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Concerned
Scientists

EXECUTIVE SUMMARY

A Bright Future for the Heartland

POWERING THE MIDWEST ECONOMY WITH CLEAN ENERGY

From the manufacturing centers and corn and soybean fields to the major finance hubs and leading research universities, Midwest states have long served as an economic engine for the United States. Yet the region is still struggling to fully recover from a recession that has made it difficult for families to pay bills and for businesses to prosper and sustain job growth.

The region's unsustainable energy system exacerbates these economic pressures. The Midwest power system is dominated by coal—largely imported from outside the region—which poses serious risks to public health and the environment, and leaves consumers vulnerable to volatile energy prices.

The good news is that practical and affordable ways are available to help revitalize the Midwest economy and ensure a clean, safe, and reliable power supply. Energy efficiency

technologies and renewable electricity resources, such as wind, bioenergy, and solar energy, offer a cost-effective and responsible path away from polluting fossil fuels toward an innovation-based twenty-first-century economy. Investing in these solutions would deliver new jobs and other economic development benefits, save consumers money, diversify the region's energy mix, and cut heat-trapping emissions that cause global warming. Boosting investment in renewable energy and energy efficiency would also help keep the Midwest competitive in the growing global clean energy industry.

A Bright Future for the Heartland shows how we can get there. The Union of Concerned Scientists (UCS) based this analysis on the renewable energy and energy efficiency goals of the Midwestern Governors Association (MGA)—a collaboration of 10 states working on key public policy issues. These goals call for producing 30 percent of the Midwest's electricity supply from renewable energy by 2030, and for investing in energy efficiency technologies to reduce power consumption at least 2 percent annually by 2015 and thereafter. In 2009 an MGA advisory group released the *Midwestern Energy Security and Climate Stewardship Roadmap* (or Energy Roadmap), a set of policy recommendations for transitioning to a clean energy economy (MGA 2009).

Our analysis focuses on two of the highest-priority recommendations in the Energy Roadmap, which we model as a renewable electricity standard (RES) and an energy efficiency

The Benefits of a Clean Energy Economy for the Midwest by 2030

Job Creation:

85,700 net new jobs from deploying renewable energy and energy-efficient technologies

Economic Development:

\$40.9 billion in new capital investment, \$1 billion in new income for farmers and rural landowners, and \$3.5 billion in new local tax revenues

Consumer Savings:

\$42.8 billion in lower electricity and natural gas bills

Diversified Energy Mix:

63,000 megawatts of capacity for generating electricity from non-hydro renewable resources (up from 13,300 megawatts in 2010)

Climate Solutions:

Reductions in global warming pollution from power plants equal to the annual emissions from 30 typical new coal plants

resource standard (EERS). An RES is a flexible, market-based policy that requires electricity providers to gradually increase the amount of renewable energy used to produce the power they supply. An EERS similarly requires utilities to meet specific annual targets for reducing the use of electricity. While the region will need other policies to overcome specific market barriers to clean energy, the RES and EERS have proven to be effective and popular tools for advancing renewable energy and energy efficiency, and can play a key role in ensuring that the Midwest meets the targets in the Energy Roadmap.



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As of April 2011, eight Midwest states have adopted an RES (among 29 states nationwide, plus Washington, DC). Five of these Midwest states also have an EERS (among 26 states nationwide). While these are important first steps, the region must go further to meet the more ambitious Energy Roadmap targets. In so doing, Midwest states can boost local and regional economies, reduce the urgent threat of global warming, and leave future generations with a cleaner and more sustainable energy system.

We used a modified version of the U.S. Department of Energy's (DOE's) National Energy Modeling System (NEMS) to examine the long-term economic and environmental effects of achieving the Energy Roadmap's renewable energy and energy efficiency targets. To evaluate a reasonable range of possible technology pathways for meeting the renewable energy targets, we modeled two policy scenarios, which we call our *core policy case* and *alternative technology pathway*. The two scenarios differ only in that the core policy case includes more pessimistic assumptions regarding biopower technology and fuel costs than the DOE assumes in the NEMS model, to reflect the significant uncertainties and constraints facing biomass development both today and into the future. We compared those two scenarios with an existing policies case, or base case,

which assumes no new state or federal policies.¹ Neither of the two main scenarios includes more recent changes in power plant regulations that the U.S. Environmental Protection Agency uses to enforce the Clean Air Act.

