ILLINOIS JOBS AND CLEAN ENERGY

Protecting the Climate and the State Economy

LABOR NETWORK FOR SUSTAINABILITY

Synapse Energy Economics, Inc.

CONTENTS

The introduction, conclusion, and boxes on the New Era cooperative and the NAACP's energy policy proposals are by the Labor Network for Sustainability. The remainder of the report is by Dr. Frank Ackerman, Tyler Comings, and Spencer Fields at Synapse Energy Economics.

INTRODUCTION

This report presents a Clean Energy Future plan that reduces Illinois' greenhouse gas (GHG) emissions 80 percent below the 1990 level by 2050 – while adding more than twenty-eight thousand jobs.

Illinois has often been told that doing its share to save the earth's climate will threaten its workers' jobs. "Illinois Jobs and Clean Energy: Protecting the Climate *and* the State Economy" refutes that claim. This report lays out a climate protection strategy that will produce more than 28,000 net new jobs per year over business as usual projections through 2050. That represents almost 0.5 percent of total employment in the state, so it should reduce the unemployment rate by one-half percent. Three-quarters of the jobs created will be in the high-wage construction and manufacturing sectors.

The report also indicates that Illinois can use the burgeoning state and national demand for clean energy to create good, stable jobs in a growing climate protection sector: manufacturing jobs, jobs for those who have been marginalized in the current labor market, and jobs for skilled union workers in the construction trades.

This report was prepared by the Labor Network for Sustainability (LNS)[1] with research conducted at Synapse Energy Economics by Dr. Frank Ackerman, Tyler Comings, and Spencer Fields.[2] It is based on the national study "The Clean Energy Future: Protecting the Climate, Creating Jobs, and Saving Money" released in October 2015.[3] That study lays out an aggressive strategy for energy efficiency and renewable energy that will:

- Transform the electric system, cutting coal-fired power in half by 2030 and eliminating it by 2050; building no new nuclear plants; and reducing the use of natural gas far below business-as-usual levels.
- Reduce greenhouse gas emissions 86 percent below 1990 levels by 2050, in the sectors analyzed (which account for three-quarters of US GHG emissions).

[1] The Labor Network for Sustainability (http://www.labor4sustainabilty.org) was founded in 2009 based on an understanding that long-term sustainability cannot be achieved without environmental protection, economic fairness, and social justice. LNS believes we all need to be able to make a living on a living planet.
[2] Synapse Energy Economics (http://www.synapse-energy.com) is a research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power sector for public interest and governmental clients.
[3] Labor Network for Sustainability, "The Clean Energy Future: Protecting the Climate, Creating Jobs, and Saving Money" http://www.labor4sustainability.org/wp-content/uploads/2015/10/cleanenergy_10212015_main.pdf

- Pay for itself – the cost of electricity, heating, and transportation under this plan is $78 billion less than current projections from now through 2050.

- Create new jobs – more than 500,000 per year over business as usual projections through 2050.

The Clean Energy Future plan does not depend on any new technical breakthroughs to realize these gains, only a continuation of current trends in energy efficiency and renewable energy costs. Most of the additional jobs will be in manufacturing and construction. Such jobs tend to have higher wages and better benefits than average, providing new opportunities for American workers. Because some jobs will be lost in fossil fuel related industries, the report calls for a vigorous program to provide new, high-quality jobs and/or dignified retirement for those affected. The report also advocates deliberate policies to create new opportunities and job pipelines for those groups who have been most excluded from good jobs.

The national study covers the entire electric system, light vehicle transportation (cars and light trucks), space heating and water heating, and waste management. It assumes conversion of all gasoline-powered light vehicles and most space heating and water heating to 100 percent renewable electricity. This strategy achieves three-fourths of the total emissions reduction needed, nationally, to reach the 80 percent by 2050 target. "Illinois Jobs and Clean Energy" shows what this plan would mean for Illinois and what additional measures will make it possible for the state to reach an 80 percent reduction in GHG emissions by 2050.

1. CUTTING EMISSIONS AND CREATING JOBS

If Illinois was a separate country, its $745 billion economy would make it number 20 in the world – and its greenhouse gas emissions, an estimated 247 million metric tons (MMT) of CO_2-equivalent (CO_2e), would make it number 34 on the list of carbon-emitting nations.[4] Cutting these emissions by at least 80 percent will be essential in the effort to stabilize the climate and leave a sustainable environment to future generations.

At the same time, Illinois workers face a disappointing labor market. The state has been slower than the rest of the country and most of its Midwestern neighbors to recover from the financial crisis and recession of 2008-2009.[5] The ongoing decline of manufacturing has eroded employment in urban and industrial areas, while the recent plunge in grain prices has depressed the economy of rural Illinois.

[4] Wikipedia, "List of countries by GDP (nominal)" and "List of countries by greenhouse gas emissions". The estimate of 247 MMT of CO_2e emissions combines data for emissions from energy use in 2012 from the Energy Information Administration (EIA) and data for non-energy sectors in 2003 from the World Resources Institute state greenhouse gas inventory – in both cases, the latest available.
[5] Ameet Sachdev, "Weak growth continues to hammer Illinois economy", *Chicago Tribune*, December 22, 2014.

Strategies for reducing carbon emissions need to be combined with measures to create jobs and stimulate growth throughout the state.

This report examines options for reducing emissions while increasing employment. It is intended as a companion to the national Clean Energy Future study[6], and should be read in conjunction with that study.

