



# Colorado Climate Action Panel Meeting #2 February 15, 2007



# Agenda

- Introductions and review of day's agenda
- Approval of draft summary of Climate Action Panel (CAP) Call #1
- Review and discussion of the Colorado GHG Inventory and Forecast
- Review and additions to the Catalog of States Actions
- Discussion of water and climate vulnerability issues
- Next Steps of PWGs and CAP
- Agenda, Time and Date for Next Meeting
- Public Input and Announcements

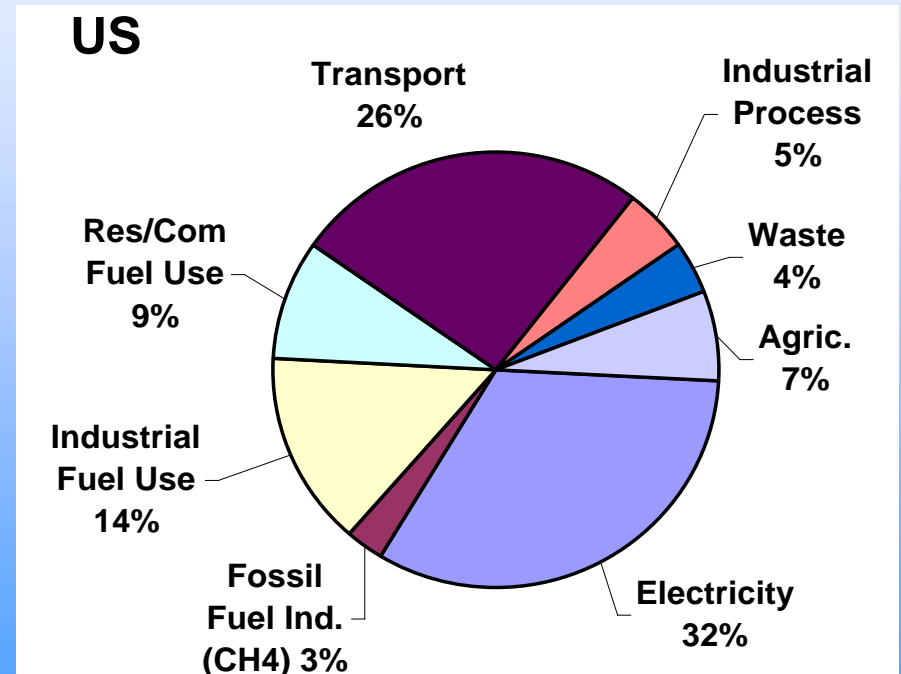
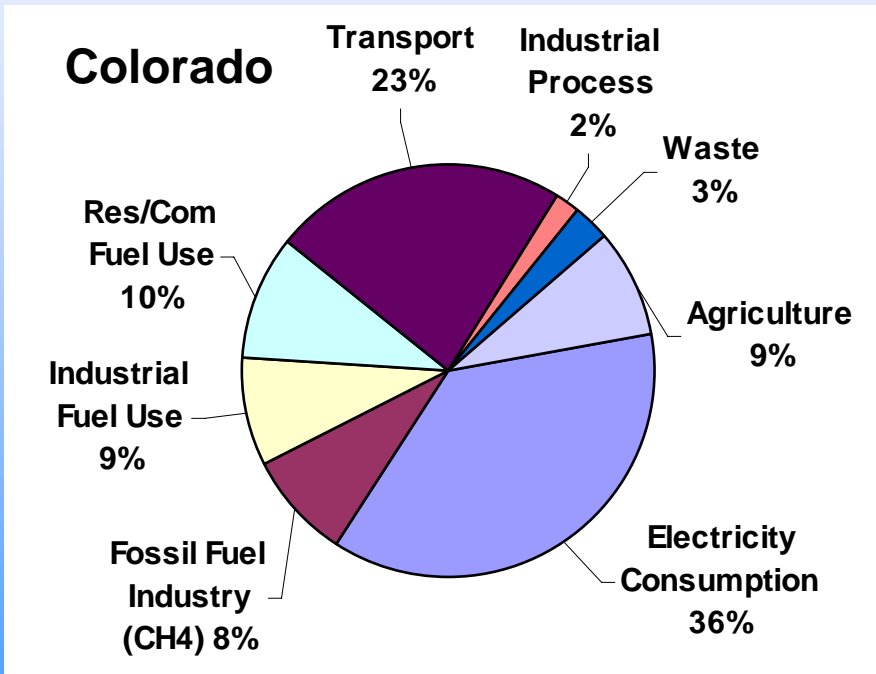
# Inventory Approach

- Standard US EPA and UN methodologies, guidelines, and tools
- Emphasis on transparency, consistency, and significance
- Preference for Colorado or regional data, where available
- Consumption and production-basis emissions from electricity generation
  - Very simplified approach used for initial analysis

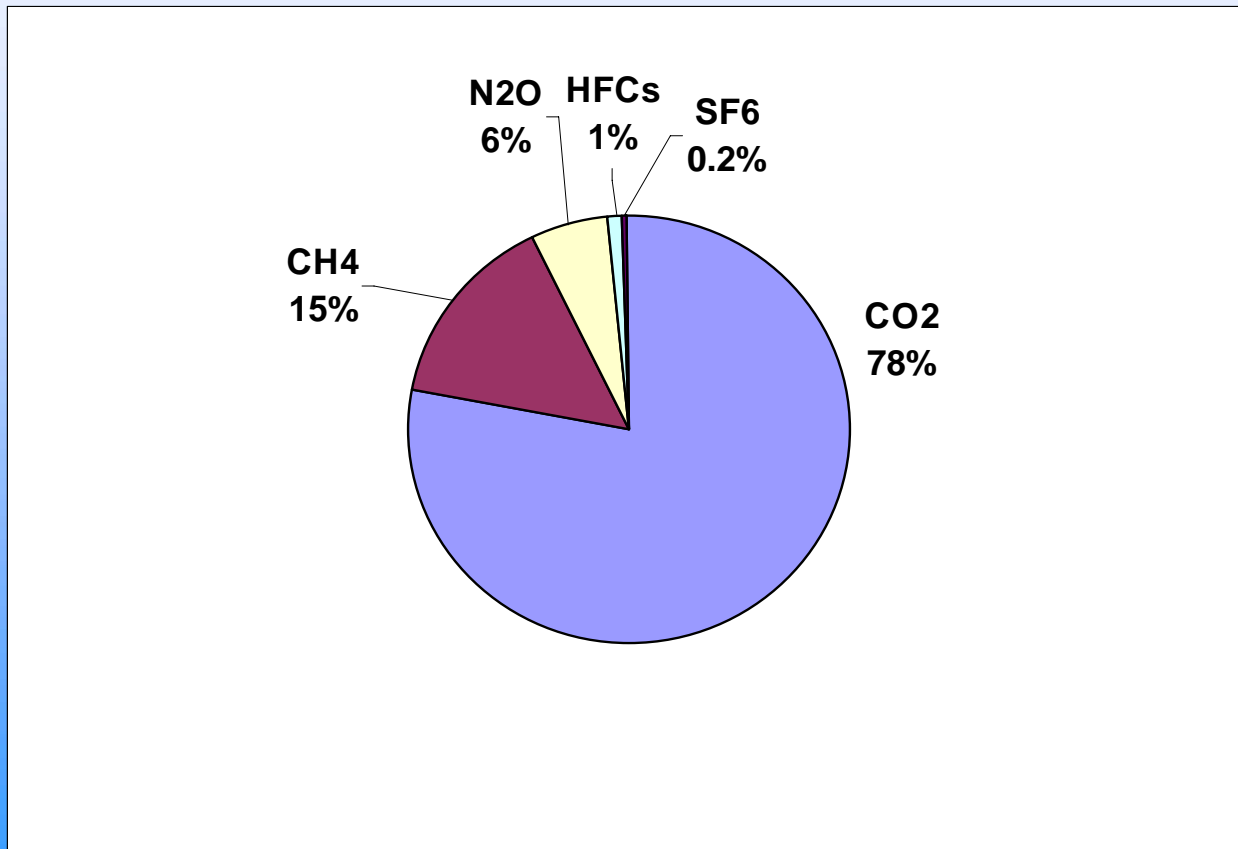
# Projection Approach

- 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
  - US Census and Bureau of Labor & Statistics
  - US Energy Information Administration

