APPENDIX N
ECONOMIC IMPACT REPORT

Economic Impact Analysis
of the
Badger State Solar Project

February 2019

Strategic Economic Research, LLC

David G. Loomis, Ph.D.
2705 Kolby Court
Bloomington, IL 6704
309-242-4690

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. In particular, he has performed economic impact analyses for renewable energy projects in Illinois, Iowa, Kansas, Michigan, Nebraska, New Mexico, New York, Ohio, Pennsylvania, South Dakota, and Wisconsin. He has served as a consultant for Apex, Clean Line Energy Partners, EDF Renewables, EO.N, Geronimo Energy, Invenergy, J-Power, the National Renewable Energy Laboratories, Ranger Power, State of Illinois, Tradewind, and others. He has testified on the economic impacts of energy projects before the Illinois Commerce Commission, Illinois Senate Energy and Environment Committee, Missouri Public Service Commission, the New Mexico Public Regulation Commission, 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.

Table of Contents

Figures:

Tables:

I. Executive Summary

Ranger Power, LLC is developing the Badger State Solar Project in Jefferson County, WI. The purpose of this report is to aid decision makers in evaluating the economic impact of this project on Jefferson County and the State of Wisconsin. This report uses the latest Jobs and Economic Development Impacts (JEDI) PV Model, which is a widely recognized methodology used in numerous U.S. studies that have been published peer-reviewed academic journals. The basis of this analysis is to study the direct, indirect and induced impacts of Badger State Solar on job creation, wages and total economic output.

The Badger State Solar Project is a 149 MW AC photovoltaic (PV) solar project representing an investment in excess of $150 million. The utility-scale project would generate about three times as much energy as the City of Jefferson uses in a year.[1]

Badger State Solar has secured land lease agreements with landowners. Pending permitting and other approvals, the project could begin construction as early as 2020, and achieve commercial operation between 2021 and 2023. The total development is anticipated to result in the following:

Jobs

- 69 new local jobs during construction for Jefferson County
- 498 new local jobs during construction for the State of Wisconsin
- 8.8 new local long-term jobs for Jefferson County
- 12.6 new local long-term jobs for the State of Wisconsin

Earnings

- Over $2.6 million in new local earnings during construction for Jefferson County
- Almost $29.5 million in new local earnings during construction for the State of Wisconsin
- Over $446 thousand in new local long-term earnings for Jefferson County annually
- Almost $683 thousand in new local long-term earnings for the State of Wisconsin annually

[1] In 2018, the City of Jefferson's annual load was ~98,000 MWh. In its first year of operation, Badger State Solar is expected to generate close to 300,000 MWh.

Output[2]

- Over $7.0 million in new local output during construction for Jefferson County
- Over $45.5 million in new local output during construction for the State of Wisconsin
- Over $887 thousand in new local long-term output for Jefferson County annually
- Over $1.5 million in new local long-term output for the State of Wisconsin annually

Taxes

- Jefferson County will receive almost $350 thousand annually and Jefferson and Oakland Townships will receive almost $250 thousand in total annually based on the State of Wisconsin Shared Revenue Utility Aid Formula.

Indirect Impacts

- Annual pollution reductions equivalent to taking 39,221-74,645 cars off the road

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

Land Use

- Using a real-options analysis, the 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 $14.17/bushel, or yields for corn would need to rise to 418 bushels per acre for corn farming to generate more income for the landowner and local community than the solar lease; at this time of this report, corn prices are $3.41 and yields are 174 bushels per acre.
- The price of soybeans would need to rise to $49.25/bushel, or yields for soybeans would need to rise to 132 bushels per acre for soybean farming to be more valuable than the solar lease; at this time of this report, soybean prices are $8.58 and yields are 47 bushels per acre.

[2] The value of production in the state or local economy. It is an equivalent measure to the Gross Domestic Product.

II. Solar PV Industry Growth and Economic Development

a. U.S. Solar PV Industry Growth

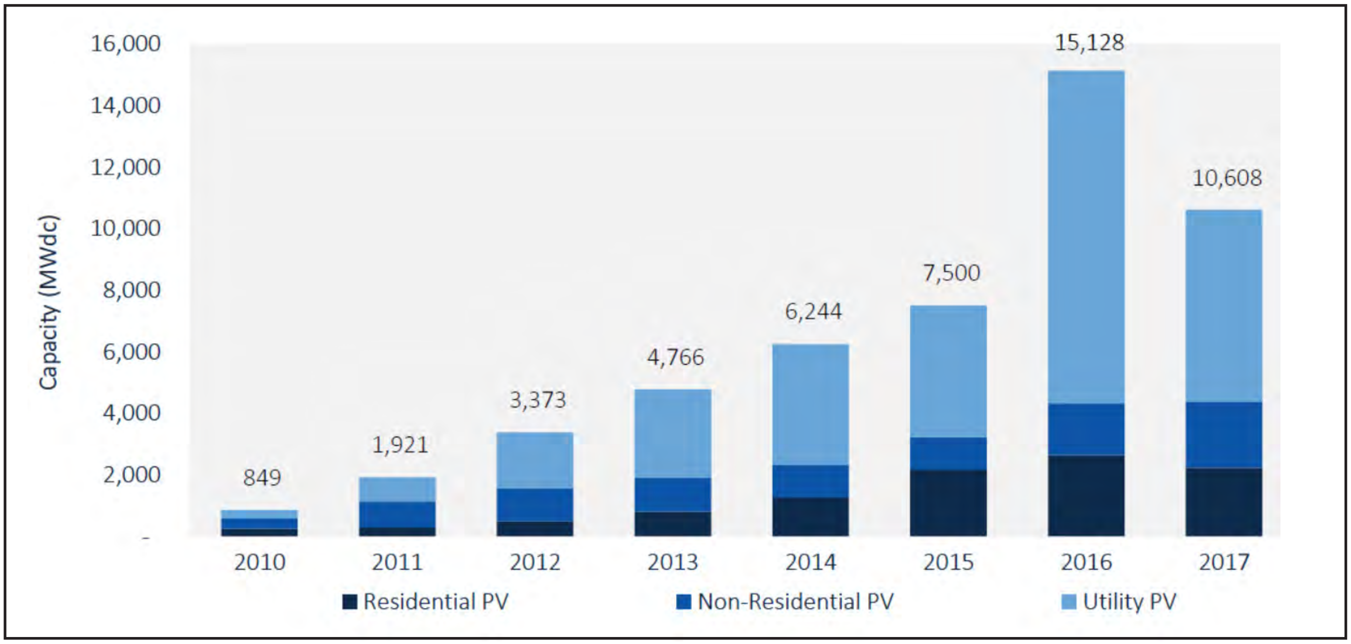
The U.S. solar industry is growing at a rapid pace – from 2013 to 2016, the amount of electricity generated from solar had more than doubled, increasing from 105% from 2013 to 2016 (EIA, 2018). The industry continued to add increasing numbers of PV systems to the grid. In 2016, the U.S. installed 15,128 MWdc of solar PV driven mostly by utility-scale PV. In 2017, the U.S. installed 10,608 MWdc of solar PV, a 30% decrease from 2016.[3] Yet, as Figure 1 clearly shows, the capacity additions in 2017 still outpaced any previous year except the record-breaking 2016.

The primary driver of this overall sharp pace of growth is large price declines in solar equipment. Since 2009, the price of solar PV has declined from about $7.50/watt in 2009 to almost $2.00/watt in 2015 according to Figure 2. Solar PV also benefits from the Federal Investment Tax Credit (ITC) which provides a 30 percent tax credit. Still, various federal tax reform measures and new tariffs on imported solar panels by the Trump Administration may lessen the price declines in 2018 and beyond.

Utility-scale PV leads the installation growth in the U.S. A total of 6.2 GWdc of utility PV projects were completed in 2017 and accounted for 59% of the total installed capacity in 2017. An additional 2.0 GWdc are under construction and are expected to come on-line in 2018. According to Figure 4, there are 30,045 MWdc of utility-scale PV solar operating in the U.S. and an additional 16,883 MWdc has been contracted as well as another 26,700 MWdc announced.

