Calculating Mode Shift and Congestion Relief-Related Greenhouse Gas Displacement For the Current Year

(see last slide for contact information)

Step 1: Estimate Reductions in Annual Auto Vehicles Miles Traveled and Reductions in Annual Auto Fuel Use due to Transit Mode Shift

Data needed for this step: 1) Passenger miles for the current year, available at the Florida Transit Information System (FTIS), 2) mode shift factor by transit area population size.

1. In the "Expansion Scenarios" Worksheet Tab, insert passenger miles for the current year for the appropriate mode of transit (if you would like to fill in the other data you may, however it is not necessary to do the calculations).
2. VMT Equivalent will be calculated automatically when passenger miles is input.

		Service Supplied						Service Consumed		
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent
Current Year										
Bus, Fixed Route	2006	8	coaches	437,493	420,927	25,351	24,096	309,232	1,861,667	1,537,737
Commuter Rail	2006									
Automated Guideway	2006									
Light Rail	2006									
Heavy Rail	2006									

Step 1: Estimate Reductions in Annual Auto Vehicles Miles Traveled and Reductions in Annual Auto Fuel Use due to Transit Mode Shift (continued)

3. Insert Mode Shift Factor by transit area population size from the table below.

Agency Size	Service Area Population	Mode Shift Factor
Small	Less than 500,000	0.34
Medium	Between 500,000 and 1,250,000	0.42
Large	Greater than 1,250,000	0.47

4. Annual Auto VMT Reduction will be calculated automatically. (If you would like to fill in the other data you may, however it is not necessary to do the calculations).

ervice Consumed			Electricity Use			Fuel Use				Mode Shift Emissions Reductions			
ed s. s Passenger Miles	VMT Equivalent	KWH of Propulsion Power	Electricity Emissions of MTCO2		Diesel (gal)	Diesel Emissions MTCO2	CNG (therms)	CNG Emissions MTCO2	Mode Shift Factor	Annual Auto VMT Reduction	Annual Auto fuel reduction (gal gas)	Avoided MTC02e Emissions to Mode Shift
2 1,861,667	1,537,737				59,458	603			0.34	522,831	25,755	228

Step 2: Calculate and sum the GHG mobile emissions reductions due to transit mode shift

Data needed for this step: 1) light duty fuel economy for the current year.

1. The calculator will automatically calculate the "Annual Auto fuel reduction of gallons of gasoline" due to transit mode shift for the year 2006.
   a) Other years of Fuel Economy for Light Duty Stock are located in the Fuel Economy Worksheet tab.

2. The calculator will automatically calculate the Avoided Metric Tons of Carbon dioxide equivalent ($MTCO_2e$) emissions due to mode shift.
   a) It calculates Carbon dioxide, methane and Nitrous oxide content of the Annual Auto fuel reduction of gallons of gasoline.
   b) These three greenhouse gases are aggregated into the metric tons Carbon dioxide equivalent.

Mode Shift Emissions Reductions			
Mode Shift Factor	Annual Auto VMT Reduction	Annual Auto fuel reduction (gal gas)	Avoided MTCO2e Emissions to Mode Shift
0.34	522,831	25,755	228

Fuel Economy Worksheet tab:

Light Duty Stock - Table A7	
	mpg
2005	19.9
2006	20.3
2010	20.3
2015	21.5
2020	23.7
2010	20.3
2011	20.5
2012	20.8
2013	21.0
2014	21.3
2015	21.5
2016	21.9
2017	22.4
2018	22.8
2019	23.3
2020	23.7

Step 3: Estimate the fuel wasted in congestion

Data needed for this step: 1) the Unlinked Passenger Trips (Ridership)

1. In the Expansion worksheet tab, input the Unlinked Passenger Trips (Ridership).

		Service Supplied						Service Consumed		
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent
Current Year										
Bus, Fixed Route	2006	8	coaches	437,493	420,927	25,351	24,096	309,232	1,861,667	1,537,737
Commuter Rail	2006									
Automated Guideway	2006									
Light Rail	2006									
Heavy Rail	2006									
2017 Scenarios										

Steps 4 and 5: Adjust the gallons of fuel wasted to fuel saved due to transit mode shift and Convert the adjusted gallons of fuel saved to CO2e

1. The TTI Urban Mobility Report Trip Adjusted Average Wasted Fuel will automatically be calculated.
2. The Trip Adjusted Gallons of Fuel Saved will automatically be calculated.
3. The Avoided Metric Tons of Carbon dioxide equivalent, including Carbon dioxide, methane and Nitrous oxide, is automatically calculated.

