A Blueprint for Action

Policy Options to Reduce Illinois' Contribution to Global Warming

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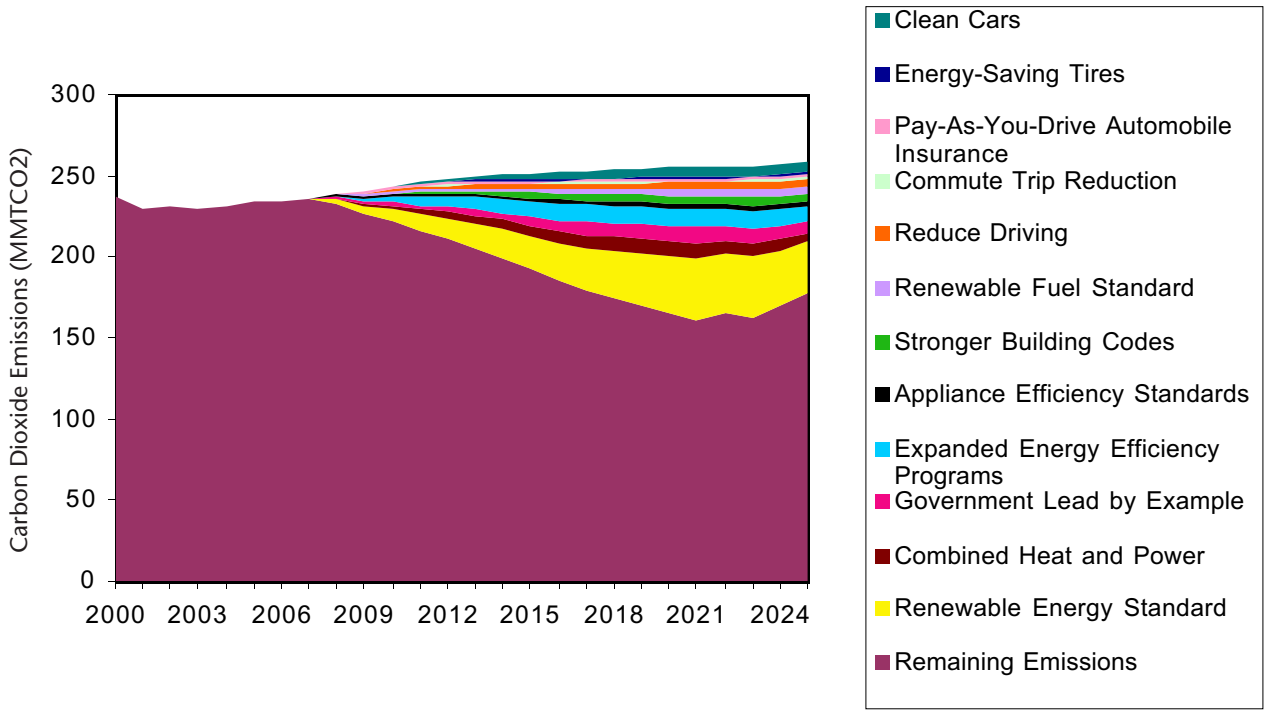
Carbon Dioxide Reductions from Recommended Strategies



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Policy Options to Reduce Illinois' Contribution to Global Warming

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Executive Summary

Illinois could make major strides towards reducing its emissions of global warming pollution by adopting a series of policy strategies to make the state more energy efficient, reduce the use of fossil fuels, and generate cleaner electricity.

Adoption of the 13 policy strategies in this report would help Illinois stabilize its emissions of global warming pollutants despite significant population growth. In the process, these strategies would improve Illinois' energy security and begin the technological shifts necessary to reduce Illinois' emissions of global warming pollution to levels that do not have a harmful effect on the climate.

Even with these strategies, however, Illinois will still need to take additional steps as part of its long-term plan to reduce its contribution to global warming.

Global warming is real, is happening now, and poses a serious threat to Illinois' future.

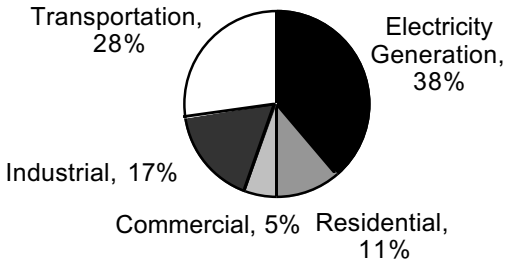
- Global average temperatures increased by 1° F in the 20th century and are now increasing at a rate of about 0.36° F per decade. Sea levels are on the rise, ice and snow cover are decreasing, and hurricane intensity has increased (p. 9).
- The consensus view of the scientific community is that most of the global warming that has occurred is due to human activities—particularly the burning of fossil fuels. Fossil fuel consumption releases carbon dioxide, which traps the sun's radiation near the earth's surface. Since 1750, the concentration of carbon dioxide in the atmosphere has increased by 35 percent—leaving the concentration of carbon dioxide in the atmosphere higher than it has been in the last 650,000 years (p. 11).
- Should the world continue on its present course, global warming emissions could triple in the next half century, with global temperatures increasing by 2.5 to 10° F over 1990 levels by 2100. The ecological balance upon which life depends would be irrevocably altered (p. 11).
- Illinois is vulnerable to negative impacts from global warming, including drought, which could reduce production of corn and soybeans, and

cause up to a five-foot drop in lake levels and river flows that would impede shipping goods by water. Public health could suffer as higher temperatures increase air pollution, the spread of tropical disease, and heat-related deaths (p. 13).

Emissions of global warming pollution are on the rise in Illinois.

- Between 1990 and 2002, Illinois' emissions of carbon dioxide from energy use increased by 17 percent. Electricity generation produces the largest share of carbon dioxide pollution in the state (38 percent), followed by transportation (28 percent), and direct use of fossil fuels in industry (17 percent), homes (11 percent), and businesses (5 percent). (See Figure ES-1.) Because Illinois does not yet collect complete data on global warming emissions from various sources, the information presented here is compiled from the federal Energy Information Administration (EIA) (p. 15).

Figure ES-1. Illinois Carbon Dioxide Pollution by Sector, 2002 (p. 17)



- Illinois is on a path that will lead to significant increases in global warming emissions over the next several decades. According to a projection based on data from EIA, Illinois' emissions of carbon dioxide from energy use could increase by 12 percent over 2002 levels by 2025, with increases in emissions from the transportation sector and electricity generation responsible for the bulk of emissions growth (p. 17).

Illinois could reduce its contribution to global warming by adopting 13 key policy strategies. There are numerous tools available to Illinois to reduce global warming pollution. Among the options are the following policies:

1. **Adopt the Clean Cars Program**, which will put increasing numbers of hybrid-electric cars on Illinois' roads and impose limits on vehicle carbon dioxide emissions.

2. Require the sale of **energy-saving replacement tires** that improve vehicle efficiency without negatively affecting safety.

3. Require automobile insurers to offer **pay-as-you-drive automobile insurance,** in which insurance rates are calculated by the mile, rewarding those who drive less while potentially reducing accidents.

4. **Reduce the number of automobile commutes** by requiring large employers to develop programs to discourage single-passenger commuting and provide employees with more transportation options.

5. Adopt policies that would **reduce growth in vehicle miles traveled** by cars and light trucks on Illinois' highways, such as measures to reduce sprawling development and encourage the use of transit and other transportation alternatives.

6. Establish a stronger **renewable fuels standard**, such that a portion of motor fuel comes from renewable sources with lower life-cycle emissions than gasoline or diesel.

7. Adopt strong statewide residential **building energy codes**.

8. Adopt strong **energy efficiency standards** for appliances and equipment.

9. Increase funding for **energy efficiency programs**.

10. Expand use of **combined heat and power**, in which commercial and industrial facilities use the same energy to generate both electricity and useful heat.

11. Adopt a **renewable energy standard** to increase the amount of clean, renewable electricity consumed in the state.

12. Adopt a **carbon cap** on emissions from the electricity sector.

13. Adopt measures to **reduce government energy use** and promote the use of clean energy in government buildings.

Adoption of these strategies would reduce global warming pollution while improving Illinois' energy efficiency and spurring the development of renewable sources of energy. (See Figure ES-2.) By 2018, Illinois' emissions of carbon dioxide would be approximately 31 percent below projected levels. By 2025, despite the retirement of 30 percent of Illinois' nuclear generating capacity, carbon dioxide emissions would be 31 percent below projected levels.

Illinois should commit to reducing its emissions of global warming pollutants by the amount necessary to do its share

Figure ES-2. Illinois' Carbon Dioxide Emissions from Energy Use after Adoption of Recommended Strategies

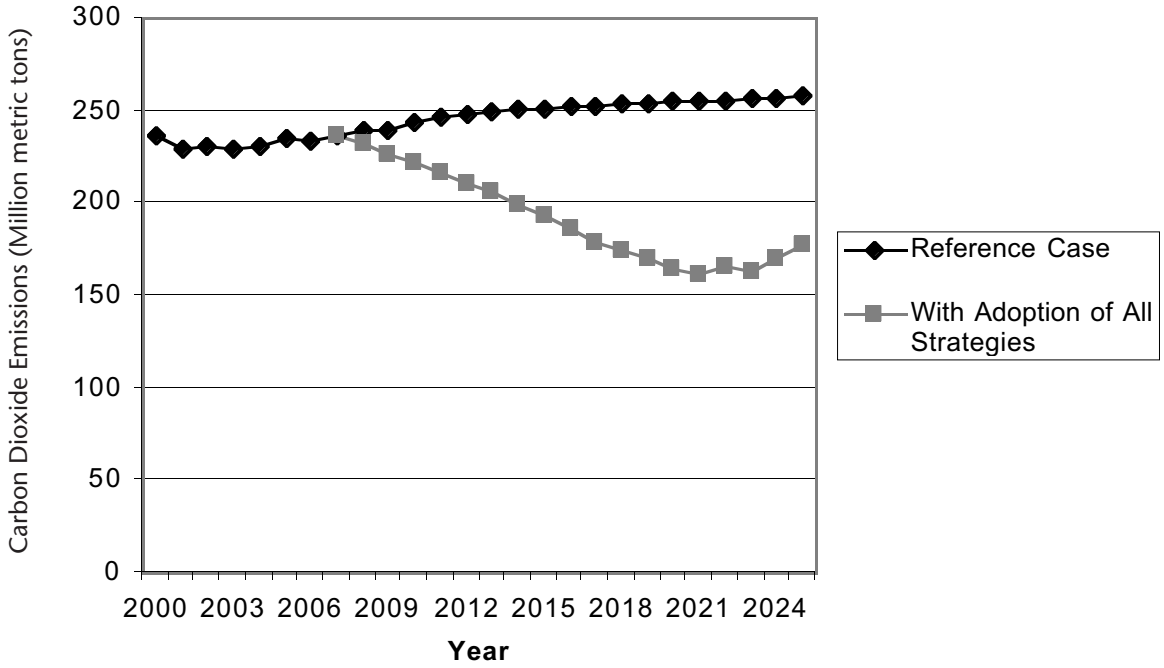
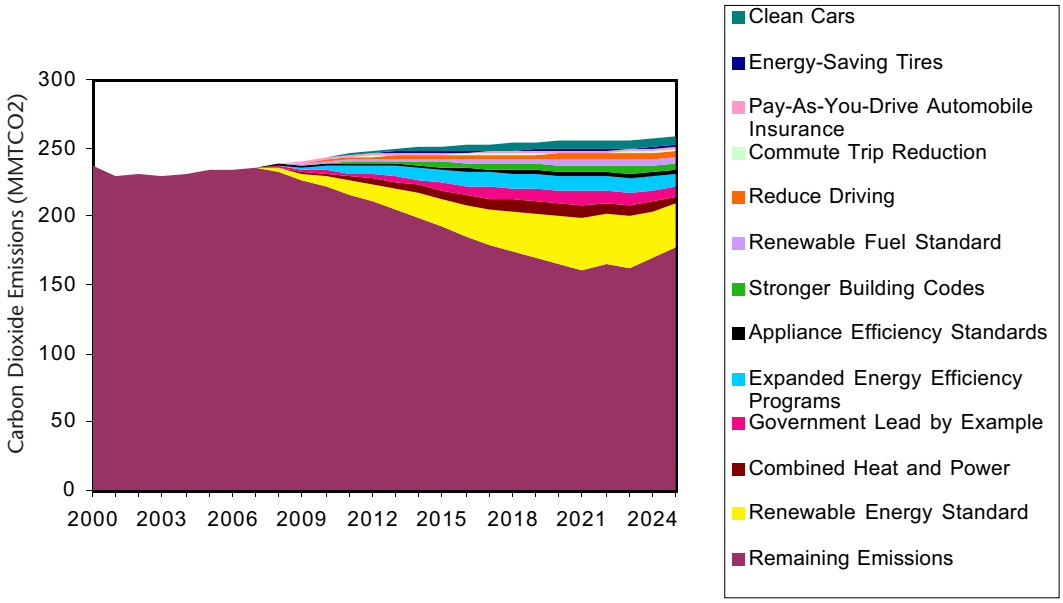


Figure ES-3. Carbon Dioxide Reductions from Recommended Strategies (p. 49)



Note: Total remaining emissions rise beginning in 2022 because three nuclear power plants reach the end of their current operating licenses and we assume they are retired. The electricity they generated is replaced with a combination of energy efficiency, zero-emission renewable energy, and an increase in coal-fired generation, which increases emissions.

to prevent dangerous climate change, and adopt public policies sufficient to achieve those reductions. Specifically, the state should:

- Commit to achieving reductions in global warming emissions of 10 percent below current levels over the next 10 years (by 2018) and of at least 80 percent by 2050, with reductions coming from every sector of the economy.

- Adopt the 13 strategies recommended in this report to achieve the 2018 target listed above and to go beyond it.

- Take additional actions to reduce global warming pollution, including:

  o Pursuing an economy-wide cap on global warming pollution at the regional or federal level to ensure that emission cuts in Illinois do not result in increases elsewhere.

  o Investigating options for additional policies to reduce global warming pollution, especially in areas not directly addressed in this report, such as emissions from air travel and industrial energy use and emissions of global warming pollutants other than carbon dioxide.

Global Warming and Illinois

Global Warming Is Happening

Global warming threatens to endanger Illinois' future health, well-being and prosperity. The first signs of global warming are beginning to appear in Illinois and throughout the world. Global temperatures and sea levels are on the rise. Other changes, such as the recent increase in the severity of hurricanes, are consistent with the kinds of changes scientists expect to occur on a warming planet and are harbingers of the dramatic climate shifts that await us if global warming pollution continues unabated.

Rising Global Temperatures

Global average temperatures increased during the 20th century by about 1° F. While this increase may not seem extreme, it is unprecedented in the context of the last 1,000 years of world history.[1] Figure 1 shows temperature trends in the Northern Hemisphere for the past 1,000 years with a relatively recent upward spike. Temperatures in the past 150 years have been measured; earlier temperatures are derived from proxy measures such as tree rings, corals, and ice cores.

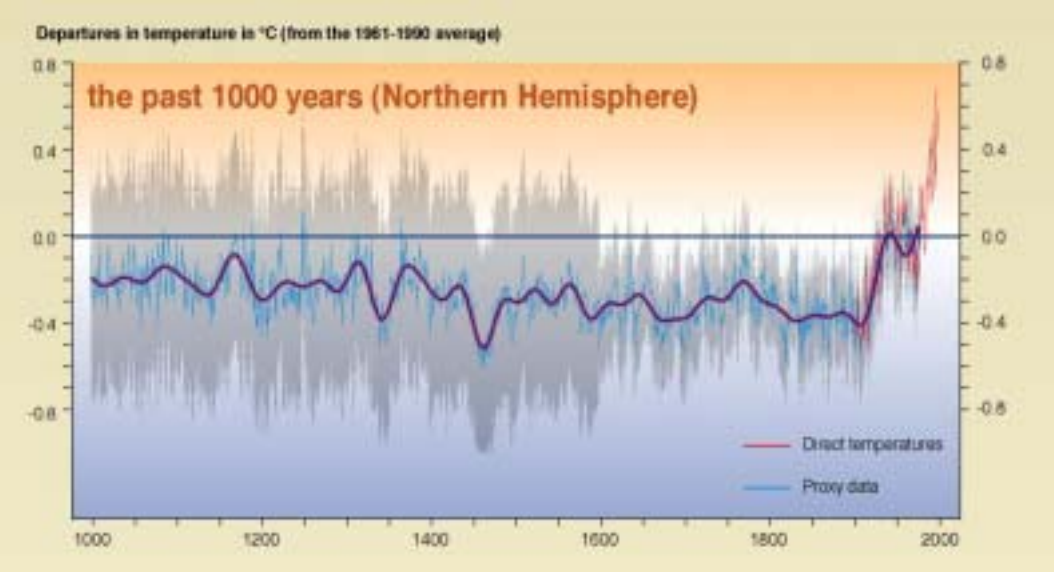
Global warming appears to have intensified in recent years. In 2006, the National Aeronautics and Space Administration (NASA) reported that, since 1975, temperatures have been increasing at a rate of about 0.36° F per decade.[3] The first six months of 2006 were the hottest such period in the U.S. over more than a century of record-keeping, with temperatures averaging 3.4° F higher than the average for the 20th century, while 2005 was the hottest year on record worldwide.[4] Nineteen of the 20 hottest years ever recorded have occurred since 1983 and nine of the 10 hottest years have occurred since 1995.[5]

This warming trend cannot be explained by natural variables—such as solar cycles or volcanic eruptions—but it does correspond to models of climate change based on human influence.[6]

Melting Ice

The rise in global temperatures has resulted in thinning ice and decreasing snow cover. Over the last three decades, the volume and extent of ice cover in the Arctic has been declining rapidly, leading to the possibility that the Arctic could be ice-free during the summer by the end of this century.[7]

Figure 1. Northern Hemisphere Temperature Trends[2]



Mountain glaciers around the world have been retreating, and since the late 1960s, Northern Hemisphere snow cover has decreased by 10 percent.[8]

Rising Sea Level

Oceans have risen with the melting of glacial ice and the expansion of the ocean as it warms. Average sea level has risen 0.1 to 0.2 meters in the past century.[9] Sea level rise has already helped cause the inundation of some coastal land. In Chesapeake Bay, 13 islands have disappeared entirely since the beginning of European settlement four centuries ago.[10] Louisiana loses approximately 24 square miles of wetlands each year, causing an increase in the destructive potential of hurricanes like Hurricane Katrina.[11] While development and land subsidence contribute to the loss of coastal land in these areas, rising sea levels also have an impact, and threaten even greater changes in coastal areas in the decades to come.

