



California Global Warming Solutions Act
of 2006

**1990 Greenhouse Gas
Emissions Level and
2020 Limit**

California Air Resources Board
November 26, 2007

Cal/EPA Headquarters

Agenda

- Requirement for establishing 1990 Emissions Level
- Proposed 1990 Emissions Level
- Development of the 1990 Emissions Level
- Major sector and category updates
- Preliminary 2020 projections



Requirement for Establishing 1990 Emissions Level

What AB 32 Requires

- Determine statewide 1990 GHG emissions level
- Approve statewide 2020 emissions limit equivalent to 1990 Level
- Present for Board consideration by January 1, 2008

1990 Level & Climate Change Program

- Statewide 1990 emissions level is basis for statewide, aggregated 2020 limit
- Used to determine state reduction goal
- Starting point for Scoping Plan development

1990 Emissions Level

- Single statewide number
- Sum of all sector estimates from 1990 inventory
- Board to consider in public hearing
- Focus of Staff Report

1990 Emissions Level (*cont.*)

- Remains in effect unless otherwise amended
- Criteria for amending
 - Significant change to emissions level
 - Major impact on statewide reduction goal (delta)



Proposed 1990 Level

Proposed 1990 Level

- Proposed 1990 Level: 427 MMTCO₂e
- Includes emissions of six GHGs (CO₂, CH₄, N₂O, PFCs, HFCs and SF₆)
- Includes estimate of statewide sinks
- Uses IPCC Second Assessment Report Global Warming Potentials

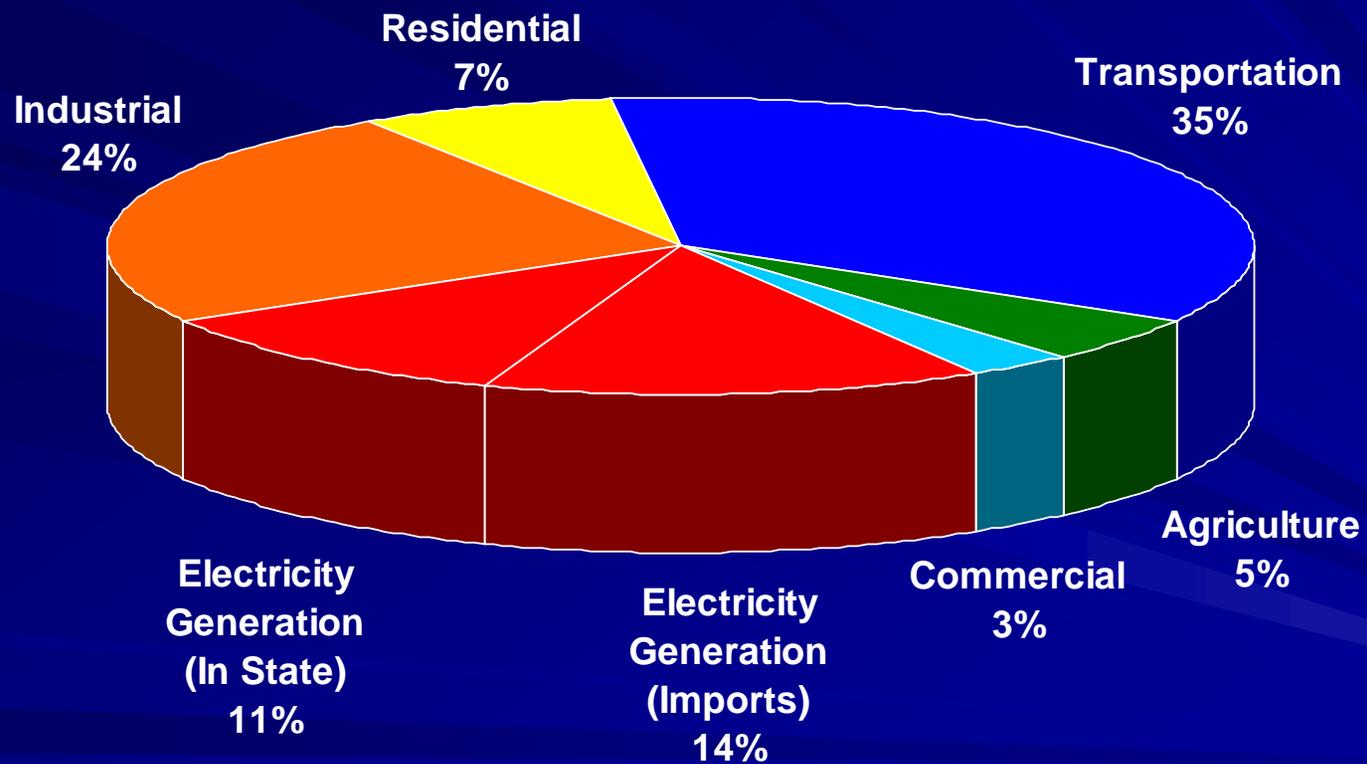
Included in the 1990 Level

- Emissions from imported electricity
 - Required by AB 32
- Emissions from international shipping in California waters
 - Responsible for emissions occurring within California waters
- Sinks from forestry
 - Recognition of CO₂ sequestration at point of occurrence
 - Consistency with earlier GHG inventories

