REDIRECTING IOWA'S ENERGY
The Economic and Consumer Benefits of Clean Energy Policies

Written by Nathaniel Baer, Matthew Davis, and Navin Nayak, Advocates with the Environment Iowa Research & Policy Center.

The authors would like to thank Marisa London, Richa Bhala, and Patrick Grenter for their research assistance. He also would like to thank Katherine Morrison for her research contributions, Alison Cassady for her research and editorial assistance, Travis Madsen for his research and editorial assistance, and Shannon Ryan for designing the report. Finally, they would like to thank Economic Research Associates for their analytical support and tireless efforts in developing this report.

In addition, the authors would like to thank Ed Woolsey from the Iowa Renewable Energy Association (I-Renew), Rich Leopold at the Iowa Environmental Council and Bruce Biewald at Synapse Energy Economics for providing editorial review of the report.

Special thanks to the Energy Foundation for making this report possible.

All photographs are courtesy of the Department of Energy/National Renewable Energy Laboratory (DOE/NREL), unless otherwise noted. The third photograph in the first row on the cover is courtesy of Solar Design Associates.

For a copy of this report, visit our website or send $30 made payable to Environment Iowa Research & Policy Center:

Environment Iowa Research & Policy Center
3209 Ingersoll Ave., Ste 210
Des Moines, IA 50312
(515) 243-5835
www.EnvironmentIowa.org/center

EXECUTIVE SUMMARY

Iowa can be a leader in renewable energy, providing home-grown power to increase our state's and country's energy security. Fortunately, investing in clean energy policies would generate new high-paying jobs, save consumers and businesses billions of dollars, and boost Iowa's economy while reducing power plant pollution. Both reducing demand through energy efficiency and diversifying our electricity mix with renewable energy sources also will solve the problems of Iowa's current reliance on coal, oil, gas, and nuclear power for electricity generation – a legacy of environmental and public health problems. This legacy also includes volatile price fluctuations, costing consumers dearly on electricity bills.

Over the past 50 years, the federal government has provided more than $500 billion in subsidies to the fossil fuel and nuclear industries, investing a fraction of that in energy efficiency and renewable sources of energy such as wind, solar and geothermal. As a result, coal, nuclear power, oil and gas provide more than 95 percent of Iowa's electricity. This dependence on fossil fuels carries severe public health consequences, including asthma attacks, respiratory disease, heart attacks, and premature deaths. Moreover, fossil fuels, such as coal and oil, pollute the environment from the point of extraction to combustion in the form of global warming, acid rain, oil spills and runoff pollution. At the same time, nuclear power has left us with a nuclear waste problem for which no safe solution exists.

Despite the environmental and public health implications of relying on fossil fuels and nuclear power to meet our energy needs, the federal government continues to push energy policies that would offer more of the same. Last year's federal energy proposals included billions of dollars in new and extended tax breaks for oil and gas drilling, loan guarantees and federal subsidies for building new coal plants, and incentives to build the first new nuclear power plants in 30 years. This continued investment in fossil fuels and nuclear energy ignores recent research documenting the potential to meet more of our electricity needs with energy efficiency and renewable sources of energy.

We can rely on clean energy resources; in fact, the technical potential of wind, clean biomass, and geothermal resources in the United States is four times greater than our current total electricity consumption. Here in Iowa, we could generate 17 times our current electricity usage from renewable energy sources such as wind and clean biomass. Additionally, conservative estimates suggest that energy efficiency programs could reduce our electricity use in Iowa by 18 to 28 percent. Rather than import dirty coal and rely on outdated fossil fuels, Iowa should harness its homegrown sources of renewable energy, including wind, solar and biomass, and lead the development of energy for the 21st Century.

Proponents of the dirty energy status quo contend that investing in fossil fuels and nuclear power are essential for a healthy and vibrant economy and that diverting investment to renewables and efficiency will cost us jobs and increase costs to consumers. A growing body of literature, however, shows that investing in energy efficiency and technologies such as wind and solar power boosts local economies and creates jobs, particularly in a state such as Iowa, whose renewable energy resources are great. Moreover, investing in renewables and energy efficiency helps to diversify the electricity market and reduces consumer dependence on coal and natural gas, thereby saving consumers money and shielding them from fluctuations in market prices.

This brings us to the central question of this report: what would be the economic and consumer impacts of pursuing clean energy policies?

Specifically, we examined the economic and consumer impacts of pursuing two different scenarios involving renewable energy and energy efficiency policies:

Scenario 1: Enacting a 20 percent clean renewable energy standard, commonly referred to as a renewable portfolio standard or RPS, which would require Iowa to generate 20 percent of its electricity from clean energy by the year 2020, and funding publicly-run energy efficiency programs in Iowa with $50 million each year from 2007 to 2020; and

Scenario 2: Enacting a 20 percent clean renewable energy standard and funding publicly-run energy efficiency programs with $100 million each year from 2007 to 2020 in Iowa, which would eliminate Iowa's projected 1.5 percent yearly increase in electricity demand.

We found that implementing these clean energy policies would greatly benefit the economy and consumers in Iowa while reducing air pollution from power plants.

The clean energy policies of Scenario 1 would:

- Create 2,340 net jobs in 2020 and a net annual average of 1,615 jobs between 2007 and 2020;
- Increase wages by $31 million in 2020 and $35 million per year on average between 2007 and 2020;
- Save all consumers—residential, commercial, and industrial—$147 million on energy bills and cut expected electricity demand by 10 percent in 2020;
- Reduce global warming carbon dioxide emissions from power plants by eight percent of 2002 levels; smog-forming nitrogen oxide emissions by seven and one-half percent of 2002 levels; and soot-forming sulfur dioxide emissions by six and one half percent of 2002 levels, all by 2020.

Adopting the clean energy policies in Scenario 2 would:

- Create 5,166 net jobs in 2020 and a net annual average of 3,061 jobs between 2007 and 2020;
- Increase wages by $37 million in 2020 and $42 million per year on average between 2007 and 2020;
- Save all consumers—residential, commercial, and industrial—$440 million on energy bills and cut expected electricity demand by 20 percent in 2020, and $1.086 billion cumulatively by 2020;
- Reduce global warming carbon dioxide emissions from power plants by 11 percent of 2002 levels; smog-forming nitrogen oxide emissions by nine percent of 2002 levels; and soot-forming sulfur dioxide emissions by eight percent of 2002 levels, all by 2020.

The findings of this report—and hence the title—underscore the benefits of *Redirecting Iowa's Energy*. Strong support for energy conservation and efficiency, coupled with increased emphasis on the development of renewable energy, can help solve our current energy problems, provide a significant boost to the economy and move us towards a safer, healthier energy future.

These findings lead us to the following three recommendations:

1. Implement a Clean Renewable Energy Standard

In Iowa, we should set a strong enforceable standard to increase the amount of electricity generated from renewable sources of energy to 20 percent renewable electricity generation by 2020.

2. Invest in Energy Efficiency Programs

To flatten electricity demand growth as we modeled in Scenario 2, policy-makers in Iowa should invest in energy efficiency investment with $100 million in publicly-run energy efficiency programs each year. A $50 million investment in publicly-run energy efficiency programs would cut projected demand growth from 1.5 percent to three-quarters of a percent, and would not have as much of a consumer benefit as an investment of $100 million. Iowa should follow the model of other states with successful, independently-audited energy efficiency programs, not run by investor-owned utilities, in order to stem energy demand in Iowa.

3. Strengthen Energy Efficiency Standards

To save consumers and businesses money and reduce our reliance on fossil fuels and nuclear power, the federal government should raise efficiency standards for key appliances. Minimally, regulators should implement stronger federal standards for residential furnaces and boilers, walk-in refrigerators, and distribution transformers.

