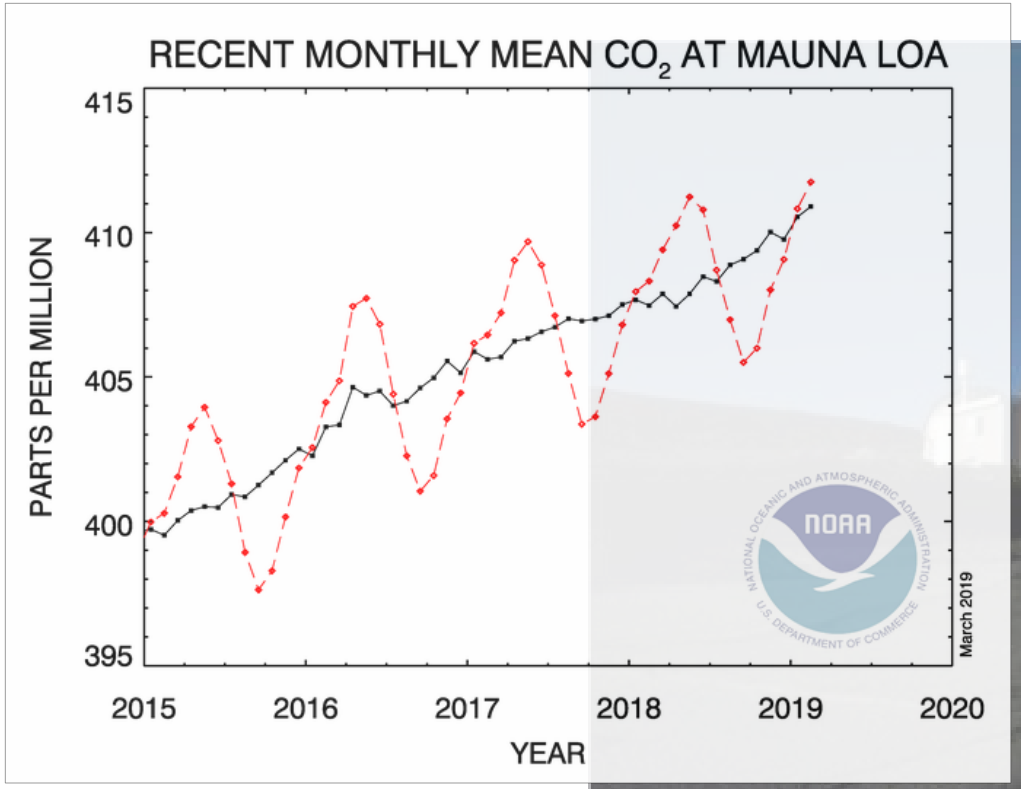
# Greenhouse Gas Emissions Inventory Presentation – VT DEC




https://www.esrl.noaa.gov/gmd/ccgg/trends/index.html


*Mauna Loa Observatory – monitoring levels of atmospheric $CO_2$*

# Greenhouse Gas (GHG) Emissions in Vermont

*Greenhouse Gas Emissions Inventory*

- Estimates of anthropogenic GHG emissions by sector for VT

- Attempt to provide a comprehensive and accurate estimate of greenhouse gas emissions totals for Vermont annually (from 2008 – 2015)

  - Methodologies consistent with
    - Final Vermont Greenhouse Gas Inventory and Reference Case Projections, 1990-2030 (2007)
    - Intergovernmental Panel on Climate Change (IPCC) guidelines
    - Also coordinate with PSD, FPR, VTrans

  - Not direct measurements of GHGs emitted to or in the atmosphere

  - Calculated based on input data (e.g. fuel use) and emission factors for multiple sectors and multiple end uses within each sector

