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AN EXAMINATION OF THE COMMUNITY LEVEL DYNAMICS RELATED TO THE INTRODUCTION OF WIND ENERGY IN INDIANA

Report

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EXECUTIVE SUMMARY

The utility-scale electricity generation by using wind power has been part of the Indiana landscape since 2008. The earliest projects were concentrated in the west-North Central part of the state, the area that had the most favorable wind conditions for the turbine technology of that time. Subsequent technological innovations, especially the development of taller turbines of larger capacity, have expanded the potential for other parts of Indiana to host utility-scale wind farms. While a large-scale generation of electricity from wind power is now viable in many counties of Indiana, county governments have used their legal authorities to inhibit or preclude development. Understanding how and why counties come to such decisions is the primary question of interest for this report.

While many studies have examined the benefits and costs associated with wind power introduction and expansion, there is still not an overall consensus at the local, state, or national level. Our project tries to find a coherent way to address the variety of assets and challenges that the communities are facing in terms of wind energy farm's construction and use.

This report examines the wind energy sector in Indiana and selected counties and includes information gathered via two different replicable approaches: rigorous secondary data analysis and primary data collection using an online survey and online listening sessions. The goal was to assess the wind energy sector in Indiana.

County governments that have allowed the development of utility-scale wind farms have benefitted financially from the decision. The counties that allowed the first turbines – Benton and White Counties – collected $4.3 million and $2.3 million, respectively, in 2019, property taxes from their local wind farms. The industry also makes substantial payments to the counties under the terms of economic development agreements. Road use agreements and decommissioning agreements are designed to offset other potential burdens the industry might place on the county.

The wind-generated electricity industry is capital intensive, which means that a large share of the industry's revenues must go to compensate those who financed the substantial investments made at the time of construction. But the industry also makes payments to local citizens. The industry pays local landowners – primarily those who host turbines on their land - but also others that are affected by its presence. In the short periods of construction, there is an intense economic activity in the local areas and numerous short-term employment opportunities. In the operation phase, the employment numbers are smaller, but the jobs are more stable and well-paid.

Trying to capture the multi-dimensional nature of community development, online listening session participants identified the following key assets of wind energy in White County and Benton County: natural, cultural, human, social, political, financial, financial, and built capitals.

Wind energy represents a huge infrastructure investment in Indiana communities. The wind farms bring geographically diverse and long-lasting benefits, including millions of dollars in property tax revenue, annual lease payments for Indiana's farmers, and well-paid maintenance and construction jobs as the main source of employment. But wind energy is associated with skepticism, suspicion, and opposition. We provide a couple of suggestions that might help in the effort to support the development of wind farms:

- Awareness of key assets and challenges in counties supporting or declining wind farms that are related to the wind energy
- Legislative instruments
- Technology development
- Awareness-raising capacity building and education
- Fostering positive relationships between the commercial wind energy company and local communities

INTRODUCTION

Wind power, electricity created by capturing the kinetic energy of wind by modern wind turbines, is an attractive, clean, and one of the lowest-cost renewable electricity alternatives currently available (IOED, 2019). Wind energy is not new to Indiana. According to the Indiana Office of Energy Development, by 2017, there were 1,095 large-scale wind turbines located in much of the northern half of the state (IOED, 2019).

Most of the wind projects are built in rural areas, and they represent a source of revenues for counties, lease payments for rural landowners, short and long-term job growth, and much needed rural economic development. Utility-scale wind farms can provide rural areas with significant capital infrastructure investments, while small-scale wind installations for households and businesses can reduce dependency on the electric grid and decrease electrical energy costs for rural communities (Clean Grid, 2019). While these advantages provide compelling evidence for supporting wind power expansion, wind power has experienced community-level opposition in numerous communities in Indiana, including an outright ban in Tippecanoe County or zoning regulations stringent enough to discourage wind farm developers, such as in Newton County.

Renewable energy, including wind energy, deserves closer examination given the inherent advantages and disadvantages, and, most importantly, it is potential for becoming a critical element in Indiana's community development and energy portfolio.

While many studies have examined the benefits and costs associated with wind power introduction and expansion, there is still not an overall consensus at the local, state, or national level. Our project tries to find a coherent way to address the variety of assets and challenges that the communities are facing in terms of wind energy farm's construction and use.

METHODOLOGY

This report examines the wind energy sector in Indiana and selected counties and includes information gathered via two different replicable approaches: rigorous secondary data analysis and primary data collection using an online survey and online listening sessions. The goal of this study was to assess the socio-economic impacts of the wind energy sector in Indiana.

The intention was to focus on counties where wind farms are currently operated. However, public opinion regarding the acceptance of these wind projects differs. Also, most of the eligible counties are rural with low population density, and wind energy may tangibly impact the local economy. Given these similarities and difference, along with the timeframe for the proposed work, the following counties have been chosen as the case studies:

Group 1 – For wind energy counties: Benton, White, Randolph, and Madison
Group 2 – Against wind energy counties: Tippecanoe, Clinton, Montgomery, Jay, and Tipton

Profile of the wind energy sector in Indiana. The Purdue team generated a list of quantitative variables to examine trends related to the job and occupational dynamics, changes in industry sector composition, assessed values by parcel, etc., in areas that did and did not move forward with wind energy proposals.

A literature review of the local economic impacts of utility-scale wind energy generation concentrates on wind energy development and estimates local economic impacts of wind power generation activity, especially the estimated effects of wind energy generation on local per capita income and employment. Evidence on other outcomes such as local tax revenues and lease payments is sparse, and we expected to rely on survey and listening sessions for these figures. In addition, we reviewed the literature on the impacts of wind farms on real estate values and land prices, often a contentious topic in the communities.

Socio-economic profile of the selected counties. The profile presents a descriptive statistical analysis of a variety of demographic, economic, labor market, and quality of life data that enables to gain a better perspective on the current condition in the counties in Indiana, chosen as the case studies: Benton, White, Jay, Randolph, Tipton, Madison, Tippecanoe, Clinton, and Montgomery counties.

Analysis of wind energy attitudes in the selected counties is aimed at examining the mindset of the counties, selected as case studies, towards current or future wind energy farms. Selected counties include White, Benton, Jay, Randolph, Tippecanoe, Clinton, and Montgomery County.

On-line listening sessions. The Purdue team hosted two on-line listening sessions and addressed participants who have various connections to the local community and local wind energy farms.

We chose four counties with a different public opinion regarding the acceptance of wind farms: Benton, White, Jay, and Randolph counties.

An on-line key informant survey was conducted in the Benton, White, Jay, and Randolph counties and complemented online listening sessions. Questions were focused in general on experiences, local government benefits, lessons learned, and forms of community benefit provisions.

PROFILE OF THE WIND ENERGY SECTOR IN INDIANA

In 2008, Indiana's first utility-scale wind farm went into operation near the small town of Earl Park in Benton County. Spurred on by generous federal subsidies, a number of subsequent wind farms in Benton County and neighboring White County came on-line in 2009 and 2010.[1] Subsequent technological developments have led to further growth of the industry in Indiana, even as the size and scope of federal subsidies have been substantially reduced. Indiana's wind power generation sector has since grown through further large investments in Benton and White Counties, and through the introduction of three more large farms with footprints in Tipton, Madison, Jay and Randolph counties.[2]

Recent technological developments - notably the development of much taller turbines - have made much of northern Indiana viable for hosting utility-scale wind power generation, even as geographic spread of the industry has fostered local resistance. Many Indiana county governments have taken explicit and/or implicit actions to impede the utility-scale wind power in their localities.

In this section of the report, we offer some descriptive background on the utility-scale wind sector in Indiana. We describe Indiana's wind resource, technological developments that have improved the economic viability of utility-scale investments, as well as the industry's footprint in the state. We describe the form and approximate value of the industry's payments to the local governments and residents. Finally, we summarize state, local and federal policies towards the development of the wind industry.

[1] The arrival of the wind power sector in Indiana coincides with a national boom in the construction of such facilities – a boom that was made possible by the American Recovery and Reinvestment Act, the federal stimulus designed to offset the effects of the global financial crisis. See Johnson (2009) for a contemporary account linking the stimulus to the wind power boom at that time.

[2] The American Wind Energy Association has produced a comprehensive and detailed map of U.S. wind facilities, which is available here: http://gis.awea.org/arcgisportal/apps/webappviewer/index.html?id=eed1ec3b624742f8b18280e6aa73e8ec. Detailed information on Indiana's wind energy production facilities can be found by scaling the US map.

I. Indiana's wind resource

In order to be economically viable, wind farms should be located in places with winds that are sustained and of sufficient speed. Wind conditions vary across locations, but stronger and more stable winds are generally found at higher altitudes. One of the most significant technological innovations in the wind-energy generation sector - particularly as it relates to the issues relevant to this report - is the development over time of ever taller turbines that can access the more favorable winds that occur at higher heights. Most of Indiana's earliest utility-scale turbines have their "hubs" located 80 meters (approx. 262 feet) above the ground.

Figure 1 is a map illustrating average wind speed at this 80-meter height for the whole of Indiana.[3] The figure shows that average wind speeds in the west north-central portion of the state - especially Benton and White Counties - average more than 7.5 meters per second 80 meters above the ground. Other locations, mostly in the state's north-central region, have wind speeds of more than 7 meters per second at the 80-meter height. 80-meter wind speeds in other parts of the state are substantially lower, especially in south-central Indiana. The key lesson taken from Figure 1 is that higher quality wind resources in Benton and White Counties are a crucial reason that the industry's earliest investments occurred there.

In recent years, the industry has adopted taller turbines. This development has meant that much larger portions of Indiana are now viable as hosts for utility-scale wind farms. Figure 2 shows a map of wind speeds for the United States at the height of 100 meters (328 feet). At 100-meter heights, much of the northern two-thirds of the state have average wind speeds of more than 8 meters per second. These speeds are higher than Benton and White county winds at 80 meters and are typically strong enough to make utility-scale wind energy generation economically viable.

While average wind speeds offer a useful guide to understanding spatial and vertical variation in the quality of Indiana's wind resource, an indicator known as the *capacity factor* is more helpful in understanding the implications of technological progress for wind energy generation in Indiana. The capacity factor for a given wind turbine or wind farm is calculated as the annual amount of power produced, divided by the nameplate capacity (the theoretical maximum amount of power that the turbine or farm would produce under ideal circumstances).[4] Technical analysts can combine information on wind conditions in a given location with the capabilities of a given turbine technology to predict the capacity factor of a turbine of that type if it were to be installed in that location. Experts at the U.S. National Renewable Energy Laboratory (NREL) have done these

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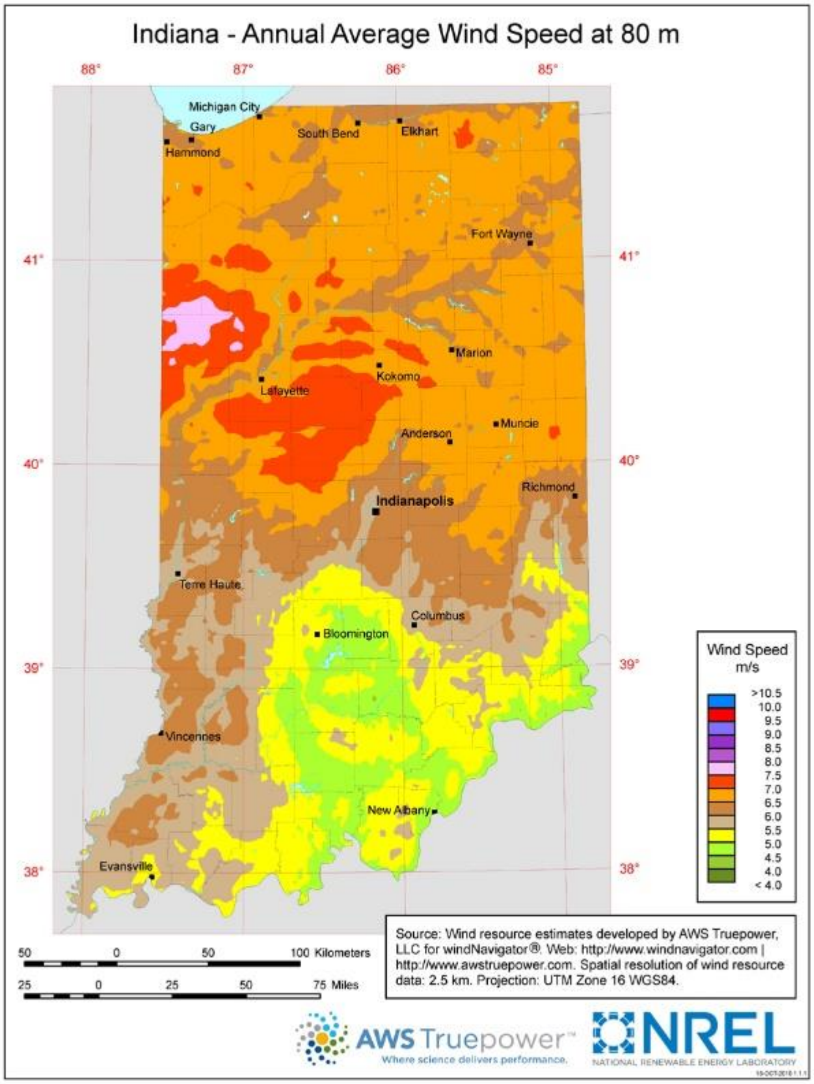
[3] The map focuses on Indiana's on-shore wind capacity, which is the focus of the issues studied in this report. Indiana also has offshore generating potential in Lake Michigan, which can be viewed at https://windexchange.energy.gov/maps-data/171.

[4] Capacity factors for wind energy are affected by the intermittency of sufficiently strong winds, but also by down time for maintenance and repairs. Other generation technologies also have down times, and therefore have capacity factors below the theoretical maximum of 100. EIA (2020d) reports annual average capacity factors for existing installed capacity of various generation technologies in 2019. Some examples are: Coal (47.5), Combined Cycle Natural Gas (56.8), Hydroelectric (39.1), Nuclear (93.5), Photovoltaic Solar (41.5) and Wind (34.8).

calculations, and their estimates help to explain why the production of wind-generated electricity is now viable in locations outside the west-north central region.

Figure 1. Average wind speeds in Indiana at 80 meters



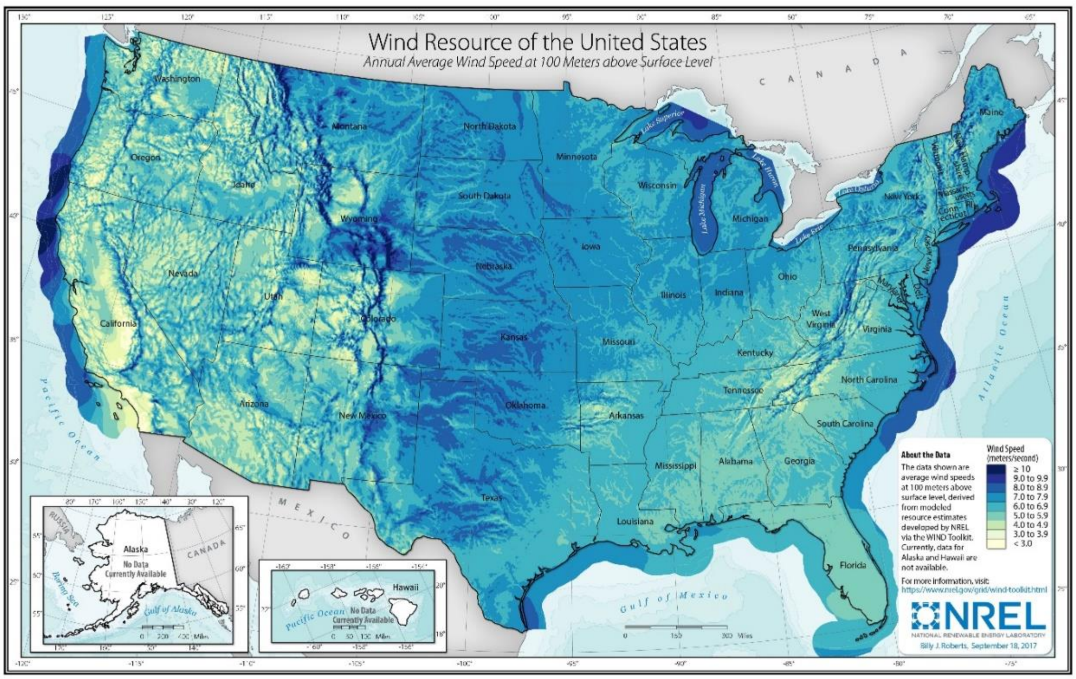
Source: https://windexchange.energy.gov/maps-data/40 using data from NREL

The NREL analysts began their calculations by screening outlands that are not suitable for development for legal or other reasons (populated areas, state and national parks, wildlife refuges, airfields, etc.).[5] These exclusions leave approximately 60,000 of Indiana's 23 million acres as

[5] The analysis does not appear to have taken into account access to the electrical grid, which is another important factor in siting decisions.

potential hosts of wind turbines. The question the NREL analysts then asked was, “how productive would each of three different generations of wind turbines be if they were sited on each of these 60,000 acres?” The analysts considered this question for three different technologies, the leading technology in 2008 (with 80-meter hub heights), in 2014 (with 110-meter hub heights), and the technology that is expected to be available in the *near future* (with 140-meter hub heights).

Figure 2. Wind resources of the United States at the height of 100 meters



Source: https://windexchange.energy.gov/maps-data/324 using NREL data.

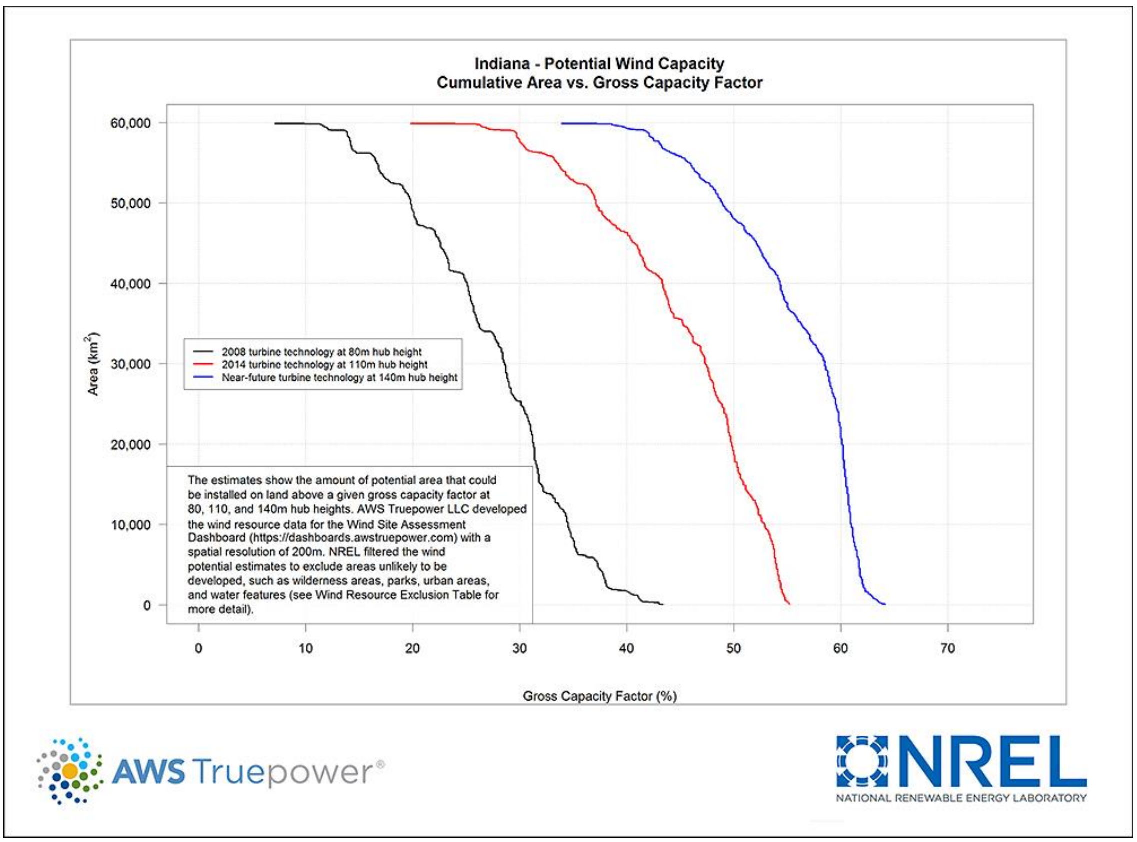
The results of this analysis are reproduced in Figure 3. The bottom axis of the figure measures (gross) capacity factors.[6] The left-hand axis indicates the cumulative number of acres with a capacity factor that exceeds a given level. The first line on the figure, the black line, shows the cumulative number of modeled Indiana acres that are capable of achieving each level of a capacity factor with the 2008 technology. The distribution of capacity factors across suitable acres in Indiana with the 2008 technology is broad, ranging from less than 10 to over well over 40. More importantly, with the 2008 technology, there are relatively few acres (approximately 8,000) with gross capacity factors that exceed 35, the level that is generally understood to be necessary for

[6] The *gross* capacity factor uses the amount of electricity produced by the turbine it its location as the numerator in the capacity factor calculation. A related concept is the *net* capacity factor, which is lower than the gross capacity factor because the quantity of output in this calculation is reduced by losses that occur in the transmission of electricity over space.

utility-scale wind energy production to be economically viable. The relatively small share of Indiana acres with capacity factors of 35 or higher using the 2008 technology reflects much the same information as appeared in Figure 1; a relatively small portion of Indiana (primarily the west-North central part) has wind conditions that are favorable to production at 80-meter hub heights.

Technological progress between 2008 and 2014 substantially enhanced the productivity of Indiana's wind resource, making new areas of Indiana economically viable as locations for wind energy generation. The second line in Figure 3, the red line, shows the cumulative number of modeled Indiana acres that achieve a given capacity factor with the 2014 technology, a technology with 110-meter hub heights. Under the 2014 technology, capacity factors range from 20 to approximately 55. With the technological improvement, nearly 53,000 of the 60,000 modeled Indiana acres meet the threshold for viability, a gross capacity factor of 35.

Figure 3. The distribution of capacity factors across suitable acres in Indiana at different hub heights



Source: https://windexchange.energy.gov/maps-data/42 using NREL data.

The third line in the figure, the blue line, illustrates the same calculations assuming a near-future generation technology, a technology with 140-meter hub heights. Capacity factors with this technology vary from the mid-30s to the mid-60s. Virtually all of the modeled acres have capacity factors of 35 or more. Figure 3 thus shows how advancing technology in the sector makes ever larger parts of Indiana viable as hosts for wind energy generation.

Estimates of economic viability implicit in the above figures consider only technological variables and show that steady increases in wind energy production go along with increases in turbine size. Larger turbines, are, however, more expensive to build and install. Recent modeling efforts have moved beyond simple technological analysis, asking instead which hub heights are likely to be most profitable, after taking into account the costs of construction and operation at several different hub heights. Lantz *et al.* (2019) estimate that, for the vast majority of locations in Indiana, 110-meter hub heights produce lower "levelized costs of energy" (LCOE) when compared with turbines at 140- and 160-meter hub heights. The publication offers caveats, however, noting that the cost estimates across different hub heights are not very different. Using the assumed cost variables, 110-meter turbines would be more profitable than 140-meter turbines, but not by a large margin.[7]

II. The footprint of utility-scale wind energy generation in Indiana

Table 1 provides a listing of operational wind farms in Indiana, the dates in which they became operational, and other key characteristics. Projects are sorted by year of entry-into-operation and host county. The table reports nameplate capacity, the amount of electricity each farm can produce under optimal conditions. Hub heights are also included in order to illustrate the trend of increasing hub heights.

Table 1 shows that the first burst of investment activity in Indiana occurred in Benton and White Counties. Initial exploration of these counties' wind resources began in 2006-7, and the first set of projects came online in 2008-2010. The first set of projects still account for more than one half of the state's total operational nameplate capacity. However, more recent projects use better technologies and produce more electricity per unit of nameplate capacity. More recent projects have tended to consist of turbines with higher hub heights. These more recent projects include new projects in Benton and White counties as well as others in the central part of the state. The latest project to come on-line - in White County - has turbines with 105-meter hub heights.

[7] The very low interest rate environment that arrived with the COVID-19 virus may enhance the viability of larger, more costly turbines, relative to calculations that were done in an environment with somewhat higher interest rates.

