Michigan Climate Action Council
Department of Environmental Quality

Michigan.gov
The Official State of Michigan Website

Transportation and Land Use Technical Work Group

Summary List of Pending Policy Options-Draft

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
		2015	**2025**	**Total 2008–2025**			
TLU-1	Promote Low-Carbon Fuel Use in Transportation	1.3	6.5	45	3912	86	Pending
TLU-2	Eco Driver Program	0.4	0.9	8.3	-1395	-168	Pending
TLU-3	Truck Idling Policies	0.35	0.87	7.4	-402	-54	Pending
TLU-4	Advanced Vehicle Technology	0.03	0.3	1.6	2687	1660	Pending
TLU-5	Congestion Mitigation	0.04	0.10	0.82	-81	-100	Pending
TLU-6	Land Use Planning and Incentives	TBD	TBD	TBD	TBD	TBD	Pending
TLU-7	Transit and Travel Options	0.15	0.49	3.7	823	222	Pending
TLU-8	Increase Rail Capacity, and Address Rail Freight System Bottlenecks	TBD	TBD	TBD	TBD	TBD	Pending
TLU-9	Great Lakes Shipping	0.24	0.27	2.5	TBD	TBD	Pending
	Sector Totals	2.5	9.4	69	5544	80	
	Sector Total After Adjusting for Overlaps	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**NA**
	Reductions From Recent Actions	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**NA**
	Sector Total Plus Recent Actions	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**NA**

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Negative numbers indicate cost savings.

TLU-1. Promote Low-Carbon Fuel Use in Transportation

Policy Description

Reduce the GHG emissions from the use of transportation fuels through a package of incentives, education and standards, including recommendations by the Michigan Renewable Fuels Commission (RFC). Renewable fuels and electric propulsion provide significant opportunities to reduce GHG emissions from the transportation sector if promoted in a way that emphasizes the reduction of GHG emissions on a lifecycle basis.

Policy Design

Goals: Reduce GHG emissions from the transportation sector by reducing the average carbon "intensity" of on-road transportation fuels sold within the state, measured on a life-cycle basis. Achieve (XX%) reduction of GHG emissions on a lifecycle CO_2 basis by 2015 and (XX%) reduction by 2025 compared with BAU forecasts. *[Note: Reduction numbers to be determined after analysis is complete.]*

In its June 2007 report, the Michigan RFC recommended a variety of actions to stimulate the production and use of renewable, low-carbon fuels within the state. Current priorities for the Commission include further work on these three recommendations:

Establish a Next-Generation Renewable Fuels Feedstock Program: To encourage the sustainable production of next-generation bioenergy and biomass materials while reducing risk to landowners. The program should be linked to the development of prospective biomass customers, and shall include the following:

- Payments to landowners/operators that produce dedicated energy crops (payments awarded to projects that show the greatest promise in terms of sustainability)
- Tax incentives or loan guarantees for the purchase of new equipment required for energy crop establishment, harvest, transport, or storage
- Research on agronomic production systems for energy crops in Michigan and provision of educational materials and technical assistance for sustainable energy crop production
- Creation of a "nursery" of energy crops as a basis for a biotechnology- driven plant breeding program to enhance and improve energy crops and other biomass plants, as we know them today

Create a Green Retailers program (tax incentives for E85 and biodiesel sales): The state should establish a "Green Retailers" program that rewards retail and wholesale outlets that attain benchmarks in the sale of biofuels. Such a step would provide state recognition for achievement and provide important cost-savings to both the seller and the consumer of biofuels. To provide alternative fuel choice to consumers, promote state energy security needs and reduce greenhouse gas emissions, a goal of achieving a minimum of 10 percent alternative fuel use in the transportation sector by 2012 is a critical first step. Access to alternative fuels should address both gasoline and diesel fuels. To achieve the goal of 10 percent alternative fuel use in gasoline transportation fuels, a Green Retailer designation would be provided by the state to any retail outlet that sells a minimum level of gasoline biofuel (E85).

A Green Retailer will receive incentives to support the infrastructure development needs for E85 and to help ensure that the retailer is able to provide value-based pricing (ethanol's lower energy content requires a lower price per gallon to offset the fuel economy reduction) for sustainable consumer use. The applicable incentive will be a reduction in the payment of motor fuel tax on all gasoline sold at the facility. These incentives are needed in the early stages of E85 growth to accelerate the development of new production, distribution, and retail channels.

The same incentives should apply to diesel transportation fuels, as long as a retailer meets the requirements of a Green Retailer for E85. A Green Retailer designation would apply for similar minimum levels of B20 biofuel sales. The reduction in motor fuel tax would apply to the amount of diesel fuel sales at the facility.

As an alternative to the application of incentives to the Green Retailer described above, a feebate approach could be considered where increases to the motor fuel tax (fee) are used to create a fund that would provide Green Retailers with an incentive (rebate) amount for each gallon of E85 or B20 sold. Such a public/private partnership is critically needed to accelerate consumer access to alternative fuels and support consumer value, setting the stage for increased use of renewable fuels in the transportation sector beyond low-level blends. The amount of the fee (per gallon of gas sold) could initially start at 0.01/gallon and should be increased as needed to achieve a goal of 10 percent alternative fuel sales by 2012. The amount of the fee and the amount of the rebate should be reviewed on an annual basis by the RFC.

The governor should initiate the development of a strategy to enact a low-carbon emission transportation fuels program in Michigan: Such a program should review the regulatory and legal mechanisms needed to enact a low-carbon fuels approach in Michigan. The strategy should identify mechanisms that will result in Michigan achieving 25 percent use of renewable fuels by 2025. This strategy should be integrated into and be consistent with an overall carbon reduction strategy for the state.

The above combination of incentives and requirements would work together help the state achieve a goal of reduced GHG emissions from the use of transportation fuels. A renewable fuel feedstock program would help to encourage local production of next generation feedstocks--such as perennial grasses and woody biomass--attracting new fuel producers and capturing the economic value of renewable fuel production within the state. A Green Retailers program would encourage the development of needed infrastructure for renewable fuels (such as E85 and B20), while also creating incentives for the sale and consumer purchase of those fuels. Currently available funding assistance for alternative fuel pumps and tanks is not considered to be sufficient incentive. Finally, a low-carbon fuels policy would create an overall requirement that the CO2 content, or "intensity," of transportation fuels sold in the state decline over time. This would help to ensure that the above renewable fuel incentives achieve desired GHG reduction goals, while also encouraging other potential low-carbon transportation fuels (e.g., electricity for plug-in hybrids) to play a role.

The State of California is currently developing a Low-Carbon Fuel Standard that would require a 10% reduction in the carbon intensity of transportation fuels by 2020, and other states are now considering similar policies. A recent federal proposal, not yet acted on, would require a 5% reduction in transportation fuel carbon intensity by 2022, and 10% by 2028. The federal Renewable Fuel Standard (RFS), recently passed as part of EISA, requires that new renewable fuels meet minimum GHG reduction targets but does not set an overall target for all transportation fuels, including renewable fuels currently under production.

While a federal low-carbon fuel policy would potentially make further action in Michigan unnecessary, there is no clear timeframe for such action or guarantee that Congress will act. Michigan could try to encourage federal policy in this area, but would play a stronger role by taking the lead and establishing its own state policy. By taking a leadership position, Michigan would also position itself for a competitive advantage in the development of a low-carbon fuel industry within the state.

Timing:

Parties Involved: Michigan legislature, MDEQ, MDA, MDNR, fuel providers, agricultural producers, utilities, auto companies.

Other:

Implementation Mechanisms

TBD – [CCS drafts based on TWG inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on TWG approval]

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

The gallons of diesel and gasoline forecast to be used in Michigan vehicles comes from the Michigan Inventory and Forecast. The preliminary goal is to reduce the life-cycle emissions of these fuels by 2% by 2015 and by 10% by 2025. This goal is meant as a stand-in for the TWG to help clarify the analysis being done by CCS.

Table 1-1 shows the gallons of gasoline and diesel that are forecast to be Michigan's on-road consumption. The life cycle emissions factors used for gasoline (11.74 kg CO2e/gal) and for diesel (12.69 kg CO2e/gal) come from the GREET model (ANL, 2008). The life cycle emissions of these fuels are also shown in Table 1-1. These life cycle emissions are higher than the figures for emissions from transportation seen in the Inventory and Forecast. This is because the emissions figures in the Inventory and Forecast only consider the direct emissions from combustion of fuel, rather than the life cycle emissions (which include refining and transporting the fuel). The difference between direct combustion emissions and life cycle emissions is typically around 20-25% for petroleum-based fuel.

Table 1-1: Life Cycle Emissions of Michigan Fuel Consumption

Year	Gasoline Gallons (million)	Diesel Gallons (million)	Total Life Cycle Gasoline Emissions (MMtCO2e)	Total Life Cycle Diesel Emissions (MMtCO2e)
2008	4,626	1,112	54.3	14.1
2009	4,659	1,142	54.7	14.5
2010	4,679	1,168	55.0	14.8
2011	4,682	1,185	55.0	15.0
2012	4,659	1,196	54.7	15.2
2013	4,635	1,207	54.4	15.3
2014	4,621	1,220	54.3	15.5
2015	4,614	1,235	54.2	15.7
2016	4,610	1,248	54.1	15.8
2017	4,606	1,260	54.1	16.0
2018	4,602	1,273	54.1	16.2
2019	4,599	1,287	54.0	16.3
2020	4,604	1,302	54.1	16.5
2021	4,628	1,325	54.4	16.8
2022	4,663	1,352	54.8	17.2
2023	4,708	1,382	55.3	17.5
2024	4,759	1,415	55.9	17.9
2025	4,778	1,438	56.1	18.2

The implementation path and life-cycle reduction goal for this option came by adjusting the federal renewable fuel standard to the state of Michigan according to the percentage of total fuel consumption that occurs in the state. This will serve to reduce the life cycle emissions of GHGs by 1.9% by 2015 and by 8.8% by 2025. The three fuels being considered in this analysis are biodiesel, corn ethanol and cellulosic ethanol. The implementation path of the goal and each individual fuel is shown in Table 1-2. The implementation path indicates the percentage reduction in CO2e emissions from fuel. Biodiesel use is increasing steadily towards 20% of all biofuel sales in Michigan. Cellulosic ethanol production does not begin until 2014, and increases steadily from then on. Corn Ethanol makes up the remaining biofuels.

Table 1-2: Implementation of Biofuels in Michigan

Year	Implementation Path	Percent Biodiesel	Percent Cellulosic Ethanol	Percent Corn Ethanol
2009	0.48%	5.4%	0.0%	94.6%
2010	0.71%	6.6%	0.8%	92.7%
2011	0.95%	7.9%	1.8%	90.3%
2012	1.19%	9.9%	3.3%	86.8%
2013	1.43%	10.6%	6.0%	83.4%
2014	1.66%	11.0%	9.6%	79.3%
2015	1.90%	12.2%	14.6%	73.2%
2016	2.20%	13.5%	19.1%	67.4%
2017	2.93%	14.6%	22.9%	62.5%
2018	3.67%	15.4%	26.9%	57.7%
2019	4.40%	16.1%	30.4%	53.6%
2020	5.13%	15.0%	35.0%	50.0%
2021	5.87%	13.6%	40.9%	45.5%
2022	6.60%	13.9%	44.4%	41.7%
2023	7.33%	13.2%	47.4%	39.5%
2024	8.07%	12.5%	50.0%	37.5%
2025	8.80%	11.9%	52.4%	35.7%

The gallons of each biofuel needed for TLU-1 is calculated from the amount of gasoline/diesel gallons that would need to be replaced to achieve the goals. For example, since the life cycle emissions of cellulosic ethanol are 15% that of gasoline, more than 10% of total gasoline will need to be replaced by 2025 in order to achieve a 10% reduction in GHG emissions from fuel. Then the figure for gasoline/diesel gallons replaced is adjusted to account for the different heat contents of the biofuels (for example the heat content for gasoline is higher than that of ethanol, but lower than that of diesel fuel) (EIA, 2007). This means that in order to replace 1 gallon of gasoline, more than 1 gallon of ethanol is needed to provide the same energy. The life cycle emissions per BTU are shown in Table 1-3.

Table 1-3: Life Cycle CO2e Emissions per Million BTU

Type of Fuel	Kg CO2e / Million BTU
Gasoline	93.88
Diesel	91.47
Corn Ethanol (e100)	82.24
Cellulosic Ethanol (e100)	14.25
Biodiesel (b100)	54.43

The amount of each biofuel required in the policy is shown in Table 1-4. The emissions reductions of these biofuels are calculated by multiplying the gallons of fuel being replaced by the difference in GHG emission factors between the conventional fuel and the biofuel.

