Union of Concerned Scientists

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Confronting Climate Change in the U.S. Midwest

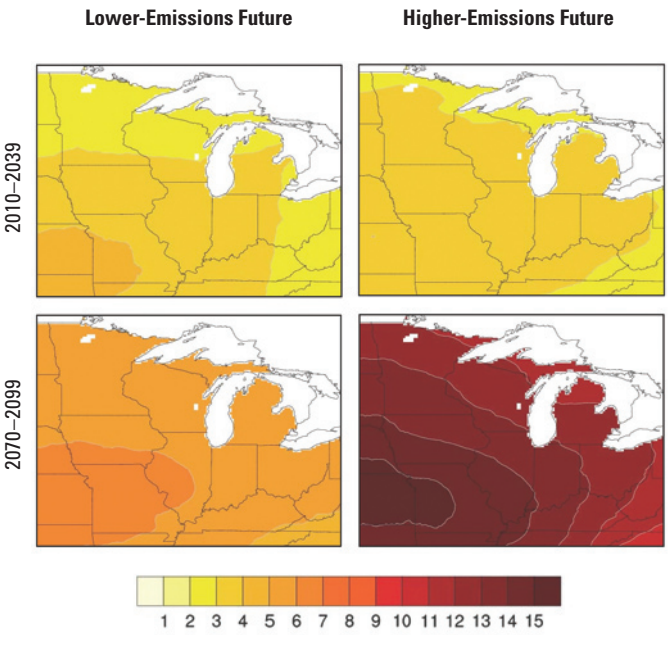
WISCONSIN

From its glacial lakes and hardwood forests to its rich farmland and many riverside communities, Wisconsin has been strongly shaped by its climate. However, that climate is changing due to global warming, and unless we make deep and swift cuts in our heat-trapping emissions, the changes ahead could be dramatic. This report presents new projections showing some of the potential impacts of global warming on Wisconsin, including severe summer heat, more dangerous storms and floods, and new threats to agricultural production.

GLOBAL WARMING AND THE MIDWEST

Global warming is caused by an increase of pollutants in the atmosphere, including carbon dioxide produced by human activities such as the burning of fossil fuels and the clearing of forests. Carbon dioxide acts like a blanket that traps heat in our atmosphere and warms our climate; oceans, forests, and land can absorb some of this carbon, but not as fast as we are creating it. As a result, heat-trapping emissions are building up in our atmosphere to levels that could produce severe effects including extreme heat, prolonged droughts, intense storms, corrosive ocean acidification, and dangerous sea-level rise.

The climate of the Midwest has already changed measurably over the last half century (De Gaetano 2002; Kunkel et al. 1999). Average annual temperatures have risen, accompanied by a number of major heat waves in the last few years. There have been fewer cold snaps, and ice and snow are melting sooner in the spring and arriving later in the fall. Heavy rains are occurring about twice as frequently as they did a century ago, increasing the risk of flooding.



Degrees F above average summer temperature (1961–1990)

Scorching Summers Become Standard

If our heat-trapping emissions continue to increase at the current rates, every summer in Wisconsin toward the end of the century is projected to be as hot as or hotter than 1988—the state's hottest summer of the last half century. Under the higher-emissions scenario (right), average summer temperatures are projected to increase over the next several decades by more than 3°F and, toward the end of the century, by an extraordinary 12°F. Under the lower-emissions scenario (left), that increase would be halved.

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New Climate Projections for Wisconsin

New research summarized here projects significant consequences for Wisconsin as soon as the next few decades, increasing in severity into the middle and end of this century. This report considers these consequences in terms of three time frames: 2010–2039 ("the next few decades"), 2040–2069 ("mid-century"), and 2070–2099 ("toward the end of the century"). We compare these periods with the climate in Wisconsin during 1961–1990 ("the historical baseline").

Toward the end of the century, if current pollution trends continue, projected effects in the state include:

Far more scorching summers

- Every summer in Wisconsin would be hotter than 1988—the hottest summer during the historical baseline.
- Milwaukee would experience more than 55 days per summer with highs over 90 degrees Fahrenheit (°F) and more than 22 days with highs over 100°F.
- Milwaukee would face at least one heat wave per summer like the one that killed hundreds in Chicago in 1995.
- Air quality would deteriorate, as hotter weather causes more severe smog problems (assuming similar levels of tailpipe and smokestack emissions). This would have serious consequences for public health, including a greater incidence of asthma attacks and other respiratory conditions.

Dangerous storms and flooding

- Heavy rains would become more common throughout the year, leading to a greater incidence of flash flooding.
- Winters and springs, when the flood risk is already high, would become 25 percent wetter.

New threats to agriculture

- Crops and livestock would face substantially more heat stress, decreasing crop yields and livestock productivity.
- Warmer winters and a growing season up to six weeks longer would enable pests like the corn earworm to expand their range.
- Crop production would be inhibited by changing rain patterns such as wetter springs (which delay planting and increase flood risk) and more than 10 percent less rain during the increasingly hot summers.

Effective and Affordable Solutions

The most dangerous effects of climate change are likely to occur if the global average temperature rises more than two degrees Celsius above where it stood in 1850. Science shows we still have a chance of keeping temperatures below this level if we cut heat-trapping emissions deeply and quickly—and limit atmospheric levels of carbon dioxide to 450 parts per million (see *www.ucsusa.org/mwclimate* for more details).

