



# TABLE OF CONTENTS

	4 The Power of Climate Change		18 Transportation
	8 Minnesota's Energy		20 Agriculture
	12 Taking Action		22 Natural Resources
	14 Energy Efficiency and Buildings		24 Waste
	16 Health		26 Do Your Part

# CLIMATE ACTION: WHERE WE STAND

In 2007, the Minnesota legislature adopted the Next Generation Energy Act, including one of the strongest renewable energy standards in the nation.

It was a proud moment in our state's history. We joined with others around the world in recognizing that changes in our climate, caused by harmful emissions from our power plants, vehicles and industries, would dramatically alter the way we live, work and play in the future—unless we took action.

The legislation was a game changer. In carrying out the law, Minnesotans would strive for more clean, homegrown energy, like wind and solar; waste less energy; and decrease our contribution to global warming.

Included in the law is the Renewable Energy Standard, which requires us to get 25% of our power from renewable energy sources by 2025. It also sets greenhouse gas reduction goals of 15% by 2015, 30% by 2025 and 80% by 2050, as well as an annual energy savings goal of 1.5% of retail sales for electric and natural gas utilities.

Fortunately, we've made significant progress in reaching our goals. According to the Minnesota Pollution Control Agency, if emission avoidance policies and programs in the electric power sector continue at present levels through 2025, Minnesota will see a 33% reduction in expected electric power sector emissions—a credit to the state's aggressive Renewable Energy Standard, Conservation Improvement Program and repowering projects.

Even so, Minnesota will not achieve the first milestone—the 15% reduction in greenhouse gas emissions by 2015. We have work to do, and I am committed to getting Minnesota back on track.

The impact of the changes we're making—incremental and invisible as they may seem now—will dramatically shape the quality of life for our children and their children. When those generations look back on our actions, will they believe that we did enough?

They will—if we seize the modern, sustainable strategies and technologies at our fingertips to save energy, reduce our reliance on coal and oil, and create jobs that grow our economy and protect our health and environment. Our grandchildren and great-grandchildren will breathe clean air, drink clean water and enjoy Minnesota's cherished lakes, woods and prairies—just as we have in our own lifetimes. And they will know that we did what was right. For everyone.

Let's move forward together, acting from the common sense foundation we've already laid. We'll make Minnesota cleaner, healthier and vibrant for future generations.



Governor Mark Dayton



# THE POWER OF CLIMATE CHANGE

*In ways both plain and simple, the world's climate is changing. As is Minnesota's.*

Scientists have issued their strongest position on climate change, warning that changes are happening now and are no longer a far-off concern. Moreover, problems will grow substantially worse unless greenhouse gas emissions are brought under control, particularly in the next 15 years, to forestall the worst effects of global warming.

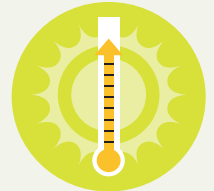
In Minnesota, climate change has hit home, with three 1,000-year floods since 2004 and dozens more intense weather events—from hailstorms to tornadoes to droughts.

Financial impacts are just as real. In 2013, Minnesota had some of the highest weather-related disaster claims in the country, even topping some tornado- and hurricane-prone states. And, University of Minnesota economists estimate that electricity generation annually causes more than \$2 billion in environmental and health damages, such as asthma aggravated by air pollutants.

Scientific predictions of extreme heat, poor air and water quality, and sweeping changes to Minnesota's wildlife and fish habitats foreshadow significant changes in the way we work, live and play.

## CLIMATE CHANGE:

GREENHOUSE GAS EMISSIONS



INCREASED TEMPERATURES

WHICH AFFECTS HOW WE



### WORK

#### Businesses Face Risks

Climate change has the power to contribute to lower gross domestic products, higher food and commodity costs, and greater financial risk.



*Minnesotans may be surprised to hear that familiar companies, such as Coca-Cola and Chipotle, are already preparing for disruptions in water and ingredient sources.*

#### Good News, Bad News for Farmers

Longer growing seasons are a blessing for farmers, but severe weather and heat-loving pests, invasive species and plant diseases could wipe out their gains. Extreme heat is another factor, which causes stress, illness and even death in livestock.



*Apple production in Minnesota was as much as 47% below normal in 2012. A hard frost in April followed an unusually warm March, damaging buds. A few months later, apples suffered damage from hail and drought.*

#### Tough Conditions for Outdoor Workers

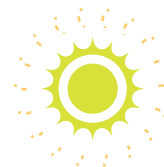
Summer heat and poor air quality could make it difficult for construction workers, landscapers and other outdoor workers to keep cool and breathe easily.



### LIVE

#### Heat and Smog

With more days topping 100-degrees Fahrenheit, Minnesotans could experience more days with poor air quality, causing respiratory and cardiovascular problems.



*With more extreme heat comes the higher risk of heat-related illness.*

100°F

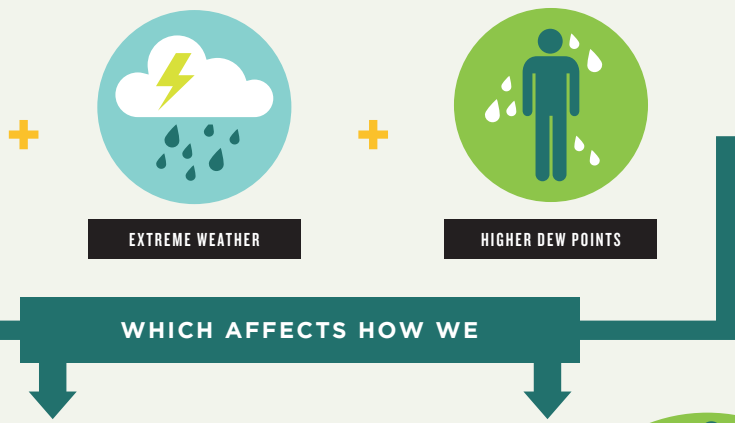
#### Floods and Drought

Intense, local thunderstorms mean some Minnesotans will experience heavy rain and flooding, while others will face severe drought and the risk of wildfires.

#### Water Woes

Drought could reduce drinking water supplies. Drinking water could smell or taste bad, thanks to heat-induced algae growth. And chances of waterborne disease outbreaks increase with more flooding.

# WHAT'S AT STAKE?



## PLAY

### Wheezing, Sneezing

A longer allergy season is likely—and allergies may be more severe. Health officials say this can worsen asthma symptoms for vulnerable populations, such as kids and the elderly.

### Food Security

Volatile weather, more heat-loving pests—and even longer growing seasons—cause swings in food production, costs, availability and nutritional value.



### Road Bumps

Increased freeze-thaw cycles in winter will degrade Minnesota's roads more quickly and increase replacement costs. More winter ice and rain (vs. snow) will make it even harder to keep roads safe. And, more summer heat means more buckled roadways.

### A Changing Forest

It is likely that iconic spruce, fir, aspen and birch trees will retreat northward, and the Boundary Waters Canoe Area (BWCA) may give way to hardwood forests.



### Shorter Snowmobile, Ski and Sled Season

Minnesota might have a shorter season of snow and ice cover, resulting in fewer winter recreational opportunities.

### Less Lake Fun

It may be difficult to boat, ski or swim in some lakes with excessive algae blooms or more rooted-plants plaguing lakes. Both grow due to nutrient-loading (from residential and agriculture runoff), warmer water temperatures and longer growing seasons.

### More Disease-Carrying Pests

Tick- and mosquito-borne illnesses are already on the rise. Health officials say climate change may explain a geographic spread of ticks, especially in northern Minnesota.

### Heads Up, Hunters and Anglers

From the North Shore to prairie country, the diversity of fish and wildlife is changing, as factors such as heat stress and flooding alter the availability of food, water and habitat.



Northeastern Minnesota's moose population has dropped 52% since 2010. Scientists have attributed some deaths to parasites and overall poor physical condition. Both may be linked to warming temperatures.



37% of all freshwater aquatic animal species, from trout in North Shore streams to walleye in Lake Pepin, could be at risk. This risk poses potential economic and cultural losses.

# THE POWER OF CLIMATE CHANGE

## Minnesota Meteorologists Explain Climate Change

Minnesotans love to talk about the weather. But when weather patterns change, experts encourage people to shift their conversations to climate change.



*"Climate is what you expect. Weather is what you get. Climate change tilts the odds towards extreme weather, the way steroids pump up a baseball player. You can't prove any single home run was sparked by steroid use, but you did see how it increased the player's batting average."*

Paul Douglas,  
Meteorologist



*"When I see changes in data from our own backyard, I take notice."*

Dr. Mark Seeley,  
University of Minnesota  
Extension Climatologist  
and Meteorologist

## By the Numbers

For decades, Dr. Mark Seeley and other climatologists have tracked three climate trends—**rising temperatures, extreme storms and higher dew points**—driving the frequency and intensity of **extreme weather** in Minnesota.

### Temperatures Are Rising

The temperature in Minnesota has increased 1°F to 2°F since the 1980s, after decades of essentially no change. The closer to the present that the trend is assessed, the greater the rate of observed increase.

