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Embracing the Future: The Midwest and a New National Energy Policy

REPORT OF THE TASK FORCE ON NATIONAL ENERGY POLICY AND MIDWESTERN REGIONAL COMPETITIVENESS

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Foreword

The national debate on energy policy and climate change has taken on a sense of urgency over the past twelve months. Volatility in commodity prices, the election of a president committed to energy policy reform, mounting scientific evidence about the gathering danger of climate change, the upcoming Copenhagen summit to negotiate a new international agreement to curb carbon emissions, and the responses to a global economic crisis have all come together to create a unique moment of opportunity. Some would say of necessity.

The Midwest has a large stake in the future shape of U.S. energy policy given its importance as an energy producer and consumer. Consider the following facts:

- The midwestern states alone account for 4 to 5 percent of global greenhouse gas emissions, and the Midwest economy as a whole is significantly more carbon intensive than the national average.

- Eighty-five percent of all ethanol production capacity is in the Midwest and Great Plains.

- The transportation industry, the backbone of the Midwest economy, is a major contributor to global warming, accounting for 32 percent of U.S. carbon dioxide emissions.

- Nearly half of U.S. auto assembly plants are located in Michigan, Indiana, and Ohio, and roughly one in five Midwest jobs is dependent on General Motors alone.

Simply put, the Midwest cannot afford to be absent at the creation of a new national policy. The future of the Midwest economy depends on a successful transition from a carbon-intensive to a low-carbon model of growth. This transition depends upon the region’s voice being heard in Washington and beyond. The Midwest requires national and international action that reduces the negative consequences of a new carbon-limiting energy regime and opens a path to sustainable regional economic competitiveness. It also requires the region’s leaders, companies, universities, civic organizations, and citizens to develop solutions and take actions within their states and communities.
Embracing the Future: The Midwest and a New National Energy Policy

The Chicago Council on Global Affairs

Foreword

fuel economy standards, the role of renewable and clean energy sources, carbon sequestering, improving regional transportation infrastructure, and methods to increase economic competitiveness in the auto industry and manufacturing as well as newer industries related to energy efficiency.

Acknowledgments

The Chicago Council would first like to thank the Task Force cochairs, John Livingston, Sally Mason, and John Rowe, for their skill and dedication throughout the project. The issues surrounding energy policy in the Midwest are complex and require expertise from individuals from diverse disciplines and backgrounds. It speaks to their standing and dedication that the project was able to assemble a diverse Task Force with wide-ranging expertise on the topic and to incorporate these perspectives into a thorough, well-founded report. Their respective teams at McKinsey & Company, the University of Iowa, and Exelon also provided tremendous support throughout the project and especially during the development of the final report. I am grateful in particular to Ralph Loomis, vice president for corporate strategy and chief of staff at Exelon Corporation, for his considerable contributions to this project.

McKinsey & Company served as the Task Force’s research partner by providing economic analytical capabilities critical to the project. The results of McKinsey’s extensive research and analysis of global and U.S. cost curves for greenhouse gas abatement and the completion of case studies of key Midwest sectors and industries proved vitally important in informing Task Force thinking and recommendations.

The Council would also like to extend its deepest appreciation to the members of the Task Force, each of whom brought distinct experiences and expertise to the table, yet worked together effectively to achieve consensus on the report’s recommendations. I would like to especially thank them for their time and willingness to exchange views candidly during and following the Task Force deliberations.

The Council would also like to extend its gratitude to Marika Tatsutani, principal writer for this report. Marika brought a great wealth of knowledge, skill, and insight to the framing of the report’s recommendations and patiently managed many and often competing interests in the development of a balanced final report.

The Council would like to thank Bill White and Daria Karetnikov of David Gardiner and Associates, who served as the primary con-

Task Force Cochairs and Membership

The Task Force on National Energy Policy and Regional Competitiveness began its work in May 2008 and held five meetings in Chicago over the following six months. The Task Force set itself two objectives: (1) to bring a specifically midwestern perspective to the national debate and work to advance the region’s interests in that context and (2) to help build a consensus among public- and private-sector stakeholders within the Midwest around concrete and significant actions that address pressing environmental and energy challenges, while enhancing the region’s economic competitiveness.

The Task Force has been led by three cochairs: John Livingston, managing partner in the Chicago office of McKinsey & Company; Sally Mason, president of the University of Iowa; and John W. Rowe, chairman and chief executive officer of Exelon Corporation. The Task Force cochairs provided leadership and direction throughout the year-long process of meetings, working groups, and report preparation and played critical roles in shaping the overall Task Force findings and recommendations. The Task Force comprised thirty-two midwestern leaders with experience and expertise in energy and economic affairs from the fields of business, government service, nongovernmental civic and advocacy organizations, and academia.

Task Force Process

During the Task Force meetings, outside experts and participating Task Force members worked to develop a baseline understanding of state and national policy proposals and associated costs. They thoroughly reviewed the research on energy use and emissions in the Midwest, the current status of regulatory discussions, and the timing and cost of alternative abatement options. The Task Force also examined the specific midwestern implications of alternative abatement and energy usage options.

In the meetings and throughout the drafting of the report, the cochairs sought to guide the Task Force toward a consensus on how these various measures would affect overall economic competitiveness and standards of living in the Midwest and on what policy options might best engage the Midwest’s stakeholders in forging national approaches. The group focused on developing regionally beneficial recommendations on critical issues likely to be included in future federal legislation such as cap-and-trade programs, higher
Executive Summary

In the decades ahead, the Midwest will have to grapple with the fundamental and interconnected issues of climate change, maintaining competitiveness in an increasingly globalized economy, and improving energy security. Despite growing support for action—particularly on the issue of climate change—the path forward is far from clear. The overall challenge has been vastly complicated by the current global financial crisis, which has relieved upward pressure on energy demand and prices in the near term, but also poses grave threats to U.S. and world prosperity. The crisis can be expected to shape the political and economic context for energy policy decisions in profound but as yet unpredictable ways for some time to come.

The Task Force on National Energy Policy and Midwestern Regional Competitiveness was convened in May 2008 by The Chicago Council on Global Affairs. Comprised of thirty-two experts and stakeholders, it has sought to bring a Midwest perspective to the ongoing national debate on climate and energy policy. Because the region is a major energy consumer and greenhouse gas emitter, climate and energy legislation will have a dramatic impact on its economy. To manage these impacts while simultaneously revitalizing the region’s economy, state governments and other organizations and institutions throughout the Midwest will have to be more proactive and coordinate more effectively than they have in the past. The work of the Task Force is a step in this direction.

Key Task Force Findings

1. The Midwest can and must turn the challenge of changing energy and climate policy to its economic advantage.

The Midwest comes to the national energy debate with a unique combination of advantages and disadvantages. With 22 percent of the nation’s population, the region’s twelve states account for more than one-quarter (29 percent) of national greenhouse gas emissions and roughly 4 to 5 percent of global greenhouse gas emissions. The overall carbon intensity of the Midwest economy is higher than the national average, in part because of the region’s substantial reliance on coal. This could mean disproportionate near-term costs under a national policy to limit greenhouse gas emissions. Given the importance of its manufacturing sector, the Midwest could be especially
vulnerable to trade impacts and competitive disadvantages as a result of higher energy prices. At the same time, the region has substantial opportunities to improve energy efficiency and to deploy its strong manufacturing base; an experienced, skilled workforce; distinctive research universities; and innovative technology companies in the transition to a low-carbon economy.

Realizing these opportunities requires predictable incentives, a predictable and transparent cost of carbon, and reliable rules of investment so that the private sector can make appropriate long-term investment decisions. Second, it requires well-regulated markets and policies designed to ensure that the nation and region capture the lowest-cost opportunities first. Finally, government stimulus and support must be targeted to those low-carbon solutions that would not achieve economic viability in the necessary time frame without a public partner to help overcome otherwise prohibitive up-front development costs or risks. There is no single technological answer to the nation’s climate or energy security concerns, and policymakers must not prejudge winners and losers.

2. Prompt enactment of national climate change legislation is essential to the Midwest’s future prosperity and competitiveness.

As important as predictability is the need to get started without further delay on the technologies and investments that will be required to address the long-term challenges we face. A coherent national policy is needed because no state or region by itself can mount a sufficient response to global problems like climate change and oil dependence. We must rectify a national approach to energy policy that for more than thirty years has consisted of a patchwork of short-term responses—usually prompted by an equally short-lived perception of crisis.

3. Regional and local action is likewise essential.

Federal action is essential, but the Midwest cannot afford to wait for it. Individual states and the broader region must begin moving forward on a number of fronts. These include maximizing the energy efficiency of buildings, industries, and transportation systems; modernizing outdated infrastructure; developing new energy technologies; engaging the region’s universities in leading-edge energy research and innovation; addressing critical workforce issues; and improving regional coordination and cross-jurisdictional decision-making processes. All of these are things the Midwest can and must do to save jobs and sustain a vibrant economy well into the twenty-first century.

4. Addressing carbon emissions will not be cheap.

Addressing climate and future energy security will require coordinated action across every sector of our economy. An analysis of the cost of different greenhouse gas abatement options in the Midwest shows that while energy efficiency and emission offsets offer relatively low-cost alternatives, substantial long-term investments in new energy supply and end-use technologies will be essential.

Energy Efficiency, Emissions Offsets, and Low-Carbon Supply Technologies

To inform its assessment of the challenges that confront the Midwest and provide a fact base for its recommendations, the Task Force commissioned a new region-specific analysis of carbon abatement options and their costs. The Task Force also consulted a number of existing sources and recognized experts in different fields. The region-specific analysis was conducted by McKinsey & Company and produced a detailed cost curve comparing different carbon dioxide abatement options. The cost curve shows the full range of emission reduction actions that are possible with technologies that either are available today or offer a high degree of certainty about their potential within a 2020 time horizon.

Based on the cost-curve analysis and input from other sources, the Task Force focused on energy efficiency, emissions offsets, and low-carbon supply technologies as three critical areas for advancing regional goals with respect to climate change, the economy, and energy security. A full list of our specific recommendations in each of these areas may be found on pages 10 through 16, immediately following this summary. A few key points from the discussion are highlighted below.

Energy Efficiency

Energy efficiency improvements offer the most cost-effective, near-term options for reducing greenhouse gas emissions in the Midwest. Efficiency improvements also provide a variety of other important benefits. These include reducing other kinds of pollution, reducing
costs and improving productivity, mitigating the economy’s exposure to high and volatile energy prices, enhancing grid reliability, and keeping resources that would otherwise go to purchase imported fuels, like oil, inside the region. Capturing these opportunities will require up-front investment, but can greatly reduce the long-term costs of achieving substantial greenhouse gas reductions.

Policy options for improving energy efficiency include standards for appliances, equipment, and vehicles; technology incentives such as tax credits for certain types of efficiency improvements; informational programs such as the federal government’s Energy Star and other labeling programs; and utility-sponsored demand management programs. Given the importance of energy efficiency, the Task Force developed specific efficiency recommendations for each of the three chief energy-using sectors of the economy: buildings, transportation, and industry.

Emissions Offsets

Emissions offsets are credits for emission reductions that are achieved at sources or in sectors that are not covered by a mandatory regulatory regime. Offsets have special relevance for the Midwest for at least two reasons: (1) because they are a means of reducing near-term compliance costs under a new greenhouse gas regulatory regime and (2) because the region seems likely to enjoy a comparative advantage as a supplier of domestic agricultural offsets. Offset opportunities in the Midwest include reductions in methane emissions from waste management and feedlot operations and reductions in nitrous oxide emissions from fertilizer applications as well as soil carbon sequestration.

There are compelling economic and environmental reasons to recognize offsets as an alternative compliance mechanism in the context of a mandatory climate program, provided rigorous standards are applied to ensure that credited reductions are real, verifiable, additional, permanent, and enforceable. The challenge for policymakers is to design a robust offsets program that creates effective incentives for capturing these opportunities without undermining either the environmental integrity of the broader effort or incentives for long-term technology investments. The Midwest has a significant head start in this area inasmuch as roughly seven years have already been invested in the development of a full suite of offset protocols, including protocols for agricultural offsets, at the Chicago Climate Exchange. In addition, Midwest universities—several of which have already been active in this work—can continue to play a key role in advancing scientific understanding and methodological innovations in this area.

Low-Carbon Supply Technologies

Even with aggressive efforts to boost efficiency throughout the Midwest economy and the ability to tap a wider array of abatement options via emissions offsets, realizing the kinds of long-term greenhouse gas reductions targeted in current regional and national proposals will require a substantial push to develop and commercialize new low-carbon energy supply technologies. Though recent years have seen substantial progress in this area, additional low-carbon resources will need to be deployed at lower cost and on a far larger scale to achieve and sustain dramatically lower overall carbon emissions, while reliably meeting society’s energy demands over the long term. Thus, an important element of positioning the Midwest for economic prosperity in a carbon-constrained future involves fostering the region’s competitive advantage in emerging low-carbon technologies.

The Task Force examined four major categories of low-carbon supply technologies: advanced coal with carbon capture and sequestration, nuclear power, renewable energy (primarily wind), and biofuels. Overall, the Task Force concluded that continued efforts to advance all of these technologies are warranted by the important contribution each can make to meeting future energy needs in the context of significant carbon constraints. But the Task Force also recognizes that significant hurdles must be overcome in all cases and that a clear-eyed view of each technology’s real-world drawbacks, costs, potential, and development and deployment time frame is crucial to guide sound policymaking and cost-effective investments.
Task Force Recommendations

Building Energy Efficiency

Federal

- Update and expand appliance and equipment efficiency standards to ensure they capture technically feasible and economically advantageous energy saving opportunities.

- Charge a designated federal agency (such as the Department of Energy (DOE) or the Environmental Protection Agency (EPA) with (a) establishing national targets for improved building energy efficiency and (b) developing strategies and demonstrating progress toward those targets. The EPA has already developed some tools for comparing efficiency across different building types and climate zones that could be helpful in implementing this and other policies in this section.

- Emphasize efficiency investments and building retrofits in federal energy legislation, climate legislation, or future economic stimulus plans; consider making efficiency performance part of the criteria used to determine eligibility of projects for federal funding as part of that package.

- Extend and expand federal tax credits for building efficiency improvements for both residential and commercial buildings.

- Consider other federal incentives for promoting efficiency upgrades—or at least information disclosure—at the point of sale, especially in the case of federally subsidized mortgages.

- Provide federal funding for state and local programs to train workers to implement efficiency improvements.

- Support research and development (R&D) on new efficiency technologies.

- Support increased funding for the Weatherization Assistance Program to improve the efficiency of low-income homes.

State/Regional

- Develop and promote a regional model for state-of-the-art building codes and appliance standards (for products not preempted by federal standards). The Midwestern Governors Association could play a lead role. Update and expand appliance and equipment efficiency standards.

- Consider new incentives and foster innovation in city- or university-scale programs to promote efficiency upgrades in existing buildings. One strategy may be to target incentives to specific windows of opportunity such as the point of sale for an existing building. Other opportunities exist when building owners undertake major repairs, renovations, or facility expansions (see University of Iowa Flood Recovery, page 45). Innovative policies can also be used to promote improvement above minimum standards, e.g., expedited siting and permit approval for projects that meet aggressive efficiency targets such as LEED certification (see LEED-Certified Renovation of Exelon Headquarters, page 44).

- Ensure that government retraining efforts allocate sufficient funding for developing the talent necessary to achieve the efficiency targets.

- Address workforce training needs to expand in-region expertise and capacity for designing and implementing efficiency improvements and enforcing codes and standards.

- Consider regulatory reforms to increase utility incentives for investment in customer-side efficiency programs.

- Encourage additional financing mechanisms for leveraging energy efficiency opportunities such as energy services companies (ESCOs).

Transportation Energy Efficiency

Federal

- Extend and expand tax credits for consumers to purchase advanced technology vehicles.
Executive Summary

- Modernize all regulatory, tax, and other policies to remove barriers to efficiency and enable efficiency investments to capture more of the value they create.

- Seek effective solutions to concerns about competitiveness in energy-intensive domestic industries in the design of national and international climate policies. For example, the United States should work through multilateral institutions to develop rules for international trade that can accommodate differences in national-level climate policies.

State/Regional

- Marshal regional resources in combination with federal funding to provide workforce training and skill building.

- Focus on capturing efficiency opportunities in key Midwest industries such as food processing, chemicals, fabricated metals, machinery, and other manufacturing.

Emissions Offsets

Federal

- Enable use of emission offsets as an alternative compliance mechanism in any mandatory national program to limit greenhouse gas emissions.

- Enforce rigorous regulation and verification requirements to ensure that credited project benefits are truly additional, verifiable, permanent, and enforceable.

- Support research efforts at universities, national laboratories, and research centers to identify domestic sources of offsets that meet these criteria, especially in the agriculture sector.

State/Regional

- Build a regional center of expertise in offset identification, verification, management, and trading leveraging the Midwest’s historic human capital strengths in commodities, futures and options, agriculture, and business services. Such a center could

State/Regional

- Invest in regional improvements to the high-speed rail network.

- Draw on in-region resources, both universities and the domestic auto industry, to make the Midwest region a national center for advanced vehicle technologies, including plug-in hybrid (PHEV) and battery electric vehicle technology. Begin planning for and investing in the grid and infrastructure improvements necessary to support these technologies in a way that maximizes potential benefits.

- Undertake regional planning for transit and economic development that incorporates integrated land use, transit funding, and new mechanisms designed to better align private incentives with public objectives (examples include user fees and congestion pricing).

Industrial Energy Efficiency

Federal

- Deploy tax policy to promote industrial energy efficiency (e.g., investment tax credits or accelerated depreciation).

- Level the playing field of subsidies/incentives to treat all low-carbon alternatives equally (i.e., not just renewables like wind, but also energy efficiency and combined heat and power [CHP]).

- Provide federal funding for workforce training and skill building to take advantage of opportunities in energy management and advanced energy technologies.

State/Regional

- Provide increased funding for advanced battery research and development.

- Create a market for advanced technology vehicles by implementing strong fleet requirements for the federal fleet.

- Provide increased funding to upgrade regional rail systems, including relieving freight rail congestion in the Chicago area.

- Draw on in-region resources, both universities and the domestic auto industry, to make the Midwest region a national center for advanced vehicle technologies, including plug-in hybrid (PHEV) and battery electric vehicle technology. Begin planning for and investing in the grid and infrastructure improvements necessary to support these technologies in a way that maximizes potential benefits.

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State/Regional

- Build a regional center of expertise in offset identification, verification, management, and trading leveraging the Midwest’s historic human capital strengths in commodities, futures and options, agriculture, and business services. Such a center could
combine the best of our private-sector institutions with the strength of Midwest universities and key public sector agencies, leading to further growth opportunities in this area.

- Support efforts by universities and other institutions in the region to obtain public and private funding for research in innovative offset opportunities such as improved verification protocols.

Low-Carbon Supply Technologies

Federal

- Ensure that the market rewards innovations that reduce emissions. This is the most effective way to advance low-carbon technology. Thus, a federal policy that establishes a market price on carbon is the essential foundation for other programs and incentives to spur carbon reductions and promote climate-friendly technologies. Either a carbon tax or a cap-and-trade program could achieve this important objective. Each has advantages and disadvantages, but both have the effect of providing a tangible market incentive for developing and adopting low-carbon technologies.

- Emphasize well-designed, performance-based (rather than technology-specific) deployment incentives for technologies that have been (or are ready to be) successfully commercialized. Incentive programs should also provide greater consistency and temporal stability to avoid the boom/bust effect that uncertainty about the federal production tax credit has had on the wind and solar industries. This does not mean that some technologies should get perpetual incentives. Rather, public support should decline as technologies become commercially viable. But since investors need predictability, information about changes in incentives should be known in advance. Finally, because it is impossible to predict the path of technological innovation, programs must be open to new technologies, even if they were not originally anticipated. One of the advantages of performance-based policies is that they have the natural flexibility to accommodate new technologies.

- Provide longer-term clarity about future incentives so that investors have enough confidence to move forward with new technologies. The recent three-year extension of the renewable production tax credit adopted as part of the economic stimulus package was a step in the right direction, but predictability will continue to be important going forward.

- Provide sufficient loan volume under the loan guarantee provisions for low- and zero-emitting technologies included in Title XVII of the Energy Policy Act of 2005. The current cap allows for the development of at most two or three new nuclear plants. In addition, Congress must continue to appropriate and DOE must more efficiently deliver funds for programs that have already been authorized under existing legislation.

- Provide funding for basic scientific R&D to advance technologies that are still in the experimental phase. Much of this R&D has historically been conducted or coordinated through the DOE national laboratories.

- Provide public support in the form of direct cost, risk, and/or equity sharing for first-mover and demonstration projects for technologies that are at the precommercial stage (e.g., coal integrated gasification combined-cycle [IGCC] with carbon capture and sequestration [CCS]). In choosing projects, the government inevitably has to focus on specific technologies and make judgment calls about which technologies and projects merit public support. To improve on the past record, these choices should be based to the greatest extent possible on objective assessments of potential payoffs and likelihood of success.

- Commit to partnering with the private sector to provide the necessary cost- and risk-sharing support to implement a minimum number of demonstration plants for key technologies like CCS and nuclear. Even generous authorizations for such efforts will be meaningless unless Congress follows through with adequate appropriations.

State/Regional

- Rationalize state or regional policies to promote the deployment of technologies that are commercial or close to commercial to focus on desired outcomes (e.g., carbon reductions).
Foster innovation across the Midwest’s university system to drive technological advances and successful commercial applications in critical renewable energy areas. In particular, increased collaboration between Midwest universities, research institutions, and the private sector would enhance the region’s ability to win a share of federal R&D resources and to establish itself as a world leader in the development of new low-carbon technologies.

Work across jurisdictions and regulatory agencies and with the federal government and private sector to develop risk-sharing approaches that open the door to the financing of new technologies and first-mover projects. Financing is a critical barrier for many new technologies as they advance to the demonstration/precommercial stage.

