



Climate Solutions and Economic Opportunities



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The Environmental Quality Board

Outline

- Why we care about climate in MN
- Federal and state action
- An economic perspective
- What do we do next? State strategies for climate action

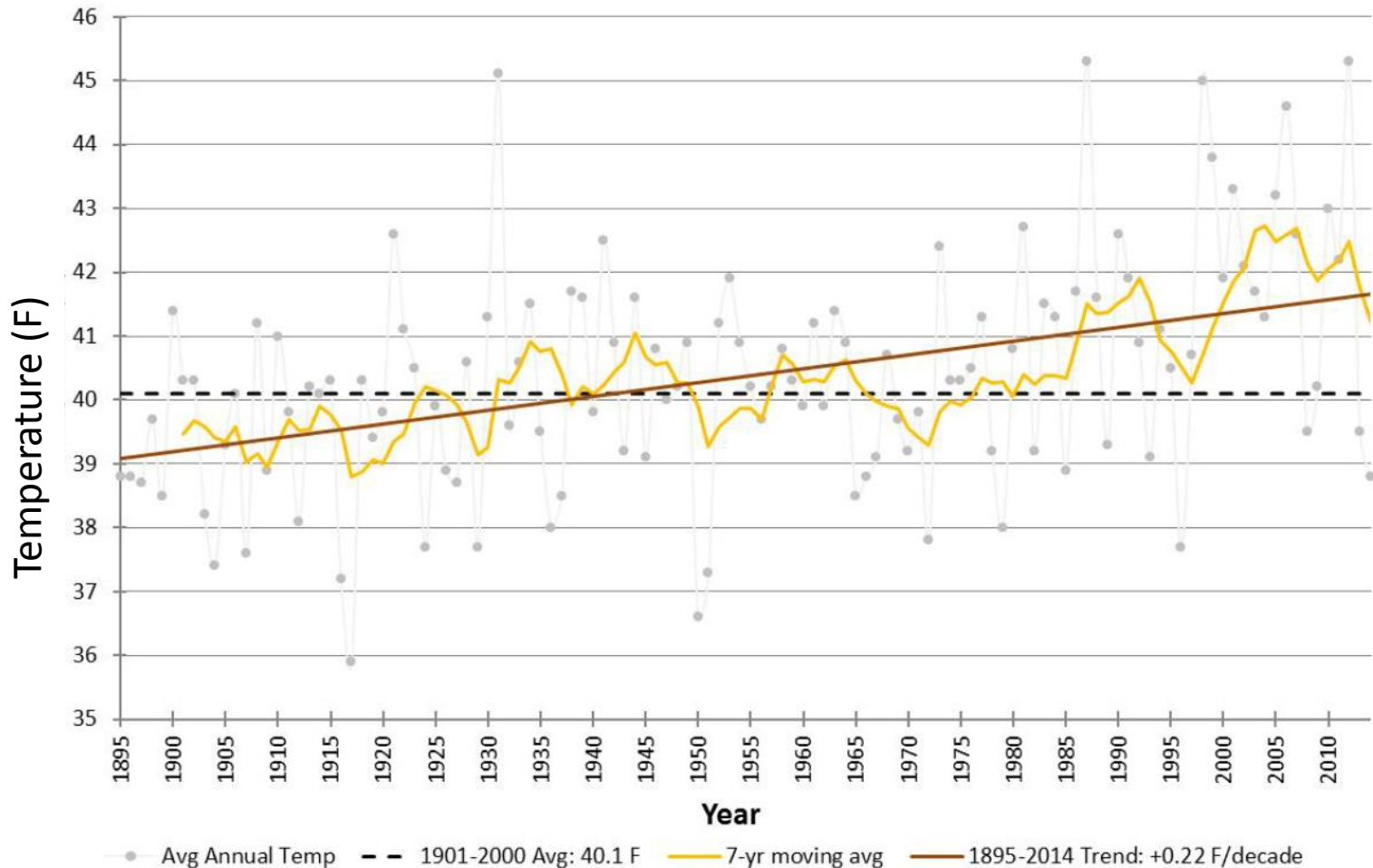
The Environmental Quality Board (EQB)



- Governor's office
- Five citizen members
- Board of Soil and Water 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

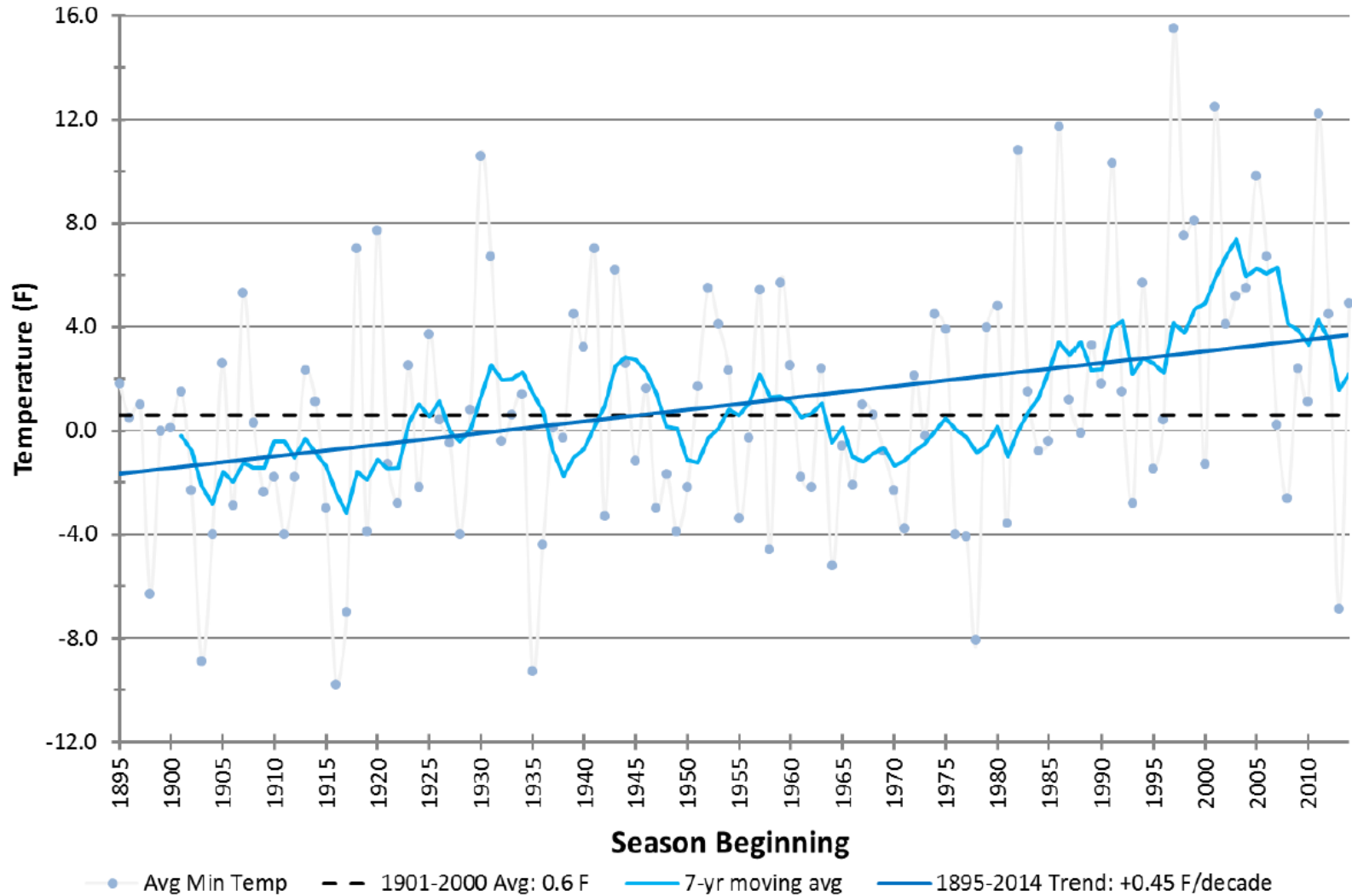
Warming is well underway in Minnesota

Minnesota, Statewide Average Temperatures
1895-2014



Cold temperatures warming fastest

Minnesota, Average Daily Minimum Temperatures
Winter (Dec - Feb) 1895-2014



“Extreme heat, heavy downpours, and flooding will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will also exacerbate a range of risks to the Great Lakes.”