Projected increases: 2°F to 6°F more by 2050 and 5°F to 10°F by 2100.

### Extreme Storms

Yearly frequency of the largest storms—those with three inches or more of rainfall in a single day—have more than doubled in just over 50 years.

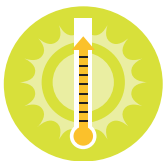
In the past decade, such dramatic rains have increased by more than 70%.

Scientists project that extreme weather events will occur more frequently.

### Dew Points Are Higher

Dew point measures the air's moisture. When dew point temperatures reach 70-plus degrees Fahrenheit they are tropical. We are experiencing greater frequency of 70°F dew points. When the dew point and air temperature are high, so is the heat index, a measure of how the temperature feels with the two combined.

Minnesota had never recorded an 80°F dew point until the summer of 1966. Since then, 80°F dew points have occurred more frequently.



Seven of Minnesota's 10 warmest years occurred in the last 15 years.



Since 2004, Minnesota has had three 1,000-year flash floods.



On July 19, 2011, Moorhead was the hottest, most humid spot on Earth. Its 88°F dew point and 134°F heat index eclipsed the Amazon Jungle—the only other place in the Western Hemisphere with a dew point in the 80s.

## How We Cause Climate Change

Ninety-seven percent of scientists—including the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA)—agree that humans are causing climate change.

"Changes in temperature, precipitation patterns, snow and ice cover, and sea level have naturally happened throughout history," Dr. Mark Seeley said. "What's different now is how quickly changes are happening, given increasing levels of greenhouse gases in the atmosphere."

Burning fossil fuels (oil, coal, natural gas) to run our power plants, vehicles and factories produces carbon dioxide, the most predominant greenhouse gas. The Earth's atmosphere acts like a pane of glass in a greenhouse, trapping the sun's heat in the lower atmosphere and causing the Earth's surface to warm.

## Minnesota Experts and Economists Raise Flags

While total costs of some climate change impacts, such as heat-related illnesses and water quality issues, are still unknown, two costs are hitting people's pocketbooks now.

### Already Paying the Price for Climate Change

The cost associated with climate change is real—not just a projection for the future. We are already paying the price.

Climate change makes weather events like severe drought more likely and is causing sea levels to rise.

As the frequency and intensity of extreme weather increases, so do our home insurance rates, the number heat-related health emergencies, and disturbances to our crops and other industries.



### Disaster Costs

We also pay the costs of responding to climate-related emergency situations and rebuilding afterwards.

Since 1997, 32 severe weather natural disasters cost Minnesota nearly \$500 million. This is the price we pay for not adapting ourselves. And, we will continue to pay the price if we do not work together.

### Billions in Damages from Electricity Generation

University of Minnesota economists estimate the total annual health and environmental damages from electricity generation in Minnesota are more than \$2 billion.

That is \$800 million in health costs—largely related to respiratory and cardiovascular health impacts from “criteria air pollutant” emissions (sulfur dioxide, nitrous oxides, particulates, ammonia and volatile organic compounds).

More than \$1.2 billion is from damages related to global climate change.

Emissions from coal-fired electricity generation contribute to more than 90% of the total damages.

Further, the American Lung Association estimates particulate matter from coal-burning power plants cause 24,000 premature deaths, 550,000 asthma attacks and 38,000 heart attacks per year nationally.



## Drought and Floods at Once?

New precipitation trends have the potential to cause both increased flooding and drought, based on the localized nature of storms and their intensity, leaving parts of the state drenched and others dry. In 2007, 24 Minnesota counties received drought designation, while seven counties were declared flood disasters. “At first, we thought that vast discrepancy was a singularity, a sample of one,” Dr. Mark Seeley said. **“But in 2012, 55 Minnesota counties received federal drought designation at the same time 11 counties declared flood emergencies.** Two times in 10 years is no longer a singularity.”



*Flooding in 2012 in Northeast Minnesota damaged roads and bridges, water and sewer systems and other infrastructure, costing \$108 million. More than 1,700 homes and 100 businesses were damaged or destroyed, costing more than \$12 million.*

## About that Polar Vortex — Earth Still Logged Its Fourth-Warmest January

Despite bone-chilling cold in Minnesota, the 2014 Polar Vortex was an icy blip in a hotter global story.



Meteorologist Paul Douglas explains: “We are all hard-wired to react to weather, not the longer, slower (global) climate trends that have so many scientists concerned. You’d never know it staring at the thermometer in your backyard, but the planet continues to run a low-grade fever.” Here’s a clip from Climate Central: “[January 2014] was the fourth-warmest January since recordkeeping began in 1880. It was also the 347th consecutive month with above-average temperatures compared to the 20th century average, which has been fueled in large part by climate change.”



# MINNESOTA'S ENERGY

## An Aerial View

*Reducing emissions that are causing climate change begins with understanding how we're using energy, where our energy comes from, and how energy choices are made. In Minnesota, we use most of our energy (80%) to earn a living and commute to and from work or transport products. The remainder is for keeping our homes comfortable, bright and connected.*

## Energy Sources

For at least a century, Minnesota's electricity system has been largely reliant on fossil fuels, 100% of which are imported from other states and countries. Today, Minnesota receives more than 55% of its electricity from U.S. coal-fired power plants, the biggest emitter of greenhouse gases in our state. However, in less than one decade, the state's use of coal has dropped by 33%.



### Coal

Minnesota has historically relied heavily on coal to meet electricity needs. Our use of coal has declined in part due to environmental and health policies. It also has been heavily influenced by market forces—from increases in energy efficiency to decreases in the price of natural gas and renewable energy.



### Nuclear

In the 2030s, Minnesota's nuclear power plants will reach the end of their current licenses. Important decisions need to be made about their future. As opposed to coal and natural gas, nuclear power omits no carbon. For that reason, pressure to reduce carbon may influence future discussions on nuclear.



### Natural gas

Natural gas is a fossil fuel that Minnesota imports. Prices have fallen dramatically and U.S. supply has increased with the development of hydraulic fracturing. Even as this technology is widely deployed, the debate continues over environmental impacts and necessary environmental regulations.



### Gasoline

Minnesota imports all of its gasoline, primarily from other countries. In 2012, the United States imported about 10.6 million barrels of petroleum per day from about 80 countries. Our imports decrease with increased domestic production, more efficient vehicles and the use of biofuels.



### Clean Energy

Minnesota's energy portfolio changed dramatically over the past decade. We used less coal and more wind and natural gas sources to generate electricity. Today, renewables account for almost 20% of Minnesota's electricity generation annually, up from nearly 6% in 2000. Minnesota is not alone in this shift. Demand for electricity generation from renewables is expected to increase by 49% from 2012 to 2018 globally, according to the International Energy Association. Additionally, Minnesota now meets 10% of its gasoline demand with ethanol made primarily from corn.

\$\$\$\$\$\$\$  
\$\$\$\$\$\$\$  
\$\$\$\$\$\$\$

# \$13 BILLION

Minnesota annually imports \$13 billion worth of energy, including fossil fuels such as coal, oil and natural gas, from other states and countries because we don't have them here.

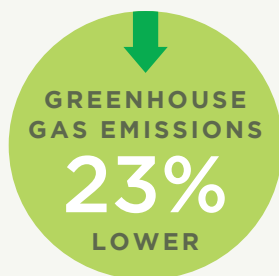


## Shaping Our Energy Portfolio

Many situations and considerations face policymakers as they adjust our energy portfolio to meet Minnesotans' needs, reduce emissions, strive for energy independence and economic growth, and ensure our health in the decades to come.

### State Renewable Energy Standard Is Driving Change

Minnesota's 2007 Next Generation Energy Act is a law that requires utilities to generate at least 25% of their electricity from wind, solar and biomass by 2025 (30% by 2020 for Xcel Energy). Likewise, our state solar energy standard requires investor-owned utilities to meet 1.5% of their electricity needs from solar generation by 2020.



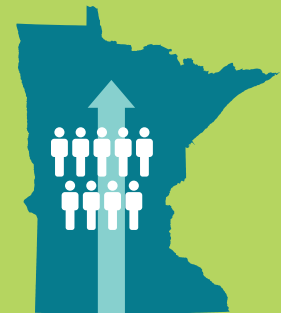
Due in large part to these laws, Minnesota's investor-owned utilities are on track to meet our state renewable energy goals. And, the Minnesota Pollution Control Agency estimates that annual greenhouse gas emissions in 2010 from the electric power sector were 23% lower than they would have been without the laws.



Using wind to generate electricity in Minnesota reduces carbon dioxide emissions by more than 5.4 million metric tons each year, the equivalent of taking about one million cars off the road.

### Energy Demand Is Growing

The energy we use for residential and commercial buildings, transportation, industry (including agriculture), and electricity production has increased over the past three decades.



