Appendix D: Transportation Sector Strategy Analysis

INTRODUCTION

This technical appendix for Chapter 5 includes the following background data:

- Connecticut Registered Vehicles by Class
- Connecticut Registered Vehicles by Fuel Type
- Assumptions for Compressed Natural Gas Light-Duty Passenger Vehicle Net Present Value Calculations
- Background to Detailed Analysis for Long-Term Vision
- Technical Assumptions for Long-Term Vision
- Summary Table of Alternative Revenue Sources for the State of Connecticut

CONNECTICUT REGISTERED VEHICLES BY CLASS

Table D-1: Connecticut Registered Vehicles by Class, 2011

Vehicle Class	General Description	Technical Description (GVWR = gross vehicle weight rating)	Number of 2011 Registered Vehicles in Class	Rough Estimate 2011 Passenger Vehicle Population CT
HDBS	School buses	School Buses	7,219	
HDBT	Transit/urban buses	Transit/urban buses	2,209	
HDV2B	Large commercial vans and small box trucks	Class 2b Heavy-Duty Vehicles (8501-10,000 lbs. GVWR)	88,440	88,440
HDV3		Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)	26,282	
HDV4	Large box trucks and medium multi-axle trucks	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)	9,267	
HDV5		Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)	5,974	
HDV6		Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)	8,411	
HDV7		Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)	7,253	
HDV8a	Large multi-axle short & long-haul trucks (e.g. tractor-trailer rigs)	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)	5,184	
HDV8b		Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)	9,655	
LDT2	Small/medium pick-ups & SUVs	Light-Duty Trucks 1&2 (0-6,000 lbs. GVWR)	770,468	770,468
LDT4	Medium/large pick-ups & SUVs	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR)	270,077	270,077
LDV	Cars	Light-Duty Vehicles (Passenger Cars)	1,486,706	1,486,706
MC	Motorcycles	Motorcycles	95,371	95,371
Total			2,792,516	2,738,173

Source: Connecticut Department of Motor Vehicles response to DEEP data request (June 29, 2012).

CONNECTICUT REGISTERED VEHICLES BY FUEL TYPE

Table D-2: Connecticut Registered Vehicles by Fuel Type, 2012

Fuel types of vehicles registered in Connecticut in 2012 ("Blank" indicates that a customer did not fill in the fuel type and "Unkown" indicates that fuel type information could not be read/determined on registration application

Fuel Type	Number of Vehicles
Electric	92
Flexible	31,439
Ethanol	60
Methanol	7
Compressed natural gas	451
Compressed natural gas l/e 8500 wt	128
Propane	96
Hybrid gas/electric	7,292
Convertible	804
Diesel	92,543
Gasoline	2,765,316
Liquefied gas	39
Blank	253,154
Other	0
Kerosene	0
Unknown	15,911
Total records read	4,838,246
Total records listed	3,167,204

Source: Connecticut Department of Motor Vehicles response to DEEP data request (September 28, 2012).

ASSUMPTIONS FOR COMPRESSED NATURAL GAS LIGHT-DUTY PASSENGER VEHICLE NET PRESENT VALUE CALCULATIONS

The assumptions used for the payback calculations for the compressed natural gas (CNG) light-duty vehicle shown in Table 13 in Chapter 5 (Transportation) are detailed below. The assumptions were provided by Northeast States for Coordinated Air Use Management (NESCAUM).

Fuel Economy: (in miles per gallon equivalent): 23 (from U.S. Energy Information Administration, "Annual Energy Outlook 2011" (AEO 2011))

Lifetime: 12 years

Incremental Vehicle Cost: $8,000 (AEO 2011)

Fuel Prices: AEO 2011 High Oil – price of natural gas for transportation sector in New England

AEO's 2011 fuel price forecast for CNG: $1.78/gallon of gas-equivalent (without state taxes); Gasoline: $4.47/gallon

Vehicle Miles Traveled: 12,000 miles, derived from VISION NE Transportation Fleet Model and assumed to be the same as a comparable gasoline internal combustion engine vehicle

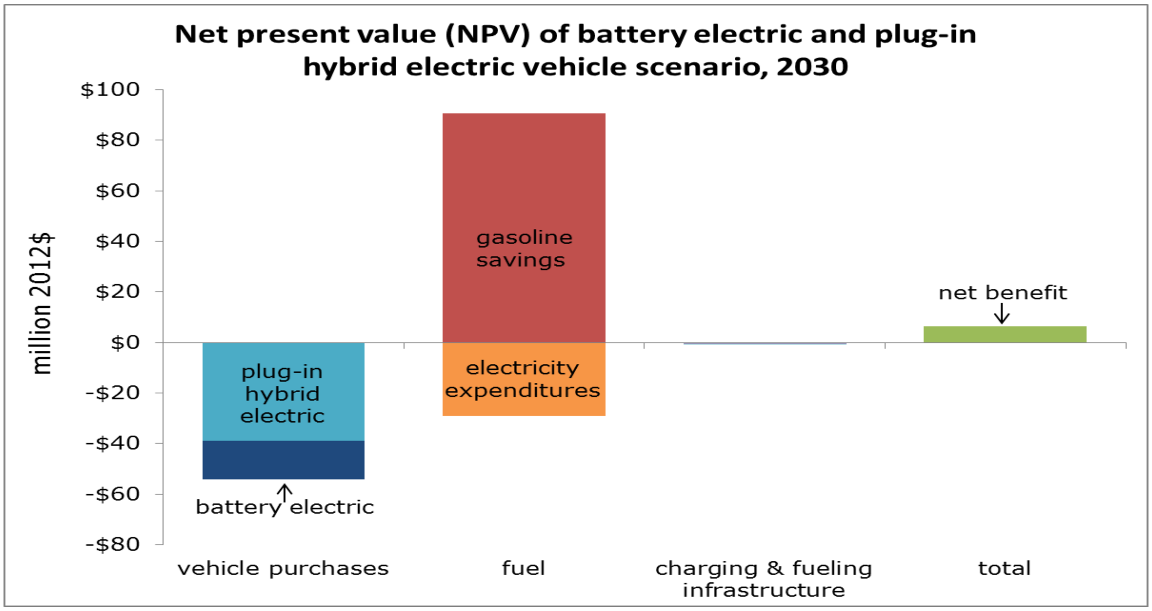
Infrastructure Costs: $0.26/gallon of gasoline equivalent (NESCAUM analysis of DOE/Clean Cities infrastructure costs and other northeastern estimates)