Table 1-4: Biofuels Quantities and the Associated Emissions Reductions from the Implementation Path

Year	Million Gallons of Biodiesel (B100)	Million Gallons of Cellulosic Ethanol (E100)	Million Gallons of Corn Ethanol (E100)	Life Cycle Emissions Savings, Total (MMtCO2e)
2009	11	0	282	0.33
2010	19	3	393	0.50
2011	28	9	477	0.67
2012	40	20	519	0.83
2013	45	38	530	0.99
2014	48	63	517	1.16
2015	52	93	464	1.33
2016	59	124	437	1.54
2017	77	180	491	2.06
2018	93	242	518	2.57
2019	109	305	539	3.10
2020	110	382	546	3.62
2021	106	471	523	4.18
2022	116	550	515	4.75
2023	119	634	529	5.34
2024	122	722	541	5.96
2025	123	807	550	6.54
Total				45.45

The costs of this option are calculated based on the difference in cost between conventional fuels and biofuels. The cost estimates for gasoline, diesel, corn ethanol and biodiesel come from the common assumptions memo. The cost estimates for cellulosic ethanol come from an NREL source, which states that cellulosic ethanol will cost $1.00 per gallon more than corn-based ethanol in 2006[1](EIA, 2008). This figure is discounted to the proper year and added to the corn-ethanol figure. The costs of each biofuel are shown in Table 1-5.

[1] This estimates the cost of cellulosic to be 1$ greater than the cost of corn ethanol, but for this to decline in the future. The 1$ difference between the two prices is assumed to remain constant in our analysis.

Table 1-5: Cost of Biofuels Program

Year	Additional Cost of Biodiesel (Million $)	Additional Cost of Cellulosic Ethanol (Million $)	Additional Cost of Corn Ethanol (Million $)	Additional Cost of all Biofuels ($MM)
2009	4	0	92	96
2010	7	3	149	160
2011	11	10	192	213
2012	15	20	212	248
2013	18	24	61	103
2014	19	35	38	92
2015	21	30	-42	9
2016	24	71	63	158
2017	31	101	79	211
2018	38	131	88	258
2019	45	153	86	284
2020	46	181	87	315
2021	45	198	73	317
2022	50	185	46	281
2023	51	218	59	329
2024	53	234	61	347
2025	53	251	64	369

If this policy were implemented as it is currently written, it would exceed the amount of ethanol which could be consumed through the use of E10 in gasoline. This would therefore require the introduction of additional flex-fueled vehicles capable of running on E85. According to the AEO 2008, the additional cost of a mid-sized vehicle to be able to run on flex-fuel is $400. The number of vehicles that would be required to run on flex fuel is calculated by assessing the amount of ethanol produced beyond 10% (which can be burned in all gasoline engines as E10), and the % of new vehicle sales that would need to take place in order to burn the additional levels of ethanol. The estimate for new vehicle sales is calculated in TLU-4. The total costs of the program, in terms of biofuels and vehicle costs are also shown in Table 1-6.

Table 1-6: Costs of Vehicle Modifications and Total Costs of Program

Year	Estimated New Vehicle Sales	% Gasoline replaced	% of Cars needed to be Flex Fueled Vehicles	Number of cars needed to be Flex Fueled Vehicles	Additional Cost of Flex-Fuel Vehicles	Total Cost of TLU-1
2009	627,795	4.08%	0.00%	0	$0	96
2010	630,493	5.71%	0.00%	0	$0	160
2011	632,541	7.00%	0.00%	0	$0	213
2012	634,595	7.79%	0.00%	0	$0	248
2013	636,656	8.27%	0.00%	0	$0	103
2014	638,723	8.46%	0.00%	0	$0	92
2015	640,798	8.14%	0.00%	0	$0	9
2016	641,965	8.19%	0.00%	0	$0	158
2017	643,134	9.81%	0.00%	0	$0	211
2018	644,305	11.13%	1.13%	8,532	$3	261
2019	645,479	12.36%	2.36%	17,933	$7	292
2020	646,654	13.58%	3.58%	27,198	$11	325
2021	646,869	14.47%	4.47%	33,988	$14	330
2022	647,083	15.39%	5.39%	41,045	$16	297
2023	647,297	16.64%	6.64%	50,581	$20	349
2024	647,512	17.89%	7.89%	60,101	$24	371
2025	647,727	19.14%	9.14%	69,624	$28	397
Total						**$3,912**

Data Sources:

US EIA "Biofuels in the U.S. Transportation Sector". Feb 2007
http://www.eia.doe.gov/oiaf/analysispaper/pdf/tbl12.pdf Accessed Aug 11, 2008

US EIA, 2008. http://www.eia.doe.gov/oiaf/aeo/conf/collins/collins.ppt Accessed on 8/14/08.

ANL, 2008. "GREET Model 1.8" Argonne National Laboratory's GREET model can be downloaded at http://www.transportation.anl.gov/modeling_simulation/GREET/index.html

Quantification Methods: [e.g., Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

There are significant uncertainties in predicting the cost of fuel over a long period of time. Depending on the cost difference between conventional gasoline/diesel and biofuels, the cost figures for this option could be changed significantly. The price of cellulosic ethanol is particularly difficult to estimate, because it is not currently available on a commercial scale, so fuel cost estimates are largely speculative.

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-2. Eco Driver Program

Policy Description

Driving behavior can significantly influence a vehicle's fuel economy performance. Eco-driving principles incorporate a wide range of initiatives that can help drivers maximize the fuel efficiency from their existing vehicles by better understanding the direct impact that driving style, driving patterns, vehicle technologies, and vehicle maintenance have on a vehicle's fuel economy. A properly designed eco-driving program not only enhances driver awareness and understanding in the short term but also provides a systematic program framework that can alter driver behavior and yield tangible environmental and consumer cost benefits.

Eco-driving programs leverage driver behavior across the entire fleet of existing vehicles in use. The primary focus of an eco-driving campaign would target light duty vehicles where driver education on eco-driving principles would have the greatest benefit. Michigan drivers consume over 5 billion gallons of gasoline per year which generate over 44 million metric tons of CO_2 emissions. Eco-driving training programs in Europe and Canada have documented reductions in fuel consumption ranging from 16% to 25% for individual drivers. An integrated eco-driving program in Michigan can be designed to achieve a fuel-economy increase (and corresponding GHG reduction) of at least 10% in the mid-term with long term benefit potential of up to 20%.

Policy Design

A properly designed eco-driving program must move beyond a list of driver "tips" and focus on providing the appropriate tools and programs to systematically change driver behavior.

Key eco-driving principles must cover:

- Driving style
  - Acceleration: accounts for 50% of a vehicle's fuel consumption in city driving
  - Speed limits: driving at 65mph requires 15% more fuel than 55mph
  - Safe driving distances: 20% less fuel to accelerate from 5mph than from a full stop
- Starting and idling
- Trip planning
- Vehicle drag/weight
  - Excess cargo: fuel economy drops 1% for every 25-50 lbs of additional weight
  - Open windows/truck bed covers/vehicle add-ons
- Proper maintenance
  - Engine tuning
  - Correctly inflated tires

- Vehicle technology applications
  - Use of instantaneous fuel economy readouts
  - Use of navigation/direction systems

A Michigan eco-driving program must consider the following program initiatives:

Direct Driver Training Initiatives

- **Scope:** Provide direct, hands-on training from professional eco-driving instructors to provide a credible "real-world" basis for individual drivers to understand the direct impact that their driving "decisions" have on fuel consumption and costs. This direct interaction can start with new drivers who must currently pass a "driver education" course. In addition, eco-driving seminars and training can be linked with corporate/coalition initiatives to highlight specific eco-driving benefits.
- **Key Enablers:**
  - Development of an eco-driving module to be incorporated into all "new driver" course instruction. Module must include both written (online materials) as well as hands-on driving practice with the driving instructor.
  - Eco-driving course instruction and hands on training for all "new driver" licensed instructors. Training to be provided by professional eco-drivers in a series of state-sponsored training courses.
  - State support for eco-driving training seminars in partnership with key auto coalition sponsors (AAA, Automakers etc.). Goal is to document average savings for typical drivers to use as a media event to highlight eco-driving impact. Typical training package used in Europe and Canada targets 50+ drivers and includes 1) fuel economy monitoring during 20+ mile course (city/highway) 2) eco-driving instruction and discussion and 3) repeat of 20+ mile course with eco-driving instructor to define improvement.
- **Goal:** Newly trained drivers will gradually spread what they learn to friends and neighbors, extending the impact of the program beyond the formal participants. Full implementation for new drivers programs by 2010. State supported training in partnership with corporate/coalition members should target 5-10 regional events per year to leverage media focus.

General Eco-Driving Education

- **Scope:** Highlight importance of ongoing eco-driving education by incorporating the review of an eco-driving training module as part of the state's driver license renewal requirement.
- **Key Enablers:** Development of an interactive, on-line eco-driving module. (Development of this module can leverage existing resources provided by automakers and other auto related groups)
- **Goal:** State-wide implementation by 2010.

Vehicle Maintenance

- **Scope:** Proper inflation of tires is one of the most direct eco-driving actions that can be taken and can increase fuel economy by 2-5%.
- **Key Enablers:**
  - Encourage all fueling stations to provide free tire air and accurate pressure gauging by providing a tax credit for up to 50% of the equipment cost. By 2010, require that all fuel stations (exempting low volume operators) have a tire pressure pump/gauge in place.
  - Encourage all repair/oil-change facilities to adjust tire pressure as part of their service – along with an eco-driving checklist – and create a state sponsored "eco-star" program that highlights repair/oil change facilities that incorporate eco-driving initiatives.
  - Require aftermarket tire manufacturers to display fuel economy ratings (rolling resistance standards) from tire manufacturers.
- **Goal:** Full customer access to tire pumps by 2010. Repair/oil change checklist with air pressure - 90 percent participation by 2012.

Vehicle Applications

- **Scope:** Real-time fuel economy indicators on vehicle instrument panels are one of the best means for encouraging eco-friendly driving because they provide prompt, quantitative feedback to drivers. Unfortunately the State of Michigan acting alone cannot require manufacturers to offer such indicators on all vehicles, and it does not seem to be practical at present to install such indicators as after-market devices. Therefore we have not included a goal relating to fuel-economy indicators. Key Enablers:
- **Key Enablers:** Pursue a resolution with the governor and state officials to encourage manufacturers to offer real-time fuel economy indicators more widely."
- **Goal:** 90% of new vehicles with real-time fuel economy indicators by 2015.

Implementation Mechanisms

The low rolling resistance tire program should include an information campaign aim at making people more aware (at the point of sale) of the potential for fuel savings from low rolling resistance tires.

There may be difficulties in compelling currently licensed drivers to undergo additional driver training, but if the costs of such a program were low (or completely state funded) then it is possible that some people would participate to save money on fuel.

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

TBD – [CCS should provide a worksheet and other reference material as needed for transparency]

Data Sources: [TBD by CCS on TWG approval]

Quantification Methods:

Four methods of improving Michigan's driving and vehicle maintenance habits were considered in this analysis: Low Rolling Resistance Tires, Proper Tire Inflation, Direct Eco-Driver Training and General Eco-Driver Training. While the benefits of these programs have a definite potential for overlap, other eco-driving initiatives that are not considered in this analysis will likely have further savings which are not quantified. Other potential eco-driver initiatives include in-car vehicle readouts to show fuel efficiency and general vehicle maintenance to ensure optimal efficiency.

Low Rolling Resistance Tires

Rolling Resistance reduces the amount of power coming from the engine that can be transferred to moving a vehicle along the road. This policy is intended towards encouraging the use of low rolling resistance tires on replacement tires, because often new vehicles already use rolling resistance tires in order to achieve their CAFE fuel economy requirements. The fuel efficiency savings possible from installation of low rolling resistance tires was estimated at 3% according to the California Energy Commission (CEC, 2003). The fuel efficiency savings from trucks are even more significant, with an average savings of 3.9%(Ang-Olson and Schroeer, 2001)[2]. The life cycle emissions of gasoline (for the passenger cars) were 11.74 kg CO2e/gal, while the life cycle emissions for diesel fuel (for the freight trucks) were estimated to be 12.69 kg CO2e/gal (ANL, 2008). Both of these emissions factors come from the GREET model. The implementation path represents the percentage of vehicles which will have low rolling resistance tires that otherwise would not have them. The path chosen can have a dramatic impact on the savings possible with this type of program. The implementation path used and the GHG savings from low-rolling resistant tires can be seen in Table 2-1.

[2] 3.9% figure is an average of the Bridgestone and Michelin Study on low rolling resistant tires.