The national Clean Energy Future study describes a scenario in which:

- Energy efficiency programs are greatly expanded
- A renewable portfolio standard (RPS) requires 70 percent renewable electricity nationwide by 2040
- Coal is phased out nationwide – half by 2030, entirely by 2050
- No new nuclear plants are built, while existing ones are phased out after 2030
- Electric vehicles replace all gasoline-powered cars and light trucks
- Electric heating replaces most fossil-fueled space and water heating

This Clean Energy Future scenario is compared to a Reference Case, assuming no new environmental policies or greenhouse gas reduction initiatives. (The two scenarios make similar assumptions about nuclear power, but diverge on most other issues.) In this report we explore the implications of the Clean Energy Future for Illinois, and then review available options for greater reduction in state emissions.

Illinois' role in the national Clean Energy Future does much but not all of what is needed to reduce state's emissions. Since state emissions were 231.3 million tons of CO_2e in 1990, the common target of 80 percent reduction by 2050 would mean getting down to 46.3 tons. Table 1-1 shows the reduction achieved by the Clean Energy Future, assuming that other emissions and sectors remain unchanged at their 2003 levels (the latest available comprehensive data for these sectors). While emissions are reduced by 91 percent in the sectors covered by the Clean Energy Future, this amounts to only a 52 percent reduction in the statewide total.

[6] As described in "The Clean Energy Future", a report from Labor Network for Sustainability, 350.org, and Synapse Energy Economics, available at http://www.labor4sustainability.org/wp-content/uploads/2015/10/cleanenergy_10212015_main.pdf.

	CO_2e (Million Metric Tons)		
	1990 Emissions	Clean Energy Future, 2050 or 2003 Actual	Percent Reduction from 1990 Emissions
Electric Power	56.9	6.0	89%
Cars & Light Trucks	33.3	0.9	97%
Residential (Space & Water Heating)	22.7	3.4	85%
Commercial (Space & Water Heating)	11.5	1.6	86%
Waste	13.4	0.0	100%
Total CEF Sectors	**137.8**	**11.9**	**91%**
Industrial	49.3	52.9	-7%
Agriculture	17.5	14.6	17%
Residential/Commercial Other	4.1	4.2	-2%
Transportation (Except Cars)	22.6	26.8	-19%
Total Other Sectors	**93.5**	**98.5**	**-5%**
State Total	**231.3**	**110.4**	**52%**

Table 1-1. Illinois GHG emissions: 1990 and projected 2050

To reach an 80 percent reduction in state emissions by 2050, substantial additional measures are needed, targeting emissions from industry, non-car transportation (largely trucking), and agriculture. Several feasible initiatives and ongoing trends could contribute to that goal, allowing Illinois to reduce emissions by more than 80 percent by 2050.

We begin with a description of the implications of the Clean Energy Future for the energy system and employment in Illinois, and then turn to additional options for emission reduction.

2. BUILDING CLEAN ENERGY

Illinois is a windy state, with more than 3,500 MW of wind capacity installed at present. Even in a Reference Case projection, with no new policies promoting renewable energy, that capacity is projected to more than triple, reaching 12,400 MW by mid-century. The Clean Energy Future will do much more, as shown in Figure 2-1, building 49 GW (49,000 MW) of wind capacity in the state. Despite the huge projected expansion, this is less than 20 percent of the technical potential for wind power in Illinois, according to the National Renewable Energy Laboratory (NREL).[7]

[7] Illinois has the technical potential for 250 GW of onshore wind capacity, and 16 GW of offshore wind, according to Anthony Lopez et al. (2012), "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis", http://www.nrel.gov/docs/fy12osti/51946.pdf. All of the projected Clean Energy Future wind capacity is onshore.

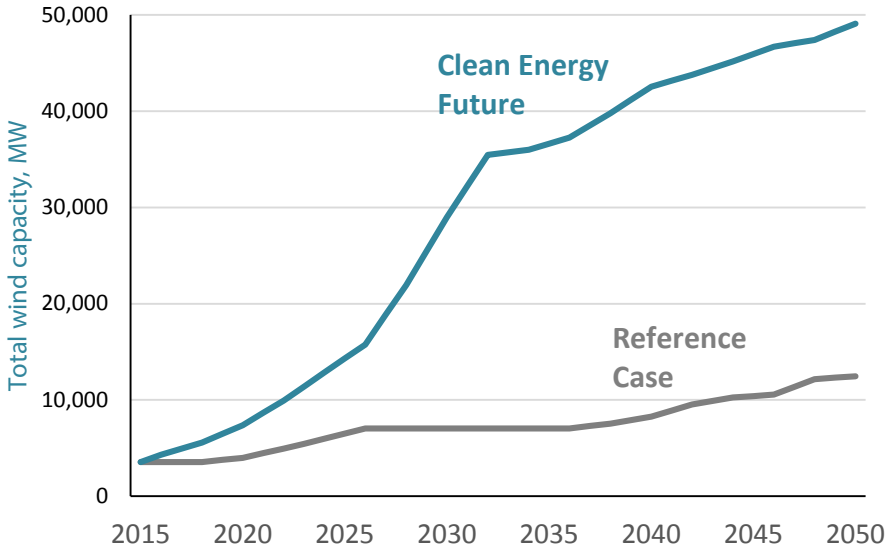

Figure 2-1. Wind power capacity in Illinois, 2015-2050

A similar comparison of the two scenarios for solar power is, if anything, more extreme. Starting from less than 100 MW of solar capacity today, Illinois is projected to install almost 2,000 MW of photovoltaic capacity by 2050 in the Reference Case – and almost 16,000 MW in the Clean Energy Future. Again, this is only a fraction of the state's technical potential for solar power.[8] As Figure 2-2 suggests, solar capacity is projected to soar in the 2030s, as nuclear capacity drops due to retirements, while solar power costs continue to decline.