- National Climate Assessment

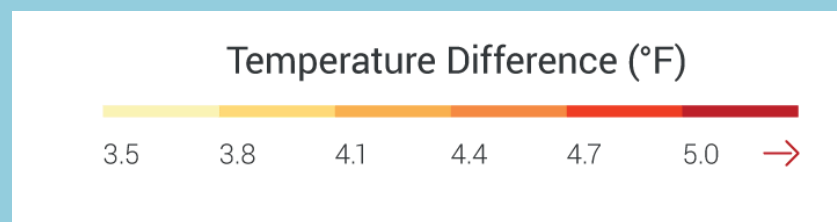
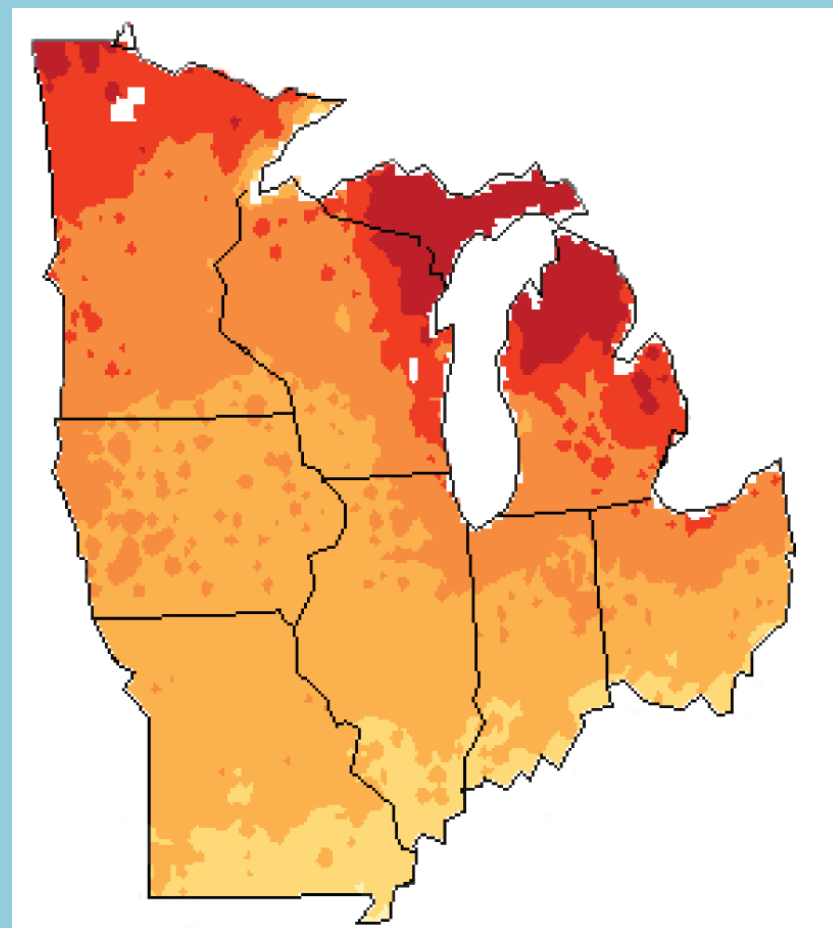


Figure source: NOAA NCDC / CICS-NC

Minnesota is already paying a price for climate change



\$4.3 Billion

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



Fig. 1-11. Flood damage along Whitewater River exceeded \$4 million at Whitewater State Park.

Climate Change Impacts our Health

OBSERVED CLIMATE CHANGES



Increased temperatures



Increased extreme weather



Higher dew points

LIKELY EVENTS

EXTREME HEAT

AIR POLLUTANTS/OZONE

LONGER POLLEN SEASON

SEVERE STORMS

CHANGES IN ENVIRONMENT & HABITAT

DROUGHT

FLOODING

WILDFIRE

HEALTH OUTCOMES

Heat-related illness and death

Cardiovascular disease and stroke

Respiratory illness, allergies

Injuries, drowning

Infectious disease

Stress and mental illness

Displacement

— PRESIDENT OBAMA'S PLAN TO —
ADDRESS CLIMATE CHANGE

- ✓ **Reduce carbon pollution from power plants and build cars that burn less fuel.**
- ✓ **Cut energy waste from our homes and businesses.**
- ✓ **Help states and cities prepare for the impacts of climate change.**
- ✓ **Lead global efforts to address climate change.**

111D: Proposed Clean Power Plan Rule

Goal: Reduce carbon intensity of existing fossil fuel power plants in the U.S. by 32% by 2030 (below 2005 baseline)

- Trading encouraged across states
- Allows flexibility for compliance within the limits of **permanent, verifiable, enforceable**

