

The Greenhouse Gas Emissions Inventory

Overview Presentation to the Science and Data Subcommittee of the Vermont Climate Council

April 26, 2023

The Greenhouse Gas Emissions Inventory

- Inventory of anthropogenic (human caused) greenhouse gas (GHG) emissions for Vermont
 - Annual estimates of total gross GHG emissions (no emissions sinks/CO₂ removals) in the state by sector
 - Transportation
 - Residential/Commercial/Industrial (RCI) fuel use
 - Electricity generation (consumption based)
 - Industrial Processes
 - Agriculture
 - Waste and Wastewater
 - Fossil Fuel Industry
 - * Does not include biogenic CO₂ in gross totals per IPCC inventory guidelines (estimated separately for several sectors)
 - Uses available activity data (e.g. fuel sales,), emission factors, and various process assumptions to estimate GHG emissions
 - Inventory estimates emissions for GHGs covered by internationally agreed upon protocol in million metric tons of CO₂ equivalent (MMTCO₂e)
 - CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, NF₃

The Greenhouse Gas Emissions Inventory

- Methodologies consistent with accepted GHG inventory standards/protocols
 - Final Vermont Greenhouse Gas Inventory and Reference Case Projections, 1990-2030 (2007) report
 - Intergovernmental Panel on Climate Change (IPCC)
 - EPA
 - Regional collaboration to discuss and understand methodologies used in neighboring states
- Used to track levels of GHG emissions in Vermont through time
 - Attempt to maintain comparability of emissions estimates through time
 - To better understand sector contributions which can help to guide actions for greenhouse gas mitigation and track progress toward our state emissions reduction requirements
 - To be a participant in a larger scale (regional, national, worldwide) effort to understand, track, and combat anthropogenic driven global warming

The Greenhouse Gas Emissions Inventory

- Inventory relies on a number of federal datasets and EPA tools and therefore lags several years behind the calendar year when the emissions occurred
- Newly released inventory (1990 – 2020)
- Inventory relies heavily on the EPA State Inventory Tool (SIT) modules
 - Modules developed by EPA to assist states in quantifying GHG emissions by sector
 - Able to use default values in the tool or incorporate state specific data where available
- Inventory and associated tools/methodologies utilizes a large amount of data from multiple sectors
 - Data and tool availability varies
 - Potential inaccuracies in generating estimates based on assumptions/projections
 - Lag in inventory release is typical of GHG inventories

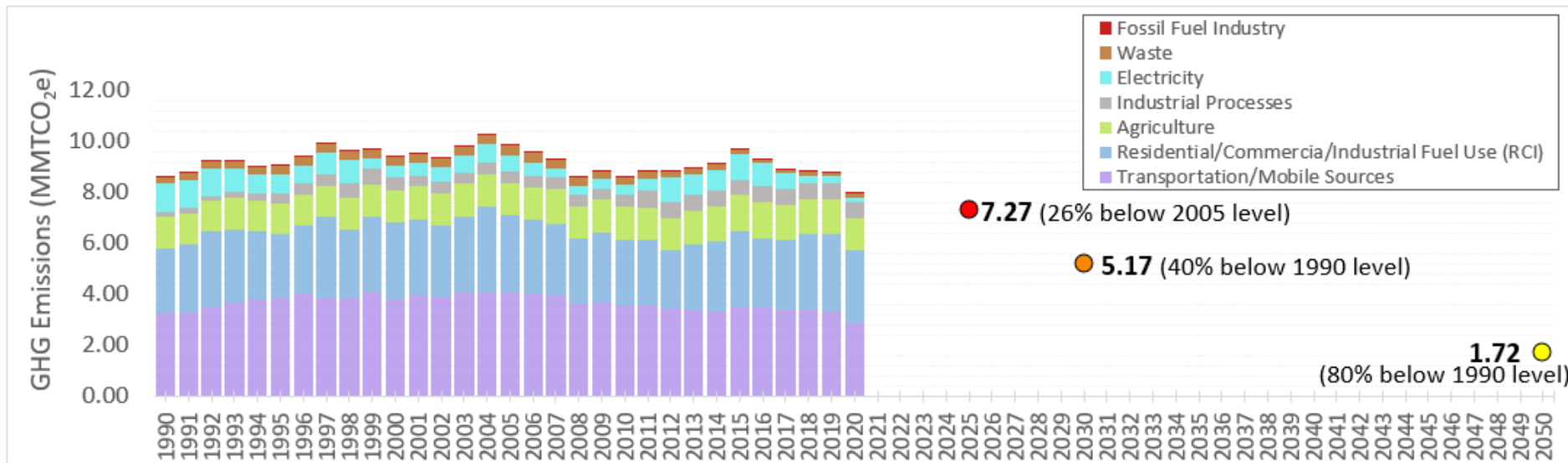
GHG Inventory Release (1990-2020)

