Chapter 5
Transportation and Land Use

Overview of GHG Emissions

The transportation sector accounted for about 25% of Minnesota's gross greenhouse gas (GHG) emissions in 2005 (about 37.2 million metric tons of carbon dioxide equivalent [$MMtCO_2e$]). The GHG emissions associated with Minnesota's transportation sector increased by 8.5 $MMtCO_2e$ between 1990 and 2005, accounting for about 22% of the state's net growth in gross GHG emissions in this period.

From 1990 through 2005, GHG emissions from transportation fuel use have risen steadily at an average rate of about 1.7% annually. Table 5-1 shows historic and projected transportation and land use (TLU) GHG emissions by fuel and source. Figure 5-1 graphically illustrates their growth. In 2005, on-road gasoline vehicles accounted for about 61% of transportation GHG emissions. On-road diesel vehicles accounted for another 18% of emissions, aviation fuels for roughly 13%, and marine vessels for 5%. Rail and other sources (natural gas- and liquefied petroleum gas [LPG]-fueled vehicles used in transport applications) accounted for the remaining 3% of transportation emissions. As a result of Minnesota's population and economic growth and an increase in total vehicle miles traveled (VMT) during the 1990s, on-road gasoline use grew 31% between 1990 and 2005. Meanwhile, on-road diesel use rose 49% during that period, suggesting an even more rapid growth in freight movement within or across the state. Aviation fuel use grew by about 30% from 1990 to 2005.

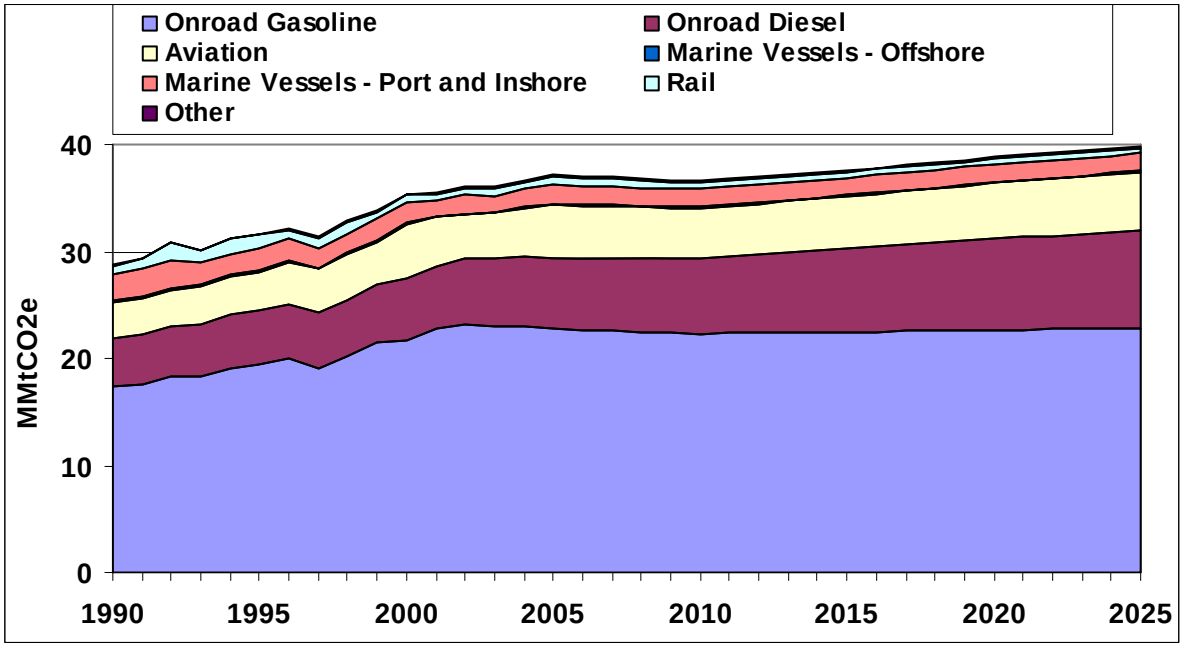
Table 5-1. Historic and projected emissions for the transportation sector ($MMtCO_2e$)

Fuel Source	1990	1995	2000	2005	2010	2015	2020	2025
On-Road Gasoline Vehicles	17.3	19.4	21.7	22.7	22.3	22.5	22.7	22.8
On-Road Diesel Vehicles	4.5	5.0	5.9	6.7	7.1	7.8	8.5	9.2
Aviation Fuels	3.5	3.7	5.0	5.0	4.6	4.9	5.2	5.5
Marine Vessels, Offshore	2.5	2.0	1.9	1.8	1.7	1.7	1.7	1.7
Marine Vessels, Port and Inshore	0.16	0.14	0.13	0.11	0.11	0.10	0.10	0.10
Rail	0.71	1.3	0.70	0.83	0.58	0.53	0.49	0.44
Other	0.08	0.12	0.16	0.16	0.17	0.17	0.18	0.18
Total	**28.7**	**31.7**	**35.4**	**37.2**	**36.6**	**37.6**	**38.8**	**39.8**