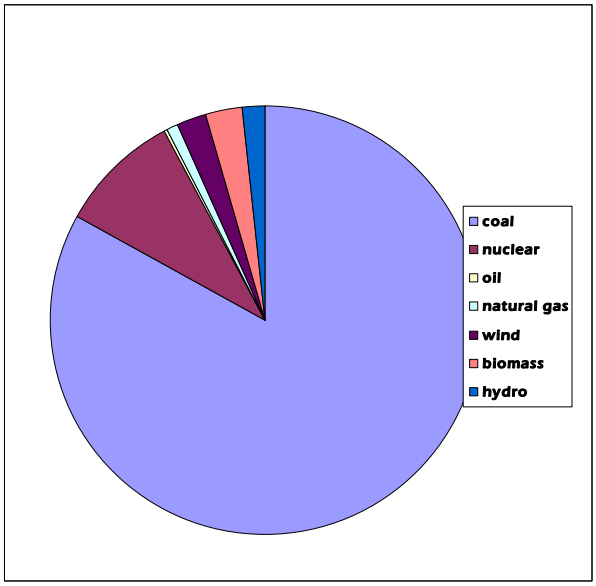
OUR CURRENT ENERGY STATUS

The Electricity Mix in Iowa

In 2003, Iowa generated more than 95 percent of its electricity from fossil fuels and nuclear power and slightly more than two percent from renewable sources such as wind (See Figure 1).[1] Coal accounted for over 85 percent of the state's electricity mix, making Iowa one of the most coal-dependent states in the country. The state also relied on the aging Duane Arnold nuclear power plant for nearly 10 percent of its electricity.

Since 2003, Iowa has seen some growth in renewable wind power. The percentage of electricity generated from renewable sources may have increased as a result, but no reliable data is available for years after 2003. However, Iowa's coal capacity also increased during this time and several additional new coal-fired power plant proposals have emerged.[2]

Figure 1. Iowa's Electricity Mix by Fuel Source: 2003



Public Health and Environmental Impacts of Our Current Electricity Mix

Iowa's reliance on fossil fuels and nuclear power has environmental and public health impacts—both within the state and beyond our borders. Today, 159 million Americans—or 55 percent of the population—live in places where the air is literally unsafe to breathe, in large part because of emissions from energy production and consumption.[3] According to the Iowa Department of Natural Resources (DNR), Iowa's air is unhealthy to breathe several days of the year. Although the past 30 years have produced significant advances in reducing harmful emissions from power plants and cars, increased consumption has eroded many of these gains, leaving the public vulnerable to the severe health and environmental impacts of burning fossil fuels.

Mercury

Coal-fired power plants are by far the nation's largest unregulated source of mercury pollution, contributing 41 percent of all U.S. mercury emissions in 1999.[4] Mercury bioaccumulates in the tissue of fish and other aquatic animals and persists in the environment, magnifying its public health impacts. Even at low levels, mercury can cause serious neurological damage to developing

fetuses, infants and children. The neurotoxic effects of low-level mercury poisoning are similar to the effects of lead in children. In 2004, the Environmental Protection Agency's scientists estimated that one in six women of childbearing age in the U.S. has levels of mercury in her blood that are sufficiently high to put 630,000 of the four million babies born each year at risk of learning disabilities, developmental delays, and problems with fine motor coordination, among other problems.[5] The Iowa Department of Natural Resources (DNR) warns that men limit their consumption of predator fish, such as largemouth bass and walleye, from the Cedar, Upper Iowa and Volga Rivers and that women and children limit their consumption of these fish from all Iowa waters due to mercury contamination.[6]

Smog

Ground-level ozone, commonly known as smog, is our nation's most prevalent air contaminant. Ground-level ozone forms when nitrogen oxides (NOx) mix with volatile organic compounds (VOCs) in the presence of sunlight. Ground-level ozone is most common in the summer months, when the sun is the strongest. In 2002, power plants alone emitted 78,956 tons of NOx in Iowa, the equivalent of the annual emissions of four million cars.[7]

Inhaling ground-level ozone can be extremely dangerous. The ozone gas inflames and burns through sensitive lung tissue. The swelling and associated scarring decreases oxygen intake and can lead to asthma, bronchitis, emphysema, and other respiratory problems.[8] For vulnerable populations, such as children, the elderly and people with respiratory problems, ground-level ozone can pose an immediate and severe health threat.

Fine Particulate Matter

Sulfur dioxide (SO_2), another byproduct of energy production and use, is a primary component of fine particulate matter, or "soot." In 2002, power plants alone emitted 127,847 tons of SO_2 in Iowa.[9] In fact, fine particulate matter often creates several days of unhealthy air in Iowa, both during the winter and summer months.[10] Fine particles, such as those that result from power plant emissions, can bypass the lung's defense mechanisms and become lodged deep in the lungs where they can cause a variety of health problems. An extensive body of evidence indicates that exposure not only causes respiratory damage leading to asthma and bronchitis, but also causes lung cancer and cardiac effects, increasing the risk of heart attacks.[11]

In Iowa in 2002, particulate matter from power plants caused an estimated 580 non-fatal heart attacks and 300 deaths, including 35 deaths from lung cancer.[12] Power plant pollution also causes and exacerbates chronic health problems, such as asthma. Approximately 140,000 adults in Iowa suffer from asthma.[13] In 2002, particulate matter from power plants caused an estimated 7,300 asthma attacks and 41,000 lost work days.[14]

Nuclear Waste

Our reliance on nuclear power causes a different set of problems. Aside from the risk of a reactor meltdown and explosion, as happened in Chernobyl in 1986, the nuclear industry lacks a proven system for safely storing irradiated nuclear fuel rods, the most radioactive material on earth and most toxic substance ever produced by humankind. As of 2003, 49,000 metric tons of spent fuel sat in temporary storage in the U.S.[15] By 2011, the Duane Arnold reactor in Iowa is projected to have produced 467 metric tons of high-level radioactive waste.[16] Whether this waste is stored on site or shipped to Yucca Mountain by rail or road, the risk of catastrophic events and leakage of

radioactive material into our environment poses great threats to public health. Radiation causes death, cancer, genetic and chromosomal instabilities, developmental deficiencies in the fetus, hereditary disease, and accelerated aging.[17]

Global Warming

Burning fossil fuels releases heat-trapping global warming pollution into the atmosphere, which alters the climate of the planet and throws weather systems out of balance. According to the Intergovernmental Panel on Climate Change (IPCC), an officially appointed body of the world's climate experts, if we do nothing, atmospheric carbon dioxide (CO_2) concentrations will at least double and could triple by the end of the 21st century.[18] The emissions already released will remain in the atmosphere for many decades to centuries. Therefore, even if global warming concentrations are stabilized, global warming could persist for hundreds of years.

Evidence of global warming is all around us. Average temperatures are increasing at a rate that far exceeds the normal temperature swings for the past thousand years.[19] The average temperature for the first seven months of 2006 ranged between 4.0° F and 6.6° F above the 20th century average in Iowa.[20] Future climate scenarios show likely increases in temperature, irregular and heavy precipitation, and more common and prolonged droughts. Scientists fear that global warming will worsen the intensity and duration of these extreme weather events.[21]

The United States is responsible for a quarter of all global warming pollution released worldwide and emits more carbon dioxide than China, India and Japan combined.[22] Power plants in the U.S. are responsible for 39 percent of all domestic carbon dioxide emissions.[23] In 2002, power plants alone emitted 40 million tons of CO_2 in Iowa, the equivalent of the annual emissions of seven million cars.[24]

Oil Drilling & Spills

In addition to the environmental consequences of burning fossil fuels, extracting and transporting fossil fuels can cause problems as well. Our dependence on oil and natural gas is increasing calls for more drilling on America's public lands and coastlines. Drilling rigs on and offshore leave more than a footprint, releasing toxic chemicals into often delicate ecosystems, disturbing wildlife and marine life, and potentially causing devastating oil spills. For coastal states dependent on tourism, new oil and gas drilling could mar the beaches and waters that attract visitors.

Between 1973 and 1993, 200,000 oil spills occurred in U.S. waters, spilling more than 230 million gallons of oil, or an average of 31,000 gallons every day.[25] The impacts of these spills, ranging from the smothering of plant and animal life to the contamination of drinking water, vary depending on the specific habitat affected and the chemical composition of the oil.

