ILLINOIS DEPARTMENT OF LABOR

JB PRITZKER
GOVERNOR

JANE R. FLANAGAN
DIRECTOR

March 21, 2024

To: General Assembly Members and the Honorable Governor Pritzker

The Energy Transition Workforce Commission (Commission) was created within the Department of Commerce and Economic Opportunity through the Energy Community Reinvestment Act as part of Public Act 102-662, commonly referred to as the Climate and Equitable Jobs Act (CEJA). The Commission was charged with producing a report that analyzes the impact on the Illinois workforce of the clean energy transition, including recommendations to address these changes. The Commission, through the research and analysis from the University of Illinois – Springfield Center for State Policy and Leadership, is happy to submit this Phase II report to you.

On December 8, 2022 – the commission released a preliminary report (Phase I) that included:

- A basic model of statewide electricity demand to make projections of statewide job losses in the fossil fuel generating sector and job gains in the renewable energy generating sector;
- Examines demographic and job characteristics of the fossil fuel and renewable energy sectors; and
- Analyzes statewide emissions impacts from fossil fuel sector closings.

This is the second report (the Phase II report), which includes improvements on certain aspects of the Phase I report, including:

- Improved estimates of energy demand, considering electrification and energy demand conservation estimates, addressing the effects by regional transmission organization, and addressing off-peak as well as peak energy demand.
- Improved modeling of coal plant closures, considering coal exports, and including modeling of coal ash impoundments.
- Estimates of the effects of the rooftop solar industry.
- Implementation of a computable general equilibrium (CGE) model for statewide economic and labor market estimates, including supply chain effects and temporary construction jobs.
- Development of a model for wind and solar siting.
- Implementation of a CGE model for local effects of fossil-fuel plant closures and renewable generation effects.
- Improved modeling of air pollution effects using EPA's COBRA tool.
- Identification of developing industries in regions affected by fossil fuel plant closures.

Sincerely,

Jason Keller
Chair
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CLIMATE AND EQUITABLE JOBS ACT ECONOMIC AND WORKFORCE EFFECTS ANALYSIS – PHASE II

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EXECUTIVE SUMMARY

The University of Illinois – Springfield Center for State Policy and Leadership (UIS – CSPL) was engaged by the Department of Commerce and Economic Opportunity in the summer of 2022 to assist the Energy Transition Workforce Commission (ETWC) in assessing the economic and environmental effects of the transition to clean energy production envisioned under Public Act 102-0662. This is the second of two reports generated as part of this effort.

In this report we use state of the art electric demand and generation models as well as economic and environmental models to examine the effects of the transition to clean energy production. We find that electrical demand and generation under several reasonable models will increase dramatically during the period 2025-2040. We further find that under Public Act 102-0662, the use of renewable energy sources (wind and solar as well as associated battery storage) will increase dramatically (while they likely would have increased as renewable energy costs fell, the Act will likely lead to faster and greater adoption of renewable energy generating capacity). The need for increased renewable energy generation capacity will drive a strong increase in construction and supply chain employment as the capacity is built out and a somewhat smaller but still significant increase in employment during the operational phase of the new generation capacity. The gains in renewable energy and construction employment will far exceed losses in the fossil fuel generating industry. The model we use accounts for and projects some losses in other industries caused by employment loss in the fossil fuel generation industry and through slightly higher wages for construction and construction industry related labor due to the dramatic increase in construction employment due to the energy transition. However, once again the employment gains due to construction and operation of new renewable energy generating capacity will more than offset these losses.

We further find that there will be a distinct geographic pattern to employment (and related property tax) gains from the construction and operation of renewable energy electrical generation. Using a well-documented renewable energy siting model developed by a federally funded research institution, we find that broad swaths of the middle of the state will see much greater renewable energy siting and therefore economic benefits. We also find a distinct geographic pattern of environmental benefits and economic benefits related to the alleviation of pollution, using a model from the US Environmental Protection Agency. These will tend to accrue to areas where fossil fuel generation was sited, and in nearby areas. These areas tend to be where renewable energy generation is less likely to be sited. Therefore, all areas of the state will benefit significantly from the transition to renewable energy generation in one way or another.

INTRODUCTION

The University of Illinois – Springfield Center for State Policy and Leadership (UIS – CSPL) was engaged by the Department of Commerce and Economic Opportunity in the summer of 2022 to assist the Energy Transition Workforce Commission (ETWC) in assessing the economic and environmental effects of the transition to clean energy production envisioned under Public Act 102-0662 (the portion of the act requiring the study to assess the workforce and economic impacts of the Act's plant closure requirements is the Energy Community Reinvestment Act and the portion that mandates plant closures has been colloquially referred to as the Climate and Equitable Jobs Act – CEJA – this is what we will use to refer to the Act's provisions for plant closures hereafter). As part of this process, CSPL delivered to the ETWC a preliminary report from CSPL on the effects of the clean energy transition in January 2023. This first report (referred to as the Phase I report) was a broad overview of the economic effects of the energy transition and CEJA, without considering the effects of changes in energy production on the overall economy. This is the second report (the Phase II report), which includes improvements on certain aspects of the Phase I report, including:

- Improved estimates of energy demand, considering electrification and energy demand conservation estimates, addressing the effects by regional transmission organization, and addressing off-peak as well as peak energy demand.
- Improved modeling of coal plant closures, considering coal exports, and including modeling of coal ash impoundments.
- Estimates of the effects of the rooftop solar industry.
- Implementation of a computable general equilibrium (CGE) model for statewide economic and labor market estimates, including supply chain effects and temporary construction jobs.
- Development of a model for wind and solar siting.
- Implementation of a CGE model for local effects of fossil-fuel plant closures and renewable generation effects.
- Improved modeling of air pollution effects using EPA's COBRA tool.
- Identification of developing industries in regions affected by fossil fuel plant closures.

We note here that we were unable complete another item requested by the ETWC, namely documentation of the full-time/part-time split of workers affected by plant closures, estimates of layoffs versus other forms of separation from employment such as early retirements, and salary changes. Insufficient information existed on these items to generalize about them.

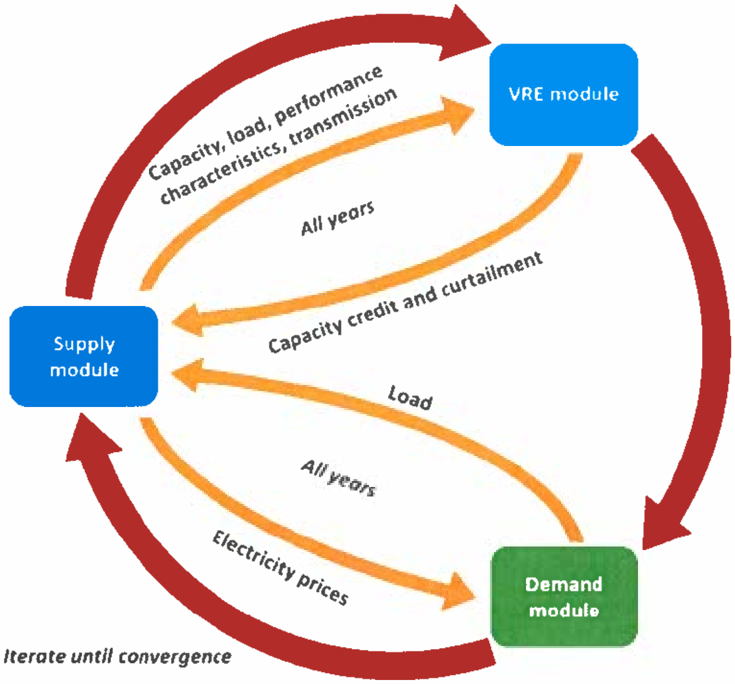
ENERGY DEMAND AND ELECTRICAL GENERATION CAPACITY MODEL

In the Phase I report, we used historical data from Illinois on electrical generation capacity and a forecasting model to estimate the future need for generation capacity. For the Phase II analysis, we use a widely accepted and well documented model of energy demand and supply, the Regional Energy Deployment System (ReEDS) published by the National Renewable Energy Laboratory (Ho, et.al., 2021). NREL economists and policy analysts developed ReEDS to provide a consistent and structured model for capacity planning within the power sector. It is a simulation model of the evolution of the generation and transmission of power throughout the nation from the present until 2050 (and in some cases later than that).

ReEDS is a "mathematical programming model" of electricity generation, transmission, and usage. What that means is that behavior of "actors" in the model – customers, generating companies, transmission companies – is explained mathematically. Each actor optimizes their decisions in response to changes in the system that affect them. In one sector, customers increase or decrease their usage of electricity based on prices for power, their economic and social activities, their income, and their preferences for consumption. So, if for example, the price of electricity increases, all things held equal their demand for electricity will be lower. And if their income increases, again all things held equal, their demand will rise (assuming the electricity consumption is what economists call a normal good, which in almost all studies of behavior has been shown to be the case).

There are three major modules representing distinct sectors in the model (Figure 1). The Supply Module includes all forms of traditional energy supply, including fossil fuel generating units, as well as "imported" energy for different regions (so for example, a major source of electricity in some northern states is hydroelectric generation in Canada). The Demand Module includes major sectors that consume energy, the household sector, industry, commercial and retail entities. Additionally, NREL includes a Variable Renewable Energy Module (VRE) which contains renewable energy sectors, including battery storage. The reason for modeling these as a different sector is that there are specific capabilities and performance characteristics that differ from traditional energy generators.

Figure 1. ReEDS Structure Assuming a Sliding Window (Perfect Foresight).



Source: NREL (2020).

The model is expressed in a set of mathematical equations, as noted earlier. Here we briefly describe the workings of the model without mathematical notation. The presentation will be necessarily basic, interested readers should consult NREL (2020) for more details. The model can start in any module, assuming that we start in the Supply Module on the left side of the graphic, generators use inputs of labor and capital to generate electricity in order to meet projected loads, charging a price based on the costs of their inputs (they set prices across time, which introduces another variable for them to consider as they plan capacity, namely what electricity demand will be not only now but in the future. The model assumes that they solve this problem with perfect foresight, thus the term "All Years" in the lower left quadrant of the model graphic, this means that the actors in the model adjust their short-term decisions to a projected long-term growth path of consumption and generation). They also must meet the load demand from customers over a certain time period within their balancing region. Balancing units take the generated electricity and allocate it to users to meet the load demand. ReEDS assumes 134 balancing areas in the United States, of which 4 are located in Illinois. In terms of time, ReEDS assumes that balance must be achieved over 17 periods which they call "time-slices." These consist of a season, time of day, and period (for example, time-slice H1 in the ReEDS model is summer months, overnight, from 10:00 PM to 6:00 AM). Appendix A contains a map of the ReEDS balancing areas and time-slices. Once again, further details can be found in the NREL documentation.

If there is not enough generation to meet load demand, imported generation capacity must come online or the use of VRE capacity becomes necessary (VRE Module). The choice is based on the relative cost and performance characteristics of each source, once again perfect foresight is assumed. Excess generation can be exported, although over long periods of time the mathematical model essentially ensures balance in the model. Customers (Demand Module) then observe the price of electricity and once again with perfect foresight into the future, they make load demand choices. The revised demand characteristics force changes to generating capacity and the use of VRE and imported electricity. The system is "iterative" in that it requires constant calibration and updating until equilibrium is reached. The equilibrium is where no actor has a better choice other than the current one.

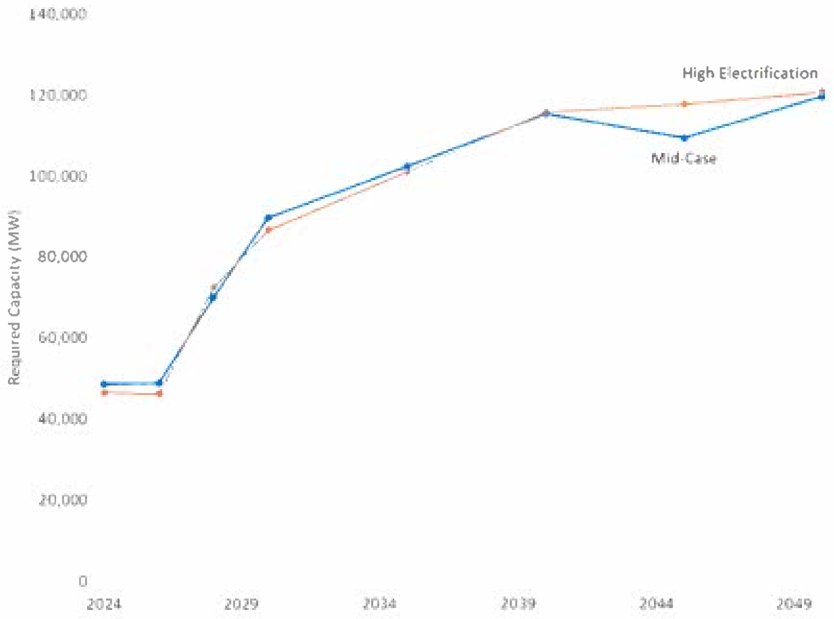
Costs and generating characteristics are based on historical data and projections. For the VRE sector, these characteristics are based on "resource classes," essentially characteristics generated by physical constraints such as average wind speed for wind technologies or average hours of sunlight for photovoltaic systems. Battery storage is modeled explicitly as it provides a "buffer" for solar and wind system availability, improving the ability of those resources to provide required generating capacity. Appendix A contains maps of resource classes for wind and utility-level photovoltaic systems. Projections of costs and generating characteristics for all types of generation are done separately by NREL and included in the model. A final note about the ReEDS model is that it includes a hidden "policy" module. The policy module contains information about current federal, state, and local policies that constrain decision-making. So, it contains updated information about how state policies limit certain generating choices. This is obviously an important characteristic given that Illinois has chosen a policy to phase out fossil fuel generation by 2045. The model essentially does that through limiting the choices that actors can make, and so is updated to include the most recent information on Tax Incentives, Renewable Energy Standards, and Clean Energy Standards.

Obviously, an important part of the model is the projected path of the cost of generation. We choose to use the assumptions made in the "Cambium" study sponsored by NREL (Gagnon, Cowiestoll, and Schwarz, 2023). This study, carried out by the Cambium consulting group, uses the most updated emissions, cost, and operational data characteristics within the ReEDS framework to generate estimates of overall capacity demand and share in each generation technology. They also model several different scenarios. For our purposes, we examine the "mid-case" estimates (essentially the average of all scenarios) and the "high electrification" estimates. Appendix B contains assumptions underlying the

Cambium scenarios. The Mid-Case scenario (we use the one without tax credit phaseout) assumes "central estimates for inputs such as technology costs, fuel prices, and demand growth. No nascent technologies. Electric sector policies as they existed in September 2022. IRA's PTC and ITC are assumed to not phase out." The High Electrification scenario in the report assumes "the same set of base assumptions as the first scenario, but where demand growth is assumed to average 1.99% from 2022 through 2050, representing higher rates of electrification than the base assumption. The emission threshold specified in IRA is not reached in this scenario, and consequentially, the PTC and ITC do not phase out, and there is no corresponding scenario with a phaseout." (Gagnon, Cowiestoll, and Schwarz, 2023, p. 8). Appendix C shows the key assumptions from the Mai, et.al. (2018) paper that forms the basis for the electrification estimates built into the Cambium study models.[1]

Figure 2 shows estimates for required capacity estimated by the ReEDS model for the entire state of Illinois under the Cambium Mid-Case and High Electrification estimates. The model indicates that the required capacity to balance loads over the balancing areas and time-slices in each year are remarkably similar up to 2040, when the High Electrification scenario begins to show consistently higher capacity needs in the state. We note that in each of these scenarios, the projected future demand for electricity generating capacity is higher than in the Phase I report. In that report, we used historical capacity demand to estimate future demand. The difference in part comes from better modeling in the NREL models, as well as assumptions of falling cost of renewable energy generation.