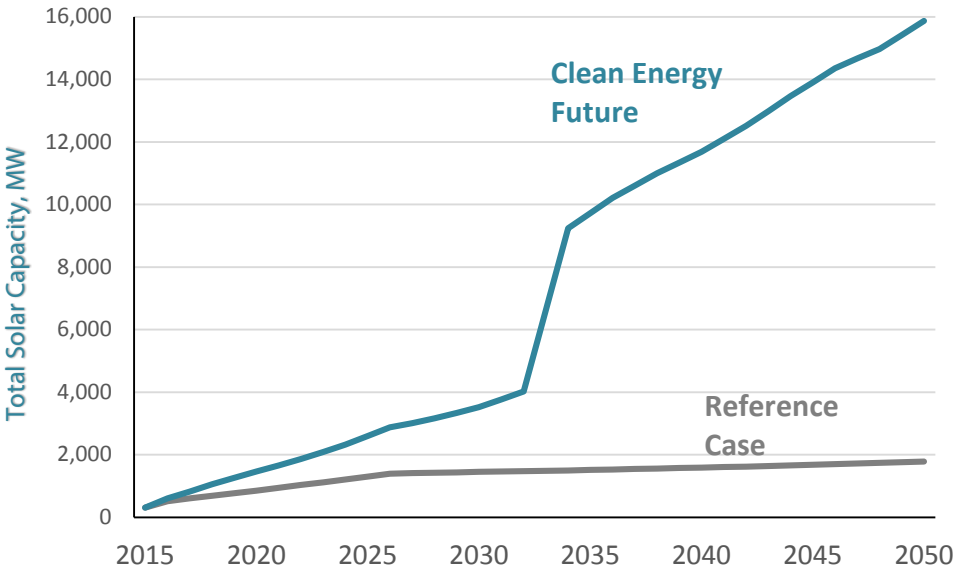

Figure 2-2. Solar power capacity in Illinois, 2015-2050

[8] Illinois has the technical potential for 26 GW of rooftop photovoltaics, and a staggering 4,969 GW of rural utility-scale photovoltaics; see Lopez et al. (2012).

For coal capacity the difference between the two scenarios is equally stark in the opposite direction, as seen in Figure 2-3. Illinois currently has 14,900 MW of coal plants, an amount that declines by only 10 percent over the next 35 years in the reference case. In the Clean Energy Future, half the state's coal capacity is gone by 2031, and the last coal plant closes in 2048.

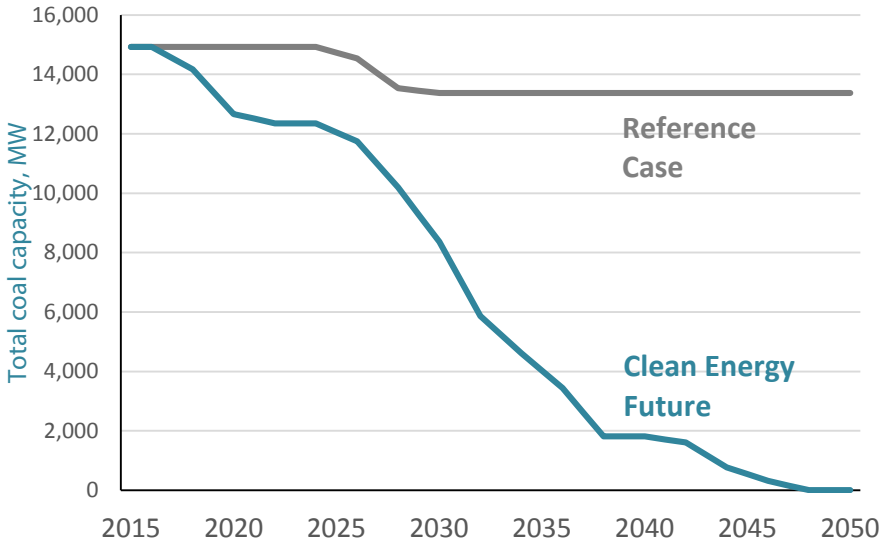

Figure 2-3. Coal plant capacity in Illinois, 2015-2050

The two scenarios are identical in their treatment of nuclear power (not shown here), retiring plants after 60 years in service. And in natural gas capacity, the two scenarios are identical until 2028, and barely differ until 2044, as shown in Figure 2-4. A spurt of construction in the 2040s then leaves the Reference Case with 11 percent more gas capacity than the Clean Energy Future by 2050. Nonetheless, the Clean Energy Future is replacing Illinois coal plants almost entirely with wind and solar power, not gas.

