US GHG Inventory Data, UNFCCC Reporting, and Collaborations with CMS

Leif Hockstad
U.S. EPA - Office of Air & Radiation
Office of Atmospheric Programs
Climate Change Division

CMS Policy Speaker Series
June 22, 2016

EPA's Approaches - Outline

- National-level annual emissions
  - Accounting of overall emissions levels in comparable manner
- Policy-relevant data
  - Facility-level
  - Project-level
- Inventory improvements driven by available data and new studies

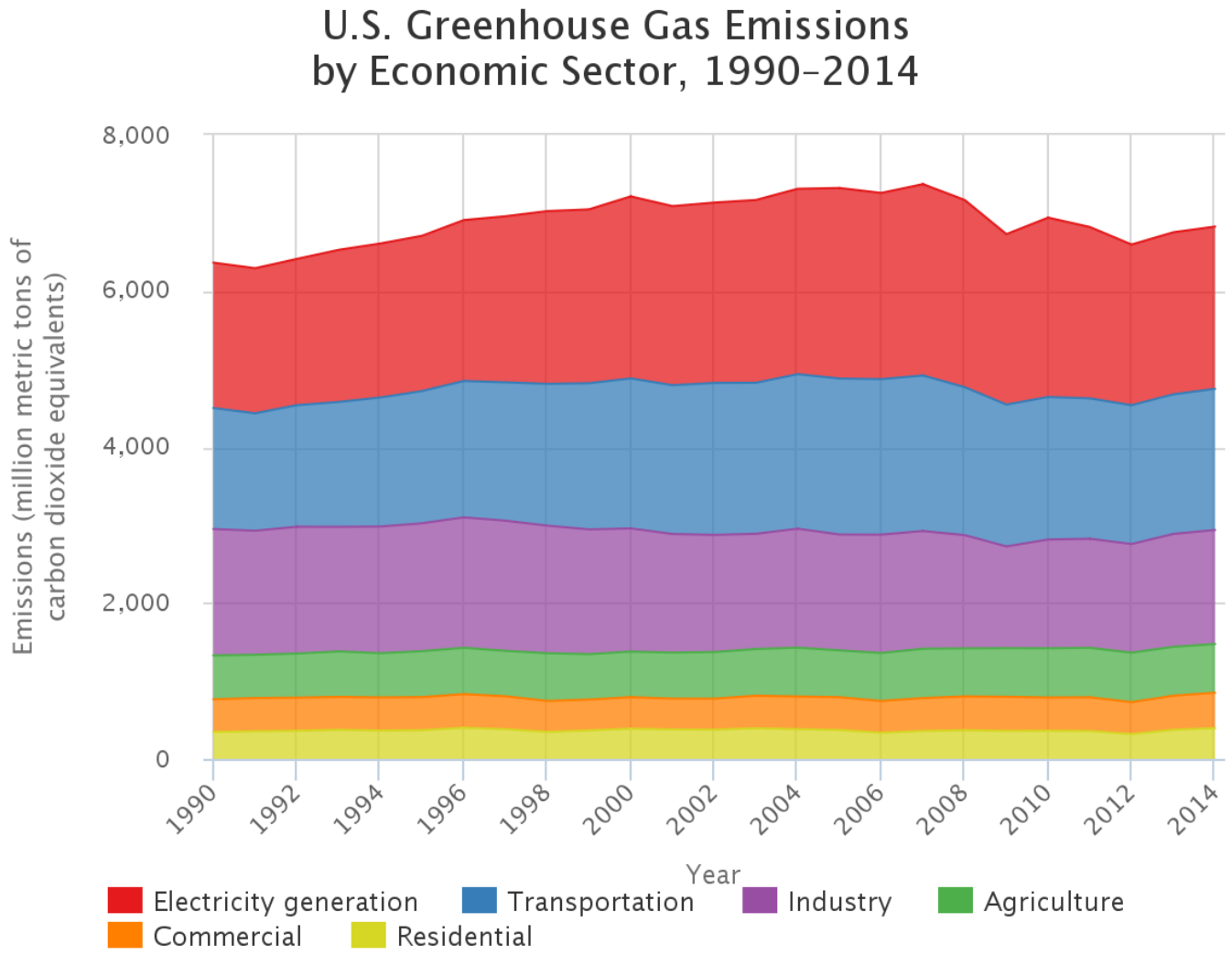
EPA's GHG Data Requirements

- Why does EPA need GHG emissions data?
  - Fundamental for developing, implementing, and assessing policies and programs to reduce emissions
  - EPA can't wait for perfect information (not an excuse to delay action)
- Data quality requirements
  - **Complete**: cover all anthropogenic sources, exclude natural sources
  - **Consistent**: collected consistently over time to reflect real trends
  - **Transparent**: Stakeholders need to review and understand methodologies
  - **Accuracy/Bias**:
    - Uncertainties can not be eliminated, but should be managed and reduced.
    - Bias (e.g., systematic under- or over-estimation) is more problematic
  - **Resolution:**
    - Spatial: Important for some applications but not others, e.g., UN reporting
    - Temporal: International and national reporting is annual
    - Unit/process: Need to connect emissions data to the activities and equipment that cause emissions to be policy and program relevant.

