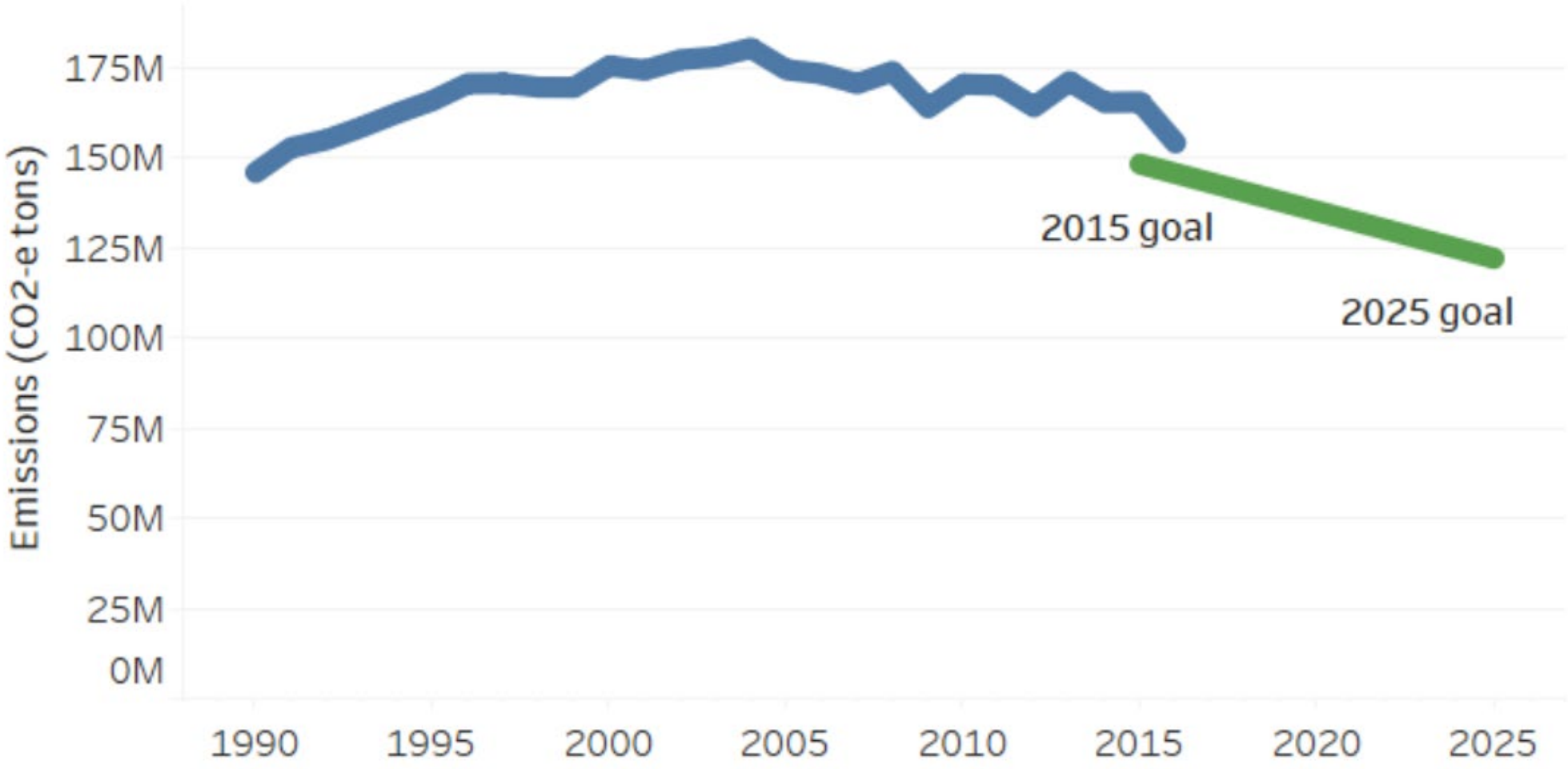
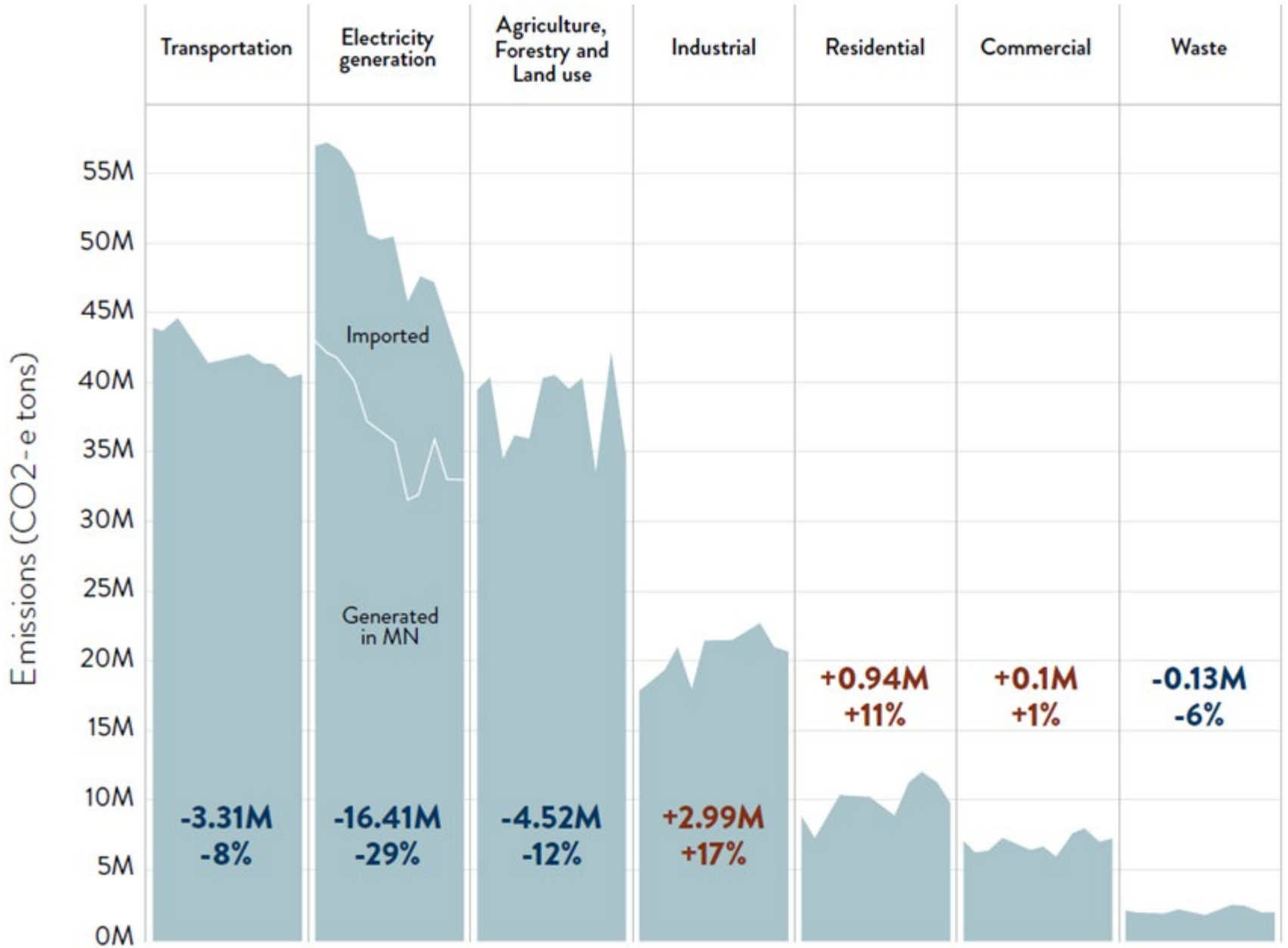
Pathways to Decarbonizing Transportation in Minnesota

Siri Simons, MnDOT



Minnesota's GHG emissions, 1990-2016, compared to the 2015 and 2025 goals of the Next Generation Energy Act. Although emissions are decreasing, we did not meet the 2015 emissions reduction goal.

