



Overview of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010*

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U.S. Greenhouse Gas Inventory Background



- The U.S. Government annually submits a national U.S. GHG Inventory Report
 - This is the official U.S. Government GHG Inventory
 - Meets U.S. commitments under the UNFCCC
 - Impartial and policy-neutral
- Interagency effort led by EPA
 - Data and input provided by DOE, USDA, DOT, DOD, the State Department, and others
- Open for 30 day public review and comment period
 - As well as “peer review” targeted at technical audience
 - International peer review through the UNFCCC

United Nations Framework Convention on Climate Change



- The UN Framework Convention on Climate Change “sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change”
 - Adopted in 1992
 - Signed and ratified by the U.S. in 1992
 - Ratified by 189 countries
 - Annex I
 - Industrialized nations and “economies in transition”
 - Non-Annex I
 - Developing countries
- Under the UNFCCC, governments:
 - “Gather and share information on greenhouse gas emissions, national policies and best practices”
 - GHG inventories are considered mechanisms to compare relative contributions

GHG Inventory Reporting under the UNFCCC



- All Annex I countries (i.e., developed countries) are required to report annual emissions and sinks of greenhouse gases to the UNFCCC Secretariat
 - 41 Annex I countries (+ European Union)
- Anthropogenic sources and sinks
- CO₂, CH₄, N₂O, HFCs, PFCs, SF₆
 - Weighted using “Global Warming Potential”
 - Include “indirect GHGs” for informational purposes: ozone precursors (CO, NO_x, NMVOCs) & SO₂
- Calculated using consistent and comparable methodologies

GHG Inventory Compilation Process



- Unlike criteria pollutant inventory (i.e., NEI), GHG emissions are not collected from States for use in national GHG inventory
- U.S. GHG emissions calculated using internationally-accepted methods and appropriate statistics and data for national-level GHG estimates
 - Similar calculation methods used in GHRP (*our next presentation*)
 - But where GHGRP focuses on facility-level calculations of emissions from large entities, focus of GHG inventory is to account for all U.S. GHG emissions across all emitting sources
- In order to provide complete coverage, often aggregated national statistics are used
 - Example: Total fuel use in U.S. economy provided by DOE's Energy Information Administration, which is utilized to estimate total U.S. GHG emissions from fuel combustion

IPCC Methodologies



- IPCC guidelines/guidance provide broad international calculation methods:
 - List of emission source types and a compendium of information on methods and factors for the estimation of emissions
 - Step-by-step directions for assembling, documenting and transmitting national inventory data consistently
- Assists development of inventories that are transparently documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and quality assurance, and efficient in the use of resources



IPCC Methodologies (II)



- IPCC guidelines divided into sectors:
 - Energy = emissions of all greenhouse gases resulting from stationary and mobile energy activities including fuel combustion and fugitive fuel emissions
 - Industrial Processes = by-product or fugitive emissions of greenhouse gases from industrial processes not directly related to energy activities (not fuel combustion)
 - Solvent and Other Product Use = emissions that are produced as a by-product of various solvent and other product uses
 - Agricultural = anthropogenic emissions from agricultural activities (except fuel combustion)
 - Land Use, Land-Use Change and Forestry = emissions and removals of CO₂ from forest management, other land-use activities, and land-use change
 - Waste = emissions from waste management activities

General, Basic Methodologies



$$\text{Emissions} = \text{Activity Data} \times \text{Emission Factor}$$

- Activity data is generally from national level statistics
 - e.g., CO₂ from Fossil Fuel Combustion: based on fuel consumed
 - Fuel consumption collected and aggregated to national level by EIA
 - Based on EIA surveys and EIA definitions of sectors
 - e.g., CO₂ from Iron & Steel Production: based on national production statistics
 - Coal and coke consumption from EIA; coke consumed for pig iron production and scrap steel consumption from AISI; iron ore consumption in sinter production from USGS
- Emission factors can be mix of IPCC default and country-specific
 - e.g., CO₂ from Fossil Fuel Combustion: based on fuel-specific carbon content analyses conducted by EIA (coal, petroleum, natural gas)
 - Non-CO₂ from IPCC
 - e.g., CO₂ from Iron & Steel Production: based on mix of factors
 - Pig iron and crude steel carbon contents from IPCC
 - Electric arc furnace carbon anodes from DOE

