Memorandum

March 6, 2009

To: TPB Technical Committee

From: Eulalie Lucas
Daivamani Sivasailam
Department of Transportation Planning

Subject: Climate Change Work Program Activities

Background

During the summer of 2007 Department of Transportation Planning Staff embarked on an exercise to develop mobile source CO_2 emissions inventories which is a major component of the greenhouse gases (GHG) to support the activities of the COG Climate Change Steering Committee (CCSC). Land use and transportation networks from the 2007 Constrained Long Range Plan (CLRP) and FY 2007-2012 Transportation Improvement Program (TIP) were used to estimate the travel demand and EPA's Mobile 6.2 model was used for CO_2 emissions rates. TPB's Scenarios Task Force has a "What Would It Take" scenario to meet the mobile source GHG reduction goals set forth in CCSC report. Since the travel demand model, land use, and highway and transit networks have changed since the 2007 CO_2 emissions inventories were developed, a work program element to update mobile source GHG emissions inventories to reflect the changes for the 2002, 2005, 2010, 2012, 2020, 2030 milestone years was included in the FY 2009 UPWP. The updated February 2009 inventories were developed based on the 2008 CLRP and FY 2009-2014 TIP. This memorandum discusses the methodology used to develop the new inventories, provides a comparison with the 2007 inventories, highlights the differences between the two sets of inventories and provides an update on the analysis of GHG emissions reduction TERMs.

Methodology

The geography for which CO_2 emissions inventory is developed is the same as the 8-hour ozone non-attainment area (see Map1). EH Pechan and associates was hired to develop a post-processor tool to be used along with the travel demand model to develop CO_2 inventories as well as Methane (CH_4) and Nitrous Oxide (N_2O) emissions, which are expressed as CO_2 equivalents. Total GHG is the sum of CO_2, methane as CO_2 equivalent, and N_2O as CO_2 equivalent. Since EPA's Mobile model rates does not include congressionally mandated new corporate average fuel economy standards (CAFÉ) standards for light duty vehicles another consultant (Dan Meszler) was hired to develop a program to estimate the impact of CAFÉ 35 on GHG emissions. Since CAFÉ impacts only light duty vehicles the percent reduction in CO_2 emissions due to the CAFÉ program is applied to the light duty total GHG emissions for the various milestone years.

Comparison of Summer 2007 and February 2009 inventories

Since there were changes to the land use, network, and travel demand model we wanted to isolate the impact of the changes to the emissions brought about by these differences. Exhibit 1 is a table comparing the model area VMT for the two inventories. We can observe an 8% difference (decrease) between the June 2007 VMT and February 2009 VMT. Exhibit 2 is a table comparing the CO_2 emissions from the June 2007 inventory and February 2009 inventory. The difference in the emissions inventory in 2030 is 5% (decrease). The difference in CO_2 emissions can be attributed to lower VMT due to updates in networks, land use and travel assumptions Exhibit 3 is a chart of the same data showing the June 2007 and February 2009 inventories.

GHG emissions inventories were developed results are shown in exhibit 4 emissions are reported by pollutant (CO_2, Methane, and Nitrous Oxide) for 2002 and 2030. We can observe that total GHG is about 4% higher than CO2 in the year 2002. However, by 2030 the same number drop down to 0.4% which means almost the entire total GHG comes from CO_2. This is also illustrated graphically in exhibit 5.

Exhibit 6 is a bar chart showing CO_2 inventory and the impact of CAFÉ 35 on the inventory in 2020 and 2030. By 2020 CAFÉ 35 reduces CO_2 emissions by 19.5% and by 2030 reduces it by 26.8%.

Highlights

The following are the highlights from the new inventories:

- In 2030 CO_2 emissions are 5% lower than the summer 2007 inventory.
- By 2030 mobile source GHG emissions are only 0.4% higher than CO_2 emissions.
- CAFÉ 35 reduces CO_2 emissions by 27% in 2030.
- CAFÉ 35 reduces GHG emissions by 33% in 2030.

