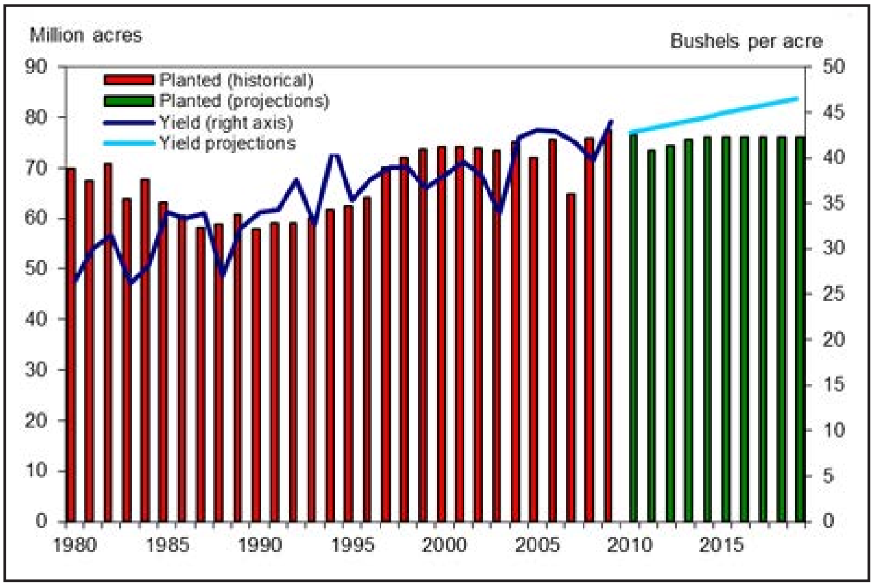
Farmland has gotten more productive over the years with better farming equipment and techniques resulting in higher yields on the same amount of land. Corn production has risen due to improvements in seed varieties, fertilizers, pesticides, machinery, reduced tillage, irrigation, crop rotations and pest management systems. Figure 17 shows the dramatic increase U.S. corn yields since 1926. Soybean yields have also increased though not as dramatically. Figure 18 displays the soybean yields in the U.S. since 1980.

Figure 17.—U.S. Corn Acreage and Yield



Source: USDA, Economic Research Service, https://www.ers.usda.gov/topics/crops/corn-and-other-feedgrains/background/

Figure 18.—U.S. Soybean Acreage and Yield



Source: USDA Agricultural Projections to 2019, February 2010, USDA, Economic Research Service

c. Methodology

To analyze the specific economic land use decision for a solar energy center, 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 energy 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).

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). The "real options" enhancement allows for the possibility that subsequent decisions could modify the farming NPV. This enhancement allows for a more dynamic modeling process than the static analysis implied by the standard NPV. By projecting historical trends and year-to-year variations of farming profits into the future, the real options model captures the new information about farming profitability that comes from crop prices, yields and cost in each future year.

In order to forecast returns from agriculture in future years, we use a linear regression using an intercept and time trend on historical data to predict future profits.

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

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

V. Land Use Results

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

	1992	1997	2002	2007	2012	2017
Total Farm Income Per Farm	NA	NA	$3,246	$8,924	$7,318	$7,395
Total Farm Production Expenses (average/farm)	$30,776	$23,152	$29,232	$34,012	$43,058	$40,154
Average Farm Size (acres)	307	278	272	268	250	232
Net Cash Income per Farm[3]	$2,282	$7,962	$5,625	$9,515	$14,177	$5,571
Average Market Value of Machinery Per Farm	$41,812	$46,530	$48,265	$72,055	$83,208	$89,494

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

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

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 20 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 at 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.

Table 3.— Machinery Depreciation and Opportunity Cost of Farmer's Time for Delta County, Michigan

	1992	1997	2002	2007	2012	2017
Average Market Value Machinery Per Farm	$41,812	$46,530	$48,265	$72,055	$83,208	$89,494
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$1,394	$1,551	$1,609	$2,402	$2,774	$2,983
Mean Hourly Wage in MI for Farming (Bureau of Labor Statistics)	$5.73	$6.52	$7.31	$10.05	$10.60	$11.71
Annual Opportunity Cost of Farmer's Time (Wage times 8 weeks times 40 Hours/Week)	$1,835	$2,086	$2,339	$3,216	$3,392	$3,747

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

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

Table 4.— Profit Per Farm Calculations for Delta County, Michigan

	1992	1997	2002	2007	2012	2017
Net Cash Income per Farm	$2,282	$7,962	$5,625	$9,515	$14,177	$5,571
Machinery Depreciation	($1,394)	($1,551)	($1,609)	($2,402)	($2,774)	($2,983)
Opportunity Cost of Farmer's Time	($1,835)	($2,086)	($2,339)	($3,216)	($3,392)	($3,747)
Profit	($947)	$4,325	$1,677	$3,897	$8,011	($1,159)
Average Farm Size (Acres)	307	278	272	268	250	232
Profit Per Acre in 2012 Dollars	($3.08)	$15.56	$6.17	$14.54	$32.05	($5.00)
CPI	141.9	161.3	180.9	210.036	229.601	246.524
Profit Per Acre in 2017 Dollars	($5.36)	$23.78	$8.40	$17.07	$34.41	($5.00)