Chapter I
Introduction

Along with the nation—and indeed the world—the Midwest confronts a set of daunting and deeply interconnected energy, economic, and environmental challenges. Events over recent months and years provide an unsettling preview of what is to come if these challenges are not addressed: unprecedented volatility in energy prices, continued economic weakness and job losses in many manufacturing-dependent regions of the United States, and still rising global greenhouse gas emissions despite ever more urgent scientific warnings about the risks. No region has a greater stake in energy and climate policy than the Midwest. No region has a greater stake in immediate economic stimulus and job creation. By the end of the 2008 election year, bipartisan support for new policies and increased public and private investment to bring about a long-term transformation of the nation’s energy systems had strengthened substantially. Indeed, the broader economic context in which states, regions, and a new administration and Congress would engage these issues shifted even more dramatically than Task Force members could have envisioned when they first convened in May of 2008.

The work of the Task Force on National Energy Policy and Midwestern Regional Competitiveness was motivated by the desire to bring a Midwest perspective to the ongoing national debate on climate and energy policy. At the time the Task Force was launched, there was a widespread expectation that Congress would take up federal climate legislation early in the first term of a new administration. In addition, several states and regions were moving forward with their own climate and energy initiatives, including several members of the Midwestern Governors Association, who adopted a regional accord on reducing greenhouse gases in November of 2007.

To support ongoing Midwest efforts and to help inform its own conclusions and recommendations, the Task Force commissioned a new region-specific analysis of carbon abatement options and their costs, consulting a number of sources and recognized experts in different fields. The region-specific analysis was conducted by
In November 2007 the governors of six midwestern states (Illinois, Iowa, Kansas, Michigan, Minnesota, and Wisconsin) and the Province of Manitoba signed a regional accord on reducing greenhouse gas emissions as part of a broader Energy Security and Climate Stewardship Platform. The states of Indiana, Ohio, and South Dakota and the Province of Ontario joined the accord as observers. The accord commits signatories to:

- establish greenhouse gas reduction targets and time frames consistent with the Midwestern Governors Association member states’ targets;
- develop a market-based and multisector cap-and-trade mechanism to help achieve those reduction targets;
- establish a system to enable tracking, management, and crediting for entities that reduce greenhouse gas emissions;
- develop and implement additional steps as needed to achieve the reduction targets such as low-carbon fuel standards and regional incentives and funding mechanisms.

The Midwestern Governors Association is currently working to establish regional targets for greenhouse gas reductions and to complete development of a proposed cap-and-trade agreement and model rule.

McKinsey & Company, resulting in a detailed carbon dioxide abatement cost curve. The creation of the cost curve relied heavily on McKinsey’s previous work Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? published in conjunction with the Conference Board. The results are included as Figures 7 and 8, showing updated U.S. and Midwest cost curves (without international offsets included).² The McKinsey cost curve, along with information from other sources such as the U.S. Energy Information Administration (EIA), Metropolis 2020, the International Energy Agency (IEA), and the National Renewable Energy Laboratory (NREL), provides a fact base for the Task Force’s assessments. This report’s conclusions are solely those of the Task Force, not of McKinsey.

Despite a growing consensus about the need for action, the path to a national political consensus remains far from clear. This is in large part because there is no single technology and no single policy initiative that can successfully resolve our energy security and environmental sustainability concerns. Indeed, the challenge has been vastly complicated by the current global financial crisis, which poses grave threats to the United States and world prosperity and can be expected to shape the political and economic context in profound but as yet unpredictable ways for some time to come.

In the near term, the crisis will stimulate an increase in public spending, some of it for energy-related purposes. In fact, the economic stimulus bill passed in February 2009 contained $38 billion in energy-related direct spending and $20 billion in energy-related tax cuts (see Table 1). Much of this is directed to projects and initiatives authorized under previous energy legislation, notably, the energy bills passed in 2005 and 2007.

This new spending represents only a first step toward addressing the long-term energy and environmental challenges that confront the Midwest and the entire nation. Given the magnitude of the challenge, the Task Force believes that a much larger effort sustained over a far longer period of time will be needed. And, this effort will need to be mounted under fiscal and political constraints that are likely to become more challenging, not less.

The Midwest can play a pivotal role in forging the national consensus needed to move forward on these difficult issues. Indeed, if the region could unite around a set of defined actions and principles, this would greatly improve prospects for national progress. In particular, the votes of the Midwest congressional delegation could be a key factor in determining when federal climate and energy legislation is passed, what it will look like, and what support it will provide for reducing demand and advancing new energy technologies.

Given its huge stake in national energy and climate change policy developments, the Midwest needs to speak with a coherent and unified voice on these issues. Because the region is a major energy consumer and greenhouse gas emitter, climate and energy legislation will have a dramatic impact on its economy. To manage the impact, while revitalizing the region’s economy and improving its competitiveness, state governments and other Midwest organizations will have to be more proactive and coordinate more effectively than they have in the past.

Against the backdrop of great economic and political uncertainty, this report attempts to address all levels of the debate. The report emphasizes the importance of coordinated public and private action as well as the need for leadership at all levels of government—local, state, and national.
I. Introduction

1. The Midwest can and must turn the challenge of changing energy and climate policy to its economic advantage.

Task Force members recognized from the outset that the Midwest has a unique combination of advantages and disadvantages. Together, the region’s twelve states account for more than one-quarter (29 percent) of national greenhouse gas emissions and roughly 4 to 5 percent of global greenhouse gas emissions. More importantly, the overall carbon intensity of the Midwest economy is higher than the national average. This is primarily because the Midwest uses coal to a greater extent than other regions. In addition, rates of energy consumption are somewhat above the national average as a result of the concentration of manufacturing and heavy industry in the region, ample land resources that enabled or facilitated low-density development, and a climate that imposes significant heating and cooling requirements.

Access to ample, low-cost energy helped the Midwest economy thrive for decades. Today that legacy creates new challenges and opportunities. On the one hand, the Midwest has tremendous potential to reduce emissions and improve efficiency. At the same time, higher-than-average carbon intensity could mean that the region incurs disproportionate near-term costs under a national policy to limit greenhouse gas emissions.

Likewise, the regional economy’s long-standing roots in manufacturing and agriculture are a source of both vulnerability and possibility. No part of the country is more sensitive to the trade impacts and potential competitive disadvantages of higher energy prices. Yet few regions are better positioned to reap benefits from a massive, new national-level effort to invest in infrastructure, new technology, and green energy alternatives.

Indeed, the Midwest enjoys tremendous assets that can and must be leveraged to assure our future competitiveness in a low-carbon economy. These assets range from a strong manufacturing base and an experienced, skilled workforce to distinctive research universities and a strong stable of companies leading the way in new technologies. To leverage these advantages, the Task Force urges decision makers at all levels to adhere to certain basic principles for energy and climate policymaking.

Table 1. Energy-Related Provisions of the American Recovery and Reinvestment Act of 2009

<table>
<thead>
<tr>
<th>Item</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Grid</td>
<td>$11 billion ($6.5 billion for upgrades, $4.5 billion to modernize grid)</td>
</tr>
<tr>
<td>Loan guarantees for renewable energy and transmission projects</td>
<td>$6 billion (expected to leverage $60 billion)</td>
</tr>
<tr>
<td>Federal high-performance green buildings program</td>
<td>$4.5 billion</td>
</tr>
<tr>
<td>State energy programs</td>
<td>$6.6 billion ($3.2 billion for energy efficiency and conservation block grants plus $3.4 billion for state energy programs)</td>
</tr>
<tr>
<td>Public housing capital fund</td>
<td>$1 billion (out of $4 billion total for HUD’s public housing capital fund to be directed to energy efficiency retrofits)</td>
</tr>
<tr>
<td>Weatherization assistance</td>
<td>$5 billion</td>
</tr>
<tr>
<td>Advanced Research Project Agency-Energy</td>
<td>$400 million</td>
</tr>
<tr>
<td>Fossil energy research and development</td>
<td>$3.4 billion (expected to be mostly for research and development on carbon capture and sequestration technology)</td>
</tr>
<tr>
<td>Federal motor vehicle procurement</td>
<td>$300 million</td>
</tr>
<tr>
<td>Advanced battery research loans and grants</td>
<td>$2 billion</td>
</tr>
<tr>
<td>Public transportation</td>
<td>$8.4 billion (includes $100 million in discretionary grants to public transit agencies for investments in efficiency and reduced greenhouse gas emissions)</td>
</tr>
<tr>
<td>High-speed rail and Amtrak</td>
<td>$9.3 billion ($1.3 billion for Amtrak, $8 billion for high-speed rail corridors and intercity passenger rail)</td>
</tr>
<tr>
<td>Green jobs training</td>
<td>$500 million</td>
</tr>
</tbody>
</table>

Additional tax incentives or provisions:
- Extension of production tax credit (through 2013) for renewable energy
- Extension of tax credit (to 2010) and increase in credit cap for residential energy efficiency investments
- Expansion and simplification of tax credit for electric and plug-in electric hybrid vehicles
- Increase in bond limit for Clean Renewable Energy Bonds (to $1.6 billion from $800 million) and qualified energy conservation bonds (to $2.4 billion from $800 million)

Source: www.recovery.gov.
First, policymakers must assure predictable incentives, a predictable and transparent cost of carbon, and reliable rules of investment so that the private sector can make appropriate long-term investment decisions. Either a carbon tax—set at an initially moderate level and increasing gradually at a preestablished rate over time—or a cap-and-trade system with an effective cost containment mechanism can provide an appropriate balance of price predictability and meaningful emissions abatement.3

Second, even in the wake of the current financial crisis, the Task Force believes that well-regulated markets are best able to ensure economically efficient outcomes. While policymakers must encourage innovation, they must also ensure that the nation and region capture the lowest-cost opportunities first.

Third, government stimulus and support must be targeted to low-carbon solutions that would not achieve economic viability in the necessary time frame without a public partner to help overcome otherwise prohibitive up-front development costs or risks.4 There is no single technological answer to the nation’s climate or energy security concerns, and policymakers must not prejudge winners and losers.

2. Prompt enactment of national climate change legislation is essential to the Midwest’s future prosperity and competitiveness.

As important as predictability is the need to get started without further delay on the technologies and investments that will be required to address the long-term challenges we face. From an ecological perspective, postponing action to change the trajectory of future greenhouse gas emissions will effectively put more stringent atmospheric stabilization goals out of reach. From an economic perspective, it would be extremely shortsighted to allow temporarily lower energy prices to derail development of the technologies needed to maintain competitiveness and improve energy security over the next century. A coherent national policy is critical to the development process. Clearly, no state or region by itself can mount a sufficient response to global problems like climate change and oil dependence. We must rectify a national approach to energy policy that for more than thirty years has consisted of a patchwork of short-term responses—usually prompted by an equally short-lived perception of crisis. An effective and credible national policy will also enhance our ability to play a leadership role in the negotiation of international agreements necessary for effective climate policy.

3. Regional and local action is likewise essential.

While federal action is essential, the Midwest cannot afford to wait for it. Individual states and the broader region can and must move forward on a number of fronts regardless of what happens in Washington, D.C. The Task Force applauds the recent efforts of the Midwestern Governors Association to develop a regional platform for climate action. The opportunities for regional coordination are many. They include:

- maximizing the energy efficiency of our buildings, industries, and transportation systems;
- modernizing outdated infrastructure;
- developing new energy technologies that will be needed to cope with future carbon constraints;
- engaging the region’s universities in leading-edge energy research and innovation;
- addressing critical workforce issues;
- improving regional coordination and cross-jurisdictional decision-making processes for interstate transmission and carbon capture and storage infrastructure.

3. A reasonably predictable carbon price is critical to allow firms and investors to respond effectively in terms of their planning and investment decisions. A tax provides more certainty or predictability about future carbon prices than a cap-and-trade system, but it does not offer certainty about final emissions. A cap-and-trade system, by contrast, provides more certainty about future emissions, but absent a cost-containment mechanism does not offer certainty about future prices. Hybrid approaches—such as a cap-and-trade system with a price cap or safety valve—can provide some of the predictability of a tax and may be helpful in striking a balance between the competing goals of price and emissions certainty.

4. Obviously, there is a tension between free market principles and our call for government support for research and development. The Task Force acknowledges this tension and believes it is best addressed by focusing direct government investment on the early stages of the technology development process, while simultaneously adopting a technology-neutral, performance-based approach to broader deployment policies aimed at accelerating the diffusion of technologies that are further along in the development trajectory. This is discussed in the introduction to Chapter V of this report.
I. Introduction

minimizing the potential for volatile prices and inequitable price impacts. Policymakers must be especially attentive to disproportionate impacts on both low-income households and energy-intensive industries that compete in global markets. Well-designed policies and a reasonably predictable and transparent cost for carbon are ultimately as important for consumers and domestic industry as they are for investors.

The remainder of this report is organized as follows. Chapter II provides a snapshot of the Midwest’s current energy economy, identifies key areas of opportunity and vulnerability, and begins to establish an analytical framework for organizing the technology and policy options discussed in later chapters. Chapters III and IV focus on two areas—energy efficiency and emissions offsets—where the Midwest could make substantial progress to improve its competitiveness, leverage in-region assets, and manage compliance costs in the early phases of a greenhouse gas reduction regime.

In Chapter V the report turns to long-term, low-carbon energy supply options. The chapter explores the critical barriers that need to be overcome to ensure Midwest access to adequate, secure, reliable, economically viable, and environmentally acceptable sources of energy in the future. Realizing this objective will require well-designed policies along with targeted public and private investments in promising technologies at various stages of development and commercialization. The Midwest, with its strong industrial and manufacturing base and deep expertise in key areas—notably, vehicle technology and wind, nuclear, coal, and bioenergy technologies—has an opportunity to take the lead in advancing a new generation of energy options that will increasingly be sought by markets in the United States and abroad.

4. Addressing carbon emissions will not be cheap.

The Task Force recognizes that addressing climate change and energy security will require coordinated action across every sector of our economy. The Midwest cost curve developed by McKinsey & Company in conjunction with this report shows the costs associated with various carbon abatement solutions and graphically illustrates the enormity of the task (see Figure 8 and the discussion on pages 33-40).

The solutions in the chart fall into three main categories around which this report is structured: (1) improving energy efficiency, (2) taking advantage of emission offsets, and (3) developing new low-carbon energy supplies. While energy efficiency and emission offsets offer relatively low-cost alternatives, the curve makes clear that substantial long-term investments will be essential to developing the new energy supplies and technologies necessary to reduce carbon emissions and make the Midwest economy more efficient and globally competitive.

Some of that investment must come from public-private partnerships, particularly for new technologies that are not ready for commercial deployment. Most of that investment, however, must ultimately come from the private sector. To assure such investment, predictable incentives and rules of investment must be in place. Most importantly, a transparent and reasonably predictable price for carbon must be established. This can be done through a cap-and-trade regime and/or through taxes on emissions. Either way, some reasonable predictability about the future cost of carbon emissions is critical to enable long-term investments in low-carbon technologies.

At the same time, consumers must be protected during the transition to a low-carbon future. While a financial incentive to avoid emissions (i.e., a carbon price) will motivate the development of climate-friendly technologies, it will also raise energy prices, including the price of electricity. Thus, even as we invite innovation and explore low-carbon energy solutions, we must ensure that our policies support the best and least costly opportunities first, while...
Chapter II
The Midwest Economy and Energy

Energy has always shaped the Midwest economy. Indeed, access to ample and relatively inexpensive supplies of coal and oil helped make the Midwest a center of industrial production. It also supported a geographically dispersed economy that featured a large agriculture sector, major hubs for commerce and the movement of goods, and a concentration of manufacturing industries, including the “Big Three” domestic auto companies and steel production. Now the Midwest must adapt to a changing energy context and leverage its in-region assets so these historic advantages continue to create opportunity rather than becoming economic and environmental liabilities.

The Midwest Economy

Table 2 summarizes population, gross state product, median household income, and energy-related carbon dioxide emissions for the twelve midwestern states using the latest available U.S. government data, in most cases from 2007 (2005 in the case of carbon dioxide emissions). Table 3 shows employment and value added in the region’s most important manufacturing sectors, both in absolute terms and as a percent of the U.S. total in each sector. Overall, the twelve-state region is home to 22 percent of the overall U.S. population and accounts for 20 percent of the nation’s total economic output. The region plays a disproportionate role in manufacturing, accounting for nearly 30 percent of the value added nationally by this sector and 32 percent of the total manufacturing workforce nationwide.

Improvements in productivity and the competitive pressure of globalization have led to a net loss of manufacturing jobs in the nation and the Midwest over the last two decades, even as total manufacturing output continued to grow. The region has also lost population relative to other parts of the country, while household income, for the Great Lakes states in particular, has slipped relative to the national average. The current economic downturn is strongly affecting the goods-intensive Midwest economy and the manufacturing sector in particular—with the domestic auto industry in especially precarious shape. Until recently, nearly half of U.S. auto assembly
II. The Midwest Economy and Energy

plants were located in Michigan, Indiana, and Ohio, and roughly one in five Midwest jobs was dependent on General Motors alone. Figure 1 illustrates the decline in manufacturing jobs in parts of the region over time.

Thus, regional trends even prior to the present economic crisis suggest that the Midwest faces longer-term economic and demographic challenges. One concern is that the region has been lagging relative to other parts of the country in developing new industries and attracting the kind of entrepreneurial investment that could generate job growth in the future. Figure 2 ranks individual states by the amount of venture capital financing they attracted in 2005 as a fraction of gross state product. All of the midwestern states are below the U.S. average in this ranking, and none of them approach the levels of venture capital financing associated with leading states in the West and Northeast. The Midwest also competes with other regions in conducting cutting-edge research, generating patents for new technologies, graduating students with advanced degrees in science and engineering, and attracting federal grants for energy-related R&D. The Midwest’s strong network of leading universities has long been one of its most important assets. But recent data comparing the fifteen Great Lakes universities to the country’s top five patent-
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II. The Midwest Economy and Energy

II. The Midwest Economy and Energy

generating universities (in terms of their share of academic patents and doctorate degrees and postdoctorates awarded over the last decade) suggest that the region is falling behind. Thus, preserving competitiveness in this crucial arena needs to be a major priority for policymakers, business leaders, academic institutions, and citizens throughout the Midwest.

How to improve the region’s entrepreneurial and educational competitiveness in an increasingly global marketplace is a larger question that has been addressed elsewhere, for example in the report Rising Above the Gathering Storm, released by the National Academy of Sciences in 2007. In any case, it is critical that energy and climate issues as they relate to the Midwest be seen in the broader context of regionally distinct economic challenges and conditions.

The Midwest Energy Mix and Carbon Footprint

Figure 3 compares the overall energy supply mix of the Midwest to that of the nation as a whole. Figure 4 compares the mix of fuels used to generate electricity in the region. As is clear from Figure 4, the Midwest utilizes coal for electricity production to a greater extent than other regions. The region is also proportionately less reliant on low-carbon resources like natural gas and renewable energy in the electric sector. Specifically, 50 percent of installed electric generation capacity in the region is coal (compared to 30 percent nationwide), while approximately 70 percent of actual electricity production is coal-based (compared to approximately 50 percent nationwide).

In terms of energy consumption, the breakdown of energy demand by end-use sector in the Midwest (shown in Figure 5) is comparable to that of the nation as a whole. Overall, however, the region consumes more energy per capita and per dollar of GDP than the nation as a whole (367 billion Btu per person per year compared to 337 billion Btu per person per year, and 8.75 trillion Btu per billion dollars GDP compared to 7.39 trillion Btu per billion dollars GDP).

Not surprisingly, given slightly higher-than-average rates of energy consumption and a relatively coal-heavy supply mix, the Midwest economy is also more carbon intensive than the U. S. economy as a whole, generating an estimated 0.55 million metric tons of carbon dioxide equivalent (MtCO₂e) for every billion dollars of economic output in 2007. This compares to a national average of 0.43 MtCO₂e per billion dollars of economic output in the same year. Per capita greenhouse gas emissions averaged 23.3 tons per person per

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6. The Great Lakes universities include Case Western, Ohio State, Purdue, Wayne State, Iowa State, Michigan State, Northwestern, and the universities of Chicago, Cincinnati, Indiana, Illinois, Iowa, Michigan, Minnesota, and Wisconsin. The nation’s top five patent-generating universities include the University of California, MIT, Cal Tech, the University of Texas, and Stanford.
A more carbon-intensive economy creates obvious potential for above-average exposure to the impacts of a mandatory policy to limit greenhouse gas emissions. Economists and other experts agree that energy prices will have to rise in the future to reflect the cost of climate impacts and to create the concrete market incentives needed to stimulate the development and widespread adoption of low-carbon technologies. Ensuring that higher energy prices do not disproportionately burden firms and households in the Midwest requires (1) careful policy design at the federal level to ensure that a regulatory program for greenhouse gases delivers clear and effective market signals, while simultaneously addressing concerns about regional equity and international economic competitiveness and (2) thoughtful and proactive responses at the state and regional level to take maximum advantage of the Midwest’s particular economic strengths and substantial efficiency and clean technology potential.

Building a Foundation for Future Economic Competitiveness

For the Midwest—a region that has benefited historically from cheap energy, especially cheap electricity, but that now confronts a new set of challenges—part of the solution lies in investment and, by extension, in the design and application of policies that create new incentives for innovation. Policymakers and stakeholders at every level will be focused in the near term on how and where to direct funds to jump-start the economy. But the difficulty of ensuring that public resources are well spent and that new initiatives are implemented in ways that maximize long-term returns to the economy extends well beyond the immediate political horizon. The stakes are especially high in the energy arena, where the needed investments are large and the consequences of missed opportunities are often long-lived. For example, if the region fails to exploit available, cost-effective energy efficiency opportunities, it may need to build additional generation capacity sooner rather than later, potentially locking in a major new carbon liability for decades to come. Thus, in setting priorities—whether at the national or regional level—a clear-eyed assessment of the cost, potential, and barriers that confront different options is invaluable. The remainder of this report attempts to provide such an assessment across a variety of supply- and demand-side options.

