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# GETTING PREPARED

## Economic Development in a Transforming Energy Economy



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## DEFINITIONS

**Greenhouse Gases (GHG's):** Atmospheric gases that contribute to the greenhouse effect by trapping heat in the atmosphere. Major greenhouse gases include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

**Watt:** A unit of power in the International System of Units which measures the rate of energy conversion. One watt is equal to one joule per second.

**Kilowatt (kw):** A unit of power equal to 1,000 watts.

**Megawatt (mw):** A unit of power equal to 1,000 kilowatts.

**Gigawatt (gw):** A unit of power equal to 1,000 megawatts.

**British Thermal Unit (BTU):** A unit of energy used in the power and heating and cooling industries.

**MBTU:** A unit of energy equal to 1,000,000 BTU.

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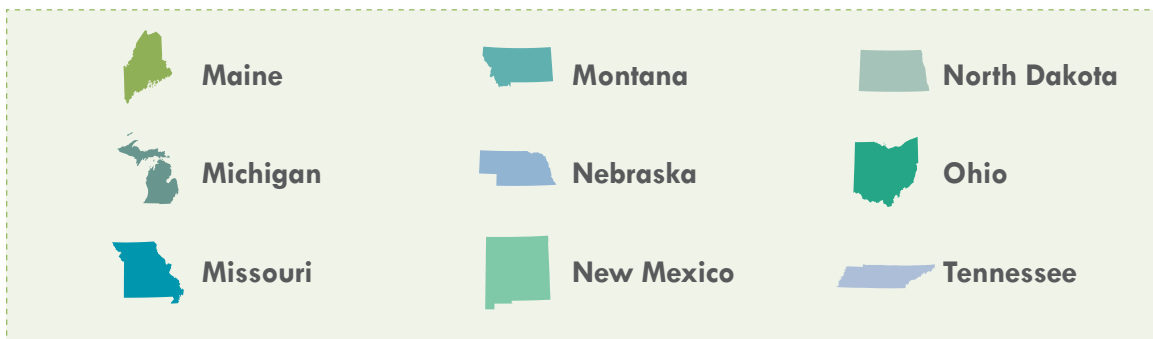
# GETTING PREPARED

## Economic Development in a Transforming Energy Economy

Now more than ever, economic development has to adapt to a volatile energy market and policies that are emerging to shape that market, a process that holds both opportunities and challenges. While the specifics of the transition to a low-carbon economy are still being deliberated both nationally and internationally, it appears likely that some type of cap and trade or carbon pricing will emerge. A price on carbon will hold significant implications for U.S industries, regions and the nation as a whole. This document is intended to help economic developers and those in related fields think about how they can prepare and position their local economies to benefit from such a transition.

To understand how states are preparing for this changing policy paradigm, IEDC convened a group of state economic development leaders in the fall of 2009. The meeting was intended to explore the opportunities and challenges presented by a regional or economy-wide move toward carbon pricing. The states represented diverse geographies and economic circumstances.

Following the meeting, IEDC engaged in case study research on each of the states, plus others, to better understand how they are transitioning to the low-carbon economy and working to reduce their greenhouse gas (GHG) emissions. This report includes case studies on the following nine states:



## **Purpose of the Report**

A carbon cap and trade system, on the federal policy agenda over the past nine months, has been viewed as a grave concern by some and a budding opportunity by others. Given this, IEDC wanted to better understand:

- What cap and trade is;
- What opportunities and challenges it could present to economic development; and
- How current economic development efforts are preparing states for the potential opportunities and pitfalls that could stem from carbon pricing on the national level.

### ***Defining the Clean Tech Industry***

Throughout this report we refer to the clean energy industry. For the purposes of this report, this includes businesses developing, supplying, generating, or storing energy, in areas such as: renewable energy sources, nonrenewable energy technologies (e.g. carbon capture and sequestration), efficiency technologies, and advanced energy storage technologies (e.g. batteries).

Preceding this study, IEDC published “What Is Carbon Cap and Trade? A primer for economic developers,” in the fall of 2009. The document outlines how a carbon cap and trade system functions, how cap and trade systems are working in other parts of the world, and how the challenges and opportunities of a cap and trade system might impact economic development activities.



## **WHAT IS DRIVING THE MOVEMENT TOWARDS CARBON PRICING?**

Spurred by the desire for greater energy security, climate change mitigation, long-term energy affordability, and the transition to a clean energy economy, we are starting to see the federal government, Congress, the international community and the global business community move toward putting a price on carbon. Outlined below are the primary factors energizing this shift.

### **Changing Policy Environment**

In December of 2009, the United Nations Framework Convention on Climate Change took place in Copenhagen, Denmark, bringing together key nations with the goal of reaching an agreement to replace the expiring Kyoto Protocol. While the conference did not achieve a binding agreement for long-term action, a ‘political accord’ was negotiated by approximately 25 countries, including the U.S. and China. Notable within the accord was an agreement among developed countries to commit U.S. \$30 billion in new resources toward reducing carbon over the next 3 years, and \$100 billion by 2020.

Nationally, after the American Clean Energy and Security Act passed the House in June of 2009, comprehensive legislation addressing clean energy stalled in the Senate. Senators Barbara Boxer and John Kerry released the Clean Energy and American Power Act in September 2009; however, it did not garner enough political support to move forward. More recently, Senator Kerry has worked with Senators Lindsey Graham and Joe Lieberman to craft a bipartisan bill that includes provisions that are favorable to traditional energy industries, such as an expansion of offshore oil drilling, in addition to placing a price on carbon. Political wrangling and the uncertainty emanating from the recent oil spill in the Gulf of Mexico are repositioning political support for the current bill. Thus, the outcome of national U.S. politics on this issue remains uncertain.

While the Congress remains in flux on the issue of GHG mitigation, federal agencies are moving forward. In 2009, the Environmental Protection Agency determined that carbon is a pollutant, thus giving them more power to regulate its emission. In addition, the Securities and Exchange Commission has mandated that companies disclose their carbon usage and risk. The carbon disclosure guidance areas include the impacts of legislation and regulation; the impact

of international accords; the indirect consequences of regulation or business trends; and the physical impacts of climate change. Moreover, the American Reinvestment and Recovery Act and the President's 2010 and proposed 2011 budgets prioritize investment in clean energy research, greater energy efficiency and the promotion of green jobs.

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### **Sub National Activity Focused on Climate Change Mitigation**

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While national and global agreements are still being formulated, much activity focused on reducing carbon and incenting the emergence of cleaner energy and greater energy efficiency is taking place at the regional, state and local levels. Cap and trade programs are in place at the regional level, such as the Regional Greenhouse Gas Initiative, the Western Climate Initiative, and the Midwest Greenhouse Gas Accord. State and local governments have become laboratories of innovation, leading the charge in this area.

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### **Global Business Community Forging Ahead**

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The global business community also has been moving rapidly to position itself at the forefront of green and clean energy investments. According to McKinsey Quarterly, the \$45 billion private-equity purchase of the energy utility TXU hinged on the insistence of the buyer that TXU reduce its plan to build several new coal-powered plants, and instead make investments in clean coal, energy efficiency and renewable energy.<sup>1</sup> Further, we now see numerous large corporations forming coalitions to create a business-led response to climate change. Consortia of major businesses – such as Business for Innovative Climate and Energy Policy (BICEP), which includes such corporations as Starbucks, Sun Microsystems, Levi Strauss, Nike and Timberland; and the United States Climate Action Partnership (USCAP), which includes members such as Alcoa, John Deere, Duke Energy, and Dow Chemical Company – function under the belief that a proactive business response to climate change will create more economic opportunities than risks for the U.S. economy.

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### **Changing Economic Competitiveness**

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Volatile energy prices are changing the location and competitiveness factors of businesses, and thus of communities. In some cases, businesses are returning to the U.S. to be closer to consumer markets or inputs to product development. Other corporations are relocating overseas for the same reasons.

Additionally, there is an overall sense that the U.S. is falling behind other countries in the energy market, which is projected to be one of the largest growth areas in the world – especially as the BRIC countries (Brazil, Russia, India and China), which are huge in both land mass and population, start demanding more and more energy to fuel growth. Further, the current policy gridlock on energy and carbon emissions provides mixed signals to the market, inhibiting investments in energy of all types.

Lastly, investment in clean tech sectors is growing globally. How those sectors develop and what policies steer their evolution can influence where jobs grow and the quality of those jobs. Understanding these changes and tapping into them is one of the reasons for this research.

It is clear that changes are on the horizon, and it is most visible in the current Federal policy arena. The implementation of a cap and trade or some type of carbon pricing would create opportunities and challenges for local economies. Opportunities include: 1) the establishment of a transparent price on carbon, enabling energy investments, which have slowed for both traditional and renewable sources, due to the current uncertain and dynamic policy and market environment; 2) new resources through carbon offsets, allowances and overall increased public and private funding in this realm; 3) emerging markets for new energy sources, energy efficient technologies, etc; 4) emerging new industries that can create new jobs, diversify local economies, and new economic opportunities; 5) opportunities to reposition struggling industries such as manufacturing to access new opportunities (e.g. wind turbine production) and 6) stimulating innovation by creating new demands and providing resources for research and development.

The challenges that communities face include: 1) higher energy prices; 2) transition costs for firms that have to adapt to carbon pricing through emission reductions, investing in energy efficient technologies or adapting to higher energy costs; 3) variation in dependence upon energy intensive industries, requiring greater transition costs and job losses in some places; 4) transitioning the workforce to access jobs in new industries; and 5) leakage whereby some economic activity moves to countries with laxer policies.

The ability for states and communities to position their economies to benefit from these changes depends to a certain extent to how they prepare for them. As our research shows,

states have already started down this path. In what follows, we offer a framework for preparedness. The strategies that states are using look to both tap into the emerging opportunities that this changing policy and market environment present, but also have started to assist with the transitions which also will occur.

## **WHAT IS PREPAREDNESS?**

Regardless of personal beliefs regarding global warming and the GHG mitigation debate, trends are pointing toward a future in which low-carbon economies will be rewarded. Changes to energy cost, delivery and availability are certain, whether those changes result from increased global demand, geopolitical forces and volatile prices, or whether carbon pricing is implemented on a national level. With this change as the only certainty, how states and localities prepare for this paradigm will impact their future opportunities and challenges. Preparedness in the face of a shifting global energy market and increasing pressures to reduce GHG emissions is essential for capitalizing on an economy's assets, while buffering and bolstering its weaknesses. In the transition to a low-carbon economy, the following elements contribute to preparedness.

### **Implementing Energy Efficiency Measures throughout the Economy**

Policies that encourage energy efficiency on the part of government, institutions and firms will lead to consumers to lower energy costs, which will act as a net return to the economy. According to the McKinsey Global Institute, implementing energy efficiency activities will abate a significant proportion of carbon emissions and provide positive economic returns through energy cost savings.<sup>2</sup> This is the “low hanging fruit” that many governments and firms have already begun to reap.

### **Strengthening the Demand for Cleaner Sources of Energy and Energy Efficiency**

Demand-side policies that encourage the purchase and use of clean sources of energy, as well as energy-efficient products, will help end users afford to make the shift.

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## Developing Clean Energy Options

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As demand for low-carbon solutions grows, this will lead to the emergence of new energy options, and new value chains that disrupt existing industries and create new ones.<sup>3</sup> As a result, we are witnessing investment opportunities increase globally, new businesses being created, and the emergence of entrepreneurial leaders in these industries. We also are seeing the emergence of new markets for traditional industries, such as the transition of manufacturers from making products such as automobile parts to fabricating wind turbine components.

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## Tapping Into and Strengthening Existing Resources

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Each state and region has different assets and vulnerabilities in the face of shifting energy markets and potential carbon pricing. These will be determined by a state's existing industry mix, their dependence on low energy prices, and the degree to which their industry base is integrated into the global economy. States that will be better prepared to manage this shifting market are acting in the following three areas:

***Helping existing businesses meet new demands (e.g. energy efficiency, utilities):*** While large corporations can do this on their own, and many are, small businesses are still struggling to adapt. As they are the drivers of the U.S. economy, aiding their transition to changing energy costs and greater energy efficiency is imperative.

***Targeting industries with potential to prosper under these conditions (e.g. manufacturing):*** While manufacturing has been declining in the U.S. for over 20 years, there is still a significant manufacturing base present in many states. These assets can be retooled into emerging areas that would be favored in a low-carbon economy – building wind and solar facilities, for example, requires significant manufacturing inputs.

***Training workers for new opportunities:*** Many workers in traditional fields such as manufacturing have skills parallel to those required for clean tech manufacturing, but retraining will be required. Moreover, in face of a carbon price, job losses will likely occur in some industries such as coal mining, oil and gas extraction and petroleum refining, requiring retraining for new opportunities.<sup>4</sup> Finally, the need for clean tech may reignite interest in nuclear energy, which faces a significant skilled worker shortage. Consequently, many states and regions are implementing training systems and degree programs that complement their targeted clean tech sectors.

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## **Developing New Resources, New Partnerships, and New Ways of Working to Accomplish All of the Above.**

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Preparedness demands new partnerships across government agencies and with the private and community sectors in order to accomplish the complex tasks required to shift to a low-carbon economy.

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## **A FRAMEWORK OF PREPAREDNESS**

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In this report are nine case studies that highlight the assets in each state (**Maine, Michigan, Missouri, Montana, Nebraska, New Mexico, North Dakota, Ohio, Tennessee**), along with a profile of their energy economy and their preparations for a low-carbon economy. Specifically, it examines energy generation in each state; the nature of each state's industry mix, particularly the importance of energy-intensive industries in that mix; and the policies each state has undertaken to reduce GHG emissions, promote clean technology, and transition its industries and workers in face of energy policy and market changes.

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## **The Energy Economy Snapshot**

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The energy economy snapshot looks at the energy generated in each state to assess its dependence on cheaper, fossil fuel-driven energy generation, and the degree to which cleaner energy options are emerging. This snapshot suggests areas of vulnerability – particularly if a state is highly dependent on low energy prices – as well as areas of opportunity, such as the ability to export cleaner energy sources.

The snapshot also provides an overview of each state's major industries and the percentage of its employment and GDP that is composed of energy-intensive industries. Energy-intensive industries are those highly dependent on energy and thus highly sensitive to energy prices; heavy emitters (e.g., some manufacturing); or both. This vulnerability is enhanced when the industry or sub-industry trades in a global market, driven by price competition, thus with little margin to absorb increased energy costs. These industries also face the prospect of “carbon leakage,” whereby companies move their production or buy from producers in countries with looser laws governing carbon emissions. For this study, we define energy-intensive industries to include agriculture, mining, utilities, construction, and manufacturing.<sup>5</sup>

These energy economy snapshots suggest how each state stands in light of an emerging policy environment of which carbon pricing or cap and trade is part, and helps to determine a state's assets and opportunities as well as its dependence on non-renewables. It also helps to provide a deeper picture of how the state's economic base might be affected by the need to reduce GHG emissions.

### ***Identifying Vulnerabilities within Energy- Intensive Industries***

While unprecedented opportunities will come from the switch to a lower-carbon economy, transition pains and significant investments will, without a doubt, be required to make it happen. Energy-intensive industries and the communities that host them will feel the pinch as they adapt to a changing energy environment. Some of the vulnerabilities inherent to energy-intensive industries are listed below.

- **Mining and Extractive Industries:** According to the Congressional Budget Office, coal mining would be one of industries heaviest hit by a carbon price, because it is the highest GHG emitter per unit of energy. However, carbon capture and sequestration technologies may reenergize and redefine the industry, thus possibly mitigating these impacts. Other mining, for materials such as metals and chemical inputs, will also be impacted because of the energy expended in the process, but that decline is predicted to be small.

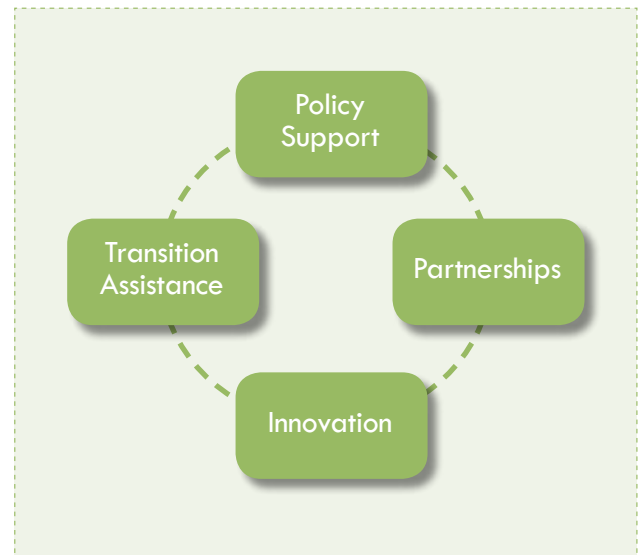
Similarly, oil and gas extraction will see demand decline as prices increase and other, cleaner options enter the marketplace; thus, job losses may occur. However, as oil is traded in the global marketplace, some of these impacts may be mitigated by increasing demand from other countries. Finally, the impacts on natural gas are mixed. On one hand, overall energy price increases may reduce demand, as natural gas emits more GHGs than renewables; but as gas currently has lower emissions than coal, it may pick up some of that market.<sup>6</sup>

- **Agriculture:** For this industry, the economic challenge emerges from increased energy costs. This challenge may be mitigated by new opportunities and additional resources that directly benefit agriculture, such as land rent from wind turbines, new and growing markets for biomass products, and income from land management offset projects.

- **Utilities:** Utilities will be challenged to manage their costs without relying heavily on the ability to pass cost increases to consumers.
- **Construction and Manufacturing:** Both of these sectors represent a mix of vulnerabilities and opportunities. On one hand, both are vulnerable to increased energy costs, especially within their supply chains; higher costs will lead to reduced demand, and thus the potential for job loss and firm closure. However, carbon pricing may also reenergize these industries and create growth opportunities for emerging subsectors that complement the growth of energy efficiency and clean tech sectors. For example, glass manufacturers are finding new opportunities in solar panel manufacturing, and insulation manufacturers and installers are responding to demands for greater energy efficiency. Equally important, investments in energy efficiency and other transition support measures can help mitigate the challenges and better enable these industries to tap into the opportunities from a growing cleaner energy market.

### Preparing for the Low-Carbon Economy

Across the majority of states examined for this report, we found a significant amount of GHG mitigation activity, much of which is linked to economic development or is in the process of developing such linkages. Policies such as renewable energy standards, state and local energy efficiency strategies, new building codes, as well as clean tech development and deployment have tremendous implications for economic development. While some policies stand alone, others are part of a set of complementary policies that are capable of transitioning economies over the long term.



If national and local economies are to maintain and increase competitiveness, reduction of GHGs must be understood as beneficial to the future health of the economy, not just the environment. Almost all states are now taking steps toward changing their energy profiles and



incorporating sustainability into their economies. As such, the case studies examine not only what each state is doing to mitigate GHGs but also how they are using those mitigation efforts as economic drivers. The challenge of transitioning will be to employ and connect all of these pieces in a synergistic way. Despite their diversity of assets and differences, all of the states indicated some movement toward greater preparedness. That preparedness emerged in four areas detailed below: policy drivers; investments in innovation; transition assistance, and new partnership development.

### ***Policy Drivers: leadership and financial stimulus***

In all states, we saw the development of policy initiatives and financial incentives that aimed to catalyze clean energy development and energy efficiency by stimulating demand and supply. In many cases, the state would lead by example, such as with energy-efficiency commitments. In Montana, for example, the state designed the State Building Energy Conservation Bond program to finance energy improvement projects on state owned buildings. Similarly, North Dakota offers the State Facility Energy Improvement Program which also uses state bonding to finance energy efficiency in state agencies and institutions.

Equally important but evident only in some states were efforts to address the development of the electricity grid, and its ability to absorb and deliver new forms of energy developed in diverse locations. For example, New Mexico created the Renewable Energy Transmission Authority to develop new transmission projects to enable renewable energy to get to the market. In Nebraska, as another example, Recovery Act funding is being used to implement smart grid technologies in two power districts.

The biggest policy driver is the adoption of renewable portfolio standards (RPS), which are now legislated in 30 states and account for more than half of the electricity sales in the United States. These targets allow private industry to adjust and adapt to a regulatory framework by providing stability for alternative energy investment. Without a regulatory guide with reasonable benchmarks, the private sector will not invest in alternative energy technologies. In addition, states are employing both supply- and demand-side incentives, such as tax rebates to clean tech energy suppliers, revolving loan funds for firms to transition to more energy-efficient practices, and rebate programs for consumers to purchase energy-efficient products.

Further, regional-level carbon pricing policies and programs are moving forward, the most notable of which is the Regional Greenhouse Gas Initiative (RGGI), of which one of the case study states in this report, Maine, is a participant. RGGI, a mandatory cap and trade program addressing carbon dioxide emissions from power plants, is the first such program in the United States. The goal is to reduce CO<sub>2</sub> emissions from the power sector 10 percent by 2018. The RGGI encourages power producers in ten northeastern states (representing over 50 million people) to cut greenhouse gas pollution by requiring them to buy allowances, which decrease annually, to offset their emissions. States sell emission allowances through auctions and invest proceeds in consumer benefits such as energy efficiency, renewable energy, and other clean energy technologies.

RGGI has already made progress in financing and expanding energy efficiency programs in participating states and in generating revenue. The RGGI stipulates that states may allocate their auction revenue freely, as long as at least 25 percent is used for consumer benefit or strategic energy purposes. However, most states have gone far beyond the 25 percent requirement, placing a much higher percentage of revenue toward these objectives. As of spring 2009, 71 percent of the revenue has been used for clean energy initiatives.

RGGI is not the only regional carbon reduction initiative. New Mexico and Montana, two case studies covered, are part of the Western Climate Initiative (WCI), a collaborative effort of Western U.S. states and two Canadian provinces to reduce greenhouse gas emissions, and includes a regional cap and trade program. Michigan is a member and Ohio is an observer in the Midwestern Regional Greenhouse Gas Reduction Accord (MGGA), which looks to establish GHG reduction goals and timelines that are consistent with each state's goals.

In addition to these burgeoning regional policy initiatives, the case studies display a range of state policy activity to reduce GHG emissions and invest in solutions that stimulate economic growth. Common across the states are incentives to stimulate the production of and demand for cleaner energy options. Missouri for example offers the Linked Deposit program which offers low-interest loan programs to cover operational costs for any Missouri-based firm producing or selling power that is not generated by fossil fuels. Missouri also created the Biodiesel Producer Incentive fund to support biodiesel production. As another example, Nebraska offers a Renewable energy tax credit for electricity generated at a new zero-emission facility that is

powered by wind, moving water, solar, geothermal, fuel cells, methane or photovoltaics and the Rural Community-based Energy Development Act Wind Legislation to support the development of community wind energy. Tennessee offers the Small Business Energy Loan Program which offers low-interest loans, to a maximum of \$300,000 to Tennessee-based businesses to increase energy efficiency in buildings, plants or manufacturing processes.

### ***Transition Assistance***

Helping businesses retool to reduce energy use and emissions, as well as to find new opportunities in a shifting global marketplace, is a critical state activity. These efforts also include supportive mechanisms to help the workforce prepare and retrain for new and emerging industries. While large companies are largely leading this pathway, assistance is especially important for small and medium-sized businesses, as they drive job creation but also often compete at the economic margins, with insufficient resources to make transition investments (e.g. workforce training, energy-efficient heating and lighting systems, etc.).

In all cases, we saw a variety of initiatives to promote the transition of industries and workers. In Michigan, for example, the Michigan Economic Development Corporation, working with NEXTEnergy and a consortium of non-profits, suppliers, and government agencies, are linking component manufacturing to opportunities in alternative energy supply chains, especially wind energy. In Ohio, the Department of Development partnered with the Edison Materials Technology Center Alternative Energy Technology Group to build up the fuel cell supply chain. Similarly, the Missouri Partnership is working with the Missouri Department of Economic development and the Missouri Department of Natural resources to develop clean energy supply chains.

In New Mexico, the Mesalands Community College established the North American Wind Research and Training Center to deliver training for operations, maintenance and management of wind farms. Similarly, Lake Region State College in North Dakota worked with the wind industry to develop certificate and degree programs for Wind Turbine Technicians.

### ***Investing in Innovation***

New technologies and innovation are critical for the economy to transition. Innovations can help reduce prices for cleaner fuels; enable high emitters to better control or capture emissions; increase the overall efficient use of energy; and better store energy for later or longer use. Currently, many states are investing in innovation through pilot projects and through research and development in alternative energies to reduce their costs, and helping high-emitting industries and firms adapt to this new economic environment. In each state, we see very different types of investments and pilots across a range of issues.

Across the case studies, we see the states aggressively supporting innovation in existing assets to meet GHG reduction goals while stimulating new economic opportunities. Ohio's Third Frontier Program, for example, is a 10 year \$1.6 billion research and development funding program that is supporting innovation in alternative energy industries such as fuel cells and photovoltaics among others. In Tennessee, the University of Tennessee is partnering with DuPont to build a pilot plant and process development center to push innovation in biofuels. In North Dakota, the state is an active member of the Plains CO<sub>2</sub> Reduction partnership, a collaboration of 80 U.S. and Canadian stakeholders, investing in innovations in carbon capture and sequestration. Similarly, research activities within the University of Nebraska system includes the potential of dryland and irrigated cropping system for carbon sequestration and solar energy production. In Missouri, the Donald Danforth Plant Science Center is focusing its research efforts on the potential of algae for biomass development and the commercialization for biodiesel. In Maine, the Advanced Structures and Composites Center at the University of Maine has received \$15 million from the Department of Energy to test and evaluate floating platform designs for offshore wind farms.

### ***Partnerships***

States are not going it alone but are relying more and more on unique partnerships – both across state agencies and among businesses, governments, and non-profits – as part of the transition to a lower-carbon economy. This demands that agencies that may never have had reason to collaborate before learn how to do so, and in ways that may require a fundamental reorganization of responsibilities.

One of the premier examples of this approach is Michigan’s merger of its former state departments of labor, economic growth and energy into one combined department, the Department of Energy, Labor, and Economic Growth (DELEG) – a clear sign that the state recognized the importance of alternative and renewable energy technology to its economy.

Further, instances of multi-jurisdictional cooperation are taking place in some states, as issues of energy almost always cross jurisdictional borders. Whether the aim is to export energy or to coordinate a statewide energy planning effort, support between multiple levels and jurisdictions of government is becoming an increasingly critical success factor. In Montana, the Department of Commerce is partnering with local economic development organizations to use the Job and Economic Development Impact Model, developed by the Department of Energy’s National Renewable Energy Laboratory, to understand the economic impacts of developing and then deploying wind power plants, particularly their job and tax development implications. The purpose is to provide local economic development organizations with practical data to help the community understand the economic potential for such projects.

Partnerships with the private sector also emerge in the case studies. In Tennessee, for example, the state is building a partnership with Nissan and the Tennessee Valley Authority to develop electric cars and electric charging capacity.

What follows in the rest of this report are focused case studies, showing how various states are managing a variety of economic challenges with different resources and assets.

#### ENDNOTES

1 Nick Hoffman and James Twining, “Profiting from the low carbon economy,” McKinsey Quarterly, August 2009, [http://www.mckinseyquarterly.com/Profiting\\_from\\_the\\_low\\_carbon\\_economy\\_2412](http://www.mckinseyquarterly.com/Profiting_from_the_low_carbon_economy_2412) (Accessed September 3, 2009).

2 McKinsey Global Institute, “The Carbon Productivity Challenge: curbing climate change and sustaining economic growth,” (June 2008).

3 Per-Anders Enkvist, Tomas Naucler, and Jens Riese, “What countries can do about cutting carbon emissions,” The McKinsey Quarterly, no. 2 (2008), 38.

4 Congressional Budget Office, “How Policies to Reduce Greenhouse Gas Emissions Could Affect Employment” (May 5, 2010).

5 Not all subsectors within each of these broad industry sectors are energy intensive. But for the purpose of comparison and data availability, we use these broad categories for our analysis.

6 Op. cit.



## Diversification Through Research and Innovation

Tennessee sits at an interesting crossroads between the traditional energy economy and a newer, low-carbon economy. Tennessee is making progress to leverage the research and innovation capacity already present in the state especially in the fields of energy efficiency, biofuels and solar energy. The state is also pursuing a diverse portfolio of renewable energy companies, in areas such as solar, electric vehicles, and biofuels.

The federally administered Tennessee Valley Authority (TVA), a public power company and regional economic development agency, owns virtually all of the state's electricity generation assets. Tennessee does not currently have a renewable portfolio standard; TVA is federally chartered and thus cannot follow state mandates. TVA currently generates 60 percent of its wholesale power via fossil fuels. Because TVA is the nation's largest public power company, serving 9 million people, it is thought to be an excellent test case for the adoption of cleaner energy. Thus far, TVA's current renewable energy portfolio includes 3,889 megawatts from hydro, wind, solar and methane sources in the Valley.<sup>1</sup>

The Governor's Task Force on Energy Policy, a 16-member panel of clean energy business, government, science and conservation leaders, has developed key goals to drive forward the state's competitiveness in the energy arena. Their goals included identifying opportunities for state government to lead by example; prospective policies to encourage energy efficiency and conservation; possible public-private partnerships encouraging research and development; and strategies for expanding the use of alternative fuels and renewable energy.

Further, in 2009, Governor Bredesen signed into law the Tennessee Clean Energy Future Act. The law includes financial commitments to new solar energy and electric vehicle initiatives; requires the state government to lead by example in managing its buildings and vehicle fleet; makes the clean-energy technology sector eligible for Tennessee's emerging industry tax credit; and promotes residential energy efficiency by streamlining the distribution of federal funds for weatherizing low-income homes and establishing a limited statewide residential building code for new construction.<sup>2</sup>

This legislation complements a diverse array of incentives, partnerships, and innovation to deepen Tennessee's role in the low-carbon economy and broaden its economic competitiveness.

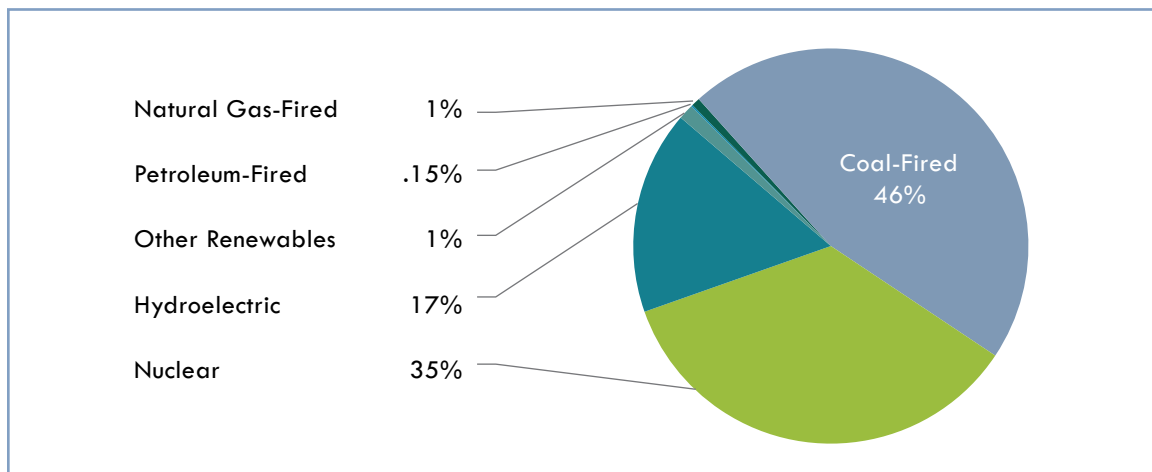
### Energy Economy Snapshot

Tennessee has few fossil fuel reserves, but has some of the highest hydroelectric power potential in the United States. Tennessee also has minor coal reserves in the Appalachian Basin in the eastern part of the state.<sup>3</sup> Tennessee’s three nuclear reactors provide nearly triple the power of all the dams in the state. The state’s single-unit Watts Bar Nuclear Plant began commercial operation in 1996 and was the last new nuclear reactor to be brought online in the country.<sup>4</sup>

In 2009, total electricity generation in Tennessee was 46 percent coal-fired, 17 percent hydroelectric, over one third nuclear, and 1 percent natural gas and renewables.

Renewables are growing as a proportion of total electricity generation. Biomass is the largest renewable energy resource in the Tennessee Valley,<sup>5</sup> allowing for the production of biofuels in the state. Further, approximately 800 MW of wind energy capacity is available within five miles of the TVA service area, and about 400 MW of solar photovoltaic capacity exists in the state.<sup>6</sup>

#### TENNESSEE ELECTRIC GENERATION BY FUEL SOURCE, 2009

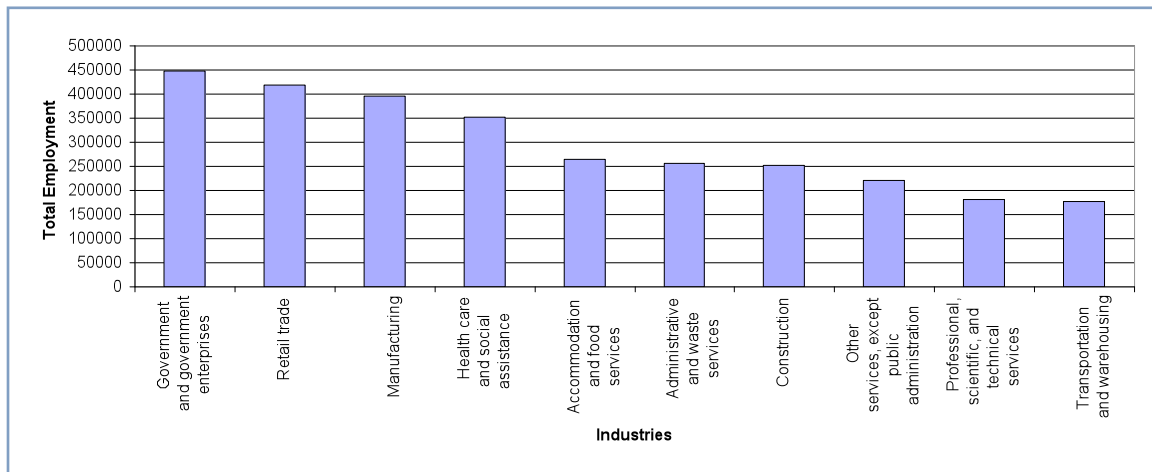


Source: U.S. DOE, Energy Information Administration, State Energy Profile, 2009

## Industry Overview of Tennessee

Government, retail trade, healthcare and social services, and manufacturing combined account for over 1.6 million employees in Tennessee. Accommodation and food services, construction, and administrative and waste services employ approximately 750,000 workers. Other services except public administration, professional, scientific, and technical services, and transportation and warehousing employ approximately 500,000 workers.

### TOP 10 INDUSTRIES BY EMPLOYMENT IN TENNESSEE: 2007



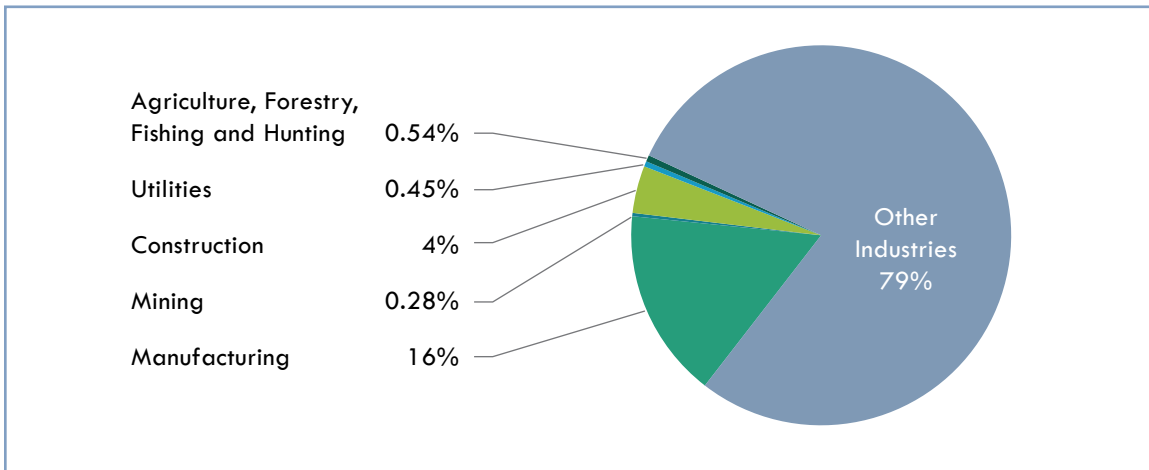
Source: BEA, 2007

Energy-intensive industries make up 22 percent of the total gross domestic product in Tennessee and 20 percent of the state’s employment. From the five energy-intensive industries, manufacturing (16 percent) and construction (4 percent) represent the largest share of total GDP. Mining (.28 percent), utilities (.45 percent) and agriculture make up less than two percent of total GDP in the state. In regards to employment, manufacturing and construction again represent the highest share among the energy-intensive sectors (11 percent and 7 percent, respectively), while utilities, mining and agriculture, forestry, fishing and related activities total less than 3 percent of the total working population.



Looking at location quotients to understand the state’s economic advantages, manufacturing stands out as a specialization for Tennessee, in terms of GDP, especially in motor vehicle body and parts manufacturing; electrical equipment and appliance manufacturing; wood products manufacturing; and paper manufacturing.<sup>7</sup> Employment specializations include manufacturing, agriculture, and construction. Sub-industry specializations include electrical equipment and appliance manufacturing; wood product manufacturing; paper manufacturing; and plastics and rubber products manufacturing.

