Economic Impact and Land Use Analysis
of the
Black Diamond Solar Project

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About the Author

Dr. David G. Loomis is Professor of Economics at Illinois State University and Co-Founder of the Center for Renewable Energy. He has over 10 years of experience in the renewable energy field and has performed economic analyses at the county, region, state and national levels for utility-scale wind and solar generation. He has served as a consultant for Apex Clean Energy, Clean Line Energy Partners, EDF Renewables, E.ON Climate and Renewables, Geronimo Energy, Invenergy, J-Power, the National Renewable Energy Laboratories, Ranger Power, State of Illinois, Tradewind Energy, and others. He has testified on the economic impacts of energy projects before the Illinois Commerce Commission, Missouri Public Service Commission, New Mexico Public Regulation Commission, Wisconsin Public Service Commission, Illinois Senate Energy and Environment Committee, 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 25 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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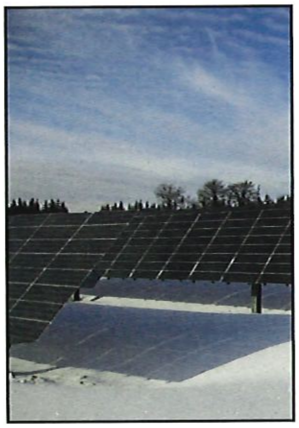

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I. Executive Summary

Swift Current Energy is developing the Black Diamond Solar Project in Christian County, Illinois. Swift Current Energy is a clean energy focused development and investment firm. Founded in 2016 by industry veterans, Swift Current has over a gigawatt of utility scale wind, solar, and energy storage power projects in development across North America. The purpose of this report is to aid decision makers in evaluating the economic impact of this project on Christian County and the State of Illinois. The basis of this analysis is to study the direct, indirect, and induced impacts on job creation, wages, and total economic output.

The Black Diamond Solar Project is a 299 MW solar project using single-axis tracking panels. The project represents an investment in excess of $425 million. The total development is anticipated to result in the following:

Economic Impact

Jobs - all jobs numbers are full-time equivalents

- 892 new local jobs during construction for Christian County
- 1,232 new local jobs during construction for the State of Illinois
- 13.1 new local long-term jobs for Christian County
- 23.7 new local long-term jobs for the State of Illinois

Earnings

- Over $20.7 million in new local earnings during construction for Christian County
- Over $103 million in new local earnings during construction for the State of Illinois
- Over $572 thousand in new local long-term earnings for Christian County annually
- Over $1.7 million in new local long-term earnings for the State of Illinois annually

Output - the value of production in the state or local economy. It is an equivalent measure to the Gross Domestic Product.

- Over $67.3 million in new output during construction for Christian County
- Over $178.5 million in new output during construction for the State of Illinois
- Over $1.3 million in new long-term output for Christian County annually
- Over $4.1 million for the State of Illinois in new long-term output annually

Property Taxes

- Over $29.5 million in total school district revenue over the life of the Project
- Over $6.4 million in total township and road district property taxes over the life of the Project
- Almost $4.8 million in total county property taxes for Christian County over the life of the Project
- Over $45.8 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 Analysis

- Using a real-options analysis, the value of using the land for solar exceeds the value of using the land for agriculture.
- The price of corn would need to rise to $16.51/bushel, or yields for corn would need to rise to 516 bushels per acre for corn farming to generate more income for the landowner and local community than using the land for solar energy; at the time of this report, corn prices are $3.60 and yields are 210 bushels per acre.
- The price of soybeans would need to rise to $49.26/bushel, or yields for soybeans would need to rise to 188 bushels per acre for soybean farming to be more valuable than using the land for solar energy; at the time of this report, soybean prices are $8.95 and yields are 65 bushels per acre.

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.

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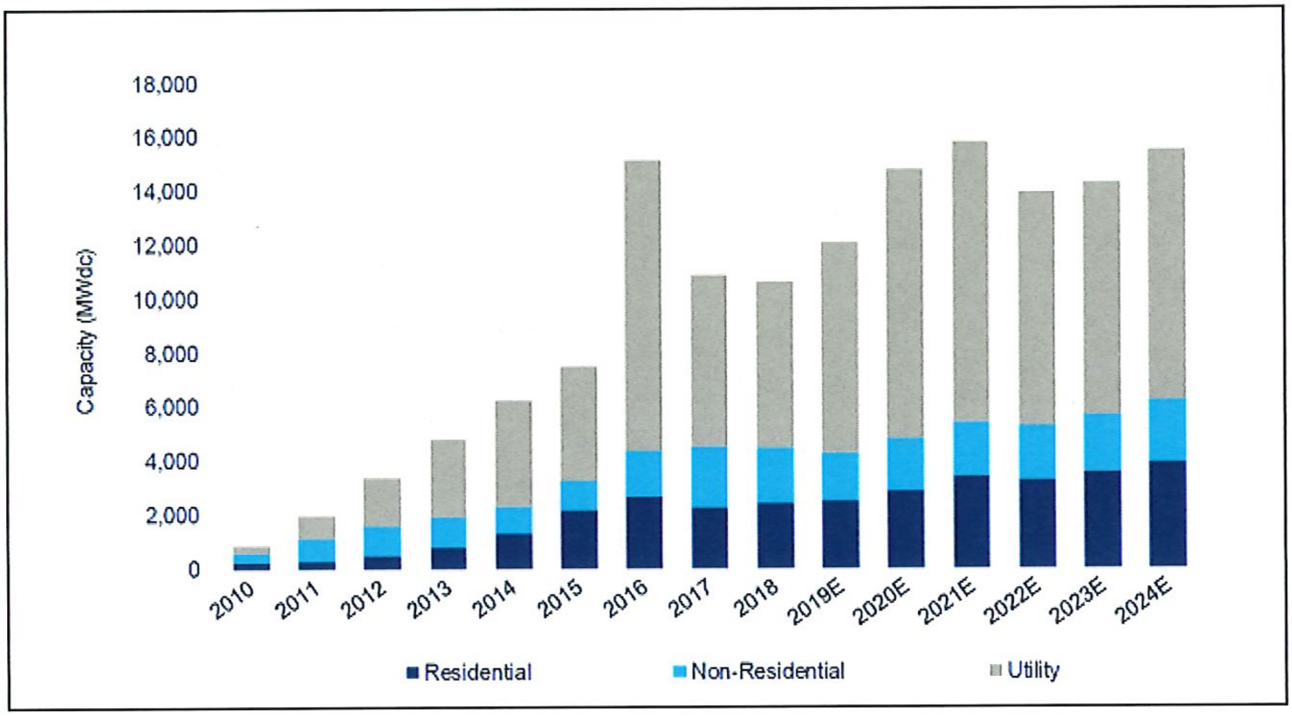
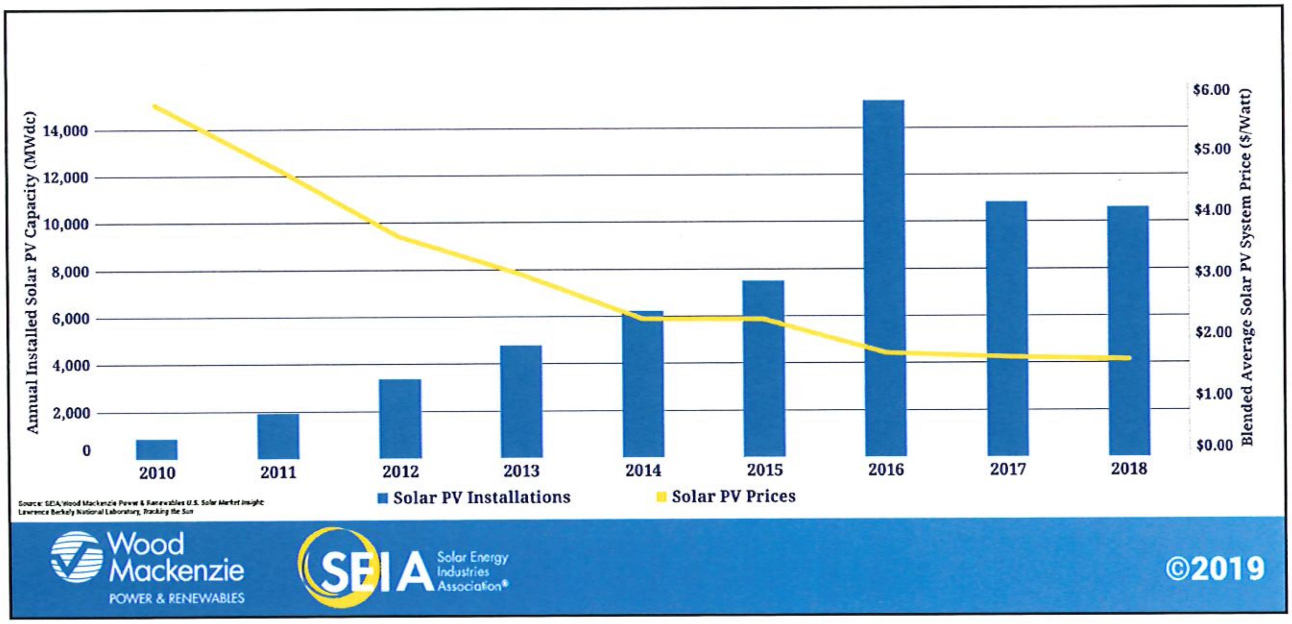
[1] Solar modules generate direct current (DC) electricity, which must be inverted to alternating current (AC) to connect to the grid. Projects typically have a DC/AC ratio of about 1.3. For example, Black Diamond Solar Energy Center is 389 MW DC but only 299 MW AC. The report uses DC measurement in 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

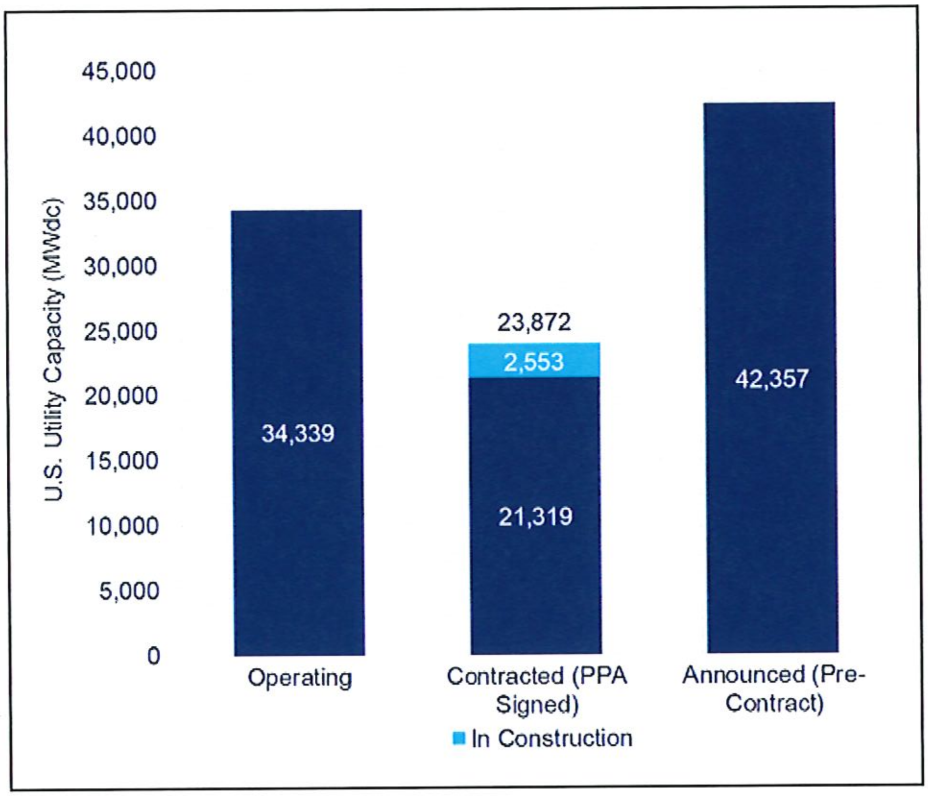
Figure 2.—U.S. Annual Solar PV Installations and Prices



Source: SEIA/Wood Mackenzie Power & Renewables U.S. Solar Market Insight; Lawrence Berkeley National Laboratory, *Tracking the Sun*

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. Illinois Solar Industry

According to SEIA, Illinois is ranked 33rd in the U.S. 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 irradiation that they receive. However, other states with similar solar irradiation to Wisconsin rank highly including New Jersey (7th), Massachusetts (8th), New York (10th), and Maryland (15th). In 2019, Illinois installed 101.95 MW of solar electric capacity bringing its cumulative capacity to 211.48 MW.