As mentioned in this report’s foreword, the Task Force commissioned a new region-specific analysis of carbon abatement options and their costs. The curve shows any known technology up to $50 per
The Chicago Climate Action Plan

The Chicago Climate Action Plan, the product of a broadly representative task force, is the City of Chicago’s blueprint for dealing with climate change, focusing on both mitigation and adaptation. The Chicago Plan outlines five separate strategies: (1) energy efficient buildings, (2) clean and renewable energy sources, (3) improved transportation options, (4) reduced waste and industrial pollution, and (5) adaptation. These five strategies are broken down into twenty-six actions to mitigate greenhouse gas emissions—with a goal of a 25 percent reduction below 1990 levels by 2020—and nine actions to prepare for climate change, particularly the effects of hotter summers, heavier rain storms, growing flood risks, and stresses on the city’s infrastructure and economy.

The City of Chicago has also pioneered the innovative use of technology to achieve long-standing ambitions in the realm of energy efficiency. To take just one example, the Center for Neighborhood Technology (CNT), a think tank focused on urban issues, advised the city on optimal ways to target city and partner programs to increase the energy efficiency of buildings, which account for approximately 70 percent of all city emissions. CNT analyzed and geo-coded address-specific utility data, allowing it to analyze energy intensity across the city, thus providing up-to-date information about where the city should focus its efforts to maximize greenhouse gas reductions.

To ensure that the goals of the Chicago Plan are met, a Green Ribbon Committee composed of business and community leaders will continually monitor and assess the implementation of each of the five strategies.

Figure 7 - 2020 U.S. Carbon Abatement Curve without International Offsets

The cost curve shows the full range of emission reduction actions that are possible with technologies that are either available today or offer a high degree of certainty about their potential within a 2020 time horizon.

On the cost curve, the width of each bar represents the potential of that abatement opportunity to reduce CO₂ emissions in a specific year, compared to the projected business-as-usual trajectory for the Midwest census region. The potential of each opportunity assumes aggressive national action starting in 2010 to capture that specific opportunity and does not represent a forecast of how each option will develop in light of existing policies. The height of each bar represents the average cost of avoiding one metric ton of CO₂ emissions by 2020 using the technology or measure in question. The cost is a weighted average across suboptions and years. All costs are in 2005 real U.S. dollars. The options are displayed left to right according to cost, from the lowest-cost abatement opportunities to the highest.

The width of each bar is an attempt to capture the realistic potential of each analyzed abatement opportunity within the bor-
The resulting incremental cost or benefit is captured as the height of each opportunity on the cost curve. To analyze the cost of each opportunity, the net resource costs of abatement were assessed by examining incremental net initial capital investments, operating and maintenance costs, replacement costs, and avoided costs as applicable. These costs were refined and adjusted to account for Midwest-specific regional costs based on regional indices that the Energy Information Administration and other government agencies use to adjust for such differences. The team also applied a 7 percent discount rate to account for the time value of money between initial investment and any resulting savings. The resulting incremental cost or benefit is captured as the height of each opportunity on the cost curve.

Uncertainty in the underlying data can be significant for individual abatement opportunities (both in terms of volume and cost estimates) and for emerging technologies. Cost factors fluctuate constantly. Any abatement cost curves developed today using more current data would differ in some details from Figures 7 and 8. Therefore, the curve should be used for overall comparisons of the size and cost of different opportunities, the relative importance of different sectors, and the overall size of the emissions reduction opportunity, rather than for forming predictions about the development of individual technologies.

One should also bear in mind that the cost of abatement is calculated from a societal perspective (i.e., excluding taxes and subsidies and with a capital cost similar to government bond rates). This methodology is useful because it allows for comparisons of opportunities across individual sectors and individual abatement opportunities. However, it also means that the costs calculated are different from the costs a company or consumer would see, as these decision makers would include taxes, subsidies, and different interest rates in their calculations. Therefore, the curve cannot be used for ascertain-
The cost curves highlight several important insights for stakeholders:

- There are no easy technological solutions for reducing energy-related carbon emissions on the scale needed to materially impact global climate change, and there is no single option that will go all or most of the way toward solving the problem. Rather, the abatement cost curve is highly fragmented and encompasses all sectors of the economy. That means multiple options will need to be pursued and further technology innovations will be needed.7

- The costs of many of the carbon abatement options currently under discussion vary widely. If opportunities to systematically take advantage of the relatively lower-cost options are not seized, the overall cost of achieving any given abatement target can greatly increase. For example, McKinsey has estimated that it could cost $10 billion to capture 50 percent of cost-effective energy efficiency potential (primarily in the areas of commercial and residential buildings), but doing so could save up to $30 billion in compliance costs.

- Even those efficiency options that appear, on the basis of a narrow engineering cost-benefit calculation, to be low cost or “no regrets” (i.e., the upfront expense is in theory quickly recouped by energy savings) can be difficult to capture and usually aren’t free inasmuch as incentives or other inducements are required to overcome market barriers to the adoption of these technologies.

- Nevertheless, energy efficiency improvements offer the most cost-effective, near-term opportunities for reducing greenhouse gas emissions and enhancing the region’s economic competitiveness. After efficiency, emissions offsets represent the next lowest-cost, near-term abatement option. Low-carbon supply options remain generally more expensive than efficiency or offsets, at present, though their contribution will also be needed to achieve and sustain the level of reductions targeted in current legislative proposals.

- For that reason, continued efforts are needed to reduce deployment hurdles to already commercial or near-commercial low-carbon supply options such as wind and next-generation nuclear. The technology improvements and cost reductions needed to scale up not-yet-commercial alternatives such as carbon capture and sequestration and advanced biofuels must also be pursued to make them more competitive with conventional energy technologies.

- Comparing the regional cost curve to the national cost curve (see Figure 8a), the Midwest has a proportionately larger supply of agricultural abatement opportunities than the United States as a whole. It also has a proportionately smaller supply of power sector abatement opportunities at costs below $50 per ton. This suggests that the Midwest would benefit on a relative basis from the inclusion of domestic offsets in a regulatory regime. It also suggests that for a given national-level allowance clearing

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7. Numerous studies have reached this conclusion. The “wedges” analysis of Socolow and Pacala (2004), in particular, highlights the scale and complexity of the technological challenge at the global level.
price, less renewable energy potential would be unlocked in the Midwest relative to the nation overall.

Subsequent chapters cover the three main categories of abatement options—energy efficiency, offsets, and low-carbon supply technologies—in the order suggested by the regional cost curve. In each of these areas, the Task Force has endeavored to present findings, primarily with respect to the costs, potential, and barriers pertinent to each option, and to develop specific recommendations for action at the federal, regional, and state levels. The following general themes run through all of these recommendations:

- Although the Task Force recommends actions that are applicable outside the Midwest, we have tried to focus on those actions or priorities that are specifically Midwest-focused and/or can be stimulated with regional action.

- We encourage policies and actions that will create the certainty and long-term stability necessary to stimulate private sector investment in new solutions—not simply those that rely on government funding.

- We emphasize a “level playing field,” where government does not pick technology winners, but establishes rules and targets that reward desired outcomes and by doing so encourages private companies to develop the most viable solutions.

- We call for direct federal funding in two specific areas—R&D and infrastructure—where incentives for private-sector investment, even with the aid of enlightened policy, are likely to fall consistently short of what is justified from the standpoint of societal benefit. In both these areas, however, federal spending must be directed more effectively than it has been in the past.

- Workforce development is also an important area for public investment. The Midwest has the potential advantage of a large pool of skilled labor with expertise in manufacturing. This is an opportune time to retrain those workers for jobs in the new energy economy.

Chapter III
Energy Efficiency: A Critical Opportunity to Reduce Emissions and Improve Regional Competitiveness

As noted in the previous chapter, an examination of carbon abatement options in the Midwest indicates that the most cost-effective, near-term solution for helping to reduce greenhouse gas emissions is to improve energy efficiency. Improving energy efficiency also provides other important environmental benefits and advances the region’s economic competitiveness and energy security. Doing more with less energy can reduce costs and improve productivity, reduce the economy’s exposure to high and volatile energy prices, enhance grid reliability, and keep resources that would otherwise go to purchase imported fuels like oil inside the region. In many cases, better technologies and energy-saving innovations make it possible not only to reduce consumption, but to deliver improved performance and amenity at the same time. Finally, improved efficiency can play an essential role in improving the viability of new low-carbon supply options. The cost, technology, and scale-up challenges associated with many of these options become much more manageable if end-use energy demands are minimized from the outset.

A strong emphasis on energy efficiency in achieving greenhouse gas reductions is supported by numerous analyses. So-called “bottom-up” technology assessments consistently find that substantial energy savings opportunities exist throughout the economy. From an engineering standpoint, these opportunities are often highly cost-effective since the costs incurred to implement the efficiency measure could be recouped relatively quickly through energy savings. In other words, the rate of return on these efficiency investments often appears quite favorable relative to other investment opportunities.

This is also why many of the efficiency measures shown in the cost curve presented in Figure 8 appear to offer emissions reductions at negative cost. Yet energy savings opportunities that are cost-effective from an engineering standpoint may or may not be economic when taking consumer preferences, market barriers, and other factors into account. This helps explain why otherwise cost-effective measures are not always automatically adopted by the marketplace. A more meaningful assessment of efficiency costs must therefore include the cost of implementing the programs and policies nec-
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III. Energy Efficiency

necessary to motivate real-world firms and consumers to undertake the improvements.

The barriers to energy efficiency have been well documented, and considerable field experience exists with policies that are designed to overcome them. One common barrier is “split incentives,” or when decision makers have no incentive to concern themselves about efficiency because they will not be paying the energy bills down the line. Examples include landlords versus tenants, and builders versus owners. In some cases consumers and companies do not have ready access to relevant information when making purchasing decisions. In other cases energy efficiency is simply given less weight relative to other considerations.

Arguably, such barriers should be less significant for industrial and other large energy users who are typically better informed and more motivated—for cost reasons—to capture energy-saving opportunities. Nevertheless, there is ample evidence that industrial energy users—like commercial and household energy users—often demand rates of return on efficiency investments that far exceed typical rates of return on other capital investments.

Informational and other barriers are common in all sectors. For example, even large firms frequently lack dedicated energy managers, and many are highly resistant to interrupting their operations to install new equipment or implement process changes. Even though their energy expenditures may be substantial, these firms often do not view energy as part of their core business. Finally, energy markets do not always provide end users with accurate price signals. For example, the price most residential and small commercial consumers pay for a kilowatt-hour of electricity usually bears little relation to the true cost of delivering that kilowatt-hour at a particular point in time. Price distortions—whether in the form of overt subsidies or (perhaps more commonly) because of a failure to fully value externalities in market prices—can also lead to levels of consumption and systematic underinvestment in efficiency that undermine the goal of reducing emissions.

While such market barriers and other factors have prevented many seemingly cost-effective improvements from happening “on their own,” these barriers are not insurmountable. Over the last four decades, a number of policy tools have been deployed to accelerate the introduction of efficiency improvements. Examples include efficiency standards for appliances, equipment, and vehicles; technology incentives such as tax credits for certain types of efficiency improvements; and informational programs such as the federal government’s Energy Star and other labeling programs. Over the last two decades there have also been considerable efforts to achieve customer-side efficiency improvements through utility programs as an alternative to expanding generation capacity.

Estimates of the overall impact and cost-effectiveness of past policies vary, but there are some notable successes—including the oft-cited dramatic improvement in refrigerator efficiency since the 1970s. This suggests that further gains could be made. Codes and standards, in particular, appear to be a relatively cost-effective tool for advancing efficiency improvements. At the same time, public attitudes and awareness are changing rapidly in ways that could significantly boost progress toward improved efficiency. As noted in the next section on buildings, a number of large companies have made high-profile commitments to efficiency in recent years, and a number of them have documented substantial energy cost savings after undertaking improvements.

As a result of past policies, structural changes, technological improvements, and competitive pressures, the Midwest economy—like the national economy—has become gradually more energy efficient (and correspondingly less carbon intensive) over time. Figure 9 shows the region’s historic carbon intensity, closely tracking a national trend of declining carbon emissions per dollar of economic output starting in the 1970s. (Nationally, the rate of decline has averaged approximately 1 percent per year over the time period shown.)
To achieve net reductions in absolute terms, however, the rate of improvement in energy and carbon intensity must outpace the rate of growth of the economy, which has not happened to date. In fact, the Midwest’s total energy-related carbon emissions increased by 14 percent in absolute terms between 1990 and 2003. The question for policymakers, therefore, is how to accelerate the region’s adoption of more efficient technologies and behaviors beyond the business-as-usual baseline.

Efforts to quantify the theoretical potential for economy-wide efficiency improvements on the basis of technology assessments range widely. Typically, however, savings are estimated on the order of 15 to 25 percent, in some cases with significant gaps between what is deemed technologically possible, economic or cost-effective, and practically achievable. On the basis of an engineering cost assessment, McKinsey has estimated that efficiency improvements could produce reductions of at least 750 million metric tons per year at a cost below $50 per ton CO₂ nationally by 2020. This corresponds to a reduction of 9 percent from the business-as-usual emissions baseline. For the twelve-state Midwest region, McKinsey estimates that energy efficiency improvements could produce carbon dioxide-equivalent (CO₂e) reductions of at least 180 million metric tons per year at a cost below $50 per ton CO₂ regionally by 2020. This corresponds to a reduction of 9 percent from the regional business-as-usual baseline.

LEED-Certified Renovation of Exelon Headquarters

In 2004 Exelon’s Real Estate and Facilities business unit initiated the consolidation of Exelon’s downtown Chicago locations and one suburban location into a single flagship headquarters to increase productivity and reduce long-term occupancy costs. The U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED®) program defines the parameters for building and operating new and existing buildings to be more environmentally friendly. In evaluating its potential participation in the LEED program, Exelon determined that the building and design marketplace had evolved to a point that made it feasible to incorporate many established and forward-thinking elements of sustainable design and construction into its new headquarters. The company also found that the costs associated with sustainable design are now on a par with typical building materials and processes.

The Exelon headquarters renovation project entailed the design and construction of more than 220,000 square feet of office space on ten floors in an existing landmark building in downtown Chicago. The result was a 50 percent reduction in energy consumption, achieved by measures such as reducing lighting requirements to below one watt per square foot. Exelon moved into its new headquarters in December 2006. In April 2007 the U.S. Green Building Council awarded Exelon’s headquarters with the LEED® Platinum Commercial Interiors (CI) certification. Exelon’s new headquarters is the largest office space in the world to be LEED-CI certified at the platinum level.

University of Iowa Flood Recovery

The University of Iowa is a major research university located on a 1,900-acre campus in Iowa City, Iowa. Its physical plant consists of 261 buildings totaling 16.7 million square feet. The university owns and operates a central power plant, three chilled water plants, and a water treatment facility. The main power plant is a combined heat and power facility, producing both steam and electricity. The primary sources of fuel for these facilities are coal, biomass (cut hogs), and natural gas.

In summer 2008, historic flood levels on the Iowa River forced the evacuation and closure of more than twenty university buildings, including the central power plant, the student union, the performing arts center, and several major academic buildings. Nearly 2.7 million square feet were affected, and many buildings were severely damaged.

Despite the substantial financial challenges associated with recovering from a natural disaster of this magnitude, university leaders and facilities officials have insisted that recovery efforts include steps to upgrade energy efficiency wherever such opportunities exist. For example, the campus utility tunnel system and power plant suffered extensive flooding, and rebuilding efforts have included upgrading insulation and replacing old lighting fixtures with higher-efficiency fluorescent fixtures or even more energy-efficient induction technology lighting systems. As other buildings are renovated, damaged air handling equipment is being replaced with more efficient systems, and improved control systems are being installed. Although these steps involve additional investment by the university, they are expected to yield significant energy and cost savings in the long run.

Of the carbon reductions achievable nationally through efficiency improvements, McKinsey further estimates that roughly 20 percent can be expected to occur through a combination of existing policies and mandates (including a number of provisions introduced in the federal Energy Independence and Security Act of 2007) and (to a much smaller extent) from changes in consumer behavior. Another roughly 40 percent can be achieved through efficiency improvements in new facilities, where it is relatively easier and less costly to install energy-saving technologies and systems and where fewer actors typically need to be involved in planning, financing, and implementing improvements. The remaining 40 percent of the overall efficiency-based carbon abatement potential involves retrofits and may therefore be considerably harder to capture. In practice, given the difficulty of imposing mandates on existing buildings or equipment, policymakers will likely need to rely to a greater extent on carrots (incentives) rather than sticks (mandates) to reach these abatement opportunities.
Capturing these opportunities will require up-front investment, as we have already pointed out. In fact, the regional cost analysis indicates that capturing roughly half (50 percent) of the region's cost-effective efficiency potential could cost on the order of $10 billion per year—hardly a “free lunch,” but still a better deal from a cost-benefit perspective than most of the other near-term abatement options available to the Midwest. Moreover, this level of investment in energy efficiency could save the region as much as $20 to $40 billion per year if carbon prices were in the range of $20 to $40 per ton.

Figure 10 compares estimates of potential energy savings in the region to projected baseline energy consumption in different end-use sectors. It indicates that of the total theoretical potential identified in this analysis, roughly half of available energy savings are found in buildings (commercial and residential), while the remaining half is split between the transport and industrial sectors. Specifically, the principal energy efficiency opportunities in the Midwest are as follows: (1) residential lighting, air conditioning, and electronics; (2) commercial lighting and equipment; (3) industrial efficiency and cogeneration, or combined heat and power (CHP); and (4) improved vehicle fuel economy.

The remainder of this chapter reviews opportunities and challenges in each of these sectors or categories—buildings, transportation, and industrial—and describes the Task Force's recommendations in each of these areas.

Task Force Findings on Energy Efficiency in Buildings

Nationally and in the Midwest, commercial and residential buildings account for approximately 40 percent of overall energy consumption, taking into account the energy consumed to supply electricity. When industrial facilities are included, the total is 46 percent. The major opportunities for improving energy efficiency in buildings involve lighting, electronics and appliances, shell improvements, water heaters, and heating and cooling systems.

The buildings sector is affected by a number of the market barriers to efficiency improvements described earlier, notably split incentives, capital and financing constraints, and informational barriers. Dramatic energy savings are often technically achievable, especially in new construction, but achieving them—especially in large buildings—often requires a sophisticated understanding of how different building systems function together. Building codes and equipment standards are proven policy tools for assuring a minimum level of energy performance in the buildings sector. However, to continue delivering improvements, these codes and standards must be updated over time and effectively enforced. Currently, building codes are set and enforced primarily at the state level, while efficiency standards for certain equipment and appliances are imposed at the federal level. In most cases, states are preempted from setting more stringent standards for products covered by federal efficiency requirements. However, there are approximately twenty categories of appliances and equipment that are open to state regulation.

Beginning in the early 1990s, utilities in many parts of the country—often with the encouragement or insistence of local regulators—increasingly initiated programs designed to promote customer-based efficiency improvements. Utility spending on demand-side programs declined for a time in the mid-1990s as many states undertook restructuring efforts. But the recent trajectory seems to be headed upward again as a number of states have begun experimenting with new approaches. These approaches include energy efficiency portfolio requirements or resource standards; systems benefits or energy efficiency charges (essentially a fee imposed on all electricity sales to generate revenues for implementing efficiency programs); and so-called “decoupling,” in which electric or gas utility revenues are delinked from sales to remove disincentives to investment in customer-side demand reductions. Utility spending on demand-side management programs has increased in the Midwest over time, but
remains at lower levels overall than spending in other regions such as California and the Northeast.

Recent developments suggest increased interest in energy efficiency on the part of state legislators and regulators, public and civic institutions, municipalities, utilities, and major companies in the Midwest. In 2007, for example, Illinois enacted a major bill (SB 1592) aimed at promoting large-scale electric utility efficiency programs. The legislation directs utilities to impose a charge on sales of electricity to fund such programs, where the charge starts at no more than 0.5 percent of overall rates in the first year of implementation and escalates by 0.5 percent per year thereafter to a cap of 2 percent of total rates in 2011. This provision will generate a substantial increase in funding for efficiency programs—on the order of $50 million per year starting in the first year, compared to $3 million per year prior to 2006. In addition, SB 1592 establishes an energy efficiency resource standard that requires utilities to achieve gradually increasing end-use electricity savings up to a maximum requirement of 2 percent of total sales by 2015 and thereafter. (A separate requirement was also established for achieving peak demand reductions.)

Table 4 summarizes utility-based initiatives and related policies in each of the midwestern states, along with the status of building codes and appliance standards in each state. Additionally, a number of cities and towns, universities, and some large companies with a major presence in the Midwest have voluntarily adopted ambitious energy efficiency goals, including Wal-Mart, Home Depot, and Johnson Controls.