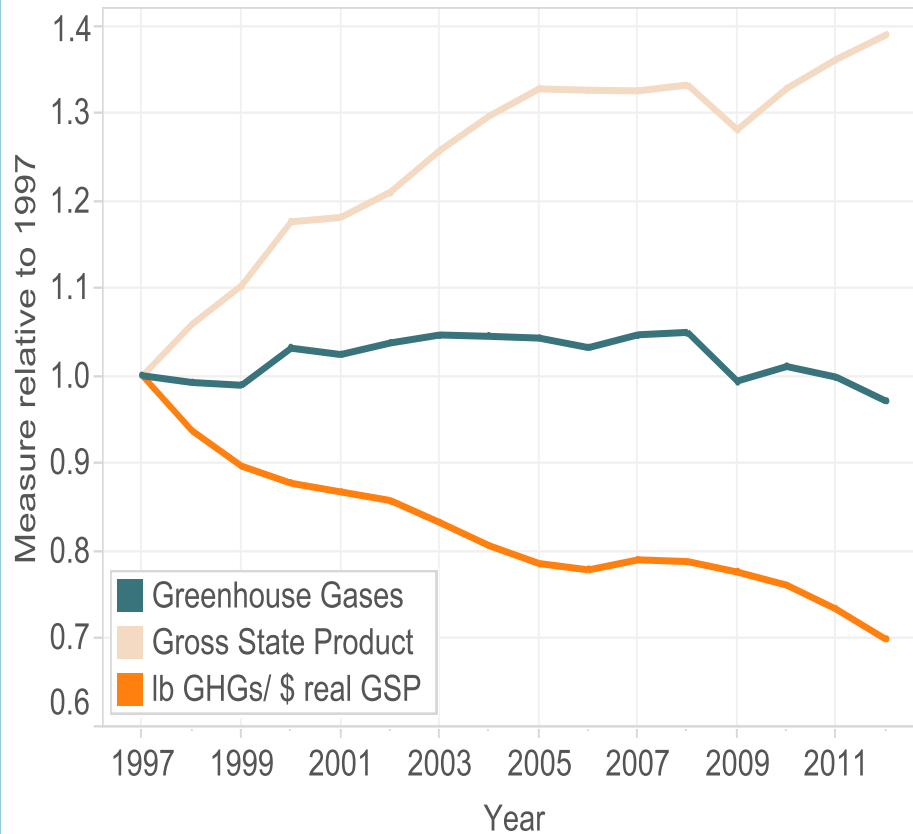


Minnesota State Policy

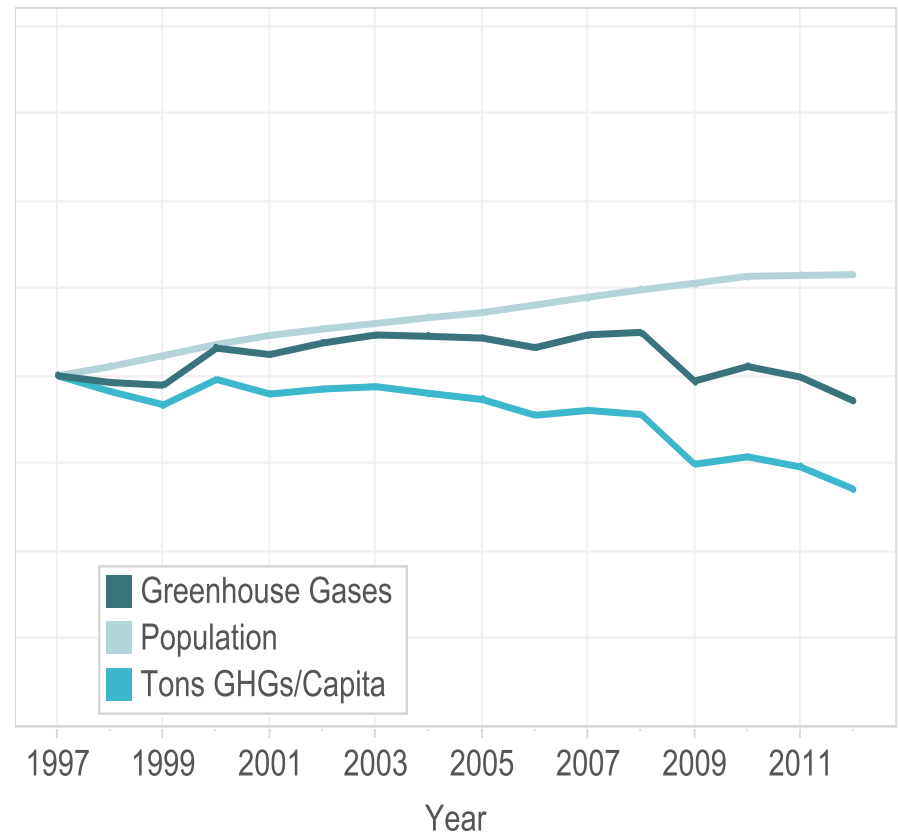
- Reduce energy use 1.5% a year through cost-effective efficiency measures
- 25% of states energy be derived from renewable energy resources by the year 2025
 - 1.5% Solar requirement for investor-owned utilities by 2020
 - 10% Solar goal by 2030.
- Reduce statewide greenhouse gas emissions:
 - ✓ 15 percent by 2015
 - ✓ 30 percent by 2025
 - ✓ 80 percent by 2050

Economic growth has diverged from energy use (and emissions)

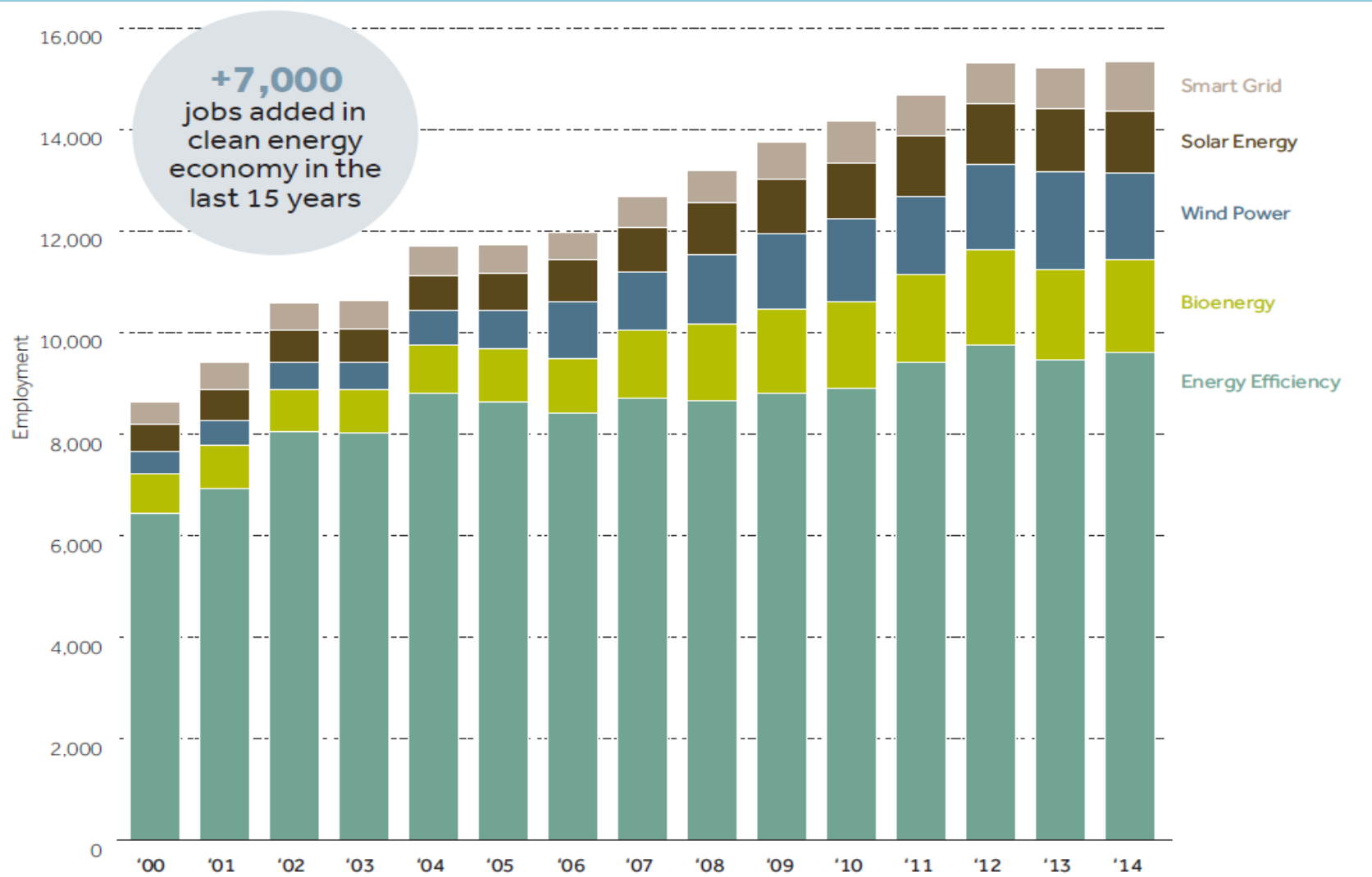
Intensity of GHG emissions compared to gross state product