**ENERGY INTENSIVE INDUSTRIES BY GDP IN TENNESSEE, 2007**



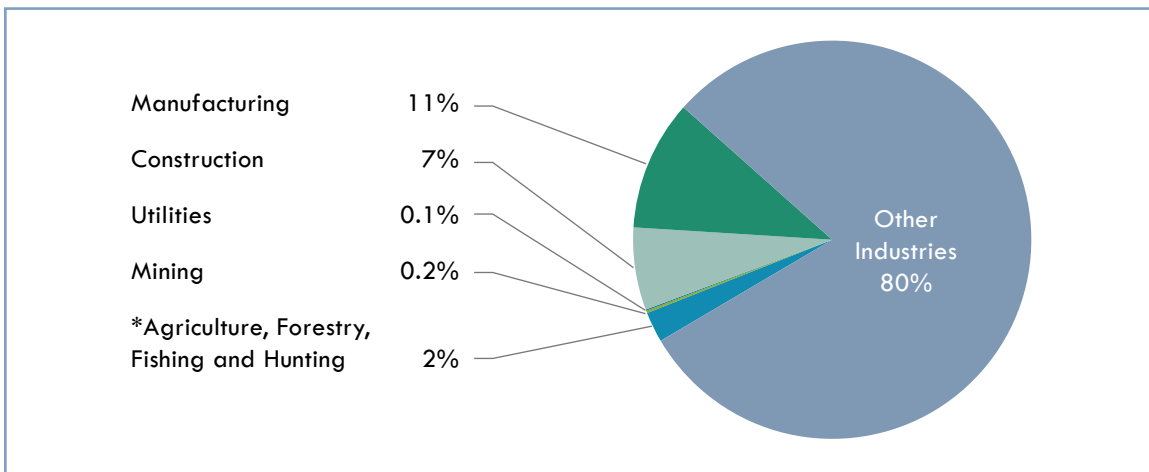
Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Mining	Utilities	Agriculture, Forestry and Fishing	Construction	Manufacturing
LOCATION QUOTIENT		.13	.22	.44	.92	1.38
Total GDP by Industry	\$245,162	\$680	\$1,111	\$1,329	\$10,152	\$39,949
Percentage of State GDP	100%	.28%	.45%	.54%	4%	16%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0

**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN TENNESSEE, 2007**



\*Includes farm employment Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY EMPLOYMENT**

Industry	Total: All Industries	Mining	Utilities	Construction	Agriculture, Forestry, and Fishing	Manufacturing
LOCATION QUOTIENT		.34	.34	1.04	1.16	1.32
Total Employment by Industry	3,632,959	7,018	4,084	249,828	92,366	395,152
Percentage of State Employment	100%	.2%	.1%	7%	2%	11%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0

**Preparing for the Low-Carbon Economy**

TVA announced in 2007 its commitment to be a leader in energy efficiency and according to the Energy Information Administration, Tennessee utilities spent \$10 million on energy efficiency in 2007, saving 63,547 MWh.<sup>8</sup> In May 2008, the TVA board approved a suite of pilot energy efficiency programs, including in-home energy auditing programs and prescriptive incentive programs for HVAC technologies.<sup>9</sup>

As part of the TVA’s strategy, it created a renewable energy initiative that offers consumers a choice in the type of power they buy. “Green Power Switch” was created through the collaboration of local public power companies working with input from the environmental community. The TVA generates electricity through renewable resources such as solar, wind, and methane gas, adds it to the power mix and sells it to residential consumers in 150-kilowatt-hour blocks (approximately 12 percent of a typical household’s monthly energy use). Each block adds \$4 to customers’ monthly power bills; consumers can buy as many blocks as they like. Green Power Switch is also marketed to commercial and industrial customers, who are asked to buy blocks based on the amount of energy they use.<sup>10</sup>

In addition to TVA's extensive role in the state's energy activities, the state government has a large slew of activity in this area. In March of 2008, the Governor established the Governor's Task Force on Energy Policy. The Task Force was charged with developing a state energy plan to help state government lead by example and to make recommendations to help the state become a leader in energy efficiency and renewable energy sources, and the development of clean-energy technology. The Task Force includes representatives of four state agencies and members representing business, environmental, legislative, and other interests.

Based on the Task Force's recommendations, in July 2009, the Governor signed into law the Tennessee Clean Energy Future Act of 2009 as the cornerstone for all future energy policy in the state. The legislation requires state government to do a better job of leading by example and makes the clean-energy technology sector eligible for Tennessee's emerging industry tax credit. It further promotes residential energy efficiency by streamlining the distribution of federal funds for weatherization of low-income homes and establishing a limited statewide residential building code for new construction.<sup>11</sup>

## State and Local Incentives

Tennessee offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

### *Incentives to encourage production:*

Tennessee offers the **Green Energy Tax Credit** to certified green energy supply chain manufacturers. The credit must be used to offset the certified manufacturer's franchise and excise tax liability. Any tax credit that cannot be used to benefit a certified manufacturer during a fiscal year may be returned to the taxpayer in the form of a cash overpayment. TVA has agreed to supply necessary information to the commissioner of revenue to verify the amount of the credit.<sup>12</sup>

***Incentives to encourage demand:***

The **Green Island Corridor Grant Program**, which is administered by the Tennessee Department of Transportation (TDOT), assists retail vehicle fuel stations and farm co-ops with up to 80 percent of the cost to convert or install storage and fuel dispensing equipment for E85 (*motor fuel blends of up to 85 percent ethanol and 15 percent gasoline*) and B20 (biodiesel) pumps, with a cap of \$45,000 per pump. TDOT advertises biofuel station locations on the official state map and provides interstate signage at exits with participating biofuel stations. This program is working to establish a statewide network of E85 and B20 pumps alongside interstate and major highway corridors to make these fuels available to citizens, travelers and fleets.<sup>13</sup>

The **Small Business Energy Loan Program** provides low-interest loans of up to \$300,000 to qualified Tennessee-based businesses to improve energy efficiency in their buildings, plants and manufacturing processes.<sup>14</sup>

The Tennessee Department of Economic and Community Development offers **Tennessee Clean Energy Technology Grants** to businesses to offset the cost of installing clean energy technologies such as solar electric generating equipment, wind energy systems, solar thermal systems, hydrogen fuel cells and hybrid solar lighting.<sup>15</sup>

Further, the Tennessee Department of Economic and Community Development offers **low-interest loans to municipal and county governments to fund energy-related improvements** to courthouses, administration buildings, schools, maintenance facilities and other buildings owned by local government. Even if a local government doesn't apply for the loan program, the Energy Office will arrange for an energy audit to provide technical assistance to communities interested in lowering their energy costs. The loan maximum for each community is \$500,000 annually.

To help local governments keep up with rising energy costs and help schools save money on utility bills, a portion of lottery funds were used to establish an **Energy Efficient Schools Program** in 2008. The program is expected to reduce energy bills by 18.5 percent if the schools implement the upgrades and utilize best practices for energy conservation, saving an estimated \$29 million in energy costs for Tennessee schools annually.<sup>16</sup>

Under the **Pollution Control Equipment Tax Credit**, the purchase of equipment that is mandated by state, federal or local law and that results in the reduction of water and/or air pollution, or the elimination of hazardous waste, may qualify for tax credits such as exemption from sales and use taxes, among other incentives.<sup>17</sup>

In 2007, the state passed legislation that requires at least 30 percent of the motor vehicles purchased for the state fleet each fiscal year be energy-efficient. In a separate bill, the state required that state agencies, universities, and community colleges develop and begin implementing plans to reduce motor fleet use of petroleum products by 20 percent beginning in January 2009.<sup>18</sup>

## **Transition Assistance**

With Tennessee's strong history in manufacturing and its emerging focus on biofuels and energy efficiency, the state is beginning to embark on initiatives that support the transition of its industries and its workforce.

### ***Transitioning Industry***

#### ***Energy Efficiency***

Tennessee received \$42 million in federal stimulus funds through the Energy Efficiency and Conservation Block Grant Program. Most of the funds will go directly to small- and medium-sized cities and counties to provide assistance in conserving energy and reducing fossil fuel emissions. Areas of funding that will be given priority include: developing an overall energy efficiency and conservation strategy; retrofitting existing buildings with cost-effective energy efficiency measures; implementing renewable energy technologies on government buildings; and replacing traffic signals and street lighting with energy-efficient technologies. Of the remaining funds, \$13.8 million will go to the Department of Economic and Community Development, which will issue \$9.3 million in grants and use \$4.5 million for public education and worker training.<sup>19</sup>

The public education campaign will be targeted to help Tennesseans improve the energy efficiency of their homes, and will use various channels to disseminate information, including workshops and print media. The training initiative will provide worker skills in a variety of green sectors, including weatherization, advanced energy codes, and solar installation. These programs will better position Tennessee's workforce to take advantage of the clean energy economy.

With one of the highest per capita rates of residential electricity consumption in the U.S., Tennessee recently announced its State Energy and Efficiency Appliance Rebate Program (SEEARP), also funded through the American Recovery and Reinvestment Act (AARA). Tennessee is receiving \$5.9 million for the program's rebates and administrative costs. The program will provide residential rebates of \$250 for air source heat pumps and central air conditioners, and \$40 for room air conditioners with the Energy Star designation. Consumers receiving rebates may be eligible for additional financial assistance through TVA's existing residential efficiency programs.

In July 2009, the governor announced a \$9.3 million grant program – also funded by the Recovery Act – for small- and medium-sized cities and counties seeking cost savings through energy-efficiency upgrades at local government facilities.<sup>20</sup> The funds (up to \$100,000 per local government) are subject to approval by the U.S. Department of Energy (DOE), and preference is given to local governments that commit to promoting community-wide energy efficiency efforts, including minimum standards for new home construction.

### **Biofuels**

Beyond encouraging energy efficiency in the built environment, Tennessee also is investing in biofuels. In 2006, Governor Bredesen formed the Alternative Fuels Working Group as a first step in developing an alternative fuels strategy for Tennessee. In 2007, the governor and the General Assembly set aside more than \$72 million to position Tennessee to be a national leader in the production of biomass ethanol and related research.<sup>21</sup> See more on biofuels research taking place in Tennessee in the innovation section of this chapter.

**Wind**

Wind development is an ongoing target for the state; about half of TVA's current renewable energy is generated from wind. Wind Prospecting in the Tennessee Valley Region is a two-year joint project of the Tennessee Energy Policy Office, Tennessee Valley Authority and Appalachian State University, funded by the DOE. The project aims to assess the wind-generating potential of various high altitude sites in eastern Tennessee. Several sites have been surveyed and identified as potential generating sites; physical inspections have been conducted at some sites and monitoring towers and equipment have been installed. The project will support the TVA's Green Power Switch program.<sup>22</sup>

**Solar**

Tennessee is a participant in the Million Solar Roofs program, a DOE initiative to promote the use of solar energy. The initiative focuses on two solar technologies: photovoltaics (solar electric cells), which produce electricity from sunlight, and solar thermal panels, which produce heat for domestic hot water, space heating or heating swimming pools. The initiative establishes state and community partnerships that bring together business, government, the energy industry and community organizations to coordinate national and state resources and eliminate barriers to the use of solar energy.

**Electric Cars**

The state is also pursuing an aggressive agenda to make electric vehicles part of its economy. Tennessee is one of five states participating in what is described as "the largest deployment of electric vehicles and charging infrastructure ever undertaken." The multistate project is being funded through a \$99.8 million DOE grant to Electric Transportation Engineering Corp. The project will install electric vehicle charging infrastructure and deploy up to 5,000 Nissan battery electric vehicles in strategic markets in Tennessee, Arizona, California, Oregon and Washington.



### *Transitioning the Workforce*

In November 2008, the state Department of Labor and Workforce Development's Employment Security Division–Labor Market Information Section published a report outlining the state's potential in green job growth, "Growing Green: the potential for green job growth in Tennessee." The report also discusses how the state's assets could be used to support such growth.

Education and training programs forming or already in place that complement the state's focus areas in energy efficiency and clean tech industries are detailed below.

To prepare the biorefinery workforce, the Biosucceed program is developing a new curriculum of a complete Master of Science degree program that can be delivered by any of three university partners and via distance education. It will develop six graduate-level classes, two classes aimed at undergraduates, and modules that can be inserted in individual classes. Ultimately, these classes will be offered at no cost for customization by any institution around the country. The program is funded by a U.S. Department of Agriculture Higher Education Grant and is a partnership between North Carolina State University, North Carolina A&T, and the University of Tennessee Agricultural Experiment Station.

The Tennessee Energy, Industry and Construction Consortium, which includes a range of private and public sector employers and unions, is planning recruiting and training strategies for skilled trades workers that could be linked with energy efficiency projects. The state also offers comprehensive energy auditor training on performing inspections, surveys, and collecting diagnostic information on homes as part of the state's Weatherization Assistance Program.

Other green workforce assets in the state include:

- A Sustainability MBA at David Lipscomb University;
- Training in energy efficiency and solar power installation for residential construction at Cleveland State Community College, as part of an associate's degree program (which, with experience, can lead to solar PV installer certification); and
- Project Lead the Way, a pre-engineering program in 33 school sites in the state which introduces students to concepts related to energy efficiency.<sup>23</sup>

## Investing in Innovation

Innovation is key to enabling the transition to a low-carbon economy. Research and development in alternative energies and energy efficiencies aims to reduce their costs and help high emitting industries and firms in adapting to this new economic environment. Tennessee's innovation efforts are focused in energy efficiency, biofuels, and solar technologies. They are detailed below.

### **Energy Efficiency**

Tennessee has a world-class research facility in Oak Ridge National Laboratory (ORNL). ORNL is the largest of DOE's science and energy labs and houses the Bioenergy Science Center, Buildings Technology Center, High Temperature Materials Laboratory, and the National Transportation Research Center. The lab's activities now complement the state's extensive efforts in the area of energy efficiency through its series of "deep energy retrofit" research projects. (The lab defines *deep energy retrofits* as renovations to existing structures that use the latest energy-efficient materials and technologies and result in significant energy reductions.)<sup>24</sup> The projects are being supported by DOE's Building America Program, which has received additional funding from the Recovery Act. At least 10 homes across the region will be sought to participate. It is expected that data on savings from energy efficiency resulting from the project may be used to encourage more deep retrofits across the region.

### **Biofuels**

The University of Tennessee Biofuels Initiative (UTBI) is a five-year, \$70 million commitment funded by the state. In 2007, the legislature appropriated \$40.7 million for capital construction and \$8.25 million for research, farmer incentives, and operating incentives for the biofuels initiative. The goal is to produce switchgrass, a non-food crop not previously grown commercially in Tennessee, through a farmer incentive program, and to construct and operate a pilot biorefinery with the capacity to produce 5 million gallons of cellulosic ethanol per year (about the amount the state currently uses annually for the state fleet). The plant in Vonore had its official grand opening in January 2010 and is now in production.

## **Solar**

In September 2009, DOE confirmed Recovery Act funding to support the Volunteer State Solar Initiative in Tennessee. Under DOE's State Energy Program, the governor has proposed a statewide plan that prioritizes energy savings, creates or retains jobs, increases the use of renewable energy, and reduces carbon pollution. After demonstrating successful implementation of its plan, the state will receive \$31 million in additional funding, for a total of nearly \$62.5 million.<sup>25</sup>

The Volunteer State Solar Initiative is a comprehensive solar energy and economic development program focusing on job creation, education, renewable power production, and technology commercialization. The goal is to stimulate short-term economic growth while positioning the state to support long-term expansion of the solar industry. The initiative focuses on two projects:

**The Tennessee Solar Institute** at the University of Tennessee and Oak Ridge National Laboratory, which will focus on industry partnerships to improve the affordability and efficiency of solar products; and

**The West Tennessee Solar Farm**, a five-megawatt, 20-acre power generation facility that will be one of the largest installations in the Southeast and serve as a demonstration project for education and economic development.

The Solar Institute will create a "Solar Opportunity Fund" to underwrite a series of new innovation and installation grants, helping to establish relationships with industry and leverage ARRA funding. Over the next three years, approximately \$23.5 million in grants will be distributed to solar industry firms looking to strengthen or expand their operations, as well as businesses looking to install solar-energy generation systems.<sup>26</sup> Moreover, Innovation Grants will provide funds to the state's solar industry firms for technical assistance, facility or process improvements, and workforce development. Installation Grants also will be issued to accelerate the deployment of solar energy statewide, providing grants to businesses to fund the purchase and installation of small-scale solar photovoltaic systems.

The Solar Farm will serve as an educational demonstration site for the public and students to learn about the benefits of renewable energy, showcasing commercially available solar

techniques and technologies. The Tennessee Department of Transportation will control the property for the farm in order to develop a pull-through interstate welcome center that encourages greater access to the site for educational purposes. In addition to its education mission, the farm will serve as a showcase for Tennessee-made solar products and components. Land acquisition and construction will be funded outside the Recovery Act.

## Partnerships

Many noteworthy partnerships are growing in Tennessee to drive forth the low-carbon economy as a greenhouse gas mitigation initiative as well as an economic driver. In addition to those already noted in this chapter, the partnerships highlighted below show successful coordination among state and quasi-state agencies.

**The Tennessee Department of Community and Economic Development (ECD)** is the lead economic development agency for the state, working to recruit and expand businesses in Tennessee. Recruiting a diverse portfolio of renewable energy companies to Tennessee is one of the ECD's focus areas. Additionally, ECD Commissioner Matt Kisber serves on the Governor's Task Force on Energy Policy, which is leading the state's energy plan.

**The Southern Alliance for Clean Energy (SACE)** is the contractor for ECD's Million Solar Roofs initiative. SACE has been involved in a variety of activities since 2003 designed to increase the acceptance and utilization of solar energy. A statewide stakeholders meeting has been held, drawing approximately 175 representatives from academia, the solar and utility industries and the general public who are interested in furthering the use of renewable energy technologies.<sup>27</sup>

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## Supply Chain Advancement to Retool the Manufacturing Base

In May 2008, Ohio became one of the first states in the country to pass a renewable portfolio standard (RPS) which mandates that by 2025, at least 25 percent of the electricity sold in Ohio must be generated from advanced energy technology – with a minimum of 12.5 percent from alternative sources such as third-generation nuclear power plants, fuel cells, energy-efficiency programs, and clean coal technology. Additionally, Ohio created a renewable energy credit tracking system, which allows utilities to buy, sell, and trade credits to comply with the renewable energy and solar energy requirements. Furthermore, electric utilities will be required to achieve energy savings of 22.5 percent by the end of 2025 through energy efficiency programs. Utilities must also implement programs to reduce peak energy demand by one percent beginning in 2009, and an additional .75 percent per year through 2018. Since public utilities are the largest emitters of greenhouse gases (GHG's), this state-mandated cap on emissions is expected to provide the stimulus for significant investment in the alternative energy industry.<sup>1</sup>

Further, Governor Ted Strickland has made advanced energy technology a centerpiece of his economic development policy. The Ohio Energy Office's Business and Industry team manages a portfolio of technical and financial resources, and works with partners to improve the competitiveness of Ohio manufacturers and to foster emerging energy technologies. Executive goals for Ohio include:



- Improving the Competitiveness of Ohio Business;
- Fostering New and Emerging Energy Technologies;
- Assisting Businesses to Connect to Financial Resources;
- Assisting Businesses Connect with Partners; and
- Assisting Businesses Connect to other Resources.

Regionally, Ohio joined the Midwestern Regional Greenhouse Gas Reduction Accord (MGGA), as an observer in November 2007. The MGGA is a regional agreement between six Midwestern states including: Iowa, Illinois, Kansas, Michigan, Minnesota, Wisconsin and one Canadian Province (Manitoba) to reduce GHG's. The MGGA program has four main goals: to establish GHG reduction targets in time frames consistent with signing states' targets; to develop a market-based and multi-sector cap-and-trade mechanism to help achieve those reduction targets; establish a system to enable tracking, management, and crediting for entities that reduce GHG emissions; and to develop and implement additional steps as needed to achieve the reduction targets, such as a low-carbon fuel standards and regional incentives and funding mechanisms.<sup>2</sup>

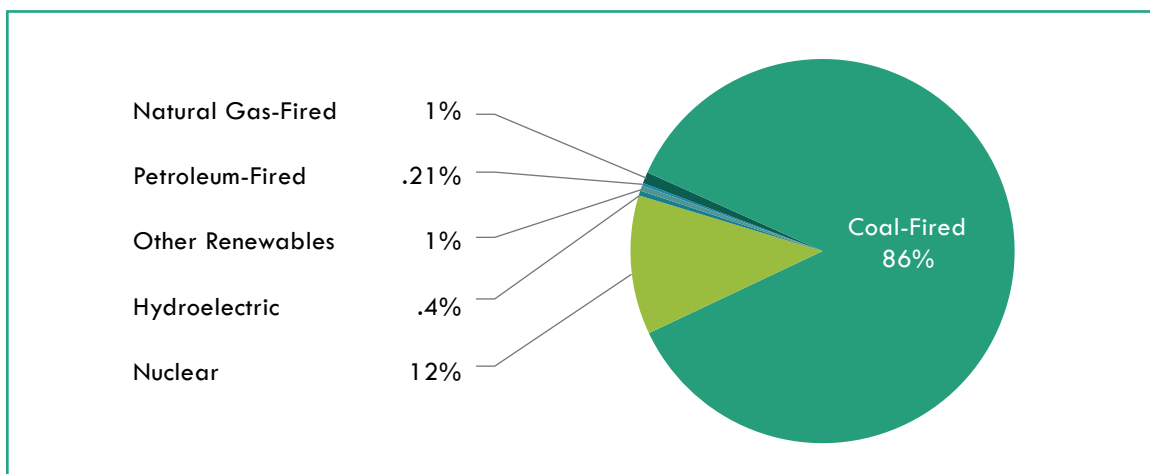
According to the American Council for an Energy-Efficient Economy<sup>3</sup>, Ohio could save over \$19 billion by using energy efficiency strategies. The state could also create more than 32,000 new jobs by 2025, including trade and professional jobs needed to design, install, and operate energy efficiency measures. By 2007, 2,513 businesses had generated more than 35,000 Ohio jobs in the clean energy economy, and venture capitalists are investing nearly \$75 million in Ohio's clean energy businesses.<sup>4</sup>



## Energy Economy Snapshot

Ohio is rich in coal which constitutes 86 percent of its electricity generation. With a large population and a heavily industrial economy, Ohio is among the top states in total energy consumption. Other sources of electric generation in Ohio are nuclear (12 percent), natural gas (1 percent), renewable (other than hydroelectric, 1 percent), and petroleum (less than 1 percent). Of note, energy consumption in Ohio's industrial sector ranks among the highest in the nation, yet its energy costs are below the national average.

### OHIO ELECTRIC GENERATION BY FUEL SOURCE, 2009



Source: US DOE, Energy Information Administration, State Energy Profiles, 2009

Existing renewable energy facilities in Ohio include, but are not limited to the following:

#### **Wind**

- Four 1.8 megawatt (mw) wind turbines in Bowling Green operated by the municipal utility
- 225 kilowatt (kw) wind turbine at the Great Lakes Science Center in Cleveland

#### **Solar**

- 783 kw solar photovoltaic array on seven acres at the Ohio Air National Guard 180<sup>th</sup> Fighter Wing headquarters in Toledo (facility will eventually generate more than 1 mw).
- 159 kw and 60 kw solar photovoltaic arrays located at the at Oberlin College
- 42 solar panels at the Cleveland Indians Progressive Field provide 8.4 kw of solar power





### **Hydro**

- 130 mw hydroelectric capacity statewide, plus a 42 mw hydroelectric plant located in West Virginia on the Ohio River as a joint venture of American Municipal Power-Ohio member communities

### **Other**

- 17 landfill gas projects of which seven generate electricity for a total capacity of 37 mw
- Biomass generation using waste residue to generate heat and power onsite in the wood manufacturing and paper industries

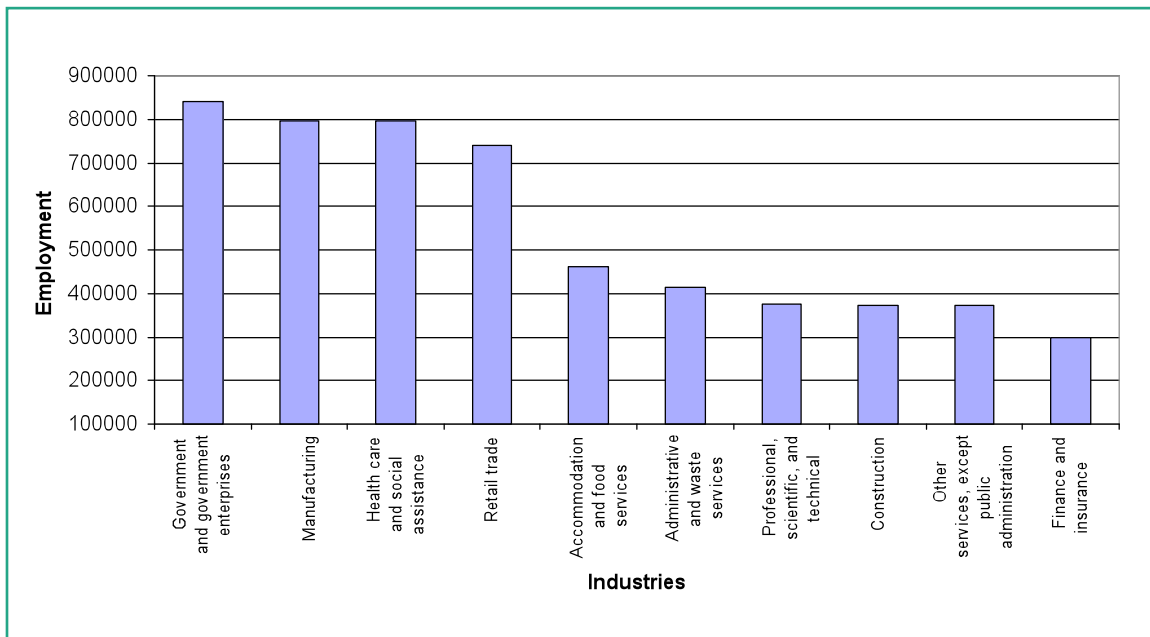
## **Industry Overview of Ohio**

Identifying the opportunities and challenges emerging from the move to a low-carbon economy requires an understanding of the state's current vulnerabilities and areas of resilience in their current industry mix. Ohio's industry mix is focused in government, manufacturing, health care and retail trade. These four industries combined employ over 3,000,000 employees. Accommodation and food services; administrative and waste services; professional, scientific and technical services; construction; and other services except public administration employ over 1,750,000 employees in the state.

Energy intensive industries make up 25 percent of the total gross domestic product (GDP) in Ohio and 19 percent of the total employment. From the five energy intensive industries, manufacturing (18 percent), construction (4 percent), and utilities (2 percent) make up 24 percent of the total GDP. Mining (.49 percent) and agricultural, forestry, fishing and hunting (.73 percent) only make up a little more than 1 percent of the total GDP in the State.



### TOP 10 INDUSTRIES BY EMPLOYMENT IN OHIO: 2007



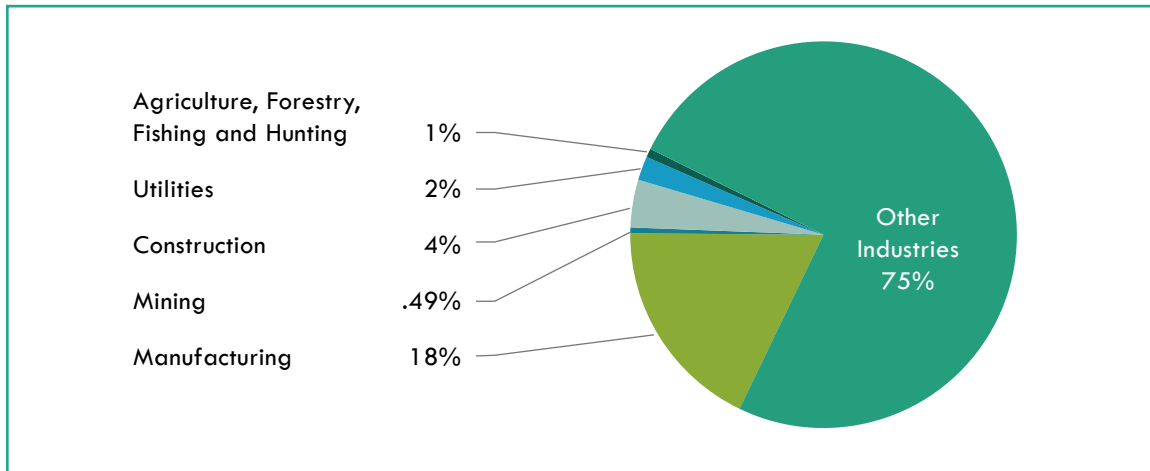
Source: BEA, 2007

Energy Intensive Industries make up 19 percent of the total working population in Ohio. Both manufacturing (12 percent) and construction (5 percent) make up the highest number of employment by energy intensive sectors in the state, followed by agriculture (2 percent).

Looking at location quotients<sup>5</sup> to understand the state's economic advantages, utilities and manufacturing stand out as specializations for Ohio, in terms of GDP and employment. The following are sub industry specializations within Ohio's manufacturing industry: motor vehicle, body trailer, and parts manufacturing; primary metal manufacturing; product manufacturing; fabricated metal product manufacturing; electrical equipment and appliance manufacturing; and plastics and rubber products. Note that there are no sub industry specializations denoted within the utilities industry.



### ENERGY INTENSIVE INDUSTRIES BY GDP IN OHIO, 2007



Source: BEA, 2007

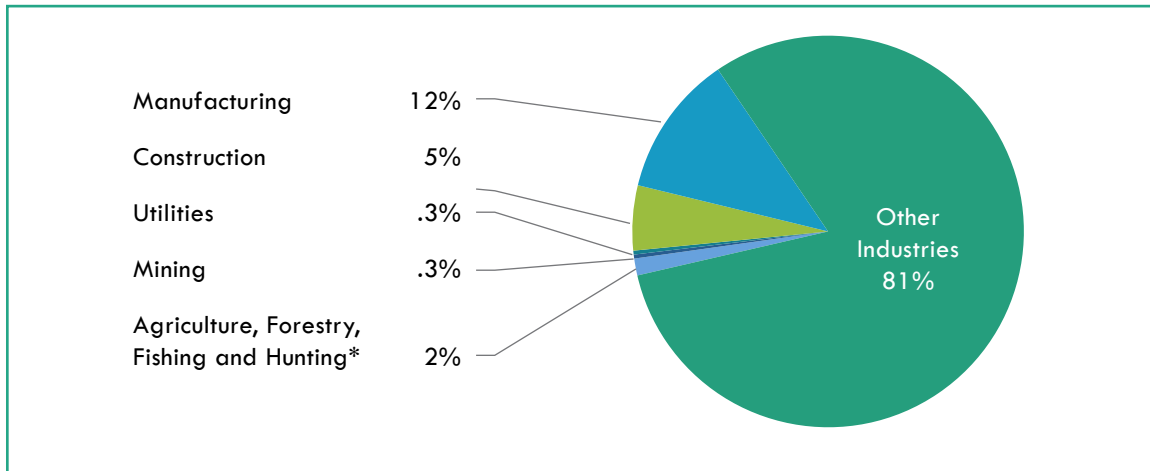
### LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY GDP

Industry	Total: All Industries	Agriculture, Forestry and Fishing	Mining	Construction	Utilities	Manufacturing
Location Quotient		.59	.24	.83	1.02	1.55
Total GDP by Industry	\$462,506	\$3,367	\$2,245	\$17,195	\$9,766	\$84,986
Percentage of State GDP	100%	1%	.49%	4%	2%	18%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0



### ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN OHIO, 2007



\*Includes farm employment Source: BEA, 2007

### LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY EMPLOYMENT

Industry	Total: All Industries	Mining	Agriculture, Forestry and Fishing	Construction	Utilities	Manufacturing
Location Quotient		.59	.65	.83	1.01	1.45
Total Employment by Industry	6,812,623	22,193	95,186	365,455	21,952	796,758
Percentage of State Employment	100%	.3%	2%	5%	.3%	12%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0



## Preparing for the Low-Carbon Economy

In May 2008, Ohio Governor Strickland signed Senate Bill 221 into law, enacting an alternative energy portfolio standard that requires that 25 percent of electricity sold by Ohio's electric distribution utilities or electric services companies must be generated from alternative energy sources by 2025. At least half of this energy must come from renewable energy sources, such as solar, wind, biomass and hydro with a minimum of 0.5 percent coming from solar resources. One half of the renewable energy facilities must be located in Ohio.

In addition to the renewable sources requirement, the remainder of the alternative energy required to meet the standard may be generated from advanced energy resources, such as clean coal, nuclear, fuel cells, customer cogeneration, and solid waste. The law sets annual benchmarks, or incremental percentage requirements for renewable energy, through 2025. Each utility and electric services company is subject to compliance payments if the annual benchmarks are not met. Utilities and electric services companies may purchase renewable energy credits to meet the renewable portion of the standard. Moreover, the state government offers the industrial sector funding opportunities along with business and technical services in order to help Ohio manufacturers become more competitive and to foster emerging energy technologies.<sup>6</sup>

In 2007 the Governor announced an Energy, Jobs and Progress plan to address the threat of climate change in the state. The objectives included:

- Ensuring affordable and stable energy prices to protect Ohio consumers and jobs;
- Attracting energy jobs of the future through an Ohio advanced energy portfolio standard;
- Safeguarding Ohio families by empowering consumers and modernizing Ohio's energy infrastructure.



## State and Local Support Programs and Incentives

Ohio offers state and local incentives that support the transition to a lower-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

### *Incentives to encourage production:*

**The Ohio Third Frontier** is a 10-year, \$1.6 billion research and development funding program, which has leveraged an additional \$6 billion in federal and private sector support for emerging industries and technologies. As of June 30, 2009, Ohio Third Frontier had awarded more than \$970 million for energy related research, development and product commercialization.<sup>7</sup> There are several divisions devoted to alternative energy industries including the Advanced Energy Program, Advanced Materials Program, Fuel Cell Program, Innovation Ohio Loan Fund, Ohio Research Commercialization Grant Fund, Photovoltaic Program, and Targeted Industry Attraction Grants.<sup>8</sup> SRI International, Inc. recently concluded that investment from Ohio Third Frontier has resulted in \$6.6 billion of economic impact and the creation of 41,300 jobs.<sup>9</sup>

The Ohio Department of Development operates the **Advanced Energy Fund**, which provides incentives for both commercial and utility-scale projects and manufacturing. The fund began with a \$307 million contribution from the State of Ohio.<sup>10</sup>

**The Advanced Energy Job Stimulus Fund** is a \$150 million fund that provides grants for development of clean energy. Forty four percent of the funds are to be used for clean coal technology projects, the remainder will be for non-coal-related projects. The Fund is being administered by the Ohio Air Quality Development Authority.<sup>11</sup>

### *Incentives to encourage demand:*

The Ohio Department of Development's Ohio Energy Office is administering the **Targeting Industry Efficiency grant program**. These grants will help manufacturers in Ohio make improvements in energy efficiency, create long-term jobs, and improve the environment by reducing carbon emissions. Targeted industries include advanced energy, aerospace and aviation, agriculture and food processing, bioscience and bio-products, instruments, controls and electronics, motor vehicles and parts manufacturing, and polymers and advanced materials. Technologies



may include combined heat and power, demand reduction, assessments for carbon mitigation opportunities, improvements in process heat applications, motors and other industrial systems. Awards will range between \$250,000 and \$1 million and will be selected through a competitive process.<sup>12</sup>

**The Advanced Energy Fund** provides two residential solar energy incentive programs, the Solar Thermal Energy Incentive for Residential Housing Units and the Residential Solar Photovoltaic Energy Incentive. The programs provide grants of up to \$3 per watt, up to \$25,000, and go towards solar systems at least 2,000 watts. The grants, when combined with current Federal tax credits for solar reduce the payback for installation from 30 to 11 years.<sup>13</sup> The Edison Materials Technology Center (EMTEC) Alternative Energy Technology Group has developed a solar supply chain database with 113 companies in Ohio.<sup>14</sup>

**The Energy Efficiency Loan Program** was established to provide low-interest loans to residents and businesses wishing to invest in energy efficiency and renewable energy projects. It is financed through a rider on electric bills in the state and is authorized to collect \$100 million over a 10-year period with the purpose of promoting economic development and to improve environmental quality.<sup>15</sup>

In June 2009, the Ohio House of Representatives passed **Ohio's Solar Schools Bill**. The bill institutes a pilot program for solar schools which would install solar electricity panels in the 70 largest school districts around the state and install solar panels on all public schools within five years. The solar initiative for schools offers tax credits and other incentives to investors.

### **Transition Assistance and Market Forces**

Much of the focus in Ohio is in increasing energy efficiency across residential, commercial and institutional users. The U.S. Department of Energy has set aside \$84 million for Ohio's local governments to spend on energy efficiency and conservation projects. The money set aside for Ohio includes \$25 million to the Ohio Department of Development's Energy Office. The office must award 60 percent of that, or \$15 million, to smaller towns and counties across the state. The grant is part of \$3 billion in the American Recovery and Reinvestment Act (ARRA) funds being distributed through the Department of Energy's Efficiency and Conservation Block Grant program. The effort is designed to help local governments, including Indian tribal governments,



pay for projects and upgrades, reduce energy use and cut combustion emissions<sup>16</sup>. Funds will be used to provide home energy audits and weatherization programs, replace inefficient appliances by providing rebates for new energy efficient appliances, and requiring that inefficient appliances are exchanged, upgrade commercial lighting and refrigeration, and provide incentives for manufacturers to replace inefficient equipment with more efficient technologies.

Prior to ARRA, Ohio was already beginning to focus on energy efficiency. In 2004, Ohio made the top 10 list of states with the highest share of Energy Star-qualified homes, with 12 percent of all homes built in Ohio receiving an Energy Star label. It is estimated that the investments made in Ohio through Energy Star could prevent the emissions of 14 million metric tons of GHG's, equivalent to eliminating the emissions from 9 million vehicles.<sup>17</sup> In 2006, the state ranked number 8 in terms of the total number of Energy Star homes built, and in Columbus alone 2,122 Energy Star certified homes were built in 2006.<sup>18</sup> Further, Ohio's manufactures are also becoming Energy Star certified and in February 2009 Honda's auto plants in Marysville and East Liberty, Ohio received Energy Star awards from the U.S. EPA for advances in curbing energy use during the production of passenger cars and light trucks. At the Marysville plant, associates significantly reduced electricity use by reprogramming plastic injection molding machines to run only during the production cycle, reducing CO<sub>2</sub> emissions by 80,000 pounds per year.<sup>19</sup>

### ***Transitioning Industry***

In addition to spurring savings via energy efficiency, Ohio is also working to develop emerging clean tech industries that build off of the state's many assets in its manufacturing economy.

### ***Fuel Cells***

Ohio has coordinated state-level programs that are spurring the growth of its fuel cell supply chain.<sup>20</sup> The Edison Materials Technology Center (EMTEC) Alternative Energy Technology Group has partnered with the Ohio Department of Development to build the fuel cell supply chain.<sup>21</sup> EMTEC maintains a supply chain database, currently with 935 businesses that can leverage the on-line forum to develop their business model, receive constructive feedback, establish credibility, and identify where best to reside in the fuel cell supply chain.<sup>22</sup> The fuel cell supply chain is clustering around the Cleveland/Akron area, Cincinnati, Dayton and Columbus.





EMTEC developed their Fuel Cell Hierarchy (FCH) to map out the network of suppliers for this complex newly evolving technology.<sup>23</sup>

Further, the Ohio Fuel Cell Coalition (OFCC) consists of members from government, academia and the private sector, who are working towards building the networks necessary for the fuel cell supply chain to prosper in Ohio. Using grants from the Ohio Department of Development and Ohio Third Frontier, OFCC's website provides valuable information for companies looking to expand into Ohio's fuel cell supply chain.<sup>24</sup> The Fuel Cell Corridor Portal provides more detailed information for OFCC members.

### **Solar Energy**

Solar Energy is one of the Ohio Department of Development's targeted industries. There are more than 115 businesses and research institutions involved in the solar energy supply chain in Ohio. These companies range from mid-sized solar installation companies like Dovetail Solar and Wind to larger companies like First Solar in Perrysburg that employs nearly 700 people.<sup>25</sup> The automotive glass supply chain is providing a solid underpinning of a new solar clustering taking place around Toledo.<sup>26</sup> Wood County, OH, which encompasses Toledo, is seeing large scale investment by its solar cluster. First Solar, Inc., and Willard & Kelsey Solar Group, LLC are investing \$241 million into Perrysburg that they anticipate will create 534 new jobs. Cabo USA, Inc. is expanding operations at its current facility.