Illinois has great potential to expand its solar installations. According to Jo, Aldeman, and Loomis (2013a), solar PV could produce 7.5% of Illinois' electric load. Yet in 2016, Illinois produced only 0.14% of its electricity from Solar PV and Solar Thermal according to the EIA (2019). Illinois has three utility-scale solar farms in operation: Exelon City Solar is a 10 MW installation on the south side of Chicago; Grand Ridge Solar Farm is a 20 MW installation near Streator, IL; and the Rockford Solar Farm is a 3 MW installation near the Chicago Rockford International Airport. The 200 MW Black Diamond Solar Project will be the largest installation in Illinois to date and is ten times the size of the largest existing solar PV installation.

There are more than 395 solar companies in Illinois including 80 manufacturers, 142 installers/developers, and 173 others.[2] Figure 4 shows the locations of solar companies in Illinois as of the time of this report. Currently, there are 5,513 solar jobs in the State of Illinois according to SEIA.

Figure 5 shows the Illinois historical and forecasted installed capacity by year according to the SEIA. Huge growth in solar is forecasted in 2019 and beyond due largely to new energy legislation that was passed in Illinois in 2016. The legislation, titled the Future Energy Jobs Act, is expected to spur 1,300 MW of new wind development and 3,000 MW of new solar development by 2030.

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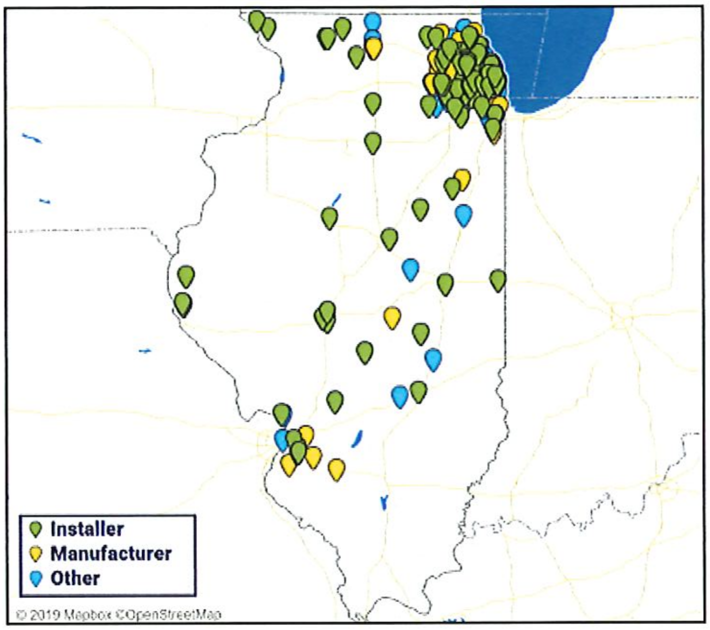
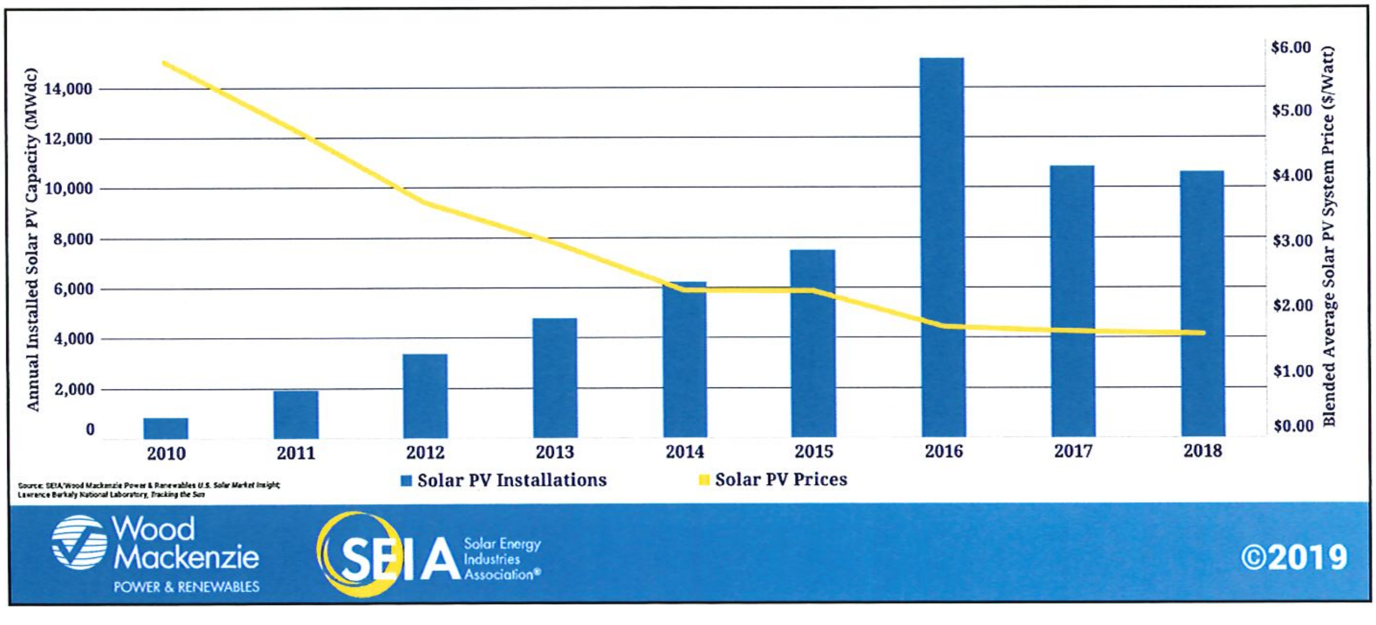
[2] "Other" includes Sales and Distribution, Project Management, and Engineering.

Figure 4.—Solar Company Locations in Illinois



Source: Solar Energy Industries Association, Solar Spotlight: Illinois

Figure 5.—Illinois Annual Solar Installations



Source: Solar Energy Industries Association, Solar Spotlight: Illinois

c. Economic Benefits of Utility-Scale Solar 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. 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 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. Wisconsin ranked fifth supporting 30.08 jobs during construction and 0.03 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.

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.

III. Black Diamond Solar Project Description and Location

Figure 6.—Location of Christian County, Illinois

Source: https://en.wikipedia.org/wiki/Christian_County,_Illinois#/media/File:Map_of_Illinois_highlighting_Christian_County.svg

a. Project Description

Black Diamond Solar Project is a proposed photovoltaic (PV) solar energy generating facility and associated systems totaling 299 MW AC nameplate capacity in Christian County, IL. The developer intends to install bifacial solar panels in single-axis tracker systems.

b. Christian County, Illinois

Christian County is located in the central part of Illinois (see Figure 6). It has a total area of 716 square miles and the U.S. Census estimates that the 2010 population was 34,800 with 15,563 housing units. The County has a population density of 49 (persons per square mile) compared to 232 for the State of Illinois. Median household income in the county was $41,712.

Economic and Demographic Statistics

As shown in Table 1, the largest industry is "Health Care" followed by "Professional Services," "Other Services," and "Administrative Government." These data for Table 1 come from IMPLAN covering the year 2018 (the latest year available).

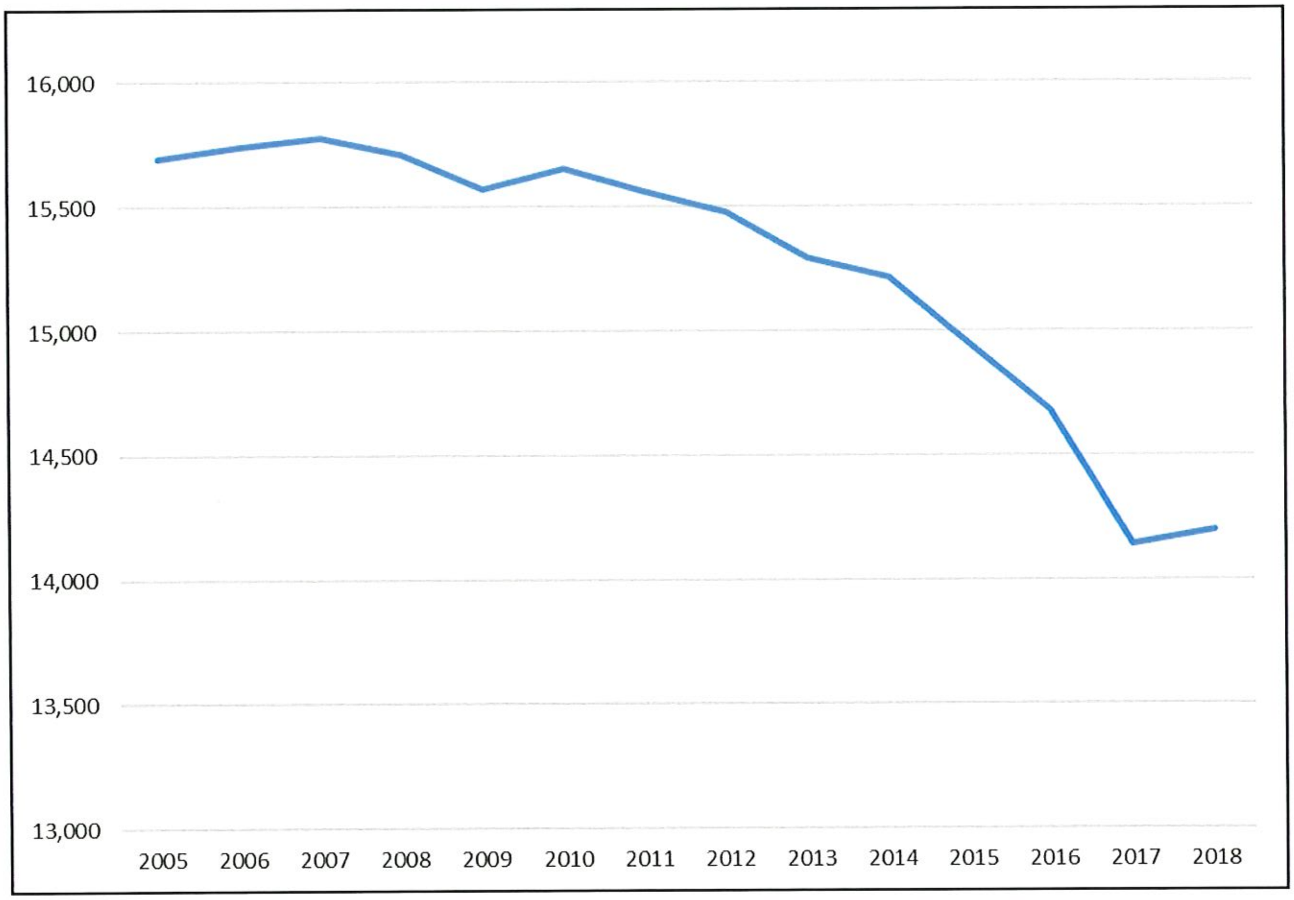
Table 1.—Employment by Industry in Christian County