More Severe Storms and Extreme Weather

Storms throughout the middle and high latitudes of the Northern Hemisphere have been getting more intense. The increase in the frequency of heavy precipitation events arises from a number of causes, including changes in atmospheric moisture, thunderstorm activity and large-scale storm activity. [12]

In addition, hurricanes have become more powerful and more destructive over the last three decades, a phenomenon that some researchers link to increasing global temperatures.[13] The number of Category 4 and Category 5 hurricanes has nearly doubled worldwide over the last 35 years.[14] And the Atlantic hurricane season of 2005 was the worst ever recorded with the most named storms (28), the most hurricanes (15), the most Category 5 hurricanes (4), the most major hurricanes to hit the U.S. (4), the costliest hurricane (Katrina, which caused more than $80 billion in damage),

and three of the six strongest hurricanes recorded (Wilma, the strongest ever, plus Katrina and Rita).[15]

Illinois has also experienced a string of extreme weather events, including:

- The great Mississippi River flood of 1993, which caused $15 billion of damage in the Midwest, as well as a severe flood in 1996.
- The 1995 heat wave that killed more than 700 people in Chicago and a 1999 heat wave that caused more than 100 deaths.[16]
- The drought in 2005 that was one of the three most severe in the state's 112-year history of record-keeping.[17]

Human Activities Are Causing Global Warming

Many of the changes described above are consistent with the kinds of climatic shifts scientists believe will occur as a result of global warming. They are also signs that human activities have begun to affect the climate through the release of pollutants (known as greenhouse gases or global warming pollutants) that exacerbate the earth's natural greenhouse effect.

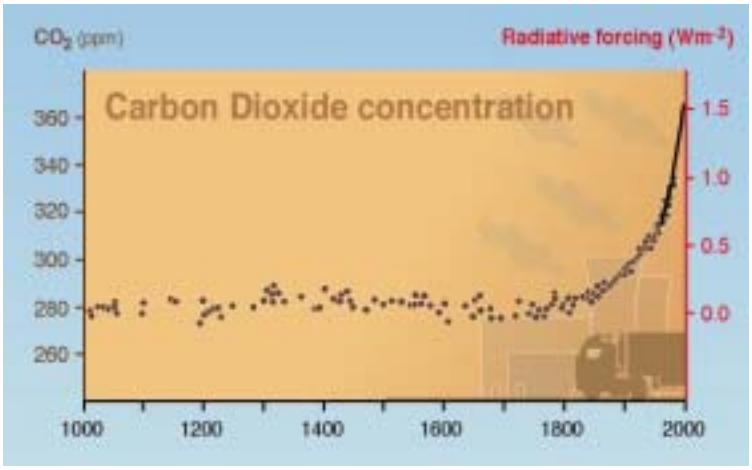
The Greenhouse Effect

Global warming is caused by human exacerbation of the greenhouse effect. The greenhouse effect is a natural phenomenon in which gases in the earth's atmosphere, including water vapor and carbon dioxide, trap radiation from the sun near the planet's surface. The greenhouse effect is necessary for the survival of life; without it, temperatures on earth would be too cold for humans and other life forms to survive.

But human activities, particularly over the last century, have altered the composition of the atmosphere in ways that intensify the greenhouse effect.

Since 1750, for example, the concentration of carbon dioxide (the leading global warming pollutant) in the atmosphere has increased by 35 percent as a result of human activity.[18] The current rate of increase in carbon dioxide concentration is unprecedented in the last 20,000 years.[19] Concentrations of other global warming pollutants have increased as well. (See Figure 2.)

Figure 2. Atmospheric Concentrations of Carbon Dioxide[20]



Global Warming Will Have a Severe Impact—Unless We Begin to Act Now

Climate scientists warn that the world faces dire environmental consequences unless we find a way to quickly and rapidly reduce our emissions of global warming pollutants.

Global Impacts

Many scientists and policy-makers (such as the European Union) recognize a 2° Celsius (3.6° Fahrenheit) increase in global average temperatures over pre-industrial levels as a rough limit beyond which large-

Global Warming Pollutants

Human activities result in the release of many pollutants that are capable of altering the global climate. The main pollutants that contribute to global warming are the following:

- **Carbon dioxide** – Carbon dioxide is released mainly through the combustion of fossil fuels. Carbon dioxide emissions are the leading contributor to global warming and the leading global warming pollutant released in the United States. In 2004, carbon dioxide emissions represented approximately 84 percent of the U.S.'s annual contribution to global warming.[21]

- **Methane** – Methane gas escapes from garbage landfills, is released during the extraction of fossil fuels, and is emitted by livestock and some agricultural practices. Methane represents about 9 percent of U.S. global warming emissions.

- **Nitrous Oxide** – Nitrous oxide is released in automobile exhaust, through the use of nitrogen fertilizers, and from human and animal waste, and is responsible for about 5 percent of the U.S. contribution to global warming.

- **Fluorocarbons** – Used in refrigeration and other products, many fluorocarbons are capable of inducing strong heat-trapping effects when they are released into the atmosphere. However, because they are generally emitted in small quantities, fluorocarbons are responsible for only about 2 percent of the U.S. contribution to global warming.

- **Sulfur Hexafluoride** – Sulfur hexafluoride is mainly used as an insulator for electrical transmission and distribution equipment. It is an extremely powerful global warming gas, with more than 20,000 times the heat-trapping potential of carbon dioxide. However, it is released only in very small quantities and is responsible for only a very small portion of the nation's global warming emissions.

- **Black Carbon** – Black carbon is a product of the burning of fossil fuels, particularly coal and diesel fuel. Recent research has suggested that, because black carbon absorbs sunlight, it may be a major contributor to global warming, perhaps second in importance only to carbon dioxide. Research is continuing on the degree to which black carbon emissions contribute to global warming, and it is difficult to judge exactly how large a role black carbon might play in the U.S.'s contribution to global warming.[22]

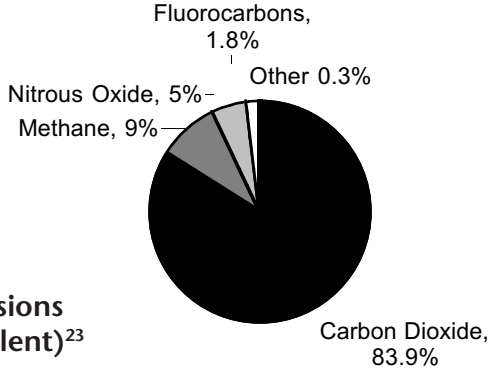


Figure 3. U.S. Global Warming Emissions by Pollutant (carbon dioxide equivalent)[23]

scale, dangerous impacts of global warming would become unavoidable.[24] Even below 2° C, significant impacts from global warming are likely, such as damage to many ecosystems, decreases in crop yields, sea level rise, and the widespread loss of coral reefs.[25]

Beyond 2° C, however, the impacts of global warming become much more severe, including some or all of the following impacts:

- Eventual loss of the Greenland ice sheet, triggering a sea-level rise of 7 meters over the next millennium (and possibly much faster)[26];
- A further increase in the intensity of hurricanes;
- Loss of 97 percent of the world's coral reefs;
- Displacement of tens of millions of people due to sea level rise;
- Total loss of Arctic summer sea ice;
- Expansion of insect-borne disease;
- Greater risk of positive feedback effects—such as the release of methane stored in permafrost—that could lead to even greater warming in the future.[27]

At temperature increases of 3 to 4° C (5.4 to 7.2° F), far more dramatic shifts would take place, including:

- Increased potential for shutdown of the thermohaline circulation, which carries warmth from the tropics to Europe;
- Increased potential for melting of the West Antarctic ice sheet, triggering an eventual 5 to 6 meter rise in sea level;
- Major crop failures in many parts of the world;
- Extreme disruptions to ecosystems.[28]

In addition, the more global temperatures rise, the greater the risk of abrupt climate change. The historical climate record includes many instances in which the world's climate shifted dramatically in the course of decades, even years—with local temperature changes of as much as 10° C (18° F) in 10 years.[29]

Should the world continue on its current course, with fossil fuel consumption continuing to rise, temperature increases of well above 2° C are likely to occur. The Intergovernmental Panel on Climate Change, in its 2001 Third Assessment Report, laid out a scenario in which population, economic output and fossil fuel consumption continue to grow dramatically. Under that scenario, the concentration of carbon dioxide in the atmosphere in 2100 would be nearly three-and-a-half times its preindustrial level, global average temperatures by the end of the century would be 4.5° C (8.1° F) higher than in 1990, and temperatures would continue to rise for generations to come.[30]

Illinois Impacts

Global warming could have severe consequences for both rural and urban areas in Illinois.

Scientists predict that average annual temperatures in Illinois could increase by 3.9 to 7.2° C (7 to 13° F) in winter and 5 to 10° C (9 to 18° F) in summer by the end of this century, if current trends in emissions of global warming pollutants continue.[31] The number of extreme heat events could increase as well.[32]

Predictions of future precipitation trends vary, with projected increases ranging from 10 to 70 percent.[33] The timing of precipitation could change significantly, with precipitation in winter increasing and summer precipitation declining.[34] Even if the state does experience an increase in average precipitation, the increase could come in the form of heavy rain events.[35]

These predicted changes will have complex effects on Illinois' environment.

Higher temperatures increase the rate of evaporation from soil and bodies of water, a change that could outweigh any projected increase in precipitation. Some scientists project that the combination of higher average temperatures and more frequent high precipitation events could lead to the paradoxical result of both more frequent drought *and* severe flooding events.

Scientific models predict as much as a five-foot drop in lake levels and lower river flows.[36] Shipping agricultural and industrial goods by barge on the Great Lakes or the Mississippi River would become less reliable. However, increases in heavy precipitation events could also cause greater flooding, making rivers unsafe for barges and covering rail lines in water for weeks on end, as occurred in 1993.[37] Due to these challenges, the cost of water-based shipping may rise 5 to 40 percent, reducing the attractiveness of the state's agricultural and manufactured products.[38] In sum, Illinois would experience lower average water levels and more extreme flooding.

Agriculture is a $9 billion industry in Illinois and crop yields could decline with higher temperatures and increased evaporation.[39] Research suggests that higher levels of carbon dioxide, which fosters plant growth, may not fully offset these other factors.[40] Depending on how much temperatures and precipitation change, production of corn could drop by as much as 32 percent and soybeans by 24 percent.[41] Declines in agricultural production could hurt related industries, such as the $13.4 billion food processing industry and Illinois' plans to produce crops for its burgeoning ethanol industry.[42]

Public health could suffer. Higher temperatures could lead to more days of extreme heat during the summertime and longer, multi-day heat waves, exacerbating heat stress among the elderly.[43] For example, for places like Chicago, the frequency of events in which daytime temperatures exceed 100° F and nighttime temperatures remain above 80° F for three consecutive days could increase from once every 50 years to once every 10 years by the 2030s.[44]

High temperatures also increase the formation of ozone smog that contributes to respiratory problems.[45] One recent study projects that the number of days in which ozone levels in Chicago reach dangerous levels could double or triple.[46] Warmer, wetter conditions could lead to increasing spread of vector-borne diseases such as St. Louis encephalitis and malaria.[47]

The Need for Immediate Action

There is hope in the climate science, however. Scientists tell us that, if we act quickly and aggressively to reduce global warming emissions, there is a much greater chance of staving off the worst impacts of global warming. To have a reasonable chance of keeping global temperatures from rising by more than 2° C, the atmospheric concentration of carbon dioxide must be held below 450 parts per million (ppm)—about 60 percent higher than pre-industrial levels and about 18 percent higher than today.[48] Holding concentrations below 400 ppm would be even more effective.

To stabilize carbon dioxide levels at 450 ppm, however, the world will need to halt the growth of global warming pollution in this decade, begin reducing emissions soon, and slash emissions by more than half by 2050.[49] Greater reductions would be required to limit carbon dioxide levels to 400 ppm. Because the U.S. is the world's largest global warming polluter, the degree of emission reductions required here will be greater.

By adopting an aggressive target for reducing global warming pollution and setting in motion the changes that will meet that target, Illinois can set an example for the rest of the nation, while reducing its own significant contribution to global warming.

Global Warming Pollution in Illinois

Illinois is a significant contributor to global warming, mainly through the release of carbon dioxide resulting from consumption of fossil fuels. In 2002, the last year for which complete data are available, Illinois released approximately 231 million metric tons of carbon dioxide, the leading global warming pollutant.[50] Were Illinois its own country, it would have ranked 23rd in the world for emissions during 2002, ahead of nations such as Venezuela and Greece.[51]

Illinois' emissions of carbon dioxide have been increasing and are likely to increase still further in the years to come in the absence of concerted action to reduce global warming pollution. Various sectors of Illinois' economy are responsible for varying amounts of global warming pollution and will require different strategies to reduce emissions.

Global Warming Pollution on the Rise

Between 1990 and 2002, carbon dioxide emissions in Illinois increased by 36 $MMTCO_2$—or about 17 percent—slightly faster than the rate of increase as the U.S. as a whole.[53]

Illinois' emissions of global warming pollution are expected to rise over the next two decades. In the absence of measures to reduce global warming pollution, the state's carbon dioxide emissions could be expected to increase by 10 percent over 2002 levels by 2018 and by 12 percent over 2002 levels by 2025. (See Figure 4, p. 17.)

Over the next two decades, Illinois' emissions from the transportation, commercial and electricity generating sectors can be expected to increase. In absolute terms, the greatest increase is likely to take place in the transportation sector, with an increase of 16.6 $MMTCO_2$ possible between 2002 and 2025. Carbon dioxide pollution from the electricity generating sector can be expected to increase by 16.1 $MMTCO_2$, with a smaller increase in the direct use of fossil fuels in the commercial sector (1.3 $MMTCO_2$). Emissions from the residential sector and industrial sectors can be expected to decline because of more widespread use of lower emission fuels. (See Figure 5, p. 17.)

Counting Global Warming Pollution: Background on this Analysis

There are many ways to calculate a state's impact on the global climate. Estimates of global warming pollution and pollution trends depend on the original data source used and the types of emissions that are included or left out.

In this document, we use energy consumption data and projected regional trends compiled by the U.S. Energy Information Administration (EIA) as the basis of our estimates of Illinois' past, current and future carbon dioxide emissions (called the "reference case" in this report). The methods we used to project future emissions are described in detail in the "Methodology" section at the end of this report.

This report includes only energy-related emissions of carbon dioxide and not emissions of other global warming pollutants (like methane and nitrous oxide). In addition, our estimates are calculated on a *production* basis—that is, based on emissions that take place within Illinois' borders. An alternative approach would be to calculate emissions on a *consumption* basis, including all emissions resulting from the consumption of energy or products within Illinois. This distinction is especially important with regard to the electricity sector, since Illinois is a net exporter of electricity to other states. Our estimates include emissions from electricity that is generated within Illinois' borders, even if some of that power is exported for use in other states.

Because we calculate emissions on a production basis, we also generally do not include "upstream" emission reductions (for example, from reduced production of gasoline in other states if Illinois reduces demand for transportation fuel) in our estimates of pollution savings from the various strategies discussed in this report.[52] As a result, many of the strategies discussed will deliver greater overall emission reductions than are estimated here.

Finally, there are multiple ways of expressing quantities of global warming emissions. We have chosen to express emissions in terms of million metric tons of carbon dioxide (or $MMTCO_2$). Some other studies use million metric tons of carbon or carbon equivalent (MMTCE) as the unit of measure. To convert carbon equivalent to carbon dioxide, one can simply multiply by 3.67.

Figure 4. Projected Illinois Carbon Dioxide Emissions, Reference Case

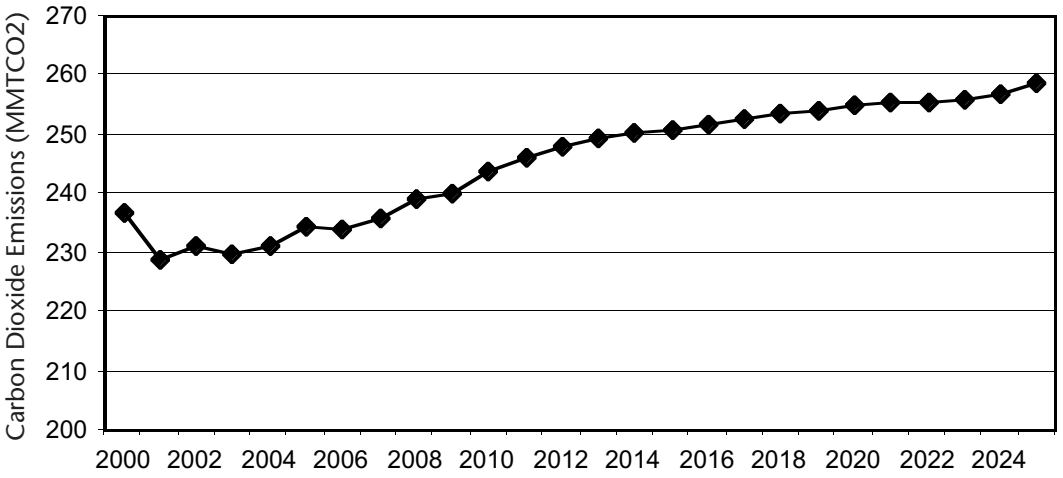
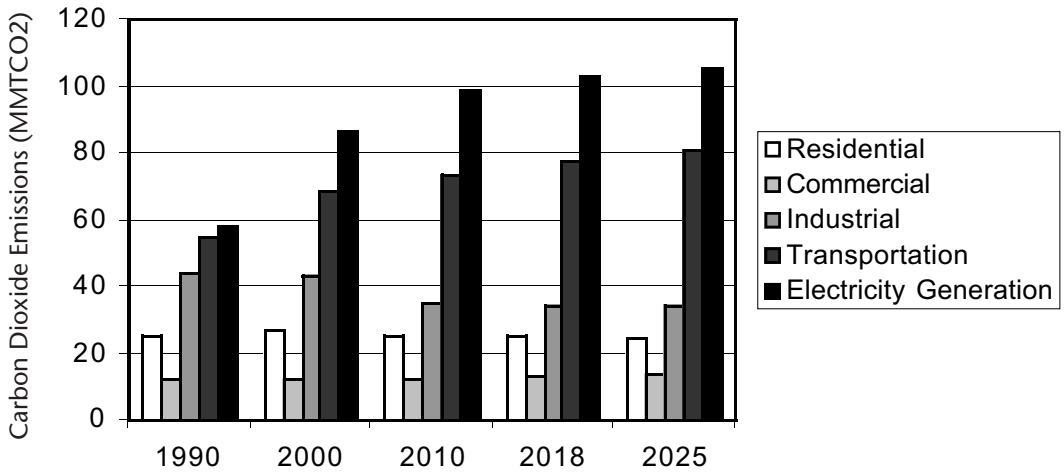


Figure 5. Historic and Projected Illinois Carbon Dioxide Emissions by Sector



Sources of Carbon Dioxide Emissions in Illinois

A coherent strategy to address global warming pollution in Illinois must begin from an understanding of the sources of the pollution. Electricity generation is the leading source of global warming emissions in Illinois, but emissions from transportation are projected to grow most quickly in the next two decades.

Electricity Generation

Power plants are the largest source of carbon dioxide in Illinois, responsible for 38 percent of the state's emissions. Emissions from electricity generators increased by more than 50 percent between 1990 and

2002, representing the largest percentage increase in any sector of the state's economy. The vast majority of global warming emissions come from coal- and natural gas-fired power plants. (Illinois' nuclear power plants, which generate nearly half the state's electricity, produce no direct carbon dioxide emissions, but do have severe environmental and public safety impacts. See "The Future of Nuclear Power in Illinois," page 35.)