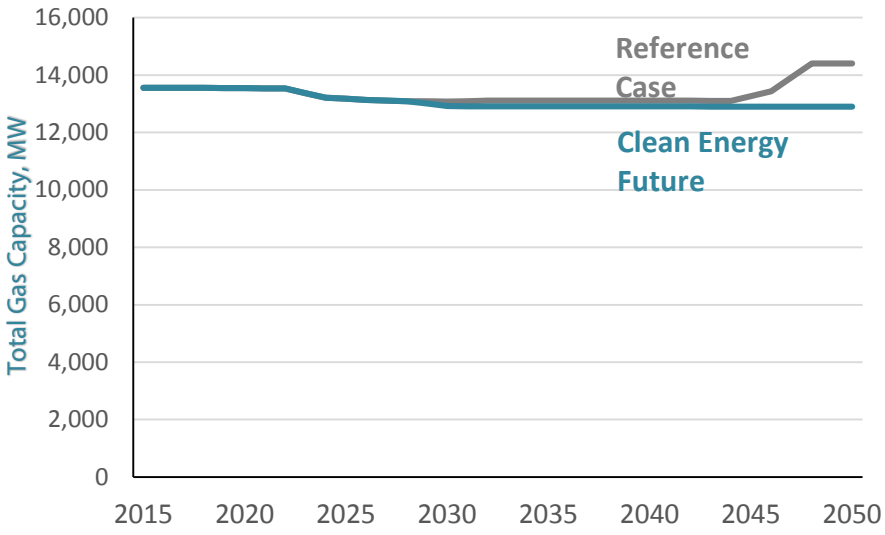

Figure 2-4. Natural gas power plant capacity in Illinois, 2015-2050

3. CLEAN ENERGY AND ILLINOIS JOBS

A Worker Coop Creates a "New Era" for Jobs and Energy Efficiency

In December 2008, Republic Windows and Doors in Chicago shut down and laid off 250 workers. Then the workers, with support from the United Electrical Workers union, did something that has happened rarely if ever in recent years: They occupied their factory and refused to leave. Amidst worldwide publicity, they not only won their immediate demands for vacation and severance pay; the union helped find a buyer who promised to reopen the plant with the existing workforce.

In 2012, the new owners threatened to close the plant. The workers held another occupation, organized a co-op, and reopened the plant under their own control. The workers renamed their company New Era, "as we hope it will be an inspiration for how future jobs can be created in America." They maintain that, "Everyone can participate in building the new economy we all want, and no one should be treated as temporary or just raw material for someone else's business."[9]

The New Era cooperative was established with support from the United Electrical Workers Union, the Center for Workplace Democracy, and Occupy Chicago (the local equivalent of Occupy Wall Street). It has received financing from The Working World, a loan fund that has financed dozens of worker-controlled factories in Latin America. New Era's 23 worker-owners produced half-a-million dollars' worth of energy-efficient windows and doors in 2014, and the business has been growing rapidly since. The workers hope to spawn other cooperatives, for example by encouraging drivers to form a coop to provide delivery services for the company.

The Clean Energy Future creates an annual average of 28,552 more jobs in Illinois, compared to the Reference Case. This is almost 0.5 percent of total employment in the state, as shown in Table 3-1. Three-quarters of the new jobs are in construction and manufacturing, the industries with the greatest percentage increases in employment.

Among the economic sectors shown in the table, only utilities and mining are projected to have net job losses under the Clean Energy Future. The losses in these sectors are less than 10 percent of the net job gains for the state as a whole.

[9] New Era Windows Cooperative, http://newerawindows.com/about-us/our-story

	2012 Employment	New Jobs in Clean Energy Future	
		Annual Average	As Percentage of 2012
Total, All Industries	6,166,236	28,552	0.46%
Above Average Growth			
Construction	188,916	11,258	6.0%
Manufacturing	582,735	10,080	1.7%
Wholesale Trade	294,361	1,976	0.7%
Management of Companies & Enterprises	102,494	614	0.6%
Real Estate, Rental & Leasing	71,962	398	0.6%
Below Average Growth			
Other Services	280,007	1,237	0.4%
Finance & Insurance	293,754	1,249	0.4%
Arts, Entertainment & Recreation	78,709	244	0.3%
Agriculture	76,292	190	0.2%
Information	100,018	248	0.2%
Health Care & Social Assistance	733,693	1,662	0.2%
Retail Trade	596,393	773	0.1%
Administrative & Waste Management Services	395,224	311	0.1%
Accommodation & Food Services	457,007	359	0.1%
Professional, Scientific & Technical Services	363,206	247	0.1%
Education	568,857	275	0.0%
Government	365,894	117	0.0%
Job Losses			
Transportation, Warehousing & Utilities	297,344	-647	-0.2%
Mining	10,137	-2,039	-20.1%

Table 3-1. New jobs in Illinois in the Clean Energy Future - all sectors

More detail on manufacturing jobs is shown in Table 3-2. Almost all of the 10,080 new jobs are in the top five branches of manufacturing: electrical equipment, transportation equipment, primary metals, machinery, and fabricated metal products. Among the branches of manufacturing shown here, only oil refining is projected to lose jobs.[10]

[10] The loss of only 5 percent of the jobs in refining may call for explanation. Refinery output and employment will be reduced, even in the Reference Case, due to the ongoing improvement in vehicle fuel economy and resulting reduction in demand for fuel. The Clean Energy Future involves sharper reductions in refinery output in the later years of the scenario, as electric vehicles become more important. But the annual average difference between the two cases in refinery jobs from 2016 to 2050, the number reported here, is still relatively small.

	2012 Employment	New Jobs in Clean Energy Future	
		Annual Average	As Percentage of 2012
Manufacturing, Total	582,735	10,080	1.7%
Above Average Growth			
Electrical Equipment & Appliances	23,938	1,819	7.6%
Transportation Equipment	39,722	2,014	5.1%
Primary Metals	19,718	534	2.7%
Machinery	82,098	2,033	2.5%
Fabricated Metal Products	94,525	2,314	2.4%
Plastics & Rubber	39,654	612	1.5%
Nonmetallic Mineral Products	12,762	192	1.5%
Paper	19,555	142	0.7%
Textiles, Apparel & Leather	8,332	40	0.5%
Below Average Growth			
Computers & Electronic Products	33,933	140	0.4%
Chemicals	44,918	152	0.3%
Printing	29,116	82	0.3%
Miscellaneous Manufacturing	28,750	60	0.2%
Wood Products	28,750	60	0.2%
Food Products	76,489	150	0.2%
Beverages & Tobacco	5,758	11	0.2%
Furniture	12,181	20	0.2%
Job Losses			
Petroleum Refining & Coal Products	5,395	-247	-4.6%

Table 3-2. New jobs in Illinois in the Clean Energy Future – Manufacturing
Note: "Above average" and "below average" categories are based on the average for all sectors, from Table 3-1.

