AGENCY OF NATURAL RESOURCES

TESTIMONY ON S.5

Julie Moore, Secretary
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March 21, 2023

Agenda

- Background/overview of GHG Inventory

- Connection between GHG Inventory and S.5
  - Life-cycle Analysis

- Preview of next GHG Inventory report (1990 – 2020)

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Greenhouse Gas Emissions Inventory

- Required by statute 10 V.S.A. § 582

- Establishes 1990 and 2005 baseline GHG levels

- Estimates gross GHG emissions (no emissions sinks/CO2 removals) by sector

    - Transportation
    - Residential/Commercial/Industrial (RCI) fuel use
    - Electricity generation (based on total electricity consumed)
    - Industrial Processes
    - Agriculture
    - Waste and Wastewater
    - Fossil Fuel Industry
    - * Land-use, Land Use Change, and Forestry (LULUCF), *not included in gross totals*

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Greenhouse Gas Emissions Inventory

- Used to determine progress toward GWSA GHG reduction targets as established in 10 V.S.A. § 578

  ...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...

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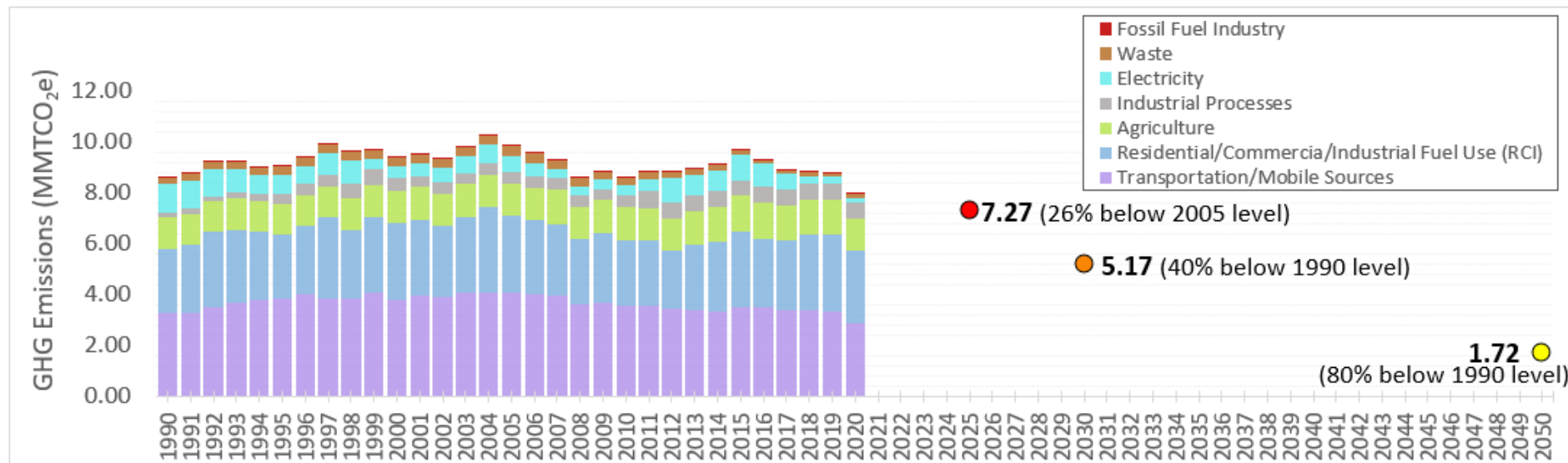
Greenhouse Gas Emissions Inventory

- Approach consistent with accepted GHG inventory standards/protocols
  - Intergovernmental Panel on Climate Change (IPCC)
  - Many of the calculations utilize EPA State Inventory Tool (SIT) tool
    - 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

- Enables regional collaboration with neighboring states and allows Vermont to participate in a larger scale (regional, national, worldwide) efforts to understand, track, and combat anthropogenic driven global warming

- Maintains comparability of emissions estimates through time to the extent possible

- Informs understanding of sector contributions and can guide actions for GHG mitigation

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Greenhouse Gas Emissions Inventory