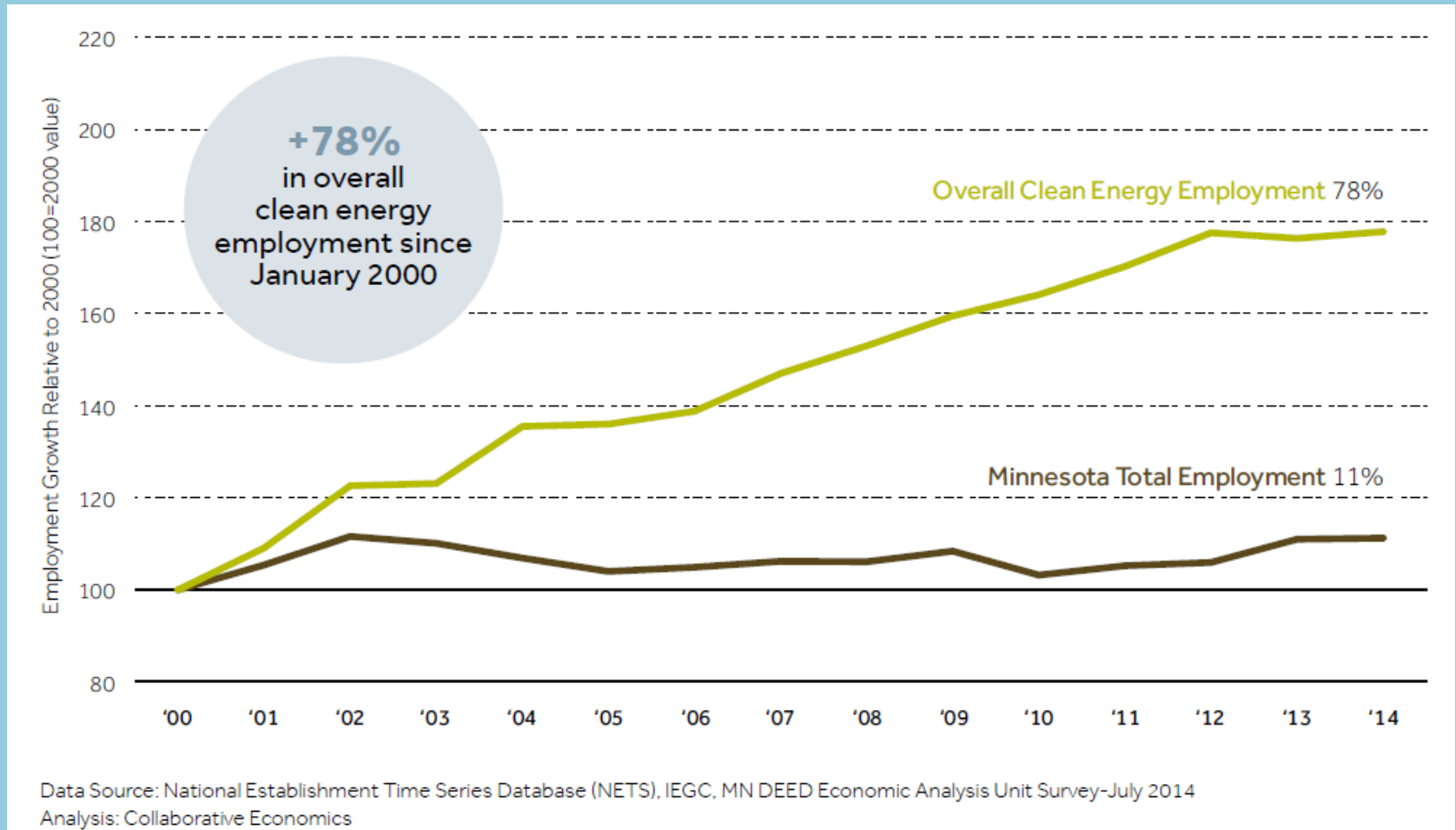
Intensity of GHG emissions compared to population