US Greenhouse Gas Inventory Background

- The U.S. Government annually produces a national-level GHG Inventory Report
  - EPA compiles 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
- Report undergoes cycles of review
  - "Peer review" targeted at technical audience
  - 30-day informational review to solicit public comments
  - International peer review through the UNFCCC
- **Final inventory due every April 15 to UNFCCC**

1990-2014 US GHG Inventory



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014.
http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

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 transparent, 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

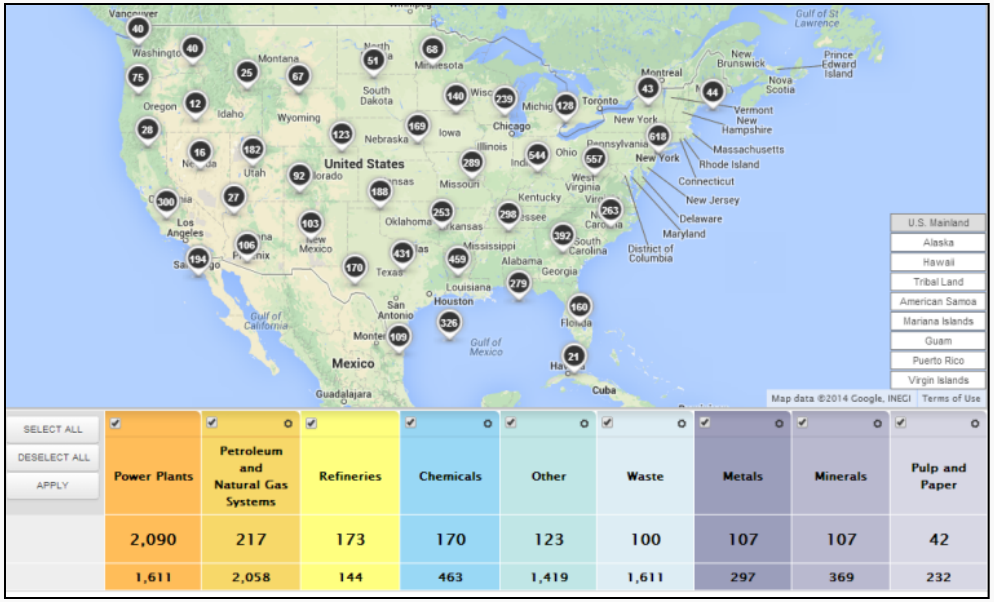
- IPCC Guidelines Approaches to Monitoring & Measurement
  - Calculation methodologies estimate emissions from a particular activity, and those methods can vary with the level of detail collected by inventory compilers
  - Data collection can be highly aggregated and only available at national scale
    - Apply default emission factor to aggregate data
      - E.g., national-level natural gas consumption and default emission factor (carbon content of fossil fuel)
  - Or specific measurements can be made at the emission source
      - E.g., concentration monitor and flow meter at a coal burning industrial facility or site specific measurement of gas at industrial facility
      - Or field testing N_2O releases from agricultural soils integrated in to a model simulation

UNFCCC Inventory Reporting

- Developed countries report annual inventories, using the UNFCCC inventory reporting guidelines
  - The format of an inventory submission is negotiated by Parties to the UNFCCC
  - Ensure adequate, reliable and comparable information is reported by countries on GHG inventories and emission trends
  - Inventory findings are included in a report that follows a standard chapter format
    - Explanations of emission trends
    - Explanations of methodologies used for calculating emission sources using the IPCC guidelines
      - Explanation why the methodological approach was taken

EPA's Greenhouse Gas Reporting Program (GHGRP)

- 40 CFR part 98 requires annual GHG reporting from large direct emitters and suppliers
- GHGRP is being used to improve the U.S. GHG Inventory and provide detailed sector-level data to inform policy decisions
  - Reporting by direct emitters ~55% of direct U.S. GHG emissions
    - Reporting by suppliers adds ~30% (indirect GHG emissions)
  - Provides detailed facility-level data (bottom-up)
  - Does not include Ag, Land Use, small sources