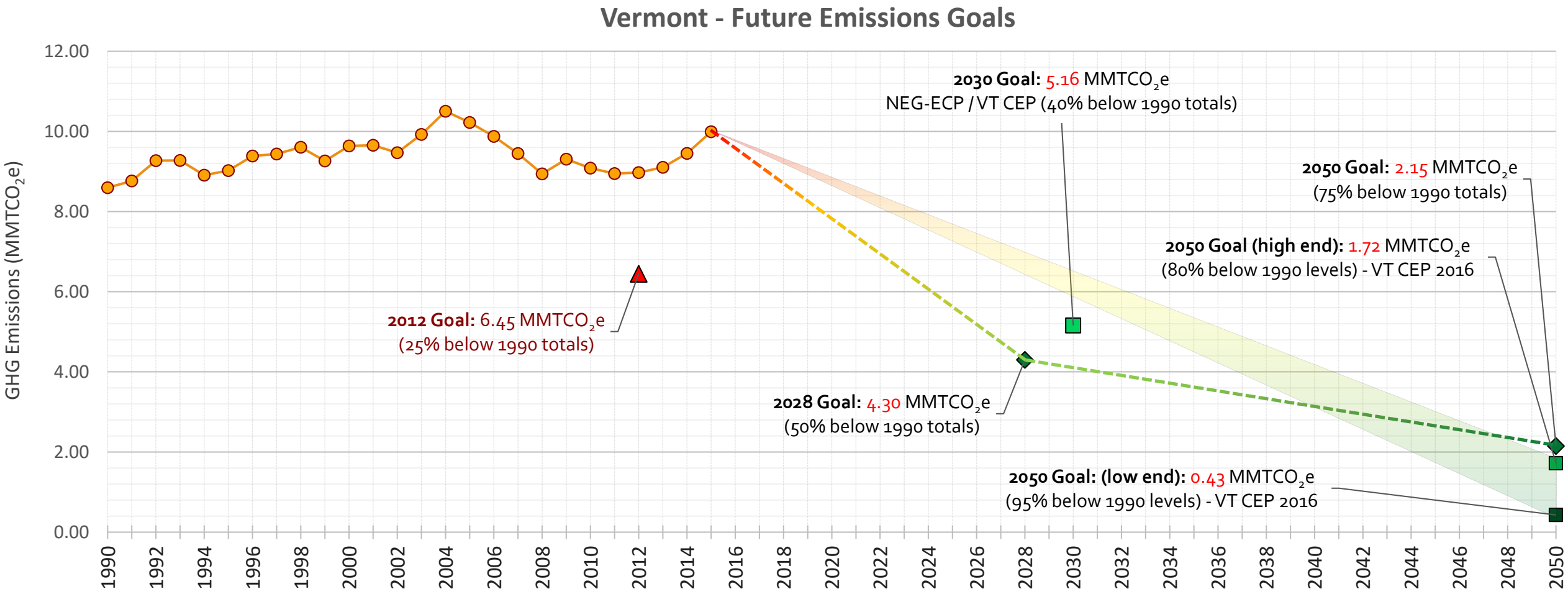
  - Emissions units in million metric tons $CO_2$ equivalent ($MMTCO_2e$) which adjusts non-$CO_2$ emissions by a global warming potential to be comparable to $CO_2$

# Greenhouse Gas Emissions Inventory

- Required by state statute (10 V.S.A. § 582)
  - Initiated under Act 209 (2008) and built upon Governor's Commission on Climate Change Process (Governor Douglas)
- To Facilitate tracking of progress towards Vermont's greenhouse gas emissions reduction goals
  - 2012: 25% below 1990 baseline (Statute)
  - 2028: 50% below 1990 baseline (Statute)
  - 2030:  40% below 1990 totals (CEP)
  - 2050: 75% below 1990 baseline (Statute)
  - 2050: 80% - 95% below 1990 baseline (CEP)
- To be a participant in a larger scale (regional, national, worldwide) effort to understand, track, and combat anthropogenic driven global warming
  - Climate Alliance and New England Governors – Eastern Canadian Premiers (NEG-ECP)

# Vermont – Total Emissions Trends and Goals

- Emissions goals for 2028, 2030, and 2050 from Statute and CEP
- New England Governors & Eastern Canadian Premiers (NEG-ECP) goals for 2050 are 75% - 85% below 2001 levels
  - Region-wide (no strict requirement for any one entity)



# Inventory Overview

## - Sectors Included in GHG Emissions Totals

- Transportation
- Residential/Commercial/Industrial (RCI) – Fuel Use
- Agriculture
- Electricity (Consumption)
- Industrial Processes
- Waste/Wastewater
- Fossil Fuel Industry

## - Covers greenhouse gases listed in the Kyoto Protocol

- Carbon dioxide ($CO_2$), Methane ($CH_4$), Nitrous oxide ($N_2O$), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur hexafluoride ($SF_6$), Nitrogen trifluoride ($NF_3$)

## Data Sources for Inventory Development

- National Emissions Inventory (Triennial NEI)
- Energy Information Administration (EIA) – State Energy Data System (SEDS)
- U.S. Department of Agriculture (USDA)
- Air Point Source Registration Data
- PSD Utility purchases (kWh)
- Others…

# Why is the current inventory only through 2015?

- **Many sectors rely on large national data sources**
  - Energy Information Administration (EIA) – State Energy Data System (SEDS) – lag time in data availability

- **Large amount of data from multiple sectors required for models/modules**
  - Use of EPA tools (default data available varies as well as tool release dates)
  - Data availability for calculations in many sectors is lagging (some by multiple years)
  - Potential inaccuracies in generating estimates based on assumptions/projections