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

On-road gasoline consumption accounts for the largest share of transportation GHG emissions. Emissions from on-road gasoline vehicles increased by about 31% from 1990 to 2005 and contributed 61% of total transportation emissions in 2005. GHG emissions from on-road diesel fuel consumption increased by 49% from 1990 to 2005 and, by 2005, accounted for 18% of GHG emissions from the transportation sector. Emissions from aviation grew by 44% between 1990 and 2005 to account for 13% of transportation emissions in 2005, and emissions from boats and ships decreased by 31% during that period, to account for 5% of transportation emissions in 2005. Emissions from all other categories combined (locomotives, natural gas, LPG, and oxidation of lubricants) contributed less than 3% of total transportation emissions in 2005.

Figure 5-1. Transportation GHG emissions by fuel source, 1990–2025



VMT since 1990 have increased statewide by 45%. This is one of the fastest growth rates in the nation, far outpacing the state population growth of 19% in the same period. The regions outside the seven-county metro area are responsible for much of the increase in VMT. While the metro area held 52% of the state population in 1990, it produced only 45% of the annual state VMT. In 2005, the metro area had 54% of the statewide population and 40% of the state VMT. These percentages will continue to diverge.

After years of essentially unbroken growth that outpaced both population and employment growth, VMT was essentially flat during 2004–2006. As a result, the Metropolitan Council and Minnesota Department of Transportation (MnDOT) traffic modelers recently adopted a forecast of statewide VMT growth of 0.9% annually, which is a substantial decrease from historic rates. If this slower rate of growth continues, it will substantially slow the rate of increase in GHG emissions from Minnesota transportation.

However, other sources of transportation GHG emissions will continue to grow rapidly. Historic growth for diesel fuel has been stronger than for gasoline. This trend is expected to continue for the 2005–2030 period, with gasoline and diesel fuel consumption projected to increase by 0.6% and 51.2%, respectively. Jet fuel and aviation gasoline consumption is projected to increase by 17% between 2005 and 2030. The historic negative growth for marine vessels is projected to continue, with a decline of 7% from 2005 to 2030. Figure 5-1 summarizes historic and projected transportation GHG emissions by fuel source.

Key Challenges and Opportunities

Minnesota has substantial opportunities to reduce transportation emissions. In the state, and in the nation as a whole, vehicle fuel efficiency has improved little since the late 1980s, yet many studies have documented the potential for substantial increases consistent with maintaining

vehicle size and performance. The use of fuels with lower GHG emissions is growing, and larger market penetration is possible. Minnesota has taken steps to increase transit options and plan for growth that reduces emissions, and the state can absorb growth in development patterns that will produce far lower emissions than forecast.

The Transportation Land Use (TLU) Framework organized these opportunities into three groups:

- **TLU Area 1:** Reduce the number of miles driven.
- **TLU Area 2:** Reduce carbon per unit of fuel (cleaner fuels).
- **TLU Area 3:** Reduce carbon per mile and/or per hour (improved vehicle efficiency).[1]

Taken together, this three-legged stool of TLU policy recommendations can substantially reduce Minnesota's transportation GHG emissions.

Overview of Policy Recommendations and Estimated Impacts

The 12 policy options recommended for the TLU sector offer major economic benefits and emissions savings.

[1] Transportation carbon emissions = miles driven × carbon per mile; carbon per mile = vehicle emissions per unit × carbon per unit of fuel.