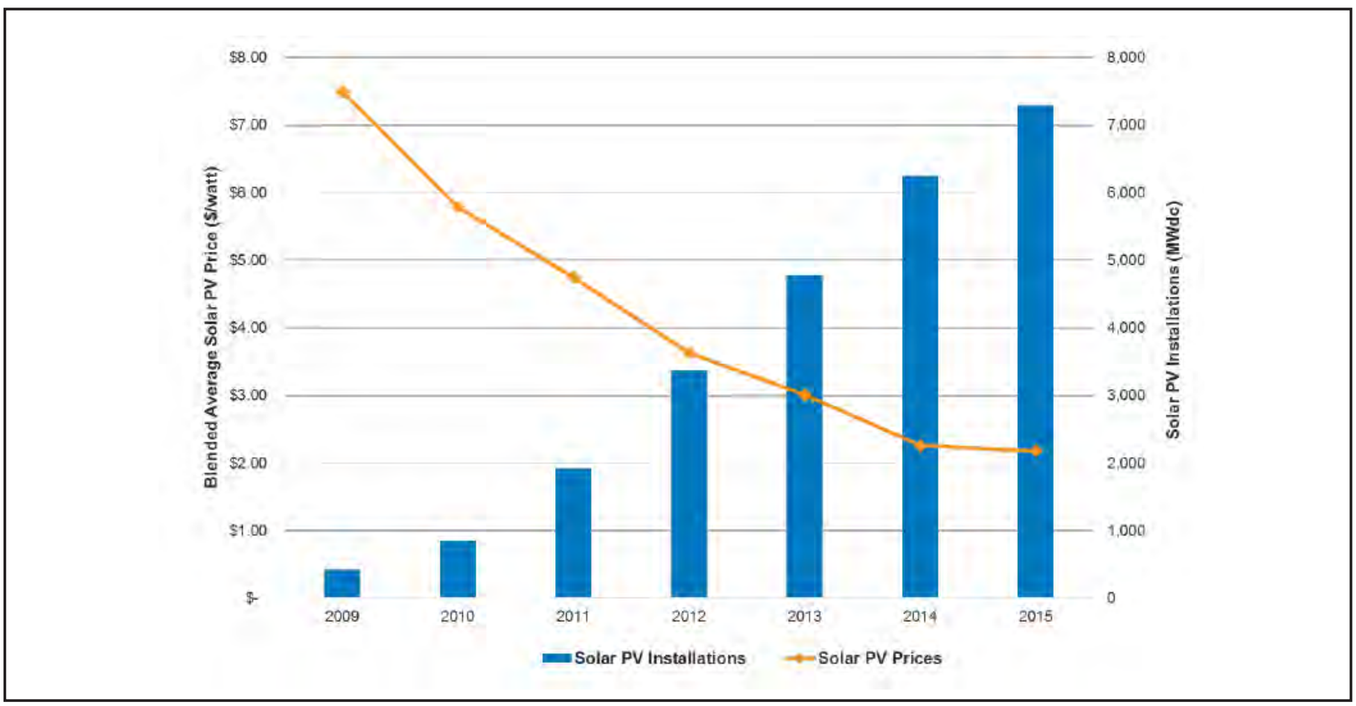
[3]There was a dramatic increase in 2016 because the industry was expecting the expiration of the federal investment tax credit and rushed to complete as many projects as possible before the expected expiration. This rush effectively pulled projects that were originally slated for 2017 and 2018 forward into 2016 resulting in the high amount installed in 2016 but a lower amount installed in 2017.

Figure 1.—U.S. Annual Solar PV Installations, 2010-2017



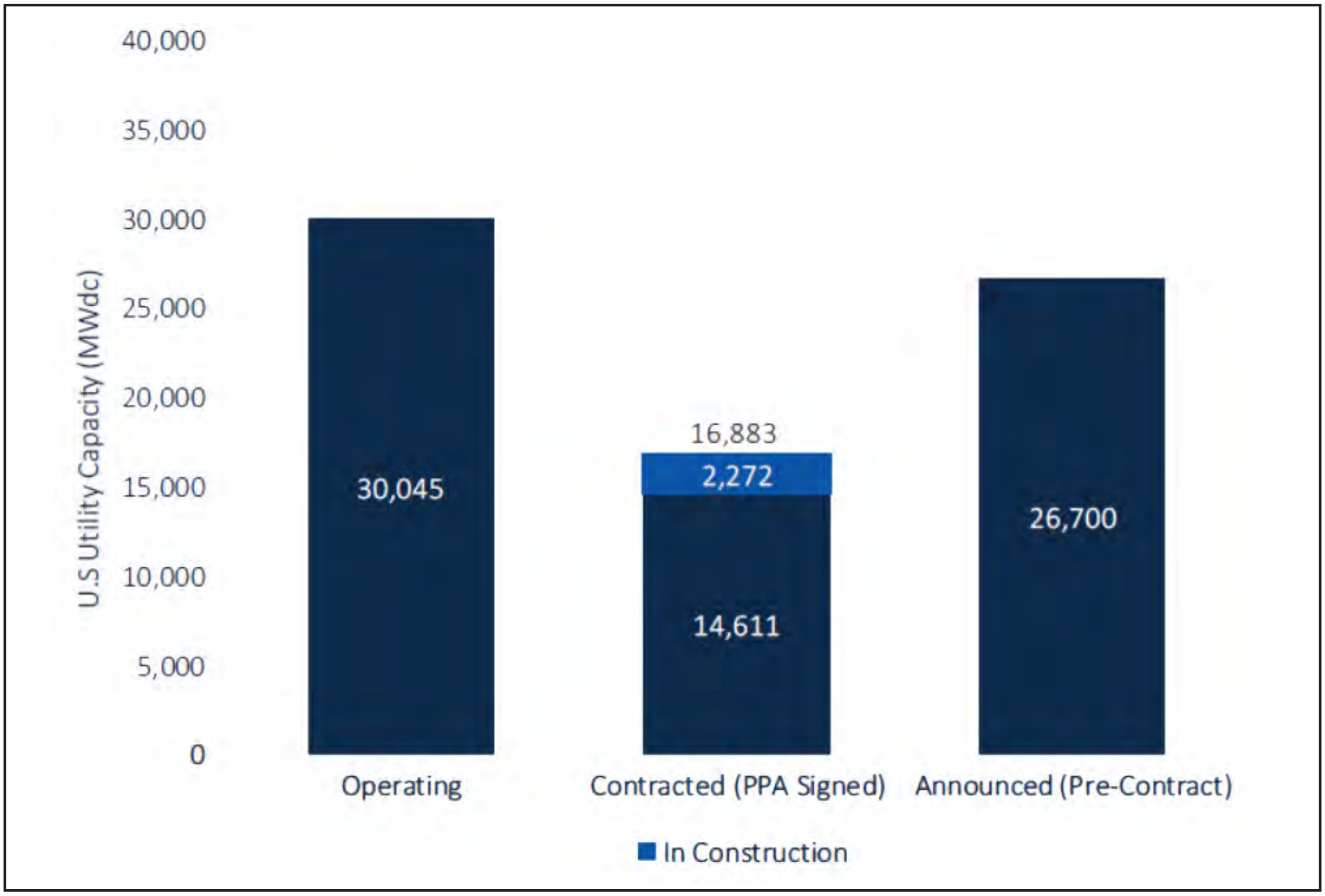
Source: Solar Energy Industries Association, Solar Market Insight Report 2017

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



Source: Solar Energy Industries Association, Solar Market Insight Report 2016 Q4

Figure 3.—U.S. Utility PV Pipeline



Source: Solar Energy Industries Association, Solar Market Insight Report 2017

b. Wisconsin Solar PV Industry

According to SEIA, Wisconsin is ranked 38th in the U.S. in cumulative installations of solar PV. California, North Carolina, and Arizona are the top three states for solar PV which may not be surprising because of the high solar resource. However, other states with similar solar resource as Wisconsin rank highly including New Jersey (5th), Massachusetts (6th), New York (11th), and Maryland (13th). In 2017, Wisconsin installed 20.9 MW of solar electric capacity bringing its cumulative capacity to 50.4 MW. For context, the state has 16,840MW of installed capacity across all technologies, both traditional fossil-fuel and renewable.

There are more than 184 companies serving the solar industry in Wisconsin including 38 manufacturers, 98 installers/developers, and 48 others.[4] Almost all of these companies are involved in onsite residential or commercial/industrial solar rather than utility-scale solar. Currently, there are 2,921 solar jobs in the State of Wisconsin according to SEIA.

There are a few currently operating utility and industrial solar projects in Wisconsin. New Auburn DPC Solar is the largest installation at 2.5 MW of capacity. The 2 MW Warren DPC Solar was completed in 2017. The 1 MW Jefferson Solar Park was completed in 2013. Epic Systems in Verona has built a solar generating system covering 18 acres and Target Corporation has installed solar in Wisconsin with their 380 kW Oak Creek project.

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

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 the indirect supply chain purchases and the higher spending that is induced by these workers. Solar projects strengthen the local tax base helping to improve county 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 while other studies analyze utility-scale solar energy. In his seminal 2012 study, Croucher 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 Wisconsin ranked fifth in the nation, supporting 30.08 jobs during installation and 0.03 jobs during operations.

In a 2018 report submitted to the Public Service Commission of Wisconsin, Cadmus examines the economic impacts of Wisconsin's Focus on Energy's 2015-2016 energy efficiency and renewable energy programs. Although the effect of solar energy is not broken out separately, the combined effects of the program supported 8,769 job-years and an economic benefit of $762 million.

Several other reports quantify the economic impact of solar energy. 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 550 MW 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, CA and $336 million of indirect benefits to local businesses in the county are included. Loomis et. al. (2016) estimates the economic impact for the State of Illinois if the state were to build new solar installations of 2,292 MW, 2,714 MW or 11,265 MW and 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.