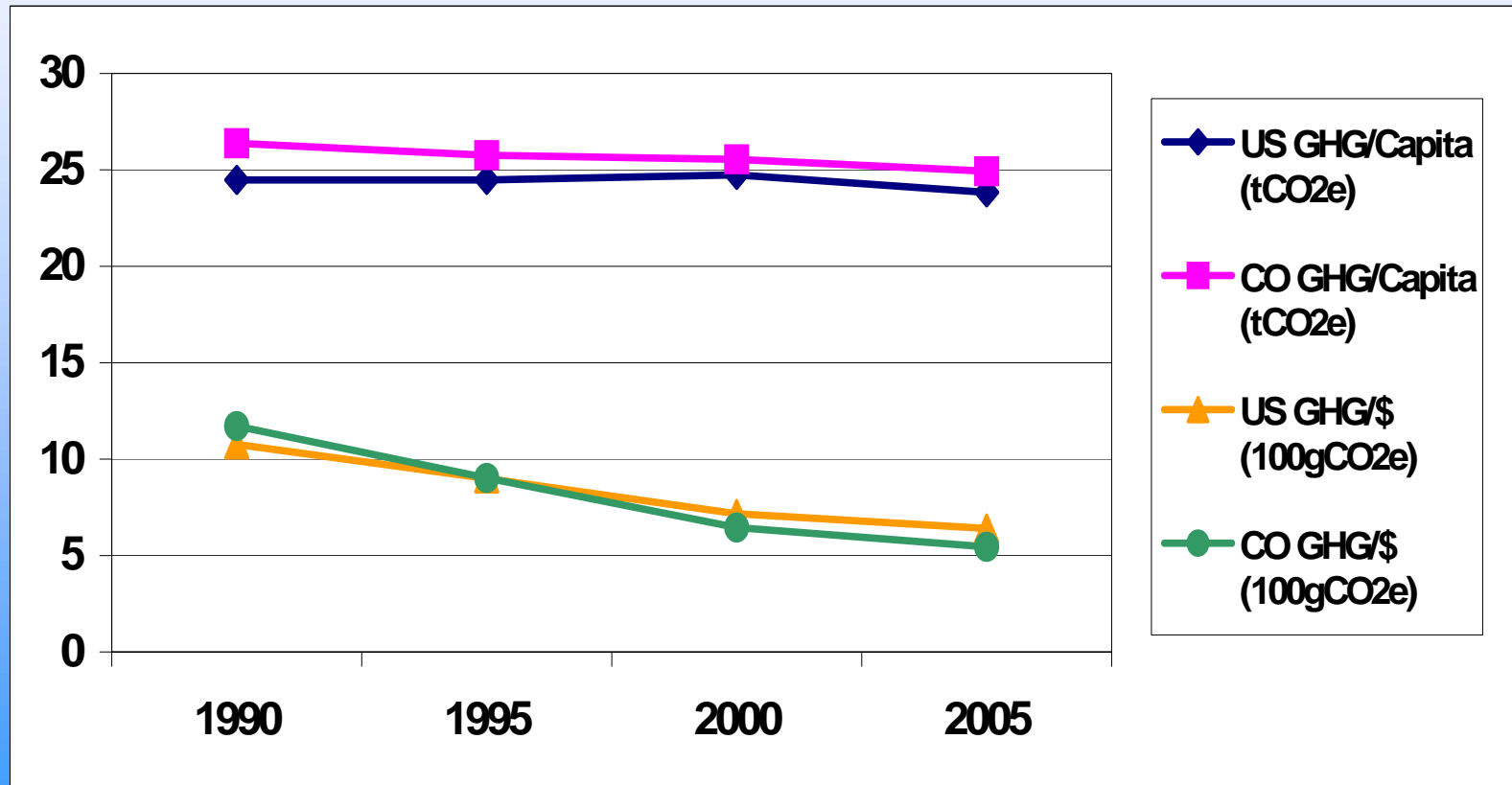
# Colorado & US Emissions By Sector, Year 2000



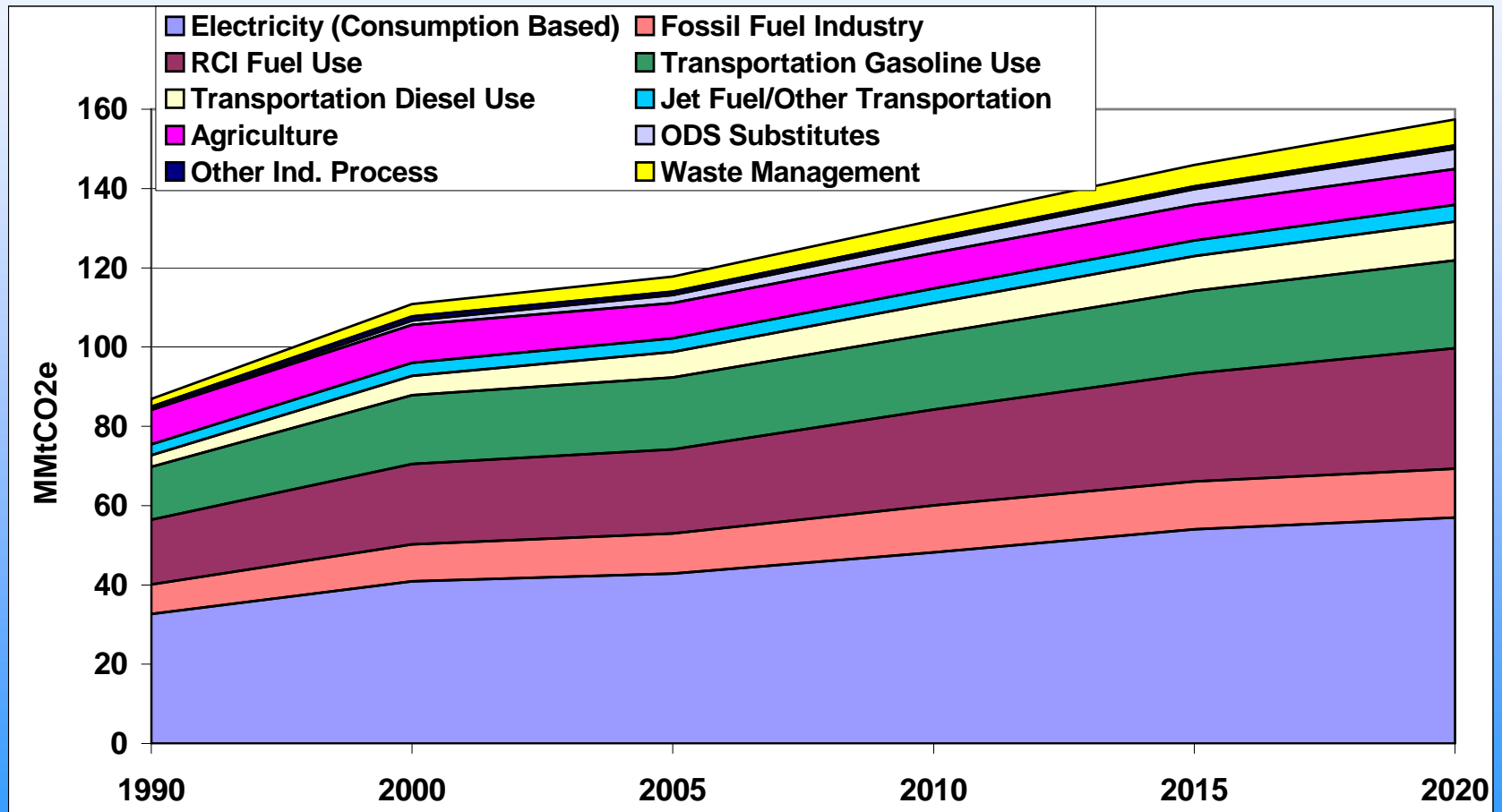
# Colorado Emissions By GHG, Year 2000 (MMtCO<sub>2</sub>e Based)