Industry	Number	Percent
Health Care and Social Assistance	1,773	11.8%
Professional, Scientific, and Technical Services	1,681	11.2%
Other Services (except Public Administration)	1,667	11.1%
Administrative Government	1,528	10.2%
Retail Trade	1,497	9.9%
Manufacturing	1,001	6.6%
Accommodation and Food Services	835	5.5%
Construction	754	5.0%
Agriculture, Forestry, Fishing and Hunting	729	4.8%
Finance and Insurance	668	4.4%
Administrative and Support and Waste Management and Remediation Services	625	4.2%
Wholesale Trade	623	4.1%
Transportation and Warehousing	364	2.4%
Real Estate and Rental and Leasing	353	2.3%
Management of Companies and Enterprises	254	1.7%
Utilities	187	1.2%
Arts, Entertainment, and Recreation	181	1.2%
Government Enterprises	135	0.9%
Information	114	0.8%
Educational Services	55	0.4%
Mining, Quarrying and Oil and Gas Extraction	31	0.2%

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

Table 1 provides the most recent snapshot of the total employment but does not examine the historical trends within the county. Figure 7 shows the total employment from 2005 to 2018. Year-over-year employment has largely decreased since hitting a high of 15,779 in 2007. Overall, Christian County employment has decreased from 15,695 in 2005 to 14,198 in 2018, a loss of 1,497 jobs. Since 2005, Christian County has lost an average of 124 jobs each year.

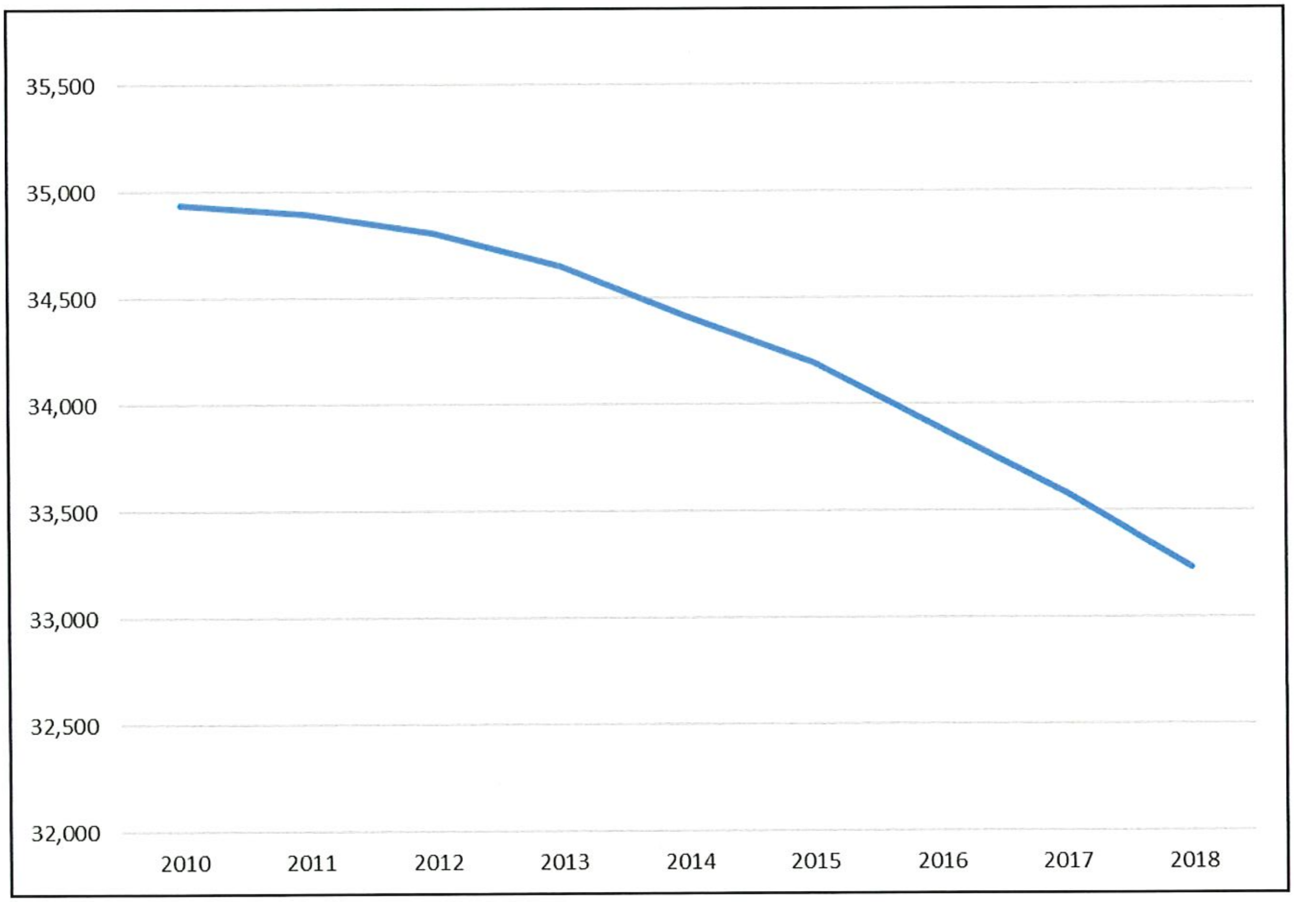
Figure 7.—Total Employment in Christian County from 2005 to 2018



Source: Bureau of Economic Analysis, GDP and Personal Income, 2005 to 2018

The employment trends mirror the overall population trends in the county. As shown in Figure 8, Christian County population has decreased each year since 2010. Christian County population was 34,936 in 2010 but only 33,231 in 2018, a loss of 1,705. The average annual population decline over this time period was 213.

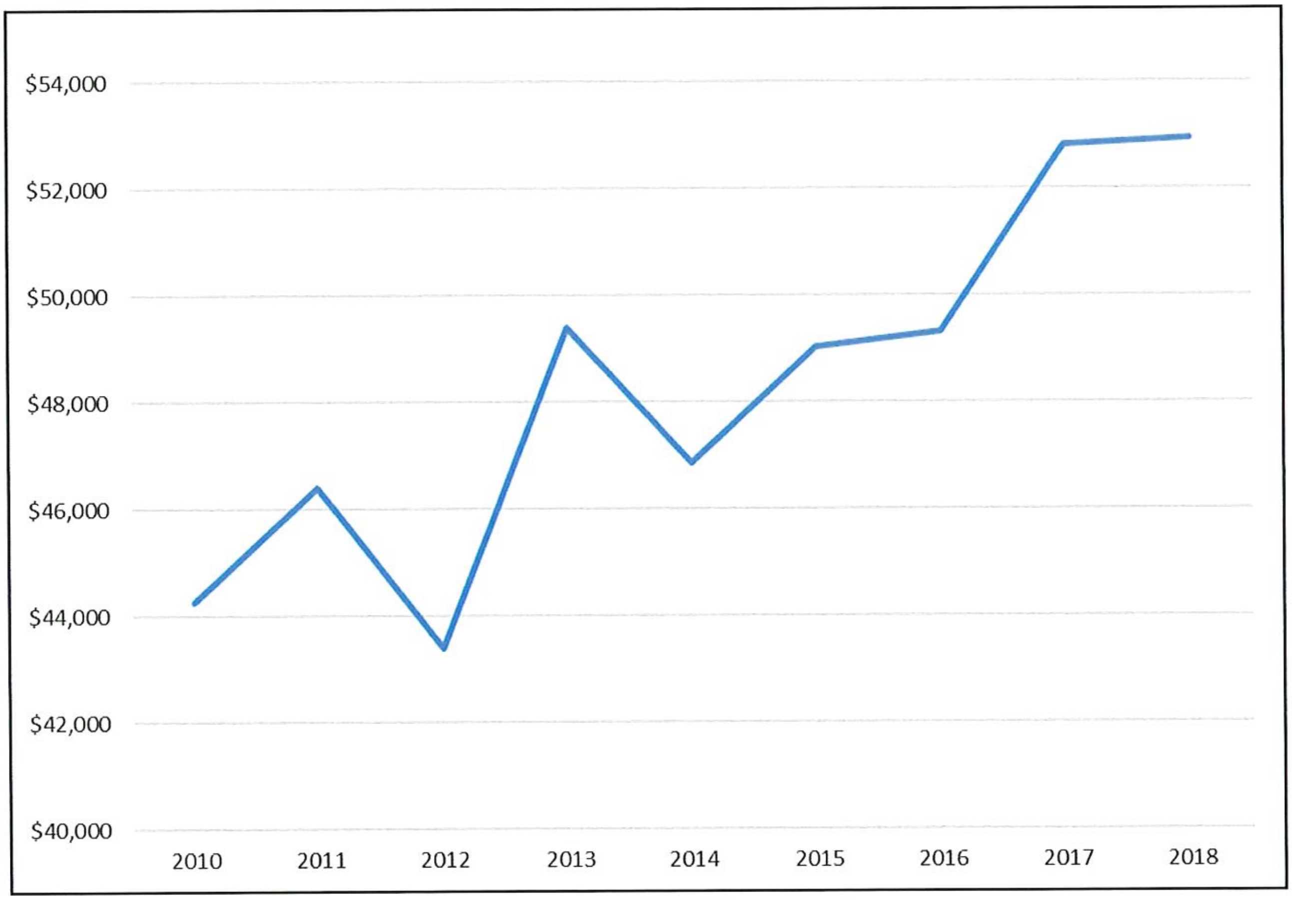
Figure 8.—Population in Christian County 2010-2018



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census

In contrast to declines in employment and population, the median household income in Christian County has gone up. Figure 9 shows the total household income in Christian County from 2010 to 2018. Median income increased from $43,393 in 2012 to $52,936 in 2018.

