Memorandum

December 23, 2008

To: Travel Management Subcommittee

From: Erin Morrow, COG/DTP

Subject: Progress on Analysis of Greenhouse Gas Reduction Strategies

This document contains progress made by staff on the analysis of transportation-related greenhouse gas reduction strategies from the *National Capital Region Climate Change Report* since the November 25, 2008 meeting.

Climate Change Measure A.1.iii – Provide Incentives for Early Vehicle Retirement

Description
Implement a "Cash-for-Clunkers" program to remove older, higher emitting passenger vehicles (both cars and light-duty trucks such as SUVs) from the roads

Analysis Approach

- Use sketch planning analysis to calculate emissions reductions which result from the program implementation by estimating emissions with the old versus the new vehicles.

Assumptions

- The "Drive a Clean Machine" program is being implemented in Texas (Dallas-Fort Worth, Austin, Houston-Galveston) to provide financial incentive to replace cars that are 10 years or older or have failed an emissions test. Some of the criteria for this analysis is patterned after this program.
- The program begins in 2010.
- The minimum age of the "clunker" is 10 years and the newly purchased vehicles will contribute to GHG reductions for six years.
- Individuals drive their vehicles 12,000 miles/year, whether a clunker or a new vehicle.
- Individuals must replace their "clunker" with a new vehicle which has a 10 mpg increase in highway fuel economy.
- The financial incentive is $1,000 per each vehicle.
- The program will last five years.
- Incentives will be provided for 100 vehicles each year for a total of 500 for the duration of the program.

Impact

Travel

No travel impacts as the VMT is assumed to be the same

Emissions

The annual CO2 emissions reductions per 100 replaced vehicles are estimated to be 1,162 tons.

Cost

Subsidy: $100,000/year for five years
Administrative costs: $100,000/year for five years
Marketing: $100,000/year for the first two years
$50,000/year for the last three years

Cost Effectiveness

The cost effectiveness for the first year of the program is estimated to be $258 per ton of CO2 in 2010, the first year of the program.

Climate Change Measure A.1.iii – Provide Incentives for Early Vehicle Retirement
DRAFT - December 22, 2008

Cash for Clunkers Program

Assumptions:
- To be eligible for this program, an individual must replace a vehicle that is 10 years or older with a new one with a minimum 10 mpg improvement in fuel economy
- The new vehicle purchased will contribute to GHG reductions for six years
- Individuals drive their vehicles 12,000 miles each year
- The program begins in 2010
- The program is funded for five years, with 100 incentives of $1,000 available each year

Annual Miles =	12,000	mi/year
Highway Fuel Economy Improvemnet =	10	mi/gal
Fuel Savings =	1,200	gallons/year
Number of Vehicles =	100	vehicles
ıel saved per 100 vehicles in one year =	120,000	gallons
	8,788	g CO2 produced by 1 gallon of gas
Total CO2 Emissions Reduced =	1,054,560,000	g CO2 saved each year
Total CO2 Emissions Reduced =	**1,162**	**tons CO2 saved in one year for 100 vehicles replaced**

	Year					
	2010	**2011**	**2012**	**2013**	**2014**	**2019**
Annual CO2 Benefits (tons)	1,162	2,325	3,487	4,650	5,812	1,162
Cumulative CO2 Benefits (tons)	1,162	3,487	6,975	11,625	17,437	34,874
Cumulative Cost of the Program	$ 300,000	$ 600,000	$ 850,000	$ 1,100,000	$ 1,350,000	$ 1,350,000
Cumulative Cost Effectiveness ($/ton)	$ 258.07	$ 172.05	$ 121.87	$ 94.63	$ 77.42	$ 38.71

Climate Change Measure A.2.i – Green Fleet Policy

Description
Establish a regional green fleet policy with measurable goals and time tables

Analysis Approach
- Use a sketch planning analysis to estimate emissions associated with existing fleets versus "green fleets."
- Determine which fleets are subject to state and/or local regulation.
- *MWCOG's Alternative Fuels Clean Cities Partnership is currently conducting a survey of public fleets in the region for the total number vehicles in fleet, current age distribution of fleet, and current vehicle replacement policies and schedules*
- *The partnership is also developing a "Green Fleet Policy" which will be finalized shortly.*
- Use offline analysis to calculate emissions benefits for specific region-wide "green fleet" conversion percentages for comparison to the baseline