Wisconsin can do its part by implementing its own carbon-reducing state policies and investing in clean energy technologies that can both reduce consumer energy costs and build new growth industries in the state. Wisconsin can also play a lead role in calling for strong federal legislation that would provide climate-friendly choices for Wisconsin consumers and businesses and help for resource managers and local governments that must prepare for the effects of climate change that cannot be avoided.

A recent analysis by the Union of Concerned Scientists (UCS), *Climate 2030: A National Blueprint for a Clean Energy Economy* (Cleetus, Clemmer, and Friedman 2009), demonstrates that the United States can cut heat-trapping emissions deeply and swiftly enough to avoid the most dangerous consequences of climate change. A comprehensive climate and energy approach—combining a cap on emissions with policies that encourage renewable electricity, energy efficiency, and cleaner transportation choices—can reduce emissions 26 percent below 2005 levels by 2020 and 56 percent below 2005 levels by 2030 while saving consumers and businesses money.

Our Analysis

Our analysis considers two different possible futures: one with a lower level of global warming pollution and one with a higher level (see *www.ucsusa.org/mwclimate*). These futures represent the best and worst cases of the emissions scenarios described by the international scientific community in 2000 and which have been used for scientific analysis ever since. However, they by no means encompass the full range of futures that could plausibly unfold.

Climate protection policies, if implemented quickly, could reduce emissions significantly below the lower-emissions scenario considered here. On the other hand, up until 2008, global emissions have been higher than the higher-emissions scenario being considered.

HOW WILL EMISSIONS CHOICES AFFECT WISCONSIN'S FUTURE?

Dangerously Hot Summers

Our new analysis projects dramatically hotter summers for Wisconsin. This is true under both the lower- and higher-emissions scenarios, but the prevalence of extreme heat is much greater under the higher-emissions scenario. The conditions that constitute "extreme" heat were measured in two ways: counting the expected number of days above 90°F and 100°F per summer, and projecting the likelihood of extreme heat waves similar to the one that hit Chicago in 1995. By both measures, summers in Wisconsin will become dangerously hot.

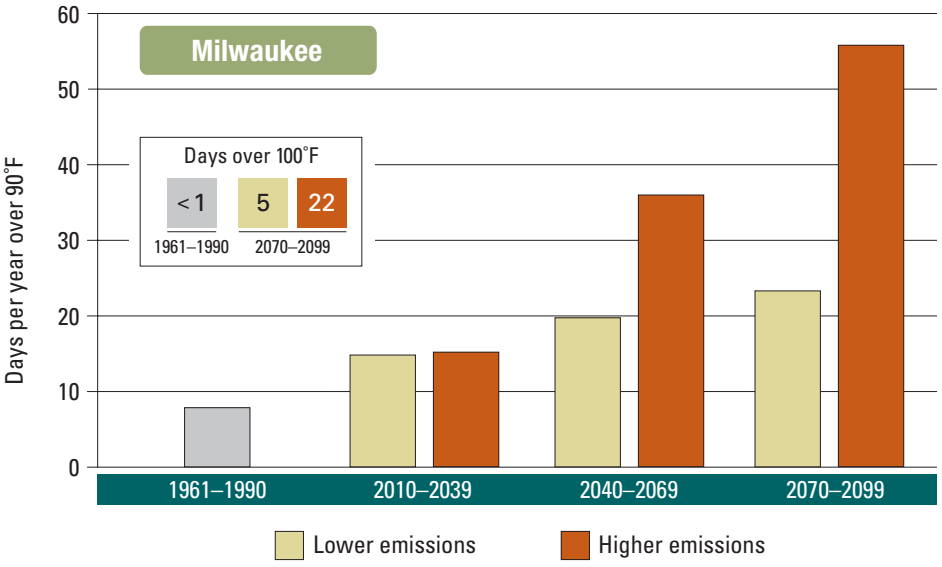
More days over 90°F and 100°F

Because heat waves are especially lethal in cities, where urban landscapes absorb more heat during the day and are less effective at releasing it at night (the "heat island" effect), our analysis focused on the extreme heat projected for the state's largest city, Milwaukee, and the number of days each year likely to exceed 90°F and 100°F. During the historical baseline Milwaukee averaged only nine days per summer with highs over 90°F. That number rises substantially in the next several decades to more than 15, and toward the end of the century under the higher-emissions scenario, the city is projected to experience more than 55 days over 90°F—more than half the summer. Under the lower-emissions scenario that number would be cut by half.

As for the more dangerous days over 100°F, Milwaukee averaged less than one such day each summer during the historical baseline. But toward the end of the century under the higher-emissions scenario, the city is projected to face more than 22 such days. That number would be reduced to five under the lower-emissions scenario. Compounding matters is the likelihood that Wisconsin's summers will continue to be humid—probably even more humid. Other Wisconsin cities such as Kenosha, Madison, and Racine will face conditions similar to Milwaukee.