EPA Source-Specific Model

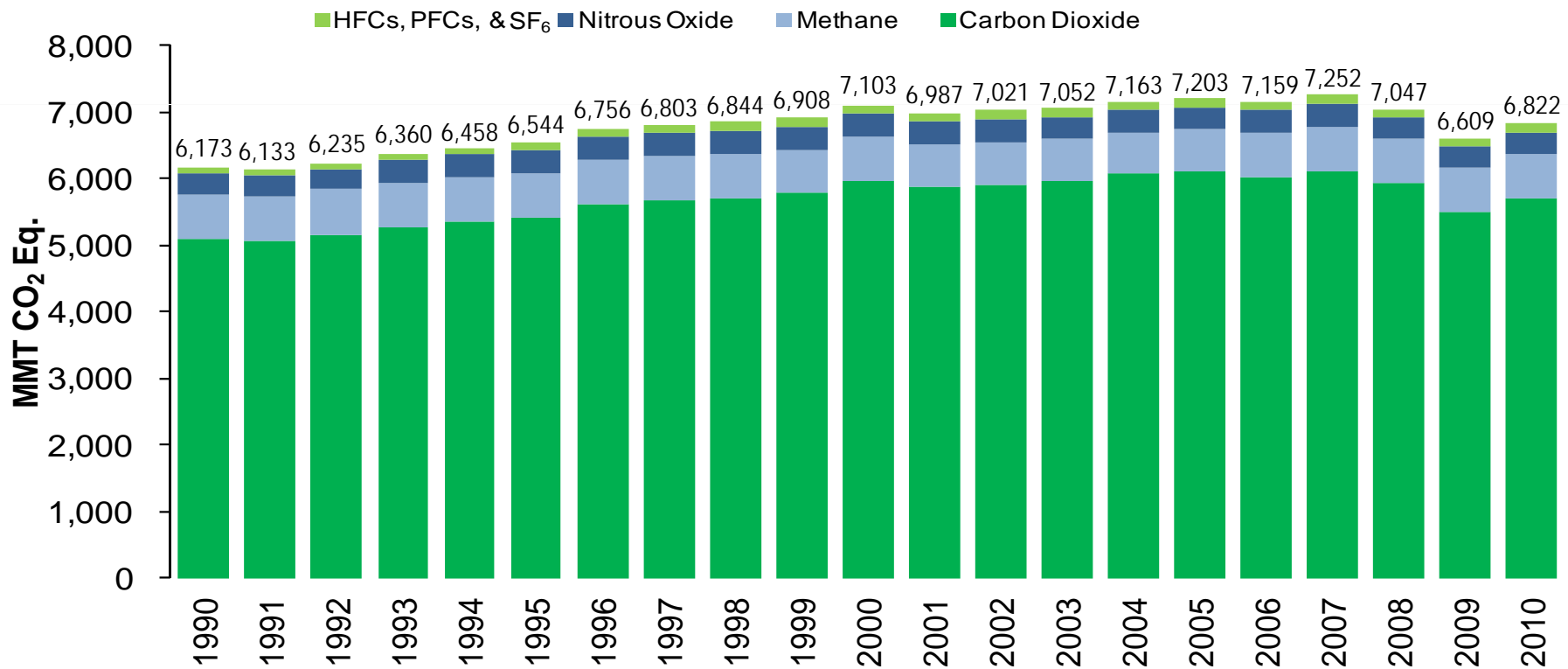


- “Vintaging Model”
 - Tracks turnover in equipment containing ODSs based on estimates of historical equipment and material (e.g., foams) stocks
 - Simulates replacement of ODSs in equipment over time with substitute chemicals including HCFCs, HFCs, PFCs, and SF₆
- “Landfill Model”
 - First order decay model with CH₄ generation coefficients, based on empirical measurements, are applied to waste in place data
 - CH₄ emissions are adjusted for gas recovery for energy, additional CH₄ generation in industrial landfills, and CH₄ oxidation
- Enteric Fermentation
 - Model of livestock populations by animal type and age group applied to CH₄ conversion factors
- Agricultural Soil Management
 - Model uses fertilizer consumption data combined with N₂O emission factors for fertilizer use on agricultural soils

U.S. GHG Emissions by Gas



- U.S. greenhouse gas emissions increased by 3.2% from 2009 to 2010



Taken from: *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (April 2012)