Coal Mining

Coal mining, especially mountaintop removal mining, harms local ecosystems and threatens public health. One mountaintop removal operation can strip up to ten square miles and dump enough waste to fill twelve valleys, each up to 1,000 feet wide and one mile long.[26] A draft study by the U.S. Office of Surface Mining found that without more stringent regulation, future mountaintop removal coal mining could obliterate 230,000 acres of ecologically diverse hills and hollows in West Virginia, western Virginia, eastern Kentucky and Tennessee. Already, between 1985 and 1999, at least 562 miles of Appalachian streams were buried under mining waste from mountaintop removal.[27]

The Consumer Costs of our Electricity Mix

Beyond these environmental and public health problems, our energy system has proven unreliable and expensive—unnecessarily costing consumers and the economy billions of dollars. Plus, Iowa residents and businesses send money out of state for almost the entirety of their energy sources.[28]

A decade of electric industry restructuring has led to few benefits for the majority of consumers, and any benefits consumers have experienced are likely to be short-lived. Mandatory rate reductions and rate caps that benefited consumers in many states with retail deregulation are scheduled to be removed over the next several years. In New Jersey, the expiration of price caps in August 2003 led to immediate rate hikes of more than 15 percent for many consumers.[29] The lifting of rate caps in San Diego in 1999 – which caused rates for some consumers to triple the following year – was one of the first manifestations of the California energy crisis.[30]

In addition, this restructuring has increased the country's reliance on natural gas, fueling a boom in the construction of natural gas power plants. As a result, natural gas prices have doubled since the mid-1990s. Even during the unseasonably warm winter of 2005, the approximately 1,928,443 Iowans who depend on natural gas for heating paid about 30 percent more than in 2004.[31] In fact, rising natural gas prices cost the U.S. economy an estimated $111 billion over the last four years.[32] The high price of natural gas has forced several industries to move their plants overseas, costing Americans thousands of jobs.[33]

TOWARD A NEW ENERGY FUTURE

Strong support for energy conservation and efficiency, coupled with increased emphasis on the development of clean, home-grown renewable energy, can help solve our energy problems and move us toward a safer, healthier energy future.

Energy Efficiency

Energy efficiency is the quickest, cheapest, cleanest way to reduce energy consumption and save consumers money. Energy conservation and efficiency measures should always be our first response to potential supply/demand imbalances; they have the same effect as increasing supply without the negative consequences of increased energy production and use. In most cases, efficiency measures are also cheaper and faster to implement than supply-side options. For example, large gas-fired power plants take two to five years to get online; savings from conservation measures can be realized in days or months.[34]

There are great opportunities for energy conservation and energy efficiency improvements in each of the main sectors of electricity use—industrial, commercial and residential. Several reports have documented the potential of existing and future technologies to make our homes, offices and appliances more energy efficient, thereby saving consumers and businesses billions of dollars.[35] Indeed, existing energy efficiency measures have already saved businesses and consumers money. For example, if the U.S. had not dramatically reduced its energy intensity over the past 27 years, energy use in 2000 would have equaled about 171 quadrillion Btus instead of the 99 quadrillion Btus actually consumed. Consumers and businesses would have spent at least $430 billion more on energy purchases in 2000 had this 72 quadrillion Btus of savings not occurred. About 60 percent of this decline in energy intensity is attributable to real energy efficiency improvements (the other 40 percent is due to structural changes in the economy and fuel switching).[36] However, we have only scratched the surface in terms of implementing energy efficiency measures. A study from 1999 calculated that Iowa had 7.3 billion kilowatt-hours of economic potential for electricity efficiency in 2002 from the investor-owned utilities efficiency program, which would have been 18 percent of actual electricity use in 2002.[37] In fact, more recent conservative estimates suggest that we still have the potential to reduce our electricity use in Iowa by 28 percent by 2020.[38]

To realize these long-term benefits, consumers and businesses need incentives to offset the initial upfront costs of new energy-efficient equipment. While the federal government has supported energy efficiency measures to a certain degree, much more is required to fully realize the benefits of these technologies. Federal policies that reduce energy demand are relevant to Iowa because surrounding states may use power generated in Iowa. This is of particular concern when coal-fired power plants are built in Iowa to supply power to other states. Known as "merchant" plants, these plants leave the mercury, soot, and smog pollution in Iowa while exporting the electricity. Outlined below are two of the primary policies that the state and federal government should support to increase development and use of energy efficiency technologies.

Funding Energy Efficiency

To increase the energy efficiency of our homes, buildings and appliances, the state government should develop energy efficiency programs that would reward homeowners and businesses for investing in energy efficient technologies. Iowa should bolster its funding of energy efficiency

programs by $100 million per year through the public benefit charge and use agency-administered and/or independently-audited programs to maximize the investment for public benefit.

If consumers have access to products that use less electricity, they may be able to pay higher rates for the electricity those products consume and still emerge with lower overall bills. However, there are many well-documented market barriers that prevent consumers from taking advantage of these efficiency opportunities (including information barriers; split incentives between builders and homeowners and landlords and tenants, in which one buys the equipment and the other must pay operating costs; and the need to pay for improved energy efficiency up-front versus over time). Efficiency programs are necessary to overcome these barriers.

Well designed efficiency programs take these barriers head on—educating consumers, reducing split incentives, providing subsidies that reduce the up-front costs, and systematically driving the penetration of efficient technologies into the marketplace where they can make the greatest difference. For example, programs could provide tax credits for the builders of new energy-efficient homes; consumer rebates to buy and install energy-efficient clothes washers and refrigerators; low-interest loans for high efficiency heat pumps, furnaces, and central air conditioners; and tax credits or low-interest loans for businesses to invest in fuel cells and efficient combined heat and power projects. To stimulate investment in these technologies, the incentives should be guaranteed to exist over the long term. Other efficiency programs could target whole-house appliance and lighting retrofits as well as better sealing and insulation to boost efficiency of targeted households, such as those receiving home heating assistance.

Supplemented with policy changes like appliance efficiency standards, updated building codes and related measures, efficiency programs can produce dramatic results.

Efficiency Vermont

Efficiency Vermont provides a great example of a successful and well-designed efficiency program. Efficiency Vermont is the nation's first statewide energy efficiency utility, specializing in assisting homeowners and businesses to identify and take advantage of cost-effective energy saving opportunities with technical assistance and financial incentives.

Efficiency Vermont is funded by a surcharge on consumers' electricity bills. The funds are administered by an independent non-profit organization under contract to the Vermont Public Service Board, and all work undergoes independent financial and savings verification audits, ensuring that the public's money is being well spent.

In 2004, Efficiency Vermont worked with 12 percent of the state's electric ratepayers to complete efficiency investments that resulted in:[39]

- 58 million kWh of annual savings, achieved at 37 percent of the cost utilities would have paid to purchase that energy on the wholesale market and deliver it to customers; and
- Reducing growth in the state's energy needs by 44 percent and cutting summer peak energy demand by 9 MW.

The type of work Efficiency Vermont does is exemplified by the renovation of Enosburg Falls Middle and High School. Black River Design called on Efficiency Vermont to help optimize the energy efficiency of the project. Efficiency Vermont developed a design that capitalized on opportunities for cost-effective heating, ventilating, cooling and lighting—resulting in significant savings and a quality building. The school district spent $57,600, with incentives from Efficiency Vermont totaling $62,000, achieving annual energy cost savings of $32,600—a 56 percent return on the investment.

Efficiency Standards

To reduce electricity demand, the federal government should raise efficiency standards for key appliances. For the last three years, the Department of Energy has named efficiency standards for residential furnaces and boilers, walk-in refrigerators, and distribution transformers as its "high priorities," yet during that period the agency has missed its own target deadlines and fallen even further behind the legal deadlines. If the federal government enacted these standards, by 2030 they could eliminate the need for more than 70 new power plants and reduce the demand for natural gas by enough to heat one out of every ten U.S. homes that rely on natural gas heating.[40]

Research and Development

While the federal government has provided more than $100 billion in research and development funding to the fossil fuel and nuclear industries over the past 50 years, it has only invested $11 billion in efficiency technologies, or nine percent of all federal energy research and development subsidies over that period. (See Figure 2).[41] Despite the many benefits of efficiency programs, spending on state and utility-sponsored energy efficiency programs decreased by approximately 38 percent between 1993 and 2000.[42] Several efficiency technologies are on the verge of making a breakthrough, while others have the potential to save substantial amounts of energy in the future. Federal investment is needed to ensure that these and other newer technologies live up to their promise.