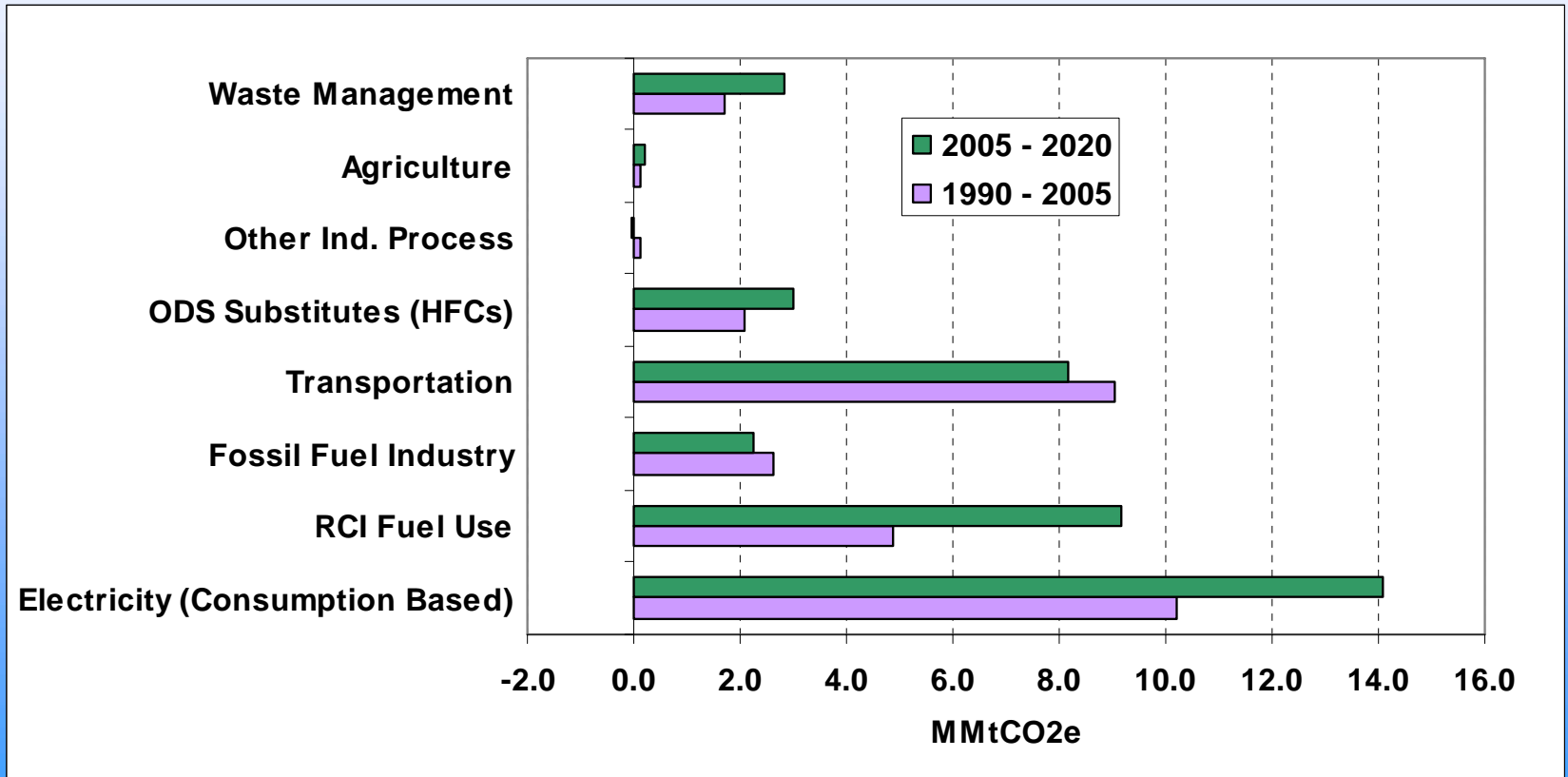
# Per Capita and GSP/GDP GHG Emissions, 1990-2002



# Gross Colorado GHG Emissions By Sector, 1990-2020



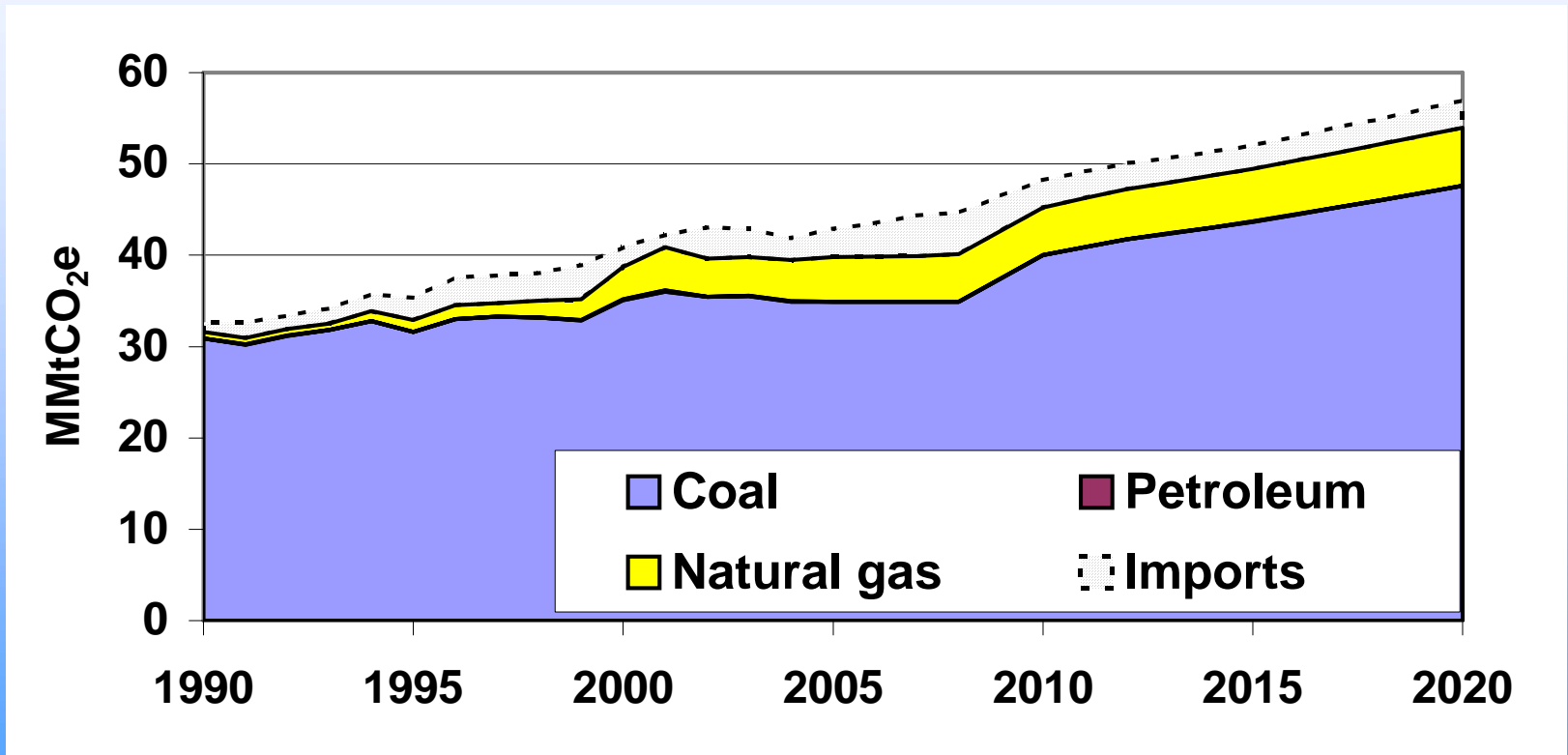
# Colorado Emissions Growth (MMtCO<sub>2</sub>e Basis)