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

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

Using an unsophisticated static analysis, the farmer would be better off using his land for solar if the solar lease rental per acre exceeds the 2017 profit per acre of -$5.00. Because this was a particularly bad year, any positive lease payment would exceed this agricultural loss. 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:

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

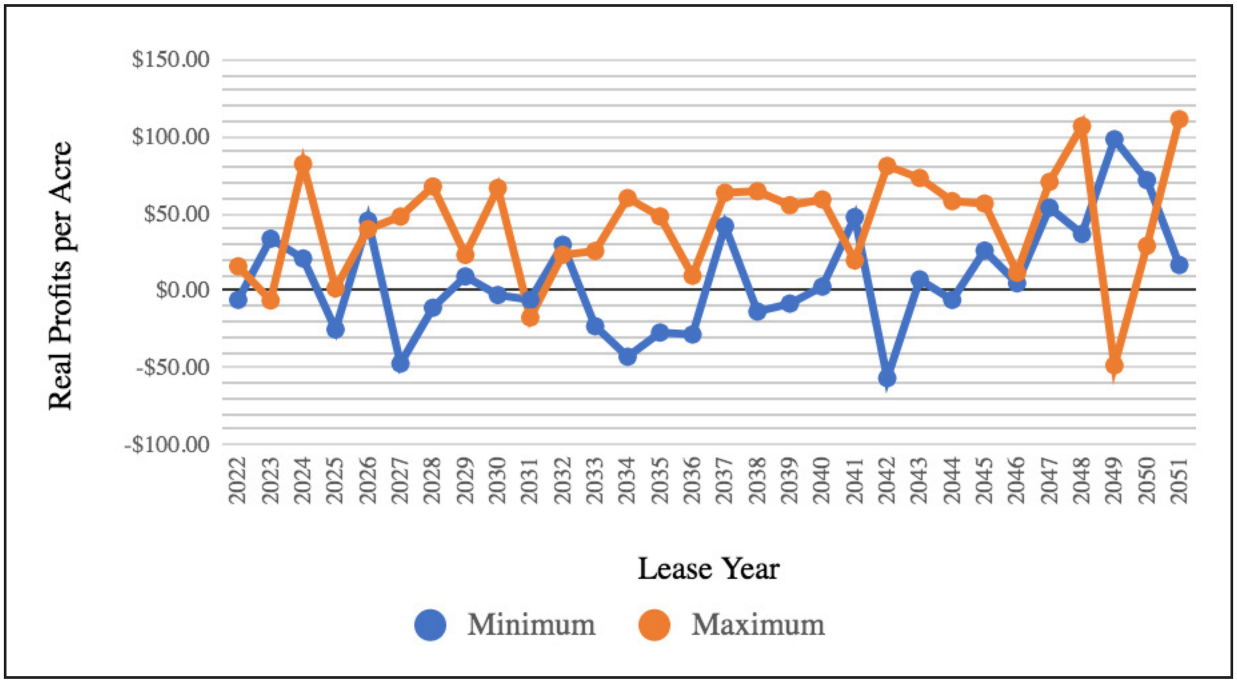
Where π_t is the farming profit in year t; α is intercept; β is the trend and time is a simple time trend starting at 1 and increasing by 1 each time period.

Using the Census of Agriculture data from 1992 to the present[5], the intercept is $10.81 with a standard error of $11.59. The time trend is $0.23 with a standard error of 0.73. This means that agriculture profits are expected to rise by $0.23. 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 2051, 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 Monte Carlo simulation. We assume that the solar farm will begin construction in 2022 and operate through 2051. Using 500 different simulations, the real profit per acre never exceeds $231 in any single year. Overall, the maximum average annual profit over the 30 years is $36 and the minimum average annual profit is $17. 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 2051 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.

[5] We substituted zero for the losses in 1992 and 2017. This will help make agriculture look more attractive relative to the solar lease.