Next Steps

1. Incorporate Alternate Fuel/ Technology Vehicles in our fleet.
    - Department of Energy (DOE) market estimates
    - VMT
    - GHG estimates

2. TERMs Analysis

Exhibit 7 shows all the "Transportation and Land Measures" from the CCSC's "National Capital Region Climate Report" and whether they would be analyzed as a TERM, analyzed under the scenario analysis or whether it is a policy measure. Staff has analyzed

a number of the TERM measures (shown shaded) and presented the technical analysis to the Travel Management Subcommittee. Staff is presently updating the measures based on comments received at the subcommittee meeting. The CO_2 and GHG emissions rates to be used in analyzing these measures are under development and are based on MOBILE 6.2 CO_2 emission rates and E H Pechan provided GHG emissions rates which will be adjusted to reflect 35 mpg CAFÉ standards and alternate fuel/technology vehicles impacts.

- Completion of this step will yield the baseline forecast inventories

3. Apply data in Scenarios Analysis (TPB & CCSC initiatives) to develop control strategies.

Map 1
Exhibits 1- 7

Map 1

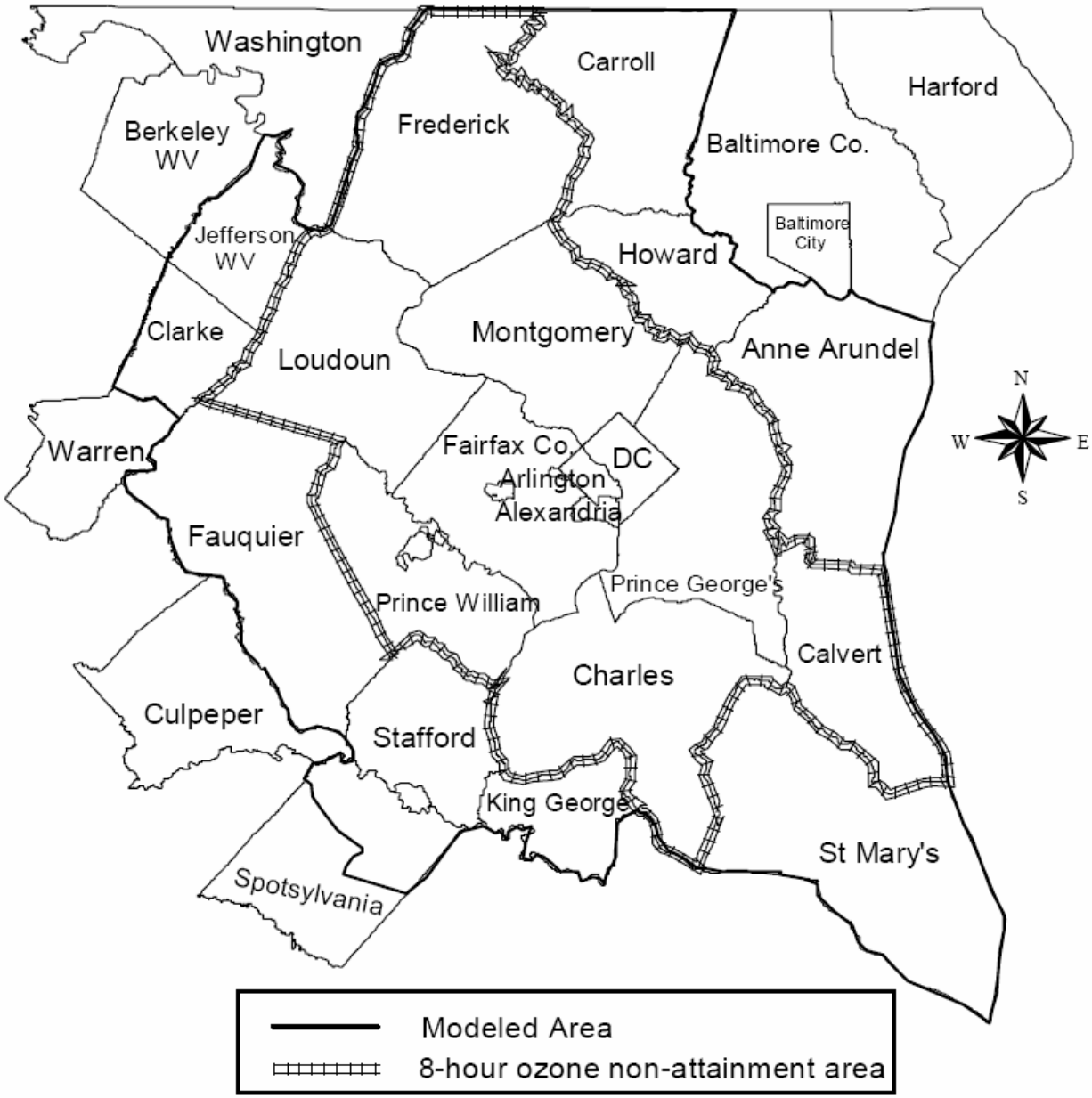

Washington
Carroll
Harford
Berkeley
WV
Frederick
Baltimore Co.
Baltimore
City
Jefferson
WV
Howard
Clarke
Montgomery
Anne Arundel
Loudoun
N
W
E
S
Warren
Fairfax Co.
DC
Arlington
Alexandria
Fauquier
Prince George's
Prince William
Calvert
Charles
Culpeper
Stafford
King George
St Mary's
Spotsylvania
Modeled Area
8-hour ozone non-attainment area

Exhibit 1

COMPARISON OF MODELED AREA TRIPS AND VEHICLE MILES TRAVELED(000'S)