Figure 2. Projected Required Electrical Generation Capacity (MW), State of Illinois, 2024-2050.



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[1] A commissioner has highlighted that there exist a set of targets for renewable energy generation under the Illinois Power Agency Act, as modified by Public Act 102-0662. We acknowledge these targets but view them as policy goals or targets rather than a well-defined model.

One of the big distinctions in the scenarios is the split of generating technologies. Figure 3 on the next page shows the projected capacity needs for the Wind sector under both scenarios. Demand for wind generation rises faster under the High Electrification scenario compared to the Mid-Case. Figure 4 shows the projected capacity needs for the Utility Photovoltaic (Solar) sector. In this case, the High Electrification scenario projected need is always less than the Mid-Case. This difference seems to be driven by the relative availability of photovoltaic during certain time-slices. As evening and overnight loads are increased relatively more by electrification (when people are home and charging devices and vehicles), solar is offline. So, the need for solar under high electrification is lower while wind is somewhat higher. Once again, we note that the relative demand for wind and solar in the ReEDS model is greater than what was projected in the Phase I study. It appears that significantly more renewable energy capacity must be developed in the state to meet the demands of a growing population and economy, especially under the High Electrification scenario.

Figure 3. Projected Required Electrical Generation Capacity (MW), Onshore Wind Sector, 2024-2050.

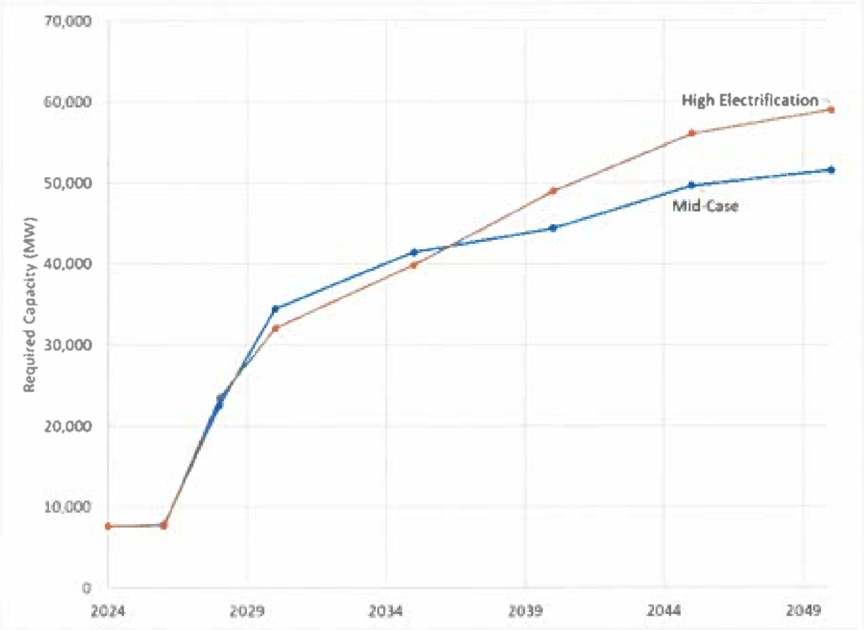
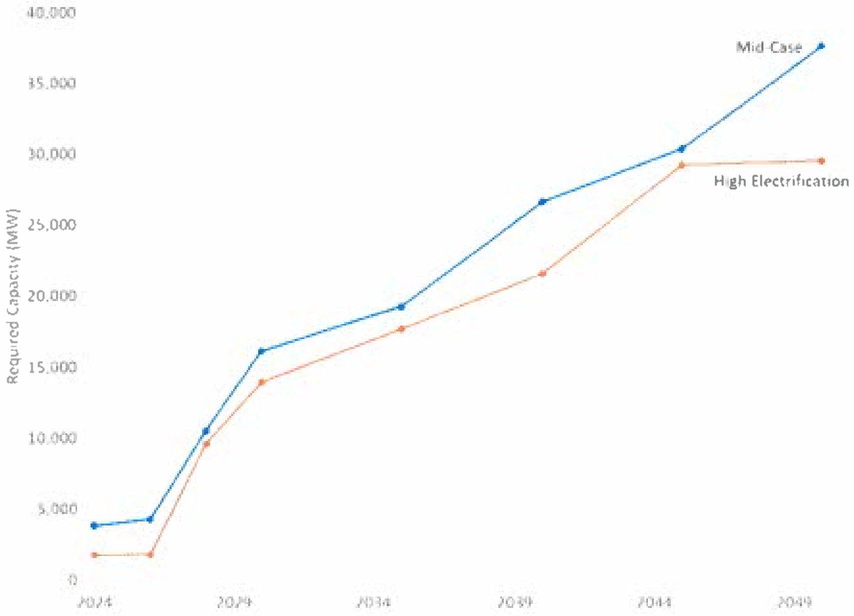
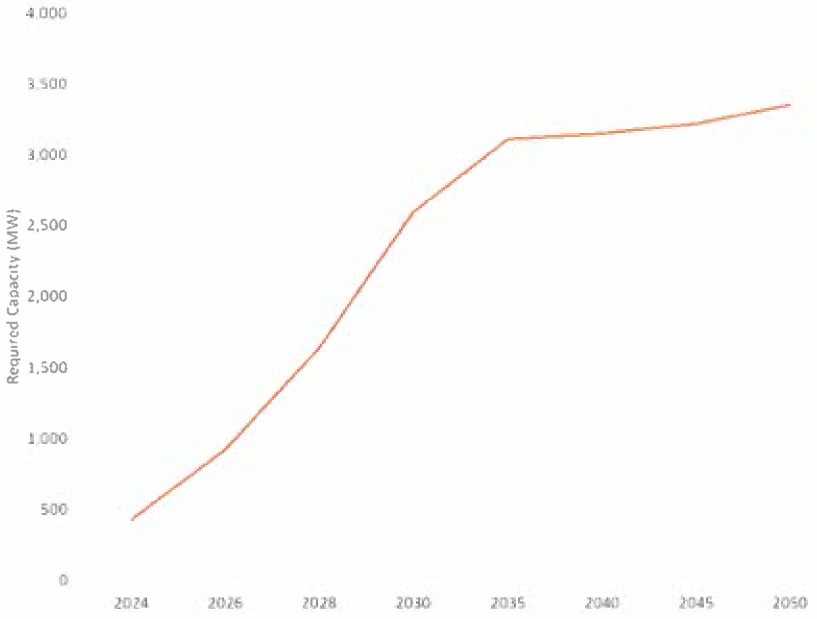


Figure 4. Projected Required Electrical Generation Capacity (MW), Utility-Level Photovoltaic Sector, 2024-2050.



Another benefit of using the ReEDS model is that it models explicitly the distributed photovoltaic sector. Cost and performance metrics differ between the utility-level solar and the distributed solar sector. The ReEDS model does not break out "rooftop solar" separately from small-scale commercial solar, but the data show that the distributed solar sector will grow significantly over the next quarter decade (Figure 5). One of the things that keeps distributed solar from growing more quickly is that utility-level solar is expected to see significant cost decreases. The relatively higher cost per kilowatt of distributed solar will hold back its development, absent the deployment of significant incentives.

Figure 5. Projected Required Electrical Generation Capacity (MW), Distributed Photovoltaic Sector, 2024-2050.

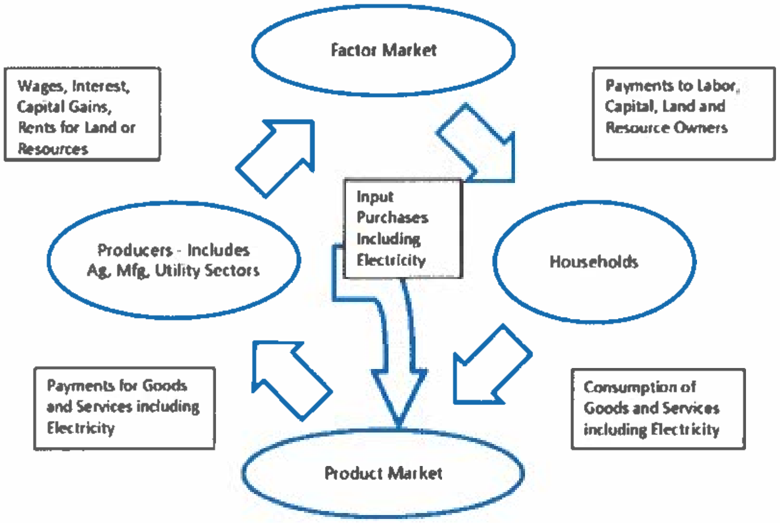


STATEWIDE EMPLOYMENT ESTIMATES

In the Phase I report, we used historical and projected ratios of employment to electricity generation capacity to estimate statewide employment changes. For Phase II, we created a computable general equilibrium model (CGE) to estimate employment changes. A computable general equilibrium model provides a mathematical representation of the economy. It captures the circular flow of income, goods, and services across different sectors and different markets in a national or regional economy. The notion is that resources flowing across sectors and through markets creates economic activity. By tracking the flows of resources, we can estimate changes in economic activity (including employment) throughout the economy caused by a change in some part of it. These changes may come from changes in employment brought on by a company moving in or out of the region, changes in income caused by some outside factor, or changes brought on by policy as in the case here.

The structure of a CGE model is shown in Figure 6. As with the ReEDS model, the model itself is estimated as a set of mathematical equations. But here we describe the working of the model without the mathematical notation (interested readers can consult, for example, Sue Wing (2009)). As with the ReEDS model, the model can start anywhere. Starting arbitrarily on the left, Producers enter the Factor Market to obtain inputs, including labor, capital, and other inputs such as electricity. They pay the factors according to how they increase productivity (technically according to their marginal product). The producers then create goods and services and sell them in product markets to household consumers (actually other businesses can be consumers through the sale of "intermediate goods," such as machines or product inputs). The households pay the businesses in the product market with income received for their labor in the factor markets. As with the ReEDS model, CGE models iterate until an equilibrium is reached and no sector can make better choices and all markets "clear" (where the quantity supplied in a market equals the quantity demanded).

Figure 6. Circular Flow of Income in a CGE Model.



The "social accounting matrix" (SAM) is at the heart of a CGE model. It is a mathematical matrix that describes the parameters of a model, such as the typical usage of inputs per unit of output in certain sectors. Using those parameters, changes to the system can be tracked throughout the system. So, for example, if the usage of wind generation increases, and we have parameters that say how much capital, labor, and other inputs go into wind generation, we can track the effects of a hypothetical change throughout the economy. We use a SAM generated from an economic input-output model known as IMPLAN©. The IMPLAN model is one of the earliest economic input-output models, developed in the 1970s as a way to track changes in the economy caused by changes in land management strategies. The model originated in the US Forest Service and was housed for years at the University of Minnesota but is now a private company (IMPLAN, 2023). We purchased access to the IMPLAN model and associated SAM with funds from this project. We then augmented the SAM with various equations capturing the cost of inputs and associated revenues to factors. This makes the SAM into a CGE.[2]

We estimated the CGE model assuming the changes in relative generating capacity from the ReEDS model High Electrification and Mid-Case scenarios. There are numerous results available from the model, including changes in income and wages. However, for our purposes the most important results are changes in Net Employment (Figure 7). The model must be calibrated to a base year, so we use 2024 as the base year.[3] All the values in the results presented here are relative to 2024. There are likely to be strong net employment gains throughout the state due to the transition to renewable energy. In the Mid-Case, employment rises by over 100,000 FTE jobs per year by 2028, levels off, then falls somewhat by 2035, but employment levels permanently remain approximately 60,000 jobs higher than in the base year. In the High Electrification scenario, employment rises by almost 120,000 FTE jobs by 2028, then falls to around 60,000 in 2035 but then begins to rise to nearly 100,000 more jobs in 2045 than there were in 2024.

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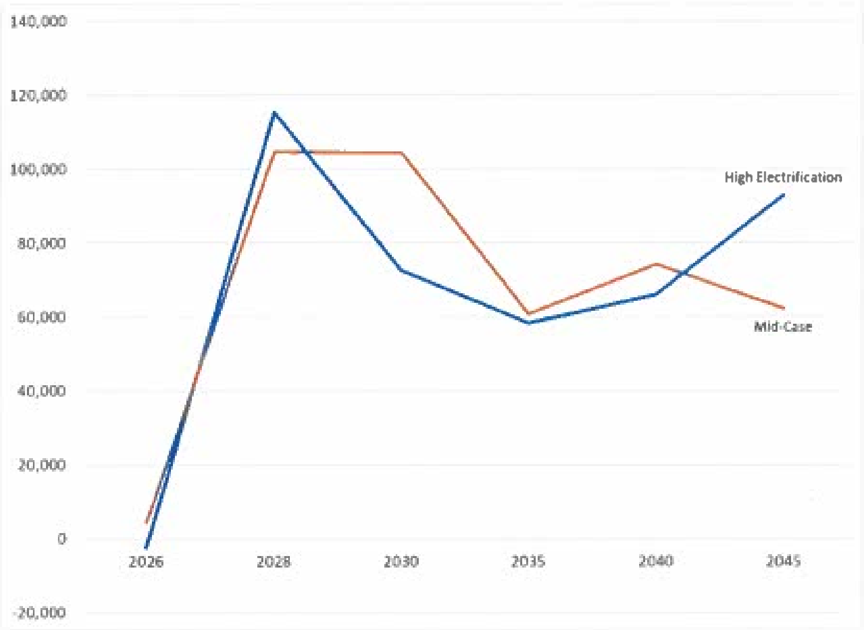
[2] A major limitation of economic input-output models using SAMs alone is that they do not allow for "price effects." So, while relatively small changes such as a single company entering or exiting a region may not have a large effect on relative wages or income, economy-wide changes like the ones modeled here are quite likely to change those things. Those changes will have follow-on (or "multiplier") changes throughout the economy. One note here is that we did an independent analysis using software development by NREL called the Jobs and Economic Development Impact (JEDI) software. The estimates are qualitatively similar, except for the small "take back" of jobs described below.

[3] The choice of base year is driven by the first year that the ReEDS model estimates are available.

Figure 7. Projected Change in Total Employment Relative to 2024, State of Illinois, 2026-2045.