Achieving the Energy Roadmap's clean energy targets would spur innovation and inject capital into the economy.

Below, we present the results from our core policy case followed by the alternative technology pathway. Our findings show that achieving the Energy Roadmap's clean energy targets would spur innovation, inject capital into the economy, and create tens of thousands of jobs in big cities, small towns, and rural communities across the Midwest. Cuts in power use stemming from efficiency gains, and downward pressure on electricity prices stemming from competition from renewables, would provide much-needed savings on energy bills for families and businesses, and keep more money in the regional economy. Tapping into the Midwest's wealth of wind, bioenergy, solar, and efficiency resources would diversify the region's power supply, making it more reliable

and secure. That approach would also move the Midwest away from its overdependence on coal, improving public health and reducing the dangers of global warming.

JOB CREATION AND OTHER ECONOMIC DEVELOPMENT BENEFITS UNDER THE ENERGY ROADMAP

The renewable energy sector has been one of the few bright spots for struggling job markets in many Midwest states. For example, one recent estimate lists 169 Ohio-based companies contributing to the manufacturing supply chains of the wind and solar industries (Craig, Learner, and Gray 2011a). That report also notes that Toledo has become a national hub for research on and manufacturing of thin-film solar cells.

Illinois boasts more than 100 companies participating in the wind energy supply chain, supporting 15,000 employees, according to the same analysts (Craig, Learner, and Gray 2010). And Michigan has more than 240 manufacturing firms in the wind and solar supply chain (Craig, Learner, and Gray 2011b). In fact, just about every Midwest state now has a plant making wind turbine equipment (Wiser and Bolinger 2009). Midwest states have attracted clean energy companies because of their strong renewable energy resources, skilled labor force, existing manufacturing infrastructure,

¹ Existing policies include state-level RESs and EERSs adopted as of March 2010, and the federal renewable energy tax credits and incentives in the American Recovery and Reinvestment Act of 2009.



access to transportation, and state laws and incentives that support investment in renewable energy.

Further investments in renewable energy and energy efficiency, spurred by clean energy targets, would lead to significant new job opportunities and other local benefits throughout the region. Under the core policy case, the clean energy investments needed to achieve the renewable energy and energy efficiency targets in the Energy Roadmap would create a net 85,700 jobs in Midwest states by 2030. Those jobs would be on top of those created under today's policies, and would span numerous sectors of the regional economy, including manufacturing, construction, operations, maintenance, agriculture, forestry, finance, and retail. Those investments would also yield \$4.2 billion in new annual income, and \$2.8 billion per year in new gross state product.

Transitioning to a cleaner, safer energy system would curb job opportunities in the fossil fuel sector, and our analysis takes that into account. We find that job gains from investments in renewable energy and energy efficiency far outweigh job losses in the fossil fuel sector. Investments in clean energy typically deliver more jobs than those in fossil fuel power because a larger share of the money is spent in the regional economy, and on labor-intensive sectors such as manufacturing, installa-

tion, and maintenance. By contrast, much of the expenditures on power production from coal and natural gas flow to states outside the region, and support less-labor-intensive fuel extraction and transportation.

The Midwest now spends a significant amount of money importing fossil fuels from outside the region. In 2008, for example, the Midwest imported 63 percent of the coal used in its power plants from as far away as Wyoming, sending \$7.5 billion out of the region (Deyette and Freese 2010). The Midwest also imports almost all the natural gas used to generate elec-

The clean energy investments needed to achieve the renewable energy and energy efficiency targets in the Energy Roadmap would create a net 85,700 jobs in Midwest states by 2030.

tricity and meet other energy needs. Substituting local clean energy for fossil fuels could reduce out-of-state fossil fuel purchases and keep more money circulating in local economies across the Midwest. In fact, our

analysis shows that meeting the Energy Roadmap targets would cut the region's expenditures on coal and other fossil fuels by \$2.1 billion per year in 2030.

