Greenhouse Gas Emission Inventories and Forecasts for Nine Western States

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EPA’s 15th Annual International Emissions Inventory Conference
May 14-17, 2007
WRAP/CCS Assistance Agreement

- Agreement Effective June 1, 2006
- Prepare Initial Inventory & Forecast (I&F) for 9 Western States:
  » AK, CO, ID, MT, NV, SD, UT, WY, WA
WRAP GHG Emissions/Sinks

- Inventory and Reference Case Projections
  - Inventory of historical emissions from 1990 to most recent data year
  - Projection of emissions to 2020
- Preliminary analysis by CCS for further discussion and final revision
Pollutant Coverage

- Six gases per USEPA and UNFCCC guidelines
  - Carbon Dioxide ($\text{CO}_2$), Methane ($\text{CH}_4$), Nitrous Oxide ($\text{N}_2\text{O}$), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur Hexafluoride ($\text{SF}_6$)
  - Black Carbon considered separately
Source Coverage

- All major emitting sectors
  - Electricity (generation / supply)
  - Fossil Fuel Production, Transmission, & Distribution
  - Residential, Commercial, Industrial Fuel Use
  - Transportation
  - Other Industrial Processes (non-fuel use)
  - Waste Management (solid / liquid)
  - Agriculture (livestock and crop production)

- Carbon sinks (sequestration)
  - Terrestrial: Forestry, Agriculture
  - Geological: CO2 storage
Inventory Approach

- Standard US EPA and UN methodologies, guidelines, and tools
- Emphasis on transparency, consistency, and significance
- Preference for WRAP State, Tribal, or regional data, where available
- Consumption and production-based emissions from electricity generation
  - Production – emissions from in-state generation
  - Consumption – net emissions driven by State’s electricity demand (imports / exports)
Projection Approach

- Reference case assumes no major changes from business-as-usual (BAU)
  » Includes approved policies and actions to the extent possible (e.g. Energy Efficiency, Renewable Energy)

- Growth assumptions from existing sources
  » State/Regional population & employment forecasts
  » US Census and Bureau of Labor & Statistics
  » US Energy Information Administration
States Included in this Presentation

- WRAP/CCS Assistance Agreement
  - Nine western States:
    - AK, CO, ID, MT, NV, SD, UT, WY, and WA
- Additional States
  - AZ and NM:
    - I&F prepared by States/CCS for Climate Action Plans
  - CA and OR:
    - I&F prepared by these two States
Gross GHG Emissions by State

Gross Consumption-based GHG Emissions by State: Historical and Projected
Ranking of 2000 GHG State and National Emissions

- China
- European Union (25)
- Russian Federation
- India
- Japan
- 13 Western States
- Germany
- Brazil
- Canada
- United Kingdom
- Italy
- Mexico
- Korea (South)
- France
- Indonesia
Ranking of 2000 GHG Emissions by State

PECHAN
Population Growth

Annual Average Growth

1990-2005

2005-2020

AK AZ CA CO ID MT NM NV OR SD UT WA WY
Gross GHG Emissions Per Capita

States with low population and low growth rate in forecast

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Employment Growth

![Graph showing employment growth by state and sector from 1990-2005 and 2005-2020.](image)

- **Manufacturing - 1990-2005**
- **Manufacturing - 2005-2020**
- **Commercial - 1990-2005**
- **Commercial - 2005-2020**

States included: AK, CO, ID, MT, NV, SD, UT, WA, WY.
Vehicle Miles Traveled (VMT) Growth

Average Annual Growth

- 1990-2005
- 2005-2020

States: AK, AZ, CA, CO, ID, MT, NM, NV, SD, UT, WA, WY
Electricity Supply (Consumption Based)
Electricity Supply
(2005 Consumption vs. Production)
Residential, Commercial, Industrial (RCI) Fuel Use Emissions
RCI Emissions by State and Sector, 2005