III. Badger State Solar Project Description and Location

a. Badger State Solar Project Description

The Badger State Solar project is a 149 MW AC solar photovoltaic project proposed in Jefferson County, Wisconsin. The Project is located on privately-owned land along US Highway 18 west of State Highway 89, approximately 2-4 miles west of the City of Jefferson, near the existing ATC-owned Jefferson 138 kV substation. The primary and alternative sites for the facility are located in the Town of Jefferson and the Town of Oakland. Pending permitting and other approvals, the project will achieve commercial operation by 2023.

The Project is being developed by Ranger Power LLC, a utility-scale solar development company focused on cost-effective renewable energy projects in the Midwest region. The company is committed to working closely with landowners and communities to bring new investment, jobs, and clean energy to the area. Ranger Power's team of experienced developers and renewable energy specialists have successfully developed early-, mid-, and late-stage solar projects throughout the country. Collectively, the Ranger Power team has worked on over 3,500 MW of renewable energy projects.

b. Jefferson County, Wisconsin

Jefferson County is located in the southeastern part of Wisconsin (see Figure 4). It has a total area of 583 square miles and the U.S. Census estimates that the 2010 population was 83,686 with 30,092 housing units. The County has a population density of 133 (persons per square mile) compared to 105 for the State of Wisconsin. Median household income in the county was $69,418 (2012-2016) which is below Wisconsin's statewide median income of $71,459 (2012-2016).

Figure 4.—Map of Jefferson County, Wisconsin

Source: https://commons.wikimedia.org/wiki/File:Map_of_Wisconsin_highlighting_Jefferson_County.svg, public domain

Economic and Demographic Statistics

As shown in Table 1, the largest industries are manufacturing, retail trade, health care followed by accommodations and food services, other services, and wholesale trade.

Table 1.—Non-Governmental Employment by Industry in Jefferson County

Industry	Number	Percent
Manufacturing	8,501	27.8%
Retail trade	4,163	13.6%
Health care and social assistance	4,129	13.5%
Accommodation and food services	2,324	7.6%
Other services (except public administration)	2,061	6.7%
Wholesale trade	1,908	6.2%
Transportation and warehousing	1,261	4.1%
Construction	1,258	4.1%
Administrative and support and waste management and remediation services	1,191	3.9%
Finance and insurance	641	2.1%
Management of companies and enterprises	619	2.0%
Professional, scientific, and technical services	591	1.9%
Information	548	1.8%
Arts, entertainment, and recreation	498	1.6%
Educational services	446	1.5%
Real estate and rental and leasing	316	1.0%
Utilities	20-99	0.1%-0.3%
Agriculture, forestry, fishing and hunting	0-19	0.0%-0.1%
Mining, quarrying, and oil and gas extraction	0-19	0.0%-0.1%
Industries not classified	0-19	0.0%-0.1%

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

Data for Table 1 comes 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 565 principal operators with farming as their primary occupation and another 660 principal operators having another occupation as their primary occupation. **These principal operators would put the agriculture sector at around 4% of the county's private sector workforce.**

Agricultural Statistics

Wisconsin is ranked ninth among U. S. states in total value of agricultural products sold (Census, 2012). It is ranked eighth in the value of livestock, and sixteenth in the value of crops (Census, 2012). In 2017, Wisconsin had 68,500 farms and 14.3 million acres in operation with the average farm being 209 acres (State Agricultural Overview, 2017). Wisconsin had 3.5 million cattle and produced 30.3 billion pounds of milk (State Agricultural Overview, 2017). In 2017, Wisconsin yields averaged 174 bushels per acre for grain corn with a total market value of $1.7 billion (State Agricultural Overview, 2017). Soybean yields averaged 47 bushels per acre with a total market value of $940 million (State Agricultural Overview, 2017). The average net cash farm income per farm is $44,058 (Census, 2012).

In 2012, Jefferson County had 1,225 farms covering 227,901 acres for an average farm size of 186 acres (Census, 2012). The total market value of products sold was $256 million, with 58 percent coming from livestock sales and 42 percent coming from crop sales (Census, 2012). The average net cash farm income of operations was $42,209 (Census, 2012).

The approximately 1,000 acres planned to be used by the Badger State Solar Farm represents less than 0.5% of the acres used for farming in Jefferson County. As we will show in the next section, the decision some farmers are making to shift land into solar farming makes economic sense because solar farming yields a greater financial return than crop farming.

IV. Land Use Methodology

a. Agricultural Land Use

Land available for farming is a valuable commodity and some have expressed concern about the conversion of farmland to residential, commercial or 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. He argues that 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, 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 both the US and global perspective, it is simply not true that we are running out of farmland.

b. Agricultural Land and Solar Farms

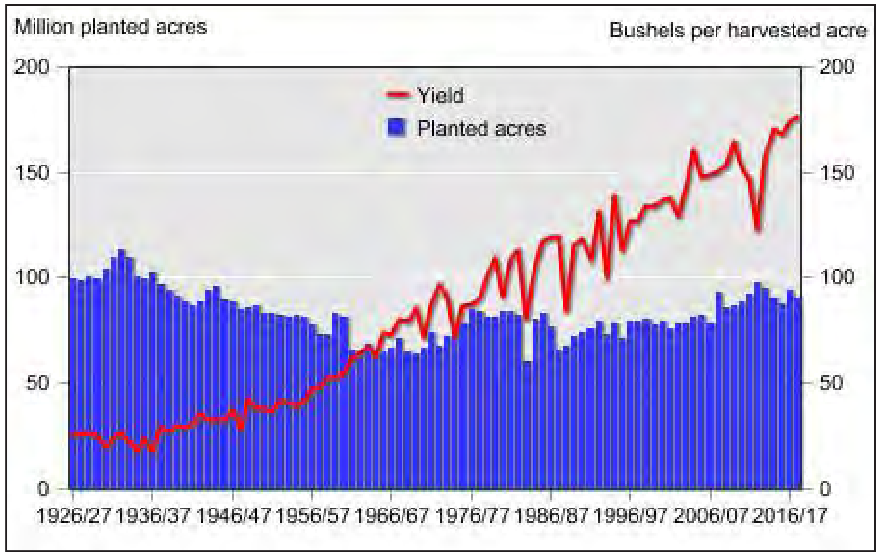
One valid concern of agricultural land conversion is that the change is often irreversible. However, the present case of leasing agricultural land for a solar energy generating facility rises above this debate in several important ways. First, the use of agricultural land for a solar energy center is only temporary. The term of the solar leases for this Project is 40 years, then they would expire if the option to extend is not exercised. At the end of the lease, the land will be restored to its original condition, suitable for agricultural use. This restoration is ensured by legal 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 fee and there are no decommissioning requirements or surety.

Second, the land under the solar panels will be vegetated year-round throughout the life of the project, allowing nutrients in the soil to regenerate. In addition, the land included in the project may be able to immediately use organic farming practices after the decommissioning of the project because fertilizers, pesticides, and other common agricultural treatments will not be used. Finally, many solar projects use "pollinator-friendly" vegetation in and around the solar project, which could help pollinators in the area thrive. Accordingly, solar energy is in fact a benefit to agricultural land and the surrounding community.

Third, 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. 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 available for agricultural use in the future. These same economic forces provide a feedback mechanism that will serve to slow the conversion of cropland to solar use if crops provide a better economic return.

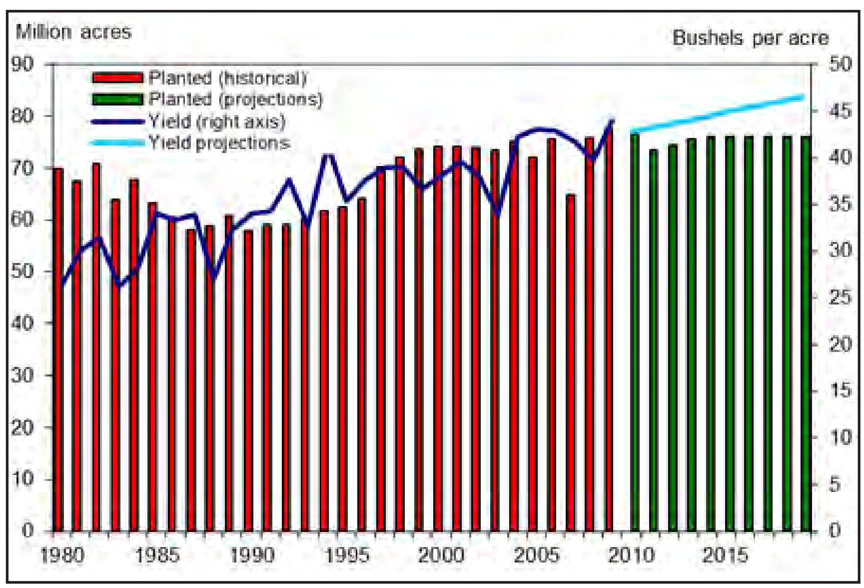
Finally, farmland has become consistently more productive over the years with better farming equipment and techniques resulting in higher yields on the same amount of land. Corn production has risen due to improvements in seed varieties, fertilizers, pesticides, machinery, reduced tillage, irrigation, crop rotations and pest management systems. Figure 5 shows the dramatic increase U.S. corn yields since 1926 and seems to suggest the trend will continue. Soybean yields have also increased, though not as dramatically, and also are projected to continue. Figure 6 displays the soybean yields in the U.S. since 1980. If these trends continue, demand for the land to return to agricultural use as solar leases expire will be softened. If, on the other hand, increases in productivity plateau, then the solar leases will function like a land bank and land temporarily taken out of agricultural production can be restored to agricultural use.