Renewable Energy

Although Iowa has the technical potential to generate 17 times its current electricity usage from renewable energy, only about 2.5 percent of the state's electricity came from clean renewable resources in 2003.[43] The technical potential of wind, biomass, and geothermal resources in the United States is four times greater than our current total electricity consumption.[44] We only harness a fraction of that power, but solar and wind have the potential to significantly relieve our energy problems.

Beyond the obvious environmental benefits, increasing electricity generation from renewable energy would help boost local economies and create jobs. Currently, most states import energy from other places, so money spent on petroleum and coal, for example, flows from the local economy to other states or even other countries.[45] Some economists estimate that 80 percent of every dollar spent on energy bills leaves the state economy.[46] Renewable energy, on the other hand, redirects dollars spent on energy into local economies. Farmers especially benefit from increased renewable energy use, with some developers paying between $2,500 to $4,000 per year to people who allow the developer to install a wind turbine on their land.[47] Another, more long-term and potentially more economically beneficial, option for landowners and local communities is to own the turbines themselves. Here in Iowa, under a 20 percent clean renewable energy standard, farmers and rural landowners could receive at least $37 million in lease payments from wind power by 2020.[48]

Although we are starting to take advantage of our extensive renewable energy potential, we still have a ways to go and need to start investing in renewable technologies now in order to transform our energy system. Outlined below are a few of the primary renewable energy policies and programs that policymakers should support.

Renewable Energy Standard

We should create state and national renewable clean energy standards, commonly referred to as a renewable portfolio standard or RPS, to require that a certain percentage of electricity be generated from renewable energy. Arizona, California, Connecticut, Colorado, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Nevada, New Jersey, New York, New Mexico, Rhode Island, Texas, and Wisconsin already have passed state renewable energy standards to encourage development of clean energy technologies.[49]

Here in Iowa, we should set a strong enforceable standard of 20 percent power generation from renewable energy by 2020. While states must continue their efforts to generate more electricity from renewable sources, we should also set national standards to ensure that all Americans can enjoy the benefits of renewable electricity.

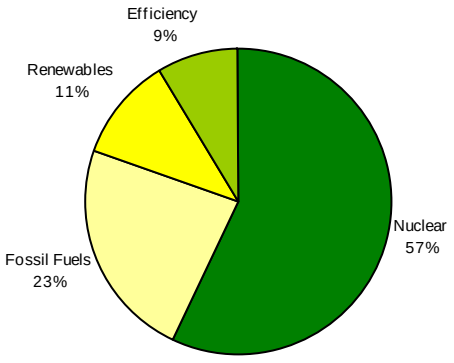
Alternate Energy Revolving Loan Program

The Iowa Energy Center administers a revolving loan fund that helps to finance the construction of renewable energy projects in Iowa, including wind, solar, and biomass.[50] Since the program's inception in 1996, the fund has assisted the construction of 45 projects and demonstrations, including 25 wind, 15 biomass, and 1 solar, which together produce enough renewable energy for 133,000 homes per year.[51] The loan program now relies entirely on loan repayments to fund new projects; an additional boost of funding of $50 million per year will allow the program to fund many more successful renewable energy projects throughout Iowa.

Research and Development

Renewable energy programs have been chronically under-funded for several years. Between 1948 and 1998, the federal government spent $128.5 billion on energy research and development, with more than $100 billion, or 80 percent, going to nuclear and fossil fuels and only $14 billion, or 11 percent, going to renewables (See Figure 2).[52] Despite this, renewable energy has become increasingly cost competitive. The American Wind Energy Association estimates that the cost of electricity from utility-scale wind systems has dropped by more than 80 percent over the last 20 years.[53] While last year's federal energy proposals included some money for further development of these clean technologies, much more is needed.

Figure 2. Federal Energy Research and Development Spending by Sector (1948-1998)



FINDINGS: AN ECONOMIC BOOST

Proponents of the status quo contend that fossil fuels and nuclear power are essential for a healthy and vibrant economy and that diverting investment to renewables and efficiency will cost us jobs and increase costs to consumers. Our analysis evaluates the credibility of these assertions by comparing the economic and consumer impacts of two different energy policies.

Specifically, we examined the effect of two energy scenarios on jobs, wages, gross state product (GSP), natural gas and electricity savings, and power plant emissions of nitrogen oxides (NOx), sulfur dioxide (SO_2), and carbon dioxide (CO_2) in Iowa between 2006 and 2020. All of the results are state-specific and based on the impacts on Iowa's economy and consumers.

Specifically, we examined the economic and consumer impacts of pursuing two different scenarios involving renewable energy and energy efficiency policies:

Scenario 1: Enacting a 20 percent clean renewable energy standard, commonly referred to as a renewable portfolio standard or RPS, which would require Iowa to generate 20 percent of its electricity from clean energy by the year 2020, and funding publicly-run energy efficiency programs in Iowa with $50 million each year from 2007 to 2020; and[54]

Scenario 2: Enacting a 20 percent clean renewable energy standard and funding publicly-run energy efficiency programs with $100 million each year from 2007 to 2020 in Iowa, which would eliminate Iowa's projected 1.5 percent yearly increase in electricity demand.[55]

We found that implementing these clean energy policies would greatly benefit the economy and consumers in Iowa while reducing air pollution from power plants.

The clean energy policies of Scenario 1 would:

- Create 2,340 net jobs in 2020 and a net annual average of 1,615 jobs between 2007 and 2020;
- Increase wages by $31 million in 2020 and $35 million per year on average between 2007 and 2020;
- Save all consumers—residential, commercial, and industrial—$147 million on energy bills and cut expected electricity demand by 10 percent in 2020;
- Reduce global warming carbon dioxide emissions from power plants by eight percent of 2002 levels; smog-forming nitrogen oxide emissions by seven and one-half percent of 2002 levels; and soot-forming sulfur dioxide emissions by six and one half percent of 2002 levels, all by 2020.

Adopting the clean energy policies in Scenario 2 would:

- Create 5,166 net jobs in 2020 and a net annual average of 3,061 jobs between 2007 and 2020;
- Increase wages by $37 million in 2020 and $42 million per year on average between 2007 and 2020;
- Save all consumers—residential, commercial, and industrial—$440 million on energy bills and cut expected electricity demand by 20 percent in 2020, and $1.086 billion cumulatively by 2020;
- Reduce global warming carbon dioxide emissions from power plants by 11 percent of 2002 levels; smog-forming nitrogen oxide emissions by nine percent of 2002 levels; and soot-forming sulfur dioxide emissions by eight percent of 2002 levels, all by 2020.

The findings show that investing in clean energy generates significant economic and consumer benefits; specifically, pairing both the clean energy standard and investment in energy efficiency provides a great benefit to Iowa's economy, particularly with a $100 million investment in energy efficiency modeled in Scenario 2 (See Table 1).

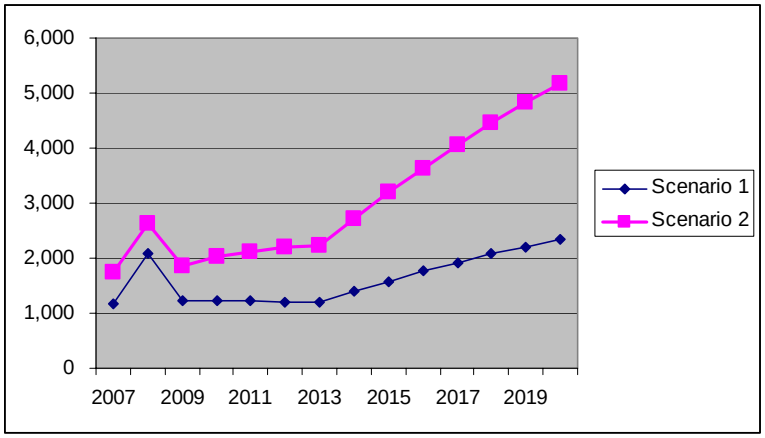
TABLE 1: SUMMARY OF ECONOMIC AND CONSUMER IMPACTS IN IOWA OF TWO CLEAN ENERGY SCENARIOS

	Scenario 1	Scenario 2
Net Job Increase in 2020 (actual)	2,340	5,166
Net Increase in Wages in 2020 (millions of 2001$)	$31	$37
Annual Elec. Savings in 2020 (millions of 2001$)	$147	$440
Avg. Annual Elec. Savings 2005-2020 (millions of 2001$)	($4)	$78

Jobs and Wages

Under Scenario 1 —enacting a clean energy standard of 20 percent and investing $50 million dollars in energy efficiency—Iowa could generate 2,340 net jobs and a $31 million net increase in wages above projected levels in 2020. Between 2007 and 2020, Scenario 1 would create a net average of 1,615 jobs and $35 million in wages above projected levels each year. Under Scenario 2 – enacting a clean energy standard of 20 percent and investing $100 million in energy efficiency – Iowa could generate 5,166 net jobs and a $37 million net increase in wages above projected levels in 2020. Between 2007 and 2020, Scenario 2 would create a net average of 3,061 and $42 million in wages above projected levels each year (See Figures 3 & 4 and Appendices 1 & 2).