Table 1. Operational utility-scale wind farms in Indiana and their characteristics.

Project name	County	Nameplate Capacity (MW)	Turbine count	Year online	Hub Height (m)
Benton County Wind Farm (Goodland I)	Benton	130.5	87	2008	80
Fowler Ridge	Benton	301.3	162	2009	80
Fowler Ridge	Benton	99	60	2009	80
Fowler Ridge	Benton	200	133	2009	80
Hoosier	Benton	106	53	2009	80
Meadow Lake Wind Farm	White	199.65	121	2009	80
Meadow Lake Wind Farm	White	98.7	47	2010	80
Meadow Lake Wind Farm	White	99	66	2010	80
Meadow Lake Wind Farm	White	103.5	69	2010	80
Wildcat I	Madison, Tipton	202.5	125	2012	100
Headwaters	Randolph	200	100	2014	95
Amazon Wind Farm (Fowler Ridge)	Benton	149.5	65	2015	80
Bluff Point	Jay, Randolph	119.7	57	2017	94
Meadow Lake Wind Farm	White	100	50	2017	95
Meadow Lake Wind Farm	White	200.4	61	2018	105

Source: Science for a Changing World, AWEA Wind Project Mapping Portal, the US Wind Turbine Database. Retrieved from https://eerscmap.usgs.gov/uswtdb/viewer/#6.3/37.778/-87.597, http://gis.awea.org/arcgisportal/apps/webappviewer/index.html?id=eed1ec3b624742f8b18280e6aa73e8ec

II.a. Electricity produced by the utility-scale wind sector in Indiana

There appears to be no publicly available information on the levels of annual production for individual Indiana wind farms. But annual production at the state level is tracked by both private and public entities. The U.S. government's Energy Information Agency (EIA) reports in EIA (2019) that the total quantity of electricity produced in Indiana in 2018 was 113.5 million megawatt-hours. The same source put Indiana's net generation of electricity from wind power in 2018 at 5.4 million megawatt-hours, or 4.8% of Indiana's total.[8] Comparable figures for 2019 are not yet available from the EIA, but the American Wind Energy Association (AWEA), the wind industry's trade association, reports total output of 6.2 million megawatt-hours in Indiana in 2019, or 6.0 percent of Indiana's total electricity production. The change in output from 2018 to 2019 represents a 14.8 percent increase in the amount of electricity produced by wind in Indiana.

It is difficult to put a precise dollar value on Indiana's wind industry output. Many of Indiana's wind farms have contracted to sell their energy to corporate and institutional buyers at a fixed price. These fixed prices are the prices that matter for the profitability of the wind farms themselves, but spot prices are more useful in representing the economic value of their output. Spot prices vary substantially over time (and throughout the day), so it is difficult to establish a precise best estimate for valuing the industry's electricity output. We were able to obtain spot price data for the "Indiana hub" of the Midcontinent Independent System Operator for 2018. These prices ranged from $3/MW to $524/ MW during 2018.[9] The median spot price in 2018 was $27.12 per megawatt-hour. Applying that figure as a rough proxy for the price of electricity produced in the state, we estimate that the market value of the electricity produced by wind power in Indiana in 2018 was $147.5 million.

We were unable to obtain comparable data on spot prices from 2019, but note that EIA (2020c) reports that wholesale electricity prices were 15-30% lower in 2019 than in 2018, mainly as a result of lower 2019 prices for natural gas.[10] In terms of valuing the 2019 value of Indiana production, a 15 percent reduction in the price of wholesale electricity would just offset the 15 percent increase in production. The EIA report thus suggests that the dollar value of Indiana's wind-generated electricity output was roughly stable from 2018 to 2019, though possibly somewhat lower.

II.b. Investments in Indiana's wind energy production capacity

Figures that offer another perspective on the economic value of the sector are the size of investments made in wind energy capacity in Indiana. A rough rule of thumb is that each kilowatt of nameplate capacity installed requires an investment of $1000-$2000. By this calculation, a 2MW turbine costs between $2 and $4 million to install. The $1000-$2000 rule of thumb implies that the dollar values of investment required to install the capacity recorded in Table 1 lies between $2.3 and $4.6 billion. The AWEA - with access to more detailed data that include investments not

[8] "Net generation" adjusts gross generation figures by the estimated amount of electricity lost in transmission.

[9] These figures are indicative of all sales of electricity at the Indiana hub, not only electricity produced by wind power. Hourly price data downloaded from LCG consulting (2020).

[10] See EIA (2020c).

completed or not yet completed - estimates that the cumulative value of investments in Indiana's wind sector is $5.0 billion.[11]

III. The wind industry as a source of income

Although the possibility of broader economic benefits of the wind sector should be considered (and will be, elsewhere in the report), the most important local economic benefits are those that flow from direct payments made by the industry to local actors. Unlike coal- and gas-powered electricity generation, the wind generation industry does not pay for purchases of fuel. This means that the vast majority of operation and maintenance costs involve payments to local economic actors. These payments accrue to local governments through tax and other payments to workers at local establishments that perform maintenance on the turbines and to the owners of the land where turbines are sited. In this section of the wind profile, we discuss the industry's payments to private entities. The next section discusses payments to local governments.

Before documenting these payments, it is essential to understand that among electricity-producing technologies, wind power is one of the most capital-intensive. An installed turbine like those in Indiana represents an investment of as much as $4 million. In marked contrast to coal and gas-powered turbines, operators of wind-generated power need not pay for ongoing purchases of fuel. Relatively low operation and maintenance costs are a key reason that the sector can be cost-competitive with other generating technologies. Estimates of the total "levelized" costs of electricity show that the purchase and installation of the turbines themselves represent a significant share of the total cost of generating wind-powered electricity.[12] A large share of industry revenues must, therefore, go to compensating the owners of the turbines for their investments in installed capacity. A much smaller share of revenues goes to operation and maintenance, and this share is the primary source of payments to local entities.

III.a. Lease payments

One of the most significant direct payments by the wind sector to local entities is lease payments paid to landowners for the use of their land. The most common of these payments are those made to owners of the land on which a turbine is located, though there are a number of other reasons that the industry makes payments to landowners. In some cases, additional infrastructure is needed to facilitate the transmission of the electricity, and the affected landowners would be paid to host this infrastructure.

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[11] See AWEA (2020).

[12] Table 1a in EIA (2020b) estimates that the levelized capital cost of installed wind capacity in 2025 will represent $23.51/MW out of a total levelized system costs of $34.10/MW. In other words, roughly 70 per cent of costs of generating electricity relate to the costs of purchase and installation.

Detailed information on the magnitudes of each of these types of payments is not readily available, but we were able to collect some information on the value of payments made to landowners who host the turbines. Information on aggregate payments is reported by the AWEA. We consider each of these in turn.

In a news report about the situation in Ohio, an AWEA spokesperson said that the landowners were paid between $3,000 and $6,000 per megawatt of nameplate capacity installed on their land.[13] Knowledgeable residents suggested that payments per MW of nameplate capacity in Benton and White Counties lie near the middle of this range. One local resident told us said that the level of compensation is quite consistent across landowners when measured on the basis of megawatts of nameplate capacity. Landowners do receive different payments on a *per turbine* basis. Recently installed turbines have nameplate capacities of approximately 3 MW, and the owners of land with these turbines would be paid twice as much as the landowners who have the earliest generation of turbines (with approximately 1.5 MW of nameplate capacity each).

Indiana's total nameplate capacity of utility-scale wind turbines is just over 2300 MW. Using the $3000-$6000 per MW range quoted in the news article, this means that landowners in Indiana are paid somewhere in a 7.5 to 15-million-dollar range for hosting turbines. AWEA (2020), an annual report by a wind industry trade association, indicates that payments to landowners in Indiana totaled $20 million in 2019. The gap between the AWEA figure and the bottom-up estimate that we calculate here probably reflects the inclusion of other types of payments to local landowners in the AWEA figure.

An understudied issue that matters for understanding the distribution of lease income and possibly the effects of such income on the local economy relates to the distinction between landowners and farmers. Forty-five percent of farmed land in Indiana is rented.[14] This share is considerably higher in areas with grain crops, the primary crop in areas of Indiana where utility-scale wind turbines operate. Counties hosting wind power in Indiana typically have high shares of rented farmland. Estimates from the Census of Agriculture (2017) put the share of rented farmland acres in Benton County at 74%, White County at 64%, Madison County at 59%, Tipton County at 59%, Randolph County at 46%, and Jay County at 37%.[15] A key question for analysis of the local economic impact of the lease payments is the degree to which the lessors receiving payments recirculate these funds in the local economy. There is anecdotal evidence that some portion of the land hosting turbines is owned by non-resident owners (who would be less likely than local residents to use the lease payments to purchase local goods and services), but we were not able to establish that non-resident land ownership is common.

[13] See Kowalski (2019).
[14] USDA (2016). This compares against a 40% share for the United States as a whole.
[15] Census of Agriculture (2017). Data drawn from https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Ag_Census_Web_Maps/Data_download/index.php, Feb 25, 2020.

III.b. Employment

Although wind-powered generation is a capital-intensive industry, it employs workers engaged in a wide variety of activities. Since 2012, the US Bureau of Labor Statistics (BLS) has tracked employment within a well-defined wind energy generation sector, which is defined as code 221115 in the North American Industry Classification System (NAICS). The national figures offer a detailed breakdown of the occupations of workers employed directly by the sector. Data for Indiana lack the occupational detail available in the national statistics but are more directly informative about the industry's relationship to Indiana. We first review employment data from the national data, discuss shortcomings of these data for our purposes, and then provide another set of estimates based on publicly available information on ongoing local employment. We also review a study that quantified short-run employment tied to the construction of Indiana's first round of turbines. We follow this by reviewing estimates of Indiana employment in activities that are related to those of the wind-energy production sector through up- and down-stream linkages.

III.b.1 National employment in the wind generation sector

The BLS' documentation of national employment in the industry includes information on 25 different occupational categories of the sectors' employees. In addition to employees involved in the construction and maintenance of wind turbines, industry employment includes occupational categories such as management, electrical engineers, lawyers, and more. The BLS estimates that the industry's nation-wide direct employment in 2017 was 5,240 workers.[16] The mean annual wage across all these workers was $73,720.[17] Employees in some of the smaller employment categories (such as "Top Executives" or "Operations Research Analysts"), likely do most if not all of their work outside of Indiana, and the average wage for Indiana might, therefore, be expected to be somewhat lower than the reported national average.

It is the larger occupational categories in the BLS classification that include employees who do work in Indiana. The BLS estimates indicate that over half of the employees in the wind generation sector fall under the employment category "Installation, Maintenance and Repair Occupations." This occupational heading has 2730 employees nationally, with an annual average wage of $61,480. 2020 of these employees are "Wind Turbine Service Technicians," a group that has an annual average wage of $60,240. Lam (2016) interviews George Myers, a turbine service technician in Colorado, who describes his work as a turbine service technician. It is employees like Myers, who would comprise the majority of wind-sector employees in the rural Indiana counties that allow wind-powered generation.

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[16] As we note later in the section on Indiana's employment in the sector, these figures are likely an understatement of the number of employees who are active in the construction and operation of utility-scale wind turbines. Some firms that are not classified by the Census Bureau as being primarily in wind generation industry sector have employees who are employed full time in activities that support the activity of wind generated electricity.

[17] BLS estimates from May 2017, downloaded here https://www.bls.gov/oes/2017/may/naics5_221115.htm on February 26,2020.

As Myers indicates in his interview, there are two distinct phases to the employment of turbine technicians on a wind project. During the construction phase, a project employs a large number of technicians (as well as a broad array of other occupations). The construction phase is temporary, though, and many of these workers will move on to work on the construction of new wind farms in other locations. A small number of turbine technicians (and some support staff) remain behind to conduct maintenance throughout the life of the turbines' productive life, which maybe 30 years or more. The different time profiles of the two phases of the project are an important consideration for understanding the industry's payments to labor. In our documentation of industry employment in Indiana, we first report available statistics on long-term employment at or near the wind farms and then discuss the differences between employment in the construction and maintenance phases of a project.

III.b.2 Wind Industry employment in Indiana

The official data for wind industry employment dates from 2012 when the Census Bureau first began to track employment in the sector. The official U.S. statistics for the sector's employment in Indiana are reported in Table 2. Official estimates of the industry's employment in Indiana rose by more than a factor of three during the period in which data is available. In 2010, the industry itself employed 19 full-time workers; in 2018, the sector employed 67 full-time workers.

Table 2. BLS estimates of wind-industry employment in Indiana, 2010-2018.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Employment	19	24	44	50	56	59	56	60	67

Notes: Data reported by the Indiana Department of Workforce Development. Original data from the BLS Quarterly Census of Employment and Wages. These figures exclude self-employment and owner-operators. They also exclude employment by firms that are classified outside the wind-power generating sector, even though some parts of those firms' businesses in the State may include participating in the installation or maintenance of turbines. For this reason, official figures are almost certainly an underestimate of total employment in the sector.

The official employment figures for NAICS 221115 are likely to understate total employment in the sector within Indiana in any given year. Employees of firms that are not identified by the Census Bureau as firms whose primary activities are in the wind sector would not be included in these data. Some firms that are classified as belonging to other industries may be involved in the installation of turbines during the construction phase. Other firms from different sector classifications might employ workers who help to maintain the turbines. In neither case would these workers appear in Table 2 estimates because the parent firm's primary activity is in another sector.[18]

[18] For example, a firm that is primarily in the business of providing engineering services might be engaged in the maintenance of turbines, and its employees would be attributed to NAICS 541330 rather than to 221115.

In order to offer a different perspective, we use publicly available information on local employment to provide an unofficial estimate of total employment linked to wind farms in Indiana. Table 3 reports estimates of permanent wind farm employment taken from publicly available web sites. While these figures are unofficial, the employment estimates in each location appear reasonable and correlate well with the number of turbines in each location. We view these figures as a good estimate of the level and distribution of full-time employment in rural Indiana that is linked directly to the presence of wind farms. Taking the individual estimates as given, we calculate that approximately 185 permanent full-time jobs in Indiana are linked directly to the operation and maintenance of the wind farms.

Table 3: Estimated employment linked to the ongoing operation of wind farms, by location.

County or wind farm project	Source	Estimated permanent full-time employment
Benton County	Benton County Economic Development Corporation	95
Meadow Lake Wind Farm (White County)	Meadow Lake Wind Farm	63
Wildcat Windfarm I (Madison/Tipton Counties)	E.on Climate & Renewables	8-12
Headwaters Wind Farm (Randolph County)	Headwaters Wind Farm	12
Bluff point wind farm (Randolph/Jay Counties)	Online news article	5
Total for Indiana Wind counties		Approx. 185

Notes: Publicly available information on full-time employment at Indiana wind farms. Source information: Benton County (https://benton4business.com/benefits),
Meadow Lake Wind Farm (https://meadowlakewindfarm.com/),
Wildcat Wind Farm (https://www.madisoncounty.in.gov/assets/wwf_madison_sep_tab_0d.pdf),
Headwaters Wind Farm (https://headwaterswindfarm.com/),
Bluff Point Wind Farm (https://www.power-grid.com/2017/12/07/aep-nextera-energy-open-200-million-indiana-wind-farm/#gref). All web sites accessed June 23, 2020.

III.b.2.i Wind turbine technician employment in Indiana

Wind turbine technicians are the primary category of employees working in the wind industry in Indiana. These jobs offer high salaries, relative to others in rural Indiana, and there are numerous positions available. The website Indeed.com – which produces its estimates by combining local information on salaries with other industry reports from across the country – estimates that the annual salary for wind technicians in Indiana of $52,964 per year, with an estimated $8,250 in annual overtime pay.[19] Indeed.com is also a website with job listings, and the same web search that produced these salary estimates revealed two openings for web technicians in Indiana (one in

[19] Source information https://www.indeed.com/salaries/wind-turbine-technician-Salaries,-Indiana. Downloaded February 26, 2020.

Fowler and one in Chalmers), and one in nearby Hoopeston, Illinois. All three of these job listings had been posted within seven days of the web search.

One advertisement – for a position of Wind Technician II in Chalmers, Indiana - lists a range of physical, technical, communication, and problem-solving skills that are required for the position.[20] Technical skills involve knowledge related to working with electricity, with cranes and rigging equipment, Microsoft Office skills, and more. This position asks for 1+ years of college or technical education, or equivalent experience. Prospective employees may spend 10% of their time on work-related travel, but would presumably be able to live and work primarily in Chalmers. The employee should be prepared to work on holidays and weekends and to be willing to respond to emergencies. The employee should also be able to lift up to 50 lbs. of weight, and to climb turbine towers above 100 meters in height. This advertisement did not discuss salary or benefits, but another advertisement (for an entry-level wind technician position) indicates that compensation includes a variety of benefits including Medical, Dental, Vision and Life Insurance, and a 401K with a company match.[21]

III.b.2.ii Employment in the development and construction of wind farms

Maintenance positions represent the primary source of ongoing employment once the wind turbines have been installed. At the development and construction stage, the sector employs a large number of workers with a broader variety of skills, but does so over a relatively short period. Some of the employees engaged in the development and construction phases of the project would be residents of Indiana, while others would only reside here during the projects' development and construction stages. During the construction phase, the industry also provides short-term employment of local residents for a variety of temporary tasks.

The short-term nature of work in the development and construction stages means that employment in these sectors may not be represented in official statistics. Perhaps the best source of the division between employment in the development and construction phases is Tegen *et al.* (2014). They attempt to estimate the economic impacts of Indiana's first 1000 MW of wind capacity. We review the analytical approach of the study in the section of the report that examines studies of economic impact. In this section, we relay information from that report on direct employment by the sector during the construction phase of the project. The authors of the study conducted extensive interviews with the industry and are therefore likely to have produced the best estimates of direct employment in the two stages of activity.

Tegen *et al.* (2012) explain that a typical wind farm requires a 6- to 12-month construction period. This period entails the employment of a wide variety of employees, including managers, engineers,

[20] Job advertisement for position with EDP Renewables, listed on the employment website GlassDoor on February 10, 2020.
[21] Indeed.com advertisement for "Wind Service Technician – Level 1" at Sky Climber Renewables in Fowler, Indiana. Posted on February 19, 2020.

construction workers, administrative staff, and more. During the construction of the first seven Indiana projects, Tegen *et al.* estimate that the developers spent $553 million in Indiana during the construction phase. They report that 50 to 75 percent of the construction workers were Indiana residents. Approximately 930 workers were employed on-site in the process of developing Indiana first seven utility-scale wind projects.

In a subsection of the more extensive report, Tegen et al. (2012) describe qualitative aspects of the local employment consequences of the construction phase via an interview with the owner of a small business in Earl Park, Bennet's Garage. The developers employed this local garage to do maintenance on vehicles used in construction. In addition to the local workers hired to work on the project itself, the garage also expanded its workforce in order to support the construction phase. For example, the garage owner hired local teens who were hired at $10 per hour to do flagging in support of the transportation of construction materials to the site. Hotels and local residents were also paid to house construction workers, and the industry purchased local materials such as concrete. Construction of the wind farm was also accompanied by road construction and repair to support the movement of heavy turbines to their destination. These activities also generated a temporary boost in local employment.

III.b.3. Related employment outside the wind-energy generation sector

Wind turbines are difficult to transport over long distances, so turbine manufacturers that are proximate to the locations of turbine installation offer a significant cost advantage.[22] Wind turbines are also exceptionally complicated pieces of machinery. The manufacturers of the finished elements of the turbines require large numbers of inputs, some of which are produced near final-stage producers of pieces of the turbine. Indiana's history as a location of sophisticated manufacturing facilities, together with its proximity to sites of wind energy generation, has meant that the state's manufacturing industry has participated in this complex supply chain.

The AWEA identifies 15 manufacturing facilities engaged in the production of turbines components or of upstream inputs.[23] The NREL Wind Prospector identifies three wind-related manufacturing facilities in Indiana, one each in Bloomington, Lafayette, and Bedford.[24] The smaller number of manufacturing facilities identified in the NREL data presumably represents a much narrower definition of wind-related manufacturing than the AWEA uses.

Direct estimates of employment in wind-related manufacturing in Indiana are not practical, as many of the manufacturing facilities identified by AWEA would also be engaged in activities not linked to producing wind-turbines. Using input-output analysis, Tegen *et al.* attribute 3770 jobs in

[22] Using Danish and German data, Cosar, *et al*, (2015) estimate that a 1% increase in distance reduces by 0.36% to 0.54% the probability that a manufacturer will supply a given wind project.
[23] AWEA (2020)
[24] https://maps.nrel.gov/wind-prospector/.

the upstream supply chain that arise from the construction of Indiana's wind power.[25] In the context of this report, which focuses on the local dynamics within counties that are considering whether to allow wind farms and under what conditions, it is important to note that these supply chain impacts arise almost entirely outside the affected counties, even when they do occur within the state.

Employment outside the wind sector itself is not exclusively limited to upstream suppliers. Tegen *et al.* note that a small "wind tourism" industry has arisen in Benton County, where a large number of turbines are present. Moreover, local community colleges have also developed programs to train workers for the industry. Some wind-related services in Benton County serve the wind industry outside of Indiana.[26] These "exports" by local Indiana firms to other states would not have arisen if the large-scale presence of the industry in this state had not first arrived here.

IV. Payments to local governments

The industry's payments to landholders and employees are paid to private citizens. The industry also makes payments to local governments, both in the form of taxes and in the form of additional payments associated with designated purposes. Payments to local governments are the most direct way that the industry benefits communities as a whole. In Indiana, siting and planning authority is allocated to county governments, and payments made to these and other local governments are part of the county governments' decision-making process. It is therefore helpful to review available information about payments made to these and other local governments. Conceptually it is useful to divide payments into those that are collected in the form of assessed taxes and other payments that are not made as tax payments. We report some publicly available estimates for state-wide totals for tax revenues and other payments, and then provide some detail on the size and timing of payments made to Benton and White Counties.

IV.a. Tax payments

AWEA estimates that annual tax payments from the wind industry to state and local governments in Indiana total $12 million per year.[27] While detailed information on the form and geographic

[25] It is important to understand that the 3770 figure is an imputed number that does not take into account opportunity costs, or the switching of manufacturing outputs across downstream buyers. The analysis assumes that manufacturers respond to an order for materials from the wind sector by hiring new workers to produce for that order. Upstream manufacturing firms might see this instead as one order in a flow of orders from multiple buyers, and not respond to each order with new hiring. On the other hand, it is likely that wind-related manufacturing in Indiana also produces inputs into turbines that are located in other states, and construction in other states is not considered in the analytical exercise. It would be better to say that the construction of Indiana's first seven large wind farms *temporarily supported* as many as 3770 jobs, during the period of construction, rather than to imply, as Tegen, *et al.* do, that the 3770 new jobs were created by these investments.
[26] The owner of Bennet's Garage interviewed in Tegen, *et al.* (2014) now serves out-of-state wind projects, for example.
[27] AWEA (2020)

distribution of these tax revenues across Indiana does not appear to be available publicly, the relevant officials in Benton and White counties make some information available. State and local governments in Indiana have sometimes offered property tax abatements to attract investment. A news report on the Amazon Wind Farm Fowler Ridge project in Benton County notes that the wind farm was offered an abatement for the first 10 years of the project's life.[28] The same report quoted the Benton County Local Economic Development Officer as saying that once the abatement period ends, the property tax revenues are "fantastic," though the article does not provide specific figures for property tax revenues.

One rationale for property tax abatements is that at the beginning of a wind project's life, the assessed value of the turbines is very high, by local standards, and immediate taxation would impose a substantial financial burden. A case study of Benton County notes that the assessed value of the Amazon Wind Farm Fowler Ridge was $150 million.[29] With local property tax rates in Benton County of just over 1 percent, this would have generated an annual local tax bill of $1.5 million.[30] This is only a single project; others would have similar assessments and large associated property tax bills. The ten-year abatement period allows the owners of the wind turbines to depreciate their investment substantially before it becomes taxable.

The Benton County Assessor's office and the White County Auditor's office collect information on taxes collected from the wind industry in their respective counties and make this information available to the public. In order to provide some sense of the scale of these payments, and the way in which they vary over time, we reproduce those figures here. Annual estimated property tax revenues the two counties receive from the industry are reported in Table 4. These vary over time, but the most recent (2019) figures were $4.3 million for Benton County and $2.3 million for White County.