Table 2-1: Implementation Path and GHG Savings of Low Rolling Resistance Tires

Year	Implementation Path (tire improvements)	Reduction in Fuel Use, Low Rolling Resistance Tires, Passenger Cars	Reduction in Fuel Use, Low Rolling Resistance Tires, Freight Trucks	GHG reduction, Rolling Resistance Tires (MMtCO2e)
2008	0%	0.00%	0.00%	0.00
2009	1.2%	0.04%	0.05%	0.03
2010	2.4%	0.07%	0.09%	0.05
2011	3.5%	0.11%	0.14%	0.08
2012	4.7%	0.14%	0.18%	0.10
2013	5.9%	0.18%	0.23%	0.13
2014	7.1%	0.21%	0.28%	0.16
2015	8.2%	0.25%	0.32%	0.18
2016	9.4%	0.28%	0.37%	0.21
2017	10.6%	0.32%	0.41%	0.24
2018	11.8%	0.35%	0.46%	0.26
2019	12.9%	0.39%	0.50%	0.29
2020	14.1%	0.42%	0.55%	0.32
2021	15.3%	0.46%	0.60%	0.34
2022	16.5%	0.49%	0.64%	0.37
2023	17.6%	0.53%	0.69%	0.40
2024	18.8%	0.56%	0.73%	0.43
2025	20%	0.60%	0.78%	0.46

Estimate of the vehicles in the program were made by multiplying the passenger vehicles or commercial trucks registered in Michigan(BTS, 2008). The costs of this policy were based on the additional costs of four rolling resistant tires, estimated to be 100 dollars (Snyder, 2008). These costs were applied to all vehicles in the program in their first year and then every three years after that. For trucks, the same cost factor was used, but applied to 18 wheels rather than 4. The costs of this policy are shown in Table 2-2. Taking into account the fuel savings over the course of the policy period, the use of low rolling resistance tires is a net cost savings.

Table 2-2: Costs and Cost Savings from Low Rolling Resistance Tires.

Year	Cost Rolling Resistant Tires, Passenger Cars (Million $)	Cost, Rolling Resistant Tires, Freight Trucks (Million $)	Cost Savings, Passenger Cars (Million $)	Cost Savings, Diesel (Million $)	Total Cost, Rolling Resistant Tires (Million $)
2008	$0	$0	$0.0	$0.0	$0.0
2009	$9.5	$0.4	$4.6	$1.4	$4.0
2010	$12.7	$0.5	$9.5	$2.8	$0.9
2011	$15.9	$0.7	$14.6	$4.5	-$2.5
2012	$19.1	$0.8	$19.8	$6.1	-$6.0
2013	$22.2	$1.0	$25.2	$8.0	-$10.1
2014	$25.4	$1.1	$30.8	$10.0	-$14.3
2015	$28.6	$1.2	$36.0	$11.9	-$18.0
2016	$31.8	$1.4	$41.5	$13.9	-$22.3
2017	$34.9	$1.5	$47.4	$16.3	-$27.3
2018	$38.1	$1.6	$53.3	$18.6	-$32.1
2019	$41.3	$1.8	$59.7	$21.1	-$37.7
2020	$44.5	$1.9	$66.3	$23.7	-$43.6
2021	$47.6	$2.0	$73.6	$26.6	-$50.5
2022	$50.8	$2.2	$80.2	$29.3	-$56.5
2023	$54.0	$2.3	$86.1	$31.8	-$61.5
2024	$57.2	$2.4	$92.8	$34.7	-$67.9
2025	$60.4	$2.6	$98.6	$37.7	-$73.3

Proper Tire Inflation

The General Accounting Office estimated that 25% of vehicles have tires that are 8 psi or more underinflated (GAO, 2008). In passenger cars, tires 1 psi less than optimal inflation reduces fuel efficiency by 0.4% (Carcare, 2008). Freight trucks are estimated to have 0.6% reduced efficiency because of underinflated tires (Ang-Olson and Schroeer, 2001). This policy involves modeling a tire inflation campaign for the state of Michigan after a similar program adopted in Sarasota, FL. The implementation path used for this policy approaches 20%, and therefore 20% of drivers that otherwise would have had underinflated tires are assumed to now be practicing proper tire maintenance. The implementation of the policy can be seen in Table 2-3. The fuel consumption reduction from the proper tire inflation campaign is determined by multiplying the % of fuel improvement possible with both passenger cars and trucks by the amount of fuel consumed in the state by the emissions factor for a gallon of each fuel. The total GHG reductions possible with this policy are shown in Table 2-3.

Table 2-3: Implementation Path and GHG Reduction from Proper Tire Inflation

Year	Implementation Path (tire improvements)	Fuel Improvement Possible, Tire Inflation, Passenger Cars	Fuel Improvement Possible, Tire Inflation, Commercial Trucks	GHG reduction, Tire Inflation (MMtCO2e)
2008	0%	0.00%	0.00%	0.00
2009	1.2%	0.01%	0.01%	0.01
2010	2.4%	0.02%	0.01%	0.01
2011	3.5%	0.03%	0.02%	0.02
2012	4.7%	0.04%	0.03%	0.02
2013	5.9%	0.05%	0.04%	0.03
2014	7.1%	0.06%	0.04%	0.04
2015	8.2%	0.07%	0.05%	0.04
2016	9.4%	0.08%	0.06%	0.05
2017	10.6%	0.08%	0.06%	0.06
2018	11.8%	0.09%	0.07%	0.06
2019	12.9%	0.10%	0.08%	0.07
2020	14.1%	0.11%	0.08%	0.07
2021	15.3%	0.12%	0.09%	0.08
2022	16.5%	0.13%	0.10%	0.09
2023	17.6%	0.14%	0.11%	0.09
2024	18.8%	0.15%	0.11%	0.10
2025	20%	0.16%	0.12%	0.11

The costs of the tire inflation campaign were modeled after the Sarasota, FL tire information campaign (Florida, 2008)[3]. These costs were adjusted according to Michigan's population relative to Sarasota and scaled into an annual cost of 2.7 million dollars. The cost savings come from reduced fuel use. The costs and cost savings are shown in Table 2-4.

[3] This program is aimed to reducing tire waste and promoting better tire care and maintenance. It is possible that a campaign aimed only at improving tire maintenance/inflation could be run at a lower cost.

Table 2-4: Costs and Cost Savings from Proper Tire Inflation Program

Year	Cost of Tire Inflation Campaign (Million $)	Cost Savings, Tire Inflation (Million $)	Net Costs, Tire Inflation (Million $)
2008	$0.0	$0.0	$0.0
2009	$2.7	$1.4	$1.3
2010	$2.7	$3.0	-$0.2
2011	$2.7	$4.6	-$1.8
2012	$2.7	$6.2	-$3.5
2013	$2.7	$8.0	-$5.2
2014	$2.7	$9.8	-$7.0
2015	$2.7	$11.4	-$8.7
2016	$2.7	$13.2	-$10.5
2017	$2.7	$15.1	-$12.4
2018	$2.7	$17.1	-$14.3
2019	$2.7	$19.1	-$16.4
2020	$2.7	$21.3	-$18.6
2021	$2.7	$23.7	-$21.0
2022	$2.7	$25.9	-$23.2
2023	$2.7	$27.8	-$25.1
2024	$2.7	$30.1	-$27.3
2025	$2.7	$32.1	-$29.4

Eco-Driver Training

Direct eco-driver training serves to encourage driving habits that reduce fuel consumption. These habits include shifting to a higher gear earlier, using cruise control, coasting into stoplights and accelerating more gradually. Habits such as these have both environmental and economic benefits to the driver. An eco-driving course in Europe found that reductions in fuel consumption of 15-25% were quite possible for drivers in the first year (Ecodrive, 2007). This improvement typically decreases as old habits set back in for drivers, so subsequent years had an average of 6.3% reduction in fuel consumption (Ecodrive, 2007). This policy was only applied to drivers of passenger vehicles, because it is assumed that while eco-driving techniques could save fuel in freight trucks, these are likely to have different costs and benefits than a program aimed at cars. The reduction in fuel consumption and GHG benefits are shown in Table 2-5.

Table 2-5: Implementation Path and GHG Savings of Direct Eco-Driver Training

Year	Implementation Path (behavior changes)	Driver Training (passenger cars only)	GHG Reduction, Direct Driver Education
2008	0.00%	0.00%	0.00
2009	0.29%	0.06%	0.03
2010	0.59%	0.08%	0.04
2011	0.88%	0.09%	0.05
2012	1.18%	0.11%	0.06
2013	1.47%	0.13%	0.07
2014	1.76%	0.14%	0.08
2015	2.06%	0.16%	0.09
2016	2.35%	0.18%	0.10
2017	2.65%	0.20%	0.11
2018	2.94%	0.21%	0.12
2019	3.24%	0.23%	0.12
2020	3.53%	0.25%	0.13
2021	3.82%	0.27%	0.14
2022	4.12%	0.28%	0.15
2023	4.41%	0.30%	0.16
2024	4.71%	0.32%	0.17
2025	5.00%	0.33%	0.18

The costs for direct eco-driver training were estimated based on the costs of a similar program in the Netherlands, which was an investment of 2 million Euros to train 6,500 driving instructors(Wilbers et al., 2006). 92% of these driving instructors said that they would be taking the methods taught in the course into account (Wilbers et al., 2006). These costs were applied to the number of drivers assumed to be taking an eco-driving course, as shown in the Implementation Path, reaching 5% of the population by 2025. The costs of the direct eco-driver training are shown on Table 2-6.

Table 2-6: Costs of Direct Eco-Driver Training

Year	Cost of driver training (passenger cars) (Million $)	Cost Savings, Driver training (passenger cars) (Million $)	Net Costs, Driver Training (Million $)
2008	$0.0	$0.0	$0.0
2009	$9.3	$7.7	$1.7
2010	$9.3	$10.3	-$0.9
2011	$9.3	$12.9	-$3.5
2012	$9.3	$15.5	-$6.1
2013	$9.3	$18.2	-$8.9
2014	$9.3	$21.1	-$11.7
2015	$9.3	$23.6	-$14.2
2016	$9.3	$26.3	-$17.0
2017	$9.3	$29.3	-$20.0
2018	$9.3	$32.2	-$22.9
2019	$9.3	$35.4	-$26.1
2020	$9.3	$38.8	-$29.5
2021	$9.3	$42.5	-$33.2
2022	$9.3	$45.8	-$36.5
2023	$9.3	$48.7	-$39.3
2024	$9.3	$52.0	-$42.7
2025	$9.3	$54.8	-$45.5

General Eco-Driving Initiative

The general eco-driving initiative seeks to encourage all drivers to operate their vehicles in a safer manner, with the emphasis on reduced highway speeds. The implementation path used for this program assumes that 5% of drivers will modify their driving habits and thus reduce their typical highway speed from 70 to 60 mph. It is likely that the true benefits of this program will be different: more than 5% of the population is likely to change their driving habits in some small way, and some drivers will reduce their highway speed, but only some of the time or only a few mph. However, this estimate should serve as an example of the fuel reductions that can come from a general eco-driver initiative aimed at encouraging reduced highway speeds.

The fuel savings of this program were estimated by multiplying the implementation path by the average amount of high speed (>55 mph) driving for both cars (24%)(FHWA, 2008) and trucks (50%[4]) (Ang-Olson and Schroeer, 2001). This was then multiplied by the reduction in fuel efficiency that comes with driving 70 mph rather than 60 mph. This fuel efficiency improvement for cars was estimated to be 16%(Speed Figure, 2007)[5], while the improvement for freight trucks is 14% (Ang-Olson and Schroeer, 2001). The GHG benefits of the General Eco-Driver Initiative are shown in Table 2-7.

---

[5] The average of these seven different efficiencies was used in this analysis.

Table 2-7: Implementation Path and GHG Benefits of General Eco-Driver Initiative

Implementation Path (behavior changes)	General Eco-Driver Initiative (passenger cars)	General Eco-Driver Initiative (freight trucks)	GHG Reduction, General Eco-Driver Initiative
0.00%	0.00%	0.00%	0.00
0.29%	0.01%	0.02%	0.01
0.59%	0.02%	0.04%	0.02
0.88%	0.03%	0.06%	0.03
1.18%	0.05%	0.08%	0.04
1.47%	0.06%	0.10%	0.05
1.76%	0.07%	0.12%	0.06
2.06%	0.08%	0.14%	0.07
2.35%	0.09%	0.16%	0.08
2.65%	0.10%	0.19%	0.08
2.94%	0.11%	0.21%	0.09
3.24%	0.13%	0.23%	0.10
3.53%	0.14%	0.25%	0.11
3.82%	0.15%	0.27%	0.12
4.12%	0.16%	0.29%	0.13
4.41%	0.17%	0.31%	0.14
4.71%	0.18%	0.33%	0.16
5.00%	0.20%	0.35%	0.17

The costs of this eco-driver initiative were based on a similar eco-driver initiative in the Netherlands(Senternovem, 2004)[6]. The cost savings of this policy come from the reduced cost of fuel over the policy period. The costs of the eco-driver program are shown in Table 2-8.

Table 2-8: Costs and Cost Savings of Eco-Driver Initiative

[6] The largest year for this policy was 2002 which had a budget of 7 million euros. This amount was used for our costs, and then adjusted according to differences in the Netherlands/Michigan population and exchange rates. The result is an investment of 6.3 million annually.