ANNUALIZED AVERAGE WEEKDAY TRAFFIC(AAWDT)
(Based on Final Iteration)

YEAR	REGIONAL VMT (JUNE 2007)	REGIONAL VMT (FEBRUARY 2009)	% DIFFERENCE
2002	149,042,049	146,236,145	-1.9%
2010	171,390,904	165,004,265	-3.7%
2020	195,384,352	187,128,108	-4.2%
2030	216,770,129	199,495,367	-8.0%

Exhibit 2

Comparison of Washington Area CO2 Emissions Inventories

Draft 03-6-2009

Emissions are in Tons per year

8-Hour Non-Attainment Area	2002			2010		
	Initial	Updated	% Diff.	Initial	Updated	% Diff.
Major Roads	21,062,507	20,822,954	-1.1%	24,975,069	24,224,866	-3.0%
Local Roads	1,702,682	1,722,694	1.2%	2,051,185	1,896,339	-7.5%
School Buses	148,886	151,397	1.7%	157,151	157,553	0.3%
Transit Buses	238,837	241,449	1.1%	259,626	258,566	-0.4%
Auto Access	82,729	81,780	-1.1%	142,750	113,603	-20.4%
Total	23,273,168	23,020,274	-1.1%	27,585,781	26,650,927	-3.4%

8-Hour Non-Attainment Area	2030		
	Initial	Updated	% Diff.
Major Roads	31,274,167	29,825,933	-4.6%
Local Roads	2,568,474	2,310,466	-10.0%
School Buses	157,557	157,564	0.0%
Transit Buses	258,072	258,837	0.3%
Auto Access	132,537	156,749	18.3%
Total	34,390,808	32,709,549	-4.9%

Notes on Inputs:

Initial Mobile Source Inventory	Updated Mobile Source Inventory
2006 CLRP and the FY2007-2012 TIP	**2008 CLRP and the FY2009-2014 TIP**
Ver 2.1D Travel Demand Model	**Ver 2.2 Travel Demand Model**
Round 7.0a Cooperative Forecast	**Round 7.1 Cooperative Forecast**
Interpolated Values for Auto Access to Transit	**Values Based on Network Analysis**
"Post-Processor" Emissions Estimatiion	**"Pechan Software" Emissions Estimation**