### **Wind Energy**

Ohio's history with wind turbines and as an advanced manufacturing hub provides it with a solid base for capturing supply chain opportunities for wind turbines.<sup>27</sup> The world's first electric wind turbine was built in Ohio in 1888 in Cleveland, and the first megawatt-sized turbine was built in Cleveland in 1941. While the production processes of automobile manufacturing and wind turbine construction requires a certain amount of retooling (automobile manufacturing requires small parts at huge scales, and wind turbines manufacturing requires larger parts at typically lower volumes), the proximity of so many component manufacturers with decades of experience in castings, machining, bearings, gears, forging and fabricating parts is unparalleled in North America. More than 220 businesses and research institutions are involved in Ohio's wind energy supply chain, and more than 1,000 companies have been identified as eligible to transition into manufacturing components for the wind energy supply chain.<sup>28</sup>



Further, the Ohio Wind Working Group (OWWG), originally organized under an Ohio Energy Office Grant by Green Energy Ohio, is now operated by the Ohio Department of Development and is funded by the U.S. Department of Energy's Wind Powering America Program. OWWG continues to engage the nation's top wind developers, public utilities, state and local officials, researchers, landowners, nonprofit organizations, and other interested parties to identify issues, obstacles, and opportunities which impact wind energy development in Ohio. Drawing from the manufacturing, government, development and research sectors, as well as local landowners, OWWG members work collaboratively on information-sharing, education, and outreach on emerging wind energy issues relevant to Ohio. The results have been promising with 2006 alone representing \$250 million in investment and the creation of 1,700 direct and indirect jobs.<sup>29</sup>

Further, the State of Ohio offers incentive programs to accelerate the wind energy supply chain:

- **The Wind Production and Manufacturing Incentive Program**, which offered a production-based incentive has not been funded since 2007, but included a \$5 million grant to EverPower's Buckeye Wind Project and JW Great Lakes Wood County Wind Farm.
- **The Anemometer Loan Program** provides 100 percent of the cost and equipment for a non-profit entity to perform pre-development studies on wind energy potential.<sup>30</sup>
- The City of Cleveland passed new **wind turbine zoning legislation** in June 2009 that is expected to provide a transparent regulatory process for business and residential owners by establishing predictable guidelines for the installation of wind turbines.<sup>31</sup>

The Ohio Department of Development has provided approximately \$100 million in research funds since 2002 for advanced energy systems including wind. Timken Company, Owens Corning and Parker Hannifin, three leading suppliers of wind turbine parts are located in Ohio, and all operate research facilities in the state.<sup>32</sup> Case Western Reserve University has partnered with seven regional companies, Parker Hannifin, Lubrizol Corporation, Rockwell Automation, Swiger Coil Systems, Cleveland Electric Laboratories, Phillips Group, and Wm. Sopko & Sons Company to establish an Ohio Wind Energy Research and Commercialization Center. The Ohio Controlling Board is providing a \$500,000 grant towards the center which will be affiliated with the Case Western Energy Institute seeking ways to test and bring to market new wind turbine technologies.<sup>33</sup>



### ***Biofuels***

There are more than 60 Ohio businesses and research institutions involved in the biomass industry and over 1,300 wood manufacturing companies in the state that produce residues that are capable of being converted onto biomass energy.<sup>34</sup> Further, Ohio is one of seven states participating in the Great Lakes Biomass State and Regional Partnership. The Partnership is administered by the Council of Great Lakes Governors and receives grant funding from the U.S. Department of Energy.

The Ohio Biomass Energy Program provides information, resource referrals, business connections and periodic funding assistance to support the development and use of biomass energy resources in Ohio.<sup>35</sup> The mission of the Ohio Biomass Energy Program is to increase the development and utilization of biomass energy resources in Ohio in order to promote energy sustainability and a cleaner environment. To achieve this mission, their objectives are to:

- Acquire, develop, and promote information about biomass energy resources;
- Increase the production and use of biomass energy resources;
- Encourage Ohio investments in biomass energy technologies;
- Facilitate cooperative approaches among Ohio state agencies, industry, and organizations on biomass development;
- Promote the environmental benefits of renewable biomass energy resources; and
- Manage projects of the Great Lakes Biomass State and Regional Partnership.

Lastly, in August 2009, Ohio Edison Company, a subsidiary of FirstEnergy Corp., agreed in a consent decree to repower one of its coal-fired power plants - the R.E. Burger Units near Shadyside, Ohio - using primarily renewable biomass fuels. The agreement will reduce net GHG emissions by 1.3 million tons a year. Ohio is joined by the states of New York, New Jersey and Connecticut in this agreement.<sup>36</sup> The consent decree will also reduce emissions of SO<sub>2</sub> and NO<sub>x</sub> from Burger's current levels. This will be the largest coal-fired electric utility plant in the country to repower with renewable biomass fuels and the first such plant at which GHG will be reduced under a Clean Air Act consent decree.

### ***Transitioning the Workforce:***

Ohio is taking a proactive stance in developing its green workforce and in connecting people to green training and green jobs. In July 2009, the University System of Ohio partnered



with the Ohio Environmental Council to launch The Ohio Green Pathways (OGP) to develop the University System of Ohio's capacity to develop a green collar workforce<sup>37</sup>. This project directly links education and training opportunities available in the system with jobs in green industries across the state, with the goal of making Ohio's workforce a global leader in the green economy. The project developed a catalog of the University System of Ohio's green education and training programs targeted at prospective, students and employers.<sup>38</sup>

Additionally, the Ohio Green Workforce Training Partnership (led by the Corporation for Ohio Appalachian Development) is working to widen opportunities to workers participating in the Ohio Home Weatherization Assistance Program to pursue career opportunities beyond low-income residential weatherization programs. The program combines the knowledge and experience of Ohio's existing weatherization network, organized labor, environmental groups and local community and technical colleges. Partnership participants include the Central Ohio Technical College, Cuyahoga Community College, Electrical Trades Center of Central Ohio, Hocking College Logan Campus, Laborer's District Council of Ohio, Laborers' International Union of North America, Ohio Environmental Council, Ohio Apollo Alliance, Ohio Association of Community Action Agencies, Ohio Department of Development, Ohio Partners for Affordable Energy, Ohio State Building and Construction Trades, Ohio Urban Resources System (OURS), Policy Matters Ohio, Third-Sun Solar & Wind, Ltd., and the Cuyahoga Community College.<sup>39</sup>

Further, ARRA funds are supporting the transition towards green jobs in Ohio. The Ohio Department of Job and Family Services received two State Labor Market Information Improvement Grants from the U.S. Department of Labor as part of ARRA.<sup>40</sup> The Green Jobs Grant was awarded to develop a statewide infrastructure to support green jobs workforce development, education and training. Job and Family Services is partnering with the Governor's Workforce Policy Advisory Board, the Ohio Board of Regents and the University System of Ohio to identify the skills needed by green industries, so that curricula and training programs can be developed around those needs. Interested job seekers can then be connected with related workforce development services, training providers and job opportunities.

Additionally, the Auto Industry Grant is a \$4 million shared grant with Indiana and Michigan to coordinate efforts to help dislocated auto industry workers pursue new career paths in green industries. Along with Michigan, Ohio's role will be to gather information from auto industry



manufacturers and parts suppliers about their changing business environments and labor force needs. Ohio also will conduct a green jobs survey of Ohio employers, to better identify the number of green jobs available in the state and the skills required to fill them.

## Investing in Innovation

Innovation will enable the economy to transition. Through proactive and cutting edge partnerships between state, quasi-state, and university partnerships, Ohio is targeting innovation in the areas that are complementary to their emerging clean tech supply chain areas. Some of the notable efforts are listed below. Much of Ohio's innovation efforts support their existing industrial assets to help position them for participation in this rapidly changing energy marketplace.

### **Fuel Cells**

Six companies were recently awarded a total of \$6.38 million towards continued fuel cell research by Ohio Third Frontier and the Ohio Department of Development. The fuel cell awards are designed to focus on the technical and cost barriers for expanding the commercialization of fuel cell technology.<sup>41</sup> Further, researchers at the University of Dayton have demonstrated the use of carbon nanotubes as a catalyst in fuel cells, which could potentially lead to a significant reduction in the cost of fuel cells, which until now have primarily relied on platinum catalysts.<sup>42</sup>

### **Solar**

The Ohio Third Frontier also runs the Photovoltaic Program to fund research and commercialization of solar energy research in conjunction with Ohio's universities. The Program awarded six projects for Fiscal Year 2010 totaling slightly more than \$6 million to six firms. The projects range from improving photovoltaic longevity, functionality, thickness, affordability.<sup>43</sup> Researchers at The Ohio State University are working on developing next generation solar energy materials that capture more of the sun's energy.<sup>44</sup> As example of the photovoltaic clustering around Toledo, Xunlight Corporation is a company specializing in the development of next generation solar modules. It was established in 2002, to commercialize solar technology that was developed at the University of Toledo's Thin Film Silicon Photovoltaic Laboratory.<sup>45</sup>



### ***Clean Coal***

Clean coal refers to the development and implementation of technology designed to mitigate the environmental effects of using burning coal. It can include anything from the gasification of coal, known as IGCC (Integrated Gasification Combined Cycle), to carbon sequestration, which buries the carbon dioxide released from the burning of coal. The Ohio Coal Development Office (OCDO) is a program within the larger Ohio Air Quality Development Authority<sup>46</sup>, which co-funds the development and implementation of technologies that are attempting to find cost-effective and environmentally sustainable methods of leveraging Ohio's vast reserves of high-sulfur coal. To date, the Ohio Coal Development Office has funded approximately 300 projects. Further, The Third Frontier Commission awarded \$10.5 million to The Ohio State University's Institute for Energy and the Environment to coordinate the Advanced Energy via Green Industrialization Ohio Research Program. This will enable The Ohio State University to staff a leading researcher in carbon sequestration, and to expand its partnership in clean coal research with Ohio University.<sup>47</sup>

Approximately \$1.3 million was awarded in 2006 to seven universities in Ohio to fund research into improving the efficiency of converting coal into energy including improving GHG and mercury capture (byproducts of burning coal), and greatly increasing hydrogen yields (to be used for direct electricity generation and improving fuel cell technology). Of particular note is Demonstration Project D-06-02, which was given to The Ohio State University, in partnership with American Electric Power, Brookhaven National Laboratory, Oak Ridge National Laboratory, Oxford Mining and B&N Coal to improve management methods for carbon sequestration in reclaimed mine land soils. Included in this research will be the development of protocol for trading carbon credits on the Chicago Climate Exchange.<sup>48</sup>



### **Geothermal**

A specific example of ARRA fund usage is Wright State University's research into the development of more advanced ground-based heat pumps (GHP's) for geothermal projects. The development of more accurate computer models that can determine the efficiency of GHP's, allowing owners of systems a more thorough analysis before installation of a new system should translate into a more transparent decision-making process, and speed up the commercialization of geothermal technologies.<sup>49</sup>

### **Partnerships**

In addition to many of the partnerships discussed earlier in this document, the key role of the Ohio Department of Development along with its energy office, as well as a diversity of non-profit and trade association partnerships have emerged in Ohio to further support the growth and development of the state's clean tech industries. Many of them are denoted below.

The **Ohio Department of Development (ODOD)** is the lead economic development agency for the state. The department has a deep agenda in supporting the growth of the advanced energy business sector with a robust supply chain. ODOD operates the Advanced Energy Fund, the Ohio Wind Working Group (OWWG) and is involved in numerous other partnerships that are driving forward the advanced energy sector within Ohio.

Within ODOD is the **Ohio Energy Office** which is focused on ensuring stable energy prices, modernizing Ohio's energy infrastructure, and attracting jobs through the growth of environmentally friendly industries. The OEO has a lead role in accomplishing the goals of Ohio's energy bill. Further, OEO funds projects related to the deployment of renewable energy technologies including wind, solar photovoltaic, solar thermal, and geothermal, as well as energy efficiency measures for industrial, commercial, and some consumer classes of residential. The Office has been involved in supporting energy-related components of ARRA, including the State Energy Program, the Energy Efficiency and Conservation Block Grant Program, and the Energy Efficient Appliance Rebate Program.

Formed in 2007, **Ohio Advanced Energy** is a non-profit business-trade association dedicated to the development of a vibrant advanced and renewable energy economy in Ohio.<sup>50</sup>



**Clean Fuels Ohio** is a non-profit based in Columbus whose stated goal is to increase public-private partnerships in building the biofuel supply chain in Ohio.<sup>51</sup>

**Green Energy Ohio** is a leading organization in Ohio with the goal of promoting environmentally and economically sustainable energy policies and practices. It maintains a valuable, continuously updated website providing a comprehensive snapshot of existing research, state programs and examples of successful commercialization of alternative energy technology.<sup>52</sup>

**WIRE-Net**, a membership organization of business professionals devoted to sharing ideas about economic growth and job creation,<sup>53</sup> created the **Great Lakes Wind Network (GLWN)** as an industry-based organization of manufacturers, suppliers and research organizations with a mission to serve this market by growing the supply chain. Their mission is to increase the domestic (North America) content of wind turbines. GLWN hosts local conferences and workshops around the U.S. and Canada to educate OEM's (original equipment manufacturers) on how they can enter the supply chain. A successful example of this is HPM America, which faced declining demand for its injection molding machines when its customer base shrank following a retrenchment in the domestic automobile industry that began in 2003. HPM America recognized that they needed to diversify their production base, and concluded that the alternative energy sector was an opportunity for high growth. They started a contract manufacturing unit, and were approached by a wind turbine manufacturer, which has led to resurgence in revenue and job creation.<sup>54</sup>

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## Transitioning to Wind while Advancing Carbon Capture and Sequestration

While staying true to its deep economic base in oil and coal, North Dakota is also expanding its economy by targeting wind energy and carbon capture and sequestration technologies.

Wind energy represents an enormous asset in North Dakota. It has the potential to produce more than 1.2 trillion kilowatt (kw) hours of electricity every year, enough to power over a quarter of the U.S.<sup>1</sup> As of December 2008, the state ranked first in the country for potential wind energy output, but 11th for actual wind energy output. Wind potential has not been fully exploited due to concerns over constraints on the transmission grid.<sup>2</sup> Even though North Dakota has further room to develop its wind assets, since 2000, its actual wind energy generation has grown from one-half megawatt (mw) to over 850 mw, in place or under construction.

Hydroelectric power also represents an important alternative energy source in North Dakota, accounting for 5 percent of the state's total electricity production, according to the U.S. Department of Energy in 2009.

The state is the largest U.S. producer of canola and is 11th in soybean production and 16th in corn production, providing great potential for producing biofuels such as diesel and ethanol.<sup>3</sup> With six ethanol plants in the state and one bio-diesel plant, North Dakota has considerable production capacity.



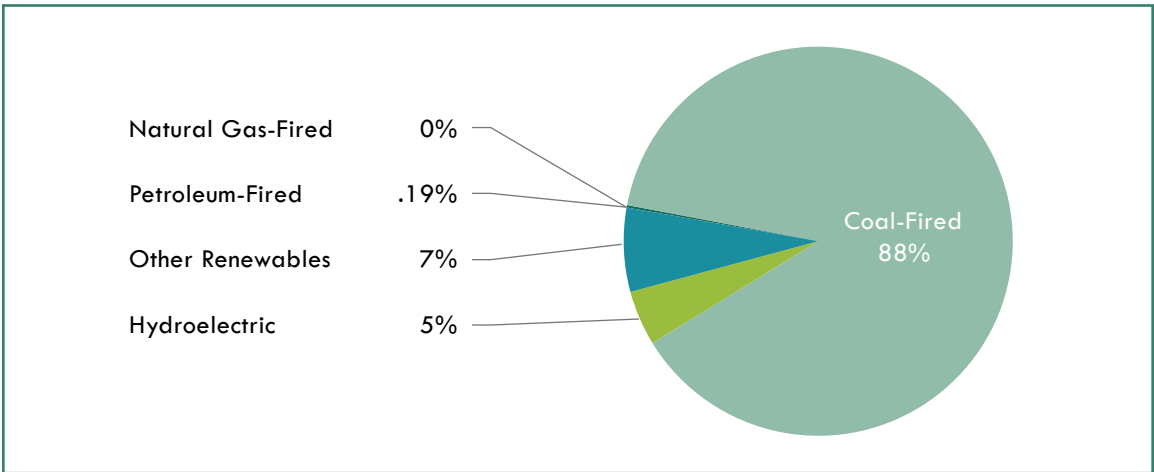
**Energy Economy Snapshot**

North Dakota’s per capita energy consumption is among the highest in the nation, which is due in part to heating demand in the winter.<sup>4</sup> However, given the small size of North Dakota’s population, both electricity generation and demand are relatively low in raw numbers. Nearly all of the state’s electricity is generated by coal-fired power plants that draw on the state’s considerable fossil fuel reserves. Coal is extracted from large surface mines in the central part of the state, while the western part of the state has substantial crude oil and natural gas reserves.<sup>5</sup>

North Dakota is the fourth largest oil-producing state in the U.S.<sup>6</sup> The state’s oil output accounts for about 2 percent of total U.S. crude oil production. The state is also an entry point for Canadian crude oil transported via pipeline to U.S. refining markets in the Midwest. The state also produces approximately 1 percent of the nation’s annual natural gas production. The majority of the state’s natural gas is transported via major pipelines originating in Montana and western Canada to markets in the U.S. Midwest for consumption.<sup>7</sup>

North Dakota generates 88 percent of its electricity from coal, 7 percent from renewable sources (other than hydroelectric), 5 percent from hydroelectric, and less than 1 percent from petroleum-fired and natural-gas fired plants.

**NORTH DAKOTA ELECTRIC GENERATION BY FUEL SOURCE, 2009**

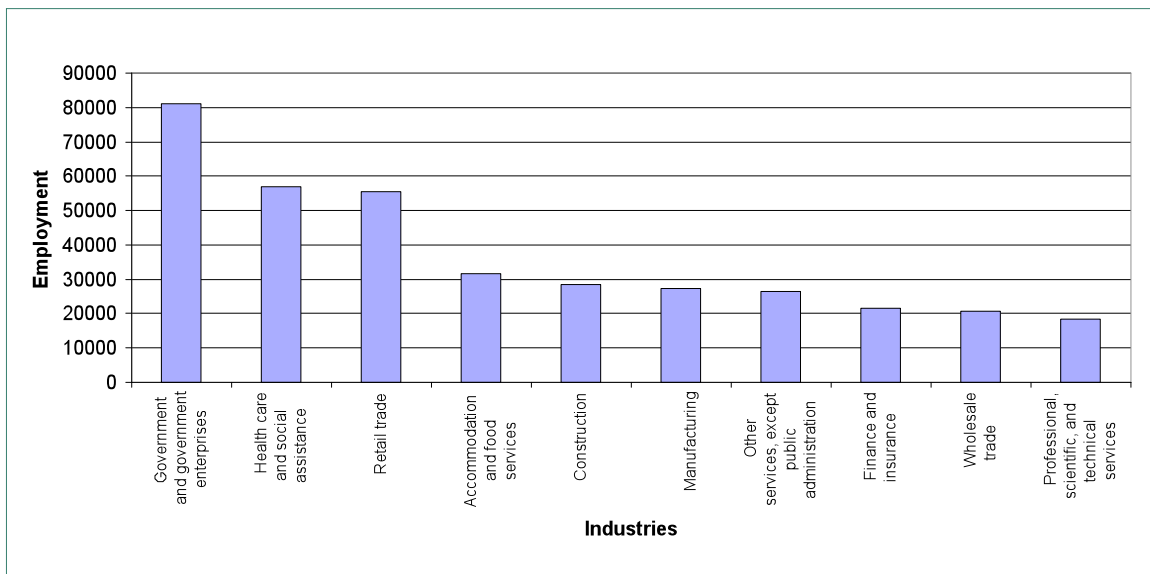


Source: US DOE, Energy Information Administration, State Energy Profiles, 2009

## Industry Overview of North Dakota

Understanding the vulnerabilities and areas of resilience in the state's current industry mix will help identify the challenges and opportunities of moving to a low-carbon economy. Government, healthcare and social services, and retail trade account for the highest number of employees in North Dakota, approximately 190,000 people. Accommodation and food services, construction, manufacturing, and other services (except public administration) employ approximately 90,000 workers, while finance and insurance, wholesale trade, and professional, scientific and technical services employ approximately 60,000 workers.

### TOP 10 INDUSTRIES IN NORTH DAKOTA BY EMPLOYMENT 2007



Source: BEA, 2007

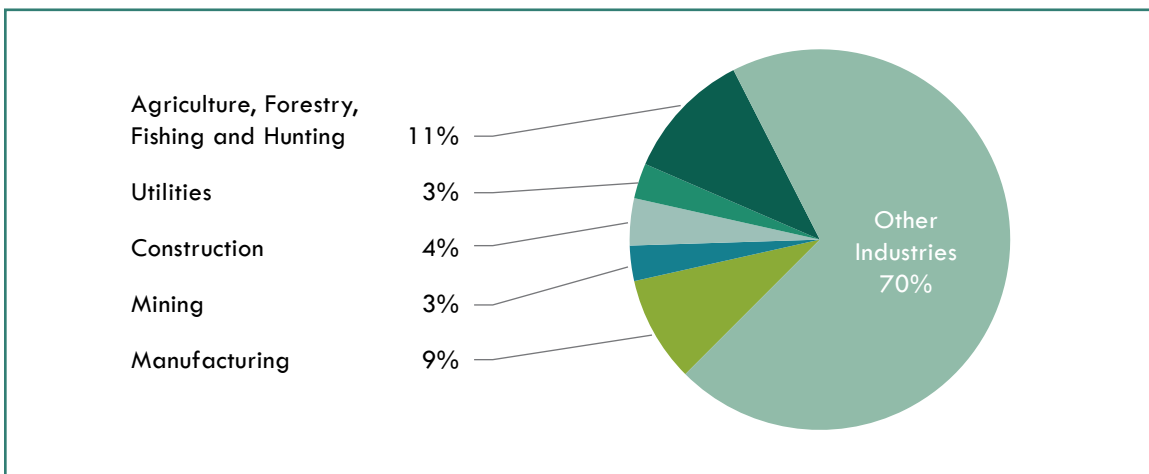
Energy-intensive industries make up 30 percent of the state's gross domestic product (GDP) and 21 percent of total employment in North Dakota. From the five energy-intensive industries, manufacturing (9 percent), construction (4 percent), and agriculture, forestry, fishing, and hunting (11 percent) make up 24 percent of total GDP. Mining (3 percent) and utilities (3 percent) comprise 6 percent of GDP in the state. Agriculture (7 percent) is the largest employment sector among the energy-intensive industries, followed by construction and manufacturing (both 6 percent). Mining and utilities comprise 1 percent each of North Dakota employment.



Looking at location quotients<sup>8</sup> to understand the state’s economic advantages, agriculture, mining, and utilities stand out as specializations for North Dakota in terms of GDP. Especially strong are crop and animal production for agriculture, as well as support activities for mining, except oil and gas. Utilities do not have sub industry classifications.

Additionally, North Dakota has employment specializations in the areas of agriculture, mining, and utilities. Sub industry specialization include: agriculture and forestry support activities; oil and gas extraction, mining (except oil and gas); and support activities for mining.

**ENERGY INTENSIVE INDUSTRIES BY GDP IN NORTH DAKOTA, 2007**



Source: BEA, 2007

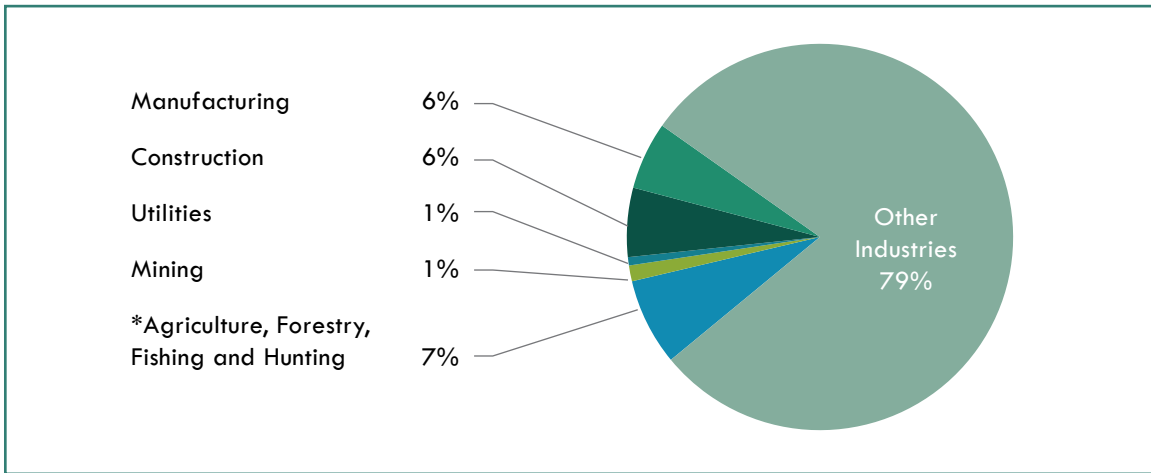
**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Mining	Agriculture, Forestry and Fishing
LOCATION QUOTIENT		.78	.96	1.29	1.60	8.72
Total GDP by Industry	\$28,518	\$2,638	\$1,227	\$760	\$918	\$3,046
Percentage of State GDP	100%	9%	4%	3%	3%	11%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0



**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN NORTH DAKOTA, 2007**



\*Includes farm employment Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY EMPLOYMENT**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Mining	Agriculture, forestry, fishing, related activities, and other
<b>LOCATION QUOTIENT</b>		.70	.89	2.17	2.43	3.42
Total Employment by Industry	483,868	27,422	27,971	3,360	6,401	35,261
Percentage of State Employment	100%	6%	6%	1 %	1%	7%

Source: BEA, 2007   Shaded areas represent location quotients over 1.0



## Preparing for the Low-Carbon Economy

In 2005, North Dakota's Governor Hoeven signed comprehensive legislation designed to accelerate production of wind energy and biofuels, as well as to enhance the transmission infrastructure necessary to get both renewable and conventional energy to market.<sup>9</sup> The legislation also created an Office of Renewable Energy and Energy Efficiency within the Division of Community Services at the state Commerce Department to assist in the development of renewable energy and promote energy conservation in both the public and private sectors. The office administers programs and advances information pertaining to state and federal incentives available for the full range of renewable energy sources.

In March 2007, North Dakota adopted a voluntary renewable portfolio standard with the objective of having 10 percent of all retail electricity sold in the state be obtained from renewable energy and recycled energy by 2015.

## State and Local Incentives

North Dakota offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

### *Incentives to encourage production:*

The North Dakota **Renewable Energy Corporate Tax Credit** allows any taxpayer - individual or corporation - to claim an income tax credit of (3 percent per year for five years) for the cost of equipment and installation of a system that uses geothermal, solar, biomass or wind energy and that is installed after December 31, 2000.<sup>10</sup>

**The Renewable Energy Property Tax Incentive** exempts from local property taxes any locally assessed solar, wind, or geothermal energy device serving a new or existing building or structure. Stand-alone systems and those that are part of conventional systems are eligible. For solar, wind or geothermal systems that are part of a conventional energy system, only the renewable energy portion of the total system is eligible.<sup>11</sup>





**The Large Wind Property Tax Reduction** offers property tax reductions for commercial wind turbines constructed before 2011. Originally, the law reduced the taxable value of centrally assessed wind turbines with capacity of 100 kw or greater from 10 percent to 3 percent of their assessed value, a property tax savings of 70 percent. However, this law has been amended, resulting in slightly different tax valuation procedures for some installations.<sup>12</sup>

A **100 percent sales and use tax exemption** is available for purchasing building materials, production equipment and other tangible personal property used in the construction or expansion of wind-powered electrical generation facilities.

*Incentives to encourage demand:*

**The State Facility Energy Improvement Program**, delivered by the Office of Renewable Energy and Energy Efficiency, utilizes state bonding to finance energy improvement projects. This program has provided over \$10 million to state agencies and institutions for energy efficiency improvements, resulting in \$1.5 million of annual energy savings.

Performance contracting is a second mechanism for state agencies and institutions to finance energy efficiency improvements. Performance contracting uses an energy services company to provide a detailed energy audit of a state-owned facility and then defines projects for energy savings. Since 2001, over \$22.3 million in energy efficiency upgrades have been implemented through performance contracts, resulting in \$2.2 million in energy savings annually.<sup>13</sup>

The **Biofuels Partnership in Assisting Community Expansion (PACE) Loan Program** provides an interest buy-down of 5 percent below the note rate to biodiesel and ethanol production facilities; livestock operations that use byproducts from biodiesel or ethanol facilities for feed; and facilities that provide storage of grain used in biofuels production.<sup>14</sup>

**The Ethanol Production Incentive** provides qualified ethanol producers who meet certain eligibility requirements with quarterly incentive payments based on the number of gallons produced during adverse times. The incentive amount is based on the average North Dakota wholesale ethanol price for the preceding quarter and the average North Dakota corn price for the preceding quarter.<sup>15</sup>



**The State Energy Efficient Appliance Rebate Program (SEEARP)**, funded by \$615,000 from the Recovery Act, provides rebates to purchase new energy-efficient refrigerators. The state will be issuing \$150 rebates for full-size refrigerators that replace an old full-size refrigerator.<sup>16</sup>

## Transition Assistance

North Dakota is focusing on supporting industry transition in the areas of energy efficiency, wind, and carbon capture, all of which are detailed below.

### *Transitioning Industry:*

#### **Energy Efficiency**

The State Energy Program, funded by the Recovery Act, is designed to promote energy conservation and efficiency and reduce the growth of energy demand. The state is presently accepting applications for the following activities within the program:<sup>17</sup>

- **Wind Monitoring:** This initiative provides grants to North Dakota communities for activities that promote and advance the use of wind resources. Possible activities include wind resource monitoring, demonstration projects and feasibility studies. The initiative provides opportunities for North Dakota communities and job development authorities to investigate developing their wind energy potential. Grant funds have been used to conduct over 40 wind energy assessments around the state.
- **Landfill Gas Feasibility Studies:** This activity proposes to fund six landfill gas utilization studies for cities and counties. Grants will be limited to \$15,000.
- **Electric Vehicles:** This will provide cost-sharing grants to state agencies and institutions for the purchase of Global Electric Motocar electric vehicles for use in state campuses, state parks, and other appropriate venues.

#### **Wind**

As noted above, North Dakota has been identified as having the greatest wind resources of any of the lower 48 states by the Department of Energy's National Renewable Energy Laboratory. The state also has few environmental constraints regarding land availability.<sup>18</sup> The governor is supporting further development of wind and has signed legislation promoting new



and substantial investments in transmission lines across the state. Moreover, several financial incentives are in place, including tax credits, property tax reductions, and local property tax exemptions to promote growth in the wind energy industry. For example, property taxes are reduced by 70 percent for 100 kw wind facilities or larger. These systems are also exempt from sales taxes. Throughout the region, more than 4,000 mw are in the planning and development stage.<sup>19</sup>

North Dakota's Commerce Department has hired a British firm to explore business prospects in Europe, where a number of large wind energy companies are based. The state currently has two principal manufacturers that supply the wind industry with steel towers for wind turbines, and turbine blades. The state is working to recruit companies that produce or assemble nacelles (the unit that converts wind energy into electricity) and companies that make parts for nacelles.<sup>20</sup>

### ***Carbon Capture and Sequestration***

The state has created incentives to build a new natural gas infrastructure, so that energy that was previously flared off and lost could be captured and put back into the market. North Dakota is currently home to the only commercial plant in the U.S. that produces synthetic natural gas from coal. The Great Plains Synfuels Plant in Beulah is owned and operated by the Dakota Gasification Company, a subsidiary of Basin Electric Power Cooperative, and has been in operation since 1984.

The plant produces more than 54 billion standard cubic feet of natural gas annually, using 6 million tons of lignite coal. The plant also demonstrates CO<sub>2</sub> capture and sequestration and supplies CO<sub>2</sub> to the world's largest carbon capture and storage project in the world in Saskatchewan, Canada (the plant captures about 3 million tons of CO<sub>2</sub> annually). According to Dakota Gas, the CO<sub>2</sub> production capacity is more than 200 million standard cubic feet per day.

Up to 50 percent of the CO<sub>2</sub> is captured each day of operation. Since 2000, CO<sub>2</sub> emissions at the Synfuels Plant have been reduced by about 45 percent, and through 2008, Dakota Gas has captured more than 16 million tons of CO<sub>2</sub>.<sup>21</sup>



### ***Transitioning the Workforce:***

Energy and clean tech-related education is growing in North Dakota with programs that complement the states' clean tech focus areas.<sup>22</sup>

Devils Lake, North Dakota, is home to Lake Region State College. The college offers a Wind Turbine Technician program to educate and train a workforce to manufacture, test and maintain wind turbines. Lake Region State College worked closely with wind industry representatives to create a program that will provide a workforce capable of industry-ready productivity upon graduation. Two programs are being offered to develop skill sets in the areas of mechanics, electronics, hydraulics, meteorology, composites, computer science and power transmission: a one-year certificate and a two-year Associate in Applied Science Wind Turbine Technician program. The program is expected to train 80 students in 2010.

There are additional programs at other institutions around the state:

- United Tribes Technical College offers an energy auditor training program to certify individuals in residential and commercial auditing.
- The National Energy Center of Excellence at Bismarck State College offers a diversity of education and training for the energy industry.
- Dakota College at Bottineau offers an environmental technology program.
- The State College of Science in Wahpeton offers instruction in biofuels.
- North Dakota State University offers natural resource management.
- The University of North Dakota has a program in earth system science and policy.

### **Investing in Innovation**

Innovation is key to enabling the transition to a low-carbon economy. Research and development in alternative energies aims to reduce their costs and help high emitting industries and firms in adapting to this new economic environment. Because of North Dakota's strong coal and oil resources, it is focusing on innovating in the areas of carbon capture and sequestration. Below are some of the leading areas of research and development taking place in the state.

### ***Carbon Capture and Sequestration***

The state is currently active in The Plains CO<sub>2</sub> Reduction (PCOR) Partnership, a collaboration of over 80 U.S. and Canadian stakeholders that is laying the groundwork for practical, environmentally sound CO<sub>2</sub> sequestration projects. The Partnership is led by the Energy & Environmental Research Center at the University of North Dakota, under the U.S. Department of Energy's Regional Carbon Sequestration Partnership program (out of the National Energy Technology Laboratory, part of DOE's Office of Fossil Energy).

The PCOR Partnership's work began in 2003 with Phase I, which was to identify major stationary CO<sub>2</sub> sources and possible sequestration sites ("sinks") in the Upper Great Plains area. Among the participants in the PCOR Partnership are the Basin Electric Power Cooperative, Dakota Gasification Company, Great Northern Power Development, Lignite Energy Council, Minnesota Power, Minnkota Power Cooperative, and Otter Tail Power Company. Phase I also included a public outreach component, in order to raise awareness on carbon sources and sinks.

Phase II, which began in 2005, involved geologic sequestration field tests at two North Dakota sites. One involves storing CO<sub>2</sub> in an oil field for simultaneous sequestration and enhanced oil recovery. The second project involves storing CO<sub>2</sub> in lignite beds.

In September 2007, the Energy & Environmental Research Center (EERC) at the University of North Dakota received a \$67 million award from DOE to further accelerate the deployment of CO<sub>2</sub> sequestration technologies, as the PCOR Partnership evolved from field tests (2005-2009) to one large-scale demonstration test in Phase III (post-2009).<sup>23</sup> The Phase III project will be a longer-term operation at commercial scale.

EERC, a non-profit research center and technology commercialization vehicle, develops cleaner, more efficient energy as well as other environmental technologies. EERC concentrates on the following program areas:

- Advanced Power and Energy Systems
- Energy Conversion System Optimization
- Environmental Chemistry & Waste Management
- Emission Control Technologies
- Fossil Energy Resources (oil, gas, and coal)



- Hydrogen Production, Distribution, and Fuel Cell Technology
- Renewable Energy
- Research Information Systems
- Water Management (availability, contaminant remediation, and flood and drought protection)<sup>24</sup>

In fiscal year 2009, the total value of EERC's contract portfolio was over \$236 million; 14 companies have developed as spinoffs of the center. Overall, EERC is a key player in innovation in North Dakota.

Adding further to North Dakota's carbon capture and storage research and development is the Antelope Valley Carbon Sequestration Demonstration project. Awarded a \$100 million grant from DOE in July 2009 and a \$300 million loan from the U.S. Department of Agriculture in January 2009, this project of the Basin Electric Power Cooperative plans to capture over one million tons of CO<sub>2</sub> per year. Scheduled to launch in 2012, this project would be among the largest of its kind in the world, with a 90 percent capture target. The demonstration is anticipated to result in commercial-scale development.<sup>25</sup> Further, there may be economic opportunity stemming from exporting the captured carbon.

### ***Biofuels***

The Centers for Renewable Energy and Biomass Utilization conduct critical research, development, demonstration, and commercial deployment of technologies utilizing biomass, wind, solar, geothermal, and hydroelectric energy sources. The centers also aid in the development of technologies focused on energy efficiency. The centers' areas of technical expertise include biomass feedstocks, biopower, bioproducts, and biofuels for transportation. Research areas include everything from the development of new tactical fuels for the U.S. Department of Defense to conducting pilot- and full-scale co-firing tests of biomass with coal.<sup>26</sup>

## Partnerships

In addition to other partnerships discussed above, others require detailed mention. The **North Dakota Department of Commerce** is the state's lead economic development agency, charged with coordinating and focusing the state's economic development resources. The department is also the lead agency for much of the state's transition into new energy industries, one of its five target industries, with a particular focus on the wind industry. These efforts involve working closely with local and regional developers across North Dakota. In addition to energy, the department also targets value-added agriculture, advanced manufacturing, technology-based businesses and tourism, many of which also will be part of the transition to a low-carbon economy.<sup>27</sup>

In support of the biofuels industry, North Dakota joined **The Regional Biofuels Corridor**, a partnership among nine states (North Dakota, Indiana, Iowa, Kansas, Michigan, Minnesota, Nebraska, South Dakota, and Wisconsin) focused on implementing the Energy Security and Climate Stewardship Platform Plan. The plan establishes a regional biofuels corridor program and directs state transportation, agriculture, and regulatory officials to develop a system of coordinated signage across the Midwest for biofuels and advanced transportation fuels.<sup>28</sup>

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<sup>8</sup> *Location Quotients: A location quotient is a useful economic base analysis tool to determine which industries have a high percentage of GDP or employment compared to a comparison area such as the nation. Location quotients with a result of 1 or higher are determined to be specialized industries.*

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## Diversification and Asset Development as an Economic Driver

While traditionally an oil and gas state, New Mexico is on a fast trajectory to diversify its energy profile. Its strategy includes taking advantage of its vast natural and renewable resources while supporting leading research and development institutions and forging cutting edge partnerships that are not only intended to drive the economy of New Mexico, but that will also have wide ranging effects on the southwest region as a whole. New Mexico is one of thirty states with a renewable portfolio standard (RPS) and by 2011, aims to generate 10 percent of its energy from renewable resources, increasing to 20 percent by 2020. In the years between 1998-2007, New Mexico's Clean Energy Sector grew by 118 percent and green jobs grew by 50 percent.<sup>1</sup> Further, according to the Pew Charitable Trusts, by 2007 577 businesses had generated more than 4,800 New Mexico jobs in the clean energy economy, and venture capitalists are investing \$148 million in New Mexico's clean energy businesses.<sup>2</sup>

The state is strategically positioned at the intersection of three of the United States' 10 major electricity grids. Being at the heart of this intersection gives New Mexico a unique opportunity to sell its power to load centers in multiple directions. As such, the state is positioning itself to combine its diverse renewable energy sources to become a hub for renewable energy.

While New Mexico is a founding partner in the Western Climate Initiative (WCI), a collaboration of western North American jurisdictions focused on reducing greenhouse gas (GHG) pollution, spurring growth in new green technologies, and reducing dependence



on foreign oil; the New Mexico Environment Department is also seeking to draft a New Mexico-specific cap and trade plan. The state has also created the Climate Change Advisory Group (CCAG) which made 69 recommendations in December 2006. Over 40 have been implemented thus far, including:

- Mandatory GHG reporting for large emitters with the intent of having better data on emissions in New Mexico;
- Renewable Energy Transmission Authority, designed to help get New Mexico's world-class renewables to market;
- Efficient Use of Energy Act, which requires its large utilities to provide more energy efficiency to their customers.