Discount Rate: 5%

BACKGROUND TO DETAILED ANALYSIS FOR LONG-TERM VISION

NESCAUM performed modeling and analysis to support the long-term vision proposed in Chapter 5 (Transportation). The information below provides the background and supporting data for this analysis.

Figure D-1: Net present value (NPV) of battery electric and plug-in hybrid electric vehicles in 2030



Source: NESCAUM analysis using the EPA Motor Vehicle Emission Simulator (MOVES) model and post-processing tools

In addition to high fuel economy gasoline vehicles, some alternative fuel vehicles also provide economic benefits over the vehicle lifetime. Connecticut's participation in the California zero emission vehicle (ZEV) program already commits automobile manufacturers to introduce battery electric and plug-in hybrid electric vehicles in the state, but exceeding those commitments by another 1.8% of sales by 2020 would produce $61 million in fuel savings over the vehicles' lifetime, for a net benefit of $6 million after accounting for the increased purchase price of these vehicles. Figure D-1 shows that increased use of battery electric and plug-in hybrid vehicles comes with relatively large upfront costs, but these are outweighed by fuel savings over the vehicle lifetime.[1] The challenge, however, is that these vehicles cost at least $10,000 more each than comparable conventional vehicles. The payback of this upfront investment appears to be longer than the 1-4 year payback period a typical consumer expects when purchasing a new vehicle, as show in Table 13 of Chapter 5 (Transportation). Without incentives, adoption of electric vehicles will proceed at a relatively slow pace until pricing becomes more competitive and other consumer concerns such as range anxiety and safety have been more fully addressed.

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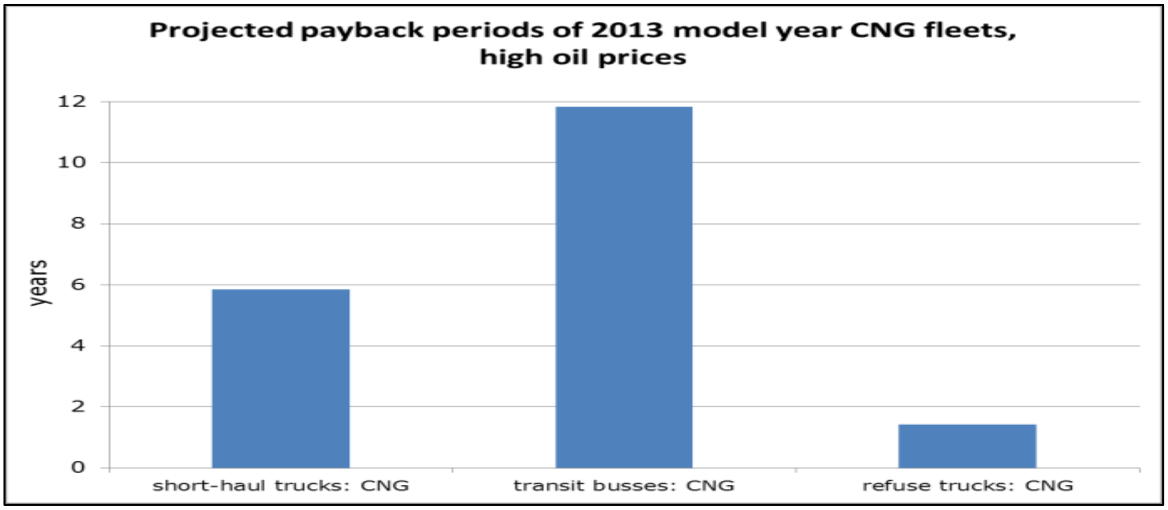
[1] Neither Figure 13 nor 14 in Chapter 5 (Transportation) include the $7,500 federal rebate in their analyses. Inclusion of this rebate could make these vehicles more economically attractive.

Similarly, the payback for compressed natural gas fleet vehicles, using a high oil price scenario, is shown in Figure D-2 below and Figure 14 of Chapter 5 (Transportation). Refuse truck fleets have the quickest payback and pilot projects to convert such fleets should be a priority.

