

Data Quality Challenges and Opportunities with Greenhouse Gas Emissions Reporting in the US and Implications for Future Policy to Mitigate Climate Change

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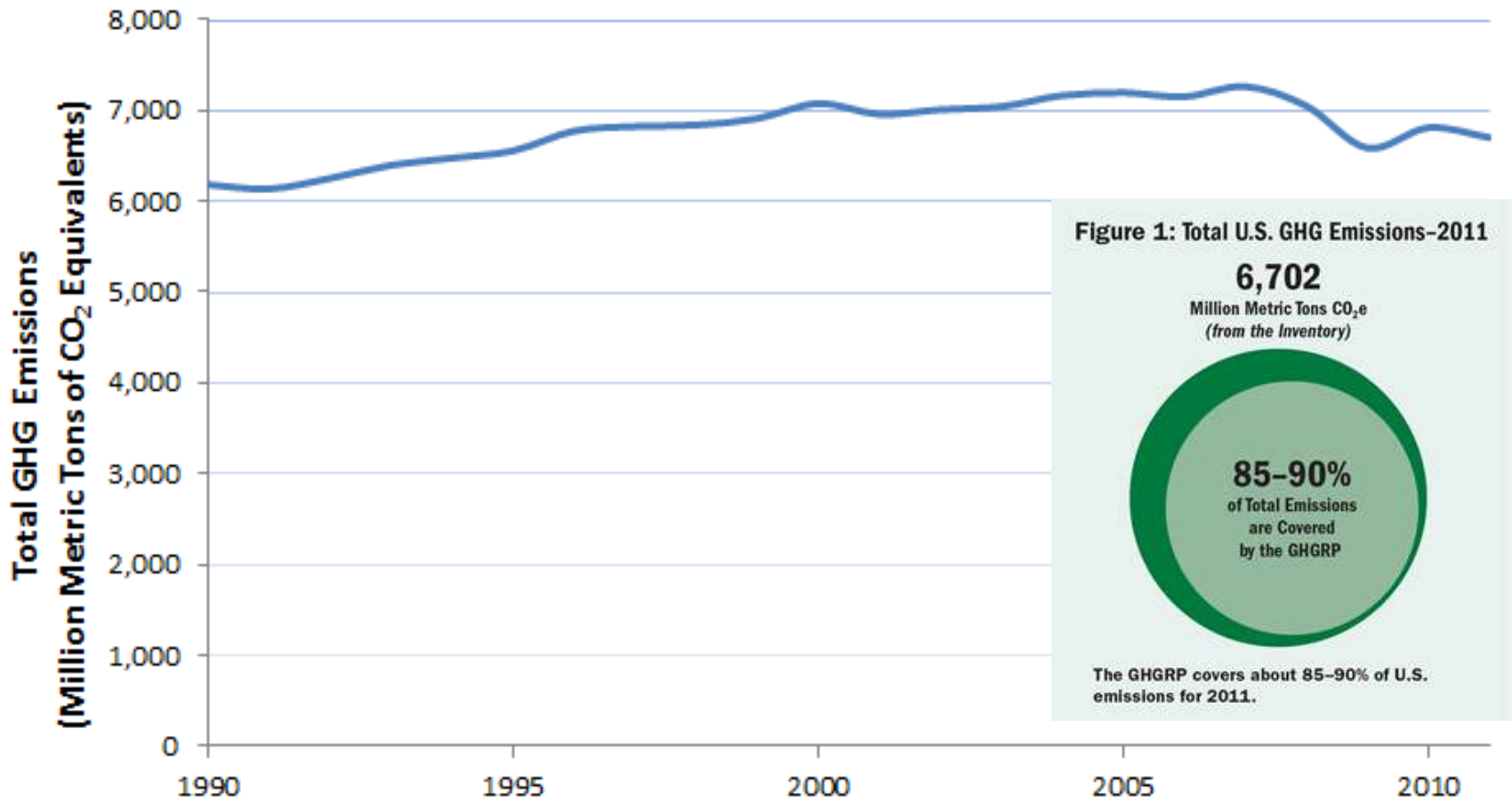
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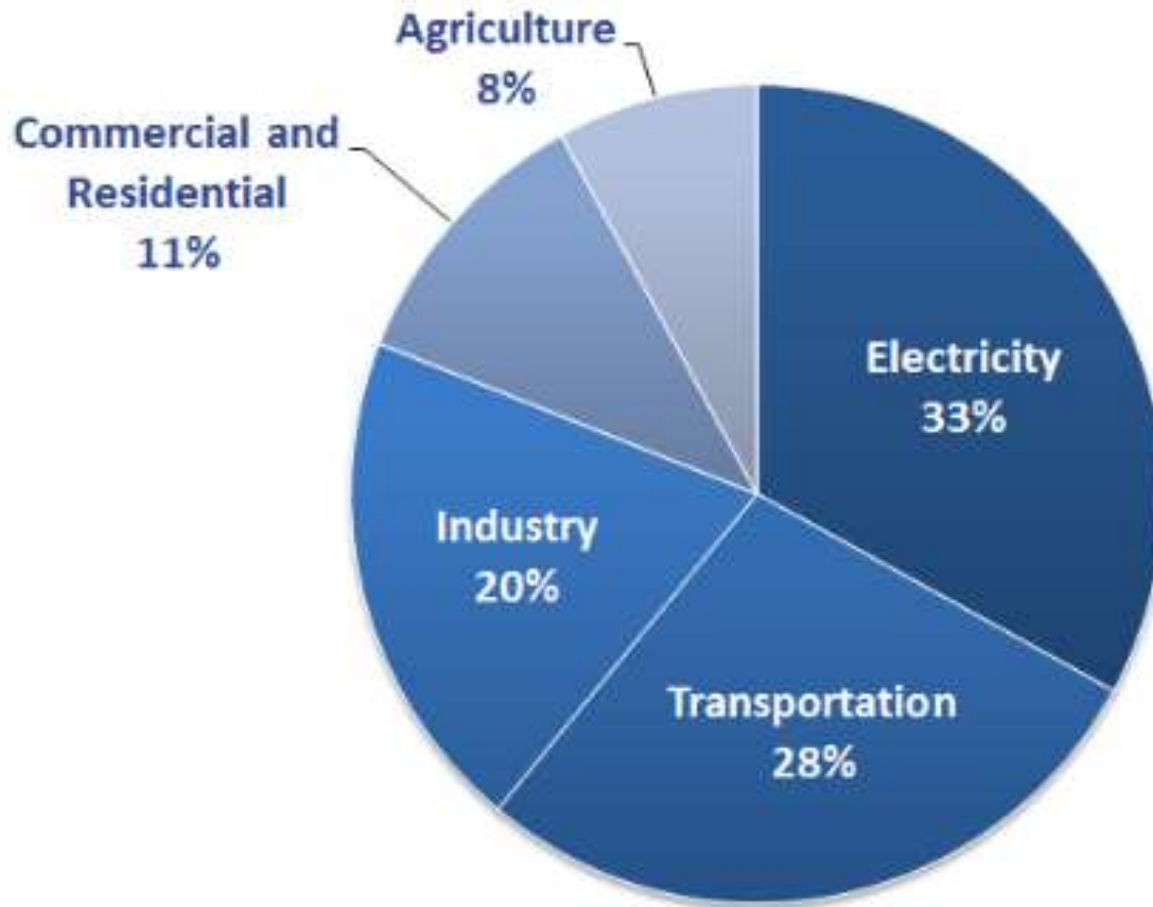
Background - CO₂e Emissions in the US