Minnesota Emissions by Sector 2005-2016[9]



Project Overview

Technical Stakeholder Engagement

Work with technical experts from the public, private, and nonprofits sectors to inform modeling assumptions and strategies that should be considered.

April – June 2019

Modeling

Model different pathways for decarbonizing transportation.

April – May 2019

Public Engagement

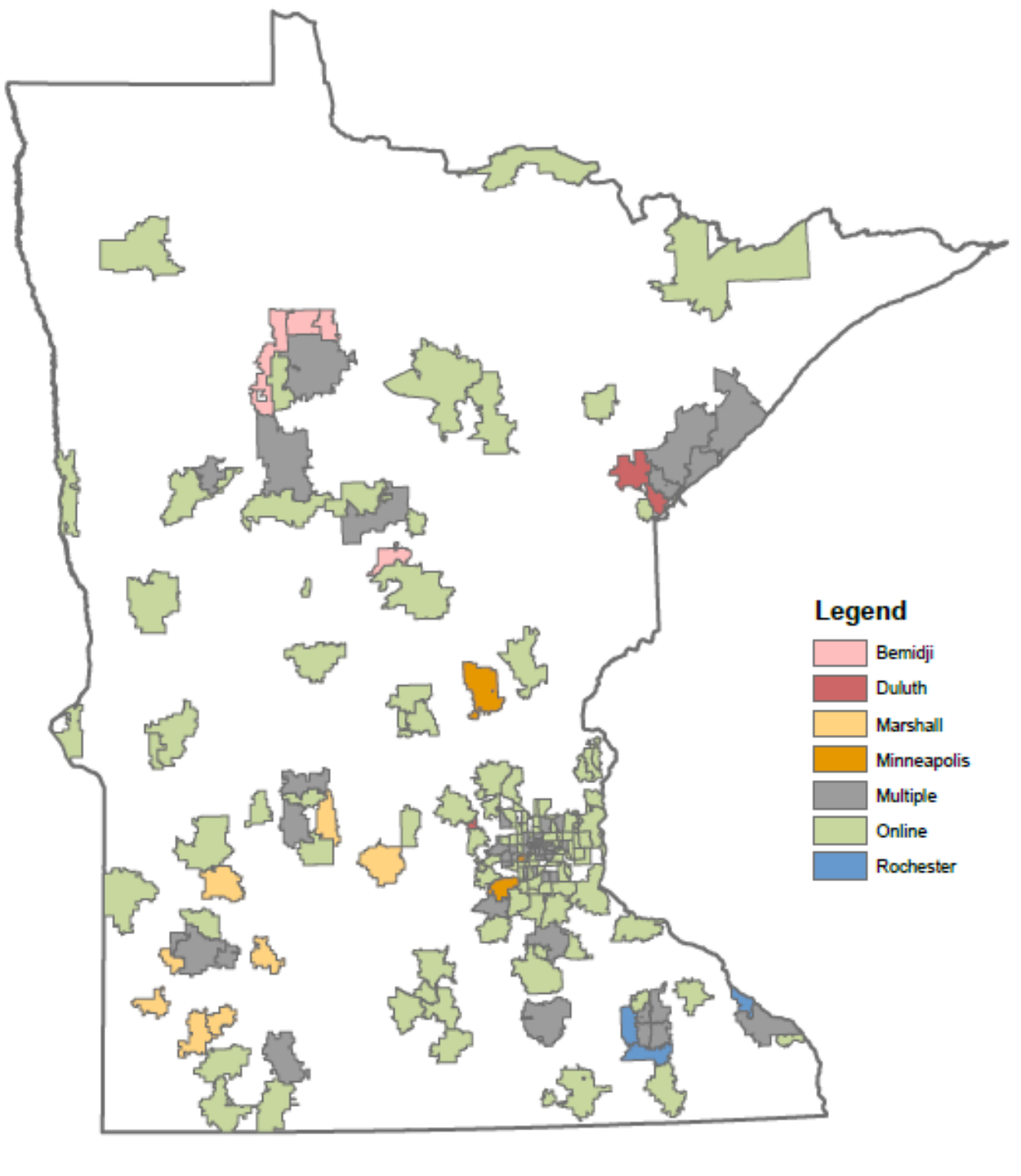
Meet with the public at locations around the state to hear their feedback and thoughts on strategies.