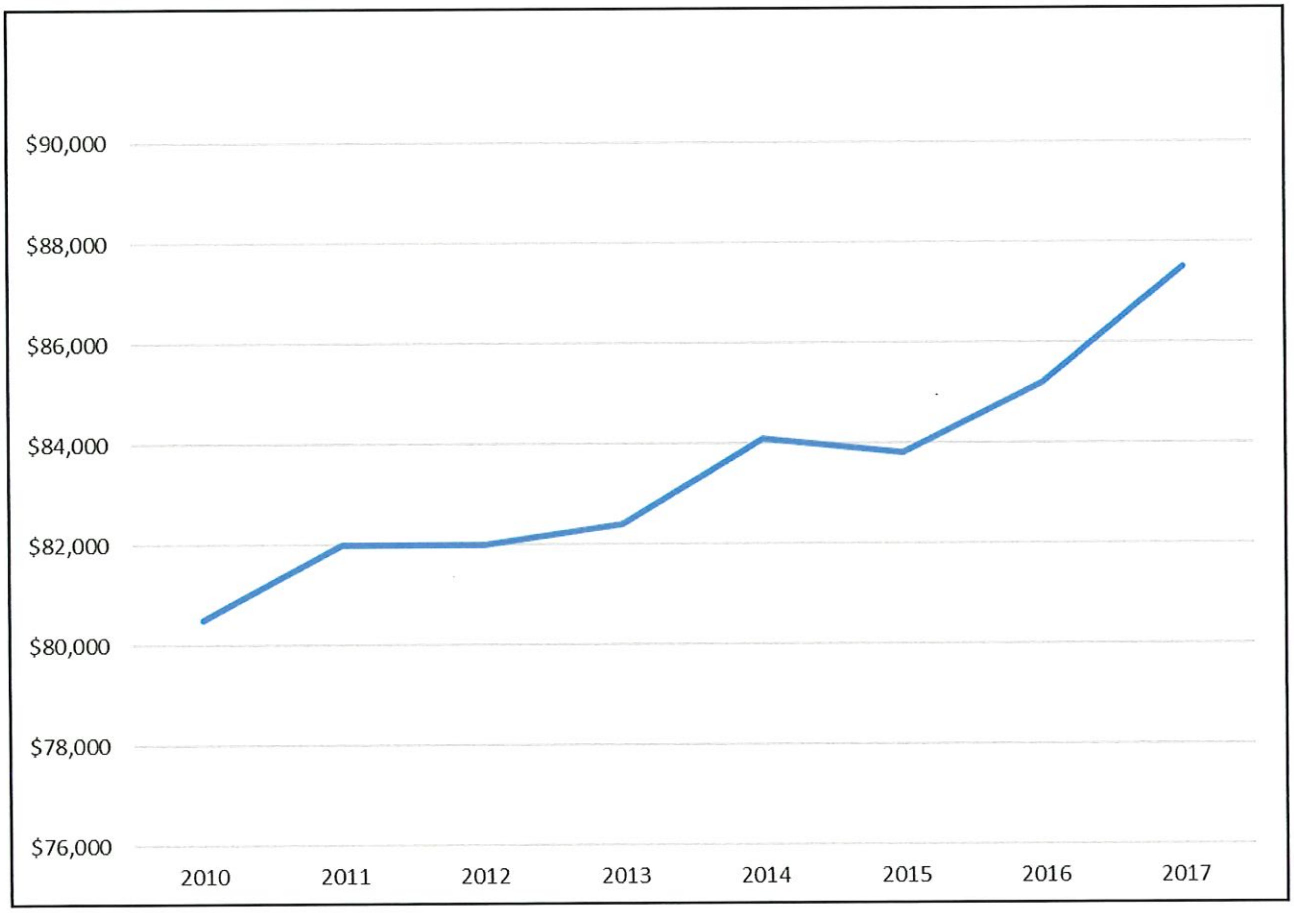
Figure 9.—Median Household Income in Christian County from 2010 to 2018



Source: Federal Reserve Bank of St. Louis Economic Data, U.S. Census

Owner-occupied housing values have increased with median property values rising from $80,500 in 2010 to $87,500 in 2017 as shown in Figure 10.

Figure 10.—Median Owner-Occupied Property Values in Christian County from 2010-2017



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

Agricultural Statistics

Illinois is ranked seventh among U. S. states in total value of agricultural products sold (Census, 2017). It is ranked 24th in the value of livestock, and second in the value of crops (Census, 2017). In 2019, Illinois had 71,400 farms and 27 million acres in operation with the average farm being 378 acres (State Agricultural Overview, 2019). Illinois had 82 thousand cattle and produced 1.7 billion pounds of milk (State Agricultural Overview, 2019). In 2019, Illinois yields averaged 181 bushels per acre for grain corn with a total market value of $7.1 billion (State Agricultural Overview, 2019). Soybean yields averaged 54 bushels per acre with a total market value of $4.8 billion (State Agricultural Overview, 2019). The average net cash farm income per farm is $69,418 (Census, 2017).

In 2017, Christian County had 794 farms covering 402,703 acres for an average farm size of 507 acres (Census, 2017). The total market value of products sold was $278.7 million, with almost 90 percent coming from crop sales (Census, 2017). The average net cash farm income of operations was $104,155 (Census, 2017).

The 2,018 acres planned to be used by the Black Diamond Solar Project represents just 0.50% of the acres used for farming in Christian County. Given the excess supply of farmland, this small reduction will help stabilize crop prices. 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

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 percent 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.

In the United States, federal taxpayers actually pay to take cropland out of production through the U. S. Conservation Reserve Program (Dean, 2019). In Illinois nearly 878,751 acres are not being farmed in order to preserve the land and reduce crops to limit additional supply. In 2018, there was 878,751 acres under contract in Illinois (USDA, 2019). 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, 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).

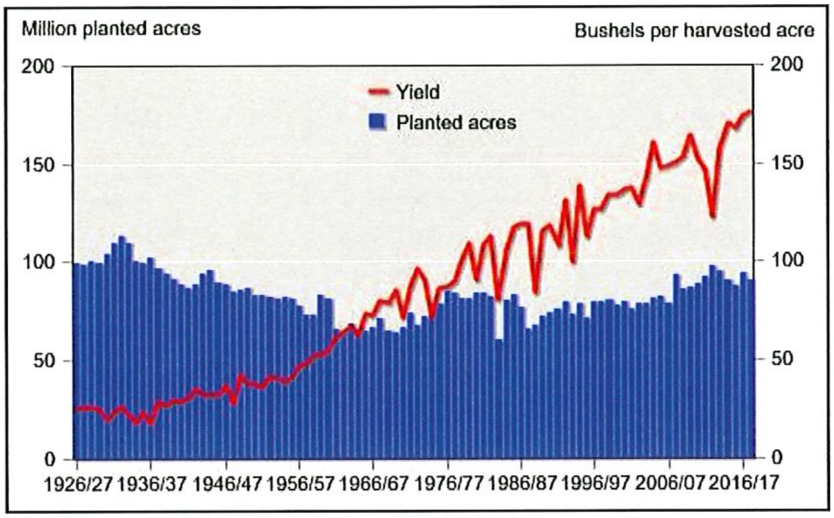
b. Agricultural Land and Solar Farms

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."

However, the present case of using 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. At the end of the project, the owner is required to restore the land to its original condition and will likely return to agricultural use. This requirement is typically in the solar ordinance for permitting and the Agricultural Impact Mitigation Agreement (AIMA). This is far different from residential or commercial development where the land is often owned in fee 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. Third, the free market economic forces are working properly because solar farms present landowners with an opportunity for a higher value use on their land.

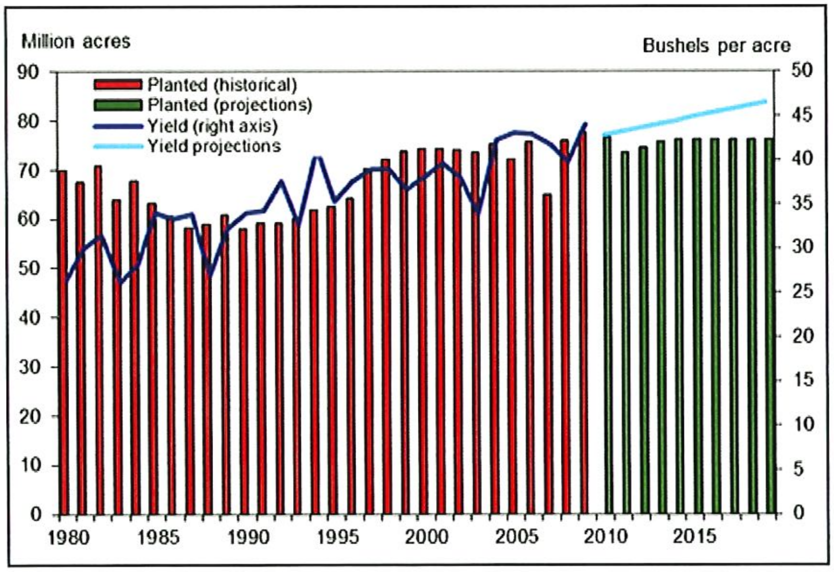
Farmland has gotten more productive over the years with better farming equipment and techniques resulting in higher yields on the same amount of land. Corn production has risen due to improvements in seed varieties, fertilizers, pesticides, machinery, reduced tillage, irrigation, crop rotations and pest management systems. Figure 11 shows the dramatic increase U.S. corn yields since 1926. Soybean yields have also increased though not as dramatically. Figure 12 displays the soybean yields in the U.S. since 1980.