- Uses available activity data (e.g. fuel volumes), emission factors, federal datasets, EPA tools and various process assumptions to estimate GHG emissions
  - Availability of key data and tools can lag several years behind the calendar year when the emissions occurred

- Estimates emissions for GHGs covered by internationally agreed upon protocol in million metric tons of CO_2 equivalent (MMTCO2e)
  - CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3

- Does not include biogenic (read: wood) CO_2 in gross totals, per IPCC guidelines
  - Estimated separately for several sectors

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Greenhouse Gas Emissions Inventory

- Next GHG Inventory and Forecast report (1990 – 2020) will be released in April 2023
  - Will include the inventory and a separate methodology document
    - Methodology report to remain as a more static document; updated as needed when changes to the methodology are made
    - Inventory will be released on a consistent schedule going forward

- Given the importance of the Inventory to the GWSA, including legal cause of action, ANR is developing a procedure that will establish how significant changes to datasets or methodologies used in the Inventory will be made going forward

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Greenhouse Gas Emissions Inventory and the Clean Heat Standard (S.5)

- § 8124(a)(1) requires the PUC to establish the number of clean heat credits that need to be retired each year based on "…each obligated party's contribution to the thermal sector's lifecycle CO2e emissions in the previous year."
  - There is ~24-month "data lag" in producing the GHG Inventory
    - GHG Inventory currently uses default data from the Energy Information Administration (EIA) for the thermal sector
  - Fuel sales are noisy and weather driven… unclear whether relying on the "previous year" will be practical
- GHG Inventory estimates gross GHG emissions by sector within the state boundary **VS.** S.5 (§ 8127(g)(1)) is based on lifecycle emissions for various fuels and Clean Heat measures
  - Unclear how to establish and harmonize the non-lifecycle GHG Inventory values with lifecycle emissions requirements of S.5
  - GHG Inventory could not incorporate the emissions from the lifecycle analyses without creating inconsistencies with IPCC/EPA methods/standards as counting lifecycle emissions in Vermont's GHG Inventory would result in double counting

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Lifecycle Assessment (LCA) Project

- LCAs incorporate emissions from all phases of a product's lifecycle – from extraction to combustion or disposal
  - Are **not** the same framework as the GHG Inventory
  - Helpful additional information (more holistic view) to inform policies related to energy choices and alternatives
- Current ANR contract seeks to:
  - Conduct LCAs for all existing and emerging energy sources used in Vermont
    - Fossil fuels, biofuels, renewables, hydro, other fuels in imported electricity
  - Complete analysis to:
    - Provide GHG emissions factors for each phase of the energy pathways used in Vermont; and
    - Quantify the GHG emissions for each pathway based on energy usage totals in the inventory
    - * Lifecycle analysis totals will not be included in the GHG inventory itself because it is not a comparable accounting framework, but will be available as supplemental information
- Expected completion of LCA project by July 2023

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Greenhouse Gas Emissions Inventory
## Transportation

- EPA State Inventory Tool (SIT) modules used to estimate transportation sector emissions
  - Onroad emissions
  - Nonroad emissions
  - Aviation gasoline and jet fuel
  - Utilize both default data and JFO fuel sales data