Total GHG Emissions in the US from 1990-2011

Sources: <http://www.epa.gov/climatechange/ghgemissions/sources.html>,
<http://epa.gov/ghgreporting/ghgdata/inventory.html>

Background – CO₂e Emissions in the US



Total US Greenhouse Gas Emissions by Economic Sector in 2011 in Units of CO₂ Equivalents (CO₂e)

Source: <http://www.epa.gov/climatechange/ghgemissions/sources.html>

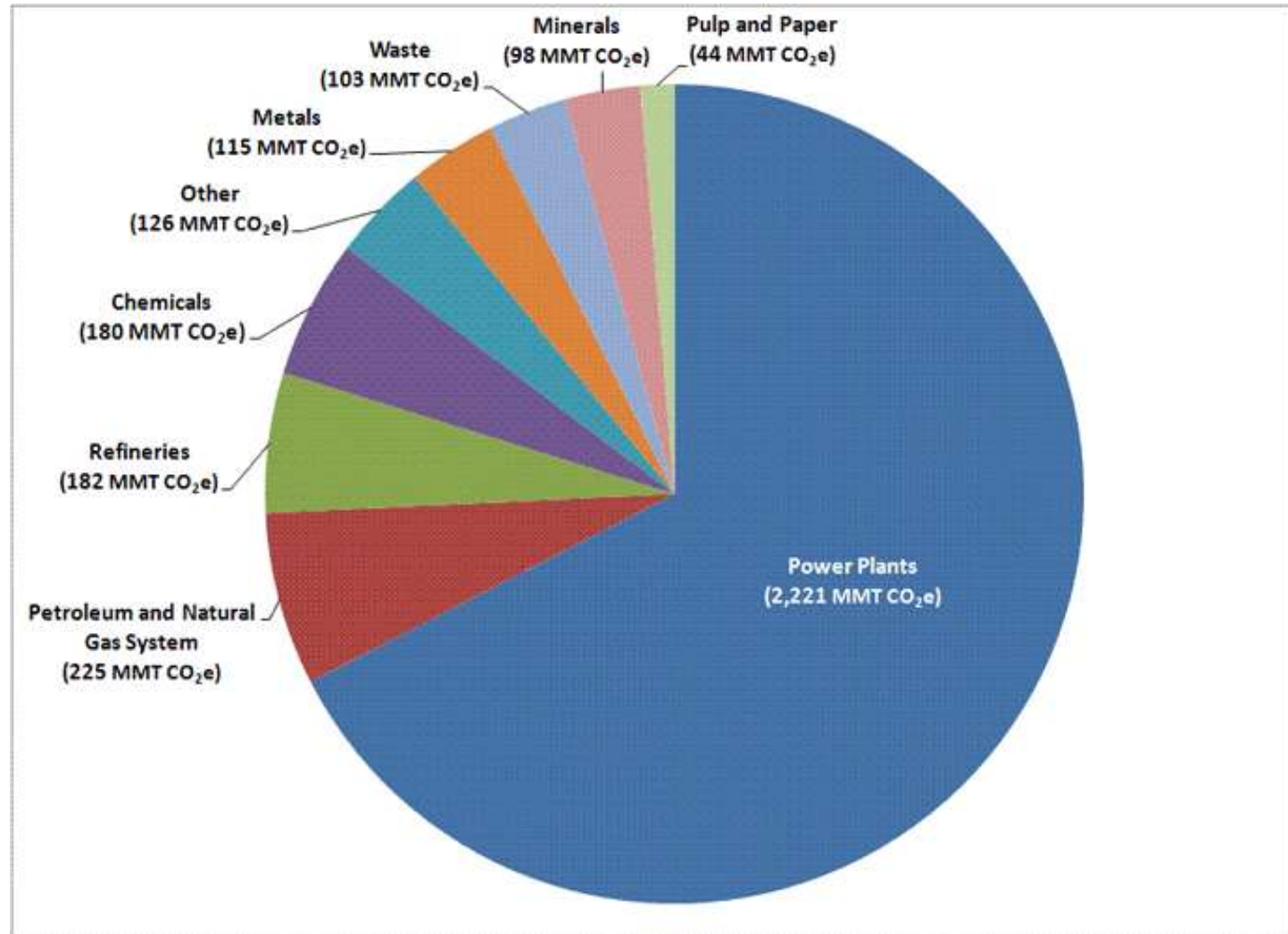
Background – EPA’s GHGRP

- EPA’s GHGRP is Codified in 40 CFR 98
 - Promulgated to collect GHG emissions data to inform future policy decisions. It may apply to:
 - Direct emitters
 - Manufacturers of heavy-duty and off-road vehicles and engines
 - Fossil fuel and industrial gas suppliers
 - Prescribes
 - Requirements for how each industry sector must calculate GHG emissions.
 - Specific QA/QC requirements for certain parameters.
 - EPA attempted to minimize additional burden on industry.



Case Studies – Focus on Largest Direct Emitters

2011 Data from the GHGRP for Direct Emitters



Source: <http://www.epa.gov/ghgreporting/ghgdata/reported/index.html>

Case Study – Electricity Generation

- **CO₂ Emissions Measurements**

- The Acid Rain Program (ARP) was established in 1990
- The ARP is applicable for power plants >25 megawatts
- Already required to monitor and report CO₂, SO₂, and NO_x emissions
 - CEMS based for direct measurement, or
 - Mass balance methodology based on fuel flow rates and carbon content



- **40 CFR 98 Subpart D – Electricity Generation**

- CO₂ emissions reported under the GHGRP are same as for ARP
- CH₄ and N₂O emissions reported as per GHGRP Subpart C