Figure 5.—U.S. Corn Acreage and Yield



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

Figure 6.—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 Paymentt is the lease payment the owner receives in year t; Pt is the price that the farmer receives for the crop (corn or soybeans) in year t; Yieldt is the yield based on the number of acres and historical average of county-specific productivity in year t; Costt 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.

Following Gazheli and Di Corato (2013), we assume that the net returns from agriculture fluctuates according to the following geometric Brownian motion:

$$\frac{d\pi t}{\pi t} = \alpha \, dt + \sigma \, dzt$$

Where πt is the farming profit in year t; α is drift; σ is volatility and dzt is a standard Wiener process.[5] The drift and volatility parameters come from historical farm profitability data.

[5] A Wiener process is a continuous-time stochastic process names in honor of Norbert Wiener. For more explanation about a Wiener process and the methodology for real options analysis, please see Dixit and Pindyck's Investment Under Uncertainty, (1994).

V. Land Use Results

In this section, we will examine the farmers' decision to lease their land in three ways: (1) profit per acre expected from farming; (2) the increase in the price of crops to match solar leasing; and (3) the increase in the crop yields to match solar leasing.

In order to analyze future returns from farming the land, we will use historical data from Jefferson 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 2012 for total farm income, production expenses, average farm size, and average market value of machinery per farm.

Table 2.—Agricultural Statistics for Jefferson County, Wisconsin

	1992	1997	2002	2007	2012
Total Farm Income Per Farm	$83,023	$105,860	$97,621	$145,951	$209,024
Total Farm Production Expenses (average/farm)	$67,418	$87,652	$80,517	$112,182	$179,218
Average Farm Size (acres)	182	195	174	170	186
Net Cash Income per Farm[6]	$15,870	$18,444	$20,166	$40,065	$42,209
Average Market Value of Machinery per Farm	$65,345	$67,111	$90,242	$98,058	$134,604

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

The production expenses listed in Total Farm Production Expenses line item 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 this last item, we can use the average market value of machinery per farm and use straight-line depreciation for 30 years with no salvage value. This is a very conservative estimate of the depreciation since the machinery will likely qualify for a shorter life and accelerated or bonus depreciation. To calculate the opportunity cost of the farmers' time, we obtained the mean hourly wage for farming in each of these years from the Bureau of Labor Statistics. Again, to be

[6] 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."

conservative, we estimate that the farmer spends a total of 8 weeks @ 40 hours/week farming in a year. It seems quite likely that a farmer spends many more hours than this in 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 Jefferson County, Wisconsin

	1992	1997	2002	2007	2012
Average Market Value Machinery Per Farm	$65,345	$67,111	$90,242	$98,058	$134,604
Annual Machinery Depreciation over 30 years - Straight Line (Market Value divided by 30)	$2,178	$2,237	$3,008	$3,269	$4,487
Mean Hourly Wage in Wisconsin for Farming (Bureau of Labor Statistics)	$7.61	$9.24	$11.99	$13.17	$14.78
Annual Opportunity Cost of Farmer's Time (Wage times 8 weeks times 40 Hours/Week)	$2,436	$2,957	$3,837	$4,214	$4,730

Source: United States Department of Agriculture's National Agricultural Statistics Service (NASS), Census of Agriculture, and U.S. 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).[7] These calculations and results are shown in Table 4.

Table 4.—Profit per Farm Calculations for Jefferson County, Wisconsin in 2017 Dollars

	1992	1997	2002	2007	2012
Net Cash Income Per Farm	$15,870	$18,444	$20,166	$40,065	$42,209
Machinery Depreciation	($2,178)	($2,237)	($3,008)	($3,269)	($4,487)
Opportunity Cost of Farmer's Time	($2,436)	($2,957)	($3,837)	($4,214)	($4,730)
Profit	$11,256	$13,250	$13,321	$32,582	$32,993
Average Farm Size (Acres)	182	195	174	170	186
Profit per Acre in 2012 Dollars	$61.85	$67.95	$76.56	$191.66	$177.38
CPI	141.9	161.3	180.9	210.036	229.601
Profit per Acre in 2017 Dollars	$107.44	$103.85	$104.33	$224.95	$190.45

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

[7] 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.

According to Table 4, the profit per acre is significantly higher in 2007 and 2012 than it was in the previous years. Since this is more recent data, we will focus our comparison against these more recent and more profitable years.

According to the local University of Wisconsin Extension Office in Jefferson County, these national USDA statistics do not tell the whole story of on-the-ground farming in the county. The average farm size for corn and soybeans is about 1,200 to 1,500 acres. While corn and soybeans are the predominant crops, mint farms, sod farms, dairy farms and specialty farms are all present in the county. Further, land values and cash rent prices are increasing and may not be justified based on current crop prices. To account for these local conditions, we can make the following adjustments. First, we will assume the average farm (as it is actually farmed rather than owned) is 1,500 acres. Second, we assume that farmer pays cash rent of $200/acre for 1,000 acres that the farmer doesn't own. Third, we assume that the farmer works 2,400 hours per year (this is 1.6 hours per acre which is consistent with the previous analysis and near the middle of the Extension's 2,000-3,000 hour range). Table 4A shows the 2017 analysis based on the USDA "raw" statistics in the first column and the 2017 analysis based on the assumptions outlined above from the Extension Office. The Extension Office estimates result in slightly negative profits after the farmer "pays" himself at $15.75/hour for his time farming and paying cash rent for the 1,000 acres that he does not own. The result of a loss of $12.38 per acre is consistent with the opinion that cash rent and land prices are exceeding their economic value based on current crop prices. To be conservative, we will continue to use the higher profit per acre of $190.45 for the rest of this analysis. Using the lower profit per acre results from the Extension Office Estimates would make the economic land use decision even more attractive for a solar energy center. It is also consistent with the cash rent price of about $200/acre.

Table 4A.—Profit Per Farm Calculations Based on University of Wisconsin Extension Office Estimates

	2017 USDA	2017 Adjusted based on Extension Estimates
Average Farm size	186	1,500
Total Farm Income per farm	$224,430	$1,809,922
Total Farm Production Expenses (average/farm)	$192,427	$1,551,834
Net Cash Income per farm	$45,320	$258,088
Machinery Depreciation	$4,818	$38,851
Opportunity Cost of Farmer's Time	$5,078	$37,800
Cash Rent	-	$200,000
Profit	$35,424	-$18,563
Profit Per Acre in 2017 Dollars	$190.45	-$12.38

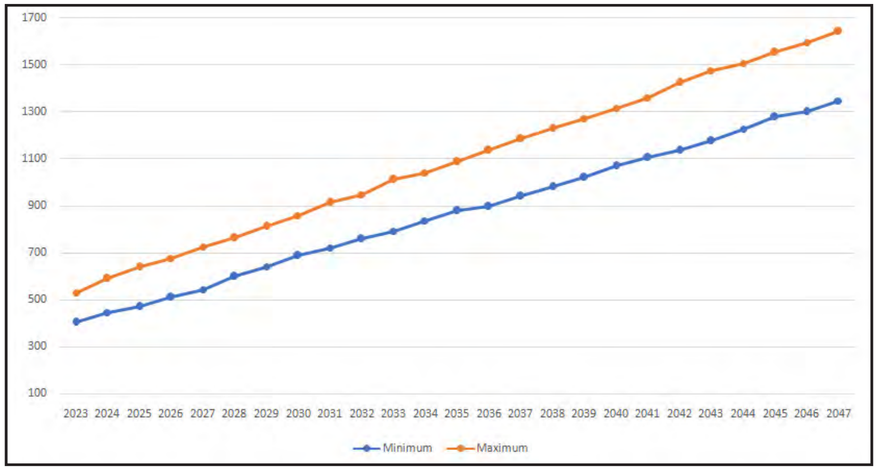
Using an unsophisticated static analysis, the farmer would be better off using his land for solar if the solar lease rental per acre exceeds the inflation-adjusted 2012 profit per acre of $190.45. Yet this static analysis fails to capture the dynamics of the agricultural market and the farmer's hope 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 geometric Brownian motion:

$$\frac{d\pi t}{\pi t} = \alpha\, dt + \sigma\, dzt$$

Where α is drift; σ is volatility and dzt is a standard Wiener process. A standard Wiener process dzt is simulated by randomly picking a number from the normal distribution with a mean of zero and a standard deviation of 1. Drift is the expected annual increase in profits using 2017 dollars plus half of the variance in this number. Because local agriculture profitability has changed so much since 1992, these historical numbers are no longer relevant. In fact, profitability increased substantially in 2007 from the previous years. Using the data from 2007 to the present, the expected annual increase in real profits was $0.33 and the variance is $85.83. Volatility measures how those annual real profits have varied from year to year. Since the Census of Agriculture is only reported every five years, the annual increases are linearly interpolated from the five-year numbers. This may understate the volatility but there are no annual values to compare them to. From 2007 to the present, the standard deviation of the change in annual real profits is $9.26 which is our value for σ or volatility. Using this information, we can simulate future profitability for the farmer using the above equation.

