



VERMONT

Greenhouse Gas
Emissions
Inventory
Update
1990 – 2011

December 2013



Department of Environmental Conservation
Air Quality and Climate Division

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EMISSIONS SUMMARY

Vermont's statewide greenhouse gas (GHG) emissions decreased slightly in 2010 (approximately 2%) from 2009 levels to 8.23 million metric tons CO₂ equivalent (MMTCO₂e). This level is approximately 1.5% higher than 1990 levels. Based on available data, statewide GHG emissions declined again in 2011 from 2010 levels to 8.11MMTCO₂e, a level equal to 1990 levels (see Table 1).

Emissions from most sectors declined slightly or remained nearly constant between 2010 and 2011. Reductions in the transportation sector are primarily attributable to a combination of Vermont's adoption of the California Zero Emission Vehicle (ZEV) and GHG standards, economic drivers such as continued relatively high fuel prices, and changes in travel behavior (e.g., increased transit ridership). Reductions in Residential / Commercial / Industrial (RCI) fuel combustion emissions are driven by reduced heating demand (from warmer winters in recent years), improving building weatherization and efficiency, and relatively high fuel prices.

Total electricity consumption for 2010 and 2011 were comparable to 2009, and the GHG emissions associated with electricity consumption in Vermont remain relatively small (about 5% of the total). However, emissions associated with this sector have been increasing slowly over the past few years despite effective energy efficiency programs and an increase in in-state renewable energy generation. This has been caused by a greater reliance on higher GHG-emitting regional market power in Vermont's electricity contract mix.

The emissions estimates presented in this report were developed using methodologies consistent with the *Final Vermont Greenhouse Gas Inventory and Reference Case Projections, 1990-2030*¹ developed by the Center for Climate Strategies (CCS), the most current State Inventory Tool modules from the U.S. Environmental Protection Agency, and data available from a variety of in-state and national sources including the Vermont Agency of Transportation, Vermont Department of Public Service, Vermont Legislative Joint Fiscal Office (JFO), U.S. Department of Agriculture, U.S. Department of Energy, and others. Historical and updated GHG emissions data have been calculated and are summarized by sector in the tables and graphs that follow.²

At present, calendar year 2010 is the most current year for which activity data is available for *all* inventory sectors. As a result, this inventory provides a comprehensive GHG emissions update through calendar year 2010. However, Table 1 provides 2011 emissions estimates for sectors where data were available (black text). For sectors having no 2011 data available (grey text), this inventory assumes no change in the emissions value from 2010. These data will be revised, if necessary, in the next GHG emissions inventory update.

¹ See http://www.anr.state.vt.us/anr/climatechange/Vermont_Emissions.html

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Table 1. Vermont Historic GHG Emissions by Sector
 Million Metric Tons CO₂ equivalent (MMTCo₂e)³

Sector	Year					
	1990	2000	2005	2009	2010	2011
Electricity Supply & Demand (consumption-based)	1.09	0.44	0.64	0.39	0.43	0.43
Coal	0	0	0	0	0	0
Natural Gas	0.047	0.018	0.003	0.004	0.005	0.005
Oil	0.014	0.058	0.011	0.03	0.042	0.042
Wood (CH ₄ & N ₂ O)	0.003	0.009	0.009	0.012	0.014	0.012
System Purchases & Net Imported Electricity	1.03	0.35	0.62	0.34	0.37	0.38
Residential / Commercial / Industrial (RCI) Fuel Use	2.43	2.88	2.98	2.70	2.53	2.53
Coal	0.02	0.003	0.0003	-	-	-
Natural Gas	0.31	0.50	0.44	0.45	0.44	0.45
Oil, Propane & other petroleum	2.06	2.34	2.49	2.20	2.05	2.04
Wood (CH ₄ & N ₂ O)	0.05	0.04	0.04	0.05	0.04	0.04
Transportation	3.22	3.99	4.20	3.91	3.89	3.73
Onroad Gasoline	2.64	3.20	3.29	3.04	2.90	2.77
Onroad Diesel	0.41	0.66	0.69	0.61	0.70	0.68
Rail / Ships / Boats	0.06	0.04	0.02	0.02	0.12	0.12
Jet Fuel & Aviation Gasoline	0.08	0.07	0.17	0.21	0.09	0.10
Other	0.02	0.02	0.02	0.03	0.08	0.06
Fossil Fuel Industry	0.012	0.012	0.014	0.015	0.015	0.015
Natural Gas Distribution	0.011	0.011	0.013	0.014	0.014	0.014
Natural Gas Transmission	0.0007	0.0008	0.0009	0.001	0.001	0.001
Industrial Processes	0.12	0.27	0.30	0.29	0.29	0.29
ODS Substitutes	0	0.15	0.21	0.24	0.23	0.23
Electric Utilities (SF ₆)	0.05	0.03	0.02	0.02	0.02	0.02
Semiconductor Manufacturing (HFC, PFC & SF ₆)	0.07	0.06	0.03	0.01	0.01	0.01
Limestone & Dolomite Use	0	0.02	0.03	0.016	0.025	0.025
Soda Ash Use	0.006	0.006	0.005	0.005	0.004	0.004
Waste Management	0.24	0.31	0.29	0.26	0.24	0.27
Solid Waste	0.18	0.25	0.23	0.20	0.18	0.21
Wastewater	0.06	0.06	0.06	0.06	0.06	0.06
Agriculture	1.0	0.96	0.92	0.85	0.84	0.84
Enteric Fermentation	0.59	0.56	0.53	0.52	0.50	0.50
Manure Management	0.12	0.14	0.15	0.18	0.17	0.17
Agricultural Soils	0.29	0.26	0.24	0.15	0.17	0.17
TOTAL GROSS EMISSIONS	8.11	8.86	9.34	8.42	8.23	8.11
<i>Change relative to 1990</i>	-	+9%	+15%	+4%	+1.5%	0%