*Our growing population—partly responsible for growing energy demands—is projected to increase 13% by 2040 and up to 33% in some counties, placing increased pressure on transportation and building services.*

### Our Energy Future Is Our Choice

Minnesota is successfully cutting emissions by increasing energy efficiency, increasing the use of renewable energy, and switching from coal to natural gas at power plants. As we look to the future, we have critical decisions to make about our coal-fired and nuclear power plants, as well as how we integrate increasing amounts of renewable energy into our system. These choices offer opportunities to improve our air and water quality, protecting the health of our communities and ecosystems. Additionally, these choices challenge entrepreneurs and scientists to develop new businesses and to be innovative—and our communities to redefine “business as usual.”



*More than 2,600 solar panels sit atop the Minneapolis Convention Center and help directly power the facility. (Photo Credit: Minneapolis Convention Center)*

# MINNESOTA'S ENERGY

## Our Clean Energy Economy

With an abundance of wind, solar and bioenergy—Minnesota is poised to grow our own clean energy economy, fulfill our own energy needs, and reduce our emissions. In fact, we already are well on our way. Minnesota is the fourth best state for favorable policies and the ninth best state in clean technology leadership, based on a review of technologies, state policies and access to capital. Four clean energy industries in Minnesota already have a strong base from which to grow local businesses. Representing huge potential earnings for clean energy workers, these industries are expected to add more jobs in Minnesota in the coming decades.

### WIND

Minnesota generated nearly 16% of its electrical power from wind in 2013, ranking fifth nationwide. And, in 2013, landowners received more than \$10 million in annual land-lease payments.

**In 2011, large-scale wind power from the upper Midwest was available for just over 3 cents per kWh (\$30/MWh), compared to new natural gas plants at 6-8 cents per kWh (\$61-87/MWh).**

### SOLAR

Minnesota has as much sun to power solar panels—for seven hours a day—as Houston, Texas. This abundance—along with increasing demand for solar, decreasing solar prices and the state's aggressive renewable energy policies—could mean a boon for Minnesota companies in the solar market. Solar demand in the United States increased more than 33% in 2013, and solar energy consumption is projected to increase by roughly 19% in 2014. Driving demand for solar in Minnesota is the state's solar energy standard, which requires investor-owned utilities to meet 1.5% of their electricity needs from solar by 2020.

**Solar module prices plummeted 40% from 2008 to 2012.**



### BIOENERGY & BIOCHEMICALS

We can replace petroleum with fuels and chemicals derived from plants. For more than a century, Minnesota has used its rich endowment of timber and farmland to become a pioneer in bioenergy. Today, the Department of Natural Resources and the Statewide Wood Energy Team are accelerating the substitution of high-cost fossil fuels, such as propane and fuel oil, with sustainably managed wood from Minnesota's forests.

**The Minnesota Department of Natural Resources estimates that we could offset about 3% of our fossil needs with woody biomass.**



### ENERGY EFFICIENCY

The cheapest, cleanest energy is energy we don't have to produce, making energy efficiency an energy resource, just like wind or solar. Minnesota's Conservation Improvement Program requires an annual energy savings goal of 1.5% of retail sales for electric and natural gas utilities. The policy has saved electricity and gas customers millions of dollars over the last few decades and created thousands of stable jobs that cannot be outsourced, such as weatherizing (insulating) homes, installing new windows, and upgrading heating, venting and air conditioning systems and lighting. Today, Minnesota's energy efficiency firms employ about 9,000 people.

#### EFFICIENCY IS CHEAP

The cost to *SAVE* a kilowatt-hour of electricity is about

**1.5 CENTS**

The cost to *BUY* a kilowatt-hour of electricity is about

**8 CENTS**



#### DID YOU KNOW?

Renewables account for almost 20% of Minnesota's electricity generation annually, and our residential electricity rates are still consistently below the national average.

## By the Numbers

### CLEAN ENERGY JOBS



**15,300+** Minnesotans Work in Clean Energy

More than 15,300 Minnesotans work in clean energy. In 2013, these workers added more than \$1 billion in direct wages to the Minnesota economy.



**75%+** Growth in Clean Energy Jobs

Minnesota's clean energy jobs grew more than 75% between 2000 and 2014. By comparison, the total Minnesota economy grew 11% during the same period.

### BIOFUELS EXPORTS



**79%** of Ethanol Is Exported

Minnesota is such a large ethanol producer that we export 79% of what we make.

## Success Stories



**Xcel Energy** has said that wind is now less expensive than a 20-year natural gas contract. The company is the nation's number one purchaser of wind power and operates two wind farms in Minnesota. The American Wind Energy Association named Xcel Energy its "2013 Energy Utility of the Year" for its commitment to wind power.



In 2012 alone, wind energy provided up to 2,000 direct and indirect jobs in Minnesota.



St. Paul-based **SimpleRay** predicts that by the end of the decade Minnesota's solar requirement could boost in-state solar panel sales by a factor of 40. Increasing solar demand, lower prices and aggressive renewable energy policies are driving market growth in Minnesota.



Minnesota solar businesses plan to hire 250 more workers through 2015.



Minneapolis-based startup **SmartThings** developed a cloud-based infrastructure that allows users to control thermostats, lights and other household electronics from their smartphones. The company received \$12.5 million in venture capital investment in 2013.



SmartThings technology makes it easy for consumers to save money and energy.



Downed trees and waste wood were taken from Frontenac State Park to generate energy.



Climate adaptation, mitigation and economic opportunities can be linked to each other. In 2013, overgrown trees and invasive buckthorn were removed from Frontenac State Park to support landscape biodiversity. The waste wood was then brought to **District Energy in Downtown St. Paul** and directly used to generate enough energy to heat 90 homes for one year, displacing fossil fuel sources.

**Segetis**, a biochemical company in Golden Valley, uses plant-based chemicals to displace petroleum products that would otherwise be used in household products. The company's solvents can be found in Method laundry detergent and Seventh Generation cleaning products.

### DID YOU KNOW?

From 2004 to 2013, Minnesota clean energy firms received **\$422 million in venture funding**—more than Wisconsin, Iowa and North Dakota combined. Minnesota solar, wind and bioenergy firms also received **\$10.87 billion in energy project financing**.

# TAKING ACTION

*There is no magic bullet to stop climate change. To prepare for it, we can work together to implement thoughtful strategies that build Minnesota's resiliency, reduce future risks, and provide benefits for our economy, health and natural resources.*

Shifting to cleaner, low-carbon energy sources is one part of the equation. Tracking our greenhouse gas emissions and identifying strategies to significantly decrease (or mitigate) them is another. Weaving in efforts that address how our health and natural resources are being harmed by climate change—and implementing ways to adapt—is also critical.

#### Some Progress, with More Work to Be Done

On the emissions front, between 2005 and 2010, Minnesota experienced modest reductions of 3%. Minnesota will miss its first greenhouse gas emissions reduction target of 15% by 2015.



However, due in large part to Minnesota's Renewable Energy Standard and energy efficiency efforts, **our electric utility sector is on track to reduce greenhouse gas emissions in 2025 by 33% below what levels would be without these programs**, demonstrating that Minnesota's aggressive energy laws and programs are working.

The Minnesota Environmental Quality Board coordinates interagency work and efforts across local, state and federal government to create long-range plans and review proposed projects that would significantly influence Minnesota's environment. The Board is leading efforts to address climate change in Minnesota and to ensure that all our communities are resilient to future risks and changes associated with our evolving environment.

The following pages showcase what Minnesota has been doing to address climate change, what's happening next, and how you can help.

## WHAT IS MITIGATION + ADAPTATION?

### MITIGATION

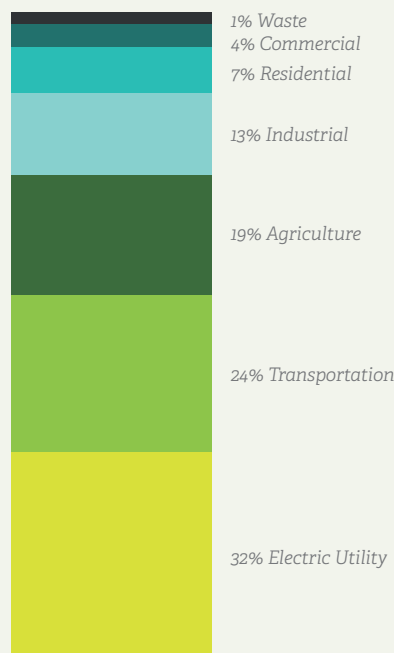
*Reduce emissions to lessen future climate change impacts.*

#### EXAMPLE ACTIONS

- Conserve energy
- Use renewable energy (wind, solar, biofuels)
- Drive energy-efficient vehicles
- Bike, walk and take public transit

## WHERE ARE WE TODAY?

### Minnesota's Greenhouse Gas Emissions Sources



### Our Actions

MITIGATION AND ADAPTATION PROGRAMS,  
POLICIES, LAWS AND INDIVIDUAL ACTIONS

## ADAPTATION

*Prepare for climate change impacts happening now.*

### EXAMPLE ACTIONS

- Plan for storms and heat waves
- Build resilient roads and bridges
- Improve stormwater management systems
- Protect waterways from erosion

## BOTH

*Mitigation and adaptation often work together.*

### EXAMPLE ACTIONS

- Use water wisely
- Install “green infrastructure”
- Plant urban trees
- Use sustainable building practices

## Sector Highlights

### Core Metrics

3%

Reduction in greenhouse gas emissions between 2005-2010. Minnesota will miss its goal of a 15% reduction by 2015.