Figure 11.—U.S. Corn Acreage and Yield



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

Figure 12.—U.S. Soybean Acreage and Yield



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

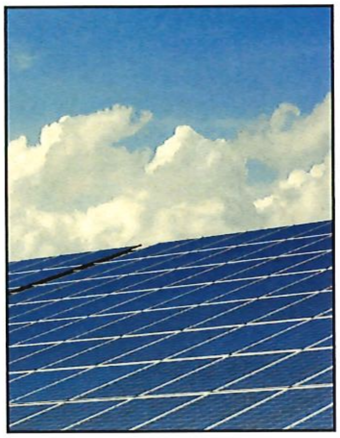
c. Methodology

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 Christian 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 Christian County, Illinois

	1992	1997	2002	2007	2012	2017
Total Farm Income Per Farm	NA	NA	$6,192	$9,963	$34,346	$21,703
Total Farm Production Expenses (average/farm)	$76,536	$82,569	$99,365	$137,980	$216,414	$235,387
Average Farm Size (acres)	437	476	516	494	458	507
Net Cash Income per Farm[3]	$55,638	$59,873	$51,463	$126,387	$163,625	$140,155
Average Market Value of Machinery Per Farm	$89,075	$112,806	$129,646	$171,450	$240,299	$311,771

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

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[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 savage value. This is a very conservative estimate of the depreciation since the machinery will likely qualify for a shorter life and accelerated or bonus depreciation. To calculate the opportunity cost of the farmers time, we obtained the mean hourly wage for farming in each of these years from the Bureau of Labor Statistics. Again, to be conservative, we estimate that the farmer spends a total of 16 weeks 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 Christian County, Illinois

	1992	1997	2002	2007	2012	2017
Average Market Value Machinery Per Farm	$89,075	$112,806	$129,646	$171,450	$240,299	$311,771
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$4,454	$5,640	$6,482	$8,573	$12,015	$15,589
Mean Hourly Wage in IL for Farming (Bureau of Labor Statistics)	$5.76	$6.55	$9.31	$11.09	$12.10	$13.79
Annual Opportunity Cost of Farmer's Time (Wage times 8 weeks times 40 Hours/Week)	$3,688	$4,192	$5,958	$7,098	$7,744	$8,826

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 Christian County, Illinois

	1992	1997	2002	2007	2012	2017
Net Cash Income per Farm	$55,638	$59,873	$51,463	$126,387	$163,625	$140,155
Machinery Depreciation	($4,454)	($5,640)	($6,482)	($8,573)	($12,015)	($15,589)
Opportunity Cost of Farmer's Time	($3,688)	($4,192)	($5,958)	($7,098)	($7,744)	($8,826)
Profit	$47,496	$50,041	$39,022	$110,717	$143,866	$115,741
Average Farm Size (Acres)	437	476	516	494	458	507
Profit Per Acre in 2012 Dollars	$108.69	$105.13	$75.62	$224.12	$314.12	$228.29
CPI	141.9	161.3	180.9	210.036	229.601	246.524
Profit Per Acre in 2017 Dollars	$188.82	$160.67	$103.06	$263.06	$337.27	$228.29

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

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[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.

Because Swift Current is purchasing the land rather than leasing it from the current landowner, we need to find the annual holding costs of owning the land. The holding costs would consist of the opportunity cost of capital (i.e. the interest rate that the firm could have earned if it didn't tie up its funds in the purchase of the land) and property taxes. For this analysis we assume a cost of capital of 5% and an agricultural tax rate of $53/acre.

Using an unsophisticated static analysis, the land would be better used for solar if the annual holding costs per acre exceeds the 2017 profit per acre of $228.29 which adjusts to $237.51 in 2019 after counting for inflation. 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:

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

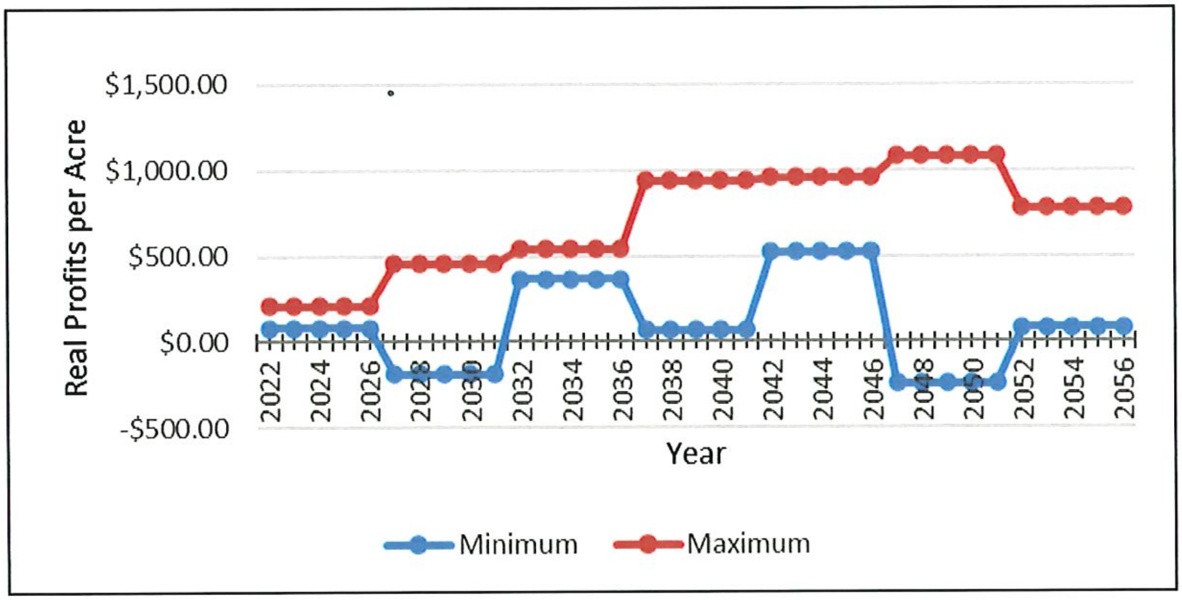
Where π_t is the farming profit in year t; α is intercept; β is the trend and time is a simple time trend starting at 1 and increasing by 1 each time period.

Using the Census of Agriculture data from 1992 to the present, the intercept is $70.69 with a standard error of $107.36. The (five-year interval) time trend is $36.94 with a standard error of $25.30. This means that agriculture profits are expected to rise by $36.94 over each five-year period. 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 interval to interval. Since the Census of Agriculture is only reported every five years, the agriculture profits are forecasted in five-year intervals. Using this information, we can simulate future profitability for the farmer using the above equation.

For each five-year interval, we assume that the profit per acre follows the equation above but allows for the random fluctuations. Using the standard errors that result from the regression question on historical data, we can simulate the random fluctuations using Monte Carlo simulation. We assume that the solar farm will begin operation in 2022 and end 35 years later in 2056. Using 500 different simulations, the average real profit per acre never exceeds $807.41 over the 35-year life of the Project. Figure 13 is a graph of the overall highest and lowest real profit per acre simulations.

When comparing the average annual payment projected in the maximum simulation to the solar lease per acre payment, the solar lease provides higher returns than farming in all of the 500 simulations. This means the farm is financially better off when used for solar PV in 100% of the 500 of the scenarios analyzed.

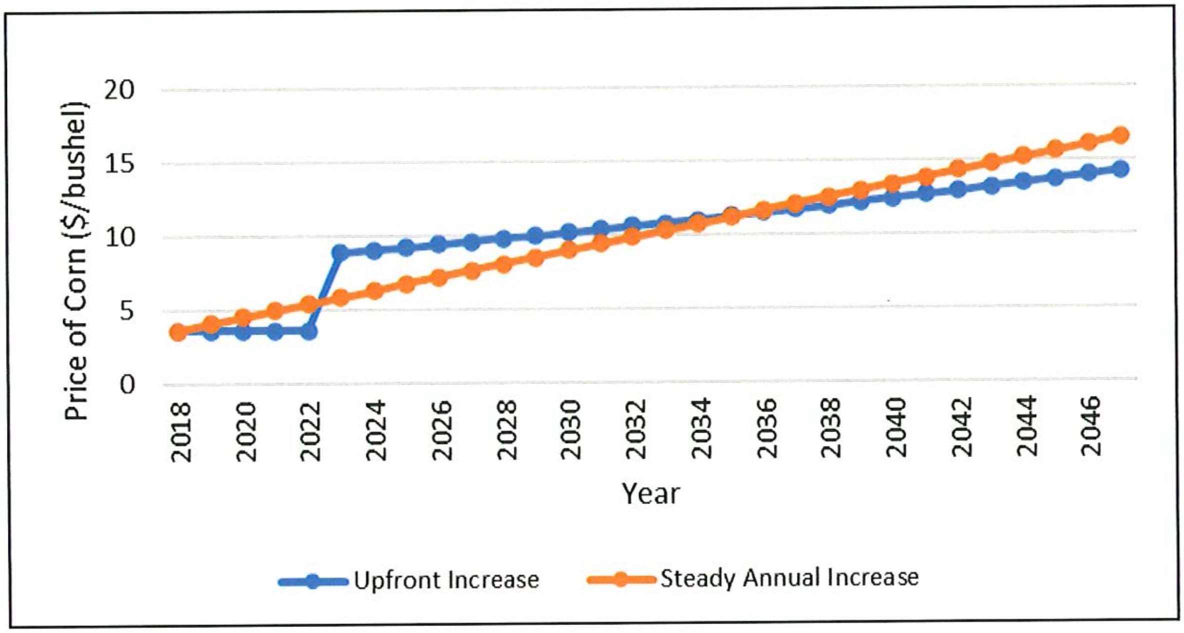
Figure 13.—Simulations of Real Profits Per Acre Based on Data from 1992



Source: Author's Calculations

Another way to look at this problem would be to ask: How high would the price of corn or soybeans 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 $3.60 per bushel in 2018 to $8.85 in 2023 and rise to $14.32 per bushel by 2047 as shown in Figure 14. Alternatively, the price of corn would need to rise by $0.445 per bushel each year from 2018 to 2047 when it would reach $16.51 per bushel.

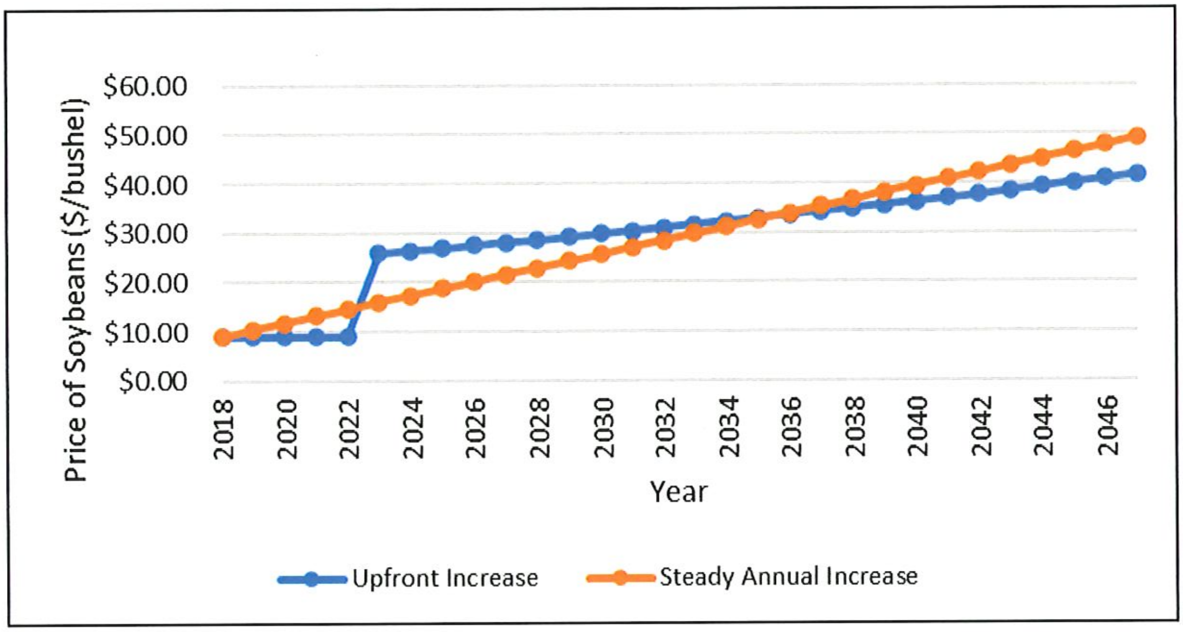
Figure 14.—Simulated Price of Corn per Bushel to Match the Solar Lease



Source: Author's Calculations

If we assume the yields and input costs stay the same, the price of soybeans would have to rise from $8.95 per bushel in 2018 to $25.91 per bushel in 2023 and rise to $41.68 by 2047 as shown in Figure 15. For a linear increase, the price of soybeans would need to rise by $1.39 per bushel each year from 2018 to 2047 when it would reach $49.26 per bushel.