Each year, we assume that the real profits go up by $43.25 (drift) plus $9.26 times the random normal distribution number (Weiner Process). Because of this randomness, we can simulate multiple futures using Monte Carlo simulation. We assume that the solar farm will begin operation no later than 2023, and end 25 years later in 2047. Using 250 different simulations, the highest real profit per acre realized is $1,642.22 in 2047. In this case, the average annual profit over the 25 years is $1,061.48. The lowest real profit per acre realized is $1,347.82 in 2047 because we have excluded any annual decrease in real profits from the analysis. In this case, the average annual profit over the 25 years is $913.08. Simulations with these decreases in real profits for agriculture added in will show that the solar lease makes the farmer better off. By excluding these decreases, we are again building in conservative assumptions into our calculations. Figure 7 is a graph of the highest and lowest real profit per acre simulations. **The solar lease per acre payment is higher than the $1,061.48 average annual payment projected in the maximum simulation by 2047 which means the farmer is financially better off under the solar lease in every year over the 25-year lease.**

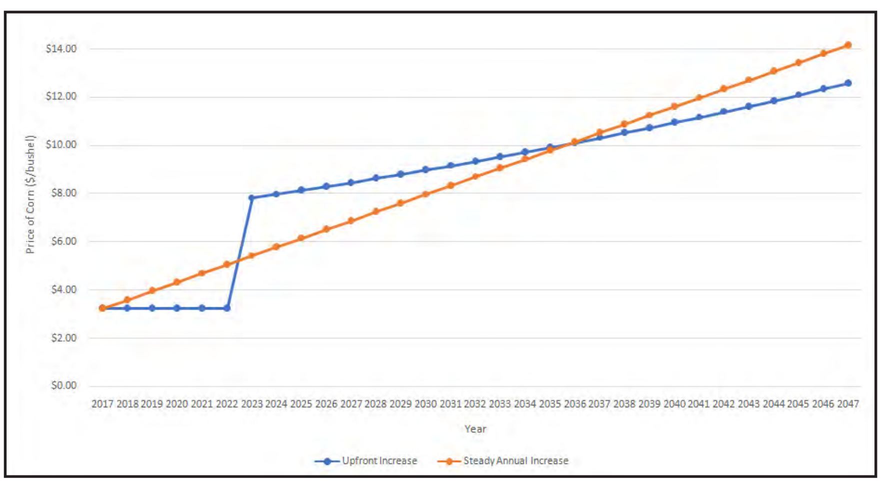
Figure 7.—Simulations of Real Profits per Acre Based on Data from 2007



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 $3.25 per bushel in 2022 to $7.82 in 2021 and rise to $12.58 per bushel by 2047 as shown in Figure 8. Alternatively, the price of corn would need to rise by $0.364 per bushel each year from 2018 to 2047 when it would reach $14.17 per bushel.

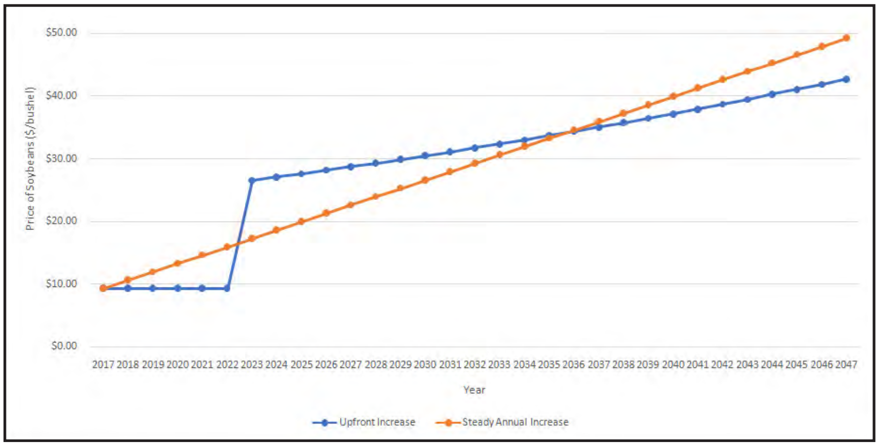
Figure 8.—Simulated Price of Corn per Bushel to Match the Solar Lease



Source: Author's Calculations

Alternatively, if we assume the yields and input costs stay the same, the price of soybeans would have to rise from $9.35 per bushel in 2022 to $26.57 per bushel in 2023 and rise to $42.74 by 2047 as shown in Figure 9. For a linear increase, the price of soybeans would need to rise by $1.33 per bushel each year from 2018 to 2047 when it would reach $49.25 per bushel

Figure 9.—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 more than double from 174 bushels per acre in 2017 to 418 bushels per acre in 2023 and stay at that level until 2047. The yields for soybeans would need to rise from 47 bushels per acre in 2017 to 132 bushels per acre in 2023 and stay there until 2047.

VI. Economic Impact Methodology

The economic analysis of solar PV project development presented here uses the National Renewable Energy Laboratory (NREL) latest Jobs and Economic Development Impacts (JEDI) PV Model (PV12.23.16). NREL is a national laboratory of the U.S. Department of Energy, a federal agency. 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 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 supported by the new solar energy project development and does not analyze the potential loss of jobs due to declines in other forms of electric generation because if it difficult to estimate which, if any, power plants would close.

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 the 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. Utility-scale 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 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 cost estimates supplied by theBadger State Solar Project. In addition, the Badger State Solar Project also estimated the percentages of project materials and labor that would be coming from withinJeffersonCounty and the State of Wisconsin.

Two separate JEDI models produced results to show the economic impact of the Project. The first JEDI model used the 2016 Jefferson County multipliers from IMPLAN. The second JEDI model used the 2016 State of Wisconsinmultipliers and the same project costs.

Tables 5-7 show the output from these models. Table 5 lists the total employment impact from the Badger State Project forJefferson County and the State of Wisconsin. Table 6 shows the impact on total earnings and Table 7 contains the impact on total output.

Table 5.—Total Employment Impact from the Badger State SolarProject

	Jefferson County Jobs	State of Wisconsin Jobs
Construction		
Project Development and Onsite Labor Impacts (direct)[8]	38	345
Module and Supply Chain Impacts (indirect)	23	71
Induced Impacts	8	82
New Local Jobs During Construction	69	498
Operations (Annual)		
Onsite Labor Impacts (direct)	4.0	4.0
Local Revenue and Supply Chain Impacts (indirect)	2.6	3.7
Induced Impacts	2.2	4.9
New Local Long Term Jobs	8.8	12.6

[8] This estimate comes directly from the company which expects to hire four onsite technicians.

The results from the JEDI model show significant employment impacts from the Badger State 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 69 new direct jobs during construction in Jefferson County, though the construction of the solar center could involve closer to 138 workers working half-time for a year. Thus, due to the short-term nature of construction projects, the JEDI model 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 69 for Jefferson County, and 498 for the State of Wisconsin. New local long-term jobs created from the Project total 8.8 for Jefferson County and 12.6 for the State of Wisconsin.

Direct jobs created during the operational phase last the life of the solar energy center, typically 25-35 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 Project, which are categorized by construction impacts and operations impacts. The new local earnings during construction total over $2.6 million for Jefferson County and almost $29.5 million for the State of Wisconsin. The new local long-term earnings total over $446 thousand per year for Jefferson County and over $682 thousand per year for the State of Wisconsin.

Table 6.— Total Earnings Impact from the Badger State Solar Project

	Jefferson County	State of Wisconsin
Construction		
Project Development and Onsite Earnings Impacts	$1,390,608	$22,301,589
Module and Supply Chain Impacts	$947,177	$3,452,386
Induced Impacts	$294,361	$3,729,130
New Local Earnings During Construction	$2,632,146	$29,483,105
Operations (Annual)		
Onsite Labor Impacts	$264,948	$264,948
Local Revenue and Supply Chain Impacts	$104,914	$197,684
Induced Impacts	$76,270	$220,351
New Local Long Term Earnings	$446,132	$682,983

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 $7.0 million for Jefferson County and over $45.5 million for the State of Wisconsin. The new local long-term output totals over $887 thousand for Jefferson County and over $1.5 million for the State of Wisconsin.