Assumptions

- The assumptions will be based on the green fleet policy that is under development

Impact

Travel

No travel impacts as VMT is assumed constant

Emissions

Annual CO_2 emissions benefit in 2020 and 2030 and cumulative reductions would be calculated using spread sheet calculators

Costs

Costs will be based on the green fleet policy under development

Cost-Effectiveness

Climate Change Measure B.1.iii – Shift Short Vehicle Trips to Non-motorized Modes

Description

Identify the number/percentage of auto trips 3, 2, 1, and 0.5 miles in length and develop a strategy to shift half of these trips to bike, pedestrian, or transit modes and evaluate the benefits

Analysis Approach

- The following is a sensitivity analysis of shifting short trips from auto to non-auto modes. The analysis does not address the policy that will play a role in shifting the trips.

Assumptions

- The start year for the program is 2010
- The number of auto person trips of three miles and less in the modeled area was obtained from the Version 2.2 travel demand model for the year 2010.
- The number of auto person trips in the MSA was estimated by taking the ratio of VMT in the MSA to VMT in the modeled area.
- Estimates of trip shifts of less than 50 percent (10 percent and 20 percent) were also calculated because this type of VT/VMT reduction measure would be more likely to be successful in higher density areas of the region.

Impact

Travel

Shifting 50% of short trips in the MSA away from auto would result in an estimated decrease of 3.7 million vehicle trips and 5.6 million VMT daily.
Shifting 10% of short trips in the MSA away from auto would result in an estimated decrease of 750 thousand vehicle trips and 1.1 million VMT daily.
Shifting 20% of short trips in the MSA away from auto would result in an estimated decrease of 1.5 million vehicle trips and 2.2 million VMT daily.

Emissions

The estimated annual CO2 emissions reductions resulting from shifting 50% of short trips from auto modes is 873,000 tons for one year. The estimated annual CO2 emissions reductions resulting from shifting 10% of short trips from auto modes is 175,000 tons for one year. The estimated annual CO2 emissions reductions resulting from shifting 20% of short trips from auto modes is 350,000 tons for one year.

Cost

No cost estimates have been prepared since it is dependent on the method (policy) that will be put into place to encourage drivers to shift their trips to other modes.

Cost Effectiveness

The cost effectiveness has not been calculated for this measure because cost estimates have not been prepared.

Climate Change Measure B.1.iii - Shift Short Vehicle Trips to Non-motorized Modes
DRAFT - December 19, 2008

Assumptions
- This program begins in 2010

Summary of Trips, Avg. Trip Lengths, and Pct. Of Trips <= 3 miles by Purpose & Mode
From 2007 CLRP Conformity (modeled area) from Version 2.2 Travel Demand Model

	HBW		Non-HBW	
	Auto Person	Transit	Auto Person	Transit
2010 Average Weekday Trips	4,196,906	654,317	20,945,102	514,909
Avg. Trip Length (mi)	13.24	10.49	7.36	6.36
Pct. Trips <= 3 miles	17%	17%	44%	31%
Total Trips <= 3 mi	700,883	111,103	9,222,128	159,055
ESTIMATED MSA TRIPS <= 3 miles (using ratio of MSA VMT to modeled area VMT)	529,604	83,952	6,968,462	120,186

Scenario 1 - Shift 50% of short trips away from auto mode

Average Trip Length =	1.5	mi
Percentage of HBW Trips Shifted from Auto =	**50%**	
Percentage of non-HBW Trips Shifted from Auto =	**50%**	
Number of Daily HBW Trips Shifted from Auto =	264,802	VT
Number of Daily non-HBW Trips Shifted from Auto =	3,484,231	VT
Daily VMT reduced from HBW Trips =	397,203	miles
Daily VMT reduced from non-HBW Trips =	5,226,347	miles
CO2 rate for commuter TERMS =	461.1	g/mi
Total CO2 Emissions Reduced =	2,592,850,166	g CO2 saved each day
Total CO2 Emissions Reduced =	**873,907**	**tons/year**