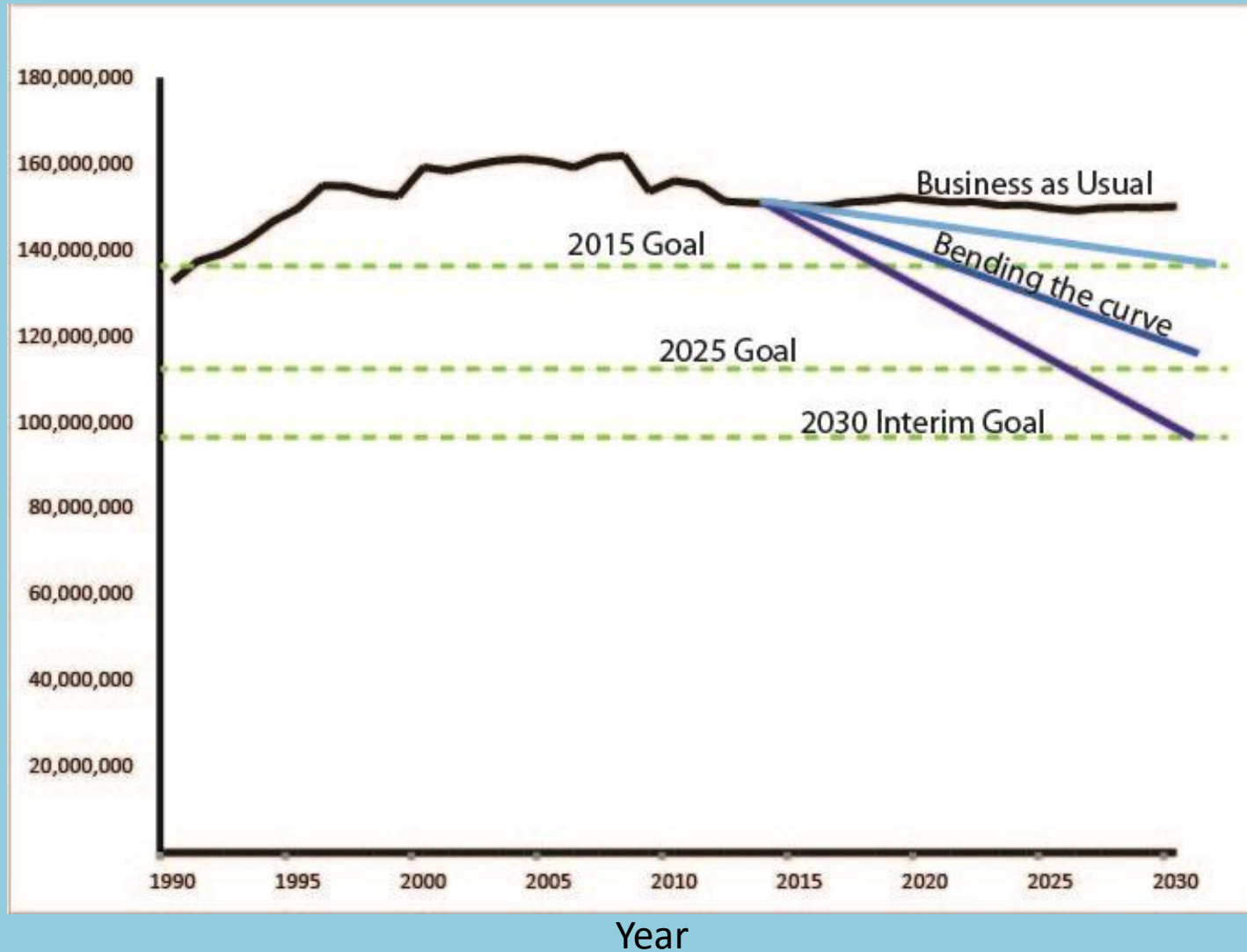
Clean Energy Job Growth



Clean energy jobs have grown much faster than the overall state employment

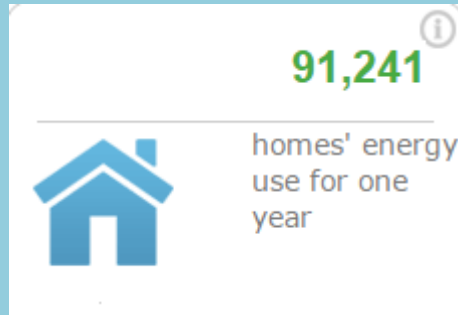


What is next: Identify strategies to bend the curve

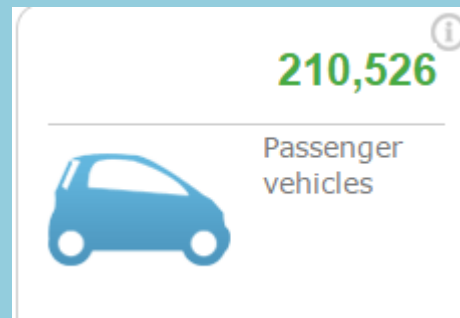


~50 million metric tons

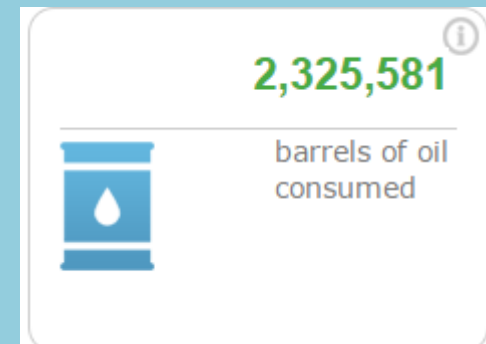
How much is a million metric tons of CO2 equivalent?



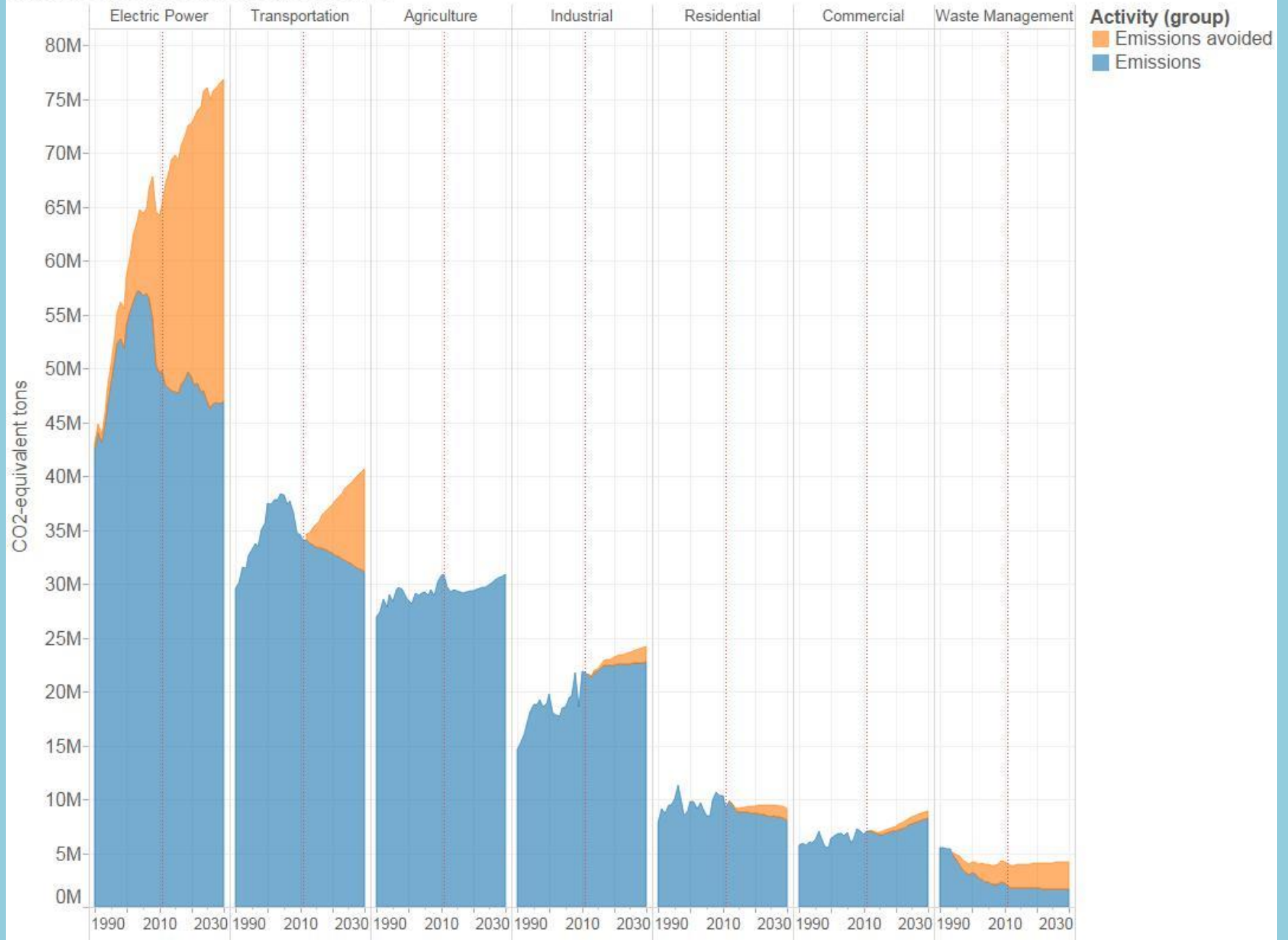
or



or



Emissions by sector, historic and forecasted



What do emission reduction strategies look like in Minnesota?



Energy Supply

40% Renewable Energy Standard

50% Renewable Energy Standard

Repower Sherco 1&2 to natural gas

Retire Sherco 1&2

Repower one unit, retire the other

111(d) Scenarios

Energy Demand-Side Management

Combined Heat and Power

SB2030 Building Guidelines

2.5%/yr Energy Efficiency

Thermal Renewable Energy

Transportation and Land Use

Transportation Pricing

PAYD Insurance

Carbon Tax

Fuel Tax

Compact Metro Development

Metro Mass Transit

Electric Vehicles

TLU-2&3 (combined)

Agriculture

Fertilizer Reduction

Cover Crops

Increase Perennials

Advanced Biofuels

State Biofuel Goal

Forests, grasslands, and wetlands

Protect Peat lands

Best Management Practices

Community Forests*

Disturbance Response

Conservation of natural land*

Waste Management

Waste Water Treatment Efficiency

Waste Reduction

Increased Recycling and Composting



Energy Supply Sector

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Minnesota exports \$18 billion a year for fossil fuels

What can we do?

- Instead of investing capital into updating old coal plants, retire them and replace with natural gas or wind.
- Increase state renewable energy requirements.



While we are on track to meet our state renewable energy standard, we are **not close to meeting our renewable energy potential**

Renewable Resource	Existing Capacity in Minnesota (MW)	NREL Calculated Potential for MN (MW)
Biomass	369	3,000
Rooftop PV		12,000
Urban large scale PV		20,000
Utility scale solar		6,500,000
All PV		6,532,000
Wind (onshore)		2,769
Hydro	199	<1000

Data source: NREL



Increasing the Renewable Energy Standard to 40 or 50% by 2030

- Current state Renewable Energy Standard is ~28.5% by 2025
- CSEO assesses incremental increases over the current RES:



Standard by 2030	Wind	Solar	Biomass CHP	Small hydro
40%	31	3	3	3
50%	34	10	3	3

Renewable Energy Standard

	2030 GHG reductions (Tg CO ₂ e)	2015 – 2030 cumulative reductions (Tg CO ₂ e)	Net present value of societal costs, 2015 – 2030 (million \$2014)	Cost effectiveness (\$2014/tonne CO ₂ e)
40% Scenario	9	83	\$228	\$2.70
50% Scenario	16	122	\$542	\$4.50

*****Next Generation Goal is to reduce annual emissions by ~50 million metric tons of CO₂e by 2030*****



Transportation and Land Use Sector

What can we do?