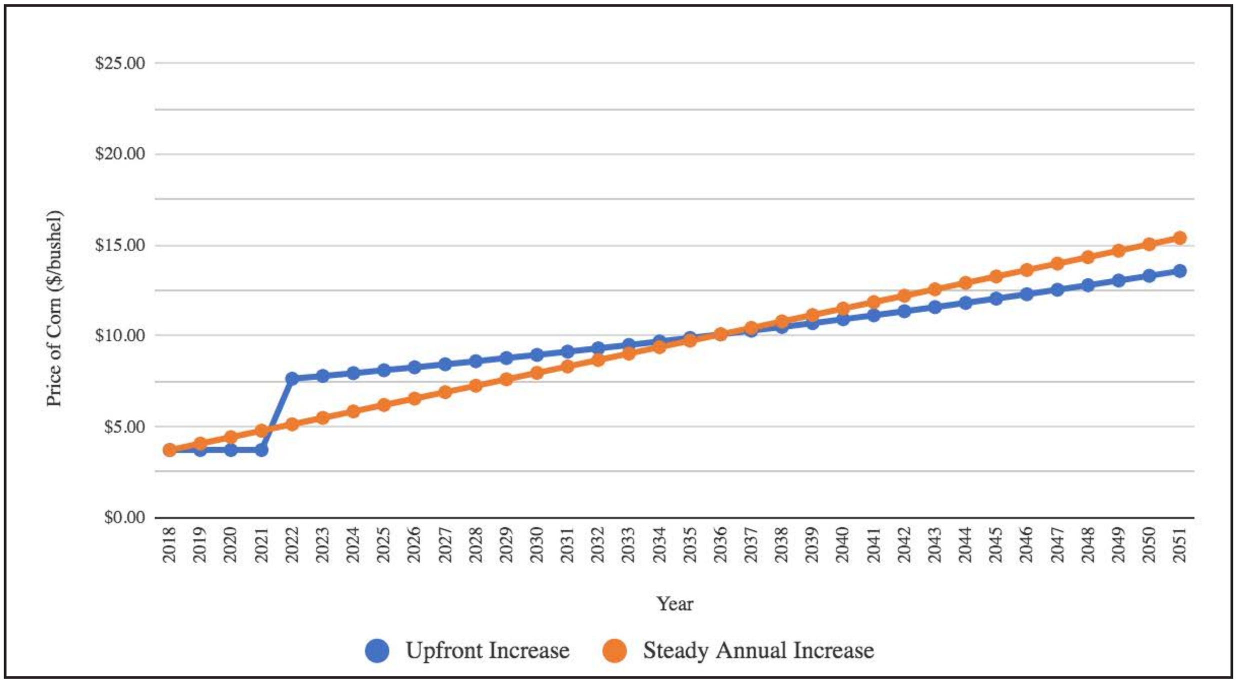
Figure 19.—Simulations of Real Profits Per Acre



Source: Author's Calculations

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 $3.72 per bushel in 2018 to $7.64 in 2022 and rise to $13.57 per bushel by 2051 as shown in Figure 20. Alternatively, the price of corn would need to rise by $0.35 per bushel each year from 2018 to 2051 when it would reach $15.39 per bushel.

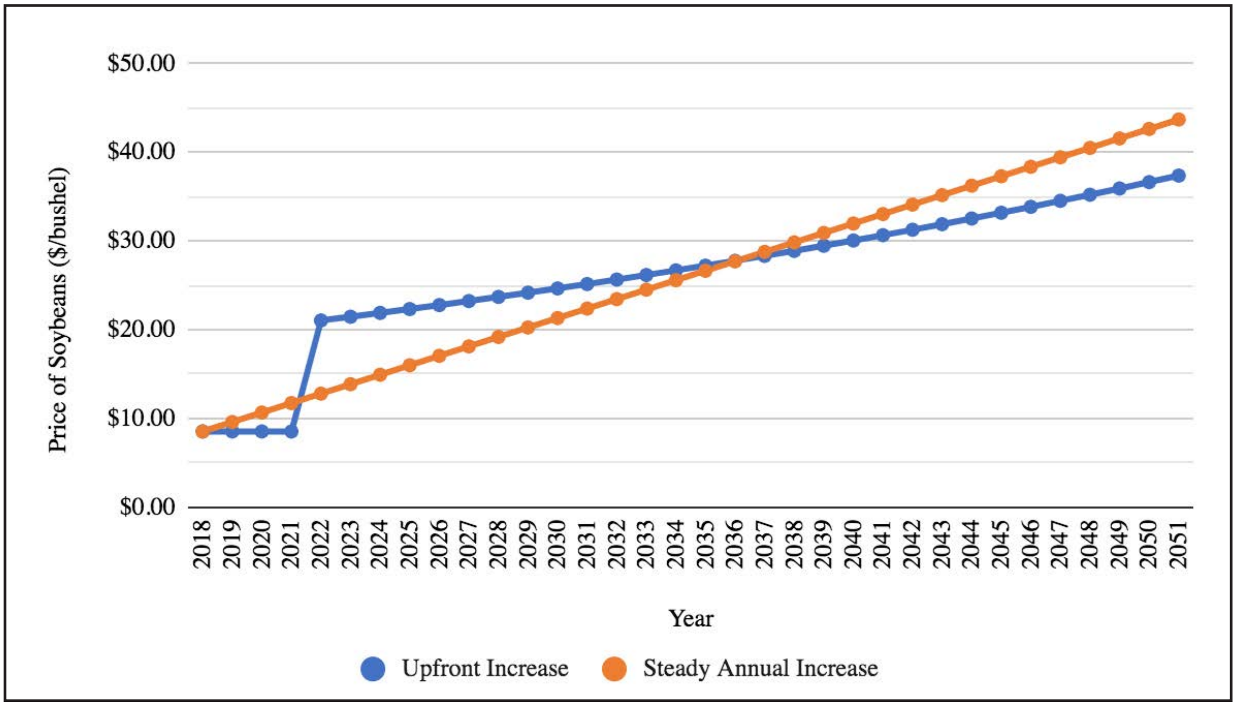
Figure 20.—Simulated Price of Corn per Bushel to Match the Solar Lease