# Key Points

- Preliminary draft prepared by CDPHE and CCS under WRAP project
- Preliminary draft for PWG and CAP review and revision, as needed
- Helpful for diagnosis of GHG emissions, but not a baseline for modeling or compliance for individual options
- Consumption and Production methods
- Net and Gross methods

# Electricity



# Electricity

- Data Sources
  - US DOE, EIA State Energy Data
    - Historic energy consumption and electricity sales
  - Colorado's Electricity Future, Xcel/PSCo website
    - Projected electricity sales
    - Proposed plants and generation through 2010
  - US DOE, Annual Energy Outlook
    - Projected generation, amount and type, 2010-2020
- Methods
  - Historic – use energy consumption and emission factors
  - Projections for energy based on growth and mix of new generation, emissions based on energy X emission factors

# Electricity

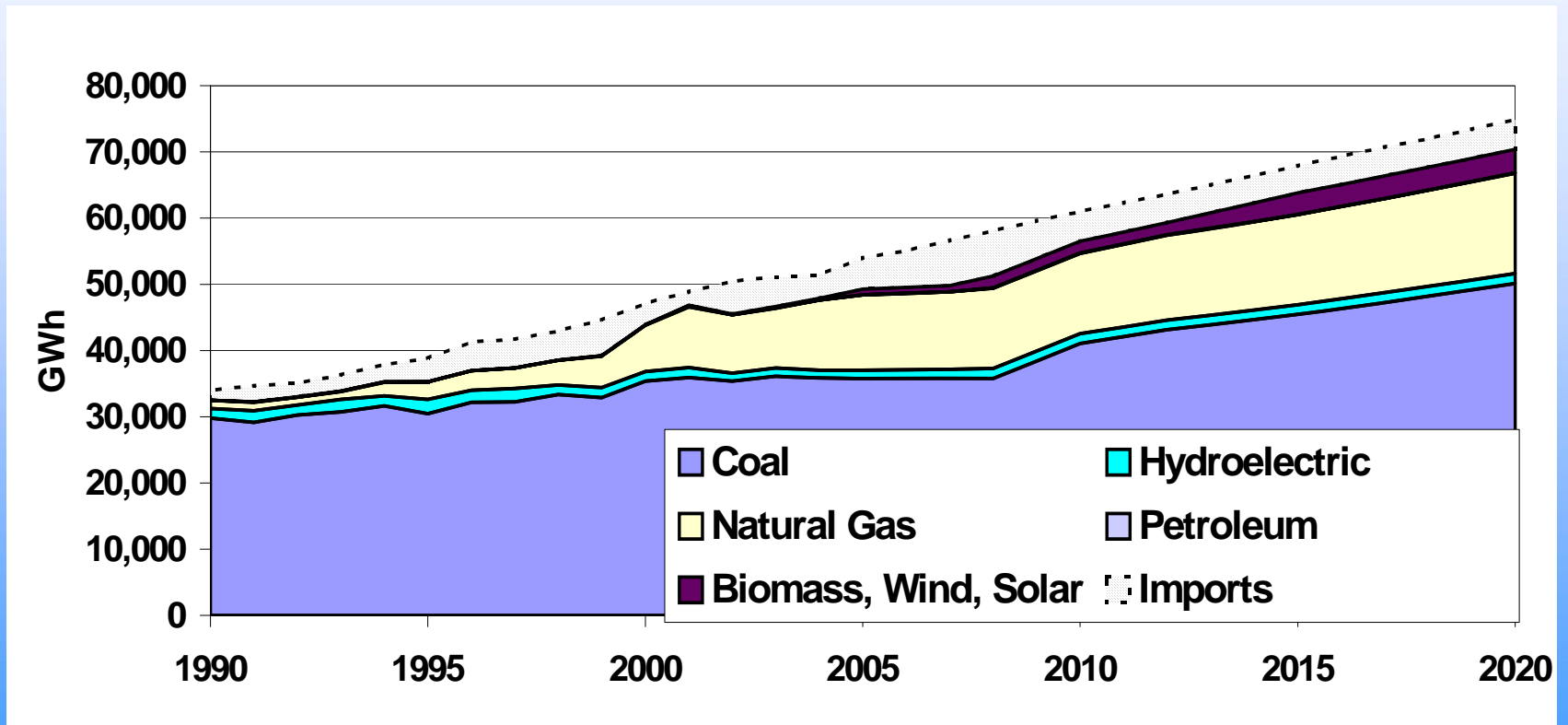
- Key Assumptions

- Electricity sales grow at 2.9% to 2010, 2.1% to 2020
- Generation grows at 2.8% to 2010, 2.2% to 2020
- RPS met by IOUs and 4 public utilities (65% of sales), 10% of sales by 2015, wind and solar
- New non-renewables plants
  - 90% coal / 10% natural gas for 2007 to 2010
  - 75% coal / 25% natural gas for 2011 to 2020

- Key Uncertainties

- Amount of new generation / mix of non-renewables
- Source of electricity imports and exports