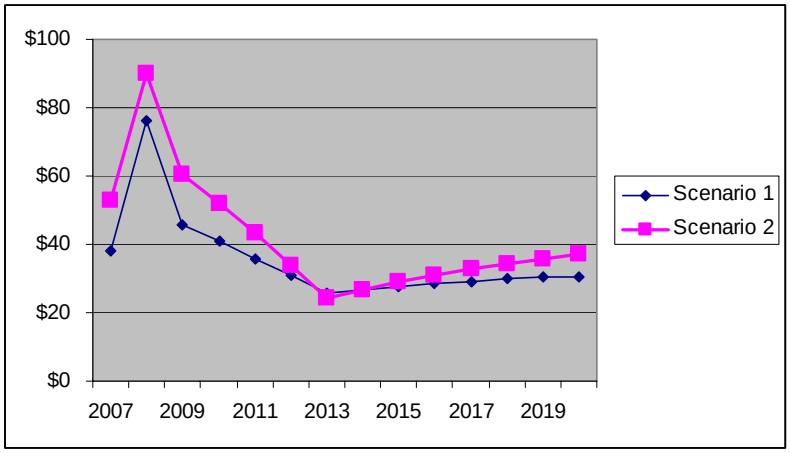
Figure 3. Net Job Creation in Iowa Under Scenarios 1 and 2 (actual jobs)



The majority of the new jobs created under clean energy policies would be well-paying jobs in the manufacturing, construction, finance, and agricultural sectors. (See Appendix 3 and 4 for net job impacts by sector). Clean energy policies produce more jobs because they stimulate these sectors, which are more efficient at creating jobs than the dirty energy sectors. In Iowa, for example, for every $1 million invested in the agricultural sector, 19.9 jobs are created both directly and indirectly. Comparatively, investing $1 million in the utilities sector only creates 5.5 jobs. (See Appendix 5 for job creation capacity by sector in Iowa). Furthermore, homegrown renewable

energy boosts the local economy instead of relying on other states or countries for our energy needs.

Figure 4. Net Wage Increase in Iowa Under Scenarios 1 and 2 (millions of 2001$)



Economic Growth

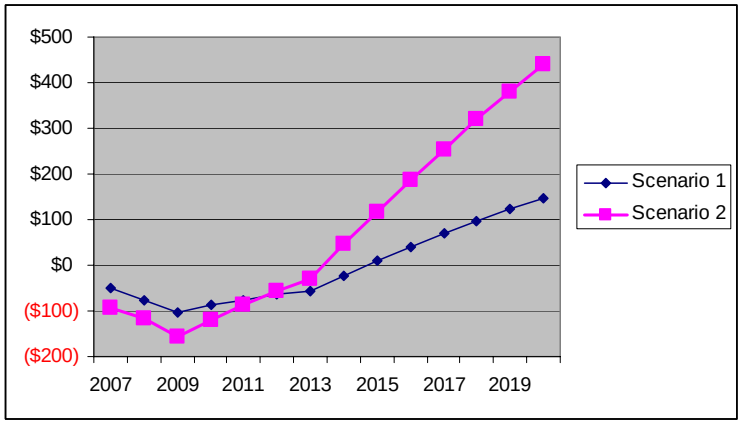
By stimulating the construction and development of renewable energy facilities such as wind farms and solar panel installations, clean energy policies provide an important stimulus to the economy. Investments in energy efficiency programs help reduce energy costs, putting more money back into the consumer's pocket.

While building these clean energy projects and investing in energy efficiency improvements, Iowans will also be redirecting their energy expenditures homeward, rather than sending these funds out of state. According to the most recent progress report from the Department of Natural Resources, Iowa imports energy from out of state to meet 97 percent of our state's energy demands- from electricity production to transportation.[56]

Consumer Benefits

Consumers also would benefit from clean energy policies. Increased production of renewable energy would reduce demand for natural gas, resulting in lower natural gas prices, while stronger investments in energy efficiency help lower electricity bills for all consumers. Under Scenarios 1 and 2, as shown in Figure 5, all consumers — residential, commercial and industrial – would save ($49) million and $1.086 billion, respectively, on energy bills cumulatively by 2020, even when factoring in slight increased costs up front for more efficient products (parentheses indicates negative number). These consumer savings would result from consumers using less energy and the lower cost of electricity and natural gas due to the resulting decreased energy demand. The slight decrease in natural gas prices would also help cut home and business heating costs.

Figure 5. Annual Electricity Savings in Iowa Under Scenarios 1 and 2 (millions of 2001$)



Investments in energy efficiency programs help reduce the cost of electricity for consumers, resulting in significant savings on electricity bills. Investing $100 million in energy efficiency programs generates an annual electricity savings of $440 million for consumers in 2020, and an average annual savings of $78 million between 2006 and 2020. An average Iowa household would save more than $9 on each monthly electric bill during 2020 (See Figure 5).[57]

These consumer savings—enjoyed across all sectors of the economy—are an important part in creating new jobs. The high price of natural gas in the past few years has forced several businesses to move their plants overseas, costing Americans thousands of jobs.[58] Because investing in energy efficiency and boosting clean renewable energy lowers natural gas prices, it also reduces energy costs for businesses and helps stimulate job creation.

Public Health Benefits

In addition to economic and consumer benefits, investing in clean energy policies would produce public health and environmental benefits. Our analysis did not capture all of the environmental and public health benefits resulting from investments in clean energy, such as reducing nuclear waste production or eliminating the need for increased drilling on public lands. We did examine how each scenario would affect power plant emissions of CO_2, NOx and SO_2.

Scenario 1 would reduce CO_2 emissions from power plants in Iowa by 3 million metric tons by 2020 – equivalent to eight percent of 2002 levels; and Scenario 2 would reduce CO_2 emissions from power plants in Iowa by 4 million metric tons by 2020—equivalent to 11 percent of 2002 levels.

Reductions would be similar for other air pollutants when establishing a clean renewable energy standard of 20 percent by 2020 and investing in energy efficiency. An investment of $50 million annually in energy efficiency along with the clean energy standard would reduce soot-forming SO_2 emissions from Iowa's power plants by 9,000 short tons and smog-forming NOx emissions by 5,000 short tons by 2020 – equivalent to seven and one-half and six and one-half percent, respectively, of 2002 levels. An investment of $100 million annually in energy efficiency along with the clean energy standard would reduce soot-forming SO_2 emissions from Iowa's power plants by 11,000 short tons and smog-forming NOx emissions by 6,000 short tons by 2020—equivalent to nine and eight percent, respectively, of 2002 levels.

CONCLUSION: REDIRECTING IOWA'S ENERGY

Iowa's current energy choices are compromising public health, costing consumers and industry billions of dollars, and polluting the environment. To address these problems, we need an energy policy that moves away from fossil fuels and nuclear power and toward clean, homegrown renewable energy and energy efficiency. As the analysis detailed in this report shows, investing in clean renewable energy and energy efficiency programs would have a positive impact on the economy and consumers in Iowa. Enacting clean energy policies would generate new jobs, save consumers billions of dollars, boost Iowa's economy, and reduce air pollution from power plants. To realize these broad consumer, economic and environmental benefits, we offer the following three recommendations:

Implement a Renewable Energy Standard

Policy-makers in Des Moines should implement a clean renewable energy standard to increase the amount of electricity generated from renewable sources of energy to 20 percent of power generation in Iowa by 2020.