Source: Author's Calculations

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 $8.53 per bushel in 2018 to $21.03 per bushel in 2022 and rise to $37.35 by 2051 as shown in Figure 21. For a linear increase, the price of soybeans would need to rise by $1.06 per bushel each year from 2018 to 2051 when it would reach $43.66 per bushel.

Figure 21.—Simulated Price of Soybeans per Bushel to Match the Solar Lease



Source: Author's Calculations

If we assume that the price of corn stays the same, the yields for corn would need to increase from 153 bushels per acre in 2018 to 314.3 bushels per acre in 2022 and stay at that level until 2051. The yields for soybeans would need to rise from 48 bushels per acre in 2018 to 118.3 bushels per acre in 2022 and stay there until 2051.

VI. Economic Impact Methodology

The economic analysis of solar PV project development presented here uses the NREL's latest 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. When an installer/developer purchases a module 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 economy.

The first Jobs and Economic Development Impacts (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 PV installation creates a second layer of impacts, referred to as "supply chain impacts" or "indirect impacts." **Indirect impacts** during construction period consist of the changes in inter-industry purchases resulting from the direct final demand changes and include construction spending on materials and PV equipment and other purchases of goods and offsite services.

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 PV project who receive their paychecks and then spend money in the community is included. Additional local jobs and economic activity are supported by these purchases of goods and services.

VII. Economic Impact Results

The economic impact results were derived from detailed project estimates supplied by Orion Renewables. In addition, Orion Renewables estimated the percentages of project materials and labor that will be coming from within Escanaba Township and the State of Michigan.

Two separate JEDI models produced results to show the economic impact of the Chandler Solar Project. The first JEDI model used the 2018 Escanaba Township multipliers from IMPLAN. The second JEDI model used the 2018 JEDI state multipliers for the State of Michigan and the same project costs.

Tables 5-7 show the output from these models. Table 5 lists the total employment impact from the Chandler Solar Project for Escanaba Township and the State of Michigan. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

Table 5.—Total Employment Impact from the Chandler Solar Project

	Escanaba Township Jobs	Delta County Jobs	State of Michigan Jobs
Construction			
Project Development and Onsite Labor Impacts (direct)	31	78	122
Module and Supply Chain Impacts (indirect)	63	73	82
Induced Impacts	13	27	59
New Local Jobs During Construction	107	178	263
Operations			
Onsite Labor Impacts (direct)	1.0	1.7	3.3
Local Revenue and Supply Chain Impacts (indirect)	3.6	4.8	5.7
Induced Impacts	2.9	5.3	9.1
New Local Long Term Jobs	7.5	11.8	18.1

The results from the JEDI model show significant employment impacts from the Chandler Solar Project. Employment impacts can be broken down into several different components. The employment numbers presented 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 31 new direct jobs during construction in Escanaba Township, though the construction of the solar center may actually involve hiring closer to 62 half-time workers. Construction of this Project is expected to take 12-18 months.

As shown in Table 5, new local jobs created or retained during construction total 107 for Escanaba Township and 263 for the State of Michigan. New local long-term jobs created from the Chandler Solar Project total 7.5 for Escanaba Township and 18.1 for the State of Michigan.

Direct jobs created during the operational phase last the life of the solar energy center, 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 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 Chandler Solar Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction total over $7.3 million for Escanaba Township and over $21.2 million for the State of Michigan. The new local long-term earnings total over $282 thousand for Escanaba Township and over $1.0 million for the State of Michigan.

Table 6.— Total Earnings Impact from the Chandler Solar Project

	Escanaba Township	Delta County	State of Michigan
Construction			
Project Development and Onsite Earnings Impacts	$2,838,939	$7,799,778	$12,923,890
Module and Supply Chain Impacts	$4,043,051	$4,397,748	$5,395,458
Induced Impacts	$440,939	$937,366	$2,976,255
New Local Earnings During Construction	$7,322,929	$13,134,893	$21,295,603
Operations (Annual)			
Onsite Labor Impacts	$48,987	$81,646	$325,729
Local Revenue and Supply Chain Impacts	$131,850	$181,944	$312,104
Induced Impacts	$101,597	$183,769	$454,249
New Local Long Term Earnings	$282,434	$447,358	$1,092,082

Output refers to economic activity or the value of production in the state or local economy. It is an equivalent measure to the Gross Domestic Product, which measures output on a national basis. According to Table 7, the new local output during construction totals over $10.5 million for Escanaba Township and over $32.9 million for the State of Michigan. The new local long-term output totals over $936 thousand for Escanaba Township and over $2.7 million for the State of Michigan.