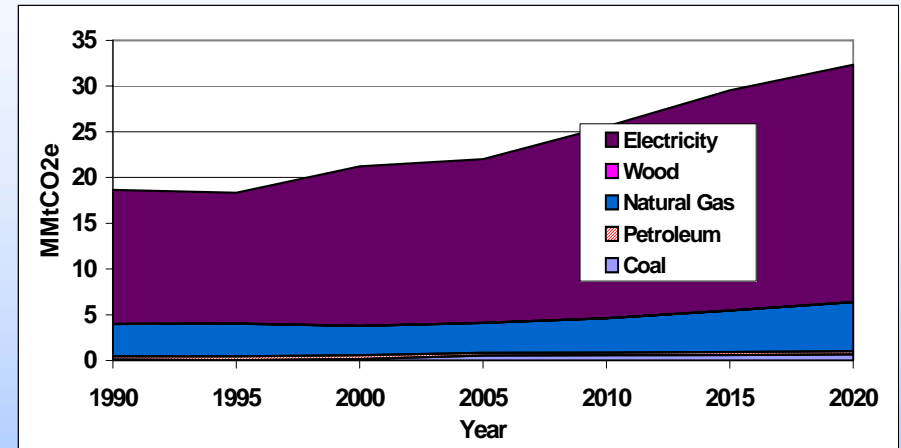
# Electricity



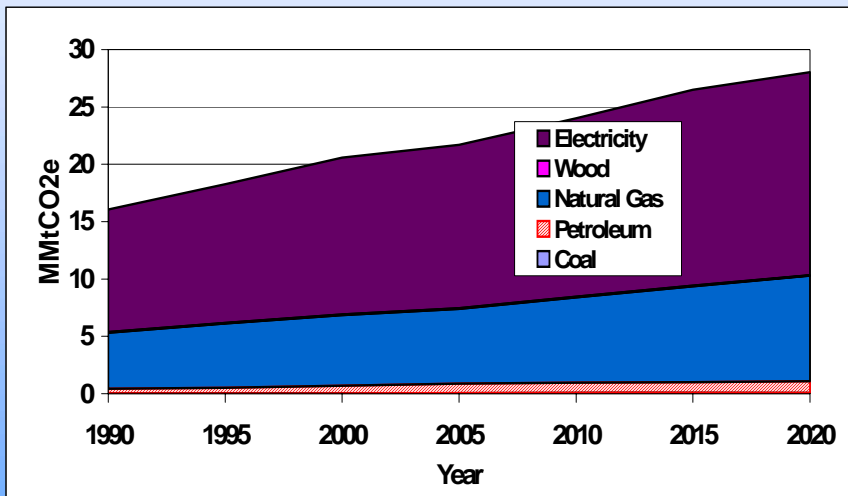
Source: Colorado Energy Plan, 2005

# RCI

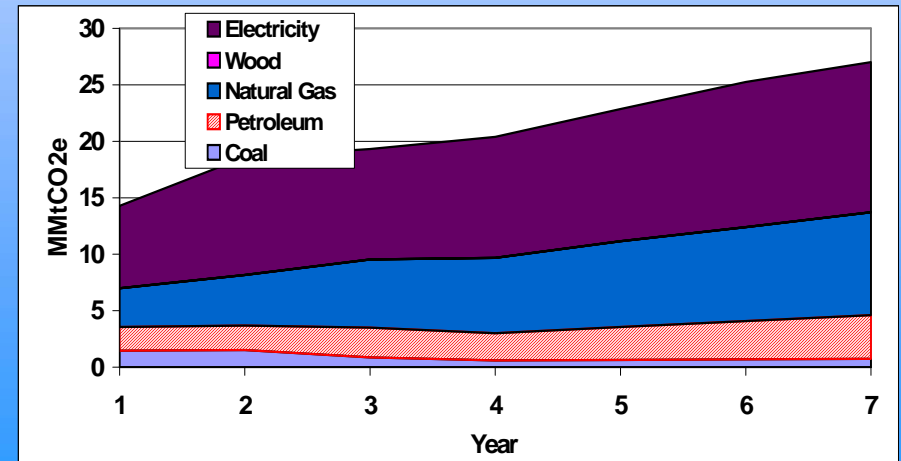
## Commercial Sector



## Residential Sector



## Industrial Sector



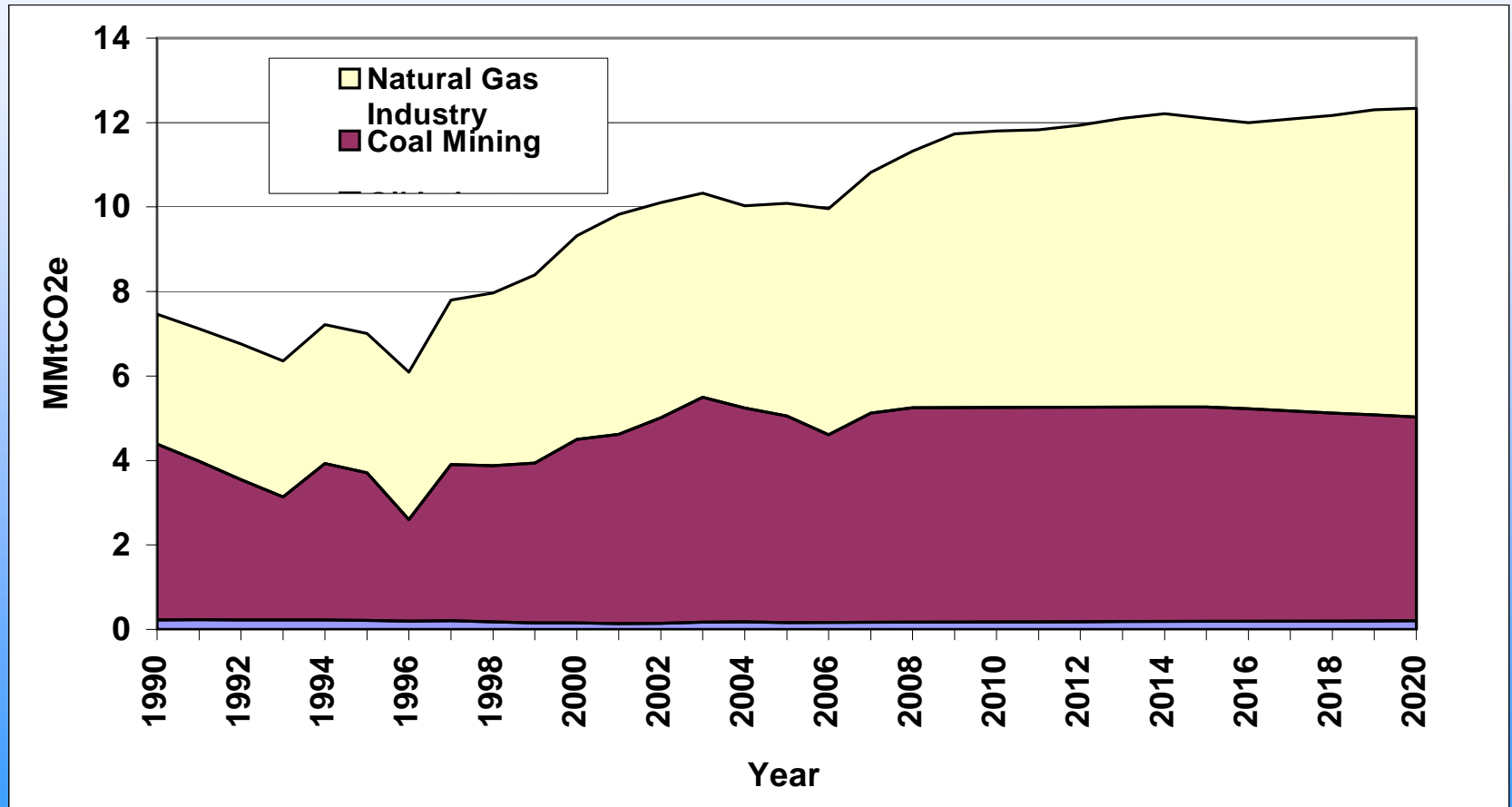
# RCI

- Data Sources
  - EIA State Energy Data (SED)
    - Historic energy consumption for natural gas, oil, wood, coal
  - EIA Annual Energy Outlook 2006 (AEO2006)
    - Projected consumption, amount and type
- Methods
  - Energy consumption multiplied by emission factors

# RCI

- Key Assumptions
  - Projections based on regional projections scaled for Colorado population and employment growth projections
- Key Uncertainties
  - Regional projections
  - Industrial sector growth and mix
  - EIA regional forecast for coal-to-liquids plants

# Fossil Fuel Production



# Fossil Fuel Production

- Data sources
  - Natural Gas – Gas Facts, US DOE (wells, pipelines, processing)
  - Oil Industry – US DOE (oil produced and refined)
  - Coal Mining – US EPA National GHG Inventory
- Methods
  - Based on US State GHG Inventory Tool
  - Activity x emission factors