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<th>State</th>
<th>Policies Adopted</th>
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<tr>
<td>IL</td>
<td>• Customer Energy Efficiency (EE) Programs</td>
<td>Illinois has historically had little involvement with utility energy efficiency programs other than a small annual funding requirement (~$3 million/year) created in the Illinois restructuring legislation (HB262) in 1997 to support some small programs administered by the state Department of Commerce and Economic Opportunity. New legislation in 2007 required substantial electric utility energy efficiency programs and created a strong energy efficiency resource standard (EERS) savings requirement, beginning at 0.2% of sales in 2008 and ramping up to 2.0% of sales per year by 2015.</td>
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<td>IN</td>
<td>• Customer EE Programs</td>
<td>There is limited energy efficiency program activity in Indiana’s utility sector. There are no legislative or regulatory requirements for providing ongoing, comprehensive energy efficiency programs and services to utility customers. The state’s investor-owned utilities and gas utilities fund and offer relatively small energy efficiency programs through voluntary efforts or limited requirements from individual rate cases. Total utility spending on energy efficiency programs in Indiana in 2006 was $3.7 million. There have been some recent efforts under a statewide strategic energy plan to identify and explore policy and program options to improve energy efficiency and infrastructure. This strategic plan, “Hoosier Homegrown Energy,” was completed in 2006.</td>
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<td>IA</td>
<td>• Customer EE Programs</td>
<td>Iowa’s utilities administer energy efficiency programs under a regulated structure with oversight by the Iowa Utilities Board (IUB). Iowa statute, Code 476.6.17, requires regulated electric and natural gas utilities to offer energy efficiency programs through cost-effective energy efficiency plans. The utilities recover program costs of the plans approved by the IUB through tariff riders on customer bills. Iowa’s utilities have long records of funding and providing comprehensive portfolios of energy efficiency programs to all major customer categories—residential, commercial, industrial, and agricultural. Funding levels have been strong throughout the years, with a notable decrease in the late 1990s as the state considered restructuring proposals. Since the early 2000s, the state has renewed and increased its commitment to energy efficiency through utility programs. In 2006 Iowa’s utilities spent $52.2 million on energy efficiency programs.</td>
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<td>KS</td>
<td>• Customer EE Programs</td>
<td>Many utilities in Kansas offer some level of energy efficiency programs and services, although generally none offer a full set of comprehensive customer energy efficiency programs that span all customer segments. Total funding levels reflect this low overall level of program activity. In 2006 total statewide utility spending on energy efficiency programs was $336,000. This picture may well change as the result of recent initiatives by the Kansas Corporation Commission and the governor. In 2007 the Commission concluded a general investigation regarding energy efficiency programs, which yielded recommendations to develop a uniform framework for reviewing and encouraging energy efficiency programs. Another outcome of this general investigation was the opening of two separate dockets by the commission—one to address the benefit-cost tests used for evaluating programs and the second to examine cost recovery, decoupling, and financial incentives to utilities. In parallel with this development, Governor Kathleen Sebelius in her 2007 State of the State address asked energy producers to undertake a statewide consumer education and conservation effort to reduce consumption 5% by 2010 and 10% by 2020.</td>
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### III. Energy Efficiency

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<th>MI</th>
<th>Customer EE Programs</th>
<th>EE Program Funding</th>
<th>EE Resource Standards</th>
<th>Reward Structures for Successful EE Programs</th>
<th>EE as a Resource</th>
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<td>Michigan had a history of fairly aggressive utility energy efficiency programs until 1995, when &quot;demand-side management&quot; and &quot;integrated resource planning&quot; were abandoned during the move toward electric restructuring. Michigan has had essentially no utility energy efficiency programs since 1996. New legislation in September 2008 has now created a requirement for utility energy efficiency programs, including setting annual energy savings targets (an &quot;energy efficiency resource standard&quot;) for both electricity and natural gas utilities. It is expected that energy efficiency programs will be in operation during 2009.</td>
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<th>EE as a Resource</th>
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<td>Minnesota has a long record of customer energy efficiency programs offered by both investor-owned and publicly owned utilities. Minnesota has achieved significant savings from these programs, which have been in place in various forms for well over two decades. These programs and efforts have remained steadfast in Minnesota with no interruption or upheavals as occurred in other states that restructured their electric utility industries. Minnesota's utilities have been required to expend set percentages of total utility revenues on customer energy efficiency programs. These requirements were established by Minnesota statutes. In 2007 the Minnesota legislature established energy efficiency resource standards, which will move the program requirements away from the amount of money spent to the amount of energy saved.</td>
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<td>Missouri has historically had limited energy efficiency programs in place for utility customers. While fundamental rules have been in place since the early 1990s for integrated resource planning (IRP) and demand-side management (DSM), such rules have not yielded significant levels of utility spending on DSM programs to date. Dramatic changes are under way that will greatly increase funding and availability of energy efficiency programs in Missouri. There is a renewed emphasis on energy efficiency, driven by rising energy costs and related concerns. Spending on energy efficiency by two of Missouri's largest utilities will total roughly $35 million in 2009. Statewide total spending on programs in 2006 was about $2.2 million. Legislation also was introduced in 2008 (SB 1277) that would strengthen requirements for utility energy efficiency programs, clarify cost-effectiveness criteria and cost recovery, and open the door to mechanisms to provide utilities financial incentives for energy efficiency programs.</td>
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<td>Nebraska has only publicly owned utilities that serve electric utility customers. There is limited activity statewide. The Omaha Public Power District accounts for most utility program spending and efforts in the state. Total statewide spending on utility energy efficiency programs was $866,000 in 2006. The Nebraska Energy Office administers a loan program for energy efficiency improvements using federal and state funding to operate the program. The Nebraska Energy Office also initiated a statewide energy planning process in early 2008 that is to examine such energy options as energy efficiency and renewable energy. The final plan is expected to be released early in 2009.</td>
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<td>North Dakota's utilities generally have not funded or offered energy efficiency programs to their customers, with the exception of a few publicly owned utilities. Total spending on electric energy efficiency programs in North Dakota in 2006 was $513,000. This picture may change significantly. In 2008 Xcel Energy filed a petition for a demand-side management program and cost recovery rider. The slate of programs proposed for 2009 has a budget of about $1.1 million.</td>
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<td>Ohio's investor-owned utilities will soon begin administering energy efficiency programs under a regulated structure with oversight by the Public Utilities Commission of Ohio (PUCO). A recently passed Senate bill established energy savings goals for electric utilities and allows for cost recovery and decoupling for implementing energy efficiency programs. In 2006 Ohio's utilities spent $28.75 million on energy efficiency programs. Rules implementing the Senate bill are expected to be approved by the PUCO in October 2008. Subsequently, utilities will propose energy efficiency plans to the commission.</td>
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<td>South Dakota's utilities historically have not funded or offered much in the way of customer energy efficiency programs. In 2006 total spending on energy efficiency programs was $619,000. Recent initiatives are changing this picture. The South Dakota Energy Smart Initiative, a collaborative effort, is bringing together partners to pledge their support to improve energy efficiency in South Dakota. Partners include both investor-owned and publicly owned utilities, which report numerous plans and new efforts to offer energy efficiency programs and services to their customers. One utility had a one-year pilot energy efficiency program approved by the South Dakota Public Utilities Commission in 2008.</td>
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III. Energy Efficiency

Task Force Recommendations for Building Energy Efficiency

Federal

- Update and expand appliance and equipment efficiency standards to ensure they capture technically feasible and economically advantageous energy saving opportunities.

- Charge a designated federal agency such as the Department of Energy or the Environmental Protection Agency with (a) establishing national targets for improved building energy efficiency and (b) developing strategies and demonstrating progress toward those targets. The EPA has already developed some tools for comparing efficiency across different building types and climate zones that could be helpful in implementing this and other policies in this section.

- Emphasize efficiency investments and building retrofits in federal energy legislation, climate legislation, or future economic stimulus plans; consider making efficiency performance part of the criteria used to determine eligibility of projects for federal funding as part of that package.

- Extend and expand federal tax credits for building efficiency improvements for both residential and commercial buildings.

- Consider other federal incentives for promoting efficiency upgrades—or at least information disclosure—at the point of sale, especially in the case of federally subsidized mortgages.

- Provide federal funding for state and local programs to train workers to implement efficiency improvements.

- Support R&D on new efficiency technologies.

- Support increased funding for the Weatherization Assistance Program to improve the efficiency of low-income homes.

State/Regional

- Develop and promote a regional model for state-of-the-art building codes and appliance standards (for products not preempted by federal standards). The Midwestern Governors Association could play a lead role. Update and expand appliance and equipment efficiency standards.

- Consider new incentives and foster innovation in city- or university-scale programs to promote efficiency upgrades in existing buildings. One strategy may be to target incentives to specific windows of opportunity such as the point of sale for an existing building. Other opportunities exist when building owners undertake major repairs, renovations, or facility expansions (see University of Iowa Flood Recovery, page 45). Innovative policies can also be used to promote improvement above minimum standards, e.g., expedited siting and permit approval for projects that meet aggressive efficiency targets such as LEED certification.

- Ensure that government retraining efforts allocate sufficient funding for developing the talent necessary to achieve the efficiency targets.
• Address workforce training needs to expand in-region expertise and capacity for designing and implementing efficiency improvements and enforcing codes and standards.

• Consider regulatory reforms to increase utility incentives for investment in customer-side efficiency programs.

• Encourage additional financing mechanisms for leveraging energy efficiency opportunities such as energy services companies (ESCOs).

Task Force Findings on Transportation Energy Efficiency

The transportation sector accounts for 24 percent of energy consumption and 30 percent of energy-related carbon emissions in the Midwest. On-road vehicles—cars and trucks—account for the largest share (75 percent) of sectoral energy use and emissions. After nearly two decades of stagnation in the average efficiency of the U.S. vehicle fleet and in light of the recent advent of new vehicle technologies such as hybrid-electric drive trains, substantial opportunities exist to achieve efficiency gains in this sector. Some of those gains have already been mandated. Under the Energy Independence and Security Act of 2007, federal corporate average fuel economy (CAFE) standards increase to at least 35 miles per gallon by 2020.

Based on engineering cost assessments, vehicle efficiency improvements are among the most cost-effective carbon abatement options available nationally and in the Midwest. However, until recently, fuel efficiency had not been a priority for consumers, who were more concerned about the size, speed, and power of their vehicles. Responding to these preferences, manufacturers used efficiency improvements to build larger, faster, and more powerful vehicles that would get the same mileage as the previous generation. As became evident when gasoline prices spiked in the summer of 2008, domestic manufacturers—whose product lines, including trucks and SUVs, generally had lower average fuel economy than those of their Asian competitors—were vulnerable when consumer preferences shifted in favor of more efficient vehicles. Domestic manufacturers are now moving aggressively to introduce new advanced technology vehicles such as plug-in electric hybrids, conventional hybrids, and flex-fuel vehicles that can run on 85 percent ethanol blends as well as gasoline. Yet they are also coping with a broader economic crisis that is posing problems for the industry as a whole. Their ability to survive and thrive beyond the current downturn is widely viewed as being closely linked to their ability to regain a leadership position in the new vehicle technologies of the future. Reflecting this view, Congress in 2008 adopted a $25 billion package specifically aimed at supporting domestic manufacturers’ efforts to retool for the production of higher mileage and advanced technology (e.g., hybrid) vehicles. Because of the large auto industry presence in the Midwest, the issue of vehicle efficiency and its impact on the competitiveness of domestic manufacturers also has broader significance for the Midwest economy.

The next generation of plug-in hybrids and all-electric vehicles can be expected to offer more significant opportunities for carbon reduction at lower cost than the hybrids currently available in the marketplace. Because they link to the electricity grid, these vehicles open up substantial new possibilities for diversifying transportation energy sources to include more low- and no-carbon resources.

The impact of a significant increase in market share for plug-in hybrid and all-electric vehicles will need to be carefully assessed and managed to minimize additional stresses on the electricity grid. However, many analysts believe that if most charging occurs at night—that is, during off-peak hours—it should be possible to reap benefits in terms of improved electric system stability and overall operating efficiency. In the most optimistic scenarios, electric vehicles could even serve as a form of distributed energy storage for electricity generated during off-peak hours that could be drawn upon when the grid becomes overloaded.

However, substantial infrastructure investments—beyond simply adding recharging capability to the existing electricity distribution network—will be necessary to realize some of these possibilities and to maximize the potential contribution from future low-carbon electricity sources. So-called “smart grid” improvements—such as the widespread deployment of advanced net metering technology—would have a host of benefits and will likely be critical in managing a successful transition to an electrified vehicle fleet. But despite considerable attention and support for the smart grid concept, efforts to deploy a new generation of grid technologies have remained limited to a few pilot projects to date. (Barriers to these kinds of necessary system investments are discussed more generally in the next chapter on low-carbon supply technologies.) However, new funding for grid improvements—and for smart grid technologies specifically—was included as part of the economic stimulus bill enacted by Congress earlier this year.
New battery technologies offer one unique opportunity to improve emission levels, reduce dependency on foreign oil, and create a new industry for high-skilled manufacturing workers. Advanced battery technologies can be applied to automobiles, trains, utilities and enterprises (as stationary power), and electronics. The Midwest is in a unique position to lead in this area. The Midwest's base in auto and rail transport, its manufacturing skills, and the depth of research from labs such as Argonne National Laboratory create the foundation for global leadership. The state of Michigan has recently announced over $300 million in grants to build new battery plant capacity in the state in order to draw the industry to the Midwest. Building this capacity is critical. Without leadership, we may trade our dependence on foreign oil for a dependence on foreign battery technology. With the right investments and federal policies, the Midwest's advanced battery business could be larger than Asia's significant battery production industry.

Reducing travel demand—typically expressed as vehicle miles traveled or VMT—is another area of opportunity for reducing transport sector fuel consumption and emissions, while improving regional connectivity and economic competitiveness. Here a focus on broader systems (beyond just highway vehicles) and regional transport networks is necessary. For example, “transportation oriented development” combined with thoughtful zoning reform can have a substantial impact on patterns of travel, overall transportation demand, and infrastructure needs over the long term. Requiring developers to pay the full costs of infrastructure expansion can create strong incentives to build where there are existing support systems and reduce sprawl.

Meanwhile, transportation investments and planning decisions should aim to maximize benefits across multiple public policy objectives, taking into account considerations of energy security and environmental quality as well as enhanced mobility and access. A report released in 2007 by Chicago Metropolis 2020 found that expanded investments in public transit systems could generate substantial net economic benefits, relieve congestion, and improve quality of life in the Chicago area. At the same time, an expanded regional high-speed passenger rail network could link many midwestern cities more efficiently, offering commuters a viable and less carbon-intensive alternative to short-distance air travel and amplifying economic growth opportunities.

More recently, Chicago Metropolis 2020 quantified the significant economic benefits associated with relieving freight rail congestion in the Chicago area. Current delays are costly in economic as well as energy terms. In some cases it can take a freight train as long to traverse the short distance through the Chicago area as it takes to travel all the way to Chicago from the West Coast. More efficient rail systems could also encourage greater reliance on freight rail transport in place of truck transport, providing potentially substantial local economic benefits along with broader environmental benefits. In fact, rail transport is a highly efficient alternative to heavy-truck transport. Trains have substantially lower rates of energy use and carbon dioxide emissions per ton-mile than trucks.

In sum, the Midwest is uniquely positioned—by virtue of its historic links to the auto manufacturing industry and its geographic placement as a major hub for long-range air, rail, road, and barge transport—to play a leadership role in advancing a comprehensive agenda for improving transportation efficiency. Implementing such an agenda, particularly with respect to promoting more efficient land use and economic development patterns and improving local and regional transit networks, will require innovative thinking to design effective policies and address major financing challenges. Success will require a willingness to consider new approaches—some of which, like congestion road pricing, are already being tried elsewhere—along with improved coordination and cooperation across different jurisdictions, agencies, and advocacy groups throughout the region. It will also require an integrated approach to the region’s transportation needs that encompasses broader issues of economic development. An example is the need for improved information technology networks in rural areas, which could both expand opportunity in rural communities and reduce travel demand.

The long-lived and capital-intensive nature of much transportation infrastructure—along with the fact that transportation patterns are shaped by millions of individual business and commuter decisions—means that there is enormous inertia in the system. It also means that the up-front costs of changing the system are high, while the benefits accrue over a long period of time and may be difficult to quantify at the outset. Nevertheless, as a region that confronts significant transportation challenges—from a combination of relatively low-density development in rural areas (which in turn makes for higher-than-average vehicle use and oil consumption), an aged and in some places badly deteriorating infrastructure, and chronic congestion in major metropolitan areas like Chicago—the Midwest also stands to capture substantial in-region benefits from investments in improved transportation technologies and systems.
Task Force Recommendations for Transportation

Energy Efficiency

Federal

- Extend and expand tax credits for consumers to purchase advanced technology vehicles.
- Provide increased funding for advanced battery research and development.
- Create a market for advanced technology vehicles by implementing strong fleet requirements for the federal fleet.
- Provide increased funding to upgrade regional rail systems, including relieving freight rail congestion in the Chicago area.

State/Regional

- Invest in regional improvements to the high-speed rail network.
- Draw on in-region resources, both universities and the domestic auto industry, to make the Midwest region a national center for advanced vehicle technologies, including plug-in hybrid (PHEV) and battery electric vehicle technology. Begin planning for and investing in the grid and infrastructure improvements necessary to support these technologies in a way that maximizes potential benefits.
- Undertake regional planning for transit and economic development that incorporates integrated land use, transit funding, and new mechanisms designed to better align private incentives with public objectives (examples include user fees and congestion pricing).

Task Force Findings on Industrial Energy Efficiency

Industrial uses account for approximately 25 percent of overall energy consumption in the Midwest. In fact, the region has the greatest concentration of industrial energy use of any area of the country. Heavy industries located in the Midwest include steel, glass, chemicals, foundries, and ore processing. These industries benefited historically from ample and low-cost energy supplies—especially of coal-generated electricity—and though their efficiency has improved with modernization, in some cases quite markedly, many industrial facilities continue to consume large amounts of energy and emit significant amounts of waste energy.

As noted in the introduction to this chapter, large industrial users typically have larger incentives and a greater capacity for identifying and implementing energy efficiency improvements. Nevertheless, barriers apply in this sector also, with the consequence that untapped potential for efficiency improvements can still be found in many industrial settings. Efforts to quantify and, more importantly, capture this potential are hampered by the heterogeneity of the industrial sector and by the wide variation in specific conditions. In 2004 the American Council for an Energy-Efficient Economy (ACEEE) reviewed eleven available studies of U.S. industrial sector energy efficiency potential. Taking the estimates of technically achievable and (from an engineering standpoint) cost-effective energy savings cited by each of these studies, ACEEE found the median estimate for potential energy savings was more than 20 percent for electricity and nearly 10 percent for natural gas. Even if it is only possible to capture a fraction of these savings, the potential for industrial efficiency improvements in the Midwest—given the concentration of energy-intensive industry in the region—would appear to be large.

Combined heat and power (CHP) or cogeneration projects that make use of otherwise wasted thermal energy at existing facilities, in particular, can deliver substantial improvements in overall efficiency, with correspondingly large economic and environmental benefits. Opportunities for implementing such projects are especially abundant in the Midwest and merit focused attention from policymakers. Recycling by-product heat from steam boilers to provide hot water or low-pressure process steam, for example, can substantially increase the overall efficiency of conventional fossil-fuel-based electricity generation. (The efficiency of conventional fossil-fired steam-electric power plants in the United States averages only about 30 to 35 percent, an overall level of performance that has improved only marginally over the last half century.)

The Midwest has many process industries that require low-grade thermal energy. Examples include ethanol plants, wall board manufacturing, food processing (including dairy), chemical production, petroleum refineries, plating steel, and paper and cardboard production. In addition, some large commercial and residential facilities may offer good combined heat and power opportunities.
Opportunities also exist to recycle waste energy from other types of industrial processes to generate electricity, often at very high incremental efficiencies. Many industrial processes require high temperatures for production, but then emit streams of waste energy (in the form of low-energy off-gases or otherwise wasted steam or high-pressure gas) that still contain the potential to do useful work. Examples include coke production, metals production and processing, glass production, petroleum refining, and many chemical processes.8

Recycling waste energy is an appealing, low-carbon option for several reasons. Besides displacing energy requirements and emissions elsewhere, it can help diversify energy portfolios, reduce transmission and distribution requirements, and improve system resiliency. At the same time, however, this option faces unique hurdles. First, an economic use or need for the waste energy must exist, generally in close proximity to where the waste energy is generated. Second, CHP systems often involve unique engineering requirements and thus require the services of highly competent professionals. Finally, the economics can be challenging, particularly at facilities that are paying low prices for electricity and/or cannot sell excess electricity back to the utility at competitive prices.

The regional abatement cost curve developed for this report (see Figure 8) estimates that approximately forty-five million tons of carbon dioxide reductions are available through improved industrial efficiency in the Midwest at a cost below $50 per ton. Other estimates that are more optimistic about the potential economics of CHP and cogeneration systems are two to three times as high.

In any case, recycling currently wasted energy at power plants and other industrial facilities represents a particularly significant opportunity for the Midwest given its deep industrial base. The return on these investments is highly dependent on conventional energy prices and will improve if prices rise to reflect carbon emissions. In some cases, otherwise promising projects may be hampered by the absence of—or difficulty of accessing—markets for the surplus energy they produce or by regulatory and other barriers. Policies that have been introduced at the state level in an effort to promote CHP include streamlined standard interconnection rules, financial incentives (such as grants, tax incentives, rebates, and low-interest loans), output-based emission standards (or, in the context of a cap-and-trade program, output-based allowance allocation), and allowing CHP projects to count toward compliance with renewable or clean energy portfolio standards.9

Other examples of policies that have been deployed to promote industrial sector efficiency include:

- technical assistance (e.g., the Energy Savings Assessment Program introduced by the U.S. Department of Energy in 2006 to provide free assessment of energy saving opportunities for some of the nation’s most energy-intensive manufacturing facilities),
- benchmarking or target-setting programs (an approach implemented at the national level in a number of other countries),
- financial incentives (can include a variety of direct grants or subsidies as well as tax incentives such as accelerated depreciation for certain types of capital investments).

Where public incentives are not available, alternative financing may be available through channels such as energy services companies or venture capital funds. Importantly, efficiency standards can be applied to certain types of standard industrial equipment such as electric motors. Finally, as already noted in the foregoing section on building efficiency, growing numbers of large, multinational corporations are voluntarily undertaking efficiency initiatives. Prominent examples in the industrial sector include ArcelorMittal, Dow, and Alcoa, all of which have major operations in the Midwest.

**Task Force Recommendations for Industrial Energy Efficiency**

**Federal**

- Deploy tax policy to promote industrial energy efficiency (e.g., investment tax credits or accelerated depreciation).

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8. In 1996, for example, Primary Energy developed a $165 million facility to capture exhaust heat from 268 ovens that produce blast furnace coke. The waste heat is used to produce 17 billion kilowatt-hours of power every year. The project also scrubs sulfur out of the coke oven exhaust. While other similar coke facilities vent exhaust heat, this plant produces up to 95 megawatts of electricity from recycled energy and delivers up to 1 million pounds of steam for ArcelorMittal’s East Harbor steel mill in northern Indiana.