Task	Inventory	Greenhouse Gas Reporting Program
Find total U.S. emissions	✓	
Review trend data for the past 20 years	✓	
Browse a map to find largest emitters in your area		✓
Compare facility emissions across an industrial sector		✓
Find total reported emissions by state		✓

Updating Estimates for Future GHG Inventories

- Enhancing the US Greenhouse Gas Inventory is a key part of the US commitments to the UNFCCC
  - Incorporation of EPA data collected under GHGRP
  - Promoting transparency and stakeholder input
- Evaluation of updates to estimates key to maintaining GHG Inventory quality
  - Continuous improvement - if better data become available, IPCC good practice and UNFCCC obligates its consideration
  - Emphasis on improving estimates and devoting resources to large sources, or rapidly changing sources ("Key Sources")
  - Annual reassessment of methodologies and refinements for each source category
- EPA notes updates under consideration in "Planned Improvements" section of Inventory

Attribution Considerations

Sources not included in GHG Inventory

- Non-anthropogenic emissions not included in GHG Inventory
  - Natural sources include both fossil (e.g. geological seepage) and biological sources of carbon (e.g. wetlands)
  - Likely large sources in U.S. include wetlands and geological seepage
  - Global estimates (EPA 2010 and IPCC 2013) ~40% of total global CH_4 from non-anthropogenic activities
    - Wetlands (60-80%), geological seepage (~20%), and smaller amounts from lakes, termites and wild animals
- Anthropogenic emissions not included in GHG Inventory
  - Abandoned oil and gas wells

Informing Emission Factors and Activity Data

- Activities taking place at the time of measurement
  - General operating conditions
  - High-emission venting events
  - Maintenance schedule
- Regional versus national factors
- Controlled versus uncontrolled
- Super emitters
  - Where do they occur (e.g. which processes or equipment)?
  - How common are they?
- Corresponding activity data
  - Is national data available?