Figure 15.—Simulated Price of Soybeans per Bushel to Match the Solar Lease



Source: Author's Calculations

If we assume that the price of corn and soybeans stays the same, the yields for corn would need to increase from 210 bushels per acre in 2018 to 516 bushels per acre in 2023 and stay at that level until 2047. The yields for soybeans would need to rise from 65 bushels per acre in 2018 to 188 bushels per acre in 2023 and stay there until 2047.

VI. Economic Impact Methodology

The economic analysis of solar PV project presented uses 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 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 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 Swift Current. In addition, Swift Current also estimated the percentages of project materials and labor that will be coming from within Christian County and the State of Illinois.

Two separate JEDI models were produced to show the economic impact of the Black Diamond Solar Project. The first JEDI model used the 2018 Christian County multipliers from IMPLAN. The second JEDI model used the 2018 IMPLAN multipliers for the State of Illinois and the same project costs.

Tables 5-7 show the output from these models. Table 5 lists the total employment impact from the Black Diamond Solar Project for Christian County and the State of Illinois. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

Table 5.—Total Employment Impact from the Black Diamond Solar Project

	Christian County Jobs	State of Illinois Jobs
Construction		
Project Development and Onsite Labor Impacts (direct)	497	612
Module and Supply Chain Impacts (indirect)	337	338
Induced Impacts	59	282
New Local Jobs During Construction	892	1,232
Operations (Annual)		
Onsite Labor Impacts (direct)[5]	4.0	4.0
Local Revenue and Supply Chain Impacts (indirect)	3.7	5.5
Induced Impacts	5.4	14.2
New Local Long-Term Jobs	13.1	23.7

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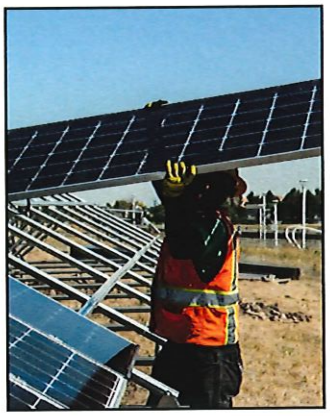
[5] This result comes from Swift Current which expects 4 direct hires on this project.



The results from the JEDI model show significant employment impacts from the Black Diamond 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 892 new jobs during construction in Christian County, though the construction of the solar center could involve closer to 1,784 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 892 for Christian County, and 1,232 for the State of Illinois. New local long-term jobs created from the Black Diamond Solar Project total 13.1 for Christian County and 23.7 for the State of Illinois.

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 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 Black Diamond Solar Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction total over $20.7 million for Christian County and over $103 million for the State of Illinois. The new local long-term earnings total over $572 thousand for Christian County and over $1.7 million for the State of Illinois.

Table 6.—Total Earnings Impact from the Black Diamond Solar Project

	Christian County	State of Illinois
Construction		
Project Development and Onsite Earnings Impacts	$6,492,971	$64,881,672
Module and Supply Chain Impacts	$12,245,799	$21,352,066
Induced Impacts	$1,981,036	$16,781,944
New Local Earnings During Construction	$20,719,806	$103,015,682
Operations (Annual)		
Onsite Labor Impacts	$272,187	$543,158
Local Revenue and Supply Chain Impacts	$118,024	$368,934
Induced Impacts	$182,689	$844,317
New Local Long-Term Earnings	$572,900	$1,756,409

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 $67.3 million for Christian County and over $178.5 million for the State of Illinois. The new local long-term output totals over $1.3 million for Christian County and over $4.1 million for the State of Illinois.

Table 7.—Total Output Impact from the Black Diamond Solar Project

	Christian County	State of Illinois
Construction		
Project Development and Onsite Jobs Impacts on Output	$23,758,016	$73,972,938
Module and Supply Chain Impacts	$36,266,754	$55,886,810
Induced Impacts	$7,359,918	$48,735,462
New Local Output During Construction	$67,384,688	$178,595,210
Operations (Annual)		
Onsite Labor Impacts	$272,187	$543,158
Local Revenue and Supply Chain Impacts	$428,768	$1,118,953
Induced Impacts	$678,901	$2,453,011
New Local Long-Term Output	$1,379,856	$4,115,123

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. New legislation, Public Act 100-0781, sets a uniform formula for the fair cash value of a solar farm that would be similar to the uniform formula used for wind farms. This bill was signed into law by Governor Rauner in August, 2018. According to this law, the fair cash value for a utility-scale solar farm in Illinois is $218,000 per megawatt of nameplate capacity beginning in 2018 and is annually adjusted for inflation and depreciation. The inflation adjustment, as known as the Trending Factor, increases each year according to the Bureau of Labor Statistics' Consumer Price Index for all cities for all items. Depreciation is allowed at 4% per year up to a maximum total depreciation of 70% of the trended real property cost basis (calculated by taking the fair cash value of the solar project and multiplying by the Trending Factor).

Tables 8-11 detail the tax implications of Black Diamond Solar Project. There are several important assumptions built into the analysis in these tables.

- First, the analysis assumes that the fair cash value of the solar farm is $218,000/MW on January 1, 2017 and adjusted annually for inflation.
- Second, the tables assume inflation is constant at 2.2% and the depreciation is 4% until it reaches the maximum of 70%.
- Third, all tax rates are assumed to stay constant at their 2019 (2018 tax year) rates. For example, the Christian County tax rate is assumed to stay constant at 0.75762 through 2052.
- Fourth, the analysis assumes that the Project is placed in service on January 1, 2023 at a fair cash value of $95,525,391 and that the taxable value is 1/3 of the fair cash value.
- Fifth, it assumes that the Project is decommissioned in 30 years and pays no more taxes after that date.
- Sixth, 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 $2.3 million but declines due to depreciation (and offset by the trending factor) until it reaches the bottom in 2041. After that, the Project is fully depreciated, and the trending factor causes the taxable value and taxes to increase. The expected total property taxes paid over the lifetime of the Project is over $45.8 million and the average annual property taxes paid will be over $1.5 million.

Table 8.—Property Tax Revenue from Black Diamond Solar Project

Tax Year	Taxable Value of Solar Farm	Total Property Taxes
2023	$31,841,797	$2,305,616
2024	$31,240,624	$2,262,086
2025	$30,597,588	$2,215,524
2026	$29,911,137	$2,165,819
2027	$29,179,674	$2,112,855
2028	$28,401,550	$2,056,513
2029	$27,575,064	$1,996,668
2030	$26,698,468	$1,933,195
2031	$25,769,954	$1,865,963
2032	$24,787,664	$1,794,837
2033	$23,749,681	$1,719,678
2034	$22,654,029	$1,640,343
2035	$21,498,673	$1,556,686
2036	$20,281,518	$1,468,554
2037	$19,000,402	$1,375,790
2038	$17,653,101	$1,278,234
2039	$16,237,322	$1,175,720
2040	$14,750,705	$1,068,076
2041	$14,133,019	$1,023,350
2042	$14,443,946	$1,045,864
2043	$14,761,712	$1,068,873
2044	$15,086,470	$1,092,388
2045	$15,418,372	$1,116,421
2046	$15,757,577	$1,140,982
2047	$16,104,243	$1,166,083
2048	$16,458,537	$1,191,737
2049	$16,820,624	$1,217,956
2050	$17,190,678	$1,244,751
2051	$17,568,873	$1,272,135
2052	$17,955,388	$1,300,122
TOTAL		$45,872,817
AVG ANNUAL		$1,529,094

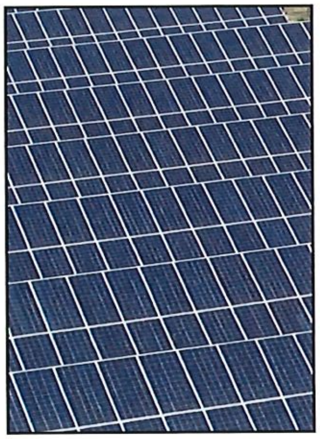


Table 9 shows an estimate of the likely taxes paid to Christian County, South Fork Township and the South Fork Road District. The table assumes that 100% of the Project is built in South Fork Township, and 100% of the Project is built in the South Fork Road District. The Christian County tax rate of 0.75762, and the South Fork Township tax rate of 1.02166 (0.43964 township rate plus 0.58202 road district rate) was used.

As shown in Table 9, in 2023, Christian County should receive $241,240, South Fork Township should receive $139,989, and the South Fork Road District should receive $185,326. The average annual amounts are $159,991 for Christian County, $92,841 for South Fork Township, and $122,909 for the South Fork Road District.

Table 9.—Property Tax Revenue from Black Diamond Solar Project for County and Township Other Taxing Bodies

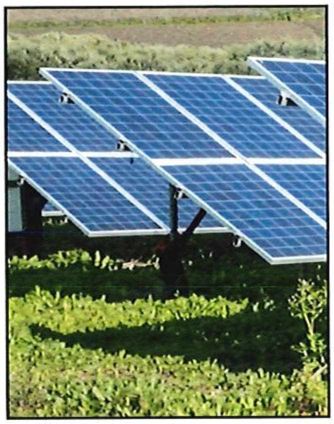
Tax Year	Christian County	South Fork Township	South Fork Road District	Total (South Fork) Township and South Fork RD
2023	$241,240	$139,989	$185,326	$325,315
2024	$236,685	$137,346	$181,827	$319,173
2025	$231,813	$134,519	$178,084	$312,603
2026	$226,613	$131,501	$174,089	$305,590
2027	$221,071	$128,286	$169,832	$298,117
2028	$215,176	$124,865	$165,303	$290,167
2029	$208,914	$121,231	$160,492	$281,723
2030	$202,273	$117,377	$155,390	$272,768
2031	$195,238	$113,295	$149,986	$263,281
2032	$187,796	$108,976	$144,269	$253,246
2033	$179,932	$104,413	$138,228	$242,641
2034	$171,631	$99,596	$131,851	$231,447
2035	$162,878	$94,517	$125,127	$219,643
2036	$153,657	$89,166	$118,042	$207,208
2037	$143,951	$83,533	$110,586	$194,120
2038	$133,743	$77,610	$102,745	$180,355
2039	$123,017	$71,386	$94,504	$165,890
2040	$111,754	$64,850	$85,852	$150,702
2041	$107,075	$62,134	$82,257	$144,391
2042	$109,430	$63,501	$84,067	$147,568
2043	$111,838	$64,898	$85,916	$150,815
2044	$114,298	$66,326	$87,806	$154,132
2045	$116,813	$67,785	$89,738	$157,523
2046	$119,383	$69,277	$91,712	$160,989
2047	$122,009	$70,801	$93,730	$164,531
2048	$124,693	$72,358	$95,792	$168,150
2049	$127,436	$73,950	$97,899	$171,850
2050	$130,240	$75,577	$100,053	$175,630
2051	$133,105	$77,240	$102,254	$179,494
2052	$136,034	$78,939	$104,504	$183,443
TOTAL	$4,799,738	$2,785,244	$3,687,262	$6,472,506
AVG ANNUAL	$159,991	$92,841	$122,909	$215,750

Table 10 shows an estimate of the likely taxes paid to Lincoln Land Community College, and South Fork Fire District. The table assumes that 100% of the Project is built in Lincoln Land Community College territory, and 100% is built in South Fork Fire District. The Lincoln Land Community College tax rate of 0.49077 and the South Fork Fire District tax rate of 0.30125 was used.