Invest in Energy Efficiency

Iowa should boost investment in energy efficiency through publicly-run and independently audited programs by $100 million in order to eliminate electricity demand growth. Funding public programs with $50 million would overcome half of Iowa's projected electricity demand growth, slowing it to approximately three-quarters of a percent yearly. We recommend investing $100 million annually in energy efficiency programs that are independently audited to track actual electricity use reductions per dollar investment; investing $50 million is not enough to pack strong consumer savings or stave off electricity demand growth. Well-designed energy efficiency programs overcome barriers to market penetration of more efficient products, processes and techniques in homes, offices and factories. For example, programs could provide tax credits for the builders of new energy-efficient homes; consumer rebates to buy and install energy-efficient clothes washers and refrigerators; low-interest loans for high efficiency heat pumps, furnaces, and central air conditioners; and tax credits or low-interest loans for businesses to invest in fuel cells and efficient combined heat and power projects.

Strengthen Energy Efficiency Standards

Raising efficiency standards for appliances would save consumers money – including initial purchase cost – while saving energy. There is ample opportunity to greatly increase energy efficiency economy-wide. At minimum, we should strengthen and expand efficiency standards for walk-in refrigerators, furnaces and boilers, and distribution transformers, as well as household appliances such as refrigerators and washers. Strengthening these standards would decrease the nation's energy consumption and save consumers and businesses billions of dollars.

METHODOLOGY

Most states do not have economic models that provide detailed projections of energy production and consumption patterns necessary to evaluate the impacts of alternative energy policies such as we describe here. For that reason, the Environment Iowa Research & Policy Center chose to develop its own state-specific energy and economic model that allows such a comparison. Completing this assessment involved three steps:

(1) We designed a state-specific economic model that reflects an accurate set of economic relationships and benchmarks the necessary energy, price, and investment variables to enable an appropriate evaluation of policy impacts. The starting point for this step was developing a set of economic accounts that describe the production and sale of goods and services among the various sectors within the local economy. This allowed us to set up a business model of the state economy. In this case we used the 2001 economic accounts provided by the IMPLAN database as the basis for the business model.[59]

(2) We established a baseline regional forecast of relevant policy variables from the period 2006 through 2020, which we used to project regional technology cost and energy prices. For each regional model that we developed, we used key state energy and price variables published by the Energy Information Administration for the 2001 base year.[60] We then updated and projected each of these key variables out to the year 2020 using a combination of state economic forecasts from Woods and Poole[61] as well as regional energy forecasts from the Energy Information Administration.[62]

(3) We developed the energy scenario evaluated in the report. Each of the energy policies evaluated implies a change in technology and other investments, energy prices, energy expenditures, and program costs unique to Iowa. In our analysis of the two clean energy policies, we boosted generation of clean renewable energy in order to fulfill the 20 percent renewable energy standard by 2020 and added energy efficiency investments of $50 million per year over the period of 2007-2020. With a full accounting for how each energy policy changes technology and other investments, energy prices, energy expenditures and program costs in Iowa, we mapped each of the policy scenarios into the state energy and economic model described in steps 1 and 2 above.

The models and resulting policy scenarios are generally consistent with a large number of state level studies that have been carried out previously.[63] This approach allows a meaningful comparison of baseline projections of energy consumption and prices with changes that would be driven by alternative energy policies or a different array of energy subsidies.[64] For a more complete description of the state-specific models, including the economic assumptions and energy projections that underpin the baseline or reference case, see the short working paper, "Modeling State Energy Policy Scenarios," available from Environment Iowa Research & Policy Center.[65]

APPENDICES

APPENDIX 1: NET ANNUAL INCREASE IN WAGES IN IOWA UNDER TWO ENERGY SCENARIOS (MILLIONS OF 2001$)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Scenario 1	$38	$76	$46	$41	$36	$31	$26	$27	$28	$29	$29	$30	$30	$31	$35
Scenario 2	$53	$90	$60	$52	$43	$34	$24	$27	$29	$31	$33	$34	$36	$37	$37

APPENDIX 2: NET ANNUAL INCREASE IN JOBS IN IOWA UNDER TWO ENERGY SCENARIOS

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Scenario 1	1,165	2,092	1,217	1,228	1,225	1,212	1,190	1,392	1,582	1,757	1,921	2,072	2,212	2,340	1,615
Scenario 2	1,737	2,634	1,868	2,016	2,122	2,194	2,233	2,728	3,197	3,638	4,057	4,449	4,818	5,166	2,679

APPENDIX 3: NET IMPACT OF SCENARIO 1 ON JOBS AND WAGE AND SALARY COMPENSATION IN 2020 IN DIFFERENT SECTORS OF THE IOWA ECONOMY

Sector	Net Gain in Jobs	Net Gain in Wage and Salary Compensation (Millions of 2001$)
Agriculture	68	$0.39
Oil and Gas Extraction	(2)	($0.00)
Coal mining	0	$0.00
Other Mining	1	$0.07
Electric Utilities	(475)	($54.34)
Natural gas distribution	(1)	($0.09)
Construction	469	$18.08
Manufacturing	157	$10.67
Wholesale trade	73	$3.91
Transportation & Public Utilities	(23)	($1.43)
Retail Trade	362	$8.38
Services	1,381	$29.79
Finance	216	$10.76
Government	114	$4.51
TOTAL	2340	$30.68

Appendix 4: Net Impact of Scenario 2 on Jobs and Wage and Salary Compensation in 2020 in Different Sectors of the Iowa Economy

Sector	Net Gain in Jobs	Net Gain in Wage and Salary Compensation (Millions of 2001$)
Agriculture	179	$1.03
Oil and Gas Extraction	(6)	($0.01)
Coal mining	0	$0.00
Other Mining	3	$0.19
Electric Utilities	(1,310)	($149.76)
Natural gas distribution	0	$0.06
Construction	857	$33.02
Manufacturing	390	$26.51
Wholesale trade	184	$9.88
Transportation & Public Utilities	(73)	($4.62)
Retail Trade	946	$21.92
Services	3,447	$74.39
Finance	291	$14.48
Government	258	$10.18
TOTAL	5,166.48	$37.28

Appendix 5: Iowa Multipliers for Key Economic Sectors

Sector	Type I Multiplier for Employment (Per $MM of Final Demand)	Type I Multiplier for Compensation (Per Dollar of Final Demand)
Agriculture	19.9	0.222
Oil and Gas Extraction	12.4	0.160
Coal mining	0.0	0.000
Other Mining	10.2	0.371
Electric Utilities	5.5	0.263
Natural gas distribution	4.4	0.187
Construction	18.8	0.481
Manufacturing	10.6	0.358
Wholesale trade	12.9	0.449
Transportation and Public Utilities	16.3	0.530
Retail Trade	28.3	0.520
Services	19.1	0.401
Finance	12.0	0.402
Government	22.8	0.825

Source: Minnesota IMPLAN Group, Stillwater, MN, based on 2001 input-output database for Iowa.

Note: Multipliers measure the change throughout the economy from a unit of change for a given sector.
Type I Multipliers capture impacts from direct or initial spending and indirect spending (businesses buying and selling to each other).
Type I Multipliers do not include induced spending—new spending resulting from money saved or earned.
Type I Multiplier for Employment measures the number of direct and indirect jobs created in each sector for every million dollars spent in that sector.
Type I Multiplier for Compensation measures the total change in wages and salaries in the economy for every dollar spent in that sector.

END NOTES

[1]Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov/emeu/states/sep_use/eu/use_eu_ia.html, 27 November 2006. Data for the year 2003 is the most recent available. These percentages may have changed slightly.

[2] Alliant close to decision on coal plant, Cedar Rapids Gazette, Nov. 3, 2006; Iowa Utilities Board, accessed from http://www.state.ia.us/iub, 13 December 2006.

[3]American Lung Association, *State of the Air 2004*, April 2004.