Figure D-2: Projected payback periods (in years) for 2013 model year compressed natural gas (CNG) fleets given a high oil price scenario



Source: NESCAUM Analysis

By pursuing a mix of alternative fuel vehicles and high-efficiency conventional vehicles, Connecticut can significantly transform its vehicle fleet over the long-term, improving fuel diversity, saving money on fuel, and reducing reliance on oil. A combined strategy that incorporates high efficiency, plug-in hybrid, battery electric, combined natural gas, and fuel cell vehicles would result in these technologies comprising nearly half the Connecticut passenger vehicle fleet by 2050.

Table D-3 below provides the assumptions for the penetration of high fuel and alternative fuel vehicles used to create the long-term vision scenario as depicted in Figure 14 in Chapter 5 (Transportation).

Table D-3: Assumptions for passenger fleet mix penetration by 2030 and 2050

Sales Share of Light-Duty Vehicles	2030	2050
High Fuel Economy Sales Share	10.0%	10.0%
Electric Vehicle Sales Share	10.7%	10.7%
Plug-In Hybrid Sales Share	12.0%	12.0%

Compressed Natural Gas Sales Share	10.0%	0.0%
Fuel Cell Vehicle Sales Share	6.0%	20.0%

Source: NESCAUM, scenario assumptions

As part of the analyses used to calculate the findings and projections presented in Chapter 5 (Transportation), several scenarios were developed and analyzed to understand how vehicle technology breakthroughs and increased penetration of alternatively fueled vehicles can help to achieve significant emission and fuel consumption reductions. In addition to the alternative fuel and advanced technology vehicles discussed previously, Table D-4 shows additional assumptions used to analyze an aggressive set of policy measures that could transform the Connecticut transportation sector by 2050.

Table D-4: Technology and policy assumptions for an "aggressive" Vision scenario

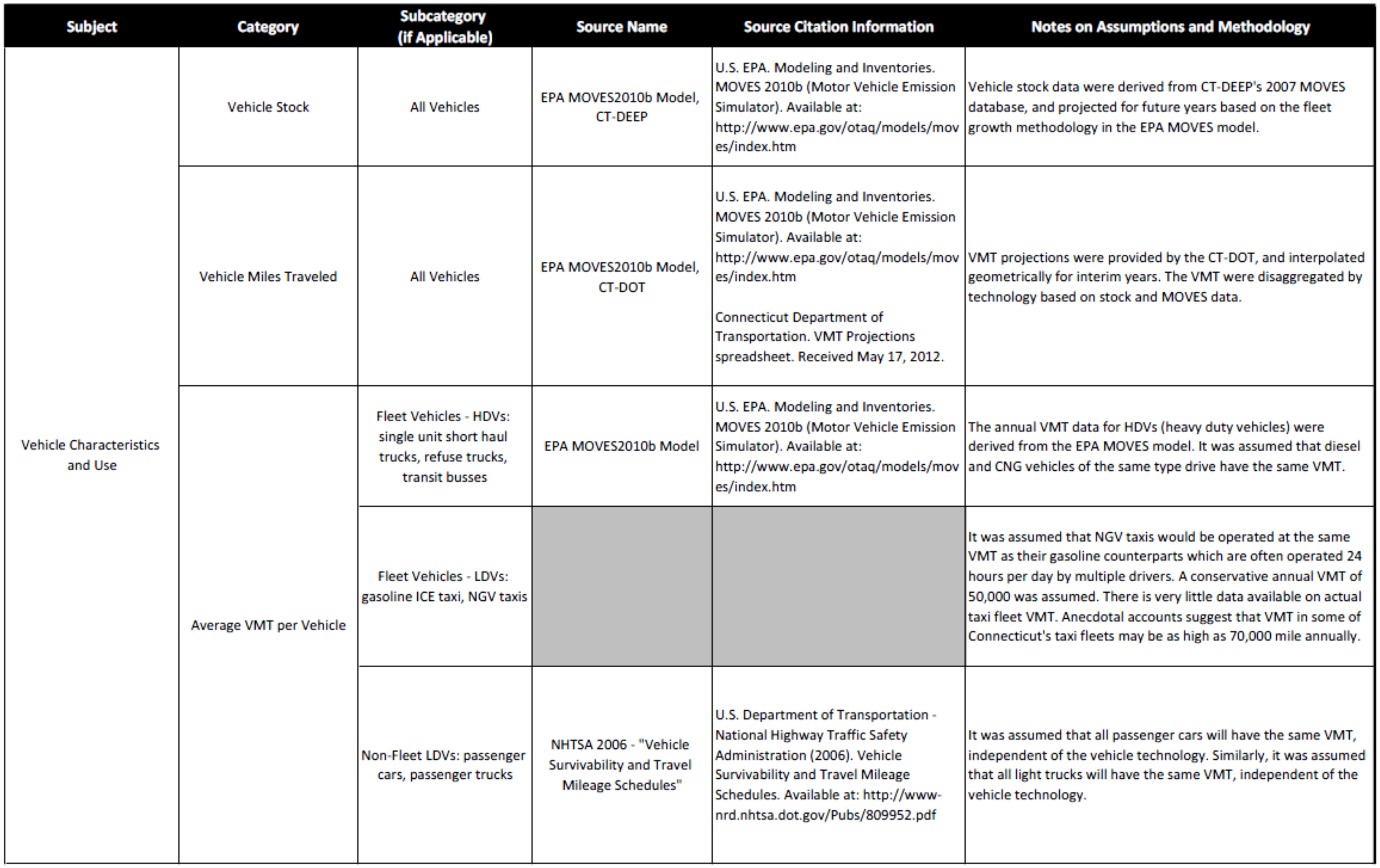
This scenario reflects a lower level of EV penetration was assumed that reflects full compliance with the ZEV mandate, but no additional programs to incent the sale of EVs.