	Mode Shift Emissions Reductions				Congestion Relief Emissions			TOTAL
	Mode Shift Factor	Annual Auto VMT Reduction	Annual Auto fuel reduction (gal gas)	Avoided MTCO2e Emissions to Mode Shift	Trip Adjusted Average Wasted Fuel from TTI Urban Mobility Report	Trip Adjusted Gallons Fuel Saved	Avoided MTCO2e Emissions from Congestion Relief	Avoided MTCO2e Emissions to Mode Shift and Congestion Relief
	0.34	522,831	25,755	228	3,533	1,502	13	241

Step 6: Total the Metric Tons of Carbon Dioxide Equivalent Avoided due to Transit Mode Shift and Congestion Relief for the Current Year

1. The calculator will automatically add the Avoided Metric Tons of Carbon dioxide equivalent emissions from mode shift and congestion relief

	Mode Shift Emissions Reductions				Congestion Relief Emissions			TOTAL
	Mode Shift Factor	Annual Auto VMT Reduction	Annual Auto fuel reduction (gal gas)	Avoided MTCO2e Emissions to Mode Shift	Trip Adjusted Average Wasted Fuel from TTI Urban Mobility Report	Trip Adjusted Gallons Fuel Saved	Avoided MTCO2e Emissions from Congestion Relief	Avoided MTCO2e Emissions to Mode Shift and Congestion Relief
	0.34	522,831	25,755	228	3,533	1,502	13	241

Calculating the 2017 Expansion Scenarios

Step 1: Quantify Data for each Transit Mode

Data needed for this step: 1) Passenger miles for base year, 2) passenger miles for benchmark year, 3) vehicle miles for base year, 4) vehicle miles for benchmark year, 5) fuel consumption for base year, 6) fuel consumption for benchmark year

1. In the “Expansion Scenarios” Worksheet Tab, insert your passenger miles, vehicle miles, and fuel consumption for the base year for the appropriate mode of transit (If you would like to fill in the other data you may, however it is not necessary to do the calculations).

		Service Supplied						Service Consumed			Fuel Use		
	year of data	Vehicles in Operation Max Service	Vehicles in Operation Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent	Diesel (gal)	Gasoline (gal)	CNG (therms)
Current Year													
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312	8,562,284	28,683,651	23,692,696	853,003		
Commuter Rail	2006												
2017 Scenarios													
Bus, Fixed Route													

Step 1: Quantify Data for each Transit Mode (cont.)

2. Estimate passenger miles for benchmark year:

   -Insert the base year annual passenger miles into the “2017 Projections” Worksheet Tab (this can be placed into each scenario as the beginning number will be the same for each of the three scenarios)

   -Make an assumption about the rate of increase for passenger miles per year for each scenario

   -Carry the assumption through to the benchmark year

Scenario 1	
Year	Passenger Miles
2006	28,683,651
2007	30,086,335
2008	31,509,381
2009	33,024,982
2010	34,613,484
2011	36,278,392
2012	38,023,383
2013	39,852,308
2014	41,769,204
2015	43,778,303
2016	45,884,039
2017	48,091,061

Base Year

Baseline Year

3. Insert the estimated passenger miles for the benchmark year into the “Expansion Scenarios” Worksheet Tab under passenger miles for the 2017 Scenarios.

		Service Supplied						Service Consumed		
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent
Current Year										
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312	8,562,284	28,683,651	23,692,696
Commuter Rail	2006									
2017 Scenarios										
Bus, Fixed Route										
Trend Scenario				5,273,143					48,091,061	39,723,217
Evenly Distributed Scenario				4,319,141					78,781,130	65,073,213
Metro Areas Scenario				5,273,143					48,091,061	39,723,217
Commuter Rail										
Trend Scenario										
Evenly Distributed Scenario										
Metro Areas Scenario										

Step 1: Quantify Data for each Transit Mode (cont.)