The Clean Energy Future will help create good jobs in Illinois, but it is not enough, in the state or the country as a whole, to transform the economy and end unemployment. It is a positive contribution, which could be one of several parts of a broader jobs strategy for the twenty-first century.

From national to state employment estimates

Estimates of Illinois employment from the Clean Energy Future were derived from the national study estimates.[11] The national study used NREL's ReEDS model to project expansion plans for the electric system, and then applied the IMPLAN model to calculate the resulting employment impacts. IMPLAN reports three categories of employment: direct jobs (such as construction workers who install wind turbines); indirect jobs created at suppliers (such as the steel mill workers who make steel for the turbine blades); and induced jobs (created when the construction workers and steel mill workers spend their paychecks, stimulating other industries).

For direct jobs, we used the actual location of existing and projected new energy facilities, as reported by the ReEDS model. Direct jobs are created in Illinois to construct and operate energy facilities located in the state, as estimated by ReEDS. For indirect and induced jobs, we assumed that jobs in each industry would be distributed in proportion to current employment. For example, Illinois currently has about 6.5 percent of national employment in fabricated metal products manufacturing. So 6.5 percent of all new indirect and induced jobs in fabricated metal products are assumed to be located in Illinois – regardless of where the demand for these products originates.

4. OPTIONS FOR DEEPER REDUCTIONS

To achieve an 80 percent reduction in state emissions, Illinois will have to go beyond the Clean Energy Future scenario described here. As seen in Table 1-1, big cuts will be needed in industrial emissions, non-car transportation, and agriculture. A reduction of roughly two-thirds in each of these sectors below 2003 levels, combined with the Clean Energy Future scenario, would reach the 80 percent reduction target.

This section addresses options for emission reductions in each of the three remaining sectors, along with a fourth area, sequestration of carbon in forests and soils, which has often been important in greenhouse gas accounting.

a. Industrial Emissions

Industrial emissions of greenhouse gases in Illinois amounted to 52.9 MMT of CO_2e in the 2003 (latest available) statewide inventory, as shown in Table 1-1. Of this amount, 5.1 MMT consisted of so-called "F-gases" – the high global warming potential gases, such as hydrofluorocarbons (HFC), widely used in the past in refrigeration and air conditioning systems.[12] Fortunately these gases are being rapidly replaced by substitutes with much lower impacts on global warming. The Chicago Climate Action Plan, adopted in 2008, projected that the city would entirely phase out the use of HFCs by 2020, reducing emissions by 1.16 MMT CO_2e.[13] There is a need for continued care in capture and disposal of F-gases when older equipment is retired, but these gases do not represent an ongoing or growing threat.

[11] See http://www.labor4sustainability.org/wp-content/uploads/2015/10/cleanenergy_10212015_main.pdf for the national study and http://synapse-energy.com/CEF_Appendix for the technical appendix.
[12] "Report of the Illinois Climate Change Advisory Group", 2008, p.16.
[13] Chicago Climate Action Plan, 2008, http://www.chicagoclimateaction.org/filebin/pdf/finalreport/CCAPREPORTFINALv2.pdf.

The remaining total in the inventory is 47.8 MMT of industrial emissions. EPA data for 2014 show Illinois emissions of 38 MMT from large facilities, or 80 percent of the state inventory total for industry.[14] (The inventory is for a different year, so the two numbers may not be directly comparable.) The EPA data include 2.6 MMT from coal mines, and 2.1 MMT from oil and gas production and distribution; the remainder, i.e. the state's emissions from major facilities excluding energy extraction, is about 33 MMT.

Remarkably enough, 13 giant facilities, each with annual emissions of at least 500,000 tons, accounted for more than 24.2 MMT, as shown in Table 4-1. This baker's dozen of monster emitters represent a large fraction of Illinois emissions by any standard: about 10 percent of all state emissions, and half of the industrial emissions in the state inventory. A strategy for reducing the state's emissions will have to address these facilities, in specific, along with other measures.

Industry	Company	City	MMT CO_2e
Refineries			10,550,223
	Phillips 66	Roxana	4,349,288
	ExxonMobil	Channahon	2,491,372
	PDV	Lemont	2,040,905
	Marathon	Robinson	1,668,658
Food Industry			7,182,063
	Archer Daniels Midland	Decatur	4,730,781
	Tate & Lyle	Decatur	880,184
	Ingredion	Bedford Park	867,596
	Archer Daniels Midland	Peoria	703,502
Other Industries			6,534,306
Steel	US Steel	Granite City	3,607,239
Chemicals	3M	Cordova	1,230,377
Fertilizer	Rentech Nitrogen	East Dubuque	626,657
Biofuels	Aventine Renewable Energy	Pekin	541,088
Coke	Gateway Energy & Coke	Granite City	528,945
Total			**24,266,592**

Table 4-1. Biggest industrial GHG emitters in Illinois, 2014
Source: http://ghgdata.epa.gov/ghgp/main.do

The four refineries, with 10 million tons of emissions, are already slated to decline: slowly in the Reference Case, as improvement in fuel economy reduces the demand for oil; much more rapidly in the later years of the Clean Energy Future, as vehicles powered by renewable electricity drive internal combustion engines off the road.

