

Soot to Solar

Illinois' Clean Energy Transition

HIGHLIGHTS

Illinois has bolstered its energy policy leadership with the Future Energy Jobs Act, which strengthens state renewable electricity and energy efficiency targets.

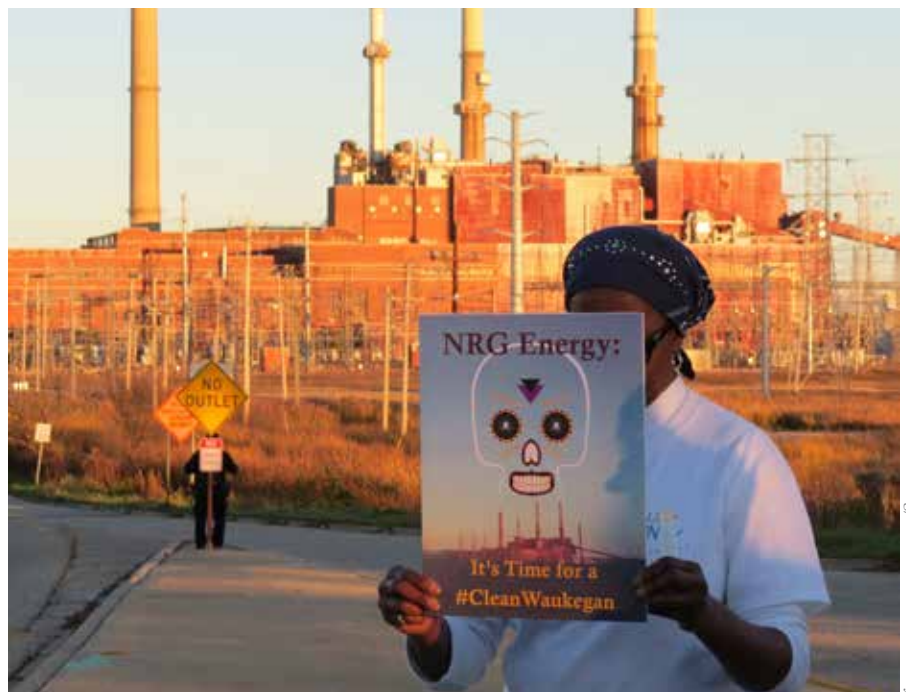
The faster the state can retire its aging, inefficient coal plants—a critical step in the clean energy transition—the greater the benefits will be for communities across the state.

This analysis quantifies the public health and economic benefits, carbon pollution reductions, air quality improvements, and social equity gains that could result from replacing coal power plants in Illinois with renewable energy, energy efficiency, and energy storage. It also outlines the steps communities, utilities, and policymakers can take to build on this momentum and lead the region to a new sustainable energy future.

Clean energy is poised for rapid growth in Illinois thanks to the Future Energy Jobs Act (FEJA), Illinois Public Act 99-0906. Passed in December 2016, FEJA improved the state's existing Renewable Portfolio Standard and increased the state's Energy Efficiency Portfolio Standard. The resulting growth in energy efficiency and renewable energy can replace generation from retiring coal plants and allow Illinois to benefit from the federal wind and solar tax credits before they expire.

Coal and nuclear power have historically dominated Illinois' power sector. As in many other states, however, the economic competitiveness of Illinois' aging and inefficient coal power plants is in decline. Coal's share of Illinois' electricity generation decreased from 47 percent in 2007 to 32 percent in 2016. During that time, 21 generators at 12 coal plants were retired.¹

As Illinois moves away from coal, investments in the state's diversity of renewable energy resources are increasing. With 4,464 megawatts (MW) of wind currently installed, enough to cover the needs of more than 1 million households, the state ranks sixth in the nation. Another 473 MW of wind power are under construction as of August 15, 2018. Illinois currently has close to 90 MW of installed solar in the state, enough to power more than 12,700 Illinois homes. The opportunity for growth in Illinois solar is strong, as it represents only 0.07 percent of the state's electricity generation, as of August 15, 2018.



Lisa Long/Clean Power Lake County

Peggy Jones, a Waukegan resident, joined faith leaders and more than 150 local residents in a march and vigil for environmental justice to commemorate Día de los Muertos in November 2015. Participants called on NRG Energy to set a retirement date for its Waukegan coal power plant.