The reason for the spike in the mid-to-late 2020s and after 2035 (primarily in the High Electrification scenario) is that gains in employment are strongest in the construction and supply chain sectors. A massive increase in generating and transmission infrastructure will be necessary to meet generating capacity needs, as indicated in Figures 3 and 4. That increase will be at its greatest during the period leading up to 2030 and after 2035. Therefore, construction jobs will be in high demand throughout the state as generating and transmission infrastructure is brought online. We implicitly assume that construction jobs will be temporary and last only part of a year (data indicates that typical solar and wind farm construction last less than 1 year) and therefore any labor hired for a construction project will be "disposable" after one year and can be used on future projects. Figure 8 shows the relative breakdown of jobs in the High Electrification Scenario, broken down into construction and operations phases of the renewable plants. Far more of the growth in jobs is due to jobs resulting from the construction of physical infrastructure than from jobs operating the new electrical generation capacity.[4]

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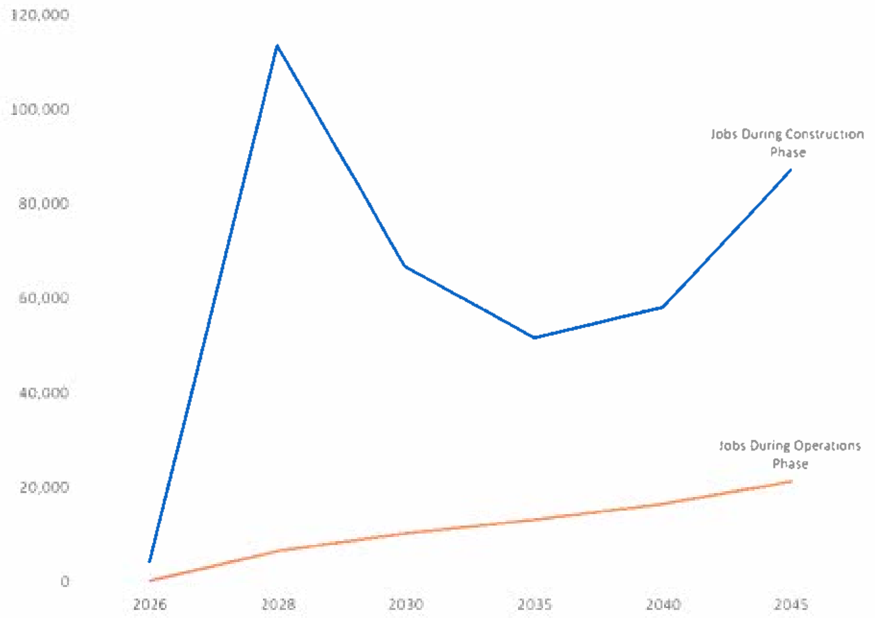
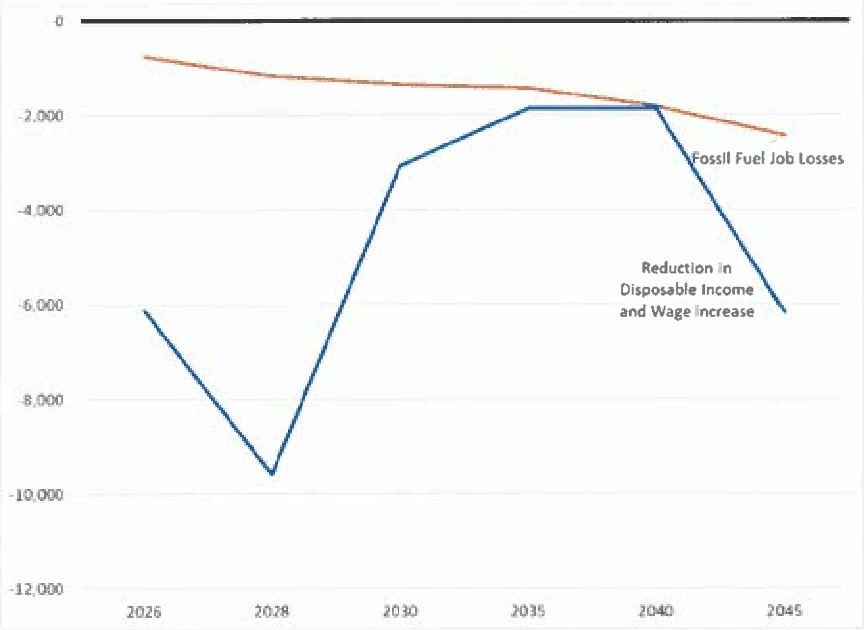
[4] Jobs during the construction phase of solar projects are roughly 50% on-site construction jobs, 10% construction-related services (such as engineering), 25% supply-chain jobs (such as construction of the solar modules), and 15% "induced impacts" from income accruing to those workers being spent in the economy. Jobs during the operation of solar projects are 70% on-site labor, with 15% each in supply chain jobs and induced impact. For wind projects, 15% of construction jobs are on-site, 55% are supply-chain, and 30% are induced. Wind project operations jobs are 20% on-site labor, with 40% supply-chain and induced impacts.

Figure 8. Projected Change in Total Employment Relative to 2024 by Phase of Projects, High Electrification Scenario, 2026-2045.



One might notice that the total jobs created suggested by Figure 8 is more than indicated in Figure 7. This is because there is a slight "take back" of jobs created by four economic effects. One is the displacement of jobs from the fossil fuels industry. This was modeled in the Phase I report. The second is a slight reduction in disposable income caused by multiplier effects from those losses, along with a slight reduction due to increased electricity prices. Third, the ReEDS model estimates that end user electricity prices will go up slightly through 2028 as fossil fuel generation is replaced by renewable generation and the price of renewable energy has not yet fallen due to increased supply. The increase is very small, and temporary, but that will reduce disposable household and business income that can be spent on other purchases. The final effect is an increase in the wages paid for low-moderate income workers in the early years of the period brought about by increased labor demand due to construction jobs. While that provides income for the workers, which is captured in the estimates of the effects of the transition, it also raises the cost of business and therefore reduces disposable income of businesses. Therefore, slightly fewer employees will be employed in other sectors. The combination of these effects is shown in Figure 9. Fossil fuel job losses are shown by the orange line, and they continue through the period. The losses due to changes in disposable income and increased wages are shown in blue. They peak in 2028 at about 9,500 then fall off as the big construction-driven wage changes subside. They still remain but are at a much lower level than at the peak. The second peak in 2045 is due to the model indicating another construction increase. This should also subside after 2045. The overall lesson from Figures 7 and 9 is that while there is some "take back" of jobs, the net job effect of the energy transition including the CEJA policy is overwhelmingly positive.

Figure 9. Projected Change in Employment in Other Sectors of the Economy Relative to 2024, High Electrification Scenario, 2026-2045.



RENEWABLE ENERGY SITING MODEL AND REGIONAL ECONOMIC EFFECTS

REGIONAL EFFECTS OF POWER PLANT CLOSURES

Public Act 102-0662 requires an analysis not only of the statewide economic effects of the energy transition but also the regional effects. In terms of fossil fuel job losses, those locations are known. In the Phase I report, we estimated job losses from fossil fuels plant closures and coal mines. We update the table here for a reduced estimate of coal mine closures. As part of our analysis, we examined IMPLAN data for the coal mining industry. More than 95% of coal mine output is exported from Illinois. Therefore, we have reduced our loss estimates to reflect this. Table 1 shows the results for fossil fuel related job losses.

Table 1. Estimated Job Losses from Fossil Fuels Electric Generation Plants and Coal Mines (2021-2045).

County	Coal Plant Losses	Gas Plant Losses	Coal Mine Losses	Total Job Losses
Bureau		1		1
Champaign		2		2
Christian	123			123
Clay		14		14
Cook		13		13
DuPage		34		34
Fayette		2		2
Ford		8		8
Franklin			16	16
Grundy		7		7

Hamilton			15	15
Jackson	2	10		12
Jasper	82			82
Kane		31		31
Kendall		39		39
Lake		19		19
Lawrence			17	17
Lee	100	41		141
Logan			8	8
Macon	68			68
Madison		18		18
Marion		8		8
Massac	121	9		130
Montgomery			9	9
Ogle		1		1
Peoria	73	1		74
Perry		12	16	28
Piatt		21		21
Randolph	138		9	147
Rock Island		19		19
Sangamon	50	4		54
Scott		5		5
Shelby		37		37
Tazewell	205			205
Vermilion		6		6
Washington	450		20	470
Will	331	160		491
Williamson	107		15	122
Winnebago		15		15
Total Job Losses	1850	537	125	2512

Note: For coal mine closures, we assume the percentage of job losses will follow the percentage of coal mine output that is consumed locally, as indicated by the IMPLAN database. Other assumptions are the same as in the Phase I report.

RENEWABLE ENERGY SITING AND REGIONAL EFFECTS OF RENEWABLE ENERGY DEVELOPMENT

To project the regional effects of the construction and operation of renewable energy facilities, we must model where those facilities will be cited. To do this, we rely on models that have been developed in academic literature. More than 100 peer-reviewed journal articles have examined the factors that go into solar and wind siting (for reviews of those articles, see Shao, et.al., 2020). Most of the models take the approach of reducing the number of potential locations in an area through "exclusion criteria" things like environmental challenges and policy restrictions, then calculating where the lowest cost of energy generation will be (based on factors such as available sunlight, wind speeds, and distance to transmission lines) to narrow into specific parcels or tracts of land. NREL (Mclaurin, et.al., 2019) has developed the Renewable Energy Potential Model (reV) that essentially replicates this approach. They start with the need for renewable energy generated by the ReEDS model in each balancing area, then apply exclusionary criteria. Then with the remaining properties they calculate "generation potential" figures that show the theoretical capacity for wind power given a set of assumptions. These indicate the most likely cites for wind and solar facilities. We use these models to assess likely wind and solar development.

Figure 10 shows the generation potential for Wind power throughout the state. The primary areas that have the most capacity for wind power development lie in two swaths from the northwest corner of the state southeast through Champaign, Vermilion, and Edgar Counties in the east-central part of the state, and a swath with slightly less capacity starting in Hancock, Adams, and Pike Counties along the Mississippi rivers southeast through Wayne County in the southeastern part of the state.

Figure 10. Wind Potential Capacity (in MWh), State of Illinois, 2030.

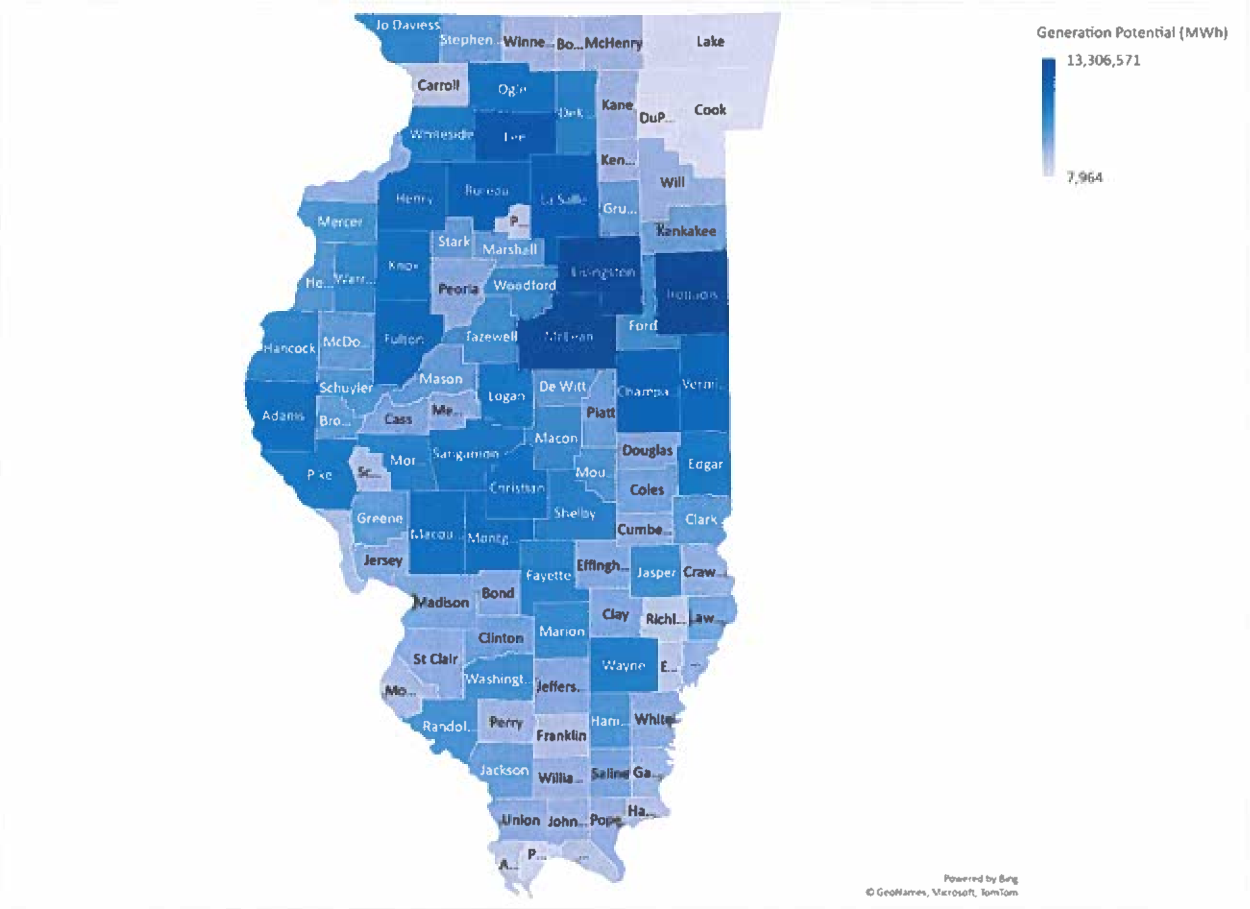
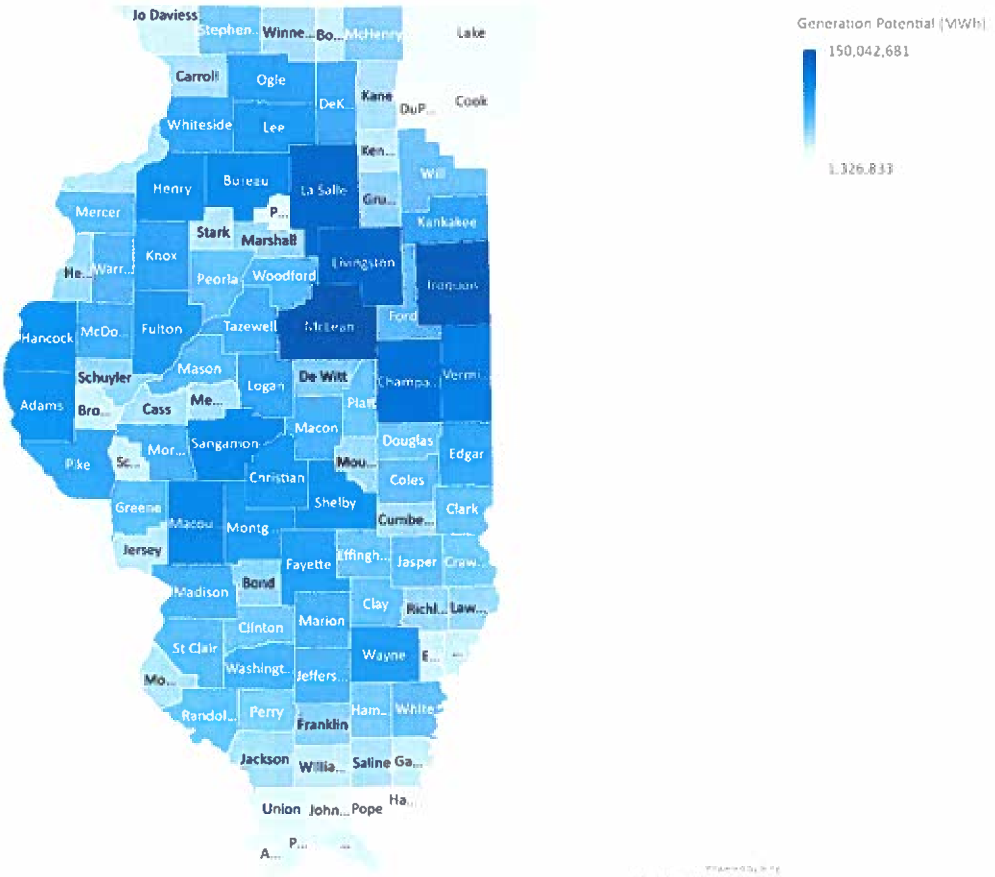