May – June 2019

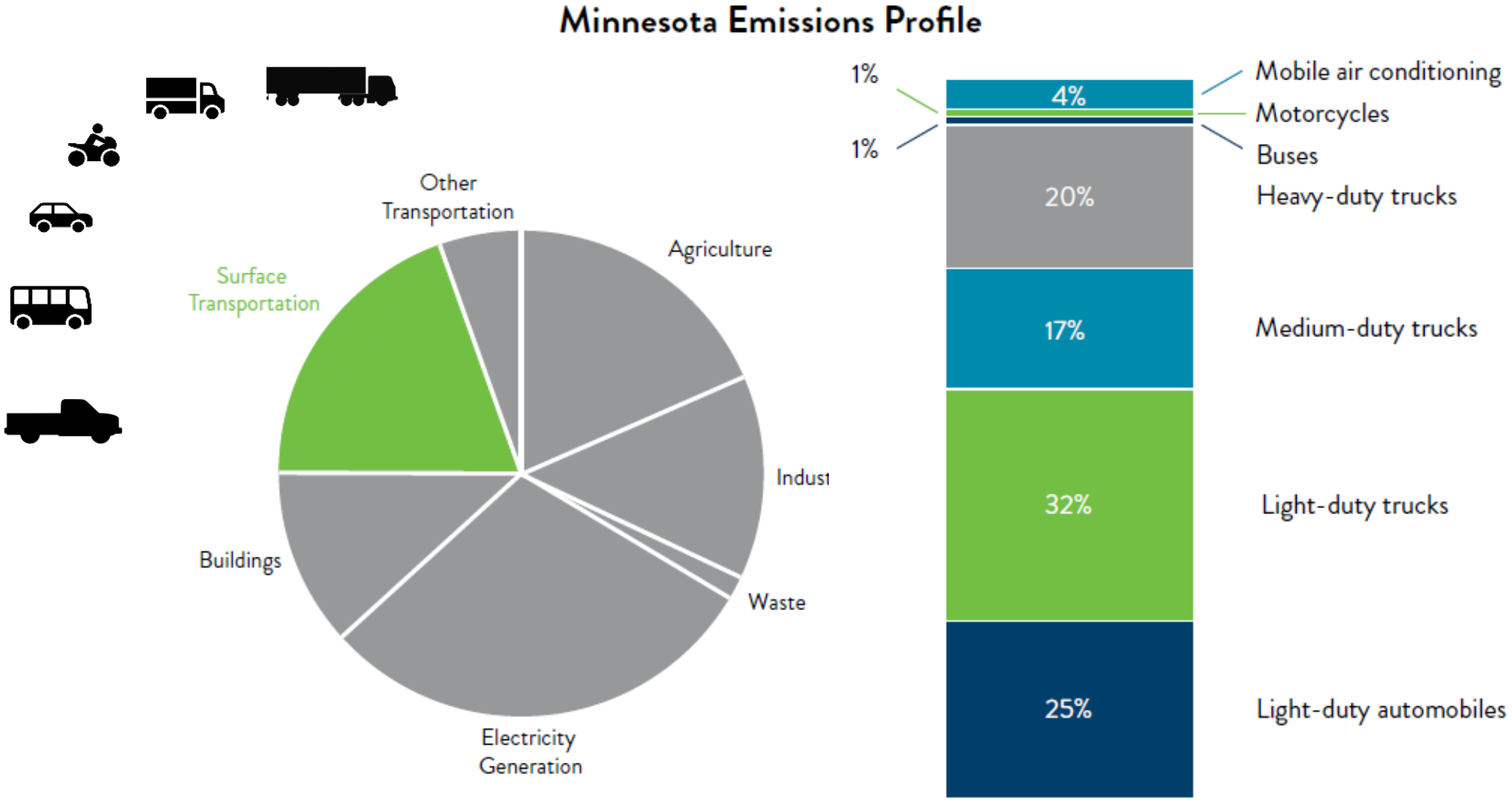
Public Engagement

Online survey responses	Online comments
1,115	4

Webinar attendees	In-person meeting attendees
53	280



Surface Transportation



Technical Stakeholder Meetings

Organization	Meeting 1	Meeting 2	Meeting 3	Total Unique Attendees
Attendance	45	41	34	106

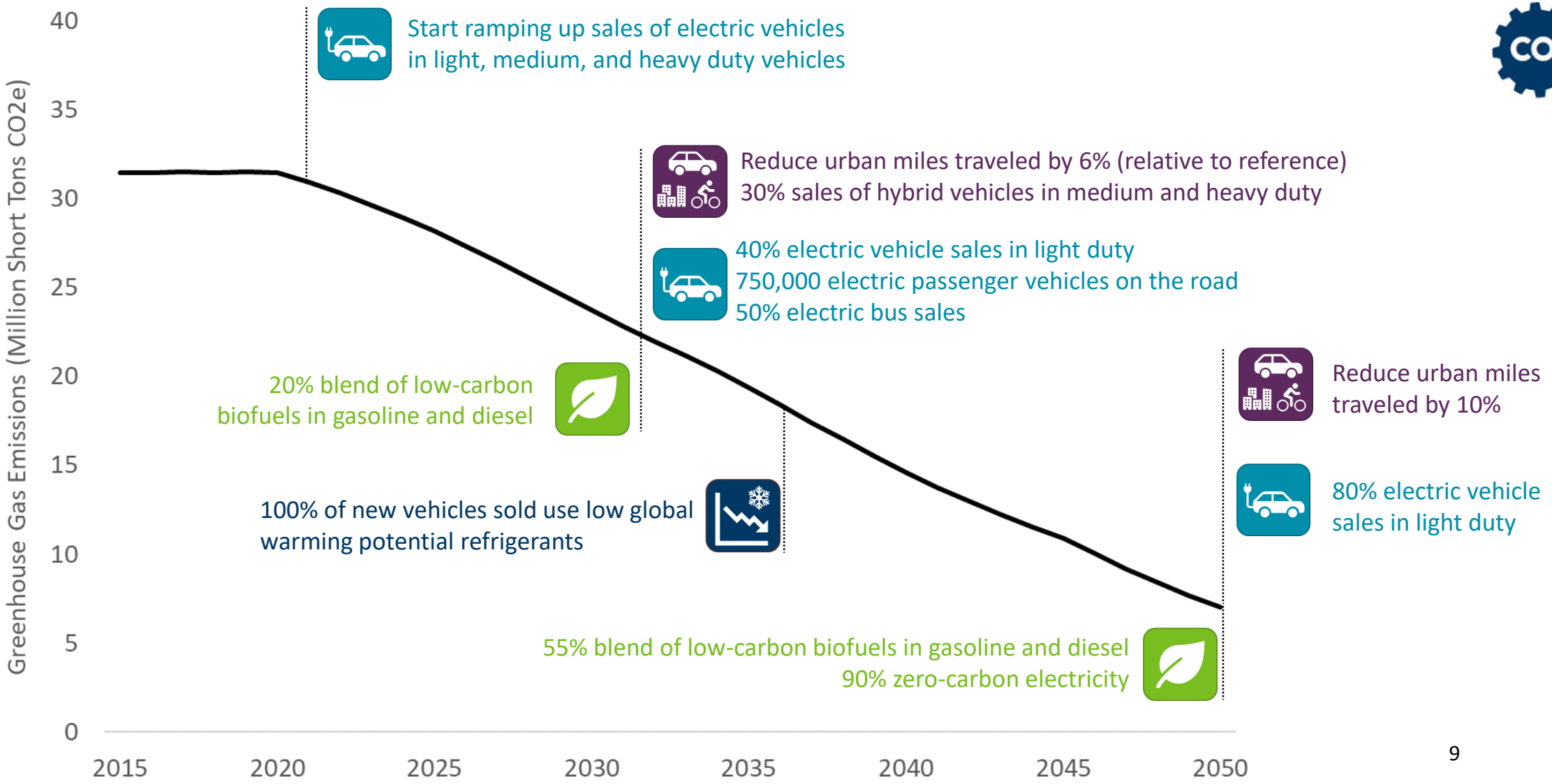
- Input on GHG reduction strategies, data, and assumptions for modeling
- 74 organizations invited, >50 attended one or more meeting
- State and local agencies, industry associations, tech companies, auto manufacturers, environmental advocacy groups, nonprofits, others…