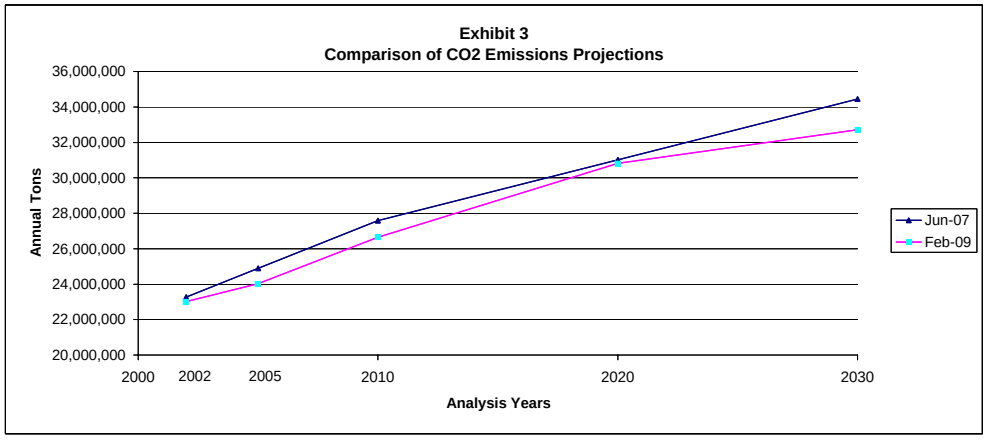


Exhibit 3
Comparison of CO2 Emissions Projections
36,000,000
34,000,000
32,000,000
30,000,000
28,000,000
26,000,000
24,000,000
22,000,000
20,000,000
Annual Tons
2000
2002
2005
2010
2020
2030
Analysis Years
Jun-07
Feb-09

Exhibit 4

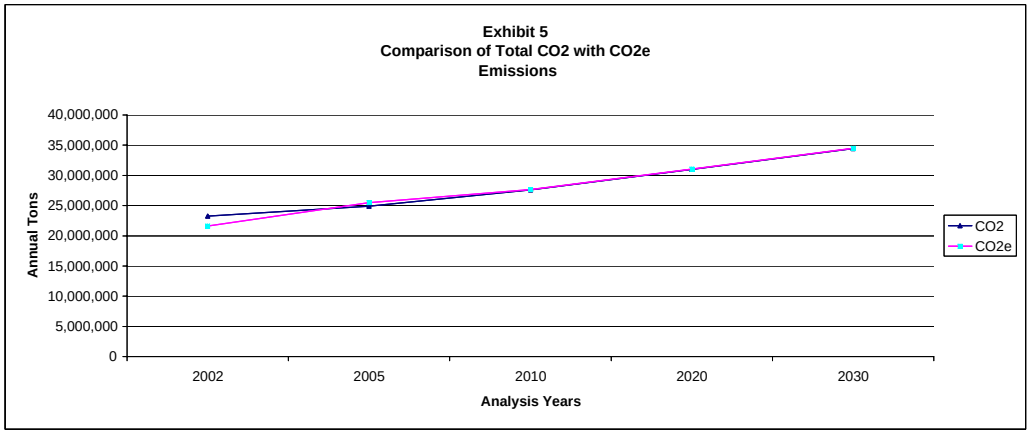
2002 CO_2 and CO_2 eq Network Emissions by Jurisdiction and Pollutant