9. Output-based standards or allocations reward technologies that produce low emissions per unit of useful energy delivered. Because a CHP plant generates both useful thermal and electrical energy, it can achieve far lower emissions per unit of output than a conventional generating plant that does not recycle waste heat.
Emissions offsets are credits for emission reductions that are achieved at sources or in sectors that are not covered by a mandatory regulatory regime. Offsets are most often associated with cap-and-trade programs, where they function as an alternative compliance option or currency. Companies (“regulated entities”) can submit offsets in lieu of allowances\(^\text{10}\) to cover some portion of their total emissions obligation.\(^\text{11}\) Examples of potential domestic sources of offsets in the context of a regulatory program for greenhouse gases include reducing fugitive methane emissions (e.g., from coal seams, natural gas pipelines, and landfills), reducing non-energy-related agricultural-sector emissions (including methane from waste management and feedlot operations and nitrous oxide from fertilizer applications), and forest and soil carbon sequestration. Because these emissions tend to be diffuse and are therefore difficult to measure or track, they are unlikely to be included in a regulatory regime that is primarily focused on limiting energy-related emissions (i.e., they are likely to stay “outside the cap”). Nevertheless, they can provide real climate change abatement opportunities, in many cases at costs below those required to achieve reductions at regulated sources of emissions.

Offsets can also be used to reward voluntary, energy-related and non-energy-related abatement activities in jurisdictions that have not yet adopted a mandatory regulatory regime. The Kyoto Protocol’s controversial Clean Development Mechanism (CDM), for example, awards offset credits for clean energy (i.e., efficiency and renewable) projects and other greenhouse gas abatement efforts (including gas recovery, forestry, and agriculture measures) undertaken in develop-
ing countries that were not included in the Protocol’s first round of reduction commitments.

Not surprisingly, the potential supply of international offsets far exceeds the potential supply of domestic offsets. Thus, modeling analyses tend to show greater reliance on international offsets in the early years and a gradual expansion of domestic offsets over time. Nevertheless, early efforts to gain acceptance for domestic offsets by demonstrating and verifying their legitimacy may be critical to establishing the credibility of offsets more broadly and clearing the way for recognition of international offsets.

There are compelling economic and environmental reasons to recognize offsets in a mandatory climate policy. In fact, all of the prominent greenhouse gas cap-and-trade proposals introduced in Congress in recent years include this mechanism, albeit in many cases with limits on the extent to which it can be used to meet overall program goals. The economic argument is straightforward: By enlarging the pool of lower-cost abatement options available for achieving a given regulatory objective, offsets directly reduce the cost of compliance to regulated entities and ultimately to society as a whole. The environmental rationale for offsets is that they provide a mechanism for encouraging abatement activities in sectors that would otherwise have no incentives to reduce emissions.

In many cases, those activities might have important ancillary environmental, economic, or ecological benefits such as promoting technology transfer and economic development in the case of energy projects in poor countries, or protecting biodiversity in the case of forest preservation projects. In addition, offsets create incentives for participation by developing countries that might otherwise opt out of international efforts and, by reducing compliance costs for domestic industry, can help secure the political support necessary to implement a mandatory policy at home.

Obviously, these rationales are valid only if offsets provide real abatement benefits. If offset credits are awarded for projects that do not deliver claimed benefits, that deliver only temporary benefits, or that would have been undertaken anyway, this only serves to undermine the environmental objective and (by lowering allowance prices) dilute incentives for more meaningful abatement activities and technology innovation. In the extreme, a market awash in low-cost, low-quality offset credits might minimize short-term economic impacts, but it could also delay major investment decisions that adequately account for long-term climate liabilities.

Accordingly, eligibility for offset credit is generally predicated on the ability to demonstrate that claimed benefits are real, verifiable, additional (or surplus), permanent, and enforceable. Unfortunately, applying these criteria in practice is rarely straightforward. Even where benefits are relatively easy to calculate, it is often inherently difficult to establish permanence and additionality. Inevitably, the demand for rigor must be balanced against considerations of cost and administrative feasibility. In spite of these difficulties, the merits of preserving a role for offsets are generally seen as outweighing the potential downsides. As a result, the political consensus seems likely to favor a somewhat circumscribed but still significant role for offsets.

Offsets have special relevance for the Midwest for at least two reasons: (1) because they are a means of reducing near-term compliance costs under a new greenhouse gas regulatory regime and (2) because the region seems likely to enjoy a comparative advantage as a supplier of domestic agricultural offsets. Compliance costs are important for the Midwest because the region will likely incur higher costs under a national carbon policy than other areas of the country—at least in the near term—given its relatively carbon-intensive energy supply mix and greater concentration of energy-intensive industries.

Figures 11 and 12 show the abatement cost curves developed by McKinsey & Company with international offsets included. In both the national and regional curves, international offsets appear as the next most cost-effective abatement option after efficiency measures. The curves also show that the total abatement potential for international offsets (in tons of carbon-dioxide-equivalent reductions) is substantial.

From an economic standpoint, the most important impact of emissions offsets for the Midwest flows from their effect on allowance prices. Several recent attempts to model the impacts of different cap-and-trade proposals find that the impact is large. For example, an EPA analysis of the 2007 Lieberman/McCain proposal (S. 280) found that projected allowance prices could vary from $10 per ton of carbon dioxide with unrestricted use of offsets to $40 per ton of carbon dioxide if offsets were excluded completely. A subsequent EPA analysis of another, more recent proposal (Lieberman/ Warner, or S. 2191) finds even greater variation in projected allowance prices

12. Experience to date with the CDM illustrates some of these difficulties. On the one hand, this program has been criticized for creating a lengthy backlog of projects awaiting certification. On the other hand, it has also been criticized for accepting inflated project claims. Critics have also pointed out that certain types of projects and certain countries have received a disproportionate share of credits under the CDM.
Figure 11 - 2020 U.S. Carbon Abatement Cost Curve with International Offsets

Abatement cost <$50/ton

Potential Gigatons/year


Figure 12 - 2020 Midwest Carbon Abatement Cost Curve with International Offsets

Abatement cost <$50/ton

Potential Gigatons/year

IV. Emissions Offsets

because some of these management practices have already been widely adopted, opportunities to achieve further gains in soil carbon sequestration are limited. Instead, methane emissions from livestock and manure management may offer the more significant opportunities for agricultural offsets in the Midwest. These sources account for 27 percent and 13 percent of total noncarbon agricultural greenhouse gas emissions, respectively. The former can be addressed through changes in feed, the latter by adopting manure storage systems that capture methane, i.e., anaerobic digesters (see explanation below), and then either flare it or (preferably) convert it to electricity.

In 2001 the Midwest had higher methane emissions from animal waste management systems than any other region of the country (an estimated 11.7 million metric tons per year in carbon dioxide-equivalent terms). This is in part because the region favors lagoon and liquid/slurry systems that have high methane emissions rates. These emissions could be substantially reduced (up to 90 percent) through the use of digesters, which are machines for composting (or digesting) organic wastes. Digesters produce methane that can be captured and used to drive a generator instead of being vented to the atmosphere. Finally, a third category of potential agricultural offsets involves reducing nitrous oxide emissions through changes in the timing, application, and quantity of fertilizers used in farming.

The challenge for policymakers is to design a robust offsets program that creates effective incentives for capturing these opportunities, while enforcing rigorous criteria for ensuring that claimed benefits are real, additional, verifiable, and permanent. While project quality, not location, should distinguish eligible offsets from ineligible ones, the reality is that domestic projects may have an advantage over overseas projects in the near term when it comes to demonstrating these criteria with a high degree of confidence. As such, they can help to establish the validity of offsets more broadly, including international offsets.

In any case, the objective is to design program requirements and other parameters—including accounting requirements, quantity or price limits, rules for terminating and trading contracts, and liability—that adequately protect overall program integrity and preserve a meaningful price signal for carbon abatement without making the process so onerous that it substantially limits the market for offsets and unnecessarily drives up costs. For example, allowing the use of statistical averages rather than site-specific measurements to estimate benefits might be an appropriate trade-off if carefully designed depending on whether and to what extent offsets are included.¹³ This is documented in Figure 13.

Offsets and other program features that help limit the risk of unexpectedly high allowance prices and that give firms greater flexibility to manage their compliance costs can play an important role in protecting the region’s economy and preserving regional competitiveness. Even a modest difference in allowance prices at the margin could save the Midwest billions of dollars in compliance costs. This is especially important in the early phases of program implementation, when new low-carbon technologies are still making the transition to full-scale commercial deployment.

In addition to managing near-term compliance costs, offsets can also provide a direct economic benefit to the region. Seventy-five percent of the entire nation’s cropland and 66 percent of its total livestock population is concentrated in the Midwest and Great Plains regions. Within the agriculture sector, the main offset opportunities are in soil carbon sequestration and reducing fugitive methane and nitrous oxide emissions. Soil carbon sequestration can be addressed through changed farming practices such as conservation tillage and conversion to lower intensity uses such as converting cropland to grassland.

Of course, measuring some of these benefits—and ensuring that they are sustained over a period of years—can be quite challenging in practice, making it difficult to assign offset credits. Moreover,


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**Figure 13 - EPA Estimate of Impact of Inclusion of Offsets on Carbon Prices**

![Graph showing the impact of offsets on carbon prices](https://example.com/figure13.png)

to avoid creating distorted incentives. Applying standard discounts to reduce the risk of overcounting is another approach.

The Midwest has a significant head start in this area inasmuch as roughly seven years have already been invested in the development of a full suite of offset protocols, including protocols for agricultural offsets, at the Chicago Climate Exchange (CCX). These protocols establish statistical guidelines for defining, quantifying, and verifying carbon sequestration and methane mitigation, and they call for an insurance reserve of credits to keep the crediting conservative and ensure environmental effectiveness. Several Midwest universities have been active in this work, including Kansas State, Iowa State, and Ohio State. The CCX offset rules, which are available on the CCX Web site, have been used and revised through five–plus years of active trading and have been subjected to hundreds of reports by third-party verifiers.14 Going forward, universities and research centers in the Midwest can continue to play a major role in improving scientific understanding of offsets, especially in the agriculture sector, and in developing methodologies and guidelines for assessing benefits and uncertainties.

Task Force Recommendations for Emissions Offsets

Federal

• Enable use of emission offsets as an alternative compliance mechanism in any mandatory national program to limit greenhouse gas emissions.

• Enforce rigorous regulation and verification requirements to ensure that credited project benefits are truly additional, verifiable, permanent, and enforceable.

• Support research efforts at universities, national laboratories, and research centers to identify domestic sources of offsets that meet these criteria, especially in the agriculture sector.

State/Regional

• Build a regional center of expertise in offset identification, verification, management, and trading leveraging the Midwest's historic human capital strengths in commodities, futures and options, agriculture, and business services. Such a center could combine the best of our private-sector institutions with the strength of Midwest universities and key public sector agencies, leading to further growth opportunities in this area.

• Support efforts by universities and other institutions in the region to obtain public and private funding for research in innovative offset opportunities such as improved verification protocols.

Chapter V
Low-Carbon Supply Technologies: Establishing the Midwest as a Leader

Even with aggressive efforts to boost efficiency and tap a wider array of abatement options via emissions offsets, a substantial push to develop and commercialize new low-carbon energy supply technologies will be required to realize the kinds of long-term greenhouse gas reductions targeted in current regional and national proposals. Though there has been substantial progress in the development of supply technologies in recent years, with particularly strong growth in the wind energy industry, additional low-carbon resources will need to be deployed at lower cost and on a far larger scale to achieve and sustain dramatically lower overall carbon emissions while reliably meeting society’s long-term energy demands.

Fostering a competitive advantage for the region in emerging low-carbon technologies is thus an important element in positioning the Midwest for economic prosperity in a carbon-constrained future. The supply technologies discussed in this section are those in which the Midwest is well suited to assume a leadership position. These technologies include wind, bioenergy, next-generation nuclear technology, and advanced coal systems with carbon capture and sequestration. These are in addition to the efficiency and combined heat and power technologies discussed in Chapter III.

Here it is important to stress the Task Force’s view that none of these options represent a “silver bullet” for the region’s climate and energy challenges. Nor do we intend, by suggesting that the Midwest starts with an advantage or particular interest in certain technology areas, to suggest that other options—including options that have not yet been identified—will not have an important role to play in the region’s future energy mix. On the contrary, it will be important to push forward on a number of technology fronts at the regional as well as the national and international level. The more options that are available a decade (or two or three) from now, the more flexibly and cost-effectively we can achieve not only climate protection, but energy security and economic competitiveness goals. According to an analysis by the Electric Power Research Institute (EPRI), an investment of $10 billion per year in energy R&D for the first ten years of a climate policy could reduce the cost of decarbonizing the electricity sector from $1.5 trillion in present value terms to about $900 billion.15

At the same time, Task Force members are mindful that public and private resources for technology investment are likely to be constrained by urgent, competing needs going forward. Especially during the basic R&D phase, choices must be made and bets placed with no clear certainty of success. Thus, the challenge for policymakers will be to adopt an expansive and comprehensive approach to technology innovation, while also providing the focus and direction needed to advance promising options, in some cases well before their ultimate costs and potential are known.

Achieving this will be far from easy, especially given the political considerations that often have a significant if not always transparent influence on technology policies. A good starting point is to recognize that different kinds of policy support are appropriate at different stages of the process, from research and development to full-scale commercial deployment. Critical intermediary steps include pilot-scale (precommercial) and commercial-scale demonstration and early deployment. Without support at these junctures, even successful innovations risk never achieving commercial success simply because familiarity, aversion to risk, and other factors tend to favor incumbent technologies.

Typically, direct public support is largest in the early phases of development, starting with basic research, and diminishes as a technology reaches the stage of full-scale commercial deployment. The role of private sector investment, by contrast, may be small during the research stage, but then tends to increase as technologies move beyond the experimental phase. A combination of support in the form of public-private partnerships is often key to bringing technologies through the precommercial or pilot phase. Such partnerships may be essential to implement first-mover demonstration plants, particularly if such plants entail long lead times and large commitments of capital. For example, even large and experienced private companies may find it extremely challenging to assume the risk and secure the financing needed to build new carbon capture systems or advanced nuclear plants without a public partner.

Once a technology is ready to enter the marketplace at commercial scale, government policies, rather than direct public investment, may be the more appropriate tool to advance deployment. Such policies can take the form of incentives or price signals (like

15. Under energy R&D, EPRI includes technologies such as carbon capture and sequestration, nuclear energy, and smart grid technologies.
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V. Low-Carbon Supply Technologies

The low-carbon supply options that are usually discussed as part of climate policy are at different stages of development and may require different forms of policy support. For example, carbon capture and sequestration (CCS) and next-generation nuclear technologies are at the precommercial stage. They are eligible for direct public incentives in the form of federal funding and loan guarantees, respectively. Wind and geothermal technologies are at the commercial stage and, along with solar, are supported by production tax credits at the federal level and in some cases by renewable portfolio standards at the state level. Meanwhile, other kinds of renewables—such as certain advanced bioenergy conversion technologies or processes—are experimental and are being supported through R&D programs, many of them centered at the Department of Energy’s national laboratories.

One way to support all of these low-carbon supply options as well as energy efficiency technologies is a federal carbon price policy. No mechanism is more effective than the market for bringing forward new technologies. Thus—as has been argued elsewhere—if the goal is to drive innovation for reducing carbon emissions, it is critical that the market provide financial rewards for such innovation. In this way, establishing a concrete and reasonably predictable price signal for carbon provides an essential foundation for all other technology policies and incentives. The extent to which other policies are needed will then depend to a large extent on the strength of that price signal.

The presumption in most of the proposals for regulating greenhouse gas emissions considered by Congress to date is that at a carbon price that is politically viable, at least in the near term, further policies and direct public support will still be needed. Such support will be needed to overcome investment hurdles for technologies that are viewed as unproven or risky, that require large up-front commitments of capital, or that are still at the experimental or basic research stage.

In sum, a combination of policies is needed to accelerate the pace of low-carbon technology innovation beyond what the private sector would deliver on its own, while simultaneously creating the market demand needed to ensure that these innovations are widely deployed. Together, these policies must be responsive to three critical concerns or questions: (1) Can we make the technology work and at the right cost? (2) Can we manage the financial risks of having some—and perhaps many—projects fail? (3) Can we economically build the support infrastructure (such as long-distance transmission lines) needed to tap some low-carbon sources? The latter point is important because in many cases the success of a technology may depend on factors that are to some extent independent of the technology itself.

Indeed, a number of barriers to widespread commercial deployment—and in some cases even to precommercial demonstration—are common to many of the prominent, low-carbon energy supply technologies. For example, the lack of an adequate infrastructure (such as long-distance transmission lines) needed to tap some low-carbon sources? The latter point is important because in many cases the success of a technology may depend on factors that are to some extent independent of the technology itself.

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Figure 14 - Wind Sites Relative to Transmission Lines

All new electricity generation, including wind energy, would require expansion of U.S. transmission by 2030.
Similar infrastructure challenges are likely to emerge in the context of the pipeline network needed to transport captured carbon to geological sequestration sites in the event that CCS technology is successfully commercialized. Such a network would also be needed to transport much larger volumes of liquid biofuels from midwestern production centers to coastal fuel markets.

Infrastructure barriers are problematic because they often present a chicken-and-egg conundrum. Investors are unlikely to finance low-carbon supply projects unless the necessary support infrastructure is in place, but they are also unlikely to finance support infrastructure before the projects that will use and pay for that infrastructure are in place. A lack of clarity about cost allocation, in particular, is emerging as a major barrier to many transmission system investments, especially when multiple jurisdictions and different layers of regulatory authority are involved.

Other common barriers to many low-carbon energy technologies include high up-front capital requirements and financing hurdles, workforce challenges, high material costs, chronic underfunding of the R&D needed to drive down costs and improve technology performance, and siting challenges. Financing hurdles, for example, are likely to be significant, especially for large or “risky” projects. These difficulties are exacerbated when the overall investment climate is highly risk-averse (as is certainly the case at present), when there is substantial uncertainty about future regulatory conditions, or when there is concern about excessive market volatility. The sensitivity of venture capital flows to changing market conditions was dramatically illustrated in 2008, when a surge of interest in green energy technologies, largely prompted by a dramatic run-up in oil prices, deflated just as rapidly when the overall economic picture darkened and oil prices declined.

Siting difficulties are another common barrier for which there are often no easy policy prescriptions. Even technologies that generally enjoy broad public support in the abstract, such as wind power, have encountered opposition in the context of actual project proposals. In some cases, the local economic benefits generated by these developments can be helpful in overcoming NIMBY (“not-in-my-backyard”) concerns. Improved planning and cooperation across different agencies and jurisdictions can also facilitate smoother sit-

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16. In fact, the history of energy technologies is replete with similar boom/bust examples. That this pattern occurs so commonly and with such negative impacts on the prospects of nascent new energy industries is one of the compelling arguments for providing some degree of price certainty through policies like a carbon tax.
underground saline formations are thought to offer the most abundant and accessible long-term storage options for captured carbon dioxide. Initial efforts to map potentially promising sites in depleted gas and oil fields, unmineable coal seams, saline formations, and basalts suggest that the Midwest has substantial geologic sequestration potential. Moreover, many promising sites in the region are near large, existing fossil-fuel power plants.

As with gasification, many of the component technologies required to compress, transport, inject, and monitor the movement of carbon dioxide in below-ground reservoirs are relatively well understood and have been demonstrated in other applications—in this case primarily for purposes of enhanced oil recovery. But there is less experience with projects generating the volume of emissions of commercial-scale power plants. A few industrial-scale demonstration projects have been implemented outside the United States, and more are planned. Duke Energy was awarded a $1 million DOE grant in 2008 to study the potential for permanent carbon dioxide storage at or near the site of its new Edwardsport IGCC facility. The grant was awarded through the Midwest Regional Carbon Sequestration Partnership, which is led by Battelle and includes eight midwestern states along with members representing state geologic surveys, universities, nongovernmental organizations, state government organizations, and several large energy companies.

In addition to cost and technology hurdles, CCS also confronts significant issues with respect to regulation, infrastructure (including the need for new pipelines to transport carbon dioxide), and public acceptance. The EPA has drafted some rules for carbon dioxide injection through its Underground Injection Control (UIC) program, but further clarity is needed on basic legal and regulatory questions. The questions relate to property rights and ownership of underground pore space, oversight of sequestration operations and site monitoring requirements, and long-term management of closed sites. Issues related to environmental impacts and public safety in the event of leakage or an unintended large-scale release of stored carbon dioxide, along with questions about the willingness of local communities to accept storage sites and related infrastructure, likewise remain far from resolved.

Overall, many experts believe that CCS technology is now at the development and demonstration stage, with a few units possible in the near term if regulatory, cost, and technology barriers are resolved. Large-scale deployment (on the level of 30 units per year for three decades), however, will likely not begin in earnest before 2020. This means that the region cannot rely on CCS to help meet near-term abatement targets. Other options, notably many of the efficiency and offset measures discussed in previous chapters, are likely to be more cost-effective and more easily scaled up in the 2010 to 2020 time frame. This does not mean, however, that the region would be wise to put CCS technology on the back burner. Given the importance of this technology to achieving regional and global environmental and energy security goals, the Task Force believes that continued efforts to lay the groundwork for—and indeed to accelerate—the successful commercialization of CCS technology (and establish the Midwest as a leader) are justified. Early attention to some of the regulatory and public acceptance issues noted above would help create more opportunities for first-mover projects, even as continued progress is made in addressing cost and technology issues.

**Nuclear Power**

Nuclear power accounts for the largest share (20 percent) of the nation’s low-carbon electricity supply and a similar fraction of the Midwest’s overall power mix. Importantly, it is the only major carbon-free source of baseload electricity. The region’s existing nuclear
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plants are aging, but they are one of the world’s most efficiently operated nuclear fleets and have been providing power safely for decades. As a result, the Midwest has developed one of the best concentrations of expertise on how to manage nuclear energy efficiently and safely. Enabling nuclear power to play an expanded role in the coming decades—not only regionally, but also nationally and globally—could significantly improve the outlook for achieving broadly held climate and energy security objectives.

Climate considerations have already contributed to a shift in expert and public attitudes toward nuclear energy. Yet the industry continues to face key barriers and uncertainties with respect to cost, waste management, and concerns about the proliferation of nuclear weapons technology. At the federal level there is considerable support for a new round of nuclear investments. In fact, Congress adopted a substantial program of loan guarantees for the development and construction of new nuclear plants as well as other low- and zero-emissions technologies as part of the Energy Policy Act of 2005. This and other incentives have spurred a new wave of interest in nuclear power. Several new projects have been proposed since 2005, and some of these proposals have even entered the pre-permitting phase. But it remains unclear at this juncture whether current incentives are enough, or whether other barriers to the actual construction of new plants can be overcome. The existing federal loan guarantee program, for example, makes $18.5 billion available, but has already received applications totaling $122 billion.