Energy use at the food industry giants is a topic worthy of research on its own. All four of these plants have their own coal-fired cogeneration plants, generating both electricity and heat – which are not counted as

[14] Calculated from http://ghgdata.epa.gov/ghgp/main.do, excluding power plants and waste management facilities. Since 2010, facilities with GHG emissions exceeding 25,000 tons have been required to report those emissions to EPA.

part of the state electricity system in our Clean Energy Future, or most other analyses. Switching these cogeneration plants to other fuels, as well as seeking to reduce energy needs in the food industry, will be important goals. That is, in parallel with the elimination of coal use by electric utilities, addressed in the Clean Energy Future, there is a need for elimination of coal use in industries, such as the Illinois food products industry.

Finally, the other big facilities represent a scattering of industries. A blast furnace from the past – one of the nation's largest steel mills – plus a company that supplies it with coke are located in Granite City, near St. Louis. The other three produce specialty chemicals, nitrogen fertilizer, and ethanol. Changes in technology and reduction in energy use and emissions are possible in each of these industries.

b. Trucking and Transportation

Transportation, excluding cars and light trucks, was responsible for 26 MMT of GHG emissions in the 2003 inventory. Most of this comes from trucking. State policies that could affect trucking emissions include support for switching to rail or barge freight transport, and measures to reduce truck idling. Federal policies that affect fuel economy in trucking could also have a large impact in the long run.

A significant fraction of tractor-trailer emissions occur when the engine is idling at truck stops. "Illinois Green Fleets", sponsored by the Illinois Environmental Protection Agency, suggests a series of measures to provide power more efficiently to trucks, including truck stop electrification facilities, and upgrades to trucks to provide auxiliary power without running the engine.[15]

The heaviest trucks on the road, Class 8 tractor-trailers, account for most trucking emissions. Federal fuel efficiency standards for trucks have just begun to take effect; Phase 1 standards require 6 percent improvement in fuel efficiency by the 2017 model year.[16] Phase 2 standards, which have been proposed but not adopted, will require an additional 18 to 24 percent improvement beyond 2017 levels by 2027.[17]

A number of innovative companies, spurred by the Department of Energy's Supertruck program, have already demonstrated that much more can be done. Tractor-trailers on the road average about 6 mpg today, and business-as-usual projections from the Energy Information Administration reach only about 8 mpg in 2050. In contrast, new, ultra-aerodynamic "Supertruck" prototypes have already achieved 10 – 13 mpg under actual highway conditions.

[15] See http://www.illinoisgreenfleets.org.
[16] EPA and NHTSA (2011), "Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles", p.5-7. (A wide range of standards are developed for different classes of trucks; this is the CO_2 emission reduction required from Class 8 truck engines under Phase 1.)
[17] EPA and NHTSA (2015), "Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engings and Vehicles-Phase 2", page ES-13.

If the average tractor-trailer on the road in 2050 is as efficient as today's Supertruck prototypes, and comparable improvements are made in other classes of trucks, then future trucking emissions could be reduced to half of today's levels. Even more than that could conceivably be done to improve fuel economy and lower truck emissions, with another 35 years of technological development.

In other modes of transportation, Chicago is an important but notoriously congested railroad hub. The 2008 Chicago Climate Action Plan noted that moving a freight train through the Chicago area can take as long as the entire trip from Los Angeles, and estimated that improvements in infrastructure and removal of rail bottlenecks could reduce freight transport GHG emissions by 1.6 MMT by 2020.

c. Agriculture

Agriculture was responsible for 14.6 MMT of greenhouse gases in the 2003 Illinois inventory. There are three principal sources of emissions from agriculture: nitrous oxide (N_2O) emissions, largely from nitrogen fertilizers; methane from "enteric fermentation" (a formal name for cattle burping); and methane escaping from manure ponds. Most of Illinois agricultural emissions, almost 11.8 MMT, are nitrous oxide, according to the inventory.[18]

Each of the three big categories of agricultural emissions can be reduced by modest changes in agricultural practices. Research on corn farming in the Midwest has found that careful calibration and timing of fertilizer application can reduce nitrous oxide emissions by up to 50 percent.[19] Enteric fermentation can be reduced by the use of modified feed mixtures for cattle. Methane emissions from manure ponds can be captured and used as a fuel.

Changes in the choice of crops and livestock produced in the state can also affect emissions. Per capita beef consumption in the United States is beginning to decline; if this trend continues, emissions from agriculture will decline as well. Even compared to other sources of animal protein, beef is an outlier: greenhouse gas emissions from beef production are five times as high as from production of the same number of calories from poultry, pork, dairy products or eggs.[20]

Climate change itself may dictate some changes in cropping patterns, as rising temperatures will reduce yields in traditional crops and livestock, particularly in southern Illinois. The *Risky Business* project, an in-depth examination of the expected impacts of climate change on the United States, observed in its Midwest

[18] "Report of the Illinois Climate Change Advisory Group" (2008), p.16.
[19] Neville Millar, G. Philip Robertson, Peter R. Grace, Ron J. Gehl and John P. Hoben (2010), "Nitrogen fertilizer management for nitrous oxide (N_2O) mitigation in intensive corn (Maize) production: an emissions reduction protocol for US Midwest agriculture", *Mitigation and Adaptation Strategies for Global Change* 15, 185-204.
[20] Gidon Eshel, Alon Shepon, Tamar Makov and Ron Milo (2014), "Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States", *PNAS* 111, 11996-12001.