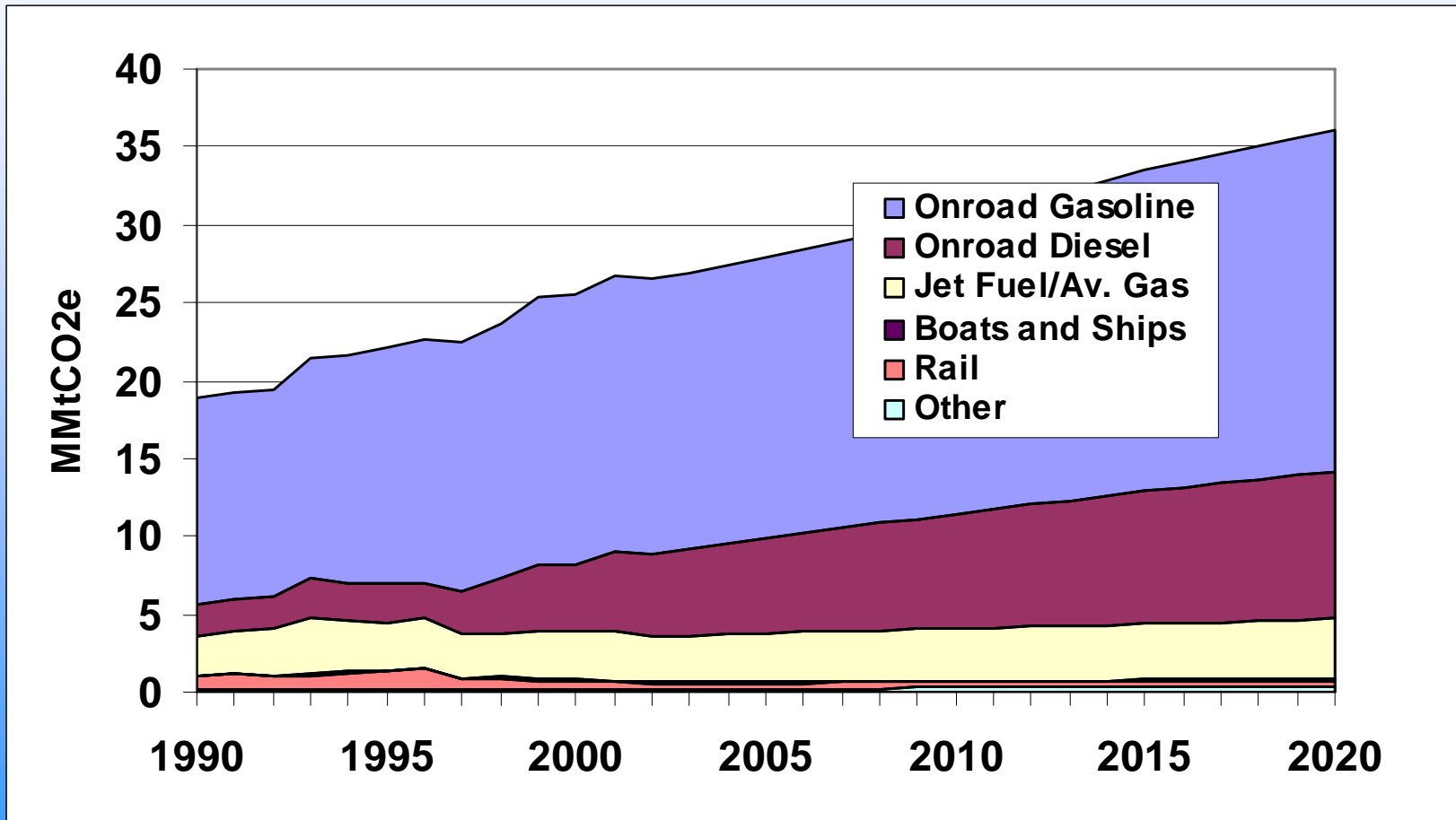
# Fossil Fuel Production

- Key Assumptions
  - Growth Rates
    - Oil and NG production
      - follow 2000-2005 growth rate through 2009
      - 2010-2020 based on US DOE, Annual Energy Outlook
    - Coal
      - Emissions follow Colorado Geological Survey coal production projections (intensity held at 2004 level)
- Key Uncertainties
  - Future production of fossil fuels
  - Production from Oil Shale
  - Coal bed methane – entrained CO<sub>2</sub>

# Break



# Transportation



# Transportation

- Data Sources: Onroad Vehicles
  - US DOE EIA State Energy Data fuel consumption thru 2002
  - State-level vehicle miles traveled (VMT) from CDOT
  - VMT allocated to vehicle type with fleet mix data from CDPHE
  - VMT projections from local planning organizations (DRCOG, NFRTAQPC, PPACG)
  - VMT forecast for rest of state from CO SIP growth rate

# Transportation

- Data Sources: Other Transport Sectors
  - Aircraft – EIA SED fuel consumption
  - Aircraft Projection – CDOT operations forecasts
  - Rail and Marine – EIA SED
  - Rail/Marine Projection – based on historical growth

# Transportation

- Methods
  - Inventory (1990-2002)
    - CO<sub>2</sub>
      - SGIT and Fuel Consumption
    - Onroad CH<sub>4</sub> and N<sub>2</sub>O
      - SGIT and VMT
    - Nonroad CH<sub>4</sub> and N<sub>2</sub>O
      - SGIT and Fuel Consumption

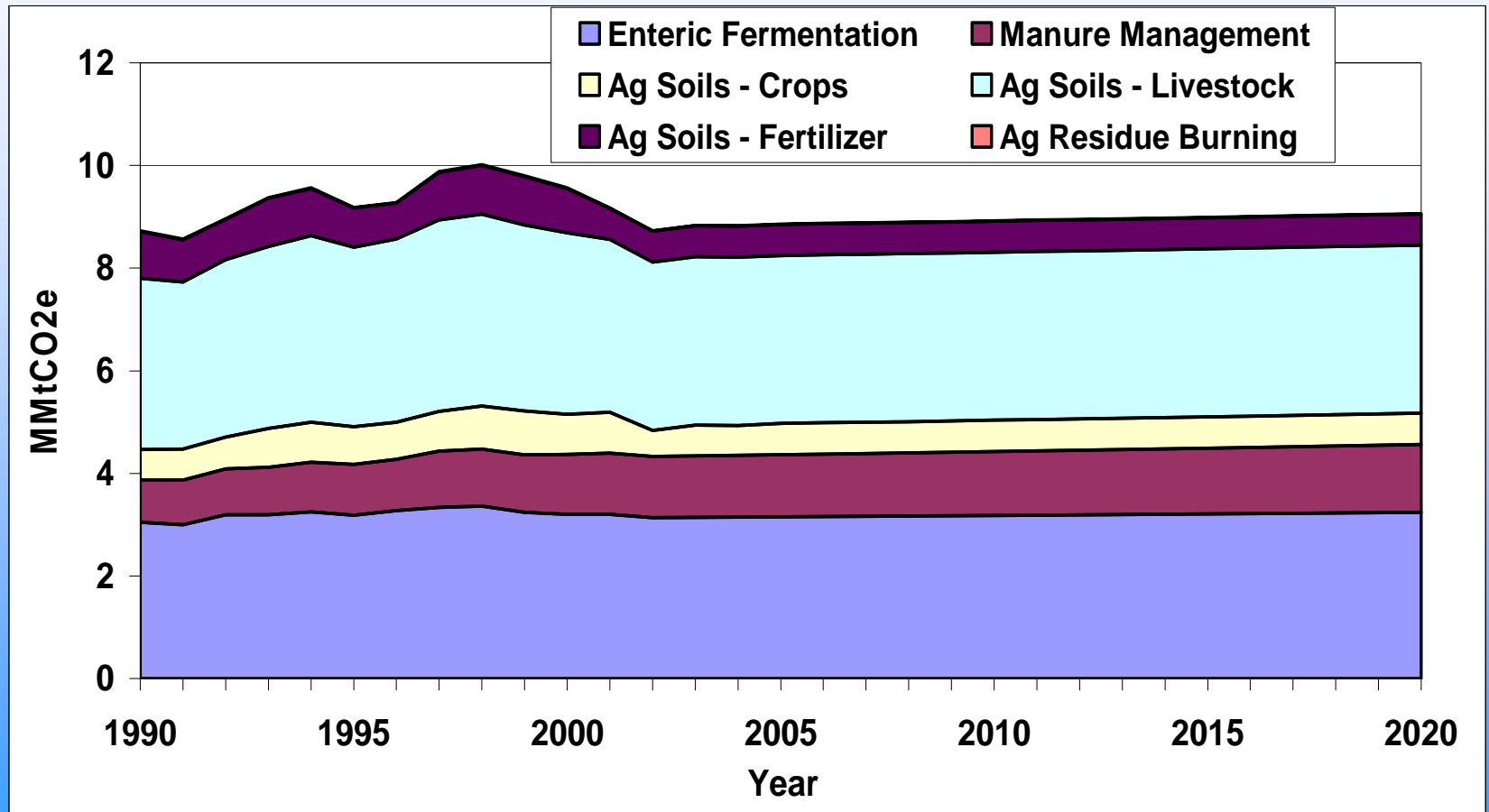
# Transportation

- Methods for Projections (2003-2020)
  - Onroad Gasoline and Diesel CO<sub>2</sub>
    - VMT forecasts from local planning organizations and CO SIP
    - VMT forecasts adjusted to account for projected fuel efficiency improvements from 2006 EIA Annual Energy Outlook
  - Onroad CH<sub>4</sub> and N<sub>2</sub>O
    - VMT projections, as above
    - VMT allocated to vehicle type using 2006 EIA Annual Energy Outlook data
  - Aviation
    - 2002-2005: Jet fuel – Denver International operations; general aviation – EIA aviation gasoline sales for CO
    - Post-2005: CDOT Aircraft Operations Forecasts
  - Rail/Marine
    - Historical growth rates