Early WCI adoption means New Mexico businesses will be ahead of the curve on a national cap and trade initiative, giving them an advantage over surrounding states. However, early adoption could lead to "leakage", losing jobs in utilities and oil and gas to surrounding states, like Texas, which have more lenient regulations. As such, as New Mexico forges a path into the lower-carbon economy, it also realizes that there is a balance to be struck between acceptable climate control elements that will allow their essential oil and gas assets to produce while still cutting GHG emissions and stimulating the growth and development of critical new clean energy technologies that will drive forward New Mexico's economy. The following outlines the various assets, opportunities and challenges that New Mexico holds as it transitions into the low-carbon economy.



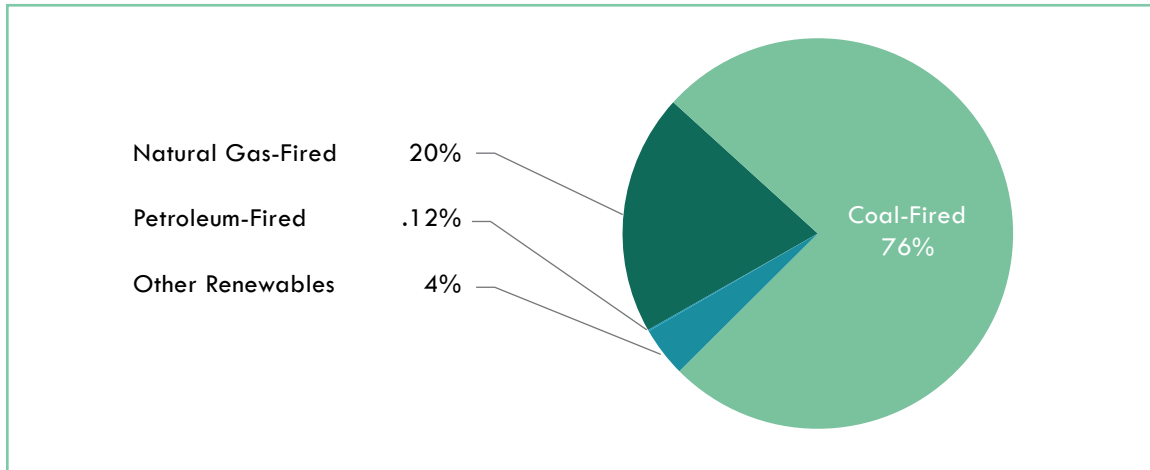
### Energy Economy Snapshot

New Mexico is rich in fossil fuel and renewable energy resources. Major oil and gas deposits are located in the state and New Mexico is a leading U.S. producer of crude oil and natural gas. Additionally, New Mexico is a top coalbed methane producer (a form of natural gas extracted from coal beds), and approximately one-third of all natural gas produced in New Mexico is coal bed methane.<sup>3</sup>

The state contains major coal deposits and much of New Mexico's Rocky Mountain region holds geothermal power potential. New Mexico additionally boasts world-class solar energy, ranking second in the nation, with the potential to provide a thousand times more energy than the Public Service Company of New Mexico's current demand.<sup>4</sup>

Pockets of the state are suitable for wind power development. New Mexico has the highest per capita wind energy usage of any state in the country and has a total of 496 mw of wind power capacity installed at its wind power plants.<sup>5</sup> According to the Western Governors' Association WREZ report, New Mexico has the largest developable renewable potential in the west at 27 gw. With a small population of fewer than 2 million people, benefiting from these resources will require exporting renewable energy to other states.

Overall, the state is mostly dependent on non-renewable sources for its electricity generation. Coal is the dominant fuel for electricity generation in New Mexico at 76 percent in 2009. Additionally, New Mexico generates 20 percent of its electricity from natural-gas fired plants, 4 percent from renewables, and .1 percent from petroleum-fired plants. However, natural gas generation nearly doubled between 2005 and 2009, as did renewable sources. Further, coal-fired generation decreased by 10 percent between 2005 and 2009. All of which are signs that New Mexico is diversifying its electricity generation sources.

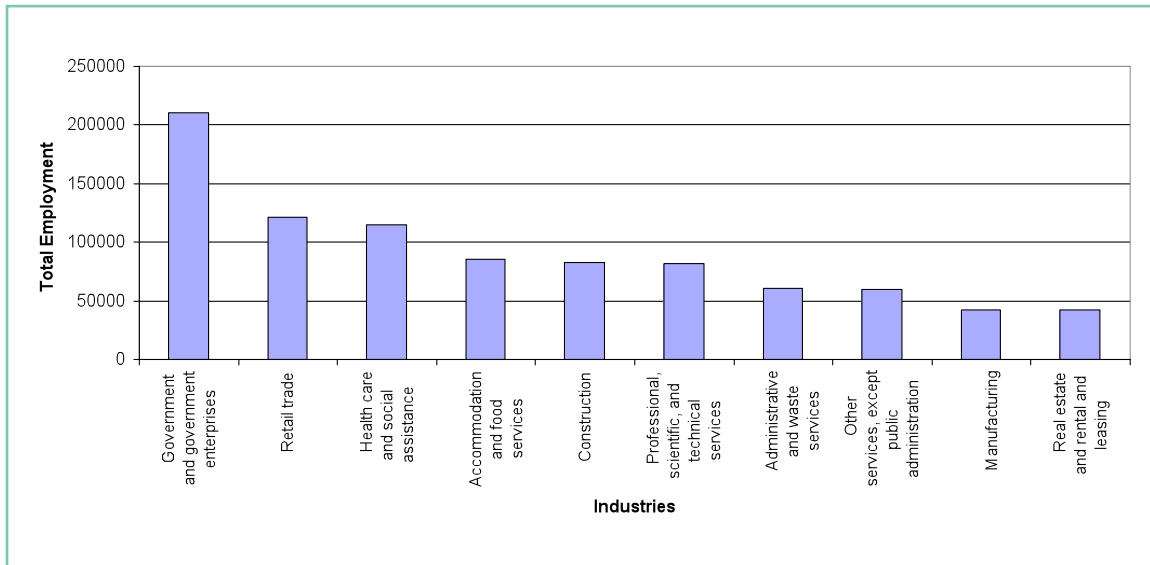
**NEW MEXICO ELECTRIC GENERATION BY FUEL SOURCE, 2009**

Source: US DOE, Energy Information Administration, State Energy Profiles, 2009

**Industry Overview of New Mexico**

In order to understand the opportunities and challenges presented in preparing for a low-carbon economy, there also needs to be an understanding of what the state's current vulnerabilities and areas of resilience are based on their current industry mix. New Mexico's diversified economy provides for a strong base for which to transition into various areas of the low-carbon economy. New Mexico's top industries are in government, retail trade, and healthcare and social services. These three industries employ approximately 400,000 employees. Accommodation and food services, construction, and professional, scientific, and technical services employ approximately 225,000 workers. Administrative and waste services, other services, except public administration, manufacturing, and real estate and rental and leasing employ approximately 200,000 workers.

## TOP 10 INDUSTRIES BY EMPLOYMENT IN NEW MEXICO: 2007



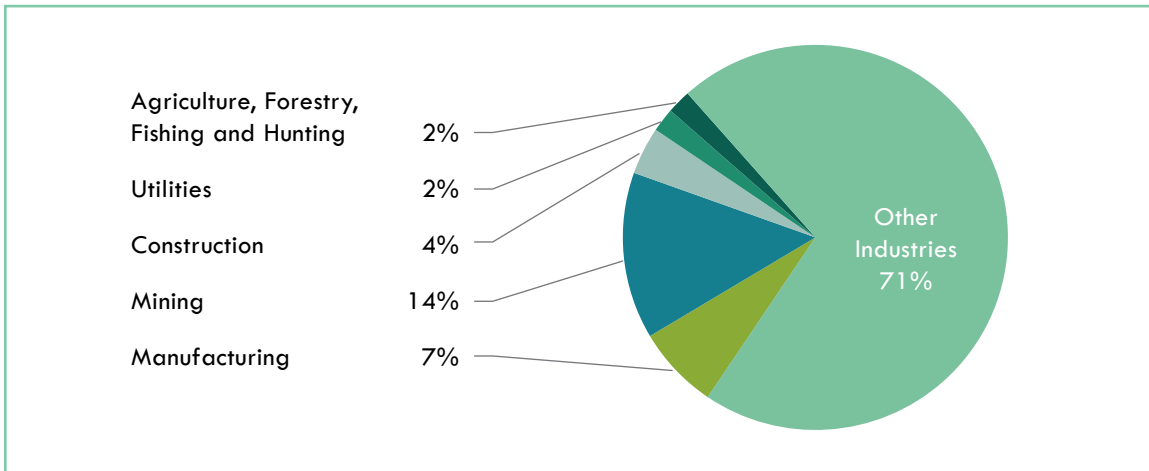
Source: BEA, 2007

Energy intensive industries make up nearly one-third of the total gross domestic product (GDP) in New Mexico, nearly double the employment figures from energy-intensive industries. Energy intensive industries make up 14 percent of the total working population in the state. Both manufacturing (4 percent) and construction (7 percent) make up the highest number of employees totaling 11 percent. Utilities, mining, and agricultural activities total 3 percent of the total working population. As measured by GDP, manufacturing and construction respectively represent 7 percent and 4 percent of the New Mexico economy. Conversely, mining composes 14 percent of New Mexico's GDP, and utilities and agriculture follow with 2 percent each.

Looking at location quotients<sup>6</sup> to understand the state's economic advantages, mining, agriculture, and utilities stand out as specializations in New Mexico's GDP. Subindustry specializations include crop and animal production (farms), oil and gas extraction, support activities for mining, and mining, except oil and gas. Employment specializations include mining, utilities, agriculture, and construction. Subindustry employment specializations include support activities for mining, mining (except oil and gas) and oil and gas extraction, and agriculture and forestry support activities.



**ENERGY INTENSIVE INDUSTRIES BY GDP IN NEW MEXICO, 2007**



Source: BEA, 2007

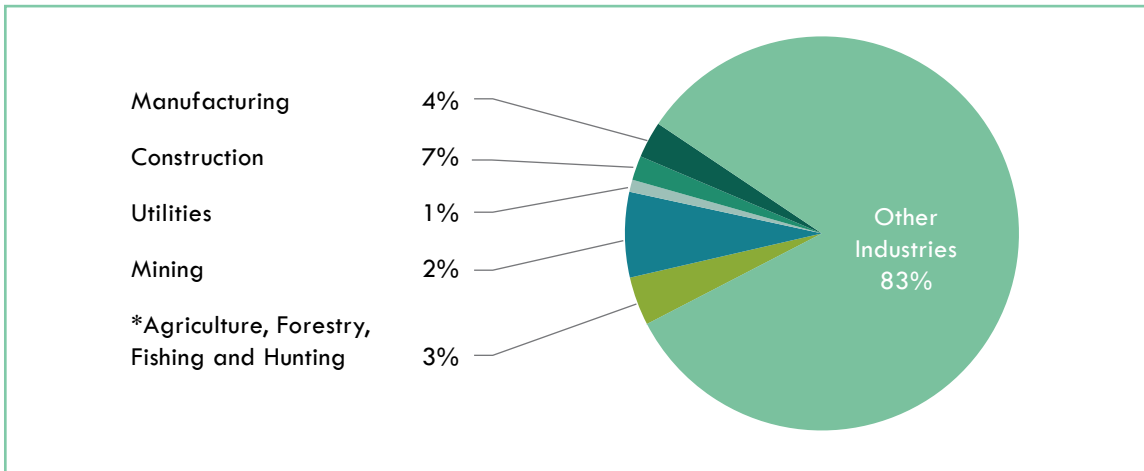
**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Agriculture, Forestry and Fishing	Mining
Location Quotient	-	.61	.99	1.04	1.55	6.85
Total GDP by Industry	\$75192	\$5,433	\$3,345	\$1,619	\$1,435	\$10,338
Percentage of State Employment	100%	7%	4%	2%	2%	14%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0



**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN NEW MEXICO, 2007**



Source: BEA, 2007 \*Includes farm employment

**LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT**

Industry	Total: All Industries	Manufacturing	Construction	Agriculture, forestry, fishing, related activities, and other	Utilities	Mining
Location Quotient		.48	1.13	1.32	1.26	4.15
Total Employment by Industry	1,100,456	42,732	80,573	30,961	4,450	24,865
Percentage of State Employment	100%	4%	7%	3%	1%	2%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0

## Preparing for the Low-Carbon Economy

In 2004, New Mexico Governor Bill Richardson gave a new name to New Mexico: the Clean Energy State. Since then, the Governor has led the state in designing one of the country's most aggressive clean energy incentive and training programs, coupling a business climate of low taxes and development costs with high accessibility to government leaders and decision-makers, garnering the support of state clean technology stakeholders, from the national labs to public universities to venture capitalists.<sup>7</sup>

New Mexico's first RPS was signed into law in 2004. This mandated that 5 percent of New Mexico's electricity come from renewable sources by 2006, increasing to 10 percent by 2011. In March 2007 the RPS was updated and the Governor signed a new bill - Senate Bill 418 - requiring that at least 15 percent of an electric utility's power supply come from renewable sources by 2015 and 20 percent by 2020. Concurrently, the Governor signed House Bill 188 to create a Renewable Energy Transmission Authority (RETA) that will promote clean energy jobs and help New Mexico to both develop its clean energy resources and to export solar, wind and other renewable energy to further build a high-tech economy in the state. RETA is the nation's first state-level financing authority whose primary focus is on developing renewable energy related transmission infrastructure. RETA has a variety of functions, including: revenue bonding and eminent domain authority to develop and finance transmission infrastructure; ability to finance or acquire interstate projects; coordinates with out-of-state authorities to establish interstate transmission corridors; and funds energy storage projects. The Transmission Authority and the Renewable Portfolio Standard work in tandem. Recently, RETA recruited the Tres Amigas Superstation to New Mexico, which will interconnect the three major U.S. energy grids and facilitate export of New Mexico renewable energy.

New Mexico is also one of the founding members of the Western Climate Initiative (WCI). The initiative requires partners to set an overall regional goal to reduce emissions, develop a market-based, multi-sector mechanism to help achieve that goal, and participate in a cross-border GHG registry. New Mexico has been an early adopter of WCI, giving them a head start to: educate their businesses on adaptation to carbon pricing; implement offset projects ahead of the curve; and send a signal to the New Mexico economy that the state is transforming into a GHG mitigation leader.





Further, the state has begun its climate change adaptation activities – led by the Governor’s Climate Change Resilience Group which is developing a state plan for adaptation to warming. The plan will identify what the state’s weaknesses are with regards to climate change, specifically in the areas of water and forestry. The plan is expected to be completed by the fall of 2010 and will provide data and decision making tools to the local level.

New Mexico has been laying a deep groundwork for transitioning its economy into not only lower-carbon areas but also areas that widen its economic base. Changes in environmental policies have been equally matched by aggressive economic development policies, which are working hand in hand to grow the dynamism and competitiveness of New Mexico.

### State and Local Support Programs and Incentives

New Mexico offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

#### *Incentives to encourage production:*

**Renewable Energy Production Tax Credit:** Each renewable energy generator of 1 mw or more may earn an income tax credit (personal or corporate) of between 1 and 4 cents per kw-hour for the first 400,000 to 500,000 mw-hours of electricity produced for ten consecutive years, beginning with the first year of production. New Mexico’s tax credit is fully refundable, meaning that a company can receive the full amount of the credit regardless of the firm’s New Mexico tax liability. The credit amounts to \$4 million for a large wind farm and \$13.5 million for a solar power plant.<sup>8</sup>

**Advanced Energy Tax Credits:** Advanced energy facilities, such as solar thermal electric, advanced technology coal or recycled energy, may qualify for up to \$60 million in credits. The credit is equal to 6 percent of facility development and construction expenditures.<sup>9</sup>

**Energy Innovation Fund:** Providing millions of dollars to public-private partnerships working to accelerate the development of innovation and enable faster commercial adaptation of clean energy technologies in New Mexico.

**Wind Energy Equipment Gross Receipts Tax Deduction:** New Mexico provides a gross receipts tax deduction for receipts from selling wind turbines, nacelles, rotors, blades and related equipment to a state or federal government entity.

**Alternative Energy Product Manufacturer's Tax Credit:** Provides grants to manufacturers of photovoltaic, solar thermal, wind, biomass and electric generation systems, electric vehicles, and fuel cell systems a tax credit of up to 5 percent of their capital expenses.<sup>10</sup>

**Biomass-Related Equipment Compensating Tax Deduction:** The value of equipment such as a boiler, turbine-generator, storage facility, feedstock processor, interconnection transformer or biomass material used for biopower, biofuels or bio-based products may be deducted in computing the compensating tax due.<sup>11</sup>

**Bio Fuels Production and Sales Tax Incentive:** Provides a tax credit on blended biodiesel fuels (a minimum of 2 percent biodiesel). Gross receipts and compensating tax may be deducted for installing biodiesel blending infrastructure up to \$50,000 per facility or \$1 million per year.

*Incentives to encourage demand:*

**The New Mexico Solar Market Development Tax Credit:** was established in 2006 to help citizens invest in clean energy for the home or business. Since its inception in 2006, more than \$13.8 million has been invested in solar installations. Of that, \$2.8 million in state solar credits was used to leverage \$1.2 million in federal tax credits. 372 solar systems producing 986 kw and 268 solar heating systems generating 20.5 million British Thermal Units (BTUs) per day have been installed in the state.<sup>12</sup>

**New Mexico's Lead by Example Initiative:** State government is implementing no- and low-cost measures like computer power management to reduce energy use in state government, and in early 2009, the Governor signed a bill that requires utilities to help their customers take advantage of cost-effective energy efficiency measures.



## Transition Assistance

With New Mexico's strong history in energy-intensive industries, much of its work in moving towards mitigating GHG emissions is in supporting the transition of its industries and its workforce. New Mexico is taking a diverse approach by pursuing multiple areas of clean technology, including: wind, solar, geothermal and biofuels. Efforts related to these industries are provided below.

### *Transitioning Industry:*

#### **Wind**

Governor Richardson is very supportive of new wind farm development and in building new transmission to serve the power markets. The first utility-scale wind power plant in New Mexico began operations in July 2003. Known as the New Mexico Wind Energy Center, it officially went online Oct. 1, 2003. The wind center consists of 136 turbines, and the facility can produce up to 200 mw of power, enough to power 94,000 average-sized New Mexico homes. Florida-based FPL Energy owns and manages the facility, while PNM, New Mexico's largest electricity provider, purchases all of its output. Exporting wind energy to other states is a key mandate of the state's Renewable Energy Transmission Authority and the Aragonne windfarm already sells its power to Arizona.

#### **Solar**

Bolstering the state's efforts to recruit new business to New Mexico, particularly in the renewable energy sector, the Schott Solar of Germany built the 200,000-square-foot plant in Albuquerque in 2008. The plant has hired more than 300 workers and has invested more than \$100 million in the local economy with the construction of the plant and plans to quadruple its size and workforce over the long term with additional investments of up to \$400 million. The plant is one of the company's largest operations in the U.S., and the first in the world capable of producing both photovoltaic panels for homes and businesses and thermal receivers for large-scale solar power plants.<sup>13</sup> Furthermore, in December 2008, Signet Solar Inc. announced intentions to build a manufacturing facility and a solar farm in the state that is expected to create 600 jobs.



### **Geothermal**

In addition to solar and wind development, New Mexico holds great potential in the geothermal sector, and the state is beginning to identify synergies between geothermal and the oil and gas sectors. One of the most intensive capital costs in geothermal is the drilling of wells, as such the state is exploring reusing oil and gas wells where there is a high temperature resource present. Further, the workforce of geothermal and the oil and gas industries have many parallels in terms of job skills, which may help to mitigate ebbs and flows in the fossil fuel industries in the future.

### **Biofuels**

Liquid fuel derived from algae also has promise in New Mexico, given its abundant sun and brackish water supplies. Sapphire Energy was recently awarded over \$100M in federal funding for a 300 acre demonstration facility in Columbus, NM. In addition, a large bio-gas plant digesting agricultural waste will begin construction in 2010 in the Las Cruces area complementing the state's dairy industry.

### **Transitioning the Workforce:**

New Mexico has the highest number of PhD's per capita in the U.S., which is serving as a critical asset to their continued focus in R&D initiatives, especially as these initiatives expand into the clean tech sectors. However, in addition to growing R&D jobs, the state is aiming to grow all job levels of the value chain from research to production, installation, monitoring, services etc. As such, New Mexico developed the Green Jobs Cabinet, led by economic development cabinet Secretary Fred Mondradon. The Green Jobs Cabinet report outlined five strategies to grow New Mexico's green economy; Governor Richardson put them into action with executive order 2010-001.

- GOAL #1: Be the Leader in Renewable Energy Export
- GOAL #2: Be the Center of the North American Solar Industry
- GOAL #3: Lead the Nation in Green Grid Innovation
- GOAL #4: Be a Center of Excellence for Green Building and Energy Efficiency
- GOAL #5: Have a Highly Skilled and Ready-to-Work Workforce



The composition of the cabinet shows its holistic and far reaching approach by representing all of the major cabinet secretaries from the various state departments. Further the Green Jobs Cabinet report outlines a comprehensive strategy for achieving growth in the green economy, which includes:

- Provide incentives for job creation;
- Stimulate or guarantee demand at state and local levels for the products of existing clean tech manufacturers and producers, and assist in attracting new businesses;
- Develop a highly skilled workforce; and
- Provide a supportive regulatory environment.

There are already interesting developments coming out of this plan. The New Mexico Department of Agriculture is developing a plan for biofuels development as well as a sustainable agriculture plan. Further, the Environment Department is developing a permitting guide for green businesses. Additionally, the Green Jobs Cabinet developed a partnership publication called the Green Jobs Guidebook which serves as a resource for job seekers, students, guidance counselors, career advisors, decision makers, etc. The guidebook provides job descriptions, salary information, educational requirements, certification programs, etc. regarding green jobs in New Mexico and the U.S.

In order to meet the demand for a skilled-workforce in the wind industry, the Mesalands Community College established the North American Wind Research and Training Center (NAWRTC). The NAWRTC began offering training for operations and maintenance and wind farm management in fall 2008. According to NAWRTC's 2005 feasibility study, the industry needs innovation and best practices for wind turbine operations, and maintenance and the curriculum is built around those requirements. Sandia National Laboratories and New Mexico State University will conduct research at the center. The college also approved a \$2.2 million contract with General Electric (GE) in July 2007 for a 240-foot wind turbine on the campus, funded by the state legislature and Department of Labor. Moreover, in 2008 GE's vice-president of renewable energy promised to hire every graduate of Mesalands Community College's wind power program for the following three years.<sup>14</sup>



Further, New Mexico has a diversity of organizations and initiatives dedicated to supporting entrepreneurship within the state. The Department of Workforce Solutions is convening a Green Industry Council to track green job creation as well as convening a clean energy entrepreneurship working group. The State Research Applications Center (RAC) was created during the 2009 legislative session (SB 205), and will bring together researchers, entrepreneurs and companies to transition technology from the labs and into businesses.

### Investing in Innovation

Innovation represents the heart of what will enable the economy to transition. This is being enabled through pilots and through research and development in alternative energies to reduce their costs, and assisting high emitting industries and firms adapt to this new economic environment. Below outlines some of the innovation initiatives taking place in New Mexico.

New Mexico has two world class research facilities in Los Alamos and Sandia National Laboratories, and both of these are being utilized as critical assets to advancing New Mexico's lower-carbon economy.

Los Alamos National Lab (LANL) is focusing on three major areas of energy research, including:

- **Fuel cells:** LANL scientists are developing better materials and technologies to improve the different components of the fuel cell. These improvements include decreasing the costs of the catalyst, improving the materials that make up the membranes, understanding what degrades the performance of fuel cells including the effects of fuel and air impurities, understanding water management inside the cell, and improving on-board vehicle hydrogen storage.
- **Carbon capture:** LANL scientists are looking to the future-hundreds of years-to perfect CO<sub>2</sub> storage; most importantly, making sure it is secure. Increasing the time stored and volume of sequestration multiplies risks, so Los Alamos researchers (also experts at hazardous waste storage) are applying varied capabilities to tackle the carbon sequestration.
- **Early climate change detection:** LANL scientists and collaborators work to measure global climate change at plant tissue level, creating an early warning system that could prevent ecological collapse.<sup>15</sup>



Sandia National Lab is focusing on a multitude of research areas in its Renewable Energy Technologies Division. Their focus is to develop commercially viable energy technologies based on solar, wind, and geothermal resources that become significant domestic and international energy supplies, with a primary focus on the utility sector. Additionally, New Mexico has been receiving funding from the U.S. Department of Energy to study the development and deployment of geothermal technologies within the state.

### ***Energy Efficiency***

New Mexico is equally looking at ways to increase its energy efficiency. In January 2009, The Energy, Minerals and Natural Resources Department Cabinet Secretary announced the release of a new report titled “New Mexico Energy Efficiency Strategy: Policy Options.” The study estimates that by implementing all of 25 options offered in the report, New Mexico could cut energy use per capita by 20 percent by 2020 and could save \$7.2 billion in net economic savings for citizens and businesses in the state. Implementing the options also would help the state meet its climate change goals by reducing GHG emissions by 8.7 million metric tons by 2020. It additionally states that by 2020, New Mexico electricity use could be reduced by 24 percent, natural gas use by nearly 20 percent, and gasoline use by 26 percent, compared to forecasted levels of energy use.<sup>16</sup>

The state aims to initially focus on low-income energy efficiency assistance, energy efficiency requirements for state agencies, stabilizing per capita vehicle miles traveled, energy efficiency for local governments and schools, greener building energy codes, expanded electric utility and natural gas energy efficiency programs, and energy efficiency public education campaigns. Other measures called for by the report that may be considered include adoption of innovative electricity rates, adoption of a residential energy conservation ordinance to spur energy efficiency, and energy savings requirements for local governments and public schools to meet in order to receive state funds.

Of particular relevance to economic development, the Energy Conservation Management Division of the New Mexico Energy, Minerals and Natural Resources Department works with the New Mexico Construction Industries Division of the Regulation and Licensing Department and a diverse stakeholder community to improve building codes, beyond the International Energy Conservation Code requirements, in order to increase energy efficiency for all new construction in the state.



## Partnerships

In addition to the initiatives discussed thus far, other noteworthy partnerships working in New Mexico are detailed below.

**New Mexico Economic Development** is the cabinet agency for economic development under Governor Bill Richardson's administration. The green economy is a major focus area for the department. In addition to Cabinet Secretary Fred Mondragon heading up the Green Jobs Cabinet for the state, the department works to market New Mexico as a premier clean tech hub and to recruit and further develop clean tech industries in the state.<sup>17</sup>

**The New Mexico Partnership** is a public-private, non-profit entity designated by the State of New Mexico and created by Governor Bill Richardson in 2003 solely to help companies locate and expand within New Mexico.

**Initiative on the New Mexico Green Grid** New Mexico's Green Grid Initiative is receiving world-wide attention due to the unique partnership of New Mexico with the New Energy and Industrial Technology Development Organization (NEDO) of Japan. New Mexico is the only state that has an agreement with Japan on joint economic development. NEDO is a partner in the Green Grid Initiative and expects to provide up to \$30 million for Japanese companies to partner in two of the five demonstration projects. The combined projects call for the installation of thousands of "smart meters" in homes and businesses, which can help consumers better monitor their energy use; construction of a wind farm in Roosevelt County; and installation of solar panels to power homes and businesses, among other projects.<sup>18</sup>

**New Mexico Renewable Energy Transmission Authority (RETA)** The New Mexico Renewable Energy Transmission Authority focuses on developing new transmission projects to promote renewable energy. It is the first of its kind in the nation, and an innovative and bold move to stimulate clean energy production and create high paying jobs, capital investment and greater economic development in rural areas.





**WIRED Seeding Innovation in New Mexico's Green Manufacturing Cluster** The goals of the New Mexico WIRED project are to foster entrepreneurship, generate talent and encourage innovation in public policy. The New Mexico WIRED project will inspire and support the innovative development and expansion of green manufacturing in New Mexico which includes advanced manufacturing, green building, clean and renewable energies, aerospace, micro-electronics and optics. The project is managed by the New Mexico Department of Workforce Solutions.

**Green Industry Council** Green Industry Council to help establish curricula in the public education system, among other tasks.

**Clean Energy Working Group** brings together point people from all of the essential New Mexico departments to resolve company requests quickly and effectively.

**Southwest Biofuels Association** The Southwest Biofuels Association (SWBA) is a non-profit organization promoting renewable biofuels through strategic partnerships between the Southwest's biofuel industry, universities, national laboratories, state agencies, educators, consumers, business entrepreneurs, agribusiness, environmental and other interested organizations. SWBA fully endorses an ecosystem-based, scientifically grounded approach to solving the energy crisis in the United States and eliminating dependence on foreign oil.<sup>19</sup>

**New Mexico Wind Working Group** is a collaborative group of individuals, professionals, and wind industry participants who have assembled to promote the development of wind energy in the state. The purpose of the group is to discuss, develop, and implement the tasks and methodologies that will hasten the development of wind energy in New Mexico. The group's objective is to promote environmental protection and boost economic development within the state through the use of wind energy and to foster the increased use of wind-generated electricity by the energy generators and consumers of New Mexico. Activities of the New Mexico Wind Working Group are funded by the U.S. Department of Energy and coordinated by the New Mexico Energy Conservation and Management Division.<sup>20</sup>



## Multi-Jurisdictional Cooperation

Issues of energy and energy planning almost always cross jurisdictional borders. Whether in exporting energy, or coordinating a state-wide energy planning effort, support among multiple levels and jurisdictions of government is critical. As a paramount example of this cooperation, the New Mexico Economic Development Partnership which serves as the lead liaison to renewable developers that are interested in locating in New Mexico, holds strong relationships with local economic developers throughout New Mexico. As such, when a firm is interested in locating in New Mexico, the Partnership helps local economic developers through the process and provides them with assistance on how they should position their community.

Further, Governor Richardson's recent executive order charged the Departments of Indian Affairs and Economic development with ensuring that tribal communities are aware of and tuned into the green job opportunities that are growing in New Mexico. This is a critical piece to ensuring that there is inclusion in the development of green jobs.

Lastly, as previously mentioned, New Mexico is a cofounding member of the Western Climate Initiative which is an interstate agreement designed to develop regional strategies to address climate change. Each member state and province designates representatives to lead the effort. These WCI Partners direct the overall work of the WCI, and form working Committees as necessary to accomplish the work of the WCI. Each WCI Partner jurisdiction may designate representatives to serve as members on each Committee.

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## Strategic Use of Agricultural Assets

Nebraska has strong roots in the agricultural sector, which it is using to its advantage to move forward its low-carbon economy while fueling economic growth. Its strategy includes taking advantage of its vast agricultural lands to support biofuels and wind development and production. Nebraska is among the top states in per capita ethanol consumption and was the second largest producer of ethanol in the country in 2009, according to the Nebraska Energy Office.

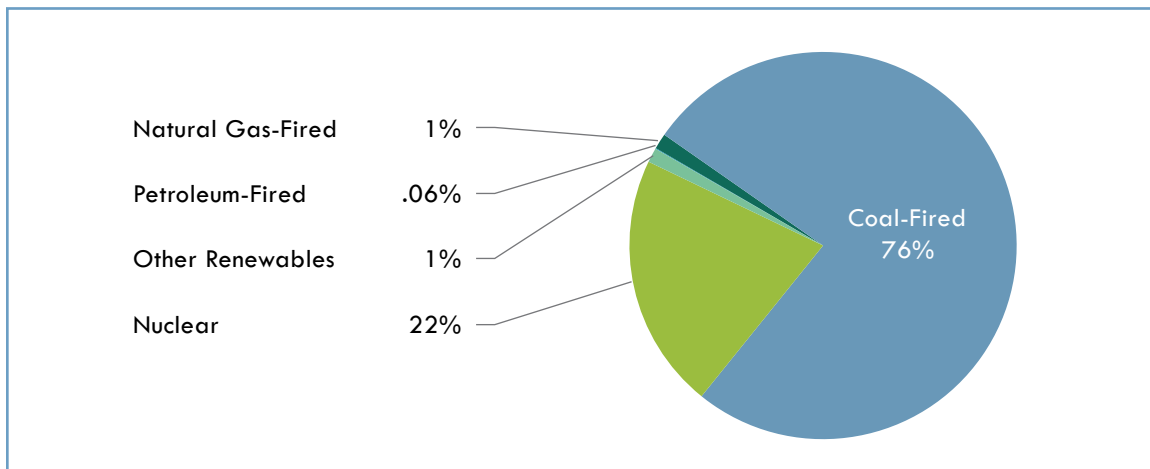
Nebraska ranks sixth in the nation for commercial-scale wind energy potential. As of November 2009, the state had 153 megawatts (mw) of installed wind energy capacity and 3,726 mw in development queues.<sup>1</sup> Nebraska also has significant solar energy resources, especially in the western part of the state. The U.S. Energy Information Administration reports that the state ranks 19th in the nation for solar energy potential. In spite of the lower national ranking for solar energy potential than wind, a difference of only .10 separates 19th-ranked Nebraska from fifth-ranked Colorado, indicating great potential for Nebraska in the solar market.<sup>2</sup> The state has also made outstanding strides in supporting energy efficiency initiatives, many of which are discussed below.

The following outlines the various assets, opportunities and challenges that Nebraska holds as it transitions into the changing energy economy.

### [Energy Economy Snapshot]

Nebraska is the only state in the nation in which 100 percent of electric power is provided at the retail level by public utilities.<sup>3</sup> Constitutional and statutory requirements stipulating that Nebraska's public utilities provide power to consumers at the lowest possible cost have helped to keep electric rates in the state very low. The state receives virtually all of its coal supply by rail from Wyoming, and has two nuclear power plants that are located along the Missouri River on the state's eastern border, along with several small hydroelectric dams along the Platte River.<sup>4</sup>

#### MICHIGAN'S ELECTRIC GENERATION BY FUEL SOURCE, 2009



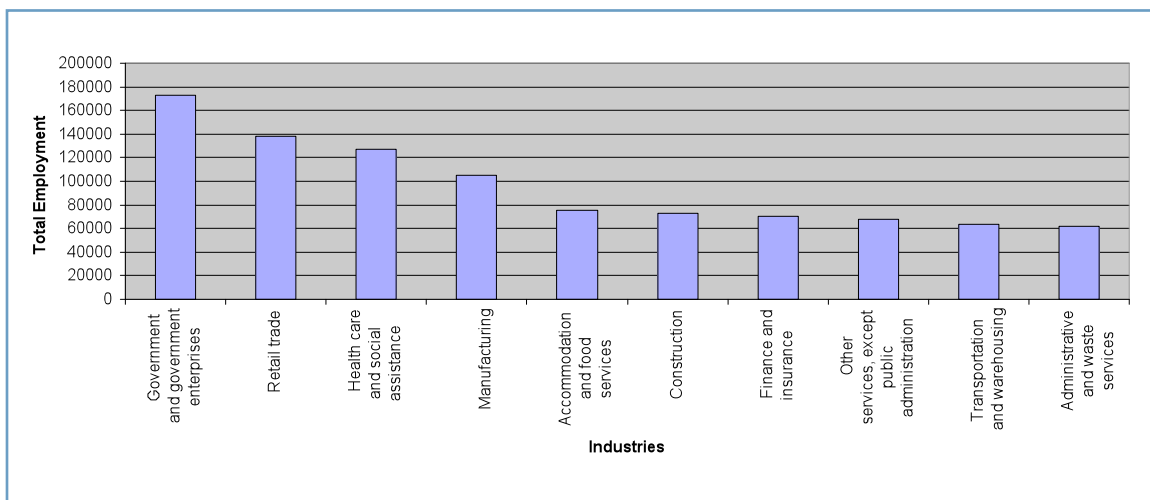
Source: US DOE, Energy Information Administration, State Energy Profiles, 2009

In 2009, coal accounted for 76 percent of electricity generation in Nebraska. Nuclear accounted for 22 percent of the state's generation and renewables (other than hydroelectric) accounted for 1 percent, as did natural-gas. Petroleum-fired plants accounted for less than 1 percent of Nebraska's electricity.

## Industry Overview of Nebraska

Identifying the opportunities and challenges emerging from the move to a low-carbon economy requires an understanding of the state's vulnerabilities and areas of resilience in its current industry mix. Nebraska's employment is focused in government, retail trade, healthcare and social services, and manufacturing. Together, these industries employ 537,000 workers. Accommodation and food services, construction, finance and insurance, and other services except public administration employ over 410,000 employees in the state.

### TOP 10 INDUSTRIES BY EMPLOYMENT IN NEBRASKA: 2007

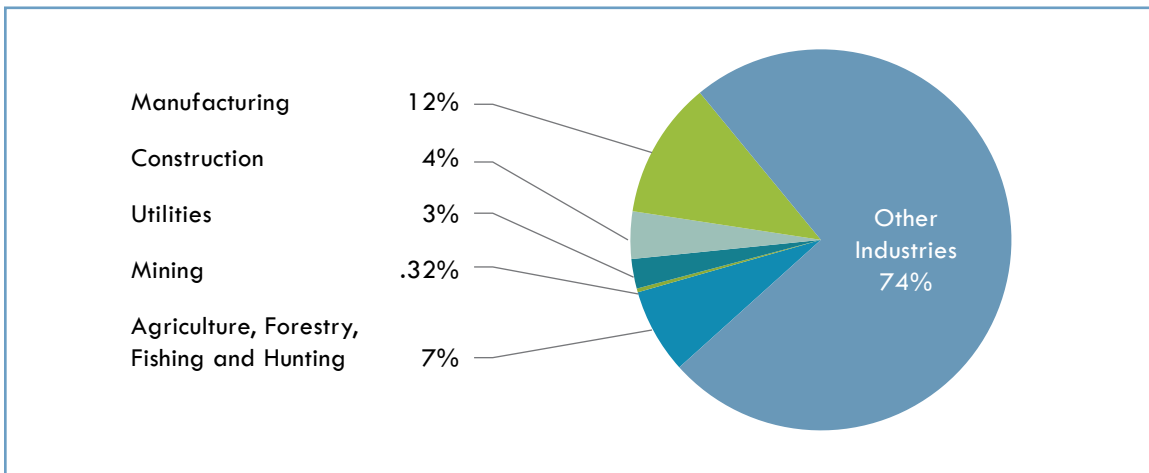


Source: BEA, 2007

Energy-intensive industries employ 19 percent of the total working population in the state and comprise 26 percent of the state's gross domestic product (GDP). Manufacturing (8 percent) and construction (6 percent) have the highest number of employees, totaling 14 percent. Utilities, mining and agriculture-related activities total just over 5 percent of the total working population. In regards to GDP, manufacturing (12 percent) and agriculture (7 percent) represent the largest proportion of GDP of the energy-intensive sectors, totaling about 19 percent. Construction accounts for 4 percent of the state's GDP.

Using location quotients to understand the state’s economic advantages, agriculture stands out as a specialization for Nebraska in terms of GDP, especially in crop and animal production but also in forestry, fishing, and related activities.<sup>5</sup> Nebraska’s employment specializations in agriculture and manufacturing also are apparent, especially in the areas of farm employment, agriculture and forestry support activities, food manufacturing, machinery manufacturing, and printing.