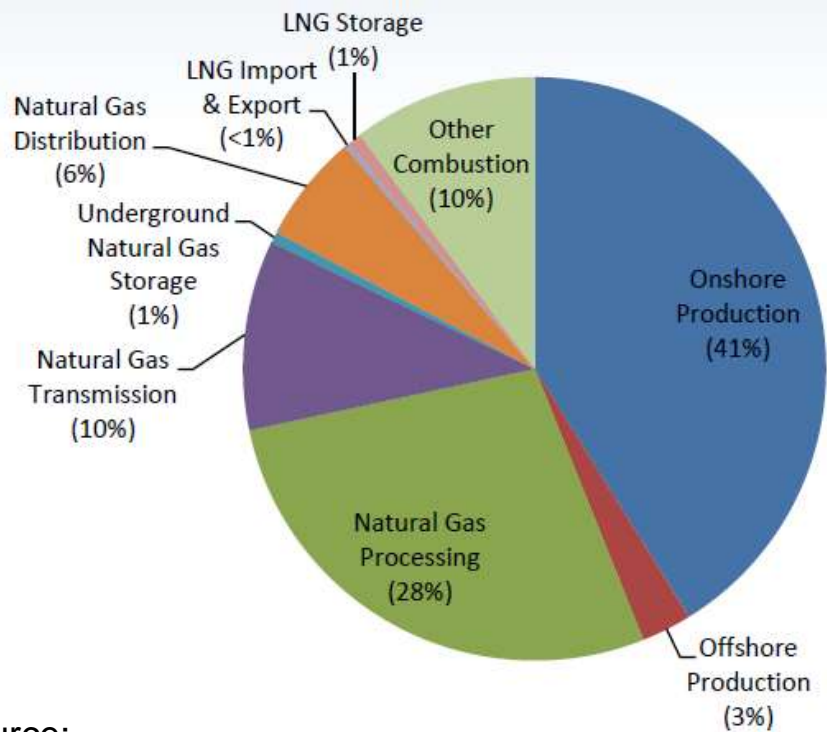
Case Study – Electricity Generation

- **Accuracy and QA/QC Requirements**
 - CEMS for CO₂
 - Must be EPA certified prior to initial start up
 - Rigorous calibrations and inspections (daily assessments, regularly scheduled calibrations and linearity check, semi-annual audits)
 - Mass balance methodology for CO₂
 - Carbon content measured using standard methods
 - Measured fuel flow rates
 - Subpart C estimates
 - Accuracy depends on Tier
- **High Data Confidence**



Case Study – Petroleum and Natural Gas Systems

- 40 CFR 98 Subpart W – Petroleum and Natural Gas Systems
 - Comprised of eight industry segments
 - Prescribes varied emissions calculation methodologies based on industry segment and source type (many as per defaults, estimates, etc.)