Sales Share by Vehicle Technology	2030	2050
Light Duty High Efficiency Sales Share	10.0%	10.0%
Light Duty Electric Vehicle Sales Share	10.7%	10.7%
Light Duty Plug in Hybrid Electric Vehicle Sales Share	12.0%	12.0%
Light Duty Compressed Natural Gas Sales Share	10.0%	0.0%
Light Duty Fuel Cell Vehicle Sales Share	6.0%	20.0%
Transit Bus CNG Sales Share	66.7%	80.0%
Refuse Truck CNG Sales Share	66.7%	80.0%
School Bus CNG Sales Share	66.7%	80.0%
Short Haul CNG Sales Share	50.0%	66.7%

Source: NESCAUM, scenario assumptions for Passenger Fleet mix penetration by 2030 and 2050

TECHNICAL ASSUMPTIONS FOR LONG-TERM VISION

Table D-5: Technical assumptions for Long-Term Vision



Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Vehicle Characteristics and Use	Vehicle Stock	All Vehicles	EPA MOVES2010b Model, CT-DEEP	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm	Vehicle stock data were derived from CT-DEEP's 2007 MOVES database, and projected for future years based on the fleet growth methodology in the EPA MOVES model.
	Vehicle Miles Traveled	All Vehicles	EPA MOVES2010b Model, CT-DOT	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm Connecticut Department of Transportation. VMT Projections spreadsheet. Received May 17, 2012.	VMT projections were provided by the CT-DOT, and interpolated geometrically for interim years. The VMT were disaggregated by technology based on stock and MOVES data.
	Average VMT per Vehicle	Fleet Vehicles - HDVs: single unit short haul trucks, refuse trucks, transit busses	EPA MOVES2010b Model	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm	The annual VMT data for HDVs (heavy duty vehicles) were derived from the EPA MOVES model. It was assumed that diesel and CNG vehicles of the same type drive have the same VMT.
		Fleet Vehicles - LDVs: gasoline ICE taxi, NGV taxis			It was assumed that NGV taxis would be operated at the same VMT as their gasoline counterparts which are often operated 24 hours per day by multiple drivers. A conservative annual VMT of 50,000 was assumed. There is very little data available on actual taxi fleet VMT. Anecdotal accounts suggest that VMT in some of Connecticut's taxi fleets may be as high as 70,000 mile annually.
		Non-Fleet LDVs: passenger cars, passenger trucks	NHTSA 2006 - "Vehicle Survivability and Travel Mileage Schedules"	U.S. Department of Transportation - National Highway Traffic Safety Administration (2006). Vehicle Survivability and Travel Mileage Schedules. Available at: http://www-nrd.nhtsa.dot.gov/Pubs/809952.pdf	It was assumed that all passenger cars will have the same VMT, independent of the vehicle technology. Similarly, it was assumed that all light trucks will have the same VMT, independent of the vehicle technology.