CA Res = 28.5
CA Ind = 67.8

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RCI Emissions by State and Fuel Type, 2005

CA NG = 68.6
CA Oil = 35.1
Transportation Emissions by State and Sub Sector, 2005

AZ Onroad = 25.3
WA Onroad = 23.2
Fossil Fuel Production Emissions by State and Sub Sector, 2005

States:
- AK (Alaska)
- AZ (Arizona)
- CA (California)
- CO (Colorado)
- ID (Idaho)
- MT (Montana)
- NM (New Mexico)
- NV (Nevada)
- SD (South Dakota)
- UT (Utah)
- WA (Washington)
- WY (Wyoming)

Emissions Categories:
- Natural Gas
- Oil
- Coal Mining

Key Observations:
- NM NG = 10.3
- WY NG = 11
Industrial Processes (Non-Fuel Use) Emissions

The chart above shows the emissions of industrial processes over time from 1990 to 2020. The emissions are measured in M Mt CO2e (10^6 metric tons of CO2 equivalent). Each state is represented by a different color, allowing for a comparison of emissions trends across different states.

Key states include:
- AK (Alaska)
- AZ (Arizona)
- CA (California)
- CO (Colorado)
- ID (Idaho)
- MT (Montana)
- NM (New Mexico)
- NV (Nevada)
- OR (Oregon)
- SD (South Dakota)
- UT (Utah)
- WA (Washington)
- WY (Wyoming)

The data shows an overall increase in emissions over the years, indicating a need for strategies to reduce industrial emissions.
Industrial Process Emissions by State and Pollutant, 2005

CA HFC/PFC/SF6 = 14.8

MMtCO₂e

CO₂
N₂O
HFC, PFC, SF₆

AK  AZ  CA  CO  ID  MT  NM  NV  OR  SD  UT  WA  WY
Industrial Process $N_2O$, $SF_6$, HFC, PFC Emissions by State, 2005

CA ODS Subs. = 13.0

- Nitric Acid Production (N2O)
- ODS Substitutes (HFCs, PFCs)
- Semiconductor Manufacturing (HFCs, PFCs, SF6)
- Electric Power T&D System (SF6)
- Aluminum Production (CO2, PFCs)
- Magnesium Production (SF6)
Waste Management Emissions

Municipal Solid Waste and Wastewater Treatment
Waste Management Emissions, 2005

MMtCO2e

AK  AZ  CO  ID  MT  NM  NV  OR  SD  UT  WA  WY

Solid Waste
Wastewater
Agricultural Emissions by State and Sub Sector, 2005

- CA Ag Soils = 19.4
- SD Ag Soils = 11.0

MMtCO2e

- Enteric Fermentation
- Manure Management
- Ag Soils
- Agricultural Residue Burning
- Rice Cultivation

States: AK, AZ, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY
Forest and Agriculture Sinks

MMtCO2e

AK  AZ  CA  CO  ID  MT  NM  NV  SD  UT  WA  WY
Forest and Agriculture Sinks by State and Sub Sector, 2005

The diagram shows the net greenhouse gas emissions from forests and agriculture soils across various states in 2005. The bars represent the emissions in million metric tons of CO2 equivalent (MMtCO2e). Positive values indicate a net release of CO2, while negative values indicate a net absorption of CO2. The states are listed along the x-axis, and the scale on the y-axis ranges from -60 to 10 (in increments of 10). The diagram distinguishes between森林 (Forests) and 农业土壤 (Ag Soils) emissions with different colored bars.
Black Carbon Emissions

Total 2002 Emissions and Comparison of 2002 & 2018 for Primary Sub Sectors

MMtCO2e

2002 Total Black Carbon
2002 Onroad+Nonroad Diesel
2018 Onroad+Nonroad Diesel

2002 Total Black Carbon
2002 Onroad+Nonroad Diesel
2018 Onroad+Nonroad Diesel
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