Jurisdiction	Pollutant	Total Emissions	Rate CO2e to CO2
DC	Carbon Dioxide (CO2)	1700256	
DC	Methane (CH4) as CO2 Eq.	3167	
DC	Nitrous Oxide (N2O) as CO2 Eq.	58788	
DC	Total CO2 Equivalent	1762211	1.04
Calvert	Carbon Dioxide (CO2)	249095	
Calvert	Methane (CH4) as CO2 Eq.	461	
Calvert	Nitrous Oxide (N2O) as CO2 Eq.	8452	
Calvert	Total CO2 Equivalent	258008	1.04
Charles	Carbon Dioxide (CO2)	484498	
Charles	Methane (CH4) as CO2 Eq.	880	
Charles	Nitrous Oxide (N2O) as CO2 Eq.	16262	
Charles	Total CO2 Equivalent	501640	1.04
Frederick	Carbon Dioxide (CO2)	1641923	
Frederick	Methane (CH4) as CO2 Eq.	2906	
Frederick	Nitrous Oxide (N2O) as CO2 Eq.	54874	
Frederick	Total CO2 Equivalent	1699704	1.04
Montgomery	Carbon Dioxide (CO2)	3979595	
Montgomery	Methane (CH4) as CO2 Eq.	6667	
Montgomery	Nitrous Oxide (N2O) as CO2 Eq.	129208	
Montgomery	Total CO2 Equivalent	4115470	1.03
Prince George	Carbon Dioxide (CO2)	4068746	
Prince George	Methane (CH4) as CO2 Eq.	7506	
Prince George	Nitrous Oxide (N2O) as CO2 Eq.	140433	
Prince George	Total CO2 Equivalent	4216684	1.04
Arlington	Carbon Dioxide (CO2)	869716	
Arlington	Methane (CH4) as CO2 Eq.	1484	
Arlington	Nitrous Oxide (N2O) as CO2 Eq.	28705	
Arlington	Total CO2 Equivalent	899905	1.03
Fairfax	Carbon Dioxide (CO2)	4944938	
Fairfax	Methane (CH4) as CO2 Eq.	8252	
Fairfax	Nitrous Oxide (N2O) as CO2 Eq.	163034	
Fairfax	Total CO2 Equivalent	5116225	1.03
Loudoun	Carbon Dioxide (CO2)	952947	
Loudoun	Methane (CH4) as CO2 Eq.	1539	
Loudoun	Nitrous Oxide (N2O) as CO2 Eq.	30472	
Loudoun	Total CO2 Equivalent	984958	1.03
Prince William	Carbon Dioxide (CO2)	1525995	
Prince William	Methane (CH4) as CO2 Eq.	2655	
Prince William	Nitrous Oxide (N2O) as CO2 Eq.	51285	
Prince William	Total CO2 Equivalent	1579936	1.04
Alexandria	Carbon Dioxide (CO2)	405245	
Alexandria	Methane (CH4) as CO2 Eq.	646	
Alexandria	Nitrous Oxide (N2O) as CO2 Eq.	12591	
Alexandria	Total CO2 Equivalent	418482	1.03
Washington Area	Carbon Dioxide (CO2)	20822954	
Washington Area	Methane (CH4) as CO2 Eq.	36164	
Washington Area	Nitrous Oxide (N2O) as CO2 Eq.	694106	
Washington Area	Total CO2 Equivalent	21553224	1.04