One striking aspect of the tax revenue collections is their growth over time. An increase in county revenues is mostly attributable to the gradual phase-out of tax abatements given to the industry when it first arrived. Both counties have also seen additional construction of turbines over time, which also raises their ability to collect taxes now and in the future. One factor that limits the growth of property tax revenues is the depreciation of the value of the assessed value of each turbine over time. Absent further construction in the two counties, and the tax revenue collections will peak, eventually, and diminish as the value of the turbines gradually depreciates.

[28] Douglas (2019)
[29] IUERI (undated)
[30] Information on local tax rates taken from http://www.stats.indiana.edu/web/profiles/tax_rates_2016/Benton.html, downloaded February 27, 2020.

Table 4. Property tax revenue paid by the wind generation industry in Benton and White Counties

	Estimated property tax receipts from the wind sector	
Tax year	**Benton County**	**White County**
2009 (payable 2010)	$135,847	-
2010 (payable 2011)	$565,124	-
2011 (payable 2012)	$1,022,809	$274,383
2012 (payable 2013)	$1,356,638	$607,036
2013 (payable 2014)	$1,817,621	$695,287
2014 (payable 2015)	$2,109,964	$985,148
2015 (payable 2016)	$2,624,256	$1,330,060
2016 (payable 2017)	$3,085,724	$1,563,636
2017 (payable 2018)	$3,646,631	$1,829,141
2018 (payable 2019)	$4,304,694	$2,260,411
Totals, to date	**$20,669,308**	**$9,545,102**

Notes: Publicly available information on property tax collections provided by the Benton County Assessor's office and the White County Auditor's office

A second striking aspect of the revenues reported in Table 4 is their scale. The scale of these figures is perhaps best understood in terms of their relationship to the population of each county. U.S. Census Bureau estimates for the 2019 population of Benton County was 8,748. This means that Benton County collected approximately $492 per person in property taxes from the wind industry in 2019. The Census Bureau estimates that the White County population in 2019 was 24,102. White County collected approximately $94 per person in property taxes paid by the wind industry.

Both Benton and White counties use tax revenues collected from the wind industry to reduce the burden of property taxes on their residents. Much of this property tax relief occurs in the particular townships where the turbines are located. Data from the White County Auditor reports the total tax levy for each township, and the share of each township's property taxes that is paid by the wind industry. In West Point Township, which has two taxing districts associated with the Frontier and Tri-County School Corporations, 51 and 41 percent of the property tax revenues are paid by the wind industry, respectively. In Round Grove Township, 45 percent of property tax revenue that is collected is paid by the wind industry.

Data from the Benton County Assessor reports tax rates for townships and towns in Benton County over the period in which the wind generation industry has been active in the county (2006-2019). Although average tax rates fell in both towns and townships, most of the tax relief associated with the wind industry occurred in the townships. Table 5 reproduces a table from the Assessor's office that documents average property tax rates over the period.[31] From 2006 to 2019, the average tax rate in Benton County's townships fell from 2.20 to 1.05 percent of assessed value. The scale of the tax reduction is quite stable across Benton County's individual townships. In Benton County towns, the average property tax rate fell from 3.01 to 2.77 percent of assessed value over the 2006-2019 period.[32]

Table 5. Average property tax rates for Benton County towns and townships, 2006- 2019

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Avg all	2.49	2.87	2.64	2.05	2.10	1.96	1.81	1.60	1.68	1.57	1.56	1.61	1.61	1.66
Avg tws	2.20	2.53	2.31	1.59	1.58	1.44	1.30	1.12	1.07	0.97	0.99	0.99	1.00	1.05
Avg towns	3.01	3.49	3.25	2.90	3.05	2.92	2.75	2.49	2.79	2.67	2.63	2.77	2.73	2.77

Notes: Average property tax rates for all Benton County tax units, for townships (tws) and for towns. Data is publicly available from the Benton County Assessor's office. Property tax rates rounded to two decimal places here for the purpose of brevity.

IV.b. Economic Development Agreement payments

In addition to tax revenues, the industry typically negotiates additional payments to local governments under the terms of an "economic development agreement." In the initial years of a project's life, property tax revenues are often delayed by tax abatement agreements. Payments from the economic development agreements are typically made nearer the beginning of the project's life. In news reports, these payments are typically reported in the aggregate. For example, Douglas (2019) writes, "the Amazon Wind Farm Fowler Ridge project is expected to make $5 million in economic development payments to Benton County over 17 years." It is also useful to understand the level and timing of annual payments under the agreements.

The White County Auditor graciously provided us with publicly available information on payments made to the county as part of economic development agreements with the Meadow Lake Wind Farm. Each of the five phases of construction of the farm generated two or three annual payments. In the first year, 2009, White County received $1.92 million of economic development funds, with somewhat larger payments in the following years. In 2011, Meadow Lake Wind farm-made scheduled payments early; these payments amounted to almost $3.3 million. As of September 2019, Meadow Lake Wind Farm had made payments amounting to more than $12.5 million to White County. These payments were linked to each of the five distinct phases of the project.

[31] Tax rates are rounded to two decimal points, from four, for brevity and clarity.
[32] The property tax changes at the town level are considerably more variable than across townships, and probably reflect other developments in the towns.

The White County government itself retained just over half of the economic development agreement payments, disbursing the rest to other local government institutions and organizations. The largest recipients of the disbursements were the Frontier and Tri-County School corporations, which by September 2019 had received more than $2.6 million and $3.3 million, respectively, of these funds. Other recipients of distributions included five different townships, the town of Chalmers, and the Brookston and Wolcott public libraries.

IV.c. Road Use and Decommissioning Agreements

Two other kinds of negotiated agreements govern relations between the industry and the county governments – road use agreements and decommissioning agreements. Both agreements require the industry to post a bond to ensure that the industry's presence does not impose a financial burden on the county.

One local government official said that road use agreements are probably the most important and most difficult agreements to negotiate with the industry. The agreements specify which roads will be used to move heavy equipment, and outline conditions under which these roads will be left. Under the terms of the agreement, the industry is responsible for funding preparation of the roads for their use and repair of the roads should any damage be caused. In some cases, the industry leaves roads in better conditions than they were before construction (because the paving of rural roads outlasts the construction period, for example). IUERI (undated) discusses the road use agreement between Benton County and Pattern Energy Group – the developer of the Amazon Wind Farm Fowler Ridge project – and explains that the project allowed the county to spend an additional $35 million over ten years on county roads.

Decommissioning agreements are designed to ensure that the turbines and other materials such as concrete will be removed at the end of the project, regardless of unforeseen circumstances. Developers post a bond with the county to cover the costs of turbine removal. Even if the wind farm were to be in financially distressed circumstances near the end of the project, these funds would be available to finance the removal of the turbines and other materials.

V. Policy

Finally, we turn to a characterization of government policies that have facilitated or impeded the growth of the utility-scale wind-energy generation sector in Indiana. The governments that are most relevant for this report are county governments, whose control over planning and siting authority gives them an effective veto on the development of large-scale wind energy production capacity. These authorities are, however, given by state law, and so a comparison of Indiana state law with those of other states is also useful. For context, it is also helpful to consider other policies at the local, state, and federal levels that are relevant to an understanding of the industry's development and footprint. The broad lesson of this summary is that federal policy, and - to a degree - state policy has been supportive of further investments in utility-scale wind energy capacity. The majority of Indiana counties that have considered the issue have, however, used siting and planning authorities to substantially limit the scale of the sectors' investments in the state. The tension between local policy decisions and policy goals at the state and federal level bears further scrutiny.

V.a. State policies towards wind energy generation

Analyses of state government policies towards renewable energy often focus on so-called *renewable portfolio standards* (RPS), policies that require regulated utilities in a state to increase their purchases of electricity that is produced by renewable sources. Illinois, for example, mandates that renewable sources will produce 25 % of the states' energy by 2025.[33] Indiana is the only state bordering the Great Lakes without a binding RPS. Instead, 2011 legislation provides financial incentives to utilities to increase their 2010 clean energy production by 2025. Indiana's law defines a large number of energy types as "clean," meaning that the policy is far less oriented towards increasing wind production than are policies in other states.

Mills *et al.* (2014) argue that the rapid growth of wind-energy production in Indiana - even in the absence of an RPS - can be attributed to two factors. First, siting authority in Indiana falls exclusively to counties, rather than to other local governments such as townships. This eases the permitting process for developers in Indiana, relative to other states, especially for projects that cross-city/township borders.[34] Second, wind equipment installed after December 31, 2011, earns a tax exemption from state and local property taxes, a law that reduces the tax burden on capital-intensive wind projects.[35]

One piece of state law that affects how local governments relate to wind energy developers is the restrictions that the state places on local governments' use of development impact fees. Development impact fees are "a monetary exaction other than a tax or special assessment that is charged by a local governmental agency to an applicant in connection with the approval of a development project to defray all or a portion of the cost of public facilities related to the development project."[36] Indiana's legislation limits the purposes for which impact fees can be collected, and imposes constraints on the ability of local governments to impose impact fees on

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[33] Illinois further mandates that 75% of these purchases should be generated by wind. See Mills *et al*. (2014) for a discussion of state policies related to wind power in the Great Lakes region. The discussion of Indiana's policies also relies on Mills, *et al.* (2014).

[34] While the number of local units that have authority over a project is typically smaller in Indiana than in other states, in recent years Indiana counties have shown themselves willing and able to use siting and planning authorities to restrict utility-scale wind production in their localities. The advantages that Mills cites in 2014, seem to have dissipated over time.

[35] For details on the tax exemption, see https://programs.dsireusa.org/system/program/detail/54 (downloaded February 29, 2020).

[36] See Brown and Lyons (2003), p.2.

developers. The financial arrangements between developers and local governments have, therefore, more often taken the form of negotiated agreements, notably *economic development agreements, road use agreements,* and *decommissioning agreements*.[37]

V.b. County-level policies

The most important policy levers that are available to county governments - with respect to wind power development - are the planning and siting authorities given to them by state law.[38] In the case of utility-scale wind-power in Indiana, these authorities are spelled out in county-level wind ordinances. Wind ordinances typically define a set of parameters that regulate the size and location of turbines. Other provisions may impose limits on the level of sound emitted by the turbines, and on the shadows that the turbines cast on other properties.

Developers of wind power see combinations of these regulations as either favorable or unfavorable to wind energy investment. Of particular importance are limitations on the height of the turbines as well as the "set-back" provisions that require a turbine to be a given distance from the properties of adjacent landowners/ and or an adjacent dwelling place. Height restrictions and/or setback provisions can effectively rule out economically viable turbines, because - as discussed earlier - turbines in most of Indiana must be 100 meters high or more to be economically viable. The following discussion of Indiana county ordinances is based on information provided by Indiana Conservative Alliance for Energy (ICAE), the sponsor of this research. A comprehensive database of Indiana county wind ordinances is available on-line.[39]

The most common setback provision in Indiana is a requirement that turbines be located inside the property at a distance of at least 1.1 lengths of the turbine tip from the nearest property line. This regulation appears in the Benton County wind ordinance, among others, so this regulation does not appear to be binding on utility-scale investments. More substantial set-backs can discourage investments. Cass County requires that turbines be set-back a distance equaling the greater of 2.5 times the height of the turbine or 1,500 feet. This is a regulation that can deter investment; for example, the 1500-foot setback rules out the use of a quarter-section of land that has neighbors on two sides.

The second form of set-back provision is the allowable distance of the turbine to the nearest dwelling. It is common for Indiana counties to require that turbines are located at least 1000 feet from the nearest residence, a regulation that does not appear to be particularly binding on Indiana wind investments. Several counties impose more substantial setback provisions for dwellings. Wabash County, for example, requires that turbines be located at least 3,960 feet from residences owned by landowners not participating in the project, while Tipton County requires turbines to be

[37] See, for example, the discussion of economic development payments made in IUERI (undated).
[38] For a comprehensive discussion of zoning issues as they relate to wind energy systems, see Schindler, *et al.* (2017). This discussion relates to Michigan in particular, but is useful for understanding the issues more broadly.
[39] https://windexchange.energy.gov/policies-incentives?state=in. Downloaded March 3, 2020.

set back 2,640 feet from non-participating residences.[40] Other counties impose set-backs relative to dwellings as multiples of tip-heights. Steuben County requires that turbines should be located at a distance from dwellings that is at least three times the height of the turbine's tip.

Some counties impose direct limits on turbine height. Hamilton County requires that the tip of the turbine be no larger than 300 feet; Delaware County requires turbines to be no larger than 150 feet.[41] The 100-meter turbines that can access strong and stable winds in most of Indiana have their hubs at 328 feet, and the tips of these turbines would be even higher. A restriction of 300-feet would thus discourage most large-scale investments, and a 150-foot limit would rule them out altogether.

County wind ordinances include a range of other restrictions that the industry sees as inhibiting or precluding investment. Some counties impose noise limits. Wabash and Montgomery counties limit the sound emitted from the turbine to no more than 32 decibels. For comparison purposes, the Occupational Safety and Health Administration estimates that a human whisper, heard at a distance of 5 feet away, is approximately 40 decibels.[42] Other counties allow somewhat higher levels of admissible sound and measure the sound at the nearest physical structure rather than at the tower itself.

Finally, several Indiana counties have imposed moratoria on investments in large-scale turbines. At current writing, 11 counties have moratoria on further investments: Allen, Boone, Clinton, Fulton, Grant, Jay, Marshall, Pulaski, Rush, Wayne, and Wells Counties.[43] A moratorium in Posey County was pending as of October 2019.

For counties without a moratorium, it is not always clear to the outsider which restrictions effectively limit investment and which do not. Technological change happens rapidly, and regulations may become more or less binding as technology changes. As of October 2019, ICAE judged nine Indiana counties to be open to further investments in the sector, while 29 counties had wind ordinances that substantially limit or effectively prohibit further investment in utility-scale wind energy capacity.[44] ICAE estimates that more than $30 million of past investments had been stranded as a result of restrictive county ordinances and that the potential investment in Indiana that had been precluded by restrictive ordinances was at least $5.08 billion.[45]

[40] Both counties have still large, but somewhat smaller set-backs from dwellings owned by landowners participating in the project.
[41] Tippecanoe County's ordinance also imposes effective restrictions on tower height, but restricts the height of the tower not the tip of the turbine. Turbine towers in Tippecanoe County may be no larger than 140 feet high, a level well below the heights necessary for economic viability of utility-scale generation.
[42] https://www.osha.gov/SLTC/noisehearingconservation/loud.html, downloaded March 3, 2020.
[43] Jasper County's moratorium is partial, applying only to areas north of County Road 1200.
[44] Benton, Blackford, Carroll, Fountain, Gibson, Huntington, Madison, Randolph and White Counties were seen as open to further investment. Allen, Boone, Cass, Clinton, Dekalb, Delaware, Fulton, Grant, Hamilton, Hendricks, Henry, Howard, Jasper, Jay, Kosciusko, LaPorte, Marshall, Miami, Montgomery, Noble, Pulaski, Rush, Steuben, Tippecanoe, Tipton, Wabash, Warren, Wayne, Wells and Whitley Counties had ordinances or moratoria that were judged to be restrictive. Posey County's wind ordinance was pending, and expected to be restrictive.
[45] Communication from the Land and Liberty Coalition, December 4, 2019.

V.c. Relevant federal subsidies

The U.S. federal government has used a variety of subsidies and tax credits designed to encourage the production of renewable energy. The structure of these programs and their generosity has varied in response to economic conditions and to technological developments in the industry. A comprehensive discussion of existing federal incentives is taken from OEERE (2020). In this survey, we review both the existing federal incentives and the incentives applied to past investments in Indiana's wind capacity.

The most well-known and most well-used subsidy in the industry is the renewable energy production tax credit (PTC). The PTC provides a federal tax subsidy for each unit of electricity produced by qualifying renewable technologies. Turbines that begin construction in 2020 receive 1.5 cents per kilowatt-hour of production in the first ten years of their productive life.[46] This amounts to $15 per Megawatt hour. To put this into a local perspective, a 2 MW turbine working at 1/3 capacity (a rough approximation of the typical turbine in Indiana) would earn about $10 per hour of under the current PTC. Most of Indiana's existing turbines would still be earning revenues under the PTC, though Indiana's oldest turbines have already finished their ten-year period of receiving the tax credit.

One longstanding alternative to the production tax credit is the Business Energy Investment Tax Credit (ITC). OEERE (2020) explains that the ITC is a one-time credit taken at the beginning of the project and is taken in place of the PTC. In general, it is understood that projects that expect to see higher production will earn more after-tax revenues with the PTC, while more marginal projects earn more through the ITC. There does not appear to be any data available on the choice of ITC vs. PTC for Indiana projects.

Another federal program that has been important for the development of wind energy in Indiana is section 1603 of the American Recovery and Reinvestment Act of 2009. Conceived at a time when financial markets were in turmoil, the program was designed to bring forward the PTC to the then-present time, encouraging investment in wind technologies and potentially providing economic stimulus to areas of rural America with wind energy resources. The program is a grant, and firms were to receive - upfront - the expected value of the PTC that they would have otherwise earned over the lifetime of their project. A federal website documenting the program lists projects that were funded under section 1603, along with the levels of funding each received. The program led $346 million of federal funds to be paid to support investments in utility-scale wind projects in Indiana in the years 2009-2012.[47]

[46] See OEERE (2020). The PTC was not planned to be extended to projects constructed after 2019. The "Taxpayer Certainty and Disaster Relief Act of 2019" extended the PTC to wind projects that begin in 2020 (National Law Review, 2020).

[47] Authors' calculations based on data downloaded from https://www.treasury.gov/initiatives/recovery/Documents/Website%20Awarded%20as%20of%203.1.18.xlsx on March 2, 2020.

V.d. Policy-tension between different levels of government

One of the lessons to take from section V is the tension that exists between state and federal policies on the one hand, and, on the other hand, the policies of counties that have limited the growth of wind power investments. While state - and especially federal - policies encourage investments in the sector, the ultimate decision about whether to allow a given project rests with the county government where the project is to be located. This situation is the result of Indiana's granting of full siting and planning authority to local county governments. Other states - notably Minnesota, Ohio, and New York in the Great Lakes Region - have responded to similar tensions by reclaiming siting and planning authority for large scale wind projects.[48] Minnesota and Ohio have reclaimed state-level decision-making authority for wind projects that are over 5MW in nameplate capacity. New York has state-level decision-making for projects of over 25MW of nameplate capacity.

VI. Conclusion

The utility-scale wind generation of electricity has been part of the Indiana landscape since 2008. The earliest projects were concentrated in the west-North Central part of the state, the area that had the most favorable wind conditions for the technology of the time. Subsequent technological innovations, especially the development of taller turbines, have expanded the potential for other parts of Indiana to host utility-scale wind farms. While the large-scale generation of electricity from wind power is now viable in many counties of Indiana, county governments have used their legal authorities to inhibit or preclude development. Understanding how and why counties come to such decisions is the primary question of interest for this report.

County governments that have allowed the development of utility-scale wind farms have benefitted financially from the decision. The counties that allowed the first turbines – Benton and White Counties – collected $4.3 million and $2.3 million, respectively, in 2019, property taxes from their local wind farms. The industry also makes substantial payments to the counties under the terms of economic development agreements. Road use agreements and decommissioning agreements are designed to offset other potential burdens the industry might place on the county.

The wind-generated electricity industry is capital intensive, which means that a large share of the industry's revenues must go to compensate those who financed the large investments made at the time of construction. But the industry also makes payments to local citizens. The industry pays local landowners – primarily those who host turbines on their land - but also others that are affected by its presence. In the short periods of construction, there is an intense economic activity in the local areas and numerous short-term employment opportunities. In the operation phase, the employment numbers are smaller, but the jobs are more stable.

[48] Mills, et al. (2014), Appendix A.

PROBABLE ECONOMIC EFFECTS OF WIND POWER FOR INDIANA COUNTIES A LITERATURE REVIEW

This section of the report reviews the academic literature on the local economic effects of wind power in order to provide insights into the likely implications for Indiana counties that allow construction and operation of utility-scale wind turbines. The capital-intensive nature of wind energy production means that the primary economic consequences of wind energy investments in a county are likely to flow from the industry's direct payments to local individuals, firms, and governments. With this in mind, we first offer a flow chart documenting the types and kinds of revenue flows that are directly related to the industry's presence in a county. The chart also highlights important "leakages," in which funds the industry invests and the revenues it earns during operations leave the county. An important source of leakage in this industry is outside investors' return on invested capital.

Next, we turn to a description of the possible economic consequences of the industry's location in a county. One should expect that the industry's presence alone will lead to modest impacts on the level and distribution of income in a county, as well as on employment. The industry's presence may also affect the structure of the local economy, through what is known as "spillovers." Because the industry makes payments to local governments – and makes some demands upon the infrastructure – one should also expect an impact on the budgets of local governments. Academic study of the impact of the industry on local public finances has centered on the industry's effects on school revenues/spending and, to a lesser degree, the effect on local tax rates. We also discuss evidence on externalities that have been linked to the industry's presence.

Most of the studies we review in this chapter use one or another form of "multiplier." A multiplier in this context relates to the scale of new wind energy capacity in a county to the scale of the change in some variable of interest. So, for example, a study focused on the effects of wind power on per capita income in a county might say that each megawatt (MW) of new generation capacity generates an additional $0.50 per year in per capita income. Using this estimate, we would infer that a county with 100MW of new capacity would have experienced a $50 per person increase in average annual income; 500 MW of new capacity would imply an increase of $250 per person.[49]

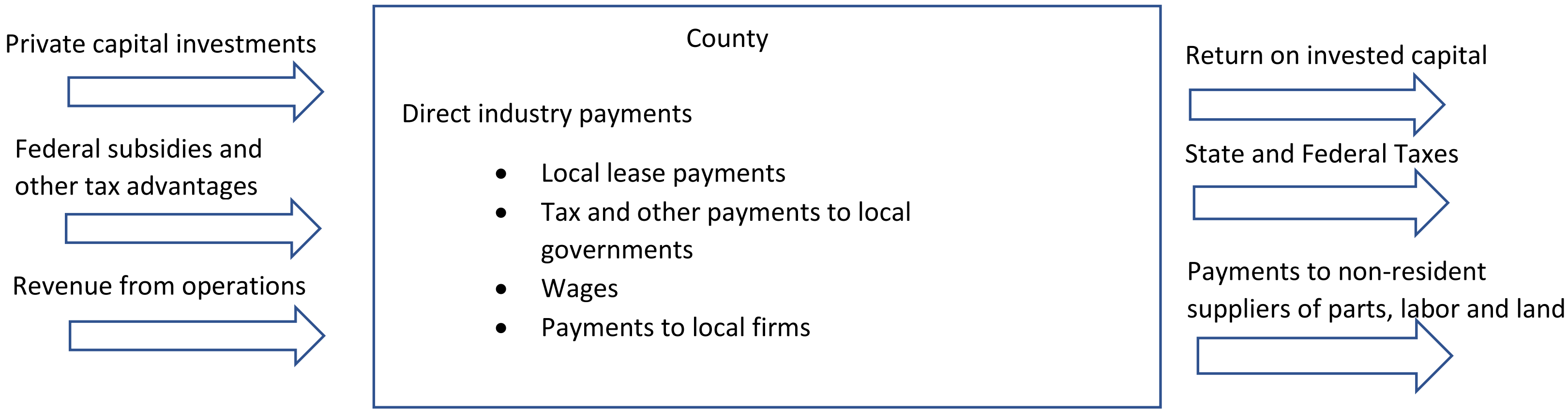
Most of the studies we review share one of two broad methodological approaches: econometric estimation or input-output modeling. Each methodology has its strengths and weaknesses, but for the purposes of this review, the econometric estimates are preferred. The circumstances of the

[49] The studies we find to be most credible relate per capita income to *MW/capita* of installed capacity, not simply to *MW* as in the example. The use of MW/capita is appropriate in most cases, but it means that the relationship between MW and per capita income is not linear, as in the example. We use a linear example to familiarize the reader with the multiplier concept.

wind-energy sector’s growth – overall US wind capacity grew rapidly over a short period of time, with many counties receiving large investments while otherwise similar counties received none – are circumstances that are very well suited for credible econometric analysis. Since econometric analysis relies on historical data, these studies are becoming more common as more data becomes available.