**ENERGY INTENSIVE INDUSTRIES BY GDP IN NEBRASKA, 2007**



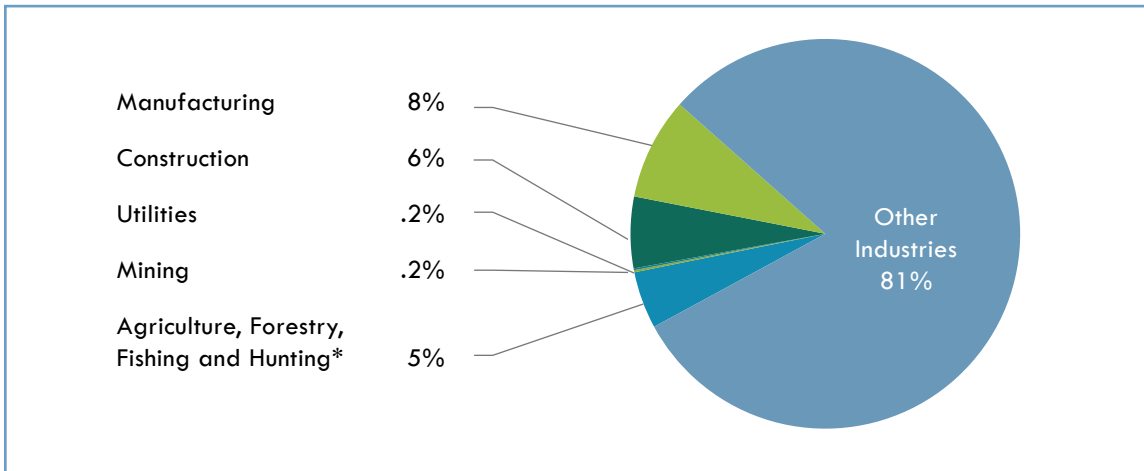
Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Mining	Construction	Manufacturing	Utilities	Agriculture, Forestry and Fishing
LOCATION QUOTIENT		.15	.89	.98	1.21	5.8
Total GDP by Industry	\$80360	\$257	\$3214	\$9310	\$2010	\$5782
Percentage of State GDP	100%	.32%	4%	12%	3%	7%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0

**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN NEBRASKA, 2007**



\*Includes farm employment Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY EMPLOYMENT**

Industry	Total: All Industries	Mining	Utilities	Construction	Manufacturing	Agriculture, Forestry and Fishing
Location Quotient		.31	.47	.91	1.05	2.22
Total Employment by Industry	1,234,186	2,123	1,865	73,046	104,680	58,633
Percentage of State Employment	100%	.2%	.2%	6%	8%	5%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0



## Preparing for the Low-Carbon Economy

Nebraska is the only U.S. state with 100 percent publicly provided power. Public power utilities are not-for-profit and are controlled by publicly elected boards, rural electric cooperative boards, and elected or appointed city council representatives. These utilities are chartered to generate and deliver power to their customers reliably and at the lowest cost.

Despite the goals of the Nebraska Public Power District and Omaha Public Power District of producing 10 percent of their energy from new renewable resources by 2020, these utilities face challenges that differ from those in other states. For example, incentives to build renewable energy sources are significantly greater in neighboring states. Further, some of these states also have higher wind energy potential, which is reflected in larger wind developments.<sup>6</sup> Public power utilities in Nebraska do not qualify for Federal Production Tax Credits, or recently expanded tax credits or grants.

However, Nebraska is making strides to develop its clean tech sectors, particularly with regard to biofuels, which are complementary to the state's agricultural background, focus and geographic location. Ethanol, for example, has created more than \$3 billion in economic activity in the state and more than 3,000 jobs, as well as generating more than \$63.3 million in new tax revenues, according to the Nebraska Ethanol Board, and the governor supports the expansion of the state's ethanol activities.<sup>7</sup> Further, the state is working to drive growth in solar and wind energy, initiatives which are further elaborated in the Transition section below.

## State and Local Incentives

Nebraska offers state and local incentives that support the transition to a lower-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

### *Incentives to encourage production:*

**Renewable Energy Tax Credit** is for electricity generated at a new zero-emission facility powered by wind, moving water, solar, geothermal, fuel cell, methane gas, or photovoltaic technology. Total tax credits are capped and the program is scheduled to end in 2018.<sup>8</sup>

In April 2007, the **Rural Community-Based Energy Development Act** was passed to support the development of community wind energy. According to Windustry “community wind” refers to wind energy development that intentionally seeks to optimize local benefits.<sup>9</sup> These projects are locally owned, and sell or offset energy on the electric grid. Community members thus have a direct financial stake in the project beyond just the land leases or local tax revenue. It may include a local school district purchasing and operating a turbine near a school building, or several local landowners joining together to share the costs of purchasing several turbines.

To further encourage community wind projects, Nebraska implemented the **Sales and Use Tax Exemption for Community Wind Projects** in 2007. This allows for an exemption from the sales and use tax imposed on the gross receipts from the sale, lease, or rental of personal property for use in a community-based energy development project.<sup>10</sup>

Nebraska has been ranked 19<sup>th</sup> in the country in the area of solar energy potential. However, little to no capacity has been installed yet. While the state does have a **tax credit for renewable power generation**, it is primarily geared toward large producers. However, if any type of federal legislation or cap and trade comes through on a national level, Nebraska is set up to let solar users keep their solar renewable energy tax credit (mentioned above).

The state’s **Ethanol Production Incentive Cash Fund** supports expanded ethanol development, and the state has 23 facilities producing over 1.5 billion gallons of ethanol annually.

#### *Incentives to encourage demand:*

Nebraska has developed an array of energy efficiency programs that cross a variety of areas, including commercial and residential energy efficiency; energy efficiency innovation grants for businesses; HVAC maintenance rebates; incentives for improving the efficiency of irrigation systems and more.

**The Nebraska Energy Office Dollar and Energy Saving Loans Program** is arguably the most notable program in Nebraska for implementing energy efficiency and renewable energy projects. The program provides low interest loans as low as 2.5 percent to help homeowners, farm operations, local governments, and non-profit groups make energy-saving improvements. Offered through a partnership between the Nebraska Energy Office and lending institutions across the state, the program encourages residents and commercial operations to replace

aging furnaces, seal homes and other buildings against air leaks, replace drafty windows and doors, or add insulation. Since 1990, nearly 25,000 loans totaling \$198 million have been approved, with more than 90 percent of all projects helping finance improvements on homes across the state. Qualified upgrades also may include upgrading to Energy Star-certified appliances and office equipment, or installing telecommunications equipment that reduces the need to travel and associated costs.<sup>11</sup>

Further, in July 2005, the **Nebraska Energy Code**, which is based on the 2003 International Energy Conservation Code, replaced the 1983 Model Energy Code, which had been the state standard for 20-plus years. The code applies to all new buildings and to renovations of or additions to existing buildings. However, only those renovations that will cost more than 50 percent of the replacement cost of the building must comply with the code. Cities and counties may adopt codes that differ from the Nebraska Energy Code; however, state law requires the adopted code to be equivalent to the Nebraska Energy Code.

### **Transition Assistance**

With Nebraska's abundance of agricultural land, much of its work in moving toward mitigating greenhouse gas (GHG) emissions and driving its lower-carbon economy is in supporting the transition and adaptation of industries that complement the state's agricultural background. Nebraska is actively involved in the recruitment and development of clean energy-related businesses.

### **Biofuels**

Nebraska is committed to growing and developing its already robust biofuels industry. The state's Department of Economic Development and Ethanol Board work with a number of different entities on exploring ideas and opportunities for second-generation biofuel facilities and the potential for new technologies that will fuel the U.S. in the years to come. Nebraska is the second largest ethanol-producing state in the nation. Its location, combined with a large corn crop and competitive rail transportation, puts Nebraska in a prime position to serve key ethanol and biofuel markets now and in the future. Nebraska leverages this advantage by working with companies and site consultants on recruitment activities.

Moreover, as noted above, ethanol has created more than \$3 billion in economic activity and more than 3,000 Nebraska jobs, generated more than \$63.3 million in new tax revenues and produces over 1.5 billion gallons of ethanol annually at 23 facilities. Soy-based biodiesel facilities also are operating in the state. Over \$60 million was invested in the research, development, and promotion of soy biodiesel over the past 12 years.<sup>12</sup> Nebraska also has great potential for producing biofuels from cellulosic biomass, especially switchgrass.

### ***Wind***

Nebraska's high potential for the development of wind energy could make it an exporter of this resource, but modifications in the utilities' current business model would be required. In 2009, the Nebraska legislature authorized a study led by the Natural Resources Committee that explored legislative changes needed to better enable development of wind-generated electricity for export to markets outside Nebraska. As a result of the study, the Natural Resources Committee introduced a bill to encourage opportunities for private developers to develop, own, and operate facilities for the export of wind energy from the state, while at the same time preserving the benefits Nebraskans receive as a result of the state's unique public power system. The bill would exempt certified renewable export facilities from eminent domain proceedings that might be brought by municipalities, public power districts, electric cooperatives among others, thus removing what is viewed as a significant barrier to greater wind energy development. In addition, the bill provides a new method of taxing projects that will benefit local communities and developers by creating an alternative to the five-year accelerated depreciation of personal property schedule that is currently in place.

Further, Nebraska is active at industry tradeshows, such as the American Wind Energy Association's WindPower conference and exhibition. The state proactively recruits manufacturers from all sectors of this growing industry. Moreover, Nebraska is working to grow its existing manufacturers and to help interested businesses connect to the wind industry supply chain.

### **Solar**

Nebraska's recruitment of the solar energy industry is primarily focused on the manufacturing of solar panels and related devices. To successfully recruit these companies, Nebraska attends and exhibits at Solar Power International, the premiere solar event in the U.S., and the Renewable Energy Technology Conference & Exhibition. In addition, Nebraska maintains contact with the University of Nebraska system and its efforts in developing and promoting solar energy production.

### **Investing in Innovation**

Innovation represents the heart of what will enable the economy to transition. This is being catalyzed through R&D in alternative energies to reduce costs, and assist traditional energy industries and firms in adapting to this new economic environment. Nebraska has a deep agricultural history that is being drawn upon as a critical asset to advance innovation.

In 2006, the Nebraska Center for Energy Sciences Research (NCESR) began as a collaboration between the Nebraska Public Power District (NPPD) and the University of Nebraska-Lincoln. The center supports both basic and applied research and explores a broad range of renewable energy opportunities, including biofuels, wind energy, solar energy, and energy conservation. NPPD has made a \$10 million commitment to the University to invest \$1 million per year in energy-related research for ten years.

Faculty competes annually for energy research funding from NCESR. Since 2006, 39 research grant proposals have been approved and funded. Examples of funded projects include nano-magnetic refrigerator compressors to improve energy efficiency; wireless "smart" network climate controls for houses and commercial buildings; new enzymes for converting cellulosic biomass to biofuels; and passive solar buildings to reduce heating and cooling costs. University researchers have been successful in attaining additional grant funding based on the success of their work. For the initial 14 projects funded by the center, researchers have been awarded an additional \$5.2 million in supplemental grant funding from private companies, the Department of Energy, the National Sciences Foundation, and other federal and state agencies.

### **Carbon Sequestration**

The University of Nebraska Carbon Sequestration Program studies carbon sequestration potential in both dryland and irrigated cropping systems in the north-central U.S. It also researches biophysical control on carbon sequestration. Through funding from the U.S. Department of Energy, the program developed a state-of-the-art research facility. Having a head start on this research could potentially give Nebraska an advantage in the offset market if a national carbon pricing system comes to fruition.

### **Smart Grid**

Nebraska received federal American Recovery and Reinvestment Act (ARRA) funds to implement smart grid technologies in two power districts. Cuming County Public Power District will receive \$1.8 million to install communications infrastructure and deploy control software. The Stanton County Public Power District will get \$397,000 to extend a smart meter network and deploy an additional 2,400 smart meters, along with computer software and hardware and data collections systems.

### **Partnerships**

Promising partnerships and coordination efforts that are growing in Nebraska to support GHG mitigation and drive economic growth are summarized below.

**The Nebraska Department of Economic Development** is the lead economic development agency for the state. Bioscience, wind, and solar are all target industries for the department. The Department also assists local Nebraskan communities/regions through a local targeting process.

In July 2008, the **Nebraska Energy Office** was made a stand-alone, cabinet-level agency within state government. The office advises state leaders on energy policy issues and manages several programs, including dispensing federal Department of Energy grants and funds and partnering with lending institutions to provide low-interest loans for energy upgrades and improvements to homes, buildings and transportation infrastructure. It also provides support for the state's wind energy working group and national advocacy organizations such as the Governors' Biofuels Coalition and the Governors' Public Power Alliance.

In October 2009, the U.S. Department of Energy approved the Nebraska Energy Office's State Energy Program Plan for \$30.91 million in ARRA funds. Selected activities include:<sup>13</sup>

- Advanced Renewable Energy Demonstration Projects
  - ARRA Funds: \$5 million
  - Estimated Jobs Created/Retained: 65
  - Estimated Annual Energy Savings: 65 million Mbtu (million btu)
  - Proposals were requested through a competitive solicitation for innovative renewable energy projects.
  - 43 wind projects totaling \$57.6 million are seeking funding
- State Building Energy Efficiency
  - ARRA Funds: \$10 million
  - Estimated Jobs Created/Retained: 110
  - Estimated Annual Energy Savings: 143 million Mbtu
  - \$6 million will fund energy efficiency building improvements on the University of Nebraska, state and community college campuses.
  - \$4 million will fund energy efficiency improvements in state government buildings under the management of the Administrative Services State Building Division.
- Building Energy Code Training and Enforcement
  - ARRA Funds: \$315,000
  - Estimated Jobs Created/Retained: 5
  - Estimated Annual Energy Savings: 152.4 million Mbtu
  - The Energy Office will provide information on residential and commercial building energy codes, and conduct training and certification for city and county code officials and members of the construction industry.
  - Update the state's building energy codes as appropriate.
  - Upgrade the state's efforts on building energy code compliance and inspections.
- Renewable Energy Curriculum
  - ARRA funds: \$1.91 million
  - Estimated Jobs Created/Retained: 21
  - The Energy Office will request proposals to develop renewable energy curricula – wind, solar, biomass and energy efficiency – at Nebraska's technical community colleges.

- Consumer Information on Energy Efficiency and Renewable Energy
  - ARRA funds: \$585,000
  - Estimated Jobs Created/Retained: 7
  - The Energy Office will develop and distribute information on energy efficiency and renewable energy choices so that Nebraskans can make wise decisions on their energy use. The information will be distributed electronically and in written formats.
  - Includes funds for 10 Wind for Schools projects.
- Dollar & Energy Saving Loans
  - ARRA Funds: \$11 million
  - Estimated Jobs Created/Retained: 135
  - Estimated Annual Energy Savings: 113.1 million Mbtu
  - Funds will be added to the existing Dollar & Energy Saving Loan Program.
  - \$11 million for 2.5 percent loans for commercial and industrial-sector building improvements, including K-12 schools. Maximum loan amount: \$750,000.
- Administration, Evaluation, Monitoring and Reporting
  - ARRA funds: \$2.1 million
  - Estimated Jobs Created/Retained: 23
  - The Energy Office will administer ARRA funds, monitor grants and report on required activities. The Energy Office will make periodic on-site inspections of ARRA-funded projects to document progress and compliance with ARRA-funded contracts. The state's Dollar and Energy Savings Loan program will also be evaluated.

In September 2009, Nebraska benefitted from additional ARRA funding to support energy efficiency and conservation activities under the Department of Energy's Energy Efficiency and Conservation Block Grant (EECBG) program. It received an \$18.8 million award, of which \$9.2 million is reserved for the state's most populous 10 counties and 10 cities. Of the remaining total, \$9.59 million is reserved for competitive grants to all communities. Sixty percent, or approximately \$5.76 million, of this amount is reserved for communities not receiving direct payments (those not among the most populous counties or cities). The state will use its Recovery Act EECBG funding to improve lighting efficiency, complete building retrofits, and expand renewable energy in the state. These projects are intended to lead to substantial energy and cost savings and create or retain more than 100 jobs statewide. Sixty percent of the funds awarded will be passed along to local governments.<sup>14</sup>



## ENDNOTES

- 1 Nebraska Energy Office, Nebraska Wind Working Group, Wind Power 2009 Conference, <http://www.neo.ne.gov/renew/wind-working-group/2009conference/conferencesignup-agenda.htm> (2009).
- 2 Nebraska Energy Office, Comparison of Solar Potential by State, <http://www.neo.ne.gov/statshml/201.htm> (Mar. 11, 2010).
- 3 The public power utilities are not-for-profit and are controlled by publicly elected public power boards, rural electric cooperative boards, and elected or appointed city council representatives that are chartered to deliver power at the lowest cost.
- 4 U.S. Energy Information Administration, State Energy Profiles: Nebraska, [http://tonto.eia.doe.gov/state/state\\_energy\\_profiles.cfm?sid=NE](http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=NE) (Apr. 29, 2010).
- 5 \*Location Quotients: A location quotient is a useful economic base analysis tool to determine which industries have a high percentage of GDP or employment compared to a comparison area such as the nation. Location quotients with a result of 1 or higher are determined to be specialized industries.
- 6 Nebraska Renewable Energy Association, <http://www.nebraskarea.org> (2008).
- 7 The Grand Island Independent, "Governor says the state has great potential in renewable energy", September 16, 2009
- 8 Nebraska Legislature, Nebraska Revised Statute 77-27,235. Renewable Energy Tax Credit; Department of Revenue, Environmental Quality Council; Powers, (Lincoln, NE: 2006).
- 9 A nonprofit, 501(c)3 organization partnered with the Institute for Agriculture and Trade Policy (IATP), another nonprofit organization that promotes resilient family farms, rural communities and ecosystems around the world through research and education, science and technology, and advocacy.
- 10 Database of State Incentives for Renewables & Efficiency, Nebraska: Incentives /Policies for Renewables & Efficiency, <http://www.dsireusa.org/incentives/index.cfm?State=NE> (2010).
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- 12 The Soybean Review, Spring 2009, <http://www.soybeanreview.com/spring09/spring09.html> (2009).
- 13 Nebraska Energy Office, American Recovery and Reinvestment Act 2009, <http://www.neo.ne.gov/ARRA/recoveryact.htm> (2009).
- 14 U.S. Department of Energy, Energy Efficiency & Renewable Energy News, <http://apps1.eere.energy.gov/industry/resources/ebulletin/>, (Sept 14, 2009).



## Investing in Clean Tech to Stimulate Rural Economic Development

Montana's traditional energy focus has been on coal, hydropower and oil. While these industries remain a critical piece of the Montana economy, the state has also begun to capitalize on its extensive wind and biofuel resources with a parallel goal of fostering rural economic development. By 2007, 408 businesses had generated more than 2,155 clean energy jobs in Montana, mostly in the categories of conservation and pollution mitigation, as well as training and support.<sup>1</sup>

Montana also has resources in other clean tech areas which could be further developed. The Department of Energy's Geopowering the West program estimates that Montana has more than 25,000 square miles of high-potential geothermal sites and areas.<sup>2</sup> Further, the state has 16.5 million acres of crop land suitable for growing grain or oilseed crops for use in ethanol and biodiesel production.<sup>3</sup>

In April 2005, as part of the Montana Renewable Power Production and Rural Economic Development Act, Montana adopted a renewable portfolio standard (RPS) that requires 15 percent of the state's energy to come from renewable sources by 2015. Montana's RPS includes specific procurement requirements to stimulate rural economic development. The RPS also includes provisions for community renewable energy projects, defined as projects under 25 megawatts (mw) where local owners have a controlling interest.<sup>4</sup>

Montana also is working to connect its renewable energy sources to the grid. In the 2007 Montana legislative session, broad property tax incentives were passed on new transmission lines that transport renewable energy, such as wind power.

In November 2007, Montana joined the Western Climate Initiative. The initiative requires partners to set an overall regional goal to reduce emissions, develop a market-based, multi-sector mechanism to help achieve that goal, and participate in a cross-border greenhouse gas (GHG) registry.



## Energy Economy Snapshot

Montana holds significant coal reserves – an estimated 120 billion tons, which constitutes 28 percent of the U.S.'s and 8 percent of the world's reserves. Montana produces about 43 million tons of coal annually, making it the nation's fifth largest producer and accounting for 4 percent of U.S. coal production. The state uses just over 25 percent of its coal production for its electricity generation, shipping the remainder to markets in more than 15 other states.<sup>5</sup>

Rivers flowing from the Rocky Mountains offer substantial hydroelectric power resources; Montana is among the top producers of hydropower in the country. Seven of Montana's 10 largest generating plants run on hydroelectric power.<sup>6</sup>

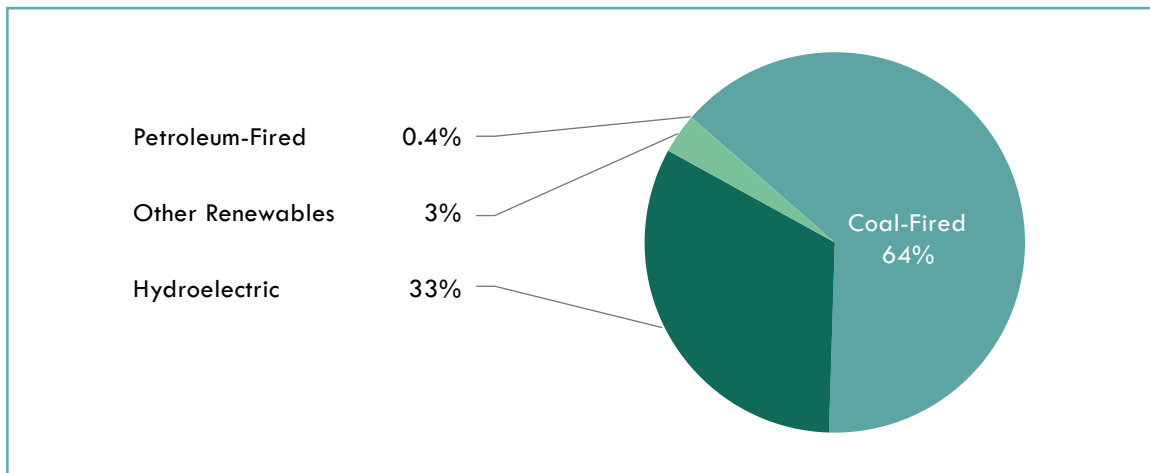
The state accounts for approximately 2 percent of U.S. crude oil production annually. Production is concentrated in the Williston Basin, covering eastern Montana and western North Dakota.<sup>7</sup> Montana oil production has more than doubled in the last 10 years, largely as a result of increased production out of the Bakken Formation of the Williston Basin.

The state holds some of the best wind resources in the nation. A 2009 study conducted by Harvard University ranks Montana as second in the U.S., while the National Renewable Energy Laboratory ranks Montana as having the best wind resources in the nation. Montana had only one mw of installed capacity in 2005, but by February 2010, the state had 375 mw of installed wind energy capacity, giving the state one of the fastest wind energy growth rates in the nation. High-voltage transmission lines connect Montana to other western electric power grids, allowing Montana to export large amounts of electricity to neighboring states.<sup>8</sup>

Montana's electricity is generated predominantly from coal (64 percent) and hydroelectric power (33 percent). Other renewables, namely wind, have grown over the past few years to constitute about 3 percent of the state's generation, while petroleum-fired generation accounts for less than 1 percent.



### MONTANA'S ELECTRIC GENERATION BY FUEL SOURCE, 2009



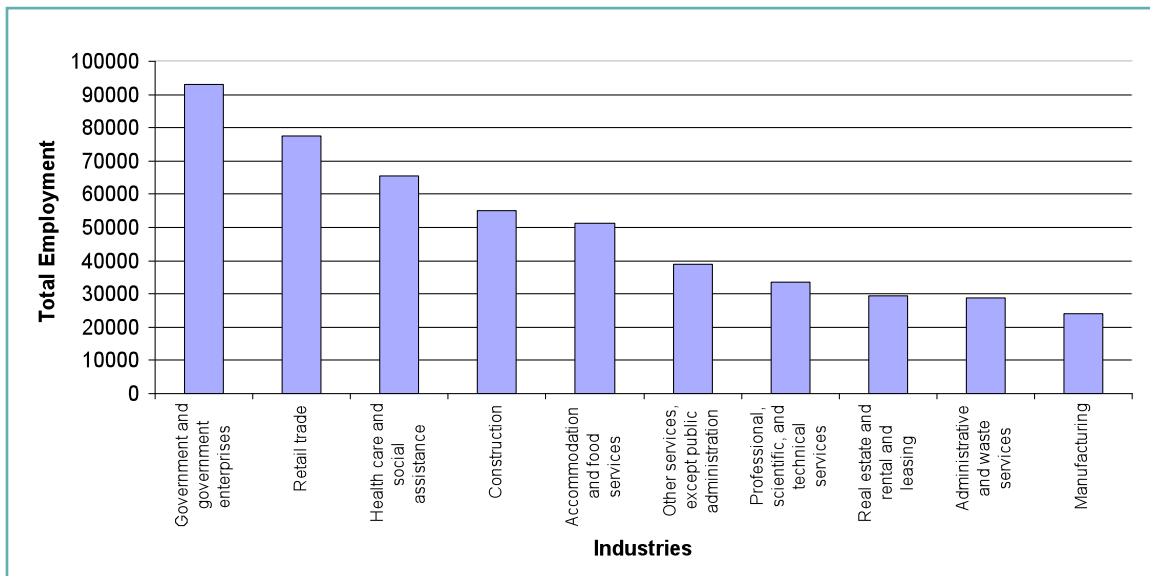
Source: US DOE, Energy Information Administration, State Energy Profiles, 2009

### Industry Overview of Montana

Identifying the opportunities and challenges of the transition to a low-carbon economy requires an understanding of the vulnerabilities and areas of resilience in the state's current industry mix. Government, retail trade, healthcare and social services, construction, and accommodation and food services account for the highest number of employees in Montana, over 320,000 collectively. Other services, professional, scientific, and technical services, real estate and rental and leasing, administrative and waste services and manufacturing, employ over 145,000 employees in the state.



### TOP 10 INDUSTRIES BY EMPLOYMENT IN MONTANA: 2007



Source: BEA, 2007

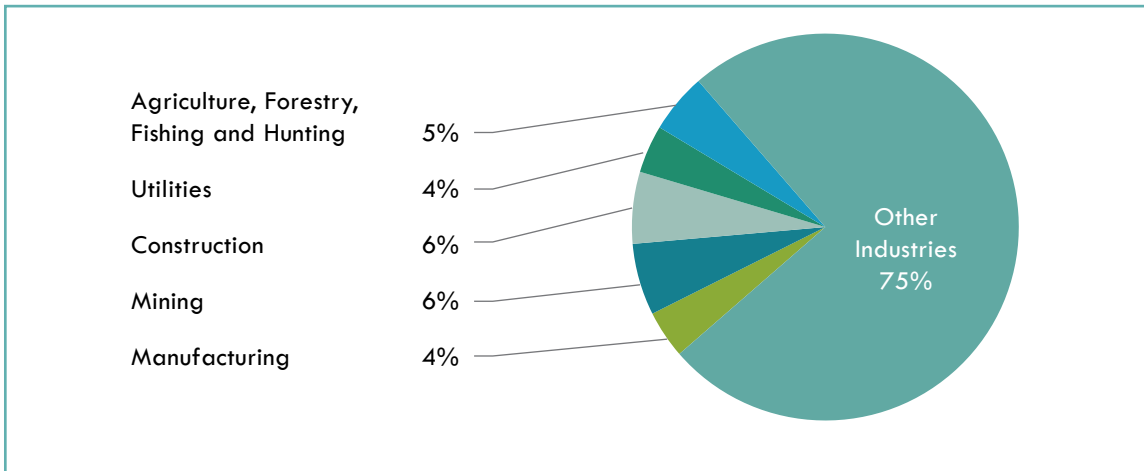
Energy-intensive industries make up 25 percent of the total gross domestic product (GDP) in Montana and 20 percent of its total employment. The energy-intensive industries comprise fairly equitable proportions of Montana's GDP, with construction comprising 6 percent, mining 6 percent, and agriculture, forestry, fishing and hunting 5 percent (for a total of 17 percent of GDP). Manufacturing (4 percent) and utilities (4 percent) make up 8 percent of the total GDP in the state. In regards to employment, construction and agriculture account for the largest employment percentages (8 percent and 6 percent, respectively), while manufacturing accounts for 4 percent and utilities and mining account for less than 3 percent.

Using location quotients to understand the state's economic advantages, agriculture, mining, utilities and construction stand out as specializations in terms of GDP – especially in crop and animal production, forestry, fishing, and related activities – as well as mining (except oil and gas), support activities for mining, and oil and gas extraction.<sup>9</sup>

Employment specializations are in mining, agriculture, utilities, and construction. Subindustry specializations include heavy and civil engineering construction; construction of buildings; forestry and logging; fishing hunting and trapping; agriculture and forestry support activities; mining (except oil and gas); and support activities for mining.



**ENERGY INTENSIVE INDUSTRIES BY GDP IN MONTANA, 2007**



Source: BEA, 2007

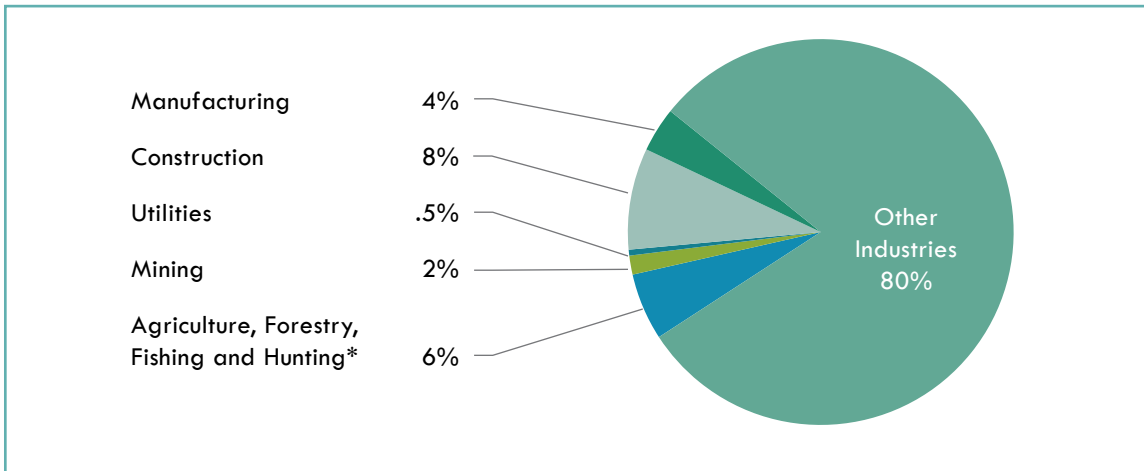
**LOCATION QUOTIENT FOR ENERGY-INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Mining	Agriculture, forestry, fishing, related activities, and other
Location Quotient		.35	1.45	1.76	2.89	3.75
Total GDP by Industry	\$34,266	\$1,423	\$2,215	\$1,243	\$1,986	\$1,575
Percentage of State GDP	100%	4%	6%	4%	6%	5%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0



**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN MONTANA, 2007**



\*Includes farm employment Source: BEA, 2007

**LOCATION QUOTIENT, TOTAL EMPLOYMENT AND PERCENTAGE BY ENERGY-INTENSIVE INDUSTRIES**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Agriculture, forestry, fishing, related activities, and other	Mining
Location Quotient		.46	1.32	1.55	2.63	2.92
Total Employment by Industry	640,624	23,934	54,476	3168	36,013	10,183
Percentage of State Employment	100%	4%	8%	.5%	6%	2%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0



## Preparing for the Low-Carbon Economy

In April 2005, Montana Governor Schweitzer signed the Montana Renewable Power Production and Rural Economic Development Act, into law, which established a renewable energy portfolio standard (RPS) for the state.<sup>10</sup> The RPS mandated that public utilities procure 5 percent of their retail electricity sales from renewable sources in 2008 and 2009, increasing to 10 percent between 2010 and 2014, and increasing again to 15 percent in 2015. Sources of energy that count toward the standard include wind; solar; geothermal; new, small hydroelectric projects (15 mw or less, built after January 1, 2005); landfill or farm-based methane gas; wastewater-treatment gas; low-emission, nontoxic biomass; and fuel cells.

In addition, in December 2005, the governor issued a letter directing the Montana Department of Environmental Quality to establish a Climate Change Advisory Committee (CCAC). The committee was charged with developing a state climate action plan by July 2007, examining state-level GHG reduction opportunities in the state to save money, conserve energy, and bolster the Montana economy.<sup>11</sup> The CCAC's 2007 Action Plan consisted of 54 policy recommendations designed to help reduce Montana's emissions of GHG's to 1990 levels by the year 2020. The recommendations covered all sectors in the state and some require legislative support. The CCAC also completed an inventory of GHG emissions for 1990-2020.<sup>12</sup>

Further, in May 2007, Governor Schweitzer signed a bill that included an emissions performance standard for new coal plants. The state's Public Service Commission may not approve applications for new plants that are primarily fueled by coal unless the plant captures and stores at least 50 percent of its carbon dioxide emissions. This rule applies to units constructed after January 2007.

Also in 2007, the governor announced a 20x10 Initiative – Leading by Example. The initiative asks state agencies to reduce their energy consumption by 20 percent by the year 2010. In addition to reducing energy use, the 20x10 Initiative sets a Montana corporate average fuel economy standard of 30 miles per gallon or better. State vehicle fleet managers are encouraged to meet the standard by procuring more efficient vehicles.<sup>13</sup>





Additionally, in July 2008, the Governor signed an executive order declaring an energy emergency and allocating approximately \$1 million in state funds to be used for weatherizing more homes. The money was split evenly between the state's Weatherization Assistance Program grantee, the Department of Public Health and Human Services, and the governor's Warm Hearts Warm Homes Initiative, which combines public and private funds, donations and volunteer labor to provide low-cost weatherization. Approximately 2,480 dwellings received low- or no-cost weatherization measures through the Warm Homes Initiative, and about 169 high-energy-burden homes received full-scale weatherization through the weatherization network. The order was prompted by concerns over record-high energy rates.<sup>14</sup>

### State and Local Incentives

Montana offers state and local incentives that support the transition to a lower-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

#### *Incentives to encourage production:*

**Montana's Property Tax Exemption** for renewable energy exempts newly built electricity generating facilities with a capacity of less than 1 mw that use renewable energy resources from property taxes. The exemption is applicable for five years after the start of operations. For all other facilities utilizing renewable energy resources, a property tax exemption can be claimed for 10 years after initial installation.<sup>15</sup>

In the 2007 Montana legislative session, **broad property tax incentives** were passed on new transmission lines that transport clean energy, such as from wind power. Tax rates were cut from 12 percent to 3 percent, including an abatement rate of 1.5 percent for the first 15 years of operation. Property tax abatements of 50 percent for the first 15 years of operation were also provided for electric power plants that capture carbon dioxide and for pipelines that transport carbon dioxide for purposes of sequestration.

The **Alternative Energy Investment Tax Credit** is for commercial and net metering alternative energy investments of \$5,000 or more. The investments are eligible for a credit of up to 35 percent against individual or corporate tax on income generated by the investment. The



credit may only be taken against net income produced by the eligible equipment or by certain associated business activities. Associated facilities, manufacturing plants producing alternative energy equipment and new or expanded businesses using the energy generated by the alternative energy investment may use the tax credit.

**Montana's Universal System Benefits (USB)** program requires utilities to set funds aside for renewable energy developments and other energy-efficiency related activities. NorthWestern Energy uses \$700,000 annually for renewable energy projects.<sup>16</sup>

**The Alternative Energy Revolving Loan Program (AERLP)** provides loans to individuals, small businesses, local government agencies, units of the university system, and nonprofit organizations to install alternative energy generating systems for their own use. The program historically has been funded by air quality penalties collected by the Department of Environmental Quality and is also using funding from the Recovery Act. The program is administered by the Department of Environmental Quality, which is responsible for developing the rules.<sup>17</sup>

***Incentives to encourage demand:***

**The State Buildings Energy Conservation Bond** program is designed to finance energy improvement projects on state-owned buildings. The Montana Department of Environmental Quality administers the program, which uses bond proceeds to fund the projects and energy savings to repay the bonds. The state encourages agencies to participate in the program to achieve energy savings. Projects include lighting upgrades, tune-ups to check out and control systems functions, insulation and infiltration control, and HVAC system upgrades.<sup>18</sup>



## Transition Assistance

### *Transitioning Industry:*

Montana's emerging clean tech industries are primarily in wind and biofuels. While biofuels have been supported in the state since the early 1990s, wind is a newer focus.

### *Wind*

In May 2009, Montana was selected as one of 53 recipients around the nation for a U.S. Department of Energy (DOE) grant for new wind energy projects. The DOE program addresses market and deployment challenges identified in the 2008 report, "20% Wind Energy by 2030" and involves up to \$8.5 million in federal funding.<sup>19</sup>

The \$100,000 award for Montana will be used by the Department of Commerce and the Department of Environmental Quality for wind-related projects. The Department of Commerce's Energy Promotion and Development Division is currently assisting and monitoring about 50 industrial wind energy projects of various sizes and stages of development, and the Energy and Pollution Prevention Bureau of the Department of Environmental Quality will use the funds from the grant to advance the wind industry in the state.

Additionally, with the aim of supporting local economic developers, the Montana Department of Commerce is using the National Renewable Energy Laboratory's Job and Economic Development Impact model to analyze the economic impacts of development and implementing wind power plants.<sup>20</sup> As with any development, wind power plants can face local opposition due to concerns around vistas, noise, property rights, and questions surrounding economic and job creation benefits. In order to support the state's comprehensive energy development strategy, the Department of Commerce has recognized that local economic developers will need to facilitate energy development and deployment in their jurisdictions. As such, the state is partnering with its localities to inform them on the job and tax implications for wind and transmission projects to empower the localities with a quantifiable understanding of such projects.



### ***Biofuels***

The Montana Biomass Energy Program, which is run through the Montana Department of Environmental Quality, receives grant funds from the U. S. Department of Energy's Pacific Regional Biomass Energy Program (PRBEP). The program is designed to:

- Assist in commercial development of biomass as an economical and environmentally preferable energy resource option, including applied research, development, and education;
- Develop, demonstrate, and bring to the marketplace new bioenergy technologies relating to energy efficiency, renewable resources, or technologies that use local (biomass) waste streams; and
- Provide technical assistance and information to local business, government, and industry that matches innovative energy technologies to local energy needs, focusing on solutions.<sup>21</sup>

Several partnered projects conducted since 1994 have focused on the use of biodiesel, E-10 (10 percent ethanol blend) and E-85 (85 percent ethanol). These renewable transportation fuels may increase transportation efficiency and reduce vehicle pollution in Montana and help support Montana's agricultural and tourism sectors, with special emphasis in the Yellowstone National Park region.

Further assistance from the Department of Environmental Quality persuaded National Park Service managers to require that E-10 be available year-round in all of Yellowstone's public service stations, starting in September 2000.