Year	Cost of Eco-Driver Information Program (Million $)	Cost Savings of Eco-Driver Program (Million $)	Net Costs, Eco-Driver Program (Million $)
2008	$0.0	$0.0	$0.0
2009	$6.3	$2.1	$4.2
2010	$6.3	$4.4	$2.0
2011	$6.3	$6.8	-$0.4
2012	$6.3	$9.2	-$2.8
2013	$6.3	$11.8	-$5.5
2014	$6.3	$14.5	-$8.2
2015	$6.3	$17.0	-$10.7
2016	$6.3	$19.7	-$13.4
2017	$6.3	$22.7	-$16.4
2018	$6.3	$25.7	-$19.3
2019	$6.3	$28.9	-$22.5
2020	$6.3	$32.2	-$25.8
2021	$6.3	$35.9	-$29.6
2022	$6.3	$39.3	-$32.9
2023	$6.3	$42.3	-$35.9
2024	$6.3	$45.8	-$39.4
2025	$6.3	$49.0	-$42.6

The entire Eco-Driver policy requires a significant investment on the part of the state of Michigan, but these investments all reap significant rewards in terms of fuel savings. The combined costs, cost savings and GHG benefits of the four eco-driver initiatives considered are shown in Table 2-9.

Table 2-9: Total Costs, Cost Savings and GHG Reductions from TLU-2

Year	Total Costs (Million $)	Total Savings (Million $)	Net Costs, TLU- 2 (Million $)	Gas gallons saved (Million Gallons)	Diesel Gallons Saved (Million Gallons)	Emissions Savings (MMtCO2e)
2008	$2.7	$0	$2.7	0.0	0.0	0.00
2009	$28.3	$17.2	$11.2	5.2	0.8	0.07
2010	$31.7	$29.9	$1.7	8.7	1.6	0.12
2011	$35.0	$43.3	-$8.3	12.1	2.5	0.17
2012	$38.3	$56.7	-$18.4	15.6	3.4	0.23
2013	$41.6	$71.3	-$29.7	19.1	4.3	0.28
2014	$44.9	$86.1	-$41.2	22.6	5.2	0.33
2015	$48.2	$100	-$51.6	25.9	6.2	0.38
2016	$51.5	$115	-$63.1	29.1	7.1	0.43
2017	$54.8	$131	-$76.0	32.4	8.1	0.48
2018	$58.2	$147	-$88.7	35.8	9.1	0.54
2019	$61.5	$164	-$103	39.1	10.1	0.59
2020	$64.8	$182	-$117	42.5	11.1	0.64
2021	$68.1	$202	-$134	45.8	12.2	0.69
2022	$71.4	$220	-$149	49.2	13.2	0.75
2023	$74.7	$237	-$162	52.6	14.4	0.80
2024	$78.0	$255	-$177	56.3	15.6	0.86
2025	$81.3	$272	-$191	60.1	16.9	0.92
Total			**-$1,395**			**8.28**

Data Sources: California Energy Commission, 2003. “California State Fuel Efficient Tire Report: Volume 1” 2003. http://www.energy.ca.gov/reports/2003-01-31_600-03-001F-VOL1.PDF

ANL, 2008. “GREET Model 1.8” Argonne National Laboratory’s GREET model can be downloaded at http://www.transportation.anl.gov/modeling_simulation/GREET/index.html

Wilbers et al. 2006. “Monitoring and evaluation of behavioral programmes”http://www.iapsc.org.uk/presentations/0606_Kroon_combined.pdf Accessed on 8/14/08.

Ecodrive, 2007. “CIECA internal project on ‘Eco-driving’ in category B driver training & the driving test” April 11, 2007. http://www.ecodrive.org/fileadmin/dam/ecodrive/Downloads/CIECA_Eco-driving_project_final_report_EN.pdf Accessed 8/12/08.

Florida, 2008. “Waste Tire Source Reduction and Public Awareness Program” http://www.dep.state.fl.us/waste/quick_topics/publications/shw/recycling/InnovativeGrants/IGyear5/fullprop/SarasotaCounty.pdf Accessed 8/12/08.

GAO, 2008. http://www.gao.gov/new.items/d07246r.pdf Accessed 8/10/08.

Carcare, 2008. http://www.carcare.org/tires_wheels/inflation.shtml Accessed 8/12/08.

Ang-Olson and Schroeer "Energy Efficiency Strategies for Freight Trucking: Potential Impact on Fuel Use and Greenhouse Gas Emissions". 2001. 3.9% figure is an average of the Bridgestone and Michelin Study on low rolling resistant tires.

BTS, 2008.
http://www.bts.gov/publications/state_transportation_statistics/michigan/html/fast_facts.html

Snyder, Jesse. 2008. "A big fuel saver: Easy-rolling tires (but watch braking)" Automotive News. July 21, 2008.

Senternovem, 2004.
http://www.senternovem.nl/mmfiles/Engelse%20folder%20april%202004_tcm24-192328.pdf
The largest year for this policy was 2002 which had a budget of 7 million Euros. This amount was used for our costs, and then adjusted according to differences in the Netherlands/Michigan population and exchange rates. The result is an investment of 6.3 million annually.

FHWA, 2008. http://www.fhwa.dot.gov/ohim/tvtw/08juntvt/08juntvt.pdf Assumes that mileage on interstate highways is all above 55 mph and non interstate highways is below 55 mph.

Speed Figure, 2007.
http://bioage.typepad.com/.shared/image.html?/photos/uncategorized/2007/05/01/fordspeed1.png
. Accessed 8/14/08. The average of these seven different efficiencies was used in this analysis.

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

Low Rolling Resistance Tires can require additional stopping distance at highway speeds, thus creating safety concerns.

Conversely, encouraging reduced speeds through the general eco-driving program can help improve highway safety.

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-3. Truck Idling Policies

Policy Description

This policy option aims to reduce greenhouse-gas and other emissions from unnecessary idling of heavy-duty vehicles, including trucks and buses. The EPA estimates that truck idling consumes 1 billion gallons of fuel annually, emitting 11 billion tons of carbon dioxide [*substitute Michigan-specific numbers when available*]. Much of this idling takes place during mandatory rest periods to provide heating or cooling of cabin air. Substantial reductions in fuel consumption and GHG emissions could be realized by providing alternate means for cabin conditioning.

Additional idling occurs during vehicle operation, for example loading and unloading of buses and trucks. The implementation of public and private fleet anti-idling policies and ordinances, targeted education of bus and truck operators, and creation of low-cost means to access available EPA-verified technologies, could help encourage emissions reductions from heavy-duty diesel engines.

Policy Design

Goals:
Reduce heavy-duty engine idling by providing increased availability of electrification at privately owned truck stops, or encouraging greater use of Auxiliary Power Units (on-board generators) for heating, cooling, and other creature comforts on heavy-duty vehicles. Provide financial assistance (e.g. low-interest revolving loans) to truck-stop operators and truck owners/operators for infrastructure development or equipment purchase. Undertake targeted educational activities as appropriate with truck, bus, and truck-stop owners and operators. Achieve diesel idling reductions from heavy-duty diesel engines of 40 percent by 2015 and 80 percent by 2025, relative to baseline.

Adopt a Michigan anti-idling law based on the EPA Model State Idling Law (http://www.epa.gov/SmartwayLogistics/documents/420s06001.pdf) and/or encourage adoption of local ordinances to address idling during operation of buses and heavy trucks.

Timing:

Parties Involved: truck and bus fleet owners and operators, MDOT, truck-stop owners and operators

Other: Issues to be resolved include, among others, the choice of implementing one EPA verified technology over another (*e.g*. electrification *vs*. Auxiliary Power Units); costs and benefits associated with providing anti-idling infrastructure/facilities at public rest areas *vs*. private truck stops; costs and benefits to fleet operators and to the state; and enforcement mechanisms that would be required. Potential funding sources include funding from the gas tax and from CMAQ and other federal agency grants.

Implementation Mechanisms

Adopt a Michigan anti-idling law based on the EPA Model State Idling Law (http://www.epa.gov/SmartwayLogistics/documents/420s06001.pdf) and/or encourage adoption of local ordinances to address idling during operation of buses and heavy trucks.

Many other states have low interest loans to finance idling reduction technology, but this is not the case in Michigan. Such a program would help provide the capital necessary to defray the up-front costs of investing in these efficiency improvements.

There are also difficulties in this program that come from misplaced incentives for efficiency improvement. For example, if the truck owner is responsible for truck maintenance (and therefore any upgrades to the truck) but the truck driver is responsible for fuel costs, then there is no incentive for either to make an investment towards efficiency improvement. Any implementation of this policy should try to account for this potential barrier to implementation.

Related Policies/Programs in Place

No state programs exist for truck stop anti-idling. Numerous trucking firms have encouraged reducing idling through grants from EPA and other sources. The City of Ann Arbor has a draft policy on truck idling reduction based on EPA recommendations.

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

Table 3.1: Estimated GHG Reductions and Cost Effectiveness

	2015	2025	Units
GHG Emission Savings	0.35	0.87	MMtCO$_2$e
Net Present Value (2009-2025)		-$402	$million
Cumulative Emissions Reductions (2009-2025)		7.4	MMtCO$_2$e
Cost-Effectiveness		-$54	$/tCO$_2$e

Data Sources:

1. American Transportation Research Institute, "Idle Reduction Technology: Fleet Preferences Survey," February 2006 for technology and maintenance costs.

2. EPA SmartWay Transportation Partnership (http://www.epa.gov/otaq/smartway/transport/what-smartway/idling-reduction.htm) for average idling hours and technology costs.

3. "Analysis of Technology Options to Reduce the Fuel Consumption of Idling Trucks," ANL/ESD-43, Argonne National Laboratory, Transportation Technology R&D Center, June 2000, for information on technology impacts.

4. Data from EPA's MOBILE6 model to estimate the proportion of CO_2 emissions attributable to Class 8 trucks.

5. Data from US DOE/EIA *Annual Energy Outlook 2008* to estimate the amount of fuel consumed annually per truck.

6. Truck-Stop Electrification data based on study done by ANTARES Group Inc. for the DeWitt Service Area facility in NY State: http://www.epa.gov/smartway/documents/dewitt-study.pdf.

7. Ang-Olson, J. and Schroeer, W. "Energy Efficiency Strategies for Freight Trucking: Potential Impact on Fuel Use and Greenhouse Gas Emissions," Transportation Research Board, 2001. Data for APU diesel consumption.

8. American Transportation Research Institute, "Fuel Savings/Emissions Reducing Technologies and Incentives: Use and Preferences Among Diesel Truck Owners in the Baltimore Region," August 2007.

Quantification Methods:

The estimated reduction in CO_2 emissions from reduced idling was calculated based on first estimating the portion of emissions and fuel consumption in the Michigan transportation inventory that were attributable to Class 8 diesel trucks. Then, the portion of the total fuel consumption that would be consumed during idling was estimated. Idle reduction percentages for each year was interpolated from 2010 to 2025 based on the Michigan reduction targets of 40% by 2015, and 80% by 2025 (see Table 3.2).

Table 3.2: Truck Idling Activities, Idling Reduction Percentages, and Diesel Savings

Year	Estimated Number of Class 8 Trucks in Michigan	Diesel Consumption in Class 8 Truck Idling (Million Gallons)	Idling Reduction Percentage Applied	Diesel Saved From Idling Reduction (Million Gallons)
2009	125,050	92.56	0%	0.00
2010	126,155	95.09	7%	6.34
2011	128,532	97.46	13%	12.99
2012	133,044	99.89	20%	19.98
2013	138,493	102.38	27%	27.30
2014	143,550	104.92	33%	34.97
2015	148,169	107.53	40%	43.01
2016	152,527	109.86	44%	48.34
2017	157,531	112.23	48%	53.87
2018	162,234	114.66	52%	59.62
2019	166,820	117.13	56%	65.60
2020	171,172	119.66	60%	71.80
2021	175,838	122.46	64%	78.37
2022	180,700	125.31	68%	85.21
2023	185,450	128.24	72%	92.33
2024	190,207	131.22	76%	99.73
2025	194,993	134.28	80%	107.42
Total Reductions				**906.89**

For the purpose of this analysis, emissions from the usage of Auxiliary Power Units (APU) for truck idling were quantified. Specifically, it was assumed that auxiliary diesel engines burn 0.2 gallons of fuel per hour of idling (see Source 7 above). The CO_2 emissions saved from idle reduction was then netted against the CO_2 emitted from APU usage. Table 3.3 shows the APU diesel consumption and the net CO_2 reduced from idling.