Scenario 2 - Shift 10% of short trips away from auto mode

Average Trip Length =	1.5	mi
Percentage of HBW Trips Shifted from Auto =	**10%**	
Percentage of non-HBW Trips Shifted from Auto =	**10%**	
Number of Daily HBW Trips Shifted from Auto =	52,960	VT
Number of Daily non-HBW Trips Shifted from Auto =	696,846	VT
Daily VMT reduced from HBW Trips =	79,441	miles
Daily VMT reduced from non-HBW Trips =	1,045,269	miles
CO2 rate for commuter TERMS =	461.1	g/mi
Total CO2 Emissions Reduced =	518,570,033	g CO2 saved each day
Total CO2 Emissions Reduced =	**174,781**	**tons/year**

Scenario 3 - Shift 20% of short trips away from auto mode

Average Trip Length =	1.5	mi
Percentage of HBW Trips Shifted from Auto =	**20%**	
Percentage of non-HBW Trips Shifted from Auto =	**20%**	

Number of Daily HBW Trips Shifted from Auto =	105,921	VT
Number of Daily non-HBW Trips Shifted from Auto =	1,393,692	VT
Daily VMT reduced from HBW Trips =	158,881	miles
Daily VMT reduced from non-HBW Trips =	2,090,539	miles
CO2 rate for commuter TERMS =	461.1	g/mi
Total CO2 Emissions Reduced =	1,037,140,067	g CO2 saved each day
Total CO2 Emissions Reduced =	**349,563**	**tons/year**

Climate Change Measure B.4.ii – Programs to Enhance Access to Transit and Alternative Modes

Description
Expand existing and fund new programs to enhance access to transit and alternative modes, commuter connections, guaranteed ride home, telework programs, bike/pedestrian access, and park/ride lots.

Analysis Approach

Previously analyzed sketch level bicycle/pedestrian programs, such as Bicycle Parking at Metro and other transit stations; pedestrian access improvements such as sidewalk, pedestrian signals, and bus stop improvements will form the basis for the analysis

Pedestrian Access to Transit

Use TERM M-93 as basis for analysis. Please see supporting document.

Assumptions

Pedestrian Access to Transit

M-93assumes improvements to sidewalks, curb ramps, crosswalks, and lighting in order to improve pedestrian access to 11 MARC stations and 12 Metrorail stations in Montgomery County. The current analysis was conducted based on needs shown in a Maryland Department of Transportation/ Mass Transit Administration report published in June, 1997 (*Access 2000 – Bicycle and Pedestrian Access to Rail Transit Stations in Maryland*). Analysis year - 2010.

Impact

Travel

Pedestrian Access to Transit

Daily reductions of 1,428 vehicle trips and 22,134 VMT.

Emissions

Pedestrian Access to Transit

Annual reduction of 2,770 tons of CO2

Costs

Pedestrian Access to Transit

The total cost for M-93 is $14.2 million ($1.42 million annualized over 10 years).

Cost-Effectiveness

Pedestrian Access to Transit

The cost effectiveness of M-93 is $635/ton over 10 years.

M-93 Improve Pedestrian Facilities Near Rail Stations

Description

This measure assumes improvements to sidewalks, curb ramps, crosswalks, and lighting in order to improve pedestrian access to 11 MARC stations and 12 Metrorail stations in Montgomery County. The current analysis was conducted based on needs shown in a Maryland Department of Transportation/ Mass Transit Administration report published in June, 1997 (*Access 2000 – Bicycle and Pedestrian Access to Rail Transit Stations in Maryland*).

Summary of Impacts (2010)

Daily VT Reduction:	1428	VT
Daily VMT Reduction:	22134	VMT
Daily NOx Reductions:	0.01021	tons/day
Daily VOC Reductions:	0.00635	tons/day
Daily CO2 Reductions	8.934	tons/day
Annual CO2 Reductions	**2,770**	**tons/year**
Cost Effectiveness (NOx)	556,154	$/ton
Cost Effectiveness (VOC)	894,870	$/ton
Cost Effectiveness (CO2)	635	$/ton