NEARLY  
20%

The amount of renewables used for electricity generation annually is almost 20%, up from just 5.8% in 2000.

NEARLY  
15%

Clean energy employment grew 14.5 percent from 2012 to 2014, far faster than the 5.3 percent growth of the Minnesota economy overall.



### ENERGY EFFICIENCY AND BUILDINGS

The number of medium-sized power plants that Xcel Energy has not needed to build thanks to efficiency programs in place since 1992.

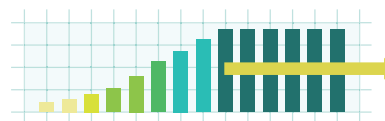
### HEALTH



1,255 ER Visits

The number of heat-related emergency room visits in 2011 statewide.

### TRANSPORTATION



#### Driving Less

After decades of near constant growth, vehicle miles traveled stopped increasing in 2004 and leveled, despite population growth.

+



5.8 Billion Metric Tons  
of Carbon Dioxide

### NATURAL RESOURCES

Minnesota's forests store the equivalent of about 5.8 billion metric tons of carbon dioxide.

### WASTE



\$8.5 Billion in Economic Activity

Minnesota's value-added recycling manufacturers generated approximately \$8.5 billion in total economic activity, including sales, compensation and tax revenue, and supported nearly 37,000 jobs in 2011.

### AGRICULTURE

10%



The amount of gasoline used by Minnesotans that's now displaced by corn-based ethanol.



# ENERGY EFFICIENCY AND BUILDINGS

Minnesota is succeeding in reducing emissions in our electric utility sector—the engine fueling our buildings and industry. Shifting to cleaner energy is a big part of our progress, but energy efficiency is just as powerful. Minnesota's energy efficiency incentives and programs, which have been implemented by utilities, have changed how we use electricity in our homes, construct our buildings and operate our businesses. We're cutting wasted energy and putting money back into our economy with energy savings—proving that with energy efficiency, we can do more with less.

## One Energy Savings Goal, Endless Opportunities

Energy efficiency efforts in Minnesota have been in place since the early 1980s through the state's **Conservation Improvement Program**. In 2007, Minnesota took another big step forward. We added one of the strongest energy efficiency standards nationwide, requiring electric and natural gas utilities to achieve an annual energy savings goal of 1.5% of their retail energy sales.

Today, Minnesotans are incentivized with a variety of tools to save energy and money as a means to a critical end: greater emissions reductions. With utility energy efficiency and rebate programs and a host of state and federal grants and loans, Minnesotans should consider their buildings and industries powerful partners in mitigating the effects of climate change.

## HOMES



We use energy to heat and cool our homes, cook our meals, take hot showers, and power our electronic devices and appliances. Extreme temperatures demand greater energy use, causing Minnesotans' energy bills to change from year to year. In 2012, according to the U.S. Energy Information Administration, the average Minnesota household spent \$1,875 on utility costs each year. Minnesotans are lowering their energy bills and emissions by participating in their utilities' energy efficiency programs, retrofitting existing homes and constructing new homes to high energy standards.

### Energy Savings Tools

**Building Energy Codes**—Minnesota uses the most efficient codes in the nation so that new homes avoid air leaks, inefficient lighting, heating and cooling equipment, and more.

**Home Energy Reports**—Some Minnesota utilities provide reports that show how much energy we use compared to our neighbors. In just two years, the reports helped Minnesotans save \$6 million in utility bills.

**Energy Efficiency Home Improvement Loan Program**—Homeowners can access unsecured, low-interest loans for energy efficiency upgrades to their homes through the Minnesota Housing Finance Agency.

### Paying Off



The first Twin Cities Habitat for Humanity Net Zero home in north Minneapolis is built to the highest levels of energy efficiency, insulated at least three times as much as a regular house and sealed extremely well to keep drafts out.



The first LEED Gold-certified, multi-family residential project created in Minneapolis was completed in 2013. The design of **7west**, a 213-unit apartment building, incorporates features that go beyond typical sustainable construction and energy conservation techniques.



### Energy Savings Tools

**U.S. Department of Energy**—The U.S. Department of Energy provides a variety of energy efficiency and conservation programs for federal-state-S&P.

**Trillion BTU**—A bus... Xcel Energy has funded... created 890 jobs.

**PACE (Property Assessed Clean Energy)**—Property Assessed Clean Energy (PACE) efficiency retrofits on...

### Paying Off



**IRR**  
Iron Range Resource  
Rehabilitation Board

## LOOKING AHEAD

Minnesota is investigating what it would mean to incorporate higher levels of renewable energy and energy efficiency into our electricity sector. The growing momentum of clean energy will require entrepreneurship, innovation and the public to get involved. Some technologies that might become more important are combined heat and power, solar hot water heaters, energy storage, anaerobic digestion and net-zero energy building techniques.



DO YOUR PART

## By the Numbers



### 10 Power Plants

The number of medium-sized power plants that Xcel Energy has not needed to build in its territory thanks to efficiency programs.



### Nearly 2 Million Tons of CO<sub>2</sub> Saved

The number of tons of carbon dioxide that were saved through energy efficiency efforts in Minnesota between 2010 and 2011. This is the equivalent of removing about 400,000 cars from the road each year.



### 8.5 to 1.5 Return on Investment

In Minnesota, utility conservation programs returned an average of 8.5 cents per kWh for every 1.5 cents spent for measures implemented in 2010 and 2011.

## BUSINESSES

In any business, it takes energy to keep the lights on, keep spaces comfortable for workers and customers, and run equipment and appliances. In 2012, according to the U.S. Energy Information Administration, Minnesota's commercial sector spent about \$2.8 million on energy. Experiencing energy inefficiencies in any business is like watching hard-earned money blow out of a drafty doorway. Minnesota businesses and commercial buildings are seizing opportunities to save energy and grow their bottom lines.

### Tools

**Energy State Energy Program (SEP)**—We receive federal funds for state and renewable energy programs that help reduce U.S. emissions. Every \$1 SEP partnership yields \$723 in energy cost savings.

**Business loan program** developed by the St. Paul Port Authority and SEP partnership yields \$723 in energy cost savings.

**Financed Clean Energy**—This financing tool helps businesses make energy efficiency improvements on their properties and pay them back through their mortgages.



St. John's Hospital, Maplewood, received \$875,000 from Trillion BTU and other sources to help finance a \$1 million building automation and efficiency project for its air, heating and cooling systems. \$200,000 per year in energy savings are projected.



The Iron Range Resources and Rehabilitation Board has a project to assist Hibbing businesses with energy efficiency decisions and financing for energy retrofits. Energy savings from 13 projects are expected to save more than \$70,000 a year. Projects employed 18 local contractors and 13 local vendors, yielding 4,900 hours of work.

## PUBLIC BUILDINGS



Energy cost savings in public buildings free up taxpayer money for other priorities. In Minnesota, energy efficiency efforts help achieve a state goal to reduce total energy consumption by 20% throughout all state agencies by 2020. If achieved, Minnesota will reap an estimated \$5.3 million in energy savings.

### Energy Savings Tools

**Guaranteed Energy Savings Program**—Energy-savings contractors pay the upfront cost of retrofits in our school districts, local governments and state agencies, and higher learning institutions. Costs are paid back through energy savings from the installations.

**GreenStep Cities/GreenCorps**—Minnesota's GreenStep Cities is a voluntary program to help communities achieve their sustainability and quality-of-life goals. GreenCorps professionals work with communities, nonprofits and educational institutions on energy conservation efforts.

**SB2030 Standards**—Construction and renovation of large public buildings in Minnesota must meet a mandatory set of design standards that reduce energy use and carbon intensity.

### Paying Off



Energy consumption in the Capitol Complex was reduced more than 20% from 2008 to 2013, saving an estimated \$2 million in utility costs.



The Minnesota History Center has reduced energy consumption 53%, carbon emissions 37% and energy costs 35% over the last seven years.

### Understand your electricity and gas use.

The Environmental Protection Agency's free Home Energy Yardstick software program assesses a home's energy use. Enter information from your utility bill to get started.