4. Estimate the vehicle miles for benchmark year:
   - -Insert the base year vehicle miles into the "2017 Projections" Worksheet Tab (this can be placed into each scenario as the beginning number will be the same for each of the three scenarios)
   - -Find the load factor by dividing the base year passenger miles by the base year vehicle miles
   - -Make assumption about the rate of increase of the load factor per year for each of the three scenarios
   - -Carry the assumption through to the benchmark year
   - -Divide the estimated passenger miles for each year by the estimated load factor for each year to get the vehicle miles for each year
5. Insert the estimated vehicle miles for the benchmark year into the "Expansion Scenarios" Worksheet Tab under vehicle miles for the 2017 Scenarios.
6. Once you have done this, the fuel consumption for the benchmark year is automatically calculated using your inputs for the vehicle miles for the benchmark year

Scenario 1			
Year	Passenger Miles	Load Factor	Vehicle Miles
2006	28,683,651	9.12	3,145,137
2007	30,063,335	9.12	3,296,418
2008	31,509,381	9.12	3,454,976
2009	33,024,982	9.12	3,621,160
2010	34,613,484	9.12	3,795,338
2011	36,278,392	9.12	3,977,894
2012	38,023,383	9.12	4,169,231
2013	39,852,308	9.12	4,369,771
2014	41,769,204	9.12	4,579,957
2015	43,778,303	9.12	4,800,252
2016	45,884,039	9.12	5,031,145
2017	48,091,061	9.12	5,273,143

Base Year

Baseline Year

		Service Supplied					
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours
Current Year							
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312
Commuter Rail	2006						
2017 Scenarios							
Bus, Fixed Route							
Trend Scenario				5,273,143			
Evenly Distributed Scenario				4,319,141			
Metro Areas Scenario				5,273,143			
Commuter Rail							
Trend Scenario							
Evenly Distributed Scenario							
Metro Areas Scenario							

Step 2: Calculate Annual Auto VMT Reductions

1. Calculate the VMT-Equivalent of passenger miles

   -In the “Expansion Scenarios” Worksheet Tab, the calculator will automatically calculate the VMT-equivalent of passenger miles (how many miles would have been driven by automobile had transit not been an option) from passenger miles for both the base year and the benchmark year for each of the three scenarios.

2. Determine the mode shift factor for the base year

   -Determine the mode shift factor from the following table provided by APTA

Agency Size	Service Area Population	Mode Shift Factor
Small	Less than 500,000	0.34
Medium	Between 500,000 and 1,250,000	0.42
Large	Greater than 1,250,000	0.47

- In the “Expansion Scenarios” Worksheet Tab, insert the mode shift factor for the base year

		Service Supplied						Service Consumed			Fuel Use			Mode
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent	Diesel (gal)	Gasoline (gal)	CNG (therms)	Mode Shift Factor
Current Year														
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312	8,562,284	28,683,651	23,692,696	853,003			0.34
Commuter Rail	2006													

Step 2: Calculate Annual Auto VMT Reductions (cont.)

3. Determine the mode shift factor for the scenarios

   -Make assumptions about how much of the increase in passenger miles (from the base year to the benchmark year) is from choice riders for each scenario. For example:

   -If it is assumed that the percentage of choice riders remains the same in the benchmark year as it was in the base year, the mode shift factor does not change

   -If it is assumed that the increase in passenger miles is from choice riders only from the base to the benchmark year, then a new mode shift factor should be calculated for the evenly distributed and metro areas scenarios. To do this, first, calculate the number of miles by dependent riders by multiplying the passenger miles (from Step 1) for the trend scenario benchmark year by the mode shift factor for the base year. Holding the number of transit dependent riders Second, subtract the dependent rider miles from the total passenger miles for the trend scenario to get the miles by choice riders. Third, divide the total passenger miles for the scenario by the miles by choice riders for the scenario to get the mode shift factor for that scenario.