The more quickly Illinois transitions to clean energy and energy efficiency, the greater the public health and economic benefits for local communities across the state.

The Union of Concerned Scientists (UCS) conducted this analysis to gauge the public health, economic, and social equity gains that could result by replacing coal power plants in Illinois with clean energy technologies such as wind, solar, energy efficiency, and energy storage. The more quickly Illinois closes its aging, polluting coal plants and transitions to clean energy and energy efficiency, the greater the public health and economic benefits for local communities across the state. UCS also wants to help ensure that the clean energy transition in Illinois benefits pollution-burdened and lower-income communities. Communities of color in particular have historically faced environmental injustices including disproportionate exposure to toxic air pollutants such as coal plant emissions.

This analysis examines five coal plants in Illinois through case studies on the costs and benefits of a replacement strategy that prioritizes local renewable energy sources combined with energy storage. We hope that this analysis will help local communities fully capitalize on new Illinois solar programs; strengthen community voices calling for clean energy; aid in efforts to retire old, polluting coal plants in communities; and support the redevelopment of former coal plant sites that resonates with communities' values and needs.

Methodology

UCS conducted a multi-layered analysis of Illinois' energy future, evaluating scenarios before and under FEJA as well as two scenarios including additional coal plant retirements. Using the Regional Energy Deployment System (ReEDS)—a power-sector model developed by the National Renewable Energy Laboratory—we analyzed four scenarios:

- **Pre-FEJA baseline:** assumes existing policies without FEJA and the early retirement of the Clinton and Quad Cities nuclear power plants.
- **FEJA scenario:** assumes existing policies including FEJA, with its subsidy for and continued operation of Quad Cities and Clinton nuclear plants.
- **Waukegan and Edwards coal plant retirements:** Layers over the FEJA scenario and retires both the Waukegan and Edwards coal plants early.² Both plants are also

examined in the case studies accompanying the full report (online at www.ucsusa.org/soottosolar).

- **Dynegy-Vistra coal plant retirements:** Layers over the FEJA scenario and retires all eight of Dynegy-Vistra's financially struggling MISO plants before the end of their expected design lives.³

To look more deeply at how coal plant retirements can present opportunities for shifting to clean renewable energy, we modeled the solar and energy storage potential at the Waukegan plant site and within the community. To determine whether there would be any reliability issues with the retirement of the existing Waukegan generation, we contracted PowerGEM to conduct a grid reliability study. Lastly, we partnered with the Clean Air Task Force to conduct a public health analysis of Illinois coal plants.

In this analysis we found that Illinois is on track to a cleaner electricity sector. With additional coal plant retirements this transition will accelerate, improving public health and spurring new investment in local communities across the state. The transition to renewable energy, energy storage, and energy efficiency also lowers household electricity bills, reduces carbon emissions, and leads to a more diversified portfolio of cleaner energy resources in the state's electricity mix.



Illinois ranks sixth in the nation for wind power, with 4,464 MW installed and another 473 MW under construction. The Future Energy Jobs Act will add another 1,300 MW of new wind capacity to the state by 2030.

Dori/Creative Commons (Wikimedia Commons)



Solar power represents only 0.07 percent of Illinois' electricity generation, giving this clean energy resource tremendous opportunity for growth in the years ahead. Indeed, nearly 90 MW of solar are installed in the state, but the Future Energy Jobs Act is poised to increase new solar capacity by more than 3,400 MW.

Adverse public health impacts decrease if coal plants are retired sooner:

- Retiring the Waukegan and Edwards coal plants before 2030 avoids an estimated cumulative total of 104 incidents of chronic bronchitis, 124 cardiovascular and respiratory hospital admissions, 178 asthma-related emergency room visits, 264 heart attacks, and 431 premature deaths.
- The pre-2030 retirement of six Dynegy-Vistra units avoids an estimated cumulative total of 260 incidents of chronic bronchitis, 278 cardiovascular and respiratory admissions, 408 asthma emergency room visits, 592 heart attacks, and nearly 1,000 premature deaths.