### Participate in your utility's energy efficiency rebates and programs to save money and reduce emissions.

### Buy energy efficient appliances and equipment.



# HEALTH

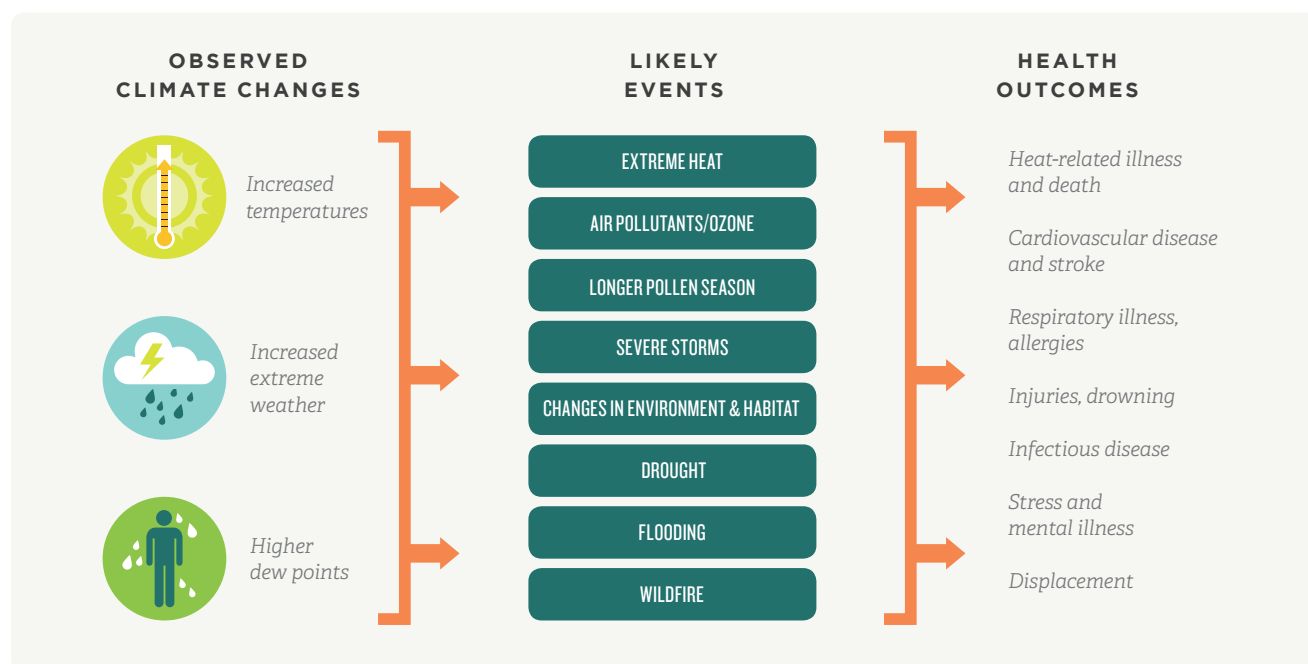
With more powerful and intense weather events upon us today, human health is now a leading climate change issue. Extreme weather increases flooding, overwhelming storm water systems and potentially contaminating recreational and drinking water, which may be in short supply due to drought. Heat illness, respiratory problems, food security and property loss add to the list of concerns among public health officials. Minnesotans can learn about climate-induced health risks, and towns and cities statewide can make changes that build their resilience and improve their communities.

## WHAT'S HAPPENING?

### Climate Cause and Effect: When Health Professionals Get Involved

How people's health is affected by climate change can be as complex as it is overwhelming. Obvious problems are heat stroke and exhaustion; injuries sustained from extreme weather; or asthma aggravated by poor air quality. But what about food safety or an influx of heat-loving, disease-carrying ticks and mosquitoes?

Climate change impacts human health in many ways, including extreme heat, water and air quality, agriculture and food security, and mental health. Some populations are more vulnerable than others, including children, the elderly, and people living in poverty. They are particularly susceptible or lack resources to respond to bad air days, heat waves or storms.



### LOOKING AHEAD

With powerful storms forecasted for years to come, towns are investing in safety and taking steps to reduce future damages. The Division of Homeland Security and Emergency Management (HSEM) helps towns envision their future, offering grants and planning resources for "mitigation measures" that reduce or eliminate the severity of future disasters. For example, when a 1,000-year flood hit Zumbro Falls in 2010—its fourth significant flood since 1970—community leaders had enough. The town of 200 secured \$1.9 million in city, state and federal funds to buy out 14 homeowners and one business on "Water Street," preventing future damage and protecting residents. The green space now provides an area for community festivals and cultural events, showing that good can come from painful changes. Also with HSEM's help, Wadena-Deer Creek added a tornado-safe room to its school. And, Moorhead secured a new water pumping system so water is safe to drink during the Red River Valley's flood season.

## By the Numbers



*Estimated damages from air pollutants emitted by electricity generation each year. These pollutants cause most harm to humans near the source who suffer from asthma and cardiovascular disease.*



*Estimated damages to property in Minnesota due to extreme weather between 2000 and 2012.*

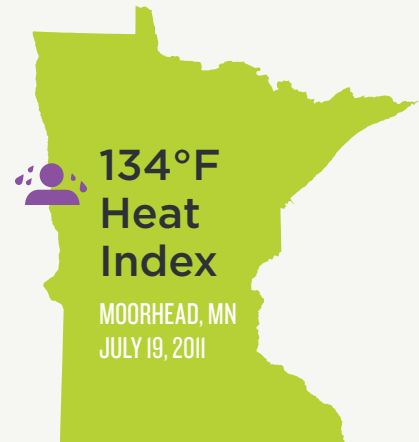


*The number of heat-related emergency room visits in 2011 statewide, 168 more than the previous decade's high of 1,087 visits (2001).*

## Keeping Our Cool When Heat Hits

When Moorhead was the hottest place on Earth with a heat index of 134°F on July 19, 2011, only two Minnesota public health departments had a heat-response plan. That summer, five heat episodes resulted in heat advisories or warnings, and the number of emergency department visits statewide alarmed state health officials. To help prepare communities, the Minnesota Department of Health developed the **Minnesota Extreme Heat Toolkit**, offered online and through trainings. The agency also helps communities map populations that are vulnerable to heat-related illness against other risk factors, such as lack of resources. For example, the Minneapolis Health Department and the Minnesota Department of Health used Geographic Information System (GIS) maps to pinpoint where Minneapolis residents could access a public building with air conditioning during a heat wave.

### HOTTEST PLACE ON EARTH



## Improving Our Air Quality

A 2001 state law allowing Minnesota utilities to recover the costs of moving to cleaner technology with a modest cost to customers improved metro-area air quality. Xcel Energy's Metropolitan Emissions Reduction Project added state-of-the-art emissions controls to its Oak Park Heights plant and converted coal-fired plants in northeast Minneapolis and near downtown St. Paul to natural gas.

**As a result of Xcel Energy's overall project efforts, emissions that can cause respiratory diseases dropped by more than 90% and carbon emissions fell 21%. Customers paid less than expected, and the plants' total production increased.**



*Converted for natural gas production, the Xcel Energy High Bridge Generating System in Saint Paul came on line in May 2008.*



Create your extreme weather emergency plan.

Heed heat advisory, storm and air-quality warnings.

Drive less and walk more to boost your health and cut your use of gasoline.

# TRANSPORTATION

Over the last decade, Minnesota has seen transportation-related emissions decline with a combination of people driving less and using more fuel-efficient vehicles and lower-carbon fuels. Reductions are expected to continue if we do more of the same. However, opportunities for greater reductions are linked to questions of how to meet growing demand for cleaner, more efficient transportation and update Minnesota's aging transportation infrastructure. Extreme weather adds to the challenge. Harsh winters cause outbreaks of potholes that strain city, county and state budgets. And, flooding events can severely damage roadways, debilitating communities and costing millions.

## From Point A to Point B with Less Impact

Congestion and idling consumes more fuel and adds emissions. These traffic management practices from the Minnesota Department of Transportation (MnDOT) keep us moving.



**Roundabouts eliminate idling**  
at signals, reducing vehicle  
emissions and fuel consumption  
by 30% or more.



**300 miles of bus-only shoulders**  
in the metro have for decades  
allowed buses to bypass congestion,  
increasing ridership.



**MnPASS lanes**  
provide an alternative to heavy traffic.  
Solo drivers pay; buses, carpools  
and motorcyclists do not.

## Transitioning from Gasoline to Renewable Fuel Sources

By 2015, Minnesota aims to displace 14% of petroleum with biofuels, such as ethanol and biodiesel. Biofuels can reduce vehicle emissions and decrease our reliance on imported oil. Through a public-private partnership, the **Drive Electric Program** is expanding charging stations for electric vehicles, which reduce emissions by about 40% compared to gas-powered vehicles. Public stations are installed at 150-plus sites, including the Minneapolis-St. Paul Airport, the Depot in Duluth, downtown Rochester, and metro ramps and parking lots. Down the road, wind- or solar-generated electricity may power stations, reducing emissions even more.

**30%**

Minnesota's goal is to  
transition 30% of our gasoline  
to biofuels by 2025.



Metro Transit reduced CO<sub>2</sub>  
exhaust emissions and saved more  
than \$300,000 over a five-month  
period in 2013 by using B-10 and  
B-20 fuel blends in its buses.

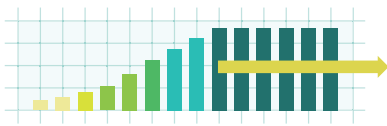


St. Cloud is the nation's first city  
to have a public bus powered by  
recycled vegetable oil.