Table 7.—Total Output Impact from the Badger State Solar Project

	Jefferson County	State of Wisconsin
Construction		
Project Development and Onsite Jobs Impacts on Output	$2,774,785	$23,420,504
Module and Supply Chain Impacts	$3,212,763	$10,644,048
Induced Impacts	$1,031,472	$11,481,146
New Local Output During Construction	$7,019,020	$45,545,697
Operations (Annual)		
Onsite Labor Impacts	$264,948	$264,948
Local Revenue and Supply Chain Impacts	$354,795	$602,815
Induced Impacts	$267,289	$678,595
New Local Long-Term Output	$887,033	$1,546,359

VIII. Tax Revenue

Solar PV projects, like other generating facilities in Wisconsin, are exempt from property taxes. However, the county and townships in which the projects are located will receive increased revenue through the State's shared revenue utility aid program. This funding creates a new revenue source for county and township government services and compensates local governments for costs they incur in providing services to utilities and related facilities. The revenue takes the place of the property tax local governments might otherwise collect from the generating facility. For new generation facilities, utility shared revenue is driven by both the size and type of generating capacity for the facility.

Table 8 details the shared revenue utility aid tax implications of the Badger State Solar Farm. There are several important assumptions built into the analysis in this table. First, the analysis assumes that the project has a capacity of 149 MW for taxing purposes, which determines the shared revenue impact. Second, the projections use the MW based payment and incentive payment formulas in the "Wisconsin Shared Revenue Utility Aid Summary" developed by the Wisconsin Department of Revenue (2017).

According to Table 8, the townships will receive $248,333 annually from the Badger State Solar Project and Jefferson County will receive over $347,667 annually. Modern PV solar facilities are expected to have useful lives in excess of 30 years. A conservative estimate of 25 years of shared revenue would result in almost $15 million to the county and townships hosting the Project.

Table 8.—Illustration of "Utility Aid" Associated with the Badger State Solar Project

	Total	Townships	County
MW Based Payment	$298,000	$99,333	$198,667
Incentive Payment	$298,000	$149,000	$149,000
Total	$596,000	$248,333	$347,667

IX. Indirect Impacts

In addition to the economic impacts and the property tax revenue, this project will also produce the indirect benefits of reducing air pollution. The clean power produced by the Badger State Solar Project will likely replace fossil-fueled power plants that currently supply grid power. It is difficult to know for certain exactly what power plants will reduce output once the Badger State Solar Project is producing electricity for the grid. Because the grid uses security-constrained economic dispatch, the reduction could come from nearby power plants or high-cost units that are further away depending on the hourly demand and the marginal cost of currently available power plants. In order to give rough estimates of the reduction in air pollution, one can estimate the reduction based on two possible outcomes: (1) if Badger State Solar Project reduces the output of a nearby coal plant or (2) if Badger State Solar Project reduced output evenly across the existing power plants in Wisconsin.

The Badger State Solar Energy Project is located near the Columbia Energy Center, a coal-fired power plant in Pacific, Wisconsin. The Columbia Energy Center is a base load, sub-bituminous coal plant and according to data from the U. S. EPA's 2016 Egrid Reporting Program, it produced 3,481 tons of NO_x emissions, 1,393 tons of SO_2 emissions, 990,206 lbs of CH_4 emissions, 184643 lbs of N_2O emissions, and 5,996,766 tons of CO_2. The nameplate capacity of the plant is listed as 1,112 MW with a capacity factor of 0.5109.

Given the geographic proximity of the Badger State Solar Project to the Columbia Energy Center, it is possible that the energy produced by the solar project would be offset by reductions of generation and associated emissions at the Columbia Center. If all the reductions took place at the Columbia Energy Center and adjusting for both the capacity size difference (149 MW versus 1,112 MW) and the capacity factor difference (an expected first-year minimum of 0.2222 versus 0.5109), the Badger State Solar Project would have the following results regarding air pollution:

- Reduction of 405,717 lbs of NO_x
- Reduction of 162,357 lbs of SO_2
- Reduction of 57,705 lbs of CH_4
- Reduction of 10,760 lbs of N_2O
- Reduction of 698.9 million lbs of CO_2.

According to the EPA's Greenhouse Gas Equivalencies Calculator, this reduction in greenhouse gas emissions is equal to 74,645 passenger vehicles driven for a year.

Alternatively, if we assume that the reduction in electricity is spread uniformly across all power plants in Wisconsin, the Badger State Solar Project would have the following results regarding air pollution:

- Reduction of 195,186 lbs of NO_x
- Reduction of 146,172 lbs of SO_2
- Reduction of 20,882 lbs of CH_4
- Reduction of 5,800 lbs of N_2O
- Reduction of 405 million lbs of CO_2.

According to the EPA's Greenhouse Gas Equivalencies Calculator, this reduction in greenhouse gas emissions is equal to 39,221 passenger vehicles driven for a year.

X. References

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

Bezdek (2007) Economic and Jobs Impacts of the Renewable Energy and Energy Efficiency Industries: U.S. and Ohio, presented at SOLAR 2007, Cleveland, Ohio, accessed on 11/25/2013 at http://www.greenenergyohio.org/ page.cfm?pageID=1386.

Bhavin, Shah. (2008). Solar Cell Supply Chain. Asia Pacific Equity Research, accessed on 11/1/2013 at http://www.slideshare.net/JackChalice/solar-cell-supplychain.

Cadmus. (2018). Focus on Energy Economics Impacts 2015-2016. accessed on 11/8/2018 at https://www.focusonenergy.com/sites/default/files/WI%20FOE%202015%20to%202016%20Econ%20Impact%20Report-%20Final.pdf

Center for Competitive Florida. (2009). The Positive Economic Impact of Solar Energy on the Sunshine State, Briefings, accessed 11/25/2013 at http://www.floridataxwatch.org/resources/pdf/04162009SolarEnergy.pdf.

Chopra, Sunil and Peter Meindl. (2004). What is a SupplyChain?, Supply Chain Management.

Dixit, Avinash and Robert S. Pindyck. (1994).Investment Under Uncertainty. Princeton University Press: Princeton, NJ.

Gazheli, Ardjan and Luca Di Carato. (2013). Land-use change and solar energy production: a real option approach.Agricultural Finance Review. 73 (3): 507-525.

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

Jo 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.

Loomis, D.G., Jo, J.H., and Aldeman, M.R., (2016). Economic Impact Potential of Solar Photovoltiacs in Illinois, Renewable Energy, 87, 253-258.

National Renewable Energy Laboratories. (2012). Utility-Scale Concentrating Solar Power and Photovoltaics Projects: A Technology and Market Overview. National Renewable Energy Laboratory.

Overview of the Solar Energy Industry and Supply Chain, accessed on 10/30/2013 at http://www.thecemc.org.

SEIA. (2016a). Solar Market Insight Report 2016 Q4. Solar Energy Industries Association.

SEIA. (2016b).Solar Spotlight: Virginia. Solar Energy Industries Association.

Solar Foundation. (2013). An Assessment of the Economic, Revenue, and Societal Impacts of Colorado's Solar Industry. October 2013, accessed on 11/25/2013 at http://solarcommunities.org/wp-content/uploads/2013/10/TSF_COSEIA-Econ-Impact-Report_FINAL-VERSION.pdf.

Stone & Associates (2011). Overview of the Solar Energy Industry and Supply Chain, Prepared for the Blue Green Alliance, accessed on 12/13/13 at http://www.thecemc.org/body/Solar-Overview-for-BGA-Final-Jan-2011.pdf.

Toothman, Jessica, and Aldous, Scott. (2013). How Solar Cells Work, How Stuff Works, accessed on 10/28/2013 at http://science.howstuffworks.com/environmental/energy/solar-cell.htm.

Wisconsin Department of Revenue. (2017). Shared Revenue Utility Payment, accessed on 9/15/2018 at https://www.revenue.wi.gov/DORReports/17utilit.pdf.

XI. Curriculum Vita - David Loomis

David G. Loomis
Illinois State University
Department of Economics
Campus Box 4200
Normal, IL 61790-4200
(309) 438-7979
dloomis@ilstu.edu

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 five 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 five companies to 16 organizations.
Doubled the number of workshop/training events annually.
Supervised two 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.)

2007-2017 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 four professional staff members and supervised three 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 four 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 Forecasters, and International Telecommunications Society.

Professional Publications

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

Loomis, D.G., Hayden, J., Noll, S. and Payne, J.E. (2016). Economic Impact of Wind Energy Development in Illinois, The Journal of Business Valuation and Economic Loss Analysis, 11(1), 3-23.

Loomis, D.G., Jo, J.H., and Aldeman, M.R., (2016). Economic Impact Potential of Solar Photovoltiacs in Illinois, Renewable Energy, 87, 253-258.

Aldeman, M.R., Jo, J.H., and Loomis, D.G. (2015). The Technical Potential for Wind Energy in Illinois, Energy, 90(1), 1082-1090.

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.

Professional Publications (cont.)

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. &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.

Theron, S., Winter, J.R, Loomis, D. G., & 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. &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. & 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., &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., & 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., & 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., & Loomis, D. G.(2010). Issues in the determination of the optimal portfolio of electricity supply options. Energy Policy, 38, 2198-2207.

Carlson, J. L., &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., &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.

Professional Publications (cont.)

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

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

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

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

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

Taylor, L. D. & Loomis, D. G. (2002). Forecasting the internet: understanding the explosive growth of data communications. Boston: Kluwer Academic Publishers.

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

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

Malm, E. & 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

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.