- Updated format that separates the report into the report itself and an accompanying methodology document
 - GHG Inventory and Forecast report (1990 – 2020) released
 - Accompanying methodology report released
 - Methodology report to remain as a more static document to be updated as needed when changes to the methodology are made
 - Work to commence in the coming months:
 - Setting a date for a consistent scheduled annual inventory release
 - Determining a transparent process and procedure for significant changes to datasets or methodologies
 - Potentially through a review process with the Science and Data Subcommittee

The Greenhouse Gas Emissions Inventory

Connection to the GWSA

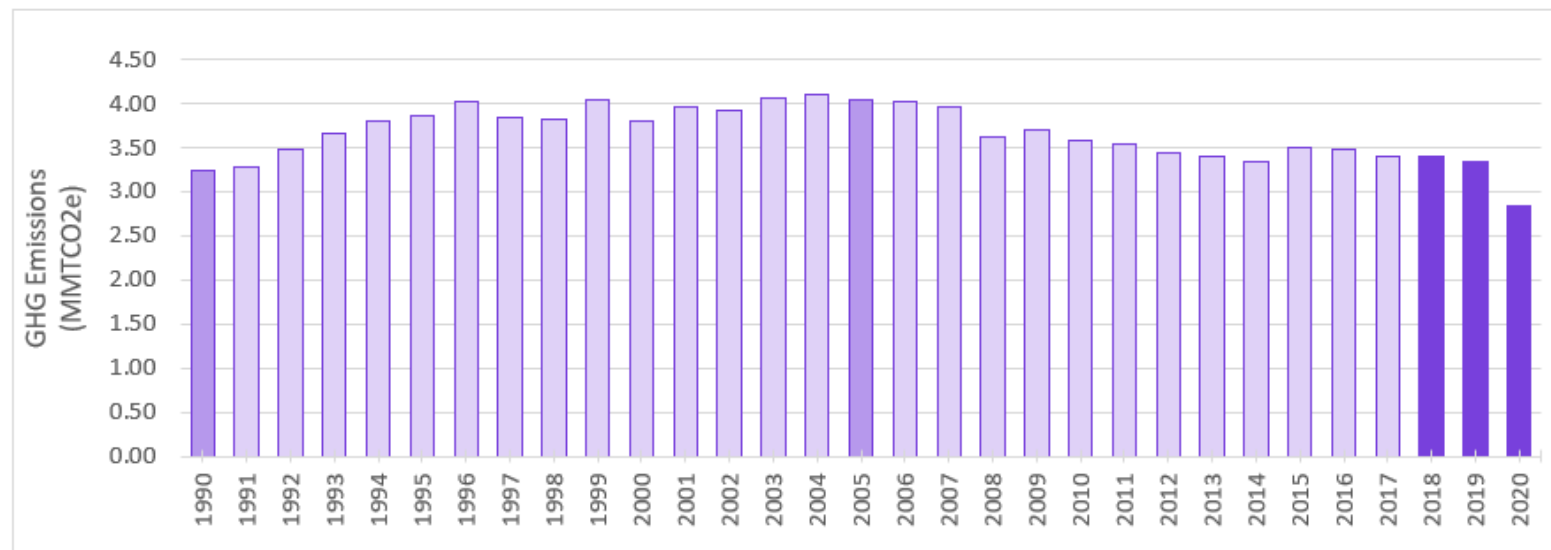
- GHG Inventory is referenced in the Global Warming Solutions Act as being the metric for determining whether Vermont's GHG emissions levels have been achieved.
 - "Greenhouse gas reduction requirements. Vermont shall reduce emissions of greenhouse gases from within the geographical boundaries of the State and those emissions outside the boundaries of the State that are caused by the use of energy in Vermont as measured and inventoried pursuant to section 582 of this title..."
- Inventory establishes the historical baseline values by which emissions reduction progress is measured (1990 and 2005) and whether the required reductions are achieved.