Technical stakeholder meeting #1

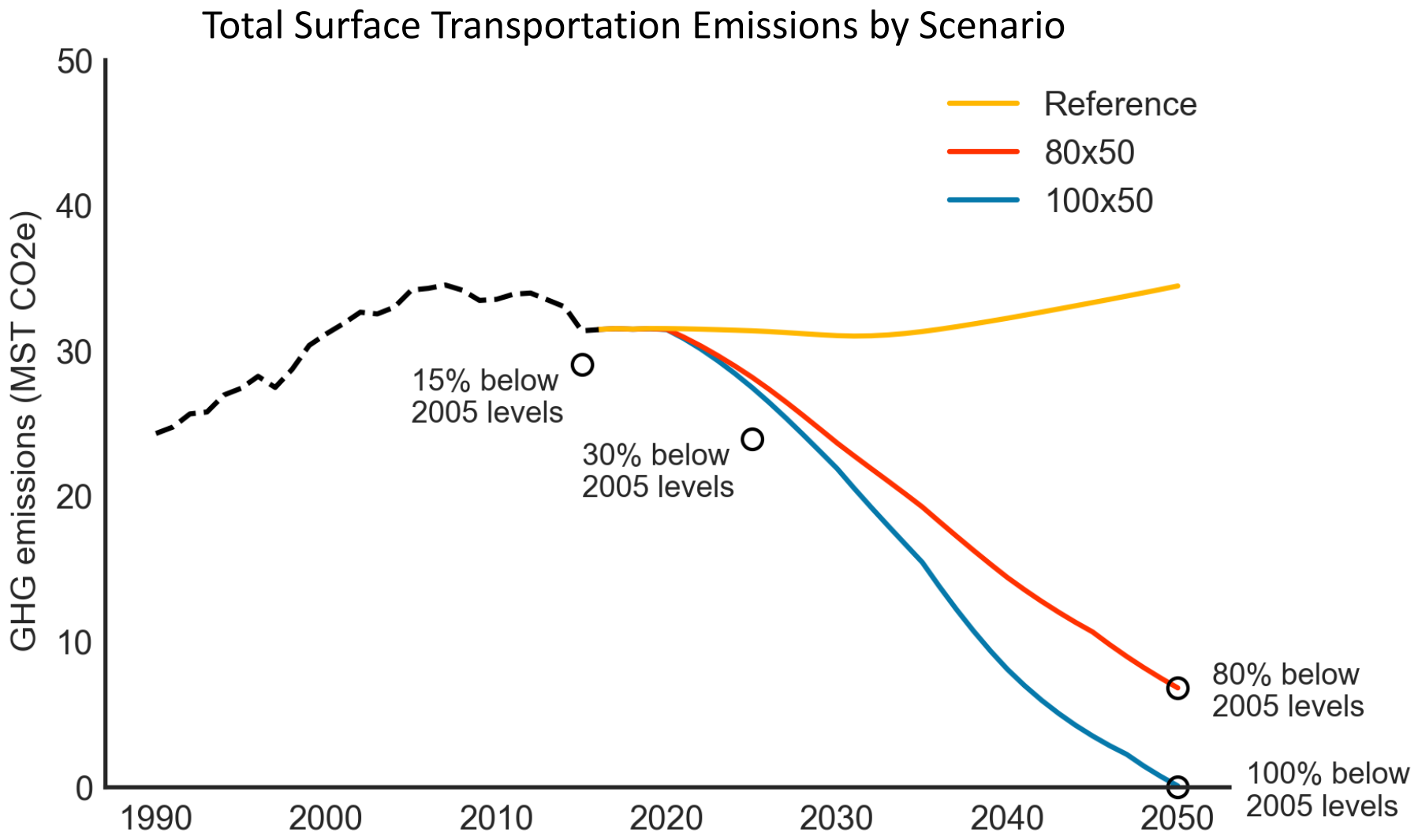
Actions to reduce emissions in transportation

Model strategy	Example tactics to reduce transportation carbon pollution
Improve fuel economy	• Federal or state vehicle efficiency standards
Reduce driving and VMT	• Smart, dense city design • Neighborhoods built for biking, walking, and rolling • Carpooling incentives • Improved public transit
Increase electric vehicle sales	• Consumer rebates • State vehicle targets • Public and workplace charging stations
Reduce the carbon intensity of biofuels	• Regenerative agricultural and soil practices • Process efficiency • Low-carbon fuel standard
Increase lower-carbon electricity generation	• Clean electricity standards • Utility greenhouse gas reduction goals • Retire coal plants

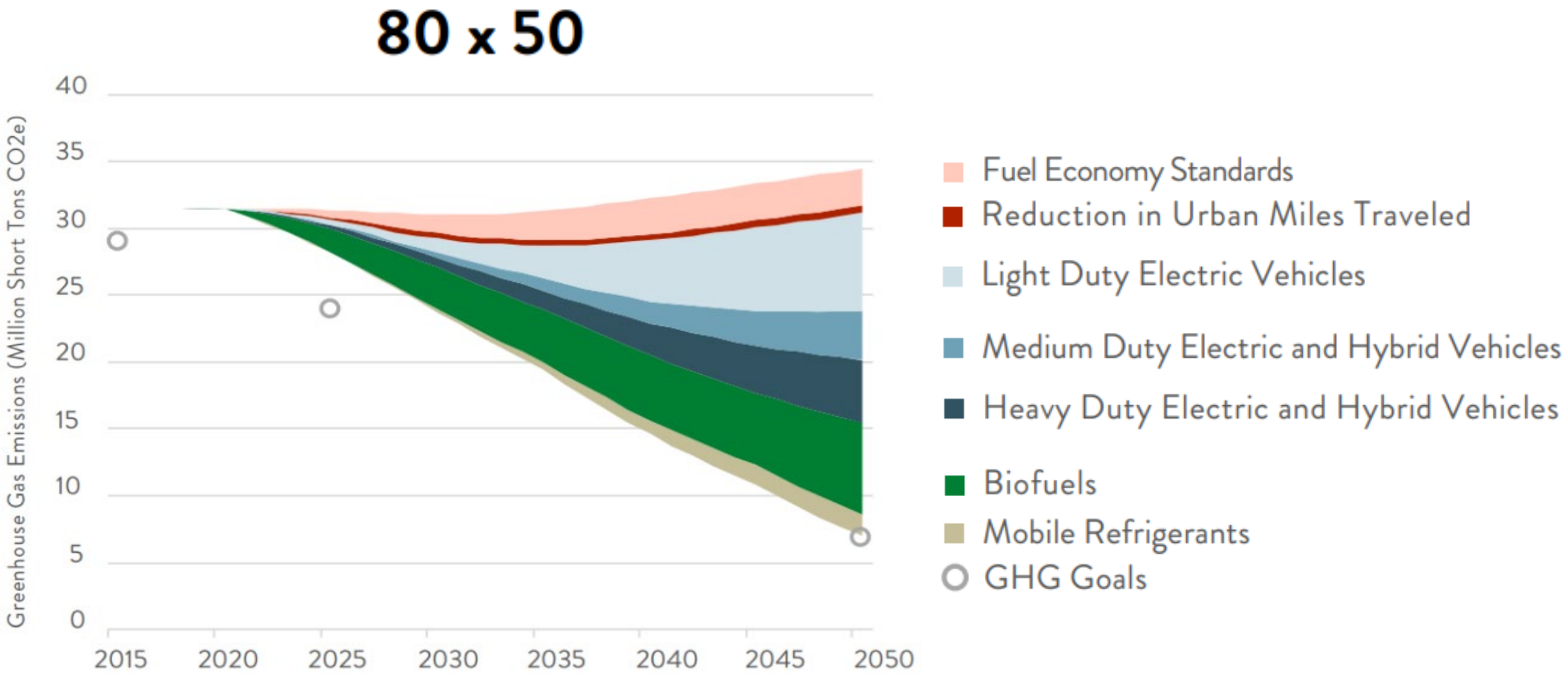
Minnesota Greenhouse Gas Emissions Reduction Measures in Transportation, 80x50 Scenario



Emissions Reduction Scenarios



Emissions Reductions



Actions and Recommendations

Actions

- What MnDOT can do now in response public input

Recommendations

- Outside of MnDOT's control and suggested for consideration by other state agencies and the Governor

Actions

Find Integrated Solutions

- Sustainable Transportation Advisory Council (STAC)
- Regional Collaboration on EV Corridors