Waste management may present less of a hurdle to new nuclear plant construction going forward, though the issue continues to lack a clear federal resolution.17 With the Department of Energy’s efforts to develop a permanent repository for commercial and defense nuclear waste at a standstill, there is growing support among industry experts and policymakers for decentralized, retrievable storage options (such as dry casks) rather than a single, centralized long-term storage site. Meanwhile, the Nuclear Regulatory Commission has determined that used fuel can be safely stored at reactor sites for decades.

Developing new nuclear power sources competes favorably with other supply-side carbon abatement options in terms of cost, technological feasibility, and proven compatibility with reliable grid operation. In the cost curve shown in Figure 8 (page 36), new nuclear falls to the left of wind and even coal-to-gas switching in cost per ton of carbon dioxide–equivalent reductions. It is also far to the left of less established technologies like coal with CCS and solar photovoltaics. However, it is still more expensive than the most cost-effective demand-side options such as improving end-use efficiency, implementing combined heat and power at industrial facilities, and improving conversion efficiencies at existing power plants.

For power suppliers confronting the need to add new generating capacity, current economics, taking into account investment risks and regulatory and other uncertainties, in most cases still favor new natural gas systems over either nuclear or advanced coal systems.18 Thus, while broad-based support can be found for the proposition that nuclear energy will be needed to achieve climate and other energy policy goals in an economically reasonable manner, it seems likely that additional policies and incentives—particularly relating to cost, waste, security, and disposal—will be necessary to overcome current barriers to investment in a new generation of nuclear

17. The federal government failed to meet a 1998 deadline for removing used fuel from reactor sites. More recently, the Obama administration decided to suspend all work at the Yucca Mountain site. Energy Secretary Steven Chu has indicated that he plans to charge a blue ribbon panel with examining long-term options for managing spent nuclear fuel, but policy recommendations are unlikely for eighteen to twenty-four months.

18. One strategy that may hold promise for improving the economics of new nuclear plants is building multiple, somewhat smaller plants using the same design.
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Renewable Energy

Renewable energy technologies such as wind, solar, biomass, hydropower, and geothermal offer a number of important advantages. They avoid greenhouse gas and other pollutant emissions, enhance energy security and fuel diversity, and in some cases support local economic development. Growing global demand for renewable energy technologies may present a new area of economic opportunity and competitive advantage for the Midwest, given its manufacturing base and industrial expertise. The map of wind turbine and component manufacturing facilities in the United States shown in Figure 17 indicates that several facilities are located in the Midwest. In November 2008 news outlets reported plans for additional wind turbine manufacturing facilities in Iowa, Indiana, and Minnesota.19

As a source of low-carbon energy, the theoretical potential of renewable energy is large. To cite just one example, the National Renewable Energy Laboratory (NREL) has estimated that the nation could economically supply 20 percent of its total electricity needs using wind power.20 In fact, besides biomass, wind is probably the region’s most abundant renewable resource. Sites with promising wind potential have been identified throughout the Midwest region, including potential sites offshore in the Great Lakes.21 By contrast, the Midwest is generally less well endowed with solar, geothermal, and hydropower resources. Biomass energy is discussed in a separate section since it is mainly a source of alternative liquid fuels for the transport sector. Biomass has potential applications in the electric power sector since it can be cofired with coal in conventional steam ele

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wind has been the most successfully commercialized large-scale renewable electricity technology to date, the industry remains subject to boom/bust cycles related to the federal production tax credit. Solar power, meanwhile, remains expensive compared to conventional sources and other carbon dioxide abatement options shown in Figure 8.

As mentioned earlier, the lack of adequate infrastructure to connect renewable resources in remote areas to populated demand centers is emerging as a major issue for large-scale development of wind and solar energy. Expanding the transmission infrastructure, which entails long-distance, high-voltage lines that traverse multiple jurisdictions, is expensive and difficult. The same NREL study that found wind could account for 20 percent of supply also concluded that reaching this goal will require investing as much as $60 billion to add thousands of miles of new transmission lines. In the Midwest there is currently debate about the construction of new high-voltage transmission lines to deliver power from wind-rich areas of the Dakotas to markets in urban areas to the east or west. Meanwhile, the Midwest Independent System Operator has received hundreds of applications for grid connections to support proposed wind projects, but has been unable to act on most of those applications due to transmission constraints.

Other concerns include the integration of intermittent renewables like wind and solar with a grid that must meet high standards of stability and reliability. In contrast to conventional power plants, the output of wind and solar generators is variable and dependent on time and weather. This creates challenges for grid operators who must instantaneously and at all times match supply to demand. Current renewable penetration levels in the United States are generally well below the threshold where grid integration becomes a problem. But several states have committed to a rapid expansion of renewable power to levels of as much as 25 percent of total supply over the next fifteen years.

There is some debate about how significant these grid integration issues are and how much they will cost to address. A study conducted for the Minnesota Public Utilities Commission in 2006 concluded, for example, that one-quarter of that state’s electricity needs could be met using wind energy without reliability problems or excessive cost. This conclusion depended, however, on the availability of ancillary services to back up wind generation at a wholesale cost of about $4 to $5 per megawatt-hour.\(^22\) Obviously, the need for such ancillary services is an additional cost factor for intermittent renewables such as wind. At higher levels of penetration, the need for these services could also have important implications for natural gas markets and for the power-sector supply mix more broadly, since natural gas turbines would likely be the first choice for providing backup capacity in most cases for the foreseeable future.

As intermittent renewable energy technologies play a larger role, improved grid technology, larger and better-connected transmission and distribution networks, and improved grid management techniques will be needed to alleviate grid integration challenges and significantly reduce costs. The development and commercialization of cost-effective energy storage technologies\(^23\) that would allow intermittent renewable generators to function more like conventional power plants in terms of providing firm capacity could make an important difference and warrants further R&D. Finally, as noted in the introduction to this chapter, some renewable energy projects have encountered siting problems and local opposition, despite the public’s general support for these technologies. The proposed Capewind project off the coast of Massachusetts is a recent, well-publicized example. Local jurisdictions should work proactively with project developers and relevant regulatory agencies to try to anticipate and address siting concerns and reach out to local communities.

Support for renewable energy at the federal level has primarily come in the form of support for R&D and a federal production tax credit. Other policies include accelerated depreciation for tax purposes for certain projects and the Clean Renewable Energy Bonds (CREBs) program, which provides an alternative financing mechanism for projects that cannot take advantage of other tax incentives. Along with high conventional fuel prices and state policies (discussed below), the production tax credit, in particular, has played an important role in driving rapid expansion of wind energy capacity across the country in recent years. A major flaw of this program, however, is that Congress has been renewing the credit for only one or two years at a time. This has created substantial year-to-year uncertainty, making it difficult for the domestic wind industry to develop in an

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\(^22\) These findings played a major role in winning political support for Minnesota’s 25 percent renewable portfolio standard. The study is available at http://www.uwig.org/windrpt_vol%201.pdf.

\(^23\) An example is compressed air storage. During low-demand periods, excess output from renewable generators (e.g., when wind turbines run at night) would be used to compress air. The compressed air could be stored in natural caverns or some other containment vessel and accessed during high-demand periods to generate power as needed.
orderly and sustainable way. At the state level, a policy tool that has become increasingly popular for promoting renewable energy is the renewable portfolio standard (RPS) or renewable electricity standard (RES). At present, twenty-eight states and the District of Columbia have some form of renewable standard. This includes seven midwestern states (see Table 5).

**Biofuels for the Transportation Sector**

Unlike the electric power sector, the transportation sector at present is overwhelmingly dependent on a single dominant form of energy: liquid petroleum fuels (primarily gasoline and diesel). This limits the variety of renewable energy alternatives that can readily be applied in the transportation sector in the near term. However, the introduction of large numbers of all-electric and plug-in hybrid electric vehicles (as discussed in Chapter III) could open the door to a greater role for low-carbon, electric generating technologies of all types in supplying transportation energy needs. In any case, biofuels have emerged as the main alternative to liquid petroleum–based fuels in the transportation sector. A significant corn-based ethanol industry now exists in the United States, with the vast majority of its production capacity located in the Midwest. Domestic biofuels production, nearly all of it corn ethanol, totaled 9.2 billion gallons in 2008—enough to displace approximately 4.5 percent of U.S. gasoline consumption, taking into account the lower energy density of ethanol.

Biofuels production in the United States is set to increase dramatically under the federal renewable fuels standard (RFS), which was first introduced in the Energy Policy Act of 2005 and was subsequently expanded by the Energy Independence and Security Act of 2007. As amended, the current RFS calls for 12 billion gallons of conventional renewable fuels in 2010, 15 billion gallons in 2015, and 36 billion gallons of total (conventional and advanced) renewable fuels in 2022. The domestic biofuels industry also benefits from subsidies and other incentives, including a 45 cent-per-gallon federal blender’s tax credit for ethanol and a 54 cent-per-gallon tariff for imported ethanol.

Although the U.S. ethanol industry grew rapidly between 2006 and 2008—domestic production capacity approximately doubled during this relatively short period—the economics had become less favorable for many producers even before the current economic downturn. Rising fuel and feedstock prices threatened to put some producers out of business. More recently, falling oil prices have posed a challenge. As with other forms of renewable energy, the boom/bust pressures that have recently characterized ethanol markets underscore the difficulty of establishing and sustaining new energy industries.

From a climate change abatement perspective, many experts believe corn ethanol has limited benefits, at best, and should be viewed as a transition fuel to more advanced forms of biofuels. Such biofuels could produce significantly larger greenhouse gas benefits by using different feedstocks and conversion processes. Efficient processes for converting cellulosic (woody or fibrous) plant materials (as opposed to starch or sugar) to liquid fuels would open the door to a wider range of feedstocks such as grasses or fast-growing trees that can grow on marginal land with less fertilizer and pesticide. This would not only reduce the upstream emissions associated with cultivating energy crops, it would alleviate the land-use pressures and feedstock supply constraints that might otherwise arise as a result of greatly expanded markets for biofuels.

The land-use issue is at the heart of a current debate about the net greenhouse gas impacts of biofuels. Some recent studies have concluded that when the indirect effects of increased demand for cultivated land—especially where it leads to accelerated deforestation in tropical developing countries—are included, the benefits of biofuels such as corn and sugar cane ethanol go from moderately positive (some reduction in net emissions relative to petroleum fuels) to negative (an overall increase in emissions).

The current federal RFS program reflects a consensus that improved biofuels options are needed. The program calls for a rapid increase in the volume of cellulosic ethanol in the U.S. fuel mix over

<table>
<thead>
<tr>
<th>State</th>
<th>Renewable Electricity Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>25% by 2025</td>
</tr>
<tr>
<td>Iowa</td>
<td>105 megawatts</td>
</tr>
<tr>
<td>Michigan</td>
<td>10% by 2015</td>
</tr>
<tr>
<td>Minnesota</td>
<td>25% by 2025</td>
</tr>
<tr>
<td>Missouri</td>
<td>11% by 2020 voluntary goal; 15% by 2021 mandatory requirement</td>
</tr>
<tr>
<td>Ohio</td>
<td>12.5% by 2024</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>10% by 2015</td>
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</tbody>
</table>

Source: www.eia.doe.gov
the next decade. Specifically, the mandate for cellulosic biofuels increases thirtyfold over a five-year period, from 0.1 billion gallons in 2010 to 3 billion gallons in 2015 and 16 billion gallons in 2022. This is an aggressive schedule, to say the least, given that commercial-scale cellulosic ethanol production has not yet been demonstrated in the United States or elsewhere. Substantial efforts are now under way to improve the efficiency and reduce the cost of cellulosic ethanol production. At the same time, researchers are pushing the frontiers of biological and chemical science to explore the potential for further game-changing advances in bioenergy. Some new areas under investigation involve the use of genetic selection and molecular engineering, specialized enzymes, and photosynthetic microbes such as algae.

The Midwest is already a center of the commercial biofuels industry and of agricultural research centers, universities, national laboratories, and other institutions with relevant resources and expertise. The region is therefore naturally situated to take the lead in developing and commercializing new bioenergy technologies and incubating new bioenergy companies. Ultimately, these technologies could support advanced biorefineries capable of efficiently coproducing a range of useful products, including electricity, liquid fuels, and chemicals. The development of a vibrant and diversified bioenergy industry in the Midwest would have important benefits for the regional economy and for farmers and their communities.

Natural Gas

Natural gas is a well established energy source and one for which efficient and economic end-use technologies are fully developed. It is an important fuel for many major industries and a primary source of energy for many households. It is also critically important as a bridge fuel that can deliver reliable energy and immediate greenhouse gas reductions (relative to other fossil fuels) in the transition to more advanced but not yet commercialized technologies and more fully decarbonized energy systems. The issue of access to adequate supplies of natural gas has important implications for the economic and energy security of the Midwest and the nation. Indeed, in recent years there was a significant run-up in natural gas prices and growing concern about the potential for domestic production to fall short of future demand. As a result, there was much discussion about the need for diversifying natural gas supplies and expanding capacity to import liquefied natural gas (LNG) from overseas.

More recently, the issue of high gas prices and potential future supply shortages has receded. The sharp run-up in natural gas prices earlier this decade prompted the development of significant new sources of supply from both traditional and nontraditional sources. A number of prominent estimates of the recoverable domestic gas resource base have recently been revised upward quite significantly. In addition, LNG imports—according to some recent media reports—can be expected to rise in the future. Finally, the current economic downturn has eased demand pressures on U.S. natural gas markets. The concern now is that an overabundance of low-cost natural gas for some years to come—while welcome from an environmental and economic perspective in the short run—could delay the development of alternative low-carbon technologies needed to address climate change over the long term.

Whether or not volatility in the gas market returns, prices will affect climate and energy developments. Modeling analyses suggest that natural gas prices are an important factor in near-term carbon abatement costs, given that fuel-switching to natural gas is often seen as a first step to achieving rapid emissions reductions. Abundant natural gas supplies and low prices can therefore be extremely helpful in managing the near-term costs of carbon abatement.

At the same time, however, natural gas prices also set the cost threshold for other low- or noncarbon supply alternatives to compete in the market, thus having a direct effect on private-sector incentives to invest in new technologies. Given these important dynamics, policymakers will need to pay close attention to trends in natural gas supply and demand going forward and consider broader climate and energy policy efforts in that context.

Task Force Recommendations for Low-Carbon Supply Technologies

Federal

- Ensure that the market rewards innovations that reduce emissions. This is the most effective way to advance low-carbon technology. Thus, a federal policy that establishes a market price on carbon is the essential foundation for other programs and incentives to spur carbon reductions and promote climate-friendly technologies. Either a carbon tax or a cap-and-trade program could achieve this important objective. Each has advantages and disadvantages, but both have the effect of providing a tan-
gible market incentive for developing and adopting low-carbon technologies.25

- Emphasize well-designed, performance-based (rather than technology-specific) deployment incentives for technologies that have been (or are ready to be) successfully commercialized. Incentive programs should also provide greater consistency and temporal stability to avoid the boom/bust effect that uncertainty about the federal production tax credit has had on the wind and solar industries. This does not mean that some technologies should get perpetual incentives. Rather, public support should decline as technologies become commercially viable. But since investors need predictability, information about changes in incentives should be known in advance. Finally, because it is impossible to predict the path of technological innovation, programs must be open to new technologies, even if they were not originally anticipated. One of the advantages of performance-based policies is that they have the natural flexibility to accommodate new technologies.

- Provide longer-term clarity about future incentives so that investors have enough confidence to move forward with new technologies. The recent three-year extension of the renewable production tax credit adopted as part of the economic stimulus package was a step in the right direction, but predictability will continue to be important going forward.

- Provide sufficient loan volume under the loan guarantee provisions for low- and zero-emitting technologies included in Title XVII of the Energy Policy Act of 2005. The current cap allows for the development of at most two or three new nuclear plants. In addition, Congress must continue to appropriate and DOE must more efficiently deliver funds for programs that have already been authorized under existing legislation.26

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25. The presumption for some time has been that a cap-and-trade approach is far more viable politically than a carbon tax in the U.S. context. However, the tax approach has a number of advantages and policymakers may revisit this option as a new Congress reengages the climate policy issue in the months ahead.

26. DOE recently approved the first project under the existing loan guarantee program, nearly four years after the Energy Policy Act of 2005 was passed.
VI. Conclusion

The energy and climate challenges confronting the Midwest, the United States, and the wider world can be simply stated: We cannot afford another decade of rising carbon emissions, volatility in commodity prices, a lack of a national energy policy, and inadequate international cooperation of the kind that has characterized the immediate past. Another ten years in which our practices remain unchanged will result in a general deterioration of our economic position as well as damage to the environment we share in common with all other nations, both of which may prove irreversible.

In 2009 we face a set of choices and circumstances that offer the most significant opportunity to shape our economic and environmental future in almost twenty years. Consider the following. An international financial crisis—the duration, severity, and full impacts of which remain impossible to predict—has shaken the global economy to its core and raised the question of what economic model we want going forward. A new president and Congress are engaging on climate and energy policy with a seriousness that promises significant change. Internationally, nations are negotiating a new treaty on the ever-worsening threat of climate change, which will culminate with a summit in Copenhagen in December 2009.

Some look at this moment of social, political, and economic upheaval and argue that the United States must scale back its ambitions in energy and climate change until things settle down and get back to normal. This Task Force takes a very different view. The Midwest must treat this challenge as an opportunity to build a new foundation for economic prosperity in the twenty-first century. Change will be difficult, but it will only grow more difficult over time. We must play our part in the historic international effort to combat climate change, recognizing that action to curb carbon emissions in the United States and the Midwest is a critical step in breathing new life into these negotiations.

Federal leadership is crucial, but the Midwest cannot wait for Washington to “get out in front” of the economic and energy trends that will surely dominate the coming decades and probably the next century. The Midwest has too much at stake to remain inactive. Preserving the past is no longer an option. There is much the region can do to prepare for a carbon-constrained future and begin turning those challenges to its competitive advantage. This report has outlined a series of concrete steps that can be taken in this regard. Midwest stakeholders must ensure that the region’s voice is heard nationally and internationally. Without the region’s input, legislation and treaties will be less effective and more vulnerable to political attack.

This report is a beginning, not an end. It outlines the points of consensus in the Midwest about the urgency of action, but there remains plenty of room for debate on the details of specific policies. The Task Force encourages businesses, environmental groups, policymakers, educators, and individual citizens to play their part in continuing this important conversation in the months and years ahead.
A Reservation on Emissions Offsets

The undersigned members of the Task Force support the report except for elements of the proposal on offset emissions and offer the following explanation for our exception to the recommended approach.

Rules for carbon markets or cap-and-trade protocols should limit offsets to a small fraction of total greenhouse gas reductions, especially within the early compliance periods, and international offsets should be limited to a portion of offsets allowed for the following reasons: (a) to send the necessary price signals to support clean energy investments; (b) to insure integrity of the offsets through the progressive development and implementation of robust verification, monitoring, and enforcement mechanisms; and (c) to provide assurance of investment in emissions reductions within the Midwest economy.

(a) The report strongly and repeatedly emphasizes that a predictable carbon price signal increasing over time is very important to drive low-carbon investment, capital stock turnover, and energy innovation. Solving the U.S. contribution to global warming means reducing fossil fuel emissions by 80 percent or more during the time frame that the U.S. economy will triple in size. This will require a massive retooling of our energy, transportation, and agriculture economies using not just the lowest-cost technological options, but also many that fall in the middle and, in some cases, upper portions of the McKinsey cost curve (Figure 7).

Contrary to this central premise of the report, Figures 11, 12, and 13 (pages 66-68) purport to show the cost containment benefits of inclusion of unlimited offsets in a cap-and-trade program, with the implication that keeping carbon dioxide prices low is good strategy. However, it more effectively shows how inclusion of unlimited offsets would suppress the price signal needed by investors to move to transformational technologies that, at least initially, have higher costs. With unlimited use of offsets, carbon prices that revolutionize energy investments and energy markets could be effectively delayed for decades. The important concerns regarding the potential of high carbon prices to harm both consumers and the international competitiveness of energy-intensive industries in the Midwest should be addressed through other strategies rather than the blunt tool of suppressing the price signal provided by the cap.

(b) Further, the report emphasizes that there are potential environmental and cost benefits of offsets, and that rigorous protocols must be established to assure that any offsets are real, additional, quantifiable, permanent, verifiable, and enforceable. It recognizes that international offset markets are larger and more diverse than domestic ones as well as more difficult to verify. But there is not sufficient recognition that the requisite national government regulatory capacities in both buyer and seller countries and the international regimes for accrediting carbon offsets do not yet exist and will have to be built up and proven effective over an extended period of time.

Nor does the report acknowledge that risky or questionable carbon reductions could undermine confidence in the CO₂ reduction program, just as subprime mortgages undermined confidence in the mortgage market. To limit this risk, the solution is to start slow with offsets and condition expansion of their use in future periods on demonstration of their reliability and effectiveness in preceding ones. The states participating in the Regional Greenhouse Gas Initiative (RGGI) have decided to limit the use of offsets to a very small portion of reductions: 3.3 percent at the start, growing to 10 percent under certain conditions. The Midwest Governors Association’s Regional Greenhouse Gas Accord’s stakeholder draft protocol urges limiting offsets to no more than 20 percent of total reductions and requires at least 80 percent of those to be within the Midwest region.

(c) Finally, international offsets represent an export of investment from the region. By limiting offset markets to a fraction of total reductions and limiting international offsets to a portion of that fraction, carbon market rules can drive investment to modernization of existing businesses and development of new clean-tech industries that will boost productivity and growth in the region, especially over the medium and long term.

Submitted by:

Bill Abolt  
Chicago District Manager  
Shaw Environmental and Infrastructure, Inc.