Transportation

Transportation does not produce as much global warming pollution as electricity generation, but it is responsible for a growing share of Illinois' pollution. In 2002, transportation accounted for 28 percent of the state's energy-related carbon dioxide emissions. Between 1990 and 2002, global warming pollution from transportation increased by 17 percent.

Personal vehicles such as cars, pick-up trucks and SUVs are the main sources of global warming pollution in Illinois, accounting for 65 percent of the state's transportation-related emissions.[54] The number of miles traveled on Illinois' highways has increased by 63 percent since 1980, to 106 billion miles per year in 2002.[55] Population growth accounts for some of the increase, but the number of vehicle-miles traveled per capita has also increased by 48 percent between 1980 and 2004.[56]

Illinois' status as a transportation hub also contributes to its impact on global warming. Approximately 9 percent of transportation-related carbon dioxide emissions result from combustion of jet fuel. O'Hare Airport is the nation's and the world's second busiest airport, serving more than 76 million passengers in 2005.[57]

Freight transportation adds to Illinois' global warming pollution. Three-quarters of freight shipped within the state and more than half shipped out of the state is sent via truck, which has higher global warming emissions than rail.[58]

Over the next two decades, global warming pollution from gasoline consumption in Illinois (most of it used in cars and light trucks) is expected to increase by approximately 21 percent, while consumption of diesel fuel (used primarily in heavy-duty trucks, as well as trains) is poised to increase by 70 percent. Reducing global warming emissions from Illinois' transportation sector, therefore, will require action on a number of fronts.

Residential, Commercial and Industrial Energy Use

Direct consumption of fossil fuels in Illinois homes (not including electricity consumption) accounted for about 11 percent of the state's carbon dioxide emissions in 2002. Consumption of natural gas for home heating and other household uses has increased only 5 percent since 1990, despite a 10 percent increase in Illinois' population during that time. Household consumption of electricity, however, has increased dramatically—37 percent between 1990 and 2002—helping to fuel the rapid rise in carbon dioxide emissions from electricity generation.

Industrial energy consumption (again, not counting electricity use) accounted for 17 percent of Illinois' carbon dioxide emissions in 2002. Carbon dioxide emissions from industrial energy use declined by 12 percent between 1990 and 2002 as energy use declined and as industries switched to lower emission fuels. Carbon dioxide emissions from industry are expected to decline over the next two decades.

Direct fossil fuel consumption in commercial buildings accounts for the remaining 6 percent of Illinois' carbon dioxide emissions. Carbon dioxide pollution from commercial buildings was essentially flat between 1990 and 2002, because businesses switched from higher-polluting fuels to natural gas for space heating and other energy needs. However, as with residential buildings, electricity consumption increased dramatically in commercial buildings over the last decade, helping to fuel the increase in global warming emissions from electricity generators over that period.

Addressing Global Warming Pollution in Illinois

Illinois must address global warming emissions from all sectors of the state's economy. Fortunately, there are many policy options that have the potential to curb global warming emissions in the state while boosting Illinois' energy security and the long-term health of its economy. The policy suggestions that follow are not the only options available to the state to reduce Illinois' global warming emissions to levels consistent with preserving the global climate. But they do have the potential to reverse the trend toward rising global warming emissions in the state within the next decade and to put Illinois on a trajectory toward further reductions in global warming pollution in the years to come.

Illinois should begin by committing to reductions in global warming emissions of at least 10 percent below current levels by 2018 and of at least 80 percent by 2050. Establishing a firm goal for the next 10 years allows the state to measure its progress. A 10 percent reduction below current levels is achievable; the policies proposed in this report demonstrate that Illinois can easily go far beyond this goal. Reductions come from every sector of the economy, often by capturing cost-effective efficiency savings that also will save money in the long run.

Global Warming Strategies for Illinois

Illinois has many strategies that it can pursue to reduce global warming emissions. The following 13 strategies are among those the state can use to improve the energy efficiency of its economy and expand the use of renewable energy—two steps that can significantly reduce global warming emissions.

Reducing Emissions from the Transportation Sector

Light-duty vehicles are the largest source of transportation-sector carbon dioxide emissions, responsible for about two-thirds of transportation emissions in Illinois. Any strategy to deal with transportation's contribution to global warming, therefore, must begin with addressing emissions from cars, light trucks, and SUVs.

Achieving reductions in transportation emissions will require swift action. Many of the transportation-sector strategies have a long lead time before they begin to produce significant savings due to the fact that they primarily affect new vehicle purchases. Once sold, new vehicles typically remain on the road for 10 to 15 years or more. Thus, any delay in adoption of these measures will result in more high-carbon vehicles traveling Illinois' roadways for years to come.

There are three main ways to reduce carbon dioxide emissions from motor vehicles: improve fuel economy, switch to low-carbon fuels, or reduce vehicle travel. To achieve meaningful reductions, the state will have to make progress in all three areas.

Governor Blagojevich recently proposed reducing motor fuel consumption by 10 percent by 2017.[59] The six strategies below would help the state achieve that goal.

1. Adopt the Clean Cars Program.
2. Require energy-saving tires.
3. Charge for automobile insurance by the mile.
4. Reduce the number of automobile commutes.
5. Reduce the growth in vehicle travel through smart growth and expanding transportation choices.
6. Require that a percentage of transportation fuel come from renewables.

Strategy #1: Adopt the Clean Cars Program

If Policy Is Enacted Alone
Potential Savings:
0.22 MMTCO$_2$ by 2010
5.69 MMTCO$_2$ by 2018
7.84 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Savings:
0.22 MMTCO$_2$ by 2010
5.07 MMTCO$_2$ by 2018
6.66 MMTCO$_2$ by 2025

Illinois can adopt the Clean Cars Program developed by the state of California and adopted by 10 other states, which will require significant reductions in global warming emissions from vehicle tailpipes.[60]

The federal Clean Air Act allows states that fail to meet clean air health standards to choose between two sets of emission standards: those in place at the federal level and the traditionally tougher standards adopted by the state of California.

Over the last several decades, the Clean Cars Program has evolved to include three elements:

- Low emission vehicle standards that require reductions in smog- and soot-forming pollutants.
- Advanced technology vehicle standards that spur the introduction of low-polluting, high-technology vehicles into the fleet, such as near-zero emission gasoline cars, hybrid-electric vehicles, and eventually hydrogen fuel-cell vehicles.
- Tailpipe emission standards for global warming pollution.

Of the three components of the Clean Cars Program, the advanced technology standards and tailpipe emission standards for global warming pollution have the greatest potential to reduce global warming pollution from Illinois' transportation sector.

Advanced Technology Standards

While primarily a program for reducing smog-forming and toxic emissions from automobiles, the Clean Cars Program's "technology forcing" component will likely reduce carbon dioxide emissions by requiring the introduction of significant numbers of advanced technology vehicles (including hybrid-electric vehicles) and, eventually, hydrogen fuel-cell vehicles. Beginning in 2010 (which is when 2011 model year cars will go on sale), automakers would be required to sell the equivalent of approximately 35,000 hybrid vehicles per year in Illinois, with the numbers increasing over time. Then, beginning in 2011, automakers would be required to sell small numbers of hydrogen fuel-cell vehicles—again, with the numbers increasing over time. By 2020, as the program is currently designed, about 9 percent of new light-duty vehicles sold in Illinois would be hybrids, while about 1 percent would be hydrogen fuel-cell or other vehicles with zero emissions.[61]

Hybrid-electric vehicles have already proved popular with drivers in Illinois and elsewhere. Sales of hybrid-electric vehicles have increased steadily since their introduction to the domestic market in December 1999. About 210,000 hybrids were sold in the U.S. in 2005, 2.5 times as many as in the previous year.[62] Plug-in hybrid vehicles, which have larger batteries and can travel farther than standard hybrids on low-emission electric-only capacity, are under development and a few test vehicles are on the road.

The future of hydrogen fuel-cell vehicles is less certain. Fuel cells use a chemical reaction involving hydrogen to produce electricity, which is then used to power a vehicle. When pure hydrogen is used in a fuel cell, the only byproduct is water and heat. While a limited number of fuel cell vehicles are currently on the road in dem-

onstration projects, and while major automakers have committed themselves to the technology, significant technological and market hurdles remain in the way of an effective system for generating, storing and distributing pure hydrogen. Even if pure hydrogen can be used as a fuel, the possibility exists that polluting and dangerous fuels such as coal and nuclear power could be used to generate the hydrogen, creating new environmental and public health threats. Thus, renewable sources of hydrogen are central to a fuel cell future that delivers dramatic reductions in global warming pollution.

In its Greenhouse Gases, Regulated Emissions and Energy Use in Transportation (GREET) model, the Argonne National Laboratory estimated that hybrid-electric passenger cars release approximately 47 percent less carbon dioxide per mile than conventional vehicles. Fuel cell passenger cars operating on hydrogen derived from natural gas are projected to produce about 62 percent less carbon dioxide than conventional vehicles.[63] The requirements for these vehicles would likely produce a 1 to 2 percent reduction in global warming emissions from light-duty vehicles in Illinois.[64]

Global Warming Emission Standards

In 2002, the Clean Cars Program was expanded with the addition of a law calling for standards for carbon dioxide emission standards for motor vehicles. The Greenhouse Gas Emission Standards for Vehicles law was the first in the nation to regulate carbon dioxide for automobiles.

The legislation required the California Air Resources Board (CARB) to propose limits that "achieve the maximum feasible and cost effective reductions of greenhouse gas emissions from motor vehicles." Limits on vehicle travel, new gasoline or vehicle taxes, or limitations on ownership of SUVs or other light trucks could not be imposed to attain the new standards.[65] In September 2004, CARB adopted rules for implementation of the greenhouse gas emissions standards for vehicles. In addition, in 2006 California adopted legislation placing limits on global warming emissions from throughout the state's economy. This new law could lead to tightening of the vehicle global warming emission standards beyond 2016.

In estimating the benefits of the global warming and vehicles standards, we assume that Illinois vehicles will achieve the same percentage emission reductions as estimated by CARB—34 percent for cars and 25 percent for light trucks by 2016.[66] CARB estimates that adoption of the standards would lead to net consumer benefits of $3 per month for new car purchasers and $7 per month for light-truck buyers, with the higher cost of vehicles being more than offset by reductions in operating costs, primarily the cost of fuel (assuming that gas costs $1.70 per gallon, well below the current cost of gas).[67]

Illinois can lay the groundwork for implementation of the global warming and vehicle standards by moving forward with full adoption of the Clean Cars Program. Illinois should also encourage other states in the region to adopt the strongest available automobile emission standards. The emergence of a regional bloc of states in support of carbon dioxide emission standards will create leverage that can be used in securing stronger strategies to reduce automotive carbon emissions at the federal level and that may encourage automakers to sell only Clean Car Program-compliant vehicles nationwide.

Strategy #2: Require Energy-Saving Tires

If Policy Is Enacted Alone
Potential Savings:
0.48 MMTCO$_2$ by 2010
0.93 MMTCO$_2$ by 2018
1.04 MMTCO$_2$ by 2025

The Importance of Fuel Economy Standards

The most effective tool for reducing global warming emissions from transportation is also one that is out of the hands of Illinois state officials: increasing federal fuel economy standards for light-duty vehicles to 40 miles per gallon (MPG) or more. Federal law prohibits states from adopting their own fuel economy standards for vehicles, but Illinois can urge the federal government to adopt stronger standards and take other actions to encourage improvements in vehicle fuel economy.

Increasing federal fuel economy standards to 40 MPG is both technologically feasible and likely to save consumers money. The Union of Concerned Scientists (UCS) has concluded that average vehicle fuel economy of 40 MPG is attainable within a 10-year timeframe, even without the widespread use of hybrid technology. In addition, UCS concluded that such standards would provide a net savings to purchasers of more-efficient light trucks, even given a relatively conservative estimate of gasoline prices ($1.75 per gallon).[68] Similarly, the Consumer Federation of America concluded that a 50 MPG standard would be both feasible and cost-effective by 2030, assuming gasoline prices of $3 per gallon, using technologies that are either currently available or projected to be available soon.[69]

Most of the technologies used to achieve the fuel economy improvements and global warming pollution reductions described above are neither new nor exotic. Technologies such as six-speed automatic transmissions, continuously variable transmissions, turbocharging and cylinder deactivation are already finding their way into growing numbers of vehicles. Other more advanced technologies, such as improved electrical systems and idle-off (in which the gasoline engine is shut off during idling), can also significantly reduce emissions.

Unfortunately, American consumers have had very limited choice of fuel-efficient vehicles. According to the EPA, there were only 42 model year 2006 vehicle models that achieved 30 MPG combined city/highway mileage or greater (compared with more than 400 models that achieved less than 20 MPG combined). Of those 42 vehicles, 27 were compacts, subcompacts or other small cars. Only three mid-sized cars, no mid-sized station wagons, and six SUV models achieved 30 MPG or greater.[70]

Improving the fuel economy of light-duty vehicles reduces the per-mile emissions of global warming pollutants from vehicle tailpipes. A 40 miles per gallon fuel economy standard, however, would deliver reductions above and beyond those possible under the Clean Cars Program.

The state of Illinois should urge Congress and the Bush administration to strengthen federal fuel economy standards. In addition, the state should consider ways in which it can promote improved fuel economy through measures other than standards—for example, through financial incentives for purchasers of highly efficient vehicles coupled with penalties for purchases of gas-guzzlers. Finally, the state should urge the federal government to create fuel economy standards for heavy-duty trucks, which are responsible for a sizeable share of transportation global warming emissions in Illinois.

If Policy Is Enacted With Others Identified in This Report

Potential Savings:
0.46 MMTCO$_2$ by 2010
0.82 MMTCO$_2$ by 2018
0.88 MMTCO$_2$ by 2025

Energy efficiency standards for replacement tires can improve the fuel economy of the existing vehicle fleet at a net savings to consumers.

Automobile manufacturers typically include gasoline-saving low-rolling resistance (LRR) tires on their new vehicles in order to meet federal fuel economy standards. However, energy-saving tires are generally not available to consumers as replacements when original tires have worn out. As a result, vehicles with replacement tires do not achieve the same fuel economy as vehicles with original tires.

The potential savings in fuel and carbon dioxide emissions are significant. A 2003 report conducted for the California Energy Commission found that LRR tires would improve the fuel economy of vehicles operating on replacement tires by about 3 percent, with the average driver replacing the tires on their vehicle when the vehicle reaches four, seven and eleven years of age. The resulting fuel savings would pay off the additional cost of the tires in about one year, the report found, without compromising safety or tire longevity.[71]

Several potential approaches exist for encouraging the sale and use of LRR tires—ranging from labeling campaigns similar to the federal Energy Star program to mandatory fuel efficiency standards for all light-duty tires sold in the state. California

Heavy-Duty Truck Fuel Economy

Heavy-duty trucks are major consumers of fuel. Large tractor-trailers consumed about 14 percent of the fuel used by all highway vehicles nationally in 2004, and fuel consumption by large trucks has been increasing by more than 4 percent per year since the early 1990s.[77] As is the case with the light-duty vehicle fleet, fuel economy among the largest trucks has also been declining, dropping 5 percent between 1997 and 2002.[78]

Heavy-duty trucks are exempt from federal fuel economy standards. But significant increases in fuel economy for these trucks are possible at a net lifetime savings to vehicle owners. A 2004 study conducted by the American Council for an Energy-Efficient Economy (ACEEE) found that fuel economy improvements for tractor-trailers of 58 percent are achievable and cost-effective. The study also identified cost-effective improvements in fuel economy for other types of large trucks.[79] Calculations of cost-effectiveness were based on diesel fuel prices of $1.41 to $1.60 per gallon, well below the recent prices of $2.57 and higher charged recently at pumps across the United States.[80] As a result, the ACEEE estimates of cost-effective savings are likely conservative.

Imposing federal fuel-economy standards designed to increase the fuel economy of tractor-trailers by 50 percent would significantly reduce global warming pollution from the fast-growing freight transportation sector. The increase would be sufficient to raise the average fuel economy of heavy-duty trucks from approximately 5.7 MPG to about 8.5 MPG. The United States should also devise strategies to reduce fuel consumption and promote energy-efficient technologies in all medium- and heavy-duty trucks.

recently chose the latter approach, adopting legislation requiring that replacement tires sold to consumers beginning in July 2008 have the same average energy efficiency as the original tires provided by automakers.[72] The state will rate the energy efficiency of different tires based on testing information provided by manufacturers. The law does not require that each tire be labeled with its efficiency rating, but the information will be readily available to Illinois to develop similar requirements.

A standards program that required the sale of LRR tires beginning in 2009 in Illinois—assuming the same tire replacement schedules and per-vehicle emissions reductions found in the California study—would ultimately reduce carbon dioxide emissions from light-duty vehicles by about 2 percent by 2025, while also providing a net financial benefit to consumers through reduced gasoline costs.

Strategy #3: Implement Pay-As-You-Drive Automobile Insurance

If Policy Is Enacted Alone

Potential Savings:
1.06 MMTCO$_2$ by 2010
1.48 MMTCO$_2$ by 2018
1.51 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report

Potential Savings:
1.02 MMTCO$_2$ by 2010
1.32 MMTCO$_2$ by 2018
1.28 MMTCO$_2$ by 2025

Shifting the calculation of automobile insurance rates from a flat annual rate to a per-mile basis would encourage car owners to drive fewer miles and reduce global warming pollution.

In a perfectly functioning market, the rates individuals pay for automobile insurance coverage would accurately reflect the risk they pose to themselves and others. Insurers currently use a host of measures—including vehicle model, driving record, location and personal characteristics—to estimate the financial risk imposed by drivers.

One measure that is strongly linked to automobile safety and yet is not used with much accuracy in the calculation of insurance rates is travel mileage. Common sense and academic research suggest that drivers who log more miles behind the wheel are more likely to get in an accident than those whose vehicles rarely leave the driveway.[73] Many insurers do provide low-mileage discounts to drivers, but these discounts are often small, and do not vary based on small variations in mileage. For example, a discount for vehicles that are driven less than 7,500 miles per year does little to encourage those who drive significantly more or less than 7,500 miles per year to alter their driving behavior. As a result, the system fails to effectively encourage drivers to reduce their risk by driving less.

Requiring automobile insurers to use mileage as a factor in calculating insurance rates is just one of many potential ways to reallocate the upfront costs of driving. Currently, high initial cost barriers to vehicle ownership—such as insurance, registration fees and sales taxes—may reduce driving somewhat by denying vehicles to those who cannot afford these costs. But for the bulk of the population that can afford (or has little choice but to afford) to own a vehicle, these high initial costs serve as an incentive to maximize the vehicle's use. Per-mile charges operate in the opposite fashion, providing a powerful price signal for vehicle owners to minimize their driving and, in the process, minimize the costs they impose on society in air pollution, highway maintenance and accidents.

A pay-as-you-drive (PAYD) system of insurance in Illinois might work this way:

vehicle insurance could be split between those components in which risk is directly related to the ownership of a vehicle (comprehensive) and those in which risk is related to mileage (collision, liability). The former could be charged to consumers on an annual basis, as is done currently. The latter types of insurance could be sold in chunks of mileage—for example 5,000 miles—or be sold annually with the adjustments of premiums based on actual mileage taking place at the end of the year. Of critical importance to the success of the system would be the creation of accurate, convenient methods of taking odometer readings and communicating them to the insurer.