Table 7.— Total Output Impact from the Chandler Solar Project

	Escanaba Township	Delta County	State of Michigan
Construction			
Project Development and Onsite Jobs Impacts on Output	$3,440,428	$8,401,267	$13,362,107
Module and Supply Chain Impacts	$5,635,262	$6,854,943	$10,611,691
Induced Impacts	$1,465,447	$3,213,355	$8,999,939
New Local Output During Construction	$10,541,136	$18,469,565	$32,973,737
Operations (Annual)			
Onsite Labor Impacts	$48,987	$81,646	$325,729
Local Revenue and Supply Chain Impacts	$550,372	$740,219	$1,083,473
Induced Impacts	$337,012	$628,553	$1,372,249
New Local Long-Term Output	$936,371	$1,450,418	$2,781,451

VIII. Property 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, park districts, and road maintenance. According to a memo from the State Tax Commission at the Michigan Department of Treasury dated May 13, 2008, "MCL 211.8 provides that wind energy systems are to be classified as personal property. However, the statute does not address which personal property classification they should be given. At their meeting on May 12, 2008, the State Tax Commission determined that these systems should be classified Industrial Personal." (State Tax Commission, 2008). According to Varnum Law, similar analysis should apply to property used in a solar energy project.

The taxable base for personal property is 50% of its fair market value in Michigan (Haney and Roberts, 2018). Industrial personal property is exempt from the 6-mill state education tax and is also exempt from up to 18 mills levied for school operating purposes (Michigan Department of Treasury, 2007). Orion Renewables provided a Varnum Memo regarding property tax projections which were verified for reasonableness. These projections are the basis of the property tax analysis in this section.

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

- First, the analysis assumes that the total taxable basis of $124 million is classified into Industrial Personal Property, Utility Personal Property and Real Property.

- Second, the tables assume real property depreciation of 2% per year and personal property depreciation based on the 2019 Michigan STC Machinery and Equipment Property Composite Factors until it reaches its maximum of 77% depreciation.

- Third, all tax rates are assumed to stay constant at their 2019 (2018 tax year) rates. For example, the Delta County millage rate is assumed to stay constant at 5.03170 through 2047.

- Fourth, no comprehensive tax payment was calculated, and these calculations are only to be used to illustrate the economic impact of the Project.

According to Table 8, a conservative estimate of the total property taxes paid by the Project starts out at over $1.2 million but declines due to depreciation. The expected total property taxes paid over the lifetime of the Project is over $13.4 million and the average annual property taxes paid will be $538,607.

Table 8.—Property Tax Revenue from Chandler Solar Project

Tax Year	Total Property Taxes
2023	$1,230,008
2024	$1,061,737
2025	$943,872
2026	$851,343
2027	$771,419
2028	$704,320
2029	$650,240
2030	$609,343
2031	$554,848
2032	$527,141
2033	$485,830
2034	$457,963
2035	$430,031
2036	$415,669
2037	$346,573
2038	$345,830
2039	$345,086
2040	$344,343
2041	$343,599
2042	$342,856
2043	$342,113
2044	$341,369
2045	$340,626
2046	$339,882
2047	$339,139
TOTAL	$13,465,179
AVG ANNUAL	$538,607

Table 9 shows an estimate of the likely taxes paid to Escanaba Township and Delta County. The Escanaba Township millage rate of 0.80410 and the Delta County millage rate of 5.03170 was used. As shown in Table 9, in 2023, Escanaba Township should receive $44,436, and Delta County should receive $278,062. The average annual amounts are $18,789 for Escanaba Township, and $117,574 for Delta County.

Table 9.—Property Tax Revenue from Chandler Solar Project for Township and County

Tax Year	Escanaba Township	Delta County
2023	$44,436	$278,062
2024	$38,026	$237,950
2025	$33,584	$210,154
2026	$30,126	$188,518
2027	$27,161	$169,960
2028	$24,687	$154,482
2029	$22,706	$142,083
2030	$21,217	$132,764
2031	$19,235	$120,365
2032	$18,238	$114,124
2033	$16,749	$104,805
2034	$15,751	$98,565
2035	$14,754	$92,324
2036	$14,249	$89,163
2037	$11,775	$73,685
2038	$11,762	$73,603
2039	$11,749	$73,522
2040	$11,736	$73,440
2041	$11,723	$73,358
2042	$11,710	$73,276
2043	$11,697	$73,195
2044	$11,684	$73,113
2045	$11,671	$73,031
2046	$11,658	$72,949
2047	$11,645	$72,867
TOTAL	$469,729	$2,939,358
AVG ANNUAL	$18,789	$117,574

Table 10 shows an estimate of the likely taxes paid to State Education, the Operating School, School Debt, Intermediate School, and Community College. State Education and Operating School Tax is applicable to real & personal utility property only.