## LOOKING AHEAD

The Metropolitan Council predicts the seven-county metro region will add 800,000-plus people by 2040. While not all cities in the state will continue to grow, jobs and services are consolidating in small urban areas and regional centers. As the population distribution changes, we may need to expand our public transit and design more bike-friendly and walkable communities.

## By the Numbers



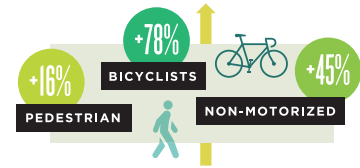
### Driving Less

After decades of near constant growth, vehicle miles traveled stopped increasing in 2004 and leveled, despite population growth.



### Using Less Fuel

Since 2007, annual transportation fuel usage dropped by more than 10% due to more fuel-efficient vehicles and decreases in driving and other factors.



### More Transit Use, Biking and Walking

Transit ridership hit 105 million in 2011, an overall increase since 2003. Biking and walking in Minneapolis and Saint Paul has increased markedly from 2007–2013.

## Paving the Way for Low-Emission Travel

Choosing to walk or bike instead of driving for trips less than one mile can significantly decrease carbon emissions. You can lower your emissions further with longer trips. Minneapolis is consistently recognized as one of the most bike-friendly communities in the United States, reducing tens of thousands of tons of carbon per year.



Reconstructed Highway 68 in Marshall

*MnDOT's Complete Streets policy ensures roads in any size community work for everyone. Walkers, bicyclists and transit users can safely travel to their destinations. Reconstructed Highway 68 through Marshall features bike lanes, sidewalks, curb bump-outs, and better lighting.*

*Climate-friendly land-use and development planning helps reduce miles traveled. "Region 5"—Cass, Crow Wing, Morrison, Todd and Wadena counties—uses Resilient Region planning strategies and tools to incorporate long-range transportation plans for Safe Routes to School and bike and walking paths.*

## Building Roads to Withstand Extreme Weather

In recent years, intense rains and floods have cost Minnesota communities hundreds of millions in damage to roads and bridges. **Minnesota is starting to dedicate resources to fortify key roads, including \$50 million for the Statewide Flood Mitigation Program.** By 2016, approximately 30 projects in towns across the state, from Ada to Ortonville and Chanhassen to Breckenridge, will be completed.

## Economic Win-Win: Connecting People to Jobs

Mass transit—including light-rail and bus rapid transit—reduces emissions by taking drivers off the road. It also connects thousands of Minnesotans to jobs. In a two-year period after light-rail service began, the number of low-wage jobs reachable within 30 minutes of transit travel jumped by 14,000 in light-rail station areas and 4,000 in areas with direct rail-bus connections. As light-rail extends into suburban locations, it will link to some of the region's largest employers. Along the proposed Green Line Extension, for example, UnitedHealth Group is building a 70-acre campus for 6,700 employees in Eden Prairie near a planned light-rail station.



**Drive smart—go easy on the brakes and idle less.**

**Take the bus, bike or walk when you can.**

**Choose the cleanest, most fuel-efficient vehicle you can.**

### DID YOU KNOW?

Ongoing and projected vehicle fuel economy improvements, in part driven by federal fuel efficiency standards, will reduce emissions that are equivalent to taking millions of vehicles off of the road.

For more tips, visit the Environmental Protection Agency's Transportation and Climate webpage.

# AGRICULTURE

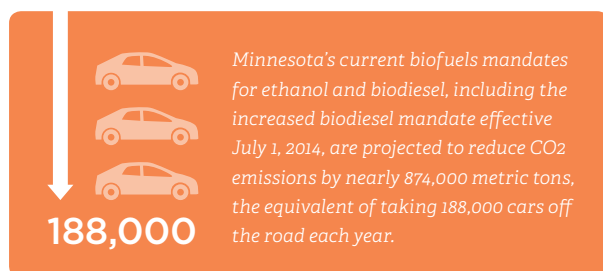
Over time, longer growing seasons and more carbon dioxide in the atmosphere from climate change may boost crop yields, but extreme weather swings and invasive species may increase the risk of crop failure. If Minnesota agriculture were disrupted, it would impact our economy and affect the global food supply. On the flip side, agriculture plays a role in climate change, releasing emissions through fertilizer application and certain field practices. Farmers face critical decisions about how to meet a growing population's needs, while protecting the environment—the foundation of their livelihood and everyone's quality of life. There are no easy answers, but state leaders, farmers and agricultural businesses will need to work together to address this challenge.

## Displacing Fossil Fuels with Energy from Plants

The agriculture industry is producing homegrown energy in a number of ways, keeping energy dollars in Minnesota and reducing the state's fossil fuel consumption. "Bioenergy"—energy from organic matter, such as plants, wood or residues from agriculture or forestry—can provide biofuels for transportation and biomass for electricity and heat.

### Biofuels

Biofuels displace the amount of fossil fuels that we use. In Minnesota, corn-based ethanol and soybean-based biodiesel have reduced our fossil fuel usage and grown our rural economy by billions of dollars.



By 2015, Minnesota aims to transition 14% of our gasoline to biofuels. (By 2025, we are striving for 30% in biofuels.) Minnesota was the first state to mandate the use of ethanol in its fuel supply. In doing so, the state moved from substandard air quality to achievement of the Clean Air Act standard by the mid-90s.

### Advanced Biofuels

In a retrofitted ethanol plant in Luverne, GEVO, a renewable chemicals and advanced biofuels company, produces isobutanol. With 30% more energy content than conventional biofuels, isobutanol already is used as jet fuel in army helicopters and as a replacement for fossil-fuel-based chemicals for making plastics, rubber, textiles, paint solvents and more.

### Biomass

Biomass from agricultural and forestry byproducts can be used to produce heat and electricity.

### Koda Energy

A combined-heat-and-power plant in Shakopee, Koda Energy is a joint venture with Rahr Malting Company and the Shakopee Mdewakanton Sioux Community. Koda Energy burns agricultural and plant seed byproducts to create steam to generate energy in the form of electricity and heat. Rahr Malting uses residual heat from electricity generation in its malting process, replacing natural gas usage. The community is exploring burning native prairie plants in Koda Energy's facility, which could drive conversion of less-productive cropland to grassland cover and energy crop production; reduce agricultural runoff; and create wildlife habitat.



General Mills provides Koda Energy about 160–200 tons of oat hulls from the processing of its cereals each day.

## LOOKING AHEAD

Questions about rising on-farm emissions and protecting water quality are pressing, particularly when crop prices are fluctuating and land prices are high. Between 2007 and 2012, higher crop prices, increased land values and fewer federal conservation incentives encouraged conversion of about one million acres of Minnesota conservation and pasture land to row crops, lowering carbon sequestration. On the horizon, cutting-edge projects offer potential new opportunities to reduce emissions. For example, the University of Minnesota's West Central Research and Outreach Center in Morris has launched a process that takes energy from wind, converts it to hydrogen, and then to ammonia that can be used as fertilizer on surrounding farmlands. Fertilizer accounts for a significant portion of corn production's carbon footprint. Producing fertilizer in a renewable way could significantly reduce its impact.



## By the Numbers

### ECONOMIC IMPACT



**\$75 billion** per year

In Minnesota, agriculture and related businesses generate approximately \$75 billion per year for our economy and employ nearly 350,000 people.

### BIOFUELS



**12,600 jobs** and \$5 billion

Total jobs and economic output, respectively, from Minnesota's ethanol industry in 2011.



**10%**

The amount of corn-based ethanol Minnesotans use instead of gasoline. In 2011, Minnesota exported 880 million gallons, or 79%, of the ethanol it produced.

## Protecting Our Waters

When it rains or when snow melts, water runs off of farm fields, carrying sediment, fertilizers and pesticides to ponds, lakes and streams. The **Minnesota Agricultural Water Quality Certification Program** helps farmers adopt on-farm conservation practices that protect nearby waters from agricultural runoff—a critical step in preserving our water quality as we adapt to climate change.



Grassed waterways in the Root River watershed in southeastern Minnesota prevent soil erosion while draining runoff water from adjacent cropland.

Farmers receive technical assistance and a combination of federal and Minnesota Clean Water Legacy funds for a variety of activities, such as removing excess pollutants by filtering water through grasses and other vegetation; adopting tilling methods to minimize erosion; and drainage methods that reduce water runoff into waterways. Upon certification, a farmer will obtain regulatory certainty for a period of 10 years. The program—piloted in four watersheds touching Olmsted, Wabasha, Winona, Stearns, Jackson, Martin, Faribault, Wilkin and Otter Tail counties—could become a model for other parts of the country.

## Reducing Emissions by Changing the Way Business Is Done

Minnesota farmers are improving their bottom lines—and reducing their carbon footprints—by changing the way they work. For example, with new technology and seed quality, tractor trips across fields are reduced, lessening emissions. Fertilizing crops with a precise amount at the right time, with the right techniques, keeps nutrients in the soil and lowers nitrous oxide emissions.