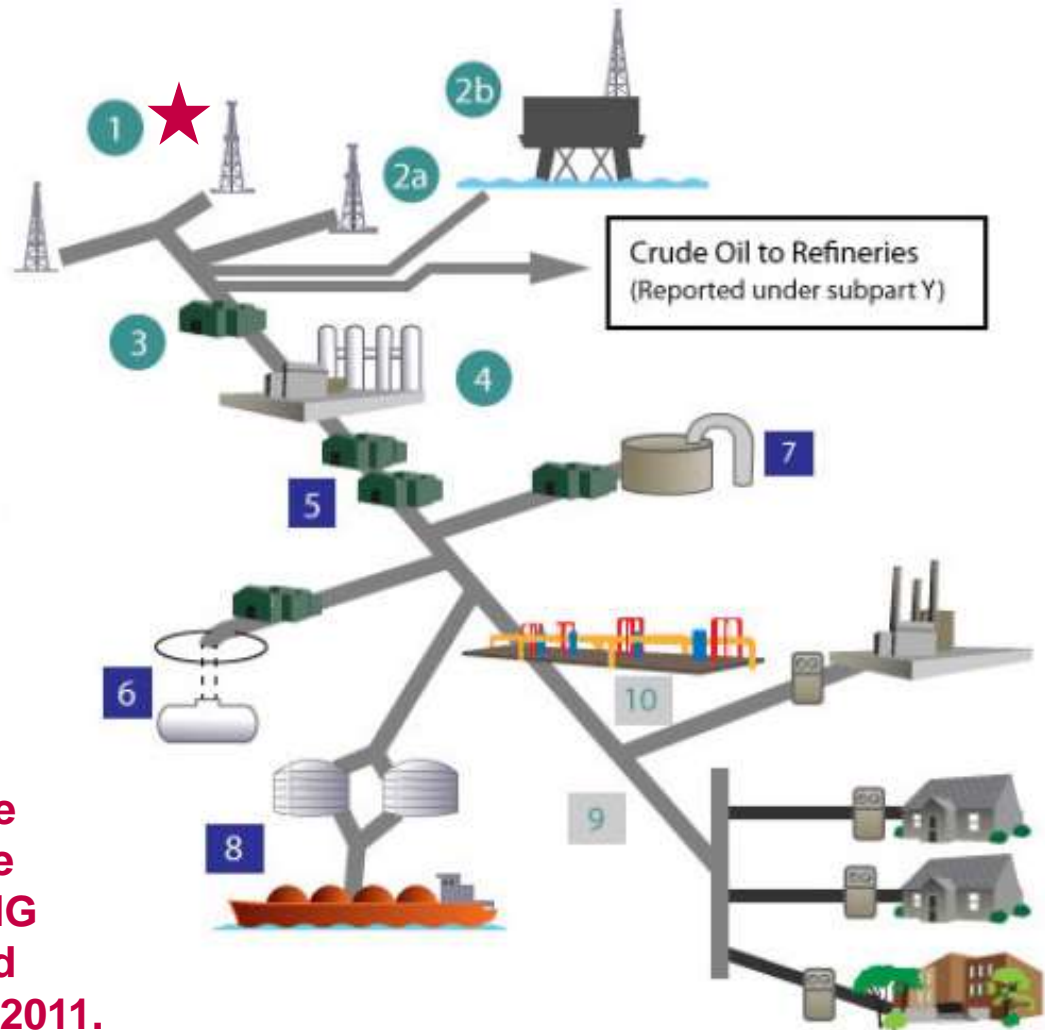


Source:

http://www.epa.gov/ghgreporting/documents/pdf/2012/documents/subpart_W_2011_data_publication_fact_sheet.pdf

Case Study – Petroleum and Natural Gas Systems

- Production and Processing**
 1. Onshore Production
 - 2a, 2b. Offshore Production
 3. Gathering and Boosting (not covered by Subpart W)
 4. Natural Gas Processing
- Transmission and Storage**
 5. Natural Gas Transmission
 6. Underground Natural Gas Storage
 7. LNG Storage
 8. LNG Import-Export
- Distribution**
 - 9, 10. Natural Gas Distribution



★ **Case study focuses on onshore production as it contributed the largest percentage (41%) of GHG emissions to the Petroleum and Natural Gas Systems sector in 2011.**

Source:

http://www.epa.gov/ghgreporting/documents/pdf/2012/documents/subpart_W_2011_data_publication_fact_sheet.pdf

Case Study – Onshore Production

- **Accuracy and QA/QC Requirements for Example Source Types**
 - **Combustion emissions** (calculated under Subpart W)
 - Fuel usage based on company records
 - **Storage tank emissions**
 - For tanks with throughput >10 bbl/day, must use software based on Peng-Robinson equation (e.g. E&P Tanks v2.0)
 - All inputs into the software program are allowed to be based on best available data
 - **Emissions from completions with hydraulic fracturing**
 - Rigorous QA/QC requirements for flow meters used to measure volume of gas at flow back
 - For pressure drop method, strict calibration requirements of pressure gauges



Discussion/Implications for Future Policy

- **GHGRP Data Accuracy**

- Accuracy currently varies by industry sector and source category; direct measurement not always feasible
- Larger data sets including future reporting years will identify trends/highest contributing source categories

- **Opportunities for Improvement**

- Refine emissions calculations methodologies, focusing on sources with highest emissions contribution
- Increased accuracy requirements and reduced reliance on "best available data"

- **Impact on Future Policy**

- Accurate GHG emissions data as backbone of potential market based program



Future Policy- Potential Market-Based Systems



Questions?