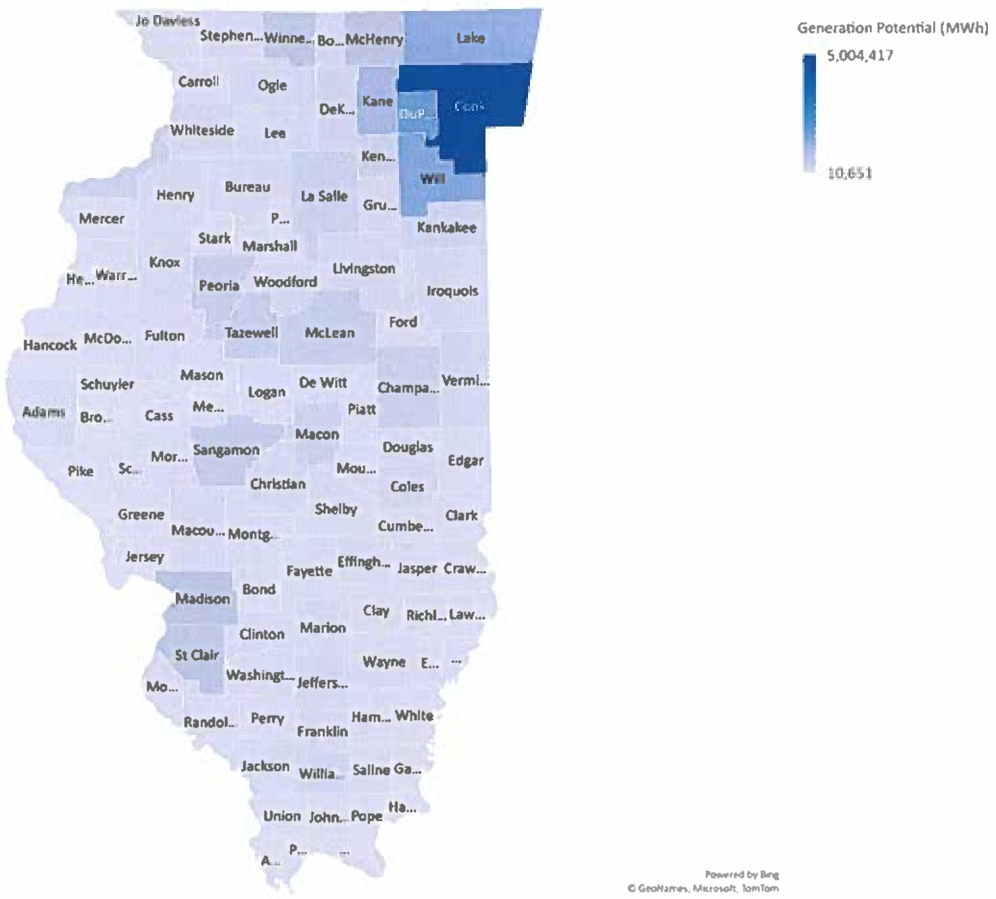
Figure 11 shows the generation potential for utility-level solar. The pattern is much the same as with wind power. However, the potential is much higher (~11x the potential for wind). Also, some northern counties are relatively less well-suited for utility-level solar development and some southern counties better suited.

Figure 11. Utility-Level Solar Potential Capacity (in MWh), State of Illinois, 2030.



Finally, Figure 12 shows the generation potential for residential solar. As can be expected, the primary concentrations of rooftop solar potential are in urban areas. Also, the overall capacity of residential solar is much smaller than either wind or utility-level solar (less than half of wind capacity).

Figure 12. Residential Solar Potential Capacity (in MWh), State of Illinois, 2030.



We then took the shares of the generation capacity for each county to the total for each balancing area and multiplied that by the total generating capacity estimates from the ReEDS data. This projects into the future the development of renewable energy in each county. We then used the economic model SAM data for each county to project the expected jobs generated in each county, following the same logic as the statewide model. We assume that job losses due to income and wage effects are evenly realized throughout the state according to employment levels in each county. The results for McLean County are shown in Figure 13, Sangamon County in Figure 14, and Johnson County in Figure 15. We choose to show these three counties because they represent strong potential renewable energy development (McLean), moderate potential (Sangamon), and low potential (Johnson). The differences in scale are striking. McLean County is projected to add over 6,000 jobs from renewable energy construction and operations (mostly from construction) by 2028. The employment effect falls off as less capacity is built, but job gains stay generally above 2,000 throughout the period. Sangamon County adds over 5,000 jobs by 2028, but the gains fall off sharply to less than 1,000 through 2045. Johnson County never realizes a multi-thousand job increase, and their job gains increase over the period, peaking at just over 400 in 2040. Results for all counties are shown in Appendix D. There will be winners and losers from the energy transition and the CEJA policy, depending on the technical capacity of renewable energy generation.

Figure 13. Net Employment Change, Renewable Energy Generation, ReEDS High Electrification Scenario, McLean County, 2026-2045.

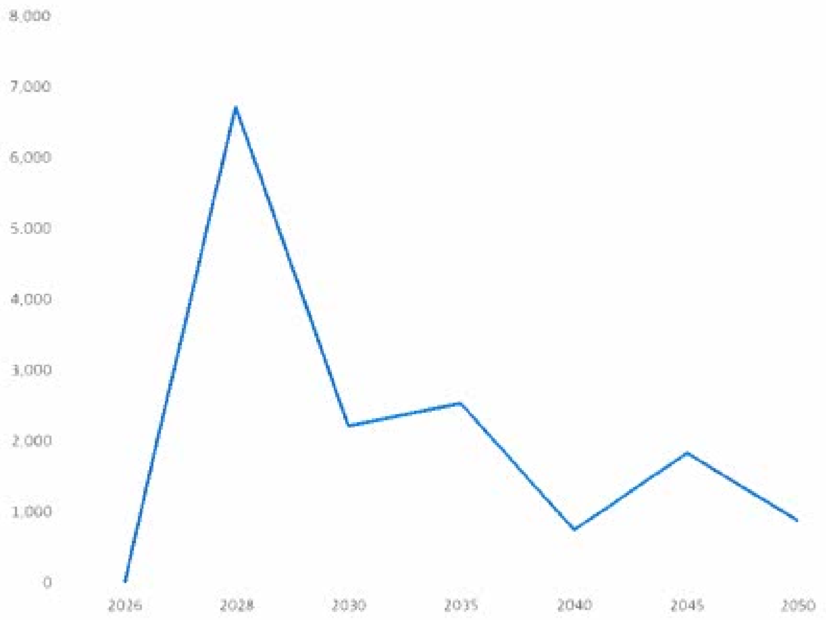


Figure 14. Net Employment Change, Renewable Energy Generation, ReEDS High Electrification Scenario, Sangamon County, 2026-2045.

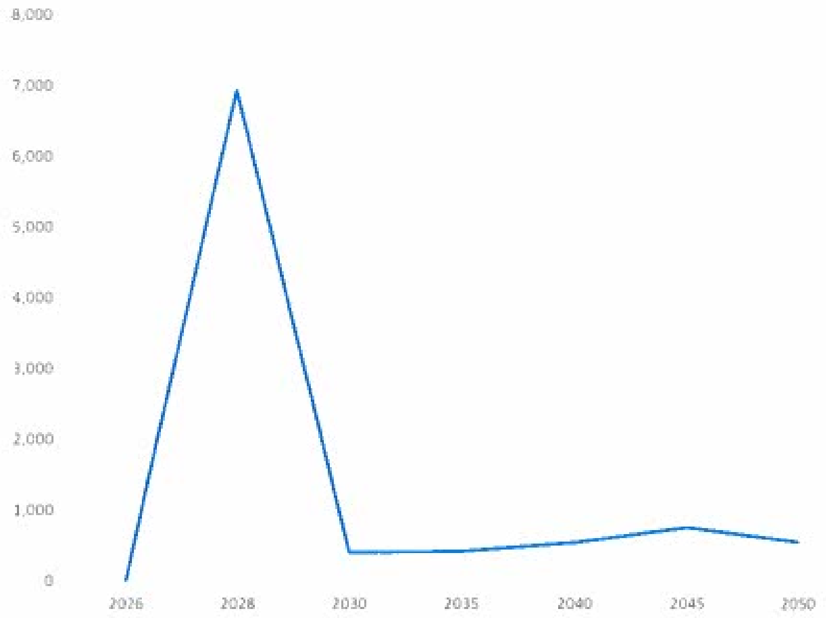
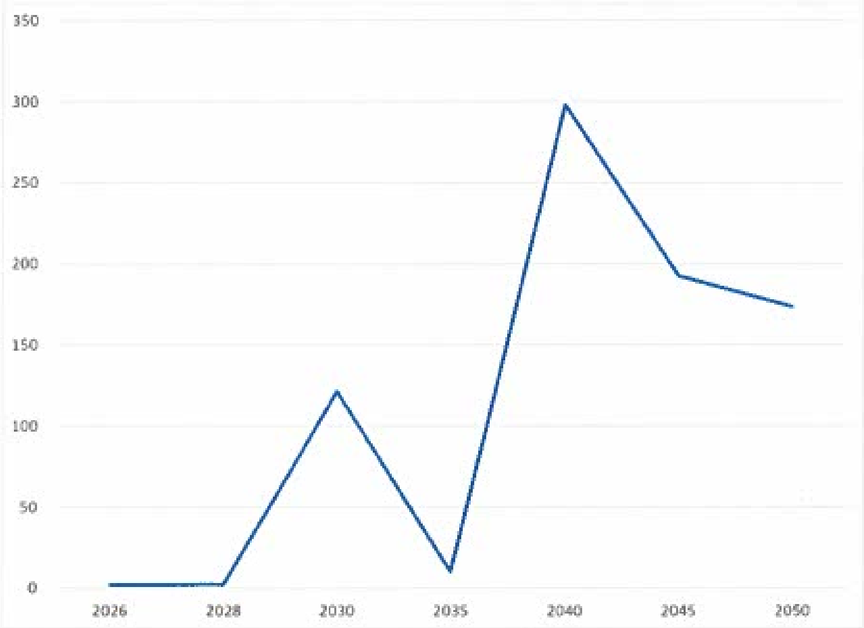


Figure 15. Net Employment Change, Renewable Energy Generation, ReEDS High Electrification Scenario, Johnson County, 2026-2045.



PROPERTY TAX ANALYSIS

As required by Public Act 102-0662, in the Phase I report we estimated the statewide property tax effects of renewable energy infrastructure. At the time of that report, we lacked a siting model to be able to allocate the effects regionally. As we have since developed the siting model listed above, we present the regional property tax effects in Table 2. The assumptions used to develop these estimates are the same as the Phase I report. Property tax revenues are expected to increase substantially across the state, with larger effects in those areas particularly well suited to wind and solar infrastructure development.

Table 2. Property Tax Impacts of Renewable Energy Infrastructure Development, 2024-2045.

County	Total Increase to 2045	Average Annual Increase
Adams	$91,283,217	$4,346,820
Alexander	16,161,354	769,588
Bond	38,390,842	1,828,135
Boone	129,240,706	6,154,319
Brown	46,701,759	2,223,893
Bureau	104,368,408	4,969,924
Calhoun	23,091,752	1,099,607
Carroll	125,346,600	5,968,886
Cass	39,667,552	1,888,931
Champaign	389,337,798	18,539,895

Christian	326,045,843	15,525,993
Clark	186,046,875	8,859,375
Clay	151,054,945	7,193,093
Clinton	43,016,302	2,048,395
Coles	163,887,077	7,804,147
Cook	23,196,655	1,104,603
Crawford	134,346,123	6,397,434
Cumberland	131,630,262	6,268,108
De Witt	188,834,093	8,992,100
DeKalb	336,323,687	16,015,414
Douglas	150,245,906	7,154,567
DuPage	10,575,635	503,602
Edgar	302,767,282	14,417,490
Edwards	71,185,583	3,389,790
Effingham	149,245,630	7,106,935
Fayette	70,536,745	3,358,893
Ford	224,954,462	10,712,117
Franklin	24,194,665	1,152,127
Fulton	95,666,222	4,555,534
Gallatin	28,909,412	1,376,639
Greene	48,352,007	2,302,477
Grundy	215,711,268	10,271,965
Hamilton	53,414,523	2,543,549
Hancock	74,055,556	3,526,455
Hardin	20,328,075	968,004
Henderson	53,507,036	2,547,954
Henry	95,420,352	4,543,826
Iroquois	513,130,610	24,434,791
Jackson	44,400,844	2,114,326
Jasper	222,828,776	10,610,894
Jefferson	39,477,817	1,879,896
Jersey	35,874,920	1,708,330
Jo Daviess	245,184,597	11,675,457
Johnson	28,839,626	1,373,316

Kane	158,728,181	7,558,485
Kankakee	263,959,323	12,569,492
Kendall	141,953,544	6,759,693
Knox	88,513,606	4,214,934
Lake	32,084,801	1,527,848
LaSalle	529,342,890	25,206,804
Lawrence	159,937,348	7,616,064
Lee	474,194,234	22,580,678
Livingston	597,524,829	28,453,563
Logan	226,671,447	10,793,878
Macon	242,462,942	11,545,854
Macoupin	88,594,616	4,218,791
Madison	41,720,730	1,986,701
Marion	62,086,730	2,956,511
Marshall	130,840,689	6,230,509
Mason	50,263,414	2,393,496
Massac	19,770,143	941,435
McDonough	52,098,704	2,480,891
McHenry	179,878,587	8,565,647
McLean	503,771,146	23,989,102
Menard	38,723,853	1,843,993
Mercer	58,493,314	2,785,396
Monroe	27,877,746	1,327,512
Montgomery	87,957,203	4,188,438
Morgan	71,739,848	3,416,183
Moultrie	193,534,505	9,215,929
Ogle	387,961,423	18,474,353
Peoria	123,036,698	5,858,890
Perry	31,239,778	1,487,608
Piatt	173,847,243	8,278,440
Pike	80,529,708	3,834,748
Pope	28,810,886	1,371,947
Pulaski	9,131,137	434,816
Putnam	16,674,442	794,021

Randolph	56,188,081	2,675,623
Richland	75,339,413	3,587,591
Rock Island	36,805,752	1,752,655
Saline	39,588,834	1,885,183
Sangamon	244,089,427	11,623,306
Schuyler	53,022,663	2,524,889
Scott	26,784,394	1,275,447
Shelby	281,433,100	13,401,576
St. Clair	36,818,420	1,753,258
Stark	128,815,643	6,134,078
Stephenson	227,708,633	10,843,268
Tazewell	178,370,225	8,493,820
Union	32,956,370	1,569,351
Vermilion	375,361,037	17,874,335
Wabash	113,913,635	5,424,459
Warren	67,670,284	3,222,394
Washington	59,008,562	2,809,932
Wayne	75,502,584	3,595,361
White	37,362,324	1,779,158
Whiteside	363,211,113	17,295,767
Will	194,268,128	9,250,863
Williamson	30,853,303	1,469,205
Winnebago	156,712,300	7,462,490
Woodford	175,788,936	8,370,902
Statewide	$13,948,308,245	$664,205,155