Many other studies have used input-output models to study the economic consequences of wind power. The county-level focus of this report makes such analyses less useful than they otherwise would be. In rural areas where wind energy generation is most feasible and most common, county economies are generally quite small. The prevalence of sizable leakages from the county - leakages that are difficult to measure - makes it difficult for input-output analysis to answer these questions credibly. There are a relatively large number of input-output studies on the impact of wind energy on state economies, and we will review the first input-output study of the impact of wind energy generation on Indiana in some detail.

Figure 4. Schematic representation of revenue flows



Possible economic consequences of the wind generation industry

- Changes in the level of per capita income and employment
- Changes in the distribution of income
- Changes in local government revenues and government services
- Changes in the structure of local economies (Spillovers)
    - Effects on related industries
    - Scale effects on local business
    - Crowding out
- Externalities

I. Analytical Framework

The framework that orients our analysis is displayed in Figure 4, which offers a qualitative representation of the flows of funds that follow a county's decision to allow the construction of utility-scale wind turbines. On the left side of the figure are monetary inflows to the county. These include private investment capital in the early stages of the project, revenues from operations once the project is up and running, and a variety of subsidies and tax advantages to investors that operate at both stages of the project. In the center of the figure is a list of direct payments made to local entities. On the right side of the figure are outflows of revenues, which include returns on capital to outside investors, tax payments to higher levels of government, and industry payments to non-residents - non-resident landowners and workers, and suppliers of parts and equipment. Both the inflows and the outflows of funds are large. The primary interest of this study is the consequence of the portion of the inward flows that do not leak out of the county. At the bottom of Figure 1, we provide a list of the types of possible economic consequences of the industry's presence, and this list forms the structure of our review of the available evidence.

One of the most striking features of the wind-generated electricity industry is its high level of capital intensity. Investors - almost all of them residing outside the Indiana counties of interest - make substantial investments to install the turbines. The cost of installing each turbine can range from $2 to $4 million. Although federal subsidies and favorable tax treatment reduce the risks borne by these investors, the risks are still significant, and investors expect a reasonably high rate of return on their capital if they are to make such significant long-term investments. A high rate of return on capital applied to a capital-intensive industry means that a large share of the income generated by the turbines will inevitably be returned to outside investors. Payments to local entities constitute a smaller share of industry revenues. But the relatively large size of the industry – relative to the size of small rural economies – can mean that the industry's payments to local individuals, firms, and governments are large enough to have a quantitatively significant impact on local economic outcomes. Key questions that local governments should ask in this context are:

- How large are the local economic benefits the industry would bring?
- Are there local policies that would enlarge these benefits?
- Can the economic benefits of the industry be spread more widely across the local population?
- What negative consequences might also be attached to the industry's presence?

Before turning to estimates of the quantitative consequence of accepting the location of wind turbines, we first define the concepts that we use to consider the economic costs and benefits of accepting turbines in a county.

II. A compendium of possible economic effects of the industry on the local economy

In Figure 1, we illustrate the sources of economic impact and other possible effects of wind energy production on local economies into five categories. The first, and most important, category of economic consequences are changes in the level of income and local employment. The most significant sources of these changes are likely to be direct payments the industry makes to county residents, whether they be locally resident employees, local landowners, or other firms. Payments the industry makes to local governments might also be expected to directly support additional local employment and indirectly contribute to higher local incomes.[50]

The second category of economic impacts is the effect of the industry on the distribution of local income. Due to data availability, most economic studies limit themselves to study of the industry's effect on total economic activity or employment. But the benefits to the industry are likely to be concentrated - with affected landowners and employees receiving the bulk of the industry's direct payments. Since any disamenities that the sector might cause are shared more widely across the population, distributional effects of the industry's economic impact are salient in local political discussions of the issue. There is very little academic evidence on the consequences of the industry for the local distribution of income, but we raise it here because of its saliency.

The most plausible means for addressing distributional consequences of the industry's presence are payments by the industry to local governments. New sources of revenue for local governments can be used to offset the tax burden on other local residents and/or to provide improved public services. The section of this report that profiles the wind energy generation industry in Indiana offers anecdotal information on payments the industry has made to local governments. Econometrics or other statistical studies have investigated the effects of the industry on county tax bases, tax revenues, and school district expenditures, and we review these below.

The next category in the figure is "spillovers," that is, various ways that the industry might affect the structure of the local economy (apart from merely providing a new source of income to county residents). Spillover effects on related industries may operate through purchases of inputs from local businesses, or through the creation of new, related industries.[51] In the rather small economies

[50] Payments to local governments may include regular tax payments and/or non-tax payments such as the "economic development payments" discussed in the section of the report that profiles the wind industry in Indiana.

[51] NREL (2014) discusses the creation of a small wind tourism industry in Benton County, which is anecdotal evidence of spillover effects. They also discuss in detail how an Earl Park garage business expanded to serve the

of rural Indiana counties, additional local income generated by the industry may increase the viability, the scale, or the number of local retail establishments. On the other hand, the industry might compete with local firms for resources – bidding up wages of local workers, for example – in what is known as a "crowding out" effect. There is, as yet, relatively little econometric evidence on spillover effects, but we review one paper that investigates these effects empirically.

The final category of consequences the industry might impose is "externalities" on local businesses and on local residents. An externality is defined as a "situation when the effect of production or consumption of goods and services imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided."[52] These would include any costs or benefits of the industry on county residents that are not compensated. The industry's most apparent externality is the change it brings to a county's visual landscape. Other externalities - less far-reaching than the visual impact - are the flicker of shadows on the nearby ground and the sounds emitted by the turbines during operation. The magnitudes of externalities are quite difficult to measure, especially when they apply to diverse populations with different aesthetic preferences. We briefly review a broader literature that attempts to quantify the effect of turbines on nearby property values. We also discuss a study showing the positive effects of turbines on crop productivity.

III. Impacts on the level of economic activity and employment

For local officials who are considering whether to allow utility-scale wind turbine investments in their county, one of the most central questions is likely to be: what will be the impact on the local economy? An analytical tool has been developed to study these impacts, a regional input-output model known as the Jobs and Economic Development Initiative (JEDI). We review the first JEDI study in Indiana. The most useful pieces of evidence on the effects of wind energy on aggregate economic outcomes come from two econometric studies.[53] We review these and calculate the implied impact on Indiana counties that comes from their results.

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industry. Our objective here is to investigate more systematic evidence that the industry affects the structure of local economies.

[52] Khemani and Shapiro (1993) cited by Organization for Economic Cooperation and Development at https://stats.oecd.org/glossary/detail.asp?ID=3215, downloaded March 16, 2020.

[53] Econometric studies are backward looking studies that employ statistical tools to compare economic outcomes in counties that where wind power investments were made to otherwise similar counties where such investments were not made.

III.a. Input-output analyses

The most comprehensive study of the industry's economic effects that focusses specifically on Indiana is a study that employs a regional input-output model to assess impacts on the state as a whole. National Renewable Energy Laboratory (NREL, 2014) uses the JEDI model to study the economic impacts of the first 1000 MW of installed capacity in Indiana. The first-1000-MW frame of the study means that it considers projects built between 2008 and 2011, which were 70- and 80-meter turbines located in Benton and White counties.[54]

The JEDI model was developed to facilitate input-output modeling of the wind sector and has been applied to the study of wind power in many different US states.[55] The primary objective of input-output models is to measure and to incorporate into the analysis, the activities of "upstream" sectors that supply the project, as well as industries even further upstream (the industries that supply the suppliers, and the industries that supply them, etc.). The analysis uses an input-output table to track each industry's purchases from each other industry. Applying a mathematical formula known as an infinite sum to the input-output table produces a multiplier that is then applied to the direct measures of investment and/or employment that are taken from project-level data. A key reason that the wind-energy sector has adopted input-output modeling as an analytical tool is that turbines themselves are extremely complicated pieces of machinery that involve long supply chains.[56] These methods are an attempt to quantify the scale of upstream sectors' participation in economic activities related to wind energy production.

As measures of changes in economic activity, input-output models have several well-known analytical weaknesses, weaknesses that are helpfully summarized in Gretton (2013). Gretton identifies five particular weaknesses that can be summarized as follows: input-output models focus attention on one set of economic dependencies - the reliance of a project on upstream sectors for inputs - but ignore other such dependencies.[57] The incorporation of upstream sectors into the analysis tends to expand the estimated impact of any given investment. In contrast, the interdependencies that are routinely ignored in input-output analyses would tend to limit or reduce the estimated impact of a project. It is for this reason that careful authors, like those in the NREL study, describe their estimate as gross effects of wind power, rather than net effects. Policy

[54] The Meadow Lake wind farm has turbines located in neighboring Jasper county as well as in Benton and White Counties.
[55] NREL (2004) describes the JEDI model in detail. The model has been used to study the impact of the first 1000 MW of power in a series of individual U.S. states.
[56] Many states, including Indiana, host manufacturing firms that participate in these supply chains.
[57] See Gretton (2013) for a listing of the five dependencies not considered in the input-output framework.

decisionmakers should, of course, be interested primarily in the sector's net effect on their local economies, not the gross effects.

There are two additional weaknesses that apply to the input-output analysis of sub-national units, and these apply with greater force at the level of counties than at the level of states. First, the data describing input-output relationships in the economy are typically reported at the national level. Analysts typically use inference and assumptions to try to adjust this data to fit local conditions. Still, studies of smaller geographic areas must rely - to some degree - on data that is imputed or assumed rather than collected. Since the focus of this report is county-level outcomes, a much more significant problem applies leakages out of the county of interest are likely to be very significant. A significant amount of the additional income that county residents earn from the sector - payments the sector makes to labor for work done in the county, lease payments the sector makes to landowners - may leave the county before being spent if the workers and landowners are not residents of the county. A second complication for input-output analysis in this context is the relative absence of upstream sectors in the small rural counties that host wind-powered generation. The construction phase relies on a long and complex supply chain, but almost none of the manufacturing activities that support this supply chain are sited in the counties themselves. The operational phase relies on relatively few local inputs.

The analysis in NREL (2014) is conducted at the state level for Indiana. The authors provide separate estimates of indirect costs for the construction and operation phases of the wind projects. Separation of this kind is appropriate when possible because the construction phase is brief but high intensity, lasting one to two years but still accounting for most of the project's lifetime expenditures in the county. In the operation phase - which the NREL study judges to last twenty years - the project makes considerably smaller annual expenditures in the county but offers more durable support to the employment and incomes for which it is responsible.

The authors of NREL (2014) further divide their estimates into three kinds. *Direct effects* are the estimates of the industry's expenditures and employment. *Indirect effects* are those calculated by applying the multiplier associated with upstream purchases to the direct expenditures. The third attribution of benefits - which the report labels *induced impacts* - are calculations that consider downstream spending effects linked to the higher incomes earned by households who are paid by the sector. As with the indirect effects, these estimates focus on the extrapolations that attempt to quantify the recirculation of payments inside the local economy. The induced impact calculations are subject to many of the same critiques that Gretton (2013) outlines for calculations of indirect effects.

The direct effects are the most reliable estimates for making judgments about the sectors' local impacts. These are taken from surveys of industry participants and relate directly to the operation of the industry itself. The authors calculate that, during the two-year construction phase, Indiana's first 1000 MW of power was associated with the employment of 690 full-time equivalent (FTE) workers and $64.5 million of additional economic activity. In the operation phase, the authors attribute 96 FTE jobs to direct employment and $6.3 million in additional economic activity. They also estimate annual payments to landowners of $3.7 million per year and local property taxes of $6.3 million per year. Indiana now hosts approximately 2000 MW of installed capacity so that cumulative totals would be approximately twice as large as those reported in the NREL (2014).

The study's estimates of indirect impacts are that the first 1000 MW supported 2820 FTE jobs and generated $395 million of economic activity during the construction phase. In the operational phase, they attribute 94 FTE jobs to the industry and $24 million per year to local economies. The induced impacts were as follows: 900 FTE jobs and $108.7 million of economic activity during the construction phase; 73 FTE jobs and $8.79 million of economic activity during the operational phase.

III.b. Econometric studies of aggregate impact

For economic policy decision-making, input-output analyses have two main shortcomings; they calculate gross rather than net effects, and they do not acknowledge or report uncertainty around their estimates. These two shortcomings of input-output analyses are strengths for econometric studies. In this section, we review the findings of two such studies and apply the multipliers they derive to figures for installed generation capacity in Indiana counties. The studies use somewhat different statistical techniques, but arrive at very similar conclusions: 1) There is considerable uncertainty around the estimated impacts of wind energy generation on local incomes and employment; 2) the effects on average county incomes are nonetheless large enough that it is safe to conclude that wind energy generation raises average incomes in counties that allow it, and 3) both studies point to positive net effects on county employment, but these effects are not large enough to be judged to be statistically different than zero.

Brown *et al.* (2012) use data on Great Plains counties to study the impact of wind generation capacity added between 2000 and 2008. The authors measure a county's exposure to wind energy investments in terms of a variable that measures MW of capacity per person. Using an econometric method known as instrumental variables, which is well suited for this question, the authors estimate that, on average, the installation of an additional MW of capacity per person in a county raises income per capita there by just over $11,000.

One of the advantages of statistical approaches to studying such questions is that the methods acknowledge uncertainty and quantify it. The estimates produced in this study are subject to considerable statistical uncertainty but indicate a high degree of confidence that the effect of wind energy investments in a county on its average income is positive. The 95% confidence interval for the effect of an additional MW per person on per capita income is [$544, $21,755]. This means that the estimates imply 95 percent confidence that the true effect of an additional MW per person generates an increase in average income in the county that lies between $544 and $21,755.

In the same article, the authors use the same techniques to study employment and estimate that an increase in one MW of installed capacity per person raises per capita employment in the county by 0.48 jobs. The 95-percent confidence interval for this estimate is [-0.07, 1.03]. These estimates indicate that the effect of wind energy capacity on employment is, most likely, positive, but also that statistical uncertainty around this estimate does not allow us to conclude with high confidence that the net effect of the sector on employment is, in fact, positive.

A second econometric study investigates the effect of wind energy investments on economic outcomes in Texas counties during the years 2001-2011. De Silva *et al.* (2015) investigate statistical relationships between the 10-year change in installed wind power capacity and employment, the number of business establishments located in the county, average and median incomes, and local public finance variables that we discuss later. The authors use an ordinary least squares method and estimate that the effect of an additional MW of capacity per person raises average income in a county by $2,658. The 95 percent confidence interval for this estimate is [$636, $4680]. The estimates here are lower than in Brown *et al.* (2012), but also less variable. Still, once again, the estimates indicate high confidence that the true effect of wind power on the average income in a county is indeed positive. De Silva, *et al.* (2015) also study the effects of wind power on employment. Like Brown *et al*., they estimate a small positive effect on employment, but the statistical uncertainty around that estimate means that we are once again unable to conclude with high confidence that the industry's net effect on county employment is positive.

Although both studies indicated considerable variability in their estimates of the effects of new wind capacity on per capita income and employment, the two studies deliver similar results, even though they studied different samples of counties, over different periods, and used slightly different methods. Both studies found positive and statistically significant effects of added wind capacity on per capita income. The estimated effects of wind capacity on employment were large and positive, but subject to statistical uncertainty that limits our ability to attribute positive net effects on employment to the industry's presence.

Although it is important to acknowledge that the effects of wind power in Indiana on economic outcomes in Indiana might differ from what was observed in the Great Plains and Texas, these studies offer the most credible available way to infer the net impact of wind power on the economies of Indiana counties.[58] To guide the reader as to the most likely impact of wind power in Indiana, we apply the estimates from Brown *et al.* (2012) and De Silva *et al.* (2015) to data from Indiana counties on megawatts of installed capacity and population. For each county, we calculate the changes in per capita income and employment that are implied by each study, as well as the uncertainty around these estimates, by applying the estimates from those studies to the data from Indiana counties.

The results of this analysis are reported in Table 6. To illustrate how to interpret the results in this table, we discuss the results for Benton County, a low-population county with a large amount of installed wind capacity. The implied effects on other counties are reported in the table and are generally smaller. Applying Brown *et al.* (2012) estimates to Benton County's data on population and installed capacity generates an estimated increase in average incomes in Benton County of approximately $1270 per year. Because of statistical uncertainty, the $1270 figure is overly precise. The 95% confidence interval in Brown *et al.* (2012) implies that the true effect on Benton County incomes probably lies somewhere in the range between $62 per person and $2480 per person, per year. $1270 is the most probable estimate in that range. The implied effects of the De Silva *et al.* 2015) study indicate a range of between $72.5 per person and $533 per person per year, with a central estimate of $303.

Benton County's combination of a relatively low population with a large base of installed wind capacity means that these studies imply large effects on Benton County's employment and even larger confidence intervals; in both cases, the confidence interval contains zero. Brown *et al.*'s estimates suggest that the change in employment lies between -69 and 1016, with an implied central estimate for Benton County of 473 new jobs. De Silva *et al*.'s estimates indicate that the employment effects lie between -247 and 2564 jobs, with a central estimate of 1163.[59]

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[58] Statistical analyses like those in Brown, *et al.* and Silva, *et al.* require a large number of counties to have adopted wind in order to reach firm conclusions. Since Indiana has relatively few counties that have adopted wind it is not possible to do this kind of study solely in an Indiana setting.

[59] The central estimate of changes in employment in Benton County is implausible. Bureau of Labor Statistics Data indicates that employment in Benton County in 2019 was 2,283. The multiplier that is applied here relates to a county's MW/capita, and Benton County has unusually large ratio of installed capacity to population. This is one

Table 6. Wind power impacts on Indiana counties economics

County	Capacity installed (MW)	Population (2018)		Brown *et al.* (2012) estimates		De Silva *et al.* (2015) estimates	
				Per capita income ($)	Employment	Per capita income ($)	Employment
Benton	986	8,653	**Mean estimate**	1270	473	303	1163
			95% interval	[62, 2480]	[-69, 1016]	[72.5, 533]	[-247, 2564]
Jay	120	20,764	**Mean estimate**	64.5	58	15.4	142
			95% interval	[3.14, 126]	[-8.4, 124]	[3.7, 27]	[-30, 312]
Madison, Tipton	203	144,770	**Mean estimate**	15.63	97	3.73	240
			95% interval	[1, 31]	[-14, 210]	[0.9, 6.6]	[-51, 528]
Randolph	200	24,850	**Mean estimate**	90	96	21.4	236
			95% interval	[4.4, 175]	[-14, 206]	[5.12, 38]	[-50, 520]
White	801	24,133	**Mean estimate**	371	385	88.2	945
			95% interval	[18, 722]	[-56, 825]	[21, 155]	[-200, 2083]

Sources: AWEA Wind Project Mapping Portal, United States Census Bureau, Brown et al. (2012), Silva et al. (2015). Note: Capacity installed is the total capacity installed of all wind farms in a county. Changes in per capita income were calculated by multiplying the estimates of the effect of capacity installed per capita on income per capita by the ratio of installed capacity to population. Employment was calculated by multiplying the estimates of the effect of changes in per capita capacity installed on per capita employment and multiplying by the county's population. Madison and Tipton counties are aggregated for our calculations because their only installed turbines sit on the border between the two counties.

These estimates are indicative of the uncertainty surrounding the employment effects of wind energy generation. Although there are high paying maintenance jobs in the sector, the absolute number of these is small and can be swamped by other local developments in county economies,

illustration of the lack of precision in the available estimates of the effects of wind power generation on net employment. This lack of precision is also evident in the large confidence intervals surrounding the estimates.

even in small rural economies. The econometric results include net effects, including spillovers and externalities, on employment. Unfortunately, the variability of the measured effects across all the affected counties in the data is so large that it makes it difficult to establish with high levels of statistical confidence that the average net effect of the industry on local employment is positive.

Although it is clear that there is some direct employment by the sector in the counties - mainly in counties with large wind sectors such as Benton County - the statistical evidence to date does not point to the industry's presence is large enough to generate net gains in employment that are observed consistently across counties that accept wind turbines. In terms of aggregate effects, the evidence that the sectors' presence raises local incomes is much stronger than the evidence indicating it increases local employment.

IV. Impacts on the distribution of income

The relatively large and statistically significant effect of the industry on average incomes in the econometric studies obscures a question that is important for broader political acceptance of the industry in Indiana counties. Much of the measured increase in average income may be due to large payments to a small number of landowners and relatively high salaries paid to a relatively small number of workers, especially those that install and maintain the turbines. If the industry generates few spillovers to the rest of the economy, then the majority of the population may not see a significant increase in their own incomes when new generating capacity is installed. Measuring the effect of the sector on the local distribution of income is difficult, and there are not yet any available studies that address the question directly.[60] One of the primary sources of friction in the local political debates about the decision to allow utility-scale wind energy investments is likely to be the uneven distribution of the benefits. Survey evidence from Michigan indicates that residents feel that wind turbines create tensions within their communities because some landowners receive revenues from wind turbines, and the others do not (Mills, 2016).

Key challenges, for the industry and local policymakers, are to design policies that spread the economic benefits of the sector more widely and to communicate the ends and means of those policies more clearly. The most practical way to spread the economic benefits of the sector to the broader community is likely to be through payments to local governments. We review the evidence

[60] De Silva, *et al.* (2015) conduct the most comprehensive study of county level outcomes. They find statistically significant and positive effects on average incomes, while the effects on *median* incomes are not statistically significant. The point estimates for changes in the two variables are very similar though, so it is difficult to take this as conclusive evidence that the industry has a deleterious effect on the distribution of income.

on the industry's effects on public finances separately in a section below. Another approach to spreading the benefits is for the industry itself to widen the set of landowners who receive lease payments. In a news article, the University of Michigan researcher Sarah Mills reports seeing "an uptick in royalty payments that expand the pool of landowners who receive money from development — not just those with wind turbines on their property."[61] In other quite different contexts, revenues from resource extraction industries have financed direct payments to the citizenry, whether they be landowners or not.[62]

If the spillover effects of the industry are significant, so that the presence of a sector contributes to a general increase in local economic activity, one could see the benefits shared more broadly that way. This might be difficult to detect in a rigorous study, and we know of no studies that show, for example, reduced poverty rates or other such evidence that would be consistent with the industry generating broadly-shared increases in local incomes.

V. Impacts on local public finances

The wind energy profile section of this report provides evidence that the industry has directly improved local public finances of specific counties in Indiana.[63]

The econometric literature on the impact of wind energy on local public finances is small but nonetheless informative. The broad lesson seems to be that the presence of utility-scale wind energy generation can be a boon to local governments - local school districts, mainly - but that whether or not additional tax revenues translate into higher school expenditures depends on institutional features such as offset funding from the state. There is also reasonably good evidence that counties that allow installation of industry-scale turbines are able to reduce the local tax burden.

In their study of Texas counties, De Silva *et al.* find that wind turbines raise the tax base of counties in which they are located. They estimate that a 10 percent increase in wind capacity generates an approximate 4.4 percent increase in the size of the county's tax base, after controlling for the overall size of the tax base (because the tax base depends on wind capacity), the authors estimate

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61 See Balaskovitz (2017).
62 The best known of these in an American context are the annual oil dividend payments made to Alaskans from the Alaska Permanent Fund Corporation.
63 In 2019, White County collected $2.2 million of property taxes from the wind industry and received another $450,000 from an economic development agreement. Benton County received $3.6 million in property taxes from the industry in 2018.

that a 10 percent increase in wind capacity generates a 2 percent reduction in local property tax rates. School tax rates in Texas do not appear to have been affected by the presence of the arrival of wind generating capacity. It seems that reduced payments from the state offset some portion of increased school tax revenues that come through the larger tax base. In the end, the authors find no statistically significant effect of wind capacity on total per-student expenditures in the local schools, but they do find an increase in the portion of per-student spending that is financed through local taxes.

A somewhat cruder statistical analysis by Castleberry and Greene (2017) uses data from 108 school districts in Oklahoma from 1997 to 2015 to examine the effects of wind development on school funding.[64] In their analyses, the authors utilized t-tests for independent samples and Mann-Whitney U tests to evaluate changes in the distribution of growth rates across school districts that did and did not receive new installed wind capacity. The results show that districts with turbines installed before 2011 observe an average increase in local and county revenues of 59.8%, while the revenues of those without turbines only increase by 27.8%. The statistical tests reveal no statistical differences between districts with and without wind turbines for a variable measuring changes in the student/teacher ratio. Only several isolated districts with wind generating capacity saw a decrease in student-teacher ratio. Finally, the authors found that, on average, there is no statistical difference between districts with and without wind capacity concerning the percentage change in per-student expenditures. The authors argue that the main benefit of wind turbine installation for the affected school districts is that higher revenues from local sources leave them less exposed to sudden changes in funding from state and federal governments.