³ Note: Grey text for some emissions sectors for 2011 indicates that data are held constant from 2010 levels until actual data become available. As a result, the 2011 data are subject to change, and will be revised in the next inventory update.

Figure 1. Historical VT & US (1990-2011)⁴ Gross GHG Emissions

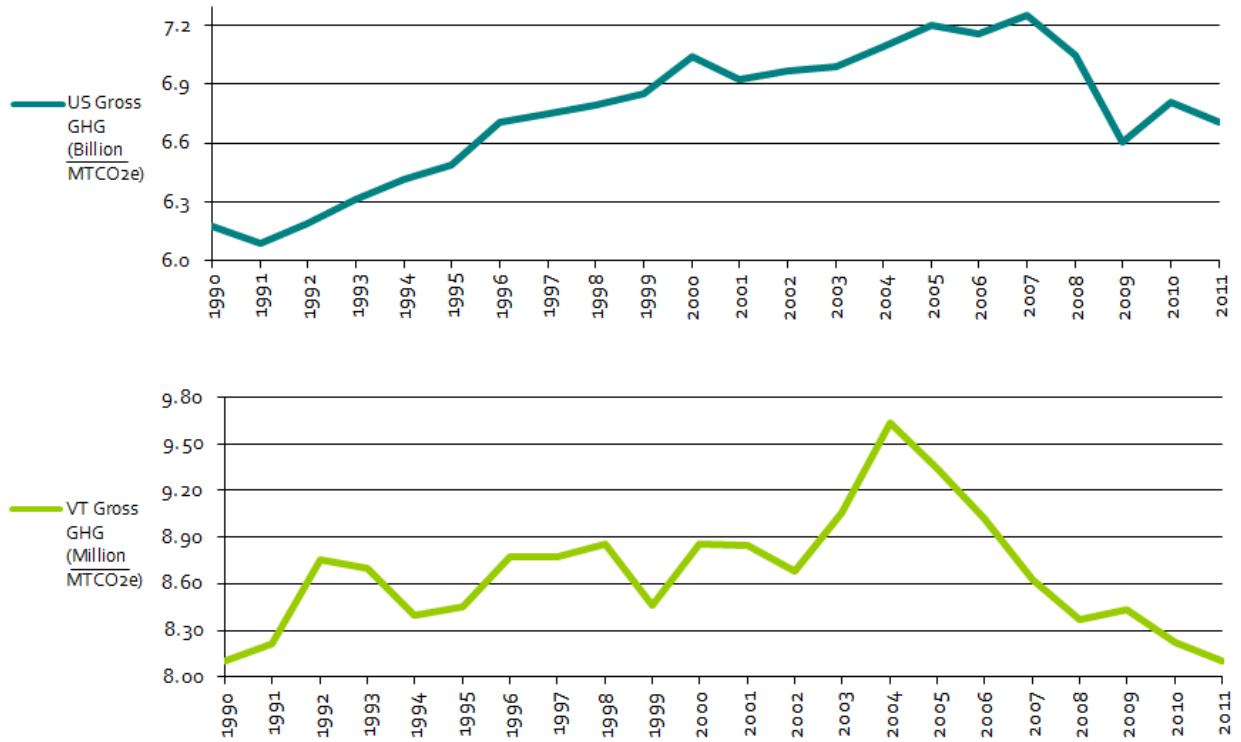
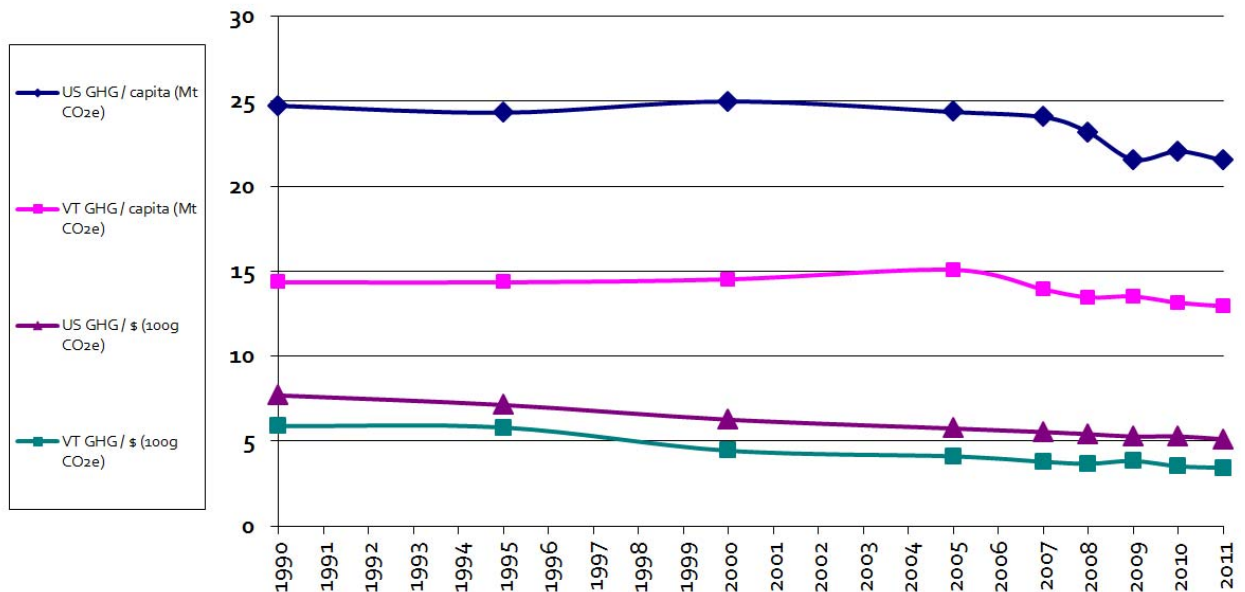