The severe heat projected for Wisconsin poses serious health risks for its residents. Heat waves already kill more people in the United States each year than hurricanes, tornadoes, floods, and lightning combined (CDC 2006), and the average annual death toll of nearly 700 may well be an underestimate, since there are no uniform reporting requirements and many deaths are probably misclassified (Luber and McGeehin 2008). Studies show that deaths from many causes, including cardiovascular and respiratory disease, increase during heat waves.

The health costs associated with heat waves are not limited to deaths; many other people become sick enough to be hospitalized. In 2005, medical costs related to extreme heat and cold totaled $1.5 billion nationwide, or more than $16,000 per patient. The Chicago heat wave of



Extreme Heat Becomes More Frequent

Under the higher-emissions scenario, Milwaukee could experience more than 55 days per summer with highs above 90°F toward the end of the century. Under the lower-emissions scenario, the number of such days would be halved. Dangerously hot days over 100°F (shown in the inset box) are also projected to increase dramatically, with more than three weeks of such days expected under the higher-emissions scenario.

Wisconsin Could Face Heat Waves of Historic Proportions

In July 1995, Chicago experienced its worst weather-related disaster ever. Temperatures reached or exceeded 90°F for seven days in a row and exceeded 100°F on two of those days (Kaiser et al. 2007). Conditions were made worse by high humidity levels, unusually warm night-time temperatures, and pollution that built up in the stagnant air. Thousands of Chicagoans developed serious heat-related conditions, overwhelming the city's emergency responders and forcing 23 hospitals to close their emergency room doors to new patients. Like the city's hospitals, the county morgue was completely overwhelmed (Klinenberg 2002).

The heat wave was ultimately responsible for between 450 and 700 heat-related deaths (Klinenberg 2002; CDC 1995). Hundreds of additional heat-related deaths occurred in other parts of the Midwest and along the East Coast (NOAA 1996).

If our heat-trapping emissions continue unabated, heat waves of historic proportions are projected to become routine in Wisconsin.

If our heat-trapping emissions continue unabated, heat waves like these are projected to become common in Wisconsin. Under the higher-emissions scenario, for example, Milwaukee would face a heat wave as hot as the 1995 Chicago heat wave at least once every summer toward the end of the century.

Chicago's experience actually pales in comparison to the European heat wave of 2003—the worst of the past 150 years in terms of both duration and intensity. For almost three months daily high temperatures were hotter than normal, with half of those days more than 10°F above normal. Daily low temperatures were also abnormally hot. The death toll was initially estimated around 30,000 (UNEP 2004), but more recent analyses have identified 70,000 heat-related deaths that summer in 16 countries (Robine et al. 2008). Hardest hit was France, where fatalities exceeded 2,000 per day during the heat wave's peak (Pirard et al. 2005).

Projections for Chicago and Minneapolis show that these cities—not far from Milwaukee—are very likely to suffer a heat wave comparable to the 2003 European heat wave in the next several decades. Under the higher-emissions scenario a heat wave of this magnitude would occur at least every fifth year by mid-century and every other year toward the end of the century.

1995 increased admissions to Cook County hospitals 11 percent (more than 1,000 patients) during the peak week (Semenza et al. 1999). Many heat-related deaths and illnesses can be prevented by improving warning systems, access to air conditioning, and year-round medical staffing.

More dangerous air pollution

In areas where there are local sources of fossil fuel emissions, ground-level ozone—a dangerous air pollutant and the main component of smog—increases at temperatures over 90°F (Luber and McGeehin 2008). Since our projections show that, under the higher-emissions scenario, Wisconsin will experience such temperatures virtually the entire summer toward the end of the century, large cities can expect far more days of unhealthy ozone levels than would occur without global warming. This is particularly bad news for the eight counties (including those around Milwaukee) that already experience ozone levels higher than the Environmental Protection Agency's (EPA's) health-based ozone standard (EPA 2008b).

High concentrations of ground-level ozone (not to be confused with ozone in the stratosphere, which provides an important natural shield against solar radiation) diminish lung function, cause a burning sensation in the lungs, and aggravate asthma and other respiratory conditions. Ozone may also contribute to premature death, especially in people with heart and lung disease (EPA 2008). Studies show that when ozone levels go up, so do hospitalizations for asthma and other lung conditions, and it appears that heat and ozone together increase mortality (Luber and McGeehin 2008). Ozone also damages plant life; the EPA warns that a climate change-induced increase in ozone could damage ecosystems and agriculture as well as human health (EPA 2008).

Another air contaminant of particular concern is small particulate pollution (or soot). Small particulates increase the severity of asthma attacks in children, increase the number of

heart attacks and hospitalizations related to cardiovascular disease and asthma, and cause early deaths from heart and lung disease (ALA 2009). While Wisconsin currently meets the EPA's standard for particulate pollution, the state still experiences numerous days—more than 100 between 2005 and 2007—when the air is considered unhealthy for sensitive groups including children, the elderly, people with cardiovascular or respiratory disease, and athletes (ALA 2009).

The leading source of small particulate air pollution is coal-fired power plants, and as demand for electricity increases in response to rising temperatures, power plants generate more emissions. Therefore, climate change threatens to exacerbate Wisconsin's particulate air pollution.