### ***Transitioning the Workforce:***

Montana's AgroEnergy Plan (MAP) is part of the Workforce Innovation in Regional Economic Development (WIRED) program sponsored by the U.S. Department of Labor's Employment and Training Administration. Through partnerships with citizens, state agencies, private businesses, investors, academic institutions, entrepreneurs, philanthropists and tribal leaders, the program aims to create a globally competitive bio-energy and bio-products cluster.<sup>22</sup> The goals of the program are to:



- Develop a world-class bio-products industry
- Develop a highly trained and stable/growing workforce to support bio-products and other value-added agricultural products
- Create an agile, integrated talent development system that will prepare state residents to act quickly to take advantage of new economic opportunities and that is responsive to business needs
- Create an inclusive and sustainable regional identity and leadership structure that will promote innovation and ensure the long-term success of the transformational initiative

There are a multitude of partnerships and initiatives under way to support the success of the AgroEnergy Plan. At Miles Community College, for example, activities include offering curricula that provide an introduction to biofuels and renewable energy; increasing awareness to potential students by performing outreach activities across eastern Montana; and having faculty and staff present information and conduct demonstrations at high schools and at industry and community gatherings.<sup>23</sup>

Additionally, the Montana Department of Agriculture has a Bio Product Innovation Center (BPIC) Network that provides customized training for bio-product businesses, entrepreneurs evaluating new business opportunities, members of cooperatives pursuing bio-product and related agricultural business opportunities, and producers interested in growing feedstock for the biofuels industry. The network has centers throughout the MAP region. Areas of training include feasibility studies, writing business plans, and more..<sup>24</sup>

Further, the Montana Office of the Commissioner of Higher Education focuses on bio-products and energy industries training for students in universities, community colleges, and tribal colleges. For example, MSU-Northern is offering a Departmental Certificate of Completion in Biodiesel with training in areas such as quality control, fuel performance and more.<sup>25</sup>



## Investing in Innovation

Innovation ultimately drives the transition to a low-carbon economy. This is being fostered through pilots and through research and development in alternative energies to reduce their costs, and by assisting heavier emitting industries and firms adapt to this new economic environment.

With Montana's economic base and energy profile heavily based on coal, there is significant research going on throughout the state on clean coal technologies. Additionally, as biofuels are an emerging clean tech area for Montana, there are new initiatives to support the growth of the biofuel supply chain throughout the state. Below are some of the innovation initiatives taking place in Montana.

### ***Carbon Capture and Sequestration***

Montana is partaking in the Big Sky Carbon Sequestration Partnership (BSCSP), one of the U.S. Department of Energy's seven regional carbon sequestration initiatives. Led by Montana State University, the partnership includes Montana, Wyoming, Idaho, South Dakota and the eastern part of Washington and Oregon. The partnership's vision is to prepare its member organizations for a possible carbon-constrained economy and enable the region to cleanly utilize its abundant fossil energy resources and sequestration sinks to support future energy demand and economic growth.

The BSCSP will achieve this vision by demonstrating and validating the region's most promising sequestration technologies, and creating the supporting infrastructure required to deploy commercial-scale carbon sequestration projects. This supporting infrastructure includes a geographic information system-based economic and risk assessment tool to help determine optimal energy development strategies; regulatory and permitting approaches; and enhanced public understanding and acceptance. The infrastructure also includes a robust outreach program that trains scientists and engineers and communicates the contribution that carbon sequestration technologies and the BSCSP can make to the region's clean energy future.

In May 2009, leaders from Montana and Saskatchewan in Canada agreed to develop North America's first large-scale project to capture the gas from a coal-burning power plant. The



goal is for the new plant to test a range of technologies in the capture of up to 1 million metric tons of CO<sub>2</sub> over a four-year period.<sup>26</sup> Each party is turning to its federal government to help cover costs, with the hope that the project could go online in 2011.

Other carbon capture proposals are in the works in Montana, mostly involving gasification, which is already in use commercially at North Dakota's Beulah plant. (Gasification makes it easier to capture CO<sub>2</sub> because the GHG is separated from other gasses early in the industrial process.<sup>27</sup>) In addition, in May 2009, the governor signed a bill that creates regulatory guidelines for storing carbon dioxide underground in Montana. The bill will allow a storage company to turn a site over to the state after 30 years if it is problem-free, and gives ownership of underground spaces where gas might be stored to surface landowners.<sup>28</sup>

### **Biofuels**

There are also research and development efforts going on in the area of biofuels. In August 2009, The University of Montana's Native American Research Laboratory received a \$300,000, two-year grant from the National Science Foundation to develop a new process that boosts the efficiency of ethanol production. The goal is to perfect an enzyme technology that makes cellulosic ethanol, a high-octane, renewable fuel produced from the stalks and stems of plants. This will make the production process more efficient and make ethanol cheaper to buy, enabling it to better compete with fossil fuels.<sup>29</sup>

Additionally, the Montana State University-Northern Bio-Energy Center is positioning itself to be a leader in the developing bio-energy industry. The center performs both chemical analysis and performance testing for petroleum and bio-based fuels, oils and additives, providing a complete array of testing services. Recently, it completed a new biodiesel pilot plant, which can create biodiesel on an industrial scale for large-scale testing.<sup>30</sup>



## Partnerships

In addition to the initiatives discussed thus far, other noteworthy partnerships working in Montana are detailed below.

Within the **Montana Department of Commerce is the Energy Promotion and Development Division**, which was created in 2007 to help implement Governor Schweitzer's commitment to clean energy development in Montana. The Energy Promotion and Development Division is the front line for state support for energy development in Montana and assists in all aspects of potential energy projects, both energy production facilities and the supportive energy delivery infrastructure. The Division works with the governor, the Governor's Office of Economic Development and other state agencies to help facilitate processes related to permitting, siting, workforce, and financial assistance.<sup>31</sup>

**The Governor's Office of Economic Development** advises the governor on policy issues related to economic development; leads the state's business recruitment, retention, expansion, and start-up efforts; and serves as the state's primary economic development liaison among federal, state, and local agencies, Montana tribal governments, private economic development organizations and the private sector.<sup>32</sup> The office is highly focused on growing and developing the potential of energy as an economic driver within Montana.

**The Montana Climate Action Project** is a collaboration of partners working to find solutions, create opportunities and empower people around the issue of climate change. The organization's goal is to provide citizens with information and tools to understand climate change and make personal changes that can help mitigate climate change.<sup>33</sup>

**The Montana Rebuild America Partnership Program** is a network of community partnerships made up of local governments and businesses focused on energy savings. These voluntary partnerships, working with the U.S. Department of Energy, choose the best ways to improve the energy efficiency of commercial, government and apartment buildings. Rebuild America supports them with business and technical tools and customized assistance. In addition to energy savings, the program is seen as a green jobs driver for Montana.<sup>34</sup>



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## Asset Development in Clean Energy Research and Production

While traditionally an agricultural and manufacturing state, Missouri is on a path to broaden these assets into a full cycle clean energy research and production economy. Missouri is one of thirty states (plus the District of Columbia) to create a renewable portfolio standard (RPS) with the passing of the Missouri Clean Energy Initiative. Investor-owned utilities must increase their renewable electricity generation to 15 percent by 2021. It is mandated that 2 percent must come from solar energy, and the remainder from other renewable such as landfill gas, wind, biomass, and hydroelectric power. A limiting factor placed on utilities is a 1 percent cap on consumer price increases as a result of the renewable mandate.<sup>1</sup> This is designed to push utilities to not only switch to more renewable sources, but also to become more energy efficient.

The passage of a state-level RPS is having a desirable effect on the creation of an alternative energy value/supply chain in Missouri and the state is well positioned with complementary assets. The most promising areas of expanded value chains in Missouri are in the biofuels, wind, and solar industries. Cleantech patents from 2006-2008 in Missouri totaled 9 compared to 2,931 nationwide, representing 0.4 percent of the total. However, in 2008, evidence of growth is visible as cleantech venture capital (VC) in Missouri reached an all-time high of \$16 million.

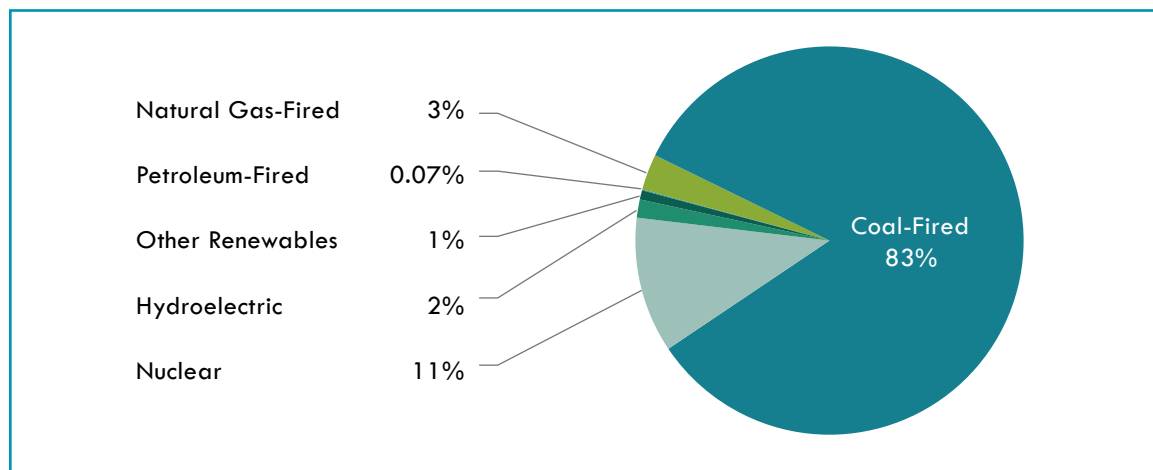


## Energy Economy Snapshot

Missouri's total electricity generation is only at 50 percent of its total capacity<sup>2</sup>, which could be a contributing factor to the state's low electricity costs along with its extensive cooperative electricity generation industry model. Below U.S. average electricity rates create little natural financial incentive for expanding alternative energy sources. However, the Missouri RPS which mandates that at least 15 percent of the state's electricity come from renewable sources by 2021 (including a mandated 2 percent for solar) is expected to drive the alternative energy supply chain. As of 2009 only 1 percent of electricity in Missouri is generated from renewable sources (other than hydroelectric).

Coal is the overwhelmingly dominant fuel for electricity generation in Missouri and typically supplies more than 80 percent of the state's electricity market, compared to the approximately 50 percent rate for the nation as a whole.<sup>3</sup> Missouri generates 11 percent of its annual electricity from nuclear power, 2 percent from hydroelectric, 3 percent from natural gas, and 1 percent from other renewable sources. The residential sector leads the state's natural gas consumption with almost three-fifths of Missouri households using natural gas as their primary energy source for home heating. The industrial and commercial sectors each account for just under one-fourth of the state's natural gas consumption.<sup>4</sup>

### MISSOURI'S ELECTRIC GENERATION BY FUEL SOURCE, 2009



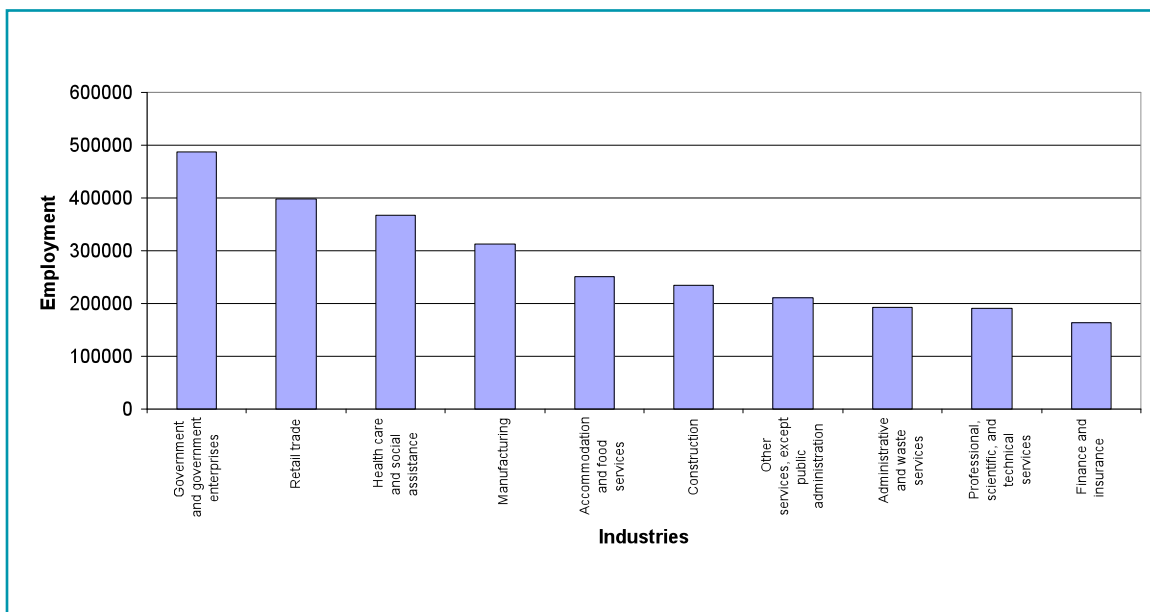
Source: US DOE, Energy Information Administration, State Energy Profiles, 2009



## Industry Overview of Missouri

Identifying the opportunities and challenges emerging from the move to a lower-carbon economy requires an understanding of the state's current vulnerabilities and areas of resilience in their current industry mix. Missouri's diversified economy provides for a strong base for which to transition into various areas of the low-carbon economy. Government, retail trade, health care and social assistance and manufacturing have the highest number of employees in Missouri. These four industries employ over 1,500,000 employees. Accommodation and food services, construction, and other services, except public administration also employ over 650,000 employees in the state and make up the middle group of the top ten industries. Administrative and waste services, professional, scientific, and technical services, and finance and insurance employ approximately 525,000 employees.

### TOP 10 INDUSTRIES BY EMPLOYMENT IN MISSOURI: 2007



Source: BEA, 2007

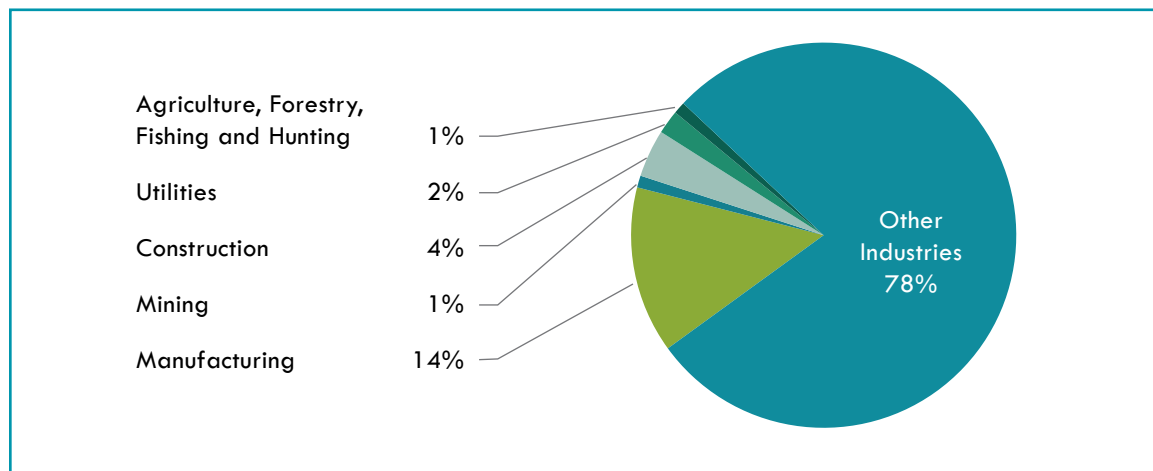


Energy intensive industries make up 22 percent of the total GDP in Missouri compared to 19 percent of employment. Of the five energy intensive industries, manufacturing (14 percent), construction (4 percent), and utilities (2 percent) make up 20 percent of the total GDP. Mining (1 percent), agricultural, forestry, fishing and hunting (1 percent) compose 2 percent of the total GDP in the state. For employment, both manufacturing (9 percent) and construction (7 percent) makes up the highest number of employees totaling at 16 percent. Agriculture, utilities, and mining compose about 4 percent of the total working population.

Looking at location quotients<sup>5</sup> to understand the state's economic advantages, agriculture, manufacturing, and construction stand out as specializations for Missouri, in terms of GDP, especially in crop and animal production; appliance manufacturing; motor vehicle parts manufacturing; food product manufacturing; printing and related support activities; and transportation equipment manufacturing.

Missouri has employment specializations in the areas of farm, agriculture, forestry, fishing; manufacturing; and utilities. These industries hold employment sub specializations in: construction of buildings and specialty trade contractors, electrical equipment and appliance manufacturing, motor vehicles, bodies and trailers, and parts manufacturing, leather and allied product manufacturing, beverage and tobacco product manufacturing, and food manufacturing.

#### ENERGY INTENSIVE INDUSTRIES BY GDP IN MISSOURI, 2007



Source: BEA, 2007

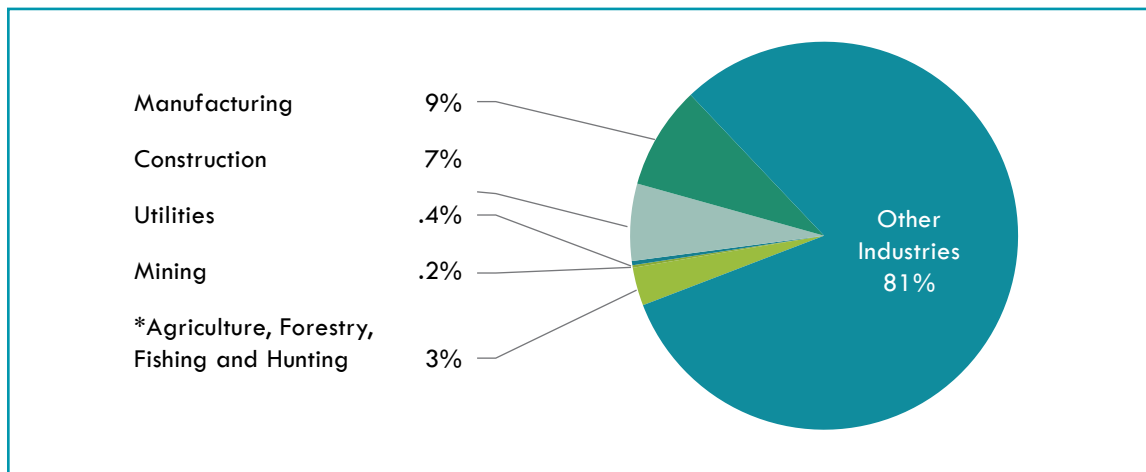


**LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Mining	Utilities	Construction	Manufacturing	Agriculture, Forestry and Fishing
Location Quotient		.26	.84	1.01	1.16	1.19
Total GDP by Industry	\$229,027	\$1,205	\$3,985	\$10,314	\$31,506	\$3,353
Percentage of State GDP	100%	1%	2%	4%	14%	1%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0

**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN MISSOURI, 2007**



\*Includes farm employment Source: BEA, 2007



### LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT

Industry	Total: All Industries	Mining	Construction	Manufacturing	Utilities	Agriculture, forestry, fishing, related activities, and other
Location Quotient		.38	.99	1.07	1.09	1.49
Total Employment by Industry	3,632,959	7641	233,194	312,208	12,728	115,718
Percentage of State Employment	100%	.2%	7%	9%	.4%	3%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0

### Preparing for the Low-Carbon Economy

In November 2008, Missouri voters approved the Missouri Clean Energy Initiative, creating the third state Renewable Portfolio Standard (RPS) to be adopted by ballot initiative in the country. The initiative requires that investor-owned utilities increase renewable electricity generation to 2 percent of total output by 2011, 5 percent by 2014, 10 percent by 2018, and 15 percent by 2021. Two percent of generation must come from solar energy with the remainder coming from other renewable sources including landfill gas, wind, biomass, and hydroelectric power. In order to protect rate-payers, utilities are prevented from increasing power prices more than 1 percent. The Clean Energy Initiative bolsters the goals set forward in S.B. 54 enacted in Missouri in 2007, which calls on utilities to make a “good-faith effort” to generate 11 percent of electricity from renewable sources by 2021.<sup>6</sup>

In July 2009, Missouri Governor Jay Nixon signed into law the Energy Efficient Investment Act (SB376), which aims to meet increased demand for electric power while protecting the environment and holding costs down for consumers. The law sets a goal for Missouri’s investor-owned electric utilities to achieve all cost-effective savings possible from energy efficiency programs. It provides the state Public Service Commission the ability to promote cost-effective energy efficiency by developing cost recovery mechanisms for approved programs. These programs,





which require Commission approval, must be cost-effective or in the public interest, result in energy savings, and be beneficial to customers in the customer class in which it is proposed.<sup>7</sup>

The law also requires the state to buy appliances that meet energy efficiency specifications under the Energy Star program, part of a U.S. Environmental Protection Agency effort, unless the cost exceeds the energy savings.

### State and Local Support Programs and Incentives

Missouri offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency. Missouri's incentive programs are focused on encouraging production and demand in the area of biofuels, as well as incentives that spur demand for energy efficiency.

#### *Incentives to encourage production:*

In August 2009, the **Show Me Energy Cooperative** of Missouri became the first biomass conversion facility in the nation to qualify for matching payments to its suppliers under the U.S. Department of Agriculture's new Biomass Crop Assistance Program. Under the program, agricultural producers who sell biomass materials to Show Me Energy receive matching federal funds equal to the payments they receive from Show Me Energy. Show Me conducted its first pilot project in 2008, using biomass pellets for coal firing. The completion of a 150-ton biomass pellet test burn at the Aquila generating facility at Sibley, Missouri marked the first time that biomass pellets were used for electrical production in the U.S. saving over 253 tons of CO<sub>2</sub>.<sup>8</sup> The Show Me Energy Cooperative seeks to establish an innovative, profitable, leading model for the production of biomass-based fuels. This model may be replicated across the country by small producer-owned cooperatives that will provide a positive economic impact on the regions in which they are located.<sup>9</sup>

The **Missouri Linked Deposit Program** is a low-interest loan program designed to provide funding for alternative energy businesses. These loans are available for operating expenses for any Missouri-based firm that produces or sells fuel or power not derived from fossil fuels. The for-profit firm needs to maintain operations and conduct business in Missouri.<sup>10</sup>



The Missouri State Department of Agriculture administers the **Missouri Biodiesel Producer Incentive Fund** that encourages biodiesel production. According to the Missouri Department of Natural Resources, there are currently five operating biodiesel plants located throughout the state that are capable of producing a combined total of more than 127 million gallons of fuel.

***Incentives to encourage demand:***

In addition to production incentives, demand for the biofuels industry in Missouri is also being incentivized. State programs include a **Biodiesel Fuel Use Incentive** and a **Fleet Biodiesel Fuel Use Incentive**. As of January 1, 2008 all gas stations in Missouri were required to offer ethanol-blended gasoline if the cost of ethanol-blended gasoline was equal to or lower than regular gasoline. The Missouri law relies heavily on the market to enforce the law because it is financially beneficial for gas stations to purchase the blended fuel.<sup>11</sup>

**The Missouri Energy Loan Program**, administered by the Energy Center of the Missouri Department of Natural Resources provides access to low-interest loans for Missouri schools, universities and local governments to purchase energy efficiency and renewable energy products solar power equipment.<sup>12</sup>

**The Columbia Water & Light Super Saver Loan Program** offers customer's low-interest, five-year loans to install solar water heaters and space heating systems. They offer rebates of \$500/kw to install a solar electricity system, and can be applied to any solar system from 250 watts to 10 kw, with an average of 3 kw.<sup>13</sup> Ameren announced December 2, 2009 that it will be constructing several solar-energy systems to continue studying the expanded potential in Missouri.<sup>14</sup>



## Transition Assistance

Much of the transition towards energy efficiency in Missouri is happening on the municipal level. Additionally, the state is focusing on building up its clean tech industries, with a focus on biofuels, wind, and solar.

In September 2009, Missouri benefitted from the funding from the American Recovery and Reinvestment Act (ARRA) to support energy efficiency and conservation activities under the Department of Energy's Efficiency and Conservation Block Grant (EECBG) program. The nearly \$13 million award will be administered by the state's Department of Natural Resources (MDNR) and is expected to create more than 100 green jobs across the state. MDNR put the majority of these funds toward a competitive solicitation for local cities and counties with priority given to projects that maximize energy savings, create jobs and leverage funds from other resources.

Funding will also be used to conduct energy building code workshops for local government officials, homebuilders, and other interested parties. These workshops will provide information regarding building code criteria, the benefits of codes, code enforcement and related subjects. The goal of this initiative is to increase the number of local communities that adopt the latest edition of the International Energy Conservation Code, as the minimum energy building code for residential and commercial buildings.<sup>15</sup> The state was also awarded \$57 million towards its State Energy Program. Part of this funding is to develop a Missouri Energy Plan to provide a complete picture of the state's energy status and focus on the important relationship between energy, environmental quality and economic vitality.<sup>16</sup>

Further, there are local programs such as the Kansas City Green Impact Zone and the St. Louis Green Business Challenge that are helping the state to deepen its GHG mitigation efforts on the local level. The Kansas City Green Impact Zone is a demonstration project designed to strengthen neighborhoods, create jobs and improve energy efficiency. The initiative includes housing rehabilitation and weatherization programs, community policing and services, job training and placement, and health and wellness programs, all built around a comprehensive neighborhood outreach program and using sustainability as a catalyst for this transformation. The goal is not just for neighborhood revitalization, but for this comprehensive approach to be a model of energy efficiency for other communities.<sup>17</sup>



The St. Louis Green Business Challenge, led by the St. Louis Regional Chamber and Growth Association, will use a scorecard to measure savings and sustainability achievements at a company's headquarters site in 6 areas: Energy, Waste, Indoor Environment, Water, Transportation, and Outreach. Green Business Challenge teams determine their individual baseline score and then improve on their baseline by implementing sustainability strategies throughout 2010. Companies will be recognized for their improvements and accomplishments at a special Green Business Challenge event in November 2010. The St. Louis Green Business Challenge will hold seminars throughout 2010 to assist companies in implementing their sustainability strategies.<sup>18</sup>

### ***Transitioning Industry:***

#### ***Biofuels***

Missouri currently has six operating ethanol plants with total capacity of 284 million gallons annually. Nine other plants have received permits and are in the construction phase with a potential capacity of 810 million gallons.<sup>19</sup> The Missouri State Department of Agriculture administers the Missouri Biodiesel Producer Incentive Fund that encourages biodiesel production. Other state programs include a Biodiesel Fuel Use Incentive and a Fleet Biodiesel Fuel Use Incentive. Additionally, the Missouri Alternative Fuels Commission promotes the production and utilization of alternative and renewable transportation fuels in Missouri. Motor fuel taxes are also reduced for alternative fuel vehicles.<sup>20</sup>

The Missouri Forest Products Association is using a Cellulosic Ethanol Feasibility Study grant from the Missouri Agricultural and Small Business Development Authority (MASBDA) to conduct research into developing and evaluating the use of woody biomass as an input for the production of fuel ethanol and other energy sources.<sup>21</sup>

#### ***Advanced Biofuels***

The Missouri Life Science Research Board (MLSRB) was created in 2003 with the goal of enhancing research capacity in life sciences to promote Missouri as a hub for life science research and development. The Board's mission is to build on the success of existing Missouri research institutions, create and attract new research and development institutions, and



transform that research into commercial life science technology.<sup>22</sup> An example of the Board's activities include two January 2009 grants totaling \$1.5 million given to the Donald Danforth Plant Science Center, one of the leading agricultural research institutions in the nation, located in St. Louis.

Further, The Missouri Department of Natural Resources has developed a guide to assist entrepreneurs interested in developing an industrial-scale production facility, including helpful tips about management issues, financing, location, and environmental permits located at <http://www.dnr.mo.gov/pubs/pub1347.pdf>.

### **Wind**

Wind is a clean tech target industry for Missouri. In 2009 The Missouri Departments of Economic Development and Natural Resources sponsored a joint workshop presented by the Missouri Partnership and the Great Lakes WIND Network to target existing St. Louis manufacturers considering involvement in the wind energy supply chain. Attendees of the workshop included automotive engineers, aerospace suppliers, machine shops and metal fabrication companies.<sup>23</sup>

Continued growth of wind development in Missouri can be found in the Wind Capital Group's continued expansion in the state.<sup>24</sup> Wind Capital Group built its first wind farm, Bluegrass Ridge, in 2007, and is in the midst of constructing its second one, Lost Creek, a 150 mw facility. The 100 GE 1.5 mw wind turbines and 100 ABB transformers will be built by Swiss-based ABB's Jefferson City, Missouri plant. Financing was all accomplished with private sources led by European project finance arms of Nord/LB, Bayern LB, Rabobank, Santander, as well as Union Bank. The debt facilities consist of a construction loan, term loan and letter of credit facility totaling \$240 million.<sup>25</sup>

### **Solar**

One of the leaders in the solar supply chain in Missouri is Confluence Solar, based in Hazelwood, MO. It was founded in 2007 by several silicon industry veterans attempting to create premium, low-cost single crystal silicon platforms for high efficiency solar cell design. Current technology consists of multi-crystal designs. The goal is to reduce the cost per watt for solar cells. To



deepen the solar energy portfolio of Missouri, Ameren announced in December of 2009 that it will be constructing several solar-energy systems to continue studying the expanded potential in Missouri.<sup>26</sup>

Additionally, the Missouri Energy Loan Program provides access to low-interest loans for Missouri schools and local governments to purchase solar power equipment.<sup>27</sup> The Columbia Water & Light Super Saver Loan Program offers customer's low-interest, five-year loans to install solar water heaters and space heating systems. They offer rebates to install a solar electricity system, and can be applied to any solar system from 250 watts to 10 kw, with an average of 3 kw.<sup>28</sup>

### ***Transitioning the Workforce:***

Energy and clean tech related research and education is growing in Missouri, with the addition of targeted research centers and degree programs that provide training for energy disciplines often in conjunction with relevant R&D and commercialization efforts.

For example, the Center for Sustainable Energy at the University of Missouri was launched as a collaboration between the College of Agriculture, Food and Natural Resources and the College of Engineering to support and coordinate research, education and commercialization of renewable energy sources. The Center focuses on five primary areas: energy policy and management, research, education and training, service, and commercialization. The Center is involved in numerous energy-related research projects including using nanotechnology composites to enhance methane and hydrogen storage. The center is also partnering with two-year institutions in the state to develop curriculum in energy-related industries.<sup>29</sup>

Further, The Missouri University of Science and Technology Energy Research and Development Center (formerly Rolla) developed the Energy Research and Development Center, with the mission of educating students in energy topics and collaborating with industry and government to develop solutions to energy-related issues.<sup>30</sup>

There are also movements taking place on the community college/ associate degree level. In partnership with CleanEdison, St. Louis Community College offers Building Performance Institute certification-BPI Building Analyst, which gives trainees the skills to conduct residential energy audits. Further, Crowder College offers an Associate's degree in Alternative Energy for



engineering and science students who are wanting to focus in clean tech specializations, such as biofuels, solar, wind, and energy efficiency.

## Investing in Innovation

Innovation represents the heart of what will enable the economy to transition and create new economic opportunities. In Missouri, innovation is being catalyzed through research and development in alternative energies to reduce their costs, and assist high emitting industries and firms in adapting to this new economic environment. As Missouri has a strong agricultural sector, it's focusing on innovating in advanced biofuels. Further, with Missouri's energy profile heavily based on coal, there is also significant research going on in clean coal technologies. Below outlines some of the leading research and development taking place in Missouri.

### ***Biofuels***

One of the emerging biofuel areas in Missouri is algae. The Donald Danforth Plant Science Center is focusing on algae as a focal point of biomass development and commercialization for biodiesel, ethanol and livestock feed. The research at the center continues to deepen with funding from multiple federal grants. Further, researchers at the Missouri University of Science and Technology are attempting to perfect a method of creating algae-based biofuel underground, which would decrease the need for one of the two main ingredients of algae photosynthesis: sunlight and water. The testing, which is being conducted in a former mine shaft, is attempting to demonstrate the use of LED-supplied light as a substitute for sunlight. Almost half of the capital cost of surface algae ponds is infrastructure. By utilizing existing mines, which also provide a desirable constant temperature, more of the funds can be used for lighting, which is imperative because LED lighting is relatively expensive.

While the LED-induced photo bioreactor undergoes further viability testing, Saline County, MO is using \$121 million of industrial development revenue bonds to help finance a commercial algae production facility as part of a larger integrated bio-refinery complex. The complex will be owned and operated by EcoAlgae USA LLC, and constructed by a consortium led by United Biorefineries Corp. The four companies providing the main technical expertise for the project are Green Star Products, Pure Energy Corp., MKW Biogas, and Biotech Research.



### ***Carbon Capture and Sequestration***

Coal's abundant use in Missouri makes it a target of research into how its combustion efficiency can be improved in order to utilize it as a bridge fuel between fossil fuels and future sustainable fuels. Missouri was once one of the leading coal producers in the country; however, passage of the Clean Air Act dramatically changed the state industry. All of Missouri's 3.86 billion tons of recoverable coal reserve are classified as high-sulfur coal, making it less economically viable. Coal-interests in the state are therefore trying to expand research into clean-coal technology.

Washington University in St. Louis, MO is providing \$60 million towards research into energy, environment and sustainability issues including clean coal technologies. An additional \$12 million has been pledged from Arch Coal, Peabody Energy and Ameren, to develop more efficient and clean methods of coal combustion and carbon sequestration. Peabody is the world's largest coal company and is based in St. Louis, MO. It is dedicating significant research dollars into developing a zero-emission combustion process. Coal's abundant supply in the United States continues to make it a target of research into how its combustion efficiency can be improved in order to utilize it as a bridge fuel between fossil fuels and future sustainable fuels.

### **Partnerships**

Many noteworthy partnerships are growing in Missouri. In addition to the partnerships already denoted throughout this chapter, the partnerships highlighted below show successful coordination between state and quasi-state agencies.

**The Missouri Partnership**, which serves as the principal business recruitment and marketing organization for the state of Missouri, has identified energy as one of the target industries for the state and has been pursuing the development of clean tech sectors in Missouri through the recruitment of wind energy and other renewable energy companies. Through its comprehensive marketing program – which includes advertising, earned media, digital, tradeshow exhibitions, conference sponsorships, and thought leadership activities both domestically and overseas – the Partnership is telling the story of how Missouri's assets align with the development of the state's clean tech sectors, especially in the areas of wind, solar and biomass/biofuels.

The Missouri Partnership is being supported by **The Missouri Departments of Economic**





**Development** in developing clean energy supply chains and production. In 2009 they partnered with the Missouri Department of Natural Resources to sponsor a joint workshop in April 2009 presented by the Missouri Partnership and the Great Lakes WIND Network to target existing St. Louis manufacturers considering involvement in the wind energy supply chain. Attendees of the workshop included automotive engineers, aerospace suppliers, machine shops and metal fabrication companies.<sup>31</sup>

**The Department of Natural Resources** is also leading several state efforts in the installation and deployment of clean energy technologies. In 2004 they became a **Million Solar Roofs (MSR) Partnership**, with the intention to facilitate the installation of 500 solar roofs on state buildings by the year 2010. Additionally, in 2004, the Department launched the Missouri Schools Going Solar (MSGs), partnering schools with the Missouri Department of Natural Resources' Energy Center, local utilities, and the local community to provide solar array installations in K-12 schools.<sup>32</sup>

In addition, the **Missouri Energy Center** - a non-regulatory state office *within* the Missouri Department of Natural Resources - is currently conducting a survey of Missourians who use or produce solar, wind, and biomass energy in the state. It is designed to learn and share with all Missourians what the state is doing in the field of renewable energy. The data gathered in the survey will help to enable the Energy Center to develop and disseminate reliable statistics on the production and use of renewable energy in the state, provide technical and market information that can be used to better provide technical assistance to firms and individuals producing or using renewable energy, and provide contact information for prospective users or producers of renewable.

Further, **The Environmental Improvement and Energy Resources Authority (EIERA)** is a quasi-governmental agency that serves as the financing arm for the Missouri Department of Natural Resources.<sup>33</sup> As a non-regulatory agency, EIERA's primary mandate is to provide financial assistance for energy and environmental projects and protect the environment. EIERA conducts research, supports energy efficiency and energy alternatives and promotes economic development. Missouri also has a Market Development Program designed to increase markets for recycled materials by offering financial incentives, technical assistance and information services to businesses, governments and other organizations.<sup>34</sup>



Lastly, **The Missouri Life Science Research Board (MLSRB)** was created in 2003 with the goal of enhancing research capacity in life sciences to better serve the health and welfare of Missouri citizens, and promote Missouri as a center of life science research and development. The Board's mission is to build on the success of existing Missouri research institutions, create and attract new research and development institutions, and transform that research into commercial life science technology.<sup>35</sup> An example of the Board's activities include two January 2009 grants totaling \$1.5 million given to the Donald Danforth Plant Science Center, one of the leading agricultural research institutions in the nation, located in St. Louis. As noted above, the Danforth Plant Science Center is leading the research on algae's conversion to biofuel.

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## Retooling Manufacturing as the Pathway to Green Jobs

Michigan's strong roots in manufacturing are providing a new entryway into the low-carbon economy. According to the Michigan Green Jobs Report 2009, the fastest-growing sector of Michigan's green economy is renewable energy production. This cluster, which accounts for an estimated 10 percent of all green jobs in the state, created approximately 1,900 jobs between 2005 and 2008, a 30 percent growth rate.<sup>1</sup> These figures illustrate the potential for retooling Michigan's manufacturing base to lead the renewable energy value chain. The experienced advanced manufacturing workforce and the presence of a large number of original equipment manufacturers (OEMs) and engineers makes Michigan an ideal location for green manufacturing jobs. By 2007, 1,932 businesses had generated more than 22,600 jobs in the clean energy economy. Venture capitalists are investing over \$55 million in clean energy businesses in the state,<sup>2</sup> and Michigan is a leader state in green technology patents, having secured 260 between 2006 and 2008.<sup>3</sup>

The Renewable Energy Policy Project, a Washington, D.C.-based renewable energy think tank, prepared the *Component Manufacturing: Michigan's Future in the Renewable Energy Industry* in November 2006. It concluded that a national commitment to generating 185,000 megawatts (mw) of renewable energy in the U.S. over ten years would translate into the creation of 34,777 new jobs for approximately 2,000 existing Michigan industrial firms that could supply the component parts.<sup>4</sup>

Further, Michigan is a member of the Midwestern Greenhouse Gas Reduction Accord (MGGA).<sup>5</sup> The MGGA is regional agreement among six Midwestern states (including Iowa, Illinois, Kansas, Michigan, Minnesota, Wisconsin) and Manitoba in Canada to reduce greenhouse gases (GHGs). The MGGA program has four main goals: to establish GHG reduction targets and time frames consistent with signing states' targets; to develop a market-based and multi-sector cap-and-trade mechanism to help achieve those reduction targets; to establish a system to enable tracking, management, and crediting for entities that reduce GHG emissions; and to develop and implement additional steps as needed to achieve the reduction targets, such as a low-carbon fuel standards and regional incentives and funding mechanisms.<sup>6</sup>



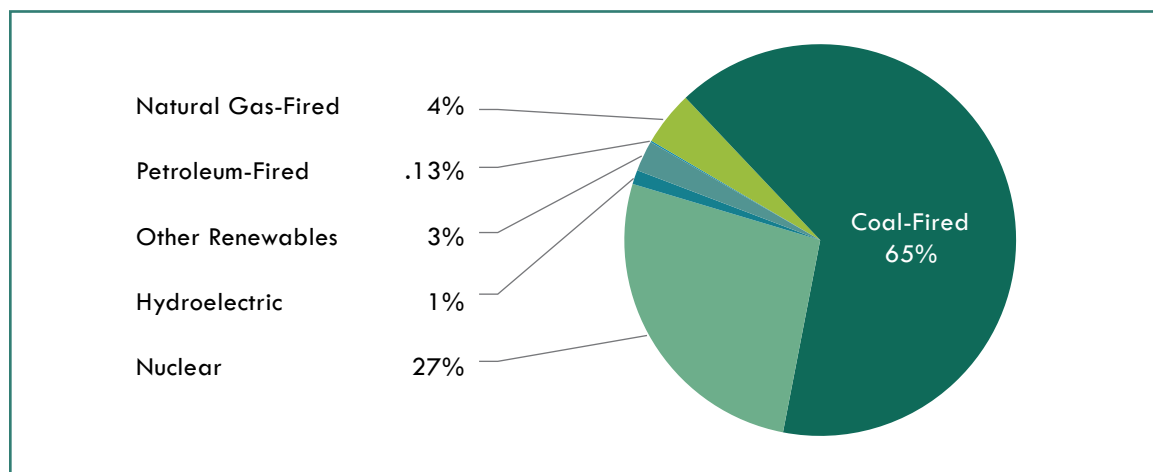
## Energy Economy Snapshot

In October 2008, Michigan adopted a renewable portfolio standard (RPS) mandating that 10 percent of the state's energy come from renewable sources by 2015.<sup>7</sup> The state's total energy consumption is high, due in part to the large population, northern climate and active industrial sector.<sup>8</sup> The governor's office seeks to reduce fossil fuel usage by 45 percent by 2020.<sup>9</sup>

Michigan imports 97 percent of its petroleum needs, 80 percent of its natural gas and 100 percent of coal and nuclear power from other states and nations. Michigan spent a total of \$37 billion on all forms of energy in 2007 and of that amount, \$26 billion was for energy resources imported from other states and nations.<sup>10</sup>

Michigan has significant potential for energy from renewable resources, particularly from biomass, wind, and solar.<sup>11</sup> The state's current electricity generation profile is dominated by coal (65 percent), followed by nuclear at 27 percent, natural gas at 4 percent, and renewable at 3 percent. Hydroelectric accounts for about 1 percent of the state's electricity, and petroleum accounts for less than 1 percent.