Excluded from the 1990 Level

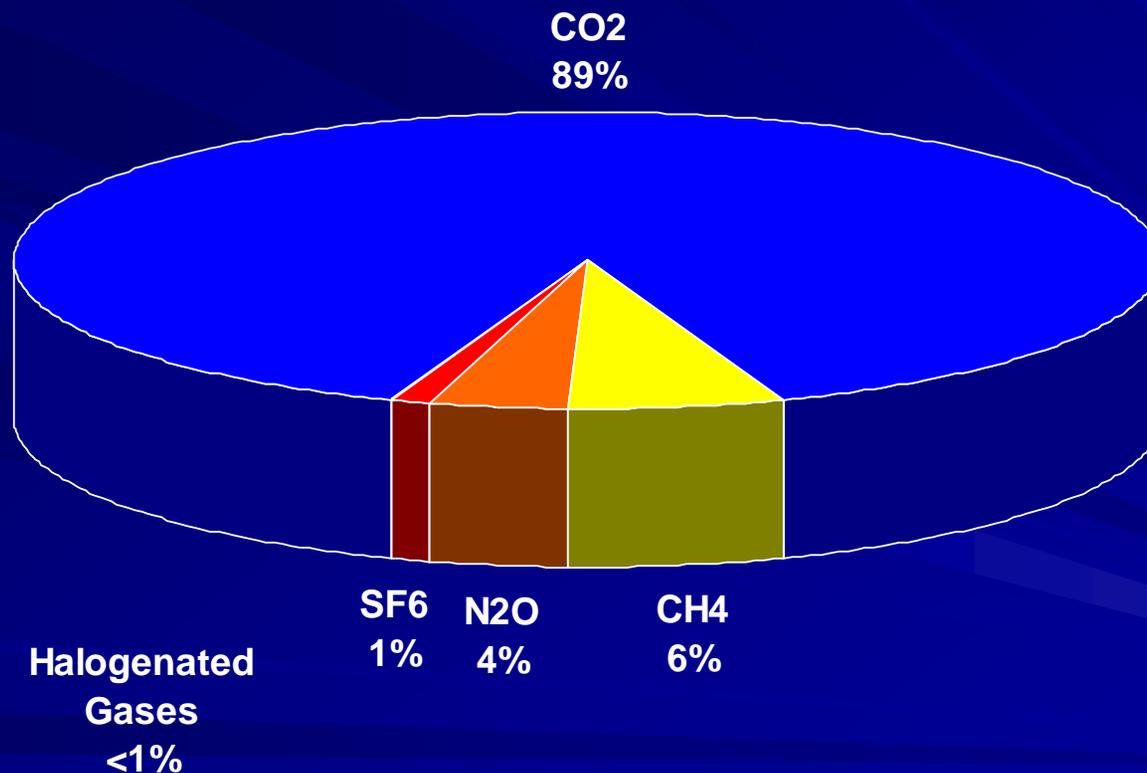
- Emissions from interstate aviation
 - Interstate aviation akin to international aviation at statewide level
- Emissions from international shipping and aviation bunker fuels
 - Consistency with international guidance on GHG inventories

1990 GHG Emissions



Source: ARB GHG Inventory November 16, 2007

1990 GHG Emissions by Gas



Source: ARB GHG Inventory November 16, 2007

Comparison of 1990 Emission Level Estimates

- ARB 1990 estimate: 427 MMTCO₂e
- CAT 1990 estimate: 426 MMTCO₂e
- CEC 1990 estimate: 413 MMTCO₂e

*Data Sources: ARB GHG Inventory November 16, 2007;
Climate Action Team Report, March 2006; California Energy
Commission GHG Inventory, December 2006*



Development of the 1990 Emissions Level

GHG Inventory

- Transferred to ARB on January 1, 2007 from CEC
- Includes GHG emissions estimates from 1990 – 2004
- Staff updated entire time series
 - Most recent IPCC and USEPA guidance
 - Stakeholder input
 - Includes emissions estimates from all sectors
 - Improved data and methods
- Next update will include 2005 & 2006