   - In the "Expansion Scenarios" tab, insert the mode shift factor for each of the scenarios

		Service Supplied						Service Consumed			Fuel Use			Mode
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent	Diesel (gal)	Gasoline (gal)	CNG (therms)	Mode Shift Factor
Current Year														
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312	8,562,284	28,683,651	23,692,696	853,003			0.34
Commuter Rail	2006													
2017 Scenarios														
Bus, Fixed Route														
Trend Scenario				5,273,143					48,091,061	39,723,217	1,588,473			0.34
Evenly Distributed Scenario				4,319,141					78,781,130	65,073,213	1,301,091			0.60
Metro Areas Scenario				5,273,143					48,091,061	39,723,217	1,588,473			0.34

4. Calculate the annual auto VMT reductions

   -In the "Expansion Scenarios" Worksheet Tab, the calculator will automatically calculate the annual auto VMT reductions (VMT equivalent * mode shift factor).

Step 3: Calculate Energy Savings from Annual Auto VMT Reductions

1. In the “Expansion Scenarios” Worksheet Tab, the calculator will automatically calculate the energy savings from annual auto VMT reductions by dividing the difference in annual auto VMT reductions from 2006 to 2017 by the average fuel economy in miles per gallon for the fleet of cars on the road in 2017.

		Service Supplied						Service Consumed			Fuel Use			Mode Shift Emissions Reduct		
	year of data	Vehicles in Operation Max Service	Vehicles in Operation - Units	Total Vehicle Miles	Vehicle Revenue Miles	Vehicle Hours	Vehicle Revenue Hours	Unlinked Pass. Trips (Ridership)	Passenger Miles	VMT Equivalent	Diesel (gal)	Gasoline (gal)	CNG (therms)	Mode Shift Factor	Annual Auto VMT Reduction	Annual Auto fuel reduction (gal gas)
Current Year																
Bus, Fixed Route	2006	109	coaches	2,831,654	2,679,969	246,602	236,312	8,562,284	28,683,651	23,692,696	853,003			0.34	8,055,517	396,823
Commuter Rail	2006															
2017 Scenarios																
Bus, Fixed Route																
Trend Scenario				5,273,143					48,091,061	39,723,217	1,588,473			0.34	13,505,894	603,481
Evenly Distributed Scenario				4,319,141					78,781,130	65,073,213	1,301,091			0.60	39,043,928	1,744,590
Metro Areas Scenario				5,273,143					48,091,061	39,723,217	1,588,473			0.34	13,505,894	603,481
Commuter Rail																
Trend Scenario																
Evenly Distributed Scenario																
Metro Areas Scenario																
Increase to 2017																
Bus, Fixed Route																
Trend Scenario				2,441,489					19,407,410	16,030,521	735,470			0.34	5,450,377	243,538
Evenly Distributed Scenario				1,487,487					50,097,479	41,380,517	448,088			0.60	30,988,411	1,384,648
Metro Areas Scenario				2,441,489					19,407,410	16,030,521	735,470			0.34	5,450,377	243,538
Commuter Rail																
Trend Scenario																
Evenly Distributed Scenario																
Metro Areas Scenario																

Step 4: Calculate GHG Emissions from Energy Savings and Annual Auto VMT Reductions

1. In the “Bus” or “Commuter Rail” tab, the calculator will automatically calculate the GHG emissions of autos for CO_2, N_2O, and CH_4 for each scenario.

Emissions

GHG Emission Reductions

Scenario 1	Fuel Reduction	243,538
	VMT Reduction	5,450,377
	CO2 Emissions (MMt)	0.002
	N2O Emissions (MMt)	2.78E-08
	CH4 Emissions (MMt)	9.16E-08
	GHG Emissions (MMtCO2e)	0.002
Scenario 2	Fuel Reduction	1,384,648
	VMT Reduction	30,988,411
	CO2 Emissions (MMt)	0.012
	N2O Emissions (MMt)	1.58E-07
	CH4 Emissions (MMt)	5.21E-07
	GHG Emissions (MMtCO2e)	0.012
Scenario 3	Fuel Reduction	243,538
	VMT Reduction	5,450,377
	CO2 Emissions (MMt)	0.002
	N2O Emissions (MMt)	2.78E-08
	CH4 Emissions (MMt)	9.16E-08
	GHG Emissions (MMtCO2e)	0.002

Step 5: Convert GHG Emissions for Auto Trip Reductions to CO_2e

1. In the “Bus” or “Commuter Rail” tab, the calculator will automatically convert the GHG emissions (CO_2, N_2O, and CH_4) for auto trip reductions to CO_2 equivalents for each scenario.