Exhibit 4a

2030 CO_2 and CO_2 eq Network Emissions by Jurisdiction and Pollutant

Jurisdiction	Pollutant	Total Emissions	Rate CO2e to CO2
DC	Carbon Dioxide (CO2)	2021943	
DC	Methane (CH4) as CO2 Eq.	1219	
DC	Nitrous Oxide (N2O) as CO2 Eq.	6233	
DC	Total CO2 Equivalent	2029395	1.004
Calvert	Carbon Dioxide (CO2)	371375	
Calvert	Methane (CH4) as CO2 Eq.	224	
Calvert	Nitrous Oxide (N2O) as CO2 Eq.	1138	
Calvert	Total CO2 Equivalent	372737	1.004
Charles	Carbon Dioxide (CO2)	775781	
Charles	Methane (CH4) as CO2 Eq.	471	
Charles	Nitrous Oxide (N2O) as CO2 Eq.	2399	
Charles	Total CO2 Equivalent	778652	1.004
Frederick	Carbon Dioxide (CO2)	2605209	
Frederick	Methane (CH4) as CO2 Eq.	1561	
Frederick	Nitrous Oxide (N2O) as CO2 Eq.	7992	
Frederick	Total CO2 Equivalent	2614762	1.004
Montgomery	Carbon Dioxide (CO2)	5259720	
Montgomery	Methane (CH4) as CO2 Eq.	3159	
Montgomery	Nitrous Oxide (N2O) as CO2 Eq.	16185	
Montgomery	Total CO2 Equivalent	5279065	1.004
Prince George	Carbon Dioxide (CO2)	5507831	
Prince George	Methane (CH4) as CO2 Eq.	3309	
Prince George	Nitrous Oxide (N2O) as CO2 Eq.	16874	
Prince George	Total CO2 Equivalent	5528014	1.004
Arlington	Carbon Dioxide (CO2)	1020908	
Arlington	Methane (CH4) as CO2 Eq.	621	
Arlington	Nitrous Oxide (N2O) as CO2 Eq.	3176	
Arlington	Total CO2 Equivalent	1024704	1.004
Fairfax	Carbon Dioxide (CO2)	7004025	
Fairfax	Methane (CH4) as CO2 Eq.	4183	
Fairfax	Nitrous Oxide (N2O) as CO2 Eq.	21410	
Fairfax	Total CO2 Equivalent	7029618	1.004
Loudoun	Carbon Dioxide (CO2)	2099390	
Loudoun	Methane (CH4) as CO2 Eq.	1258	
Loudoun	Nitrous Oxide (N2O) as CO2 Eq.	6444	
Loudoun	Total CO2 Equivalent	2107092	1.004
Prince William	Carbon Dioxide (CO2)	2610805	
Prince William	Methane (CH4) as CO2 Eq.	1564	
Prince William	Nitrous Oxide (N2O) as CO2 Eq.	7985	
Prince William	Total CO2 Equivalent	2620355	1.004
Alexandria	Carbon Dioxide (CO2)	548946	
Alexandria	Methane (CH4) as CO2 Eq.	331	
Alexandria	Nitrous Oxide (N2O) as CO2 Eq.	1694	
Alexandria	Total CO2 Equivalent	550971	1.004
Washington Area	Carbon Dioxide (CO2)	29825933	
Washington Area	Methane (CH4) as CO2 Eq.	17899	
Washington Area	Nitrous Oxide (N2O) as CO2 Eq.	91532	
Washington Area	Total CO2 Equivalent	29935364	1.004



	2002	2005	2010	2020	2030
CO2	23,273,168	24,890,398	27,585,781	31,018,352	34,450,922
CO2e	21,625,139	25,484,775	27,649,236	31,065,042	34,497,111