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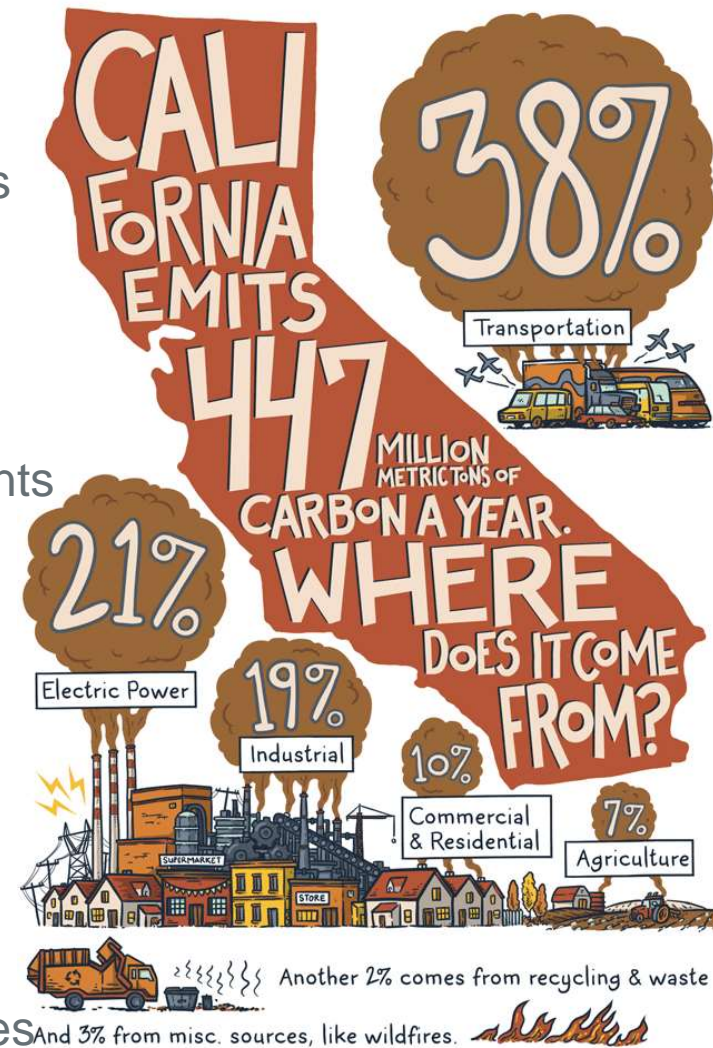
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Cap and Trade in California

- Program Goals
 - Reduce carbon emissions to 1990 levels by 2020.
 - Reduce carbon emissions by 80% from 1990 levels by 2050.
- California Air Resources Board
 - Enforceable program meeting the AB32 requirements
 - Working with Canada through the Western Climate Initiative.
 - Enforceable compliance obligation starts with 2013 GHG emissions.
- Economics
 - Permits have been selling out at auctions with prices rising.



Based on 2010 data from the CA Air Resources Board. Illustrated by Andy Warner.

Cap and Trade in the US Northeast

- Regional Greenhouse Gas Initiative (RGGI)
 - Cooperative effort between 9 states
 - CT, DE, ME, MD, MA, NH, NY, VT
 - States sell emissions allowances
 - Revenue is then invested into consumer benefits
 - Energy efficiency, clean energy technology, and renewable energy
 - States have raised \$912 million since 2009
- Impact on Emissions
 - CO₂ emissions have decreased by >50% from 2005 to 2012
 - Emissions are currently 45% below the cap for 2013
 - Additional factors beyond cap and trade impacted emissions
 - Decreased electricity demand due to economic recession
 - Swapping from coal to natural gas



Cap and Trade in Europe

EU's Emissions Trading Scheme

- Sets emissions caps for half of Europe's industries
- Companies are allotted a certain number of permits which they can then trade freely
- The number of permits is supposed to decrease each year
- Decreasing permits should yield increasing permit prices, and subsequently, increased prices to pollute.

Economics

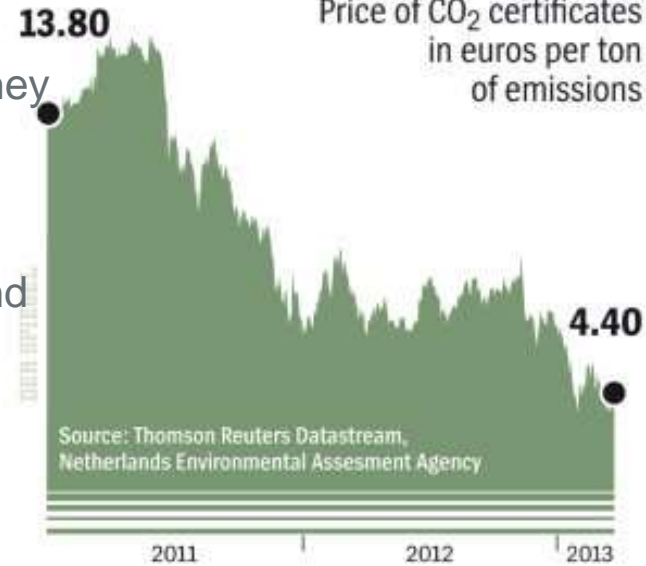
- In the current economic downturn, the price of CO₂ certificates has sharply declined.
- Decreased prices makes it cheaper to pollute.