Edmund Miller  
Director  
Legacy Fund

Henry Henderson  
Midwest Director  
Natural Resources Defense Council

Michael Noble  
Executive Director  
Fresh Energy

William Luther  
Former Member  
U.S. House of Representatives
Response to the Reservation

I believe that arbitrary limits on the use of offsets for compliance are unjustified. Monitoring and verification (M&V) challenges are not unique to offsets by any means. Indeed, M&V concerns pervade any scheme to regulate emissions, and our goal should be to subject all compliance options—whether from regulated sources or unregulated ones—to appropriately rigorous standards. Passing this M&V gamut—with attention to whether reductions are real, surplus, verifiable and permanent—is the criterion we should meet. Arbitrary ceilings risk increasing the cost of compliance unnecessarily and threaten to preclude important sectors—agriculture and forestry in particular—from contributing to a comprehensive climate program.

Submitted by:

Stephen Brick  
Executive Director  
International Biochar Initiative

Appendix A: Recommendations by Actor

Recommendations for Congress

- Emphasize efficiency investments and building retrofits in federal energy legislation, climate legislation, or future economic stimulus plans; consider making efficiency performance part of the criteria used to determine eligibility of projects for federal funding as part of that package.

- Extend and expand federal tax credits for building efficiency improvements for both residential and commercial buildings.

- Consider other federal incentives for promoting efficiency upgrades—or at least information disclosure—at the point of sale, especially in the case of federally subsidized mortgages.

- Provide federal funding for state and local programs to train workers to implement efficiency improvements.

- Support research and development on new efficiency technologies.

- Support increased funding for the Weatherization Assistance Program to improve the efficiency of low-income homes.

- Extend and expand tax credits for consumers to purchase advanced technology vehicles.

- Provide increased funding for advanced battery research and development.

- Provide increased funding to upgrade regional rail systems, including relieving freight rail congestion in the Chicago area.

- Deploy tax policy to promote industrial energy efficiency (e.g., investment tax credits or accelerated depreciation).

- Level the playing field of subsidies/incentives to treat all low-carbon alternatives equally (i.e., not just renewables like wind, but also energy efficiency and CHP).
• Provide federal funding for workforce training and skill building to take advantage of opportunities in energy management and advanced energy technologies.

• Modernize all regulatory, tax, and other policies to remove barriers to efficiency and enable efficiency investments to capture more of the value they create.

• Seek effective solutions to concerns about competitiveness in energy-intensive domestic industries in the design of national and international climate policies. For example, the United States should work through multilateral institutions to develop rules for international trade that can accommodate differences in national-level climate policies.

• Enable use of emission offsets as an alternative compliance mechanism in any mandatory national program to limit greenhouse gas emissions.

• Enforce rigorous regulation and verification requirements to ensure that credited project benefits are truly additional, verifiable, permanent, and enforceable.

• Support research efforts at universities, national laboratories, and research centers to identify domestic sources of offsets that meet these criteria, especially in the agriculture sector.

• Ensure that the market rewards innovations that reduce emissions. This is the most effective way to advance low-carbon technology. Thus, a federal policy that establishes a market price on carbon is the essential foundation for other programs and incentives to spur carbon reductions and promote climate-friendly technologies. Either a carbon tax or a cap-and-trade program could achieve this important objective. Each has advantages and disadvantages, but both have the effect of providing a tangible market incentive for developing and adopting low-carbon technologies.

• Emphasize well-designed, performance-based (rather than technology-specific) deployment incentives for technologies that have been (or are ready to be) successfully commercialized.

Incentive programs should also provide greater consistency and temporal stability to avoid the boom/bust effect that uncertainty about the federal production tax credit has had on the wind and solar industries. This does not mean that some technologies should get perpetual incentives. Rather, public support should decline as technologies become commercially viable. But since investors need predictability, information about changes in incentives should be known in advance. Finally, because it is impossible to predict the path of technological innovation, programs must be open to new technologies, even if they were not originally anticipated. One of the advantages of performance-based policies is that they have the natural flexibility to accommodate new technologies.

• Provide longer-term clarity about future incentives so that investors have enough confidence to move forward with new technologies. The recent three-year extension of the renewable production tax credit adopted as part of the economic stimulus package was a step in the right direction, but predictability will continue to be important going forward.

• Provide sufficient loan volume under the loan guarantee provisions for low- and zero-emitting technologies included in Title XVII of the Energy Policy Act of 2005. The current cap allows for the development of at most two or three new nuclear plants. In addition, Congress must continue to appropriate and DOE must more efficiently deliver funds for programs that have already been authorized under existing legislation.

• Provide funding for basic scientific R&D to advance technologies that are still in the experimental phase. Much of this R&D has historically been conducted or coordinated through the DOE national laboratories.

• Commit to partnering with the private sector to provide the necessary cost- and risk-sharing support to implement a minimum number of demonstration plants for key technologies like CCS and nuclear. Even generous authorizations for such efforts will be meaningless unless Congress follows through with adequate appropriations.
Recommendations for the Administration and Federal Agencies

- Update and expand appliance and equipment efficiency standards to ensure they capture technically feasible and economically advantageous energy saving opportunities.

- Charge a designated federal agency (such as the Department of Energy or the Environmental Protection Agency) with (a) establishing national targets for improved building energy efficiency and (b) developing strategies and demonstrating progress toward those targets. The EPA has already developed some tools for comparing efficiency across different building types and climate zones that could be helpful in implementing this and other policies in this section.

- Create a market for advanced technology vehicles by implementing strong fleet requirements for the federal fleet.

- Provide public support in the form of direct cost, risk, and/or equity sharing for first-mover and demonstration projects for technologies that are at the precommercial stage (e.g., coal IGCC with CCS). In choosing projects, the government inevitably has to focus on specific technologies and make judgment calls about which technologies and projects merit public support. To improve on the past record, these choices should be based to the greatest extent possible on objective assessments of potential payoffs and likelihood of success.

Recommendations for the Midwest Region

- Develop and promote a regional model for state-of-the-art building codes and appliance standards (for products not preempted by federal standards). The Midwestern Governors Association could play a lead role. Update and expand appliance and equipment efficiency standards.

- Address workforce training needs to expand in-region expertise and capacity for designing and implementing efficiency improvements and enforcing codes and standards.

- Draw on in-region resources, both universities and the domestic auto industry, to make the Midwest region a national center for advanced vehicle technologies, including plug-in hybrid (PHEV) and battery electric vehicle technology. Begin planning for and investing in the grid and infrastructure improvements necessary to support these technologies in a way that maximizes potential benefits.

- Undertake regional planning for transit and economic development that incorporates integrated land use, transit funding, and new mechanisms designed to better align private incentives with public objectives (examples include user fees and congestion pricing).

- Marshal regional resources in combination with federal funding to provide workforce training and skill building.

- Focus on capturing efficiency opportunities in key Midwest industries such as food processing, chemicals, fabricated metals, machinery, and other manufacturing.

- Build a regional center of expertise in offset identification, verification, management, and trading leveraging the Midwest's historic human capital strengths in commodities, futures and options, agriculture, and business services. Such a center could combine the best of our private-sector institutions with the strength of Midwest universities and key public sector agencies, leading to further growth opportunities in this area.

- Support efforts by universities and other institutions in the region to obtain public and private funding for research in innovative offset opportunities such as improved verification protocols.

- Foster innovation across the Midwest's university system to drive technological advances and successful commercial applications in critical renewable energy areas. In particular, increased collaboration between Midwest universities, research institutions, and the private sector would enhance the region's ability to win a share of federal R&D resources and to establish itself as a world leader in the development of new low-carbon technologies.
• Work across jurisdictions and regulatory agencies and with the federal government and private sector to develop risk-sharing approaches that open the door to the financing of new technologies and first-mover projects. Financing is a critical barrier for many new technologies as they advance to the demonstration/precommercial stage.

**Recommendations for the Midwest States**

• Update and expand appliance and equipment efficiency standards to ensure they capture technically feasible and economically advantageous energy saving opportunities.

• Consider new incentives and foster innovation in city- or university-scale programs to promote efficiency upgrades in existing buildings. One strategy may be to target incentives to specific windows of opportunity such as the point of sale for an existing building. Other opportunities exist when building owners undertake major repairs, renovations, or facility expansions (see University of Iowa Flood Recovery, page X). Innovative policies can also be used to promote improvement above minimum standards, e.g., expedited siting and permit approval for projects that meet aggressive efficiency targets such as LEED certification.

• Ensure that government retraining efforts allocate sufficient funding for developing the talent necessary to achieve the efficiency targets.

• Consider regulatory reforms to increase utility incentives for investment in customer-side efficiency programs.

• Encourage additional financing mechanisms for leveraging energy efficiency opportunities such as energy services companies (ESCOs).

• Create a market for advanced technology vehicles by implementing strong fleet requirements for state- and local-government-owned fleets.

• Invest in regional improvements to the high-speed rail network.

• Rationalize state or regional policies to promote the deployment of technologies that are commercial or close to commercial to focus on desired outcomes (e.g., carbon reductions).
Appendix B: Glossary of Terms

Abatement
Reducing the degree or intensity of greenhouse gas emissions.

Adaptation Fund
Established by parties to the Kyoto Protocol to finance concrete adaptation projects and programs in developing countries. The fund is to be financed with a share of proceeds from Clean Development Mechanism (CDM) project activities as well as with funds from other sources.

Additionality
A key eligibility test for projects designed to generate carbon credits under the Kyoto Protocol and other carbon offset schemes. The test dictates that projects are only eligible for carbon credits if the resulting emission reductions were not going to happen anyway (i.e., they are additional to what would have occurred without the carbon credit incentive).

Allowances
Under a cap-and-trade program, the government issues a quantity of allowances equal to the total emissions budget or cap. Requiring all regulated entities to surrender allowances equivalent to their actual emissions for each subsequent compliance period then ensures that overall emissions do not exceed the overall cap.

Alternative Fuels
Alternative fuels, for transportation applications, include the following:
- methanol
- denatured ethanol and other alcohols
- fuel mixtures containing 85 percent or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels
- liquefied petroleum gas (propane)
- hydrogen
- coal-derived liquid fuels
- fuels (other than alcohol) derived from biological materials (biofuels such as soy diesel fuel)
- electricity (including electricity from solar energy)

Ancillary benefits
Complementary benefits of a climate policy, including improvements in local air quality and reduced reliance of imported fossil fuels.

Baseline and credit
A type of emissions trading scheme where firms are encouraged to reduce their greenhouse gas emissions below a projected “business-as-usual” path of increasing emissions. Any reductions below that future path earns credits for the difference, which can be sold to other emitters above baseline levels. See also cap and trade.

Base load
The minimum amount of electric power delivered or required over a given period of time at a steady rate.

Biomass fuels or biofuels
A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted such as firewood, alcohol fermented from sugar, and combustible oils extracted from soybeans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.

Capacity building
In the context of climate change, the process of developing the technical skills and institutional capability in developing countries and economies in transition to enable them to effectively address the causes and results of climate change.

Cap and trade
The most popular type of emissions trading scheme, where emissions are subject to a cap (maximum), allowances or permits are issued up to that cap, and regulated entities are required to surrender an allowance or permit for every ton of emissions. Once issued, allowances or permits can be freely traded, allowing each regulated entity to choose the most cost-effective combination of reducing emissions and holding allowances.

Carbon capture and storage (CCS)
A two-step process to prevent carbon dioxide from being emitted to the atmosphere, particularly from power generation and industrial
processes. Instead of venting CO₂, it is captured and pumped underground under pressure and sealed off, where it cannot contribute to global warming. Also known as carbon sequestration.

**Carbon footprint**
The impact of human activities on global warming in terms of the amount of greenhouse gases they produce. The emissions associated with the use of power, transport, food, and other consumption for an individual, family, or organization are added up to provide a common measure in units of carbon dioxide equivalent.

**Carbon market**
A popular but misleading term for a trading system through which countries may buy or sell units of greenhouse gas emissions in an effort to meet their national limits on emissions under the Kyoto Protocol or other agreements (such as that among member states of the European Union). The term comes from the fact that carbon dioxide is the predominant greenhouse gas, and other gases are measured in carbon dioxide equivalents.

**Carbon neutral**
An individual, family, or organization that is responsible for no net emissions of greenhouse gases from all its activities is considered “carbon neutral.” Emissions must be cut to a minimum and any necessary emissions then offset by emission-reducing activities elsewhere. Buying accredited clean electricity helps cut household or office greenhouse emissions, while investing in sustainable energy projects or afforestation are examples of offsets.

**Carbon offsets**
See offsets.

**Carbon positive**
An individual, family, or organization that is responsible for taking more greenhouse gases out of the atmosphere than it emits. This requires minimizing one’s own emissions and more than offsetting remaining emissions by paying for activities such as forest planting or investing in renewable energy.

**Carbon price**
An economic value placed on the emission of greenhouse gases into the atmosphere from human activity. This price is designed to create a disincentive for emissions and an incentive to avoid them. A carbon price takes the form of either a carbon tax or an emissions trading scheme.

**Carbon sequestration**
The process of removing carbon from the atmosphere and depositing it in a reservoir.

**Carbon tax**
An alternative approach to limiting greenhouse gas emissions in which emitters are charged a fixed price for each ton of emissions. They can emit as much as they want at that price. In contrast to a cap-and-trade system, overall emissions are determined by the level of the tax relative to the cost of abatement rather than by a fixed cap.

**CH₄**
Methane. A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at twenty-three times that of carbon dioxide (CO₂). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

**CO₂**
Carbon dioxide. A naturally occurring gas that is also a by-product of burning fossil fuels and biomass. Carbon dioxide is also emitted when organic matter decays and by certain industrial processes. It is the principal anthropogenic greenhouse gas that affects the earth’s radiative balance.

**CO₂e**
Abbreviation of carbon dioxide equivalent and the internationally recognized measure of greenhouse emissions.

**Cogeneration projects (combined heat and power)**
Cogeneration, also known as combined heat and power (CHP), is the simultaneous production of electricity and heat from a single fuel source such as natural gas, biomass, biogas, coal, waste heat, or oil. CHP is not a specific technology, but an application of technologies to meet an energy user’s needs. The two most common CHP system
configurations are gas turbine or engine with heat recovery unit and steam boiler with steam turbine.

**Compliance cost**
Expenditure of time or money to conform with government legislation or regulation.

**Conservation tillage**
Any tillage system that maintains 30 percent or more of the soil surface with crop residue after planting to reduce soil erosion by water.

**Distributed energy storage**
Energy generation and storage systems placed at or near the point of use. Encompasses a range of technologies, including fuel cells, microturbines, reciprocating engines, and energy storage systems.

**End use**
Any specific activity performed by a sector (residential, commercial, industrial, or transportation) that requires energy (e.g., refrigeration, space heating, water heating, manufacturing, feedstocks).

**Energy supply mix**
The composition of a country, region, state, or municipality’s energy portfolio.

**First-mover**
The advantage gained by the initial occupant of a market segment.

**Fossil fuel**
Any naturally occurring organic fuel such as petroleum, coal, and natural gas.

**Fugitive fuel emissions**
Unintentional greenhouse gas emissions as by-products, waste, or loss in the process of fuel production, storage, or transport (e.g., methane given off during oil and gas drilling and refining or leakage of natural gas from pipelines).

**Gasification**
The conversion of solid material such as coal, petroleum, or biomass into a gas for use as a fuel.

**Greenhouse gases (GHGs)**
The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Less prevalent but powerful greenhouse gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆).

**Greenhouse intensity**
The ratio of a nation’s greenhouse gas emissions to its GDP, or the volume of emissions per unit of economic output. A country’s greenhouse intensity may often be falling, yet overall emissions are rising due to an expanding economy. Greenhouse intensity measures are also used for companies, industrial plants, and overall industries.

**ICCP**
International Climate Change Partnership.

**Interconnection**
Two or more electric systems having a common transmission line that permits a flow of energy between them. The physical connection of the electric power transmission facilities allows for the sale or exchange of energy.

**Intergovernmental Panel on Climate Change (IPCC)**
Surveys worldwide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the subsidiary bodies of the United Nations Framework Convention on Climate Change (UNFCCC). The IPCC was established in 1988 by the World Meteorological Organization and the UN Environment Program and is independent of UNFCCC.

**Intermittent renewable sources**
Sources of electric power generation that are more variable such as wind and solar energy.

**International Climate Change Partnership**
Global coalition of companies and trade associations committed to constructive participation in international policymaking on climate change.
Kyoto Protocol
An international agreement standing on its own and requiring separate ratification by governments, but linked to the United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol sets binding targets for the reduction of greenhouse gas emissions by industrialized countries.

Kyoto mechanisms
Three procedures established under the Kyoto Protocol to increase the flexibility and reduce the costs of cutting greenhouse gas emissions: (1) the Clean Development Mechanism, (2) Emissions Trading, and (3) Joint Implementation.

Leakage
That portion of cuts in greenhouse gas emissions by developed countries—countries trying to meet mandatory limits under the Kyoto Protocol—that may reappear in other countries not bound by such limits. For example, multinational corporations may shift factories from developed countries to developing countries to escape restrictions on emissions.

Methane mitigation
In the context of climate change, a human intervention to reduce the sources or enhance the “sinks” of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other sinks to remove greater amounts of carbon dioxide from the atmosphere.

N₂O
Nitrous oxide. A colorless greenhouse gas naturally occurring in the atmosphere. Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Net metering
Allows small power generators to sell power back to the grid through the existing meter on their home or business.

“No-regrets options”
Technology for reducing greenhouse gas emissions whose other benefits (in terms of efficiency or reduced energy costs) are so extensive that the investment is worth it for those reasons alone.

Offsets
Credits issued in return for a reduction of atmospheric carbon emissions through projects such as replacing fossil fuel energy with renewable energy or reforesting cleared land to create a carbon sink. By paying for such emission-reducing activities, individuals and organizations can use the resulting credits to offset their own emissions, either voluntarily or under the rules of most emissions trading schemes. Typically, one offset credit equals an emission reduction of one ton of CO₂.

Offset credits
See offsets.

Photovoltaic
Pertaining to the direct conversion of light into electricity.

R&D
Research and development.

Renewable energy
Electricity supplied from renewable energy sources such as wind and solar power, geothermal, hydropower, and various forms of biomass. These energy sources are considered renewable because they are continuously replenished on the earth.

Retrofit
Adding new technologies or features to older systems.

Rio Conventions
Three environmental conventions, the first two of which were adopted at the 1992 “Earth Summit” in Rio de Janeiro and the third of which was adopted in 1994: (1) the United Nations Framework Convention on Climate Change (UNFCCC), (2) the Convention on Biodiversity (CBD), and (3) the United Nations Convention to Combat Desertification (UNCCD). The issues addressed by the three treaties are related, particularly the idea that climate change can
have adverse effects on desertification and biodiversity. Through a Joint Liaison Group, the secretariats of the three conventions coordinate activities to achieve common progress.

**Sink**
Any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere. Forests and other vegetation are considered sinks because they remove carbon dioxide through photosynthesis.

**Smart grid**
A system that delivers electricity from suppliers to consumers using digital technology with the intention of saving energy, reducing costs, and increasing reliability. Such a modernized electricity network is being promoted by many governments as a way of addressing energy independence and global warming issues.

**Soil carbon**
A major component of the terrestrial biosphere pool in the carbon cycle. The amount of carbon in the soil is a function of the historical vegetative cover and productivity, which in turn is dependent in part upon climatic variables.

**“Spill-over effects”**
Reverberations in developing countries caused by actions taken by developed countries to cut greenhouse gas emissions. For example, emissions reductions in developed countries could lower demand for oil and thus international oil prices, leading to more use of oil and greater emissions in developing nations, partially offsetting the original cuts. Current estimates are that full-scale implementation of the Kyoto Protocol may cause 5 to 20 percent of emissions reductions in industrialized countries to “leak” into developing countries.

**Split incentives**
Transactions or exchanges in which the economic benefits of energy conservation do not accrue to the person who is trying to conserve.

**Sustainable development**
Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

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**Technology transfer**
A broad set of processes covering the flows of know-how, experience, and equipment for mitigating and adapting to climate change among different stakeholders.

**Transmission and distribution loss**
Electric energy lost due to the transmission and distribution of electricity. Much of the loss is thermal in nature.

**UNFCCC**
United Nations Framework Convention on Climate Change.

**Upstream emissions**
Emissions that occur at an earlier stage in the production and distribution of a product or service. For example, upstream emissions associated with the use of gasoline in motor vehicles include emissions from extracting, transporting, and refining crude oil and then distributing the finished fuel product.

**Verified emission reductions (VERs)**
Tradable credits for reducing greenhouse emissions generated to meet voluntary demand for carbon credits by organizations and individuals wanting to offset their own emissions.

**Weatherization**
Programs that provide labor and supplies to help people improve the energy efficiency of their homes and protect them from the elements.

**Wind energy**
Kinetic energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators.

**Sources**
- Alliance to Save Energy Glossary: http://ase.org/content/article/detail/5356
Embracing the Future: The Midwest and a New National Energy Policy


EIA (Energy Information Administration) Energy Glossary: http://www.eia.doe.gov/glossary/


EPA Clean Energy Glossary: http://www.epa.gov/cleanrgy/energy-and-you/glossary.htm

EPA Climate Change Glossary: http://www.epa.gov/climatechange/glossary.html


UNFCCC Glossary of Climate Change Acronyms: http://unfccc.int/essential_background/glossary/items/3666.php


Cochair Biographic Summaries

John Livingston
Managing Partner
John Livingston is a director and managing partner of McKinsey & Company’s Chicago office and one of the leaders of the firm’s Climate Change Practice, serving clients on energy efficiency, greenhouse gas abatement management, and new product strategies aimed at reducing climate change. Mr. Livingston joined McKinsey in 1993 and has helped the firm open offices in South Africa (1994-95) and Northeast Asia (1999-2002). His client work at McKinsey focuses on communications companies, but he is also responsible for McKinsey’s recruiting efforts at the Kellogg School of Management at Northwestern University. He is the founder of Partners of Misericordia, a group of young leaders he brought together to support a home for children and young adults with disabilities. He is also the founder of Friends of Evanston Northwestern Healthcare. Mr. Livingston serves on the boards of the Chicago Civic Consulting Alliance, The Chicago Council on Global Affairs, Chicago Museum of Science and Industry, Chicago Symphony Orchestra, and Chicago Entrepreneurial Center. In addition, he is a fellow in the Aspen Institute’s Henry Crown Fellowship Program. Mr. Livingston earned an AB with honors in economics in 1989 from Princeton University as well as an MBA and JD in 1993 from the Kellogg School of Management and Northwestern University School of Law.