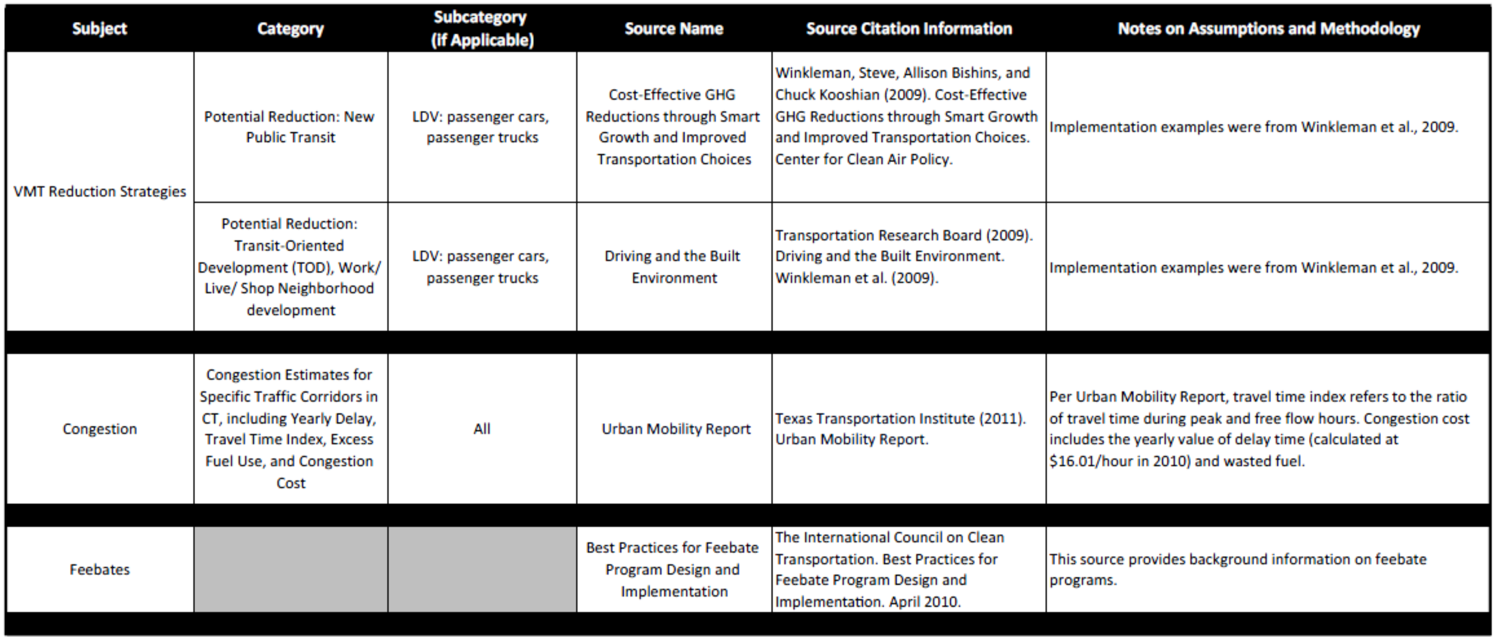
Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Vehicle Characteristics and Use	Vehicle Prices	all LDVs except High Fuel Economy ICEs	Annual Energy Outlook 2011: Supplemental Tables	U.S. Energy Information Administration. Annual Energy Outlook 2011. Table 71. New Light-Duty Vehicle Prices (suptab_71.xls). April, 2011.	The incremental costs of LDV vehicle types were calculated based on comparisons of advanced vehicle classes to their respective standard ICE classes. The average incremental costs were calculated separately for passenger cars and light trucks. These two averages were combined through a weighting process based on the number of passenger car and light truck classes in which a technology was offered. Lacking incremental cost data for hydrogen fuel cell vehicles in 2013, we used AEO projected costs for 2014 instead.
		LDV: High Fuel Economy ICEs	EPA 2012 Fuel Economy Datafile Edmunds.com	U.S. Department of Energy: Energy Efficiency & Renewable Energy. EPA 2012 Fuel Economy Datafile. 2012 FEGuide for DOE-rev1-rel dates before 3-13-2012-no-sales-3-7-2012public3-20.xlsx Available at: http://www.fueleconomy.gov/feg/epadata/12data.zip Edmunds.com Inc. New Cars. Retrieved August 3, 2012, from http://www.edmunds.com/new-cars/	The current cost of vehicles was determined my matching vehicle make and models from the EPA 2012 Fuel Economy Datafile with model-specific new car cost information from Edmunds.com. The high fuel economy ICE vehicle representation is a composite developed based upon efficiency and cost data. In each class, we identified four vehicles which exhibited both high fuel economy and low cost (relative to its class average). The average prices of these high fuel economy and low cost vehicles were compared to their class averages, yielding the incremental cost difference by class. The incremental costs for the classes were averaged to find an average incremental cost across multiple classes, including subcompact, compact, midsize, and large cars. This incremental cost was assumed to stay constant over time.
		HDVs: all	NREL 2010 - Business Case for Compressed Natural Gas in Municipal Fleets	Johnson, Caley (2010). National Renewable Energy Lab (NREL). Business Case for Compressed Natural Gas in Municipal Fleets. Retrieved July 23, 2012, from http://www.afdc.energy.gov/afdc/pdfs/47919.pdf	The incremental costs for transit busses and refuse trucks were pulled directly from this NREL study. The incremental costs for single unit short haul trucks was assumed to be equivalent to that of school busses (also represented in this report).
	Technology Learning Curves	all	Rocky Mountain Institute	RMI Analysis of M. A Kromer, "Electric powertrains: opportunities and challenges in the US light-duty vehicle fleet." (2007)	RMI learning curve estimates were developed for batteries and hydrogen fuel cells. These curves were applied to their respective technologies (batteries: BEVs, PHEVs; hydrogen fuel cells: H FCVs). We assumed that rate of incremental cost reductions by 2020 and 2030 for light duty CNG will be the same as the rate for H FCVs. We assumed that rate of incremental cost reductions by 2020 and 2030 for all heavy duty CNG vehicles would be less dramatic than for LDVs, instead following the learning curve of BEVs.

Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Vehicle Characteristics and Use	Fuel Efficiency	LDVs: all expect High Fuel Economy ICEs	EPA MOVES2010b Model & EPA-NHTSA CAFE Final Rule	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm National Highway Traffic Safety Administration. NHTSA AND EPA ESTABLISH NEW NATIONAL PROGRAM TO IMPROVE FUEL ECONOMY AND REDUCE GREENHOUSE GAS EMISSIONS FOR PASSENGER CARS AND LIGHT TRUCKS. http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE-GHG_Fact_Sheet.pdf	
		LDV: High Fuel Economy ICEs	EPA 2012 Fuel Economy Datafile	U.S. Department of Energy: Energy Efficiency & Renewable Energy. EPA 2012 Fuel Economy Datafile. 2012 FEGuide for DOE-rev1-rel dates before 3-13-2012-no-sales-3-7-2012public3-20.xlsx Available at: http://www.fueleconomy.gov/feg/epadata/12data.zip	The high fuel economy ICE vehicle representation is a composite developed based upon efficiency and cost data. In each class, we identified four vehicles which exhibited both high fuel economy and relatively low-cost (relative to its class average). For 2013, the efficiencies of these high fuel economy low-cost vehicles were averaged to find an average MPG for the represented classes. It was assumed that following 2013, the fuel economy of these vehicles will increase at the same rate as the average standard gasoline ICE.
		HDVs: all	EPA MOVES2010b Model	U.S. EPA. Modeling and Inventories. MOVES (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm	
	On-Road Degradation Factors	LDVs: all expect High Fuel Economy ICEs	VISION model	Argonne National Laboratory, 2011. VISION Model. Available at http://www.transportation.anl.gov/modeling_simulation/VISION/index.html	

Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Vehicle Characteristics and Use	On-Road Degradation Factors	LDV: High Fuel Economy ICEs	EPA 2012 Fuel Economy Datafile. 2012 FEGuide for DOE-rev1-rel dates before 3-13-2012-no-sales-3-7-2012public3-20.xlsx	U.S. Department of Energy: Energy Efficiency & Renewable Energy. EPA 2012 Fuel Economy Datafile. 2012 FEGuide for DOE-rev1-rel dates before 3-13-2012-no-sales-3-7-2012public3-20.xlsx Available at: http://www.fueleconomy.gov/feg/epadata/12data.zip	The vehicle MPG of the high fuel economy category is based on U.S. EPA's "adjusted" fuel economy values. No additional degradation factor was applied.
		HDVs	EPA MOVES2010b Model	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm	
	Vehicle Lifetime	LDVs: all	NHTSA 2006 - "Vehicle Survivability and Travel Mileage Schedules"	U.S. Department of Transportation - National Highway Traffic Safety Administration (2006). Vehicle Survivability and Travel Mileage Schedules. Available at: http://www-nrd.nhtsa.dot.gov/Pubs/809952.pdf	The average lifetime of LDVs was 12 years.
		HDVs	NREL 2010 - Business Case for Compressed Natural Gas in Municipal Fleets	Johnson, Caley (2010). National Renewable Energy Lab (NREL). Business Case for Compressed Natural Gas in Municipal Fleets. Retrieved July 23, 2012, from http://www.afdc.energy.gov/afdc/pdfs/47919.pdf	We assumed that the average lifetime of single-unit short haul trucks is equivalent to that of transit busses.
Charging and CNG Refueling Infrastructure	Electric Vehicle Charging Costs	LDVs: BEVs, PHEVs	MJ Bradley 2012 - PERSPECTIVES ON ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE	Balon, Tom. MJ Bradley. PERSPECTIVES ON ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE. April 2012.	We converted the infrastructure cost into a $/kWh basis. The cost of charging was based on a split between level 1 and level 2 chargers that changed over time. In 2013 the split was 5% level 2 to 95% level 1, by 2030 the split was 25% level 2 to 75% level 1. The analysis assumed a level 2 charger costs $500 per unit. The total kwh demand for a typical EV/PHEV vehicle was based on the average VMT per vehicle and the electric efficiency of the drivetrain. The $/kWh (charger cost/electric demand) costs were converted to $/GGE (gallon gasoline equivalent) and a capital recovery factor of 0.12 was applied.

Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Charging and CNG Refueling Infrastructure	CNG Vehicle Charging Costs	LDVs: NGVs; HDVs: all CNG	NREL 2010 - Business Case for Compressed Natural Gas in Municipal Fleets	Johnson, Caley (2010). National Renewable Energy Lab (NREL). Business Case for Compressed Natural Gas in Municipal Fleets. Retrieved July 23, 2012, from http://www.afdc.energy.gov/afdc/pdfs/47919.pdf	The cost of CNG infrastructure ($/gallon of CNG) was based on a fueling station with a full capacity throughput of 150,000 GDE (gallon diesel equivalent) per month. A capital recovery factor of 0.12 was applied to the station costs. We put this in terms of $/GGE.
Economic Conditions	Price Deflators	NA	Bureau of Economic Analysis: Table 1.1.9. Implicit Price Deflators for Gross Domestic Product	Bureau of Economic Analysis. Table 1.1.9. Implicit Price Deflators for Gross Domestic Product. Downloaded on 5/15/2012. Last Revised. April 27, 2012.	All monetary values were put in terms of 2012$ (1st Quarter).
	Social Cost of Carbon (SCC)	NA	IPCC – AR4, Working Group III Interagency Working Group on Social Cost of Carbon	IPCC – AR4, Working Group III – ch3, Issues related to mitigation in the long-term context. Downloaded from: http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch3.html Interagency Working Group on Social Cost of Carbon (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. downloaded from: http://www.epa.gov/otaq/climate/regulations/scc-tsd.pdf	We used a SCC of $50 per ton (the mid-point between values from the Interagency Working Group on Social Cost of Carbon and the Stern report) starting in 2013. The analysis escalated the SCC at an average annual rate of 2.4% (based on IPCC), by 2030 the SCC estimate was grown to $74 per ton. The SCC was not factored into net present value (NPV) calculations except where explicitly noted.
	Discount Rate	NA			A 5% discount rate was used in this analysis to be consistent with other analyses in this project.
Conversion and Emission Factors	Energy Content of Fuels	All	U.S. EIA	U.S. Energy Information Administration. Biofuels in the U.S. Transportation Sector. February 2007. http://www.eia.gov/oiaf/analysispaper/biomass.html	
	Emission Factors	gasoline, diesel, CNG, ethanol	EPA MOVES2010b Model	U.S. EPA. Modeling and Inventories. MOVES 2010b (Motor Vehicle Emission Simulator). Available at: http://www.epa.gov/otaq/models/moves/index.htm	

Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
Conversion and Emission Factors	Emission Factors	electricity	The Brattle Group, Inc.	The Brattle Group, Inc. Generation and Emissions by type_updated demand_6.28.12.xls. Received July 16, 2012.	NESCAUM calculated Connecticut-specific CO2 emission factors for electricity using the "Vision" scenario projections of CO2 emissions and generation from The Brattle Group, Inc. More specifically, we divided total projected CO2 emissions from the electricity generation sector by the total electricity load (net expanded energy efficiency).
		hydrogen	GREET version 2.7	Argonne National Laboratory. The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model Version 2.7. Downloaded July 8, 2012.	NESCAUM utilized the GREET model (version 2.7) to determine a CO2 emission factor for the production of hydrogen fuel in Connecticut. This emission factor accounts for the mix of electricity generation in Connecticut as determined by the analysis of The Brattle Group, Inc.
VMT Reduction Strategies	Potential Reduction: VMT Fee	LDV: passenger cars, passenger trucks	Understanding Transport Demands and Elasticities	Litman, Todd (2012). Understanding Transport Demands and Elasticities. Victoria Transport Policy Institute.	Implementation examples from Victoria Transport Policy Institute, 2012.
	Potential Reduction: Pay-As-You-Drive Insurance	LDV: passenger cars, passenger trucks	Pay-As-You-Drive Insurance in MA	Ferreira, Joseph and Eric Minikel (2010). Pay-As-You-Drive Insurance in MA.	Treated potential for 14% reductions as an outlier. Implementation examples were from Ferreira and Minikel, 2010. Victoria Transport Policy Institute, 2012.
	Potential Reduction: Congestion Pricing	LDV: passenger cars, passenger trucks	Moving Cooler	Cambridge Systematics, Inc. (2009). Moving Cooler.	Implementation examples were from Victoria Transport Policy Institute, 2012.
	Potential Reduction: Parking Fees in CBDs	LDV: passenger cars, passenger trucks	Moving Cooler	Cambridge Systematics, Inc. (2009). Moving Cooler.	
	Potential Reduction: Work from Home; Work Hubs; Condensed Work Weeks; Carpooling	LDV: passenger cars, passenger trucks	Moving Cooler	Cambridge Systematics, Inc. (2009). Moving Cooler.	
	Sidewalks; Bike Lanes and Paths	LDV: passenger cars, passenger trucks	Moving Cooler	Cambridge Systematics, Inc. (2009). Moving Cooler.	
	Potential Reduction: HOV Lanes	LDV: passenger cars, passenger trucks	Moving Cooler	Cambridge Systematics, Inc. (2009). Moving Cooler.	
	Potential Reduction: System Efficiency	LDV: passenger cars, passenger trucks	Cost-Effective GHG Reductions through Smart Growth and Improved Transportation Choices	Winkleman, Steve, Allison Bishins, and Chuck Kooshian (2009). Cost-Effective GHG Reductions through Smart Growth and Improved Transportation Choices. Center for Clean Air Policy.	



Subject	Category	Subcategory (If Applicable)	Source Name	Source Citation Information	Notes on Assumptions and Methodology
VMT Reduction Strategies	Potential Reduction: New Public Transit	LDV: passenger cars, passenger trucks	Cost-Effective GHG Reductions through Smart Growth and Improved Transportation Choices	Winkleman, Steve, Allison Bishins, and Chuck Kooshian (2009). Cost-Effective GHG Reductions through Smart Growth and Improved Transportation Choices. Center for Clean Air Policy.	Implementation examples were from Winkleman et al., 2009.
	Potential Reduction: Transit-Oriented Development (TOD), Work/ Live/ Shop Neighborhood development	LDV: passenger cars, passenger trucks	Driving and the Built Environment	Transportation Research Board (2009). Driving and the Built Environment. Winkleman et al. (2009).	Implementation examples were from Winkleman et al., 2009.
Congestion	Congestion Estimates for Specific Traffic Corridors in CT, including Yearly Delay, Travel Time Index, Excess Fuel Use, and Congestion Cost	All	Urban Mobility Report	Texas Transportation Institute (2011). Urban Mobility Report.	Per Urban Mobility Report, travel time index refers to the ratio of travel time during peak and free flow hours. Congestion cost includes the yearly value of delay time (calculated at $16.01/hour in 2010) and wasted fuel.
Feebates			Best Practices for Feebate Program Design and Implementation	The International Council on Clean Transportation. Best Practices for Feebate Program Design and Implementation. April 2010.	This source provides background information on feebate programs.