VI. Effects on the structure of local economies

Implicit in many views of the economic impact of wind turbines – both positive and negative opinions - are assumptions about one or another structural impact of the wind generation industry on other sectors in the local economy. It may be, for example, that the additional income the industry brings to the county increases the health of the local retail sector, which might otherwise be vulnerable in small rural counties. It may also be that well-paying jobs in the wind energy sector lure conscientious and hard-working local employees away from working in other establishments,

[64] Because these authors are studying school districts – not counties, as most studies do – they do not have a wide range of county level data that can be included as covariates in regression analysis. Instead of regression analysis, the authors do tests for differences in growth rates of variables across a sample of school districts that did and did not have turbines installed during the time of study.

a form of “crowding out.” Input-output studies such as NREL (2014) imply that industry expenditures repeatedly circulate through the local economy, with industries that sell directly to the wind sector benefitting disproportionately from the arrival of wind turbines in the county.

Impacts on the structure of the economy are an understudied issue, perhaps because the hypothesized effects are weak. The De Silva *et al.* study of Texas counties is an exception to the rule. In this study, the authors use data on county business patterns, and ask whether the installation of new wind generation capacity affects the number of business establishments or the number of employees in the county - in the aggregate, and across 20 different sectors of the local economy. Their estimated effects on aggregate employment have been reviewed above: the estimated effect is positive, but not statistically different than zero. De Silva *et al.* find a similar result for the impact of wind capacity on the number of business establishments, an estimate that is positive, but not large enough to be distinguished, statistically, from zero.

When the authors turn to sector-level analysis, they find some statistically significant effects. They estimate a negative effect on the number of establishments in the agricultural sector and a positive effect on the number of establishments operating in the utility sector. These effects are statistically significant, with 90 percent confidence, but not with the conventional threshold of 95 percent confidence. The most substantial measured effects of wind capacity are in the mining sector - these effects are positive and statistically significant at the 95 percent level of confidence. Likely, the measured increase in establishments in the mining and utilities sectors is directly related to the appearance of the industry itself. The other 17 sectors saw no statistically significant change in the number of establishments due to growth in wind energy capacity.

The authors also investigate changes in employment at the sector-level. Sectoral employment is arguably a more interesting outcome of studying than the number of establishments because overall employment in a sector can increase without growth in the number of establishments (if the existing establishments simply hire more workers). The authors find a large, positive, and statistically significant estimate of the effect that new wind generation capacity installations have on local retail employment. The estimates suggest that each 100 MW of new capacity generates an additional 20 jobs in the retail sector. Employment in the waste management sector also increases due to the arrival of the wind energy generation, with the effects taking similar magnitudes to those estimated for retail employment. The other 18 sectors that De Silva *et al.* study did not experience a statistically significant change due to the presence of the wind sector. The estimated effects on these other sectors are both positive and negative, which helps to explain the absence of a statistically significant effect on aggregate employment.

De Silva *et al.* appear to be the only study that investigates these spillover effects econometrically, relating the experience of counties with installed wind generation capacity and comparing them statistically to otherwise similar counties without wind energy generation. The study evaluates the economic consequences of wind energy generation in Texas and relies on developments in the 31 Texas counties in which wind energy generation was installed. The results are nonetheless plausible, and therefore intriguing. The increase in average local incomes that appears to be associated with the arrival of the wind sector should help to support local retail activities. Increased incomes, along with the activities of the sector itself, may increase demand for waste management services. The location of large-scale wind energy generation might also crowd out some agricultural firms, as the authors estimate.[65]

The evidence of negative effects on the number of establishments engaged in agriculture may need some perspective. Farmers who are also landowners likely benefit from the additional income from lease payments paid to compensate for the use of their land. Since lease payment income is predictable and largely uncorrelated with developments in weather and commodity markets, it may be especially valuable as a source of farm income. Mills (2018b) surveys farmers in Michigan, asking respondents about their investments in buildings and equipment, and succession plans for their farm. She finds that farmers receiving lease payments invest more in their on-farm buildings and equipment, and are more likely to have succession plans for their farm. In this way, the sector may help to support the economic viability of farms that do receive lease payments, even if it also crowds out some farms or other agricultural business establishments.[66]

VII. Possible externalities created by wind farms

One of the most salient issues in local decision-making about the acceptance of utility-scale wind investments relates to the possibility that the turbines impose sizable externalities on residents of their local areas. Externalities are social costs or benefits that the industry brings to the county that

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[65] In a footnote, the authors say that the estimated the effect of wind energy capacity on harvested acres and found a negative but statistically insignificant effect.

[66] Set-back requirements that local governments use to regulate the location of turbines make them easier to locate on the land of landowners with concentrated holdings. It may be that the estimated negative effect of wind capacity on agricultural establishments reflects the fact that counties with falling numbers of local farms are able to have more turbines sited because property ownership in those counties is becoming more concentrated (and thus less constrained by set-back requirements). It may also be that the prospect of new wind farms leads land ownership to become concentrated, in order to avoid having the set-back requirements constrain landowners' opportunities to receive lease payments.

are not fully incorporated into the industry's decision to install turbines in a given location. One of the inescapable facts of large-scale wind turbine installations is that they bring a significant change to the rural landscape. Some citizens see the turbines as disamenities, which is an example of a negative externality. Critical questions regarding negative externalities are: how significant is the harm; should there be compensation, and if so, to whom and how much? A considerable part of the academic literature on the wind turbine industry has asked whether proximity to new wind turbines reduces the value of nearby properties. Economic research has also indicated the presence of some positive externalities linked to the industry. In this section, we first provide a brief guide to the literature on changes in real estate values and then discuss recent research indicating positive externalities.

VII.a. Consumption externalities

There is considerable heterogeneity – across individuals and communities – in attitudes towards large-scale wind turbines.[67] Wind turbine projects across rural Indiana have faced opposition from local citizens. Often, this opposition has led to local regulations that effectively preclude investment, to moratoria, or even to outright bans on the development of new projects. One of the primary motivators of this opposition, in Indiana and elsewhere, is the view that the turbines are an important disamenity for residents.

A broad literature has attempted to quantify the disamenity value of nearby turbines. The most reliable studies on this topic are likely those that assess changes in house prices, comparing changes in the prices of houses with similar characteristics that differ in their level of exposure to the turbines. Purchases of houses are large expenditures, taken with considerable care, and therefore likely to represent carefully considered opinions about the implicit costs or benefits of living near the turbines. Evidence that the location of turbines near a property causes its value to fall, relative to similar houses that are less exposed to the turbines, would offer fairly convincing evidence that the turbines imposed a negative externality on those living near them.

The literature on this topic is large and growing, but still inconclusive. Vyn (2018) notes that the earliest studies on the topic had difficulty reaching firm conclusions because they lacked a sufficiently large number of real estate transactions to allow firm conclusions. Hoen *et al.* (2015) argue that a particular problem has been the absence of a sufficiently large number of real estate transactions located very near the new turbines. In earlier studies, inferences about the impact of turbines on nearby properties were made using estimates from data that mostly relied on

[67] See Vyn (2018) for a discussion.

transactions involving much more distant properties. Given the large setback distances and the placement of Indiana’s turbines in quiet rural settings, it is likely that the relatively small number of retail transactions in close proximity to the turbines would pose an important problem for any study of the turbines’ effects on Indiana's real estate prices.

Rather than review the literature extensively, we offer a brief review of three large-sample studies: Hoen, *et al.* (2015), Vyn (2018), and Jensen, *et al.* (2014). These studies are all fairly recent. Each offers a helpful review of the earlier literature on the topic, with different authors offering informed summaries of different issues in the literature.[68] Finally, the different focus of each study offers some helpful insights into the nature of the mechanisms at work.

The research by Hoen *et al.* (2015) was the first study of U.S. data that recognized that the earlier literature had been bedeviled by small sample sizes and set out to remedy it. The authors estimate an econometric model using transactions from 27 counties in nine different states – including Ohio, Illinois, Iowa, and Minnesota in the Industrial Midwest. The authors use data on more than 50,000 home sales, including 1198 sales within one mile of a turbine and 331 sales within ½ mile of a turbine. They divide the data into sales that occurred before the announcement of a project, after the project’s announcement but before construction, and the period after construction. Despite a much larger sample than earlier studies, the authors still do not have enough evidence to conclude that either the announcement of pending construction or construction itself is sufficient to cause a statistically significant negative effect on house prices on properties with one mile (or even ½ mile) from the nearest turbine. The authors acknowledge that negative effects are still possible, even if they were too small to detect in their study. They argue that their lack of conclusive evidence for negative impacts of turbines on nearby property values, together with the available evidence on the effects of plausibly greater nuisances (road traffic, waste dumps, power lines) on property values suggests that the negative effects of turbines on nearby property values are unlikely to be large. They conclude that the effects of industrial-scale turbines on the value of property within one mile of a turbine are likely to be no larger than 3-4 percent of the value of the property, and probably smaller. It is also likely that these effects will diminish over time, as people with a smaller aversion to the turbines come to live in the properties nearest them.

Jensen *et al.* (2014) conduct a large-sample study of changes in the response of property values in Denmark to the construction of nearby wind turbines. The large number of turbines in Denmark, combined with its moderately high population density – even in rural areas – means that these authors can collect a relatively large number of rural real estate transactions in the neighborhood of new turbines. Although the situation in Denmark is quite different than that in Indiana, we

[68] Interested readers are encouraged to consult these studies for a more detailed review of this literature.

include the Jensen study in this review because it offers a thorough description of the sources of negative externalities that might be associated with living near a turbine, and a careful study of their effects. The authors use detailed data on the terrain, house sizes, and the location of turbines to determine if the turbines are visible from each house.[69] The authors also calculate the exposure of each property to noise from the turbine. Taking all this into account, the authors estimate that having a view of a turbine reduces the value of a property in Denmark by 3.15 percent, on average. A more distant view implies smaller impacts on property values, as might be expected. Variation in the sound level also affects property values. Sound levels of 40-50 decibels were associated with a 6.69 percent reduction in the value of a property. Since properties that are closer to turbines are more likely to be more exposed to the visual sight of the turbine and to higher sound levels, distance offers a useful proxy for the joint effects of the two disamenities. The authors estimate that houses that are 800 meters from a turbine (approximately ½ mile) see the value of their property fall by 10.2 percent. At 1600 meters, approximately 1 mile, the effect falls to 5.4 percent.

How should we understand the rather large estimates coming from Denmark, viewed against the statistically insignificant (and small) effects estimated for the United States? Denmark has much higher population densities in its rural areas. Given the scale of the wind generation industry in Denmark, and its considerable geographic spread, the Danish people may have less choice about whether or not to live near turbines. A study from Ontario, Canada offers intriguing evidence related to this hypothesis.

Vyn (2018) offers a helpful up-to-date review of the available economic literature on the external effects of wind turbines. He especially notes that individuals and communities differ markedly in their attitudes towards new turbines. He argues that Ontario offers a useful laboratory for understanding how local attitudes and community dynamics affect the magnitude of the external effects of turbines on property values. Vyn notes that Ontario - unlike Indiana and most U.S. states - gives the provincial government, not local communities, the authority to decide whether or not wind farms are sited in a given location. Some communities welcome the turbines, while others are strongly opposed. Many communities voiced formal opposition to their wind farms, passing a resolution that they are "unwilling hosts" of utility-scale wind energy generation. Since communities in Ontario that express opposition often have turbines located there anyway, Vyn can compare the effect of turbines on property prices in communities that oppose the turbines to the effect on prices in communities that do not express formal opposition.

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[69] Most other studies use distance from the turbine as a simple proxy for exposure to its potential disamenities. Jensen, *et al.* also report estimates using the distance proxy.

A large number of turbine locations in Ontario (together with somewhat higher population density than is common in Indiana's wind counties) mean that Vyn also has a relatively large sample (of almost 17,000 transactions). Like Hoen, *et al.*, Vyn studies separately the effect of turbines on sales that occurred after the announcement of a project but before construction and the effect on sales that occurred after construction. He also studies whether the density of nearby turbines matters (e.g., whether having several turbines within one mile of the property has a larger effect than having a single turbine within one mile).

The most interesting of Vyn's finding is that a community's attitude towards the turbine determines whether or not there is a statistically significant effect on real estate prices. Communities that express formal opposition to turbines – but then receive them anyway – see negative effects of turbines on property values. The size of these effects is between 5 and 10 percent of the value of the property and applies to properties within 4 km (about 2.5 miles) of the nearest turbines. Property values are affected both in the period between announcement and construction and in the period after construction. By contrast, in communities that do not express opposition to turbines, the effect of turbines on property prices tends to be positive, though not statistically significant. Vyn also studies the effect of turbine density on property values. In communities that are opposed to wind power, he finds that a larger number of turbines within a given radius of property cause a larger reduction in the property value.[70] In communities that have not expressed opposition to turbines, however, he finds no evidence of a relationship between turbine density and property values. In communities that accept wind power without formal opposition, turbine density does not appear to matter for property values.

Vyn's findings have at least two important implications for this study. First, they highlight the critical importance of understanding community attitudes towards wind power, as well as the community dynamics that lead some counties to oppose wind power while other communities welcome it. Second, the research helps explain why authors such as Hoen *et al.* find little or no impact of wind turbines on property values in the United States. Most areas of the United States – most notably counties of Indiana – have substantial influence over whether turbines are situated in them. Since the available data on real estate transactions near turbines in the United States would be dominated by real estate transactions in communities that chose to accept wind power, we should expect little or no impact on property values in the U.S. sample.

[70] He reports separate estimates indicating that the first turbine is responsible for about ½ of the total effect, the second turbine about ¼, with higher levels of turbine density offering rather smaller negative effects on house prices.

VII. b. External effects on crop yields

The literature on the effects of turbines on real estate prices investigates the possibility that turbines impose a negative externality on their neighbors. Recent studies have also found evidence of a positive externality. Wind turbines have been found to have small impacts on the weather in their immediate vicinity. Agronomic studies investigating the effects of these small changes in the "micro-climate" have found evidence that these effects of the turbines can have impacts on crop yields (Rajewski et al. 2013; Armstrong et al., 2014). To understand the direction and magnitude of those impacts, Kaffine (2019) estimates an econometric model relating changes in installed wind capacity to changes in station-level meteorological data. The second part of his econometric model links changes in meteorological data to changes in county-level data on crop yields. The results reveal that a 100MW wind farm increases corn yields in the same county by around 0.7% to 1.2%, an effect that is highly statistically significant. Wind farms also increase yields for soy and hay, with a magnitude of about 1% for soy and 1% to 3% for hay per 100MW capacity. The economic value of these effects is approximately $5 of local benefit for each Megawatt hour of generation.[71] The total economic benefit of the increase in yields generated by the sector's presence amounts to roughly $388 million of external benefits to farmers in U.S. counties where wind power capacity is installed.

The author conducts several robustness checks. He rules out the possibility that the productivity gain comes through new investments financed by new revenues from lease payments. He finds more substantial effects for taller turbines, and evidence that the benefits accrue primarily downwind from the turbines. All of these estimates are consistent with the agronomic understanding of how wind power affects crop yields.[72]

SOCIO-ECONOMIC PROFILE OF BENTON, WHITE, JAY, RANDOLPH, TIPTON, MADISON, TIPPECANOE, CLINTON, AND MONTGOMERY COUNTIES

This chapter presents a variety of demographic, economic, labor market, and quality of life information that enables to gain a better perspective on the current condition in the counties in

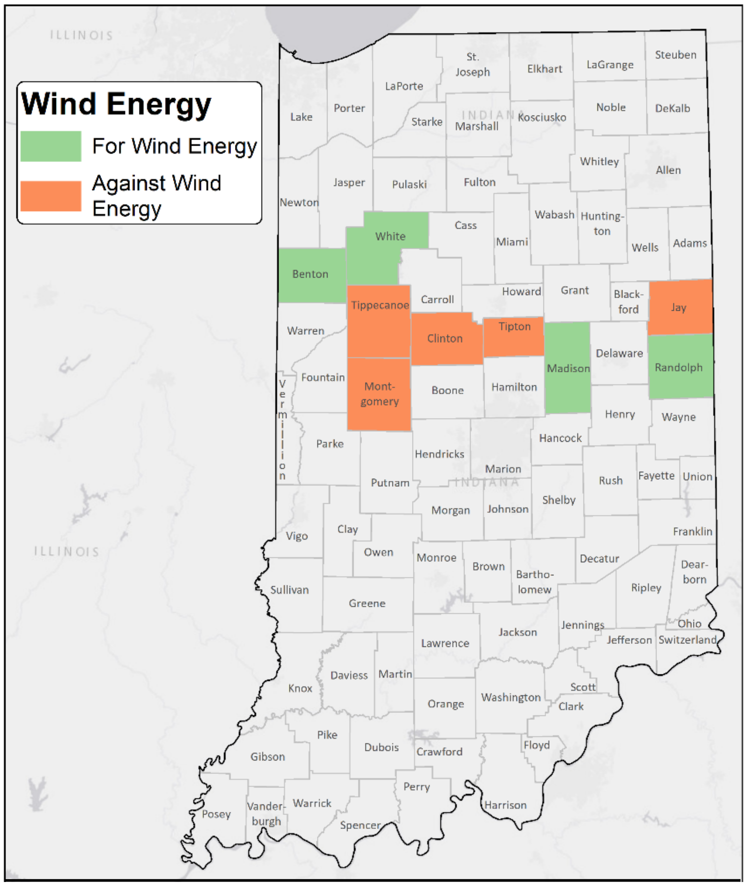
[71] A Megawatt hour represents the provision of one MW of electricity for an hour of time.

[72] See Kaffine (2019) for details. The primary mechanisms are that the turbines reduce local wind speeds and generating mixing of the air, affecting crop-level temperatures, CO_2 and moisture levels. Agronomic understanding of these mechanisms indicate that they may operate up to 10km downwind from the turbines.

Indiana, chosen as the case studies: Benton, White, Jay, Randolph, Tipton, Madison, Tippecanoe, Clinton, and Montgomery counties. Different public opinions related to the wind farm projects led us to divide counties selected as case sites into two groups (Figure 4):

Group 1 – For wind energy counties: Benton, White, Randolph, and Madison
Group 2 – Against wind energy counties: Tippecanoe, Clinton, Montgomery, Jay, and Tipton

Figure 4. Selected counties in Indiana



I. Demography

I.a. Population

Population decline is an issue that is plaguing rural communities across the country, and the nine selected counties are no exception. Table 7 comparing county population variables illustrates that only Montgomery and Tippecanoe counties experienced an increase in population between 2010 and 2018. The main reason can be attributed to natural growth, and in the case of Tippecanoe County, also to international in-migration. Also, White County shows a slight natural population growth. The remaining counties suffer from different volumes of domestic out-migration.

Table 7. Population - County Comparison, 2010-2018

	Name of County	*Total population (2018)	*Population Change (2010-2018)	**Population Density (2018)	*Components of Population Change (2000-2018)
Group 1	Benton	8,667	-187	21.33	Domestic out-migration
	Madison	129,505	-2,131	286.57	Domestic out-migration
	Randolph	25,076	-1,095	55.43	Domestic out-migration
	White	24,217	-426	47.94	Slowing natural increase
Group 2	Clinton	32,301	-923	79.74	Domestic out-migration
	Jay	20,993	-260	54.68	Domestic out-migration
	Montgomery	38,276	152	75.85	Natural increase
	Tippecanoe	189,294	16,514	378.73	International in-migration Natural increase
	Tipton	15,218	-718	58.41	Domestic out-migration

Source: *Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county,
**Stats Indiana: http://www.stats.indiana.edu/topic/population.asp

While both groups of counties have an outlier (Madison County in the Group 1 and Tippecanoe County in the Group 2), Group 1 counties are less densely populated than Group 2 counties. Excluding the outlier counties, Group 1's average density is 41.6 individuals per square mile, compared to Group 2's average of 67.2.

I.b. Educational Attainment

Educational attainment measures the highest level of education for county citizens (Table 8). Nearly all of the nine counties follow a similar trend – a majority of the county's population has a high school diploma or some college education, and roughly 25% of citizens have a college degree.

While the two groups exhibit a very general theme, there is a difference between the two groups in terms of consistency in adhering to that theme. Group 1 counties have a more consistent educational profile – the range for each educational attainment level is about 3-4%. Group 2, however, exhibits a much broader range – upwards of greater than 20% for two categories.

Group 2 has two counties at the opposite ends of the educational attainment spectrum – Tippecanoe and Jay counties. Tippecanoe county, home to Purdue University, is a stark outlier in terms of having a high level of education – over 45% with a college degree and less than 10% without a high school diploma. Jay County, on the other hand, represents the lower level of education – less than 20% with a college degree, nearly half (47.8%) with only a high school diploma, and 17.2% with no high school diploma.

Table 8. Educational Attainment – County Comparison, 2018

	Name of County	Bachelor's or higher (%)	Associate Degree (%)	Some College (%)	High School (%)	No High School (%)
Group 1	Benton	16.9	7.6	21.8	43.2	10.5
	Madison	18.0	9.0	22.1	39.0	11.9
	Randolph	14.3	8.0	21.9	42.5	13.2
	White	16.8	9.3	21.1	41.4	11.4
	Group 1 Median	*16.85*	*8.5*	*21.85*	*41.95*	*11.65*
Group 2	Clinton	16.6	7.6	17.9	44.1	13.8
	Jay	10.6	8.8	18.2	47.2	15.2
	Montgomery	18.1	7.9	22.2	41.3	10.5
	Tippecanoe	37.7	8.1	20.9	25.0	8.3
	Tipton	23.0	7.8	16.5	41.1	11.6
	Group 2 Median	*18.1*	*7.9*	*18.2*	*41.3*	*11.6*

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

II. Economy

II.a. Top Five Industries

This section analyzes the top five industries in each county by share of a total number of jobs. Table 9 illustrates each county's industry characteristics. Two industries are consistent across the top five industries of all nine counties – Government and Manufacturing. Retail trade was present in the top five for all counties except Benton County. Health Care and Social Assistance is represented in the top five in six of the nine counties.

Industry analysis indicates that Group 1 counties are more dependent on agriculture-related industries. Agriculture, Forestry, Fishing and Hunting are present in the top five industries in all of the Group 1 counties but Madison County. Comparatively, Agriculture, Forestry, Fishing and Hunting is a top-five industry in only two of the five Group 2 counties (Jay and Tipton).

Manufacturing is a much more dominant industry in Group 2 counties – occupying over % of total jobs in all but one Group 2 county (Tippecanoe). On the other hand, Manufacturing's share of total jobs never exceeds 25% in Group 1 counties. Additionally, Manufacturing is the top industry in all group 2 counties, but Tippecanoe County compared to only one-half of Group 1 counties.

Table 9. Top Five Industries– County Comparison, 2018

	Group 1				Group 2				
Share of top five industries (%)	**Benton**	**Madison**	**Randolph**	**White**	**Clinton**	**Jay**	**Montgomery**	**Tippecanoe**	**Tipton**
Agriculture, Forestry, Fishing and Hunting	15.5		9.7	7.4		10.4			13.2
Government	16.3	12.6	13.9	11.9	12.6	10.6	10.6	22.1	10.9
Manufacturing	10.6	10	17.4	21.5	28.9	29.2	25.3	15.4	26.2
Other Services	9.7				6.3				
Wholesale Trade	7.2								
Retail Trade		10.6	8.8	10.9	8.1	7.8	9.9	9.4	10.6
Health Care and Social Assistance		14		7.2	7.9	8.8	7.3	11.3	
Construction			8.2						7.3
Accommodation and Food Services		8.2					6.9	8.1	
Other Industries	40.8	44.6	42.1	41	36.2	22.8	40.1	33.7	34.3

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

II.b. Top Five Occupations

This section analyzes the top five occupations – as a percentage of total occupations – for each county. Table 10 compares each county's top five occupations. There are several common top five occupations across all nine counties. Office and Administrative Support, Production, and Sales and Related Occupations are present in all nine counties' top five occupations. Transportation and Material Moving is present in the top five occupations in all but one county (Tippecanoe). Management is present in the top five occupations in all but two counties (Tippecanoe and Montgomery).