Using renewable energy sources on the farm, cover crops and livestock grazing are other strategies. For example, cover crops can be planted when the soil would otherwise be bare before a crop emerges in spring or after fall harvest. These grasses, legumes or other plants improve soil fertility, hold nutrients for the next crop, help sustain ecosystems for wildlife, and improve the land's ability to absorb carbon.

### Cover Crops



Grasses, legumes and other plants keep soil covered and sequester carbon.

Ian Cunningham, a fourth-generation farmer in Pipestone, plants cover crops and tills his land less to increase his soil's health and the likelihood cash crops will be more profitable. A mix of annual grasses, broadleaves and winter cereals, grown between corn and soybean crop seasons, also reduces stormwater runoff and helps the soil retain moisture, especially during dry periods. After harvest, Cunningham's cattle graze cover crops and crop residue, such as cornstalks, reducing feed costs and naturally fertilizing the soil.

### Renewable Energy



Solar power can help reduce on-farm energy use and emissions, and save money.

Years of heavy rains and flash flooding near Featherstone Farms in Rushford caused owner Jack Hedin to consider the future of agriculture, climate change and how he could reduce his 250-acre farm's energy use and increase its efficiency. With financial assistance from the Minnesota Department of Agriculture, customers and friends, Hedin installed a 38-kilowatt photovoltaic array on a shed roof, which powers about half of his farm's operations.



Learn about how your food is grown. Start by visiting the [Minnesota Grown](#) website.

Purchase food from local producers at your grocery store or farmers market.

Try renewable fuels.

# NATURAL RESOURCES

Minnesota's lakes and rivers, towering pines, rolling prairies and wetlands are iconic. But these trees, waters and lands also are an important part of our economy, home to wildlife and where we go for outdoor recreation. They also contribute to the big climate picture: America's forests, grasslands and wetlands absorb about 40% of our greenhouse gases. How to sustain the diversity and health of Minnesota's natural resources so they mitigate climate change—and build resilience to it—are questions facing us now. Conservation is one answer.

## Water

Minnesota is known as the “Land of 10,000 Lakes,” but our **surface water** resource actually includes 11,842 lakes greater than 10 acres and nearly 70,000 miles of rivers and streams. Our **groundwater** resource includes several aquifers that support about 400,000 drinking water wells. As the headwaters of the Mississippi, Great Lakes and Red River, virtually all of Minnesota's available water comes as rain and snow.

Climate change leads to problems with too much and too little water. Ensuring the water we have remains clean and abundant requires wise management and conservation.

### Too Much Water

Intense storms cause flash and river flooding, putting the quality of our water at risk. When stormwater flows over land and pavement, it gathers trash, chemicals, animal waste and other contaminants that can pollute waterways and drinking water.

One inch of rain falling on a one-acre parking lot (about the size of a football field) generates enough stormwater runoff to fill three 9,000-gallon semi-tanker trucks.

Increased flows can overwhelm our water infrastructure, such as storm sewers. We can minimize the magnitude of stormwater runoff and flooding—while improving water quality—by restoring wetlands, which store and filter excess water. Innovative technology helps, too. For example, green infrastructure uses trees, shrubs and rain gardens to manage rainwater where it falls, before it flows to waterways. Its vegetation also beautifies landscapes and reduces emissions.



*Maplewood Mall*  
55 rain gardens, 6,733 square feet of permeable pavers, 375 trees, and one decorative 5,700-gallon cistern built to catch stormwater greet visitors. Together, they help intercept 20 million gallons of runoff per year before it reaches nearby Kohlman Lake.

### Too Little Water

Minnesotans use water for drinking, cooking and sanitation; growing crops and lawns; running businesses; and generating electricity. Water also supports natural habitats and contributes to our quality of life.

Our water supplies are at risk from drought and overuse. And, less predictable rainfall poses further challenges. When rain falls hard and fast, for example, it lowers the likelihood that water will saturate sub-soils and recharge or “refill” our aquifers, decreasing our water supply. Our growing population and development, which require more water, add to these challenges.

Efficient use and careful management are needed to sustain many water-dependent habitats and businesses.



#### *Bob and Steve's Shell*

*Facing well levels nearly 12 feet below the 16-year average in Worthington in 2014, the gas station decided to stop selling its top two car washes to help conserve water. The move saved about 30% of the station's water usage, while only reducing revenue slightly.*

## LOOKING AHEAD

Ensuring sustainable use of our groundwater and protecting its quantity and quality are key concerns for our future. Studying our demand for groundwater and methods to protect this water source and ecosystems for future generations are underway. The Department of Natural Resources is piloting Groundwater Management Areas in three areas with stressed resources: the north and east metro, the Straight River area and Bonanza Valley. The projects will help state agencies, local communities and water users understand how to work together to address groundwater challenges.



## By the Numbers

### WATER USAGE ON THE RISE



**1.4 Trillion** gallons of water per year

Minnesotans' overall water use has risen from about 850 billion gallons per year in the mid-1980s to almost 1.4 trillion gallons per year in 2010.

### CARBON REDUCTIONS, NATURALLY



**15 Billion** metric tons of CO<sub>2</sub>

Minnesota's peatlands are estimated to store the equivalent of about 15 billion metric tons of carbon dioxide.



**5.8 Billion** metric tons of CO<sub>2</sub>

Minnesota's forests store the equivalent of about 5.8 billion metric tons of carbon dioxide.

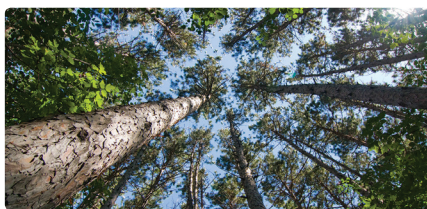
## Trees

Trees sequester, or absorb, carbon dioxide from the atmosphere. They convert the carbon dioxide into oxygen, which they release. They store the remaining carbon in their wood.

*In one year, an acre of trees absorbs the same amount of carbon dioxide produced by driving a car 2,700 miles. The DNR manages more than 3.5 million acres of state forestland with sustainable management practices that improve carbon retention, soil quality and habitats.*

### Conserving Carbon Reducers

**Minnesota Forests for the Future Program** uses state, federal and private dollars to protect large blocks of private forestland that could instead be converted to other land uses. These easements protect our forests' carbon-storing capacity and conserve timber-related jobs; increase public access for recreation; and build our resiliency to climate change. Continuous forests speed recovery from wildfires, floods and droughts, and preserve animal and plant habitats.



The **Upper Mississippi Forest Project** protects more than 187,000 acres of northern forests; more than 60,000 acres of wetlands; and 280 miles of shoreline. A working forest, the property supplies 17 manufacturing facilities supporting more than 3,200 families. Combined with adjacent public forestlands, the project connects more than 4,000 square miles of uninterrupted habitat.

### A New Way Of Planting

Community tree gravel beds—irrigated boxes filled with gravel—hold bare root trees for three to six months. The trees develop a dense network of roots, increasing chances they will survive once planted and thrive for generations. More than 25 Minnesota communities use gravel-bed systems, from Hendricks (pop. 700) to Rochester. Building on its own success, the **Sherburne County Soil and Water Conservation District** established a tree gravel bed for six communities in the county to share.

#### The Helping Tree

One large tree provides almost \$4,000 in environmental and other benefits over its lifetime. Here are just a few:

Trees near buildings can reduce the demand for heating and air conditioning.

Tree-filled neighborhoods report lower levels of domestic violence, are safer and more sociable, and reduce stress.

## Land

Sound land management prepares us for a changing climate and provides an opportunity to store and capture carbon. Preserving and restoring wetlands, prairies and grasslands, and buffer zones by lakes and streams, reduces the vulnerability of ecosystems, wildlife populations and critical carbon stocks.

*With climate change, Prairie Pothole Region wetlands could shrink and shift optimal waterfowl breeding conditions from Canadian prairies and the Dakotas into western Minnesota. Without major restoration efforts to replace drained wetlands there, ideal habitat for ducks could gradually disappear.*

## Striving for Balance

Minnesotans made a significant commitment to conservation by passing the **2008 Clean Water, Land and Legacy Amendment**. Funded by the amendment, the Minnesota Prairie Plan balances the needs of prairie-wetland ecosystems with working farmland, including cropland and pastureland. Its goal is to protect remaining prairies and connect them with a corridor of high-quality habitat for wildlife such as ducks, meadowlarks and Monarch butterflies. The plan's goals have multiple co-benefits including protecting and increasing the carbon stored in grasslands and wetlands and enabling greater ecological resilience to climate change.



Plant trees and other native plants in your yard and community. Visit the [Minnesota Shade Tree Council website](#) to learn more.

Use water wisely. Get started on the [Minnesota Pollution Control Agency's Conserving Water webpage](#).

Collect rainwater and use it to water your lawn.