Table 3.3: APU Emissions and Net CO_2 Savings from Idle Reduction

Year	Diesel Consumed From APU Usage (Million Gallons)	CO_2 Emissions from APU Usage ($MMtCO_2e$)	Net CO_2 Saved from Idle Reduction ($MMtCO_2e$)
2009	16.58	0.00	0.00
2010	17.03	0.01	0.05
2011	17.46	0.02	0.11
2012	17.89	0.04	0.16
2013	18.34	0.05	0.22
2014	18.79	0.06	0.29
2015	19.26	0.08	0.35
2016	19.68	0.08	0.40
2017	20.10	0.10	0.44
2018	20.54	0.11	0.49
2019	20.98	0.11	0.54
2020	21.43	0.13	0.59
2021	21.94	0.14	0.64
2022	22.44	0.15	0.70
2023	22.97	0.17	0.75
2024	23.50	0.18	0.81
2025	24.05	0.20	0.87
Total Reductions		**1.62**	**7.42**

The cost analysis assumes a 5-year lifetime for idling technology equipment, applied to an incremental percentage of Class 8 vehicles starting in 2010, at a cost of $6,000 per vehicle[7]. The EIA Annual Energy Outlook 2008 diesel fuel prices for the High Energy Price Case were used for estimating fuel savings. APU operating costs were based on the cost of burning 0.2 gallons of fuel per hour of idling. APU annual maintenance costs were not included in this analysis, as these costs were not adequately reported in surveys. However, ATRI indicated in a study that $300 per year can be saved in truck engine maintenance when using APU for idling. Table 3.3 shows the costs and savings from idle reduction on a year-to-year basis.

[7] Idle-reduction technology costs from ATRI (Data Source #1).

Table 3.3: Costs Estimated from Anti-Idling Policies

Year	Fuel Cost ($/gal) - High Energy Price Scenario	Annualized Capital Cost of Idle Retrofits (Million $)	Direct Fuel Savings Using APU (Million $)	Total Annual Capital Cost + Fuel Savings (Million $)
2009	$2.83	$0.00	$0.00	$0.00
2010	$2.82	$11.66	-$14.67	-$3.02
2011	$2.92	$23.75	-$31.15	-$7.40
2012	$2.92	$36.88	-$47.89	-$11.01
2013	$3.00	$51.18	-$67.23	-$16.05
2014	$3.06	$66.31	-$87.85	-$21.54
2015	$3.09	$82.14	-$109.10	-$26.96
2016	$3.14	$93.01	-$124.59	-$31.58
2017	$3.23	$104.79	-$142.84	-$38.05
2018	$3.28	$116.91	-$160.53	-$43.62
2019	$3.34	$129.47	-$179.84	-$50.38
2020	$3.41	$142.33	-$200.97	-$58.64
2021	$3.50	$155.96	-$225.17	-$69.21
2022	$3.55	$170.29	-$248.32	-$78.03
2023	$3.55	$185.04	-$269.06	-$84.02
2024	$3.57	$200.34	-$292.26	-$91.93
2025	$3.57	$216.18	-$314.81	-$98.62

Key Assumptions: This analysis assumes idle reductions are achieved only by Class 8 diesel truck population; these trucks idle for an average of 6 hours per day; they consume 1 gallon of diesel per hour during idling[8]; and that a 40% (by 2015) or 80% (by 2025) reduction of diesel idling from these Class 8 trucks will be achieved.

Program administration costs, enforcement costs, and fines have not been factored into the cost analysis. Reduced vehicle maintenance costs have not been factored into the analysis.

Key Uncertainties

Buses, as well as other diesel trucks that have not been quantified here, could achieve a small additional reduction in idling emissions. The distribution of technologies that would be selected by these trucks or fleets to reduce their emissions is highly uncertain. This would have a significant impact on the overall cost/cost savings of this measure.

The use of these technologies would also cause a slight decrease in the CO_2 and fuel consumption reductions achieved. For example, the use of truck stop electrification (TSE) would increase emissions from electricity generation. Based on a study done at a TSE service area near Syracuse, NY, about 2670 kWh of electricity was consumed using TSE each year for each parking space.[9] Using Michigan electricity CO_2 emission factors[10], this equals to about 2.1

[8] Idle assumption from EPA SmartWay (Data Source #2).
[9] See Data Source #6 for report of the Syracuse TSE study.

metric tons of CO_2 emitted per year per electrified space. If Michigan were to have 1,000 TSE spaces by 2025, the CO_2 emissions from electric consumption would be 0.002 $MMtCO_2$, a negligible number.

Also, equipment cost and lifetime will vary by technology employed. The cost value selected was based on cost data summarized by American Transportation Research Institute, representing the capital costs of a variety of idle reduction technology. The cost of $6,000 per vehicle represents a mix of higher and lower technology costs. The cost analysis does not take into account the number of vehicles that have already installed idle reduction technologies. The fuel cost assumed here is based on long-term projected fuel costs. Increases in this assumed fuel cost will lead to greater cost savings for this measure.

Additional Benefits and Costs

Reductions in idling will also reduce emissions of toxics, NOx, and PM.

Idle emission reductions will reduce wear from engine operation, thus leading to a cost savings from reduced maintenance costs.

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

[10] MI electric emission factors from Appendix F of "Instructions for Form EIA-1605 Voluntary Reporting of Greenhouse Gases." (http://www.eia.doe.gov/oiaf/1605/pdf/EIA1605_Instructions_10-23-07.pdf)

TLU-4. Advanced Vehicle Technology

Policy Description

Create policy that will expand the development and use of more efficient vehicle design and/or hybrid propulsion systems.

Policy Design

Goals:

- Create and expand a market for series Plug-in Hybrid Vehicles with modern high energy density battery technology, as set to penetrate the market in 2010 and encourage similar applications to other transportation sectors, such as public transportation, delivery, public services, etc. to obtain 5% total market penetration of new vehicle sales by 2025. Use this market to encourage Michigan-based battery research and development. Consider inclusion of other advanced vehicle technologies.
- Make available loans and subsidies to municipalities, local governments, waste management organizations, etc. to encourage more rapid adoption of hybrid vehicles by fleets offering public services (transit agencies, schools, and refuse companies) with a goal of achieving a 15% increase in hybrid use by 2020 in this sector.
- Provide funding through tax incentives for the research and development of freight vehicle efficiency improvements to realize a 20% reduction in green house gas emissions by 2025 from this industry.

Timing: The timing for advanced vehicle technology improvements will have a direct correlation with the consumer market based on fuel prices and a desire for Michigan and the United States to become more energy independent.

Parties Involved: Public Utilities, Consumers, Original Equipment Manufacturers (Battery Manufacturers, Automobile Manufacturers) Municipalities, Local Governments, Waste Management, Freight Industry

Other: Incentives directed toward the consumer will build a market that encourages original equipment manufacturers to produce more efficient vehicle and propulsion design. This will stimulate the ancillary manufactures to further improve the efficiency of products to support the OEMs. The majority of the subsidies and incentives will come at the inception of approval of these policies to encourage the market. Subsidies and incentives will slowly taper off until the full potential of market penetration has been realized and the technologies have become economically competitive.

Implementation Mechanisms

The Michigan at a Climate Crossroads study considered an alternative vehicle technology incentive measure that was designed to provide tax credits to consumers for purchasing alternative vehicle technologies. However, the models that they had available to examine such an implementation mechanism were unable to consistently capture the market pull effect of providing a tax credit to consumers for advanced vehicle technology purchases. The state tax credit that they modeled was estimated to be $1500 per vehicle, on average.

Related Policies/Programs in Place

Michigan hybrid electric vehicle laws and incentives include the following:

State Incentives—Hybrid Electric Vehicle Research and Development Tax Credit: For tax years beginning on or after January 1, 2008 and ending before January 1, 2016, a taxpayer engaged in research and development of a qualified hybrid system that has the primary purpose of propelling a motor vehicle may claim a tax credit under the Michigan Business Tax. This tax credit is equal to 3.9% of all wages, salaries, fees, bonuses, commissions, or other payments made in the taxable year for the benefit of employees for services performed in a qualified facility.

Alternative Fuel Research and Development Tax Exemption: The Michigan Strategic Fund has designated an alternative energy zone (AEZ) within Wayne State University's Research and Technology Park in Detroit to promote the research development, and manufacturing of alternative energy technologies, including alternative fuel vehicles (AFV). Businesses located within the AEZ that are engaged in qualified activities are eligible for exemption from state and local taxes, to be determined by the Michigan NextEnergy Authority (MNEA). Alternative energy technology companies located in the AEZ may also be eligible for a refundable payroll credit under the Single Business Tax.

Alternative Fuel Development Property Tax Exemption: A tax exemption may apply to industrial property which is used for high technology activities or the creation or synthesis of biodiesel fuel. High technology activities include those related to advanced vehicle technologies such as electric, hybrid, or AFVs and their components.

Acquisition and Alternative Fuel Use Requirement: The Department of Management and Budget is required to continue to comply with the requirements of the federal Energy Policy Act of 1992. The DMB must include hybrid electric vehicles within the state's fleet if the vehicles are determined to be cost effective and capable of meeting the state's transportation needs. In addition, as the state's public alternative fuel fueling infrastructure continues to develop, state motor fleet AFVs are required to fuel with alternative fuels to the extent possible. The DMB will develop rules to encourage or require the use of diesel fuel with the highest percentage of biodiesel content available for diesel-powered vehicles in the state fleet.

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

TBD – [CCS should provide a worksheet and other reference material as needed for transparency]

Data Sources: Annual Energy Outlook 2008 (AEO 2008)

Quantification Methods:

GHG Benefits of Advanced Vehicle Technology

There were two vehicle technologies which are considered in this analysis: plug-in hybrid vehicles and hydrogen fuel cell vehicles. To determine the number of vehicles in the program, first the new vehicles sold in Michigan in a given year was estimated (Wards, 2007) [11], and then along an implementation path towards 5% of all sales in 2025. The implementation path and vehicle sales in the policy are shown in Table 4-1. The AEO 2008 forecast did not have plug-in hybrids available to the mass market until 2012 and did not have hydrogen vehicles available on a large scale until 2013. Thus, those are the initial years that they are considered in this analysis.

Table 4-1: Implementation Path of Advanced Light Duty Vehicles

Year	Estimated Michigan Vehicle Sales	VMT per Vehicle	Total Sales	% plug in hybrids	% hydrogen	Sales of plug in hybrids	Sales of hydrogen vehicles
2008	625,108	12,221	0.00%	0.0%	0.0%	0	0
2009	627,795	12,273	0.0%	0.0%	0.0%	0	0
2010	630,493	12,326	0.0%	0.0%	0.0%	0	0
2011	632,541	12,366	0.0%	0.0%	0.0%	0	0
2012	634,595	12,406	0.3%	0.3%	0.0%	1,763	0
2013	636,656	12,447	0.6%	0.5%	0.1%	3,133	404
2014	638,723	12,487	0.8%	0.7%	0.1%	4,512	811
2015	640,798	12,528	1.0%	0.9%	0.1%	5,899	509
2016	641,965	12,550	1.4%	1.1%	0.3%	7,286	1,702
2017	643,134	12,573	1.8%	1.3%	0.5%	8,677	2,899
2018	644,305	12,596	2.2%	1.6%	0.6%	10,074	4,101
2019	645,479	12,619	2.6%	1.8%	0.8%	11,475	5,307
2020	646,654	12,642	3.0%	2.0%	1.0%	12,882	6,518
2021	646,869	12,646	3.4%	2.2%	1.2%	14,272	7,721
2022	647,083	12,650	3.8%	2.4%	1.4%	15,664	8,926
2023	647,297	12,655	4.2%	2.6%	1.6%	17,056	10,131
2024	647,512	12,659	4.6%	2.8%	1.8%	18,449	11,337
2025	647,727	12,663	5%	3.0%	2.0%	19,432	12,955

The costs and miles per gallon efficiency of these two advanced vehicle technologies as well as for a conventional gasoline vehicle come from the Annual Energy Outlook 2008. The average per vehicle VMT for 2005 was estimated to be 12,013(Wards, 2007)[12] and that figure is grown

[11] The estimate was made based on the Retail sales of new vehicles in the country, multiplied by the percentage of vehicle registrations that take place in Michigan. This figure was grown according to growth factors within the Michigan Inventory and Forecast.

according to VMT growth factors from the Michigan Inventory and Forecast. The gasoline used in a conventional vehicle in a typical year is determined by dividing the per vehicle VMT by the average mpg from the AEO 2008. The gasoline used in a hydrogen or plug-in hybrid is calculated in the same way, and the difference between the conventional and advanced vehicle is the gallons of fuel saved. For this analysis it was assumed that these vehicles will be on the road for an average of ten years. The gallons of fuel saved was then multiplied by the emissions factor for gasoline (11.74 metric tons/1000 gals) to determine the CO2e savings from the advanced vehicles (ANL, 2008). The GHG benefits of the policy are shown in Table 4-2.