In Wisconsin today, more than 9 percent of the population (more than 97,000 children and more than 312,000 adults) suffers from asthma (ALA 2009). Heart disease caused 486 of every 100,000 deaths among residents older than 35 between 1996 and 2000. (CDC 2009). The combination of increasing heat, ozone, and small particulate pollution can be especially dangerous for these populations.

Changes in Storm, Flood, and Drought Patterns

In 2008 much of Wisconsin experienced its wettest June on record (NCDC 2008). Up to six inches of rain fell on the town of Ontario in a single day, contributing to flash floods that caused widespread damage to homes, roads, and bridges, even destroying a dam at the Wisconsin Dells. Twenty-nine counties were declared federal disaster areas (FEMA 2008), and losses from ruined crops, lower crop yields, and delayed plantings totaled nearly $150 million (Wisconsin State Legislature 2008).

As heavy rainfalls become more common, the threat of flooding will rise, as will the value of the property at risk and the costs of emergency response systems and flood control measures such as levees and dams.

More frequent downpours and flooding

Heavy downpours are already twice as frequent in the Midwest as they were a century ago (Kunkel et al. 1999). While scientists cannot attribute any single storm to climate change, more heavy precipitation can be attributed to climate change that has already occurred over the past 50 years (Trenberth et al. 2007).

Our analysis indicates that the warming ahead will make Wisconsin substantially more vulnerable to the kind of natural disasters it suffered in 2008. Two findings stand out from the research:

- **Precipitation is more likely to come in the form of heavy rains.** Under the higher-emissions scenario Milwaukee is projected to experience a 50 percent increase in heavy rainfalls (defined as more than two inches of rain in one day) over the next few decades. Toward the end of the century, heavy rainfalls are projected to occur twice as often.
- **Winters, springs, and falls will be wetter but summers will be drier.** Winters and springs are projected to see almost one-third more precipitation toward the end of the century under the higher-emissions scenario, and autumns are

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Warming Climate Leads to Poor Air Quality

The fact that air pollution worsens as temperatures rise should concern residents of Milwaukee—poor air quality already puts large numbers of people at risk from respiratory illnesses such as asthma, chronic bronchitis, and emphysema. Higher temperatures are also expected to increase the dangers of allergy-related diseases (Ziska et al. 2008).

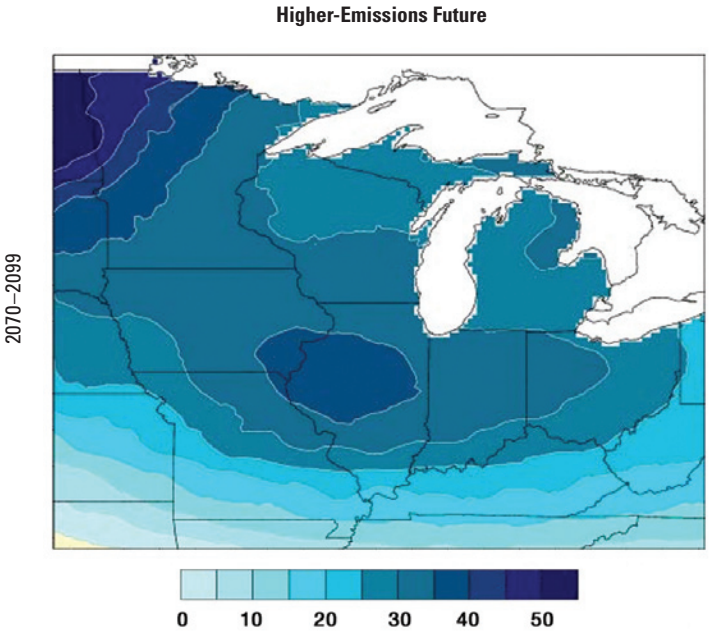
projected to see more precipitation as well. Meanwhile, summers will see 10 percent less rain. As described above, more of the rain that does fall will be in the form of downpours.

These projections support earlier studies showing a substantially increased risk of flooding in Wisconsin as the century progresses, especially if emissions are high. While there is likely to be some increase in local summertime flooding due to more frequent downpours, the greatest flooding risk will occur in the winter and spring, when rainfalls combine with melting snow and still-frozen soils to increase runoff.

In fact, analyses of various rivers in the Midwest (which used a level of emissions somewhat lower than our higher-emissions scenario) projected more than triple the number of high-flow days toward the end of the century (Cherkauer and Sinha 2009; Wuebbles et al. 2008).

More frequent short-term droughts

Paradoxically, Wisconsin could face not only the risk of greater flooding but also the risk of greater drought, although climate projections are less consistent in this regard. The more temperatures rise, the more water evaporates from the soil and plants, requiring more rainfall just to maintain the same soil moisture levels.



Percent increase in spring rainfall compared with average from 1961–1990

Spring Rains Increase

Heavy downpours are now twice as frequent in the Midwest as they were a century ago. Under the higher-emissions scenario, Wisconsin's spring rainfall is projected to increase almost 15 percent over the next several decades and up to 30 percent toward the end of the century. This may lead to more flooding, delays in the planting of spring crops, and declining water quality in rivers, streams, and storage reservoirs.

However, the Midwest is projected to receive less rain in the summer (when temperatures are hottest), not more. As a result, the likelihood of drought in the region will increase, as overall water levels in rivers, streams, and wetlands are likely to decline. In Wisconsin, short-term droughts are projected to increase, but long-duration droughts (lasting more than two years) are likely to decline.