Solar plus energy storage brings multiple benefits:

- The analysis shows that building additional new renewable energy capacity and energy efficiency measures under FEJA will drive \$1.3 billion in energy efficiency improvements⁴ and \$3.4 billion in capital investments in Illinois.
- As a result, total installed renewable energy capacity in Illinois is projected to reach more than 8,890 MW by 2030 under successful implementation of FEJA.
- Renewables, storage, and energy efficiency can play a major role in replacing the generation from the Waukegan and Edwards coal plants and the eight MISO Dynegy-Vistra coal plants. The new technologies would allow Illinois to reduce emissions by 33 to 51 percent by 2030 in the coal plant retirement scenarios and would save consumers an average of \$93 to \$102 per year on their electricity bills.

- A combination of solar, storage, and load reduction through energy efficiency could provide a stable supply of electricity at the closed plant site and the surrounding area in Waukegan. The benefits of investing in a utility-scale energy storage system to replace the existing Waukegan plant exceed the costs, and this approach represents a practical, economical option that takes into account land availability, electricity reliability issues, and environmental concerns.

No reliability issues emerge upon the closure of the Waukegan coal plant:

- We found that the combination of solar, storage, and load reduction through energy efficiency can provide a stable supply of electricity to replace existing generation at the Waukegan plant.
- The existing oil-burning combustion turbines at the Waukegan plant were installed in 1968 and are currently used only a few hours per year, making a storage plant far more economical in terms of total life cycle cost. The life cycle cost of deploying a storage peaker plant is lower than replacing the old combustion turbines with new ones of the same size.
- The Waukegan coal plant can be closed with no impacts on electricity reliability. The on-site combustion turbines can also be retired and replaced with energy storage while maintaining local reliability.
- Replacing the existing Waukegan plant with local investments in energy efficiency, solar, and energy storage will provide significant public health and economic benefits for residents and businesses, with no adverse impacts on reliability.

Community engagement is important in planning for a clean energy transition:

- In the five case studies included in this report, we explore the community-level economic, public health, and land impacts at three closed plant sites (Crawford, Fisk, and Wood River) and at two operating plant sites

Illinois is on track to a cleaner electricity sector. With additional coal plant retirements this transition will accelerate.

(Edwards and Waukegan) with the support and input from community groups in the respective areas. We collaborated with community members and organizations to ensure that local voices are at the center of the conversation about redeveloping coal plant sites and the need to develop fair and equitable transition plans.

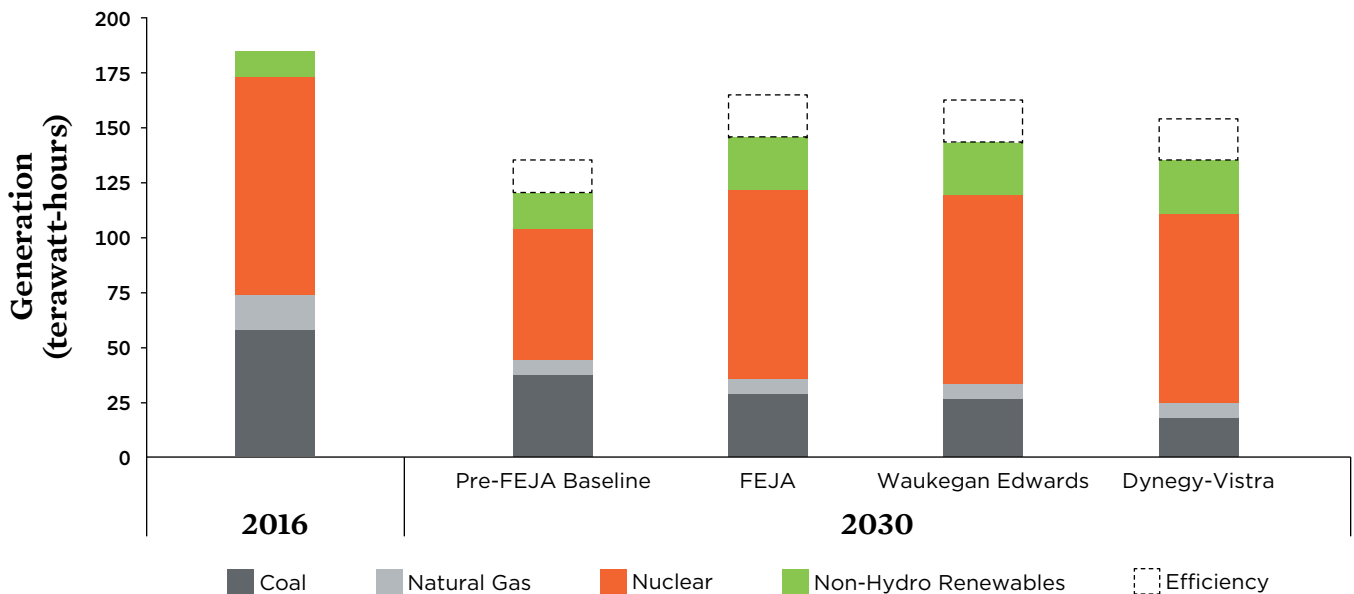
- The impact of a coal plant closure is different in each community, but clean energy is often part of the solution for community members and elected officials interested in job creation and tax revenues.
- Communities face several shared challenges to site reclamation and reuse of coal plant sites, including those associated with a decreased tax base and varying degrees of job loss. Redevelopment is complicated, since it takes place through a continuum of actions that are controlled by public, private, and community actors.
- Community groups are developing strategies to work with municipalities to build capacity to plan for the closure, facilitate transparent stakeholder engagement, and create a streamlined redevelopment process that maximizes benefits to the community.