Figure 2. Historical VT & US Gross GHG Emissions per Capita⁵ and per Unit Gross Product⁶



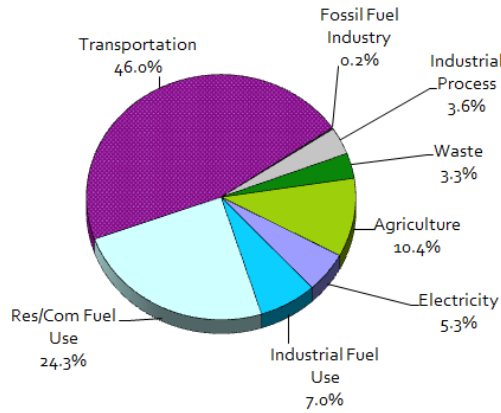
⁴ US data source: US EPA - INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2011, April 2013 - <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

⁵ Population data source: United States Census Bureau - <http://quickfacts.census.gov/qfd/states/50000.html>

⁶ GDP data source: Bureau of Economic Analysis – US Dept. of Commerce - <http://www.bea.gov/regional/index.htm>

Figure 3. 2011 Gross GHG Emissions Percent Contribution by Sector, Vermont and the United States⁷

Vermont



United States

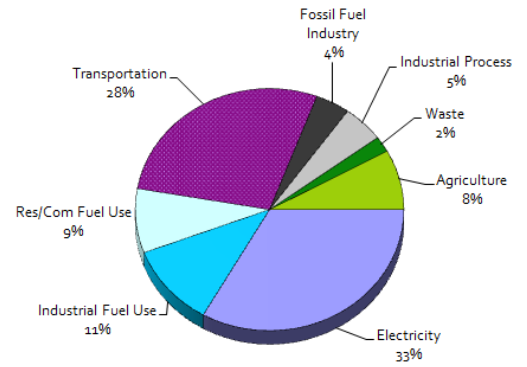
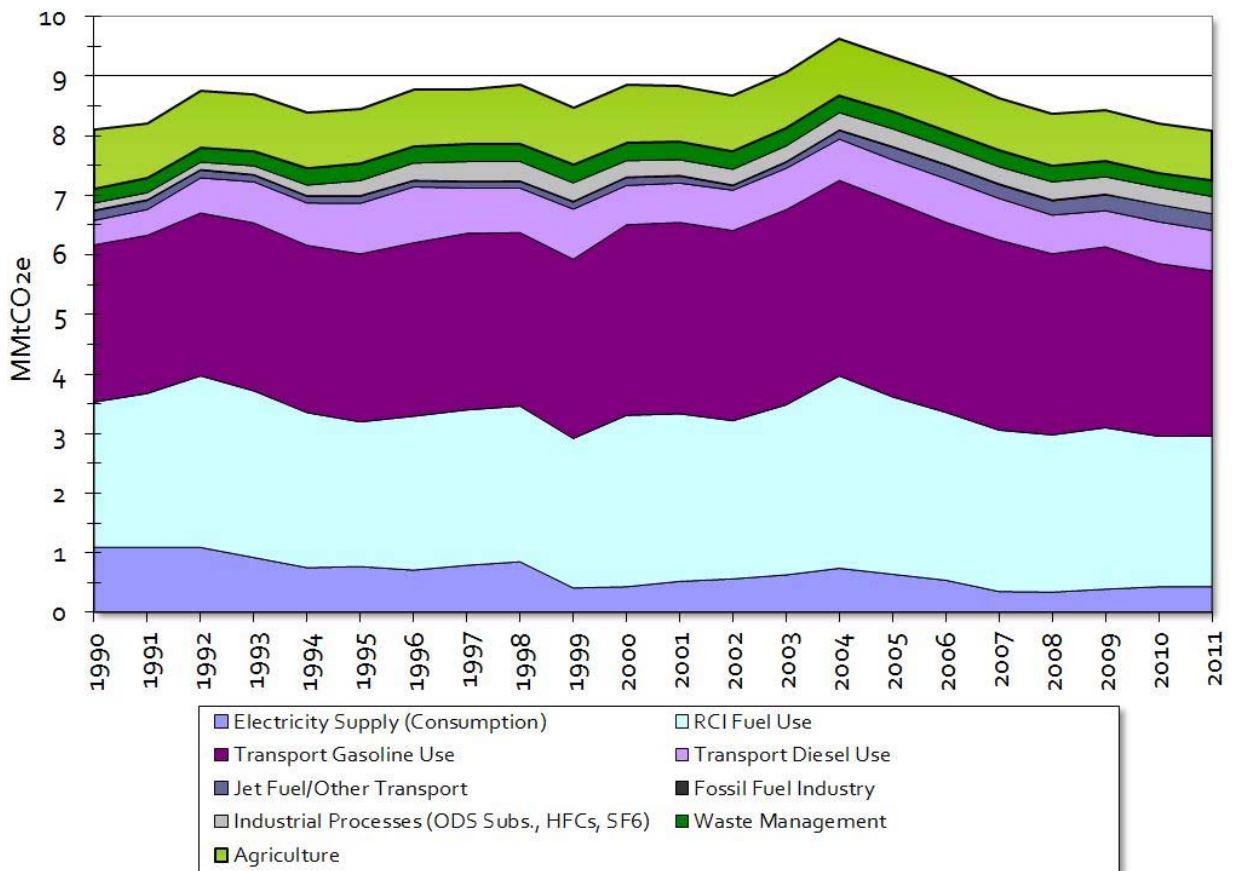


Figure 4. Total Vermont Gross GHG Emissions (1990-2011)



⁷ US data source: US EPA - INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2011, April 2013 - <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

Figure 5. Vermont Gross GHG Emissions – Individual Sector Trends (1990-2011)