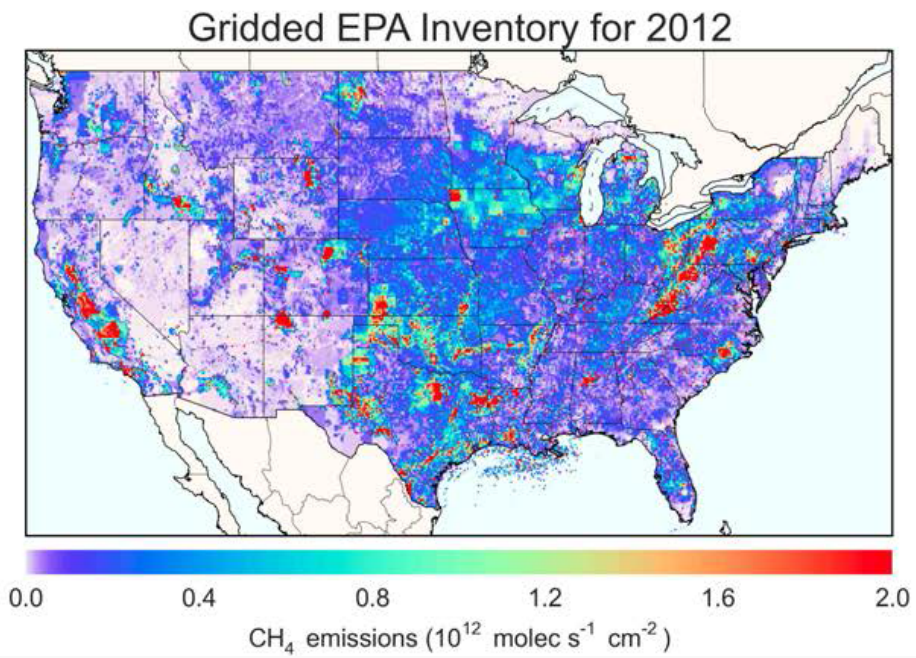
Methane Measurement Studies

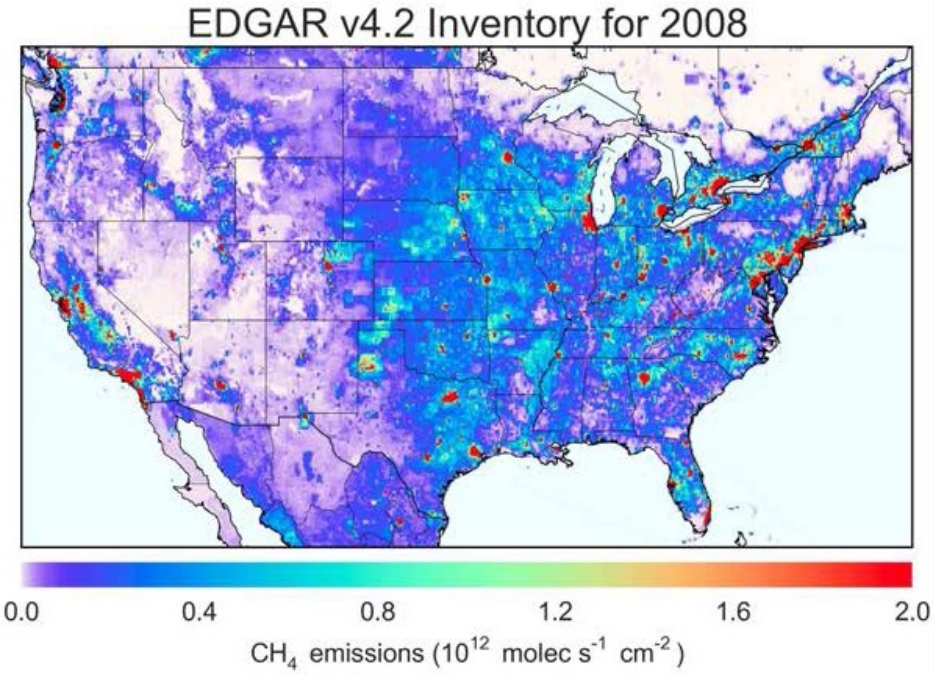
- Several recent studies have measured CH_4 emissions at the at the national or regional level, with estimates that differ from EPA's emissions estimate
  - Some studies compare to GHG inventory or GHGRP; many to other bottom-up data such as EDGAR
- EPA is considering how such measurement studies can be used to update Inventory estimates
  - Verification tool?
  - Prioritizing sources for improvement?
  - Incorporation into inventory?
- Some factors for consideration
  - Attribution—including calculations and assumptions regarding natural sources other emissions that are not the target of the study
  - How such measurements can inform emission factors and activity data used to calculate a time series for national emissions

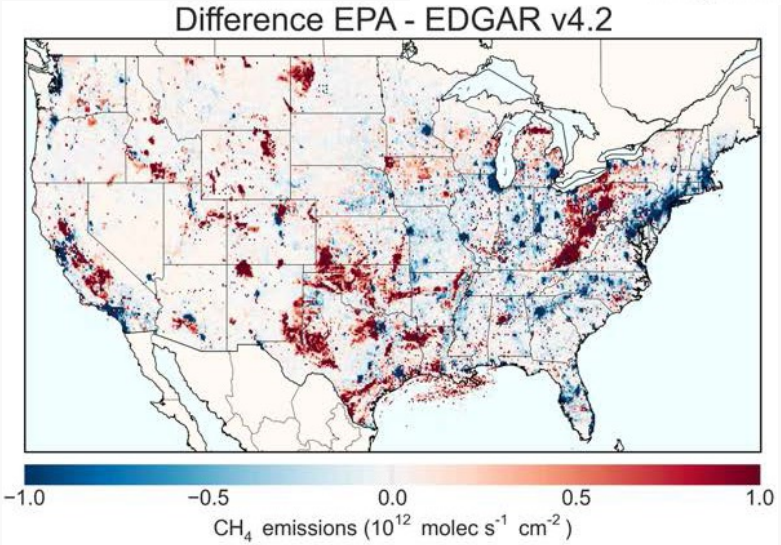
Examples of EPA work to address gaps

- Focus areas for GHGRP integration
  - Key oil and gas input data (i.e. activity data) incorporated in 2016 US GHG Inventory
  - Landfill gas waste composition and gas capture from GHGRP
- Assessment of external studies and incorporation of new data
  - E.g., API/ANGA data collection on components of oil & gas systems
- Engagement with top-down research community
  - Coordination with EPA Office of Research and Development
  - Methane gridding for U.S. GHG Inventory
    - Harvard team using GHG Inventory, GHGRP and other data to grid US GHG Inventory (spatial + temporal)