Fund EV Infrastructure

- Clean Transportation Funding Pilot Program

I-94 near Albertville

Actions

Provide More Transportation Options on Projects

- Analyze GHG emissions on transportation projects

Provide EV Incentives

- MnPass Incentive

Example: electric transit bus

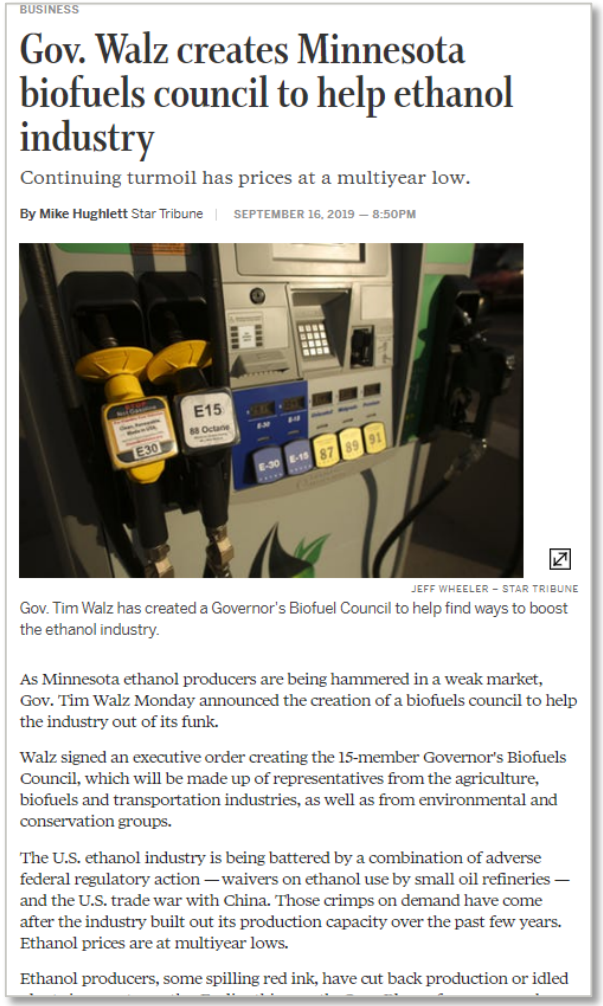
Recommendations

Build an EV Market and Provide More EV Options

- Adopt the Clean Car Standards
- https://www.pca.state.mn.us/air/clean-cars-mn-about

Promote Biofuels to Reduce GHG Emissions and Support Rural Minnesota

- Strengthen petroleum replacement goals
- Expand biofuel infrastructure
- Higher biodiesel blends and renewable diesel
- Reduce the carbon impact of biofuels



BUSINESS

Gov. Walz creates Minnesota biofuels council to help ethanol industry

Continuing turmoil has prices at a multiyear low.

By Mike Hughlett Star Tribune | SEPTEMBER 16, 2019 — 8:50PM

JEFF WHEELER – STAR TRIBUNE

Gov. Tim Walz has created a Governor's Biofuel Council to help find ways to boost the ethanol industry.

As Minnesota ethanol producers are being hammered in a weak market, Gov. Tim Walz Monday announced the creation of a biofuels council to help the industry out of its funk.

Walz signed an executive order creating the 15-member Governor's Biofuels Council, which will be made up of representatives from the agriculture, biofuels and transportation industries, as well as from environmental and conservation groups.

The U.S. ethanol industry is being battered by a combination of adverse federal regulatory action — waivers on ethanol use by small oil refineries — and the U.S. trade war with China. Those crimps on demand have come after the industry built out its production capacity over the past few years. Ethanol prices are at multiyear lows.

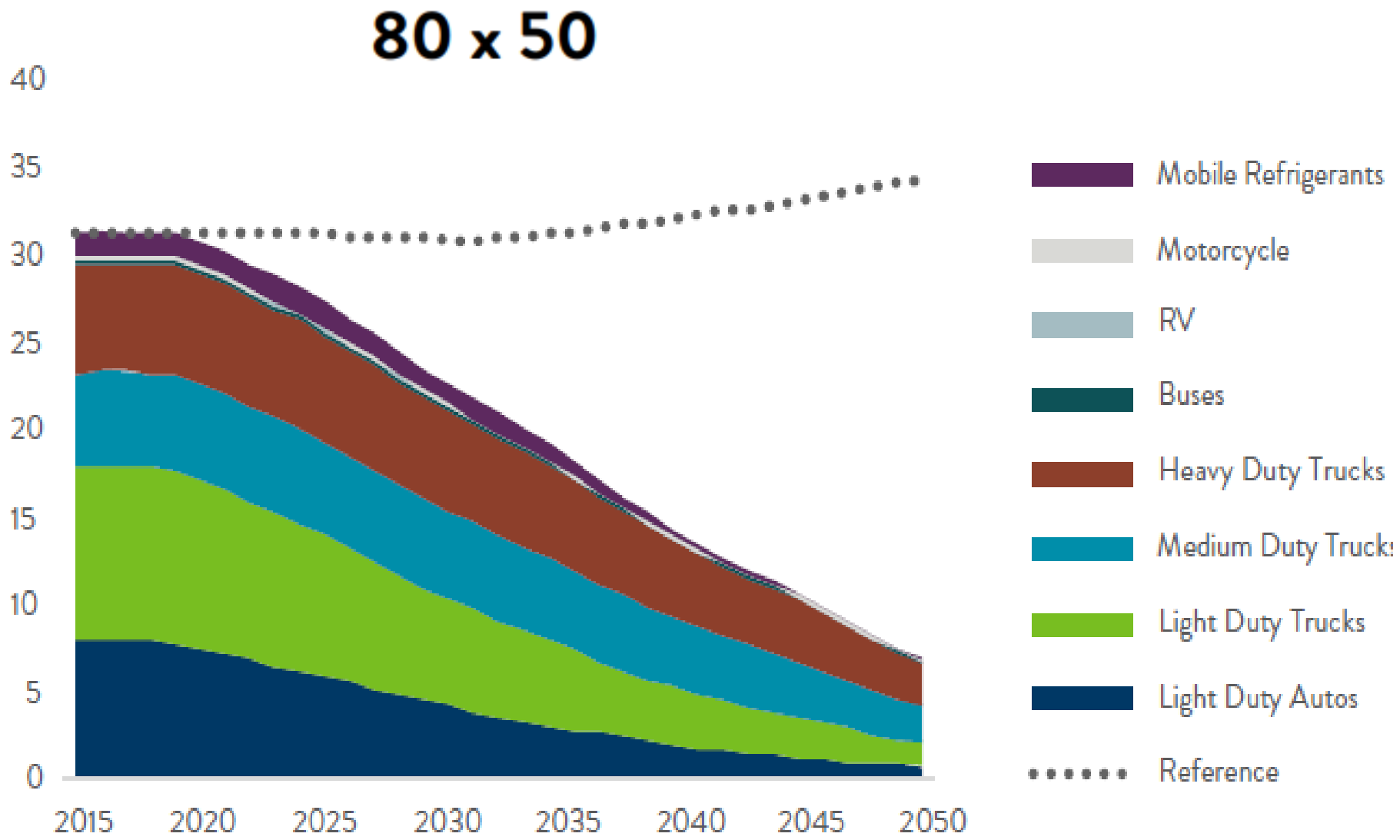
Ethanol producers, some spilling red ink, have cut back production or idled

Star Tribune, Sept 16, 2019

Panel

- Joe Smentek, Executive Director, Minnesota Soybean Growers Association
- Mary Morse Marti, Executive Director, Move Minneapolis
- Margaret Cherne-Hendrick, PhD, Director, Beneficial Electrification, Fresh Energy
- Jeff Haase, Manager, Member Services & End Use Strategy, Great River Energy