Establishing the 1990 Level

- Based on 1990 statewide inventory of emissions and sinks
- Began with CEC estimates for 1990
- Reviewed most recent guidance from IPCC and USEPA
- Extensive stakeholder input
- Documentation of calculation methods and data sources

Inventory Review Process

- Evaluated emissions from major sectors including approximately 270 sub-categories
- Reviewed more than 10,000 calculations
- Reviewed inventory with primary focus on 1990 estimates

1990 Inventory Updates

- Improved data input
 - Updated emission factors
 - Improved activity data
 - Corrected calculation errors
- Methodological improvements for some categories
- Data sources:
 - International organizations
 - Federal and state agencies
 - Stakeholders

Stakeholder Input

- Five public workshops
- Nine Focused Technical Discussions
- Additional follow-up meetings
- Input on data sources and methodological approaches for estimating 1990 emissions
- Input on industry-specific changes over time

Key Issues with Estimate of 1990 Emissions Level

- Imported Electric Power
 - Emissions from unspecified electricity imports from Pacific Northwest (PNW)
- Landfills
 - Characterization of sequestered carbon
 - Landfill gas collection efficiency
- Forestry sinks
 - Estimates of carbon storage and stock changes

Imported Electric Power in 1990

- Emissions from unspecified imported PNW power in 1990 dependent on fuel mix assumptions
- Staff proposal
 - Use current hydro/coal fuel mix assumptions approved by CEC
 - Continue to work closely with CEC staff in evaluating GHG emissions from unspecified imports in current and future years

Landfill Emissions in 1990

- Emissions level affected by characterization of sequestered carbon in landfills
- Impact of LFG collection efficiency
- Staff proposal
 - Calculate and track amount of carbon stored in landfills
 - Recognize landfills as repositories of carbon, not as CO₂ “sinks”
 - Use USEPA default LFG collection efficiency values for determining statewide 1990 emissions level

Forestry Sinks in 1990

- Carbon dioxide sinks determined from changes in forest carbon stocks
- Estimating sinks is challenging and requires long-term effort
- Staff proposal
 - Use available data as developed by Winrock to estimate net CO₂ flux for 1990 Emissions Level
 - Work collaboratively with CDF, USFS, and other stakeholders to improve methods and data used for estimating forestry sinks



Major Sector and Category Updates

Transportation

- Largest category
- Contribution to 1990 Emissions Level includes emissions from:
 - Highway vehicles
 - Airplanes (intrastate only)
 - Trains
 - Ships and Boats (emissions from activities within California waters)



Highway Vehicles - Updates

■ Data Sources:

- California Energy Balance (CALEB)
- EMFAC 2007

■ Updates:

- Used newer version of EMFAC for CH₄
- Updated diesel N₂O emissions

Highway Vehicles - Estimates

- CEC 1990 estimate:
147.4 MMTCO₂e
- Proposed 1990 estimate:
138.0 MMTCO₂e



Trains, Ships and Planes - Updates

- Data Sources:

- California Energy Balance

- U.S.EPA emission factors for CH₄ and N₂O

- Updated CH₄ and N₂O emissions using U.S.EPA emission factors

Trains, Ships and Planes - Estimates



- CEC 1990 estimate:
30.6 MMTCO₂e
- New 1990 estimate:
9.7 MMTCO₂e

Electricity Generation

- Includes emissions from both in-state and imported electricity generation
- Data sources:
 - Energy Information Administration
 - IPCC emission factors for CH₄ and N₂O
 - CEC's Quarterly Fuels and Energy Report

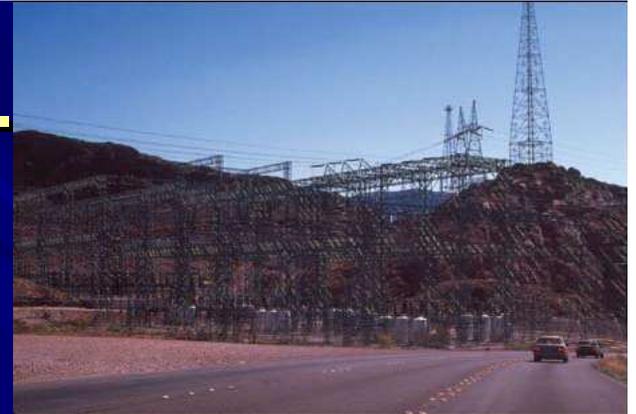
In-State Electricity Generation - Updates

- Included additional fuels (e.g., geothermal, associated gas)
- Used IPCC oxidation factor of 1
- Updated SF6 emissions
- Included CHP useful thermal output in industrial and commercial sector emissions