- Methodology updated in 1990 – 2017 inventory from VMT based to fuel volumes
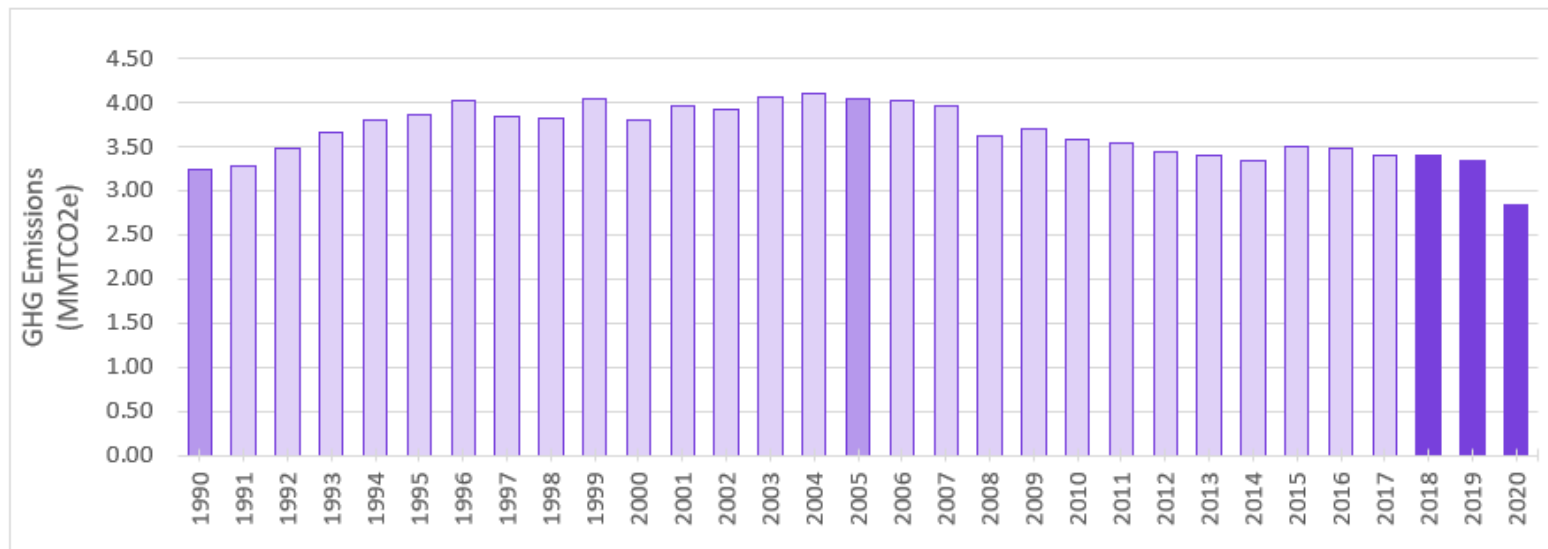
Greenhouse Gas Emissions Inventory
## Residential/Commercial/Industrial Fuel Use (RCI)

- EPA State Inventory Tool (SIT) modules used to estimate RCI sector emissions
  - CO_2 from Fossil Fuel Combustion Module
  - Stationary Combustion Module (CH_4, N_2O)
  - Use EIA SEDS data for estimates and supplemental wood use data

- Sector mainly includes emissions from heating buildings, heating water, and cooking
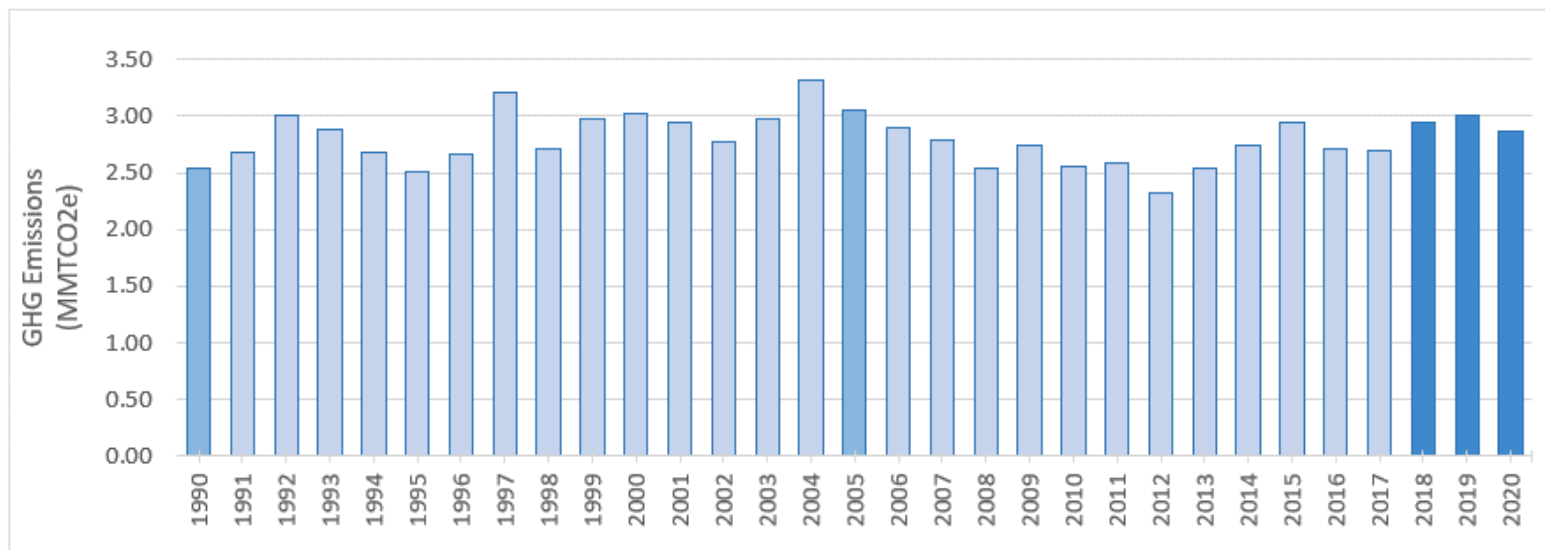
Greenhouse Gas Emissions Inventory