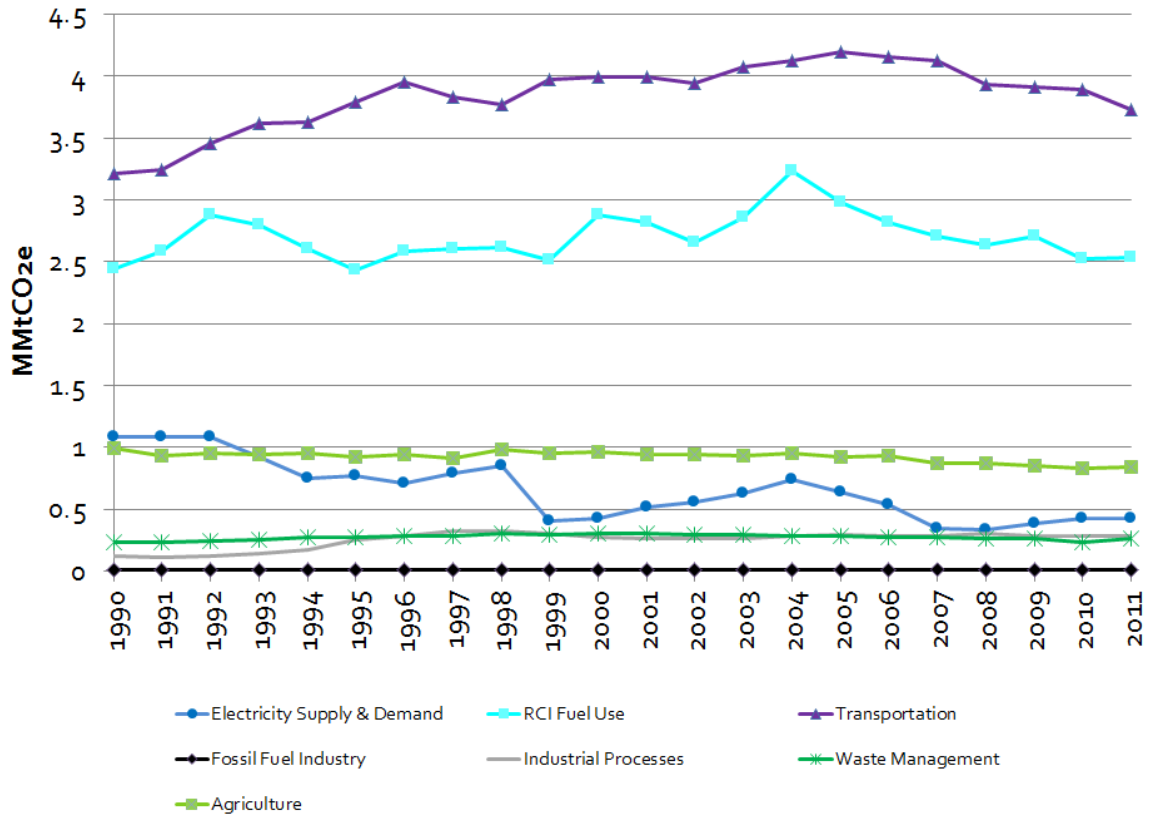