Lower water levels in the Great Lakes

Water levels in the Great Lakes are projected to decline both in summer (due to increased evaporation caused by higher temperatures) and winter (due to a decrease in lake ice) (Angel and Kunkel 2009; Hayhoe et al. 2009). The greatest declines are expected for Lake Huron and Lake Michigan. Under the lower-emissions scenario, water levels are projected to fall less than one foot toward the end of the century; under the higher-emissions scenario, levels are projected to fall between one and two feet. A decline of this magnitude can have significant economic, aesthetic, recreational, and environmental impacts, such as significantly lengthening the distance to the lakeshore, affecting beach and coastal ecosystems, exposing toxic contaminants, and impairing recreational boating and commercial shipping.

More threats to water quality

Heavy rains increase runoff that not only washes pollutants into waterways but—in cities such as Milwaukee—also causes raw sewage to spill from sewers into rivers and lakes. The Milwaukee metropolitan region has invested more than $4 billion to deal with this problem, thus far reducing sewage overflows from an average of 9 billion gallons per year in 1999 to 1.5 billion gallons

per year in 2008 (MMSD 2009). As rainfall increases, however, the Milwaukee sewer system and those of other Wisconsin cities and towns will have to continue to adapt.

New Threats to Wisconsin's Agriculture

Wisconsin is an important part of the nation's agricultural heartland. Nearly 44 percent of the state's acreage is devoted to farmland (USDA 2009a); it ranks ninth nationally in total agricultural product value, second in dairy product sales, first in acres devoted to corn for silage, and fourth in acres devoted to vegetables (USDA 2009b). In 2002, more than 16 percent of Wisconsin's jobs were farm-related (USDA 2005) and, in 2007, agricultural commodities brought nearly $9 billion to the state (USDA 2009a).

The heat and precipitation changes projected for Wisconsin have potentially profound implications for agricultural production. Toward the end of the century, growing seasons are likely to lengthen by three weeks under the lower-emissions scenario and by six to seven weeks under the higher-emissions scenario. Also, rising CO_2 levels have a fertilizing effect on crops. These changes by themselves would increase crop production, but they will be accompanied by many other changes that threaten production, such as heat stress, increased drought and flood risks, and an expansion of crop pests' range.

More heat stress for crops

The extreme summer heat projected for Wisconsin, particularly under the higher-emissions scenario, puts the region's crops at significant risk. Corn crops, for example, can fail at 95°F, with the risk increasing the longer the heat lasts. When such hot spells coincide with droughts, as they often do, crop losses can be severe.

The United States lost $40 billion from a 1988 heat wave—mostly due to crop losses. Crop yields in Wisconsin dropped precipitously that year, with corn and soybeans falling below 65 percent of their average annual yields for the period 1978–1997 (USDA 2009c). Over the next few decades (under both emissions scenarios) most Wisconsin summers are projected to be hotter than 1988, and by mid-century under the higher-emissions scenario, all Wisconsin summers are projected to be hotter than 1988.

Our analysis projects the frequency with which Wisconsin and the Midwest would face three- and seven-day periods of crop-damaging temperatures of 95°F or higher. During the historical baseline such periods of intense heat were extremely rare in the Midwest, with three-day periods occurring about once every 10 years and seven-day periods occurring on average only once every 30 years in the more southern states.

Under the higher-emissions scenario, however, a three-day period with temperatures reaching 95°F or higher is projected to occur in three of every four summers in Wisconsin within the next few decades, and in every summer toward the end of the century. A more destructive seven-day period would occur in at least half of Wisconsin's summers by mid-century and in at least three of every four

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More Disastrous Spring Floods Could Be on the Way

While Wisconsin will likely see some increase in localized summer flooding due to heavier downpours, the greatest flood risk will be in the spring, when seasonal precipitation is expected to increase the most. This would result in catastrophic flooding like that experienced in 2008, which caused damage at Lake Delton and across much of the state.

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Declining Lake Levels Endanger the State's Economy

Under the higher-emissions scenario, water levels in the Great Lakes are projected to fall between one and two feet toward the end of the century. Such a decline represents a threat to the state's lucrative shipping industry.

summers toward the end of the century. Under the lower-emissions scenario, the frequency of such periods would be significantly less toward the end of the century, with a week-long period of extreme heat occurring in about half of Wisconsin's summers.

The possibility of crop-damaging heat waves becoming commonplace in Wisconsin within a few decades represents a significant threat to the state's economy, which took in more than $1.2 billion from corn alone in 2007 (USDA 2009a). Crops such as wheat that fail at lower temperatures than corn are even more vulnerable.

More heat stress for livestock

Extreme heat is also projected to cause heat stress for much of Wisconsin's livestock. Dairy cattle are particularly vulnerable to high temperatures, and milk production can decline when temperatures exceed 75°F to 80°F depending on humidity. This represents a significant threat to Wisconsin's economy since dairy products are the state's most lucrative agricultural product, accounting for nearly $4.6 billion in 2007 revenue. During the historical baseline, average summer temperatures and humidity in Wisconsin did not exceed levels known to cause stress in livestock. Under the higher-emissions scenario, however, dairy cattle and other livestock will endure near-permanent heat stress during the average Wisconsin summer toward the end of the century—unless they are kept cool using costly measures such as air-conditioned barns.