Additional Policies in Place

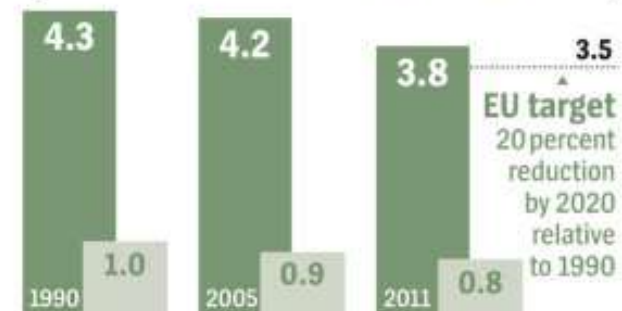
- Energy-efficiency mandate
- Renewable energy mandate

Discount Pollution

Price of CO₂ certificates
in euros per ton
of emissions

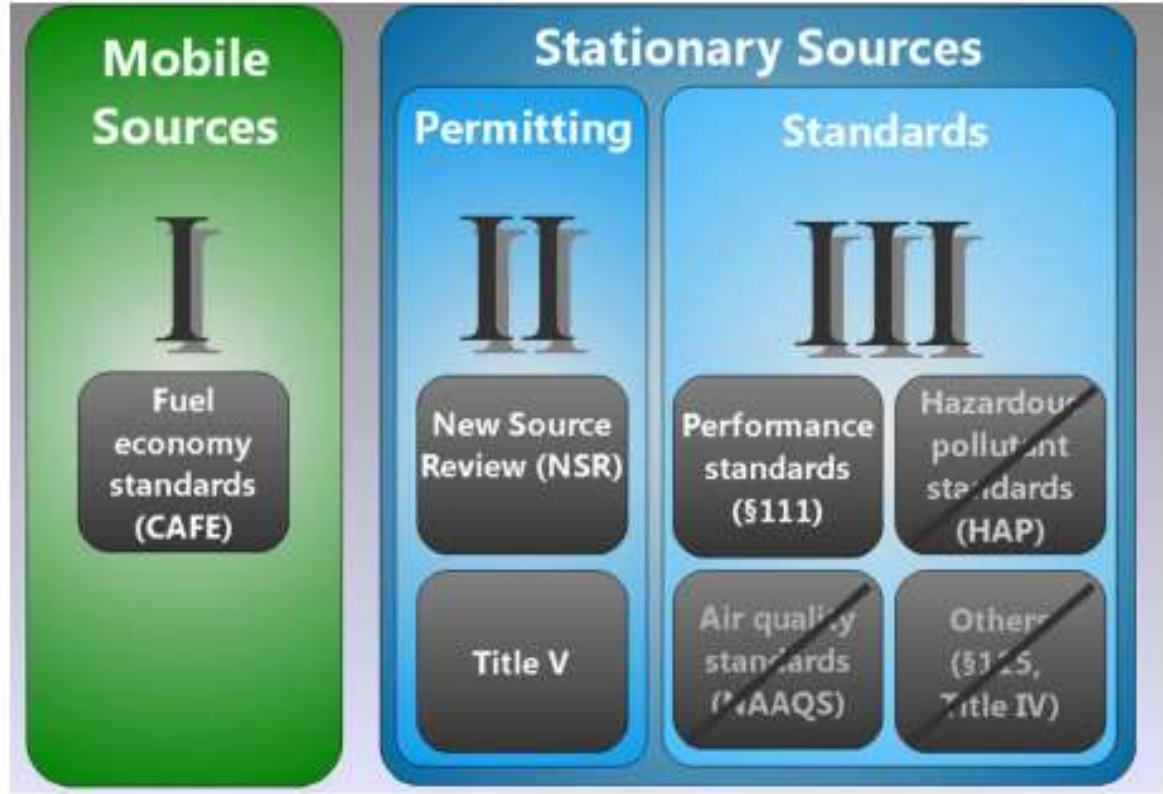


CO₂ emissions in billions of tons



Pathways for Reducing GHGs via the CAA

- Not designed to be cost-effective in the same way as market based approaches (such as cap and trade, carbon tax, etc.)