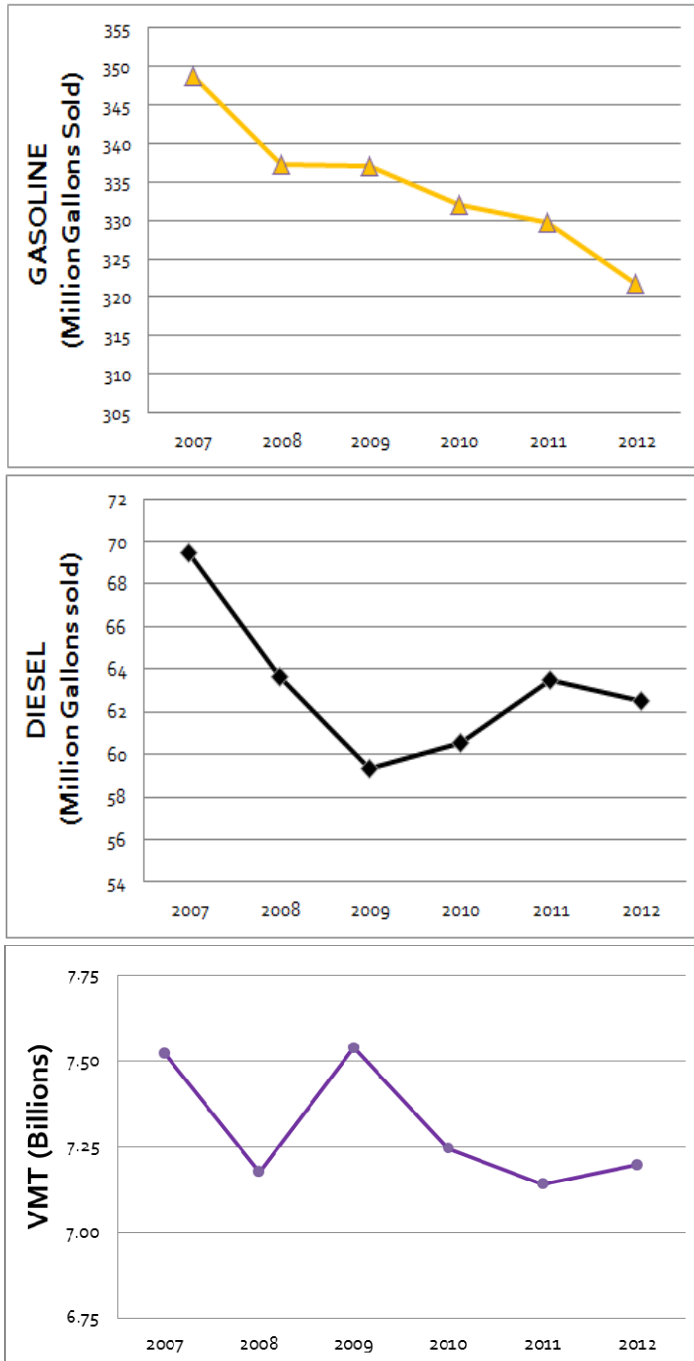