Exhibit 6

CO_2 Emissions Reductions with CAFE 35

Reductions begin beyond 2011

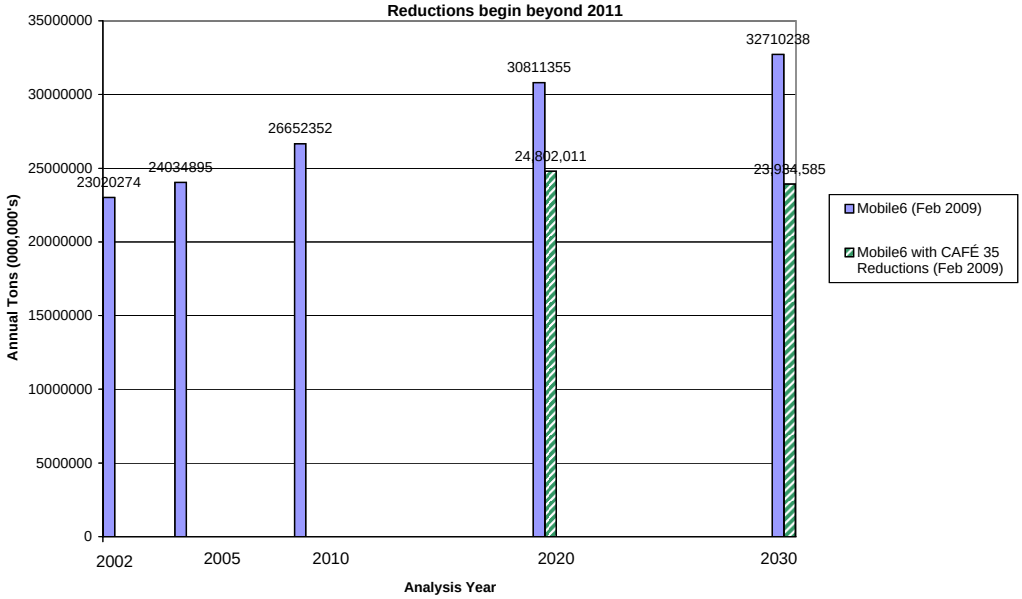


Exhibit 7

Analysis Approach for Recommended Measures in the "National Capital Region Climate Report"

Recommendations for Reducing GHG from Transportation and Land Use
Local and Regional Strategies for Government and Business

	Type of Analysis[1]			Comment
	TERM	Scenario	Policy	
A. Increase Fuel Efficiency and Use of Clean Fuel Vehicles				
1. Promote Clean Fuel Vehicles (cars, trucks, buses)				
i. Promote/accelerate adoption of efficient clean-fuel vehicles, including hybrids (cars, trucks, and buses).			X	This is a policy measure rather than a technical measure
ii. Evaluate options for promoting CA LEV-II, extending CAFE requirements past 2020 and to cover heavy trucks, and facilitating adoption of high-mileage vehicles through incentives and tax policies	X			Scope out scenarios for additional CAFÉ regulations and phasing
iii. Assess the benefits from a "Cash-for-Clunkers" program and rebates or tax incentives for the purchase of hybrid vehicles	X			Analyze as a Cash-for-Clunker
2. Adopt regional green fleet policy				
i. Establish a regional green fleet policy with measurable goals and timetables. Target public and private fleets, transit, taxicabs, rental cars, and refuse haulers. Evaluate the benefits of specific "green fleet" conversion percentages	X			Analysis approach: (1) Survey public fleet to assess market (2) Research green fleet policies in other regions (3) Propose and test scenarios accordingly
3. Promote use of clean fuels		X		See TPB Scenario Study
B. Reduce Vehicle Miles Traveled (VMT)				
1. Adopt VMT reduction goals				
i. Collaborate with the TPB to develop VMT reduction goals for 2012 and 2020 and associated options for meeting the goals			X	Policy, not technical
ii. Evaluate the potential greenhouse gas emission reduction benefits and costs of using financial incentives (e.g., pay as you travel insurance, tolling, or congestion pricing) to reduce VMT		X		See TPB Scenario Study
iii. Identify the percentage of auto trips under 3, 2, 1, and ½ miles; develop a strategy to shift half of these trips to bike, pedestrian, or transit modes; and evaluate the benefits of such a shift	X			different shift % to be studied
2. Expand transit use (incentives, exclusive transit lanes)				Will be combined with the next measure
i. Examine options to promote the increased use of existing transit capacity		X	X	
ii. Evaluate funding requirements for transit incentives and an expanded metrocheck program			X	Policy, not technical
3. Invest/Expand transit infrastructure				
i. With the Washington Metropolitan Area Transit Authority, MARC, VRE, and the local transit operators, evaluate the greenhouse gas reduction benefits of specific incremental expansion of transit capacity and commuter rail service		X		Scenario analysis
ii. Evaluate the greenhouse gas reduction benefits of expanding existing and establishing new exclusive bus transit routes, lanes, on-ramps, corridors, and intercity high-speed rail		X		Scenario analysis
4. Expand commuter options (car sharing, bicycle/pedestrian, financial incentives)				New programs and expanding current programs
i. Building on the accomplishments of Commuter Connections, develop specific targets for shifting modes from single-occupancy vehicles to transit, walking, and bicycling for commuting and noncommuting trips.	X			See State of the Commute Report and previous TERM analysis including cost-effectiveness ranges
ii. 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	X			"
iii. Fully fund the construction of bicycle/pedestrian paths in the region, as outlined in the regional bicycle/pedestrian plan.	X			"
iv. Provide incentives to developments that speed improvements in bicycle/pedestrian access, including improvements in sidewalks, curb ramps, crosswalks, and lighting	X			"
v. Address the need for on-road bicycle accommodations and facilities	X			See "Commuter Connections Carshare Survey 2008"
vi. Promote regional implementation of SmartBike program similar to the Zipcar concept	X			Needs further review
5. Promote transit-oriented development/Concentrate future growth in Regional Activity Centers				