Emissions Remaining



Key Scenario Assumptions by Scenario

	80x50 Scenario		100x50 Scenario	
Measure	2030	2050	2030	2050
Fuel Economy Standards	Included 2021-2026		Included 2021-2026	
LDV VMT Reductions	3% below Reference	5% below Reference	5% below Reference	10% below Reference
Light-duty vehicles	40% sales of EVs	80% sales of EVs	60% sales of EVs	100% sales of EVs (by 2040)
Medium-duty vehicles	30% sales of hybrids 10% sales of EVs	30% sales of hybrids 50% sales of EVs	30% sales of hybrids 20% sales of EVs	40% sales of hybrids 60% sales of EVs
Heavy-duty vehicles	30% sales of hybrids 10% sales of EVs 6.5% sales of CNG vehicles	30% sales of hybrids 50% sales of EVs 6.5% sales of CNG vehicles	30% sales of hybrids 20% sales of EVs 6.5% sales of CNG vehicles	33.5% sales of hybrids 60% sales of EVs 6.5% sales of CNG vehicles
Biofuels	20% blend ~40% reduction in CI relative to 2016	55% blend ~50% reduction in CI relative to 2016	20% blend ~50% reduction in CI relative to 2016	100% blend 100% reduction in CI relative to 2016
Electricity	22% reduction in carbon intensity relative to 2016	90% reduction in carbon intensity relative to 2016	22% reduction in carbon intensity relative to 2016	100% carbon-free
Mobile Refrigerants	100% sales by 2035		100% sales by 2025	

Key Drivers for Reference Scenario

Sector	Key Driver	Compound annual growth rate proposed for this study [%]	Data Source
Light-Duty Autos and Trucks	VMT	1% (2016-2025) 0.44% (2030-3050)	Projected growth through 2025, trending towards Population growth by 2030
Medium-Duty Vehicles	VMT	1.4%	EIA AEO 2019
Heavy-Duty Vehicles	VMT	1.4%	EIA AEO 2019
Buses	VMT	1.4%	EIA AEO 2019
RVs	Gasoline consumption	-0.9%	EIA AEO 2019
Motorcycles	Gasoline consumption	-0.9%	EIA AEO 2019

Reference Scenario Assumptions

Sector	Measure	Assumption
LDVs	Federal Fuel Economy Standards	Included through 2020, not extended 2021-2026
	LDV EV Sales	8.9% sales of EVs by 2030, 16% by 2050 (from EIA AEO)
	LDV VMT growth	1% growth 2016-2025, transitioning to 0.44% growth by 2030 (tracking with population)
MDVs	MDV EV + Hybrid Sales	N/A
	MDV VMT growth	1.4% 2016-2050
HDVs	HDV EV + Hybrid Sales	N/A
	HDV VMT growth	1.4% 2016-2050
Buses	Electric Buses	N/A
	Bus VMT growth	1.4% 2016-2050
Biofuels	Ethanol	7.4% average blend in 2016 (energy basis)
	Ethanol carbon intensity	Constant carbon intensity
	Biodiesel	20% biodiesel by 2018 (12.5% annual average)
	Biodiesel carbon intensity	Constant carbon intensity
Electricity	Electricity	48% zero-carbon generation statewide, 22% decrease in carbon intensity by 2025
RVs	Biofuels for RVs	N/A
Motorcycles	Electric Motorcycles	N/A
Mobile Refrigerants	Lower GWP Refrigerants	N/A

80x50 Scenario Assumptions

Sector	Measure	Assumption
LDVs	Federal Fuel Economy Standards	Extended through 2026
	LDV EV Sales	40% sales by 2030, 80% by 2050
	LDV VMT growth	3% reduction relative to reference (for whole state) by 2030, 5% by 2050
MDVs	MDV EV + Hybrid Sales	40% sales by 2030, 80% by 2050
	MDV VMT growth	1.4% 2016-2050
HDVs	HDV EV + Hybrid Sales	40% sales by 2030, 80% by 2050
	HDV CNG Vehicle Sales	6.5% sales by 2030
	HDV VMT growth	1.4% 2016-2050
Buses	Electric Buses	50% sales by 2030 (of those 100% BEV)
	CNG Buses	7.5% sales by 2030
	Bus VMT growth	1.4% 2016-2050
Biofuels	Ethanol	20% blend by 2030, 55% by 2050
	Ethanol carbon intensity	Declining carbon intensity (58% improvement by 2030, holding constant thereafter)
	Biodiesel	20% blend by 2030, 55% by 2050
	Biodiesel Carbon Intensity	Declining carbon intensity (25% improvement by 2030, 50% improvement by 2050)
Electricity	Electricity	90% zero-carbon generation statewide by 2050
RVs	Biofuels for RVs	20% blend by 2030, 55% by 2050
Motorcycles	Electric Motorcycles	50% of motorcycles are electric by 2050
Mobile Refrigerants	Lower GWP Refrigerants	All vehicles sold by 2035 have low-GWP refrigerant