Table 10. Top Five Occupations – County Comparison, 2018

	Group 1				Group 2				
Share of top five occupations (%)	**Benton**	**Madison**	**Randolph**	**White**	**Clinton**	**Jay**	**Montgomery**	**Tippecanoe**	**Tipton**
Management	14.2		11.3	9.4	8.2	11.8	8		12.1
Office and Administrative Support	9.4	12.2	10	9.7	10	9.4	11.2	12.9	9.1
Production	7.6	6.8	10.6	14.8	16.8	18.3	16.4	11.5	16.2
Sales and Related Occupations	11.1	11.8	10	12.9	11.1	9.5	11.1	10.4	9.1
Transportation and Material Moving	8.4	8.1	9	7	9.6	8.8	10.3		8.1
Food Preparation and Serving related		8.9						8.9	
Education, Training, and Library								7.7	
Other Occupations	49.3	52.3	49.1	46.1	44.3	42.6	42.9	48.6	45.4

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

Production occupations have a dominant presence in Group 2 counties. Production is the top occupation in all Group 2 counties but Tippecanoe county. This dominance could be explained by the major presence of Manufacturing industries in Group 2 counties.

Group 1 counties, on the other hand, are more inconsistent with the top five occupations. Management is the top occupation in Benton and Randolph counties, Office and Administrative Support is a top occupation in Madison County and Production in top occupation in White County.

II.c. Population Income

Incomes, poverty, housing costs, and transportation costs are key indicators of the vitality of communities. Table 11 compares population incomes. This section analyzes the differences in these income variables for all nine counties. Four out of the five Group 2 counties (Clinton, Montgomery, Tippecanoe, and Tipton) have a real median household income[73] above $50,000; however, only two counties (Benton and White counties) of Group 1 have a real median household

[73] **Real Median Household Income**: Includes Labor Earnings, Social Security, Retirement Income, Supplemental Security Income (SSI), Cash Public Assistance Income, and Supplemental Nutrition Assistance Program (SNAP). It is the average household income in that county.

income above $50,000. This contributes to Group 2, having a higher average real median household income.

Table 11. Population Incomes – County Comparisons, 2018

	Name of County	Total Population in Poverty (%)	Real Median Household Income ($)	Per Capita Personal Income ($)	Housing Costs (% of income)	Transportation Costs (% of income)
Group 1	Benton	11.4	51,728	42,775	22	31
	Madison	17.0	49,552	38,172	20	26
	Randolph	13.6	46,441	36,491	23	34
	White	8.5	58.380	43,852	20	28
	Group Average	*12.625*	*51,525*	*40,323*	*21.25*	*29.75*
Group 2	Clinton	11.9	51,730	39,172	23	30
	Jay	13.0	48,392	39,321	23	35
	Montgomery	10.8	53,700	40,056	23	29
	Tippecanoe	18.1	52,269	39,169	26	26
	Tipton	8.4	60,896	46,610	23	29
	Group Average	*12.44*	*53,397*	*40,866*	*23.6*	*29.8*

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

Per capita personal income[74] is very similar across both groups of counties. Six of the nine counties (Madison, Randolph, White, Clinton, Jay, Montgomery, and Tippecanoe) have a per capita personal income that falls between $36,000 and $41,000. The three remaining counties (Benton, White and Tipton) have per capita personal incomes that exceed $41,000.

Group 2 counties have a higher average real median household, and slightly lower total population in poverty compared to Group 1. Madison County in Group 1 has the highest total population in poverty (17%), while White County has the lowest (8.5%). The county with the lowest level of poverty in Group 2 is Tipton county (8.4%) and Tippecanoe is the county with the highest level (18.1%).

[74] **Per Capita Household Income:** Per Capita Personal Income (PCPI) is the sum of wage and salary disbursements and other labor income; proprietors' income with inventory and capital consumption adjustments; rental income of persons with capital consumption adjustment; personal dividend income; personal interest income; and transfer payments to persons, less personal contributions for social insurance.

Housing costs[75], as a percentage of income, are higher in Group 2 counties. All Group 2 counties housing costs are 23% of income or higher. Only one Group 1 county (Randolph) has housing costs that are at that same level of 23% of income. While both groups have comparable average transportation costs[76] as a percentage of income, transportation costs vary widely within each group. Four of the five Group 2 counties (Clinton, Jay, Montgomery, and Tipton) have transportation costs that are 29% of income or higher. Group 1, however, only have one-half of counties (Benton and Randolph) at the same transportation cost level of 29% of income.

III. Labor market

III.a. Number of Jobs, Labor Force and Unemployment Rate

The labor force across the two groups of counties varies greatly (Table 12). The least number of jobs (3,888) is in Benton County, while the highest number of jobs (110,462) is in Tippecanoe County. Each group has an outlier with a much larger total jobs number (Group 1- Madison County, Group 2- Tippecanoe County). Excluding these two counties, the groups are relatively similar in many jobs, ranging from 3,888 to 20,004.

The two groups of counties are all relatively similar in terms of the labor force participation rate. The two counties with the lowest labor force participation rate (Madison and Tippecanoe) both house universities. The low participation rate could be explained by university students that are not employed nor seeking employment. One-half of Group 1 counties have a labor force participation rate that exceeds 90%. Group 2, on the other hand, only has two out of five counties with a labor force participation rate that exceeds 90%. A majority of the nine counties have labor force participation rates that fall within a range of 80%-90%.

All of the nine counties have consistently low unemployment. All but one county (Randolph and Madison with 4.0%) have unemployment rates below 4.0%. Four out of the five Group 2 counties have unemployment rates below 3.25%. No Group 1 counties have unemployment rates below that same level (3.25%).

[75] **Housing Costs**: Housing costs include mortgage and rent payment, real estate taxes, insurance, utilities, land rent, and mobile home park fees. This indicator measures housing affordability in terms of the share of household income that is devoted to a mortgage and related costs (for homeowners) and rent and related costs (for renters).

[76] **Housing Costs**: Housing costs include mortgage and rent payment, real estate taxes, insurance, utilities, land rent, and mobile home park fees. This indicator measures housing affordability in terms of the share of household income that is devoted to a mortgage and related costs (for homeowners) and rent and related costs (for renters).

Table 12. Number of Jobs, Labor Force, and Unemployment Rate – County Comparison, 2018

	Name of County	Total Number of Jobs	Labor Force Participation rate (%)	Unemployment Rate (%)
Group 1	Benton	3,888	95.2	3.3
	Madison	53,070	79.7	4.0
	Randolph	9,622	86.1	4.0
	White	12,518	103.5	3.3
	Group 1 Median	*11,070*	*90.7*	*3.7*
Group 2	Clinton	14,486	96.2	2.9
	Jay	10,222	86.6	3.4
	Montgomery	20,004	87.3	3.1
	Tippecanoe	110,462	78.3	3.2
	Tipton	7,565	107.3	2.8
	Group 2 Median	*14,486*	*87.3*	*3.1*

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county; Housing and transportation costs data are obtained from the Center for Neighborhood Technology (CNT).

III.b. Commuting

There are three types of workers in a county – residents that work in the county, residents that work outside the county, and non-residents that work inside the county. Table 13 compares county commuter patterns. This section analyzes the commuter statistics for each county.

Group 1 counties follow the same general commuter trend – roughly half of the commuters live in the county. Still, they are employed outside, nearly one-quarter are both employed and live in the county, and roughly one-quarter are employed in the county but live outside the county. All four Group 1 counties have over 45% of commuters living in the county but being employed outside the county.

Group 2 counties, however, are more uniform in terms of percentages across the three categories. Group 2 only has one out of five counties (Tipton) that has over 45% of commuters living in the county but being employed outside the county. Additionally, a majority of Group 2 counties (Jay, Montgomery, and Tippecanoe) have over 30% of commuters living and working in the county. No Group 1 counties have a percentage of commuters that meet that same criterion for the category of living and working in the county. Tippecanoe County is the only county that has a majority (44%) of commuters living and working in the county.

Table 13. Commuting – County Comparisons, 2017

	Name of County	Both Employed and Living in County		Living in the County but Employed Outside		Employed in the County but Living Outside	
		Number of people	% of the total	Number of people	% of the total	Number of people	% of the total
Group 1	Benton	929	18%	2,900	57%	1,255	25%
Group 1	Madison	21,222	28%	34,590	45%	20,466	27%
Group 1	Randolph	3,618	26%	7,359	53%	2,917	21%
Group 1	White	4,143	25%	7,630	46%	4,805	29%
Group 1	*Group 1 Median*	*3,881*	*27%*	*7,495*	*48%*	*3,861*	*25%*
Group 2	Clinton	5,377	26%	8,346	41%	6,739	33%
Group 2	Jay	4,049	31%	5,445	42%	3,521	27%
Group 2	Montgomery	7,822	33%	8,954	38%	7,011	29%
Group 2	Tippecanoe	49,611	44%	25,894	23%	38,238	34%
Group 2	Tipton	1,778	18%	4,787	49%	3,245	33%
Group 2	*Group 2 Median*	*5,377*	*18%*	*8,346*	*49%*	*1,255*	*33%*

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county
Note: The Purdue University Data Snapshots used the commuting data/table from OnTheMap, which is the commuting data from the U.S. Census. This data is verified by the state Department of Workforce Development (DWD). Indiana DWD participates in that program.

III.c. Top Commuting Destinations

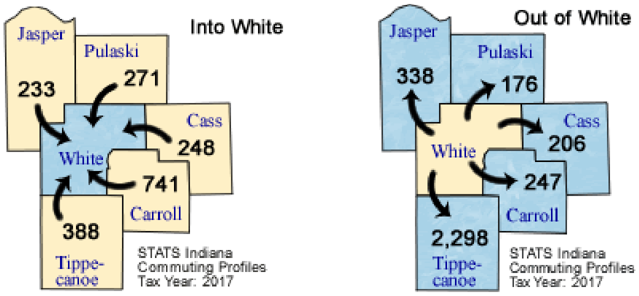
Commuting profiles are a key insight into where commuters are traveling to and from. Figure 5 and Figure 6 show an illustration of each county's commuting profile for 2017. Generally, the top destination for outbound labor and source of inbound labor are neighboring counties. Those neighboring other states (Benton, Randolph, and Jay) tend to share labor with the neighboring states.

Group 1 counties are at a net-loss with almost all neighboring counties. Only White County imports more labor from neighboring counties than it exports to those same counties (Pulaski, Cass, and Carroll Counties). Each Group 2 county, on the other hand, is a net exporter of workers to at least one neighboring county.

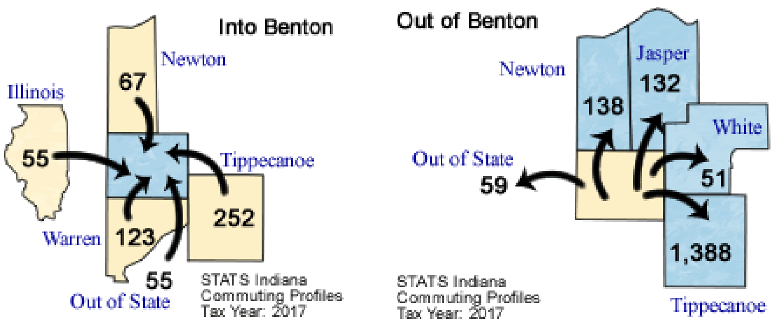
Tippecanoe County is a major importer of labor from other Group 1 and 2 counties that are within the same respective region. Tippecanoe County is the top destination for outbound workers in Benton, White, Clinton, and Montgomery Counties. Clinton and White Counties are top destinations for outbound Tippecanoe County residents but remain a net exporter of labor to Tippecanoe County.

Figure 5. Group 1 County Commuting Profiles, 2017

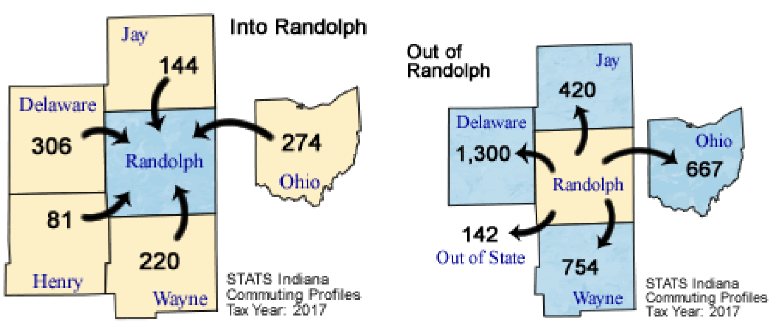
White County



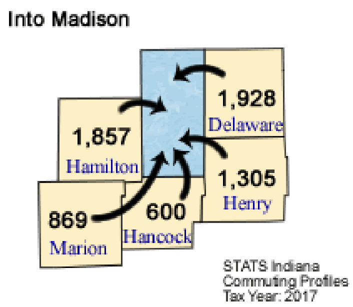
Benton County

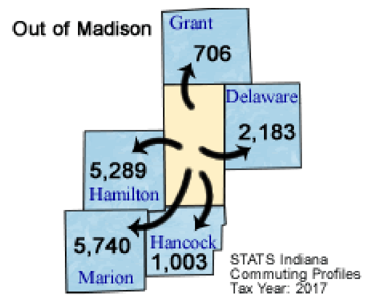


Randolph County



Madison County

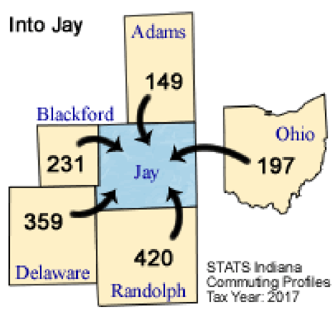


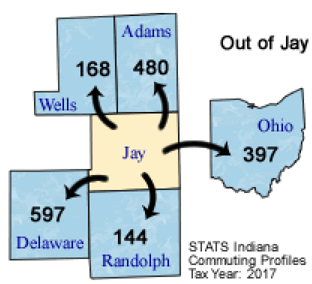


Source: STATS Indiana: http://www.stats.indiana.edu/dms4/commuting.asp
Note: The Indiana Research Business Center, Indiana University, commuting maps are based on the state tax returns filing. Not all people file taxes in a given year. These maps were used in the report to show the commuting patterns transparently.

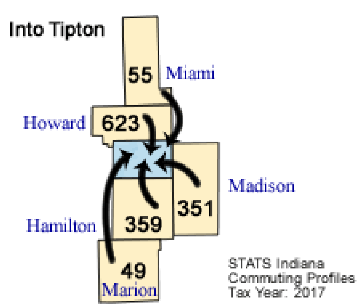
Figure 6. Group 2 County Commuting Profiles, 2017

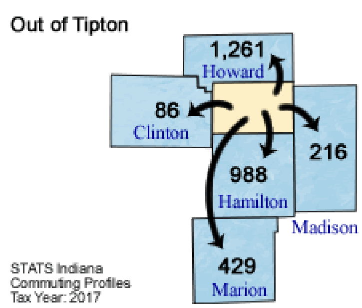
Jay County



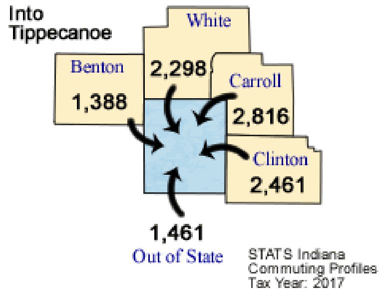


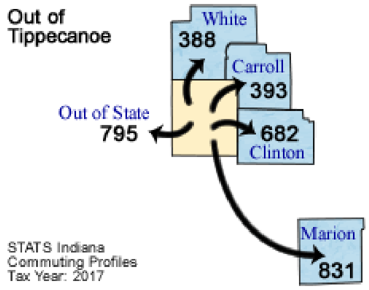
Tipton County



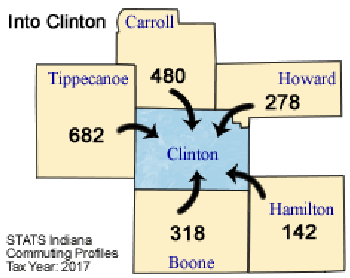


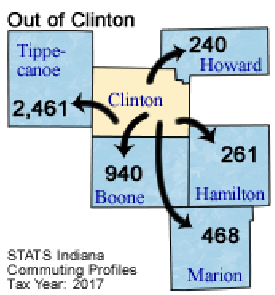
Tippecanoe County



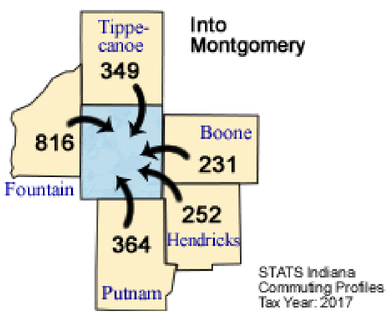


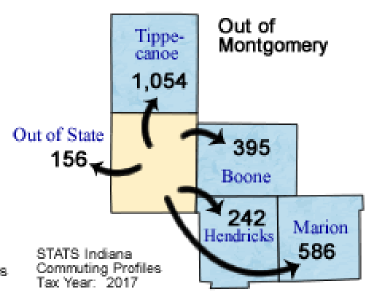
Clinton County





Montgomery County





Source: STATS Indiana: http://www.stats.indiana.edu/dms4/commuting.asp

III.d. Flow of Earnings

A net positive inflow of earnings[77] is reflective of counties that export labor to neighboring counties. Table 14 compares the county flow of earnings. This represents eight of the nine counties. A Group 2 county (Tippecanoe) is the only county that has a negative net flow of earnings – meaning that non-residents working inside the county earn more than residents working outside the county.

Table 14. Flow of Earnings – County Comparisons, 2018

	Name of County	The inflow of Earnings ($ in Thousands)	The outflow of Earnings ($ in Thousands)	Net Flows of Earnings ($ in Thousands)
Group 1	Benton	105,676	41,258	64,418
	Madison	1,341,917	604,569	679,651
	Randolph	235,977	77,481	158,496
	White	277,436	149,511	127,925
Group 2	Clinton	382,756	204,071	178,685
	Jay	133,233	95,960	37,273
	Montgomery	256,024	216,526	39,498
	Tippecanoe	447,344	1,202,577	-756,233
	Tipton	209,134	138,177	70,957

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

The inflow of earnings[78] is 100% higher than the outflow of earnings[79] in three of the four Group 1 counties (Benton, Madison, Randolph) and none of Group 2 counties.

IV. Quality of Life

IV.a. Housing Units

This section analyzes the age of housing units in each county as a percentage of total housing units. Table 15 compares county housing units. Overall, these nine counties represent a broader rural housing trend– a majority of housing units tend to be historic.

[77] **Net Flow of Earnings:** A positive net flow of earnings indicates that residents working outside the county earn more money than non-residents working in the county.
[78] **Inflow of Earnings:** Means the money earned by residents who work outside of the county.
[79] **Outflow of Earnings:** Represents the money earned at jobs within the county by people living outside the county.

Table 15. Housing Units – County Comparisons

	Group 1				Group 2				
Name of County	**Benton**	**Madison**	**Randolph**	**White**	**Clinton**	**Jay**	**Montgomery**	**Tippecanoe**	**Tipton**
Number of Housing Units in 2018[80]	3,921	59,071	11,698	13,095	13,321	9,248	16,638	75,430	6,999
Housing Age (%)[81]									
2014 or Later	0.1	0.4	0.3	0.3	0.2	0.4	0.2	1.0	0.1
2010-2013	1.1	1.0	0.2	1.9	0.7	0.7	1.2	4.2	0.4
2000-2009	5.7	8.3	5.1	10.4	5.9	7.3	10.2	15.6	7.7
1990-1999	5.5	9.1	7.8	11.3	12.7	9.9	10.6	17.0	10.3
1980-1989	6.1	7.2	7.6	9.2	6.5	8.3	9.5	10.9	9.9
1970-1979	12.2	14.7	12.6	18.1	12.1	13.4	13.1	13.8	12.8
1960-1969	11.8	16.1	10.0	10.9	7.6	8.5	11.7	11.8	9.8
1950-1959	11.3	16.0	10.2	9.8	12.2	9.5	9.9	8.6	6.5
1940-1949	5.7	6.3	7.9	7.9	7.0	7.2	3.9	12.2	7.4
1930-1939	40.5	21.0	39.3	20.2	35.2	34.8	29.6	9.9	35.1

Source: Purdue University Data Snapshots: cdext.purdue.edu/snapshots/county

Four of the nine counties (Benton, Randolph, Clinton, and Jay) have greater than 60% of housing units built before 1970. Seven of the nine counties (Benton, Madison, Randolph, Clinton, Jay, Montgomery, and Tipton) have twice as many housing units built before 1940 than after 2000. All nine counties have greater than 45% of housing units built between 1950-2000.

Only two of the nine counties (Tippecanoe and Randolph) have a majority of housing units that are younger than 50 years old. A majority of the counties (Benton, Madison, Randolph, Clinton, Jay, and Tipton) have fewer than 10% of housing units built after the year 2000. Tippecanoe county is the only county with more than 5% of housing units built after the year 2010. Four of the five Group 2 counties (Jay, Montgomery, Tippecanoe, and Tipton) have more than 8% of housing units built after the year 2000. One-half of Group 1 counties (Madison and White) have more than 8% of housing units built after the year 2000.

[80] **Housing Unit:** A house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters, or if vacant, intended for occupancy as separate living quarters.
[81] **Housing Age:** The year the building was first constructed, not when it was remodeled, added to, or converted.

Conclusion

Group 1 that includes For Wind Energy Counties (Benton, White, Randolph, and Madison), is more dependent on agriculture, suffers from decreasing population in all counties between 2010-2018, and has less population density than Group 2. Counties in this group are more consistent in terms of educational attainment levels.

Group 1 counties have a higher relative labor participation rate and a higher relative inflow of earnings compared to Group 2. Also, Group 1 counties are net exporters of labor to neighboring counties.

Madison and Randolph counties have the lowest real median household income and per capita personal income, and the highest share of the total population in poverty. Building on the previous results, Madison and Randolph's counties show the lowest labor force participation rate in Group 1. Also, these two counties demonstrate the highest unemployment rate in all nine counties. Madison and Randolph's counties exhibit a high volume of earnings inflow as a big portion of the county's inhabitants work outside the county they live. This finding could explain a high share of transportation costs on incomes.

Group 2, including Against Wind Energy Counties (Tippecanoe, Clinton, Montgomery, Jay, and Tipton), is more manufacturing-oriented, with two counties experienced an increase in population during 2010-2018. Group 2 varies widely in educational attainment across each county.

Many of the same occupations are prevalent in both groups, but production occupations tend to be more popular amongst Group 2 counties. Group 2 counties have a higher real median household income while also having higher levels of poverty – notably when Tipton County is excluded from the group. Group 2 counties have a higher share of housing and transportation costs on total income.

Also, Group 2 counties have a higher relative percentage of residents that also work in the county and a lower relative percent of residents that leave the county for work. Tippecanoe County is a major importer of workers from some of Group 1 and Group 2 counties.

In general, the statistics for Group 2 counties are consistent, except Jay County. Jay County is the county with the lowest percentage of people with a bachelor's degree or higher. The dominant industry in this county is Manufacturing, with Production as a top occupation. A higher proportion of blue-collar professions can explain the lowest educational attainment in all nine counties. Jay County has the second-lowest labor force participation rate (after Tippecanoe County that hosts tens of thousand students that do not participate in the labor force) and the lowest real median household income in the Group 2 counties. Also, Jay County shows the highest share of transportation costs on the family income in all nine counties.

Many of the counties in both groups have a higher relative percentage of older housing units compared to newer housing units. The majority of housing units in all counties were built between 1950 and 2000. Group 2 counties have a relative percentage advantage in housing units built after the year 2000.

WIND ENERGY ATTITUDES IN BENTON, WHITE, JAY, RANDOLPH, TIPTON, MADISON, TIPPECANOE, CLINTON, AND MONTGOMERY COUNTIES

This chapter is aimed at examining the prevailing attitude in the counties, selected as case studies, towards current or future wind energy farms. Selected counties include White, Benton, Jay, Randolph, Tippecanoe, Clinton, and Montgomery County.

While advantages resulting from the wind energy industry provide compelling arguments for supporting wind power expansion and the number of wind farms in Indiana has increased steadily, many wind power projects have experienced community-level opposition in the proposed wind farm area.