Public Health and Economic Benefits of Renewable Energy

In all scenarios modeled, renewable energy generation and energy efficiency increase when coal generation is retired (Figure ES-1).

- **By implementing FEJA and retiring coal plants, Illinois achieves a cleaner and more diversified generation mix.** In the FEJA scenario, both renewable generation and energy efficiency increase to meet the state’s renewable and efficiency targets. Renewable generation rises to 17.9 percent of electricity sales in 2030. Nuclear energy is also higher in the FEJA scenario compared with the pre-FEJA baseline scenario due to the Clinton and Quad Cities plants remaining open.
- **New renewable energy capacity from FEJA drives a total of \$3.4 billion in capital investments in Illinois, while energy efficiency improvements due to FEJA spurs another \$1.3 billion in investments.**⁵ In the FEJA scenario, Illinois adds 1,300 MW of new wind capacity and 3,406 MW of new solar capacity above the pre-FEJA baseline scenario by 2030.

FIGURE ES-1. FEJA and Additional Coal Retirements Diversify Illinois’ Electricity Mix, Compared with 2016



By 2030, Illinois will have undergone a dramatic shift away from coal. An energy future without the Future Energy Jobs Act, the pre-FEJA baseline, shows a generation mix still heavily dependent on coal in 2030. FEJA consists of renewable energy and energy efficiency policies that help Illinois transition more quickly to a more diversified portfolio of cleaner energy resources, as shown in the FEJA, Waukegan Edwards, and Dynegy-Vistra scenarios.

- **Greater emissions reductions occur under both coal retirement scenarios.** These emissions reductions are facilitated by the renewable energy and efficiency policies in FEJA. By 2030, carbon emissions reach 33 percent below 2016 levels for the Waukegan Edwards scenario and 51 percent below 2016 levels for the Dynegy-Vistra scenario.
- **Clean energy growth in Illinois spurred by additional coal retirements is achievable and affordable.** Under the coal retirement scenarios, annual savings for a typical household range from \$93 to \$102 per year by 2030.

In 2016 alone, air pollution from Illinois coal plants led to an estimated more than 2,300 asthma attacks and more than 350 premature deaths.