Achieving the Energy Roadmap targets would also provide an important boost to the Midwest economy by spurring innovation, entrepreneurship, and private-sector investment. Additional capital investment in renewable energy and energy efficiency would total \$40.9 billion through 2030.² When we include investment spurred by existing renewable energy and energy efficiency policies, capital investment in the region would total \$69 billion by 2030. Wind power and energy efficiency technologies represent the largest shares of the new capital investment.

Besides creating jobs and spurring capital investment in local economies, the Energy Roadmap targets would provide more income to farmers and rural landowners from the harvest and sale of biomass products, and from lease payments for wind turbines installed on their land. In fact, biomass payments would total \$4.3 billion by 2030—\$610 million more than under existing policies. Wind land-lease payments would total \$660 million—\$390 million more than under existing policies.

If farmers and other landowners owned the wind turbines, their revenues and those of communities would be even higher. Communities would also receive some \$6.7 billion

² Unless otherwise noted, results are in 2007 dollars and use a 7 percent real discount rate.

in cumulative new property taxes from investments in renewable energy by 2030—\$3.5 billion more than under existing policies. Those revenues would help pay for schools and other vital public services in these communities, especially in rural areas.

CONSUMER SAVINGS UNDER THE ENERGY ROADMAP

Consumers across the Midwest stand to realize big savings on their energy bills if the region achieves the renewable energy and energy efficiency targets in the Energy Roadmap. Investments in energy efficiency deliver much of these savings by reducing demand for electricity in homes, businesses, and industry.

More competition in the regional energy market from renewable energy and energy efficiency adds to these savings, by leading to slightly lower

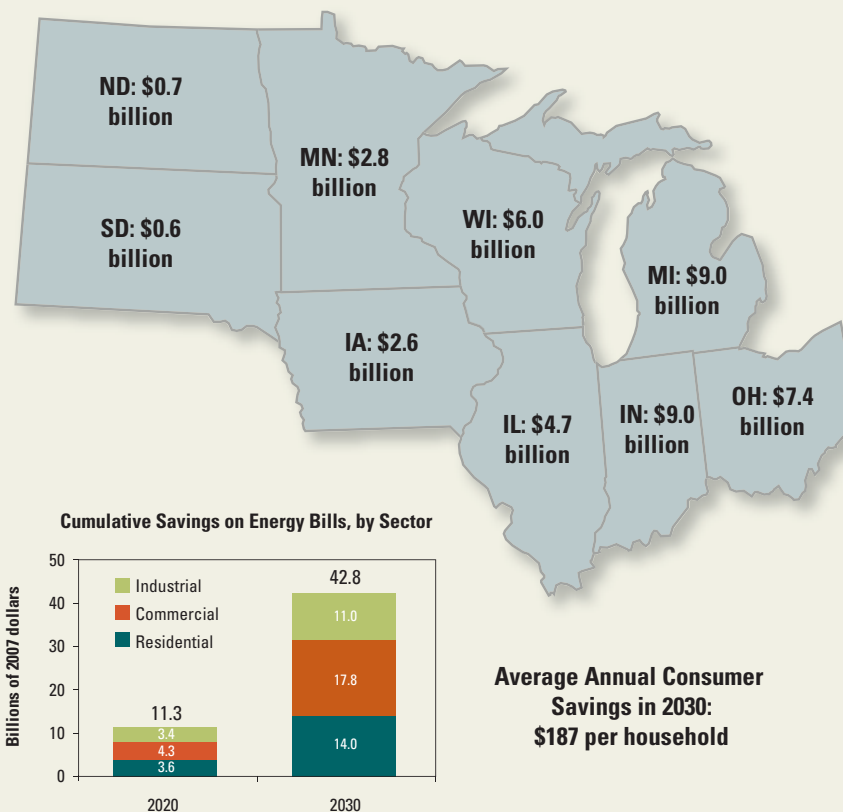
and more stable prices for the coal and natural gas used to generate electricity and provide heat for buildings and industrial uses. Under the Energy Roadmap targets, annual consumer electricity prices would be 4.4 percent lower, on average, than under existing policies from 2010 to 2030. Electricity prices would be 0.7 percent lower beginning in 2012, 2.2 percent lower by 2020, and 11.6 percent lower by 2030. Annual natural gas prices would be 0.8 percent lower, on average, during that time frame, with 0.2 percent savings starting in 2011, rising to 0.6 percent in 2020, and reaching 1.6 percent in 2030.