report that due to warming temperatures, Illinois "will likely suffer significant corn yield losses by mid-century absent adaptation", with likely losses of up to 20 percent in the next 25 years. Livestock production is also affected, since "increased body temperatures of 4°F to 5°F above optimum levels can disrupt performance, production, and fertility, limiting an animal's ability to produce meat, milk or eggs."[21]

As temperatures increase there will be a need for new, heat-resistant varieties of today's crops, or for a shift toward more heat-tolerant crops such as tomatoes, peppers and beans. This could potentially be part of a strategy to develop more diversified local food supplies, as an alternative to the current focus on corn, soybeans and livestock.

d. Carbon sequestration

Plants grow by absorbing carbon dioxide from the atmosphere, potentially offsetting emissions in other sectors. For this reason, an estimate of net forest growth is often included in greenhouse gas inventories as a negative emission, or offset to emissions. EPA's national greenhouse gas inventory includes a substantial estimate for forest carbon sequestration, although state inventories do not always include this category. It is widely recognized as more uncertain, with lower quality data than in other areas of emissions accounting. Nonetheless, it remains important in overall carbon balances.

A 2004 report for the Illinois Forestry Development Council estimated, apparently based on 1985-1998 data, that the total carbon mass in the state's forest ecosystems grew by 4.9 MMT CO_2e per year.[22] A very similar rough estimate can be developed by another means: the US GHG Inventory reports total carbon sequestration of 871 MMT of CO_2e in 2013. If that sequestration benefit is proportional to each state's forested area, the amount of it occurring in Illinois would be 5.1 MMT.[23]

Thus despite some uncertainties about the data, two distinct sources suggest that there is about 5 MMT of forest sequestration per year in Illinois. Future policies that increase, or decrease, the rate of forest growth could have an important effect on the state's net emissions.

[21] Risky Business Project (2015), "Heat in the Heartland: Climate Change and Economic Risk in the Midwest", pp. 16, 17, 18.
[22] Lyle J. Guyon and John M. Edgington (2004), "Illinois Report on Sustainable Forest Management: Criteria and IndicatorsL", http://ifdc.nres.illinois.edu/wp-content/uploads/2013/10/sm-guyon_edgington_IFDC_2004.pdf, pp.28-29. Data in that report are expressed in tons of carbon, and have been multiplied by 44/12 to convert to tons of CO_2e. Estimates in the report for sequestration in long-lived wood products have been excluded.
[23] Illinois has 4.4 million acres of forests today (see https://web.extension.illinois.edu/forestry/il_forest_facts.html), or 0.59 percent of the U.S. total of 747 million acres (Wikipedia entry, "Forests of the United States"). If the benefits of sequestration are distributed in proportion to forested area, then Illinois should have 0.59 percent of the national sequestration benefit, or 5.1 MMT.

LABOR, RACIAL EQUALITY, AND THE CLEAN ENERGY ECONOMY

The Clean Energy Future implies a reorientation of the Illinois economy, and a move toward reindustrialization. Employment in a few industries, such as coal mining, utilities and oil refining, will decline. These declines will be outweighed by much larger gains, concentrated in construction and in metals, machinery and electronics manufacturing. The boom in construction will range from small firms engaged in energy efficiency upgrades and solar panel installation throughout the state, to large firms with the equipment and experience needed to build massive, complex structures such as wind turbines.

Further changes may occur in response to climate change and other trends, particularly in agriculture and in food processing industries. Farming is part of the solution: low-carbon agriculture requires important but unthreatening changes in key practices, such as more limited and precisely targeted application of nitrogen fertilizers. At the same time, farming cannot escape the problem: Illinois farms will need to adapt to a warming world, at the least, by switching to more heat-tolerant crop varieties – and may even find it desirable to switch to different, warmer-temperature crops. This could require corresponding changes in the industries that convert crops into products such as ethanol and corn syrup. The Clean Energy Future is, above all, a vision of industries and technologies transformed by the need to address the central ecological crisis of our time.

Most of the discussion so far has been expressed in terms of total numbers of jobs. It is reasonable to wonder who will get the jobs created by clean energy. What does the reduction of carbon emissions and the conversion to renewable energy imply for minorities?

Our modeling of the Clean Energy Future scenario does not explicitly address the important issue of racial inequality. Nonetheless, the Clean Energy Future creates jobs in industries that have historically been of great importance to African-American employment and incomes, and have been central to the past successes of the labor movement. Most of the jobs it creates are in manufacturing and construction; within manufacturing, the new jobs are concentrated in heavy industry.

These are the sectors that built the industrial cities of the Northeast and the Midwest, the areas now sadly known as the Rust Belt. In their heyday, for the first three-quarters of the twentieth century, these were the industries that inspired the Great Migration of African-Americans out of the cotton fields, into the factories of Chicago, Detroit and dozens of other cities across the region. Though the new jobs and Northern cities were far from perfect, they offered better wages and greater opportunities for advancement than the agrarian economy and Jim Crow society of the South at mid-century.

NAACP Just Energy Policies for Illinois

Recommendations from the NAACP report *Just Energy Policies: Reducing Pollution and Creating Jobs*[24]:

Renewable Portfolio Standards
Illinois has a mandatory renewable portfolio standard of 25% by 2025-2026, along with technology requirements which mandate that wind and solar comprise 20.25% of electricity sales by 2025-2026. The state is on track toward clean energy leadership; as it meets the minimum recommended level, it should consider increasing its ambition.

Energy Efficiency Resource Standards
Illinois has mandatory energy efficiency resource standards (EERS) that ramp up to a 2% annual reduction, over the previous year's retail electric sales, in 2015. In the future, the state will hopefully expand its EERS beyond the 2% target to achieve even greater savings.