- Reduce driving through pricing mechanisms, densification of urban areas, and expanding public transportation
- Zero emissions vehicles, like electric vehicles.



Transforming the Metro with an anticipated population growth of ~ one million people

Business as Usual

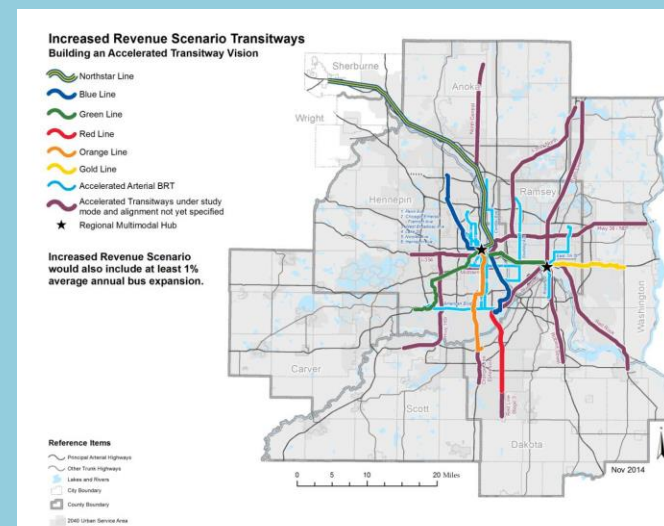
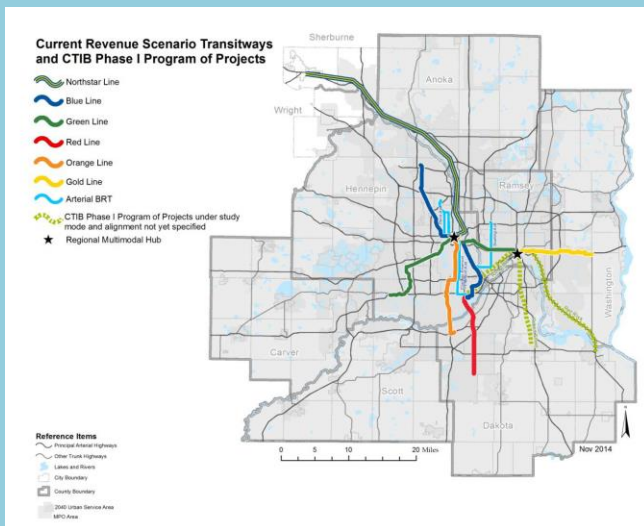
62% at 3 units/acre

38% at 8+ units/acre

Policy Option

**25% at 3 units/acre
low density**

75% at 8+ units/acre





Increase Mass Transit in the Metro

Microeconomic modelling	2030 GHG reductions (Tg CO ₂ e)	2015 – 2030 cumulative reductions (Tg CO ₂ e)	Net present value of societal costs, 2015 – 2030 (million \$2014)	Cost effectiveness (\$2014/tonne CO ₂ e)
2040 Transportation Plan	0.25	2	(\$330)	(\$165)

Next Generation Goal is to reduce annual emissions by ~50 million metric tons of CO₂e by 2030

Macroeconomic modelling	2030
Employment	680 jobs
GDP	\$40M
Income	\$45M

Q u e s t i o n s ?



Extra Slides



Waste and Water Sectors

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.

70%

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

What can we do?

- Water conservation
- Decreasing the amount of material going to landfills
- Turning into energy



Forestry Sector

CARBON REDUCTIONS, NATURALLY



15 Billion metric tons of CO₂

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



5.8 Billion metric tons of CO₂

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

What can we do?

- Maintain or increase carbon storage in forests
- Protect wetlands and peatlands
- Protect forests
- Promote urban forestry



Agriculture Sector

What can we do?

- Reduce the use of nitrogen fertilizer through efficiency of application and other practices
- Use of cover crops, grow more perennial crops that promote and protect healthy soils
- Win-win of perennial biofuels



Renewable Sector Progress

COMPARISON OF CLEAN ENERGY MARKET DEVELOPMENT

Minnesota, 2000-2012

	2000	2012	2000-2012 percent change
Energy Efficiency cumulative savings	9 trillion BTU	56.5 trillion BTU	524%
Bioenergy electricity production	1,320 Thou MWh	1,838 Thou MWh	40%
Installed wind energy capacity	290 MW	3,004 MW	935%
Installed solar energy capacity	118 kW	11,550 kW	9670%
Biofuel (Ethanol) production capacity	220 millions of gallons	1,117 millions of gallons	408%



Residential, Commercial, Industrial and Institutional (RCII)

	2030 GHG reductions (Tg CO ₂ e)	2015 – 2030 cumulative reductions (Tg CO ₂ e)	Net present value of societal costs, 2015 – 2030 (million \$2014)	Cost effectiveness (\$2014/tonne CO ₂ e)
Combined Heat & Power (CHP) for Natural Gas & Biomass	5	46	(\$1,000)	(\$22)
SB 2030, Zero-Energy Transition Codes	9	54	(\$2,050)	(\$34)
Increase Energy Efficiency Requirement, 2.0% Target	3.2	25	(\$1,270)	(\$44)

*****Next Generation Goal is to reduce annual emissions by ~50 million metric tons of CO₂e by 2030*****

New Power Plants

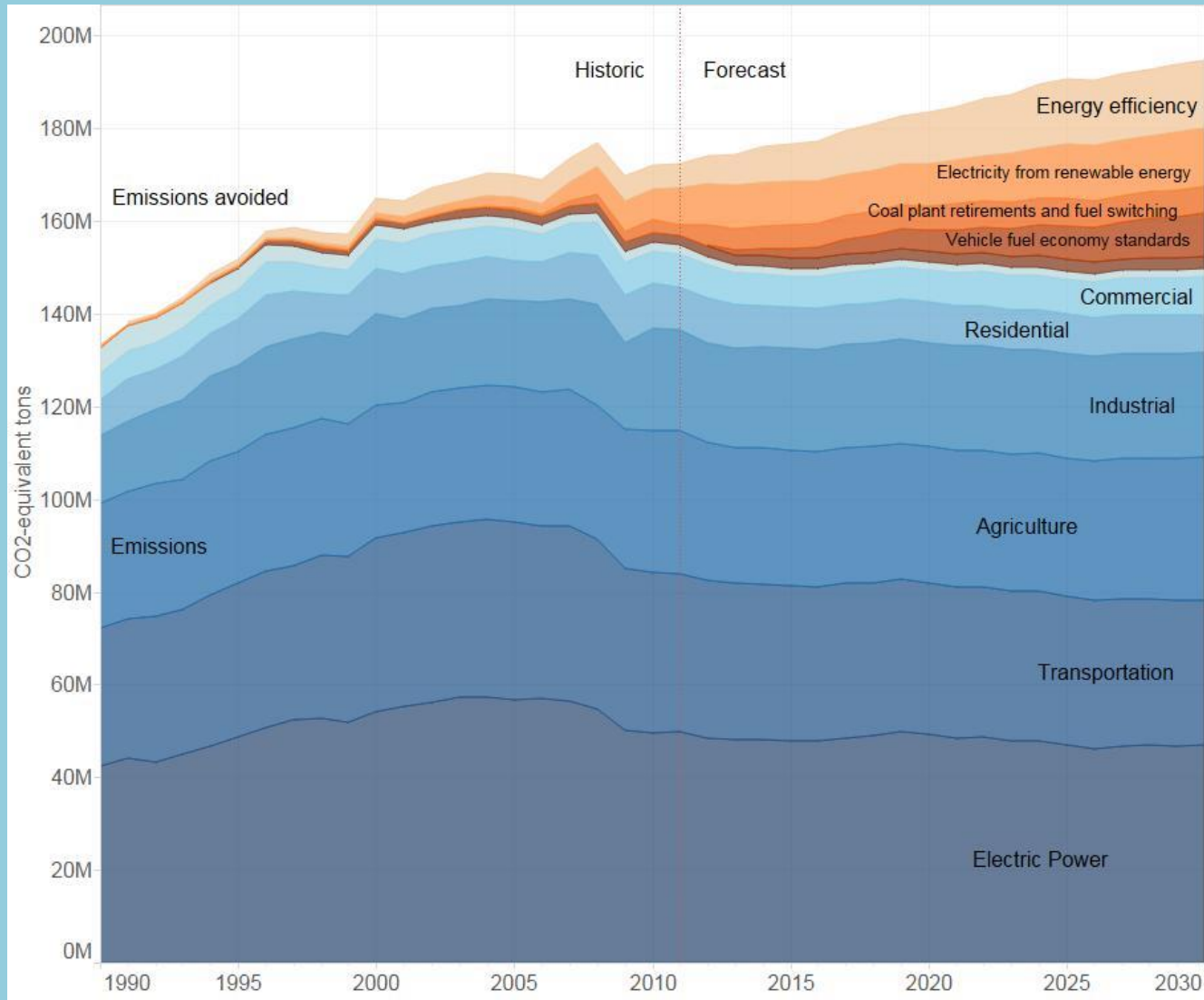
- Clean Air Act Section 111(b)
- New Source Performance Standard (NSPS)
- Plants built / modified/ reconstructed after 2014