## Electricity Generation (consumption based)

- Not true consumption-based methodology (but only sector to include emissions occurring outside the state)

- Based on megawatt hour (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

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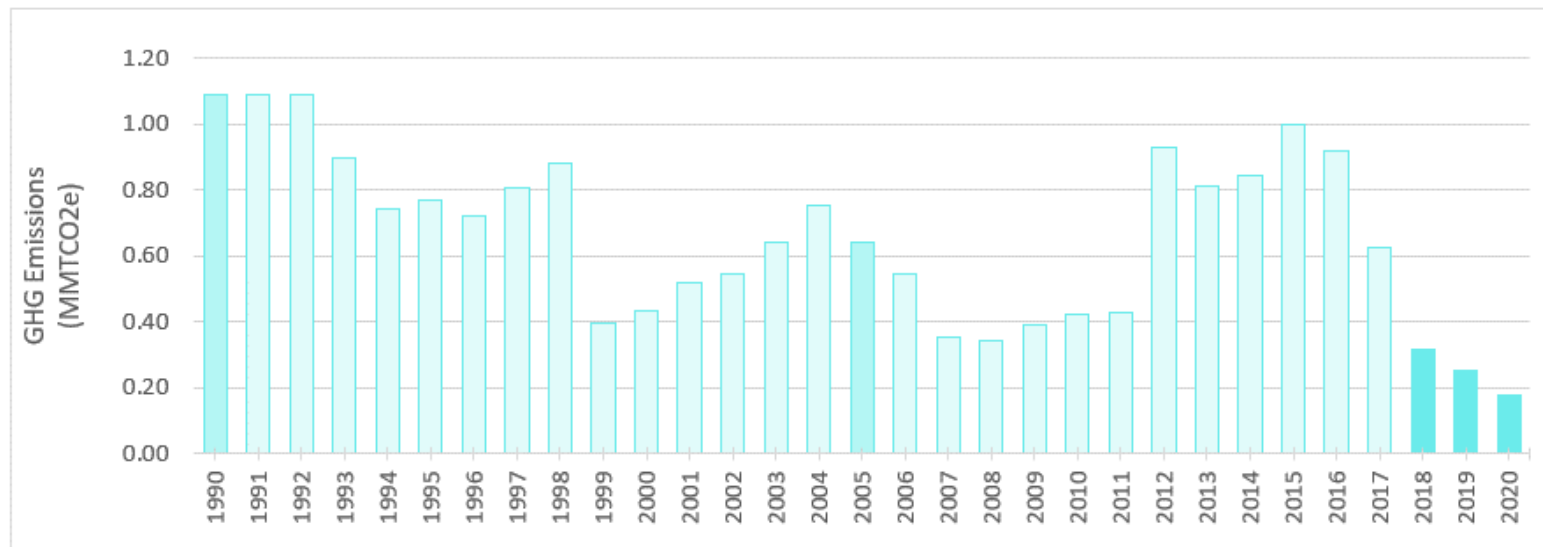
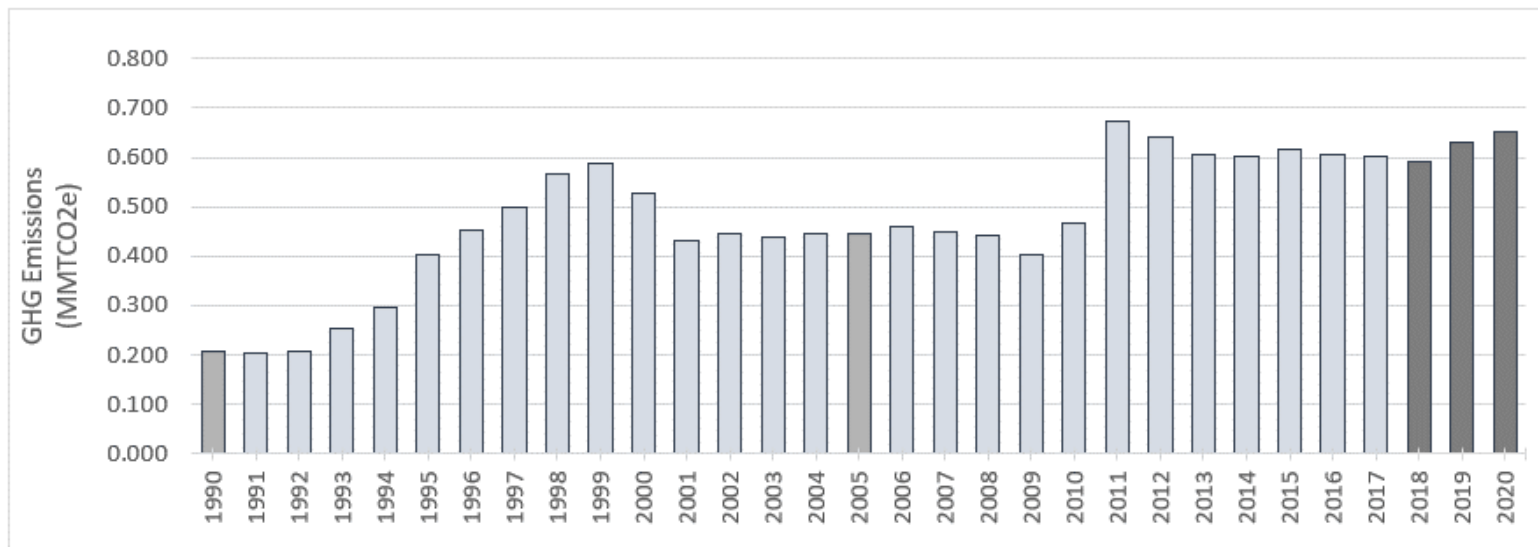# Greenhouse Gas Emissions Inventory
Agriculture