The Greenhouse Gas Emissions Inventory

Sector Breakdown - Transportation

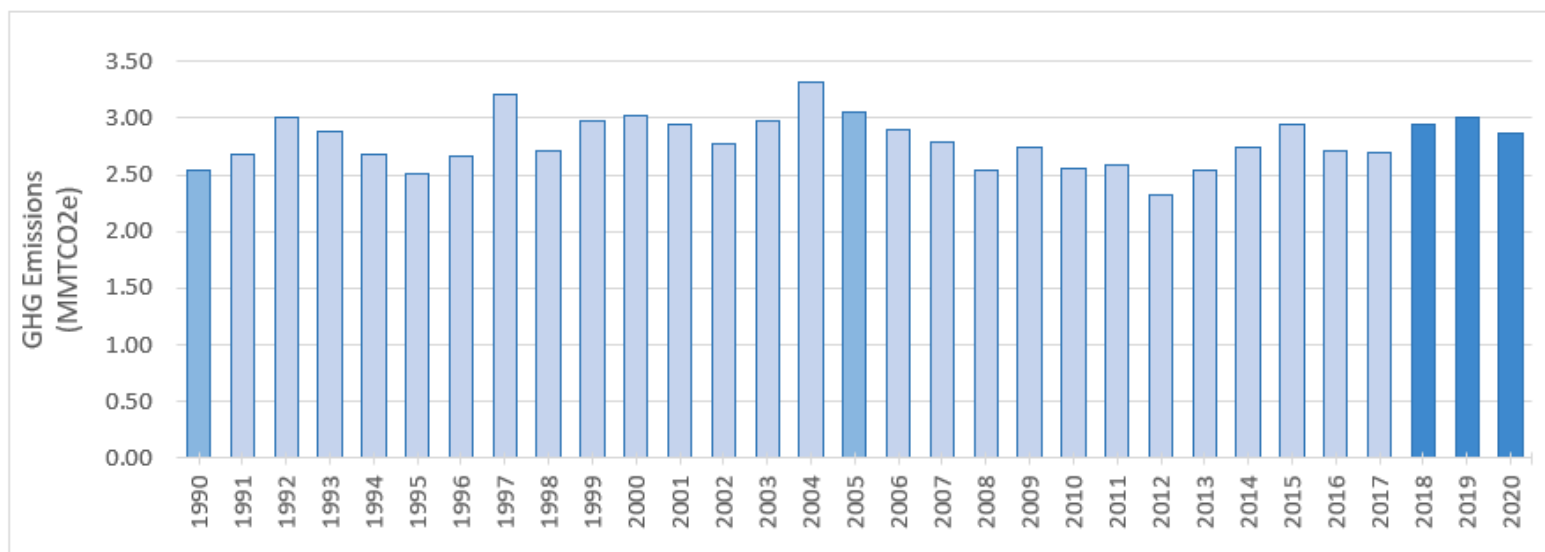
- EPA State Inventory Tool (SIT) module used to estimate transportation sector emissions
 - Onroad emissions
 - Nonroad emissions
 - Utilize both default data and JFO fuel sales data
- Methodology updated in 1990 – 2017 inventory from VMT based to fuel sales



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Residential/Commercial/Industrial Fuel Use (RCI)