Net Metering Standards
Illinois has new net metering policies that require electric utility companies to provide various credits for systems with up to 2 MW capacity. Nevertheless, new rules complicate the utility-ratepayer relationship under net metering, by introducing different sets of rules for different sets of customers. Illinois should simplify its rules and allow larger customer-level systems, up to at least 2 MW, to access the same incentives as smaller systems. Illinois has expanded statewide net metering limits from 1% to 5% of a utility's peak demand, but should ideally expand the statewide limit even further, or eliminate it.

Local Hire
Illinois energy policy lacks a local hire provision. Establishing a local hire provision for energy projects would significantly increase the reinvestment of tax dollars into the local economy, and would provide local jobs to enable more people to work near where they live.

Minority Business Enterprise
Illinois's Business Enterprise Program, run by the state's Department of Central Management Services (CMS), certifies disadvantaged business enterprises (DBEs). CMS certifies DBEs including minority entrepreneurs, businesses owned by persons with disabilities, and women-owned businesses for state procurement and other opportunities. CMS has set a goal for 20% of contract dollars, and has achieved 27.7% for contracts subject to the goal. More could be done; the state could show leadership by setting aside further funds, which would guarantee awards of a minimum portion of state procurement funds to DBEs. Additionally, Illinois could expand training opportunities under its existing programs, and could establish a proactive notification system to alert DBEs to procurement opportunities to supplement its current registry of DBEs, across all sectors, including the energy industry.

The sectors that benefit most from the Clean Energy Future are the industries in which the labor movement thrived. The victories of industrial unionism ensured relatively high wages in the auto, steel, and other heavy industries. Although the labor movement has a less than perfect record on racial equality, it did a better job and responded more quickly than many institutions in American society. Strong unions pushed for equal pay for equal work, narrowing racial inequality in unionized industries. The more recent decline of these unions and industries is an important cause of the worsening economic prospects for minority workers, particularly for those without higher education.

The Clean Energy Future does not automatically recreate the equalizing tendencies of mid-20th century

[24] http://action.naacp.org/page/-/Climate/JustEnergyPolicies%20ILLINOIS%20REPORT--FEBRUARY%202014.pdf.

industries and unions. But it expands exactly the same sectors of the economy, creating a surge of employment, of varying skill levels, in the industries that the labor movement has most successfully organized in the past. In place of jobs at Wal-Mart or McDonald's, the Clean Energy Future offers jobs building and installing wind turbines, making electric cars, and constructing countless energy efficiency measures.

Nothing is guaranteed; employers will push to weaken or eliminate unions, and to lower wages, whenever possible. But the Clean Energy Future allows the fight over equal treatment, better conditions and higher wages to occur in the arena where labor and minorities have historically done best.

CONCLUSION: ILLINOIS CAN DO IT!

Illinois' Clean Energy Future, as laid out in this report, represents a practical plan to reduce GHG emissions 80 percent by 2050 – the minimum reduction that climate scientists say is needed to limit climate catastrophe. It shows that climate protection will produce at least twenty-eight thousand more jobs than continuing on a fossil fuel "business as usual" pathway, most of them well- paid, family-supporting jobs in manufacturing and construction.

The Clean Energy Future plan provides a floor, not a ceiling, for what can be accomplished. It shows that meeting our climate goals will create more jobs. But we can, and indeed should, do more. For example, the plan uses only 20 percent of Illinois' technical potential for wind power; faster growth of wind power could reduce GHG emissions even farther – while creating even more manufacturing and construction jobs. Illinois can achieve such goals just by accelerating and adjusting the same basic plan.

Illinois can achieve many of its other goals while implementing an aggressive climate protection plan, but to realize these "co-benefits" it will need policies designed to do so:

- The Clean Energy Future will entail the creation of more than twenty-eight thousand new jobs. But will they be good jobs? We need to design our climate protection plan to maximize the number of secure, permanent jobs with education, training, and career advancement. We need to institutionalize economic planning that will provide sustained, orderly development for an expanding climate protection sector and prevent boom-and-bust cycles that are devastating for workers and employers.

- Since the current deterioration in the quality of jobs is directly related to the reduction in the size and bargaining power of labor unions, reinforcing the right of workers to organize and bargain collectively should be an explicit part of public policy for climate protection.

- In an anti-labor political climate, with past union gains under attack, even the best blue-collar jobs in construction and manufacturing – the kind of jobs created by the Clean Energy Future – are at risk of insecurity and declining wages. Good jobs only became good when workers organized to defend their rights, their wages, and working conditions. Today, in addition to creating jobs, we need to ensure that they are jobs with justice.

- About three thousand jobs in mining and utilities will be lost in the Clean Energy Future. That's less than one-tenth as many as will be added in the rest of the economy. But the workers in those jobs must not be thrown on the scrapheap. We need a vigorous program to provide new, high-quality jobs and/or dignified retirement for workers in those industries. State energy policy should require that utilities make new jobs available to any workers adversely affected by climate protection; that utilities fund a program to assist any workers they do not reemploy; and that utilities negotiate transition plans with their employees.

- The Clean Energy Future plan opens up new opportunities to counter racial, gender, geographic and other inequalities. Climate protection programs should include earmarking of funding, renewable energy and energy efficiency, and jobs for low-income communities, and communities of color.

The Clean Energy Future represents a pathway away from climate destruction that is also far better for workers than our current pathway based on fossil fuels. Illinois can start moving now to gain its share of the benefits of the Clean Energy Future. "Illinois Jobs and Clean Energy" shows it can be done.