[4]Analysis of U.S. EPA's 1999 National Emissions Inventory for Hazardous Air Pollutants as cited in Northeast States for Coordinated Air Use Management (NESCAUM), *Mercury Emissions from Coal-Fired Power Plants: The Case for Regulatory Action*, October 2003.

[5]Mahaffey, K.R., Cliffner, R.P., and Bodurow, C., "Blood Organic Mercury and Dietary Mercury Intake: National Health Nutrition Examination Survey, 1999 and 2000," *Environmental Health Perspectives*, 112(5) 562-570, April 2004; Mahaffey, K.R., U.S. Environmental Protection Agency, Methylmercury Epidemiology Update, presentation before the Fish Forum, San Diego, January 2004; National Academy of Sciences (NAS), National Research Council, *Toxicological Effects of Methylmercury*, (Washington, DC: National Academy Press, 2000).

[6] Iowa Department of Natural Resources, accessed from http://www.iowadnr.com/fish/news/consump.html, 27 November 2006.

[7]EPA, Clean Air Markets Web site, http://cfpub.epa.gov/gdm/index.cfm?fuseaction=iss.emissions. EPA estimates that an average passenger car on the road in 2000 emitted 11,450 pounds of CO_2 and 38.2 pounds of NOx each year (EPA, *Average Annual Emissions and Fuel Consumption for Passenger Cars and Light Trucks*, downloaded www.epa.gov/otaq/consumer/f00013.htm, 10 January 2005). To calculate average car emissions equivalencies for NOx, we used the following equation: (Tons of NOx emissions x 2,000 pounds)/38.2 pounds of NOx per car per year.

[8]McConnell, R., et al, "Asthma in Exercising Children Exposed to Ozone: A Cohort Study," *The* Lancet, 359, 386-391, 2 February 2002; Environmental Protection Agency (EPA), *Air Quality Criteria for Ozone and Related Photochemical Oxidants*, 1996.

[9]EPA, Clean Air Markets Web site, http://cfpub.epa.gov/gdm/index.cfm?fuseaction=iss.emissions.

[10] Iowa DNR, *Air Quality Unhealthy for Sensitive Groups Tuesday in Cedar Rapids, Davenport, August 3, 2005*, accessed from http://www.iowadnr.com/air/news/articles/05aug03.html, 3 December 2006.

[11]Devlin, R.B., Ghio, A.J., Kehrl, H., Sander, G., and Cascio, W., *Elderly Humans Exposed to Concentrated Air Pollution Particles Have Decreased Heart Rate Variability*, 21 The European Respiratory Journal (Suppl.40) 76s-80s (2003); Holguin, F., Tellez-Rojo, M.M., Hernandez, M., Cortez, M., Chow, J.C., Watson, J.G., Mannino, D., and Romieu, I., *Air Pollution and Heart Rate Variability Among the Elderly in Mexico City*. 14 Epidemiology (No.5) 521-527 (2003); Mittleman, M.A. and Verrier, R.L., *Air Pollution: Small Particles, Big Problems?* Commentary. 14 Epidemiology (No.5) 512-513 (September 2003); Brunekreef, B., *Air Pollution and Life Expectancy: Is There a Relation?* 54 Occup. Environ. Med. 781-84 (1997).

[12]Abt Associates, *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios* (June 2004).

[13]American Lung Association, *Trends in Asthma Morbidity and Mortality* (April 2004).

[14]Abt Associates, *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios* (June 2004).

[15]Office of Civilian Radioactive Waste Management (OCRWM), downloaded from http://www.ocrwm.doe.gov/ymp/about/howmuch.shtml, 25 September 2004.

[16]Office of Civilian Radioactive Waste Management (OCRWM), *Final Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*. Volume II, Table A-7. (February 2002).

[17]Williams, D., "Cancer After Nuclear Fallout: Lessons from the Chernobyl Accident," *Nature Reviews Cancer*, 2, 543-549, 2002.

[18]Intergovernmental Panel on Climate Change, *3rd Assessment Report of Working Group I*, 2001. Downloaded from

http://www.ipcc.ch/pub/spm22-01.pdf, 23 September 2004.
[19]Union of Concerned Scientists, *Confronting Climate Change in the Great Lakes Region*, 2003. Downloaded from http://www.ucsusa.org/greatlakes/pdf/confronting_climate_change_in_the_great_lakes.pdf, 24 September 2004.
[20] Iowa PIRG Education Fund, *Feeling the Heat: Global Warming and Rising Temperatures in the United States, 2006.* Downloaded from http://environmentiowa.org/reports/global-warming/global-warming-reports/feeling-the-heat-global-warming-and-rising-temperatures-in-the-united-states, 27 November 2006.
[21]Greenough, G., McGeehin, M., Bernard, Susan M., Trtanj, J., Riad, J., and Engelberg, D., "The Potential Impacts of Climate Variability and Change on Health Impacts of Extreme Weather Events in the United States," *Environmental Health Perspectives*, Volume 109, Supplement 2, May 2001: p. 191.
[22]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002,* November 2003. Downloaded from www.eia.doe.gov/oiaf/1605/ggrpt/index.html, 8 October 2004.
[23]U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2002*, 15 April 2003.
[24]EPA, Clean Air Markets Web site, http://cfpub.epa.gov/gdm/index.cfm?fuseaction=iss.emissions. EPA estimates that an average passenger car on the road in 2000 emitted 11,450 pounds of CO_2 and 38.2 pounds of NOx each year
(EPA, *Average Annual Emissions and Fuel Consumption for Passenger Cars and Light Trucks*, downloaded www.epa.gov/otaq/consumer/f00013.htm, 10 January 2005). To calculate average car emissions equivalencies for CO_2 emissions, we used the following equation: (Tons of CO_2 emissions x 2,000 pounds)/11,450 pounds of CO_2 per car per year.
[25]Union of Concerned Scientists, *How Oil Works*, downloaded from http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=83, 24 September 2004.
[26]Citizens Coal Council, *The Curse of Appalachia-Mountaintop Removal Strip Mining*, downloaded from http://www.citizenscoalcouncil.org/facts/mtntop.htm, 24 September 2004.
[27]Ken Ward Jr., "Mountaintop removal could devastate region." *Charleston Gazette*. 5 May 2002.
[28] Iowa Department of Natural Resources, *Iowa Energy Plan Update 2004: A Progress Report,* downloaded from http://www.iowadnr.com, 1 December 2006.
[29]National Center for Appropriate Technology, National Energy Affordability and Accessibility Project, *New Jersey*, downloaded from http://neaap.ncat.org/restructuring/nj-re.htm, 9 February 2004. Downloaded from http://www.appanet.org/about/statistics/statistics.cfm, 12 October 2004.
[30]National Association of State PIRGS, *Toward a Consumer-Oriented Electric System: Assuring Affordability, Reliability, Accountability and Balance After a Decade of Restructuring*, August 2004.
[31] Dick Kelly, "Natural gas prices continue to rise," *The Tribune,* March 15, 2006. Department of Natural Resources, "Heating prices drop, gasoline prices rise in the new year," downloaded from http://www.iowadnr.com/news/fuel/05jan.pdf, 27 November 2006.
[32]Cicio, P., Industrial Energy Consumers of America, *41 Month Natural Gas Crisis Has Cost U.S. Consumers Over $111 Billio*n, 19 December 2003.
[33]Russell Gold, "Natural Gas Costs Hurt U.S. Firms," *Wall Street Journal,* February 17, 2004
[34]U.S. Department of Energy, "Assumptions to the Annual Energy Outlook 2001 with Projections to 2020", DOE/EIA/0554, December 2000; American Council for an Energy-Efficient Economy, "Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets," 7 September 2003.
[35]American Council for an Energy-Efficient Economy, *New Appliance and Equipment Standards* (fact sheet), 2001; American Council for an Energy-Efficient Economy*, Overall Savings from Federal Appliance and Equipment Standards*, February 2001; Appliance Standards Awareness Project, *Facts about Appliance Standards,* 12 April 2001. www.standardsasap.org/facts.htm; National Research Council, *Progress in Improving Project Management at the Department of Energy*, 2001 located at http://books.nap.edu/books/0309082803/html/1.html#pagetop; U.S. Department of Energy, located at http://www.eere.energy.gov/.
[36]Prindle, Bill, American Council for an Energy-Efficient Economy, *Energy Efficiency Solutions to the Nation's Natural Gas Problems*, 2003.