Different public opinions related to the wind farm projects led us to divide counties selected as case sites into two groups:

Group 1 – For wind energy counties: Benton, White, Randolph, and Madison
Group 2 – Against wind energy counties: Tippecanoe, Clinton, Montgomery, Jay, and Tipton

I. Group 1 – For wind energy counties

I.a. Benton County

Benton County is home to the first wind farms in Indiana and among one of the largest single concentrated wind farms in the United States. By 2010, three wind farms (Benton County Wind

Farm, The Hoosier Wind Project, and Fowler Ridge Wind Farm), had begun operating in Benton County, comprising of 495 turbines altogether.[82] In 2019, there were four farms and nearly 600 turbines in the county.

Benton County Wind Farm is the first wind farm in Indiana. It began commercial operation in April 2008. At the time of its construction, it was Indiana's only commercial-scale wind farm. This farm was developed by Orion Energy Group, LLC, and has 87 model sl/sle Gen4GE 1.5 MW wind turbines.[83]

The Hoosier Wind Project represents the first wind energy facility developed and build by EDF Renewables in Indiana. The facility consists of 53 REpower 2 MW wind turbines and started to operate in 2009.[84]

Fowler Ridge Wind Farm is one of the largest onshore wind farms in the world. The plant is owned and operated jointly by BP Alternative Energy North America and Dominion Resources. *Phase 1 (Fowler I)* consists of 222 wind turbines. These turbines include 182 Vestas turbines of 1.65MW and 40 Clipper 2.5MW turbines. The project had begun in 2008 and was completed in 2009. Phase II (Fowler II) includes 133 GE SLE 1.5MW wind turbines. The construction had started in 2009 and finished in 2010.[85]

The Amazon Wind Farm (Fowler Ridge) is another wind energy project in Benton County. It was completed by Pattern Energy Group Inc. and reached commercial operation in December 2015. The facility consists of 65 Siemens 2.3 MW wind turbines.[86]

NIPSCO announced in February 2019 that they would develop a new wind farm project in Benton County. The *Jordan Creek Wind Project* will be constructed by NextEra Energy Resources, LLC, and be located in Benton and Warren counties. The project will include an estimated 160 wind turbines. NIPSCO will purchase the power directly from the Jordan Creek wind farm, which will operate and maintain the facilities. It is expected the project will start commercial operation by late 2020.[87]

Benton County has accepted the wind farms and use of wind energy and continues to develop this renewable energy source by planning new wind projects.

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[82] IU Environmental Resilience Institute: https://eri.iu.edu/erit/case-studies/benton-county-indiana-successfully-sites-wind-energy-protects-rural-roads-from-damage.html
[83] https://www.bentoncounty.in.gov/projects
[84] EDF renewables: https://www.edf-re.com/project/hoosier-wind/
[85] Power Technology: https://www.power-technology.com/projects/fowlerridgewindfarmi/
[86] North American WindPower: https://nawindpower.com/amazon-wind-farm-fowler-ridge-goes-online-in-indiana
[87] Wlfi.com: https://www.wlfi.com/content/news/Three-wind-farms-coming-to-northwest-Indiana-505229081.html

I.b. White County

White County has been supporting the expansion of wind energy. Since 2009, the county has been working with Texas-based EDP Renewables North America to install wind turbines at the *Meadow Lake Wind Farm*, a privately-owned wind farm in the county. Local government officials in White County worked with EDP Renewables to install wind turbines through a series of agreements.[88]

Meadow Lake Wind Farm is an 801.25-megawatt wind farm spreading over portions of White, Jasper, and Benton Counties and has six phases:

- Meadow Lake I Wind Farm (Phase I) became operational in October 2009 with 121 Vestas V82 1.65 MW turbines;
- Meadow Lake II (Phase II) Wind Farm consists of 66 Acciona AW-82 1.5 MW wind turbines;
- Meadow Lake III Wind Farm (Phase III) consists of 69 GE sle 1.5 MW wind turbines;
- Meadow Lake IV Wind Farm (Phase IV) consists of 47 Suzlon S88 2.1 MW wind turbines;
- Meadow Lake V Wind Farm (Phase V) consists of 50 Vestas V110 2 MW wind turbines;
- Meadow Lake VI Wind Farm (Phase VI) came fully online in 2019 and consists of 12 Vestas V110 2 MW wind turbines and 49 Vestas V136 3.6 MW wind turbines.

As of February 2020, Meadow Lake Wind Farm employed 414 wind turbines.[89]

In 2019, White County Commissioners and the Indiana Regulatory Commission allowed to EDP Renewables and Northern Indiana Public Service Co. (NIPSCO) to extend the Meadow Lake Wind Farm project. This extension is the Phase VII going ahead with 102-megawatt *Rosewater Wind Farm*, which will have 25 turbines. The Rosewater Wind Farm is expected to be completed by the end of 2020.[90]

In October 2019, it was declared that NIPSC and EDP Renewables would work together to build a 302-megawatt wind farm near the current Meadow Lake Wind Farm and be named *Indiana Crossroads*, which will have 80 wind turbines.[91]

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[88] IU Environmental Resilience Institute: https://eri.iu.edu/erit/case-studies/white-county-wind-energy.html
[89] Meadow Lake Wind Farm: https://meadowlakewindfarm.com/
[90] National Wind Watch: https://www.wind-watch.org/news/2019/10/30/white-county-selected-for-another-wind-farm/
[91] National Wind Watch: https://www.wind-watch.org/news/2019/10/30/white-county-selected-for-another-wind-farm/

As White County continues to grow its energy section, adding more wind turbines at Rosewater Wind Farm, the energy generation is planned to be 1,205 megawatts by 2021. It makes the county the second largest in wind energy development in the USA.[92]

I.c. Randolph County

Bluff Point Wind Energy Center is a wind generation plant with 57 2.1-megawatt GE turbines located in Jay and Randolph Counties. The project's construction was overseen by NextEra Resources that also own and manage the wind plan. The project began operation in October 2017.[93,94]

Headwaters I Wind Farm is located 70 miles east of Indianapolis along the Ohio border. The farm consists of 100 Vestas V110 2-megawatt wind turbines and is owned and operated by EDP Renewables North America. Headwaters I Wind Farm has been online since 2014. [95]

As officials of Randolph County endorse the expansion of all forms of renewable energy in the county, they also supported an extension of the existing Headwaters I Wind Farm. A new EDP *Headwaters II Wind Farm* is located southwestern Randolph County and will create 50 new wind turbines. The second stage will be online and generating power by September 2020.[96]

"The people of Randolph County and the local government officials there, economic development, all those people have been extremely welcoming," said Paul Cummings, the Project Manager of the Headwaters II Wind Farm. *"Landowners have been very easy to work with. We signed those 17,000 acres up in less than a year."*[97]

Farmer Bob Chalefant is leasing land to EDP. *"The wind is here. Why not use it if we can?"* Chalefant said. *"If we can use it for a benefit, why not?"*[98]

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[92] Herald Journal: http://www.newsbug.info/monticello_herald_journal/news/local/white-county-experiencing-growth-in-spite-of-indiana-beach-closure/article_191f322d-4d5a-5895-97a0-124221262bc5.html?fbclid=IwAR1KRQV8JqJgHxvqGjuLIgM-_0CP69AloOc0ihEdogdyqcWXr19o65mifDs
[93] Next Era Energy: http://www.nexteraenergyresources.com/what/pdf_redesign/Bluff_Point_Fact_Sheet_Dec17.pdf
[94] Daily Energy Insider: https://dailyenergyinsider.com/news/9685-bluff-point-wind-energy-center-commissioned-indiana/
[95] Headwaters Wind Farm: https://headwaterswindfarm.com/
[96] The News Gazette: http://www .winchesternewsgazette.com/news/new-wind-farm-to-be-built-in-southwestern-randolph-county/article_b158e720-1345-11e9-9278-ef02eaa1a4c8.html
[97] Inside Indiana Business: https://www.insideindianabusiness.com/story/39229862/facebook-likes-randolph-county-wind
[98] WishTV.com: https://www.wishtv.com/news/facebook-to-use-energy-of-wind-farm-being-built-in-indiana/#/registration/login?reload=1

I.d. Madison County

Madison County is also positive for wind energy projects. *Wildcat Wind Farm I* is located in two counties, 50% spreads in Madison County and 50% in Tipton County. The farm was built during 2012 and was commissioned in December 2012. It employs 125 GE Energy 1.6-100 wind turbines. Wildcat Wind Farm is owned by Enbridge/E.ON Climate Renewables and operated by E.ON Climate Renewables.[99]

II. Group 2 – Against wind energy counties

II.a. Jay County

Bluff Point Wind Energy Center is a wind generation plant with 57 2.1-megawatt GE turbines located in Jay and Randolph Counties. The project began operation in October 2017 and is owned and operated by a subsidiary of NextEra Energy Resources.[100,101]

Bitter Ridge Wind Farm is supposed to be a 52 wind turbines project developed by Colorado-based renewable energy developer Scout Clean Energy. It is anticipated to have the plant online by September 2020.[102]

However, Jay County residents want to stop the construction of Bitter Ridge Wind Farm, saying the wind farm will create financial and health problems.[103]

The Facebook group STOP Jay County Wind Farms have adamant views on stopping the development of the wind farms in the county (Figure 7). The group has around 573 followers. Many of them express a strongly negative attitude towards wind farms, which is supported by various documents.[104]

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[99] The Wind Power: https://www.thewindpower.net/windfarm_en_17996_wildcat-(indiana).php
[100] Next Era Energy: http://www.nexteraenergyresources.com/what/pdf_redesign/Bluff_Point_Fact_Sheet_Dec17.pdf
[101] Daily Energy Insider: https://dailyenergyinsider.com/news/9685-bluff-point-wind-energy-center-commissioned-indiana/
[102] Scout Clean Energy: http://www.scoutcleanenergy.com/scout-closes-210-million-construction-financing-for-indiana-wind-farm/
[103] WFFT: https://www.wfft.com/content/news/Jay-County-residents-want-to-stop-a-proposed-wind-farm--482240561.html
[104] Facebook group Stop Jay County Wind Farms: https://www.facebook.com/STOPJayCoWindFarms/

Figure 7. Wind Farm Opposition in Jay County

Source: Facebook group Stop Jay County Wind Farms: https://www.facebook.com/STOPJayCoWindFarms/

II.b. Tipton County

Tipton County shares the wind energy project *Wildcat Wind Farm I* with Madison County in the proportion of 50% each county. The farm was built during 2012 and was commissioned in December 2012. It employs 125 GE Energy 1.6-100 turbines. Wildcat Wind Farm is owned by Enbridge/E.ON Climate Renewables and operated by E.ON Climate Renewables.[105]

After the Wildcat Wind Farm, I had been built, developers showed interest in building turbines in both Howard and Tipton counties. Tipton County Plan Commission held meetings where residents argued for and against further wind development in the county. The outcome of those meetings was the amendment of wind ordinance to make it difficult, almost impossible, to develop a new wind energy project in the county.

As a result of the new stipulations in the ordinance, juwi Wind in 2014 dropped plans to develop *Prairie Breeze Wind Farm*, a project that would have included 94 wind turbines.

The ordinance includes the kinds of setbacks that wind developers have stayed away from the Tipton County and county officials have not received any new proposal from wind companies ever since.[106]

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[105] The Wind Power: https://www.thewindpower.net/windfarm_en_17996_wildcat-(indiana).php
[106] Kokomo Tribune: https://www.kokomotribune.com/news/howard-tipton-county-ordinances-keeping-wind-farms-at-bay/article_0d8cfed0-4abe-11e6-8f03-c392ffe4e16e.html

II.c. Tippecanoe County

Since 2019, commercial wind energy technology has been no longer allowed within Tippecanoe County as county commissioners unanimously approved a ban on large-scale wind farms. The county commissioners argued that the development of the wind energy sector would not be appropriate because of the high population density and potential for economic growth in the county. The ordinance still allows for individual landowners to build small turbines shorter than 140 feet in height on their property, but it shuts out commercial turbines, which can range from 300 feet to 600 feet for newer models.[107]

Tippecanoe County already made it difficult for large turbines, with restrictions set in 2007 that demanded setbacks of 750 feet from neighboring properties without turbines and at least 1,200 feet from dwellings.

The charge for the ban on taller turbines started in 2018 by a group of residents in southern Tippecanoe County, arguing that wind farms belonged in more rural counties. Residents also argued that *"large wind farms would drive down property values of those landowners who didn't sign leases from companies looking to come into Tippecanoe County. They framed their argument: This wasn't a vote against sustainable energy; it was an issue of proper placement of power plants."* At the time, *Invenergy*, a Chicago-based wind energy firm, had been working to sign land leases in the county.[108]

The situation in Tippecanoe County is even more complicated as the opinions related to the wind energy sector's development differ within the county. In June 2019, West Lafayette decided not to adopt a ban on large wind turbines that went into effect in Tippecanoe County. West Lafayette's officials argued that *"an ordinance against a renewable energy source is not the right call for the city, especially because it's home to Purdue University."*[109]

II.d. Clinton County

Clinton County enacted a moratorium on wind development in February 2017. In September 2019, the county's commissioners upheld the moratorium continuing its ban on wind farms.

The E.ON company was interested in developing a wind project in Clinton County and was proposing 35 to 52 turbines spread across a 39,000-acre area in the northeastern part of the county, four miles from Frankfort. To discuss the health, sound, environmental, and economic impact that

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[107] Indiana Public Radio: https://indianapublicradio.org/news/2019/05/tippecanoe-county-bans-wind-farms/
[108] National Wind Watch: https://www.wind-watch.org/news/2019/06/05/west-lafayette-calls-countys-wind-farm-ban-terrible-idea-for-home-of-purdue-opts-out/
[109] WBAA: https://www.wbaa.org/post/west-lafayette-city-council-rejects-county-wind-farm-ordinance#stream/0

their wind operation would bring the county, E.ON hosted the E.ON Clinton Wind Open House in Frankfort in September 2019.[110]

Figure 8. Wind Farm Opposition in Clinton County

Source: https://www.facebook.com/clintoncountywind/

County residents opposed to wind energy development prevailed at the meeting. Members of Responsible Harvest (Figure 8) argued, among other issues, that most of the landowners that had already signed up for the prospect of installing turbines on their property were not residents of the land being proposed for wind farm development. Also, the county's commissioners held the line on the moratorium.[111]

As E.ON cannot realize their project, they at least set up a website Clinton Wind where the company presents information about their project and wind energy in general.[112]

II.e. Montgomery County

In June 2019, Montgomery County adopted a restrictive industrial wind ordinance. Indiana Wind Watch mentions the following summary of protective wind ordinance in Montgomery County: 2,640 ft. setbacks or 5X height of the tower to property lines, whichever is greater, BZA may increase setbacks to 3,200 feet should it deem necessary, setback one mile from a town or school, 32 dBA, zero shadow flicker, not an essential service - wind turbines are not a utility, complete

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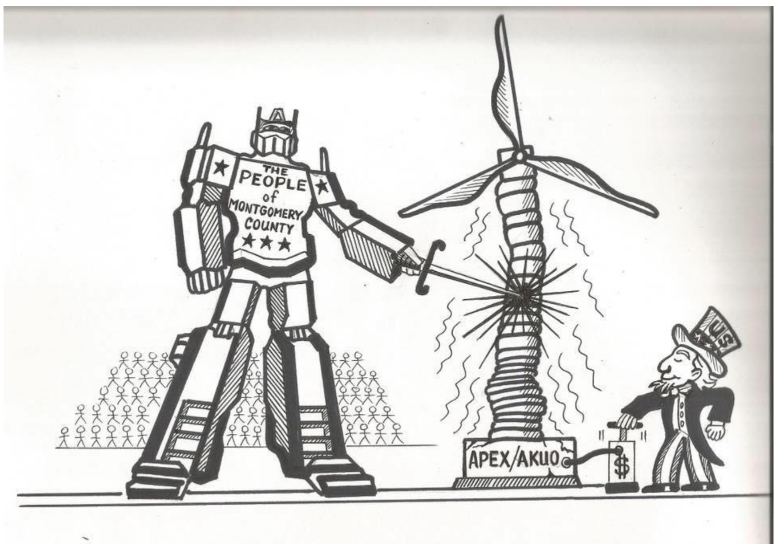
[110] National Wind Watch: https://www.wind-watch.org/news/2019/09/26/county-says-no-to-wind-farm/
[111] WBAA: https://www.wbaa.org/post/clinton-county-commissioners-keep-wind-farm-moratorium-place#stream/0
[112] Clinton Wind:http://clintonwind.com/

decommissioning - all concrete and rebar removed from the soil, property value guarantees for residents within 2 miles of a wind turbine, wind company must notify landowners within 5 miles of a wind turbine prior to pursuing land leases in the county, non-redacted safety manual required for permit application, pre and post-construction water well inspections, wind turbines limited to industrial districts.[113] Zoning was also adopted for the first time in the county's history.

The *Akuo Sugar Creek wind farm* is located in Madison and Sugar Creek Townships. The farm was supposed to have 104 turbines and become operational in 2014. It is developed, constructed, owned, and operated by European-based renewable energy company Akuo Energy. However, Akuo's website shows their project as 'under construction.'[114,115,116] Indeed, the construction has not been finished yet. Based on the recent ordinance, it is almost impossible to make the farm operational.

Figure 9. Wind Farm Opposition in Montgomery County



Source: No Wind Farm Montgomery County: https://www.nowindmoco.com/

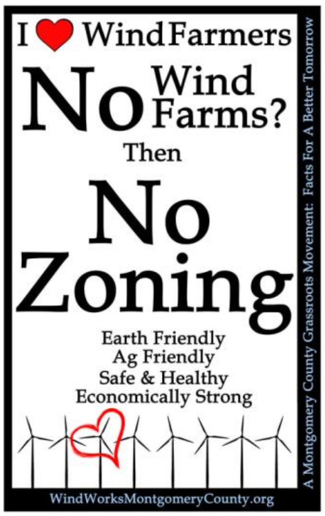
In February 2019, NIPSCO announced the first phase of plans to add a new wind farm in the county. *Roaming Bison wind project* developed by Apex Clean Energy will include 107 turbines

[113] Indiana Wind Watch: http://www.indianawindwatch.org/
[114] National Wind Watch: https://www.wind-watch.org/news/2017/11/06/akuos-sugar-creek-wind-farm-raises-concerns-for-reader/
[115] Akuo Energy: https://www.akuoenergy.com/en/wind
[116] Montgomery County: https://www.montgomerycounty.in.gov/egov/documents/1377607724_86037.pdf

and is expected to begin spinning by late 2020.[117] Apex Clean Energy had to change the project's plan to be in accordance with the new county ordinance. The new farm will be a much smaller and more defined project in the northwestern part of Montgomery County.[118] No Wind Farm Montgomery County is an active citizen group (Figure 9) actively fighting against wind activities.[119]

There are also many supporters of wind energy in Montgomery County. The website Winds Works Montgomery County (Figure 10) is dedicated to bringing facts about wind energy so that readers can make an informed decision. The NIPSCO company developed the Facebook page Roaming Bison Wind also focused on providing information about wind energy.[120]

Figure 10. Wind Farm Support in Montgomery County



Source: Wind Works Montgomery County: http://windworksmontgomerycounty.org/

[117] Inside Indiana Business: https://www.insideindianabusiness.com/story/39891019/nipsco-to-open-three-wind-farms
[118] Roaming Bison Wind: https://www.roamingbisonwind.com/about_roaming_bison
[119] Indiana Wind Watch: http://www.indianawindwatch.org/
[120] Source: Facebook: https://www.facebook.com/RoamingBisonWind/

ON-LINE LISTENING SESSIONS

One of the opportunities that researchers, local leaders, and residents are offered is finding a coherent way to address the variety of assets and challenges facing their communities. An important consideration in finding out more about the situation in the wind energy sector in the selected counties was to ask community representatives. The themes and key issues that emerged from the online listening sessions could provide substantive information that is valuable to the understanding of wind energy perception in the selected counties.

The Purdue team planned to host up to six focus group meetings (two hours each) in Indiana in March and April 2020. We intended to conduct focus group meetings in the four case study counties: White County, Benton County, Jay County, and Randolph County. Given the COVID-19 pandemic, we transferred focus groups to the 90 minutes on-line listening sessions using WebEx.

We scheduled four listening sessions, but due to considerably fewer participants than we had expected, we conducted only two of them. The Purdue team addressed participants who have various connections to the local community and local wind energy farms, such as county commissioners, local economic development board members, county auditors, county commissioners, county surveyors, county assessors, city manager/mayors, plan commission members, superintendents, local Farm Bureau board members, and other local government officials.

A total of 35 invitations were extended with regular follow-ups, resulting in a total of 3 participants, two from White County and one from Benton County. Unfortunately, no one from Jay and Randolph counties showed interest in attending the online listening sessions.

The session discussions were recorded and transcribed. Key themes were identified from transcriptions. The study protocol and confidentiality statement were approved by the Institutional Review Board at Purdue University.

In general, participants were asked to share their thoughts on the following topics:

1. **Experiences with wind energy in their county**
    - How does wind energy fit into your community and economy?

- What opportunities and challenges have surfaced since the introduction of wind energy in your community?
- In the future, what do you want wind energy to look like in your community, and what will it take to get there?

2. **The wind energy features of their community**
   - What benefits and positive impacts did wind energy bring to your community?
     - *Employment benefits*
     - *Tax revenues collected from the wind energy generation industry (property, sales, and income taxes, and the tax rate)*
     - *In-kind payments (one-time payments or recurring)*
   - Could you identify the negative impacts of wind turbines/farms on your community?
   - What would help to foster positive relationships (generate trust and reduce the suspicions) between the commercial wind energy company and local communities?
3. **Strengthening the wind energy development in their community**
   - What is the most important thing that you believe the county should do to support the development of wind energy?

Confidentiality allowed individuals to freely share their opinions and knowledge about the local wind energy environment along with factors they believe are critical to any planning and development of wind energy farms in their counties.

The online listening sessions had begun with a quick statement, so the participants were fully aware that their participation in this focus group was much appreciated and completely voluntary. "When conducting listening sessions, researchers cannot guarantee the confidentiality of the participant, as researchers cannot control what participants might share outside of the research environment. As you know, we are recording the listening sessions so we can conduct our qualitative analysis. Still, please know that the transcripts will not be shared; any quotes used in our research will not be attributable in any way, and our analysis will be aggregated across all of the listening sessions."

The sessions continued with a broad warm-up question. Once participants were warmed up, the Purdue team had introduced the project and began to ask more probing questions related to wind energy in their counties.

Thematic analysis was employed to identify seven community assets that emerged from the content of the listening sessions. Trying to capture the multi-dimensional nature of community development, online listening session participants identified the following key assets of wind energy in White County and Benton County: natural, cultural, human, social, political, financial, financial, and built capitals.

Natural Capital

Benton County (BC): Wind energy is just another way of farming. And I think it fits very well in our open spaces and agriculture community, and it has definitely helped our economy.

White County (WC): The bulk of our wind energy right now is in the southwest portion of our county; however, it is spreading.

BC: It has changed the landscape. Some people think it's wonderful and some people don't.

WC: And as people personally can see that it's not interfering with their TV reception, it's not noisy, all of their fears have gone away. That there aren't dead bats at the bottom of the wind turbines and dead birds and nobody's grandchild has been sucked up into the magnetic field of it.

WC: We cut out one acre per turbine with wind energy, the footprint doesn't take an entire acre obviously and the farmer can farm practically right up to the footprint. So no, I don't feel like it is a detriment to farming.

WC: Well so far, it [wind energy] has fit very well. We've got up to phase four. We didn't involve any small towns, cities, municipalities at all. It was basically townships with a lot of farm ground and a few businesses on it. So, it was pretty easy to fit the wind farm in that area and I'll constantly use the term wind farm. Wind farm works well in my area of the county as does farming. They're both doing the same thing. We're trying to create energy or food off of the product that's being generated, but whether it be wind farm or whether it be the farming, the two work well together.

Cultural Capital

BC: Benton County does have tours of the wind project or did, I don't know what they've done since the Corona and COVID-19 but it brought in some extra money too. They just charged a little bit and they did wind tours and they had buses of people coming in. And we had a retired schoolteacher that's very elderly, and he would take people around and give tours and educate people. And that worked really well to get the word out and see it up front and personal. They'd go right underneath the turbine and get out and learn about it.

Human Capital

BC: Very, very well-paying jobs with great benefits. That's what I said, it literally changed the lives of many of our people in our county.

BC: A lot of them are from Benton County, and now several have come from other locations as well. But I know several from Benton County and the surrounding counties that they come here to work.