i. Evaluate the benefits from achieving a range of possible goals (up to 95 percent) for directing new residential and commercial growth to designated regional activity centers, including growth around transit as well mixed-use, higher-density development		X		Scenario analysis
ii. Encourage local governments to evaluate opportunities to provide incentives (including zoning changes) to encourage mixed-use development, including workforce housing at transit stations and hubs to reduce sprawl and VMT		X		Scenario analysis
iii. Encourage localities to revisit current land-use plans, in light of current shifts in the real estate market, coupled with high energy costs		X		Scenario analysis
iv Establish TOD as the region's preferred growth strategy			X	Policy, not technical
6. Examine parking policies to reduce VMT				
i. Examine parking policies and their relation to VMT, and implement new parking policies to reduce VMT			X	Policy, not technical
ii. Strengthen financial and other incentives (e.g., tax rebates, higher parking costs, and transit benefits) to encourage residents to drive less			X	"
iii. Advocate for federal income tax benefits for transit use that equal or exceed the benefits for employer provided/subsidized parking			X	"
C. Travel Efficiency				
1. Adopt best practices for traffic engineering improvements and road management to reduce VMT and congestion. Identify locations of significant recurrent congestion, and prioritize investments to reduce	X			See TERM cost-effectiveness ranges
2. Implement the Metropolitan Area Transportation Operations Coordination Program to improve coordination among transportation agencies for data sharing and incident management	X			See TERM cost-effectiveness ranges
3. Enforce existing idling regulations	X			Review regulations and quantify existing conditions
4. Aviation				Refer to Aviation Subcommittee (?)
D. Land Use				
1. Tree canopy preservation - prepare plan to meet "increase regional canopy"				Outside transportation
2. Evaluate LEED-ND standards for new development				Outside transportation
3. Carefully plan the location and design of new, infill, and redevelopment projects				
i. Promote regional policies that support walkable communities and affordable housing near transit, and that protect green infrastructure.		X		Scenario analysis
4. Integrate GHG analyses into comprehensive planning, new capital projects				
i. Quantify projected greenhouse gas emissions from major new transportation and other new capital projects			X	Policy, not technical
ii. Identify best practices enabling local governments to include greenhouse gas reduction and energy efficiency/conservation as elements in their local comprehensive planning			X	"
iii. In cooperation with COG's Planning Directors Technical Advisory Committee and local government environmental and energy planners, convene a working group to devise a consistent, standard methodology for evaluating the greenhouse gas emissions from proposed individual development projects		X		"
iv. Encourage new commercial construction to include a "travel management plan."		X		"
E. Regional Metropolitan Planning Process				
1. Develop regional metropolitan planning process for GHGs				
i. Collaborate with the TPB to evaluate how a regional process modeled after the current regional metropolitan planning process for transportation and air quality planning might be adapted to address greenhouse gas emissions			X	Policy, not technical
2. Make greenhouse gas reduction a stated goal of regional transportation planning activities, including the newly launched multi-stakeholder Greater Washington 2050 initiative, poised to generate additional growth scenarios, and quality growth scenarios.			X	"
3. Consult with other regions around the country to broadly evaluate options for regional approaches to greenhouse gas reductions that include cap and trade and other approaches that might be relevant to our region (e.g., California SB 375), or that might be under consideration in upcoming national climate, energy or transportation legislation			X	"

[1] TERM - Sketch planning analysis methods employed in previous SIP and air quality conformity analysis

Scenario - TPB's Scenario Task Force work activities

Policy - TPB policy/goal, rather than a technical assessment