Wider spread of pests

The warmer winters ahead mean that crop pests and pathogens normally kept in check by cold temperatures are projected to expand their ranges northward. A recent study warned that the expanding ranges of corn pests could have a substantial economic impact in the form of higher seed and insecticide costs and lower yields (Diffenbaugh et al. 2008). Already, corn pests cost U.S. corn producers more than $1 billion annually; the corn earworm alone is responsible for destroying about 2 percent of the nation's corn crop every year, and it has shown resistance to a wide range of insecticides (Diffenbaugh et al. 2008).

Wisconsin's valuable corn crop would be at risk if the corn earworm does indeed move north. During the historical baseline, conditions conducive to this pest occurred rarely. Under the higher-emissions scenario, however, conditions conducive to the corn earworm will occur virtually every year in Wisconsin toward the end of the century.

Potentially damaging changes in precipitation

Crops under stress from extreme heat need more rain, but Wisconsin is projected to receive less rain in the summer growing season as the climate warms. Dry conditions will be a particular problem for Wisconsin's crops because only about 4 percent have access to irrigation (USDA 2009a).

In addition, the projected increase in spring rains could interfere with planting and pose a greater risk of floods like those of June 2008, which affected thousands of acres of the state's farmland (MRCC 2009). Changes in precipitation are therefore likely to limit farmers' ability to take advantage of the longer growing seasons expected to accompany future climate change.

CLIMATE SOLUTIONS FOR WISCONSIN

Wisconsin accounts for about 2 percent of U.S. global warming emissions (EIA 2008). Since 1990, the state's emissions have grown 1 percent per year—slightly faster than the Midwest and national averages—with the fastest growth occurring in the electricity generation sector (Governor's Task Force on Global Warming 2008).

Energy use accounts for 85 percent of Wisconsin's global warming emissions, and agriculture accounts for another 8 percent. More than half of these agricultural emissions take the form of methane gas emitted by livestock—primarily the more than 1 million head of dairy cattle in Wisconsin, which ranks ahead of every state in this regard except California (WRI 2008).

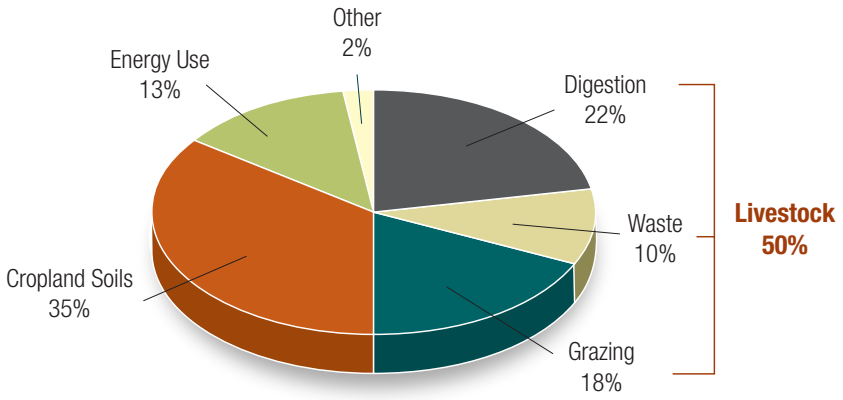
If Wisconsin and the world are to avoid the worst consequences of climate change, the state must aggressively reduce its emissions by:

- increasing energy efficiency and conservation in industries and homes;
- improving vehicle fuel efficiency and reducing the number of miles driven;
- boosting the use of renewable energy resources such as wind power, advanced biofuels, and geothermal energy; and
- improving agricultural practices to reduce the release of heat-trapping emissions from soil cultivation and fertilizer application.

These actions will also provide benefits such as lower energy costs (within a few years at most), new local jobs, and cleaner air and water. A recent analysis by the Union of Concerned Scientists shows that businesses and industries in the Midwest could collectively save $3.8 billion in 2020 and $11.9 billion in 2030 by instituting these kinds of changes, with the average household saving $200 in 2020 and $800 in 2030 (Cleetus, Clemmer, and Friedman 2009).

Wisconsin has made strides toward implementing a number of the strategies listed above and deserves credit for its progress on the following initiatives:

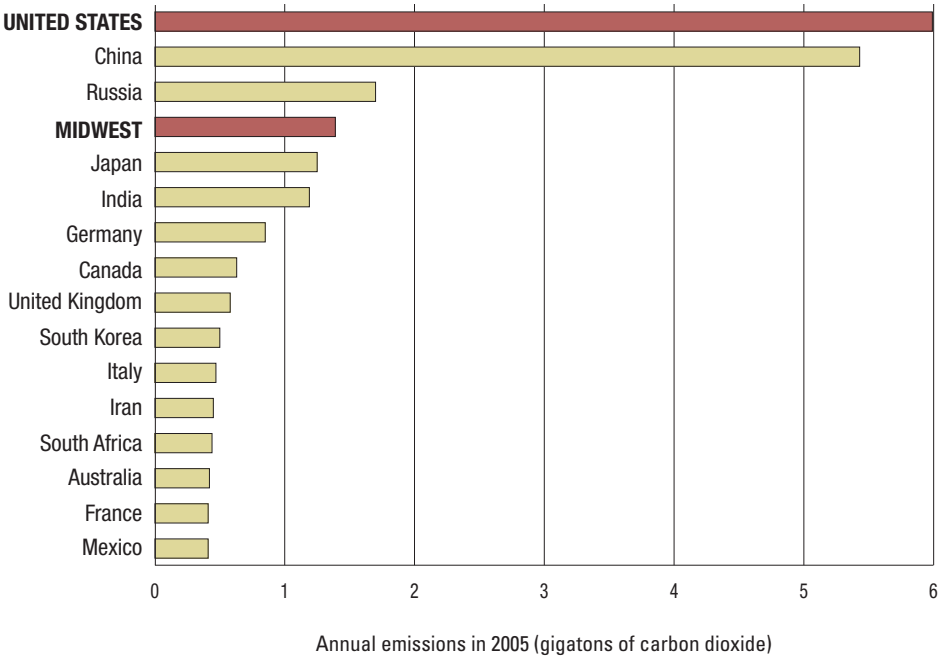
- A law that doubles the state's investment in energy efficiency by requiring all utilities to spend 1.2 percent of their annual operating revenue on energy efficiency and renewable energy (DSIRE 2008).
- A renewable electricity standard that requires utilities to supply customers with 10 percent renewable electricity by 2015 (DSIRE 2009a).
- The purchase of 92,400 megawatt-hours of renewable electricity, equivalent to roughly 10 percent of the electricity consumed each year by seven participating state agencies and the state university system (DSIRE 2009b).
- The formation of a state task force on global warming, which has already recommended a number of specific actions Wisconsin can take to reduce emissions; the recommendations are currently being drafted into legislation that will be introduced this year.
- A plan supported by Governor Doyle that would reconfigure three coal-fired power plants to run on biomass and natural gas.



Emissions percentages are CO_2-equivalent units

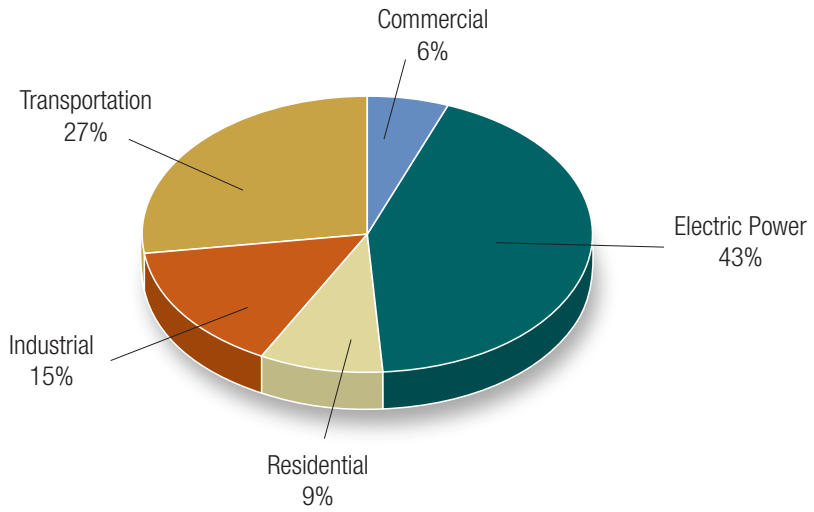
Agriculture Contributes to Warmer Temperatures

Agriculture generates 7 percent of total U.S. heat-trapping emissions, including three potent global warming gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Half of these emissions come from livestock production, one-third from the cultivation and fertilization of cropland (which decreases its ability to absorb carbon), and the rest from energy used for power generation, transportation, and construction (USDA 2008).



The Midwest Burns More Fossil Fuels Than Entire Nations

The total combined emissions from eight states (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) would make the Midwest the world's fourth largest polluter if it were a nation. The region's emissions are more than double those of the United Kingdom, which has about the same population (EIA 2008b).



Vehicles and Power Plants Are Michigan's Biggest Fossil Fuel Polluters

Transportation and electricity generation—primarily from coal-fired power plants—are the largest sources of heat-trapping emissions in Wisconsin (EIA 2008a). This chart reflects CO_2 emitted by power plants within the state; it has not been adjusted to reflect power imported to or exported from Wisconsin.

Pathways to Real Progress

Wisconsin can do much more to take advantage of clean energy opportunities and reduce global warming emissions, by pursuing the cost-effective strategies summarized below.

Strengthen the renewable electricity standard (RES)

A strong RES can create local jobs and save residents money, but Wisconsin's standard is so weak that the state's utilities have already far surpassed its requirements, thanks primarily to ample wind resources. With its capacity for producing both wind power and bioenergy, Wisconsin is particularly well-positioned to benefit from renewable energy, yet the lack of a strong RES is holding back this sector, which generated less than 5 percent of the state's electricity in 2006 (NREL 2008). Wisconsin should follow the lead of states such as Illinois and Minnesota, which both have an RES that requires 25 percent renewable electricity by 2025.