Figure 6. Vermont Transportation Indicator Trends⁸



Although a more thorough analysis to include all sectors and other GHGs such as methane (CH₄), nitrous oxide (N₂O), etc. will be performed for calendar 2012 in the next GHG inventory update, a preliminary analysis is presented below that considers only carbon dioxide (CO₂) emissions from the Transportation and RCI sectors.⁹

Statewide gasoline and diesel fuel sales data from the Legislative Joint Fiscal Office (JFO) indicate that gasoline sales continued to decline in 2012. Diesel fuel sales also showed a slight decline from 2011 levels (see Figure 6). Vehicle Miles Traveled (VMT) data for 2012 from the Vermont Agency of Transportation (VTrans) indicate that statewide VMT did not change appreciably from 2010 and 2011 levels¹⁰.

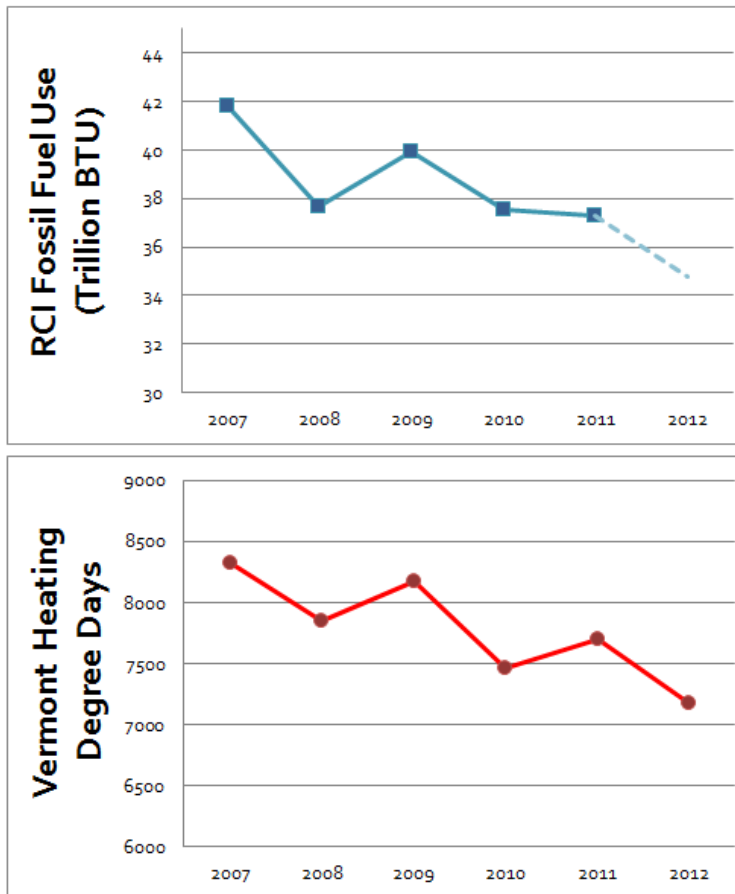
Transportation fuel sales data and VMT will not provide a comprehensive representation of actual transportation GHG emissions. Fuel sales are used in this analysis to provide a preliminary look ahead at the possible GHG emissions from the transportation sector. More accurate modeling will be done for this sector for 2012 when all the necessary data are available and processed.

⁸ Gasoline and Diesel gallons sold data obtained from the Vermont Legislative Joint Fiscal Office <http://www.leg.state.vt.us/jfo/transportation.aspx>.