Key Findings from 1990-2010 Inventory Report

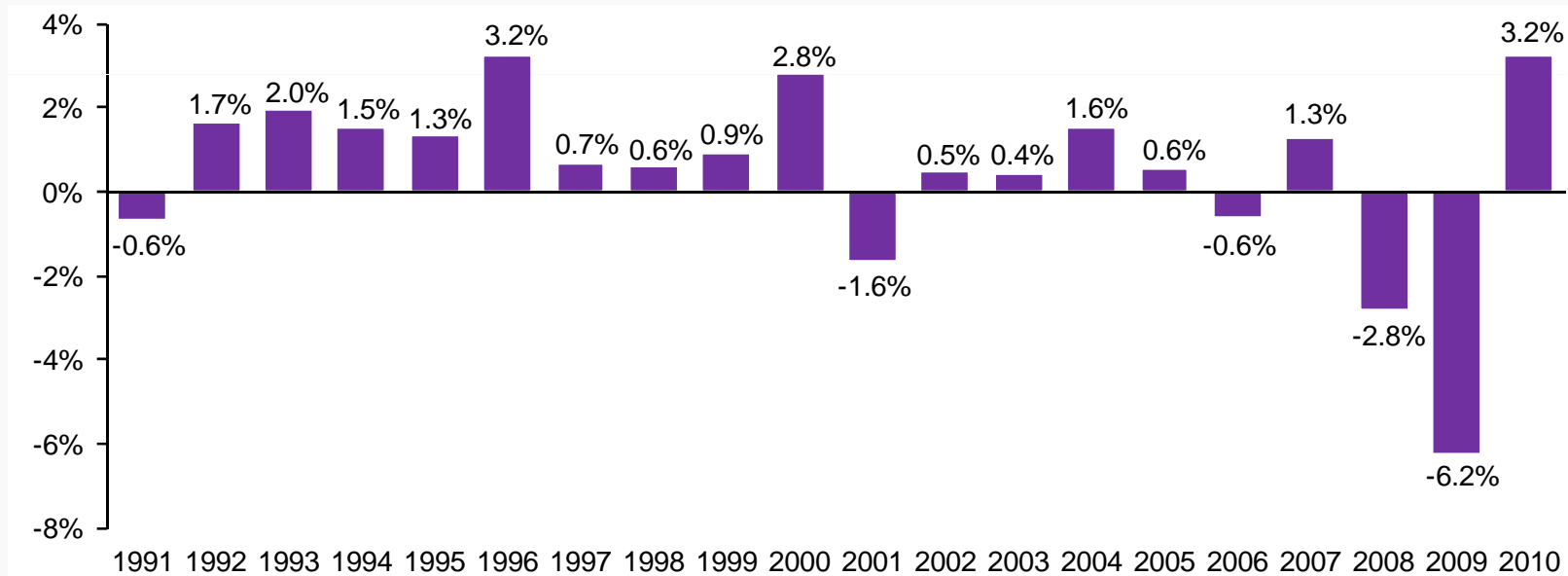


- CO₂ emissions from fossil fuel combustion dominate total emissions and trends
 - The major contributor to the increase in overall GHG emissions was the increased combustion of fossil fuels in 2010, compared to 2009
 - Increase in all sectors (transportation, industrial, residential), save for very small decrease for commercial
 - Increased electricity use in 2010, partially due to warmer summer conditions compared to 2009, which led to increased emissions from the electric power industry
- In 2010, 35% of U.S. GHG emissions come from the electric power industry

Annual percent change in GHG Emissions Since 1990



In total, emissions increased by 10.5% from 1990 to 2010



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Key Findings from 1990-2010 Inventory (II)