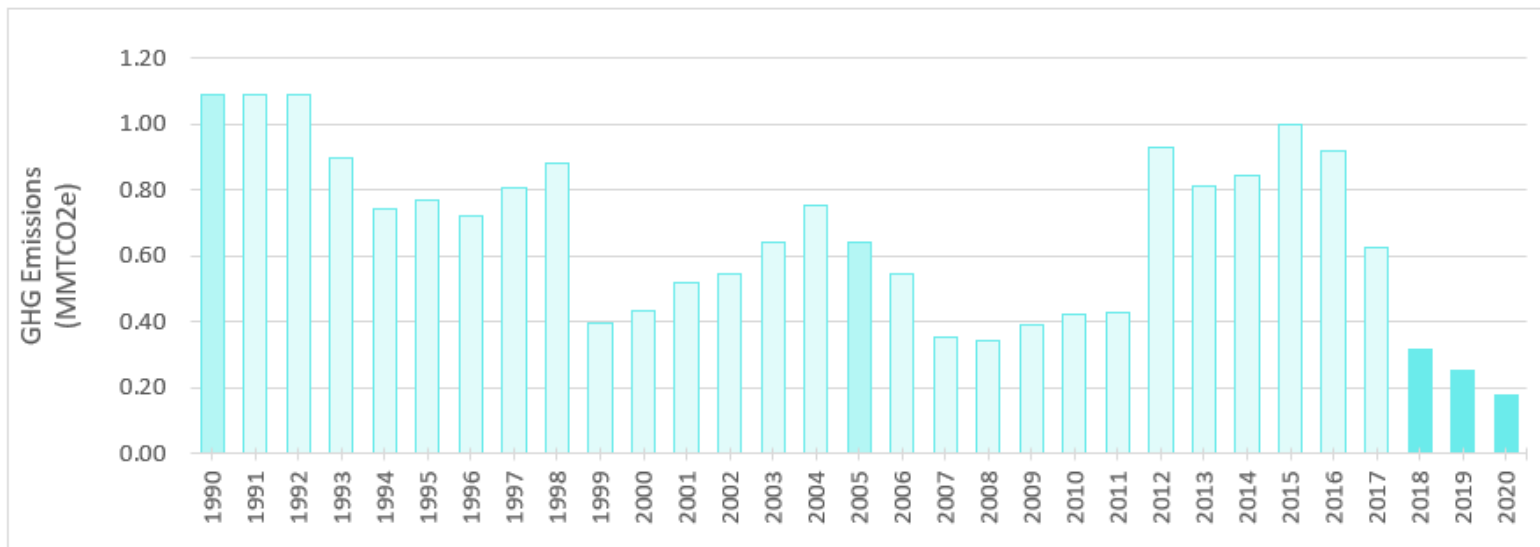
- EPA State Inventory Tool (SIT) modules used to estimate RCI sector emissions
 - CO₂ from Fossil Fuel Combustion Module
 - Stationary Combustion Module (CH₄, N₂O)
 - Use EIA SEDS data for estimates and supplemental wood use data
- Sector mainly includes emissions from heating buildings, heating water, and cooking



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Electricity Generation (consumption based)