Existing Power Plants

- Clean Air Act Section 111(d)
- Establishes emission guidelines
- States have flexibility to make their own plans

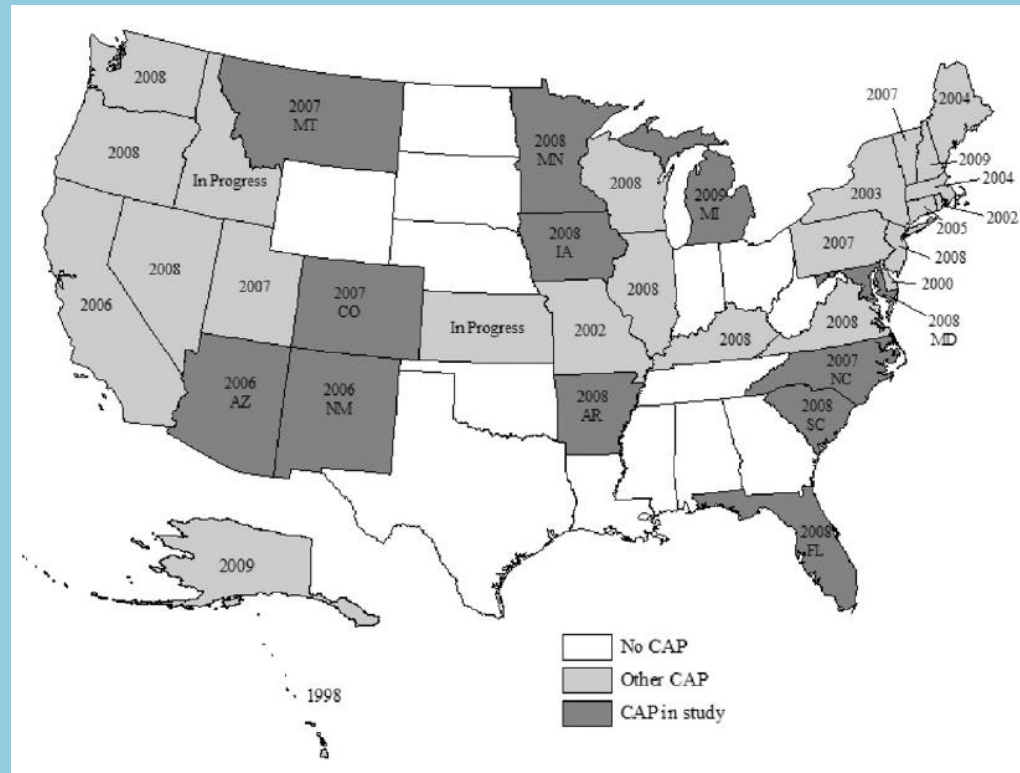


What progress have we made on emissions?



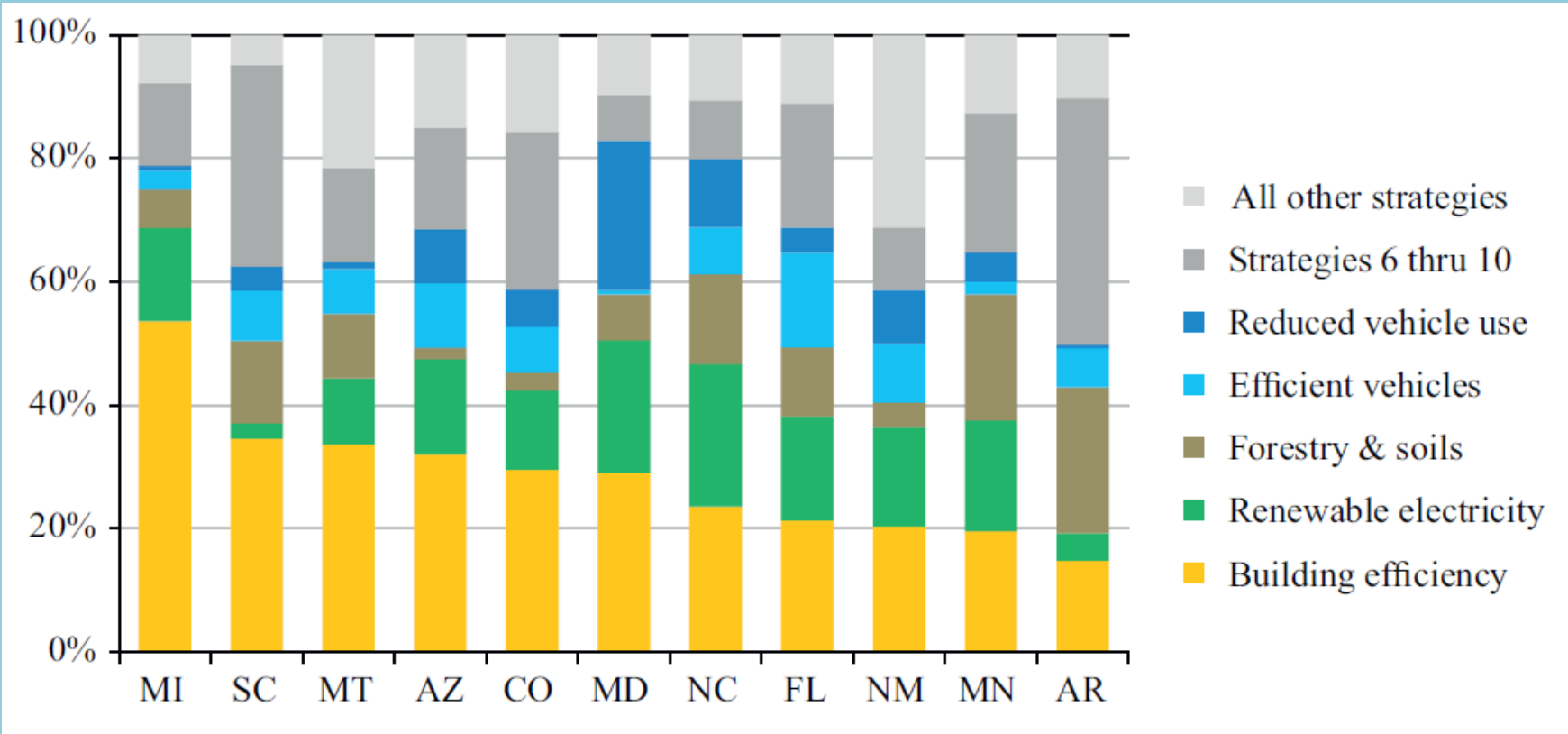
Source: Pollution Control Agency

State Climate Planning



UMN Humphrey Institute of Public Affairs: Pollack, Meyer, Wilson,
2011 in *Energy Policy*