The savings from reduced energy consumption and lower prices for electricity and fossil fuels more than offset the costs of investing in renewables and efficiency. As a result, savings on

From 2010 to 2030, a typical household would save an average of \$78 on its electricity and natural gas bills each year.

electricity and natural gas bills for Midwest consumers would total \$11.3 billion by 2020, and grow to \$42.8 billion by 2030 (Figure ES1). All sectors of the economy and all Midwest states would share in the savings. The typical Midwest family would begin to see small savings on natural gas and electricity expenses in 2011, with annual savings reaching \$64 by 2020 and \$187 by 2030. From 2010 to 2030, a typical household would save an average of \$78 on its electricity and natural gas bills each year.

Figure ES1. Cumulative Consumer Savings on Energy Bills (2010–2030) under the Energy Roadmap



DIVERSIFYING THE ELECTRICITY MIX

In 2009, a little more than 5 percent of electricity generation in the Midwest came from renewable resources. The rest of the region's power came primarily from coal, along with nuclear energy and other fossil fuels (Figure ES2). To reach the Energy Roadmap targets, the region would diversify its electricity supply by relying on a mix of homegrown renewable energy sources, and significantly reduce demand for electricity by investing in more energy-efficient technologies in buildings and industry.

A diverse mix of renewable energy sources, led primarily by wind and bio-energy, would enable the region to reach the 30 percent RES target in the Energy Roadmap (Figure ES3, p. 6). By 2030, non-hydro renewable energy capacity would grow to nearly 63,000 megawatts (MW)—a nearly fivefold increase over 2010 levels (13,300 MW)—providing enough power to serve the equivalent

of more than 40 million typical homes. Meanwhile gains in energy efficiency stemming from the EERS would cut electricity demand by the equivalent output of more than 33 new typical-size (600 MW) coal-fired power plants by 2030.

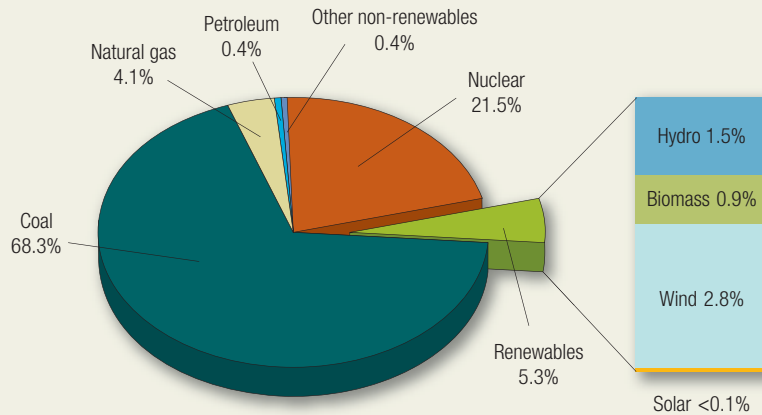
Greater reliance on renewable energy and energy efficiency would reduce the need to generate power from coal and other fossil fuels. Under the clean energy targets in the Energy Roadmap, coal generation in the Midwest would drop by nearly 9 percent from 2010 to 2030, and by 16 percent compared with coal use under existing policies in 2030. The greatest contribution to meeting new power demand and displacing existing fossil fuel generation comes from meeting the regional EERS. Efficiency measures such as advanced buildings and industrial processes, and high-efficiency appliances, lighting, and motors—on top of existing energy efficiency programs—would reduce power sales by 20 percent.