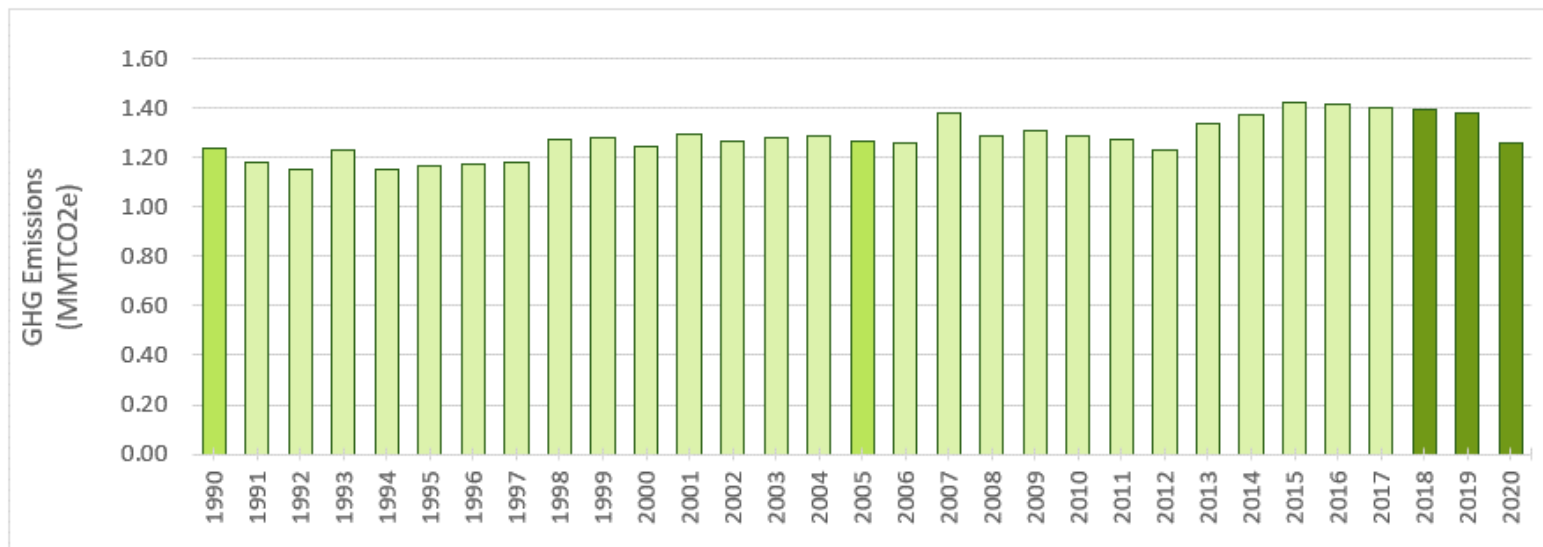
- Not true consumption-based methodology (but only sector to include emissions occurring outside the state)
- Based on MWh purchase decisions made by utilities
 - Calculations/accounting method includes sales and retirements of RECs
 - Emission factors by generation type are applied to MWh totals by generation type



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Agriculture

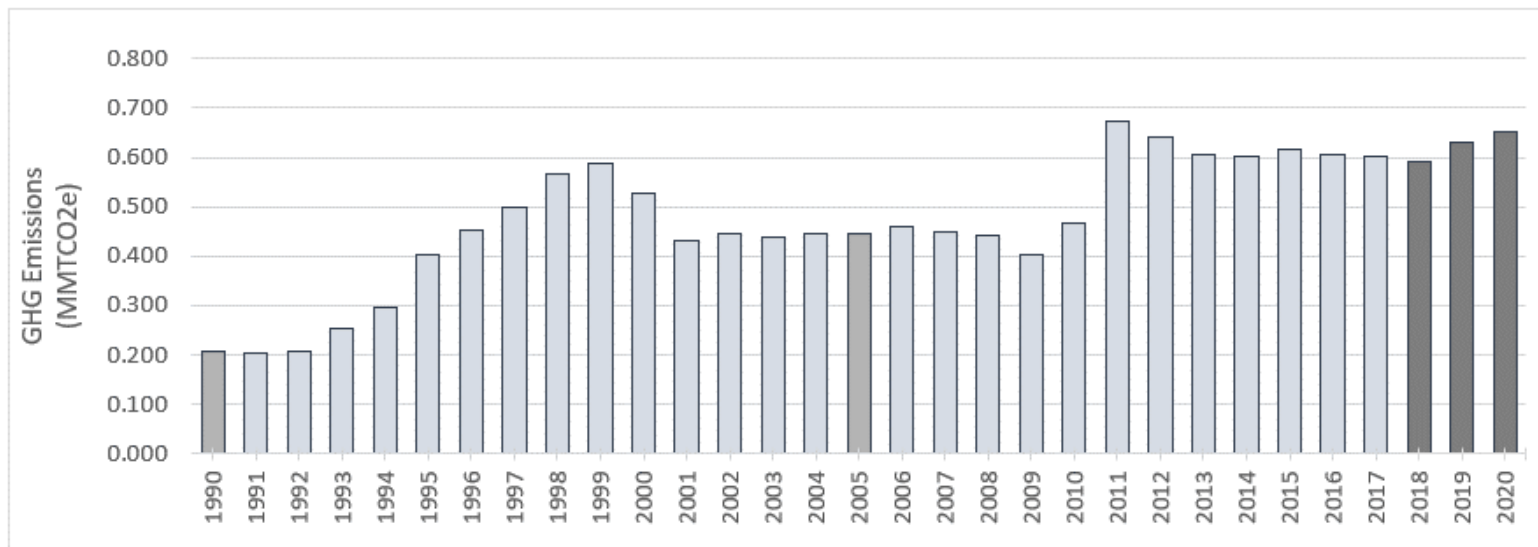
- EPA SIT module for estimating agricultural emissions
 - Almost exclusively CH₄ and N₂O
 - CO₂ is biogenic and so not included in sector totals
 - Based on EPA defaults (mainly USDA data)
- Enteric fermentation, manure management, agricultural soils, liming and urea fertilization
- Contract work to begin soon investigating tools for improved net and gross accounting in Ag sector