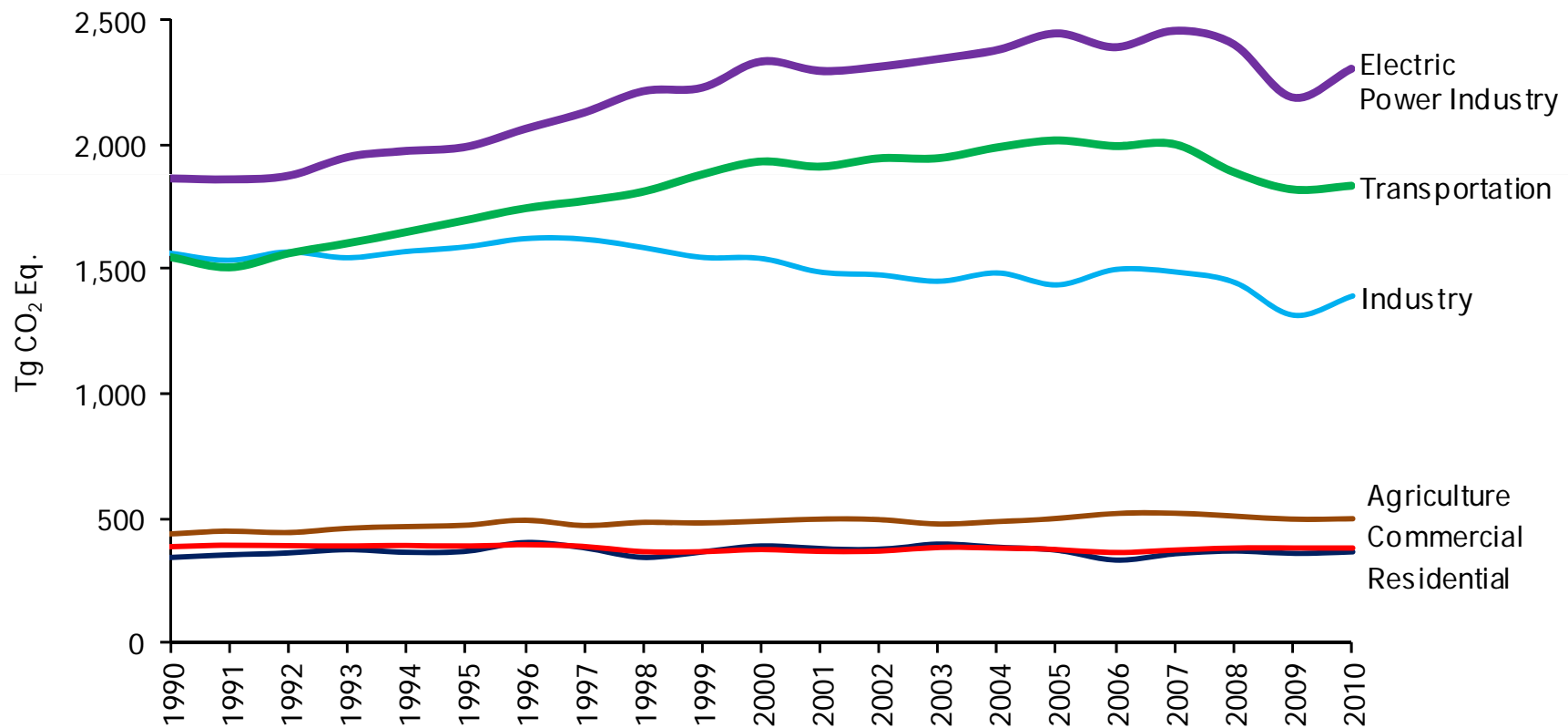


- Emissions trends across 1990 to 2010 time series fluctuate with trends in the economy, energy sources, population and weather
- Overall, since 1990;
 - GHG emissions have increased by 10.5%
 - CO₂ emissions have increased by 12%
 - CH₄ emissions have decreased by <0.5%
 - N₂O emissions have decreased by 3%
 - HFCs, PFCs and SF₆ emissions increased by 58%
- Over the same period;
 - GDP has grown by 63%
 - U.S. Population has increased by 23%
 - Energy consumption has increased by 17%