RESPONSIBLE ACTION ON CLIMATE CHANGE

If heat-trapping emissions such as carbon dioxide (CO₂) are left unchecked, global warming—which already threatens our health and environment—will worsen. Failure to reduce global emissions will have significant consequences for the Midwest in the next few decades, and they will become more severe as the century progresses.

Greater reliance on renewable energy and energy efficiency would reduce the need to generate power from coal and other fossil fuels.

Figure ES2. Sources of Midwest Electricity, 2009



Note: Includes electricity generated in the Midwest that serves other regions. Source: EIA 2010.

A recent analysis found that unabated climate change will lead to scorching summers and related heat emergencies, dangerous storms and flooding, and more stress on agriculture throughout the region (Hayhoe et al. 2009).

Fortunately, renewable energy and energy efficiency are smart and affordable global warming solutions that cut CO₂ emissions by reducing fossil fuel use. The clean energy targets in the Energy Roadmap would lower CO₂ emissions from Midwest power plants by 130 million metric tons annually by 2030 (16.7 percent below base-case levels)—equivalent to the annual emissions from 30 typical new coal plants.

Besides reducing CO₂ emissions, lowering fossil fuel use would also curb other air pollutants from power plants, such as mercury and sulfur dioxide, and would limit the damage to our water and land that stems from the extraction and transport of fossil fuel and efforts to contain its waste. In fact, the damage to public health and the environment caused by our dependence on fossil fuels exacts a major toll on the U.S. economy.

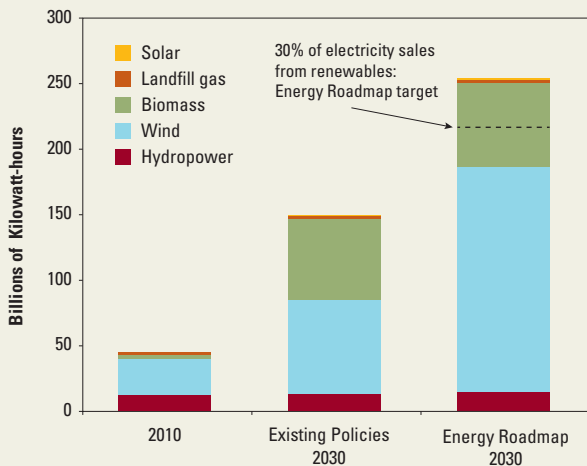
Harvard Medical School recently found that the total cost of damage

caused by coal alone approaches \$523 billion per year nationally. That amount would add as much as 27 cents per kilowatt-hour to the cost of electricity from coal if plant owners had to pay for the damage (Epstein et al. 2011). Our analysis does not account for the reductions in damage to public health and the environment that would result from cuts in coal use under the Energy Roadmap targets. We therefore underestimate the economic benefits to the Midwest from investments in clean energy.

ALTERNATIVE TECHNOLOGY PATHWAY

Given the abundant potential for diverse renewable energy resources in the Midwest, the region could develop various mixes of those resources to meet the Energy Roadmap's targets. In our model, small changes in assumptions about the cost, performance, and siting or supply constraints of each technology affects the mix. In our alternative technology pathway, we assume that some of the significant constraints facing biomass development can be overcome, leading to lower cost and better performance of the technology.

Figure ES3. Use of Renewable Energy to Generate Electricity in the Midwest under Existing Policies and the Energy Roadmap



Note: Includes electricity generated in the Midwest that serves other regions.

As with meeting the Energy Roadmap targets under our core policy case, meeting those targets under our alternative technology pathway requires a diverse mix of renewable energy technologies. However, the two cases differ in the contribution of wind power and biomass burned with coal in existing coal plants (co-firing).