Emissions

GHG Emission Reductions

Scenario 1	Fuel Reduction	243,538
	VMT Reduction	5,450,377
	CO2 Emissions (MMt)	0.002
	N2O Emissions (MMt)	2.78E-08
	CH4 Emissions (MMt)	9.16E-08
	GHG Emissions (MMtCO2e)	0.002
Scenario 2	Fuel Reduction	1,384,648
	VMT Reduction	30,988,411
	CO2 Emissions (MMt)	0.012
	N2O Emissions (MMt)	1.58E-07
	CH4 Emissions (MMt)	5.21E-07
	GHG Emissions (MMtCO2e)	0.012
Scenario 3	Fuel Reduction	243,538
	VMT Reduction	5,450,377
	CO2 Emissions (MMt)	0.002
	N2O Emissions (MMt)	2.78E-08
	CH4 Emissions (MMt)	9.16E-08
	GHG Emissions (MMtCO2e)	0.002

Step 6: Calculate GHG Emissions from Change in Transit Use for each Mode

1. In the “Bus” or “Commuter Rail” Worksheet Tab, the calculator will automatically calculate the GHG emissions of Transit for CO_2, N_2O, and CH_4 for each scenario.

Emissions from Transit Vehicles

		All Fuels	Fuel Type		
			Diesel (gal)	Gasoline (gal)	CNG (therms)
Scenario 1	Fuel Change		735,470		
	VMT Change	2,441,489	2,441,489		
	CO2 Emissions (MMt)		0.007		
	N2O Emissions (MMt)		1.17E-08		
	CH4 Emissions (MMt)		1.25E-08		
	GHG Emissions (MMtCO2e)	0.007	0.007		
Scenario 2	Fuel Change		448,088		
	VMT Change	1,487,487	1,487,487		
	CO2 Emissions (MMt)		0.005		
	N2O Emissions (MMt)		7.14E-09		
	CH4 Emissions (MMt)		7.59E-09		
	GHG Emissions (MMtCO2e)	0.005	0.005		
Scenario 3	Fuel Change		735,470		
	VMT Change	2,441,489	2,441,489		
	CO2 Emissions (MMt)		0.007		
	N2O Emissions (MMt)		1.17E-08		
	CH4 Emissions (MMt)		1.25E-08		
	GHG Emissions (MMtCO2e)	0.007	0.007		

Step 7: Convert GHG Emissions for each Transit Mode to CO2e

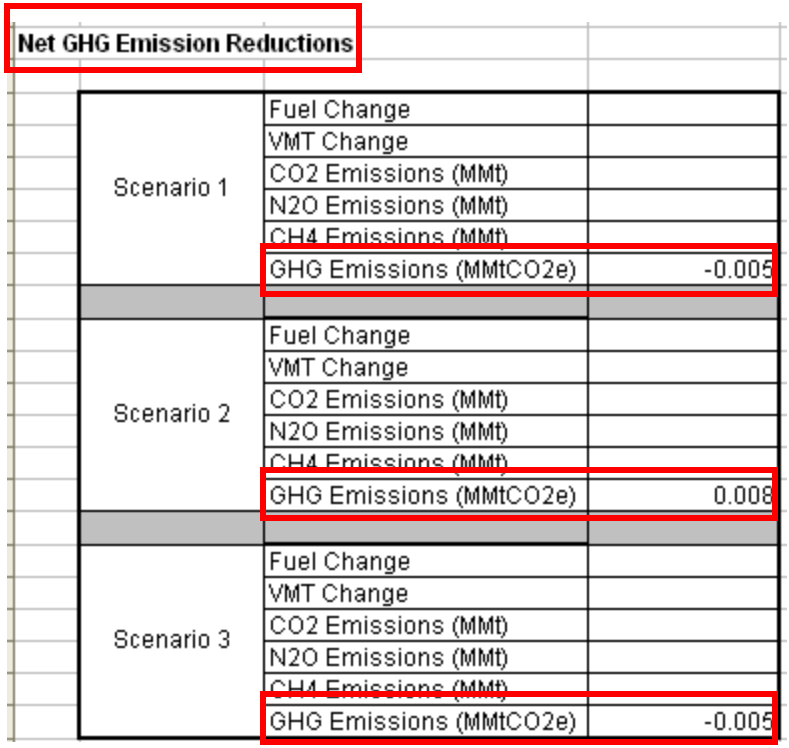
1. In the “Bus” or “Commuter Rail” tab, the calculator will automatically convert the GHG emissions (CO_2, N_2O, and CH_4) for transit to CO_2 equivalents for each scenario.