A pay-as-you-drive system of insurance would have broad benefits for Illinois—not only for reducing global warming pollution, but also for improving highway safety and reducing insurance claims. Because insurers would still be permitted to adjust their per-mile rates based on other risk factors, mileage-based insurance would add additional costs for the worst drivers, giving them a financial incentive to drive sparingly.

Most importantly, research indicates that a mileage-based insurance system would reduce driving. Converting the average collision and liability insurance policy to a per-mile basis in Illinois would lead to an average insurance charge of about 6.8 cents per mile.[74] (For comparison, a driver buying gasoline at $2.50 per gallon for a 20 MPG car pays 12.5 cents per mile for fuel.)

If 80 percent of collision and liability insurance were to be assessed by the mile, the impact on vehicle travel would be significant, reducing vehicle-miles traveled by about 5 percent below projected levels, with carbon dioxide emissions from light-duty vehicles declining by roughly the same amount.[75]

While many insurers remain resistant to the administrative changes that would be needed to implement mileage-based insurance, the concept is beginning to make inroads. The Progressive auto insurance company offered a pilot PAYD insurance system in Texas and other pilot programs are underway elsewhere. In 2003, the Oregon Legislature adopted legislation to provide a $100 per policy tax credit to insurers who offer PAYD options.[76]

Illinois should consider moving toward a system of PAYD insurance, perhaps by first requiring insurers to offer it as an alternative to traditional insurance. If the concept proves successful, the state (or insurers) could then require liability and collision rates to be expressed in cents-per-mile—thus maximizing the carbon dioxide emission reductions and other positive results of the policy.

Strategy #4: Reduce the Number of Automobile Commutes

If Policy Is Enacted Alone

Potential Savings:
0.34 MMTCO$_2$ by 2010
1.31 MMTCO$_2$ by 2018
1.46 MMTCO$_2$ by 2025

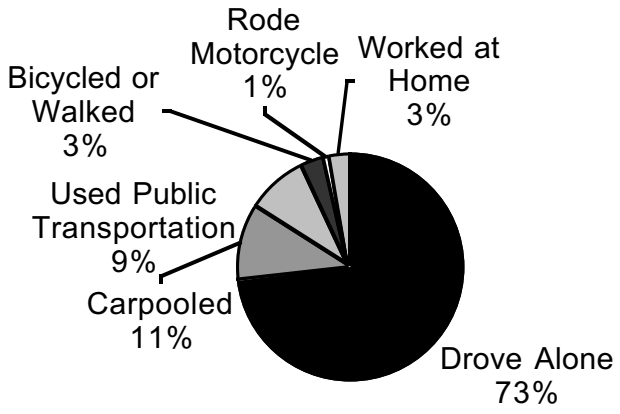
If Policy Is Enacted With Others Identified in This Report

Potential Savings:
0.33 MMTCO$_2$ by 2010
1.17 MMTCO$_2$ by 2018
1.24 MMTCO$_2$ by 2025

Commutes to and from work make up a major share of vehicle travel in Illinois. Nationally, about 27 percent of all vehicle miles are traveled on the way to or from work.[81] Programs that require employers to provide transportation alternatives to their employees can go a long way toward reducing the number of vehicle-miles traveled on Illinois' highways.

Illinois created a voluntary commute-trip reduction program for employers in the Chicago area in the 1990s. Employers who

Figure 6. How Illinois Workers Traveled to Work in 2000[86]



successfully reduced the amount of driving by their employees could sell the emission reduction credits to other area polluters who needed to comply with the federal Clean Air Act.[82]

In addition to programs offered by employers, the Chicago Area Transportation Study, a regional transportation planning authority, offers rideshare assistance programs, including a carpool matching program and help for employers creating a commute trip reduction program.[83] Pace, a Chicago area transit operator, offers vanpooling incentives, providing vans and helping to match commuters who have similar destinations.[84]

Evidence suggests that mandatory trip-reduction programs—particularly those in which government plays a strong supporting role in helping employers achieve their commute-trip reduction goals—are more effective than voluntary efforts in bringing about large reductions in single-passenger commutes.

Between 1990 and 2000, for example, the percentage of Illinois workers driving to work alone increased from 69.9 percent to 73.2 percent, in line with the national trend.[85] Only two states experienced a decrease in the percentage of drive-alone commuters during the 1990s—Washington and Oregon. Not coincidentally, those two states also have effective mandatory employer trip reduction programs.

Washington State's program was enacted in 1991 and covers employers with 100 or more full-time employers at a single worksite in the state's nine most populous counties. The program requires employers to develop plans designed to reduce vehicle-miles traveled by employees in line with a set of increasingly stringent targets.[87] Oregon's program applies to employers with 50 employees or more at a single site in the Portland metropolitan area. It requires employers to offer incentives for the use of commuting alternatives with the potential of reducing commute trips by 10 percent over three years.[88]

Both programs have achieved results in reducing commuting travel. The Washington program removes 19,000 vehicles from the state's highways each morning, and the rate of single passenger commuting at worksites covered by the program dropped from 70.8 percent in 1993 to 65.7 percent in 2003. The number of commuting vehicle-miles traveled at those facilities would have been 5.9 percent higher were it not for the program. The Washington program also reduces global warming pollution by about 74,000 tons per year.[89] Oregon claims that 30 percent of employers in its program are meeting the 10 percent reduction target, and another 35 percent have seen trip reductions of between 1 and 9 percent,

producing an annual reduction in vehicle-miles traveled of 35.4 million.[90]

A vigorous, mandatory trip reduction program for Illinois employers could achieve similar, if not better results. Illinois' extensive transit infrastructure and congestion problems could provide a solid foundation and benefit from the expansion of trip-reduction efforts.

The carbon dioxide emission reductions projected for this strategy assume that large employers in the state (those with more than 100 employees) can reduce the number of single-passenger commuting trips by 30 percent by 2019. Among the programs and measures that can be used to achieve that goal are the following:

- Incentives and preferential parking privileges for carpool and vanpool drivers.
- Shuttle service to nearby transit stations.
- Programs to encourage and facilitate telecommuting.
- Flexible work schedules that allow workers to commute fewer days of the week.
- Parking "cash out," which allows employees to receive the value of employer-provided free parking for other uses if they choose not to drive to work.
- Emergency ride home programs that ensure that workers using transit are not stranded if they need to work late or return home early.
- Providing secure bicycle storage and changing facilities for employees who bike to work.
- Reimbursing bicycle and transit mileage for business trips when those modes are comparable in speed to driving.
- Creating a trip-reduction coordinator and actively promoting commuting benefits to their employees.

In implementing an aggressive trip-reduction program, Illinois should be sensitive to the concerns of the business community—particularly those businesses that have already invested in voluntary commute trip-reduction efforts. Washington State's program, for example, includes businesses and local governments in the governance of the program, resulting in strong partnerships that enhance the program's success.

In addition, Illinois should be prepared to invest in helping businesses meet their commute-trip reduction goals. Commute-trip reduction has proven to be an extremely cost effective way to reduce highway congestion, energy use and air pollution—in Washington State, for example, $2.7 million in annual investment from the state has delivered more than $37 million in reduced fuel expenditures and travel delay alone.[91] A relatively small investment of state funds, if coupled with a mandatory trip-reduction effort, could yield large dividends in reduced global warming emissions, reduced congestion, and reduced dependence on petroleum. In addition, employer-based commute-trip reduction programs can improve employee morale, provide a desirable benefit for prospective employees, and reduce expenditures for parking.

Strategy #5: Reduce Growth in Vehicle Travel Through Smart Growth and Expanded Transportation Choices

If Policy Is Enacted Alone

Potential Savings:
1.21 MMTCO$_2$ by 2010
4.25 MMTCO$_2$ by 2018
6.38 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report

Potential Savings:
1.17 MMTCO$_2$ by 2010
3.79 MMTCO$_2$ by 2018
5.42 MMTCO$_2$ by 2025

The growth in vehicle-miles traveled (VMT) over the last several decades has its roots in many societal changes—population growth, low gasoline prices, expansion of the workforce, and residential and commercial suburban sprawl.

Reversing this trend will be challenging, but success would bring benefits not only in reducing global warming emissions but also in easing traffic congestion, reducing public expenditures on highways, enhancing Illinois' energy security, and reducing automotive emissions of other pollutants that harm public health. It would be a reasonable goal for Illinois to seek to reduce the growth rate in vehicle-miles traveled to equal the rate of population growth in the state. Even more aggressive reductions in vehicle travel may be possible in the future.

Stabilizing per-capita vehicle-miles traveled at today's levels would avoid a large projected increase in vehicle travel over the next two decades. By stabilizing travel growth in terms of per-capita travel, the number of vehicle miles traveled in Illinois would increase by only about 5 percent between 2004 and 2025, compared with an approximate 22 percent increase in the reference case scenario.[92]

Illinois residents have already begun to cut back on driving as a result of higher fuel prices. Data from the Federal Highway Administration indicate that slightly fewer vehicle miles were driven on Illinois highways in 2005 versus 2004.[93] Transit ridership has increased, with the Chicago Transit Authority reporting a 3 percent increase in bus ridership and a 5 percent increase in rail ridership in 2005.[94]

The increase in transit use in Illinois is evidence of citizens' willingness to use transit if convenient options are available. Illinois should strengthen its efforts to maintain and expand its transit systems.

The policies that Illinois should pursue to reduce growth in driving include:

- **Restrain exurban sprawl** – Even as Chicago has become an increasingly attractive place to live, the growth of "exurbs" in the far reaches of the state's metropolitan areas continues. Population growth in outer suburbs of Chicago, St. Louis and other urban areas threatens to bring even more traffic to Illinois' highways and to exacerbate global warming through longer commutes. Illinois should work with municipalities and neighboring states to ensure that new growth takes place in a way that minimizes demand for highway travel and to encourage growth in already built-up areas with transportation infrastructure.

- **Expand access to transit** – Illinois should work to expand the number of people with access to transportation alternatives by expanding access to transit. Outside of Chicagoland, transit options are relatively limited. This will require the state to increase its financial support for transit.

- **Improve the regional passenger rail network** – The passenger rail network should be expanded and improved to allow travelers to substitute rail trips for short-distance plane flights. For trips of several hundred miles, high-speed rail requires the same amount of time as a commercial plane flight but produces far less global warming pollution.[95]

- **Keep transit fares reasonable** – The Chicago region has an extensive transit network, and with gasoline prices at or near record levels, more Illinois residents are looking for alternatives to their automobile commutes. Unfortunately, transit fares have been on the

rise as well. Chicago Transit Authority increased cash fares by $0.25 this year and may have to propose further fare hikes in coming years.[96] Fare hikes can price out riders at the bottom of the income spectrum while discouraging long-distance automobile commuters from using transit instead. Rather than increasing fares yet again, state leaders should use the opportunity posed by higher gasoline prices to encourage new transit ridership by stabilizing (and, if possible, reducing) transit fares.

- **Integrate smart growth, climate policy and transportation planning** – Transportation investments have impacts that go well beyond addressing specific traffic problems. They influence patterns of future land development and have a large environmental impact. Illinois transportation planners should pursue an integrated planning approach, both in the evaluation of local projects and in statewide planning efforts. In addition, the state should ensure that "transportation demand management" measures—which often reduce the need for new capital expenses by better managing travel demand—are considered and evaluated alongside any proposals for new transportation infrastructure. Finally, the state should include a consideration of the impact on global warming emissions of all new transportation projects, so that Illinois residents can evaluate the impacts of various transportation choices on the climate.

- **Reduce automobile commuting** – As discussed in the previous strategy, there is much the state can do immediately to reduce the number of people who drive to work by themselves.

By focusing on the development of vibrant, compact communities whose residents have access to a variety of convenient, affordable transportation options, Illinois can stabilize the growth of vehicle travel, while reducing congestion on the state's highways and curbing the state's dependence on oil. The state should set a goal of stabilizing vehicle travel in terms of per-capita travel and develop transportation and land use policies sufficient to meet that goal.

Strategy #6: Adopt a Renewable Fuels Standard

If Policy Is Enacted Alone

Potential Savings:
1.39 MMTCO$_2$ by 2010
3.39 MMTCO$_2$ by 2018
5.87 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report

Potential Savings:
1.34 MMTCO$_2$ by 2010
3.02 MMTCO$_2$ by 2018
4.99 MMTCO$_2$ by 2025

Illinois can reduce its petroleum dependence, while reducing global warming pollution, by enacting a renewable fuels standard. A renewable fuels standard would require that a certain percentage of the gasoline and diesel sold in Illinois consist of biomass-based renewable fuels, such as ethanol or biodiesel. Biofuel with greater global warming emissions than the fossil fuel it is intended to replace should not be allowed.

Biofuels are typically made from such crops as corn, soybeans, rapeseed, or mustard seed. Technology that would allow cellulose from plant residues or "energy crops" (such as switchgrass) to be turned into fuel holds the promise of even greater energy and global warming pollution benefits.

Making Biofuels Sustainable

Ethanol, biodiesel and other biomass-based fuels can make a significant contribution to reducing global warming pollution—if they are produced sustainably. However, environmental damage can result if the transition to biofuels is managed poorly. Indeed, under some circumstances, production and use of biofuels could lead to greater global warming emissions than the petroleum products they are designed to replace.

To maximize the environmental benefits of biofuels, policies must be in place to ensure that they are developed sustainably.

- **Protect air quality** – Low concentrations of ethanol in gasoline (such as E10) can result in increased emissions of smog-forming pollutants.[99] Motor vehicle air pollution standards should be revised to ensure that the use of ethanol does not result in overall increases in urban smog. In addition, public policy should encourage the use of ethanol fuels in higher blends (such as E85), which do not pose a threat to air quality. Tailpipe emissions from vehicles using higher blends may be lower than vehicles using conventional fuels, but ethanol refineries may release greater pollution. Care must be taken not to create new hot spots of pollution.
- **Ensure sustainable production** – The way biofuels are produced has a large impact on their ultimate environmental benefits. Some agricultural methods for producing biomass can contribute to environmental problems such as nutrient enrichment of waterways and soil erosion.[100]

  Under some production methods, biofuels can provide negligible global warming benefits or even result in higher global warming emissions. For example, the high price of natural gas has led some ethanol producers to use coal as a fuel for their plants, a change that could reduce, or even eliminate, the global warming benefits of ethanol use.[101] To reduce emissions during production, biomass could replace fossil fuels such as coal or natural gas.

  Some biomass production methods can also lead to increases in global warming emissions from land use that reduce or cancel out the benefits from reducing consumption of fossil fuels.[102] Finally, increasing production of feedstocks for biofuels could encourage negative agricultural practices (such as broader use of genetically modified crops or applications of toxic pesticides) or the conversion of ecologically important areas to energy crops.

  A sustainable biofuels strategy must recognize these challenges and ensure that the agricultural and industrial processes used to produce biofuels do not cause unintended harm to the environment or the climate.
- **Don't substitute biofuels for efficiency improvements** – Biofuels can provide an important supplement to fossil fuels, but they are no substitute for using energy more efficiently. The "dual-fuel" loophole in U.S. automobile fuel economy standards, for example, gives automakers credit toward their fuel economy goals for the production of vehicles that are capable of running on alternative fuels such as E85, even though the vast majority of dual-fuel vehicles are operated entirely on gasoline.[103] Public policy should drive *both* improvements in fuel economy and sustainable expansion of biofuels in order to reduce fossil fuel use and achieve reductions in global warming pollution.

Renewable fuels are typically mixed with petroleum-based fuels, such as gasoline or diesel, and blends with low percentages of renewables can be used in virtually all vehicles. To run a vehicle on higher percentages of ethanol, however, requires some upgrades to the vehicle's engine. Also, a new fuel distribution infrastructure will need to be developed. However, vehicles using higher percentages of biofuels also provide much greater environmental advantages than vehicles using smaller percentages of renewable fuels. (See "Making Biofuels Sustainable" Page 31.)

Governor Blagojevich recently proposed that Illinois invest $225 million to help build 20 new ethanol and five new biodiesel facilities.[97] The plants would be constructed in the next 10 years. To facilitate distribution of this fuel, the governor proposes

Calculating Global Warming Benefits of Electricity Savings

The global warming emission reductions resulting from policies that save electricity depend on the type of electricity generation that is displaced. Illinois' electricity comes from some generators that produce large volumes of carbon dioxide pollution per unit of electricity produced (such as coal-fired power plants), those that produce fewer emissions (such as newer natural gas-fired plants), and those that produce minimal carbon dioxide (e.g. renewable energy). A large portion of the state's power comes from nuclear energy which, though it produces minimal global warming pollution, creates radioactive waste that will be dangerous for thousands of years (see "The Future of Nuclear Power in Illinois," p. 35).

In presenting carbon dioxide savings from the policy scenarios in this report, we make two assumptions about how changes in electricity demand alter global warming pollution. Through 2021, we assume that electricity savings reduce the need for generation at natural gas and coal-fired power plants. Generation from natural gas plants is stabilized at current levels and then generation at coal-fired plants is reduced.

Beginning in 2022, electricity savings from policies presented in this report are used to replace generation from the three nuclear power plants that are scheduled to be retired from 2022 through 2025. The power that they generate will need to be replaced, either with reduced power demand or new sources of generation.

In some scenarios, energy efficiency and new renewably generated electricity are inadequate to fully replace the retired nuclear capacity. Thus, generation at coal-fired power plants must increase. The result is that global warming pollution rises, relative to previous years.

To allow the reader to fully evaluate each policy in different contexts, carbon dioxide emission reductions that result from reduced electricity consumption are presented in two ways. The first set of electricity-related emission reductions assumes that the policy is implemented by itself and that no other policies are adopted that reduce the demand for electricity from highly polluting sources. The second set of data present the potential emission reductions from the policy if it were enacted in conjunction with the other policies presented in this report.

that the state spend $30 million to install ethanol pumps at more gas stations.

Gasoline in Illinois already contains 10 percent ethanol. Additional global warming emission savings could be achieved by operating some vehicles on fuel with very high amounts of ethanol, such as E85, which contains 85 percent ethanol and 15 percent gasoline. If 6 percent of vehicles in the state operate on E85 by 2020, Illinois' total ethanol use will increase to 15 percent of gasoline sales. Further, the state can require that diesel fuel be blended with renewable fuels. A requirement that 2 percent of diesel fuel consist of biodiesel (increasing to 5 percent after 2010 and 10 percent after 2015) would be a reasonable goal for the state to achieve and would ensure that Illinois residents receive the benefits of the state's financial investment in renewable fuels. A number of other states have begun to implement similar renewable fuels standards. Minnesota recently began to require that biodiesel make up a small portion (2 percent) of all diesel fuel sold. At least six other states have enacted renewable fuel standards (the most aggressive being Iowa's target of 25 percent renewable fuel use by 2019) and several states now use ethanol in small quantities as an oxygenate in gasoline.[98]

As Illinois moves forward with a renewable fuels standard, it is important that the state make policy decisions that maximize the benefits of the standard and limit environmental hazards. Illinois should consider adopting standards, incentives or other policies that encourage biofuels from plant residues and energy crops to make up an increasing share of the state's biofuel supply. The state should also ensure that implementation of the renewable fuel standard does not adversely affect air quality. To encourage the use of higher-percentage blends of ethanol (such as E85), the state should ensure that "flex-fuel" vehicles are able to take full advantage of their potential for using renewable fuels with adequate refueling infrastructure.