2010 U.S. Economic Sectors



Emissions distributed to Economic Sectors

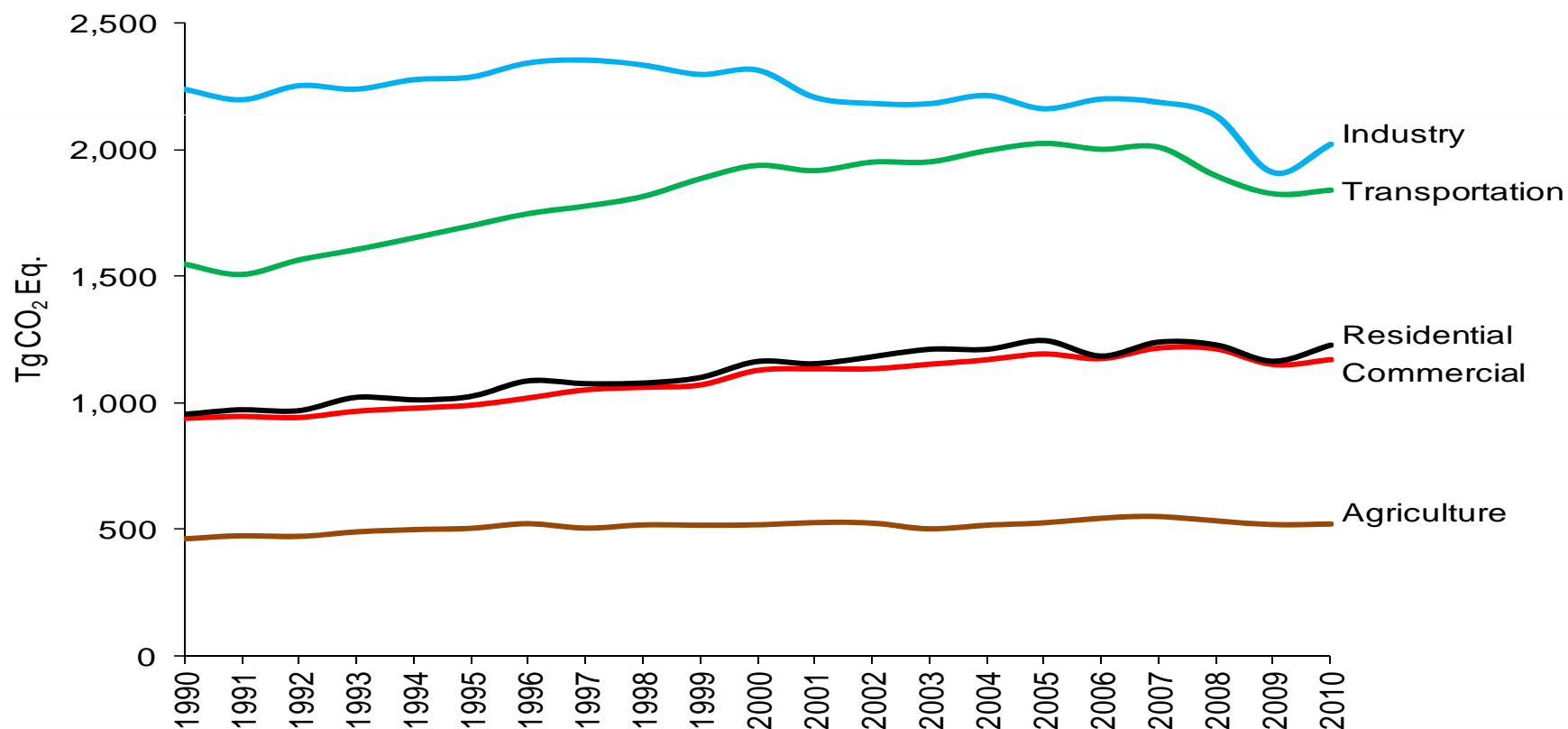


Taken from: *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (April 2012)

2010 U.S. Economic Sectors (II)



Emissions distributed to Economic Sectors, including emissions from electricity use



Taken from: *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (April 2012)

Limitations of U.S. GHG Inventory



- National-level totals for entire U.S.
 - Data for most sources is very aggregated with little to no geographic scope inside U.S.
 - Difficult to reconcile with criteria pollutant inventories
 - Which include source-specific data necessary to model emissions (e.g., state, county, latitude & longitude)
 - Efforts underway for GHGRP data (*our next presentation*)
- Coverage has been determined by Framework Convention
 - Still must use SAR GWP values (not newer AR4 {yet})
 - Defers to Montreal Protocol on ODS (which have high GWPs)
 - Impact of “indirect GHGs” and aerosols
 - Contribution of individual countries to world total limited to Annex I vs. Non-Annex I requirements

Limits of U.S. GHG Inventory (II)



- U.S. GHG Inventory accounts for all GHG emissions in a particular year across the entirety of the United States
 - Needed overview of total U.S. GHG emissions across all sources, in combination with GHGRP which provides greater detail on individual emitters
- Alternate ways to look at U.S. GHG emissions have been developed
 - EPA
 - OTAQ “Fact Sheet” focusing on detailed analysis of transportation sector; RFS analyses
 - OSWER “Opportunities to Reduce GHG Emissions through Materials and Land Management Practices” - Lifecycle approach to assign emissions to goods and materials
 - USDA focus on agricultural sector; DOT report on transportation sector
 - Interest groups focusing on GHGs from buildings, specific sectors, etc.
- U.S. GHG Inventory remains a transparent way to present overall U.S. emissions
 - Policy-neutral: “Factual, historic snapshot” of U.S. GHG emissions
 - Emissions calculated and presented consistently with other countries

Resources



- Printed copies of latest Greenhouse Gas Inventory
 - Full Report published next month
 - Stand-alone Executive Summary available soon
 - Only 20+ pages!
- Electronically download
 - <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>
- UNFCCC and IPCC Greenhouse Inventories Programme
 - unfccc.int
 - www.ipcc.ch