Table 5-2. Summary list of policy recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2008–2025			
TLU Area 1: Reduce VMT (VMT goal to be established based on VMT implied by selected strategies)							
TLU-1	Improved Land-Use Planning and Development Strategies	0.7	1.9	14.9	*Net savings*	*Net savings*	Unanimous
TLU-2	Expand Transit, Bicycle, and Pedestrian Infrastructure	0.1	0.3	3.0	$0	$0	Unanimous
TLU-5	Climate-Friendly Transportation Pricing/Pay-as-You- Drive	1.1	2.1	20.9	–$1	–$1	Super - majority (3 objections)
TLU-7	"Fix-it-First" Transportation Investment Policy and Practice	*Not quantified*					Super-majority (2 objections)
TLU-9	Workplace Tools To Encourage Carpooling, Bicycling, and Transit Ridership	0.3	0.4	4.5	*Large net savings*	*Large net savings*	Unanimous
TLU-14	Freight Mode Shifts: Intermodal and Rail	N/A					Super - majority (1 objection)
TLU Area 2: Reduce Carbon per Unit of Fuel							
TLU-3	Low-GHG Fuel Standard	1.7	3.6	36.2	*Not quantified*		Unanimous
TLU Area 3: Reduce Carbon per Mile and/or per Hour							
TLU-4	Infrastructure Management	0.04	0.1	0.7	*Not quantified*		Unanimous
TLU-6	Adopt California Clean Car Standards	0.74	1.16	13.1	–$263	–$39	Majority (16 objections)
TLU-12	Voluntary Fleet Emission Reductions	0.4	0.4	6.1	*Not quantified*		Unanimous
TLU-13	Reduce Maximum Speed Limits	0.4	0.4	6.1	N/A	$50 at $2.40/gal –$19 at $3.40/gal	Majority (16 objections)
	Sector Total After Adjusting for Overlaps	**4.7**	**9.3**	**91.2**	***Not quantified***	***Not quantified***	
	Reductions From Recent Actions	**1.4**	**1.5**	**20.2**	***Not quantified***		
	Biodiesel	**0.64**	**0.75**	**8.1**			
	Ethanol	**0.78**	**0.79**	**12.1**			
	Sector Total Plus Recent Actions	**6.1**	**10.8**	**111.4**	***Not quantified***	***Not quantified***	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; VMT = vehicle miles traveled; N/A = not available.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

The policy recommendations described briefly here not only result in significant emissions and costs savings but also offer a host of additional benefits, such as reduced local air pollution, more livable, healthier communities, and increased transportation choices.

Transportation and Land Use
Policy Descriptions

TLU Area 1: Reduce VMT

The statewide per capita VMT reduction from strategies TLU-1, -2, -5, -7, -9, and -14 taken together would be 15% from 2005 levels by 2025. Despite an 18% increase in Minnesota's population from 2005 to 2025, overall statewide VMT would not increase during this time period.. (This flat VMT is from MDOT projections assuming that higher fuel prices and other factors dampen VMT growth.)

The TLU Area 1 Overall VMT reduction goal is roughly 10.3 billion VMT in 2025, for a 2025 VMT of 56,530,900,000.

TLU-1 Improved Land-Use Planning and Development Strategies

This policy improves land-use planning and development practices to target growth in ways that reduce the number and length of vehicle trips, thus reducing GHG emissions. (It accounts for part of the VMT reduction goal, along with TLU-2, -5, -7, -9, and -14.)

TLU-2 Expand Transit, Bicycle, and Pedestrian Infrastructure

This strategy expands infrastructure and programs to increase transit ridership, carpooling, bicycling, and walking. It will reduce GHG emissions by reducing VMT (fewer vehicle trips and shorter trip distances). (It accounts for part of the VMT reduction goal, along with TLU-1, -5, -7, -9, and -14.)

TLU-5 Climate-Friendly Transportation Pricing/Pay-as-You-Drive

This policy recommends that the state of Minnesota institute requirements and policies ensuring that drivers more fully pay the costs of driving. By doing so, the policy would encourage drivers to choose transportation alternatives, purchase more efficient vehicles, drive less, and/or drive more efficiently (combining trips). This option generally reduces VMT and GHG emissions. (This strategy accounts for part of the VMT reduction goal, along with TLU-1, -2, -7, -9, and -14.)

TLU-7 "Fix-it-First" Transportation Investment Policy and Practice

This policy option recommends that the state legislature require that state and federal transportation investments be prioritized in the following order: (1) maintain existing roads, and (2) design new and expanded roads to serve higher-density, more compact, pedestrian-friendly development in priority growth areas, such as downtowns, town centers, main streets, neighborhood hubs, regional centers, transit corridors, and transit station areas. It also

recommends that the state significantly reduce investment in new roads and roadway expansion that accommodate and encourage both low-density development and more and longer vehicle trips.

This strategy will reduce GHGs emissions by increasing bicycling and walking and reducing the number and length of vehicle trips. (It accounts for part of the VMT reduction goal, along with TLU-1, -2, -5, -9, and -14.)

TLU-9 Workplace Tools to Encourage Carpooling, Bicycling, and Transit Ridership

This strategy reduces emissions by requiring certain employers and encouraging other employers to offer a Commuter Benefits program at the workplace to increase the use of transit, ridesharing, and non-motorized transportation. Commuter Benefits can include reducing the amount of free or subsidized parking, providing paid or pre-tax transit passes or mode-neutral transportation allowances, guaranteeing rides home for non-drive-alones, providing bicycle parking and employee lockers, providing telecommuting programs, and/or having employee ID cards serve as transit passes. The strategy also reduces emissions by requiring large employers (more than 200 employees) to develop and implement transit demand management plans that customize commuter benefits and transit-supportive building design to specific building locations. (It accounts for part of the VMT reduction goal, along with TLU-1, -2, -5, -7, and -14.)