Residential, Commercial and Industrial Sector Strategies

7. Strengthen residential and commercial building energy codes.
8. Adopt strong energy efficiency standards for appliances.
9. Expand state energy efficiency programs.
10. Expand combined heat and power.

Strategy #7: Adopt Strong Residential and Commercial Building Energy Codes

If Policy Is Enacted Alone
Potential Direct Emission Savings:
0.19 MMTCO$_2$ by 2010
0.89 MMTCO$_2$ by 2018
1.43 MMTCO$_2$ by 2025

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
0.96 MMTCO$_2$ by 2010
2.80 MMTCO$_2$ by 2018
0.00 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Direct Emission Savings:
0.19 MMTCO$_2$ by 2010
0.88 MMTCO$_2$ by 2018
1.41 MMTCO$_2$ by 2025

Potential Electricity Emission Savings:
0.99 MMTCO$_2$ by 2010
3.31 MMTCO$_2$ by 2018
3.16 MMTCO$_2$ by 2025

More than one third of all energy use in Illinois can be linked to buildings—whether residential, commercial or industrial. In addition to the energy consumed for heating, cooling and lighting in our homes, the places we work, and the places we shop and do business, there are a number of large appliances—such as refrigerators and washing machines—that consume energy in buildings. The importance of energy-conscious building design and construction is magnified by the fact that most buildings have a life span of at least 50 years, during which time the amount of "fixed" energy needed to heat, cool, ventilate and light the building remains fairly constant.

Building codes were originally intended to ensure the safety of new residential and commercial construction. In recent years, however, building codes have been used to reduce the amount of energy wasted in heating, cooling, lighting and the use of electrical equipment.

Though Illinois has a commercial energy code, it is one of just a handful of states in the country that do not have a statewide residential building energy code.[104] More than 60 local jurisdictions, including the state's major population centers, have adopted building codes. Approximately 30 communities have adopted the 2000 version of the International Energy Conservation Code (IECC) and 30 others have adopted the 2003 version. (The latest version of the IECC was released in early 2006 as IECC 2006.) For commercial buildings, the state has adopted the IECC 2000 with the 2001 supplement.[105] The governor has proposed that the state adopt a residential energy code equal to the commercial code.[106]

Failing to maintain and enforce the strongest building energy codes available results in lost opportunities for energy savings. And since residential and commercial buildings can last for decades, those lost opportunities can result in excessive energy consumption over the long term.

Experience in other states suggests that Illinois can achieve far greater efficiency in buildings than it does today. Most states have statewide energy codes with regularly scheduled updates to ensure that the code incorporates the latest efficiency opportunities. A number of states have gone further by promoting construction of homes meeting the federal Energy Star standard, which are certified to be at least 15 percent more efficient than homes built to the 2006 IECC. In Iowa, 42 percent of new homes met the Energy Star standard, and in New Jersey, Nevada and Texas, more than 30 percent of new homes met the higher standard in 2005.[107] In contrast, fewer than 3 percent of new homes in Illinois earned the Energy Star efficiency rating.

The global warming emission reductions projected here assume that Illinois adopts the IECC 2004 residential code and the most recent commercial building energy code in 2008. In 2010, we assume that Illinois adopts a residential energy code equivalent to the current Energy Star homes standard. And on the commercial side, we assume that energy codes capable of reducing energy consumption by 25 percent from the current code are adopted effective in 2010.

In addition to setting a higher "floor" for building energy efficiency, Illinois can also take steps to raise the bar for exceptional energy efficiency performance. Prior to adopting a code equal to Energy Star as a statewide standard, Illinois can encourage builders to construct homes to Energy Star standards and ensure that all new government buildings and renovations to existing buildings meet high energy efficiency standards. (See "Government Lead by Example," page 45.) Illinois should also encourage the development of "zero energy" homes and commercial buildings, which pair strong energy efficiency measures with small-scale renewable energy production to dramatically reduce, or even eliminate, fossil fuel consumption.

The Future of Nuclear Power in Illinois

About 27 percent of the electricity generated in Illinois comes from the state's six nuclear power plants (with 11 units total).[108] Three of these units (LaSalle units 1 and 2 and Braidwood unit 1) will have their original operating licenses expire by 2025, with LaSalle unit 1's license set to expire first, in 2022. While the Nuclear Regulatory Commission has been routinely approving 20-year license extensions for nuclear power plants across the country, the safety, security and environmental problems posed by Illinois' nuclear power plants should lead to their closure at the end of their operating licenses.

Nuclear power poses a variety of public safety and environmental problems in Illinois.

Safety: Illinois' nuclear power plants have experienced a string of safety lapses over their lifetimes.

- The Braidwood plant near Joliet has leaked tritium (a radioactive form of hydrogen) 22 times since 1996. A total of 6 million gallons of contaminated water have leaked from the plant, polluting drinking water supplies. Exelon, the owner of the plant, did not disclose the leak to residents until forced to by the Illinois Environmental Protection Agency.[109]
- At the Quad Cities unit 2, cracks have formed three times in the steam dryer since 2002 when Exelon increased the amount of energy produced at the plants. Similar problems have occurred at Quad Cities unit 1 and both Dresden units. The increased generation caused more vibrations in the plant that damaged equipment and at one plant caused a piece of metal to fall into the reactor vessel.[110]

Nuclear waste and terrorism: In the absence of a national repository for nuclear waste, spent nuclear fuel is typically stored in pools or casks on the grounds of the reactors, providing a potential target for terrorists and a potential safety threat. Illinois power plants store thousands of tons of radioactive waste. The National Academy of Sciences (NAS) has warned that "[s]pent nuclear fuel stored in pools at some of the nation's 103 operating commercial nuclear reactors may be at risk from terrorist attacks," and recommends a series of actions to reduce the danger.[111] One study estimated that a loss of coolant accident that resulted in a spent-fuel pool catching fire could result in between 2,000 and 6,000 additional deaths from cancer.[112]

The energy efficiency and renewable energy policies described in this report not only help Illinois reduce its contribution to global warming, but can help reduce the state's dependence on its aging nuclear power plants.

By moving forward with a clean energy policy that emphasizes renewable energy development and improved energy efficiency, Illinois can assure that it is able to serve its electricity needs without extending the lifetimes of its nuclear power plants and without adding new fossil fuel-fired generation that contributes to global warming.

Strategy #8: Adopt Strong Appliance Efficiency Standards

If Policy Is Enacted Alone
Potential Direct Emission Savings:
0.00 MMTCO$_2$ by 2010
0.63 MMTCO$_2$ by 2018
1.27 MMTCO$_2$ by 2025

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
0.55 MMTCO$_2$ by 2010
1.30 MMTCO$_2$ by 2018
0.00 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Direct Emission Savings:
0.00 MMTCO$_2$ by 2010
0.60 MMTCO$_2$ by 2018
1.18 MMTCO$_2$ by 2025

Potential Electricity Emission Savings:
0.61 MMTCO$_2$ by 2010
1.76 MMTCO$_2$ by 2018
1.57 MMTCO$_2$ by 2025

Many appliances that Illinois homeowners and businesses use can be made to be significantly more energy efficient than they are today. Illinois has the power to adopt energy efficiency standards for a range of residential and commercial appliances. The standards can save Illinois consumers money over the long haul and reduce the state's consumption of energy.

In 2005, Congress established or updated federal energy efficiency standards for 15 new appliances in the 2005 Energy Policy Act. However, additional energy efficiency technologies for appliances are available and new ones continue to be developed, meaning Illinois has an opportunity to adopt stronger standards for appliances that were not covered in the 2005 law. Appliances for which new standards would be appropriate, either now or in the near future, include:

- DVD players and recorders
- External power supplies for consumer electronics
- Compact audio products
- Residential furnaces and boilers
- Commercial hot food holding cabinets, walk-in refrigerators and freezers
- Bottle-type water dispensers.[113]

Most of the appliances for which new standards are appropriate are not currently covered under federal standards. As a result, Illinois has the ability to impose its own standards. For products that are currently covered under outdated federal standards, Illinois may apply for a federal waiver to apply stronger energy efficiency standards.

The American Council for an Energy Efficient Economy (ACEEE) and the Appliance Standards Awareness Project estimate that adopting a new set of recommended appliance efficiency standards in Illinois would reduce electricity demand by 570 gigawatt-hours (GWh) in 2030, reduce natural gas demand by 30,400 million cubic feet, and save Illinois more than $3.4 billion over time.[114]

Illinois should move ahead with the adoption of efficiency standards for appliances not covered by federal rules and apply for waivers of pre-emption for others. In addition, the state should allow for the expedited adoption of future appliance standards set by large states, such as California, enabling Illinois to stay on the cutting edge of energy efficiency and achieve further reductions in global warming pollution in the years ahead.

Strategy #9: Expand Energy Efficiency Programs

If Policy Is Enacted Alone
Potential Direct Emission Savings:
0.65 MMTCO$_2$ by 2010
2.40 MMTCO$_2$ by 2018
3.93 MMTCO$_2$ by 2025

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
3.73 MMTCO$_2$ by 2010
10.52 MMTCO$_2$ by 2018
0.00 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Direct Emission Savings:
0.66 MMTCO$_2$ by 2010
2.26 MMTCO$_2$ by 2018
3.65 MMTCO$_2$ by 2025

Potential Electricity Emission Savings:
3.52 MMTCO$_2$ by 2010
8.88 MMTCO$_2$ by 2018
5.36 MMTCO$_2$ by 2025

One of the most promising opportunities for reducing carbon dioxide emissions in Illinois is through improved energy efficiency. Stronger residential and commercial building codes and improved appliance efficiency standards, while important, are limited in their scope, leaving many existing buildings and sources of energy untouched.

Illinois has significant energy efficiency potential. Efficiency savings can be achieved with more efficient lighting, better insulation and weathersealing of buildings, and more efficient furnaces, air conditioners and other appliances. Governor Blagojevich's Sustainable Energy Plan calls for satisfying up to 25 percent of projected increases in electricity demand with efficiency by 2015.[115] Data presented in a study by the American Council for an Energy-Efficient Economy (ACEEE) suggests that potential energy efficiency savings are great enough to reduce energy use, not simply reduce the rate of growth in energy use. ACEEE compared the results of energy efficiency potential studies in states and regions across the country. On average, those studies found that electricity use could be reduced cost-effectively by 24 percent through energy efficiency over a period of 10 to 20 years.[116]

As the above analysis suggests, energy efficiency improvements are among the most promising and least costly ways Illinois can reduce global warming emissions. But there are several hurdles to overcome. Potential users may not know about the technologies or have an accurate way of computing the relative costs and benefits of adopting them. Even when efficiency improvements are plainly justifiable in the long run, consumers may resist adopting technologies that cause an increase in the initial cost of purchasing a building or piece of equipment. In some cases, as with low-income individuals, consumers may not be able to afford the initial investment in energy efficiency, regardless of its long-term benefits.

Public policies can help overcome these hurdles. Electric industry restructuring in the late 1990s brought about a new era of utility sector energy efficiency mechanisms, broadly categorized as public benefits funds and charges, but Illinois has thus far invested little in efficiency.

In 1997, Illinois created the Energy Efficiency Trust Fund, supported by a public benefits charge paid by all electric utility customers. However, the fund receives only $3 million annually.[117] (In contrast, Vermont spent $15 million in 2005 on electricity efficiency for one-twentieth the population of Illinois.[118]) The fund operates the Illinois Energy Efficient Affordable Housing Program, which retrofits existing homes and builds new ones with

efficient heating equipment and better insulation. The fund also supports a pilot program to increase the use of skilled contractors to improve residential energy efficiency and a program to increase the efficiency of lights in schools.[119] For small businesses, the state offers energy audits and assistance designing more efficient buildings and systems.[120] Governor Rod Blagojevich recently proposed creating a $25 million revolving loan program to help small businesses and manufacturers improve their energy efficiency.[121]

Separately, the Illinois Clean Energy Community Foundation, created with a one-time $225 million payment from Commonwealth Edison, supports several environmental initiatives, including energy efficiency. From 2001 to 2006, the foundation spent $70 million on energy efficiency programs, including more efficient construction and building retrofits, replacing old traffic lights with efficient LED lights, and lighting upgrades in public and educational buildings.[122]

Illinois needs to more aggressively pursue energy efficiency opportunities.

- The state should require that 3 percent of total electric utility revenues be spent on cost-efficient energy efficiency measures, generating roughly $300 million annually for electricity investments.[123] Based on the average cost of efficiency savings achieved in other states, as presented in a report by ACEEE, were Illinois to invest $300 million annually in electricity efficiency measures and achieve consistent savings over the years, the state would achieve a 7 percent reduction in energy use by 2025.[124]

  This would put funding for Illinois on par with the per-customer funding from states with the most successful programs. Vermont, the nation's leader in energy efficiency spending, has invested heavily in energy efficiency. As a result, Vermont's rate of electricity demand growth is less than half of what it would have been without energy efficiency programs, slashing Vermont's electricity consumption by close to 5 percent in 2005.[125]

  Natural gas use could be reduced by 7 percent below projected levels by 2025 if Illinois were to dedicate 3 percent of residential, commercial and industrial natural gas purchases to energy efficiency programs.

- All energy providers in the state should be required to develop and implement efficiency programs to capture cost-effective efficiency potential. (Cost effectiveness of efficiency measures should be compared to the cost of fuel and the environmental consequences of mining and burning fossil fuels.) In addition to requiring independent measurement, verification, and reporting of program expenditures and energy savings achieved, an improved state efficiency program should also lay out consequences for non-compliance.

  Illinois should also consider removing the perverse incentive to energy efficiency that utility companies currently experience. Because utility revenues are tied to the volume of power sold, increasing energy efficiency and reducing demand cuts into utilities' revenue. Utility company profits should be decoupled from the volume of power sold, thereby removing pressure for the power company to keep sales high.

Increasing funding for electricity and natural gas efficiency programs would help the state come closer to realizing its full, economically beneficial level of energy efficiency—delivering both reductions in global warming emissions and long-term cost savings to Illinois consumers.

Strategy #10: Expand Use of Combined Heat and Power

If Policy Is Enacted Alone

Potential Direct Emission Savings: None

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
2.18 MMTCO$_2$ by 2010
6.71 MMTCO$_2$ by 2018
0.00 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report

Potential Direct Emission Savings: None

Potential Electricity Emission Savings:
2.28 MMTCO$_2$ by 2010
8.17 MMTCO$_2$ by 2018
5.42 MMTCO$_2$ by 2025

Illinois has many opportunities to promote the use of combined heat and power, in which wasted energy from electricity generation is captured and used for other purposes.

America's electricity system is a good source of reliable power, but it also is loaded with inefficiencies. Power plants produce a large amount of waste heat during their operation. Similarly, the nation's long-distance transmission system results in the loss of between 5 and 10 percent of the electricity that crosses the wires on its way from power plants to homes and businesses.[126]

Illinois could reduce energy waste by promoting the use of combined heat and power (CHP) systems. CHP systems pair electricity generation and heating—enabling the waste heat from electricity generation to be used to provide space or water heating or to assist in industrial processes. While the average American power plant operates at a thermal efficiency of about 35 percent, CHP plants can achieve efficiencies of 80 percent or greater, meaning that more of the energy that goes into the plant is available for useful work.[127]

Various forms of CHP are already in use in Illinois, accounting for more than 1,200 megawatts of generation capacity.[128] A 2004 analysis of markets for large-scale CHP identified several industries—including chemicals and metal processing—that are both well-suited to CHP and have a major presence in Illinois.[129]

Despite the large amount of CHP capacity already present in Illinois, a major expansion of capacity is possible. Illinois has the technical potential for another 6,400 MW of CHP capacity.[130] To capture this potential, Illinois could offer technical assistance to facilities by assessing their potential for using CHP and helping to oversee the installation process, as well as by offering rebates or low-interest loans for the installation of CHP capacity. Utilities in Illinois have done little to encourage industrial power users to adopt CHP systems. The state could facilitate increased use of CHP by ensuring that power companies respond promptly to requests from CHP users and do not charge CHP users unreasonable fees for access to standby power.

Because CHP systems use fossil fuels, it is important that they are designed in such a way as to maximize their global warming emission reductions and energy savings and minimize air pollution. CHP plants should be required to meet minimum energy efficiency targets and include state-of-the-art air pollution controls.

While CHP is currently a viable option for many manufacturing facilities and large commercial and apartment buildings, improvements in CHP and other distributed generation technologies could soon bring the benefits of on-site electricity generation to a wider variety of customers. Homeowners, for example, could someday have access to small CHP systems that use fuel cells, microturbines or other technolo-

gies to pair heat production and electricity generation. Various companies in the U.S. and elsewhere are developing such systems, and while their cost is prohibitive at the moment, they could provide an attractive alternative in the years to come.

Deployment of CHP will tend to increase on-site consumption of natural gas and thus increase direct releases of global warming pollution. Overall, however, emissions decline because of lower consumption of fossil fuels for the generation of electricity in central power plants.

Electric Sector Strategies

In addition to efforts to conserve electricity, Illinois can also reduce carbon dioxide emissions from electricity use by making electricity generation in Illinois cleaner—specifically by encouraging a shift away from carbon-intensive fuels such as coal and towards renewable energy sources such as solar and wind. To achieve this goal, Illinois must encourage the deployment of renewable energy sources while simultaneously adopting policies to reduce carbon dioxide emissions from fossil fuel generators. This shift is especially important given that Illinois' power plants are the largest source of global warming emissions in the state.

As an energy exporting state, Illinois has the opportunity to lead the way among energy producing states in reducing global warming emissions from electricity generation. Expanding the use of renewable sources of energy in the state can help move the state toward a cleaner, more resilient energy system with less impact on the climate. Even with those steps, however, the state's carbon dioxide emissions still could rise if large projected expansions in coal-fired electricity generation over the next two decades actually occur. Illinois should stop any expansion in coal-fired generation and ensure that the state does not import equally carbon-intensive energy instead.

11. Adopt a Renewable Energy Standard
12. Cap Emissions from Power Generation in Illinois

Strategy #11: Adopt a Renewable Energy Standard

If Policy Is Enacted Alone
Potential Direct Emission Savings: None

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
7.32 MMTCO$_2$ by 2010
28.23 MMTCO$_2$ by 2018
17.72 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Direct Emission Savings: None

Potential Electricity Emission Savings:
7.38 MMTCO$_2$ by 2010
29.17 MMTCO$_2$ by 2018
31.40 MMTCO$_2$ by 2025

More than 15 states—including other Midwestern states such as Wisconsin, but not Illinois—have adopted a renewable energy standard (RES) for electricity supplied to that state's consumers. Essentially, an RES requires that a certain portion of the power delivered by the utilities be from renewable energy sources. The percentage of renewable power increases over time, providing a scheduled ramp-up to the provision of a significant portion of the state's power from renewable sources.