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Industrial Processes

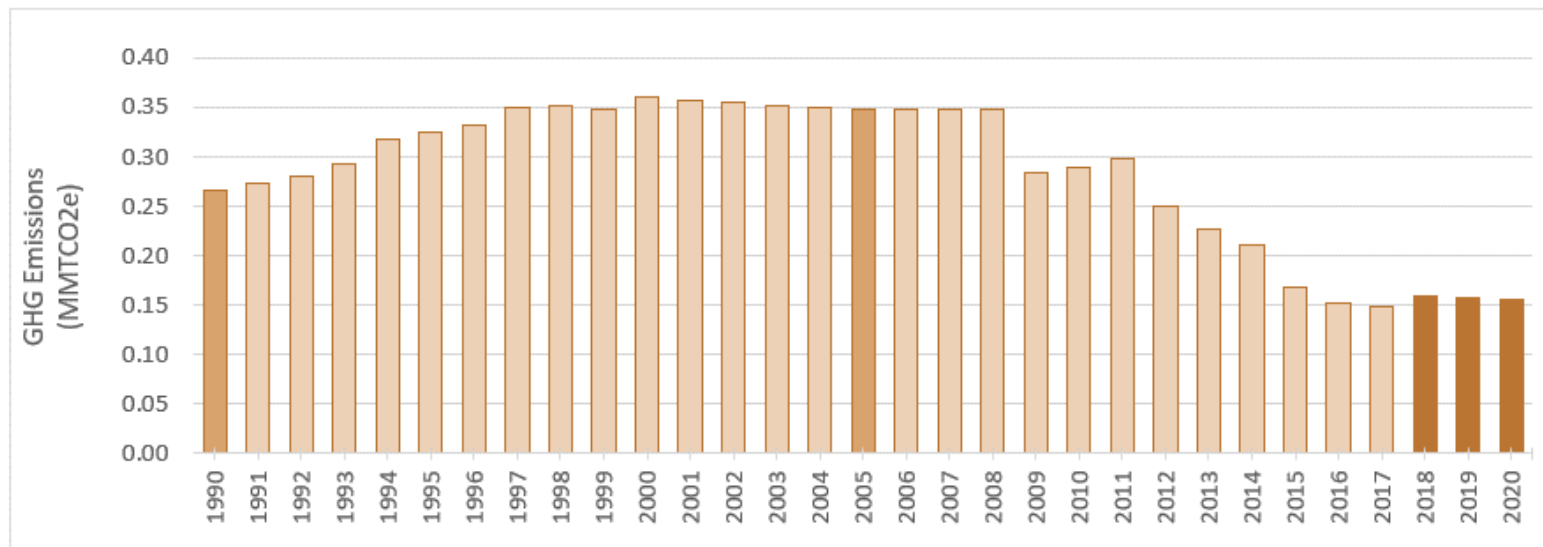
- Two main contributing categories (semiconductor manufacturing, ODS substitutes)
 - Semiconductor manufacturing – recent values based on reported data historical on National estimates
 - Ozone Depleting Substances (ODS) Substitutes – per capita tool developed for US Climate Alliance states
 - EPA SIT module (limestone and dolomite use, Electric Utilities, Soda Ash Use, Urea Consumption)
- High global warming potential gases (most many times more potent than CO₂)