Illinois Commerce Commission, Case No. 15-0277, Oral Cross-Examination Testimony on behalf of Grain Belt Express Clean Line LLC, appeared before the Commission on August 19, 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.

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

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

Missouri Public Service Commission, Case No. EA-2014-0207, Written Direct Testimony on behalf of Grain Belt Express Clean Line LLC, filed March 26, 2014.

Expert Testimony (cont.)

Illinois Commerce Commission, Case No. 12-0560, Oral Cross-Examination Testimony on behalf of Rock Island Clean Line LLC, appeared before the Commission on December 11, 2013.

Illinois Commerce Commission, Case No. 12-0560, Written Rebuttal Testimony on behalf of Rock Island Clean Line LLC filed August 20, 2013.

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, Written Direct Testimony on behalf of Rock Island Clean Line LLC, filed October 10, 2012.

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

"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.

Selected Presentations (cont.)

"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.

"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.

Selected Presentations (cont.)

“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.

“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, IL.

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

Selected Presentations (cont.)

"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.

"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.

Selected Presentations (cont.)

"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.

"Regulatory Fairness and Local Competition Pricing," presented May 30, 1996 at the 15th Annual Advanced Workshop in Regulation and Public Utility Economics.

"Optimal Pricing For a Regulated Monopolist Facing New Competition: The Case of Bell Atlantic Special Access Demand," presented May 28, 1992 at the Rutgers Advanced Workshop in Regulation and Public Utility Economics.

Grants

"Energy Learning Exchange - Implementing Nationally Recognized Energy Curriculum and Credentials in Illinois," Northern Illinois University, RSP Award Number A17-0098, February, 2017, $13,000.

"Smart Grid for Schools 2017 and Energy Challenge," with William Hunter, Illinois Science and Energy Innovation Foundation, RSP Award Number A15-0092-002 - extended, January 2017, $350,000.

"Illinois Jobs Project," University of California Berkeley, RSP Award Number A16-0148, August, 2016, $10,000.

"Energy Workforce Ready Through Building Performance Analysis," Illinois Department of Commerce and Economic Opportunity through the Department of Labor, RSP Number A16-0139, June, 2016, $328,000 (grant was de-obligated before completion).

"Smart Grid for Schools 2016 and Smart Appliance Challenge," with William Hunter, Brad Christenson and Jeritt Williams, Illinois Science and Energy Innovation Foundation, RSP Award Number A15-0092-002, January 2016, $450,000.

"Smart Grid for Schools 2015," with William Hunter and Matt Aldeman, Illinois Science and Energy Innovation Foundation, RSP Award Number A15-0092-001, February 2015, $400,000.

"Economic Impact of Nuclear Plant Closings: A Response to HR 1146," Illinois Department of Economic Opportunity, RSP Award Number 14-025001 amended, January, 2015, $22,000.

"Partnership with Midwest Renewable Energy Association for Solar Market Pathways" with Missy Nergard and Jin Jo, U.S. Department of Energy Award Number DE-EE0006910, October, 2014, $109,469 (ISU Award amount).

"Renewable Energy for Schools," with Matt Aldeman and Jin Jo, Illinois Department of Commerce and Economic Opportunity, Award Number 14-025001, June, 2014, $130,001.

Grants (cont.)

“SmartGrid for Schools 2014,” with William Hunter and Matt Aldeman, Illinois Science and Energy Innovation Foundation, RSP Number 14B116, March 2014, $451,701.

“Windpower 2014 Conference Exhibit,” Illinois Department of Commerce and Economic Opportunity, RSP Number 14C167, March, 2014, $95,000.

“Lake Michigan Offshore Wind Energy Buoy,”with Matt Aldeman, Illinois Clean Energy Community Foundation, Request ID 6435, November, 2013, $90,000.

“Teaching Next Generation Energy Concepts with Next Generation Science Standards,” with William Hunter, Matt Aldeman and Amy Bloom, Illinois State Board of Education, RSP Number 13B170A, October, 2013, second year, $159,954; amended to $223,914.

“Solar for Schools,” with Matt Aldeman, Illinois Green Economy Network, RSP Number 13C280, August, 2013, $66,072.

“Energy Learning Exchange Implementation Grant,” with William Hunter and Matt Aldeman, Illinois Department of Commerce and Economic Opportunity, Award Number 13-052003, June, 2013, $350,000.

“Teaching Next Generation Energy Concepts with Next Generation Science Standards,” with William Hunter, Matt Aldeman and Amy Bloom, Illinois State Board of Education, RSP Number 13B170, April, 2013, $159,901.

“Illinois Sustainability Education SEP,” Illinois Department of Commerce and Economic Opportunity, Award Number 08-431006, March, 2013, $225,000.

“Illinois Pathways Energy Learning Exchange Planning Grant,” with William Hunter and Matt Aldeman, Illinois State Board of Education (Source: U.S. Department of Education), RSP Number 13A007, December, 2012, $50,000.

“Illinois Sustainability Education SEP,” Illinois Department of Commerce and Economic Opportunity, Award Number 08-431005, June 2011, amended March, 2012, $98,911.

“Wind for Schools Education and Outreach,” with Matt Aldeman, Illinois Department of Commerce and Economic Opportunity, Award Number 11-025001, amended February, 2012, $111,752.

“A Proposal to Support Solar Energy Potential and Job Creation for the State of Illinois Focused on Large Scale Photovoltaic System,” with Jin Jo (lead PI), Illinois Department of Commerce and Economic Opportunity, Award Number 12-025001, January 2012, $135,000.

“National Database of Utility Rates and Rate Structure,” U.S. Department of Energy, Award Number DE-EE0005350TDD, 2011-2014, $850,000.

“Illinois Sustainability Education SEP,” Illinois Department of Commerce and Economic Opportunity, Award Number 08-431005, June 2011, $75,000.

Grants (cont.)

"Wind for Schools Education and Outreach," with Matt Aldeman, Illinois Department of Commerce and Economic Opportunity, Award Number 11-025001, March 2011, $190,818.

"Using Informal Science Education to Increase Public Knowledge of Wind Energy in Illinois," with Amy Bloom and Matt Aldeman, Scott Elliott Cross-Disciplinary Grant Program, February 2011, $13,713.

"Wind Turbine Market Research," with Matt Aldeman, Illinois Manufacturers Extension Center, May, 2010, $4,000.

"Petco Resource Assessment," with Matt Aldeman, Petco Petroleum Co., April, 2010 amended August 2010 $34,000; original amount $18,000.

"Wind for Schools Education and Outreach," with Anthony Lornbach and Matt Aldeman, Scott Elliott Cross-Disciplinary Grant Program, February, 2010, $13,635.

"IGA IFA/ISU Wind Due Diligence," Illinois Finance Authority, November, 2009, $8,580 amended December 2009; original amount $2,860.

"Green Industry Business Development Program, with the Shaw Group and Illinois Manufacturers Extension Center, Illinois Department of Commerce and Economic Opportunity, Award Number 09-021007, August 2009, $245,000.

"Wind Turbine Workshop Support," Illinois Department of Commerce and Economic Opportunity, June 2009, $14,900.

"Illinois Wind Workers Group," with Randy Winter, U.S. Department of Energy, Award Number DE-EE0000507, 2009-2011, $107,941.

"Wind Turbine Supply Chain Study," with J. Lon Carlson and James E. Payne, Illinois Department of Commerce and Economic Opportunity, Award Number 09-021003, April 2009, $125,000.

"Renewable Energy Team Travel to American Wind Energy Association Windpower 2009 Conference," Center for Mathematics, Science and Technology, February 2009, $3,005.

"Renewable Energy Educational Lab Equipment," with Randy Winter and David Kennell, Illinois Clean Energy Community Foundation (peer-reviewed), February, 2008, $232,600.

"Proposal for New Certificate Program in Electricity, Natural Gas and Telecommunications Economics," with James E. Payne, Extended Learning Program Grant, April, 2007, $29,600.

"Illinois Broadband Mapping Study," with J. Lon Carlson and Rajeev Goel, Illinois Department of Commerce and Economic Opportunity, Award Number 06-205008, 2006-2007, $75,000.

"Illinois Wind Energy Education and Outreach Project," with David Kennell and Randy Winter, U.S. Department of Energy, Award Number DE-FG36-06GO86091, 2006-2010, $990,000.

Grants (cont.)

“Wind Turbine Installation at Illinois State University Farm,” with Doug Kingman and David Kennell,Illinois Clean Energy Community Foundation (peer-reviewed), May, 2004, $500,000.

“Wind Turbine Installation at Illinois State University Farm,” with Doug Kingman and David Kennell,Illinois Clean Energy Community Foundation (peer-reviewed), May, 2004, $500,000.

“Illinois State University Wind Measurement Project,” Doug Kingman and David Kennell,Illinois Clean Energy Community Foundation (peer-reviewed), with August, 2003, $40,000.

“Illinois State University Wind Measurement Project,” with Doug Kingman and David Kennell, NEG Micon matching contribution, August, 2003, $65,000.

“Distance Learning Technology Program,” Illinois State University Faculty Technology Support Services, Summer 2002, $3,000.