Table 4-2: GHG Benefits of Advanced Vehicle Technologies

Year	Million Gallons of Fuel Saved, All Plug-ins	Million Gallons of Fuel Saved, Hydrogen	MMtCO2e Reduced, Plug-ins	MMtCO2e Reduced, Hydrogen	MMtCO2e Reduced, Total
2008			0.00	0.00	0.00
2009			0.00	0.00	0.00
2010			0.00	0.00	0.00
2011			0.00	0.00	0.00
2012	0.3		0.00	0.00	0.00
2013	0.8	0.1	0.01	0.00	0.01
2014	1.5	0.1	0.02	0.00	0.02
2015	2.4	0.2	0.03	0.00	0.03
2016	3.4	0.3	0.04	0.00	0.04
2017	4.6	0.6	0.05	0.01	0.06
2018	6.0	1.0	0.07	0.01	0.08
2019	7.6	1.4	0.09	0.02	0.11
2020	9.4	1.9	0.11	0.02	0.13
2021	11.4	2.5	0.13	0.03	0.16
2022	13.3	3.3	0.16	0.04	0.19
2023	15.1	4.0	0.18	0.05	0.23
2024	17.0	4.8	0.20	0.06	0.26
2025	18.9	5.8	0.22	0.07	0.29
Totals			**1.31**	**0.31**	**1.62**

Cost of Advanced Vehicle Technologies

The additional cost of these advanced vehicles comes from the AEO 2008. The difference between the cost of a conventional vehicle and an advanced vehicle was calculated for all years in the policy. There are also cost savings that come from reduced fuel use. The initial analysis considers 50% of the advanced vehicles sold to be compact and 50% of them to be mid-sized. In years where only compact or mid-sized are available, then 100% of the sales are in that category. While the price difference between the advanced and conventional vehicles is declining from year to year. The additional cost is between 45-25 thousand dollars for hydrogen vehicles and between 6 and 5 thousand dollars for plug-in hybrids. The price of gasoline comes from the common assumptions memo and is shown in Table 4-3. The cost savings and total costs of the policy can also be seen in Table 4-3.

Table 4-3: Costs and Cost Savings of Advanced Vehicle Technologies

Year	Additional Cost, Plug in Hybrids (MM$)	Additional Cost, Hydrogen (MM$)	Gasoline ($/gal)	Cost Savings (Fuel), Plug-in Hybrids	Cost Savings (Fuel), Hydrogen	Net Cost, Plug-in Hybrids	Net Cost, Hydrogen Vehicles	Total Cost TLU-4
2008	0.0	0.0	3.05	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	2.85	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	2.94	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	2.98	0.0	0.0	0.0	0.0	0.0
2012	9.9	0.0	3.00	0.9	0.0	9.0	0.0	9.0
2013	17.2	18.3	3.05	2.4	0.2	14.7	18.2	32.9
2014	24.2	35.1	3.11	4.6	0.3	19.6	34.8	54.5
2015	34.5	21.0	3.12	7.4	0.5	27.1	20.5	47.6
2016	42.2	67.2	3.17	10.9	1.1	31.3	66.1	97.4
2017	50.0	105.4	3.23	15.0	2.0	35.0	103.4	138.4
2018	58.8	142.7	3.27	19.7	3.2	39.1	139.5	178.6
2019	69.0	176.3	3.33	25.4	4.7	43.6	171.6	215.2
2020	78.3	209.6	3.40	31.9	6.6	46.4	203.0	249.4
2021	86.8	240.4	3.49	39.7	8.9	47.1	231.6	278.6
2022	95.2	269.8	3.53	46.8	11.5	48.4	258.3	306.7
2023	103.7	297.0	3.53	53.5	14.2	50.3	282.8	333.0
2024	112.3	321.9	3.55	60.5	17.1	51.8	304.8	356.6
2025	118.3	357.5	3.52	66.4	20.4	51.9	337.1	388.9
Total Cost						**$515**	**$2,172**	**$2,687**
$/Ton						**$393**	**$7,096**	**$1,660**

Data Sources:

US EIA. Annual Energy Outlook 2008 Supplement. *Table 59. New Light-Duty Vehicle Fuel Economy* and *Table 60. New Light-Duty Vehicle Prices.* http://www.eia.doe.gov/oiaf/aeo/supplement/index.html Accessed 8/27/08.

ANL, 2008. "GREET Model 1.8" Argonne National Laboratory's GREET model can be downloaded at http://www.transportation.anl.gov/modeling_simulation/GREET/index.html

Wards 2007. "Motor Vehicle Facts & Figures 2007." Wards Automotive Group.

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

The Miles per Gallon figure from the Annual Energy Outlook is not entirely clear. Plug-in hybrid vehicles have both gasoline and electricity consumption, so it is not certain how the electricity consumption calculated in the AEO is converted into a miles per gallon figure. The calculation for hydrogen fuel cell vehicles is even more confused, because no gasoline consumption is taking place. Nonetheless, there is a figure for miles per gallon in the AEO 2008 for both of these technologies, and that is used as a stand in for the energy consumption of these vehicles. It is assumed that their mpg values are an attempt to compute fuel cost equivalent. If these are not appropriate, then the TWG should provide a better source of the mpg of these advanced vehicles over the policy period.

In addition, the electricity generation mix for Michigan includes more coal than the national average. This could contribute to an underestimation of the emissions that come from a plug-in hybrid vehicle, if the AEO 2008 information accounts for electricity emissions on a national level.

Additional Benefits and Costs

This policy could serve to reestablish Detroit as a leader of automotive research, which would have benefits across the state. In addition, progress on advanced vehicle technology can have benefits far beyond the borders of Michigan, in terms of energy security, economic growth and environmental quality.

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-5. Congestion Mitigation

Policy Description

Improve traffic flow and travel time through expanding the use of intelligent transportation systems (ITS). In conjunction with expanding ITS, the following actions should also be considered; identifying and improving key bottlenecks, construct modern roundabouts at appropriate intersections, and continue the use of the MDOT courtesy patrol on congested roadways. All of these elements contribute to reducing travel delay for both recurring and non-recurring congestion.

Promoting the development of intermodal freight terminals will facilitate freight shipment on rail and air thus reducing the volume of freight on Michigan roadways. By supporting these efforts the congestion mitigation policy option will allow for more efficient travel and increased economic output.

Policy Design

Goals: Below are initial goals for this policy. The final goals will be determined once GHG reductions and associated costs have been analyzed.

- Reduce travel time delay from recurring and non-recurring congestion in Michigan's major urban areas (metro Detroit and Grand Rapids) by 10% by 2025. This can be achieved through implementing an appropriate combination of the methods described in the policy description. In 2005 metro Detroit drivers had 54 hours of delay annually and Grand Rapids drivers had 24 hours of delay annually. (Delay estimates are for one driver versus free-flow conditions for a single year.)
- Reduce travel time related to non-recurring congestion (i.e. road construction) by continuing to implement and refine the Michigan Work Zone Safety and Mobility Policy. This policy sets a 10 minute threshold for congestion related to road work. If a vehicle is delayed more than ten minutes this flags the department to review and modify its standards.
- Funding intermodal freight initiatives such as the Detroit Intermodal Freight Terminal (DIFT) and the West Detroit Rail Junction will increase rail efficiency and reduce the number of long haul shipments on Michigan roadways.

Timing:

Parties Involved: Michigan Department of Transportation and USDOT Federal Highway Administration, MPOs

Other:

Implementation Mechanisms

TBD – [CCS drafts based on TWG inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on TWG approval]

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

Table 5-1. Summary of TLU-5 Congestion Mitigation

	2010	2020	Units
GHG emission savings	0.04	0.10	$MMtCO_2e$
Net present value (2006–2020)		-$81	$ Million
Cumulative emissions reductions (2006–2020)		0.82	$MMtCO_2e$
Cost-effectiveness		-$99.83	$/$MtCO_2e$

GHG = greenhouse gas; $MtCO_2e$ = million metric tons of carbon dioxide equivalent;

Data Sources:

Urban Mobility Report, Texas Transportation Institute

Highway Economic Reporting System model, Federal Highway Administration

Quantification Methods: [e.g., Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-6. Land Use Planning and Incentives

Policy Description

Implement state policies and programs that encourage local and regional planning and development strategies in order to reduce the projected growth of vehicle miles traveled (VMT) and corresponding greenhouse gas (GHG) emissions. The State will enable each region to adopt a unique mixture of policies to reach reduction goals in its own manner. Strategies include:

- Promoting and expanding regional growth management options that result in more compact mixed-use, transit-oriented, walkable development
- Transportation system management and pricing that allows for greater investment in alternatives to the single-occupancy vehicle, such as public transit
- Use of other land use related economic development tools as recommended in the Michigan Land Use Leadership Council's Report (2003).

Policy Design

Goals:

- To reduce the conversion of greenfield open land to development 25% by 2015, 50% by 2025, and 80% by 2050 compared to Michigan's land use growth pattern of 2000-2005.
- To encourage communities to utilize an "infill" approach for both new and redevelopment projects by focusing on areas where infrastructure already exists. On a local and regional basis, track and compare private and public percentage of investments of infill development/redevelopment vs. greenfield development.
- Beginning in 2009, work to ensure that at least 60% of new/future statewide growth utilizes more compact development or transit-oriented development design.

These goals can be accomplished through

- Multi-jurisdictional land use planning and zoning policies, tax base sharing, and providing state and local incentives.
- Market-based approaches in future land development and housing policies that focus public and private investments toward achieving higher density, transit-oriented, compact or mixed-use development (where appropriate), while conserving natural resources and protecting our land-resource based industries.
- Integrated transportation policies, investments, system management, and pricing to offer Michigan residents and visitors access to an energy-efficient and cost-effective variety of travel options.
- A new Statewide Comprehensive Planning Law enacted. This could be focused on public participation in creating a locally driven comprehensive planning process for local units of government to follow in meeting key statewide goals for economic, social and environmental

priorities. If plans are enacted by a certain date established, those communities would qualify for priority funding from state government programs.

Timing: Governor and appropriate Cabinet members should initiate planning and administrative activities in 2009 to shape transportation and land development plans and policies that support this goal in 2010 and beyond. Prepare additional enabling legislation for the 2009-10 legislative session supporting the goal.

Parties Involved: Michigan Departments of Transportation, Environmental Quality, Labor and Economic Growth, Agriculture and Natural Resources, Michigan local governments, Metropolitan Planning Organizations; Transportation Planning Regions; real estate development and home builders industry, economic development interests, environmental, conservation and community interest groups.

Key Uncertainties

VMT has remained relatively flat in Michigan since 2002. A variety of factors may be contributing to this, in particular the economic slowdown seen in Michigan and increases in fuel prices are likely to be responsible. Changes in local economic conditions and fuel prices could both have significant impacts on VMT in the state.

Advancement in alternative fuel technology and the corresponding use of new fuel sources that either reduce or eliminate GHG emissions by vehicles in Michigan could alter the priority to reduce VMT. Therefore, more holistic and comprehensive land use development patterns that protect our farmland and other natural resources will provide more carbon sinks rather than sources and thereby further help reduce net GHG.

Additional Benefits and Costs

VMT is considered by some economists to be a “leading” economic indicator, one that foreshadows the greater economic trend. In the current economic climate, Michigan cannot afford to impose strict cap limits on VMT. The focus must remain on encouraging infill development and more compact or transit-oriented land use patterns, which will in turn lead to reductions in the growth of VMT.

Implementation Mechanisms

To achieve these land use goals, the state and local communities will need to use some or all of the following strategies. All of these strategies have been used in other states and regions.

1. Priority Areas Designated For Planned Growth

Establish a process to designate types of priority growth areas within the state. Priority growth areas could include town centers, downtowns, regional centers, neighborhood centers, transit corridors, and transit station areas. Establish a process to encourage higher density housing and employment growth, mixed-use and mixed-income development, and bicycle, pedestrian, and transit-friendly development within these areas. Priority growth areas could include brownfields (old commercial or industrial sites). Development and re-development within these areas would be promoted through incentives, technical assistance, and/or regulation.

2. School Siting and Accessibility

Review and revise school siting laws in Michigan to remove excessive acreage requirements that drive schools into undeveloped areas. Encourage the development or rehabilitation of schools in priority growth areas and to make it easier for children, teachers, and parents to get to school on foot, bicycle, and transit.

3. Jobs-Housing Balance

Plan and zone for new housing development to be prioritized near existing jobs and plan and zone for new commercial development near existing housing. Implement financial incentives and/or regulation to encourage a range of housing types and affordability levels that support a community's local work force, which will create a stronger jobs-housing balance and reduce the length and number of vehicle trips.

4. Smart Growth Planning, Modeling and Tools

Institute statewide and municipal planning requirements and/or incentives to implement TLU-6. Provide technical assistance to communities on best practices in zoning, parking, and street design to increase walking, bicycling and transit use; to encourage higher density, transit and walking-oriented development; and to balance regional residential, commercial and industrial needs. (Example: Oregon's Transportation and Growth Management technical assistance program for Oregon communities:

http://www.lcd.state.or.us/LCD/TGM/index.shtml.)