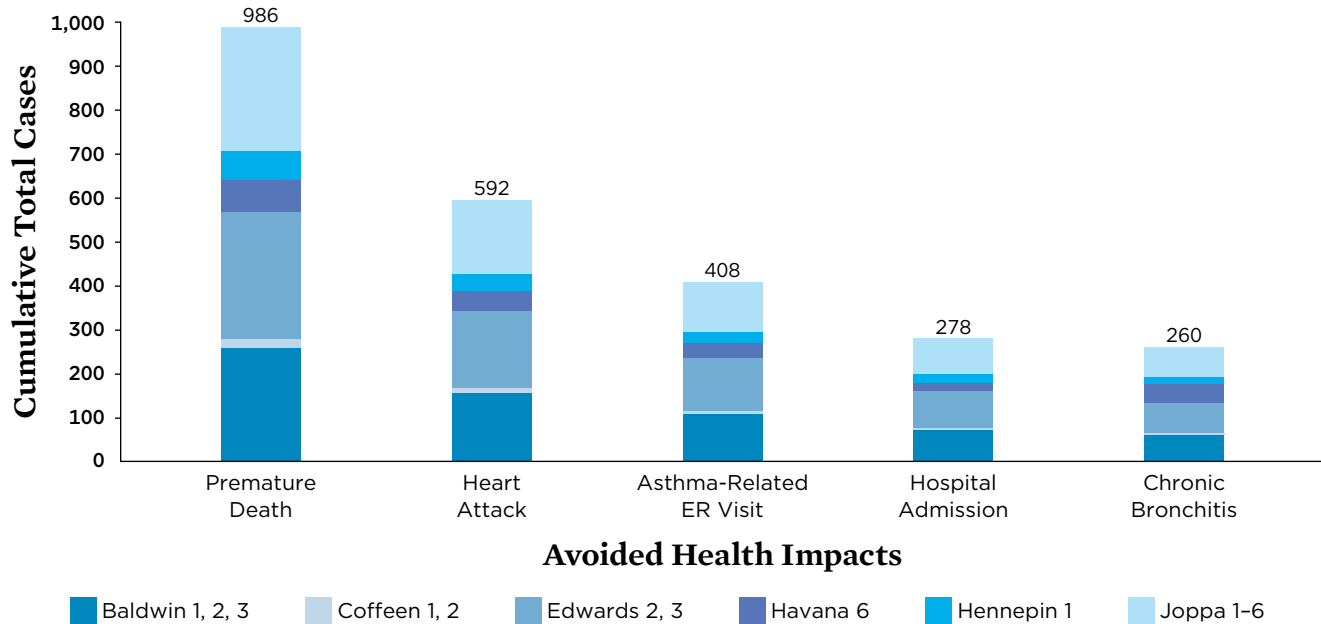
diseases, and higher ozone pollution levels in the warmer months. Low-level ozone pollution can have serious health effects, especially for the elderly, children, and individuals with respiratory illnesses.

PUBLIC HEALTH BENEFITS OF COAL PLANT CLOSURES

Illinois’ coal plants have significant negative public health impacts. In 2016 alone, air pollution from Illinois coal plants led to an estimated more than 2,300 asthma attacks and more than 350 premature deaths. Closing coal plants before 2030 greatly decreases the negative public health impacts caused by these plants (Figure ES-2). Additionally, reducing coal use is a primary method of limiting carbon emissions that lead to climate change and the associated public health problems including intense heat waves, flooding and waterborne

- **FEJA brings large carbon dioxide (CO₂) emissions reductions and reduces other air pollutants like sulfur dioxide (SO₂) and nitrogen oxides (NO_x).** Under the FEJA scenario, electricity-related CO₂ emissions in Illinois are 22 percent below the pre-FEJA baseline scenario in 2030. NO_x emissions are reduced by 36 percent, and SO₂ by 35 percent.

FIGURE ES-2. Cumulative Health Impacts Avoided through Pre-2030 Retirement of Dynegy-Vistra’s MISO Coal Plants in Illinois



Closing Dynegy-Vistra coal plants before 2030 greatly decreases the adverse public health impacts caused by the plants.

Note: Because the Dynegy-Vistra scenario does not include Duck Creek, Newton, or Hennepin Unit 2 retiring prior to 2030, these plants and units are not reflected in the above chart.

- **Illinois has considerable opportunity to reduce carbon emissions and other air pollutants.** Retiring additional coal plants accelerates carbon emissions reductions by 28 percent for the Waukegan Edwards scenario below the pre-FEJA baseline scenario and by 48 percent for the Dynegy-Vistra scenario. Cumulatively from 2016 through 2030, CO₂ emissions in these scenarios are 141 million to 156 million tons less than in the pre-FEJA baseline scenario, equivalent to taking 30 million to 33 million cars off the road. Under these two scenarios, NO_x emissions are 40 to 61 percent lower in 2030 than the pre-FEJA baseline scenario, while SO₂ emissions are 45 to 57 percent lower.
- **Reducing NO_x, SO₂, and CO₂ emissions leads to a range of respiratory and cardiovascular health benefits and fewer premature deaths.** NO_x contribute to smog (ground-level ozone) and NO_x and SO₂ contribute to soot (fine particulate matter), which exacerbate asthma and other heart and lung diseases and can result in significant disability and premature death. Closing plants prior to 2030 under the Dynegy-Vistra scenario, for example, greatly reduces these and other public health impacts.