Renewable energy sources include wind, solar and biomass. The RES could include a provision that a portion of the renewable power come from distributed generation, power generated on-site at homes and businesses, or solar equipment such as solar hot water heaters that will replace the need for electricity. Distributed generation technologies include solar and small wind power, daylighting and other solar technologies, geothermal heating and biomass.

Illinois should adopt an RES that requires the addition of 1.5 percent of new renewable capacity from 2008 to 2020, and then 1 percent per year after that. This would increase renewable energy generation to 25 percent by 2025, allowing Illinois to achieve savings of up to 29.7 $MMTCO_2$ in 2025.

In place of a renewable energy standard, Illinois currently has a non-enforceable goal. Only limited incentives are available to help achieve this standard: the Renewable Energy Resources Trust Fund, which receives approximately $5 million per year from a fee paid by all ratepayers on electricity bills, invests in renewable energy.[131]

Achieving the level of renewable energy production in Illinois contemplated in the proposed RES is feasible and would draw upon only a fraction of the state's full renewable energy potential.[132]

Illinois' wind energy potential is as much as 9,000 MW, with the best resources in central and northern Illinois.[133] Installing 9,000 MW of wind capacity would generate approximately 23.4 million MWh of power a year, enough to meet 17 percent of Illinois' electricity needs today.[134] In agricultural areas, wind turbines can be installed without disrupting other uses of the land, such as farming or grazing. In exchange for allowing a wind turbine, the landowner receives an annual payment of several thousand dollars per turbine per year, a potentially important increase in income for struggling farmers.

Solar energy is another option. Most of Illinois receives enough solar radiation that a 1 meter square solar panel can produce 4 to 5 kWh of electricity per day.[135] Installing four panels on the roof of a home would yield 16 to 20 kWh per day, or nearly three-quarters of an average household's daily electricity needs.[136] Solar panels on homes across the state could dramatically boost renewable energy generation.

In addition, Illinois could draw upon renewable energy produced in other states. Wind capacity in Illinois and nine nearby states is estimated to total 24,510 MW, while solar and biomass provide another 11,500 MW.[137]

In sum, filling a 25 percent by 2025 renewable energy standard for Illinois would be feasible—even without factoring in future technology improvements that could make solar panels more effective at turning the sun's energy into electricity, wind power feasible at lower wind speeds, or storage of solar energy possible for night-time use. Adding other types of renewable energy to the mix—such as landfill gas and clean biomass (that which does not contribute to toxic air emissions)—makes the goal of renewably generating 25 percent of all electricity consumed in Illinois by 2025 even more feasible. Renewable energy imported from other states could also be used to satisfy requirements of the RES.

To facilitate distributed generation, the state should also adopt a net metering law that allows consumers to sell unused power from their home generating capacity to the electricity company. (Currently, ComEd operates only a pilot program to purchase excess wind and solar power generated at homes and businesses.[138])

As Illinois considers how to structure and enforce its RES, it should adhere to a solid commitment to truly clean, truly renewable technologies. Polluting and environmentally damaging technologies, along with those that rely upon non-renewable resources, should continue to be excluded from use to fulfill RES requirements.

Strategy #12: Cap Emissions from Power Generation in Illinois

If Policy Is Enacted Alone
Potential Direct Emission Savings: None

Potential Electricity Emission Savings: 32.38 MMTCO$_2$ by 2018
34.88 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report
Potential Direct Emission Savings: None

Potential Electricity Emission Savings: Same as if policy is enacted alone. Emission savings are allocated among other policies.

One of the most important things Illinois can do to combat global warming in the next two decades is to address the high emissions from electricity generation.

Coal-fired electricity generation produces more carbon dioxide per unit of energy produced than virtually any other option for generating power. In 2004, Illinois' coal-fired power plants produced 1 ton of carbon dioxide for every megawatt-hour of power produced, compared to 0.75 tons for every megawatt-hour of power produced from natural gas and zero emissions from wind and solar power.[139]

Illinois faces two challenges regarding coal-fired generation: high emissions from existing plants and a potentially large increase in emissions if more plants are constructed.

Rising natural gas prices are leading to a nationwide "coal rush" as utilities and merchant electricity generators seek to serve rising demand for electricity. Across the country, 150 new coal-fired power plants have been proposed—enough to generate power for 95 million homes.[140] In Illinois, power companies have proposed building 14 new coal-fired power plants with a total generating capacity of 10,338 MW.[141] These plants could increase the state's carbon dioxide emissions by 100 million metric tons, a 45 percent increase above 2002 levels.

The "business-as-usual" scenario outlined in this report includes only a fraction of these proposed plants. Their construction remains speculative enough that the Energy Information Administration did not include them in its estimate of future generation. However, should even a fraction of these plants begin generating power, Illinois would have a very hard time reducing overall global warming pollution.

To address this dual challenge, Illinois should avoid the construction of any new coal-fired power plants and reduce emissions from existing plants by creating a cap on carbon emissions from the electric sector.

Create a Carbon "Cap and Trade" Program

"Cap and trade" systems are among the most widely considered options for limiting carbon dioxide emissions from electricity generation. The system begins with a "cap" that limits the total amount of carbon that can be released by electricity generators. A strong cap will produce greater reductions in overall emissions.

Illinois could impose such a cap on its own or as part of a regional effort. A regional cap and trade program would likely produce better results, as it reduces incentives to merely shift power generation out of Illinois and into neighboring states.

One example of a regional effort comes from the northeastern U.S., where eight states recently agreed to create such a program, called the Regional Greenhouse Gas Initiative (RGGI). The initiative calls for emissions from the region's power producers to stabilize at 2009 levels until 2015 and then to be cut by 10 percent below that level by 2019.[142]

The RGGI agreement sets a cap on power plant carbon dioxide emissions for each state. Power plants must hold an

Gasified Coal and Global Warming

Gasified coal (often called "clean coal") is being promoted as an environmentally responsible way to use coal to generate electricity. Gasified coal technologies, such as integrated gasification combined cycle (IGCC) coal-fired power plants, have important advantages over conventional coal-fired power plants: they are significantly more efficient and have lower emissions of conventional pollutants.[145] In addition, IGCC technology allows for the capture of carbon dioxide, which some believe can be stored in large quantities underground—theoretically allowing for the production of low- or zero-carbon power from coal.

However, coal gasification is far more expensive than cleaner and more sustainable ways of addressing our nation's energy-related and environmental problems. Coal gasification with carbon storage is more than twice as expensive as typical energy efficiency measures and more than 50 percent more costly than the best wind power projects.[146] Even without carbon storage, coal gasification would cost roughly twice as much as energy efficiency and could at best compete with an average wind farm.[147]

Moreover, carbon capture and storage—on the scale at which it must be implemented to fight global warming—is an immature technology. Carbon dioxide has been injected into the ground for some time to enhance oil recovery. However, the storage of captured carbon dioxide from utility operations, or from the use of coal gasification to create hydrogen fuel for automobiles, would require a vast expansion of carbon transportation infrastructure and storage. For example, storing all U.S. power plant coal emissions would require enough infrastructure to liquefy and store roughly 2 billion metric tons of carbon dioxide *annually*.[148]

Storing any quantity of carbon presents problems. Carbon dioxide stored in geological formations must be guaranteed to remain underground for hundreds or thousands of years to prevent re-release to the atmosphere.

Provided that the technological hurdles can be overcome, IGCC will likely only become a key player in the energy mix if policies are in place to make it economically competitive with conventional coal technology. A carbon cap that places a market price on carbon dioxide emissions from power plants could provide an incentive for cleaner technologies such as IGCC to develop.

"allowance" (or permit) for every ton of carbon dioxide they emit to the atmosphere. States may choose whether to auction off the allowances or give up to 75 percent of them to power generators for free. States that choose to auction the allowances may then use the funds to promote energy efficiency improvements and non-carbon emitting forms of power, such as renewables. Any power plant owner that wishes to increase emissions must buy additional allowances from the owners of other power plants that have extra allowances to sell. In theory, this cap and trade system will lead to reductions in carbon dioxide emissions at the lowest aggregate economic cost.

Illinois could impose a cap that would

reduce emissions 25 percent below current levels by 2018 and hold emissions steady after that. Reaching this target could be accomplished through several approaches, such as by adopting the other policies outlined in this report that affect emissions from the electricity sector. Through strong implementation of those policies, Illinois can achieve a 25 percent reduction in emissions from the electricity sector. Imposing an actual cap on electricity sector emissions can help push the state toward strong implementation and enforcement of policies.

Reduce Growth in Electricity Consumption and Production

Improving the energy efficiency of Illinois' economy and expanding clean distributed generation will reduce dependence on power from large, centralized power plants. Many of the policy recommendations in this report will move Illinois in this direction, but more remains to be done. A 2001 report estimated that Illinois could cost-effectively reduce consumption of electricity by 28 percent below status-quo projected levels by 2020.[143] By contrast, the specific policy options proposed in this report—stronger efficiency programs, appliance standards and building codes—capture only a portion of that potential. Even accounting for differences in baseline projections and the passage of time, Illinois clearly has further energy efficiency opportunities. There are a number of policies available to Illinois to capture more of this energy efficiency potential and reduce demand for power from coal-fired power plants.

One way to expand investment in cost-effective energy efficiency is to ensure that efficiency is considered as an alternative to new power plants in the utility regulatory process, and that it is treated fairly. Saving energy through improved efficiency generally costs less than building and operating new power plants, and it certainly costs less if the economic threat of global warming is considered. Utilities should be required to develop resource plans that include the consideration of energy efficiency, renewable energy and other cleaner sources alongside fossil fuel-fired power plants in serving future power demand. This would result in energy efficiency taking on a larger role in Illinois' energy supply system and would reduce demand for new power plants.

However, emissions from Illinois' power sector depend on more than just what happens inside the state's borders. Illinois is a net exporter of electricity to the region, so regional measures to improve energy efficiency and reduce demand for power across the Midwest could also reduce the demand for new power plants in Illinois.

Consider the True Cost of Coal-Fired Power Plants

Coal-fired power plants currently have a series of economic advantages over cleaner sources of energy. Coal-fired power plants are not forced to account or pay for the many environmental and social costs they impose—costs ranging from the public health damage caused by air pollution and unregulated mercury emissions to the use of increasingly scarce water for plant operations. In addition, many older coal-fired power plants are exempt from modern clean air standards, and their carbon dioxide emissions are significant contributors to global warming, extreme weather events, economic uncertainty and ecological disruption. Excluding these costs makes coal-fired power production in Illinois look artificially cheap.

Considering the true cost of coal-fired power plants in utility regulatory proceedings would tend to give a leg up to lower-carbon sources of electricity—such as natural gas and renewables. It could provide an incentive to replace existing, inefficient power stations with cleaner, more efficient technologies—possibly including technologies to capture and store carbon dioxide. (See "Gasified Coal and Global Warming.")

The California Public Utilities Commission requires utilities to include the cost of controlling or mitigating global warming emissions into their estimates of fuel costs from different sources. Utilities filing plans in California must budget $5 per ton of carbon dioxide in the near term, $12.50 per ton beginning in 2008 and $17.50 by 2013.[144] Another way to ensure that the global warming-related costs of coal-fired power plants are included in the cost of electricity is to adopt a carbon "cap and trade" system in Illinois.

Stop the Expansion of Coal-Fired Generation

Illinois should begin to address emissions from the electricity sector with a moratorium on construction of new coal-fired power plants (Idaho has adopted such a ban for two years, providing time to establish a long-term energy plan).[149] This will help the state avoid constructing coal-fired power plants that contradict a viable long-term energy plan.

In any case, Illinois must plan now for meeting its future energy needs with sources other than coal burned in conventional coal-fired power plants.

Other Strategies to Reduce Global Warming Pollution

Strategy #13: Government "Lead By Example"

If Policy Is Enacted Alone

Potential Direct Emission Savings:
0.24 MMTCO$_2$ by 2010
0.89 MMTCO$_2$ by 2018
1.02 MMTCO$_2$ by 2025

Potential Electricity Emission Savings (see "Calculating Global Warming Benefits from Electricity Savings," p. 32):
1.63 MMTCO$_2$ by 2010
6.05 MMTCO$_2$ by 2018
0.00 MMTCO$_2$ by 2025

If Policy Is Enacted With Others Identified in This Report

Potential Direct Emission Savings:
0.24 MMTCO$_2$ by 2010
0.89 MMTCO$_2$ by 2018
1.02 MMTCO$_2$ by 2025

Potential Electricity Emission Savings:
1.74 MMTCO$_2$ by 2010
7.61 MMTCO$_2$ by 2018
6.44 MMTCO$_2$ by 2025

State and local governments are large users of energy in Illinois. State government alone spent at least $194 million on energy in 2005, 25 percent more than three years earlier due to rising energy prices.[150] Reducing energy use in the government sector not only has a direct impact on global warming pollution and state budgets; it also sets an example for the private sector as to what can be achieved. State government should reduce its energy use in government buildings by 20 percent by 2020 and reduce global warming emissions from vehicles by 30 percent by 2020. At the same time the state government should aggressively increase its reliance on renewable energy by purchasing 10 percent its electricity from clean renewable sources by 2015 and 30 percent by 2025.

Governments in Illinois are already taking some steps to reduce their consumption of energy and contribution to global warming. Recently, the state joined the Chicago Climate Exchange, which commits the state to reducing its global warming pollution by 6 percent below 1998-2001 average levels by 2010.[151]

To achieve these goals, the state should endeavor to:

1) Reduce energy use in state facilities by 20 percent by 2020.

The state government can achieve significant energy savings by reducing energy used in state facilities by 20 percent over the next 13 years. Meeting this goal will require that the state implement an aggressive building retrofit program and design all new buildings (and major renovations) to consume at least 30 percent less energy.

Aggressive building retrofit program

The state should seek to retrofit at least half of all state buildings for improved energy efficiency by 2012. The City of Chicago's building retrofit program provides one possible model. Thus far, the city has retrofitted one-third of the 15 million square feet of public buildings it has pledged to make more efficient. By the time all buildings have been improved, emissions of carbon dioxide will be reduced by tens of thousands of tons per year and energy savings are expected to total $6 million per year.[152] Through a state operated program, state agencies that spend more than $100,000 on energy annually may finance energy efficiency audits and upgrades by borrowing against the cost savings of reduced energy use.[153] This state program provides a good starting point, but is not likely to deliver enough progress on its own. All public facilities should be considered and the state should develop a strategy to retrofit at least half of all state buildings for improved energy efficiency. Governor Blagojevich has proposed establishing a $25 million revolving loan fund to pay for energy efficiency improvements in public buildings, but it is unclear how quickly this will allow the state to retrofit buildings.[154]

All new buildings and major building renovations should be designed to use at least 30 percent less energy.

The state should set a standard that all new building projects and major building renovations be designed to use 30 percent less energy than is currently consumed by the average new building of the same type and size in the United States, with a long-term goal of developing a carbon-neutral building standard by 2030. This standard should apply to all state government buildings, all public schools, all institutions of higher education, and any other building that receives at least partial state funding.

Chicago has already taken a step in this direction. New municipal buildings in Chicago must meet the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standard that will reduce energy use, global warming pollution and energy costs by 15 to 20 percent annually.[155] To reduce global warming emissions, the state should go farther and set an example of designing and constructing buildings that consume 30 percent less energy than the average U.S. building. This is well within reach: the American Institute of Architects has established a goal of reducing fossil fuel use in new buildings by 50 percent by 2010.

Implementing a 30 percent more efficient standard would help lay the groundwork for more aggressive building design standards in the future. Ideally, the state's standards for new buildings would incrementally increase every five to 10 years so that by 2030 all new state-funded buildings would be carbon neutral in their energy use. A strong building standard would help reduce energy costs, decrease carbon dioxide emissions and set an example for the private sector to follow.

State-funded buildings could meet strong energy consumption goals through a combination of strategies, including:

- Energy-aware building designs that take advantage of natural lighting and maximize natural heating and cooling;
- Energy-efficient building materials – both construction materials that help reduce heating and cooling costs once installed (items such as insulation and energy-efficient windows) and materials that require less fossil fuel to

manufacture (such as recycled brick, stone and steel);

- Energy-saving building appliances – big-ticket items such as lighting systems, water heaters, furnaces and air conditioners; and
- Electricity that comes from renewable sources, either in the form of solar panels and other types of on-site renewable electricity generators, or from the energy grid.

2) Reduce government vehicle fossil fuel consumption by 30 percent by 2020.

Illinois should seek to reduce fossil fuel consumption from government sector vehicles. There are a number of ways Illinois could achieve a 30 percent reduction in global warming emissions from the state government's fleet within the next 10 years. These include:

- Requiring that state agencies purchase vehicles with the highest fuel economy possible for their intended use. This change, made with the mix of vehicles available today, would produce a 30 percent average increase in fuel economy.
- Running all diesel vehicles on B20 (a blend of 20 percent biodiesel and 80 percent gasoline), a change that would reduce global warming pollution from those vehicles by 13 percent.
- Developing a more extensive ethanol fueling infrastructure, which would enable the state to operate more of its more of its flexible fuel vehicles on E85 (85 percent ethanol and 15 percent gasoline) rather than on gasoline.
- Creating stronger incentives for the incorporation of hybrid technology and very fuel efficient vehicles.

3) Purchase 10 percent of state government's electricity from clean renewable sources by 2015 and 30 percent by 2025.

Currently very little of the energy used by state government agencies comes from renewable sources.

Enlisting Illinois state government as an aggressive purchaser of renewable electricity—purchasing 10 percent renewable energy by 2015 and 30 percent by 2025—would provide a critical incentive for the development of solar, wind and other forms of renewable power in the state and region. Government purchases of "green" power should be over and above the levels of renewable power required by any Renewable Energy Standard the state adopts and should include the development of distributed renewable resources on state buildings and land, such as rooftop solar systems where appropriate.

Approximately half of state government non-transportation energy use is in the form of electricity. Replacing 30 percent of electricity with carbon-free power will produce a significant drop in public-sector global warming emissions.

4) Encourage public sector improvements outside of state government.

Educational institutions (including public schools (K-12), junior colleges, colleges, universities) as well as municipal governments are major consumers of energy. The state should help promote and drive efforts to reduce carbon dioxide emissions from these institutions. This includes encouraging improvements in energy efficiency, increasing the use of renewable energy (either through purchasing green power or installing distributed electricity generation such as photovoltaic solar power), and helping these institutions purchase more efficient vehicles and equipment.

Reducing Global Warming Pollution in Chicago

The City of Chicago has undertaken a number of steps to reduce energy use and global warming pollution within the city that serve as useful examples of how government can lead by example and of how several of the policies in this report proposed for Illinois are already in use at the local level.

The city has taken several steps to increase the use of renewably generated energy, thereby reducing global warming pollution.

- The city's energy plan includes a commitment that city government will purchase 20 percent of its electricity from renewable sources.[156]
- The Chicago Solar Partnership, a public-private endeavor, has established a goal of installing 33 megawatts of solar power by 2010 in the city.[157]

The city's energy efficiency efforts target both publicly and privately owned buildings.

