HILLSBOROUGH COUNTY MPO
2035 LONG RANGE TRANSPORTATION PLAN

ANALYSIS OF GREENHOUSE GAS EMISSIONS REDUCTION OF IMPLEMENTING HILLSBOROUGH MPO's COST AFFORDABLE PLAN

Hillsborough County
Metropolitan Planning Organization
601 East Kennedy Blvd. – 18th Floor
Tampa, FL 33601
(813) 272-5940
www.hillsboroughmpo.org

The preparation of this report has been financed in part through grant(s) from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the Metropolitan Planning Program, Section 104(f) of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

November 2009

TABLE OF CONTENTS

LIST OF TABLES

This memorandum documents the methodology and findings of an analysis of the greenhouse gas (GHG) impacts of implementing two alternative Hillsborough MPO cost affordable plans. The analysis documents total GHG emissions from the regional transportation system (highways and transit) in 2006 and 2035, and compares emissions under the following four scenarios, as analyzed using the Tampa Bay Regional Planning Model (TBRPM):

- 2006 Base – The existing (2006) transportation network and travel conditions.
- 2013EC – Projected travel conditions in 2035 on the "existing plus committed" roadway network (which stops growing in 2013).
- CAA17 - 2035 travel conditions and transportation network with no new sales tax for Hillsborough County.
- CAA18 - 2035 travel conditions and transportation network with additional funding from a sales tax adopted for Hillsborough County.

The analysis reflects the GHG impacts of roadway and transit investments, resulting travel demand patterns (e.g., mode shares and trip lengths), and travel speeds/congestion on the roadway network. Lower levels of congestion should reduce GHG emissions since vehicles operate most efficiently at moderate speeds (approximately 35 to 60 mph). The analysis does not reflect any impacts from other programs or policies (such as travel demand management programs or pedestrian-friendly land use design) that cannot be directly analyzed using the TBRPM. A separate report describes a range of other GHG reduction strategies that the Hillsborough MPO may consider and presents approximate ranges of impacts from the literature.[1]

The memorandum first presents overall results, then discusses methodology and results for roadway and transit vehicle emissions separately.

OVERALL RESULTS

Table 1 shows combined GHG emissions from roadway and transit vehicles under the various scenarios. Emissions under all 2035 scenarios increase compared to 2006, due to higher levels of VMT and increased congestion (reflected in lower average travel speeds), which more than outpace projected fuel economy improvements over this time period. The "existing plus committed" scenario shows the largest increase in emissions (56 percent) while the two cost-affordable scenarios show increases of 42 to 44 percent.

---

[1] Cambridge Systematics, Inc. for Hillsborough County MPO. "Hillsborough County MPO LRTP GHG Reduction Strategies." Draft report, February 2009.

The CAA18 scenario (with sales tax) results in the lowest 2035 GHG emissions of the three scenarios. While transit emissions are higher due to the expanded transit investment, roadway emissions are lower because of reduced VMT and congestion compared with the CAA17 (no sales tax) scenario. Compared with CAA17, the increase in emissions from transit under CAA18 is 140 metric tons vs. a decrease in roadway emissions of 410 metric tons. Under any scenario transit contributes on balance a small amount of GHG emissions when compared to roadway vehicles – less than 1 percent even under scenario CAA18. Both cost-affordable scenarios show a decrease of 8 to 9 percent compared to 2035 conditions on the existing plus committed network.

Table 1: Total GHG Emissions from Roadway and Transit Vehicles, Hillsborough County

Year	Scenario	GHG Emissions from Roadways (metric tons CO_2e)	GHG Emissions from Transit (metric tons CO_2e)	Total GHG Emissions (metric tons CO_2e)	% Change vs. 2006	% Change vs. 2035 E+C
2006	2006base	16,501	96	16,597		
2035	2013EC	25,790	72	25,862	56%	
2035	CAA17	23,743	81	23,824	44%	-8%
2035	CAA18	23,326	220	23,546	42%	-9%

EMISSIONS FROM AUTOMOBILES AND TRUCKS

The approach to modeling GHG emissions from roadway vehicles (automobiles and trucks) was as follows:

- DraftMOVES2009, the EPA's best available model for greenhouse gas emissions, was run to obtain greenhouse gas emission rates in grams per mile (g/mi) for 2006 for a variety of combinations of vehicle type, fuel type, road type, area type, and speeds. The greenhouse gases include carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4), which are combined into one emission rate reported in grams of CO_2 equivalent (CO_2e). MOVES was run based on local meteorological data (built into the model) for Hillsborough County, FL along with national defaults for other factors.
- 2035 GHG emission rates were created based on 2006 rates by using fuel efficiency predictions for 2030 from the April 2009 Annual Energy Outlook (AEO) Reference Case, which is a nationally accepted forecast of fuel economy and other energy factors produced by the U.S. Department of

Energy.[2] The following factors to adjust 2006 GHG emission rates to 2035 rates were developed from the AEO for different vehicle types:

- Light duty vehicles (passenger cars, light passenger trucks)– 0.66;
- Light commercial trucks – 0.74; and
- Heavy duty vehicles (buses, single unit truck, combination truck) – 0.88.

- The proportion of vehicle-miles of travel (VMT) for light-duty vs. heavy-duty vehicles was determined for local conditions from the TBRPM, while MOVES default VMT fractions for the proportion of VMT by vehicle types within these two categories were applied. To do this, a lookup table of VMT fractions based on VMT activity data from MOVES for 2006 and 2035 was created. These fractions were adjusted for every integer percentage of trucks between 0-100, based on link-specific truck percentages from the regional model.
- Consolidated emission rates were calculated by weighting the emission rates for each vehicle and fuel type by their appropriate VMT fraction and summing together all vehicle and fuel types. Rates were maintained in lookup table by year, MOVES road type, speed, and percent trucks.
- Travel activity results (congested speed and VMT) were taken from link-level data for Hillsborough County from the TBRPM, for each of the four scenarios identified above (2006, existing plus committed, and two cost-affordable scenarios).
- Emission rates were matched to individual links from the TBRPM using year, road type, area type, speeds, and percent trucks. A conversion map was created to help match TBRPM road and area types to MOVES road types. Speeds were grouped into the nearest 5 mph MOVES speed bin, and percent trucks were rounded to the nearest integer percentage (1 percent bins).[3]

[2] MOVES produces future-year as well as base-year emission rates, but the rates from this draft version of the model were higher than 2006 rates, which was considered unrealistic given the expected increases in fuel economy resulting from existing and proposed Federal standards. The 2006 GHG emission rates produced by draft MOVES 2009 are generally consistent with known on-road fleet fuel economy levels. The April 2009 AEO forecasts account for improvements in light-duty vehicle fuel efficiency standards established under the Energy Independence and Security Act (EISA) of 2007 but not for the Obama Administration's new standards that would accelerate the achievement of fleet average fuel efficiency from 35 mpg in 2020 to 35.5 mpg in 2016 to meet California's GHG standards. The difference in 2035 emission rates is expected to be minor since most vehicles meeting the 35.5 mpg standards would be phased in by 2035 under either case. Similarly, while the AEO only includes forecasts through 2030, the difference between fleet-average fuel economy in 2035 vs. 2030 should be modest under the current policy scenario. Future increases in vehicle fuel efficiency beyond current standards would result in lower GHG emissions than those projected here.

[3] One limitation of draft MOVES is that emission rates continue to decline slightly at higher speeds (above 60 mph), whereas empirical evidence suggests that fuel efficiency starts to decrease above this point.

- Emission rates were multiplied by VMT to calculate grams of GHG emissions (CO_2e) for each link.
- GHG emissions were summed for all links in each scenario.

Table 2 shows the results of the modeling for roadway vehicles, with GHG emissions shown in metric tons CO_2e. Total VMT, average speed, average emission rate, and average fuel economy (for all vehicles) are also shown for comparison. While emission rates are 13 to 19 percent lower in future years due to improvements in vehicle technology, the large increase in VMT (75 to 82 percent) for all future scenarios leads to a projected overall increase in total GHG emissions of 56 percent under the existing plus committed scenario, or 41 to 44 percent under the two cost-affordable scenarios. Future emissions are highest under the existing plus committed scenario because this scenario has the highest VMT and also the highest congestion levels, which result in lower fuel efficiency and higher GHG emissions per VMT.

The two cost-affordable scenarios are projected to reduce GHG from highway vehicles by 8 to 10 percent in 2035 compared to the existing plus committed scenario. The CAA17 scenario, which is the no-sales tax option with limited transit and roadway projects, has slightly higher VMT and a slightly higher emission rate than the CAA18 scenario, which is the sales tax option with the largest number of transit and roadway projects. Projected GHG emissions for the CAA18 scenario are therefore slightly lower (by about 400 metric tons) than for the CAA17 scenario.