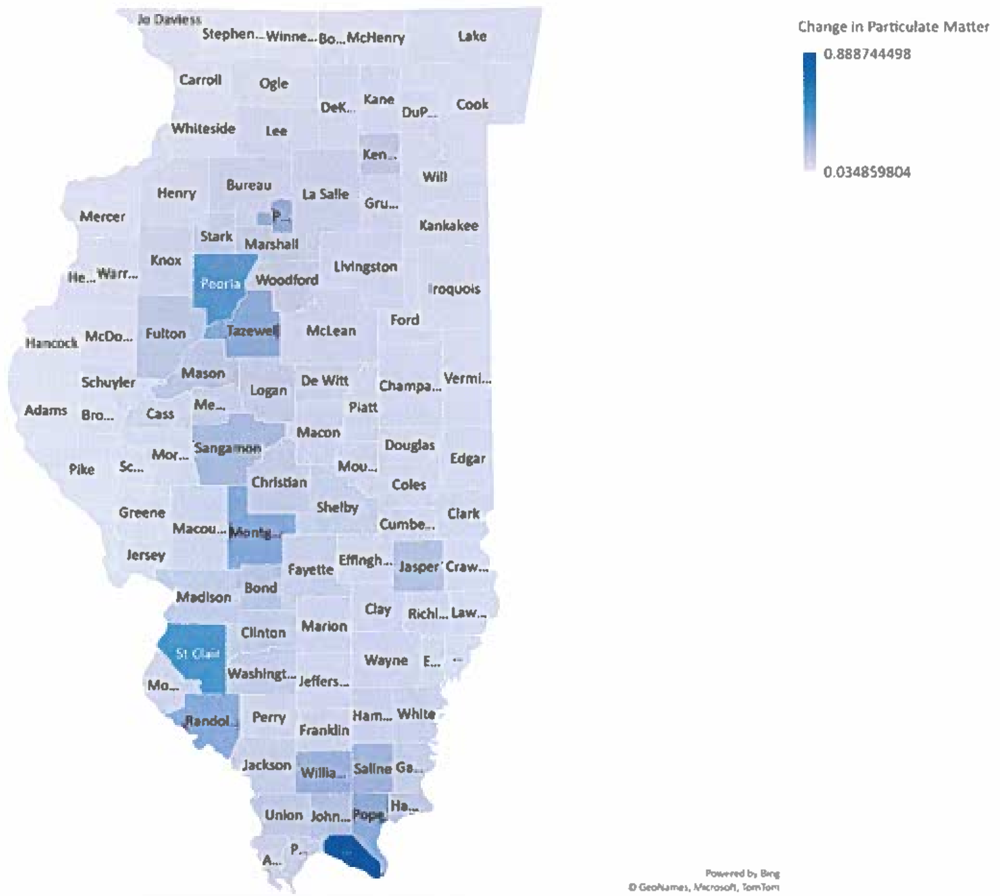
ENVIRONMENTAL AND ECONOMIC CO-BENEFITS ANALYSIS

AIR QUALITY EFFECTS

One of the items requested by the ETWC in addition to the requirements of Public Act 102-0662 was an analysis of the environmental and health benefits of transitioning away from fossil fuel electrical generation. Toward that end, we employed an online tool created by the Environmental Protection Agency. The Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) provides a tool for modeling these benefits. The tool works by mapping particulate matter (PM) estimates from the eGRID database that we discussed in the Phase I report for fossil fuel emission sources and then using a model of environmental factors (such as prevailing winds) models the likely impact areas for the emissions of fossil fuel emitters. This forms a "baseline" for environmental effects. The baseline year for the analysis is 2023. The tool also includes parameters derived from academic research that translate the likely environmental effects to health effects such as increased asthma and other lung diseases. Finally, using estimates of the economic effects of the health effects (such as reduced productivity and increased health care costs), those effects are translated into economic losses from fossil fuel generation. Users of the COBRA tool can then specify changes to policies or some change in real fossil fuel generation (such as a single plant closing) that will change the emissions figures. With the model parameters, these changes in emissions are translated into environmental, health, and economic effects. Details on the model can be found in the model documentation (EPA, 2021).

We coded the policy change brought on by the energy transition and the CEJA policy as a 100% reduction in fossil fuel electrical generation by 2045. The results of the analysis are shown graphically in Figures 16 and 17, and Table 3. Full results are available separately from the author. Figure 16 shows the reduction in particulate matter estimated by the model. Not surprisingly, the largest reductions are in counties with major fossil fuel power plants located in the county or nearby, including Massac, St. Clair, Sangamon, Peoria, and Tazewell counties.

Figure 16. Reductions in Particulate Matter ($PM_{2.5}$) Estimated by EPA COBRA Tool, Compared to Baseline 2023.



The geographic pattern of health and economic benefits is different from the distribution of reductions in particulate matter (Figure 17, which shows the "low estimate" of health benefits at a 7% discount rate). The benefits cluster in larger areas, but also in areas near major fossil-fuel generation facilities.

Figure 17. Dollar Value of Total Health Benefits, Low Estimate, 7% Discount Rate, from EPA COBRA Tool, Present Value of Cumulative Benefits over 20 Years.

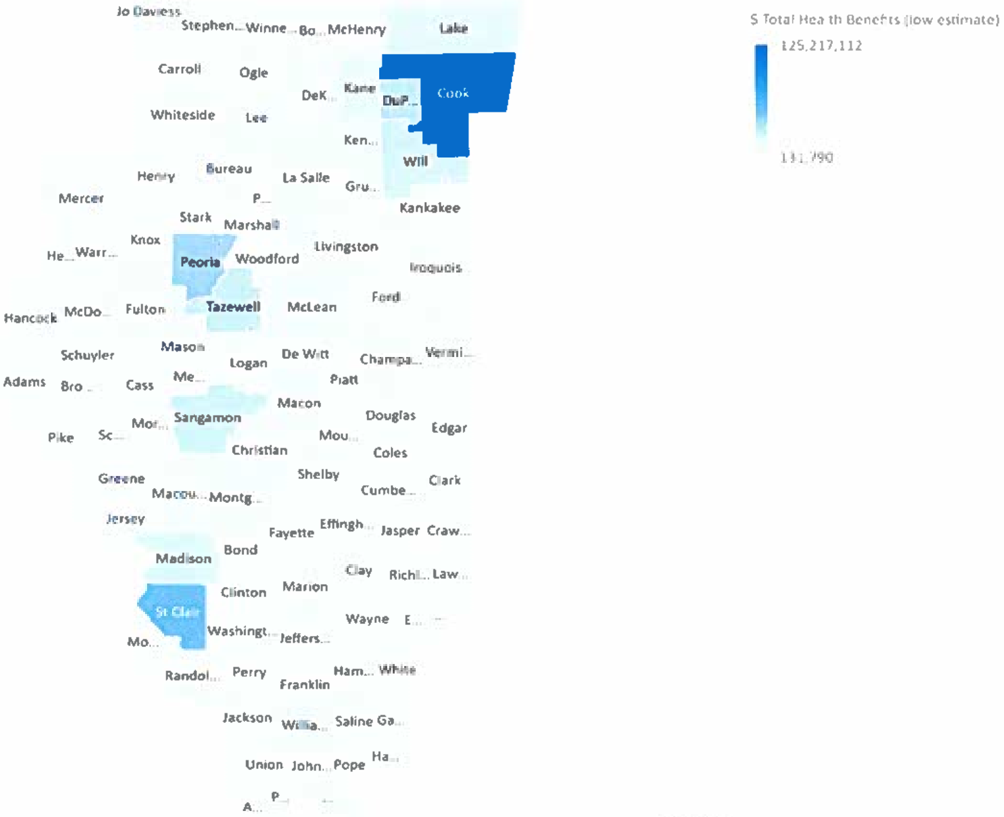


Table 3 shows the primary results on several different variables. The present value of estimated statewide economic benefits of reducing fossil-fuel emissions over the next 20 years are between $580 million and $1.5 billion, depending on the combination of assumptions used. This is obviously a significant economic benefit of the energy transition and the CEJA policy.

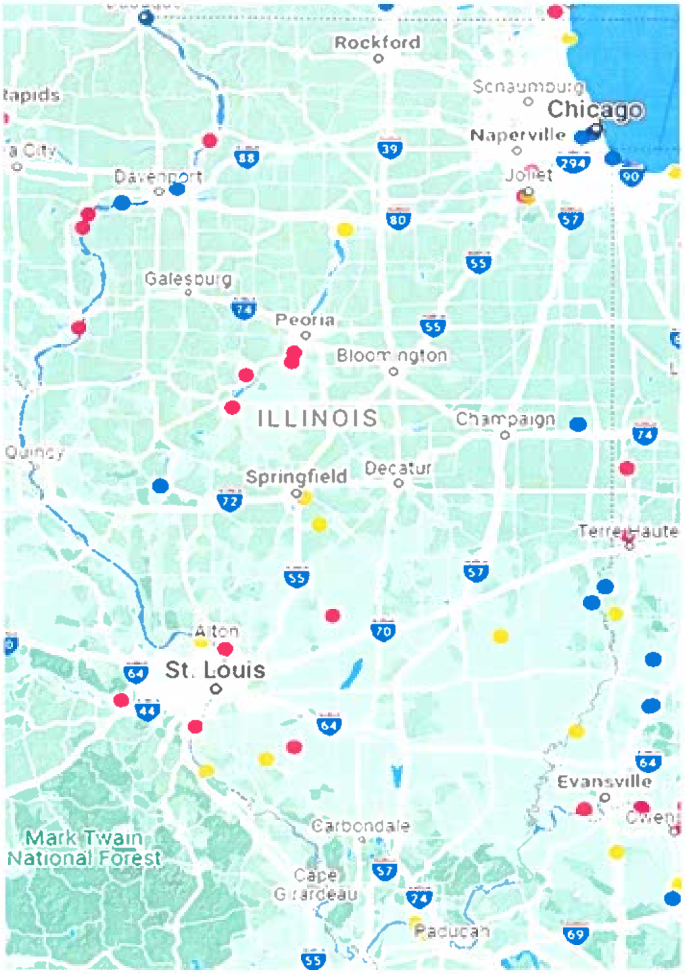
Table 3. Environmental, Health, and Economic Benefits from 100% Reduction in Fossil-Fuel Electrical Generation.

Measure	Value
Particulate Matter (reduction in $PM_{2.5}$ concentration)	12.29
Mortality (annual deaths avoided - low estimate)	58.62
Mortality (annual deaths avoided - high estimate)	132.59
Infant Mortality (annual deaths avoided)	0.35
Asthma Exacerbation (annual cases avoided)	1,448.68
Hospital Admissions for All Respiratory Diseases (annual admissions avoided)	15.04
Lost Days of Work (annual)	6,919.08
Present Value of Total Health Benefits (low estimate, 7% discount rate)	$583,117,058
Present Value of Total Health Benefits (high estimate, 7% discount rate)	$1,312,117,292
Present Value of Total Health Benefits (low estimate, 3% discount rate)	$653,307,468
Present Value of Total Health Benefits (high estimate, 3% discount rate)	$1,471,339,513

COAL ASH IMPOUNDMENT EFFECTS

Another benefit of closing coal-fired power plants is the reduction in the usage of coal and the resulting coal ash problems. Illinois has an estimated 76 coal ash impoundment sites, located near coal-fired electrical generation plants (Figure 18 – Earth Justice, 2023). 45 of these sites are federally regulated under EPA's 2015 Coal Ash Rule (these are identified by a blue dot in the figure). 31 other sites are either "legacy" sites grandfathered in under the Rule, or inactive sites awaiting cleanup (the yellow and red dots). The environmental effects of these sites include groundwater contamination and the presence of toxic chemicals such as arsenic, boron, cobalt, chromium, lead, lithium, mercury, molybdenum, radium, selenium, and other heavy metals. These chemicals have been linked to various types of cancers.

Figure 18. Coal Ash Impoundment Sites, Illinois.



Source: Earth Justice (2023).[5]

Unfortunately, no consistent estimates exist of the health or economic benefits of cleaning up the coal ash impoundments sites. There will likely be strong effects in these areas, compounding the health and economic benefits of closing the coal plants.

EMERGING INDUSTRIES IN AREAS IMPACTED BY PLANT CLOSURES

PL 102-0662 requires an analysis of emerging industries in areas that are disproportionately affected by fossil-fuel power plant closures. To complete this analysis, we used data from the US Bureau of Labor Statistics through their Quarterly Census of Employment and Wages (QCEW – US Bureau of Labor

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[5] A commissioner has pointed out other sources of information on coal ash impoundments, including https://ashtracker.org/index/facility#IL and https://www.epa.gov/coalash/list-publicly-accessible-internet-sites-hosting-compliance-data-and-information-required#il. He also pointed out that the state of Illinois has undertaken efforts to address impoundments, including a comprehensive regulatory and permitting framework. Also, the EPA has recently issued a Notice of Proposed Rulemaking to bring the legacy sites under federal regulation.

Statistics, 2023) and Quarterly Workforce Indicators (QWI – US Census Bureau, 2023) programs. For each county in Table 1 with total projected job losses of more than 100 workers, we analyzed the QWI data for industries that grew between 2018 and the present, indicating growth in the industry. From the QCEW data, we extracted industries that had a "location quotient" (LQ) of more than 1.5. This measure indicates the relative share of employment in a sector or industry in a geographic area compared to the national average. An LQ of 1.5 indicates that the sector or industry in that county would have 50 percent greater share of employment than the national average. The LQ is a commonly used indicator of whether the sector or industry exports its product outside of the county and therefore is a prime candidate for growth. Table 3 shows the results for the emerging industries in each county with more than 100 projected fossil-fuel related job losses.

Table 4. Emerging Industries in Counties Affected by Plant Closures.

County	Emerging Industries
Christian	Pipeline Transportation; Petroleum Refineries; Animal Food Manufacturing; Wiring Device Manufacturing; Phosphate Manufacturing; Automobile Manufacturing; Data Processing, Hosting, and Related Services
Lee	Warehousing & Storage; Office Administrative Services; Animal Food Manufacturing; Sand & Gravel Mining
Massac	Wet Corn Milling; Commercial Sports (except Racing); Warehousing & Storage; Business & Professional Associations; Labor & Civic Organizations
Randolph	Religious Organizations; Museums, Historical Sites, Zoos, & Parks; Footwear Manufacturing; Office Administrative Services
Tazewell	Footwear Manufacturing; Radio & Television Broadcasting; Office Administrative Services; Religious Organizations; Museums, Historical Sites, Zoos, & Parks; Other Financial Investment Activities
Washington	Promoters of Performing Arts and Sports and Agents for Public Figures; Office Administrative Services; Other Financial Investment Activities; Petroleum Refineries
Will	Religious Organizations; News Syndicates, Libraries, Archives and All Other Information Services; Office Administrative Services; Metal Mining Services; Promoters of Performing Arts and Sports and Agents for Public Figures; Commercial Sports (except Racing)
Williamson	News Syndicates, Libraries, Archives and All Other Information Services; Office Administrative Services; Religious Organizations; Petroleum Refineries; Custom Computer Programming Services; Management Consulting Services; Other Financial Investment Activities

One of the challenges for economic development is that several of these counties are small and so opportunities are relatively slim for employment after fossil fuel power plants are shuttered. Only Will County has a workforce greater than 100,000, and two other counties (Tazewell and Williamson) have employment greater than 20,000. There will likely be some geographic relocation of power plant workers as plants close.

Many of the emerging industries are in the business services sector (we excluded personal services and retail industries as those mostly involve servicing the local region), including warehousing and storage, office administrative services, management consulting, and financial investment activities. However, there are a significant number of jobs being developed in manufacturing industries (animal food manufacturing and automotive manufacturing) and religious and civic organizations. These may be opportunities for future growth in jobs for those displaced by fossil fuel plant closures.