As shown in Table 10, in 2023, State Education should receive $16,926, the Operating School should receive $50,778, School Debt should receive $276,239, the Intermediate School should receive $131,805, and the Community College should receive $127,523. The total amounts are $217,133 for State Education, $651,398 for the Operating School, $3,225,590 for School Debt, $1,393,299 for the Intermediate School and $1,348,026 for the Community College.

Table 10.— Tax Revenue from Chandler Solar Project for Education

Tax Year	State Education	Operating School	School Debt	Intermediate School	Community College
2023	$16,926	$50,778	$276,239	$131,805	$127,523
2024	$15,054	$45,162	$243,187	$112,792	$109,127
2025	$13,728	$41,184	$219,147	$99,616	$96,379
2026	$12,675	$38,025	$199,745	$89,360	$86,457
2027	$11,759	$35,276	$182,601	$80,564	$77,946
2028	$10,979	$32,936	$167,930	$73,227	$70,847
2029	$10,335	$31,005	$155,926	$67,350	$65,161
2030	$9,828	$29,484	$146,751	$62,932	$60,887
2031	$9,185	$27,554	$134,337	$57,055	$55,201
2032	$8,814	$26,442	$127,998	$54,097	$52,339
2033	$8,307	$24,921	$118,414	$49,679	$48,065
2034	$7,937	$23,810	$111,916	$46,721	$45,203
2035	$7,566	$22,698	$105,354	$43,763	$42,341
2036	$7,332	$21,996	$102,005	$42,265	$40,891
2037	$6,552	$19,656	$85,358	$34,928	$33,793
2038	$6,455	$19,364	$85,269	$34,889	$33,755
2039	$6,357	$19,071	$85,180	$34,850	$33,718
2040	$6,260	$18,779	$85,091	$34,812	$33,680
2041	$6,162	$18,486	$85,002	$34,773	$33,643
2042	$6,065	$18,194	$84,913	$34,734	$33,605
2043	$5,967	$17,901	$84,824	$34,695	$33,568
2044	$5,870	$17,609	$84,734	$34,657	$33,530
2045	$5,772	$17,316	$84,645	$34,618	$33,493
2046	$5,675	$17,024	$84,556	$34,579	$33,455
2047	$5,577	$16,731	$84,467	$34,540	$33,418
TOTAL	$217,133	$651,398	$3,225,590	$1,393,299	$1,348,026
AVG ANNUAL	$8,685	$26,056	$129,023	$55,732	$53,921

As shown in Table 11, in 2023, 911 Authority should receive $41,447, Road Patrol should receive $71,841, COMM Action should receive $33,157, and Community College Debt should receive $55,262. The total amounts are $438,126 for 911 Authority, $759,418 for the Road Patrol, $350,501 for COMM Action, and $584,168 for Community College Debt.

Table 11.— Tax Revenue from Chandler Solar Project for Other Taxing Bodies

Tax Year	911 Authority	Road Patrol	COMM Action	Community College Debt
2023	$41,447	$71,841	$33,157	$55,262
2024	$35,468	$61,477	$28,374	$47,290
2025	$31,325	$54,296	$25,060	$41,766
2026	$28,100	$48,706	$22,480	$37,466
2027	$25,333	$43,911	$20,267	$33,778
2028	$23,026	$39,912	$18,421	$30,702
2029	$21,178	$36,709	$16,943	$28,238
2030	$19,789	$34,301	$15,831	$26,385
2031	$17,941	$31,098	$14,353	$23,921
2032	$17,011	$29,485	$13,609	$22,681
2033	$15,622	$27,078	$12,497	$20,829
2034	$14,692	$25,465	$11,753	$19,589
2035	$13,761	$23,853	$11,009	$18,349
2036	$13,290	$23,036	$10,632	$17,720
2037	$10,983	$19,037	$8,787	$14,644
2038	$10,971	$19,016	$8,777	$14,628
2039	$10,959	$18,995	$8,767	$14,612
2040	$10,947	$18,974	$8,757	$14,595
2041	$10,934	$18,953	$8,748	$14,579
2042	$10,922	$18,932	$8,738	$14,563
2043	$10,910	$18,911	$8,728	$14,547
2044	$10,898	$18,890	$8,718	$14,530
2045	$10,886	$18,868	$8,709	$14,514
2046	$10,873	$18,847	$8,699	$14,498
2047	$10,861	$18,826	$8,689	$14,482
TOTAL	$438,126	$759,418	$350,501	$584,168
AVG ANNUAL	$17,525	$30,377	$14,020	$23,367

As shown in Table 12, in 2023, the Township Fee should receive $12,178, DATA should receive $27,631, Recycling should receive $16,579, and Jail Bond Debt should receive $46,144. The total amounts are $133,319 for the Township Fee, $292,084 for DATA, $175,250 for Recycling, and $487,780 for the Jail Bond Debt.