Comparisons with Gridded US GHG Inventory

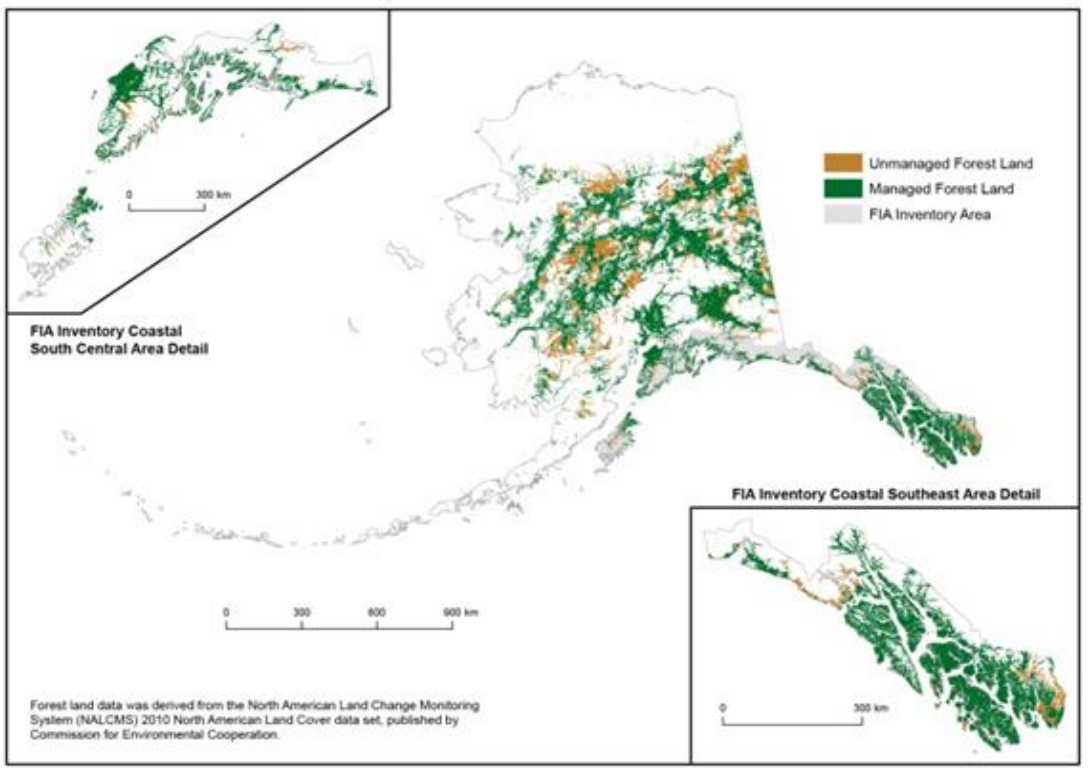






Maasakkers, et al. - May 25, 2016

“Top-down” LULUCF Data for US GHG Inventory



How can observations, measurement and modeling help to improve the quality of national greenhouse gas inventories?

- Use of remote sensing for inaccessible areas that lack conventional statistical infrastructure

Figure 2-2. Delineation of managed and unmanaged forest land in interior Alaska in addition to south central and southeast coastal Alaska which are inventoried by FIA, per application of the U.S.’s managed land definition.

Top-Down Assessment of bottom-up National Inventories

- Opportunity for Assessment
  - Instrument bias or Inventory problem?
    - Activity Data or Emissions factors?
- Emissions reduction policies generally rely on emission source level data
  - In developing mitigation strategies (e.g., most efficient, most cost-effective, etc.), need to understand emissions pathways from certain activities
  - Policy may dictate need for on the ground data (e.g., continuous emissions monitoring of a plant's stack)
  - Need to dig deeper to find which source category's emission estimation techniques may have flaws
    - Many key gaps require "low-tech" or "no-tech" solutions

How Can CMS Help Improve GHG Inventories?

- Starting with the right questions is critical
- Researchers might ask
  - *Can GHG inventories be independently tested and verified?*
  - Capabilities are improving, but a work in progress.
- Inventory compilers would ask a more general question:
  - *How can observations, measurement and modeling help to improve the quality of national greenhouse gas inventories?*
  - To be useful for inventories, studies must be linked to the underlying activities and processes that generate emissions (e.g., valves, pipelines, mines, landfills etc.)
  - Most useful in areas with highest uncertainty: e.g., land sector, area sources.

The Importance of Communication

What the media usually say	What studies actually say
“Scientists say EPA numbers are wrong”	“Study results are different from EPA results”
“EPA estimates are highly uncertain”	“Study results also have uncertainty bars”
“EPA needs to fix its data”	“EPA and researchers should work together to try to explain and account for differences”
“Scientists measured the same thing that EPA is estimating”	“We think we measured the same thing, but those natural sources can get in the way….”
“Case closed”	“This is what we can do now, but with X more data points we could do a lot better”

Resources

Thank You

- Full report and individual chapters available electronically for download
  - → https://www.epa.gov/climatechange/emissions/usinventoryreport.html
- Interactive data tool with figures and tables from report
  - → https://www3.epa.gov/climatechange/ghgemissions/inventoryexplorer/