REFERENCES

Earthjustice (2023). *Toxic Coal Ash in Illinois: Addressing Coal Plants' Hazardous Legacy*. Available at: https://earthjustice.org/feature/coal-ash-states/illinois. Accessed June 2023.

Gagnon, Pieter, Brady Cowiestoll, and Marty Schwarz. (2023). Cambium 2022 Scenario Descriptions and Documentation. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A40-84916. https://www.nrel.gov/docs/fy23osti/84916.pdf.

Ho, Jonathan, Jonathon Becker, Maxwell Brown, Patrick Brown, Ilya Chernyakhovskiy, Stuart Cohen, Wesley Cole, et al. (2021). Regional Energy Deployment System (ReEDS) Model Documentation: Version 2020. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-78195. https://www.nrel.gov/docs/fy21osti/78195.pdf.

IMPLAN. (2023). *Where It All Started*. Available at: https://implan.com/history/ . Accessed November 13, 2023.

Maclaurin, Galen, Nick Grue, Anthony Lopez, Donna Heimiller, Michael Rossol, Grant Buster, and Travis Williams. (2019). The Renewable Energy Potential (reV) Model: A Geospatial Platform for Technical Potential and Supply Curve Modeling. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-73067. https://www.nrel.gov/docs/fy19osti/73067.pdf.

Mai, Trieu, Paige Jadun, Jeffrey Logan, Colin McMillan, Matteo Muratori, Daniel Steinberg, Laura Vimmerstedt, Ryan Jones, Benjamin Haley, and Brent Nelson. 2018. *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-71500. https://www.nrel.gov/docs/fy18osti/71500.pdf.

Shao, Meng, Zhixin Han, Jinwei Sun, Chengsi Xiao, Shulei Zhang, and Yuanxu Zhao. (2020). A Review of Multi-Criteria Decision Making Applications for Renewable Energy Site Selection. *Renewable Energy 157*: 377-403.

Sue Wing, Ian. (2009). Computable General Equilibrium Models for the Analysis of Energy and Climate Policies, in Joanne Evans and Lester C. Hunt (eds.), *International Handbook on the Economics of Energy*, Cheltenham: Edward Elgar, 332-366.

U.S. Bureau of Labor Statistics. (2023). *Quarterly Census of Employment and Wages*. Available at: https://www.bls.gov/cew/ . Accessed November 15, 2023.

U.S. Census Bureau. (2023). *Quarterly Workforce Indicators (QWI) (Time Series: 1990-Present)*. Available at: https://www.census.gov/data/developers/data-sets/qwi.html . Accessed November 15, 2023.

U.S. Environmental Protection Agency (2021). *User's Manual for the Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA): Version 4.1*. Washington, DC: U.S. Environmental Protection Agency.

APPENDIX A: NREL REEDS MODEL SUPPLEMENTAL INFORMATION

Figure A.1. ReEDS Regional Structure.

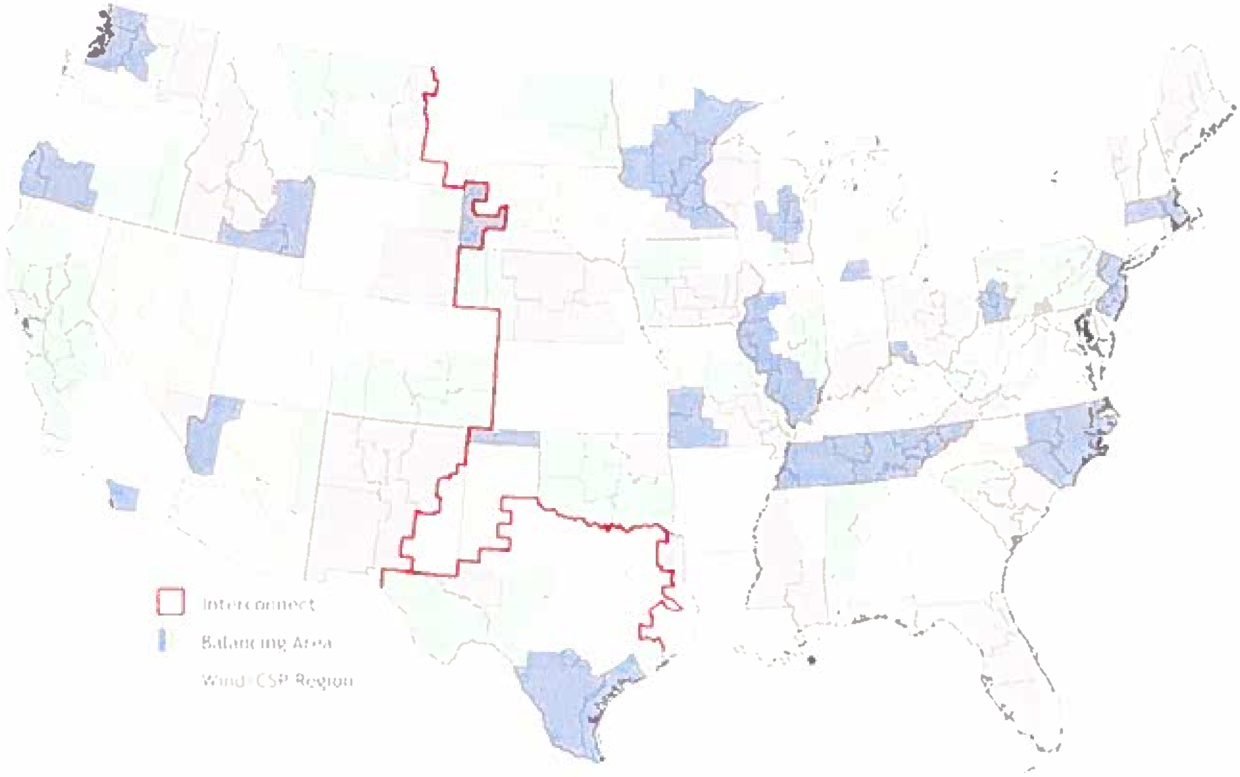


Figure A.2. ReEDS Technology Capacity Definitions – Land-Based Wind Resource Classes.

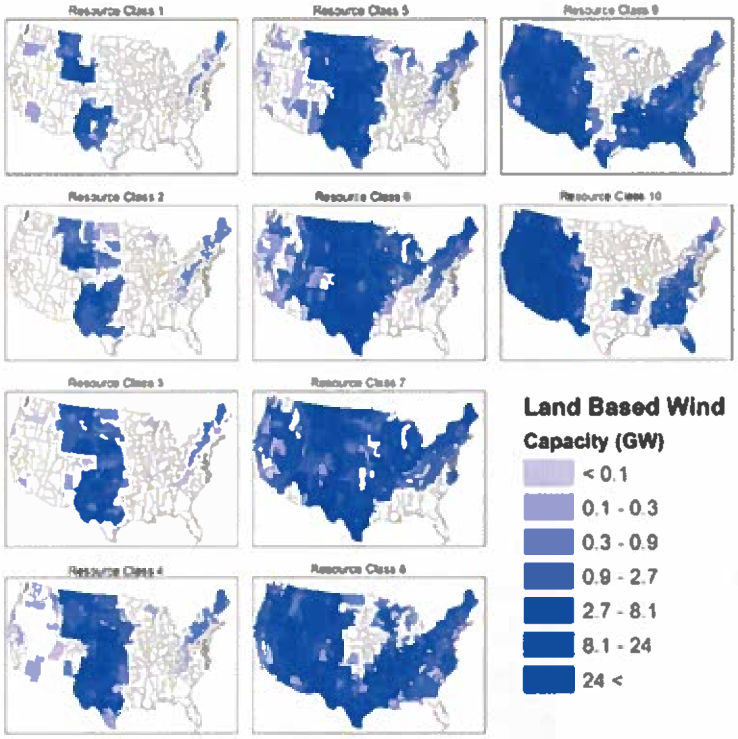


Figure 5. Land-based wind resource map for the contiguous United States

Figure A.3. ReEDS Technology Capacity Definitions - Utility-Level Photovoltaic Resource Classes.

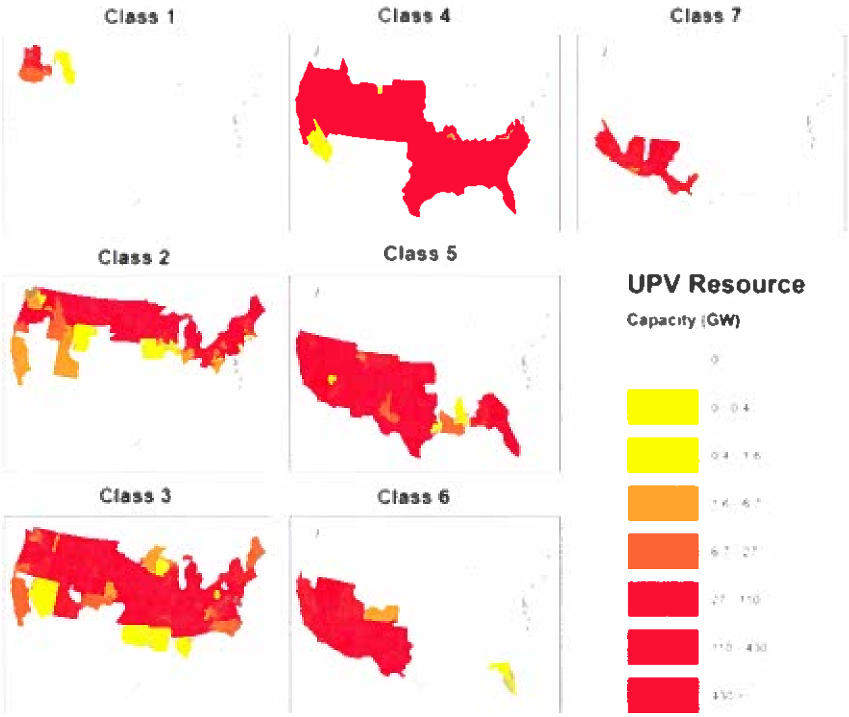


Figure 9. UPV resource availability by ReEDS BA region and resource class

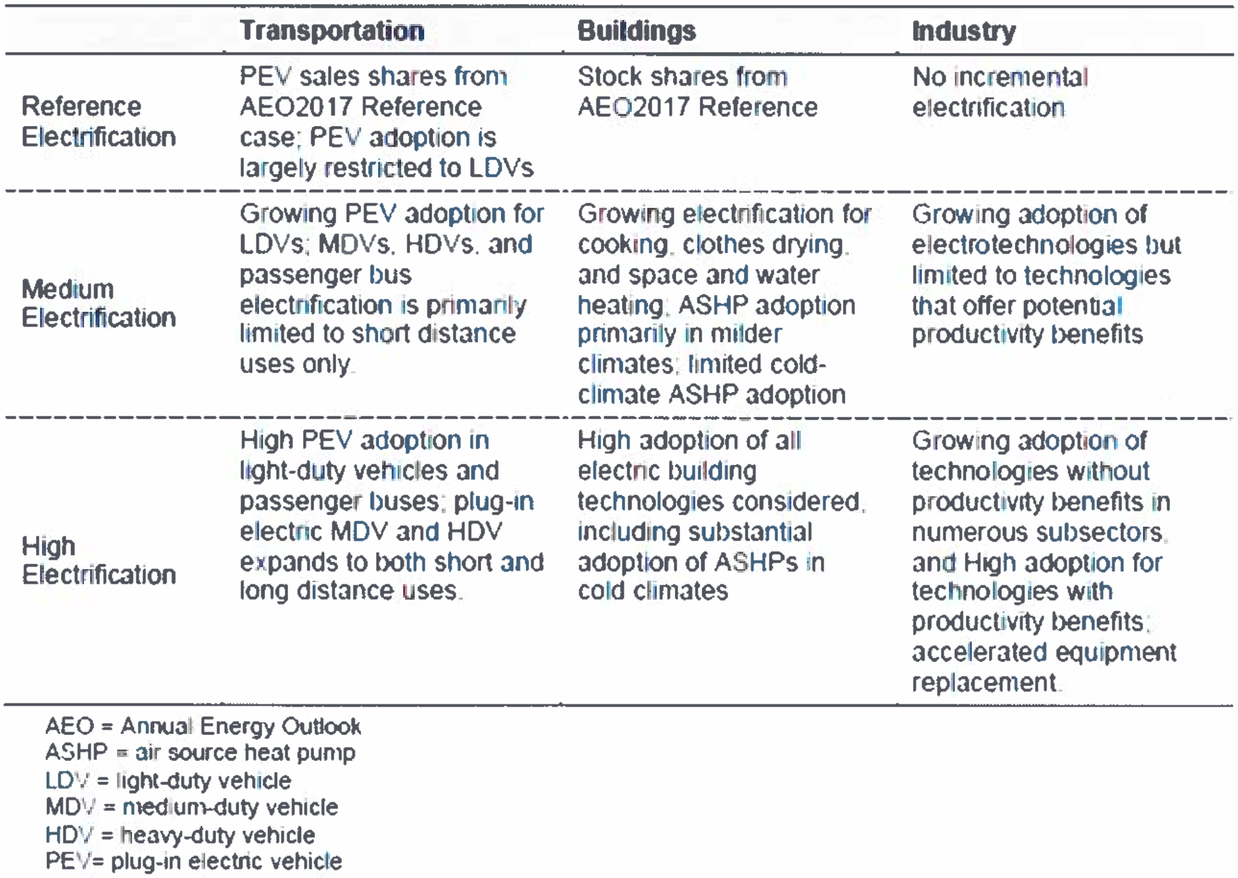
APPENDIX B. INPUTS THAT VARY WITHIN THE CAMBIUM STUDY SCENARIOS

Group	Scenario Setting	Notes
Electricity Demand Growth	*Reference Demand Growth*	*Light electrification scenario derived by slightly modifying (reducing) the Medium Electrification scenario from the Electrification Futures Study (Mai et al. 2018; Sun et al. 2020), described in the Demand Growth and Flexibility subsection below*
	High Demand Growth	High electrification scenario from the Electrification Futures Study (Mai et al. 2018; Sun et al. 2020)
Fuel Prices	*Reference Natural Gas Prices*	*AEO2022 reference*[a]
	Low Natural Gas Prices	AEO2022 high oil and gas resource and technology[a]
	High Natural Gas Prices	AEO2022 low oil and gas resource and technology[a]
Electricity Generation Technology Costs	*Mid Technology Cost*	*2022 Annual Technology Baseline (ATB) moderate projections*
	Low RE and Battery Cost	2022 ATB renewable energy advanced projections
	High RE and Battery Cost	2022 ATB renewable energy conservative projections
Policy/Regulatory Environment	*Current Law (no tax credit phaseout)*	*Includes state, regional, and federal policies as of September 2022, except that IRA's PTC and ITC do not phase out*
	Current Law (with tax credit phaseout)	*Includes state, regional, and federal policies as of September 2022, including the phaseout of IRA's PTC and ITC if the emissions threshold is passed*
	95% by 2050	*95% net reduction in electricity sector CO_2 emissions by 2050 (relative to 2005)*
	100% by 2035	*Net zero electricity sector CO_2 emissions by 2035*

Source: Gagnon, Cowiestoll, and Schwarz (2023), Table 1. Notes: AEO is the Annual Energy Outlook from the US Department of Energy, Energy Information Administration. ATB is the Annual Technology Baseline from the National Renewable Energy Laboratory.