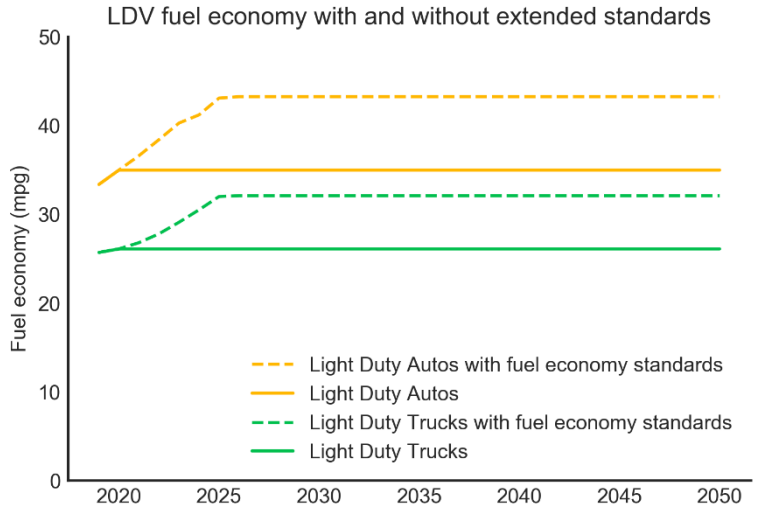
100x50 Scenario Assumptions

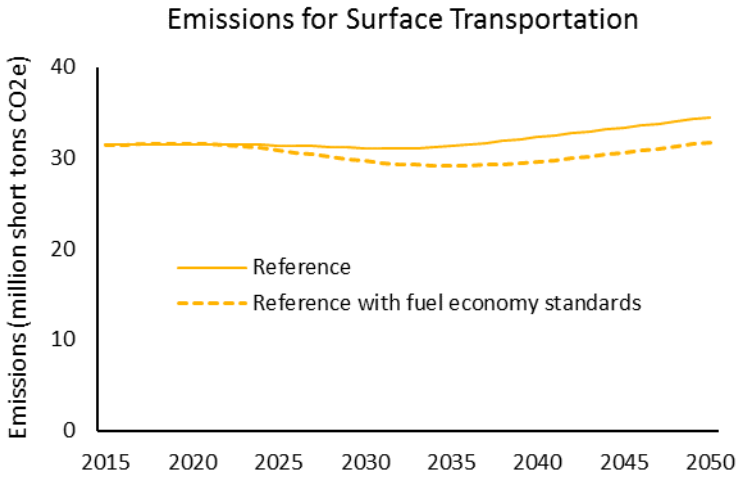
Sector	Measure	Assumption
LDVs	Federal Fuel Economy Standards	Extended through 2026
	LDV EV Sales	60% by 2030, 100% by 2040
	LDV VMT growth	5% reduction relative to reference (for whole state) by 2030, 10% by 2050
MDVs	MDV EV + Hybrid Sales	50% sales by 2030, 100% by 2050
	MDV VMT growth	1.4% 2016-2050
HDVs	HDV EV + Hybrid Sales	50% sales by 2030, 100% by 2050
	HDV CNG Vehicle Sales	6.5% sales by 2030
	HDV VMT growth	1.4% 2016-2050
Buses	Electric Buses	50% sales by 2030 (of those 100% BEV)
	CNG Buses	7.5% sales by 2030
	Bus VMT growth	1.4% 2016-2050
Biofuels	Ethanol	20% blend by 2030, 100% by 2050
	Ethanol carbon intensity	Declining carbon intensity to carbon-neutral fuels by 2050
	Biodiesel	20% blend by 2030, 100% by 2050
	Biodiesel Carbon Intensity	Declining carbon intensity to carbon-neutral fuels by 2050
Electricity	Electricity	100% zero-carbon generation statewide (emission factor goes to zero by 2050)
RVs	Biofuels for RVs	20% blend by 2030, 100% by 2050
Motorcycles	Electric Motorcycles	100% of motorcycles are electric by 2050
Mobile Refrigerants	Lower GWP Refrigerants	All vehicles sold by 2025 have low-GWP refrigerant

Vehicle Fuel Economy

- Fuel economy standards for light-duty vehicles has a significant impact on the energy consumption and emissions from internal combustion engine vehicles

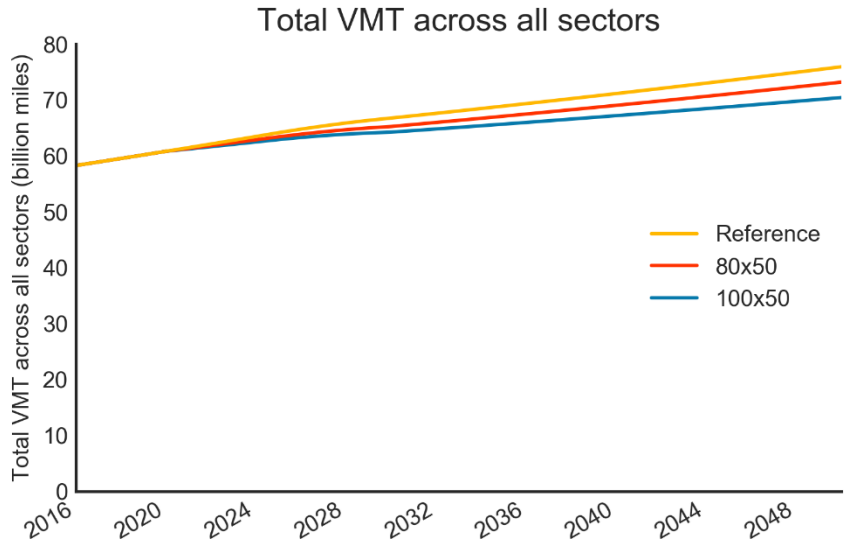
- Reference Scenario
  - Include improved vehicle fuel economy through 2020
- 80x50 and 100x50
  - Include extended improvements through 2026





Changes in Urban Vehicle-Miles Traveled

- There are many ways to reduce urban or metro vehicle-miles traveled (VMT)* including improved public transit, smart city design, carpooling, walking or biking
- Reference
  - Near-term growth (1%) through 2025, transitioning to population growth rate by 2030 (0.44%)
- 80x50 Scenario
  - Reductions of 6% by 2030 and 10% by 2050 (in light-duty vehicles only)
- 100x50 Scenario
  - Reductions of 10% by 2030 and 20% by 2050 (in light-duty vehicles only)

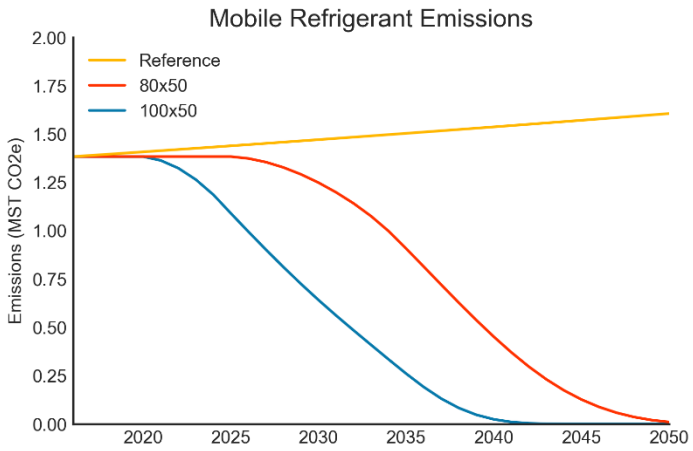


VMT reductions in urban areas can provide significant co-benefits for cities. This analysis only captures direct changes in energy consumption, GHG emissions, and statewide air pollutants.

*Urban and metro VMT was assumed to be 49% of total statewide VMT. No VMT reductions were assumed outside urban areas.

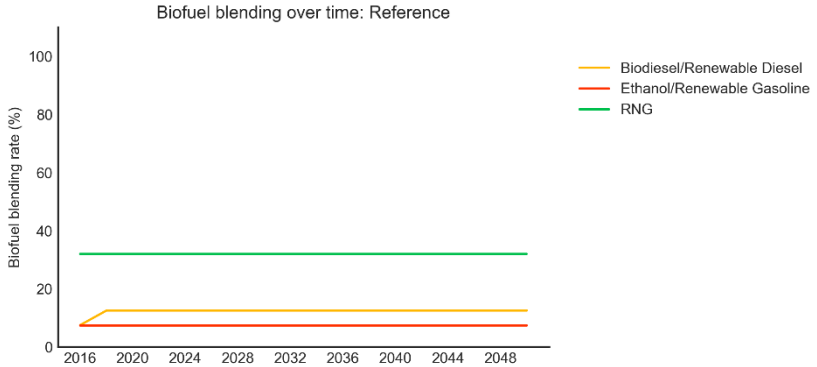
Mobile refrigerants

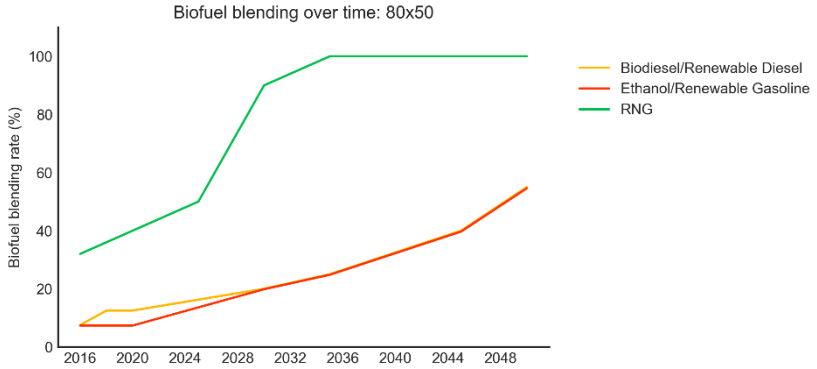
- Existing refrigerants in vehicles have a very high global warming potential (GWP). We assume that new vehicles can switch to a low-GWP refrigerant (e.g. CO2). Successful action in MN will depend on other states (e.g. CA) and US EPA.
- Reference
  - Grows with total number of vehicles (0.44% per year)
- 80x50 Scenario
  - All new cars sold by 2035 use low GWP refrigerant
- 100x50 Scenario
  - All new cars sold by 2025 use low GWP refrigerant