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Waste and Wastewater

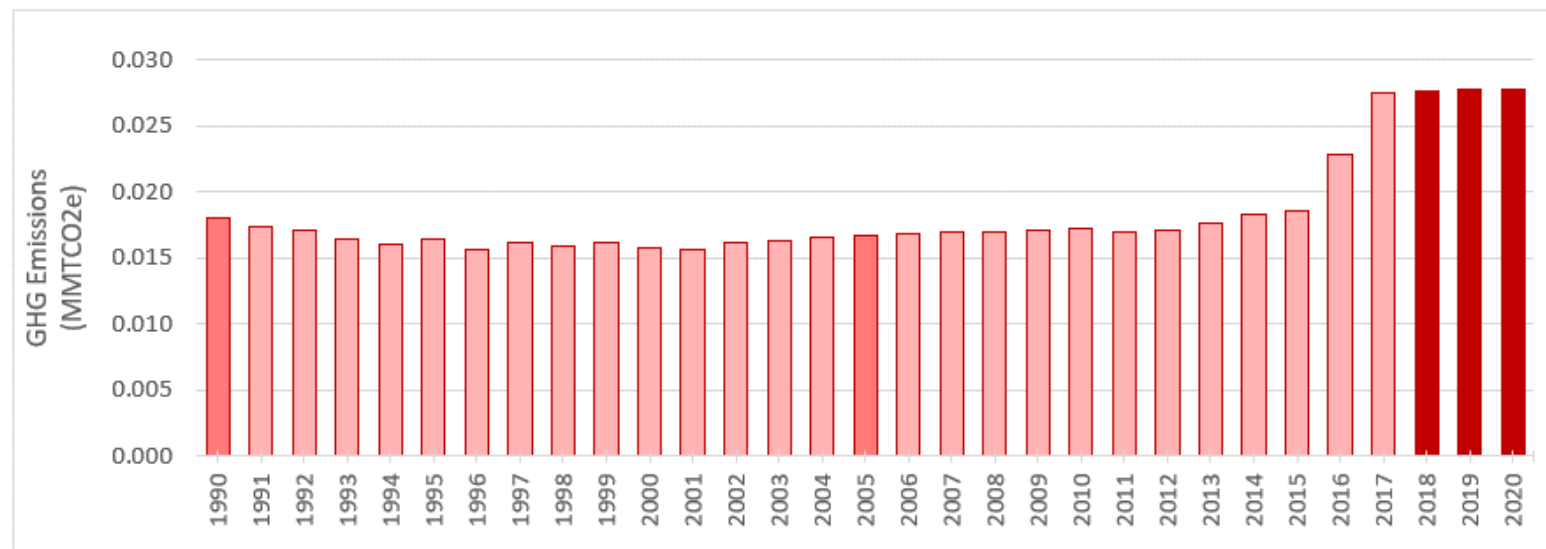
- Includes CH₄ and N₂O emissions from solid waste and wastewater (biogenic CO₂ not included)
 - Solid Waste: Emissions calculated using reported landfill gas (LFG) totals from 4 facilities (historical data from EPA SIT defaults)
 - Mainly fugitive CH₄ as LFG combusted is considered biogenic CO₂
 - Wastewater: Estimates from an EPA SIT module with mainly EPA defaults
 - Adjust percent of households on septic



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Fossil Fuel Industry

- Sector includes fugitive emissions of CH₄ from transmission and distribution of natural gas
- Emissions estimates calculated using EPA SIT module (Natural Gas and Oil Module) for transmission of natural gas and a similar approach for distribution based on miles of pipeline and different leakage rates
- Vast majority of fossil fuel emissions captured in the other sectors of the inventory



The Greenhouse Gas Emissions Inventory

Sector Breakdown – Land-Use, Land Use Change, and Forestry (LULUCF)

- Inventory now uses new state level data from EPA (based on National Inventory methodologies)
 - Other states in the region also struggling with this sector due to lack of reliable data
 - Historically sector has mainly been focused on forests (best data available)
 - Sector is the sequestration component of the GHG inventory (emissions removed from the atmosphere)
- Issue with biogenic CO₂ and the LULUCF sector
 - Emissions from combustion or decomposition of biomass are captured through changes to land use (i.e., forest land converted to settlement land releases carbon), but data needs to be annual and high enough resolution to capture those changes in order to accurately account for biogenic CO₂ component.

Questions?