Action plans: all states come up with the same basic strategies



- 70% of reductions in emissions come from the top 5 strategies
- 90% of reductions come from the top ten strategies
- Different ratios of strategies make sense for different states



Pending legislation: Increasing the Renewable Energy Standard to 40%

 WIND



 SOLAR



 BIOENERGY





BEYOND THE STATUS QUO:
2015 EQB Water Policy Report



Interconnected: Agriculture, Water, Climate



Where are there opportunities to reduce emissions?



Energy Supply

Energy
Demand-Side
Management

Transportation
and Land Use

Agriculture

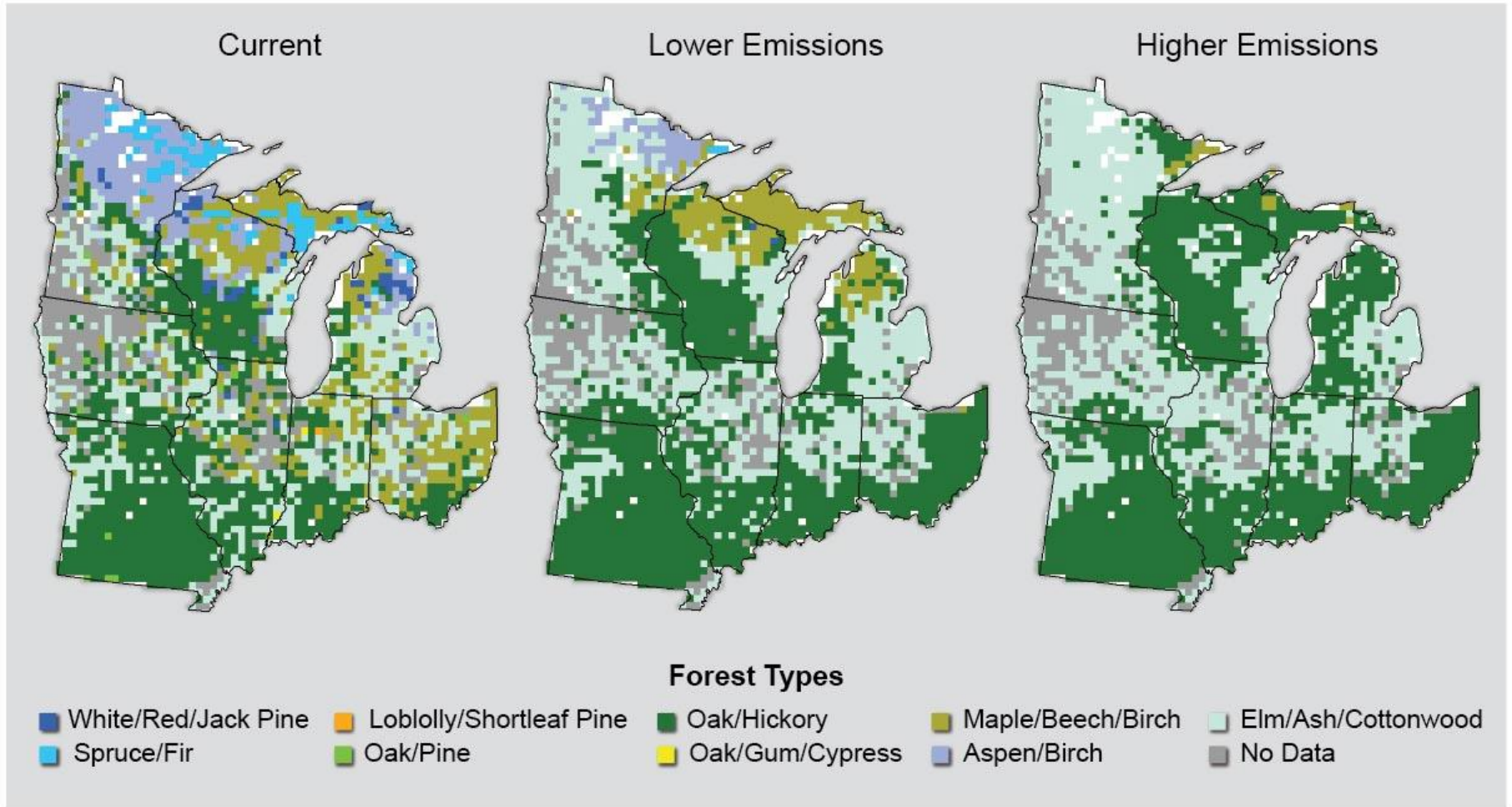
Forests,
grasslands,
and wetlands

Waste
Management

What will the future look like?



Forest Composition Shifts



Climate change has made extreme rain events more likely

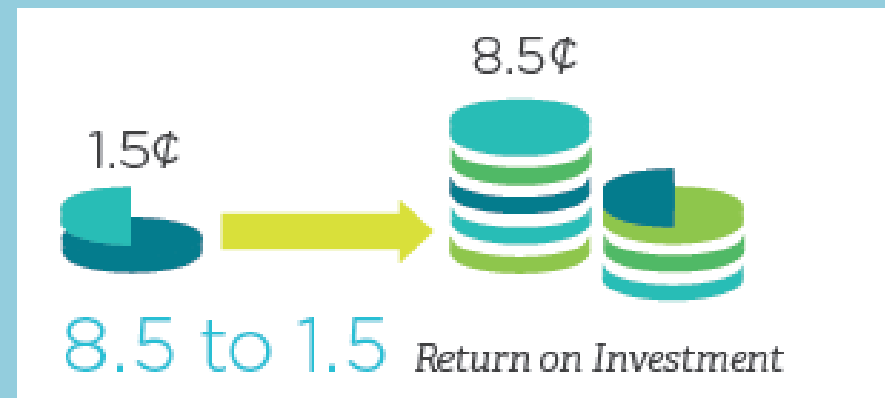




Demand-Side Energy Management Sector

What can we do?

- Remove barriers for local governments to implement building codes with stronger efficiency requirements than state code.
- Harness renewable thermal energy that we currently waste (CHP)
- Increase efficiency requirements for utilities to support efficiency in our homes and businesses.





Pending legislation: Increasing the Conservation Improvement Program

	2030 GHG reductions (Tg CO ₂ e)	2015 – 2030 cumulative reductions (Tg CO ₂ e)	Net present value of societal costs, 2015 – 2030 (million \$2014)	Cost effectiveness (\$2014/tonne CO ₂ e)
2% for electric utilities, 1.5% for gas utilities	3.2	25	(\$1270)	(\$44)
2.5% for electric utilities, 1.5% for gas utilities	4.7	42	(\$1882)	(\$45)
Business As Usual: 1.5% electric utilities and 1% gas utilities		11.87 (*by 2025)	-\$	-\$

Next Generation Goal is to reduce annual emissions by ~50 million metric tons of CO₂e by 2030