APPENDIX C: ELECTRIFICATION SCENARIOS FROM ELECTRIFICATION FUTURES STUDY.

Table C.1. Summary of Differences Between Electrification Scenarios.

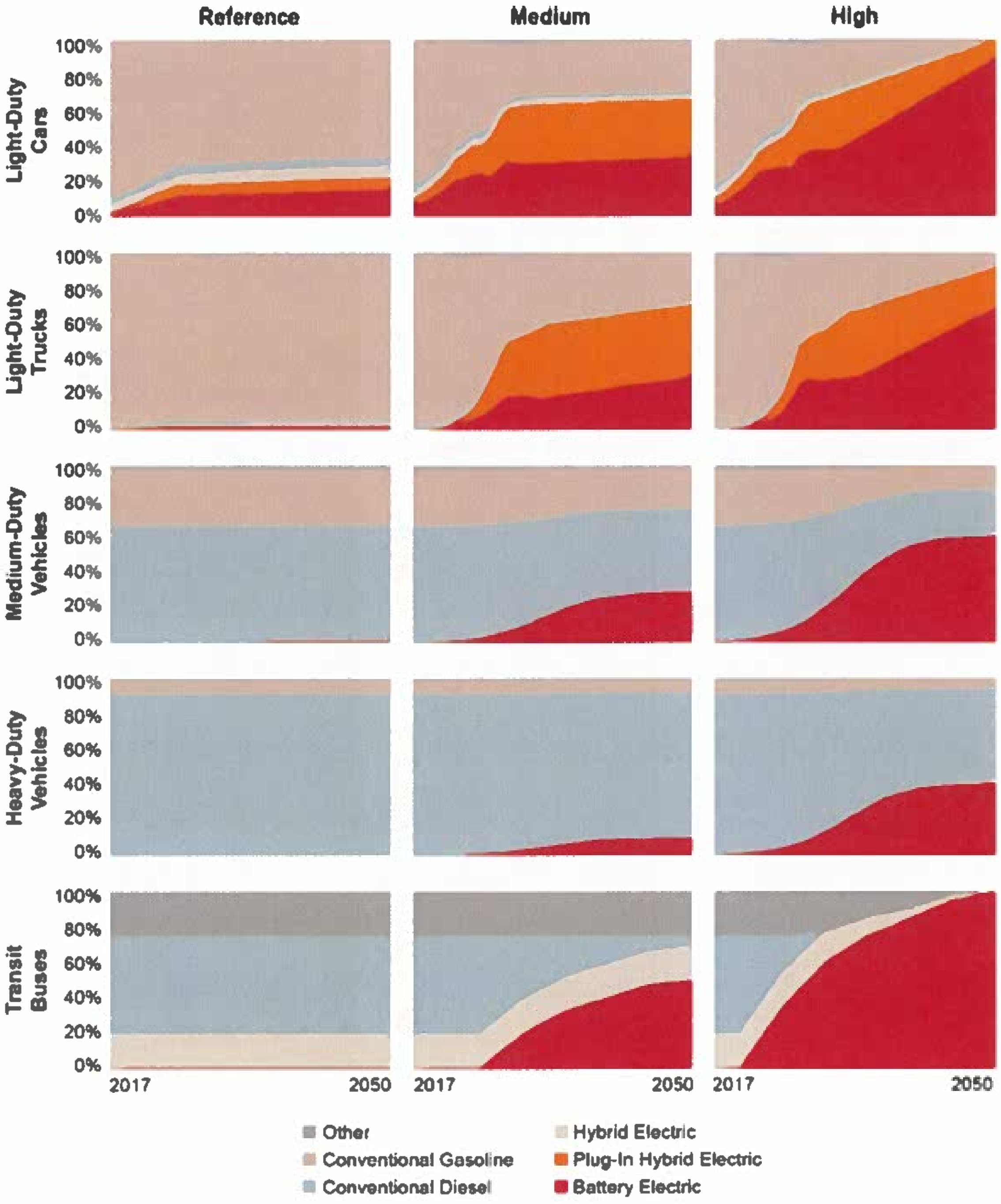


	Transportation	Buildings	Industry
Reference Electrification	PEV sales shares from AEO2017 Reference case; PEV adoption is largely restricted to LDVs	Stock shares from AEO2017 Reference	No incremental electrification
Medium Electrification	Growing PEV adoption for LDVs; MDVs, HDVs, and passenger bus electrification is primarily limited to short distance uses only.	Growing electrification for cooking, clothes drying, and space and water heating. ASHP adoption primarily in milder climates; limited cold-climate ASHP adoption	Growing adoption of electrotechnologies but limited to technologies that offer potential productivity benefits
High Electrification	High PEV adoption in light-duty vehicles and passenger buses; plug-in electric MDV and HDV expands to both short and long distance uses.	High adoption of all electric building technologies considered, including substantial adoption of ASHPs in cold climates	Growing adoption of technologies without productivity benefits in numerous subsectors, and High adoption for technologies with productivity benefits; accelerated equipment replacement.

AEO = Annual Energy Outlook
ASHP = air source heat pump
LDV = light-duty vehicle
MDV = medium-duty vehicle
HDV = heavy-duty vehicle
PEV= plug-in electric vehicle

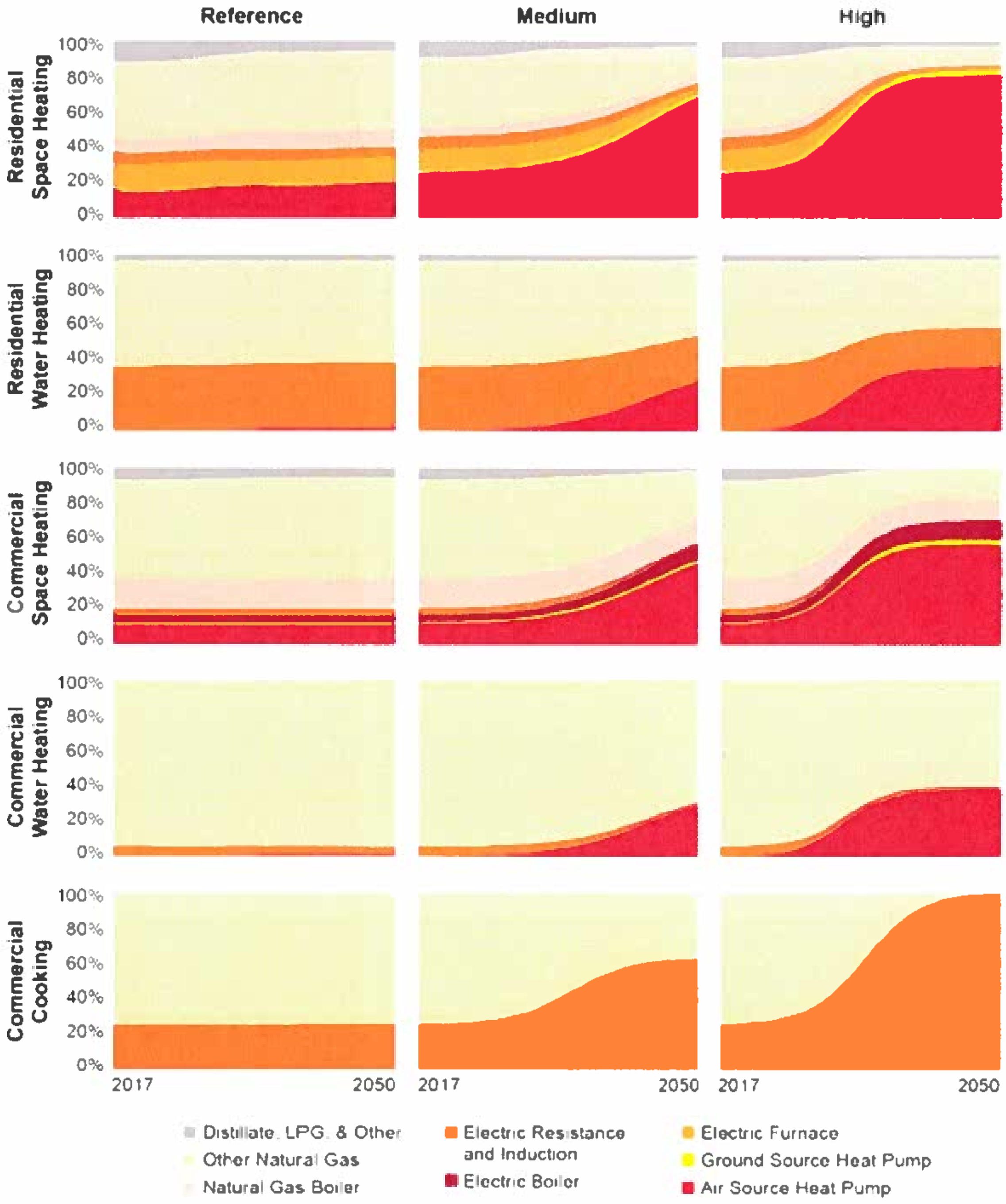
Source: Mai, et.al. (2018), Table 4.2.

Figure C.1. Transportation Technology Sales Shares by Electrification Scenario.



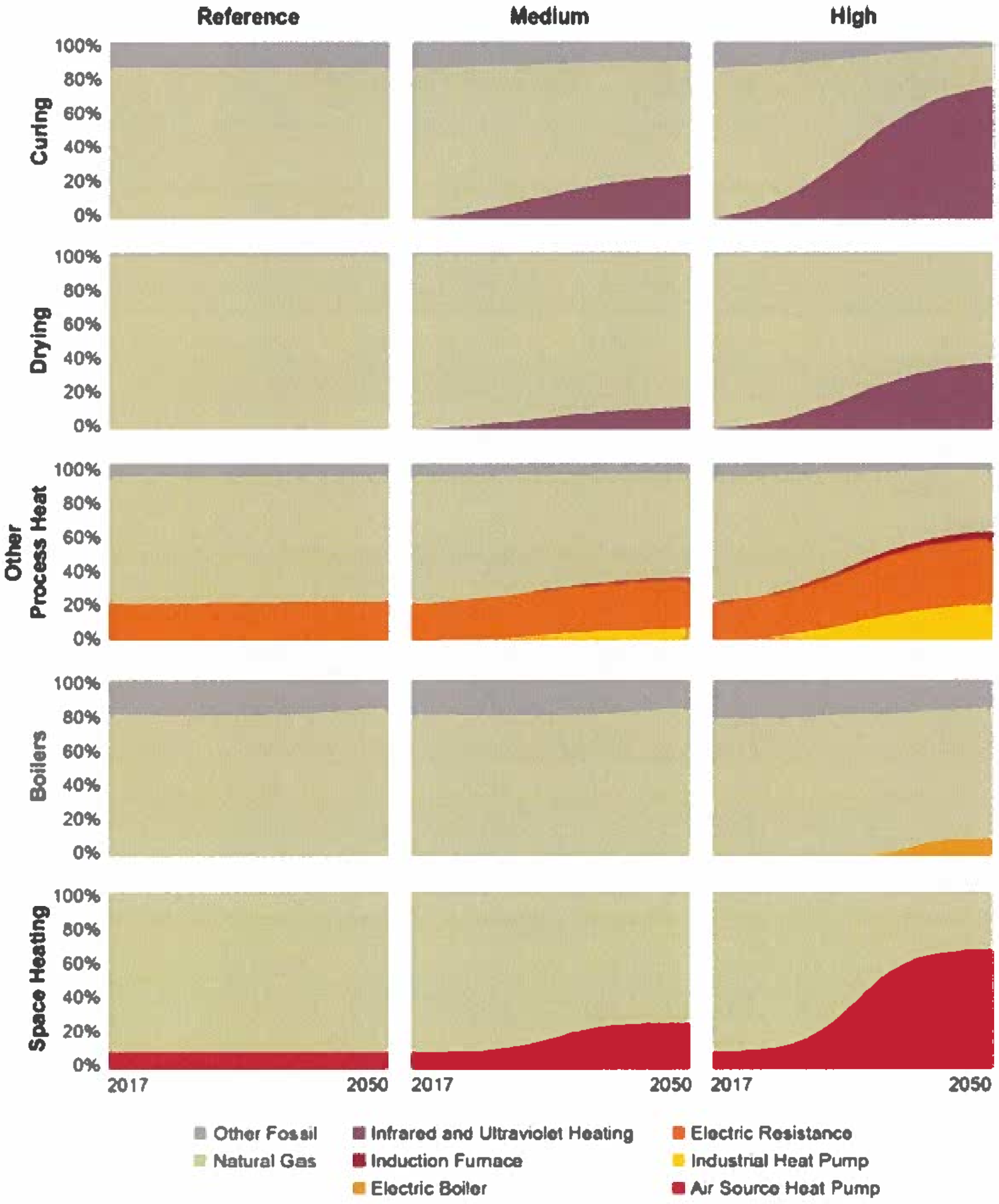
Source: Mai, et.al. (2018), Figure 4.1.

Figure C.2. Buildings Technology Sales Shares by Electrification Scenario



Source: Mai, et.al. (2018), Figure 4.2.

Figure C.3. Industrial Technology Sales Shares by Electrification Scenario



Source: Mai, et.al. (2018), Figure 4.3.

APPENDIX D: RENEWABLE JOB GAINS ESTIMATES BY COUNTY AND YEAR, 2026-2045.