Adopt a renewable energy "buy-back" program

The Governor's Task Force on Global Warming has recommended that Wisconsin encourage the growth of renewable energy by paying homeowners, farmers, small business owners, and others who generate renewable electricity and feed the excess into the electric grid; payment would be made at the same rate the state already pays utilities for their electricity. Buy-back programs (also called "advanced renewable" or "feed-in" tariffs) have succeeded in quickly expanding renewable energy production in several European countries and Canada.

Promote energy efficiency programs

Wisconsin should require its electric and natural gas utilities to increase their investments in energy efficiency. The state could also follow the lead of Illinois, Michigan, Minnesota, and Ohio, which require utilities to reduce energy demand by helping their customers become more energy-efficient.

Energy efficiency reduces global warming emissions while saving consumers money and creating local jobs for people who perform energy audits, weatherize homes, and manufacture efficient windows. A $340 million annual investment in energy efficiency, for example, would create up to 9,000 jobs in Wisconsin, reduce energy use by 1.6 percent, and save an estimated $900 million annually by 2012 (Energy Center of Wisconsin 2009). If continued through 2018, this investment would reduce energy use by 13 percent.

Stop investing in polluting coal plants

Wisconsin should adopt a moratorium (or outright ban) on both the construction of new coal-fired power plants and the import of power from new coal plants outside the state—unless and until such plants reduce their emissions using carbon capture and storage (CCS) technology (provided this proves commercially feasible). New financial commitments to coal plants without CCS will lock the state into high emissions for decades, while inhibiting needed investments in clean energy technologies.

Building More Resilient Communities

Because climate change is already upon us and some amount of additional warming is inevitable, Wisconsin must adapt to higher temperatures and more heavy rains while working to reduce its emissions. Any delay in emissions reductions will make it more difficult and costly to adapt; conversely, aggressive steps to reduce emissions *now* will provide the time ecosystems and societies need to become more resilient. For each adaptation measure considered, Wisconsin's decision makers must carefully assess the potential barriers, costs, and unintended social and environmental consequences.

A State-Federal Partnership

Although Wisconsin can achieve much with its own policies and resources, the scale of emissions reductions required suggests that individual states will need strong support from the federal government. The United States should therefore enact a comprehensive set of climate and energy policies including standards for renewable electricity, energy efficiency, and transportation that set a tight limit on heat-trapping emissions nationwide. The goal should be to reduce emissions at least 35 percent below current levels by 2020 and at least 80 percent by 2050.

A national renewable electricity standard and strong fuel economy standards for cars and trucks can boost local economies while substantially reducing emissions nationwide. For example, a renewable electricity standard of 20 percent by 2020 would create 4,240 jobs in Wisconsin and lower residents' electricity and natural gas bills a total of $90 million by 2020 (UCS 2007). A separate UCS analysis showed that if every car and light truck on U.S. roads averaged 35 miles per gallon (mpg) by 2018 (compared with the fleetwide average of 26 mpg today), drivers

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Renewable Energy Presents Opportunity for Growth

Nationwide, the wind power industry employs 85,000 people (AWEA 2009) while generating clean energy that reduces the heat-trapping emissions from coal-fired power plants (the United States' primary contributor to global warming). Wind energy in Wisconsin could provide jobs and revenue that can help build a clean energy economy.

would save enough in fuel costs to create 4,800 new jobs in Wisconsin by 2020 (UCS 2007b). The Obama administration is currently pursuing new standards that would achieve an average of 35.5 mpg by 2016.

Another complementary federal strategy known as a "cap-and-trade" program would set a price on emissions and require polluters to obtain government-issued permits in order to continue emitting. By auctioning these permits the government could generate revenue for investment in:

- Energy efficiency and renewable energy solutions
- Assistance for consumers, workers, and communities facing the most difficult transition to a clean energy economy (coal miners and mining towns, for example)
- Conservation of precious natural resources
- Assistance for communities that must adapt to unavoidable consequences of climate change

Setting a price on heat-trapping emissions will also stimulate investment in cleaner and more efficient energy technologies such as CCS (if and when this proves commercially feasible) by making them more cost-competitive.

Finally, federal resources devoted to climate monitoring and assessments can provide essential information for states and communities that need to devise and implement adaptation plans. Wisconsin's U.S. senators and representatives must therefore support strong federal climate and clean energy policies that will help the state reduce emissions, transition to a clean energy economy, and prepare for the climate change that will occur in the interim.

©Aldo Leopold Legacy Center

Green Building Design Saves Money and Energy

Despite the demands of Wisconsin's seasonal temperature extremes, the Aldo Leopold Legacy Center near Baraboo uses 70 percent less energy than a building that meets the minimum requirements of the state building code. An innovative design that combines energy efficiency and renewable energy (in the form of a rooftop solar array) makes the center completely self-sufficient in terms of its yearly energy needs.

CONCLUSION

Global warming represents an enormous challenge to Wisconsin's way of life and its residents' livelihoods, but we can meet this challenge if we act swiftly. The emissions choices we make today—in Wisconsin and throughout the nation—will shape the climate our children and grandchildren inherit. The time to act is now.

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

For more information on the Midwest's changing climate, along with a list of references for this report, visit:
www.ucsusa.org/mwclimate

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