Sally Mason
President
The University of Iowa
Sally Mason became the twentieth president of the University of Iowa on August 1, 2007. She holds a full professorship with tenure in the Department of Biology of the College of Liberal Arts and Sciences. President Mason served as provost of Purdue University from 2001 to 2007, where she was instrumental in the development of Purdue’s Discovery Park, an interdisciplinary research incubator focused on such topics as nanotechnology, entrepreneurship, and biosciences. She received her BA in zoology from the University of Kentucky in 1972, her MS from Purdue University in 1974, and her PhD in cellular, molecular, and developmental biology from the University of Arizona in 1978. She joined the University of Kansas in 1981 and in 1995 was appointed dean of the College of Liberal Arts and Sciences.
She has served as president of the Council of Colleges of Arts and Sciences, chair of the advisory committee to the National Science Foundation Directorate for Education and Human Resources, and chair of the executive committee of the National Association of State Universities and Land-Grant Colleges Chief Academic Officers Group. She also served on the executive committee of the Committee on Institutional Cooperation and was appointed to the National Medal of Science Selection Committee from 2006 to 2008.

**John Rowe**  
*M Chairman and Chief Executive Officer*  
*Exelon Corporation*

John W. Rowe is the chairman and chief executive officer of Exelon Corporation, a utility holding company headquartered in Chicago. Mr. Rowe is the senior chief executive in the utility industry, having served in such positions since 1984. Mr. Rowe has led Exelon since its formation in 2000 through the merger of PECO Energy and the parent of Commonwealth Edison. He previously held chief executive officer positions at the New England Electric System and Central Maine Power Company, served as general counsel of Consolidated Rail Corporation, and was a partner in the law firm of Isham, Lincoln and Beale. He is a past chairman and current member of the board of the Nuclear Energy Institute, a past chair of the Edison Electric Institute, and current cochair of the National Commission on Energy Policy, an industry and environmental organization dealing with climate change. Mr. Rowe is a member of the boards of directors of Sunoco and the Northern Trust Company. He serves on the Civic Committee of Chicago’s Commercial Club and is the chairman of the Illinois Institute of Technology. He is a member of the boards of The Chicago Council on Global Affairs, Chicago History Museum, Field Museum, the Wisconsin Alumni Research Foundation, and the Morgridge Institute for Research. Mr. Rowe holds a BA and a JD from the University of Wisconsin and its law school and has also received that university’s Distinguished Alumni award.

**Member Biographic Summaries**

**Bill Abolt**  
*Chicago District Manager*  
*Shaw Environmental & Infrastructure, Inc.*

Bill Abolt is the Chicago district manager for Shaw Environmental & Infrastructure, Inc. Prior to joining Shaw, he served as environment commissioner, director of the Office of Budget and Management, and chief of management, Office of the Mayor, for the City of Chicago. He is also a LEED-accredited professional and an adjunct instructor in public policy and administration at Northwestern University.

**Stephen Brick**  
*Executive Director*  
*International Biochar Initiative*

Stephen Brick is the executive director of the International Biochar Initiative, which supports researchers, commercial entities, policymakers, development agents, farmers, and others committed to supporting sustainable biochar production and utilization systems. From 2005 to 2009 Mr. Brick served as the manager of the environment program for the Joyce Foundation. Previous positions include associate director of research for the Energy Center of Wisconsin, director of environmental affairs for PGE National Energy Group, science and policy director for the Clean Air Task Force, and vice president of MSB Energy Associates.

**Thomas R. Casten**  
*M Chairman*  
*Recycled Energy Development LLC*

Thomas R. Casten is chairman of Recycled Energy Development LLP and also serves on the board of directors/advisory boards of the Carnegie Mellon Electric Industry Center, Oregon Climate Trust, Climate Institute, and the Center for Inquiry. He was founding president and chief executive officer of Trigen Energy Corporation, founding chair and chief executive officer of Primary Energy Ventures LLC, and president of the International District Energy Association. He has testified on several occasions before the energy committees of the U.S. Senate and House of Representatives, and he has advised Indian, Chinese, and Brazilian government officials on power industry governance.
Mark Drabenstott
Director, RUPRI Center for Regional Competitiveness
University of Missouri-Columbia

Mark Drabenstott was named founding director of RUPRI’s national Center for Regional Competitiveness at the University of Missouri-Columbia in September 2006. Prior to that he spent twenty-five years in the Federal Reserve System and led the creation and development of the Center for the Study of Rural America. He is chairman of the OECD’s Territorial Development Policy Committee and the chair of a U.S. Department of Commerce advisory panel that conducted the first major review of federal economic development in forty years. Additionally, he has written more than 150 articles and edited ten books. He has advised the World Bank and been invited to share his policy insights with Congress on numerous occasions.

Patrick C. Eilers
Managing Director
Madison Dearborn Partners LLC

Patrick C. Eilers is a managing director at Madison Dearborn Partners LLC. Prior to joining MDP, Mr. Eilers was with Jordan Industries, Inc. and IAI Venture Capital, Inc. and played professional football with the Chicago Bears, Washington Redskins, and Minnesota Vikings. Mr. Eilers currently serves on the board of directors of Magellan GP, LLC; Magellan Midstream Holdings GP, LLC; UPC Wind Management, LLC; and US Power Generating Company. Mr. Eilers is also a member of the University of Notre Dame College of Engineering Advisory Council and serves on the board of trustees of Hales Franciscan High School and Cristo Rey Jesuit High School.

Mark Gaffney
President
Michigan AFL-CIO

Michigan State AFL-CIO president Mark T. Gaffney represents more than 600,000 Michigan union members as president of the state federation. President Gaffney was first elected to head up the Michigan AFL-CIO in 1999 and was reelected in 2002 and 2007. He is a member of the Industrial Relations Research Association and Michigan Association of Labor/Management Committees. He is also a member of the board of directors for the United Way of Michigan, a cochair of the Economic Alliance of Michigan, a trustee of the Michigan Council on Economic Education, and serves as a board member of Blue Cross/Blue Shield of Michigan. Mr. Gaffney is also on the board of directors of the Federal Reserve Bank of Chicago and is chair of the Michigan State Fair Authority.

Terry A. Goff
Director, Emission Regulations & Conformance Power Systems
Caterpillar Inc.

Terry Goff joined Caterpillar Inc. in 1978 and became its director of emissions regulations and conformance power systems in 2008. Mr. Goff is a member of the United States Environmental Protection Agency’s Mobile Source Technical Review Subcommittee and Clean Diesel & Retrofit Working Group. He is a cochair of the agency’s National Environmental Justice Advisory Committee Goods Movement Working Group. Mr. Goff is chair of the Engine Manufacturers Association Public Policy Group and is active in Caterpillar interaction with the U.S. Climate Action Partnership, Diesel Technology Forum, and other organizations.

Marvin Gottlieb
Vice Chairman, Advisory Board
Association for the Study of Peak Oil & Gas - USA

Marvin Gottlieb is currently vice chairman of the advisory board for the Association for the Study of Peak Oil & Gas - USA, an active member of the Canadian Association of Income Trust Investors, an adviser to the Hiroshima Gateway Peace Project, and president of Howland International. He is also an active member of The Chicago Council on Global Affairs and a founding member of the Chairman’s Circle. In 1965 he founded M. Gottlieb Associates, Inc. (MGA). He has served as a consultant to IBM and an advisor to General Motors, Ford, and Zenith Electronics on global procurement issues.

Henry Henderson
Midwest Director
Natural Resources Defense Council

Henry L. Henderson is director of the Midwest regional office of the Natural Resources Defense Council (NRDC). Mr. Henderson is an environmental attorney and served as founding commissioner for the City of Chicago’s department of environment, director of the Chicago Shoreline Commission, and assistant attorney general for the State of Illinois.
Bob Holden

*Founder, Holden Public Policy Forum, Webster University*
*Former Governor of Missouri*

Governor Holden is chairman of The Holden Group, LLC, where he advises public- and private-sector clients on business development and international trade strategies. As a visiting professor at the Governor Bob Holden Public Policy Forum at Webster University, Governor Holden lectures on public policy and leadership throughout the worldwide Webster campus network. Governor Holden is also serving as a Dole Fellow at the Dole Institute on the campus of the University of Kansas. Governor Holden is vice chairman of the new Midwest U.S.-China Association. From 2001 until 2005 he served as governor of the state of Missouri. Prior to his term as governor, he served two terms as state treasurer.

Scott Klug

*Managing Director, Public Affairs*
*Foley and Lardner LLP*

Scott Klug is the managing director of public affairs at the national law firm of Foley and Lardner. He also cochairs the firm’s client service team. For eight years he represented Madison, Wisconsin, in the U.S. Congress. When he stepped down from office in 1998, Mr. Klug founded a regional magazine and book publishing company, which he sold in 2007. Prior to his election to Congress he was an Emmy award-winning reporter in Washington, D.C., Seattle, and Madison. He serves on the board of directors of McFarland State Bank and T Wall Properties, is a trustee of the German Marshall Fund of the United States, and is a member of the Board of Visitors at Northwestern’s Medill School of Journalism. He was appointed by President Bush to two terms on the President’s Advisory Board on Trade and Policy Negotiations, which provides counsel on trade with China and other issues.

William Luther

*Former Member*
*U.S. House of Representatives*

Before entering politics, Bill Luther served as a judicial clerk for the U.S. Court of Appeals and practiced business law with the Dorsey law firm in Minneapolis. In 1974 he was elected to the Minnesota House and then served in the Minnesota Senate from 1977 to 1994, where his colleagues selected him as the assistant Senate majority leader for more than a decade. In 1994 he was elected to the U.S. Congress, serving as president of the Democratic Class of 1994. In Congress he served as regional Democratic whip and was a founding member of the New Democratic Coalition. Mr. Luther currently splits his time between Minneapolis and Washington, D.C., working on government relations and business matters for a variety of clients.

Francis X. Lyons

*Partner, Environmental, Energy, and Natural Resources Practice*
*Bell, Boyd & Lloyd LLP*

Francis X. Lyons is a partner in the Environmental, Energy, and Natural Resources Practice of Bell, Boyd & Lloyd LLP. Prior to entering private practice, Mr. Lyons was appointed by former President Clinton to serve as the regional administrator of the U.S. Environmental Protection Agency, Region V. Mr. Lyons serves on the boards of directors of the Alliance for the Great Lakes and Chicago's Environmental Fund. He served thirteen years as a commissioned officer in the U.S. Army Reserve Field Artillery. He achieved the rank of captain and was twice awarded the Army Commendation Medal and the Army Achievement Medal.

David Miller

*Director of Research and Commodity Services*
*Iowa Farm Bureau Federation*

David Miller is director of research and commodity services for the Iowa Farm Bureau Federation (IFBF) and the chief science officer for AgracGate Climate Credits Corporation. He serves on the Offset Committee of the Chicago Climate Exchange and serves on the Iowa Climate Change Advisory Council. Mr. Miller joined IFBF in April 1998 as director of commodity services. Previously, he served as a commodity policy specialist for the American Farm Bureau. Mr. Miller is active in production agriculture, operating a 400-acre grain farm in southern Iowa. He also serves on the board of the Extension Section of the American Agricultural Economics Association and is a member of the Southern Agricultural Economics Association and the Western Agricultural Association. He is a member of the board of directors for the National Institute of Animal Agriculture and the Iowa Ag Innovation Center.
Edmund Miller
Director
Legacy Fund
Edmund J. Miller is the director of the Legacy Fund, a private foundation supported by the Crown family of Chicago. Prior to this, Mr. Miller was program director of the Illinois Clean Energy Community Foundation. He also served as the foundation's program officer for individual wind and biomass energy grants. Since 2004 Mr. Miller has been cochair of the Donors Forum of Chicago's Environmental Grantmakers Group. Previously, he served on the board of the Clean Energy States Alliance and worked for the Environment Program at the Charles Stewart Mott Foundation in Flint, Michigan.

Michael H. Moskow
Vice Chairman and Senior Fellow on the Global Economy
The Chicago Council on Global Affairs
Michael H. Moskow served as president and chief executive officer of the Federal Reserve Bank of Chicago from 1994 to 2007. He has been confirmed by the Senate for five government positions, including deputy U.S. trade representative with the rank of ambassador. Prior to joining the Federal Reserve, he was a faculty member at the Kellogg School of Management at Northwestern University. He serves as a director of the Northwestern Memorial Foundation and World Business Chicago. He is a fellow of the National Academy of Public Administration and a board member and former chairman of the National Bureau of Economic Research. In addition to being a trustee of Lafayette College, Mr. Moskow is a member of the advisory board of the Kellogg School of Management at Northwestern University. Since leaving his position at the Federal Reserve, Mr. Moskow joined the boards of directors of Discover Financial Services, Commonwealth Edison, Northern Funds, Diamond Management & Technology Consultants, and Taylor Capital Group.

Clay G. Nesler
Vice President, Global Energy and Sustainability
Johnson Controls, Inc.
Clay Nesler is vice president for global energy and sustainability for the building efficiency business of Johnson Controls. He also serves on the company’s Global Environmental Sustainability Council. Since joining Johnson Controls in 1983, Mr. Nesler has held a variety of leadership positions in research, new product development, marketing, and strategy in both the United States and Europe. Mr. Nesler has served on the Wisconsin Governor’s Task Force on Global Warming, the Energy Efficiency Forum Executive Council, the Leadership Group of the National Action Plan for Energy Efficiency, and the Climate Registry Advisory Committee.

Michael Noble
Executive Director
Fresh Energy
Michael Noble has served as executive director of three nongovernmental organizations (NGOs) dating back to 1982 and is a key civil society leader on energy and environmental policy in the upper Midwest. He now directs the public policy organization Fresh Energy. In addition, Mr. Noble has played key roles in the Midwest network of global warming NGOs (REAMP), including serving on its steering committee and Global Warming Strategic Action Fund and chairing its Clean Energy Working Group.

Richard L. Sandor
Chairman and Chief Executive Officer
Chicago Climate Exchange
Richard L. Sandor is chairman and chief executive officer of the Chicago Climate Exchange. Dr. Sandor is also a research professor at the Kellogg School of Management at Northwestern University and a member of the International Advisory Council of Guanghua School of Management at Peking University. He is currently a director of ICE Futures, American Electric Power, Bear Stearns Financial Products Inc., and Bear Stearns Trading Risk Management Inc. He is also a member of the design committee of the Dow Jones Sustainability Index. Prior to the creation of the Chicago Climate Exchange, Dr. Sandor was a senior financial markets executive with Kidder Peabody, Banque Indosuez, and Drexel Burnham Lambert.

Louis Schorsch
Chief Executive Officer, Flat Products, Americas
ArcelorMittal USA
Louis L. Schorsch is executive vice president at ArcelorMittal and chief executive officer of the company’s Flat Carbon Americas business unit, with responsibility for the company's flat-rolled facilities in Canada, the United States, Mexico, and Brazil. Previously, Mr. Schorsch was chief executive officer of Mittal Steel USA, the U.S. subsidiary of Mittal Steel Co. He had been president and chief executive officer of Ispat Inland Inc., a predecessor company, since October 2003.
Samuel C. Scott  
Retired Chairman, President, and Chief Executive Officer  
Corn Products International, Inc.

Samuel C. Scott is the recently retired chairman, president, and chief executive officer of Corn Products International, Inc. Mr. Scott serves on the board of Motorola, Inc., where he is lead director and chairman of the compensation and leadership committee. He also serves on the board of directors of the Bank of New York, Abbott Laboratories, and the Chicago Urban League. In addition, he sits on the boards of ACCION International, the Executives’ Club of Chicago, and The Chicago Council on Global Affairs. He is a trustee of the Conference Board.

Adele Simmons  
Vice Chair and Senior Executive  
Chicago Metropolis 2020

Adele Simmons is currently vice chair of Chicago Metropolis 2020, where she is leading the planning for the centennial of the completion of Daniel Burnham and Edward Bennett’s Plan for Chicago. She is also president of the Global Philanthropy Partnership. She is cochair of a task force that is developing a Climate Action Plan for the City of Chicago. Mrs. Simmons was president of the John D. and Catherine T. MacArthur Foundation between 1989 and 1999. Mrs. Simmons is currently on the board of The Chicago Council on Global Affairs, Synergos Institute, the Environmental Defense Fund, the Union of Concerned Scientists, American Prospect, Winning Workplaces, the National Mexican Museum, and the Field Museum. She is on the advisory committee to the World Bank Institute. She is a founder of Global Chicago and the Chicago Global Donors Network.

Lou Anna K. Simon  
President  
Michigan State University

Lou Anna K. Simon was appointed the twentieth president of Michigan State University in 2005. Simon served as provost and vice president for academic affairs from 1993 to 2004, acting as interim president in 2003. Ms. Simon is a member of the Council on Competitiveness and serves on the board of directors for the National Association of State Universities and Land-Grant Colleges, the American Council on Education, and the Association of American Colleges and Universities. In addition, she serves on the National Higher Education Security Advisory Board, is a member of the Michigan Strategic Economic Investment and Commercialization Board, the board of directors of Detroit Renaissance, and a board member of mid-Michigan’s economic development foundation, Prima Civitas. She is a member of the American Council on Education Commission on International Initiatives and the Partnership to Cut Hunger in Africa Executive Committee.

John Stowell  
Vice President, Environmental, Health, and Safety Policy  
Duke Energy

John Stowell has been the vice president of environmental, health, and safety policy for Duke Energy since April 2006. Previously, Stowell was vice president of federal legislative affairs, environmental strategy, and sustainability for Cinergy. He is a member of the external advisory board of the University of Michigan Graham Environmental Sustainability Institute and the Green Partnership for Greater Cincinnati.

Richard Stuebi  
BP Fellow for Energy and Environmental Advancement  
The Cleveland Foundation

Mr. Stuebi is currently the BP Fellow for Energy and Environmental Advancement at the Cleveland Foundation. Mr. Stuebi is on loan to the Cleveland Foundation from NextWave Energy, which he founded in 1999. Previously, Mr. Stuebi was senior vice president at Louis Dreyfus and was a management consultant for more than six years at McKinsey & Company. Mr. Stuebi is a member of the advisory board for Braemar Energy Ventures, a leading venture capital firm based in New York City, focusing on commercializing new energy technology opportunities. He also contributes weekly on www.cleantechblog.com.

William Testa  
Vice President and Economic Advisor  
Federal Reserve Bank of Chicago

Bill Testa is vice president and director of regional programs in the economic research department at the Federal Reserve Bank of Chicago. Mr. Testa directed a comprehensive, long-term study and forecast of the Midwest economy, Assessing the Midwest Economy: Looking Back for the Future, and has fashioned a series of conferences on school reform. He currently serves as economics editor of the Chicago Fed Letter and on the editorial board of Economic Development Quarterly.
His weekly “Midwest Economy” Web column, which can be found on the Federal Reserve Bank’s Web site, has become a widely read and nationally quoted feature. Mr. Testa also chairs the board of trustees of the Illinois Council on Economic Education and serves on the boards of the Global Chicago Center of The Chicago Council on Global Affairs and the Economic Development Council of Chicago. He currently lectures at DePaul University’s College of Commerce.

Wallace E. Tyner
Professor of Agricultural Economics
Purdue University

Professor Tyner is with the Department of Agricultural Economics at Purdue University. Professor Tyner’s research interests are in the areas of energy, agriculture, and natural resource policy analysis as well as structural and sectoral adjustment in developing economies. He has more than 100 publications in these areas, including three books and more than fifty refereed papers and abstracts. His current research focuses on renewable energy policy issues. He teaches a graduate course in benefit-cost analysis, which incorporates risk into the economic and financial analysis of investment projects.

John J. Viera
Director of Sustainable Business Strategies
Ford Motor Company

John Viera was appointed director of Sustainable Business Strategies for Ford Motor Company in January 2007. Mr. Viera is responsible for developing global sustainable business plans and policies, reporting externally on the company’s environmental and social performance, and leading the company’s engagement and partnerships with nongovernmental organizations (NGOs) and other stakeholders. During his twenty-four-year tenure with Ford, he has worked in the company’s truck division, led efforts in the development of natural gas-fueled pickup trucks, served as chief engineer for the Ranger compact pickup and Electric Ranger as well as the Expedition and Navigator full-size SUVs. Mr. Viera is an active member of the Product Development arm of the Ford African Ancestry Network (FAAN), with a focus on mentoring, counseling, and speaking.

Martin B. Zimmerman
Ford Motor Company Clinical Professor of Business Administration, Ross School of Business
University of Michigan

Dr. Martin B. Zimmerman is Ford Motor Company Clinical Professor of Business Administration at the Ross School of Business of the University of Michigan. He retired in 2004 from the Ford Motor Company as chief economist and group vice president, corporate affairs. He serves on the board of trustees of the National Commission on Energy Policy and the board of the National Bureau of Economic Research.
Task Force Session Speakers

*Task Force member

**Session I: The National Policy Landscape**

**Richard D. Morgenstern**  
Senior Fellow  
Resources for the Future

**William Testa***  
Vice President and Economic Advisor  
Federal Reserve Bank of Chicago

**Session II: Midwest Implications of Alternative Options of Abatement and Energy Usage**

**Judson Jaffe**  
Vice President  
Analysis Group

**Shelley Keller**  
Vice President, Strategic Initiatives  
Exelon Corporation

**Donnan Steele**  
Engagement Manager  
McKinsey & Company

**Session III: Innovation, Investment, and Opportunities for Midwestern Regional Cooperation**

**Laurence Alexander**  
Managing Director  
Jefferies & Company, Inc.

**Jesse Heier**  
Director, Washington Office  
Midwestern Governors Association

**Paul Hunt**  
Associate Vice President for Research  
Michigan State University

**Session IV: Discussion of Working Group Recommendations & Review of Draft Outline of Report**

**Jon Creyts**  
Principal  
McKinsey & Company

**Robert Frei**  
Partner  
McKinsey & Company

**Shelley Keller**  
Vice President, Strategic Initiatives  
Exelon Corporation