# Transportation

- Key Assumptions
  - Available VMT projections are accurate (statewide 2002-2020 = 2.1%/yr)
- Key Uncertainties
  - Future vehicle mix – based on national estimates
  - No data on future consumption of biofuels
  - Consumption of international bunker fuels in the aircraft sector

# Agriculture



# Agriculture

- Data Sources
  - Crop Acreage: USDA/NASS
  - Livestock: USDA/NASS
  - Fertilizer: Fertilizer Institute
- Methods
  - Crops: SGIT emission factors and crop acreage
  - Livestock: SGIT emission factors and livestock populations
  - Fertilizer: SGIT fertilizer consumption
  - No growth assumed for Ag Soils and Ag Residue Burning emissions

# Agriculture

- Key Assumptions
  - No growth or significant change in crop production for the future
  - Dairy cattle population growth (1.8%/year); no growth for other livestock categories
    - Based on Colorado Agricultural Statistics Service data
- Key Uncertainties
  - Projection data

# Forestry

Carbon Pool	MMtCO <sub>2</sub> e/yr
Live Trees	-15.3
Standing Dead Trees	-1.5
Live Understory	-0.9
Down and Dead Trees	-1.0
Forest Floor	-5.2
Soils	-7.1
Harvested Wood Products	-0.8
<b>Total</b>	<b>-31.8</b>

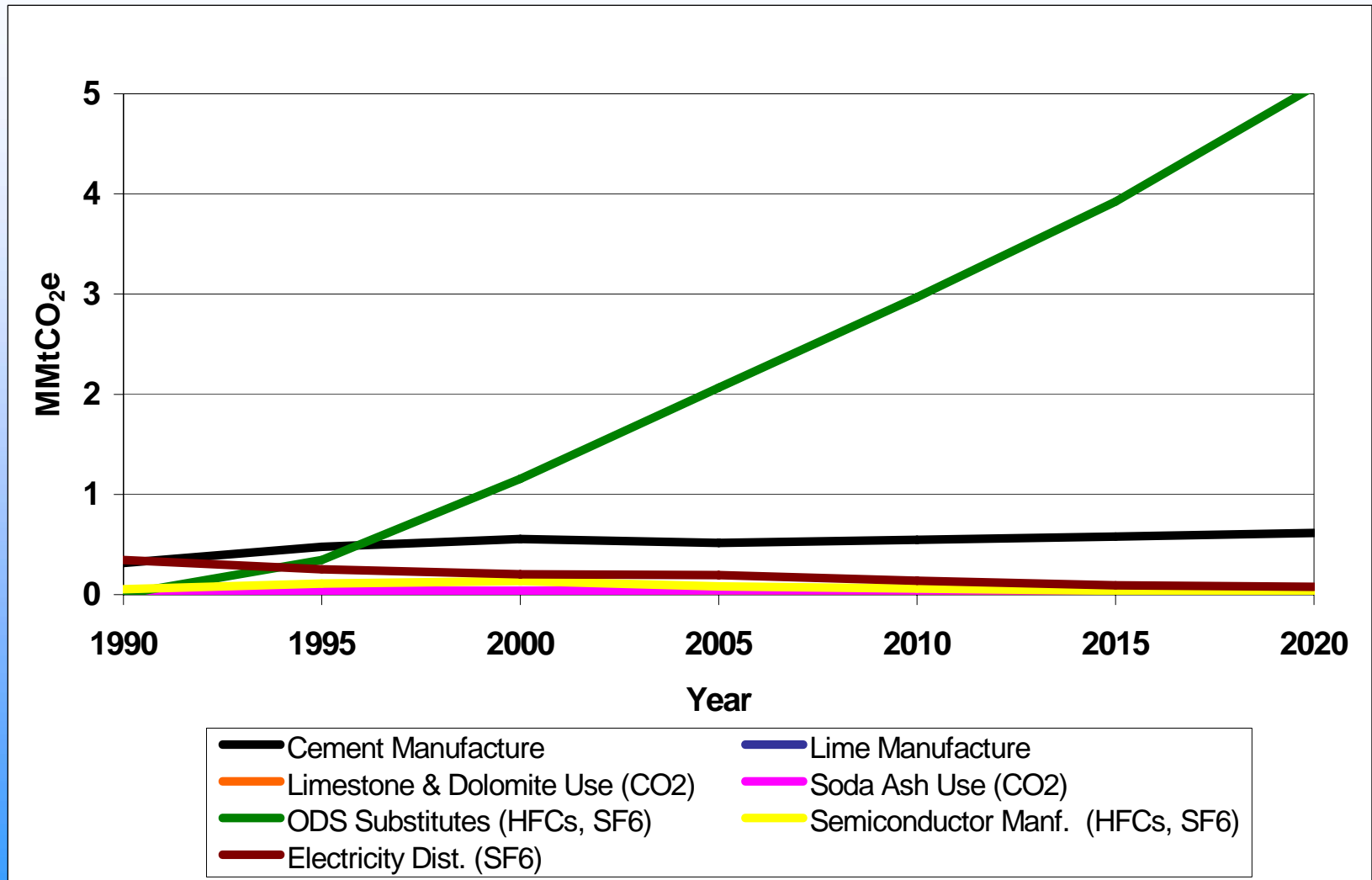
# Forestry

- Data Sources
  - USFS carbon stock for 2 inventories (1983/1984-2005) based on FORCARB2 model
  - USFS also provides modeled estimates for harvested wood products
- Methods
  - Forestry: USFS FORCARB2 carbon stock change model provides carbon pools for each inventory cycle
  - Flux calculated for each pool based on difference in time between inventory cycles
  - Carbon pool data for the 1983/1984-2005 time-period used to quantify flux.

# Forestry

- Key Assumptions
  - 1983-2005 carbon stock change representative of current conditions
  - No significant change in sequestration from 2006-2020
- Key Uncertainties
  - Effects of future development on forested acreage
  - Effects of near-term climate change on forest sequestration levels
  - Effects of increasing wildfire activity on sequestration levels