Solar, storage, and load reduction by energy efficiency can individually or together provide a stable supply of electricity.

BENEFITS OF SOLAR AND ENERGY STORAGE

Solar, storage, and load reduction by energy efficiency can individually or together provide a stable supply of electricity at the Waukegan plant site and the surrounding area. Our analysis estimates the cost of investing in the solar plus storage hybrid systems, and the electricity bill savings and pay-back period for customer-owned systems. The development of energy storage facilities also brings potential tax revenue and economic development for communities.

- **The financial benefits of solar plus storage, accompanied by load reduction by energy efficiency, exceed the costs.** The initial capital cost of installing a utility-scale energy storage system (assuming a 16 MW four-hour duration lithium-ion battery) is \$14.3 million.



Energy storage, such as this battery storage facility in McHenry County, can be coupled with solar electricity generation to provide a stable supply of electricity to replace existing generation at coal plants.

Over the 25-year project lifetime, financial benefits total \$19.1 million, including \$6.9 million of avoided transmission costs and \$12.1 million of capacity revenues, for a net benefit of \$4.8 million.

- **Investing in solar could significantly lower consumer electricity bills.** Most homes and businesses in the Waukegan area could cut their electricity bills by more than half by investing in solar energy (Figure ES-3). Stronger climate policies and expanded use of time-varying electricity rates could further improve the economics of solar plus storage systems and reduce peak demand.
- **Combining solar with investments in energy efficiency would result in even greater electricity bill savings for customers.** When energy efficiency and solar energy are combined, a household in the Waukegan area could save 66 percent annually on its electricity bill.



Prairie Rivers Network

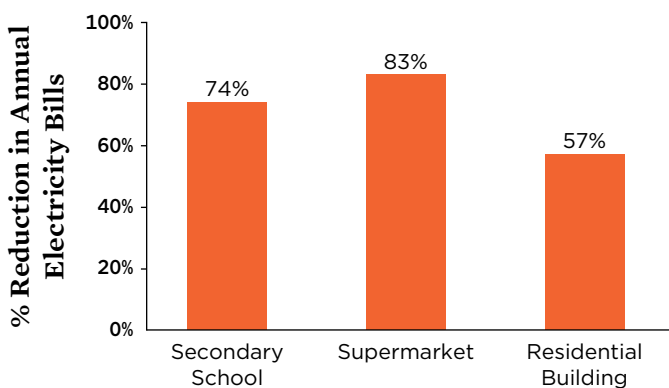
Coal power is a major source of heat-trapping emissions and toxic air pollution. In addition, coal plant sites store ash and other wastes that can spill out into local waterways if improperly managed. It is critical that coal plant retirements are coupled with site remediation plans, along with opportunities for economic diversification and job training for plant employees.

CLOSING THE WAUKEGAN COAL PLANT WHILE ENSURING RELIABILITY

The Waukegan Generating Station is the largest source of SO₂ and mercury emissions in Lake County, Illinois. Waukegan residents, anchored by the community group Clean Power Lake County, have been advocating for a just retirement and transition plan for the plant for nearly a decade due to the negative health impacts caused by burning coal. Our analysis finds that concern over electricity reliability is not an obstacle to closing the Waukegan coal plant.

- **The Waukegan coal plant can be retired with no impacts on grid reliability.** We found that generation from the two remaining coal units can be reliably replaced with an equivalent amount of generation spread evenly across power plants in the 13 states served by the grid operator PJM.
- **Existing oil-burning combustion turbines on site at the Waukegan plant would need to be replaced with 100 MW of capacity to ensure electricity reliability.** The combustion turbines are old, operate only a few hours of the year, and can be readily replaced with investments in efficiency and clean energy technologies. These investments could be made at the Waukegan site or with clean energy options like solar, storage, demand response, efficiency, and other distributed generation located across many cities and towns surrounding downtown Chicago.⁶

FIGURE ES-3. Investing in Solar Significantly Lowers Consumer Electricity Bills



Most homes and businesses in the Waukegan area could cut their electricity bills by more than half by investing in solar energy.

Note: Under Illinois' current electricity rate structure, PV plus storage is not cost effective compared with the PV-only option, and there is currently no significant difference in savings between the two options in secondary schools, supermarkets, or residential buildings.