Create an integrated transportation and land use forecasting model for use statewide. This tool would enable communities to predict increased vehicle miles traveled and greenhouse gas emissions based on proposed developments.

5. Targeted open space protection

Establish programs and/or requirements to preserve key forestlands, natural areas, agricultural land, and parkland, which will help to guide development and redevelopment into targeted/priority growth areas.

6. Transportation Investments

Transit- and Pedestrian-Oriented Development

Plan for and invest in transit- and pedestrian-oriented corridors that will draw and support higher density, mixed-use development along public transit corridors.

7. Complete Streets and Well Connected Streets

Develop statewide guidance and technical support for Complete Streets and Well Connected Streets to shorten trip distances, to make walking, and walking to transit safer and more convenient, to reduce the need for overly large urban arterial roads, and to support higher density development.

8. Funding

Target new and existing environmental bond, tax credit, tax increment financing, transportation and housing dollars from regional, state, and federal sources to those projects that help meet these land use and development goals.

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

Table 6-1 Summary of TLU-6 Land Use Planning and Incentives

	2010	2020	Units
GHG emission savings	0.00	0.30	$MMtCO_2e$
Net present value (2006–2020)		Net savings	$ Million
Cumulative emissions reductions (2006–2020)		1.51	$MMtCO_2e$
Cost-effectiveness		Net savings	$/$MtCO_2e$

GHG = greenhouse gas; $MtCO_2e$ = million metric tons of carbon dioxide equivalent;

Data Sources:

Total population and population density by Census tract, 1990 and 2000.

Per-capita VMT by Census tract population density in Michigan, from Center for Urban Transportation Research (CUTR) VMT forecasting model .

Forecast statewide population growth.

Quantification Methods:

The State of Michigan will help growth and development efforts achieve land use goals through a series of policies that includes implementation mechanisms identified below. Scientific research shows that VMT reduction in urban areas is quantifiable through improved planning software. Michigan agencies will assist local and/or regional governments in using the latest planning technology that measures VMT impacts to assist with decision making on future growth and development. The more aggressively the policies are pursued, the greater the potential reduction in VMT.

This analysis considers potential GHG reductions from fewer personal (noncommercial) VMT as a result of a shift toward more compact development patterns. The analysis relies on estimates of per capita VMT by Census tract population density range, as developed by Polzin, et al. for the CUTR VMT forecasting model. The CUTR model is based on analysis of 2001 Nationwide Household Travel Survey data. The model provides estimates of per capita VMT by state for five density ranges. The model is currently set up for years 2005, 2035, and 2055; for this analysis, results were interpolated for CCS analysis years.

The observed relationship between per capita VMT and population density is a rough proxy for the effects of Smart Growth development as described above. Higher levels of population density are associated with overall shorter trips because destinations are closer together. In addition, areas with higher population densities are more likely to have pedestrian-friendly design (e.g., walkability and mixed-use development) and to support transit service. It is difficult to separate the individual effects of the various Smart Growth strategies at this aggregate level of analysis, but the analysis should provide an indicator of what can be achieved through a combined set of Smart Growth policies.

The specific method used to estimate GHG benefits of Smart Growth strategies is as follows:

- Total population in 2000 is identified by five Census tract density ranges as identified in the CUTR model (<500, 500–1,999, 2000–3,999, 4,000–9,999, and 10,000 or more persons per square mile).
- The change in population from 1990 to 2000, and associated share of change by density range, is identified from Census data.
- For the Baseline scenario, new population growth between 2000 and 2020 (as determined from CCS baseline assumptions) is allocated to tract density ranges based on the share of growth in the 1990–2000 timeframe.
- The proportion of existing housing stock (population) that would be redeveloped over this time frame is estimated at 15%, of which two-thirds is redeveloped in place and one-third is redeveloped elsewhere, with this redevelopment allocated to tract density ranges based on the 1990–2000 share of population growth. (The 15% and two-thirds figures come from the 2007 Growing Cooler report Section 1.7.3, citing analysis of Census data by Nelson [2006]).
- For the Climate Action scenario, a significant shift in the proportion of new development and relocated redevelopment is assumed to take place, with higher-density tracts (> 2,000 persons per square mile) receiving 50% of new development under this scenario compared with only XX percent under the Baseline scenario. Total population by tract density under this scenario is then calculated.
- Total personal-travel VMT is calculated under the Baseline and Climate Action scenarios, based on VMT per capita (from the CUTR model) and total 2025 population by tract density range, and the percent reduction in personal-travel VMT is calculated.
- The percent reduction in VMT is adjusted by 90% to estimate the percent reduction in GHG emissions. This factor is the same as that used in the Growing Cooler report to account for

the fact that higher-density areas may experience somewhat lower travel speeds and therefore slightly reduced fuel economy.

Key Assumptions:

- Fraction of new population growth and redevelopment by Census tract density, under Baseline scenario.
- Assumed shift in the fraction of new population growth and redevelopment from lower-density to higher-density Census tracts, under Climate Action vs. Baseline scenario.

Percent of residential building stock redeveloped (off-site) over the analysis time frame.

Key Uncertainties

Smart Growth scenario analysis depends upon patterns of development that involve decisions of many individual property owners and private capital investors. As result, the scenarios show what is possible under a development scenario but should not be considered as predicted outcomes.

The estimates developed using this methodology are consistent with results found in meta-analysis in the published literature, such as the recent *Growing Cooler* report from the Urban Land Institute (ULI).

Additional Benefits and Costs

Smart growth generally has very low direct costs to implement; the costs consist of governmental costs of altering regulations and zoning and costs providing education and technical assistance. Tax incentives are an income transfer that results in a public sector cost but offsets developer revenue. As most smart growth policies (e.g., allowing higher density and mixed use, reducing parking requirements) are deregulatory in nature, they are opening the development market and have significant indirect benefits. An exception is growth boundaries, which restrict the land use market and have an indirect cost.

Alternative patterns of development have a large number of additional impacts, which may provide both benefits and costs. Smart growth provides a range of co-benefits that are well documented in other places. Prominent among these is the reduced cost of providing utilities and infrastructure, because smart growth makes better use of existing facilities and infrastructure and, on average, has lower demand. Improved air quality, public health (e.g., due to walking), and quality of life are also notable co-benefits.

Feasibility Issues

Smart growth policies are being considered and implemented around the country in a wide range of communities. Because most policies are deregulatory in nature, this significantly lowers political barriers.

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-7. Transit and Travel Options

Policy Description

Reduce the number of single-occupant vehicle trips and improve the efficiency of daily travel by:

- Creating, enhancing and promoting public transit options such as commuter rail, light rail, streetcars, and bus rapid transit
- Enhancing transit service through route expansion, increased service frequency, longer service hours, and/or better system coordination; and
- Facilitating increased carpooling, vanpooling, biking, and walking.

These actions will reduce GHG emissions by decreasing, or slowing the growth of, vehicle miles of travel, thus reducing fuel consumption.

Policy Design

Goals: Below are two initial goals for this policy. The final goals will be determined once GHG reductions and associated costs have been analyzed. The baseline year is 2002.

- Double transit ridership by 2015 and double it again by 2025 (line-haul systems).
- Double the number of carpool and vanpool participants by 2015 and double again by 2025.

Timing:

Parties Involved: Michigan legislature, MDOT, regional transit operators, local governments, Amtrak, freight railroads, schools.

Other:

Implementation Mechanisms

Below are several actions that would be necessary to achieve the goals listed above.

- Amend Michigan Constitution to provide broader range of funding mechanisms for public transit.
- Build additional park-&-ride lots to encourage and enable increased transit ridership. Ensure these lots have bicycle storage facilities. Also construct carpool lots to provide more opportunity for ridesharing in Michigan.
- Provide incentives for transit-oriented development and focus growth in areas already served by transit.

- Incorporate bike lanes into roadway construction and reconstruction plans wherever possible.
- Encourage/require sidewalks in new developments, and encourage their addition in areas where they are now absent.
- Implement metropolitan transit plans, including Southeast Michigan's Transit Vision; Grand Rapids' Great Transit, Grand Tomorrows study; and other existing plans throughout the state.
- Pursue implementation of inter-city transit service where it is cost effective and provides the greatest GHG benefits in relation to other transit options.
- Undertake a public education campaign to identify, quantify, and effectively communicate the benefits of public transit to people who don't currently use it. Such a campaign will be necessary to generate the support needed for local tax initiatives to fund transit improvements.

Related Policies/Programs in Place

Existing transit systems have experienced a 15 percent increase in urban ridership between 2005 and 2008.

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

Table X-5.1. Title

	2015	2025	Units
GHG emission savings	0.15	0.49	$MMtCO_2e$
Net present value (2009–2025)		$823	$ Million
Cumulative emissions reductions (2009–2025)		3.71	$MMtCO_2e$
Cost-effectiveness (2009–2025)		$222	$/$MtCO_2e$

GHG = greenhouse gas; $MtCO_2e$ = million metric tons of carbon dioxide equivalent;

Data Sources:

Making Transit Work: Insight From Western Europe, Canada, and the United States—Special Report 257. Transportation Research Board: Washington, DC, 2001.

Current and historical transit ridership, by mode type (urban/rural, bus, or paratransit) from National Transit Database.

Operating cost per passenger and per passenger-mile, by mode type (urban/rural, bus, or paratransit) from National Transit Database.

Revenue per passenger and per passenger-mile, by mode type (urban/rural, bus, or paratransit) from National Transit Database.

Quantification Methods:

This analysis examines the reductions in GHGs possible by shifting from personal motor vehicles to transit, which emits fewer GHGs per passenger mile. The calculation of GHG reductions must account for the reduction in the number of private VMTs and also account for the partially offsetting increase in transit VMTs. In addition to these direct reductions from individuals' shift of modes, two more long-term, indirect effects are estimated: (1) the shifting of trips from personal vehicles to transit can reduce the number of vehicles on the road, and thus the amount of congestion in urban areas and (2) reducing congestion improves traffic flow and can improve actual average vehicle fuel economy. Studies have also demonstrated that increased transit service can help shape land-use patterns, enabling densities and proximity to the center of urban areas. This has been shown to result in reduced VMT by those living in transit corridors, even if they never use transit.

Direct quantification was undertaken for improvements in service frequency, reductions in travel time, and the introduction of new and expansion of existing routes and services for bus, BRT, commuter rail, and vanpools.

Travel time improvements provide a well-documented means of improving transit service and ridership. There is a direct benefit to riders because the improved service reduces the "generalized cost" (time cost plus financial cost) of their trip. In addition to co-benefits in improving service frequency, there is about a –0.4 elasticity for transit travel time. Estimated percentage reductions in travel time will be multiplied by this elasticity to calculate the ridership increase.

Service frequency increases ridership by existing riders and attracts new riders. As waiting time between vehicles has been shown to be valued about two times more strongly on average than actual travel time, this mechanism can prove very effective. There is a reported –0.5 elasticity for service frequency alone (time between buses), while the aggregate impacts for service improvements in time between vehicles and travel time have shown an elasticity of between –0.6 and –1.0, incorporating the time and frequency impacts of aggregate increases in service miles provided. As above, the service frequency elasticity will be applied to improvements in this parameter. As a redundancy check, the aggregate elasticity was also applied to the total increase in vehicle revenue service miles to capture both factors together.

For service expansions and introduction, both the literature and a first-order statistical analysis show a long run elasticity for service expansion of between 0.6 and 1.0. An elasticity of 1.0 was applied to service increases.

Key Assumptions:

Transit services can be expanded and introduced at the same average operating cost as current services. A mix in transit modes that includes BRT, commuter rail, and vanpools decreases the average net operating cost of bus service, which is almost the only service being offered.

New or improved services will be able to attract ridership in a manner consistent with service improvements in other similar areas of the country (i.e., the transit market is not at saturation). Current fuel price increases provide a strong argument for this assumption.

Key Uncertainties

Funding availability for the provision of additional transit service.

Additional Benefits and Costs

The provision of transit service provides other more direct benefits and cost impacts. Most important are travel time benefits that accrue to transit users, reduced air pollution, and congestion relief that affects road users on parallel routes.

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-8. Increase Rail Capacity and Address Rail Freight System Bottlenecks

Policy Description

Michigan can reduce GHG emissions in the transportation sector by encouraging more energy efficient freight movement. Making or facilitating transportation infrastructure improvements that increase rail capacity, support connectivity, and reduce rail freight system bottlenecks will help accomplish this shift.

Most freight shipment is undertaken by the private sector. Truck transportation is the most common means of moving freight in Michigan, but rail transport is more energy efficient. Whether goods move by rail, truck or other modes, private sector shipping decisions are based on the need to ship those goods at the lowest possible cost within an appropriate time frame.

For short hauls, truck freight is, and will likely continue to be, the mode of choice; intermodal rail freight tends to be most effective for trips of 700-800 miles or longer. As the price of diesel fuel continues to increase, however, rail freight will become more cost-competitive, perhaps at shorter distances. Michigan should be prepared to take advantage of this opportunity for both environmental and economic reasons.