# Industrial Process



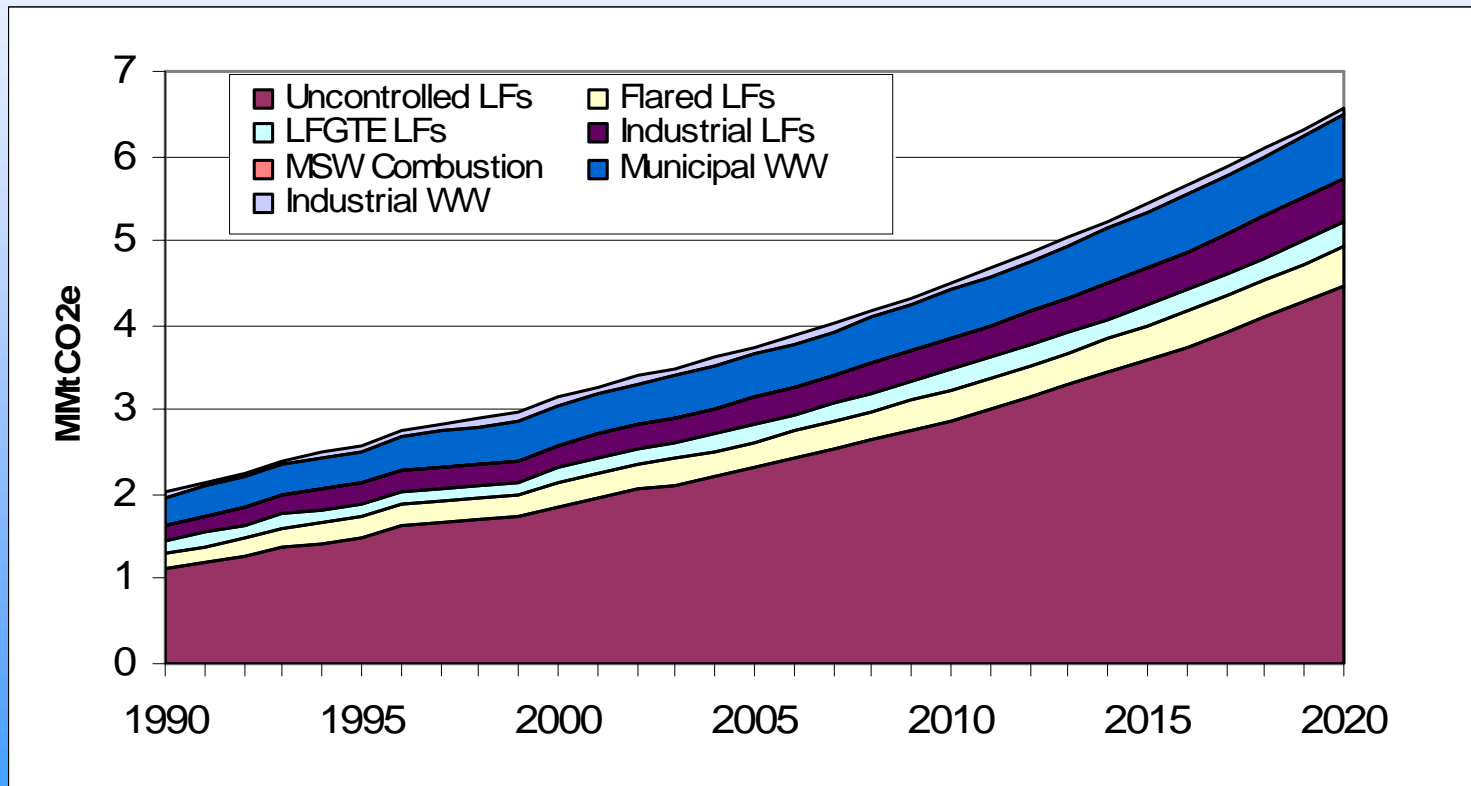
# Industrial Process

- Data sources
  - US EPA National GHG Inventory for national emissions from ODS substitutes, electric distribution, and semiconductor manufacturing
  - State CDPHE - lime production
  - USGS data
    - Cement manufacture (clinker and masonry cement)
    - Soda ash use
    - Limestone and dolomite use
- Methods
  - Based on US EPA's State GHG Inventory Tool (SGIT)
  - Scale national to state (ODS subs, Electricity Tans./Dist.)
  - Activity X emission factors (all other)

# Industrial Process

- Key Assumptions
  - Growth Rates
    - ODS subs and Elec. Dist. –
      - National growth rate (US State Dept and US EPA)
    - Cement and lime manufacture, limestone/dolomite use –
      - State employment forecasts for non-metallic minerals
    - Soda ash use – USGS national forecast
- Key Uncertainties
  - Industry activities to reduce GHG emissions
  - Clinker and masonry cement & soda ash production
    - SGIT default production - replace with plant-specific data, when available

# Waste Management



# Waste Management

- Data sources
  - EPA LMOP Database
  - CDPHE Survey on landfills
  - CDPHE data on WW flows for meat/poultry processors
  - State population and SGIT default data for municipal WW treatment
- Methods
  - SGIT with data sources above
  - CCS post-processing to account for controls and growth

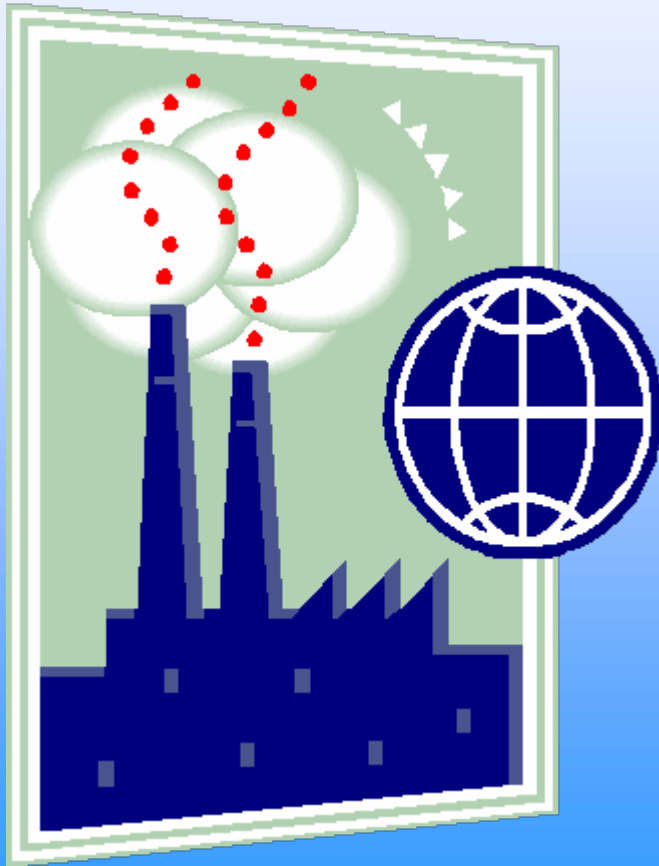
# Waste Management

- Key Assumptions
  - Growth Rates
    - Landfills – based on historic emissions growth
    - Industrial WW – held constant at 2005 levels
    - Municipal WW – CO population projections
- Key Uncertainties
  - Future controls applied to uncontrolled landfills
  - Industrial landfills – SGIT default of 7% of municipal landfills
  - Industrial WW – growth for meat/poultry; lack of data for pulp/paper and food/vegetable processing

# Black Carbon

- One of two carbonaceous aerosol species – BC and Organic Carbon (OC)
- Also known as light absorbing carbon (LAC) and elemental carbon (EC)
- Absorbs solar energy and warms the troposphere (like GHG's)

# Sources of Black Carbon



- Fossil Fuel Combustion
- Biomass Combustion
- Other (Minor) Sources

# Black Carbon Emissions

- 2002
  - 6.8 MMtCO<sub>2</sub>e
  - Primary Contributors:
    - nonroad diesel (54%)
    - onroad diesel (26%)
    - rail (7%)
    - nonroad gasoline engines (5%)
- 2018
  - Nonroad diesel drops from 3.7 to 1.1 MMtCO<sub>2</sub>e
  - Onroad diesel drops from 1.7 to 0.4 MMtCO<sub>2</sub>e

# Break



# Catalog of States Actions

- Refer to updated handout
  - Updates from PWG review:
    - Draft preliminary rankings of GHG potential, cost/cost savings for review and revision
    - Notation of actions from AZ, NM and MT
    - Supplemental descriptions of catalog actions
  - CAP addition of new potential actions?

# Next CAP Meeting

- Agenda:
  - Review TWG suggested priorities for analysis of policy options
  - Review PWG suggested updates to the Colorado emissions inventory and projection
  - Discuss policy design issues and next steps for policy options
- Date and Location TBD



# Break



# Public Input, Announcements