### MICHIGAN'S ELECTRIC GENERATION BY FUEL SOURCE, 2009



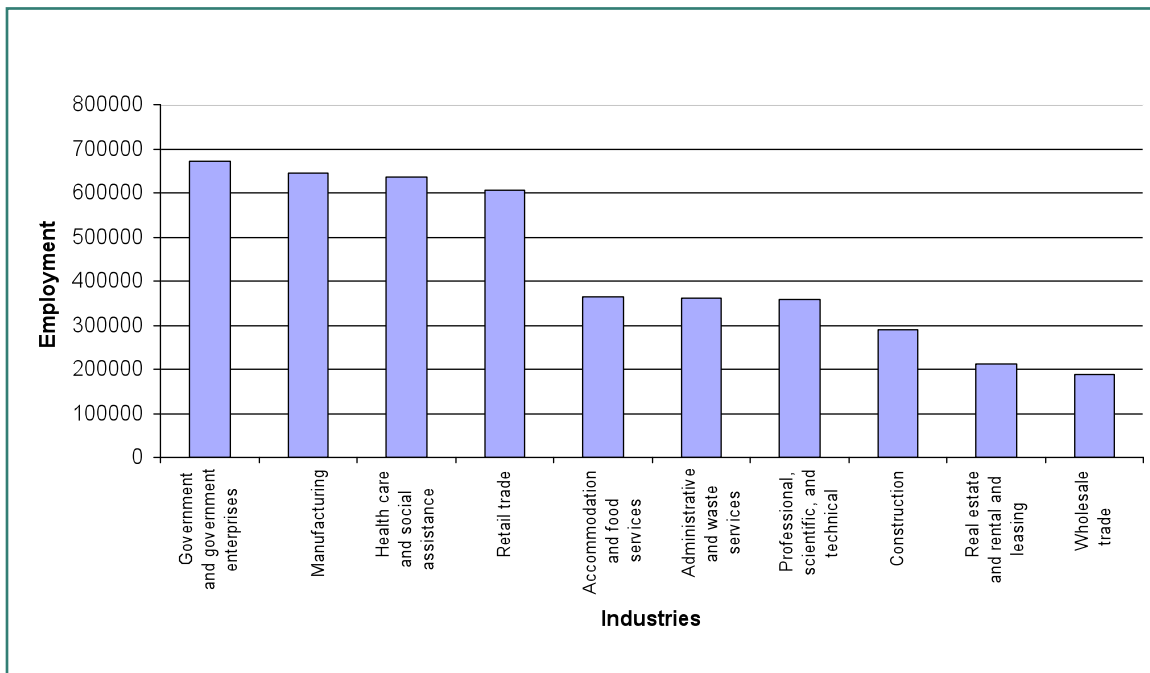
Source: US DOE, Energy Information Administration, State Energy Profiles, 2009



## Industry Overview of Michigan

Understanding the vulnerabilities and areas of resilience in the state's industry mix will help define Michigan's opportunities and challenges in preparing for a low-carbon economy. Government, manufacturing, healthcare and social services, and retail account for the top employment sectors in Michigan, together employing over 2.4 million workers. Manufacturing jobs represent the second highest employment category in the state, second only to government. Accommodation and food services, administrative and waste services, and professional, scientific and technical services together employ over 900,000 employees in the state, comprising the middle group of the top ten industries.

### TOP 10 INDUSTRIES BY EMPLOYMENT IN MICHIGAN: 2007



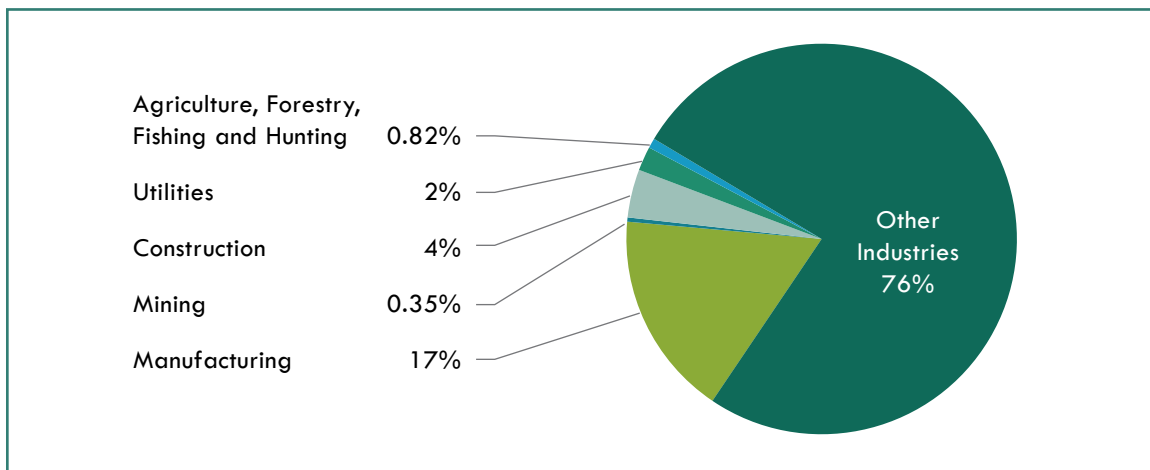
Source: BEA, 2007



Energy-intensive industries make up 24 percent of the total gross domestic product (GDP) in Michigan and 19 percent of employment. Among the five energy-intensive industries, manufacturing (17 percent), construction (3 percent), and utilities (2 percent) make up the highest proportion of GDP. Mining (.35 percent) and agriculture, forestry, fishing and hunting (.82 percent) total just over 1 percent of the state's GDP. Manufacturing and construction are the sectors with the highest employment (12 percent and 5 percent, respectively), at 17 percent of the total.

Looking at location quotients<sup>12</sup> to understand the state's economic advantages, manufacturing and utilities stand out as specializations for Michigan in terms of GDP and employment. Michigan has both GDP and employment sub industry specializations in the areas of motor vehicle parts manufacturing; furniture manufacturing; fabricated metal product manufacturing; primary metal manufacturing and machinery manufacturing. Michigan also has a specialization in plastics and rubber products manufacturing.

#### ENERGY INTENSIVE INDUSTRIES BY GDP IN MICHIGAN, 2007



Source: BEA, 2007

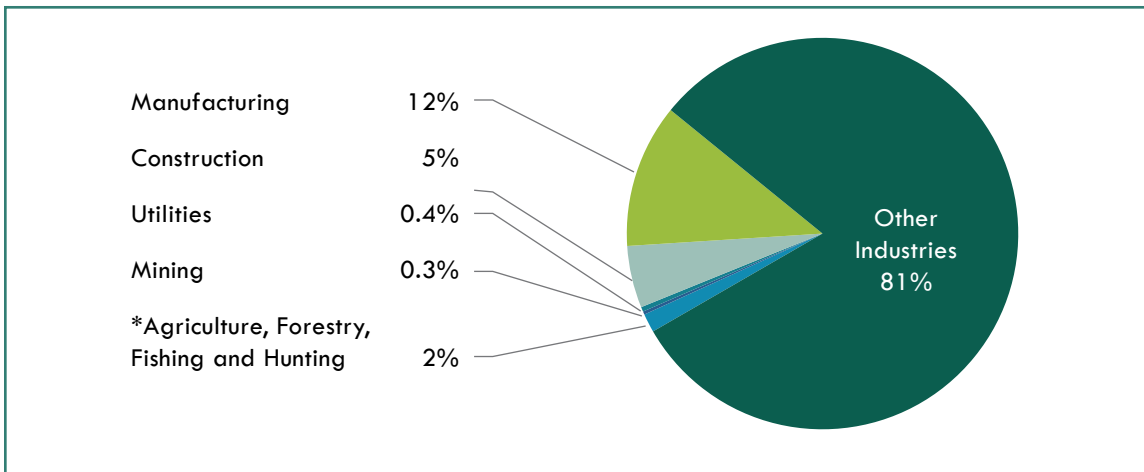


**LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Manufacturing	Construction	Utilities	Mining	Agriculture, Forestry and Fishing
LOCATION QUOTIENT		.17	.66	.84	1.21	1.44
Total GDP by Industry	\$379,934	\$1,315	\$3,100	\$14,342	\$9,457	\$64,541
Percentage of State GDP	100%	.35%	.82%	4%	2%	17%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0

**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN MICHIGAN, 2007**



\*Includes farm employment. Source: BEA, 2007





### LOCATION QUOTIENT (COMPARATIVE TO THE U.S.) FOR ENERGY-INTENSIVE INDUSTRIES BY EMPLOYMENT

Industry	Mining	Agriculture, forestry, fishing, related activities, and other	Construction	Utilities	Manufacturing
LOCATION QUOTIENT	.48	.72	.79	1.21	1.48
Total Employment by Industry	14,311	84,119	278,706	21,142	646,214
Percentage of State GDP	.3%	2%	5%	.4%	12%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0

### Preparing for the Low-Carbon Economy

Recognizing the need to address the state's dependency on imported energy, Michigan Governor Jennifer Granholm issued Executive Directive 2006-2 in April 2006, requesting that the Michigan Public Service Commission (MPSC) develop a comprehensive electric energy plan for the state. The MPSC thus created the 21st Century Energy Plan to provide recommendations on how Michigan can reliably meet its growing electric needs and keep electric costs competitive. The plan investigates all reasonable electric supply options, including the implementation of energy efficiency programs and the use of renewable electric generation.

In 2007, the governor created the 35-member Michigan Climate Action Council by executive order. The council was charged with compiling a comprehensive climate action plan with recommendations for greenhouse gas reduction goals, along with potential actions to mitigate climate change. The Clean, Renewable, and Efficient Energy Act, which became law in October 2008, sets forth procedures and guidelines to optimize energy efficiency and renewable energy generation within the state, notably establishing an integrated renewable portfolio standard mandating that 10 percent of the state's energy come from renewable sources by 2015. The governor's 2009 State of the State address established a goal that by 2020, Michigan will reduce fossil fuel dependency for generating electricity by 45 percent, to be



accomplished through increased renewable energy sources, gains in energy efficiency, and other new technologies.<sup>13</sup>

The Clean, Renewable, and Efficient Energy Act contains an energy efficiency resource standard that sets mandatory energy-saving goals for the state's electric and gas utilities. The goals start at .03 percent of electricity sales in 2009 and increase to an annual electricity-saving requirement of 1 percent total sales by 2012, continuing at that level each year after. The act also authorizes shareholder incentives for utilities that exceed the energy savings requirements and contains provisions that allow for decoupling for natural gas utilities that provide energy-efficient programs.<sup>14</sup>

Legislation related to the act allows consumers that have purchased and installed certain Energy Star products to claim an income tax credit equal to 10 percent of the cost of the product or \$100, whichever is less. Additional legislation expands the authority of the state Public Service Commission to monitor utilities, oversee rate increases and manage long-term generation plans, and requires utilities to implement net metering programs to harness consumer-generated electricity.

Accompanying this comprehensive energy legislation are numerous resources that plant managers can consult for energy efficiency and renewable energy information, or assistance in financing energy efficiency improvements or renewable energy projects at their facility.

## State and Local Incentives

Michigan offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

### *Incentives to encourage production:*

**The Michigan NextEnergy Authority (MNEA)** provides tax incentives for businesses engaged in research, development and manufacturing of alternative energy technologies. MNEA consists of an eight-person board, including the State Treasurer; the president of the Michigan Strategic Fund; the directors of the state departments of Labor and Economic Growth, and Transportation; and four private-sector appointees.<sup>15</sup> The tax credits began in 2003 and currently run through 2012.



Michigan created an **Alternative Energy Zone** around Wayne State University's Research and Technology Park in Detroit, which provides state Renaissance Zone tax benefits for companies engaged in alternative energy research, development and manufacturing. The 700-acre site is expected to be a leading alternative energy incubator.<sup>16</sup> Wayne State is dedicated to expanding R&D to promote Michigan's alternative energy industries.<sup>17</sup>

**The Michigan Advanced Batteries Credits Initiative (MABC)** is a novel approach to support the development and manufacturing of advanced energy storage and its commercialization. The Michigan Economic Growth Authority administers MABC as part of the Michigan Business Tax Credit program. The goals of MABC include energizing the value chain by driving down the price of fuel cell technology. There are four separate programs within MABC: Pack Engineering, Integration and Assembly Credits; Vehicle Engineering Credits; Advanced Battery Technology Credits; and Battery Cell Manufacturing Credits.<sup>18</sup>

**Additional tax credits include the following:**

- Michigan Business Tax (MBT) Credit
- Michigan Business Tax Refundable Hybrid Technology R&D Credit
- Michigan Business Tax Credit for polycrystalline silicon manufacture and solar photovoltaic
- Michigan Business Tax High Technology Anchor Company Payroll Credit and Taxable Property Credit
- Renewable Energy Renaissance Zones
- Alternative Energy Personal Property Tax Exemption
- Biomass Gasification and Methane Digester Property Tax Exemption and Biomass Energy Program Grants through the Michigan Department of Energy's State Energy Program<sup>19</sup>

***Incentives to encourage demand:***

**Michigan Saves** is an innovative program to help business, institutions, and residents afford energy efficiency and renewable energy upgrades. Michigan Saves finances the installation of energy measures with no upfront cost to utility consumers. It works with government and financial institutions to expand or leverage an initial \$6.5 million in base funding, establishing a network of qualified contractors and energy audit services. The program helps communities to manage other sources of funding for energy-efficiency programs related to local government buildings, businesses or residences.



## **Transition Assistance**

In September 2009, Michigan benefitted from American Recovery and Reinvestment Act funding under the Department of Energy's Energy Efficiency and Conservation Block Grant (EECBG) program. The \$19.6 million award will be used to implement programs that lower energy use, reduce carbon pollution, and create green jobs. This coincides with the state's plan to recharge the economy with its "Jobs Today, Jobs Tomorrow" initiative, which strives to employ thousands of people by accelerating 10 years of road and bridge construction work, nursing home improvements, and pollution clean-up projects.

To ensure that Recovery Act funds reach as many cities and counties as possible, the state will encourage communities to partner through multi-jurisdictional applications and to leverage other public and private resources. Michigan will use a separate competitive solicitation to award funds for Light Emitting Diode (LED) and Solid State Lighting projects.<sup>20</sup>

Additional energy efficiency efforts include the Centers for Energy Excellence Program is administered by the 21st Century Jobs Fund and totals \$45 million. The program is designed to develop, accelerate and maintain the momentum of the alternative energy value chain in Michigan. The grants can be used for the following four purposes: to match federal, international and private foundation grants for 50 percent of project costs; to match a private individual's contribution; to advance the commercialization of new alternative energy technology that is expected to reach the market within three years; or for workforce development and product demonstrations.<sup>21</sup> This program intends to promote collaboration among Michigan's university centers and for-profit ventures.

### ***Transitioning Industry:***

With Michigan's strong history in manufacturing, much of its work is focused on moving toward mitigating GHG emissions while transitioning its traditional industries into the low-carbon economy.

### ***Advanced Energy Storage***

The future of the U.S. automotive industry lies with next-generation cars that run more efficiently, using less energy, alternative energy or both. One of the most significant challenges toward this evolution is the development of advanced batteries capable of competing with



fossil fuel engines in terms of driving radius and refueling time. Michigan set out in 2006 to become a leader in advanced battery research, and its supply chain continues to grow. Michigan is focusing on four primary areas to achieve its goal of becoming the domestic and international leader in advanced energy storage:

- Aggressively recruiting fuel cell manufacturers,
- Working to populate its value chain,
- Workforce development, and
- Pushing for access to diverse markets.<sup>22</sup>

Michigan has provided significant tax incentives for the development and manufacture of advanced batteries. The total amount of funds that the state has provided for advanced battery R&D and production exceeds \$555 million.<sup>23</sup>

Additionally, a partnership between Wisconsin-based firms Johnson Controls, Inc. (one of the global leaders in automotive parts, building energy efficiency and power generation) and Saft Advanced Power Solutions LLC (a division of France's The Saft Group, a global leader in advanced technology batteries), is investing \$220 million to manufacture lithium-ion fuel cells in Holland, Michigan. The partnership is leveraging a Michigan Business Tax Credit of \$48.5 million over 15 years, as well as a four-year, \$100 million Battery Cell State Tax credit. Johnson Controls has a long relationship with Ford Motor Company that it is continuing to nurture.<sup>24</sup>

Adaptive Materials, Inc., is Michigan's largest fuel cell manufacturer and an example of Michigan's drive to expand market potential for its alternative energy firms. Adaptive Materials is a leading manufacturer of portable fuel cells for applied national defense. It utilized a \$6.27 million 21st Century Jobs Fund commercialization loan, as well as a Michigan Advanced Battery tax credit of \$760,000, to expand from an 11,000-square-foot facility to a 50,000-square-foot facility, expecting to employ 187 more people in areas such as systems, engineering and manufacturing. The company began in 2000 with just two employees.<sup>25</sup> Adaptive Materials placed second among 47 companies in a Department of Defense competition in research and engineering, and was awarded \$500,000 in 2008.<sup>26</sup>



Dow Kokam (a consortium of The Dow Chemical Co., Kokam America Inc. and Townsend Ventures LLC) is planning a \$665 million, 800,000-square-foot battery plant to produce lithium-polymer batteries. The plant will create 885 new jobs. Dow Chemical received a \$145 million tax credit from the Michigan Economic Growth Authority. The \$145 million is divided between a 15-year tax credit for \$44.6 million and a four-year battery cell tax credit worth \$100 million. The goal of the state tax credits is to position these companies for \$2 billion in federal funds available for advanced battery research.<sup>27</sup>

Austria-based AVL was given a five-year tax incentive package totaling \$298,559 to locate its North American operations, operating as VL Powertrain Engineering, in Michigan, and plans to invest \$2.6 million in a new hybrid and alternative fuel development center in Ann Arbor for electric vehicle powertrain development. The company currently has 377 employees in Michigan, and is expected to grow.<sup>28</sup>

The most highly touted program is General Motors Corporation's Chevy Volt, which will rely on a GM-produced lithium-ion battery capable of traveling 40 miles on a single charge. The engine vehicle mileage is supplemented by a 1.4-liter gasoline engine to increase its range. The fuel economy is expected to reach 100 miles per gallon.<sup>29</sup> Thus far, \$700 million has been invested in eight facilities across Michigan.

### **Wind**

According to the Renewable Energy Project Report, approximately 24,350 jobs could be created in Michigan if the component part supply chain for wind energy were developed to meet assumed demand from a national policy to stabilize carbon emissions.<sup>30</sup>

In 2006, the Michigan Economic Development Corporation enlisted NextEnergy to lead a consortium of non-profits, suppliers and government agencies to promote component manufacturing for various alternative energy supply chains, with an emphasis on wind. According to NextEnergy, more than 60 companies were invited to bid for more than \$1.5 billion worth of new contracts; 29 of them received new business worth \$377 million. These companies then invested an additional \$80.5 million of their own capital into retooling, and created or retained 1,145 jobs.<sup>31</sup>



In spring 2009, Great Lakes Towers announced that it would build a \$19 million factory to produce giant towers for commercial-scale wind turbines. Sterling Heights-based MAG Industrial Automation Systems, LLC, and Eaton Rapids-based Dowding Machining, Inc., partnered to create Astraeus Wind Energy, Inc., a new wind turbine manufacturing venture to build next-generation machine tools for wind turbine components and also carbon-fiber wind turbine blades. Their goal is to help drive down the cost of wind turbine technology so that it becomes as cost-effective as fossil fuel electricity generation.<sup>32</sup>

Dowding Industries is an example of Michigan automotive supply chain companies shifting to a green economy platform. Dowding, a leading manufacturer of progressive die stampings, metal fabrications, and welded assemblies, was a long-term supplier to the automotive industry. It now considers its core business to include machined transmission housings, components and platforms used in the assembly of wind turbines.<sup>33</sup> In 2007, Dowding invested \$7.1 million towards a \$14 million expansion of its manufacturing plant. The company expects the plant to create 200 new direct jobs and 158 supporting jobs.<sup>34</sup>

Other examples of state measures to spur the growth of the wind supply chain are actions by the Michigan Department of Energy, Labor and Economic Growth. It assisted in procuring \$1.5 million in Recovery Act funds for Loc Performance Products, Inc. to manufacture gears and gearboxes for utility-scale wind turbines, and another \$500,000 for residential photovoltaic solar manufacturer LUMA Resources LLC.<sup>35</sup>

### **Solar**

Expanding solar manufacturing in the state is part of the governor's strategy to grow high-tech companies and jobs while reducing dependence on foreign energy sources.<sup>36</sup> While no state programs are designed specifically for solar energy, the combination of general alternative energy tax credits with Michigan's net metering laws, which require public utilities to purchase excess energy produced by customers, are aiding in driving Michigan's solar value chain. Moreover, the renewable portfolio standard guidelines have led to public utilities providing their own incentive programs, such as DTE Energy's Solar Currents program, and Consumers Energy's feed-in-tariff program.<sup>37</sup> These programs incent end users of electricity to purchase solar systems, which drives up demand for the products.



In late 2008, the Hemlock Semiconductor Corporation, in a joint venture with Dow Corning, announced the company's fourth expansion, investing up to \$1 billion to expand its manufacturing facility in Hemlock, Michigan. The expansion was expected to create 576 new jobs, including 190 directly by the company. The company is the world's leading producer of polycrystalline silicon, a component used to produce solar energy.

Evergreen Solar, Inc., a Massachusetts-based firm, decided to locate a new manufacturing plant in Midland, Michigan. It received a Michigan Economic Growth Authority tax credit of \$1.8 million over 10 years, along with a City of Midland 12-year tax abatement worth \$3.9 million. The cutting-edge facility will produce the firm's proprietary String Ribbonwafer technology for solar panels. The site is expected to produce an additional \$55.2 million in new capital investment, and create 101 direct and 495 indirect jobs.<sup>38</sup> Recently, the falling cost of solar panels has forced the company to shift some labor-intensive manufacturing overseas from its plant in Devens, Massachusetts, but the company maintains that it is committed to the Michigan plant.<sup>39</sup> In late 2009, Suniva and GlobalWatt both announced new manufacturing plants in Saginaw, each creating 500 direct jobs.

Another example of the growth of the solar industry in Michigan is the partnership of Santa Barbara, California-based Clairvoyant Energy Solar Panel Manufacturing, Inc., and Austin, Texas-based Xtreme Power, Inc. The two firms, with assistance from the Michigan Economic Development Corporation, plan to acquire the former Ford assembly plant in Wixom in the second quarter of 2010. Clairvoyant is moving its world headquarters to the facility, and plans to invest \$856 million (over four phases) to manufacture solar panels. Xtreme will manufacture large-scale power systems. The two firms expect a total capital investment of \$475.4 million. Manufacturing is expected to begin in 2011. Half of the total property will be leased out to supply chain partners in a plan to create an alternative energy cluster on the site of the 4.7 million-square-foot former automobile manufacturing facility.<sup>40</sup>

United Solar Ovonic, headquartered in Rochester Hills, Michigan, is a leading manufacturer of integrated thin-film photovoltaic. It currently operates five manufacturing plants, four in Michigan and one in Tijuana, Mexico. It is expanding its two Greenville, Michigan, locations to 280,000 square feet each, and is building a new 265,000-square-foot facility in Battle Creek.<sup>41</sup>





### **Biomass**

Over a third of all renewable energy currently generated in the state is derived from wood-fired power plants.<sup>42</sup> Michigan Biomass is an advocacy group of small, wood-burning power plants that supports the continued use of waste wood, nearly 2 million tons of which would otherwise go to landfills each year. Michigan has total cellulosic biomass resources of 7.5 million dry tons, and total crop biomass resources of 6.2 million dry tons. There are currently 41 E85 (motor fuel blends of up to 85 percent ethanol and 15 percent gasoline) filling stations located throughout the state, and six operating ethanol plants with total annual production capacity of 314 million gallons. In addition, there are four operating biodiesel plants, with total annual production capacity of 35 million gallons.<sup>43</sup>

Michigan's Department of Energy, Labor and Economic Growth runs the Michigan Biomass Energy Program, which promotes the use of Michigan's biomass resources in the production of energy. The program sponsors research, provides technical assistance, develops partnerships and supports education.<sup>44</sup> The four key areas that MBEP specializes in are anaerobic digestion, biodiesel, energy crops and ethanol.

### **Transitioning the Workforce:**

The Michigan Green Jobs Initiative is designed to help ensure that emerging industries and the green economy have the trained workers they need to grow and prosper. The Green Jobs Initiative intends to:

1. Create green sector skills alliances that bring together business, labor, government and educational leaders who share interest and expertise in a specific green sector of Michigan's economy to develop training programs for jobs in these industries;
2. Invest in Michigan's community colleges, universities, and training facilities to build their capacity to develop and provide training for green jobs; and
3. Expand No Worker Left Behind to provide tuition support for eligible individuals pursuing approved green-jobs training programs at Michigan colleges and universities.<sup>45</sup>

The Michigan Strategic Fund is another workforce resource, formed in number of Renaissance Zones, which provided increased tax incentives for tool and die manufacturers, with an emphasis on alternative energy technologies and electrified vehicles.<sup>46</sup>



## Investing in Innovation

Innovation is key to enabling the transition to a low-carbon economy. Research and development in alternative energies and energy efficiencies aims to reduce their costs and help high emitting industries and firms in adapting to this new economic environment. Michigan has undertaken many innovation initiatives that will help it transition to a low-carbon economy with a focus on advanced energy storage, wind, solar, and biofuels and biomass. Below are some of the innovation initiatives taking place in the state.

### ***Advanced Energy Storage***

LG Chem and its subsidiary Compact Power, Inc. are working on a \$200 million, 660,000-square-foot, lithium-ion cell research and development plant in Michigan that is expected to create more than 300 new jobs.<sup>47</sup> Compact Power is developing lithium polymer battery packs for electric, hybrid fuel cell vehicles, along with defense and aerospace-related applications. A Single Business Tax Credit valued at \$3.8 million over 10 years was awarded to the company.<sup>48</sup>

### ***Wind***

In June 2009, General Electric announced a \$100 million investment in Van Buren Township to develop a wind turbine research and development facility. This facility is expected to enhance the aptitude of the wind turbine cluster developing in southeastern Michigan. GE is the largest U.S. manufacturer of wind turbines, with a 44 percent market share.<sup>49</sup>

Approximately \$1.5 million of Recovery Act funds was awarded to Dow Corning, Michigan Aerospace Corporation, and the University of Michigan in Ann Arbor to continue research into improving wind turbine operating efficiencies.<sup>50</sup>

### ***Solar***

Researchers at Michigan State University, the University of Michigan, Western Michigan University, Wayne State University and other Michigan higher education centers are utilizing a combination of state and federal funds to expand opportunities for the solar energy supply chain. Both the University of Michigan and Michigan State University are part of a group of 46 Energy Frontier Research Centers.<sup>51</sup>



### ***Biofuels and Biomass***

In November 2009, the Michigan Biomass Energy Program announced the award of just over \$74,000 in grants for three biomass demonstration projects. Awardees include the Lansing Board of Water & Light, Wyandotte Municipal Services and Michigan Technological University.<sup>52</sup>

In December 2009, Toledo-based N-Viro International Group was awarded a feasibility test grant from the state for its N-Viro Fuel product. An initial demonstration took place at Michigan State University in 2007; after further research was conducted, the new grant provides funding for a boiler and emissions test.<sup>53</sup> N-Viro's mission is to develop ways to stabilize and disinfect municipal waste to convert it into new uses, including fuel sources and soils.<sup>54</sup>

In November 2008, Mascoma Corporation announced that it had been awarded \$23.5 million from Michigan, augmenting a \$26 million U.S. Department of Energy grant to advance the construction of a cellulosic fuel plant in Kinross, Michigan. The facility aims to increase the commercialization of cellulosic fuels. Both General Motors and Marathon Oil are investors in Mascoma, which is building the \$250 million facility with a goal of producing 40 million gallons of ethanol annually. Mascoma is working with researchers at Michigan State University and Michigan Technological University to increase the output efficiency of cellulosic feedstock.<sup>55</sup>

Michigan State University operates the Biomass Conversion Research Laboratory, whose mission is to develop cost-effective and environmentally sustainable fuels, chemicals, materials, foods and feeds from plant biomass.<sup>56</sup> Researchers at Lake Superior State University and Michigan State University are looking at the viability of using reed canary grass as a biofuel feedstock. The grass's growth is plentiful in the eastern Upper Peninsula region.<sup>57</sup>

### **Partnerships**

In addition to the partnerships already discussed in this chapter, the partnerships highlighted below show successful coordination between state and quasi-state agencies.

As a sign of the recognized importance of alternative energy technology for Michigan, the state-level departments of labor, economic growth and energy were all combined in the **Department of Energy, Labor, and Economic Growth (DELEG)**. One of DELEG's roles is to



align the state energy strategy with effective use of Recovery Act funds. Its energy strategy targets five main areas: workforce; advanced energy storage; energy efficiency; and large-scale wind and solar.

**The Michigan Economic Development Corporation (MEDC)** is the premier business attraction and economic growth agency in the state. MEDC offers financing through the \$2 billion 21st Century Jobs Fund, along with significant tax abatement programs. One of MEDC's strategic goals is to diversify Michigan's economy through several targeted sectors. It is focusing on alternative energy and alternative fuels by building on existing strengths from the automotive research and development, advanced manufacturing and agricultural sectors.<sup>58</sup>

**NextEnergy** is a Detroit-based non-profit that seeks to catalyze the alternative energy supply chain by expanding research and business incubation services. It provides investment and technical assistance to universities, businesses and government desiring to expand into the field of alternative energy. Its goal is to expand the commercialization of alternative energy to provide for increased economic competitiveness, energy security and an improved environment.<sup>59</sup>

**The Michigan Alternative and Renewable Energy Center (MAREC)** opened in 2003 as part of the Michigan's SmartZone Initiative to commercialize new technologies. The center is a collaborative effort among Grand Valley State University, Michigan Public Service Commission, the City of Muskegon, Michigan Economic Development Corporation, and several other Muskegon-area entities. The 25,000-square-foot center is a fully functioning distributed energy generator, employing fuel cell, solar, and wind technologies. MAREC operates a 600 kilowatt wind turbine as part of the Michigan Offshore Wind Pilot Project in Muskegon Lake, as well as a biomass plant.<sup>60</sup>

**The Great Lakes Wind Council** was appointed by Governor Granholm to examine offshore wind energy and develop guidelines for its use in Michigan. The state has drawn more than two dozen wind-related manufacturers and there are significant opportunities for additional growth, given that Michigan has 1,000 auto industry suppliers that could manufacture wind components.<sup>61</sup>



**The University Research Corridor** is a formal alliance between the University of Michigan, Michigan State University and Wayne State University, the three largest university centers in the state, to promote the retooling of Michigan's manufacturing economy and to assist in diversifying its economic base.<sup>62</sup>

**Great Lakes Renewable Energy Association**<sup>63</sup> and **Michigan Green**<sup>64</sup> are additional non-profit organizations devoted to improving the alternative energy economy in Michigan.

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## Portrait of an Early Adopter

Maine is one of ten states participating in the Regional Greenhouse Gas Initiative – the first mandatory regional cap and trade program in the U.S. The program applies to carbon dioxide emissions from large fossil-fuel-fired power plants above a minimum size (greater than 25 mw). It aims to stabilize emissions between 2009 and 2014 at 2009 levels. While the program has only been fully online for about a year, Maine is seeing results and is focusing the majority of the revenue it garners from the project into energy efficiency programs for residential, commercial, and institutional purposes throughout the state. Maine is one of the earliest adopters of specific strategies to reduce greenhouse gas (GHG) emissions, implementing a renewable portfolio standard (RPS) in 1999. Maine's RPS stipulates that 40 percent of its electricity be generated by renewable sources by 2017. Thus not only has the state come to generate over half its electricity through renewable sources, but the innovations emerging from this policy filter through a wide range of industries.

Further, Maine is capitalizing on its many assets from its natural environment to further propel itself into the low-carbon economy. Its major focus is in developing its large potential in deep water offshore wind development. As a testament to this effort, the state recently passed LD 1810 which commits to establishing the state goal of 5 gigawatts (5,000 mw) of energy generation from facilities located in coastal waters by 2030. Further, the Maine Public Utilities Commission will conduct a competitive process for contracting from deep-water offshore wind energy pilot projects (up to 25 mw) or tidal demonstration projects (up to 5 mw). To meet this aggressive goal, the state is working collaboratively with industry, higher education institutions, inter and intra-state government departments, trade associations, and nonprofit organizations to collectively drive the industry forward as well as the regulatory environment necessary to make it happen.



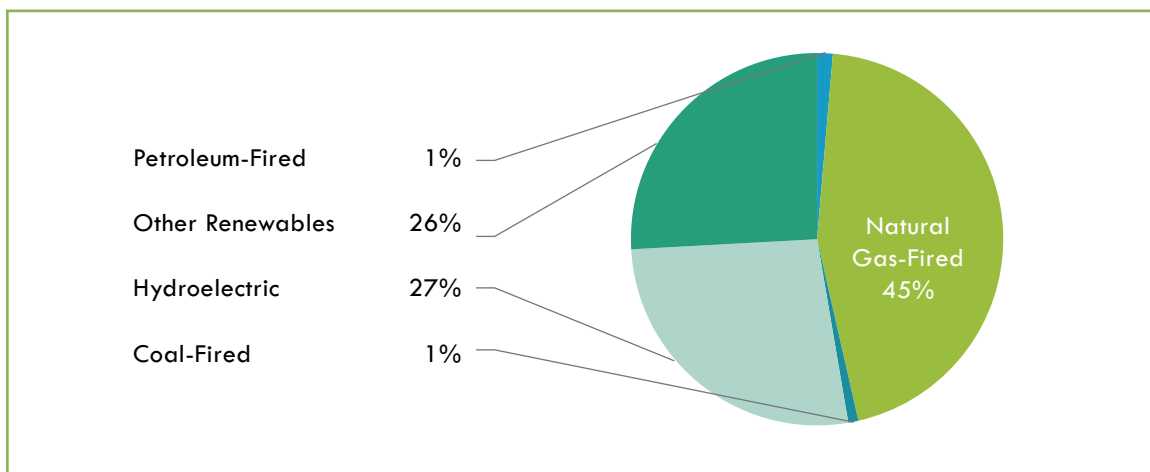


## Energy Economy Snapshot

Maine's retail rate for electricity is high as compared to some of the other RGGI states. This is often attributed to the low population and low density of the state as compared to the other states, which drives up delivery costs. The rural nature of the state means that about three-quarters of Maine's households – the highest share in the Nation – use fuel oil for home heating.<sup>1</sup>

Maine generates a larger share of its electricity from non-hydroelectric renewable resources than any other state at 26 percent. Electricity generated from natural-gas fired plants accounts for 45 percent of the state's energy, hydroelectric accounts for 27 percent, and both petroleum-fired and coal-fired plants account for 1 percent each.

### MAINE ELECTRIC GENERATION BY FUEL SOURCE, 2010



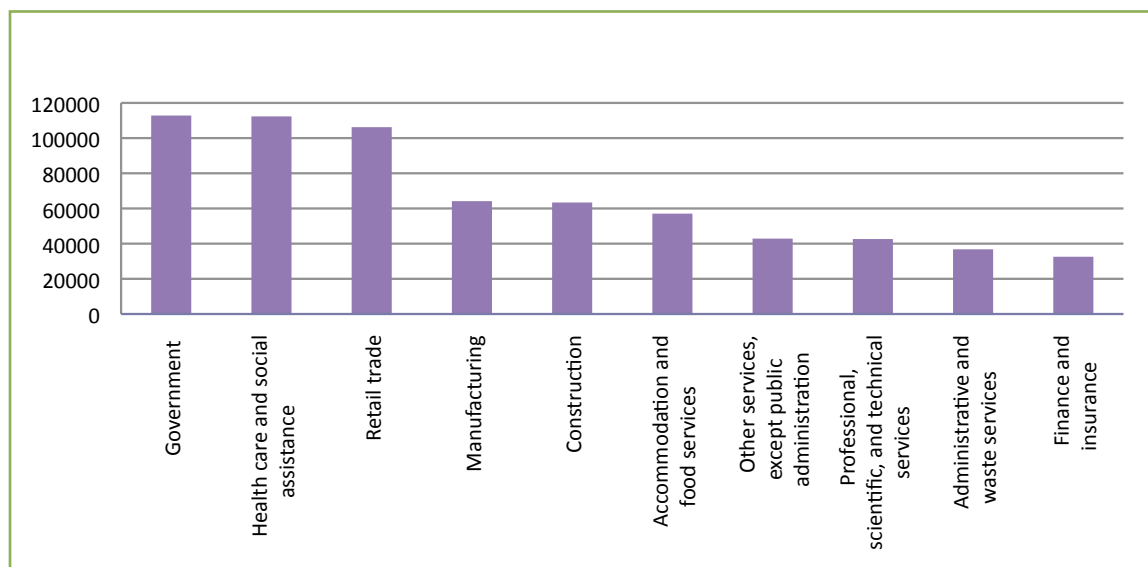
Source: US DOE, Energy Information Administration, State Energy Profiles, 2010



## Industry Overview of Maine

In order to understand the opportunities and challenges presented in preparing for a lower-carbon economy, there also needs to be an understanding of what the state's current vulnerabilities and areas of resilience are based on their current industry mix. Maine's overall industry mix by employment is dominated by government, health care and social services, and retail trade, which represent about 325,000 employees. Manufacturing, construction and accommodation and food services also represent large employment sectors, totaling about 120,000 employees.