[37] U.S. Department of Energy, *The Potential for Energy Efficiency in the State of Iowa,"* June 2001, downloaded from www.ornl.gov/sci/engineering_science_technology/cooling_heating_power/Restructuring/IowaEEPotential.pdf, December 2, 2006; Iowa Department of Natural Resources, *Iowa Energy Plan Update 2004: A Progress Report,* downloaded from www.iowadnr.com/energy/info/energydata2.html, 1 December 2006.
[38]Nadel, S., Monis Shipley, A., and Elliott, R.N., American Council for an Energy-Efficient Economy, *The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States: A Meta-Analysis of Recent Studies*, 2004.
[39] Efficiency Vermont, *Working Together for an Energy Efficient Vermont: Efficiency Vermont 2004 Preliminary Report*, subject to audit, downloaded from www.efficiencyvermont.com on 28 July 2005, final report available September 2005.
[40]Appliance Standards Awareness Project, *Powerful Priorities: Updating Energy Efficiency Standards For Residential Furnaces, Commercial Air Conditioners, And Distribution Transformers*, September 2004. Available at http://www.standardsasap.org/a043_full.pdf.
[441]Congressional Research Service, *Energy Efficiency: Budget, Oil Conservation, and Electricity Conservation Issues*. Updated 22 August 2003. Downloaded from http://www.ncseonline.org/NLE/CRSreports/03Sep/IB10020.pdf, 24 September 2004.
42York, D., and Kushler, M., American Council for an Energy-Efficient Economy, *State Scorecard on Utility and Public Benefits Energy Efficiency Programs: An Updat*e, December 2002.
[43]Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov/emeu/states/sep_use/eu/use_eu_ia.html, 27 November 2006. Data for the year 2003 is the most recent available. These percentages may have changed slightly. For Iowa renewable energy potential: Iowa Public Interest Research Group Education Fund, *Generating Solutions: How Clean, Renewable Energy is Boosting Local Economies and Saving Consumers Money*, April 2003.
[44]The class 3, 4, 5 and 6 wind areas in Kansas, Nebraska, North Dakota and South Dakota yield 5,841,659 million kWhs of generation potential, according to NREL data. In 2000, the U.S. generated 3,799,944 million kWhs of electricity. Even if Class 3 wind potential is excluded, these four states have the potential of generating 3,217,386 million kWhs of electricity from wind power. Not all of this potential will be developed due to economic, physical, and other limitations.
[45] U.S. DOE, *"Why Renewables,"* downloaded from http://www.eren.doe.gov/state_energy/why_renewables.cfm, 7 October 2004.
[46]U.S. DOE, *Energy Efficiency Strengthens Local Economies*, downloaded from http://www.eren.doe.gov/cities_countries/enrgyeff.html, 4 October 2004.
[47]Union of Concerned Scientists, *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future,* downloaded from http://www.ucsusa.org/energy/blueprint.html, 12 October 2004.
[48]Union of Concerned Scientists*, Renewing America's Economy: A 20 Percent National Renewable Electricity Standard Will Create Jobs and Save Consumers Money*, Cambridge, Mass. September 2004, downloaded from http://www.ucsusa.org, 24 September 2004. The numbers are reported in cumulative net present value 2002$ using a 7 percent real discount rate.
[49]Lists of what state incentives are in place were all generated from the Database of State Incentives for Renewable Energy (DSIRE) downloaded from http://www.ies.ncsu.edu/dsire/summarytables/reg1.cfm?&CurrentPageID=7, 18 October 2004.
[50] Iowa Energy Center, accessed from http://www.energy.iastate.edu/funding/aerlp-index.html, 13 December 2006.
[51] Iowa Energy Center, accessed from http://www.energy.iastate.edu/funding/aerlp-status.html, 13 December 2006.
[52]Congressional Research Service, *Energy Efficiency: Budget, Oil Conservation, and Electricity Conservation Issues*. Updated 22 August 2003. Downloaded from http://www.ncseonline.org/NLE/CRSreports/03Sep/IB10020.pdf, 24 September 2004.
[53]American Wind Energy Association, Most Frequently Asked Questions About Wind Energy downloaded from http://www.awea.org/pubs/factsheets/FAQUPDATE.PDF, 30 September 2004.

[54]While Iowa has the potential to generate 17 times its current electricity use from renewables, for the purpose of this analysis, we conservatively estimated that under a 20 percent renewable energy standard , Iowa would obtain 20 percent of its electricity from renewables. This estimate is consistent with other analyses (see for example Union of Concerned Scientists, *Renewing America's Economy: A 20 Percent National Renewable Electricity Standard Will Create Jobs and Save Consumers Money*, Cambridge, Mass. September 2004).

[55] Iowa Department of Natural Resources, *Iowa Energy Plan Update 2004: A Progress Report,* downloaded from http://www.iowadnr.com, 1 December 2006.

[56] Iowa Department of Natural Resources, *Iowa Energy Plan Update 2004: A Progress Report,* downloaded from http://www.iowadnr.com, 1 December 2006.

[57]Iowa Department of Natural Resources, *Iowa Energy Plan Update 2004: A Progress Report,* downloaded from www.iowadnr.com/energy/info/energydata2.html, 1 December 2006. The calculations are based on 2002 data for percentage of energy used by residential users (32 percent) and the number of household electricity customers in 2002 (1.25 million) in comparison with the census population (2.926 million), applied to the projected 2030 census for Iowa (2.955 million).While Iowa has the potential to generate 17 times its current electricity use from renewables, for the purpose of this analysis, we conservatively estimated that under a 20 percent renewable energy standard, Iowa would obtain 20 percent of its electricity from renewables.

[58]Russell Gold, "Natural Gas Costs Hurt U.S. Firms," *Wall Street Journal,* February 17, 2004

[59]Minnesota IMPLAN Group, Stillwater, MN. See http://www.implan.com, accessed July 2004.

[60]Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov/emeu/states/_states.html, 30 August 2004.

[61]Woods & Poole Economics, Washington, DC, August 2004.

[62]U.S. Department of Energy, "Annual Energy Outlook 2004: With Projections to 2025", DOE/EIA/-0383, January 2004, downloaded from http://www.eia.doe.gov/oiaf/aeo/index.html, 9 September 2004.

[63]See e.g., Argonne National Lab and Environmental Protection Agency, *Engines of Growth*: *Energy Challenges, Opportunities, and Uncertainties In the 21st Century,* January 2004, downloaded from http://www.4cleanair.org/members/committee/ozone/EnginesofGrowth.pdf, 30 September 2004; Environment California, *Renewable Energy and Jobs: Employment Impacts of Developing Markets for Renewables in California,* July 2003*;* Kammen, D., and Kapadia, K., *Employment Generation Potential of Renewables to 2010*, 2002; Hewings, G., Yanai, M., Learner, H., et al., Environmental Law and Policy Center, *Job Jolt: The Economic Impacts of Repowering the Midwest,* 2002; Tellus Institute, *Clean Energy: Jobs for America's Future*, October 2001*;* Union of Concerned Scientists, *Renewing Where We Live: A National Renewable Energy Standard Will Benefit America's Economy,* 2002 and 2003.

[64]For an overview of how this methodology might be typically applied, see Laitner, S., Bernow, S., and DeCicco, J., "Employment and Other Macroeconomic Benefits of an Innovation-Led Climate Strategy for the United States." *Energy Policy*, Volume 26, Number 5, April 1998, pp. 425-433. For an example of a study that applies this same modeling exercise within a state level analysis, see, Nadel, S., Laitner, S., Goldberg, M., Elliott, N., DeCicco, J., Geller, H., and Mowris, R., "Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania," Washington, DC: American Council for an Energy Efficient Economy, 1997.

[65]"Modeling State Energy Policy Scenarios," a working document prepared for Environment Iowa Research & Policy Center by Economic Research Associates, Alexandria, VA, January 2005.