Policy Design

Goals: To reduce transportation sector GHG emissions from freight movement by making system improvements with the goal of increasing tonnage of rail freight traveling to, through and from Michigan an additional 50% by 2020. This goal is subject to analysis of the cost and benefits it would generate.

The most recent data available from USDOT[13] indicates that freight tonnage for shipments to, through, and from Michigan is expected to increase from 752 million tons in 2002 to 1540 million tons in 2035, an increase of 105%. Tonnage is expected to increase on all freight modes, but by far the majority of this increase is anticipated to be truck freight, with a projected 576 million ton increase between 2002 and 2035. In the same period, rail freight tonnage is projected to increase by 67.4 million tons.

Increasing the projected tonnage of rail freight an additional 50% by 2020 potentially shifts a projected 17 million tons of cargo that would otherwise travel by truck. Using the national standard of 80,000 pounds[14] as the upper weight limit for trucks, **this would potentially remove an estimate of at least 200,000 trucks from the roads.**

It is important to recognize that shipping decisions are made by the private sector, and are not under the control of government. Investment to encourage greater use of rail lines and intermodal shipping must be made with that reality in mind.

[13] USDOT State by State Freight Analysis Framework 2.2
[14] Michigan's legal truck weight limits allow for 164,000 pound trucks, but fewer than 5% of the trucks on Michigan's roads travel at that weight.

A variety of approaches will be necessary to accomplish this:

- **Construct Intermodal Terminals:** The use of intermodal containers and intermodal shipping allows many goods to travel by either truck or rail, depending on the length of the trip. Construction or improvement of intermodal terminals in Michigan offers a real opportunity to improve connectivity and encourage the timely and cost-effective shipment of goods by rail rather than truck.
- **Preserve Existing Service:** Michigan's peninsular geography is an obstacle, not only to increasing the capacity of freight rail service, but also to preserving existing rail service, particularly in the northern reaches of the state. As part of any policy to improve rail freight service, attention must also be focused on preserving existing rail lines. In the short-term, this will require continued state investment in these lines, which often do not generate sufficient revenues for the private sector operator to make adequate investments of its own.
- **Preserve Right-Of-Way for Future New Service:** It is unlikely that additional rail freight lines will be constructed in Michigan on new rights-of-way, but for the long term, it is important to keep the option of future rail service available on existing rights-of-way. One means of preserving right-of-way for future rail service, whether freight or passenger, is for the state to continue and expand present efforts to develop abandoned rail lines as trailways.

Timing:
The Detroit Intermodal Freight Terminal project will consolidate and expand a complex of railroad intermodal terminals in the Detroit metropolitan area in order to accommodate growth through 2025. Improvements will also be made to railroad connections and terminal access roads to improve efficiencies for both trucks and trains. Construction of the project is anticipated to begin in FY2010 and the full build-out will occur over approximately 10 years. The project is a public-private partnership, with the railroads providing approximately 40% of the estimated at $611.7 million total cost.

The West Detroit Junction rail project involves the construction of a new connecting track at one of the busiest rail junctions in Michigan, which handles 50-60 trains per day. The new track will primarily accommodate Amtrak trains and allow significant improvements in on-time performance. Engineering work for the estimated $12 million project will begin in Summer, 2008, with construction beginning in 2009.

Parties Involved: private sector rail road companies (CN, CX, NS, etc.), auto manufacturers, MDOT, FRA, MTGA, DNR, non-motorized stakeholders

Other:

Implementation Mechanisms

TBD – [CCS drafts based on TWG inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on TWG approval]

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

TBD – [CCS should provide a worksheet and other reference material as needed for transparency]

Data Sources: [TBD by CCS on TWG approval]

Quantification Methods: [e.g., Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]

TLU-9. Great Lakes Shipping

Policy Description

Marine transportation is the most energy efficient surface form of transportation to move cargo over long distances. Michigan's commercial ports typically accommodate 85-95 million tons of cargo annually, most of which are bulk materials including stone, iron ore, coal, and cement. While Great Lakes shipping decisions and services are private sector responsibilities, the public sector has a role in providing navigation channels and related infrastructure.

Policy Design

Goals:

- Reduce transportation sector GHG emissions by maintaining the existing marine infrastructure, including maintaining federal navigation channels to their Congressionally-authorized depths. Without adequate infrastructure maintenance, continued operation of some ports or marine terminals is in jeopardy, with a resultant shift of traffic from marine to truck transportation.
- Improve the marine infrastructure by deepening commercial navigation channels at selected commercial ports to Seaway standard depths. This will allow greater cargo volumes to be carried on each vessel and reduce the number of trips needed.
- Encourage the development or expansion of "short sea shipping" (also known as "marine highway") within the Great Lakes. This could include carrying truck trailers or containers on specialized Great Lakes vessels, which would decrease the number of truck miles driven on the highways.
- Consider the use of ferry boats to move people and cars.
- Consider a biodiesel program at Michigan ports if it is feasible to burn this fuel in marine diesel engines.

Timing:

Parties Involved: Army Corps of Engineers

Other:

Implementation Mechanisms

For infrastructure maintenance, the Governor's office should lobby Congress to appropriate money from the Harbor Maintenance Trust Fund surplus to meet urgent needs in Michigan.

Related Policies/Programs in Place

Federal Harbor Maintenance Trust Fund

Type(s) of GHG Reductions

CO_2:

Estimated GHG Reductions and Net Costs or Cost Savings

The bi-national Great Lakes St. Lawrence Seaway (GLSLS) system, which includes the St. Lawrence Seaway, stretches over 2,300 miles. The 1959 opening of the MLO section of the seaway was the final step in establishing a navigation system that allows deep draft ocean vessels to move between the Atlantic Ocean and Great Lakes ports. Although traffic volumes in recent years have been about half the peak levels of the 1970s and early 1980s, the seaway continues to play a key role in the shipment of grain, iron ore, and steel. Seaway trade is particularly important for Canada, which paid more than 70 percent of the total cost of the original seaway navigation project and continues to pay a greater role than its U.S. partner in financing and operating the waterway.

Forecasting future seaway traffic has historically been problematic because of the multitude of economic and political forces affecting trade, both within the Great Lakes region and beyond.

As the seaway enters its sixth decade of service, its future role within the Great Lakes transportation system is unclear. This observation does not imply that the waterway has no future role, but rather that this role remains difficult to anticipate because of the numerous uncertainties. On the one hand, the seaway infrastructure is in need of major renovation to ensure its continuing reliability, and the waterway's locks can accommodate only a decreasing fraction of world vessel capacity as the growth of container shipping leads to the building of ever larger vessels. However, the seaway offers an alternative to increasingly congested land-based routes, particularly for cargo movements, where the relatively long transit times and seasonality of the navigation season can be accommodated. Furthermore, the growth of hub ports for container shipping on North America's eastern seaboard may provide opportunities to develop feeder services into the Great Lakes through the seaway. The overall influence of global climate change on seaway navigation is also uncertain, with the possibility that the adverse effects of lower water levels may be offset to some extent by a longer navigation season.

Maintaining navigation channels through the GLSLS depends, in part, on ensuring that all channels in the system have a minimum navigable depth. In addition to dredging, there is also a need to maintain aids to navigation such as buoys, channel markers and range markers.

Maintenance dredging is only needed in limited sections of the system—proportionally less than is required for other North American navigational systems. Sedimentation is minimal in the majority of the navigation channels and generally consists of recirculation of local sediments. On average, maintaining channel depth costs the equivalent of $20 million per year for both dredging itself, and management of the dredged material. Funding for this work is contingent on Congressional approval. To put these statistics in perspective, an average of about 185 million tons annually is shipped through the GLSLS upstream of Montreal. Dredging three million cubic meters per year represents roughly one ton of dredged material for every 40 tons of goods passing through the system.

Of the two to four million cubic meters of annual maintenance dredging, some 10 percent consists of contaminated sediments. USACE records indicate that some 32 percent of sediments from maintenance dredging are clean enough to allow for open water disposal, and 12 percent of the sediments dredged are re-introduced into the coastal zone as beach nourishment. Where containment is required, the development of approved sediment containment sites is both lengthy and costly. As a result, dredging costs in the Great Lakes average $8 per cubic yard, considerably higher than the average of $3 per yard across North America. The capacity of contaminated sediment disposal sites is an ongoing concern for port operators throughout the system. Dredging costs in the St. Lawrence River typically run significantly higher due to a lack of dredging contractors and the higher mobilization costs associated with use of contractors from the Great Lakes. In addition, contaminated upland spoiling of dredged materials is typically required in this area, and if contaminated the dredged material has to be transported to a special landfill.

The annual maintenance dredging need in Michigan each year is approximately 1 million cubic yards. The estimated annual cost to do this is $7.5 million. Shippers pay a tax to recover the costs of such maintenance. This money goes into the Federal Harbor Maintenance Trust Fund, which currently has a $3-4 billion surplus. There is a dredging backlog because these monies are not being appropriated.

Any analysis of the cost of dredging to deeper depths than is currently performed would need to be port-specific. This would involve borings and channel surveys to estimate the cubic yards of material that would have to be dredged. In addition, the dredging cost would vary according to the type of material that would need to be dredged in each port.

Data Sources:

Great Lakes Shipping, Trade, and Aquatic Invasive Species, Transportation Research Board Special Report 291, Washington, DC, 2008.

Winebrake et al., Assessing Energy, Environmental, and Economic Trade in Intermodal Freight Transportation, *J. Air & Waste Manage. Assoc.,* 1004-1013, 2008.

Great Lakes St. Lawrence Seaway Study; Transport Canada, U.S. Army Corps of Engineers, U.S. Department of Transportation, The St. Lawrence Seaway Management Corporation, Saint Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish and Wildlife Service; Fall 2007.

Quantification Methods:

The initial analysis of the GHG benefit of providing deeper channels for marine vessel cargo transport is based on a 10 percent change in the number of trips (and associated fuel consumption) by marine vessels. Based on the 2015 and 2025 CMV CO2e emissions, a 10 percent efficiency improvement in each year from 2015 on would reduce associated GHG emissions by 0.24 million metric tons in 2015 and 0.27 million metric tons in 2025.

Table 9-1 below provides CO2 emission factors from the recent Winebrake et al. JAWMA paper for the three primary freight transport modes. These factors can be used to estimate how shifting 100,000 twenty foot equivalent units (TEUs) from rail and truck to ships in Michigan might affect GHG emissions.

Table 9-1: Data for transport modes for case studies

Mode of transport	Cost ($/TEU-mi)	Energy (Btu/TEU-mi)	CO2 (g/TEU-mi)	PM10 (g/TEU-mi)	SOX (g/TEU-mi)
Truck	0.87	10704	1001	0.12	0.22
Rail	0.55	2590	201	0.09	0.04
Ship	0.50	13040	1094	0.98	3.33

Recognize that ships vary significantly in their sizes, speeds and installed power – which means that their energy and emission characteristics vary. The information in Table 9-1 is based on ship characteristics that have been highlighted favorably in recent Short Sea Shipping reports, because this was intended to represent a short movement of freight. The ship used in this is a roll-on/roll-off vessel capable of about 25 knots speed with about 11,000 KW power that carries about 200 TEVs. Using the characteristics of other vessel groups would produce different results than the comparison shown in Table 9-1.

Note that the Rochester Institute of Technology and the University of Delaware through the Sustainable Intermodal Freight Transportation Research Program are working right now on a study to develop a model that could be used to evaluate the advantages and disadvantages of increased shipping on the Great Lakes. A report on that model should be available in September 2008. The overall approach in this project is the integration of three modal networks (road, rail and water) in a single Geographic Information System (GIS) intermodal network. The decision tool that is developed will allow users to conduct route analyses based on various network attributes, including cost, time-of-delivery, distance, energy use, and emissions. The initial work phase will involve constructing the network model for the Great Lakes region and collecting data to characterize cargo flows and their energy and environmental impacts along that network.

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

Shifting freight traffic from truck or rail to marine vessels could increase PM-10 and SO2 emissions.

Feasibility Issues

Any policy option affecting Great Lakes Shipping needs to consider the effect on aquatic invasive species (AIS). The Transportation Research Board just released Special Report 291: Great Lakes Shipping, Trade and Aquatic Invasive Species. This report evaluates the issues regarding invasive species in the Great Lakes and proposes some recommended actions. The committee's recommendations include a comprehensive technology-based AIS program targeting all vessels transiting the seaway, a requirement for all transoceanic and coastal vessels transiting the seaway to conduct ballast water exchange (BWE) or salt water flushing, the adoption of a single set of ballast water standards for the Great Lakes equivalent to the proposed IMO BWM standards, and a bi-national surveillance program to monitor for the presence of new AIS in the Great Lakes.

Status of Group Approval

Pending – [until MCAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until MCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the MCAC]