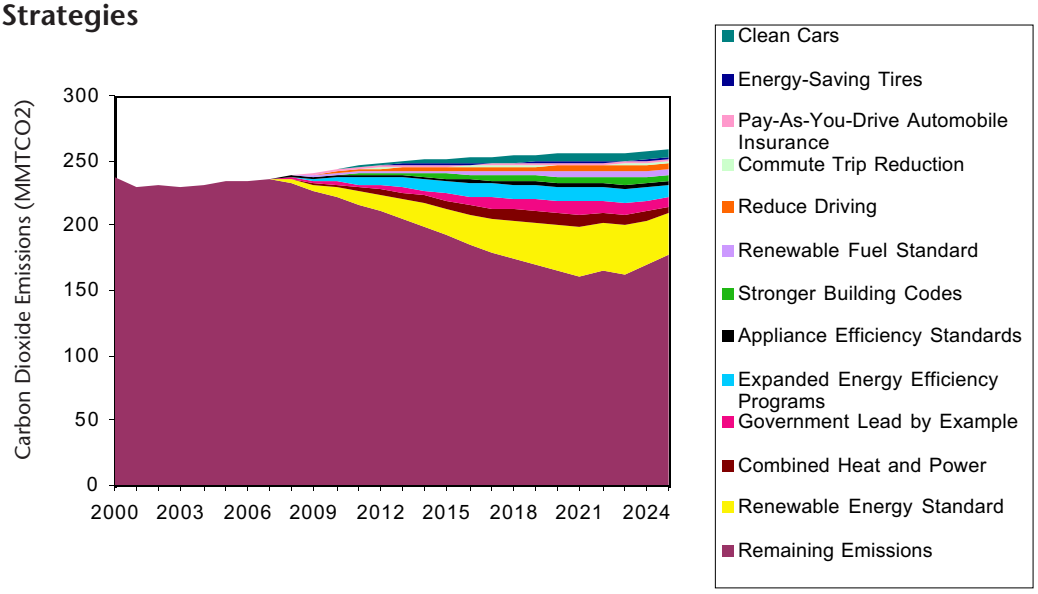
- By retrofitting up to 15 million square feet of government-owned buildings, the city will reduce energy use by an average of 30 percent in those buildings.[158]
- Universities and other large institutions may receive an energy efficiency audit to help identify opportunities for reducing energy use.
- The city's "Green Roof" program encourages the construction of rooftops with live plants to reduce the amount of energy required for heating and cooling.[159]
- New privately constructed residential buildings in Chicago must comply with the city's Energy Conservation Code, based on the IECC.[160] All households can receive energy-efficient light bulbs for free.

Finally, the city has been replacing its conventional traffic lights with efficient LEDs that use 85 percent less electricity.

The Impact of the Strategies

The strategies listed above outline a path that would lead to significant reductions in global warming emissions in Illinois. We estimate that the specific strategies listed above would lead to a 31 percent reduction in carbon dioxide emissions below projected levels by 2018 and, despite the retirement of 30 percent of Illinois' nuclear generation capacity, a 31 percent reduction by 2025. Compared with 2005 emission levels, carbon dioxide emissions in 2018 would be 26 percent lower, while emissions in 2025 would be 24 percent lower. (See Figure 7.)

Figure 7. Projected Global Warming Emissions in Illinois with Recommended Strategies



Note: Total remaining emissions rise beginning in 2022 because three nuclear power plants reach the end of their current operating licenses and we assume they are retired. The electricity they generated is replaced with a combination of energy efficiency, zero-emission renewable energy, and an increase in coal-fired generation, which increases emissions.

Opportunities for Further Reductions

These strategies are not the only ones that have the potential to reduce global warming emissions in Illinois. Indeed, the strategies listed above leave some major sources of global warming pollution—including air travel, industrial energy use, and emissions of non-carbon dioxide global warming pollutants—virtually untouched. Illinois will need to develop effective strategies for stemming the growth of global warming emissions from these portions of the economy. Another option would be for Illinois to pursue an economy-wide cap on all global warming emissions—enforced either at the state, regional or federal level.

An Economy-Wide Cap on Global Warming Pollution

Each of the strategies listed above addresses global warming emissions from one sector of the state's economy. There are many benefits, however, to combining these specific clean energy policies with an overall, economy-wide cap on global warming pollution.

Adopting an economy-wide cap on emissions would:

1. Allow policy-makers to set enforceable targets for global warming emissions that are consistent with the latest climate science.
2. Prevent increases in global warming emissions from activities other than energy use (such as methane emissions from landfills) and from portions of the economy that are not covered by specific clean energy policies.
3. If structured as part of a cap-and-trade program, allow for global warming pollution reductions to come from the portions of the economy where they can be achieved at the lowest cost.

While it would be possible for Illinois to adopt its own economy-wide cap on global warming pollution (as the state of California did recently), it is more likely that such a policy would be implemented at the regional or federal level. Such a development would appear unlikely in the near term, given the Bush administration's resistance to mandatory measures to reduce global warming emissions. But there have been recent signals of change in Congress. In 2005, the U.S. Senate adopted a "Sense of the Senate" resolution concluding that global warming is occurring and that the nation should adopt a comprehensive national program to slow, stop and ultimately reduce emissions of global warming pollutants.[161] And in 2006, Rep. Henry Waxman of California and Senator James Jeffords of Vermont both introduced legislation that would set strong targets for reduction of global warming emissions in the United States.

Putting It in Perspective—The Long-Term Goal

Ultimately, Illinois' efforts to reduce global warming pollution will be judged by the speed with which the state can reduce—and eventually eliminate—its contribution to the dangerous climate change. Achieving the long-term reductions in emissions of 70 to 85 percent that scientists believe will be needed to forestall dangerous climate change is the true test by which the state's efforts must be assessed, and should remain the overarching goal.

The strategies described in this report not only reduce Illinois' global warming emissions in the short term, but they also begin to lay the groundwork for a deeper transition that will bring the long-term goals within reach. By implementing these strategies, Illinois residents will drive vehicles that use less fuel and derive more of their energy from renewable sources, thus reducing Illinois' global warming emissions

and its dependence on petroleum. Our transportation system overall will become more efficient as Illinois residents have a wider range of transportation options and as more travel and freight movement takes place through lower-emission forms of transportation. Our homes, businesses and government offices will use energy more wisely—reducing the burden of high and volatile energy prices on our economy—and we will generate more of our power from clean, stable, renewable forms of energy. At the same time, Illinois will deploy new and improved technologies—from advanced vehicles to highly efficient appliances to combined heat-and-power applications— that will situate the state for even greater reductions in emissions in the decades to come.

Even with these advances, Illinois will still face difficult challenges. Our communities will have to be reshaped to rely less on individual cars and trucks to transport people and goods. Our buildings will have to be designed to minimize their reliance on fossil fuels. Our economic system will have to reflect more fully the environmental and public health costs of the energy we use, and provide the capital needed to make the transition to cleaner and more efficient ways of living and doing business. Emissions of other global warming gases will have to be reduced dramatically. And other states, regions and nations far from Illinois will have to do their share as well.

Affecting these changes will require an unprecedented amount of research, discussion, cooperation and political will. The strategies laid out in this report show the way forward. By using existing technologies and reasonable public policy tools, Illinois can make large strides toward reducing the state's contribution to global warming in the near term, while in many cases improving public health, economic well-being and energy security, and providing a model of leadership for others in the region to follow.

Methodology and Technical Discussion

General Assumptions and Limitations

This report makes projections of Illinois' future emissions of carbon dioxide and provides estimates of the emissions impacts of a variety of public policy strategies for addressing global warming.

There are several general assumptions and limitations that shape this analysis.

First, we rely primarily on energy consumption data and projections from the U.S. Energy Information Administration (EIA) to estimate past, present and future global warming emissions in Illinois. Emissions through 2003 (except for some petroleum products, see below) are based on state-specific EIA estimates of energy consumption in Illinois. Emissions for 2004 and future years are based on projected rates of growth in energy use for the East North Central region (which includes Illinois along with Indiana, Michigan, Ohio and Wisconsin) adjusted to reflect the slightly lower projected population growth in Illinois versus the region as a whole. Specific conditions in Illinois may be different than those in the region as a whole. Future projections of energy use depend on a range of assumptions as to the price and availability of various sources of energy and energy-consuming technologies. Thus, the projections should be viewed as one possible scenario for the future, though other scenarios are certainly possible.

Second, this analysis includes only emissions of carbon dioxide from energy use and electricity production in Illinois. Global warming is also exacerbated by emissions of other gases (such as methane and nitrous oxide) within Illinois and by "upstream" emissions resulting from the energy consumed to produce goods and services used by Illinois residents. Thus, this analysis is not a comprehensive view of the cumulative impact of Illinois on the global climate, but rather focuses only on the most significant means by which Illinois affects the global climate (through energy-related emissions of carbon dioxide) and policy tools for reducing that impact.

All fees, charges and other monetary values are 2005 dollars, unless otherwise noted.

Baseline Emissions Estimates

Baseline estimates of carbon dioxide emissions from energy use for 2003 and prior years were based on energy consumption data from EIA's State Energy Data database, downloaded from www.eia.doe.gov on 25 September 2006.

To calculate carbon dioxide emissions, energy use for each fuel in each sector (in BTU) was multiplied by carbon coefficients as specified in EIA, *Documentation for Emissions of Greenhouse Gases in the United States 2003*, May 2005.

Adjustments were made for storage of carbon through non-fuel consumption of natural gas and petroleum products using data and following the methodologies described in EIA, *Documentation for Emissions of Greenhouse Gases in the United States 2003 ("Documentation")*, May 2005. To calculate the percentage of various petroleum products used for non-fuel purposes, we either used EIA's assumptions as described in the document above, or compared the quantity of fuels used for non-fuel purposes in *Documentation* with total U.S. consumption of the products from the State Energy Data database. We derived the percentage of carbon dioxide that is released from non-fuel uses of petroleum and natural gas from values presented in *Documentation*.

Combustion of wood, biomass and waste was excluded from the analysis per EIA, *Documentation*. This exclusion is justified by EIA on the grounds that wood and other biofuels obtain carbon through atmospheric uptake and that their combustion does not cause a net increase or decrease in the overall carbon "budget." Municipal solid waste is considered a "biofuel" by EIA and its emissions are excluded.

Future Year Projections

Projections of energy use and carbon dioxide emissions for Illinois are generally based on applying the East North Central Region year-to-year projected growth rate for each fuel in each sector from EIA's *Annual Energy Outlook 2006 (AEO 2006)* to the Illinois baseline emissions estimate for 2003. Because Illinois' population (and presumably its economic activity) is projected to increase at a slightly slower rate than the East North Central region as a whole, we multiplied the year-by-year growth rate from *AEO 2006* by the ratio between the projected population growth rate in Illinois (from the U.S. Census Bureau, and the regional population growth rate assumed in *AEO 2006)*.

Further, we adjusted emissions from the electric sector to address a sharp one-year increase in emissions from 2004 to 2005 from coal-fired power plants to compensate for a temporary decline in nuclear generation. That increased generation from coal plants occurred in the region, not in Illinois. To correct for this, we adjusted the growth rate for coal. We applied EIA's regional growth rate for 2003 to 2004 to the 2003 baseline, but we replaced the 2004 to 2005 regional growth rate with an adjusted figure that removed the one year jump in coal-fired generation. The replacement figure we used was the average growth rate for 2005 to 2010.

Carbon Dioxide Reductions from Electricity Savings and Renewable Energy Use

Measures that reduce electricity consumption in Illinois or that expand renewable electricity generation were assumed to reduce the generation of electricity in Illinois by a proportional amount. That is to say, the proportion of electricity Illinois is projected to export to other states was held constant in this analysis.

Carbon dioxide emission reductions resulting from reduced demand for fossil and nuclear-powered generation in Illinois were calculated as follows:

Net electricity generation from each

type of fuel was estimated by multiplying consumption of each fuel for electricity generation in Illinois (from the EIA State Energy Data database) by the average heat rate of generators using that fuel for the Mid-America Interconnected Network (MAIN) electric reliability region, of which Illinois was a part. (MAIN has since been absorbed into ReliabilityFirst.) Heat rates for fossil fuel-fired power plants were calculated by dividing the amount of each fuel consumed in the MAIN region by the net generation from that fuel (with both figures coming from the supplementary tables to EIA's *AEO 2006*). For nuclear and renewable electricity generation, the heat rate was assumed to be the average for fossil fuel power plants in the United States, per EIA, *State Energy Consumption, Price and Expenditure Estimates (SEDS), Technical Notes for Updated Data*, Appendix B, downloaded from www.eia.doe.gov/emeu/states/_seds_updates_tech_notes.html, 19 July 2006.

Reductions in net fossil and nuclear power generation from energy efficiency improvements and renewable energy (calculated as described below) were assumed to reduce the need for electricity generation versus the reference case projection in the following manner.

Before 2022, reduced electricity demand or increased renewable production was assumed to reduce the need for new natural gas plants, thus holding natural gas generation constant at 2007 levels. Additional reductions were assumed to offset generation for coal.

From 2022 to 2025, generation from nuclear power was offset first, until 30 percent of projected nuclear power generation was offset. The 30 percent figure represents the ratio between generating capacity at Braidwood 1, LaSalle 1 and LaSalle 2, the three nuclear plants scheduled to be retired before 2025, and total nuclear generating capacity (from a comparison of generating capacity in 2004 at the three plants to be retired versus total Illinois nuclear generation capacity from EIA, *State Electricity Profiles 2004*, June 2006). Additional reductions were assumed to offset generation from coal.

The resulting estimates of net generation by fuel after the policy measures were then multiplied by the heat rate (derived as described above) to estimate the amount of fuel consumed for electricity generation. Fuel consumption was then multiplied by the appropriate carbon coefficient to estimate carbon dioxide emissions.

Emission Reductions from the Strategies

Transportation Strategies

Clean Cars Program

The percentage reduction in carbon dioxide emissions that can be expected from implementation of the Clean Cars Program was based on estimated percentage reductions in per-mile global warming emissions due to the standards per California Environmental Protection Agency, Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles*, 6 August 2004.

To calculate the reductions Illinois could expect from the standards, we sought to answer the following questions:

1) What percentage of the vehicle-miles traveled each year would be from vehicles of the various model years/ages? This would determine the emission standard to which the vehicles are held and how much carbon dioxide the vehicles would emit per mile.

2) What percentage of vehicle-miles will be traveled in cars versus SUVs? The Clean Cars Program includes different standards for cars and light trucks.

3) What would carbon dioxide emissions have been were the Clean Cars Program not in place? And what would emissions be under the standards?

1. Estimating Vehicle-Miles Traveled by Age

To estimate the amount of miles that would be traveled by vehicles of various ages, we relied on data on VMT accumulation by vehicle age from the U.S. Department of Transportation's 2001 National Household Transportation Survey (NHTS, downloaded from nhts.ornl.gov/2001/index.shtml, 21 June 2006). We used the estimates of the number of miles driven per vehicle by vehicles of various ages from NHTS to estimate the percentage of total VMT in any given year that could be allocated to vehicles of various model years. (To eliminate year-to-year anomalies in the NHTS data, we smoothed the VMT accumulation curves for cars and light trucks using several sixth-degree polynomial curve fits.)

2. Estimating the Percentage of Vehicle-Miles Traveled by Cars and Light Trucks

To estimate the percentage of vehicle-miles traveled accounted for by cars and light-duty trucks, we relied on two sources of data: actual VMT splits by vehicle type for 2000 through 2002 from the Federal Highway Administration, *Highway Statistics* series of reports and projections of future VMT splits output from the EPA's MOBILE6 mobile source emission estimating model. (Illinois-specific data on VMT splits are unavailable but the state has a slightly higher ratio of registered cars to trucks than the national average, according to Federal Highway Administration, *Highway Statistics 2004*, October 2005, Table MV-1. This should make our analysis of the programs' benefits slightly lower than will likely occur because per-mile emission reductions for cars are greater than for trucks and total emission reductions are undercounted in Illinois by using national figures for car and light truck registrations.)

EPA's projections of the VMT split among cars and light-duty trucks assign significantly more VMT to light-duty trucks than has been the case over the past several years, according to FHWA data. However, EPA's long-term projection that light trucks will eventually represent 60 percent of light-duty vehicle sales by 2008 appears to be reasonable in light of the continued trend toward sales of light trucks.

In order to estimate a trend that reflects both the more car-heavy current makeup of VMT and the long-term trend toward increasing travel in light trucks, we created two curves, one extrapolating the continued linear decline in the car portion of light-duty VMT based on trends in FHWA data from 1990 to 2002 and another using the EPA MOBILE6 estimates. We then assumed that the split in VMT would trend toward the EPA estimate over time, so that by 2020, cars are responsible for approximately 50 percent of light-duty VMT.

VMT in the light-truck category were further disaggregated into VMT by "light" light trucks (in the California LDT1 category) and heavier light trucks (California LDT2s), per EPA, *Fleet Characterization Data for MOBILE6: Development and Use of Age Distributions*, *Average Annual Mileage Accumulation Rates*, *and Projected Vehicle Counts for Use in MOBILE6*, September 2001.

3. Estimating Carbon Dioxide Emissions With and Without the Standards

Baseline carbon dioxide emissions without the Clean Cars Program are based on assumptions about future vehicle fuel economy from EIA, *AEO 2006*. These fuel economy estimates were translated into per-mile carbon dioxide emission factors assuming that consumption of a gallon of gasoline produces 8,869 grams (19.6 pounds) of carbon dioxide. This figure is based on carbon coefficients and heat content data from U.S. Department of Energy,

Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, Appendix B. Fuel economy estimates for years prior to 2003 were based on EPA laboratory fuel economy values from EPA, *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2004*, April 2004. Both the EIA estimates of future fuel economy and the EPA estimates of historic fuel economy were multiplied by an "on-road degradation factor" (representing the degree by which real-world fuel economy falls below EPA laboratory results) from *AEO 2006*.

Emissions from vehicles complying with the standards were estimated by multiplying the percentage reduction in emissions attributed to the standards (obtained from CARB as described above) for each model year by the 2004 emissions level for that class of vehicles. For all years until 2016, vehicles sold by intermediate and small vehicle manufacturers were assumed not to comply with the standards (due to an exemption in the California law) and were assigned emissions at the same rate as calculated for the reference case scenario (described above). Intermediate and small manufacturers were assumed to sell 12.7 percent of cars and 6 percent of light trucks, based on national estimates from Ward's Communications, *2003 Ward's Automotive Yearbook*, 233. In 2016 and subsequent years, small and intermediate manufacturers were assumed to achieve carbon dioxide emission reductions of 25 percent for cars and 18 percent for light trucks per a compliance option for those manufacturers described in Title 13 CCR 1961.1(C).