Source: NESCAUM response to DEEP data request (2012)

SUMMARY TABLE OF ALTERNATIVE REVENUE SOURCES FOR THE STATE OF CONNECTICUT

Figure D-3: Summary table of alternative revenue sources for the State of Connecticut

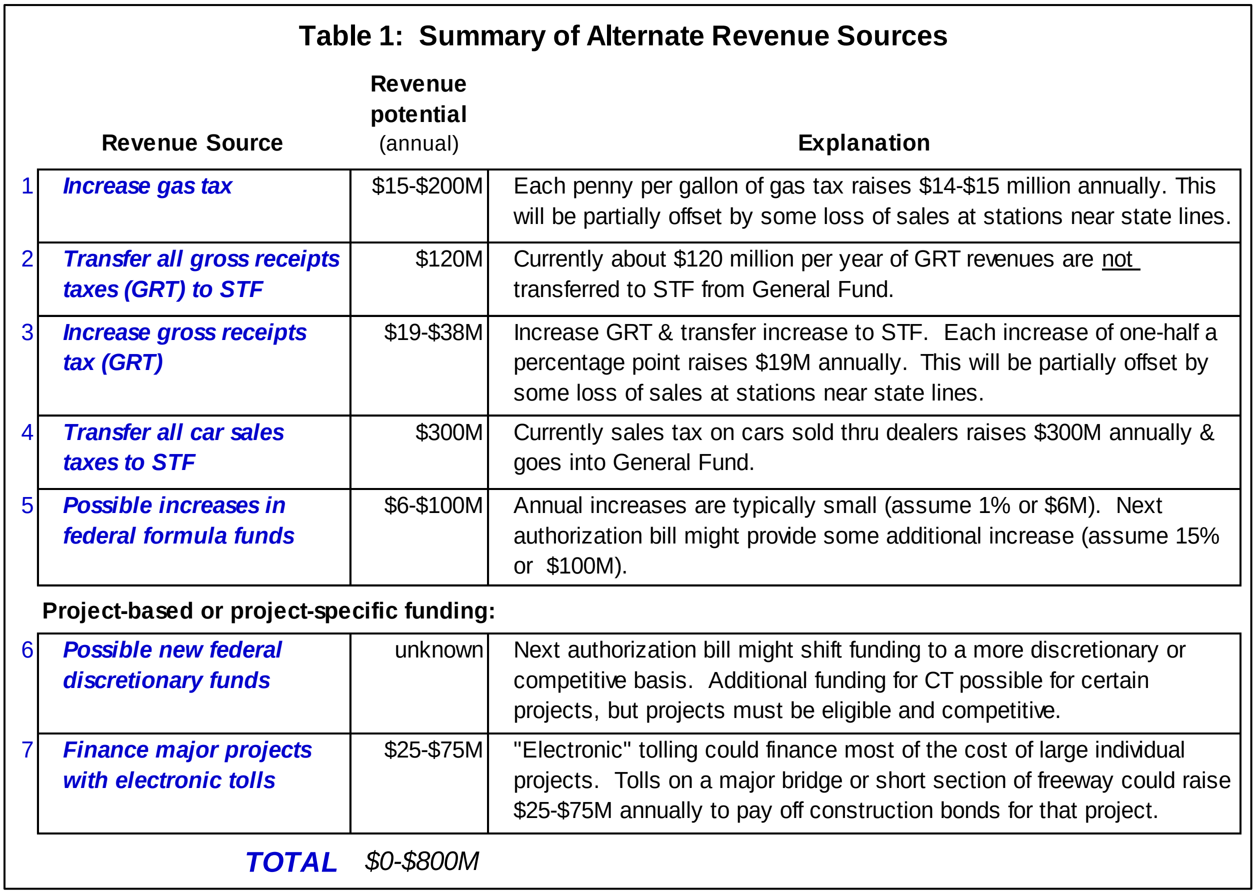


Table 1: Summary of Alternate Revenue Sources

	Revenue Source	**Revenue potential** (annual)	**Explanation**
1	***Increase gas tax***	$15-$200M	Each penny per gallon of gas tax raises $14-$15 million annually. This will be partially offset by some loss of sales at stations near state lines.
2	***Transfer all gross receipts taxes (GRT) to STF***	$120M	Currently about $120 million per year of GRT revenues are not transferred to STF from General Fund.
3	***Increase gross receipts tax (GRT)***	$19-$38M	Increase GRT & transfer increase to STF. Each increase of one-half a percentage point raises $19M annually. This will be partially offset by some loss of sales at stations near state lines.
4	***Transfer all car sales taxes to STF***	$300M	Currently sales tax on cars sold thru dealers raises $300M annually & goes into General Fund.
5	***Possible increases in federal formula funds***	$6-$100M	Annual increases are typically small (assume 1% or $6M). Next authorization bill might provide some additional increase (assume 15% or $100M).
	Project-based or project-specific funding:		
6	***Possible new federal discretionary funds***	unknown	Next authorization bill might shift funding to a more discretionary or competitive basis. Additional funding for CT possible for certain projects, but projects must be eligible and competitive.
7	***Finance major projects with electronic tolls***	$25-$75M	"Electronic" tolling could finance most of the cost of large individual projects. Tolls on a major bridge or short section of freeway could raise $25-$75M annually to pay off construction bonds for that project.
	TOTAL	*$0-$800M*	

Source: Connecticut Office of Policy & Management, "A Strategic Framework for Investing in CT's Transportation: Economic Growth – Infrastructure Growth – Sustainable Communities [Draft, January 2011]"