Assumptions

- Sketch planning is used as an analysis tool
- Made all improvements to sidewalks, curb ramps, crosswalks, and lighting at and around (0.6 mile radius from station) Montgomery County rail stations, as needed according to MDOT/MTA's *Access 2000* study.
- Used 2 % growth rate, compounded annually, to grow 1996 average weekday passenger totals to 2005 ridership numbers at each station. 1996 average weekday passenger totals from MDOT/MTA's *Access 2000* study.
- Used 5% increase in passengers for areas that needed improvements at and around (0.6 mile radius) the station, and used 3% increase in passengers for areas that need improvements just around (0.6 mile radius) the station.
- 85 percent of new users drive alone prior to using transit
- Average trip length = 15.5 miles

Emission Analysis (2010)

Increase in pedestrian due to improvements = 84765 - 83925 = 840 (refer table 1)
Increase in trips = 2 x 840 = 1680
Number of SOV trips = 1680 x 0.85 = 1428
VMT: 1428 x 15.5 = 22134

Daily Emissions Reductions

NOx Estimation

Cold Start	1428	x	0.5811 grams / 1 trip	x	1 ton / 907,185 grams	=	0.00091	tons
Running	22,134	x	0.3811 grams / 1 mile	x	1 ton / 907185 grams	=	0.00930	tons
					Total		0.01021	tons

VOC Estimation

Cold Start	1428	x	1.526 grams / 1 trip	x	1 ton / 907,185 grams	=	0.00240	tons
Running	22,134	x	0.1617 grams / 1 mile	x	1 ton / 907185 grams	=	0.00395	tons
					Total		0.00635	tons

CO2 Estimation

Running	22,134	x	1 gallon / 24 miles	x	8,788 g CO2 / gallon	x	1 ton / 907185 grams	=	8.934	tons
							Total		8.934	tons

Cost Assumptions

In order to estimate the project cost, staff estimated the miles of sidewalk, and number of intersections requiring curb cuts, wheel chair ramps, crosswalks and signal components at 22 Metro and MARC stations. The cost of the improved pedestrian facilities is estimated at $11.4 million. A contingency cost of $2.8 million, (25% of estimated cost) was added to the estimated cost. The total cost of improved pedestrian facilities including contingency cost is estimated at $14.2 million.

Cost Analysis

Cost of improved pedestrian facilities = $11.4 million
Contingency cost 25% = $2.8 million
Life span: 10 years
Number of days per year = 250
Total TIP Cost = $14.2 million
Annualized cost = $14.2 mill / 10 years =$1.42 mill

Cost Effectiveness

$$\text{Cost effectiveness NOx} = \frac{\$1.42 \text{ mill}}{250 \times 0.01021} = 556{,}154 \ \$/\text{ton}$$

$$\text{Cost effectiveness VOC} = \frac{\$1.42 \text{ mill}}{250 \times 0.00635} = 894{,}866 \ \$/\text{ton}$$

$$\text{Cost effectiveness CO2} = \frac{\$1.42 \text{ mill}}{250 \times 8.934} = 635 \ \$/\text{ton}$$

Tabel 1: Pedestrian Improvements to Transit
TERM Calculation: Pedestrian Access to Transit

	Station	1996 Avg. Weekday Passengers	Needs improvs. at station?	Grow to 2010 2% comp. Ann.	Increase due to improvement 1% growth
MARC:	Dickerson	12	Y	16	16
	Barnesville	61	Y	80	81
	Boyds	9	Y	12	12
	Germantown	345	Y	455	460
	Metropolitan Grove	152	Y	201	203
	Gaithersburg	279	Y	368	372
	Washington Grove	25	Y	33	33
	Rockville	314	N	414	418
	Garrett Park	32	Y	42	43
	Kensington	111	Y	146	148
	Silver Spring	334	N	441	445
Metrorail:	Shady Grove	8465	N	11169	11281
	Rockville	3255	N	4295	4338
	Twinbrook	3511	N	4633	4679
	White Flint	3425	N	4519	4564
	Grosvenor	3201	N	4224	4266
	Medical Center	3545	N	4678	4724
	Bethesda	7106	N	9376	9470
	Friendship Heights	7790	N	10279	10382
	Glenmont		N	0	0
	Wheaton	5125	N	6762	6830
	Forest Glen	1798	N	2372	2396
	Silver Spring	9908	Y	13073	13204

	Takoma	4802	N	6336	6399
	TOTAL	**63605**		**83925**	**84765**