As shown in Table 10, in 2023, Lincoln Land Community College should receive $156,270, and South Fork Fire District should receive $95,923. The total amounts are $3,109,167 for Lincoln Land Community College, and $1,908,504 for South Fork Fire District.

Table 10.—Tax Revenue from Black Diamond Solar Project for Other Taxing Bodies

Tax Year	Lincoln Land Community College	South Fork Fire District
2023	$156,270	$95,923
2024	$153,320	$94,112
2025	$150,164	$92,175
2026	$146,795	$90,107
2027	$143,205	$87,904
2028	$139,386	$85,560
2029	$135,330	$83,070
2030	$131,028	$80,429
2031	$126,471	$77,632
2032	$121,650	$74,673
2033	$116,556	$71,546
2034	$111,179	$68,245
2035	$105,509	$64,765
2036	$99,536	$61,098
2037	$93,248	$57,239
2038	$86,636	$53,180
2039	$79,688	$48,915
2040	$72,392	$44,436
2041	$69,361	$42,576
2042	$70,887	$43,512
2043	$72,446	$44,470
2044	$74,040	$45,448
2045	$75,669	$46,448
2046	$77,333	$47,470
2047	$79,035	$48,514
2048	$80,774	$49,581
2049	$82,551	$50,672
2050	$84,367	$51,787
2051	$86,223	$52,926
2052	$88,120	$54,091
TOTAL	$3,109,167	$1,908,504
AVG ANNUAL	$103,639	$63,617



The largest taxing jurisdictions for property taxes are local school districts. However, the tax implications for school districts are more complicated than for other taxing bodies. School districts receive state aid based on the assessed value of the taxable property within its district. As assessed value increases, the state aid to the school district is decreased. Due to the new General State Aid funding formula, no school district will receive less than did in the previous year even if their EAV increases due to the presence of a solar farm.

Table 11 shows the direct property tax revenue coming from the Project to the South Fork School District #14, the Taylorville Community School District #3, and the Edinburgh School District #4. This tax revenue uses the assumptions outlined earlier to calculate the tax revenue and assumes that 75% of the Project is built within the South Fork School District, 12.5% is built within the Taylorville School District and 12.5% is built within the Edinburgh School District. In total, South Fork School District is expected to receive over $23.2 million, Taylorville School District is expected to receive over $3.2 million and Edinburgh School District is expected to receive almost $3.1 million over the life of the Project.

Table 11.—School District Tax Implications of Black Diamond Solar Project

Tax Year	South Fork Unit School District #14	Taylorville Community Unit School District #3	Edinburgh School District #4
2023	$1,166,616	$164,728	$155,524
2024	$1,144,590	$161,618	$152,587
2025	$1,121,031	$158,291	$149,447
2026	$1,095,881	$154,740	$146,094
2027	$1,069,081	$150,956	$142,521
2028	$1,040,572	$146,930	$138,721
2029	$1,010,292	$142,655	$134,684
2030	$978,175	$138,120	$130,402
2031	$944,156	$133,316	$125,867
2032	$908,167	$128,235	$121,069
2033	$870,138	$122,865	$116,000
2034	$829,995	$117,197	$110,648
2035	$787,666	$111,220	$105,005
2036	$743,072	$104,923	$99,060
2037	$696,134	$98,295	$92,803
2038	$646,772	$91,325	$86,222
2039	$594,901	$84,001	$79,307
2040	$540,434	$76,310	$72,046
2041	$517,804	$73,115	$69,029
2042	$529,195	$74,723	$70,548
2043	$540,838	$76,367	$72,100
2044	$552,736	$78,047	$73,686
2045	$564,896	$79,764	$75,307
2046	$577,324	$81,519	$76,964
2047	$590,025	$83,312	$78,657
2048	$603,006	$85,145	$80,388
2049	$616,272	$87,019	$82,156
2050	$629,830	$88,933	$83,964
2051	$643,686	$90,889	$85,811
2052	$657,847	$92,889	$87,699
TOTAL	$23,211,134	$3,277,448	$3,094,319
AVG ANNUAL	$773,704	$109,248	$103,144

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X. Curriculum Vitae

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

Ohler A., **Loomis, D. G.**, and Ilves K. (2020). A study of electricity savings from energy star appliances using household survey data, *Energy Policy*, 144: 1-13.

Ohler A., Mohammadi, H., and **Loomis, D. G.** (2020). Electricity restructuring and the relationship between fuel costs and electricity prices for industrial and residential customers, *Energy Policy*, 142: 1-8.

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Tegen, S., Keyser, D., Flores-Espino, F., Miles, J., Zammit, D. and **Loomis, D.** (2015). Offshore Wind Jobs and Economic Development Impacts in the United States: Four Regional Scenarios, National Renewable Energy Laboratory Technical Report, NREL/TP-5000-61315, February.

Loomis, D. G. and Bowden, N. S. (2013). Nationwide Database of Electric Rates to Become Available, *Natural Gas & Electricity*, 30 (5), 20-25.

Jin, J. H., **Loomis, D. G.**, and Aldeman, M. R. (2013). Optimum penetration of utility-scale grid-connected solar photovoltaic systems in Illinois, *Renewable Energy*, 60, 20-26.

Malm, E., **Loomis, D. G.**, DeFranco, J. (2012). A Campus Technology Choice Model with Incorporated Network Effects: Choosing Between General Use and Campus Systems, *International Journal of Computer Trends and Technology*, 3(4), 622-629.

Chupp, B. A., Hickey, E. A. and **Loomis, D. G.** (2012). Optimal Wind Portfolios in Illinois, *Electricity Journal*, 25, 46-56.

Hickey, E., **Loomis, D. G.**, & Mohammadi, H. (2012). Forecasting hourly electricity prices using ARMAX-GARCH models: An application to MISO hubs, *Energy Economics*, 34, 307-315.

Professional Publications (cont.)

Theron, S., Winter, J. R, **Loomis, D. G.**, and Spaulding, A. D. (2011). Attitudes Concerning Wind Energy in Central Illinois. *Journal of the America Society of Farm Managers and Rural Appraisers*, 74, 120-128.

Payne, J. E., **Loomis, D. G.** and Wilson, R. (2011). Residential Natural Gas Demand in Illinois: Evidence from the ARDL Bounds Testing Approach. *Journal of Regional Analysis and Policy*, 41(2), 138.

Loomis, D. G. and Ohler, A. O. (2010). Are Renewable Portfolio Standards A Policy Cure-all? A Case Study of Illinois's Experience. *Environmental Law and Policy Review*, 35, 135-182.

Gil-Alana, L. A., **Loomis, D. G.**, and Payne, J. E. (2010). Does energy consumption by the U.S. electric power sector exhibit long memory behavior? *Energy Policy*, 38, 7512-7518.

Carlson, J. L., Payne, J. E., and **Loomis, D. G.** (2010). An assessment of the Economic Impact of the Wind Turbine Supply Chain in Illinois. *Electricity Journal*, 13, 75-93.

Apergis, N., Payne, J. E., and **Loomis, D. G.** (2010). Are shocks to natural gas consumption transitory or permanent? *Energy Policy*, 38, 4734-4736.

Apergis, N., Payne, J. E., & **Loomis, D. G.** (2010). Are fluctuations in coal consumption transitory or permanent? Evidence from a panel of U.S. states. *Applied Energy*, 87, 2424-2426.

Hickey, E. A., Carlson, J. L., and **Loomis, D. G.**(2010). Issues in the determination of the optimal portfolio of electricity supply options. *Energy Policy*, 38, 2198-2207.

Carlson, J. L., and **Loomis, D. G.** (2008). An assessment of the impact of deregulation on the relative price of electricity in Illinois. *Electricity Journal*, 21, 60-70.

Loomis, D. G., (2008). The telecommunications industry. In H. Bidgoli (Ed.), *The handbook of computer networks* (pp. 3-19). Hoboken, NJ: John Wiley & Sons.

Cox, J. E., Jr., and **Loomis, D. G.** (2007). A managerial approach to using error measures in the evaluation of forecasting methods. *International Journal of Business Research*, 7, 143-149.

Cox, J. E., Jr., and **Loomis, D. G.** (2006). Improving forecasting through textbooks – a 25 year review. *International Journal of Forecasting*, 22, 617-624.

Swann, C. M., and **Loomis, D. G.** (2005). Competition in local telecommunications – there's more than you think. *Business Economics*, 40, 18-28.

Swann, C. M., and **Loomis, D. G.** (2005). Intermodal competition in local telecommunications markets. *Information Economics and Policy*, 17, 97-113.

Professional Publications (cont.)

Swann, C. M., and **Loomis, D. G.** (2004) Telecommunications demand forecasting with intermodal competition – a multi-equation modeling approach. *Telektronikk*, 100, 180-184.

Cox, J. E., Jr., and **Loomis, D. G.** (2003). Principles for teaching economic forecasting. *International Review of Economics Education*, 1, 69-79.

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Wiedman, J. and **Loomis, D. G.** (2002). U.S. broadband pricing and alternatives for internet service providers. In D. G. Loomis and L.D. Taylor (Eds.) Boston: Kluwer Academic Publishers.

Cox, J. E., Jr. and **Loomis, D. G.** (2001). Diffusion of forecasting principles: an assessment of books relevant to forecasting. In J. S. Armstrong (Ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners* (pp. 633-650). Norwell, MA: Kluwer Academic Publishers.

Cox, J. E., Jr. and **Loomis, D. G.** (2000). A course in economic forecasting: rationale and content. *Journal of Economics Education*, 31, 349-357.

Malm, E. and **Loomis, D. G.** (1999). Active market share: measuring competitiveness in retail energy markets. *Utilities Policy*, 8, 213-221.

Loomis, D. G. (1999). Forecasting of new products and the impact of competition. In D. G. Loomis & L. D. Taylor (Eds.), *The future of the telecommunications industry: forecasting and demand analysis.* Boston: Kluwer Academic Publishers.

Loomis, D. G. (1997). Strategic substitutes and strategic complements with interdependent demands. *The Review of Industrial Organization*, 12, 781-791.

Expert Testimony

Marshall County (Illinois) Zoning Board of Appeals, on behalf of Akuo Energy, Direct Oral Testimony, October 17, 2019.