- EPA SIT module for estimating agricultural emissions
    - Almost exclusively CH_4 and N_2O
    - CO_2 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
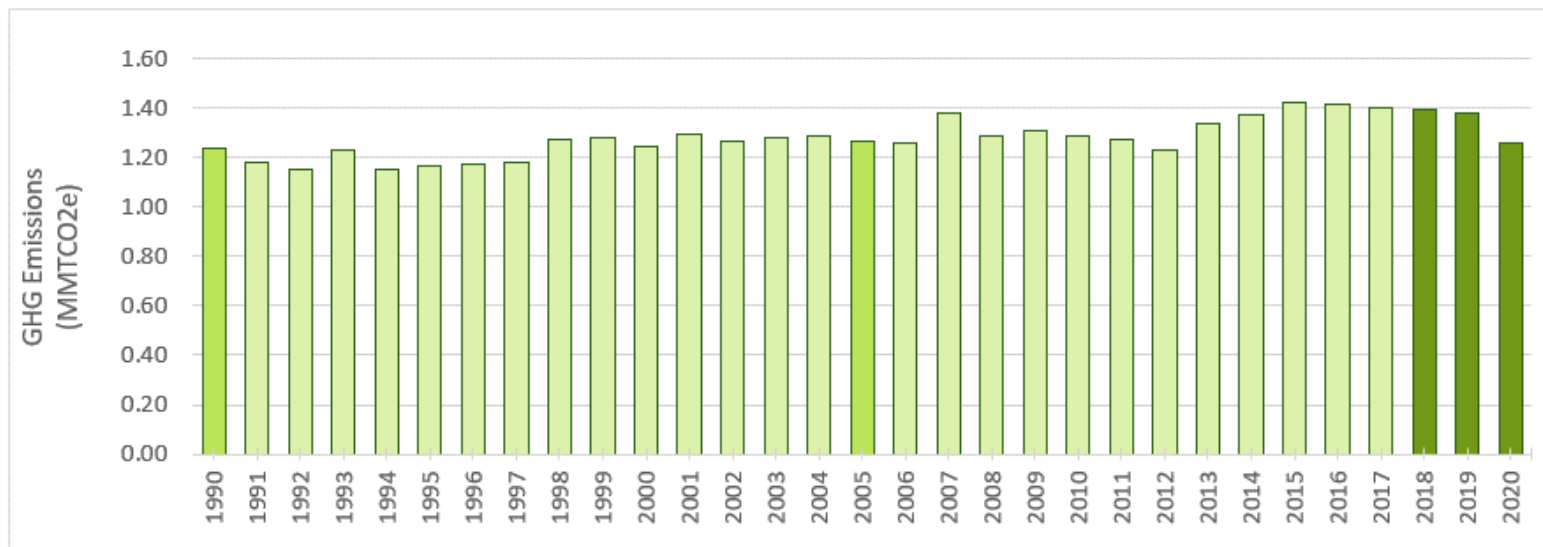
Greenhouse Gas Emissions Inventory