Table 12.— Tax Revenue from Chandler Solar Project for Other Taxing Bodies

Tax Year	Township Fee	Delta Area Transit Authority (DATA)	Recycling	Jail Bond Debt
2023	$12,178	$27,631	$16,579	$46,144
2024	$10,512	$23,645	$14,187	$39,487
2025	$9,345	$20,883	$12,530	$34,875
2026	$8,429	$18,733	$11,240	$31,284
2027	$7,638	$16,889	$10,133	$28,205
2028	$6,973	$15,351	$9,211	$25,636
2029	$6,438	$14,119	$8,471	$23,578
2030	$6,033	$13,193	$7,916	$22,032
2031	$5,494	$11,961	$7,176	$19,974
2032	$5,219	$11,341	$6,804	$18,939
2033	$4,810	$10,414	$6,249	$17,392
2034	$4,534	$9,794	$5,877	$16,357
2035	$4,258	$9,174	$5,505	$15,321
2036	$4,116	$8,860	$5,316	$14,796
2037	$3,431	$7,322	$4,393	$12,228
2038	$3,424	$7,314	$4,388	$12,214
2039	$3,417	$7,306	$4,384	$12,201
2040	$3,409	$7,298	$4,379	$12,187
2041	$3,402	$7,290	$4,374	$12,174
2042	$3,395	$7,281	$4,369	$12,160
2043	$3,387	$7,273	$4,364	$12,146
2044	$3,380	$7,265	$4,359	$12,133
2045	$3,373	$7,257	$4,354	$12,119
2046	$3,365	$7,249	$4,349	$12,106
2047	$3,358	$7,241	$4,345	$12,092
TOTAL	$133,319	$292,084	$175,250	$487,780
AVG ANNUAL	$5,332	$11,683	$7,010	$19,511

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X. Curriculum Vita - David Loomis

David G. Loomis
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Education

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

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

Experience

1996-present Illinois State University, Normal, IL
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.

2006-2017 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.

Experience (cont.)

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, Normal, IL
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.

1997-2002 International Communications Forecasting Conference
Chair
- Expanded Planning Committee with representatives from over 18 different international companies and delivered high quality conference attracting over 500 people over 4 years.

1985-1996 Business Research Bell Atlantic, Philadelphia, PA
Economist
- Wrote and taught Applied Business Forecasting multimedia course.
- Developed and documented 25 econometric demand models that were used in regulatory filings.
- Provided statistical and analytic support to regulatory costing studies.
- Served as subject matter expert in switched and special access.
- Administered $4 million budget including $1.8 million consulting budget.

Professional Awards and Memberships

2016 Outstanding Cross-Disciplinary Team Research Award with Jin Jo and Matt Aldeman – recognizes exemplary collaborative research conducted by multiple investigators from different disciplines.

2011 Midwestern Regional Wind Advocacy Award from the U. S. Department of Energy's Wind Powering America presented at WindPower 2011

2009 Economics Department Scott M. Elliott Faculty Excellence Award – awarded to faculty who demonstrate excellence in teaching, research and service.

2009 Illinois State University Million Dollar Club – awarded to faculty who have over $1 million in grants through the university.

2008 Outstanding State Wind Working Group Award from the U. S. Department of Energy's Wind Power America presented at WindPower 2008.

1999 Illinois State University Teaching Initiative Award

Member of the American Economic Association, National Association of Business Economists, International Association for Energy Economics, Institute for Business Forecasters; Institute for International Forecasters, International Telecommunications Society.

Professional Publications

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Professional Publications (cont.)

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Adams Township (Michigan) Planning Commission Hearing, on behalf of Invenergy, Direct Oral Testimony, August 27, 2019.

Christian County (Illinois) Zoning Board of Appeals, on behalf of Invenergy, Direct Oral Testimony, July 23, 2019.

Wheatland Township (Michigan) Planning Commission Hearing, on behalf of Invenergy, Direct Oral Testimony, July 18, 2019.

Christian County (Illinois) Board Meeting, on behalf of Invenergy and Tradewind Energy, Direct Oral Testimony, May 29, 2019.

DeWitt County (Illinois) Zoning Board of Appeals, on behalf of Tradewind Energy, Direct Oral Testimony, February 8, 2019.

Public Service Commission of Wisconsin, Docket No. 9697-CE-100, Application of Badger Hollow Solar Farm for a Certificate of Public Convenience and Necessity, on behalf of Badger Hollow Solar Farm LLC (Invenergy): Written Direct Testimony filed November 20, 2018; Written Rebuttal Testimony filed January 8, 2019; Surrebuttal Testimony filed January 14, 2019; Oral Cross-Examination, January 16, 2019.