THE IMPORTANCE OF COMMUNITY ENGAGEMENT

The case studies that accompany the *Soot to Solar* report (online at www.ucsusa.org/soottosolar) feature specific communities in Illinois with recently closed coal plants or with coal plants that may soon be facing closure. The opportunities

Our analysis finds that concern over electricity reliability is not an obstacle to closing the Waukegan coal plant.

and challenges vary from place to place, because no two coal transitions—and communities—are alike.

With adequate time and resources, transition plans can be developed that include (1) provisions for remediation and redevelopment at the plant and at sites associated with it (such as coal ash impoundments); (2) contingencies for lost local tax revenues; and (3) opportunities for local economic diversification, worker training, and the creation of new, well-paying jobs.

For community engagement to be truly meaningful, it must include proactive, sustained outreach that allows for community input and removes barriers to participation in government processes. Engagement must be characterized by robust communication and responsiveness to community concerns.

Recommendations

UCS offers several recommendations for Illinois to accelerate its clean energy momentum and lead the region to a new sustainable energy future:

- **Facilitate community involvement.** State and local policymakers, utilities, and power plant owners must meaningfully engage with stakeholders, especially communities of color and low-income residents living near coal plants, to ensure that equitable and just transition plans are established. These plans should include provisions for remediation and redevelopment at the plant and at sites associated with it (such as coal ash impoundments); contingencies for lost local tax revenues; and opportunities for local economic diversification.
- **Adopt policies that support the deployment of energy storage.** Illinois should consider policy options that incorporate the value of energy storage into future solar projects and reward solar projects that include energy storage, so that Illinois can fully realize its clean energy potential and integrate increasing quantities of renewable energy.

- **Design electricity rate structures that encourage customers to invest in solar and energy storage and reduce peak demand.** Less than 1 percent of ComEd and Ameren customers utilize the hourly pricing programs currently offered. Successful deployment of time-varying rates may require utilities to offer additional options such as time-of-use rates. Customer outreach and education is also crucial, with transparent communication by utilities to outline the ways in which customers can modify their everyday behaviors to maximize savings on electricity bills.

The more rapidly Illinois closes its aging, polluting coal plants and transitions to renewable energy and energy efficiency, the greater the public health and economic benefits will be for local communities across the state. With additional policies to incentivize clean energy development, Illinoisans can gain even larger public health, economic, environmental, and community benefits.

All authors are part of the UCS Climate and Energy Program:

Jessica Collingsworth is the lead Midwest energy policy analyst/advocate; Steve Clemmer is the director of energy research and analysis; Paula Garcia is an energy analyst; James Gignac is the lead Midwest energy analyst; JC Kibbey is the Midwest outreach and policy advocate; Sandra Sattler is the senior energy modeler; and Youngsun Baek is an energy modeler.

ENDNOTES

1. Representing 3,311 megawatts of nameplate capacity.
2. Prescribed dates for the coal retirement cases can be found in the technical appendix, online at www.ucsusa.org/soottosolar.
3. The Dynegy-Vistra scenario includes the following coal plants: Baldwin, Coffeen, Duck Creek, Edwards, Havana, Hennepin, Joppa, and Newton. Full details of the retirement dates for each coal plant unit can be found in the technical appendix.
4. Assuming a 7 percent discount rate.
5. Assuming a 7 percent discount rate.
6. While natural gas turbines could have been the primary solution for replacement in the past, solar plus storage is an increasingly competitive option as prices continue to drop. In addition, investment tax credits for solar and storage, solar renewable energy credits, and other climate policies make the clean energy option even more economical.

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FIND THE FULL REPORT, TECHNICAL APPENDIX, AND CASE STUDIES ONLINE:

www.ucsusa.org/soottosolar

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NATIONAL HEADQUARTERS

Two Brattle Square
Cambridge, MA 02138-3780
Phone: (617) 547-5552
Fax: (617) 864-9405

WASHINGTON, DC, OFFICE

1825 K St. NW, Suite 800
Washington, DC 20006-1232
Phone: (202) 223-6133
Fax: (202) 223-6162

WEST COAST OFFICE

500 12th St., Suite 340
Oakland, CA 94607-4087
Phone: (510) 843-1872
Fax: (510) 451-3785

MIDWEST OFFICE

One N. LaSalle St., Suite 1904
Chicago, IL 60602-4064
Phone: (312) 578-1750
Fax: (312) 578-1751