Imported Electricity Generation - Updates

- Included 8 additional specified imports and updated 2 specified imports
- Used gross imported power
- Accounted for line loss
- Included IPCC emission factors for CH₄ and N₂O
- Used IPCC oxidation factor of 1
- Updated SF₆ emissions

Electricity Generation - Estimates



- In-State CEC 1990 estimate:
45.2 MMTCO₂e
- In-State Proposed 1990 estimate:
49.0 MMTCO₂e
- Imported CEC 1990 estimate:
44.0 MMTCO₂e
- Imported Proposed 1990 estimate:
61.6 MMTCO₂e

Refineries

- Includes emissions from fuel use for H₂ production, on-site fuel combustion and some fugitive emissions
- Data Sources:
 - Petroleum Industry Information Reporting Act;
 - Quarterly Fuels and Energy Report;
 - ARB's Criteria Pollutant database (CEIDARS);
 - Literature (*Oil & Gas Journal*)

Refineries - Updates

- Included:
 - H₂ production emissions
 - Fugitive CH₄ emissions
 - CH₄ and N₂O from fuel combustion
- Used IPCC oxidation factor of 1

Refineries - Estimates

- CEC 1990 estimate:
27.9 MMTCO₂e
- Proposed 1990 estimate:
32.8 MMTCO₂e



Landfills

- Includes emissions from decomposition of landfill material (CH₄) and burning of landfill gas
- CO₂ emissions from decomposition, combustion, and oxidation addressed in Forestry
- Data Sources:
 - CIWMB for Waste in Place data and landfill controls
 - Survey data
 - IPCC, U.S.EPA and CIWMB for waste characterization
 - U.S.EPA for waste decay rate

Landfills - Updates

- Used IPCC Mathematically Exact First-Order Decay Model
- Tracks annual amount of carbon sequestered
 - Sequestered carbon not considered a sink
- Added N₂O emissions

Landfills - Estimates

- CEC 1990 estimate:
8.1 MMTCO₂e
- Proposed 1990 estimate:
6.3 MMTCO₂e
- Landfill gas to energy estimate:
0.001 MMTCO₂e (included in
electricity sector)



Cement

- Includes emissions from clinker production and fuel use
- Data Sources:
 - Cement manufacturers (PCA)
 - IPCC emission factors

Cement - Updates

- Updated clinker production data
- Used IPCC 2006 Revised Guidelines methodology for process CO₂ emissions
- Actual data for 1990, 1995, 2000, and 2005; interpolated estimates for other years

Cement - Estimates

- CEC 1990 estimate:
4.8 MMTCO₂e
- Proposed 1990 estimate:
8.1 MMTCO₂e



Agriculture

- Includes:

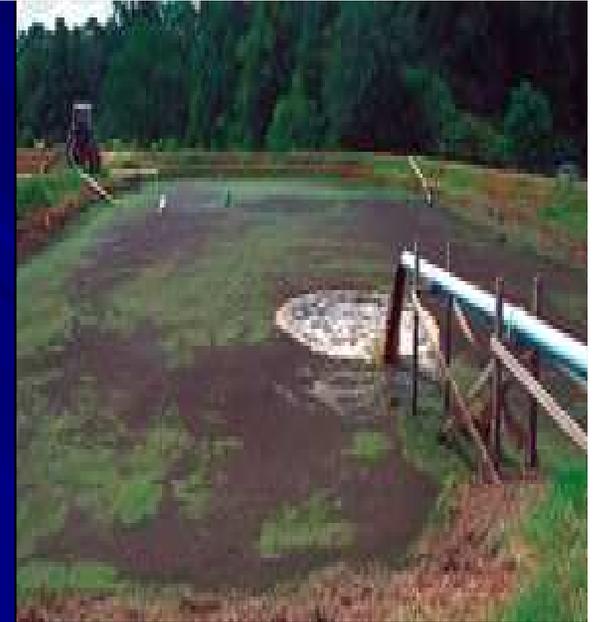
- Manure Management
- Enteric Fermentation
- Agricultural Residue Burning
- Managed Soils

Manure Management - Updates

- Includes emissions from management of livestock waste
- Data Sources: California-specific data compiled by U.S.EPA
- Updates:
 - Used 2006 IPCC methodology
 - Used data from U.S.EPA 1990-2005 inventory

Manure Management - Estimates

- CEC 1990 estimate:
4.1 MMTCO₂e
- Proposed 1990 estimate:
5.0 MMTCO₂e



Enteric Fermentation - Updates

- Includes exhaled methane emissions that are produced in animals' digestive systems
- Data Sources: California-specific data compiled by U.S.EPA
- Update:
 - Used most recent U.S.EPA model outputs