Public Service Commission of Wisconsin, Docket No. 9800-CE-100, Application of Badger State Solar, LLC for a Certificate of Public Convenience and Necessity, on behalf of Badger State Solar, LLC (Ranger Power): Written Direct Testimony filed September 10, 2019.

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

Ohio Power Siting Board, Case No. 17-773-EL-BGN, In the Matter of Hardin Solar Energy LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Hardin County, Ohio, on behalf of Invenergy, LLC, Exhibit with Report filed July 5, 2017.

Macon County (Illinois) Environmental, Education, Health and Welfare Committee, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of E.ON Energy, Direct Oral Testimony, August 20, 2015.

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.

Livingston County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of Invenergy, Oral Cross-Examination, December 8-9, 2014.

Livingston County (Illinois) Zoning Board of Appeals, Application for Special Use Permit for a Wind Energy Conversion System, on behalf of Invenergy, Direct Oral Testimony, November 17-19, 2014.

Missouri Public Service Commission, Case No. EA-2014-0207, on behalf of Grain Belt Express Clean Line LLC: Written Direct Testimony filed March 26, 2014; Written Surrebuttal Testimony, filed October 14, 2014; Oral Cross-examination Testimony, November 21, 2014.

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.)

Whiteside County (Illinois) Board and Whiteside County Planning and Zoning Committee, Examination of Wind Energy Conversion System Ordinance, Direct Testimony and Cross-Examination, on behalf of the Center for Renewable Energy, April 12, 2012.

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.

Selected Presentations

"Renewable Energy in McLean County," presented December 13, 2018 at Bloomington-Normal Economic Development Council's BN By the Numbers, Normal, IL.

"Smart Cities and Micro Grids: Cost Recovery Issues," presented September 12,2017 at the National Association of Regulatory Utility Commissioners Staff Subcommittee on Accounting and Finance Meeting, Springfield, IL.

"Cloud Computing: Regulatory Principles and ICC NOI," presented September 11,2017 at the National Association of Regulatory Utility Commissioners Staff Subcommittee on Accounting and Finance Meeting, Springfield, IL.

"Illinois Wind, Illinois Solar and the Illinois Future Energy Jobs Act," presented July 25, 2017 at the Illinois County Assessors Meeting, Normal, IL.

"Illinois Wind, Illinois Solar and the Illinois Future Energy Jobs Act," presented April 21, 2017 at the Illinois Association of County Zoning Officers Meeting, Bloomington, IL.

"Energy Storage Economics and RTOs," presented October 30, 2016 at the Energy Storage Conference at Argonne National Laboratory.

"Wind Energy in Illinois," on October 6, 2016 at the B/N Daybreak Rotary Club, Bloomington, IL.

"Smart Grid for Schools," presented August 17, 2016 to the Ameren External Affairs Meeting, Decatur, IL.

"Solar Energy in Illinois," presented July 28, 2016 at the 3rd Annual K-12 Teachers Clean Energy Workshop, Richland Community College, Decatur, IL

"Wind Energy in Illinois," presented July 28, 2016 at the 3rd Annual K-12 Teachers Clean Energy Workshop, Richland Community College, Decatur, IL

"Smart Grid for Schools," presented June 21, 2016 at the ISEIF Grantee and Ameren Meeting, Decatur, IL.

"Costs and Benefits of Renewable Energy," presented November 4, 2015 at the Osher Lifelong Learning Institute at Bradley, University, Peoria, IL.

"Energy Sector Workforce Issues," presented September 17, 2015 at the Illinois Workforce Investment Board, Springfield, IL.

"The Past, Present and Future of Wind Energy in Illinois," presented March 13, 2015 at the Peoria Rotary Club, Peoria, IL.

"Where Are All the Green Jobs?" presented January 28, 2015 at the 2015 Illinois Green Economy Network Sustainability Conference, Normal, IL.

"Teaching Next Generation Energy Concepts with Next Generation Science Standards: Addressing the Critical Need for a More Energy-Literate Workforce," presented September 30, 2014 at the Mathematics and Science Partnerships Program 2014 Conference in Washington, DC.

Selected Presentations (cont.)

"National Utility Rate Database," presented October 23, 2013 at Solar Power International, Chicago, IL.

"Potential Economic Impact of Offshore Wind Energy in the Great Lakes," presented May 6, 2013 at WindPower 2013, Chicago, IL.

"Why Illinois? Windy City, Prairie Power," presented May 5, 2013 at WindPower 2013, Chicago, IL.

"National Utility Rate Database," presented January 29, 2013 at the EUEC Conference, Phoenix, AZ.

"Energy Learning Exchange and Green Jobs," presented December 13, 2012 at the TRICON Meeting of Peoria and Tazewell County Counselors, Peoria, IL.

"Potential Economic Impact of Offshore Wind Energy in the Great Lakes," presented November 12, 2012 at the Offshore Wind Jobs and Economic Development Impacts Webinar.

"Energy Learning Exchange," presented October 31, 2012 at the Utility Workforce Development Meeting, Chicago, IL.

"Wind Energy in McLean County," presented June 26, 2012 at BN By the Numbers, Normal, IL.

"Wind Energy," presented June 14, 2012 at the Wind for Schools Statewide Teacher Workshop, Normal, IL.

"Economic Impact of Wind Energy in Illinois," presented June 6, 2012 at AWEA's WINDPOWER 2012, Atlanta, GA.

"Trends in Illinois Wind Energy," presented March 6, 2012 at the AWEA Regional Wind Energy Summit – Midwest in Chicago, IL.

"Challenges and New Growth Strategies in the Wind Energy Business," invited plenary session speaker at the Green Revolution Leaders Forum, November 18, 2011 in Seoul, South Korea.

"Overview of the Center for Renewable Energy," presented July 20, 2011 at the University-Industry Consortium Meeting at Illinois Institute of Technology, Chicago, IL.

"Building the Wind Turbine Supply Chain," presented May 11, 2011 at the Supply Chain Growth Conference, Chicago, IL

"Building a Regional Energy Policy for Economic Development," presented April 4, 2011 at the Midwestern Legislative Conference's Economic Development Committee Webinar.

"Wind Energy 101," presented February 7, 2011 at the Wind Power in Central Illinois - A Public Forum, CCNET Renewable Energy Group, Champaign, IL.

"Alternative Energy Strategies," presented with Matt Aldeman November 19, 2010 at the Innovation Talent STEM Education Forum, Chicago, IL.

"Siting and Zoning in Illinois," presented November 17, 2010 at the Wind Powering America Webinar.

Selected Presentations (cont.)

"What Governor Quinn Should Do about Energy?" presented November 15, 2010 at the Illinois Chamber of Commerce Energy Forum Conference, Chicago, IL.

"Is Wind Energy Development Right for Illinois," presented with Matt Aldeman October 28, 2010 at the Illinois Association of Illinois County Zoning Officials Annual Seminar in Utica, IL.

"Economic Impact of Wind Energy in Illinois," presented July 22, 2010 at the AgriEnergy Conference in Champaign, IL.

"Renewable Energy Major at ISU," presented July 21, 2010 at Green Universities and Colleges Subcommittee Webinar.

"Economics of Wind Energy," presented May 19, 2010 at the U.S. Green Building Council meeting in Chicago, IL.

"Forecasting: A Primer for the Small Business Entrepreneur," presented with James E. Cox, Jr. April 14, 2010 at the Allied Academies' Spring International Conference in New Orleans, LA.

"Are Renewable Portfolio Standards a Policy Cure-All? A Case Study of Illinois' Experience," presented January 30, 2010 at the 2010 William and Mary Environmental Law and Policy Review Symposium in Williamsburg, VA.

"Creating Partnerships between Universities and Industry," presented November 19, 2009, at New Ideas in Educating a Workforce in Renewable Energy and Energy Efficiency in Albany, NY.

"Educating Illinois in Renewable Energy, presented November 14, 2009 at the Illinois Science Teachers Association in Peoria, IL.

"Green Collar Jobs," invited presentation October 14, 2009 at the 2009 Workforce Forum in Peoria, IL.

"The Role of Wind Power in Illinois," presented March 4, 2009 at the Association of Illinois Electric Cooperatives Engineering Seminar in Springfield, IL.

"The Economic Benefits of Wind Farms," presented January 30, 2009 at the East Central Illinois Economic Development District Meeting in Champaign, IL.

"Green Collar Jobs in Illinois," presented January 6, 2009 at the Illinois Workforce Investment Board Meeting in Macomb, Illinois.

"Green Collar Jobs: What Lies Ahead for Illinois?" presented August 1, 2008 at the Illinois Employment and Training Association Conference.

"Mapping Broadband Access in Illinois," presented October 16, 2007 at the Rural Telecon '07 conference.

"A Managerial Approach to Using Error Measures to Evaluate Forecasting Methods," presented October 15, 2007 at the International Academy of Business and Economics.

"Dollars and Sense: The Pros and Cons of Renewable Fuel," presented October 18, 2006 at Illinois State University Faculty Lecture Series.

Selected Presentations (cont.)

“Broadband Access in Illinois,” presented July 28, 2006 at the Illinois Association of Regional Councils Annual Meeting.

“Broadband Access in Illinois,” presented November 17, 2005 at the University of Illinois’ Connecting the e to Rural Illinois.

“Improving Forecasting Through Textbooks – A 25 Year Review,” with James E. Cox, Jr., presented June 14, 2005 at the 25th International Symposium on Forecasting.

“Telecommunications Demand Forecasting with Intermodal Competition, with Christopher Swann, presented April 2, 2004 at the Telecommunications Systems Management Conference 2004.

“Intermodal Competition,” with Christopher Swann, presented April 3, 2003 at the Telecommunications Systems Management Conference 2003.

“Intermodal Competition in Local Exchange Markets,” with Christopher Swann, presented June 26, 2002 at the 20th Annual International Communications Forecasting Conference.

“Assessing Retail Competition,” presented May 23, 2002 at the Institute for Regulatory Policy Studies’ Illinois Energy Policy for the 21st Century workshop.

“The Devil in the Details: An Analysis of Default Service and Switching,” with Eric Malm presented May 24, 2001 at the 20th Annual Advanced Workshop on Regulation and Competition.

“Forecasting Challenges for U.S. Telecommunications with Local Competition,” presented June 28, 1999 at the 19th International Symposium on Forecasting.

“Acceptance of Forecasting Principles in Forecasting Textbooks,” presented June 28, 1999 at the 19th International Symposium on Forecasting.

“Forecasting Challenges for Telecommunications With Local Competition,” presented June 17, 1999 at the 17th Annual International Communications Forecasting Conference.

“Measures of Market Competitiveness in Deregulating Industries,” with Eric Malm, presented May 28, 1999 at the 18th Annual Advanced Workshop on Regulation and Competition.

“Trends in Telecommunications Forecasting and the Impact of Deregulation,” Proceedings of EPRI’s 11th Forecasting Symposium, 1998.

“Forecasting in a Competitive Age: Utilizing Macroeconomic Forecasts to Accurately Predict the Demand for Services,” invited speaker, Institute for International Research Conference, September 29, 1997.

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