Ford County (Illinois) Zoning Board of Appeals, on behalf of Pattern Energy and Apex Clean Energy, Direct Oral Testimony, October 3, 2018.

DeKalb County (Illinois) County Board Hearing, on behalf of EDF Renewable Development, Inc., Direct Oral Testimony, September 24, 2018.

Ford County (Illinois) Planning Commission, on behalf of Pattern Energy, Direct Oral Testimony, September 5, 2018.

DeKalb County (Illinois) Zoning Board of Appeals, on behalf of EDF Renewable Development, Inc., Direct Oral Testimony, June 27, 2018.

Ford County (Illinois) Zoning Board, on behalf of Apex Clean Energy, Inc., Direct Oral Testimony, June 11, 2018.

McLean County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of Invenergy, LLC, Direct Oral Testimony, January 4, 2018.

New Mexico Public Regulation Commission, Case No. 17-00275-UT, Application of Sagamore Wind Energy LLC, on behalf of Invenergy, LLC: Direct Written Testimony filed November 6, 2017; Oral Cross-examination Testimony appeared before the Commission on March 13, 2018.

Expert Testimony

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Macon County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of E.ON Energy, Direct Oral Testimony, August 11, 2015.

Kankakee County (Illinois) Planning, Zoning, and Agriculture Committee, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of EDF Renewables, Direct Oral Testimony, July 22, 2015.

Kankakee County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of EDF Renewables, Direct Oral Testimony, July 13, 2015.

Bureau County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of Berkshire Hathaway Energy/Geronimo Energy, Direct Oral Testimony, June 16, 2015.

Illinois Commerce Commission, Case No. 15-0277, on behalf of Grain Belt Express Clean Line LLC: Written Direct Testimony filed April 10, 2015; Written Rebuttal Testimony filed August 7, 2015; Oral Cross-Examination Testimony, August 19, 2015.

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Boone County (Illinois) Board, Examination of Wind Energy Conversion System Ordinance, Direct Testimony and Cross-Examination, April 23, 2013.

Illinois Commerce Commission, Case No. 12-0560, on behalf of Rock Island Clean Line LLC: Written Direct Testimony filed October 10, 2012; Written Rebuttal Testimony filed August 20, 2013; Oral Cross-Examination Testimony, December 11, 2013 .

Expert Testimony (cont.)

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State of Illinois Senate Energy and Environment Committee, Direct Testimony and Cross-Examination, on behalf of the Center for Renewable Energy, October 28, 2010.

Livingston County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of the Center for Renewable Energy, Direct Testimony and Cross-Examination, July 28, 2010.

Errata

The author found an error in the economic impact calculations after the publication of the report in January, 2020 because IMPLAN expanded the number of sectors from 536 to 546 in their latest data. After accounting for all of these sectors, some of the economic impacts changed and necessitated this update.

- Cover, changed January 2020 to April, 2020 Revised January 2020 Report
- Page 1, Jobs, bullet 1, changed 122 to 107
- Page 1, Jobs, bullet 2, changed 288 to 263
- Page 1, Jobs, bullet 3, changed 13 to 7.5
- Page 1, Jobs, bullet 4, changed 18 to 18.1
- Page 1, Earnings, bullet 1, changed $5.7 million to $7.3 million
- Page 1, Earnings, bullet 3, changed $470 thousand to $282 thousand
- Page 1, Earnings, bullet 4, changed $1.1 million to $1.0 million
- Page 1, Output, bullet 1, changed $13.1 million to $10.5 million
- Page 1, Output, bullet 2, changed Almost $37.0 million to Over $32.9 million
- Page 1, Output, bullet 3, changed $1.5 million to $936 thousand
- Page 1, Output, bullet 4, changed $2.9 million to $2.7 million
- Page 4, Figure 1 title, changed 2010-2018 to 2010-2024E
- Page 22, section title, changed a to b
- Page 36, paragraph 4, line 8, changed 24 to 31
- Page 36, paragraph 4, line 11, changed 48 to 62
- Page 36, updated Table 5
- Page 37, paragraph 1, line 2, changed 122 to 107
- Page 37, paragraph 1, line 2, changed 288 to 263
- Page 37, paragraph 1, line 4, changed 13 to 7.5
- Page 37, paragraph 1, line 4, changed 18 to 18.1
- Page 37, paragraph 2, line 12, changed $5.7 to $7.3
- Page 37, paragraph 2, line 12, changed $21 to $21.2
- Page 37, paragraph 2, line 14, changed $470 to $282
- Page 37, paragraph 2, line 14, changed $1.1 to $1.0
- Page 37, updated Table 6
- Page 38, line 5, changed $13.1 to $10.5
- Page 38, line 6, changed $36.9 to $32.9
- Page 38, line 7, changed $1.5 million to $936 thousand
- Page 38, line 8, changed $2.9 to $2.7
- Page 39, updated Table 7

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Economic Impact of the
Chandler Solar Project