# Vermont 1990 – 2015 Greenhouse Gas Emissions Update

*Vermont Greenhouse Gas Emissions Inventory Update 1990 - 2015*

Table 1. Vermont Historic Greenhouse Gas Emissions by Sector[5,6]

| Sector | Million Metric Tons $CO_2$ Equivalent: $MMTCO_2e$ | | | | | |
|---|---|---|---|---|---|---|
| | 1990 | 2000 | 2005 | 2013 | 2014 | 2015 |
| **Electricity Supply & Demand (consumption based)** | **1.09** | **0.43** | **0.64** | **0.81** | **0.84** | **1.00** |
| Coal | 0 | 0 | 0 | 0 | 0 | 0 |
| Natural Gas | 0.047 | 0.018 | 0.000 | 0.001 | 0.000 | 0.015 |
| Oil | 0.014 | 0.058 | 0.011 | 0.013 | 0.021 | 0.006 |
| Wood ($CH_4$ & $N_2O$) | 0.003 | 0.010 | 0.014 | 0.015 | 0.014 | 0.015 |
| Residual System Mix | 1.03 | 0.35 | 0.62 | 0.78 | 0.81 | 0.96 |
| **Residential / Commercial / Industrial (RCI) Fuel Use** | **2.41** | **2.86** | **2.98** | **2.46** | **2.60** | **2.78** |
| Coal | 0.017 | 0.003 | 0.000 | 0 | 0 | 0 |
| Natural Gas | 0.314 | 0.496 | 0.440 | 0.494 | 0.550 | 0.621 |
| Oil, Propane & Other Petroleum | 2.057 | 2.341 | 2.494 | 1.875 | 1.957 | 2.085 |
| Wood ($CH_4$ & $N_2O$) | 0.022 | 0.021 | 0.041 | 0.093 | 0.095 | 0.074 |
| **Transportation** | **3.38** | **4.15** | **4.49** | **3.88** | **4.10** | **4.33** |
| Onroad Gasoline | 2.64 | 3.20 | 3.29 | 2.73 | 3.03 | 3.16 |
| Onroad Diesel | 0.41 | 0.66 | 0.69 | 0.62 | 0.54 | 0.57 |
| Jet Fuel & Aviation Gasoline | 0.08 | 0.07 | 0.17 | 0.10 | 0.09 | 0.11 |
| Rail / Ship / Boats / Other Nonroad | 0.25 | 0.23 | 0.34 | 0.43 | 0.44 | 0.50 |
| **Fossil Fuel Industry** | **0.0077** | **0.0040** | **0.0039** | **0.0047** | **0.0048** | **0.0050** |
| Natural Gas Distribution | 0.0068 | 0.0030 | 0.0028 | 0.0036 | 0.0037 | 0.0039 |
| Natural Gas Transmission | 0.0009 | 0.0010 | 0.0011 | 0.0011 | 0.0011 | 0.0011 |
| **Industrial Processes** | **0.21** | **0.59** | **0.59** | **0.60** | **0.57** | **0.58** |
| ODS Substitutes | 0.00 | 0.17 | 0.21 | 0.31 | 0.32 | 0.33 |
| Electric Utilities ($SF_6$) | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| Semiconductor Manufacturing (HFCs, PFCs & $SF_6$)[7] | 0.16 | 0.37 | 0.33 | 0.25 | 0.21 | 0.21 |
| Limestone & Dolomite Use | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.03 |
| Soda Ash Use | 0.006 | 0.006 | 0.005 | 0.004 | 0.004 | 0.004 |
| **Waste Management** | **0.27** | **0.36** | **0.34** | **0.22** | **0.21** | **0.17** |
| Solid Waste | 0.21 | 0.30 | 0.28 | 0.15 | 0.14 | 0.10 |
| Wastewater | 0.061 | 0.067 | 0.068 | 0.069 | 0.069 | 0.069 |
| **Agriculture** | **1.22** | **1.23** | **1.17** | **1.12** | **1.12** | **1.14** |
| Enteric Fermentation | 0.70 | 0.69 | 0.63 | 0.64 | 0.64 | 0.64 |
| Manure Management | 0.18 | 0.22 | 0.23 | 0.20 | 0.20 | 0.21 |
| Agricultural Soils | 0.35 | 0.33 | 0.31 | 0.29 | 0.29 | 0.29 |
| **TOTAL GROSS EMISSIONS** | **8.59** | **9.64** | **10.22** | **9.10** | **9.45** | **9.99** |
| **Change relative to 1990 (baseline)** | **—** | **+ 12%** | **+ 19%** | **+ 6%** | **+ 10%** | **+ 16%** |

https://dec.vermont.gov/air-quality/climate-change

# Emission Comparison - Vermont and the U.S.

- High per capita vehicle miles traveled (VMT) for Vermont drivers
- Higher residential and commercial fuel use percentage from winter heating in VT
- Emissions from electricity consumption sector lower in VT due mostly to large hydro purchases
- Few large emission point sources in Vermont – somewhat skews transportation percentage