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)

- Most emissions from high global warming potential gases (most many times more potent than CO2)

Greenhouse Gas Emissions Inventory

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 mainly from an EPA SIT module default values
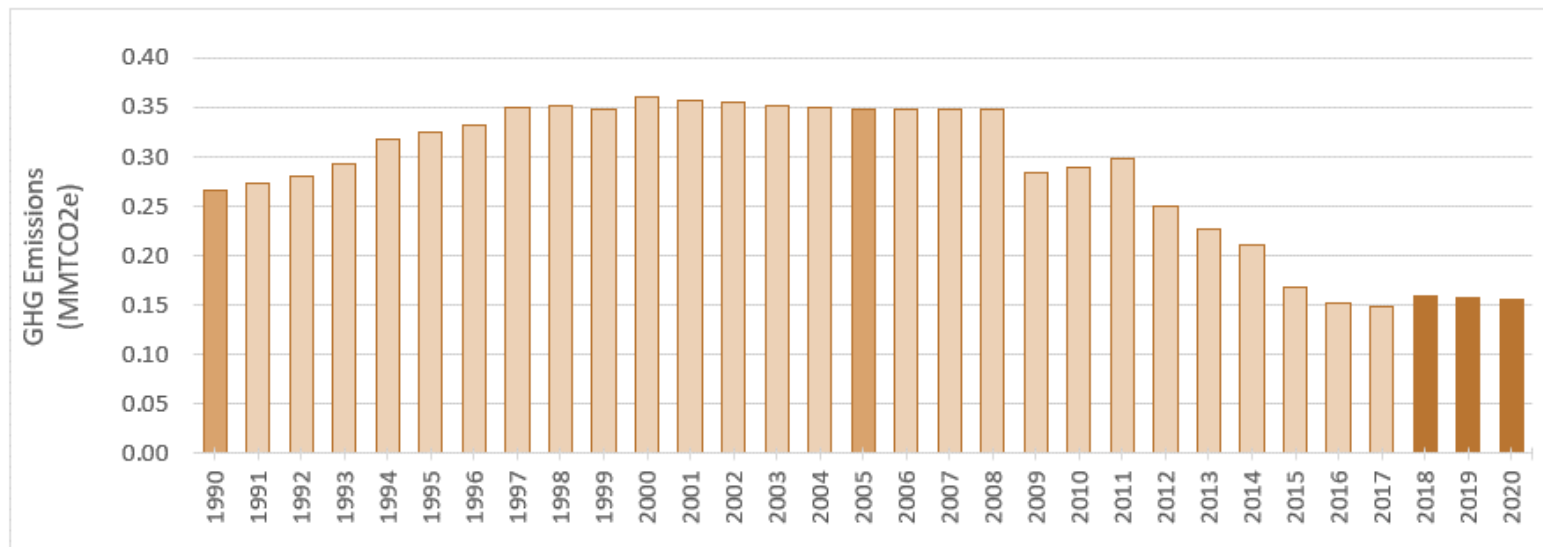
Greenhouse Gas Emissions Inventory