⁹ Estimates of CO₂ emissions were calculated using fuel-specific emission factors available from <http://www.eia.gov/oiaf/1605/coefficients.html>

¹⁰ VMT data obtained from: http://vtransplanning.vermont.gov/sites/aot_policy/files/documents/highwayresearch/AMVT-Fatality%20Rate%20History.pdf

Figure 7. Vermont Residential / Commercial / Industrial (RCI) Fuel Use Indicator Trends¹¹

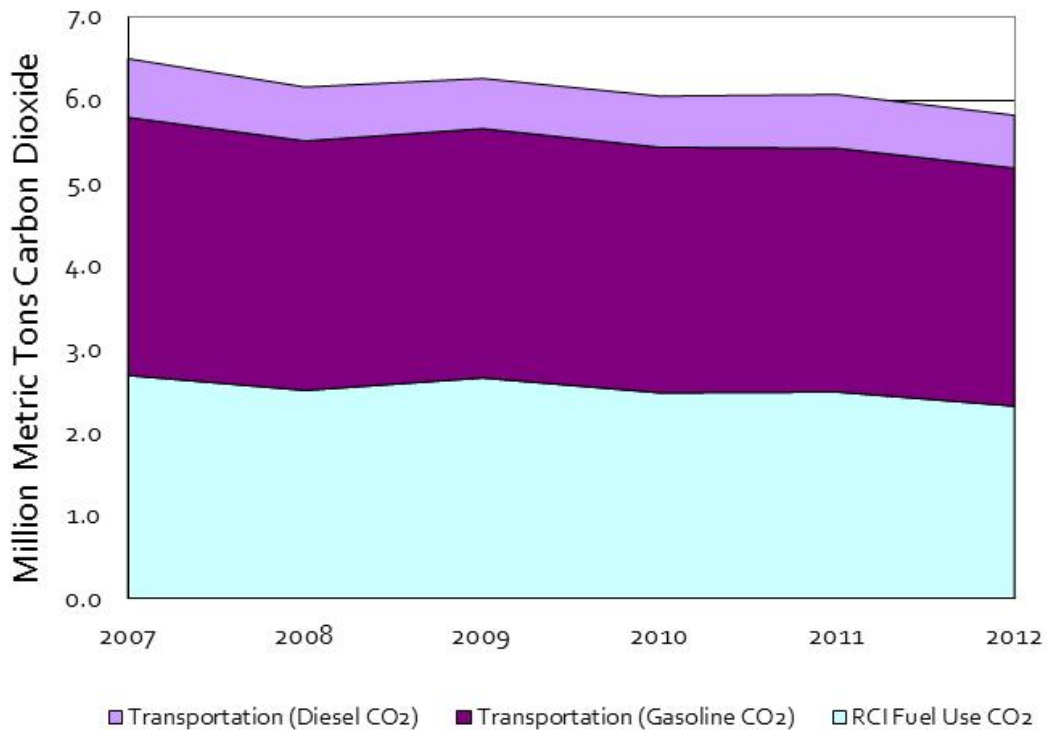


Fossil fuel consumption data for the Residential / Commercial / Industrial sectors in Vermont remained flat between 2010 and 2011, which is somewhat lower than predicted using annual Heating Degree Days (HDD) in the previous inventory update. The US Energy Information Administration data for RCI fuel consumption are not yet available for 2012. However, since much of the RCI fuel is consumed for space heating purposes, the data correlate reasonably well with annual HDD data for Vermont which are available for 2012 (see Figure 7). Given the slight decrease in HDD between 2011 and 2012, it is likely that 2012 RCI fuel consumption will be somewhat lower than 2011 levels.

¹¹ RCI Fuel consumption data obtained from the U.S. Energy Information Administration (EIA) – State Energy Data System (SEDS) <http://www.eia.gov/state/seds/seds-data-fuel.cfm?sid=US>. Heating Degree Day data obtained from http://ftp.cpc.ncep.noaa.gov/htdocs/products/analysis_monitoring/cdus/degree_days/archives/Heating%20degree%20Days/monthly%20states/

A preliminary analysis of CO₂ emissions from the Transportation and RCI sectors using these data indicates that the CO₂ emissions trend for these sectors is relatively flat from 2009 through 2012 (Figure 8). Since Transportation and RCI are responsible for approximately 78% of total statewide GHG emissions, it is likely that the statewide total gross GHG emissions trend between 2009 and 2012 will also be relatively flat.

Figure 8. Estimated Carbon Dioxide (CO₂) emissions from Transportation and Residential / Commercial / Industrial Fuel consumption (2007-2012)



