

Scientific Information Statement: Attachment A

Climate Change

Climate change is a shift in the average weather over a long period a given region experiences. There are cycles of global climate change that occur naturally, such as the occurrence of periodic ice ages, etc. However, the scientific consensus is that human activities are causing climate change to occur at an unprecedented rate by altering the chemical composition of the atmosphere through the buildup of greenhouse gases (GHGs), primarily through fossil fuel combustion. Undesirable impacts of climate change include shifting temperature averages and extremes, the timing and amount of precipitation, changes in plant and animal varieties common to a region, an increase in harmful lower atmosphere ozone levels, an increased frequency of extreme weather events, and the prevalence of vector-borne disease.

Recent estimates by the Intergovernmental Panel on Climate Change predict the Earth will warm between 2.5 to 10.4 degrees Fahrenheit in the next 100 years.¹ In New England, the potential consequences of climate change are expected to include significant warming, deteriorating air quality through increased ozone, nitrogen oxides (NOx) and sulfur oxides (SOx), a combination of droughts and flooding, changes in the character of forests, and the probable spread of Lyme Disease and toxic algal blooms.² In Vermont, this warming could produce a shorter ski season, allow incursion of warmer climate tree species which would replace the current mix of hardwoods that produce our spectacular fall foliage, and result in a dramatic change in the quality and quantity of maple sap.³

Of the human activities producing GHGs, the combustion of fossil fuels for transportation represents the single largest source of GHG emissions in Vermont. The largest sector of Vermont's total energy use is transportation, which represents the fastest growing source of carbon dioxide (CO₂) emissions. The increase in vehicle miles traveled (VMT) in Vermont was over 30 percent between 1991 and 2001 according to Vermont Agency of Transportation data. Given the basic chemistry of combustion which yields approximately 20 pounds of CO₂ for each gallon of gasoline consumed, and light-duty fuel economy averages which have remained virtually static since the mid-1980's, the increase of vehicle GHG emissions mirrors that of VMT.

GHGs emitted by motor vehicles include CO₂, which comprises 99 percent of typical motor vehicle GHG emissions, methane (CH₄), nitrous oxide (N₂O), and hydrofluorocarbons (HFCs). The proposed regulation would reduce emissions of these GHGs from motor vehicles by gradually phasing in GHG emission standards during the

¹ Intergovernmental Panel on Climate Change, *Climate Change 2001: Scientific Basis: Technical Summary*.

² New England Regional Assessment Report, U.S. Global Change Research program, "The Potential Consequences of Climate Variability and Change" *Foundation Report*, Washington, 2000.

³ U.S. Environmental Protection Agency, *Climate Change and Vermont*, EPA 236-F-98-007aa (Sept. 1998).

2009 through 2016 model years. When fully phased in, the standards will result in about a 30 percent reduction in GHG emissions.

Greenhouse Gas Inventory

The U.S. Environmental Protection Agency (EPA) estimates that Vermont produced 3.68 million metric tons of CO2 (MMTCO2) in 2000 from transportation.⁴ In 2002, according to U.S. Energy Information Administration estimates, 83 percent of transportation CO2 emissions in Vermont were from gasoline-fueled vehicles, and 92 percent of such transportation vehicles were light-duty trucks and passenger cars.⁵ Applying these percentages to the total transportation figure shows an estimated 2.81 MMTCO2 from the Vermont light-duty fleet in 2000.

The Vermont CO2 inventory for 2000 can also be calculated by comparing motor vehicle registration figures for automobiles and trucks published by the Vermont Department of Motor Vehicles,⁶ and applying emission factors for CO2 production based on average fuel consumption figures for the automobile and light truck fleets supplied by the EPA.⁷ This was then correlated with the annual VMT published by the Vermont Agency of Transportation and yielded a similar figure of 2.9 MMTCO2.

Projected GHG Reductions

The California Air Resources Board (CARB) estimates that the proposed GHG standards will reduce CO2 emissions from the California fleet by approximately 18 percent in 2020 and 27 percent in 2030,⁸ as illustrated in the following table:

Table 1: California Light-Duty Fleet CO2 Equivalent Emissions and Reductions

	2020 CO2 Equivalent (tpd)	2030 CO2 Equivalent (tpd)
Baseline Emissions (tons per day)	497,400	575,500
Projected with GHG Standards	409,600	420,300
Reductions	87,700	155,200

Sales data provided by manufacturers under Vermont’s Low Emission Vehicle Program show similarity between the Vermont and California fleet in the market penetration of new vehicle sales by the six large volume manufacturers (LVM) obligated under the

⁴ <http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsStateEnergyCO2Inventories.html>

⁵ http://www.eia.doe.gov/oiaf/archive/aeo03/supplement/sup_tran.pdf

⁶ <http://www.dmv.state.vt.us/documents/Statistics/VehicleRegistration/VehicleRegistrations1980to2001VehType.pdf>

⁷ See U.S. EPA, Office of Transportation and Air Quality, Emission Facts available at www.epa.gov/otaq/consumer/f00013.htm.

⁸ California Environmental Protection Agency Air Resources Board, *Report to the Legislature and Governor on Regulations to Control Greenhouse Gases Emissions From Motor Vehicles*, 15 (Dec. 2004) (hereinafter “CARB Report to Legislature”).

proposed GHG requirements.⁹ The Vermont and California fleets are similar in the LVM percentages of passenger cars and lightest trucks versus the heavier light trucks addressed in the proposed amendment. Therefore, it is reasonable to scale the data developed by CARB during their evaluation of the proposed GHG emission standards by looking at the ratio of Vermont fossil fuel transportation consumption to California consumption. Using this ratio, which was approximately 59:1 in 2000,¹⁰ Vermont estimates that GHG standards will reduce emissions from the Vermont fleet as illustrated in Table 2:

Table 2: Vermont Light-Duty Fleet CO2 Equivalent Emissions and Reductions

	2020 CO2 Equivalent (tpd)	2030 CO2 Equivalent (tpd)
Baseline Emissions (tpd)	8,430.5	9,754.2
Projected with GHG Standards	6,942.4	7,123.7
Emissions Reductions	1,488.1	2,630.5

In addition to reducing GHG emissions, the proposed GHG standards will also reduce fuel cycle emissions due to increased vehicle efficiencies. Fuel cycle emissions include refining, marketing and distribution of gasoline. In Vermont, fuel cycle CO2 reductions are estimated to be approximately 461 tons per day (tpd) in 2020 and 815 tpd in 2030.¹¹

Finally, the proposed GHG amendments will reduce emissions of hazardous air contaminants, such as benzene, and the criteria pollutants non-methane organic gases (NMOG), oxides of nitrogen (NOx), and carbon monoxide (CO), also associated with the marketing and distribution of gasoline. The potential reductions of the criteria pollutants in Vermont are estimated in the following table:

Table 3: Vermont Fuel Cycle Criteria Pollutant Reductions

Criteria Pollutant	2020 annual tons	2030 annual tons
NMOG	28.5	48.9
NOx	8.6	14.3
CO	1.3	2.5

Summary

Motor vehicle emissions are a significant source of GHGs responsible for climate change. The proposed regulation will reduce GHG emissions from motor vehicles in a phased process of incremental annual reductions in aggregated fleet CO2 equivalent standards.

⁹ Manufacturers claim specific figures as “Business Confidential”.

¹⁰ U.S. Department of Energy *State Energy Consumption Data (2000)*

¹¹ See *CARB Report to Legislature* at 16.