### TOP 10 INDUSTRIES BY EMPLOYMENT IN MAINE: 2007



Source: BEA, 2007

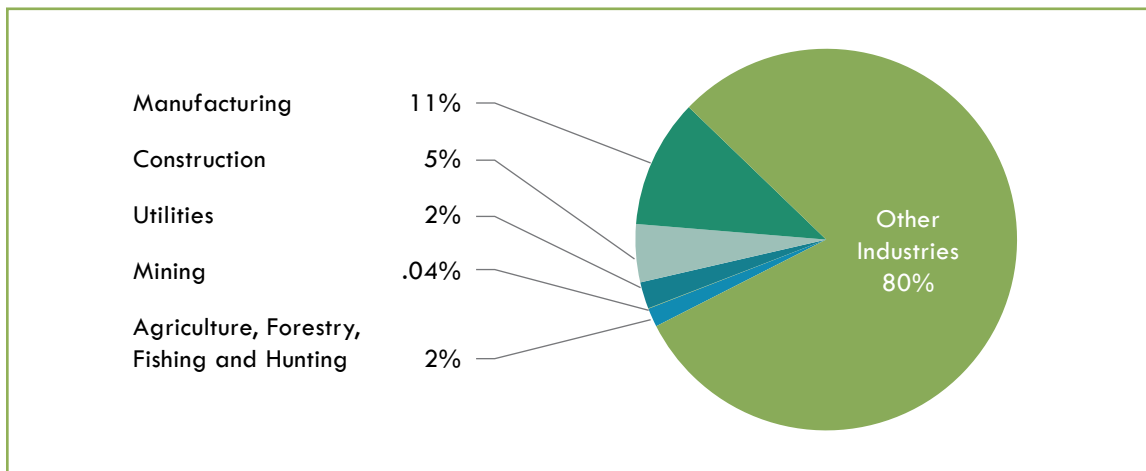
Energy intensive industries compose 20 percent of Maine's gross domestic product (GDP) and 19 percent of its total employment. Manufacturing represents the largest portion of energy intensive industries by GDP at 11 percent, followed by construction (5 percent). Utilities and agriculture, forestry and fishing both represent 2 percent respectively, and mining composes less than 1 percent of the state's GDP. Additionally, manufacturing and construction both represent 8 percent of the state's employment, followed by agriculture, forestry, fishing and hunting (3 percent). Utilities and mining both compose less than 1 percent of the state's employment.



Using location quotients to understand the state’s economic advantages, agriculture and construction stand out as specializations in terms of employment – especially in forestry and logging, fishing, hunting, and trapping; construction of buildings; and specialty trade contractors.<sup>2</sup>

GDP specializations include utilities, construction, and agriculture, forestry and fishing. Sub industry specializations are focused in forestry, fishing, and related activities.

**ENERGY INTENSIVE INDUSTRIES BY GDP IN MAINE, 2007**



Source: BEA, 2007

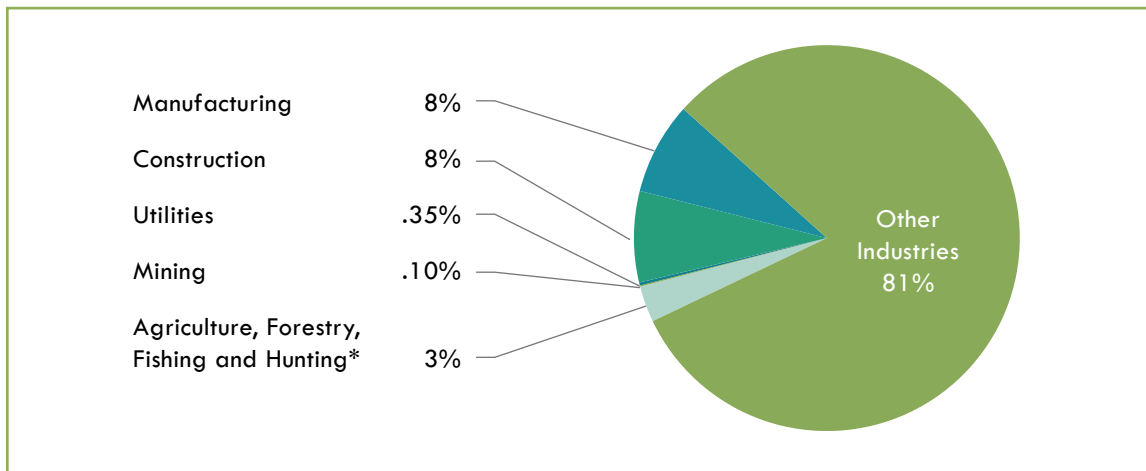
**LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY GDP**

Industry	Total: All Industries	Mining	Manufacturing	Utilities	Construction	Agriculture, Forestry and Fishing
Location Quotient		.01	.92	1.10	1.10	1.30
Total GDP by Industry	\$48,021	\$18	\$5233	\$1,086	\$2,58	\$767
Percentage of State GDP	100%	.04%	11%	2%	5%	2%

Source: BEA, 2007 (In millions of dollars)  Shaded areas represent location quotients over 1.0



**ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT IN MAINE, 2007**



\*Includes farm employment Source: BEA, 2007

**LOCATION QUOTIENT (COMPARATIVE TO THE UNITED STATES) FOR ENERGY INTENSIVE INDUSTRIES BY EMPLOYMENT**

Industry	Total: All Industries	Mining	Utilities	Manufacturing	Construction	Agriculture, forestry, fishing, related activities, and other
Location Quotient		.16	.79	.96	1.18	1.42
Total Employment by Industry	829,947	747	2,096	64,156	63,390	25,211
Percentage of State Employment	100%	.10%	.35%	8%	8%	3%

Source: BEA, 2007  Shaded areas represent location quotients over 1.0



## Preparing for the Low-Carbon Economy

Maine is a participant in the Regional Greenhouse Gas Initiative (RGGI), which has been an event 15 years in the making. The motivation for addressing increases in GHG emissions lies in the concern that Maine is already starting to see effects of climate change – reduced precipitation in parts of the state, rising temperatures, and a rise in sea levels. In 1996, with help from an EPA grant, a task force on climate change was formed within the Maine State Planning Office (SPO). The task force created an inventory of GHG emissions in the state for 1990, which was adopted as the baseline. At the same time, Maine was participating in the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP), a regional group of northeastern states and eastern Canadian provinces working together to reduce GHG emissions. NEG/ECP adopted a Climate Change Action Plan in 2001 including a comprehensive regional plan to reduce GHG emissions. Maine was the first state to codify the NEG/ECP agreement and developed its own Climate Action Plan in 2005.<sup>3</sup>

One of the recommendations of the Climate Change Action of 2001 was to develop a regional emissions registry and explore trading mechanisms that would allow emissions banking and trading. RGGI was formed out of this initial recommendation, though applicable currently to emissions from power generation<sup>4</sup> and the ten states in the initiative, including Maine.

### **Regional Greenhouse Gas Initiative (RGGI)**

RGGI is the first and only mandatory cap and trade program in the U.S. Currently it covers carbon dioxide emissions from large fossil-fuel-fired power plants above a minimum size (greater than 25 mw). It aims to stabilize emissions between 2009 and 2014 at 2009 levels, called the emissions cap. The cap is reduced by 2.5 percent each year between 2015 and 2018 to achieve a total reduction of 10 percent below 2009 levels.

Ten states are currently participating in RGGI: Massachusetts, Connecticut, Maine, New Hampshire, Rhode Island, Vermont, New York, Delaware, Maryland and New Jersey. Pennsylvania, Ontario, Quebec and New Brunswick are observers of the RGGI program.

Allowances and offsets are two key mechanisms to assist power plants in reducing their emissions over the compliance periods mentioned above. As a first step, RGGI established a regional emissions cap based on the total emissions from the regulated sources in all participating



states. Each state's respective share of the regional cap is then established. States can issue units of this regional cap, called allowances, to power plants not exceeding the total share for the state. Each allowance represents one ton of carbon dioxide emissions.

The allowances are primarily distributed through regional auctions, which started in September 2009. Power plants are required to show compliance by December 31, 2011. In other words, utilities should have enough allowances by that time to cover emissions in 2011. Utilities that are able to reduce their emissions faster can sell their allowances to others, thereby creating a secondary market (i.e. trading among allowance holders, purchases from exchanges, etc.).

Offsets provide incentives for utilities to explore emission reductions in sectors beyond power generation and be able to count them towards their goal reductions for the year. RGGI has chosen a group of offsets that utilities can use such as carbon sequestration; offsets can count up to 3.3 percent of their compliance obligations. While providing flexibility to the utilities in meeting their goals, offsets are designed to provide significant environmental and economic benefits to the projects in which the utilities invest. If allowance prices exceed certain defined limits, RGGI has a "safety-valve" that allows greater use of offset allowances and an extension of the compliance period<sup>5</sup>.

### ***Maine's Experience in RGGI***

#### ***Use of Proceeds***

As of the last RGGI auction in March 2010, Maine is reported to have earned approximately \$17.5 million from the sale of allowances. Maine has elected to use 100 percent of these proceeds for public benefit projects. Approximately 85 percent of the proceeds will be used for electrical energy efficiency and conversion. The remainder of the 15 percent of RGGI funds will be used for reducing use of fossil fuels.

The Energy and Carbon Savings Trust administers proceeds collected from the auctioning of allowances in Maine. This Trust, along with other energy efficiency programs managed by the Maine Public Utilities Commission (PUC), are being folded into the Efficiency Maine Trust creating a single organization for managing energy efficiency programs in the state. Efficiency Maine will start operations July 1, 2010.



So far, \$650,000 in RGGI proceeds has been allocated to low-income weatherization projects and 40 percent to residential energy-efficiency and conservation programs. An additional 25 percent of proceeds will be awarded as competitive grants for large energy efficiency and conservation projects, ranging from \$10,000 to \$1 million each.<sup>6</sup> Below is an overview of the various energy efficiency programs in Maine supported by RGGI and other programs:

- Business programs –technical assistance and cash incentives for improving energy efficiency in businesses
- Small business loans and energy audits (funds provided to the state by U.S. EPA)
- Weatherization and energy-efficient appliances for low-income households (supported in part by federal stimulus funding)
- Building operator certification for facility managers to improve building operations
- High performance schools – incentives for constructing energy efficient new school buildings
- Education and training for raising awareness about energy efficiency
- Residential lighting – subsidizing CFLs to residential users<sup>7</sup>

The added cost of RGGI compliance is an incentive for utilities to invest in development of renewable energy sources. Maine has seen the development of 500 to 600 mw of wind energy installed in the past two years. Research exploring the use of tidal waves and ocean wind is also underway at the University of Maine.

### ***Economic Development***

Critics of RGGI and similar climate change regulations have maintained that such activities will be detrimental to the economy. While it has been difficult to make progress on some fronts in RGGI, and it is too early in the game to predict long-term impacts, early analysis shows that RGGI has been contributing to the economic development of Maine and other participating states. In February 2010, Gov. John Baldacci attributed the creation of up to 1,000 jobs to carbon trading through energy efficiency projects in a variety of industries in Maine.<sup>8</sup> Some of the projects funded through energy efficiency grants also received federal stimulus funds. The governor also reported that the level of investments in energy infrastructure and renewable energy are among the largest capital investments in the history of the state.



### ***Impact on Electric Rates***

Increased electric utility rates have been a constant concern. “Projections concluded that the impact of RGGI on retail electricity rates would be modest under the ‘best estimate’ scenario, ranging from an increase of 0.3% to 0.6% in 2015, across all rate classes and all states in the region.”<sup>9</sup> Further, the Maine Office of the Public Advocate website<sup>10</sup> mentions, “because Maine is a regional leader in the generation of renewable power and in the implementation of electricity efficiency programs, price impacts may be substantially smaller here than in other states. In fact, because of the ability to trade allowances, generators of renewable power in Maine will command a substantially higher price for their output from the implementation of RGGI. This will mean a positive economic impact for much of rural Maine.”

### ***Offsets***

Offsets are a topic of considerable debate among RGGI states. It is important to note that thus far no offset projects have been developed in RGGI.<sup>11</sup> Two items need to be considered: 1) the categories of offsets themselves and 2) the pricing of allowances that have impacted the use of offsets as a financially viable emissions reduction option.

Different states have different resources that could be used as offsets, which results in little consensus on the categories of offsets that can be allowed. For example, while Maine has significant forest resources and is working on developing an offset category that would allow them to utilize forests as a category, forest resources in other states are not as large. At the same time, the process of approving offset categories takes time and administrative capacity.

While the Maine Department of Environmental Protection is working on developing a new offset category, the current interest within the state for use of offsets has been somewhat low primarily because the allowance prices are not sufficiently high at this point in time. The current price of each allowance is \$2 per ton. Some argue that it needs to be as high as \$10 - \$12 per ton before there will be sufficient interest in the market to make a difference. Uncertainty at the federal levels with the development of a national cap and trade program, reduction in energy use due to a slack economy and warmer winters are said to be some of the contributing factors for the low demand as well.





### ***Maine Renewable Portfolio Standards***

Maine has been at the forefront in the use of renewable energy sources for energy production for the past decade. Pursuant to the state's 1997 electric-utility restructuring law, the Maine Public Utilities Commission (PUC) adopted rules for the state's Renewable Resource Portfolio Requirement in September 1999, now called the Renewable Portfolio Standard (RPS). These rules required electricity distribution companies (load serving entities) to supply at least 30 percent of their total sales using electricity generated from eligible renewable sources such as fuel cells, tidal power, solar, wind, geothermal, hydroelectric, biomass, and generators fueled by municipal solid waste in conjunction with recycling.<sup>12</sup> Certain energy efficiency resources were also eligible. This 30 percent standard is called "Class II" standard. Interestingly enough, at the time of passage, the required percentage of renewable was actually lower than the existing percentage of renewable supply.<sup>13</sup>

Taking a step further, in June 2006, Maine enacted legislation creating an additional higher goal to increase new renewable-energy (those renewable sources placed into service after September 1, 2005) capacity by 10 percent by 2017 starting in 2008. This is called the "Class I" standard. This goal was made a mandatory target in 2007. Resources that satisfy the Class I standard cannot be used to satisfy the Class II standard as well.

### **State and Local Support Programs and Incentives**

Maine offers state and local incentives that support the transition to a low-carbon economy by encouraging production of and demand for alternative and renewable energy, and by spurring the growth of clean tech industries and energy efficiency.

#### ***Incentives to encourage production:***

**Community Based Renewable Energy Production Incentive (Pilot Program).** This program is designed to encourage the development of locally owned, in-state renewable energy resources. Legislation mandates that up to 50 mw of generating capacity (DC) will be permitted under the program, and individual participants may not exceed 10 mw. Of the 50 mw cap, 10 mw must be reserved specifically for small program participants (with generating capacity less than 100 kw) or for participants located in a service territory of a cooperative transmission and distribution utility. To be eligible for incentives, a generating facility must be 51 percent



locally owned, use renewable energy resources (solar, wind, hydro, certain biomass, fuel cells, and tidal), be no larger than 10 mw in generating capacity, and be located in the state.<sup>14</sup>

**Sales and Use Tax Refund for Qualified Community Wind Generators.** This legislation (S.B. 477) encouraged the development of community wind generation projects and defined community wind as having nameplate capacity of 10 mw or less. This bill also created a sales and use tax refund for qualified community wind energy development.<sup>15</sup>

*Incentives to encourage demand:*

**Efficiency Maine Weatherization Program.** This program offers up to \$3,000 in energy efficiency incentives for the first 4,000 homes (for Maine residents) that receive pre-approval.<sup>16</sup>

**Property-Assessed Clean Energy Financing.** Maine signed PACE legislation into law in April 2010 authorizing municipalities to establish a loan program to provide financing for clean energy improvements to property owners via local ordinance. The legislation authorizes municipalities to enter into PACE agreements with property owners, provide financing, and collect PACE assessments to repay the loans. Municipalities will be able to use federal grants or other “funds available for this purpose” to establish PACE programs.<sup>17</sup>

**Maine State Housing Authority Green Building Standard** is applicable to designers, developers, and contractors who apply for Maine State Housing Authority funding. The intention is to ensure long-term affordability by providing dwellings with low energy use that will insulate owners and occupants from rising fuel prices.<sup>18</sup>

**Energy Efficient Building Standards for State Facilities.** This standard specifies that Leadership in Energy and Environmental Design (LEED\*) standards be incorporated into the design, construction, operation and maintenance of any new, expanded or existing building owned or operated by any state agency, board, office, commission or department, including institutions of higher learning, provided that doing so is cost-effective over the life of the building. The order directs all branches of state government to cooperate with the Maine Department of Administrative and Financial Services in supplying the department with the necessary resources, information and other assistance to meet these requirements. School administrative districts and municipalities are not required to comply with these standards under this order.<sup>19</sup>



## **Transition Assistance**

As an early adopter, Maine has been able to apply the ideas of GHG reduction into thinking about new industry opportunities. In what follows, Maine has not only focused on renewable energy as a new industry, but they have introduced bio-plastics and other areas of green chemistry as possible new avenues for development. Moreover, Maine reveals a sophisticated understanding of its assets, particularly deep water wind, and the complementary industries, such as composite materials, that are needed to ensure its development.

### ***Transitioning Industry:***

#### ***Wind***

Maine is focusing on ocean energy, especially deep water offshore wind power, as a future energy source as well as a strategic economic development area. In 2008 Governor Baldacci established the Ocean Energy Task Force by Executive Order. The Task force was established to recommend a strategy for moving forward on developing the renewable ocean energy resources of the Gulf of Maine, especially deep water offshore wind power. The Task Force was charged with recommending solutions to overcome potential economic, technical, regulatory and other obstacles to the development of the state's ocean energy resources. The task force delivered a final report to the Governor in December 2009. The primary recommendation of the task force is for Maine to commit to achieving 5,000 mw of offshore wind by 2030. The report also notes the need for states in the New England region as well as the New England Independent System Operator to move forward with developing a more robust regional transmission grid that can accommodate the region's extensive renewable energy goals. While the state realizes that the commercialization of deep water offshore wind power is at minimum five to ten years down the road, they are starting to move the key pieces towards achieving their goal now.<sup>20</sup>

In follow up to the recommendations of the task force, LD 1810 passed in May of 2010 which commits the state to implementing the recommendations of the Governor's Ocean Energy Task Force, and namely establishes the state goal of 5 gw of energy generation from facilities located in coastal waters by 2030. Further, the Maine Public Utilities Commission will conduct a competitive process for contracting from deep-water offshore wind energy pilot projects (up



to 25 mw) or tidal demonstration projects (up to 5 mw). The legislation also enables a clear permitting system for projects and clarifies leasing of submerged lands for ocean energy projects. The legislation is complemented by \$11 million for research and development of ocean wind demonstration sites and wind energy components manufacturing in Maine.<sup>21</sup> To further incentivize offshore wind, Maine plans to develop a future power purchase agreement, as it is one of the more cutting edge incentive tools in the renewable energy arena.

To further Maine's transition into the wind industry, state economic development leaders are working together with research and development initiatives, the private sector and trade associations on a cluster development approach to drive forward the wind energy supply chain. One area of focus is in the composites arena. The Advanced Structures and Composites Center at the University of Maine, which focuses on technology development and has conducted 300 product developments and testing projects over the past five years in various areas, has received \$15 million from the Department of Energy to test and evaluate floating platform designs for offshore wind farms.

Additionally, The Maine Wind Industry Initiative is a joint effort between Maine Composites Alliance, the University of Maine's Advanced Structures and Composites Center, First Wind, Cianbro and the Maine Port Authority to develop Maine's industry competitiveness and opportunities in the growing wind industry. The focus of this initiative is on both on-shore and off-shore wind development. The Maine Wind Industry Initiative is striving to lead a collaborative effort involving the following organized industry clusters:

- Maine Composites Industry
- Heavy Constructors
- Precision manufacturing and machining
- Research and Development
- Government (Maine Port Authority/Governors Office)
- Major wind site developers including First Wind and Trans Canada
- Engineering and environment consulting firms operating in this market.<sup>22</sup>



The Initiative is also coordinating Maine Wind Energy Week which is designed to showcase the state's wind industry. Events range from a tour of the Searsport marine pier, where turbine components arrive by ship, to a bus tour of what will soon be the state's largest wind farm, the Kibby Wind project in western Maine.<sup>23</sup>

### ***Bio-fuels and Bio-Plastics***

In light of Maine's significant forest resources, there is now a drive to build the state's capacity to utilize wood resources in innovative ways that reduce GHG emissions. In 2006 the University of Maine received a \$6.9 million award entitled "Investing in Maine Research Infrastructure: Sustainable Forest Bioproducts" from the National Science Foundation's Experimental Program to Stimulate Competitive Research. The ultimate goal is to build research infrastructure that creates a forest-based biorefinery in Maine. The hope is to augment the pulp and paper and building products industries with new revenue streams of high-profit margin chemicals, plastics and nanotechnology products as well as new sources of energy.<sup>24</sup>

Further, the state is starting to enter the arena of bio-based plastics. The Maine Technology Institute awarded a grant to InterfaceFABRIC (formerly Guilford of Maine) in 2006 to evaluate the achievability of using Maine potatoes and other agricultural crops to meet the growing demand for PLA (polylactic acid) in the production of bio-based plastic products. Maine's sustainable bio-based plastics initiative is being driven by a market demand for non-toxic bio-based products and the industry's effort to respond to this new market opportunity. There are Maine companies interested in using this "Green Chemistry" approach to identifying new non-toxic raw materials to use in their products and investors are evaluating the potential for building a PLA production facility in Aroostook County.<sup>25</sup>

### ***Solar***

While solar is not an explicit target area for Maine, there are over 50 companies in Maine related to the solar industry, including manufacturers, installers and servicing companies for solar equipment.



### ***Home Energy Efficiency***

The need to retrofit and weatherize homes in Maine is great as it has one of the oldest housing stocks in the country and about three-quarters of Maine households are dependent on oil for heating their homes. As such, Maine has several programs to move forward on creating more energy efficiency on a state-wide level. The governor recently announced the state's commitment to retrofit and weatherize every home in Maine and there are several programs being funded through the American Recovery and Reinvestment Act (ARRA) as well as through state programs being funded through RGGI to move this goal forward.

### ***Transitioning the Workforce:***

The state Department of Labor released a study in February 2010 that provides insights into the green economy in Maine, and begins to study the demand for jobs created by the green industries in Maine.<sup>26</sup> Additional studies are currently underway at the state Department of Labor for further examining the green economy and recommending ways to fill the gap between supply and demand of the green workforce in Maine.

The following worker training programs have recently been announced specifically targeting green industries:

- Efficiency Maine—a program of the Maine Public Utilities Commission—has awarded a total of \$1.3 million in grants to four Maine Community Colleges to support their work in energy efficiency and renewable energy programs. ARRA provided federal stimulus funds for this grant program.<sup>27</sup>
- The U.S. Department of Labor announced in January 2010 that Eastern Maine Development Corp. will receive a \$2,109,088 Recovery Act grant to establish a green construction skills training program.<sup>28</sup> The program will:
  - Create a green building training program at Eastern Maine Community College and 3 Career Technical Education Centers
  - Recruit chronically un- and under-employed workers for training
  - Produce small, super-efficient replacement homes for low-income, pre-1976 mobile home residents in Eastern Maine



## Investing in Innovation

Innovation represents the heart of what will enable the economy to transition. This is being enabled through pilots and through research and development in alternative energies to reduce their costs, and assisting heavy emitting industries and firms adapt to this new economic environment. Below outlines some of the innovation initiatives taking place in Maine.

### **Wind**

Offshore Wind – In October 2009, the University of Maine along with several partners received \$8 million in funding from ARRA to expand efforts to develop offshore wind capacity. This grant will support “testing, research and optimization of model floating wind turbines and lead to the deployment of the first 25 mw floating ‘Stepping Stone’ ocean wind farm in the world in 10 years.”<sup>29</sup>

### **Biofuels**

The University of Maine’s Forest Bio-Products Institute (FBRI)<sup>30</sup> is engaged in R&D of a forest-based biorefinery that would use trees as a fuel instead of fossil fuels such as oil and gas. The University received funding from the National Science Foundation’s Experimental Program to Stimulate Competitive Research (EPSCoR) that helped with the creation of FBRI. Maine Technology Institute (MTI) has also provided R&D funding for development of forest-based bio fuels and bio-products.

### **Hydrogen**

The Chewonki Renewable Hydrogen Project, a partnership of the Chewonki Foundation, the Hydrogen Energy Center and others, received funding to create a 3 kw hydrogen fuel-cell back-up system for the Foundation’s visitor center. The state government created the Hydrogen Fuel Cell Partnership, a public-private collaboration to commercialize hydrogen-based products and services in Maine.<sup>31</sup>



### **Solar**

The University of Maine's Laboratory for Surface Science and Technology (LASST) in partnership with a private company, Ascendant Energy of Rockland, created a solar co-generator that would combine photovoltaic capability with thermal capability from the rooftop of commercial facilities.<sup>32</sup>

### **Partnerships**

Many noteworthy partnerships are growing in Maine. They are summarized below.

**Maine Department of Economic and Community Development** is the lead economic development agency for the state. The Department is targeting renewable energy industries as one of its focus areas, particularly in the area of wind development. The Department offers assistance to early stage, technology intensive Maine-based companies with the potential for high growth and public benefit.

**The Environmental and Energy Technology Council** is a Maine-based association of private companies, government agencies, educational institutions and non-profit organizations that are advancing sustainable job growth, research and development and new product commercialization.<sup>33</sup>

**Opportunity Maine** is a non profit organization that is leading grassroots initiatives to address Maine's educational, economic and energy challenges. The organization offers broad as well as targeted programs that aim to invest in human capital and local communities as a central tenet of economic development in Maine.<sup>34</sup>

**Efficiency Maine Trust** is currently under the Energy Programs Division of the Maine Public Utilities Commission. However, effective July 1, 2010 the organization will function as a stand alone agency to administer its current energy efficiency and alternative energy programs.





**Maine Energy Resources Council** is a council under the auspices of the state government and is charged with facilitating more effective interagency coordination of the state's energy issues. Specifically, the council:

1. Recommends coordinated state policy regarding major programs or proposals that affect energy use in the State and that involve the activities of more than one state agency;
2. Supports the full implementation of an integrated program to provide a substantially improved energy resources information base for planning purposes;
3. Provides direction to the State's energy planning and regulatory programs and encourage coordination of these efforts through review and comment on agency program plans, specific projects and legislative proposals that involve or affect more than one agency;
4. Periodically evaluates, in consultation with affected interests, the State's regulatory systems as they affect the generation, transmission, delivery or use of energy, and recommend appropriate action, as needed, to improve energy planning and coordination;
5. Studies specific energy issues and problems of state-level significance in order to develop sound, coordinated policies; and
6. Seeks cooperation from federal agencies with jurisdiction over energy matters to ensure that their programs and projects serve the best interests of the State.<sup>35</sup>



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## Lessons Learned

What exactly the changing energy economy will look like is still an unknown. While some type of carbon pricing seems imminent, whether in the short or long term, it is unknown at this point what form it might take. Various iterations of a carbon cap and trade system have been moving their way through the House and the Senate throughout the past year, yet little consensus has been achieved. What is known is that irrespective of outstanding questions surrounding a national cap and trade system, overall transitions in the energy economy are anticipated to hold significant implications for U.S industries, regions and the nation as a whole. It is clear that the energy-economy is already experiencing shifts, with an overall focus on moving towards a low-carbon economy.

The nine case studies presented in this report serve as a snapshot of the challenges and opportunities diverse states are facing throughout the nation as they navigate economic transformation and the movement towards a low-carbon economy. A host of challenges and opportunities stem from different geographies and assets. While the efforts and politics within each state vary, they all are beginning to utilize their specific assets to strengthen their economies and prepare for a transitioning energy market. Outlined below are the overall trends and lessons learned that have emerged from collectively examining the nine case studies.

### **Economic Development Must be Present at the Table and More Actively Engaged**

In many of the states examined in this report, economic development was a strategic component of state efforts focused on transitioning to a lower-carbon economy. In some states, economic development was even the leading entity, driving partnerships, spearheading complementary workforce initiatives, helping build the clean tech industries, etc.

However, there is still room for economic development to take a much more proactive and involved role in these efforts, both at the local, regional and state levels. The challenge for economic development professionals is the reality that a carbon price, while creating economic opportunities, also adds challenges, some of which are significant, to existing economic sectors. By focusing on the common opportunities and benefits that emerge from greater energy efficiency and the build up of new industries, particularly but not uniquely clean tech, practitioners have mitigated some risks of transition.

However, they have not just stopped there. What is also clear in the cases is the recognition that the policy environment is also shifting, and thus investments in transition are moving forward be it in the form of workforce development, R&D focused on cleaning up traditional energy sources, or thinking through actual transition options. For example, in New Mexico the Cabinet Secretary for Economic Development leads the Green Jobs Cabinet which is tasked with growing renewable energy industries and green buildings and investing in workforce skills and grid infrastructure. New Mexico is also focusing on transition, and has recognized that the emergence of geothermal can build off of the skills and technologies already developed in the oil and gas industry.

Thus, economic development professionals will first need to understand the specific opportunities and challenges facing their regions, industries and workers, and any possible linkages between those challenges and opportunities. Further, they will need to assist their community's transition and exploit new opportunities, create partnerships, leverage resources and catalyze growth. As economic development professionals are a conduit to the business community they will also need to help them understand how to adapt to a transitioning energy market. Specific actions include the following:

- Understanding the carbon footprint and energy-sensitivity of the community, particularly of the largest industries and employers, and the opportunities and challenges they face;
- Assessing what local businesses and R&D efforts are emerging that create or tap into opportunities in clean energy, energy efficiency or carbon reduction;
- Understanding and accessing resources that are available in the community to stimulate the growth and assist the transition of the clean energy economy, including but not limited to allowances, offsets and other state and federal incentives.
- Bringing business and community leaders together (through strategic planning and scenario planning techniques) to identify available local resources; create a consensus of its strengths, weaknesses, opportunities and threats; and the strategies to address them.
- Building relationships with regional players that can help to create the opportunities in a clean energy economy (e.g. universities, community colleges, banks, small business technical assistance providers) and assist the workforce and businesses that are facing challenges induced by increasing energy and carbon prices to transition to new opportunities;

- Engaging with the private sector (both emerging and threatened industries) to help them transition to greater energy efficiency and to the clean energy economy.

Overall, economic developers should be leading the charge towards understanding the opportunities and challenges presented by the transition so that they can guide industries and firms towards maintaining their competitive advantage, finding new niches in a changing marketplace, and thus the competitive advantage of local economies and communities.

### **Policies that Link Areas of Preparedness are of Critical Importance**

Across the majority of states that were examined for this report, a significant amount of GHG mitigation activity was taking place through policy. Further, a great deal of the mitigation policy had linkages and/or is in the process of developing linkages with economic development. Policies such as renewable energy standards, state and local energy efficiency strategies, new building codes, as well as clean tech development and deployment have tremendous implications for economic development. While some policy linkages are one off, others are part of a set of complementary policies that are capable of transitioning economies over the long haul from both a supply and demand perspective. Yet, more cross linkages are needed between governments, the private sector, and the non-profit sector.

Montana, for example, linked rural development efforts to the growth of the renewable energy industry. The 2005 Montana Renewable Power Production and Rural Economic Development Act created a renewable energy standard that included provisions for community renewable energy projects, thus directly tying the standard to rural economic development goals.

### **Supply Chain Transitioning is a Growing Area for Economic Development**

As the move towards a lower-carbon economy increases, opportunities are expected to filter through to various sectors of the economy, thus making prospects within a multitude of different industries and supply chains increasingly available to various communities. As seen throughout the case studies, states are already beginning to transition their economies in ways that play off of their existing assets while tapping into the opportunities presented by the shifting policy environment and changing market.

In Ohio for example, the state is extensively leveraging its manufacturing assets for multiple areas of clean tech development. The Edison Materials Technology Center (EMTEC) Alternative Energy Technology Group has partnered with the Ohio Department of Development to build the fuel cell supply chain.<sup>1</sup> Other states and communities are also trying to stay one step ahead of the transition by introducing new markets to traditional manufacturers and working with them to build relationships to encourage innovation and new products and processes.

### **Lack of Access to the Grid and Other Connectivity and Storage Infrastructure are Growing Impediments to Development**

The limitations of the current grid system create large impediments to ramping up on the installation of renewables, such as solar and wind as a cross-state commodity. The lack of energy storage capacity for renewable energy is also a hurdle that is slowing the growth of renewables as economic drivers. Texas, which has its own grid that is not connected to neighboring states, also holds the highest installed wind capacity in the nation. Having complete regulatory control over its grid has enabled the state to move quickly in building transmission lines and bringing alternative forms of energy online without the slowdown from consulting other states or the federal government.<sup>2</sup> Yet, while Texas has the population and energy demand to support its large wind capacity, not all states can say the same. For states with significant renewable energy resources to benefit economically from exporting them to other markets, it will require an updated grid system and improved regulatory environment between states.

The cases do indicate that some states have started to look at ways to strengthen connectivity infrastructure. Nebraska, for example, used Recovery Act dollars to implement smart grid technologies in two power districts. However, much more will be needed as alternative sources of energy grow.

### **An Unclear Federal Policy Environment Inhibits Investment**

Lack of clear direction from the federal level is creating market uncertainties, even in traditional energy sectors. Business is in need of clear and direct signals on national carbon and energy policy in order for investment to move forward. Of late, the lack of a clear legislative signal, along with the global credit crisis has slowed investment. With most energy investments

having low operating costs yet high start up costs, federal legislative certainty is critical if investors are going to have any kind of security in their sizable up-front costs. Not only does this mean a need for greater clarity with regards to carbon pricing, but also for a need to align energy policies across the board rather than the piecemeal response that states have put together on their own.

### **States Must Capitalize on their Assets in order to Survive and Thrive in the Low-Carbon Economy**

All states, even those with economies traditionally focused on energy-intensive industries, have assets that can be utilized in the shift to a low-carbon economy. For example, North Dakota and Montana are not only capitalizing on their extensive wind assets, but they are both strategically investing in carbon capture and sequestration (CCS) to complement their extensive coal economies. A focus on CCS helps preserve the coal industry, while mitigating GHG emissions and driving innovation and job creation.

Further, we see Michigan aggressively transforming its extensive assets in the declining manufacturing sector into emerging clean tech industries, such as advanced energy storage. To be effective in this endeavor, there will continue to be a need for certain amounts of retooling especially in workforce development through retraining, redeployment, and transferability of skills; and in redeveloping supply chains.

### **An Innovation Friendly Economy is Essential**

Innovation will be the key driver of the low-carbon economy. Investment in clean tech R&D has moved from a niche market to an increasingly mainstream target. The need for public investment will continue as issues of energy cross multiple public goods, such as environmental health, security, education, the economy, etc. Further, many of the key components that drive innovation, such as labs and universities are publically funded.

The states featured in this report all revealed significant investments in innovation, usually targeted at building up their unique assets, be it solar, biofuels, carbon sequestration or wind. Maine for example sports R&D projects that target offshore wind in a deep ocean environment and forest-based biofuels and bioproducts among others.



## **Recovery Act Dollars have Ignited Many State Activities in the Energy Efficiency and Clean Energy Arenas**

While federal investment in energy innovation has been relatively low, that changed in 2009 when the American Recovery and Reinvestment Act (ARRA) stepped in to serve as a key stimulus in clean tech research and development as well as energy efficiency. The Department of Energy was authorized to spend \$36.7 billion under the ARRA, and as of May 2010, almost 5,000 projects have been funded through this appropriation.<sup>3</sup> Across the cases, the Recovery Act emerged as an important resource enabling states to move more aggressively into activities that reduce GHG emissions and invest in cleaner energy opportunities. In Missouri, for example, ARRA investments supported a range of efforts including home weatherization activities; efforts to increase the number of local communities adopting the International Energy Conservation Code; and support for the Kansas City Green Impact Zone, a demonstration project focused on revitalizing a neighborhood through a portfolio of sustainability initiatives.

While energy efficiency initiatives already had considerable momentum prior to ARRA and will likely continue post-ARRA funding, the future of many of these efforts once this funding is depleted remains an open question. One immediate step is the anticipated passing of the American Workers, State, and Business Relief Act of 2010. The bill includes extensions to tax provisions, such as:

- tax credits for producing electricity from open-loop biomass facilities and from refined coal facilities
- tax credits for the production of low sulfur diesel fuel and the production of fuel from coke or coke gas
- tax credit for new energy efficient home expenditures
- excise tax credits and payments for alternative fuels

## **While Energy Efficiency has become a Growing Effort, there is Still Room to Benefit from More**

Often referred to as the “low-hanging fruit”, investments in energy efficiency have become a paramount focus for many local governments across the U.S. Many of the state incentives highlighted throughout this report show a strong focus on energy efficiency. These investments

provide not only the benefit of public savings, but more efficient policies on the part of government and businesses can lead consumers to lower energy costs, providing more disposable income to invest in or purchase other things. Further, they can act as a local economic stimulus in the form of job creation, product development, etc. Researchers at the Rocky Mountain Institute recently completed a study on electric productivity (measured in dollars of GDP divided by kilowatt-hours consumed) across the states. They found that if the lower-performing states would achieve the productivity of the top performing states via energy efficiency, 1.2 gw hours of energy (or 60 percent of the U.S.' coal-fired generation) could be saved.

For example, in Tennessee the potential for greater energy efficiency in their building stock has been identified as a significant opportunity. In response, Oak Ridge National Laboratory is strategically focusing on deep energy retrofit research projects<sup>4</sup>. The projects are being supported by Department of Energy's Building America Program and have received additional funding from the ARRA.

### **Conclusion – What does it Take to Transition to a Low-Carbon Economy?**

No one ever said transitioning would be easy. Given that cap and trade, or carbon pricing may become a reality of the American economy, changes are needed if it's going to be a smooth transition. How economic developers build systems that will aid the transition and tap into its potential is of critical importance. The integration of the business community, government, workforce intermediaries, utilities, and entrepreneurs will all be vital for the transition to grow organically rather than reactively or behind the curve.

While some states are ahead of the curve in this area, many still lack clear channels to stimulate growth in clean and low-carbon sectors that could potentially serve as vital economic drivers. Further, with the advent of the global credit crisis, there has been a shortage of finance as of late in the clean energy sectors; yet funding remains a critical component to drive business development and investment forward. The arrival of ARRA has quelled some of this, but it is a temporary fix.

While a carbon cap and trade program is one manifestation of changing policy world, it is equally a manifestation of a changing economy, and changing rules of the game globally. Because of the ubiquitous nature of energy usage, participation in the new energy economy will be open to a broader range of communities. Unlike the biotech sector, in which only a few regions were favored by sustained federal R&D funding, all communities can stand to benefit from the transition to a lower-carbon economy. Therefore, the real story is that preparedness is an economic driver in and of itself. The more you invest, the more prepared you are, but you're also starting to drive your economy into more dynamic areas of growth. The key will lie in balancing acceptable climate change policies with economic assets in a way that advances GHG mitigation while driving growth. While federal and global policy efforts dominate the media, many states, regions and communities are already playing in this new field.

Fear often pervades much of the discussion surrounding the shifts outlined throughout this report. While the fears are not unfounded and are often based on a slew of economic unknowns, these shifts should not overshadow the significant opportunities that are also present. With forethought, smart policies, and strategic investments, the opportunity to transition economies in the new energy economy can indeed be a win-win.

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