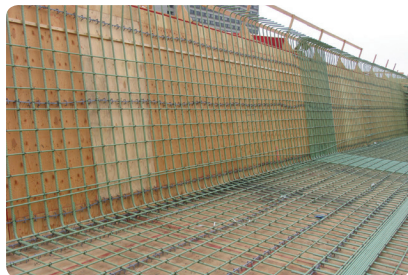
# WASTE

Managing our trash and wastewater—the water we use for washing, flushing and manufacturing—emitted nearly 2.3 million tons of greenhouse gases in 2010. While our waste-handling emissions have risen, towns and businesses are working to decrease pollution, turning waste into opportunity. Most waste-related emissions are from methane-producing landfills. Minnesotans can help by reducing their waste and reusing, recycling and composting more. Reducing electricity we use to manage our waste and wastewater is also critical.

## Reduce, Reuse, Recycle and Compost—And Boost Our Economy

An effective way to reduce greenhouse gases from landfills is to put less in them. Reducing what we consume; recycling and composting more of what we throw away; and reusing items or repairing and renting what we need (rather than buying new) can significantly reduce emissions. These practices also provide tens of thousands of jobs and billions of dollars in economic activity in Minnesota.

### Recycle More, Add Jobs



From 2004 to 2011, nearly 6,200 direct jobs were created by Minnesota recycling manufacturers—companies that make products from recycled materials and their suppliers. **Gerdau Ameristeel**, South St. Paul, is one of 200 Minnesota recycling manufacturers that prefer locally sourced recyclables for their products. The company uses steel cans from your curbside collection to make steel rebar, 7 million pounds of which was used to help rebuild the 35W bridge.

### Lost Opportunity

Minnesota recycling programs collected material worth almost \$700 million in 2010, yet Minnesotans discarded 1 million tons of recyclables worth \$210 million and spent \$200 million to dispose of it.

### Composting Together



**Full Circle Organics Recycling Cooperative and Dodge County** collect food waste from grocery stores and restaurants, combining it with yard waste to produce garden and landscape compost. In a two-year pilot, Erdmans County Market in Kasson diverted 56 tons of food trimmings and waste. That's 28 tons of rich soil for gardeners and landscapers.

### Rethinking Curbside Recycling



Since switching to single-sort recycling in 2013, **Minneapolis** has experienced a 33% increase in the volume of recyclables collected in about one year. **Winona County** has added curbside collection countywide, both single-sort and expanded-plastic collection. Ninety-six percent of Winona County residents are participating in the new program. Cities and counties with single-sort recycling can maintain participation at these levels with continuous and regular education.



More than 70% of landfill waste could be recycled or composted, conserving resources and preserving landfill capacity.

## LOOKING AHEAD

“Doing more of everything”—from recycling to composting in any town, home or business—will greatly reduce our emissions from waste. By 2030, seven metro-area counties hope to achieve aggressive waste-related goals. To that end, they are now implementing a number of activities, such as assisting businesses in expanding what they reuse and recycle and offering fix-it clinics for anyone wanting to repair small appliances, electronics and more. At a state level, an adjustment to Minnesota’s composting rules aims to increase opportunities for people to compost at home. Certain composting facilities will face fewer regulatory requirements when accepting organics, such as food and yard debris, separated from other waste.

## By the Numbers

### CAPTURING POLLUTION



**2.1 Million Tons** GHGs Captured

Over the last decade, Minnesota has steadily captured and controlled more methane emissions from solid-waste landfills. In 2011, about 2.1 million tons of greenhouse gas emissions were captured, a roughly 50% increase from 2000.

### ECONOMIC IMPACT



**46,000** Full-Time Jobs

More than 46,000 full-time workers are employed by Minnesota businesses that deal in rented, repaired or reused goods. The businesses generate \$1 billion in wages and \$4 billion in sales annually.



**\$8.5 Billion** in Economic Activity

Minnesota's value-added recycling manufacturers generated approximately \$8.5 billion in total economic activity, including sales, compensation and tax revenue, and supported nearly 37,000 jobs in 2011.

## Landfill Gas—Converting a Problem into Power

As landfill-waste decomposes, it produces methane, a greenhouse gas with global warming potential more than 20 times as potent as carbon dioxide. To tackle this problem, some Minnesota landfills capture and convert methane into electricity, heat or fuel for equipment. Besides decreasing methane gas in the atmosphere, the process produces renewable energy and avoids carbon emissions from fossil fuels.

The **Crow Wing County Landfill** in Brainerd collects its landfill gas and uses a portion of it to heat a maintenance building, replacing natural gas. The remaining landfill gas is flared, or destroyed.

Minnesota has 21 landfills in operation, nine of which employ gas collection and recovery systems. Statewide, 109 closed landfills (full and monitored for pollution) participate in the voluntary Closed Landfill Program. A number of these landfills captured and prevented a combined 28.4 million pounds of methane gas from entering the atmosphere in 2012.

## Using Less Electricity at Wastewater Treatment Plants

Pumps, motors and other equipment that clean and recirculate water used in our homes and workplaces run around the clock. That's why water and wastewater facilities are among the largest users of a community's energy—and the largest contributors to its emissions. Electricity accounts for 25% to 40% of a wastewater utility's operating budget. Cities reduce their plants' energy use by conserving water, which lessens the amount of water that must be treated; investing in new, more efficient equipment; and switching to renewable energy.

**Metropolitan Council Environmental Services** saves \$600,000 annually after switching Blue Lake, Minnesota's fourth-largest wastewater treatment plant, from natural gas to renewable "biogas" generated by anaerobic digesters. The Shakopee plant produces biogas equivalent to the natural gas usage of nearly 820 Minnesota homes. Additionally, 10% of Blue Lake's power will come from on-site solar panels in the near future.



The Blue Lake wastewater treatment plant treats an average of 29 million gallons of wastewater per day.



Think before you open your garbage can. Most materials can be recycled or composted instead.

Learn what you can recycle and compost in your county.

Start a backyard compost pile for food scraps, yard trimmings and other organic waste.

Buy used goods, not new, when possible.

### DID YOU KNOW?

Habitat for Humanity ReStores help reduce landfill-waste by offering the public a way to donate and buy gently-used building materials, appliances and furniture. Twelve Minnesota stores sell goods, using proceeds to build nearby homes.

# Minnesota & Climate Change: Do Your Part



## Conserve More Energy

Conserve energy in your house:

[www.energystar.gov/index.cfm?fuseaction=home\\_energy\\_yardstick.showgetstarted](http://www.energystar.gov/index.cfm?fuseaction=home_energy_yardstick.showgetstarted)

Buy energy-efficient appliances

Walk, bike, carpool and take public transit



## Eat Local

Plant a garden

Buy local! [www3.mda.state.mn.us/mngrown](http://www3.mda.state.mn.us/mngrown)

Compost waste in your backyard

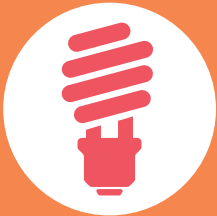


## Make Yourself Resilient

Prepare for extreme weather: [www.health.state.mn.us/oep/prepare](http://www.health.state.mn.us/oep/prepare)

Learn about how climate could be impacting your health:

[www.health.state.mn.us/divs/climatechange](http://www.health.state.mn.us/divs/climatechange)



## Educate Yourself

Learn more about climate change: [nca2014.globalchange.gov](http://nca2014.globalchange.gov)

Watch this video: [www.health.state.mn.us/divs/climatechange/climatevideo.html](http://www.health.state.mn.us/divs/climatechange/climatevideo.html)



## Start Climate Conversations

Talk with others about climate risks and how you use energy and natural resources

Contact your elected officials to find out what they are doing



## Protect Your Natural Resources

Conserve water: [www.metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Water-Conservation-Toolbox-Customers.aspx](http://www.metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Water-Conservation-Toolbox-Customers.aspx)

Learn about recycling: [www.rethinkrecycling.com](http://www.rethinkrecycling.com) and [recyclemoreminnesota.org](http://recyclemoreminnesota.org)

Plant trees and native plants in your community

# Credits

This report was developed by the Minnesota Environmental Quality Board (EQB), with contributions from the Interagency Climate Adaptation Team and EQB partner agencies. Funding was provided by the McKnight Foundation.

## EQB Partner Agencies

- Board of Water and Soil Resources
- Department of Administration
- Department of Agriculture
- Department of Commerce
- Department of Employment and Economic Development
- Department of Health
- Department of Natural Resources
- Department of Transportation
- Metropolitan Council
- Pollution Control Agency

## Source Information and Photos

For more information about the source information used in this report, please visit the Minnesota Environmental Quality Board website. All photos in this report were used with permission granted to the Minnesota Environmental Quality Board. All trademarks mentioned within this report are the property of their respective owners.



## About the EQB

*Comprised of five citizens and the leaders of nine state agencies to develop policies, the EQB creates long-range plans and reviews proposed projects that significantly influence Minnesota's environment.*

Start the Climate  
Change Conversation!



**Environmental  
Quality Board**  
520 Lafayette Road  
St Paul, MN 55155

PLACE  
STAMP  
HERE



Printed on 100% post-consumer waste recycled paper.  
The state of Minnesota is an equal opportunity employer and service provider.  
Upon request, this document can be made available in alternative formats by calling 651-259-7114.  
08-2014



# Minnesota and Climate Change:

## How Would You Start The Conversation?



WORK



LIVE



PLAY