County	2026	2028	2030	2035	2040	2045
Adams	11	17	435	45	954	754
Alexander	2	3	75	8	169	129
Bond	5	9	191	21	403	340
Boone	108	371	1,072	941	1,033	1,744
Brown	4	5	203	18	484	330
Bureau	12	19	492	51	1,089	849
Calhoun	1	2	96	8	238	150
Carroll	127	410	1,199	1,050	1,137	1,925
Cass	5	7	186	19	414	321
Champaign	8	5,324	1,730	1,955	579	1,460
Christian	6	4,272	1,425	1,635	479	1,160
Clark	4	2,537	826	934	277	695
Clay	4	2,204	689	760	230	613
Clinton	6	10	217	25	452	389
Coles	4	2,380	746	825	249	661
Cook	33	98	290	253	268	456
Crawford	4	1,989	617	676	205	555
Cumberland	3	1,801	585	661	196	494
De Witt	3	2,429	819	947	276	657
DeKalb	264	922	2,659	2,336	2,577	4,347
Douglas	4	2,148	680	756	227	595
DuPage	17	49	147	128	135	229
Edgar	5	3,886	1,313	1,518	442	1,050
Edwards	2	1,023	323	358	108	284
Effingham	4	2,177	681	751	227	605
Fayette	10	16	349	38	740	619
Ford	4	2,961	985	1,129	331	805
Franklin	5	9	138	18	258	265
Fulton	10	16	445	45	997	759
Gallatin	3	5	137	14	302	238

Greene	7	11	243	27	508	434
Grundy	170	592	1,707	1,500	1,654	2,790
Hamilton	6	10	253	26	558	436
Hancock	11	18	372	42	778	667
Hardin	0	0	77	5	208	112
Henderson	5	8	242	23	556	405
Henry	11	18	452	47	996	781
Iroquois	10	6,730	2,243	2,574	754	1,828
Jackson	5	8	207	21	463	354
Jasper	4	2,889	970	1,117	326	783
Jefferson	8	12	216	27	419	404
Jersey	4	6	168	17	374	288
Jo Daviess	124	512	1,436	1,270	1,452	2,434
Johnson	2	2	121	10	298	192
Kane	140	471	1,366	1,198	1,311	2,214
Kankakee	260	846	2,469	2,163	2,347	3,971
Kendall	114	395	1,141	1,002	1,103	1,861
Knox	10	15	411	41	922	701
Lake	41	124	368	322	343	582
LaSalle	450	1,530	4,431	3,889	4,266	7,202
Lawrence	3	2,093	699	802	235	568
Lee	323	1,187	3,393	2,986	3,331	5,607
Livingston	466	1,632	4,703	4,132	4,561	7,692
Logan	7	5,958	348	358	462	663
Macon	5	3,212	1,064	1,217	357	875
Macoupin	12	19	436	48	929	772
Madison	8	13	228	28	442	428
Marion	8	13	303	33	650	534
Marshall	4	3,416	199	205	265	381
Mason	7	11	250	28	528	446
Massac	3	4	96	10	207	170
McDonough	8	13	266	31	548	482
McHenry	176	573	1,673	1,466	1,591	2,692
McLean	10	6,718	2,217	2,528	744	1,832

Menard	5	7	183	19	404	316
Mercer	7	12	281	30	612	491
Monroe	4	7	143	17	294	260
Montgomery	11	16	417	43	919	722
Morgan	8	13	336	34	748	578
Moultrie	3	2,373	825	969	279	634
Ogle	295	1,041	2,994	2,632	2,911	4,908
Peoria	5	3,701	216	223	286	398
Perry	6	9	168	20	331	311
Piatt	4	2,391	774	873	259	656
Pike	9	15	380	39	841	655
Pope	1	0	110	7	295	160
Pulaski	2	3	53	7	98	103
Putnam	2	3	79	8	174	136
Randolph	7	11	271	29	588	474
Richland	3	1,314	371	382	122	378
Rock Island	5	7	176	19	385	306
Saline	5	7	186	19	413	319
Sangamon	9	6,934	405	417	537	756
Schuyler	5	8	242	24	552	407
Scott	3	5	128	13	280	223
Shelby	6	3,897	1,257	1,414	420	1,072
St. Clair	7	12	201	25	390	377
Stark	3	3,139	183	189	244	356
Stephenson	192	655	1,895	1,663	1,825	3,081
Tazewell	7	4,997	292	301	387	547
Union	2	3	142	12	341	229
Vermilion	7	4,991	1,650	1,884	554	1,360
Wabash	2	1,421	489	571	165	381
Warren	8	12	319	33	706	550
Washington	8	13	292	32	619	518
Wayne	10	16	371	41	791	656
White	7	11	201	25	395	374
Whiteside	279	981	2,826	2,484	2,744	4,627

Will	198	637	1,865	1,633	1,768	2,992
Williamson	4	6	147	15	322	255
Winnebago	142	474	1,378	1,209	1,319	2,229
Woodford	6	4,693	274	282	364	520
State Total	4,390	119,996	77,038	64,756	74,641	108,373

APPENDIX E: COBRA RESULTS BY COUNTY

County	Particulate Matter (reduction in $PM_{2.5}$ concentration)	Mortality (annual deaths avoided - low estimate)	Mortality (annual deaths avoided - high estimate)	Infant Mortality (annual deaths avoided)	Asthma Exacerbation (annual cases avoided)
Adams	0.035	0.152	0.343	0.001	2.920
Alexander	0.113	0.060	0.135	0.000	1.042
Bond	0.163	0.156	0.352	0.001	2.927
Boone	0.051	0.146	0.330	0.001	3.709
Brown	0.050	0.015	0.034	0.000	0.266
Bureau	0.106	0.235	0.530	0.001	3.850
Calhoun	0.044	0.013	0.030	0.000	0.234
Carroll	0.039	0.043	0.097	0.000	0.527
Cass	0.093	0.076	0.171	0.000	1.516
Champaign	0.081	0.587	1.335	0.004	21.318
Christian	0.140	0.319	0.722	0.001	5.298
Clark	0.087	0.100	0.226	0.000	1.706
Clay	0.094	0.082	0.186	0.000	1.512
Clinton	0.126	0.265	0.599	0.001	5.582
Coles	0.089	0.239	0.542	0.001	5.598
Cook	0.056	12.542	28.401	0.090	357.833
Crawford	0.074	0.094	0.212	0.000	1.555
Cumberland	0.093	0.064	0.144	0.000	1.216
De Kalb	0.074	0.311	0.704	0.002	10.292
Dewitt	0.112	0.119	0.269	0.000	1.963
Douglas	0.076	0.085	0.192	0.000	2.004
Du Page	0.070	2.874	6.494	0.013	81.446
Edgar	0.076	0.104	0.234	0.000	1.418
Edwards	0.079	0.033	0.074	0.000	0.608
Effingham	0.087	0.182	0.411	0.001	3.703
Fayette	0.113	0.132	0.299	0.001	2.721
Ford	0.077	0.085	0.192	0.000	1.226
Franklin	0.094	0.280	0.633	0.001	4.328
Fulton	0.172	0.421	0.949	0.001	6.371
Gallatin	0.133	0.055	0.123	0.000	0.750

Greene	0.063	0.050	0.112	0.000	0.923
Grundy	0.092	0.242	0.549	0.001	6.486
Hamilton	0.105	0.063	0.143	0.000	1.045
Hancock	0.041	0.050	0.112	0.000	0.812
Hardin	0.167	0.057	0.128	0.000	0.716
Henderson	0.055	0.029	0.065	0.000	0.333
Henry	0.075	0.228	0.516	0.001	4.459
Iroquois	0.069	0.144	0.326	0.001	2.192
Jackson	0.115	0.288	0.654	0.002	7.914
Jasper	0.185	0.116	0.261	0.000	2.176
Jefferson	0.089	0.228	0.515	0.001	4.228
Jersey	0.061	0.094	0.213	0.000	1.636
Jo Daviess	0.039	0.062	0.141	0.000	0.852
Johnson	0.172	0.132	0.298	0.000	2.143
Kane	0.075	1.546	3.498	0.013	57.641
Kankakee	0.062	0.397	0.899	0.003	8.716
Kendall	0.160	0.735	1.664	0.008	33.580
Knox	0.104	0.396	0.895	0.002	5.621
La Salle	0.120	0.899	2.032	0.004	15.426
Lake	0.058	1.778	4.026	0.010	56.186
Lawrence	0.078	0.080	0.181	0.000	1.276
Lee	0.090	0.188	0.427	0.001	3.477
Livingston	0.092	0.216	0.487	0.001	3.800
Logan	0.141	0.258	0.583	0.001	4.296
Macon	0.097	0.676	1.527	0.004	12.902
Macoupin	0.092	0.289	0.654	0.001	4.882
Madison	0.128	2.060	4.659	0.007	41.783
Marion	0.092	0.248	0.561	0.001	4.454
Marshall	0.150	0.133	0.299	0.000	1.810
Mason	0.160	0.168	0.378	0.000	2.313
Massac	0.889	1.035	2.328	0.003	15.077
McDonough	0.062	0.094	0.214	0.000	2.247
McHenry	0.049	0.734	1.661	0.003	19.807
Mclean	0.102	0.702	1.590	0.006	24.140
Menard	0.130	0.115	0.259	0.000	1.846
Mercer	0.048	0.054	0.123	0.000	0.848

Monroe	0.096	0.185	0.419	0.001	3.921
Montgomery	0.306	0.616	1.390	0.002	9.654
Morgan	0.071	0.157	0.354	0.001	2.814
Moultrie	0.095	0.097	0.218	0.000	1.785
Ogle	0.068	0.210	0.474	0.001	4.082
Peoria	0.415	4.033	9.115	0.034	102.733
Perry	0.094	0.127	0.288	0.000	2.075
Piatt	0.085	0.093	0.211	0.000	1.512
Pike	0.043	0.046	0.103	0.000	0.773
Pope	0.291	0.081	0.184	0.000	1.049
Pulaski	0.126	0.055	0.124	0.000	0.829
Putnam	0.299	0.111	0.251	0.000	1.730
Randolph	0.294	0.614	1.389	0.002	9.844
Richland	0.089	0.104	0.234	0.000	1.652
Rock Island	0.055	0.498	1.123	0.002	9.825
Saline	0.247	0.461	1.040	0.002	7.272
Sangamon	0.222	2.441	5.520	0.014	54.952
Schuyler	0.074	0.032	0.072	0.000	0.591
Scott	0.057	0.019	0.043	0.000	0.325
Shelby	0.116	0.165	0.371	0.001	2.902
St Clair	0.407	5.597	12.689	0.044	140.973
Stark	0.133	0.058	0.130	0.000	0.786
Stephenson	0.036	0.114	0.256	0.000	1.938
Tazewell	0.311	2.572	5.798	0.011	53.251
Union	0.147	0.192	0.434	0.001	2.771
Vermilion	0.066	0.346	0.782	0.003	6.881
Wabash	0.073	0.060	0.135	0.000	1.026
Warren	0.066	0.067	0.152	0.000	1.409
Washington	0.133	0.125	0.281	0.000	1.962
Wayne	0.098	0.117	0.265	0.000	1.922
White	0.119	0.142	0.320	0.000	2.126
Whiteside	0.049	0.190	0.430	0.001	3.276
Will	0.070	2.273	5.148	0.013	72.156
Williamson	0.258	1.124	2.540	0.006	21.520
Winnebago	0.042	0.712	1.614	0.004	15.671
Woodford	0.136	0.333	0.751	0.001	7.207

County	Hospital Admits, All Respiratory (annual admissions avoided)	Work Loss Days (annual)	Present Value of Total Health Benefits ($, low estimate)	Present Value of Total Health Benefits ($, high estimate)
Adams	0.025	12.463	1,502,599	3,378,398
Alexander	0.012	4.241	589,800	1,326,244
Bond	0.041	16.467	1,544,092	3,477,000
Boone	0.040	17.391	1,449,519	3,268,785
Brown	0.004	2.513	149,154	337,373
Bureau	0.059	19.018	2,321,883	5,231,446
Calhoun	0.004	1.104	131,790	297,082
Carroll	0.010	2.812	425,500	958,640
Cass	0.017	6.586	750,061	1,688,700
Champaign	0.179	113.361	5,888,196	13,262,467
Christian	0.072	26.230	3,158,294	7,120,023
Clark	0.021	7.578	989,503	2,227,714
Clay	0.019	6.670	815,261	1,835,001
Clinton	0.070	29.041	2,628,196	5,923,538
Coles	0.058	29.238	2,379,546	5,358,422
Cook	3.413	1817.908	125,217,112	281,623,425
Crawford	0.021	8.270	928,662	2,090,815
Cumberland	0.016	5.485	632,737	1,425,129
De Kalb	0.086	52.703	3,110,956	6,987,729
Dewitt	0.027	9.961	1,180,508	2,658,029
Douglas	0.021	8.337	844,006	1,899,408
Du Page	0.894	413.092	28,619,779	64,387,190
Edgar	0.021	7.193	1,024,582	2,306,592
Edwards	0.008	2.786	325,804	733,986
Effingham	0.043	16.643	1,807,815	4,066,207
Fayette	0.035	14.665	1,309,679	2,953,056
Ford	0.017	5.469	837,546	1,885,637
Franklin	0.055	19.986	2,772,008	6,235,292

Fulton	0.092	34.076	4,154,044	9,354,972
Gallatin	0.011	3.490	539,461	1,213,796
Greene	0.013	4.353	491,996	1,108,059
Grundy	0.063	30.211	2,411,470	5,434,380
Hamilton	0.014	4.572	626,566	1,410,741
Hancock	0.013	3.753	492,106	1,108,255
Hardin	0.012	3.464	559,635	1,260,657
Henderson	0.007	1.912	282,984	638,123
Henry	0.058	20.090	2,259,696	5,091,156
Iroquois	0.032	10.325	1,428,096	3,215,093
Jackson	0.074	44.282	2,877,265	6,480,654
Jasper	0.027	9.223	1,143,653	2,573,358
Jefferson	0.050	18.785	2,255,644	5,078,066
Jersey	0.021	7.995	931,854	2,099,136
Jo Daviess	0.017	4.337	615,430	1,387,023
Johnson	0.034	12.861	1,305,400	2,941,004
Kane	0.504	256.861	15,495,024	34,795,965
Kankakee	0.094	40.246	3,952,450	8,891,426
Kendall	0.250	143.522	7,399,830	16,593,921
Knox	0.081	29.474	3,917,357	8,822,229
La Salle	0.199	74.164	8,901,800	20,049,493
Lake	0.543	259.632	17,733,630	39,935,537
Lawrence	0.017	7.948	790,235	1,780,979
Lee	0.046	17.577	1,863,746	4,217,654
Livingston	0.050	19.612	2,136,515	4,808,978
Logan	0.058	24.100	2,554,573	5,754,047
Macon	0.152	55.360	6,695,695	15,067,804
Macoupin	0.065	23.181	2,864,889	6,452,666
Madison	0.461	199.262	20,376,942	45,962,397
Marion	0.052	18.815	2,451,515	5,528,393
Marshall	0.030	9.296	1,308,505	2,947,140
Mason	0.036	11.785	1,654,001	3,725,257
Massac	0.215	71.711	10,210,853	22,926,134
McDonough	0.023	12.309	937,338	2,114,016

McHenry	0.212	99.593	7,298,286	16,455,510
Mclean	0.204	116.842	7,030,811	15,795,655
Menard	0.026	9.101	1,135,140	2,556,719
Mercer	0.013	3.975	537,961	1,211,287
Monroe	0.052	19.835	1,839,630	4,145,243
Montgomery	0.137	50.675	6,088,156	13,704,471
Morgan	0.037	13.781	1,549,697	3,491,294
Moultrie	0.021	7.490	954,359	2,148,479
Ogle	0.053	19.843	2,075,969	4,678,504
Peoria	0.986	438.670	40,209,597	90,246,641
Perry	0.029	11.862	1,258,929	2,836,783
Piatt	0.022	7.857	923,479	2,080,816
Pike	0.010	3.543	450,771	1,014,854
Pope	0.021	6.850	803,344	1,815,472
Pulaski	0.011	3.629	540,266	1,216,023
Putnam	0.029	9.325	1,101,680	2,481,541
Randolph	0.140	56.212	6,073,404	13,704,850
Richland	0.023	7.648	1,023,368	2,303,509
Rock Island	0.117	44.074	4,932,234	11,089,423
Saline	0.089	33.318	4,561,104	10,250,909
Sangamon	0.609	254.785	24,251,740	54,582,961
Schuyler	0.009	2.857	315,310	710,522
Scott	0.004	1.600	187,872	423,402
Shelby	0.042	13.466	1,627,628	3,665,878
St Clair	1.348	621.919	55,775,741	125,627,492
Stark	0.013	3.846	567,598	1,279,181
Stephenson	0.028	8.640	1,122,381	2,528,687
Tazewell	0.614	240.757	25,480,350	57,250,289
Union	0.040	13.877	1,898,806	4,274,723
Vermilion	0.073	28.399	3,435,886	7,724,176
Wabash	0.013	4.276	589,575	1,326,676
Warren	0.017	6.250	665,077	1,499,038
Washington	0.030	10.539	1,230,633	2,771,790
Wayne	0.025	8.673	1,158,825	2,608,246

White	0.028	8.466	1,397,539	3,144,237
Whiteside	0.044	14.700	1,881,843	4,240,171
Will	0.667	343.144	22,674,715	51,071,031
Williamson	0.253	102.260	11,152,920	25,080,092
Winnebago	0.170	70.994	7,064,611	15,950,369
Woodford	0.083	29.706	3,295,037	7,418,507