Under our alternative technology pathway, biopower accounts for 47 percent of Midwest renewable energy generation in 2030. Nearly two-thirds of that power comes from co-firing biomass in existing coal plants, and the rest comes from burning biomass in highly efficient combined-heat-and-power plants. Wind generation also plays a substantial role, accounting for about 46 percent of the Midwest renewable energy mix in 2030. In the core policy case, in contrast, wind power accounts for more than two-thirds of the renewable energy generation mix in 2030, and biopower for 25 percent. The mix in the alternative technology pathway reflects the more competitive cost of biomass and a higher limit on the amount that plant

owners can burn with coal.

While that pathway alters the mix of renewable resources used to generate electricity, the region still meets the Energy Roadmap targets while delivering consumer savings and other economic benefits similar to those in the core policy case (Table ES1). Job creation and capital investments are somewhat more modest under the alternative technology pathway, because co-firing biomass in existing coal

plants is less capital-intensive than building wind facilities. However, the greater use of biomass under the alternative technology pathway puts more money in the pockets of rural landowners from the harvest and sale of biomass products.

RECOMMENDATIONS: SETTING A COURSE FOR A CLEAN ENERGY FUTURE

Placing Midwest states on a sensible and attainable path toward a clean energy future can help solve several of the region's challenges: creating jobs, boosting the economy, cutting dependence on coal, and reducing the heat-trapping emissions that cause global warming. However, taking full advantage of this opportunity requires smart and practical actions to accelerate investment in clean power solutions.

Enact or enhance renewable electricity standards to match the Energy Roadmap targets. The renewable energy targets in the Energy Roadmap must be implemented on a state-by-state basis. However, the entire Midwest will benefit most when every

state adopts the RES targets of at least 10 percent by 2015 and 30 percent by 2030 for all electric utilities.

Enact or enhance energy efficiency resource standards to match the Energy Roadmap targets. Many Midwest states rely on the EERS as an effective policy for deploying energy efficiency technologies, but only one state (Illinois) has committed to the Energy Roadmap's full targets of 2 percent annual savings for all electric utilities by 2015 and each year thereafter. To help meet their EERS targets and remove key market barriers, states can also adopt or strengthen incentives for efficiency programs and provide significant funding. Such incentives include public benefits funds, which are furnished by a small charge on all electricity sold, and support investments in efficiency technologies.

Resolve state and local conflicts around the siting of electricity transmission lines and renewable energy projects. States should remove regulatory barriers to regional transmission planning, siting, and approval. Such efforts can include adopting model legislation that enhances the ability of public utility commissions to consider and approve transmission projects spanning jurisdictions, and supporting regional efforts to plan and facilitate such projects and allocate their costs. Policy makers should also streamline the approval process for siting renewable energy projects and bolster local, state, and federal cooperation while ensuring responsible development.

Increase funding for research and development. To ensure that adequate R&D resources are available to lower costs and spur widespread use of renewable energy and energy efficiency technologies, states should support more federal and state funding for R&D.

Ensure the sustainability of biopower. States should develop guidelines and best-management practices to promote a sustainable and reliable biomass supply system. They should also support research on biomass potential and effective biomass feedstocks, and regional strategies for fulfilling that potential sustainably.

Use regulatory mechanisms to change utility incentives. To complement requirements that utilities pursue energy efficiency programs, Midwest states should adopt mechanisms that overcome utilities' traditional reluctance to sell less energy. These mechanisms include allowing regulated utilities to recover the cost of investing in energy-saving programs, and allowing utilities to reap earnings by meeting energy efficiency goals.

Adopt more stringent energy efficiency codes for buildings. All

new buildings should comply with the most stringent minimum energy code in effect at the time—now the 2009 International Energy Conservation Code (IEEC) and the 90.1-2010 code of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Midwest states should also encourage the use of above-code standards, such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, and the U.S. Department of Energy's Energy Star program for new homes.

Advance the deployment of combined-heat-and-power (CHP) systems. Midwest states should enact standards (and support federal standards) for permitting CHP systems, connecting them to the local power grid, and establishing equitable interconnection fees and tariffs for standby,



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supplemental, and buy-back power. More funding for federal and state programs that spur the use of CHP through education, coordination, and direct project support is also needed.