Fleet Emission Projections

Based on the above data, scenarios were created comparing the reference case (essentially, what emissions from the fleet would have been without the Clean Cars Program) and a policy case. Emission factors for each vehicle class and model year were calculated as described above, and multiplied by the share of total VMT attributed to vehicles of that vehicle class and model year. Total emissions were then summed across vehicle classes and model years to arrive at an estimate of total emissions from the light-duty fleet in any given year. The emissions estimate for the policy case was then compared to the emissions estimate from the reference case to arrive at an estimate of the percentage by which the Clean Cars Program would reduce light-duty vehicle emissions in any particular year. This estimate was then multiplied by the estimated amount of emissions from light-duty vehicle gasoline consumption in our reference case to arrive at the total reduction that would result from implementation of the Clean Cars Program.

In addition to the above, we made the following assumptions:

- **Rebound effects** – Research has shown that improved vehicle fuel efficiency often results in an increase in vehicle-miles traveled. By reducing the marginal cost of driving, efforts to improve efficiency provide an economic incentive for additional vehicle travel. Studies have found that this "rebound effect" may reduce the carbon dioxide emission savings of fuel economy-improving policies by as much as 20 to 30 percent.[1] To account for this effect, carbon dioxide reductions in each of the scenarios were discounted by 5 percent. This estimate is moderate: in its own analysis using California-specific income and transportation data, CARB estimated a rebound effect ranging from 7 percent to less than 1 percent.[2]

- **Mix shifting** – We assumed that neither of the policies under study would result in changes in the class of vehicles purchased by Illinois residents, or the relative amount that they are driven (rebound effect excluded). In addition, we assumed that the vehicle age distributions assumed by EPA remain constant under each of

the policies. In other words, we assumed that any increase in vehicle prices brought about by the global warming emission standards would not dissuade consumers from purchasing new vehicles or encourage them to purchase light trucks when they would otherwise purchase cars (or vice versa). Mix shifting impacts such as these are quite complex and modeling them was beyond the scope of this report, but they do have the potential to make a significant impact on future carbon dioxide emissions.

Energy-Saving Tires

Savings from the use of low-rolling resistance replacement tires were estimated using a methodology developed for RIPIRG Education Fund, *Cars and Global Warming*, Winter 2005. Emission reductions were generated by reducing carbon dioxide emission factors by 3 percent from baseline assumptions for vehicles reaching four, seven and 11 years of age, beginning in 2009, per California Energy Commission, *California Fuel-Efficient Tire Report*, *Volume II*, January 2003. Vehicle age estimates were based on VMT accumulation rates presented in U.S. Environmental Protection Agency, *Fleet Characterization Data for MOBILE6*, September 2001. This estimate assumes that the tire stock will completely turn over, that is, that LRR tires will supplant non-LRR replacement tires in the marketplace through a state requirement. Other policies to encourage, but not mandate, LRR tires would likely produce reduced savings.

Pay-As-You-Drive Automobile Insurance

The impact of pay-as-you-drive automobile insurance on vehicle travel was estimated by modifying a formula to estimate the response of driving demand to changes in per-mile marginal prices presented in Aaron S. Edlin, *Per-Mile Premiums for Auto Insurance*, University of California, Berkeley, 2002. The formula is as follows

$$M = M_0 - (e \bullet (p/t_0))$$

Where:

M represents travel demand after institution of per-mile premiums

M_0 represents travel demand before institution of per-mile premiums

e represents the elasticity of vehicle travel with respect to marginal price per mile

p represents the per-mile cost of insurance

t_0 represents the marginal, per-mile cost of driving before the institution of per mile insurance.

The value M_0 is set to 1, so that the value M provides the relative change in vehicle travel after the imposition of per-mile insurance. Elasticity of vehicle travel with respect to marginal price per mile (e) is based on recent estimates of the elasticity of vehicle travel with respect to gasoline prices produced by economist Charles Komanoff and available at www.komanoff.net/oil_9_11/price_elasticity_komanoff.xls. The version used in this analysis was produced on 30 May 2006. Per-mile cost of insurance (p) is based on 80 percent of the average collision and liability insurance expenditure in Illinois in 2003 from Insurance Information Institute, *Facts and Statistics: Average Expenditures for Auto Insurance by State, 1999-2003*, downloaded from www.iii.org/media/facts/statsbyissue/auto, 9 August 2006. The value t_0 includes per-mile expenditures for gasoline, maintenance and tires from American Automobile Association, *Your Driving Costs 2006*, downloaded from www.aaapublicaffairs.com/Assets/Files/2006328123200.YourDrivingCosts2006.pdf, 9 August 2006. It also includes an estimate of per-mile depreciation costs of 15 cents per mile, based on the upper bound of an estimate in Victoria Transport Policy Institute, *TDM Encyclopedia: The Cost of*

Driving and Savings from Reduced Vehicle Use, updated 14 December 2005.

The reduction in driving demand resulting from this calculation was applied to reference case projections of light-duty vehicle gasoline consumption to arrive at the reduction in energy use and carbon dioxide emissions that would result. Per-mile insurance was assumed to be phased in for 25 percent of drivers in 2008, with an additional 25 percent of drivers added in the following three years until all drivers are covered by per-mile insurance in 2011.

Reduce the Number of Automobile Commutes

The impact of a mandatory commute-trip reduction program in Illinois is based on the following assumptions:

1) The program would include all Illinois employers with more than 100 employees (regardless of whether those employees work at a single worksite or multiple worksites).

2) The program will include a goal of reducing commuting miles traveled by 2.5 percent in 2008, with the goal increasing by an additional 2.5 percent each year until a 30 percent reduction in commuting miles traveled is achieved in 2019.

3) Compliance with the program is 60 percent.

Commutes were estimated to account for approximately 27 percent of vehicle travel in Illinois based on national estimates from U.S. Department of Transportation, Federal Highway Administration, *Summary of Travel Trends: National Household Transportation Survey 2001*, December 2004. Workers at firms with more than 100 employees were assumed to represent 65 percent of all Illinois workers based on U.S. Census Bureau, *Number of Firms, Number of Establishments, Employment, and Annual Payroll by Employment Size of the Enterprise for the United States and States, 2003*, downloaded from www.census.gov/csd/susb/usst03.htm, 1 September 2006.

Reduce Growth in Vehicle Travel

Estimated carbon dioxide reductions from reduced growth in vehicle travel are based on the assumption that per-capita vehicle travel in Illinois is stabilized beginning in 2008. Future VMT growth increases are held to the rate of population growth projected for Illinois in U.S. Census Bureau, *Interim State Population Projections 2005*, 21 April 2005, Table 7. An annual rate of population growth was calculated from the Census Bureau's projections of population growth by decade. This rate of growth was compared to the rate of VMT growth implied by EIA's projections of increases in transportation gasoline consumption and fuel economy from *AEO 2006*. The ratio of these two VMT growth rates was then applied to the year-over-year growth rate in transportation gasoline consumption from *AEO 2006* and this was compared to the gasoline consumption projection in the reference case to determine the percentage by which gasoline consumption would be reduced through slower growth in vehicle travel.

We assumed that the reduction in vehicle travel growth in this scenario would take place as a result of changes in land-use patterns and availability of transportation alternatives. As a result, the carbon dioxide reductions from this scenario are in addition to, and not a substitute for, VMT reductions obtained through other strategies, such as commute-trip reduction programs and per-mile insurance premiums.

Renewable Fuels Standard

Estimates of emission reductions from the use of renewable fuels are based on a renewable fuel standard that requires 2 percent of transportation diesel fuel to be replaced with biodiesel beginning in 2009, with the percentage increasing to 5 percent in 2011 and 10 percent in 2016. This scenario also assumes the presence of efforts to increase the use of cellulosic ethanol over

time. Ethanol use further increases in 2020 from the current 10 percent to 15 percent.

Avoided global warming pollutant emissions from biofuels were estimated by multiplying emissions from the avoided gasoline and diesel use by the percentage life-cycle reductions in global warming emissions from the various biofuels compared to their petroleum equivalents. For ethanol, separate emission reduction factors were estimated for corn-based and cellulosic ethanol. Per-mile global warming emission reductions from corn-based ethanol were assumed to be 13 percent compared with conventional gasoline based on Alexander E. Farrell, et al., "Ethanol Can Contribute to Energy and Environmental Goals," *Science*, 311: 506-508, 27 January 2006. Per-mile global warming emission reductions from cellulosic ethanol were assumed to be 85 percent, based on Michael Wang, Argonne National Laboratory, *Updated Energy and Greenhouse Gas Emissions Results of Fuel Ethanol*, PowerPoint presentation to the 15th International Symposium on Alcohol Fuels, 26-28 September 2005.

We assumed that the proportion of ethanol coming from cellulosic sources would be 1 percent in 2009, with total cellulosic ethanol consumption increasing at a 30 percent annual growth rate, such that cellulosic ethanol makes up approximately 19 percent of the ethanol consumed in Illinois in 2025. This pathway is consistent with a scenario for the development of cellulosic ethanol described in Nathanael Greene, et al., *Growing Energy: How Biofuels Can Help End America's Oil Dependence*, December 2004.

Per-mile global warming emission reductions from biodiesel were assumed to be 65 percent per two life-cycle studies: (S&T)^2 Consultants Inc., *Biodiesel GHG Emissions Using GHGenius: An Update*, prepared for Natural Resources Canada, 31 January 2005 and Tom Beer, et al., *Comparison of Transport Fuels: Final Report to the Australian Greenhouse Office on the Stage 2 Study of Life-Cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles*.

Residential, Commercial and Industrial Strategies

Residential and Commercial Building Codes

The projected impact of building energy codes is based on the assumption that building code improvements will only affect the energy efficiency of new buildings. Since building codes affect both new buildings and major renovations of existing buildings, the emission reductions projected here are likely conservative.

For residential codes, the proportion of projected residential energy use from new homes was derived by subtracting estimated energy use from homes in existence prior to 2008 from total residential energy use for each year based on *AEO 2006* growth rates. Consumption of energy by surviving pre-code homes was calculated by assuming that energy consumed per home remains stable over the study period and that 0.3 percent of homes are retired each year, per EIA, *Assumptions to AEO 2006*.

For commercial building codes, commercial building retirement percentages were estimated for states in the U.S. Census East North Central Region by determining the approximate median age of commercial floorspace in the East North Central Region based on data from EIA, *2003 Commercial Building Energy Consumption Survey* (CBECS); estimating a weighted-average "gamma" factor (which approximates the degree to which buildings are likely to retire at the median age); and inputting the result into the equation, *Surviving Proportion = 1/(1+(Building Age/Median Lifetime)^{Gamma}* as described in EIA, *Assumptions to Annual Energy Outlook 2006*. Baseline 2007 commercial energy demand was then multiplied by the percentage of surviving per-code commercial buildings to estimate the energy use from buildings not covered by the code.

Energy savings from code improvements were based on the following assumptions:

For residential codes, a 1.4 percent

reduction in oil and natural gas consumption in new homes, beginning in 2008, from establishing IECC 2004 as the statewide building code (based on comparing estimated energy savings from the IECC 2004 code from William Prindle, Bion D. Howard, *Impact Assessment of 2004 IECC Wall Criteria Changes*, American Council for an Energy-Efficient Economy, September 2005 with estimated household space heating energy consumption from EIA, *2001 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables*, Table CE2-9c). Beginning in 2011, we assume further reductions in energy consumption of 20 percent, assuming that new codes will be implemented that are comparable with the revised Energy Star homes standard implemented in 2006 and described in U.S. Environmental Protection Agency, U.S. Department of Energy, *Guidelines for Energy Star Qualified New Homes*, downloaded from www.energystar.gov/index.cfm?c=bldrs_lenders_raters.homes_guidelns09, 20 July 2006. With regard to electricity consumption, we assume a 20 percent reduction in 2011 from adopting a code similar to the current Energy Star homes standard.

For commercial codes, we assume a 25 percent reduction in consumption of all fuels in new commercial buildings, beginning in 2010 from the adoption of more stringent codes that will reduce energy use in new commercial buildings.

Appliance Efficiency Standards

Estimates of potential energy savings from appliance efficiency standards were based on state-specific estimates for Illinois from American Council for an Energy-Efficient Economy (ACEEE) and Appliance Standard Awareness Project (ASAP), *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, March 2006. Electricity and natural gas savings estimates were prorated between the anticipated date on which the standards would be imposed and 2020, and then between 2020 and 2030. Standards related to heating and lighting energy use were assumed to be covered under building codes for new buildings, and 30 percent of the savings from those measures were eliminated in order to avoid double-counting in the combined policy case.

Energy Efficiency Programs

The amount of energy saved by Illinois' existing energy efficiency programs is based on reported annual savings from the Energy Efficiency Trust Fund in its program report for 2005. Annual electricity and natural gas savings in year 2006 and beyond were assumed to be the same as savings in 2005. Cumulative savings from previous energy efficiency measures in any particular year were based on the ratio between lifetime savings and annual savings from electric and natural gas efficiency measures in New Jersey Board of Public Utilities, Office of Clean Energy, *New Jersey's Clean Energy Program 2005 Annual Report*, undated, which was approximately 9-to-1 for electricity savings and 18-to-1 for natural gas savings. Total electricity savings for any particular year were estimated to be the annual savings for measures implemented in that year plus the annual savings for measures implemented in the previous eight years for electricity and the previous 17 years for natural gas. This is a simplistic assumption; in reality, the degree to which energy efficiency investments made in any particular year deliver energy savings in a future year depend on the type of measures undertaken (for example, installing an energy-efficient light bulb may deliver energy savings for a couple of years while installing an energy-efficient furnace may deliver savings for decades).

For electricity savings, reductions in site energy use were divided by 0.9 (to account for transmission losses) to estimate the amount of net generation that would be displaced. Carbon dioxide emission reductions were estimated according to the method described in "Estimating Emission Reductions from Energy Efficiency and Renewable Energy," above.

Projections of benefits from electricity efficiency programs were based on average savings from existing electricity efficiency programs nationwide. Energy savings per percent of utility revenue were obtained from Martin Kushler, Dan York, and Patti Witte, American Council for an Energy-Efficient Economy, *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, April 2004. Savings from each of the programs included in this study were plotted on a graph and used to generate a linear equation for the percentage of annual energy use that could be reduced via efficiency per percentage of utility revenue devoted to energy efficiency programs. These equations were then used to generate estimated percentage savings for proposed electricity efficiency programs funded with 3 percent of utility revenue.

Natural gas savings were based on the assumption that investments in natural gas efficiency programs would equal 3 percent of natural gas revenues, as presented in Energy Information Administration, *State Energy Consumption, Price and Expenditure Estimates*, 30 June 2006. The amount of natural gas savings this would yield was calculated based on the cost of natural gas efficiency savings achieved in New Jersey, per New Jersey Board of Public Utilities, Office of Clean Energy, *New Jersey's Clean Energy Program 2005 Annual Report*, no date.

Expanded Use of Combined Heat and Power

Future commercial and industrial power generation from CHP were estimated based on deployment of CHP presented in Midwest CHP Application Center, University of Illinois at Chicago—Energy Resources Center, *BCHP Baseline Analysis for the Illinois Market, 2002 Update*, August 2002. We assumed that the 6400 MW of CHP described in the Midwest CHP Application Center study would be phased in linearly between 2008 and 2020, with no further increases after 2020. The amount of net electricity generation that would be displaced by CHP was calculated assuming a 63 percent capacity utilization factor imputed from current U.S. CHP generation and generation capacity as presented in American Council for an Energy-Efficient Economy, *Combined Heat and Power: The Efficient Path for New Power Generation*, downloaded from www.aceee.org/energy/chp.pdf, 20 July 2006. We further assumed that generation from CHP would offset an additional 10 percent of generation from centrally produced power to account for transmission losses from centrally produced power.

Additional global warming emissions from natural gas consumed in CHP applications were estimated based on a heat rate of 5,000 BTU/kWh from Western Resource Advocates, *A Balanced Energy Plan for the Interior West*, 2004.

Electric Strategies

Renewable Energy Standard

We assume that Illinois adopts a renewable energy standard requiring 25 percent of electricity consumed in the state in 2025 to come from new renewable sources. The requirement is assumed to grow by 1.5 percent per year from 2008 to 2020, and then by 1 percent per year from 2020 to 2025. Emission reductions from a renewable energy standard were estimated by multiplying the percentage of renewable power required in each year to Illinois' projected net generation of electric power (derived using the methodology described in "Estimating Emission Reductions from Energy Efficiency and Renewable Energy" above), and then dividing by 0.9, which represents the estimated 10 percent of renewable power that would be lost in transmission. From this figure, we then subtracted the amount of renewable electricity generation projected for Illinois in the reference case to arrive at an estimate of new renewable generation in Illinois resulting from the renewable energy standard. This renewable generation was assumed to offset nuclear and fossil fuel-fired generation as described in "Estimating Emission Reductions from

Energy Efficiency and Renewable Energy," above.

Adopt a Carbon Cap on Emissions from the Electricity Sector

Emission savings from adopting a carbon cap on emissions from the electricity sector assume that emissions are reduced by 25 percent below 2005 levels. In addition, when calculating the combined emission reduction benefits of the 13 strategies, we assume that reductions in electricity use and increases in renewable power generation are used to offset power generation from coal-fired power plants already in existence as of 2008. To the extent that electricity savings and renewable power use offset natural gas generation instead, the carbon dioxide emission reductions in the combined scenario will be reduced.

Government "Lead By Example"

Baseline estimates of public sector energy consumption in Illinois came from the following sources:

- **Government buildings** – Government building energy use was estimated by dividing estimated energy consumption in government buildings by estimated energy use in all commercial buildings based on data from EIA, *2003 Commercial Buildings Energy Consumption Survey (CBECS)*. For electricity and natural gas, North East Central regional figures were used. For heating oil, Midwest regional estimates were used. The resulting percentage was then applied to Illinois commercial energy consumption in the reference case to arrive at an estimate of government building energy use in Illinois. Fuels not included in *CBECS* were assumed not to be used in Illinois government buildings.

- **Government vehicles** – Government vehicle energy use was estimated by dividing public sector gasoline consumption with total gasoline consumption in Illinois from U.S. Department of Energy, Federal Highway Administration, *Highway Statistics 2004*, October 2005. Government vehicle diesel use was assumed to represent the same percentage of diesel use as government vehicle gasoline use.

To these baseline estimates of government energy use, we then applied the following strategies:

- 25 percent reduction in government energy use, beginning in 2007 and phased in over 10 years;

- 50 percent reduction in new building energy consumption, assuming that all additional government building energy consumption beyond 2006 takes place in new buildings;

- 40 percent of electricity from renewable energy, assuming that renewable energy displaces nuclear and fossil fuel generation as described above;

- Replacing government vehicles with the most efficient vehicles available. We assume that the most efficient vehicles are 30 percent more efficient than current vehicles based on the average difference between the average fuel economy of vehicles in each vehicle class and the most-efficient vehicle in that class from U.S. Environmental Protection Agency, *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2005*, July 2005.

Combined Policy Case

The combined policy case includes emission reductions from all the strategies described above, with the following exceptions:

- The policy case does not include emission reductions from some appliances subject to both appliance efficiency standards and updated building codes.

- The policy case does not include emission reductions from a cap on global warming pollution from power plants because those savings are achieved through the use of other policies that reduce electricity demand and increase generation of renewable energy.

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50 See "Methodology and Technical Discussion" at the conclusion of this report for details on the methods used to estimate carbon dioxide emissions in Illinois.

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