FORESTRY & LAND USE

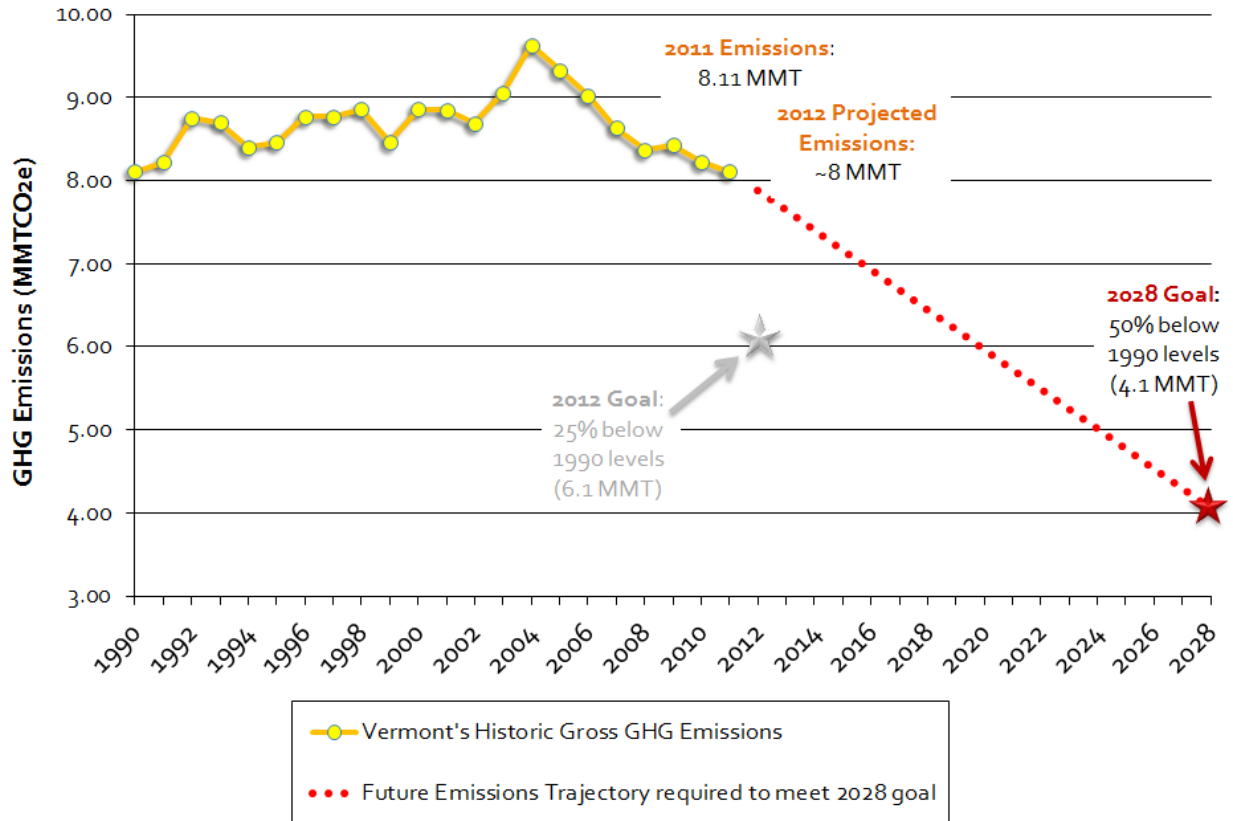
The information contained in this section was revised in the previous *Vermont GHG Emissions Inventory Update (1990-2009)* and reposted during April 2013. A more recent update is not available at this time. Please view or download the revised Forestry and Land Use section of the report at:

http://www.anr.state.vt.us/anr/climatechange/Pubs/Vermont%20GHG%20Emissions%20Inventory%20Update%201990-2009_REVISED_041213.pdf

CONCLUSIONS

Based on available data, Vermont did not achieve its 2012 goal of reducing GHG emissions to 25% below 1990 levels. Vermont now must focus its attention on the next goal on the horizon of reducing GHG emissions 50% below 1990 levels by 2028 as set forth by state statute (see Figure 9).¹²

Figure 9. Vermont GHG Emissions Relative to Reduction Goals



This will require a substantial, but not impossible, effort by Vermont State Government and all Vermonters. As illustrated in Figure 9, the average rate of decline from 2004 through 2008 was somewhat steeper than what will be required in the future to meet the 2028 goal.

Vermont state government, businesses, communities and individuals must continue to develop and implement effective policies and actions to reduce annual GHG emissions. The current Total Energy Study¹³, led by the Public Service Department, is intended to develop technology and policy pathways to achieve the state’s GHG emissions goals, as well as the goal of 90% energy from renewable sources by 2050. These efforts complement existing programs at the regional and national level, such as the Regional Greenhouse Gas Initiative (RGGI), and the federal government efforts to reduce GHG emissions and improve fuel economy for onroad vehicles and engines. A combination of national, state and local programs (both ongoing and new), along with individual actions, provides the highest probability of achieving the state’s goals.

¹² See <http://www.leg.state.vt.us/statutes/fullsection.cfm?Title=10&Chapter=023&Section=00578>

¹³ See http://publicservice.vermont.gov/sites/psd/files/Pubs_Plans_Reports/TES/Total_Energy_Study_RFI_and_Framing_Report.pdf