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
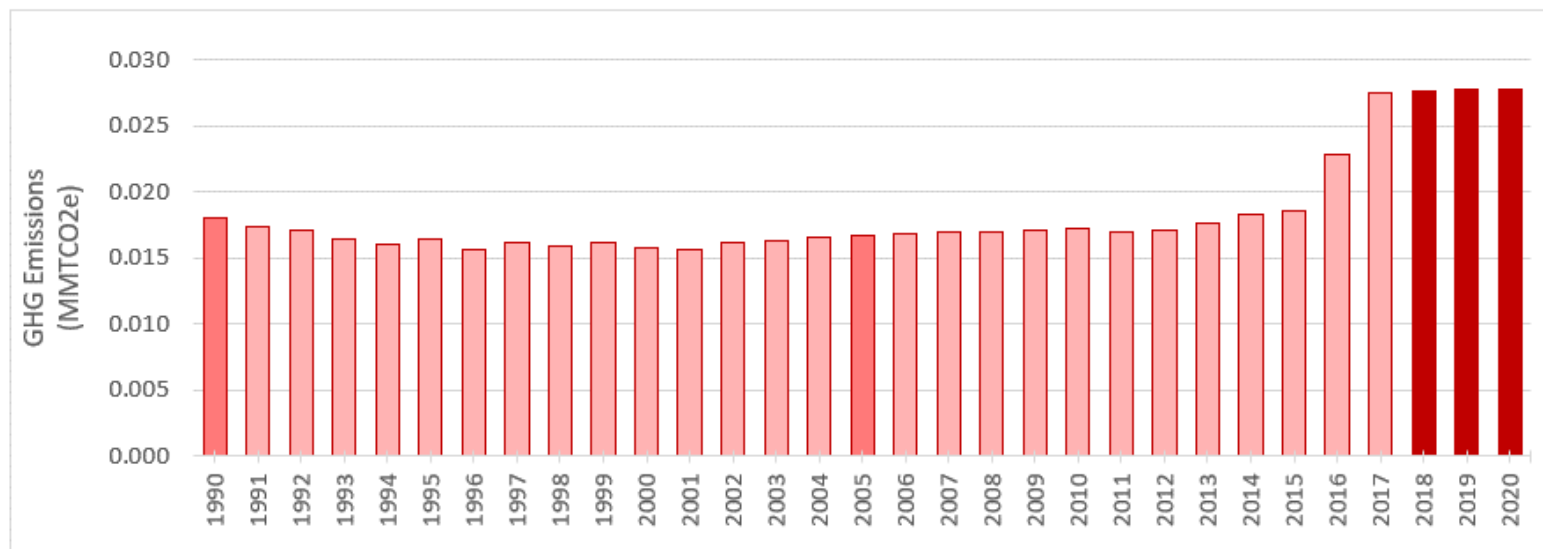
Greenhouse Gas Emissions Inventory
Land-Use, Land Use Change, and Forestry (LULUCF)

- Using a new data source for LULUCF sector in 1990 – 2020 inventory
  - EPA recently produced state level estimates based on scaling the National GHG Inventory
  - New more complete LULUCF sector is included (not in gross totals) but still a lack of confidence in the accuracy of some of the estimates
  - Other states in the region also struggling with this sector due to lack of reliable data
  - Historically sector has mainly focused on forests (best data available)

- Sector comprises the sequestration component of the GHG Inventory (emissions removed from the atmosphere by vegetation)

- Issue with biogenic CO_2 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)
  - Data needs to be annual and high enough resolution to capture those changes in order to accurately account for biogenic CO_2 component

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Thank you.

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