Set a high bar by adopting stringent energy efficiency codes for all government buildings. States should require public agencies to reduce energy use in their buildings by an annual percentage that is equal to or higher than the Energy Roadmap target.

Accelerate adoption of energy efficiency technologies. Consumer education, smart grid technologies, electricity rates that incentivize energy efficiency, and financing incentives can accelerate the deployment of energy efficiency technologies.

Support national standards, incentives, and policies for deploying renewable energy and bolstering energy efficiency, and for cutting carbon emissions. Congressional delegations from Midwest states should support national policies that promote clean energy technologies and leverage the region's unique strengths. Such policies should include a national RES of at least 25 percent by 2025 (with a national system for trading renewable energy credits), long-term extension of federal incentive programs such as the production tax credit for renewable energy, and a comprehensive carbon

Table ES1. Economic and Environmental Benefits of the Core Policy Case vs. the Alternative Technology Pathway

	Core Policy Case	Alternative Technology Pathway
Savings on Electricity and Natural Gas Bills (cumulative)		
2010–2020	\$11.3 billion	\$13.2 billion
2010–2030	\$42.8 billion	\$42.4 billion
Annual household savings, 2030	\$187	\$169
Net Job and Other Economic Benefits (in 2030)		
Net job creation	85,700	77,000
Income	\$4.2 billion	\$3.5 billion
Gains in gross state product	\$2.8 billion	\$2.3 billion
Other Net Economic Benefits (cumulative 2010–2030)		
New capital investment in renewable energy	\$26.4 billion	\$11.3 billion
New capital investment in energy efficiency	\$14.5 billion	\$14.5 billion
Biomass payments	\$610 million	\$3.2 billion
Wind land-lease payments	\$390 million	\$160 million
Property tax revenues	\$3.5 billion	\$1.5 billion
Reductions in CO₂ Emissions from Power Plants (in 2030)		
Reduction in CO ₂ emissions and percent change from base case	130 million metric tons (16.7 percent)	120 million metric tons (15.5 percent)

policy that moves swiftly to deliver deep cuts in emissions while charging polluters for any remaining emissions.

THE BOTTOM LINE

From the strong winds of the Great Plains and the agricultural lands of the Corn Belt to the sun shining bright on cities stretching from Cleveland, OH, to Rapid City, SD, the Midwest is home to some of the best renewable energy resources in the world. The region is also endowed with a strong industrial base and leading research universities, where a tradition of hard work and innovation has long made the Midwest an economic engine for the entire nation. Few areas of the world have this ideal mix of resources, industrial capacity, and knowledge base. These advantages give the Midwest the tools to turn the challenges of a stalled economy and an unsustainable, polluting energy system into an opportunity for economic prosperity, job growth, and a healthy environment.

Achieving the regional targets for renewable energy and energy efficiency set forth in the Energy Roadmap would provide significant economic benefits to the Midwest. Meeting those targets would spur innovation and create tens of thousands of jobs in big cities and small towns across the region. It would also provide much-needed savings for families and businesses on their energy bills, and a more diversified, reliable, and secure power supply. By moving the Midwest away from its dependence on coal, such an achievement would also improve public health



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and reduce the dangers of global warming and other toxic emissions.

Fully capturing these important economic benefits and removing key market barriers will require smart policy solutions. Many Midwest states have already taken important steps to promote clean energy, and there must be no retrenchment in those efforts. Instead, each state can go further to strengthen or enact policies that at least match the Energy Roadmap's clean energy targets, and to support local, regional, federal, and international efforts to promote renewable energy, energy efficiency, and cuts in carbon emissions.

Midwest states can benefit from enacting these policies individually, but they will benefit even more by acting together. With each state doing its part to promote renewable energy and energy efficiency, the region will reap many vital benefits today while building a clean and sustainable energy economy for future generations.

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The full text of this report is available on the UCS website at www.ucsusa.org/brightfuture.

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