Table 2: Roadway Travel and GHG Emissions, Hillsborough County

						GHG Emissions		
Year	Scenario	Total Annual VMT (billions)	Avg. Speed (mph)	Avg. CO_2e Emission Rate (g/mi)	Equiv. Fuel Efficiency (mi/gal)[a]	Total (metric tons CO_2e)	% Change vs. 2006	% Change vs. 2035 E+C
2006	2006base	34.0	32.4	485	19.4	16,597		
2035	2013EC	61.7	23.2	418	22.6	25,862	56%	
2035	CAA17	60.0	25.0	395	23.9	23,824	44%	-8%
2035	CAA18	59.6	25.4	391	24.1	23,546	41%	-10%

[a] The much lower fuel efficiency shown here compared to the 35 mpg light-duty standard cited above is a result of two primary factors: (1) the inclusion of heavy-duty vehicles in the mix, and (2) the fact that on-road fuel efficiency tends to be somewhat lower in practice than standards.

EMISSIONS FROM TRANSIT VEHICLES

The approach to modeling GHG emissions from transit vehicles (bus and rail) was as follows:

- Current average transit GHG emission rates for the Hillsborough area were calculated using 2006 data from the National Transit Database (NTD) for Hillsborough Area Regional Transit (HART).
  - NTD data were used to obtain gallons of diesel and compressed natural gas (CNG) usage for buses and kilowatt-hours (kWh) of electricity usage for the streetcar (light rail).
  - Fuel usage was multiplied by industry standard GHG emission rates (g/gallon) for diesel and CNG to obtain total bus GHG emissions. Electricity usage was multiplied by the GHG emission rate for electricity (g/kWh) in the Florida region from the U.S. EPA's eGrid database, to obtain total streetcar GHG emissions.
  - Total emissions were divided by vehicle revenue miles for each mode using data for HART from NTD. This provides the GHG emission rate in grams per vehicle-mile (g/veh-mi).
- 2035 GHG emission rates were estimated by adjusting the 2006 rates downward using percent per year reductions estimates due to vehicle technology improvements and reductions in the GHG intensity of electricity generation. These percent per year reductions are based on previous Cambridge Systematics work for the *Moving Cooler* report[4] and are reported below:
  - Bus – 0.54 percent per year;
  - Light rail – 1.25 percent per year.
- VMT estimates for transit vehicles were obtained from the TBRPM for Hillsborough County. These estimates are based on spreadsheet calculations using route miles and headways from the TBRPM. They are divided into VMT by scenario and mode.
- Emission rates for each mode and scenario were multiplied by the VMT for that mode and scenario to obtain total GHG emissions. Emissions were summed across modes in each scenario to obtain total scenario GHG emissions from transit.

[4] Cambridge Systematics, Inc. (2009). *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Urban Land Institute: Washington, D.C.

Table 3 shows the results of this process for transit vehicles. Total emissions decline modestly for the existing plus committed and CAA17 scenarios, due to increases in vehicle efficiency or reductions in GHG intensity. Emissions are about three times higher under the CAA18 scenario with sales tax than CAA17, due to the expanded transit investment (220 vs. 81 metric tons per year, for an increase of 139 metric tons).

In Hillsborough County the current streetcar was found to have a higher GHG emission rate than buses, which contrasts with national averages showing lower emission rates for light rail compared to buses. Since the electricity generating mix in Florida produces approximately the same GHG emissions per as the national average generating mix per kWh, this difference is probably due primarily to less-efficient streetcar vs. light rail technology. However, total light rail emissions are small even under the CAA18 scenario, so adjusting for more efficient vehicles would only make a small difference in the outcome of the analysis.

Table 3: Transit Vehicle Travel and GHG Emissions, Hillsborough County

		Motor Bus (local & express)			Light Rail (includes streetcar)			All Transit
Year	Scenario	Emission factor (g CO_2e / mile)	Vehicle-Miles	GHG (metric tons CO_2e)	Emission factor (g CO_2e / mile)	Vehicle-Miles	GHG (metric tons CO_2e)	Total GHG (metric tons CO_2e)
2006	2006base	3,000	31,200	93.7	4,440	559	2.5	96.2
2035	2013EC	2,530	31,700	70.1	2,830	559	1.6	71.7
2035	CAA17	2,530	40,300	79.2	2,830	592	1.7	80.9
2035	CAA18	2,530	106,300	189.7	2,830	10,800	30.5	220.2