WC: We're dealing with shrinking schools as far as students. This was a good way to, in my opinion and it's been one of my goals, is to try to keep our youth, our young people, in White County and have quality jobs available to them. So, I'm tying this into the economic development agreement, what it has done in turn to our community as far as its economy.

Social Capital

BC: [As far as challenges], it's just a few people in our county that maybe don't care for renewable energy and have just possibly said some negative things, but really not very much at all has been negative in Benton County from the wind.

WC: And since our wind farms went in the southwest, there were a lot of concerns and a lot of negativity before they went in. After they went in, we never received a complaint. So I think our county as a whole is pretty positive as far as wind energy. You're always going to have a handful of people who aren't, but I'm not seeing huge challenges as far as the expansion.

BC: I believe that Indiana is taking a step in the right direction. And any other groups that are just trying to get the facts out to our residents. Because you can look up anything on the internet and find something negative or (silence). And I feel like a way to do that which we've never had it, for renewables or a source for these people to understand the good that it's done. And I think that's what we need is more of this. So that the public knows they only think it helps the landowner, and that is so wrong. They think that the person getting the turbine is the only one that is being helped in their county.

WC: We have a commissioner who's very much involved in this and very knowledgeable about it. And between he and I, we try to get the word out to people and we try to explain to them how beneficial it [wind energy] is. And of course, you're still going to have all the naysayers and all the people who find all this negative information online, they're just saying searching for it. And for the most part, it's not true. Like I said, in White County, we've not had a single complaint about wind farms since the wind farm went in. We had people who didn't want turbines on their property, they wanted nothing to do with it. They didn't want to look out their window and see them, they didn't want the TV interference, the noise, they didn't want any of it.

WC: They [commissioners] know how much revenue it brings into the county and how helpful it is for the county and they spread the word out there and that's really helpful. Yes, you're always going to have a handful of people who are against it, but you have to believe that your county officials can see the big picture and have the county's best interests at heart and that they will vote in a way that benefits the entire county.

WC: So far, we've had hardly any resistance to the wind farms and that has a lot to do to the area of the southwest corner of the county where there really isn't population. Now after having used all that area, they're starting to move into some areas that have more population. Maybe come closer to towns, and we have more people concerned about it. The internet is a great thing, and it's a bad thing as far as sometimes people trying to find facts.

WC: [challenges with wind energy] Very small, and I don't know how to politely say this, but generally the problems came down to money. People who got turbines and people who didn't get turbines on their land generally was the biggest issue. There you had hurt feelings, and people felt that they should've had. What I mean, "Had turbines," if you don't have a turbine on your ground, obviously you're not going to have a wind turbine payment.

Political Capital

WC: As an example, the year before last I think the state had a summer session, and there was a push to have the state regulate wind farms instead of having counties. Obviously from my history, you'll see that I'm in favor of home rule. Let the local people that this is affecting to make the decisions and not have decisions made at state level. Thankfully unless it's coming back up again, that died down.

WC: Again, I'll emphasize the companies and the landowners have to come to agreement. If the landowners don't want to sign up, then obviously the wind farm is not going to be there. We don't negotiate for them to be here or not to be here, or to make that decision. Our decision from the county, as I've said, is to have rules and guidelines that everybody must adhere to. Generally that's what their area plan is for, and we've got a real thick book and probably at some point in time, 10 years ago, most counties probably used ours as I present it to counties as a guideline.

WC: Another thing that the county does, what we do in most counties, is **decommissioning agreements**. So if the company ever went bankrupt and walked away from the turbines, anything like that happen, we hold the money that is estimated that it will take to remove all the towers and to remove all the cement four feet underground. The county, instead of each individual landowner holding that money from the companies, the county holds that as a decommissioning agreement and has that available if the worst-case scenario would ever happen.

WC: We've had **road agreements** with the wind farm companies that helps with our roads. It's been a huge boost to us. With being as rural as we are, I don't know what state or county we'd be in right now if it weren't for wind farm, financially.

WC: The one thing that we're experienced with is the **Good Neighbor Agreement**, and that has really helped. If you're familiar with what that is, is if you have a house, for these people who have small, maybe three, or four, or five acre plots with a house on it and are in the wind farm boundary, there's a Good Neighbor Agreement that pays that landowner, the house owner, X amount of dollars per year. Then that also includes so much an acre for, say, if you farm ground and you don't have a turbine. Well, I could say that they're trying to be a good neighbor, so everybody is seeing some kind of revenue from the farms.

WC: What has happened here that we're getting closer to towns, they are focusing more on making the towns feel more a part of the project than not. Our ordinances stipulate that they've going to be so far back from the town boundaries, so that doesn't allow them to enjoy any of the benefits that come in with having wind farms on your property, but this particular company has already started to make **adjustments of the Good Neighbor Agreement** in that direction. Even though the towns won't have turbines, they are part of the community and trying to make them feel more a part of the wind project instead of we just look at them and that's all we do. So, it's being done. It's a major change in their philosophy, but again, that hasn't been an issue until the last couple of years.

WC: **Economic development agreement.** It's county and it's government. It's public material. Basically, right now, we're at about $12 million dollars through economic development agreements, and that doesn't include the current phase we're going through right now. These agreements are reached with these different companies in different ways. Different counties want a different agreement. We come to an agreement and the X amount of dollars was issued equally through four different payments or three different payments, or other counties I've heard that run into this didn't want to receive anything for 10 years. There's incentives there for doing it different ways, so.

Financial Capital

WC: There are a couple of townships, those Southwest townships, the wind energy pays almost half of the property taxes that are collected in those townships. So, with being a very rural county, as the agriculture rate, assessed value rate continues to lower, the wind energy has contributed so much to keeping our tax dollars steady and keeping us growing. In '18 pay '19, we collected over $2 million in wind energy property taxes. And since 2009, we've had over $6 million distributed between townships and schools in the county in economic development agreements.

WC: Yeah, we collected our first wind energy taxes in '11 pay '12. And at that time, we were at almost $275,000 for the year. And like I said in '18 pay '19, we're up at 2.2 million for the year. Now that's obviously an increase in the number of turbines but it's also with the abatements falling off. So, we do have 10-year abatements on each phase. So, the percentage ... we have six taxing districts that the turbines are in. And in five of those six districts ... the one township, the turbines pay 27% of the taxes, in another 45%, 51%, and the other one 40%. So, it's making a huge impact on the taxes because it then lowers everybody else's tax. The tax money comes from White County and then we distribute the tax money. So, the county gets a portion of it but those taxing districts that have the turbines in them, are going to get the bulk of the tax money.

WC: Since 2009, since this started in our six phases, we've collected $12 and a half million in economic development agreements. And $6.2 ... the county opted to keep half of that, and the other $6.2 has gone to the taxing units that are affected by the wind farms. So, the schools have benefited tremendously. We have two schools in those areas and the one school has received 2.6 million and the other one 3.3 million over the years just in the economic development agreements. And the taxpayers themselves, I know as of a couple years ago, the wind farm had paid out ... within a 10-year period, the wind farm had paid out over $30 million to landowners.

WC: I know different wind companies pay differently, but this company, if it's a 1.65 megawatt there's a fee times that 1.65 megawatt, and that's what you receive as a landowner in quarterly payments. If you've got a 2.65 turbine or a 3.65 turbine, you're going to receive a lot more money than we do with the early turbines.

BC: Depending on what company, there is additional money for production. Sometimes there is and sometimes there is not.

WC: I don't know how White County would have stayed afloat without this economic development money.

BC: I don't know that we would have been afloat without the income that the county is receiving from the wind projects.

WC: We're very fortunate in White County because we have a wind farm, we have tourism and we have a landfill. And without those three things…. We're able to have this money to develop our Commerce Park from for more industry and to help fix our roads and it's been tremendous.

WC: We have used some of the money. See, 10 years ago it wasn't common for kids to have iPads or laptops in school, but a couple of the school systems in that wind farm area, we gave the school system the money to where they could purchase those type of things.

WC: See, we're 10 years down the road but each year our property tax gets higher and higher because of the four or five phases in front of us. See, phase one has already lost its abatement, so it's at its peak taxing level. Then see, the arm that they constructed two years ago is all well. It's 80% right now going on 70%, so that number continually will increase, even if we don't have additional turbines.

WC: We've used our economic development money from the wind farms to start two businesses. They're both food-oriented businesses. They wouldn't have located there if we hadn't used the money to develop the infrastructure and actually build a SPEC building that we sold to the first one. The first business by the end of August will have invested $30 million dollars in their business. Then the next one by the fall of next year will have about another $30 million dollars invested. Each plant would have about 60 employees a piece. Not big on employees' numbers, but good quality companies that moved in the community that would not have been here otherwise.

Built Capital

BC: Wind energy has helped us with our schools, our roads, our basically businesses and we've had a lot of new construction in our county.

BC: I have seen businesses grow because they started with the first project as far as helping out with hauling equipment or gravel, to help build the project and the contacts that they made from that, they're still using and being used by companies that they met through the construction of the first projects.

BC: I feel like we are at capacity or close with wind. We've been in almost every area that I feel like we can. 622, I believe turbines right now actively developing a new project that's being constructed right now in Benton and Warren counties.

BC: I don't believe we have any construction going on right now. But when we do, yes, we're inundated with the workers but then afterwards it all calms down.

WC: Right now, we have one maintenance facility and we have another one being built. The people who work there to my knowledge are all White County residents. So, the employment is benefiting White County. I don't know how many work there. I'm thinking it's like 10 to 15 people.

BC: I can speak that currently we have over 300 construction workers in Benton and Warren County and more are coming. They're building the 400-megawatt project right now. And every rental, every campground, every hotel in a large radius is being rented or occupied by construction workers. Their maintenance trucks are being serviced by a local person in the county, little service station. The wrecker companies are busy hauling parts if we need service and they said their business has boomed because of the wind in our county. It does change once the construction is over. Of course, we only have ... let's say, at each maintenance facility there might be 10 to 15 people.

WC: We have the benefit of having our roads, specific roads not every road, that are upgraded and in far better shape than they ever would have been if the wind farms hadn't come here.

WC: What we see today in the air that's already 10 years old I understand is 37% close to 40% less efficient than the ones they're putting up today. So in 10 years, the technology has changed.

WC: Then with the economic development money, we've created this infrastructure and these buildings that currently there's 60 jobs, and in a year there will be another 60 jobs.

WC: Technology is changing, it's getting better maybe. The infrastructure is here and so hopefully, it will stay here for many years. And any technology that changes and possibly could be new and better technology, they can hopefully still use the sections and towers that are here if that's not possible. And I know they're wanting to build taller, but it's still, like you say, occupying the same amount of space. And can you really tell from the ground if it's 100 feet taller or not? Probably not.

Summary of the listening sessions

The participants in the listening sessions expressed a wide range of interest, knowledge, and experience on the topic of wind energy in White and Benton counties. Support for wind energy was universal among participants in both sessions. Unfortunately, no one from Jay and Randolph counties showed interest in attending the online listening sessions. We can only presume that different opinions of local government and the public regarding the acceptance of the wind projects led to the unwillingness to participate in the sessions. As a result, we received only a single view from the counties that support the development of the wind energy sector.

Natural capital. In general, participants agreed that wind energy fits well into the landscape, although they know some people do not consider wind turbines as a good fit as it changes the landscape. Also, participants do not feel wind farms to be a detriment to farming.

Cultural Capital. Listening session participants referred to wind turbines tours as a good practice for tourism development.

Human Capital. Wind farms provide very well-paid jobs and help schools to buy supplies and shrink classes.

Social Capital. When asked about their experience in public opinion, the participants pointed out great support for wind energy development. However, there had been a lot of concerns and negativity before the wind farms went in. Some people believed that only landowners and people who had turbines on their ground benefited from the wind farms. County commissioners and other officials and wind supporters tried to explain to the public how beneficial wind energy was.

Political capital. There is a number of documents and agreements that secure benefits from the wind farms and try to make concerned people feel more a part of the wind projects. These documents include Decommissioning Agreements, Road Agreements, Good Neighbor Agreement, Adjustments of the Good Neighbor Agreement, Economic Development Agreement.

Financial Capital. All participants agreed on the importance of income that counties are receiving from the wind projects through property taxes and various agreements. They have money to develop commerce park, fix roads, invest in businesses and schools, and make new constructions.

Built capital. Money from the Economic Development Agreement helps to invest in and create an infrastructure that leads to the multiplier effect. Each new construction employs hundreds of construction and other workers that increase demand for services, accommodation, and food. It changes once the construction is over, but still, each maintenance facility needs workers. Also, both counties and their communities are willing and able to accept any more wind projects that would develop there.

ONLINE KEY INFORMANT SURVEY

The Purdue team planned to use the face-to-face approach in the form of key informant interviews that would complement and inform the focus groups (transferred to the virtual platform as online listening sessions). Qualitative interviewing is particularly useful to study complicated personal and business relationships as well as to identify dynamic processes and events (Rubin and Rubin, 1995). Thus, this approach is appropriate to an explorative study of socioeconomic conditions that have occurred since the wind farms were (or were not) installed and made operational.

Given the COVID-19 pandemic, we had to switch the key informant interviews to the **on-line survey** using Qualtrics. The survey included mostly close-ended questions to collect quantitative data (Appendix 1). We distributed the survey to people in White, Benton, Jay, and Randolph counties.

The survey was conducted using a list frame developed by Purdue team in collaboration with the ICAE and involved a total of 35 participants in White, Benton, Jay, Randolph counties who have various connections to the local community and local wind energy farms, such as county commissioners, local economic development board members, county auditors, county commissioners, county surveyors, county assessors, city manager/mayors, plan commission members, superintendents, local Farm Bureau board members, and other local government officials. The survey was posted online and distributed by email.

For this study, 6 completed surveys were collected from the following respondents: county commissioner, county surveyor, county assessor, superintendent, mayor, and representative of energy provider. Again, the respondents came from White County (5 respondents) and Benton County (1 respondent). We have not received any response from participants in Jay County and Randolph County. Respondents did not know answers to all questions but answered questions related to their professional knowledge and expertise.

Payments to local governments and citizenry

We began our survey with the questions related to the types of taxes and non-tax payments collected from the wind energy generation industry. The majority of respondents listed both property and income taxes that are collected from wind farms. One respondent said that they did not have wind energy sources in the North White School Corporation.

Regarding non-tax payments, we got one answer on the county and taxing units to date at the amount of $12,000,000 that was one-time payment.

White County employed "economic development" payments or, in other words, any infrastructure damage, recovery, or upgrade fees from the wind farm company.

Also, one respondent informed about a 10-year tax abatement that the wind farm obtained from the local/county government.

We also included an open-ended question focused on any aspects of the industry's presence, specifically on the size of the industry's payments to local government and citizenry. One respondent replied, *"The rural electric cooperatives serve much of the area where the wind is expanding. We do feel long term we will see less residential load growth on the distribution system in the areas turbines are expanding."*

Wind Turbines

The survey revealed the total assessed value of all turbines in Benton County in 2015 was $482,236,500. There are also some kinds of zoning variances such as property line and house setbacks that must be followed in White County.

The setback requirements were determined through discussion with the landowners and resulted in two types of setbacks: one with a Good Neighbor Agreement and one without this Agreement. Both distances are identified in the wind farm ordinance.

Employment

One respondent stated that the wind industry currently employs about 60 full-time equivalent workers in White County but did not know what share of those employees were residents of the county.

Electrical transmission line upgrades

The purpose of this question was to find out if the county had any electrical transmission line upgrades due to wind farm requirements. Four respondents were positive and listed companies that paid for the infrastructure upgrade and the land easements. These companies are:

- AEP Renewables
- Northern Indiana Public Service Company (NIPSCO)
- Duke Energy Renewables
- Windfarms and/or transmission companies
- Utility companies who passed on the cost to those that use the energy

Easements

Four respondents identified kinds of easements that were needed and/or affected wind farm development:

- Electrical transmission line
- Utility easements
- Agricultural drainage easements

LOOKING FORWARD

Wind energy represents a huge capital investment in Indiana communities. Wind farms bring geographically diverse and long-lasting benefits, including millions of dollars in property tax revenues and annual lease payments for Indiana's farmers and well-paying manufacturing and construction jobs. But wind energy is associated with skepticism, suspicion, and opposition. We provide a couple of suggestions that might help in the effort to support the development of wind farms.

I. Awareness of key assets and challenges in counties supporting or declining wind farms that are related to the wind energy

- The statistical analysis of studied counties revealed a set of characteristics that are common for the counties supporting the development of the wind energy industry (Benton, White, Randolph, and Madison counties). Those counties
    - are more dependent on agriculture;
    - suffer from decreasing population;
    - have lower population density;
    - are more consistent in terms of educational attainment levels (compared to the counties that are against the wind energy);
    - have a higher relative labor participation rate (compared to the counties that are against the wind energy);
    - have a higher relative inflow of earnings (compared to the counties that are against the wind energy);
    - are net exporters of labor to neighboring counties.
- The statistical analysis of studied counties uncovered a set of features that are common for the counties declining development of the wind energy industry (Tippecanoe, Clinton, Montgomery, Jay, and Tipton). Those counties
    - are more manufacturing-oriented;
    - two counties experienced an increase in population during 2010-2018;
    - vary widely in educational attainment across each county.

- Counties with wind energy benefit financially from the development of utility-scale farms. The industry pays local landowners – primarily those who host turbines on their land - but also others that are affected by its presence.
- In For Wind Counties the public receives positive messages about wind energy from local officials in Benton and White counties. That presumably explains why there are not partisan or ideological differences in support for wind energy. In Against Wind Counties, some of the local government members and community stakeholders oppose wind energy on the grounds of its cost or other characteristics. The attitudes toward wind power become more biased, which could cause support for wind power to decline.
- Wind energy expansion can be accepted differently. Some people can see the expansion as beneficial for county development and are positive. Others may express a lot of concerns and negativity.
- The new wind energy technologies are better and possibly can use the existing infrastructure in the counties that want to expand the wind energy sector.
- Road use agreements and decommissioning agreements are designed to offset other potential burdens the industry might place on the county.
- Wind energy has been changing the landscape that challenges many people.
- The constraint on the expansion can be due to a setback requirements, such as a small airport (because of radar at the airport, it is not allowed to build wind turbines in a certain radius around the airport) and different kinds of easements such as electrical transmission line, utility easements, and agricultural drainage easements.
- It is going to be harder to find areas for wind farm expansion that stay away from municipalities and large populations or areas with receptive communities.

II. Legislative instruments

There is a tension that exists between state and federal policies on the one hand, and, on the other hand, the policies of counties that have limited the growth of wind power investments.

While the federal and state policies encourage investments in the sector, the ultimate decision about whether to allow a given project rests with the county government where the project is to be located. This situation is the result of Indiana's granting of full siting and planning authority to local county governments.

A possible step to improve an effective legislative system to promote the implementation of wind energy is reclaiming siting and planning authority for large scale wind projects.

County governments that have allowed the development of utility-scale wind farms have benefitted financially from the decision. A number of documents and agreements secure benefits from the wind farms and offset potential burdens the industry might place on the county: Decommissioning Agreements, Road Agreements, Good Neighbor Agreement, Adjustments of the Good Neighbor Agreement, and Economic Development Agreement.

III. Technology development

Wind power is capital-intensive, and the purchase and installation of the turbines themselves represent a significant share of the total costs.

Utilization of the existing infrastructure – sections and towers - in the counties that want to expand the wind energy sector might decrease the total cost of generating wind-powered electricity.

Subsequent technological innovations, especially the development of taller turbines, have expanded the potential for other parts of Indiana to host utility-scale wind farms.

Also, it is important to identify appropriate public/private partnerships for the promotion of wind energy technology development and implementation.

IV. Awareness-raising capacity building and education

The following steps might help to raise public awareness of the benefits and opportunities of wind energy:

- Implement training and education programs with regard to wind energy.
- Awareness-raising and marketing campaigns aimed at all stakeholders.
- Development and dissemination of a "benefits case for wind energy."
- Improve communication and interaction between national, state, and county government institutions on wind energy policies.
- Receiving positive messages about wind energy from local officials and work closely with the community.

V. **Fostering positive relationships between the commercial wind energy company and local communities**

There are always individuals and groups within the local community who had benefited from the community fund and considered these benefits to be valuable. However, other community members can be suspicious of the developers from the earliest stages of the planning process.

Involving the public in planning and development process may help to reduce suspicions and skepticism, give members of the local community a sense of ownership over this aspect of the development, and can lead to positive outcomes.

County and community benefits provide an excellent illustration of how increasing participation in early decision-making processes may, in turn, increase local acceptance of wind farms.

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APPENDIX – ON-LINE KEY INFORMANT SURVEY

An Examination of the Community Level Dynamics Related to the Introduction of Wind Energy in Indiana

Survey Questions
(for Qualtrics Survey)

Purpose of the survey

Renewable energy, including wind energy, deserves closer examination given the inherent advantages and disadvantages and, most importantly, it's potential for becoming a critical element in Indiana's community development and energy portfolio.
While many studies have examined the benefits and costs associated with wind power introduction and expansion in a region, there is still not an overall consensus at the local, state, or national level. Our project tries to find a coherent way to address the variety of assets and challenges that the communities are facing in terms of wind energy farm's construction and use.
But we cannot achieve our goal without capturing the insights of people like you. That is why this survey is so important and why we appreciate your valuable input. Your participation and responses to this survey are voluntary and anonymous.

1. **What county do you work in?**
   White County
   Benton County
   Jay County
   Randolph County

2. **What is your title?**
   County economic developer
   Local economic development Board Member
   County auditor
   County commissioner
   County surveyor
   County assessor
   City manager/Mayor
   Plan Commission Member/BZA
   Superintendent
   Local Farm Bureau Board member

A local government official (Please specify)
Other (Please specify…………………………………………………..)

3. **What types of local taxes are collected from the wind energy generation industry?**
Property taxes
Income taxes
Property and Income taxes (if both)
Other (please specify/explain)
I do not know

4. **If you are able, please estimate non-tax payments made by the wind energy industry to local government in the county (such as payments to the school district, the fire department, etc.)? Please exclude payments of assessed taxes from these estimates.**
Please provide examples of such payments.

5. **Please specify if the in-kind payments are one-time payments or recurring.**
One-time payments
Recurring payments
Both one-time and recurring payments
I do not know.

6. **Did your county employ any " development impact" payments or, in other words, any infrastructure damage, recovery, or upgrade fees from the wind farm company?**
Yes
No
What is the cost incurred to the local government if the company did not pay the fees?
I do not know.

7. **Did the wind farm obtain any tax abatements from the local/county government?**
Yes
If yes, what was the length of the tax abatement period?
No
I do not know.

8. **What was the total assessed value of all turbines in the county in 2015?**
$
I do not know.

9. **What was the local property tax revenue generated in 2015 from those turbines?**
$
I do not know.

10. **Sometimes the owners of the land that is leased to turbine operators are not residents of the county. What share of the turbines in your county is located on land that is owned by residents of the county itself?**
    Share of turbines
    I do not know.

11. **What kinds of zoning variances were made to facilitate locating the wind turbines?**
    Kinds of zoning variances
    There was no zoning variance in the county.
    I do not know.

12. **How did you determine the setback requirements?**
    Setback requirements
    There are no determined setback requirements in the county.
    I do not know.

13. **Approximately how many people does the wind industry sector itself employ in your county in 2020?**
    Full-time employed in construction
    Half-time employed in construction
    Full-time employed in operations
    Half-time employed in operations
    Full-time employed in maintenance
    Half-time employed in maintenance
    Full-time employed total (if not possible to specify)
    Half-time employed total (if not possible to specify)
    I do not know.

14. **Approximately what share of employees employed directly by a wind energy sector are residents of the county**?
    Share of employees
    I do not know.

15. **Did your county have any electrical transmission line upgrades due to wind farm requirements?**
    Yes
    If yes, who paid for the infrastructure upgrade and the land easements?
    No
    I do not know.

16. **How much are landowners paid for wind turbines?**
    $
    I do not know.

17. **Are there any aspects of the industry's presence that you would like to expand upon? We are specifically interested in the size of the industry's payments to local governments and citizenry.**

18. **What kinds of easement were needed and/or affected wind farm development?**
    Electrical transmission line
    Utility easements
    Agricultural drainage easements
    Other types of easements (please specify)

Thank you for your interest in the Wind Energy project. Please provide your contact information below, and Purdue Extension will send you a list of times and a link where you may provide feedback in a listening session.
Name
Email address
Phone number