Enteric Fermentation - Estimates

- CEC 1990 estimate:
7.5 MMTCO₂e
- Proposed 1990 estimate:
6.7 MMTCO₂e



Agricultural Residue Burning - Updates

- Includes emissions (CH₄ and N₂O) from burning Ag biomass waste
- Data Sources: California-specific data compiled by CEC
- Updates:
 - Accounted for rice straw phase-down
 - Revised calculations

Agricultural Residue Burning – Estimates

- CEC 1990 estimate:
0.14 MMTCO₂e
- Proposed 1990 estimate:
0.12 MMTCO₂e

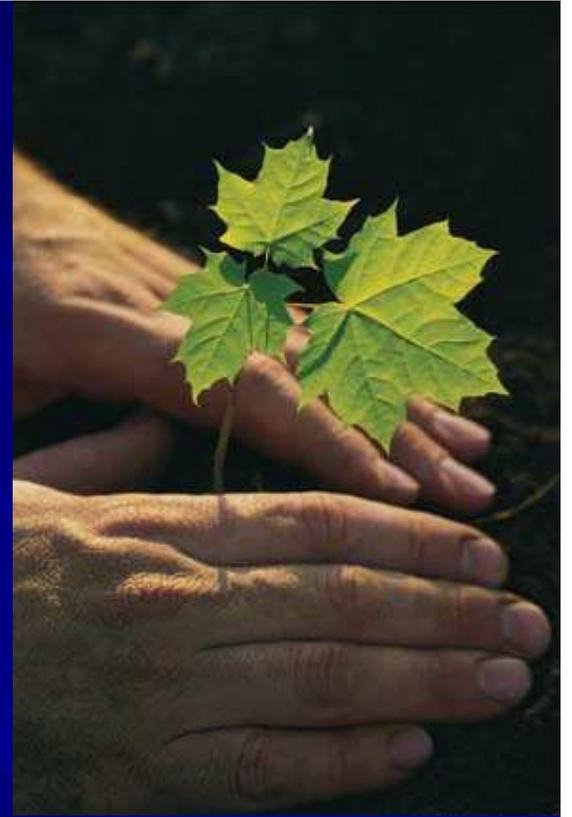


Managed Soils - Updates

- Includes Ag practices that add nitrogen to soil and increase N₂O emissions
- Data Sources: California-specific data compiled by CEC
- Updates:
 - Revised calculations
 - Improved emission factors

Managed Soils - Estimates

- CEC 1990 estimate:
14.7 MMTCO₂e
- Proposed 1990 estimate:
6.7 MMTCO₂e



Forestry (Biodegradable CO2)

- Includes CO2 emissions from:
 - Harvested slash and fuel wood
 - Landfilled and composted wood products
 - Biomass wildfires
- Includes CO2 removals from:
 - Forest and rangeland growth

Forestry - Updates

- Data Sources:
 - CEC Inventory (Winrock)
 - USFS and CIWMB data on wood consumption and wood landfill and composting data
- Used IPCC Atmospheric Flow Approach to track CO₂ flux
- Removed landfill wood products as “sinks”

Forestry - Estimates



- CEC 1990 estimates (net):
-17.2 MMTCO₂e
- Proposed 1990 estimates (net):
-6.7 MMTCO₂e



Preliminary 2020 Projections

2020 Projections

- Estimated statewide emissions if no actions taken (“business-as-usual”)
- Difference between 2020 BAU and 2020 Limit determines state reduction goal
- Scoping Plan will define official 2020 projection

2020 Forecast Method

- Similar to method used by CEC
- 2002-2004 average emissions used for base
- Base emissions projected to 2020 using growth factors from CEC and ARB

2020 Projection Growth Factors

- Growth factors for fuel-related emissions based on energy demand forecasts from CEC (2007 IEPR)
- Non-energy related growth factors based on economic, population and trend analysis
 - California Emissions Forecasting System (CEFS)
 - Population data from CA Dept. of Finance

2020 Preliminary Emission Projections

- Preliminary 2020 estimate: 600 MMTCO₂e
- Earlier 2020 estimates
 - CAT: 600 MMTCO₂e
 - CEC: 585 MMTCO₂e
- Final 2020 projection defined through Scoping Plan process
- Preliminary Delta: ~ 173 MMTCO₂e

Schedule

- Board Hearing: December 6, 2007
- Board consideration of 1990 GHG emission level / 2020 limit

Comments or Questions?



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GHG Inventory Website

<http://www.arb.ca.gov/cc/ccei/ccei.htm>