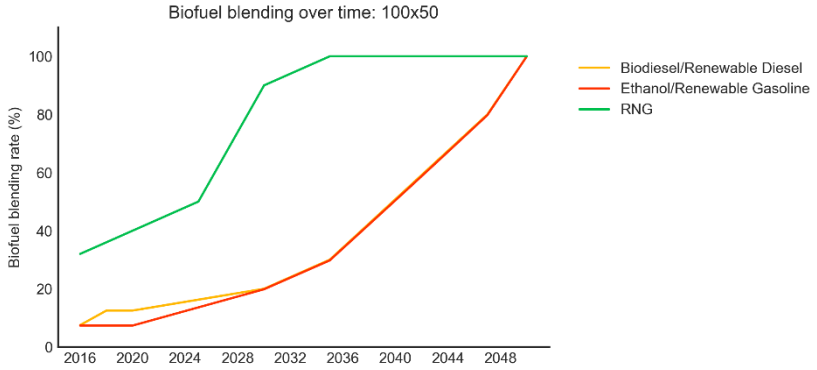


Low-carbon fuels: Biofuels
Blending rates over time

- We assume that biofuel blend rates hold constant in the Reference scenario, and slowly ramp up over time in the 80x50 and 100x50 scenarios
- Biofuels are treated as technology-agnostic, to leave room for either conventional or advanced biofuels to meet MN's need for low-carbon fuels
- If conventional biofuels are blended at rates beyond ~20%, fueling infrastructure and vehicle fleet factors will need to be addressed





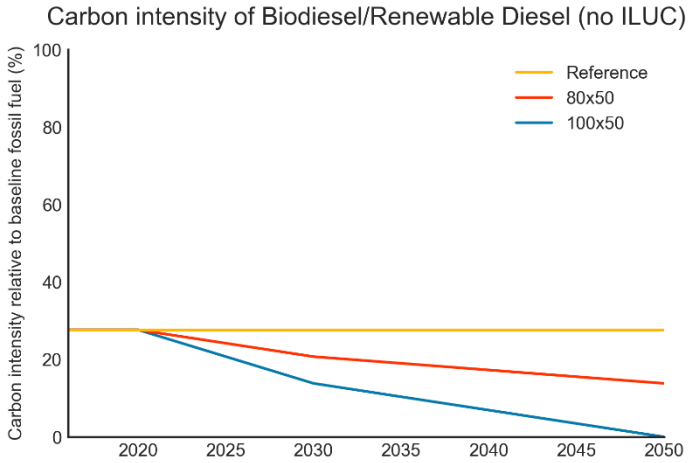


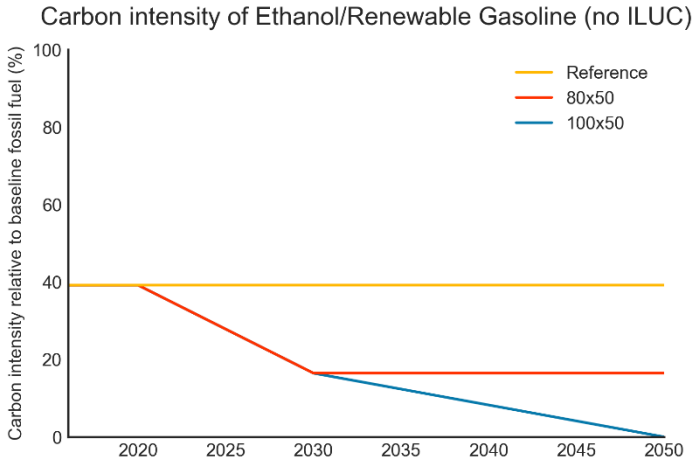
Low-carbon fuels: Biofuels
Upstream Emissions Only

Biofuels are a key measure to reduce GHG emissions from vehicles that use gasoline and diesel. We have assumed that carbon intensities are reduced through one of the following measures:

- Agricultural practices
- Process efficiency and renewable energy substitution
- Carbon capture and storage
- Advanced biofuel production

- Reference
  - Maintain current carbon intensity (CI)
- 80x50 Scenario
  - Low-carbon diesel: 50% reduction in CI by 2050
  - Low-carbon gasoline: 58% reduction in CI by 2050
- 100x50 Scenario
  - 100% reduction in CI by 2050

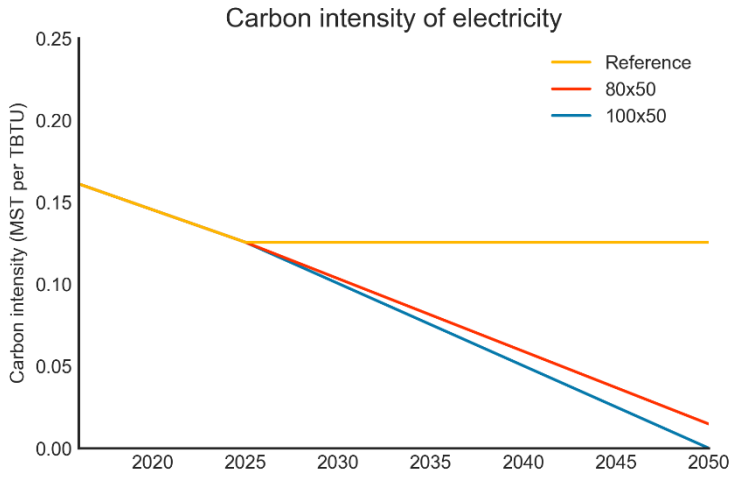




ILUC = International Land Use Change. No emissions sources outside of MN were included.

Low-carbon fuels: Electricity
Upstream Emissions Only

- As electric vehicles are more prevalent, it is important to also decarbonize the sources of electricity generation within the state
- Reference
  - Moderate reductions due to fossil retirements (20% reduction in current carbon intensity by 2025)
- 80x50 Scenario
  - 90% carbon-free electricity by 2050
- 100x50 Scenario
  - 100% carbon-free electricity by 2050



Carbon intensity assumptions
Documentation

- Current ethanol carbon intensity comes from the 2017 USDA Ethanol LCA report. “2014 Current Conditions” is used as the 2016 value.
- Current biodiesel carbon intensity comes from the Argonne National Laboratory GREET model, calculated for Midwest-produced soybean biodiesel.
- 2030 carbon intensity reduction assumption for ethanol in the 80x50 and 100x50 scenarios comes from the “2022 Building Blocks” carbon intensity in the 2017 USDA Ethanol LCA report (carbon intensity is assumed to be reduced by the ratio between the 2014 current conditions and 2022 Building Blocks numbers)
- Less data is available on the carbon intensity reduction potential for biodiesel, so simple assumptions are made on future carbon intensity
- Indirect Land Use Change is not included
- Current electricity carbon intensity is calculated from EIA and MN PCA data
- 2025 electricity carbon intensity in all three scenarios is assumed to be 22% below 2016 levels, based on projected near-term coal retirements
- 2050 carbon intensity for 80x50 scenario is calculated based on 10% natural gas generation