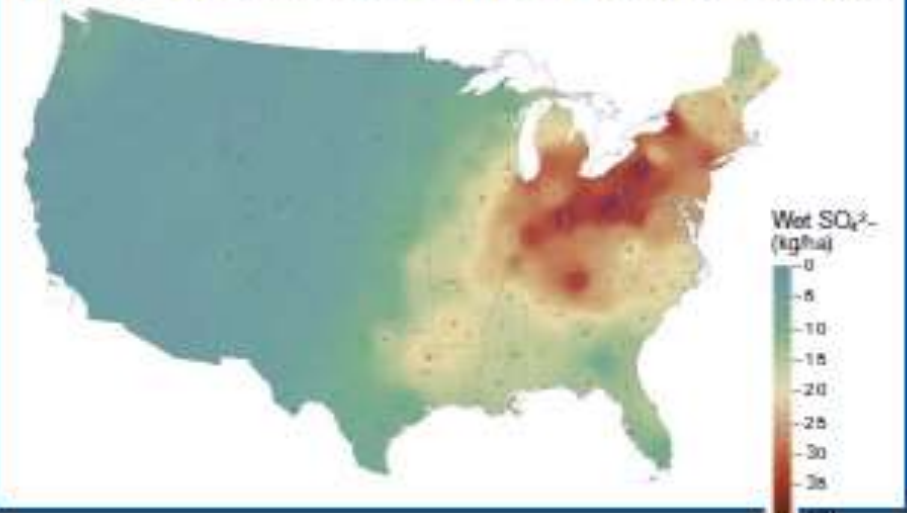


Source: Richardson et al. (2011).

Success of the ARP

A 2003 Office of Management and Budget (OMB) study found that the Acid Rain Program accounted for the largest quantified human health benefits of any major federal regulatory program implemented in the last 10 years, with benefits exceeding costs by more than 40:1.

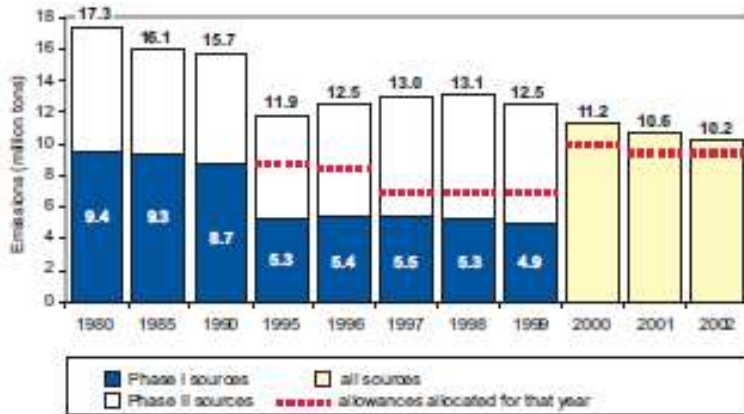
1989-1991 Average Acid Rain Concentrations



2000-2002 Average Acid Rain Concentrations



SO₂ Emissions under the Acid Rain Program



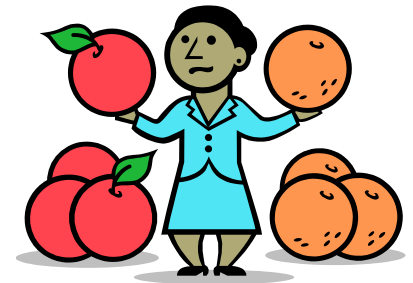
SO₂ emissions have decreased 5.5 million tons from 1990 levels and more than 7 million tons from 1980.

Source: EPA

Monitors show significant decreases in wet sulfate deposition in the Eastern U. S. Source: NADP

Key Differences Between EPA and ARB

- ARB Rule Now “Harmonized” with the EPA MRR
 - Differences to accommodate rigor needed for Cap and Trade
- General Differences
 - >25,000 MTCO₂e facilities must obtain 3rd party verification
 - >10,000 MTCO₂e facilities must report but do not need to verify
 - More stringent calibration/accuracy requirements
 - Different missing data procedures
 - Report electricity use, steam purchases, and product data
 - More elements to monitoring plan



Key Differences Between EPA and ARB

- Example of Differences in Subparts



- Subpart W

- E.g. CARB requires flow meters for NG pneumatic high bleed device and pneumatic pumps

- Subpart MM

- ARB only requires reporting of transportation fuels burned in CA

- E.g. Gasoline, LPG, diesel fuel, ethanol, but not aviation or marine fuels

- ARB requires reporting CH₄ and N₂O

- Emissions accounting will impact financial accounting due to Cap and Trade