“Providing an Understanding of Telecommunications Technology By Incorporating Multimedia into Economics 235,” Instructional Technology Development Grant (peer-reviewed), January 15, 2001, $1,400.

“Using Real Presenter to create a virtual tour of GTE’s Central Office,” with Jack Chizmar, Instructional Technology Literacy Mentoring Project Grant (peer-reviewed), January 15,2001, $1,000.

“An Empirical Study of Telecommunications Industry Forecasting Practices,” with James E. Cox, College of Business University Research Grant (peer-reviewed), Summer, 1999, $6,000.

“Ownership Form and the Efficiency of Electric Utilities: A Meta-Analytic Review” with L. Dean Hiebert, Institute for Regulatory Policy Studies research grant (peer-reviewed), August 1998, $6,000.

Total Grants: $7,482,913

External Funding

Corporate Funding for Institute for Regulatory Policy Studies, Ameren ($7,500), Aqua Illinois ($7,500); Commonwealth Edison ($7,500); Exelon/ ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midcontinent ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2017, $75,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2016, $19,667.

Corporate Funding for Energy Learning Exchange, Calendar Year 2016, $53,000.

Corporate Funding for Institute for Regulatory Policy Studies, Ameren ($7,500), Aqua Illinois ($7,500); Commonwealth Edison ($7,500); Exelon/ Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midcontinent ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Utilities, Inc. ($7,500) Fiscal Year 2016, $82,500 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2015, $15,897.

Corporate Funding for Institute for Regulatory Policy Studies, Ameren ($7,500), Alliance Pipeline ($7,500); Aqua Illinois ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Exelon/Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midcontinent ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2015, $90,000 total.

Corporate Funding for Energy Learning Exchange, Calendar Year 2014, $55,000.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2014, $12,381.

Corporate Funding for Institute for Regulatory Policy Studies, Ameren ($7,500), Alliance Pipeline ($7,500); Aqua Illinois ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midwest Energy Efficiency Alliance ($4,500); Midwest Generation ($7,500); Midwest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2014, $102,000 total.

Corporate Funding for Energy Learning Exchange, Calendar Year 2013, $53,000.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2013, $17,097.

Corporate Funding for Institute for Regulatory Policy Studies, Ameren ($7,500), Alliance Pipeline ($7,500); Aqua Illinois ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midwest Generation ($7,500); Midwest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2013, $97,500 total.

External Funding (cont.)

Corporate Funding for Illinois Wind Working Group, Calendar Year 2012, $29,325.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2012, $16,060.

Corporate Funding for Institute for Regulatory Policy Studies, Alliance Pipeline ($7,500); Aqua Illinois ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midwest Generation ($7,500); MidWest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2012, $90,000 total.
Corporate Funding for Illinois Wind Working Group, Calendar Year 2011, $57,005.

Workshop Surplus for Institute for Regulatory Policy Studies, with Adrienne Ohler, Fiscal Year 2011, $13,562.

Corporate Funding for Institute for Regulatory Policy Studies, Alliance Pipeline ($7,500); Aqua Illinois ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); Illinois American Water ($7,500) ITC Holdings ($7,500); Midwest Generation ($7,500); MidWest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2011, $90,000 total.

Corporate Funding for Center for Renewable Energy, Calendar Year 2010, $50,000.

Corporate Funding for Illinois Wind Working Group, Calendar Year 2010, $49,000.

Workshop Surplus for Institute for Regulatory Policy Studies, with Lon Carlson, Fiscal Year 2010, $17,759.

Corporate Funding for Institute for Regulatory Policy Studies, Alliance Pipeline ($7,500); Ameren ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); ITC Holdings ($7,500); Midwest Generation ($7,500); MidWest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2010, $82,500 total.

Corporate Funding for Illinois Wind Working Group, Calendar Year 2009, $57,140.

Workshop Surplus for Institute for Regulatory Policy Studies, with Lon Carlson, Fiscal Year 2009, $21,988.

Corporate Funding for Institute for Regulatory Policy Studies, Alliance Pipeline ($7,500); Ameren ($7,500); AT&T ($7,500);Commonwealth Edison ($7,500); Constellation NewEnergy ($7,500); MidAmerican Energy ($7,500); Midwest Generation ($7,500); MidWest ISO ($7,500); NICOR Energy ($7,500); People Gas Light and Coke ($7,500); PJM Interconnect ($7,500); Fiscal Year 2009, $82,500 total.

Corporate Funding for Center for Renewable Energy, Calendar Year 2008, $157,500.

Corporate Funding for Illinois Wind Working Group, Calendar Year 2008, $38,500.

External Funding (cont.)

Workshop Surplus for Institute for Regulatory Policy Studies, with Lon Carlson, Fiscal Year 2008, $28,489.

Corporate Funding for Institute for Regulatory Policy Studies, Alliance Pipeline ($5,000); Ameren ($5,000); AT&T ($5,000);Commonwealth Edison ($5,000); Constellation NewEnergy ($5,000); MidAmerican Energy ($5,000); Midwest Generation ($5,000); Midwest ISO ($5,000); NICOR Energy ($5,000); Peabody Energy ($5,000), People Gas Light and Coke ($5,000); PJM Interconnect ($5,000); Fiscal Year 2008, $60,000 total.

Corporate Funding for Illinois Wind Working Group, Calendar Year 2007, $16,250.

Workshop Surplus for Institute for Regulatory Policy Studies, with Lon Carlson, Fiscal Year 2007, $19,403.

Corporate Funding for Institute for Regulatory Policy Studies, AARP ($3,000), Alliance Pipeline ($5,000), Ameren ($5,000); Citizens Utility Board ($5,000); Commonwealth Edison ($5,000); Constellation NewEnergy ($5,000); MidAmerican Energy ($5,000); Midwest Generation ($5,000); Midwest ISO ($5,000); NICOR Energy ($5,000); Peabody Energy ($5,000), People Gas Light and Coke ($5,000); PJM Interconnect ($5,000); SBC ($5,000); Verizon ($5,000); Fiscal Year 2007, $73,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with Lon Carlson, Fiscal Year 2006, $13,360.

Corporate Funding for Institute for Regulatory Policy Studies, AARP ($1,500), Alliance Pipeline ($2,500), Ameren ($5,000); Citizens Utility Board ($5,000); Commonwealth Edison ($5,000); Constellation NewEnergy ($5,000); DTE Energy ($5,000); MidAmerican Energy ($5,000); Midwest Generation ($5,000); Midwest ISO ($5,000); NICOR Energy ($5,000); Peabody Energy ($2,500), People Gas Light and Coke ($5,000); PJM Interconnect ($5,000); SBC ($5,000); Verizon ($5,000); Fiscal Year 2006, $71,500 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Fiscal Year 2005, $12,916.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); Citizens Utility Board ($5,000); Commonwealth Edison ($5,000); Constellation NewEnergy ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); Midwest Generation ($5,000); Midwest ISO ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); PJM Interconnect ($5,000); SBC ($2,500); Verizon ($2,500); Fiscal Year 2005, $60,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Fiscal Year 2004, $17,515.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); Commonwealth Edison ($5,000); Constellation NewEnergy ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); Midwest Generation ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); PJM Interconnect ($5,000); Fiscal Year 2004, $45,000 total.

External Funding (cont.)

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Fiscal Year 2003, $8,300.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($2,500); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Fiscal Year 2003, $32,500 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 2002, $15,700.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($2,500); AT&T ($5,000); Commonwealth Edison ($2,500); Illinois Power ($2,500); MidAmerican Energy ($2,500); NICOR Energy ($2,500); People Gas Light and Coke ($2,500); Calendar Year 2002, $17,500 total.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); Calendar Year 2002, $20,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 2001, $35,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 2001, $19,400.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); SAS Institute ($10,000); Calendar Year 2001, $30,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 2000, $35,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 2000, $20,270.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); Calendar Year 2000, $20,000 total.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); Calendar Year 2002, $20,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 2001, $35,000 total.

External Funding (cont.)

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 2001, $19,400.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); SAS Institute ($10,000); Calendar Year 2001, $30,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 2000, $35,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 2000, $20,270.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); Taylor Nelson Sofres Telecoms ($10,000); Calendar Year 2000, $20,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); AT&T ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); NICOR Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 1999, $35,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 1999, $10,520.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); PNR Associates ($10,000); Calendar Year 1999, $20,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); CILCO ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 1998, $30,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 1998, $44,334.

Corporate Funding for International Communications Forecasting Conference, National Economic Research Associates ($10,000); PNR Associates ($10,000); Calendar Year 1998, $20,000 total.

Corporate Funding for Institute for Regulatory Policy Studies, with L. Dean Hiebert, AmerenCIPS ($5,000); CILCO ($5,000); Commonwealth Edison ($5,000); Illinois Power ($5,000); MidAmerican Energy ($5,000); People Gas Light and Coke ($5,000); Calendar Year 1997, $30,000 total.

Workshop Surplus for Institute for Regulatory Policy Studies, with L. Dean Hiebert, Calendar Year 1997, $19,717.

Total External Funding: $2,406,565