Emissions from Transit Vehicles

			Fuel Type		
		All Fuels	Diesel (gal)	Gasoline (gal)	CNG (therms)
Scenario 1	Fuel Change		735,470		
	VMT Change	2,441,489	2,441,489		
	CO2 Emissions (MMt)		0.007		
	N2O Emissions (MMt)		1.17E-08		
	CH4 Emissions (MMt)		1.25E-08		
	GHG Emissions (MMtCO2e)	0.007	0.007		
Scenario 2	Fuel Change		448,088		
	VMT Change	1,487,487	1,487,487		
	CO2 Emissions (MMt)		0.005		
	N2O Emissions (MMt)		7.14E-09		
	CH4 Emissions (MMt)		7.59E-09		
	GHG Emissions (MMtCO2e)	0.005	0.005		
Scenario 3	Fuel Change		735,470		
	VMT Change	2,441,489	2,441,489		
	CO2 Emissions (MMt)		0.007		
	N2O Emissions (MMt)		1.17E-08		
	CH4 Emissions (MMt)		1.25E-08		
	GHG Emissions (MMtCO2e)	0.007	0.007		

Step 8: Calculate Net GHG Emissions for each Transit Mode

1. In the “Bus” or “Commuter Rail” Worksheet Tab, the calculator will automatically calculate the net GHG emissions for each scenario.



Net GHG Emission Reductions		
Scenario 1	Fuel Change	
	VMT Change	
	CO2 Emissions (MMt)	
	N2O Emissions (MMt)	
	CH4 Emissions (MMt)	
	GHG Emissions (MMtCO2e)	-0.005
Scenario 2	Fuel Change	
	VMT Change	
	CO2 Emissions (MMt)	
	N2O Emissions (MMt)	
	CH4 Emissions (MMt)	
	GHG Emissions (MMtCO2e)	0.008
Scenario 3	Fuel Change	
	VMT Change	
	CO2 Emissions (MMt)	
	N2O Emissions (MMt)	
	CH4 Emissions (MMt)	
	GHG Emissions (MMtCO2e)	-0.005

Step 9: Sum GHG Emissions for All Modes for the Agency

1. In the “Results Summary” Worksheet Tab, the calculator will automatically sum the GHG emissions for each mode.

Summary of Impacts								
		Change in Auto Activity			Change in Transit Activity		Net Change	
Sub-Strategy/Program		VMT (million)	GHGs (MMt)		VMT (million)	GHGs (MMt)	Auto Trips	GHGs (MMt)
Bus, Fixed Route								
	Trend Scenario	-5.45	-0.002		2.44	0.007	-450,072	0.005
	Evenly Distributed Scenario	-30.99	-0.012		1.49	0.005	-2,558,911	-0.008
	Metro Areas Scenario	-5.45	-0.002		2.44	0.007	-450,072	0.005
Commuter Rail								
	Trend Scenario							
	Evenly Distributed Scenario							
	Metro Areas Scenario							
Total Emission Reduction								
	Trend Scenario	-5.45	-0.002		2.44	0.007	-450,072	0.005
	Evenly Distributed Scenario	-30.99	-0.012		1.49	0.005	-2,558,911	-0.008
	Metro Areas Scenario	-5.45	-0.002		2.44	0.007	-450,072	0.005

Also automatically summarized are the changes in auto and transit activity for each scenario and mode of transit so that the scenarios can be easily compared to one another.

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