TLU-14 Freight Mode Shifts: Intermodal and Rail

Transportation of freight by railroad generally results in less fuel use and GHG emissions than transportation by truck. This strategy recommends that a MnDOT statewide freight study currently underway examine support for expanding intermodal rail service for Minnesota shippers through public–private partnerships; increasing the competitiveness of rail rates for all Minnesota shippers; and developing public–private partnerships to support mode shifts to rail and decrease truck VMT relative to the baseline.

TLU Area 2: Reduce Carbon Per Unit of Fuel

TLU-3 Low-GHG Fuel Standard (Overlap with AFW-7)

Under this policy, the state of Minnesota would adopt a low-GHG fuel standard (LGFS), create a market-based program to reduce the GHG emissions from transportation fuels, and diversify transport fuel options for consumers. The LGFS would be designed to require fuel providers to reduce the GHG intensity of the fuels they sell in Minnesota. Fuel providers are identified as producers, importers, refiners, and blenders. The GHG intensity is specified as a CO_2e[2] per

[2] Each GHG has a global warming potential (GWP) that allows it to be expressed in terms of CO_2. This notation is referred to as carbon dioxide equivalent (CO_2e). For example, methane has a GWP of 23. Therefore, 1 metric ton (Mt) of CH_4 can be expressed as 23 $MtCO_2e$.

British thermal unit (Btu). The LGFS would not be designed to encourage the use of any particular fuel. Instead, it would include fossil and renewable fuels.[3]

The LGFS is not a tailpipe standard for GHGs, because it considers GHG emissions on a full-fuel-life-cycle basis, which includes not only tailpipe emissions but also emissions associated with the production and distribution of fuels. This will result in varying carbon impact values for fuels that would ostensibly be the same to customers.[4]

TLU Area 3: Reduce Carbon Per Mile and/or Per Hour

TLU-4 Infrastructure Management

With the state as a coordinator, this strategy will build on current efforts to create a seamless multimodal system to serve all modes, improve traffic flow, and decrease vehicle idling and congestion (where it will not negatively affect bicycling and walking or induce additional vehicle trips). This strategy will also reduce carbon emissions by reducing the number and length of motor vehicle trips; increasing walking, bicycling, and transit use; and supporting development patterns that use these modes.

TLU-6 Adopt California Clean Car Standards

This policy option reduces GHG emissions from new motor vehicles (cars and light-duty trucks) sold in Minnesota by adopting legislation equivalent to the California Clean Car standards (Assembly Bill 1493 [Pavley], named after the California lawmaker who sponsored the legislation).

California adopted legislation in 2002 (and regulations in 2004) requiring a reduction in GHG emissions from new cars and light-duty trucks sold in that state beginning with model year 2009. California plans an 8-year phase-in. The California standards incorporate the main global warming gases—CO_2, methane, and nitrous oxide—resulting directly from vehicle operation (tailpipe emissions), as well as hydrofluorocarbon emissions resulting from leakage from or operation of vehicle air conditioning systems.

TLU-12 Voluntary Fleet Emission Reductions

Under this policy, Minnesota would create new services and provide additional support to existing voluntary and incentive-based programs that help fleets reduce their GHG emissions.

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[3] Alternative fuels, which are defined in the Energy Policy Act of 1992, include biodiesel, electricity, ethanol, hydrogen, natural gas, and propane.

[4] For example, E10 in which the ethanol is derived from cellulose has the potential to reduce the full-fuel-life-cycle carbon impacts, compared with E10 in which the ethanol is derived from corn. How the ethanol is made affects its life-cycle GHG profile, and not all corn ethanol is the same. Cellulosic E10, while potentially better in its GHG profile than sugar-based (corn) ethanol, will also vary depending on feedstock(s) and thermal heat input source(s).

Approximately 10% of cars and trucks in Minnesota are in fleets. There are many ways for businesses to reduce GHG emissions from their fleets. Typically, fleets will determine a methodology to measure their GHG impact, review their current vehicle mix and vehicle operation parameters, and then analyze options to see where efficiencies can be gained. Efficiencies generally come through improved driver behavior, more efficient vehicles (either new models or technology enhancements to existing models), and/or improved operating processes (e.g., more efficient routing systems).

This current state in fleet efficiency programs points to certain challenges. First, there is no centralized support to help fleets manage these initiatives. Fleets have little support in the selection and implementation of metrics. Second, funding resources for retrofits and other technology-based efficiency solutions are limited and may be restricted to specific vehicle types. Part of this challenge is necessary because some solutions for heavy-duty trucks are inherently different from what a fleet of sedans would be facing. Third, there is no centralized Minnesota-based registry for businesses to post, track, and share fleet-based GHG improvements.

TLU-13 Reduce Maximum Speed Limits

Reduce maximum speed limits on highways in Minnesota to improve fuel economy and reduce GHG emissions per mile traveled.