Sector-Based Workshop

Business and Industry

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California Air Resources Board

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Overview

Categories Within Business and Industry Sector

• Cement
• Oil and Gas Systems
• Refineries
• Waste
• Semiconductor Industry
• High-GWP
• Other
Overview

- Emissions Within Sector
- Sector Profile
- Current Regulatory Status
- Potential Reduction Strategies
Business and Industry Emissions

1990 Inventory by Subsector [119 MMTCO₂E total]

- Refineries: 28%
- Other: 45%
- Waste: 8%
- Cement: 7%
- Oil & Gas Systems: 12%
- High-GWP: <0.1%
- Semiconductor: <0.5%
Business and Industry Emissions

2004 Inventory by Subsector [125 MMTCO$_2$E total]

- Other, 32%
- Oil & Gas Systems, 12%
- Cement, 8%
- Waste, 8%
- Semiconductors, 11%
- High-GWP, 11%
- Refineries, 28%
Business and Industry Emissions

2020 Projections by Subsector [165 MMTCO₂E total]

- High-GWP: 27%
- Semiconductor: 1%
- Oil & Gas Systems: 8%
- Cement: 6%
- Waste: 7%
- Refineries: 22%
- Other: 29%

Total: 165 MMTCO₂E
Overall Sector Profile

- **Cement**
  - 11 facilities
  - Employs approximately 2,300 people
  - Various locations in CA

- **Oil and Gas Systems**
  - 50,000 oil and 1,000 gas wells
  - Employs approximately 7,000 people
  - Mostly located in Central Valley and Southern California, including off-shore drillings
• **Refineries**
  – 21 facilities
  – Employs over 17,000 people
  – Located mostly in SF Bay Area and LA Area

• **Waste** (Landfills, Waste Water, and Composting)
  – 367 Municipal Solid Waste landfills
  – Approximately 300 composting facilities statewide
  – Employs approximately 40,000 people
  – Operating in most counties
  – Generated 85 million tons / Land-filled 42 million tons / Diverted 43 million tons (2005)
Overall Sector Profile

- Semiconductor Industry
  - Numerous facilities
  - Located throughout CA
  - Employs approximately 9,000 people
Existing Controls

• Cement
  – No explicit controls for greenhouse gases
  – Baghouses and electrostatic precipitators to control particulate matter emissions
  – Cogeneration unit at one facility regulated by a district regulation
  – ARB staff coordinating development of Early Action Measures and Scoping Plan Measures

• Oil and Gas Systems
  – District rules reduce criteria pollutants and methane emissions
Existing Controls

- Refineries
  - Air district rules reduce criteria pollutants, methane emissions reduced as a co-benefit
    - Fugitive emission rules
    - Storage tank rules
    - Cogeneration unit at facilities regulated by district permits
    - Increased energy efficiency--co-benefit of regulatory requirements
Existing Controls

• Waste
  – Methane emission controls for safety and water quality (CCR Title 27)
  – Landfills
    • Federal New Source Performance Standards/Emission Guidelines and National Emission Standards for Hazardous Air Pollutants
    • Local Air District Rules
  – Composting
    • Composting in SCAQMD and SJV requires enclosures or other mitigation measures for VOC and PM
Existing Controls

• Semiconductor Industry
  – South Coast, Antelope Valley, Bay Area, Placer and Ventura County Districts limit VOCs
  – National Emission Standards for Hazardous Air Pollutants
  – Memorandum of Understanding between U.S. EPA and over 20 national companies
  • Reduce PFC emissions to 10% below 1995 level by 2010
Potential Controls: Early Action Concepts

• Cement
  – Blended Cements: Limestone and supplementary cementitious materials (SCMs)—to be developed in collaboration with CalTrans and other affected parties
    • Blending with limestone
    • Blending with SCMs – fly ash, slag, and pozzolan
  – Alternative fuels and improved energy efficiency
    • Require preheater/precalciner heat recovery system
    • Raw material preparation
    • Clinker production
    • Emission reduction potentials and cost impacts - to be determined
Potential Controls: Early Action Concepts

- Oil and Gas Systems
  - Reduce fugitive methane emissions
    - Install cost-effective technologies
    - Improve management practices
  - Emission reduction potential of 1.0 MMTCO$_2$E
  - Scheduled for adoption in 2010

- Refineries
  - No Early Actions
Potential Controls: Early Action Concepts

• Waste
  – Landfill Methane Capture (Discrete Early Action Measure)
    • Original proposal from CIWMB – would require adoption by ARB
    • Requires controls at uncontrolled landfills
    • Surface monitoring standards
    • Gas collection and control system standards
    • Monitoring, recordkeeping, and reporting requirements
  – Composting (Early Action Measure)
    • Requirements for enclosures and other mitigation measures may increase GHG emissions
    • VOC/PM mitigation measures may limit ability to process greenwaste
Potential Controls: Early Action Concepts

- Semiconductor Industry
  - Reduce PFC emissions
  - Emissions reduction potential of 0.5 MMTCO$_2$E
  - Scheduled for adoption in 2008
Potential Emission Reduction Measures

• Cement
  – Analysis of control strategies beyond those for Early Action measures pending

• Oil and Gas Systems
  – CO₂ reductions associated with combustion activities
    • Consider energy efficiency measures
    • Evaluate potential for recycling of waste gases
Potential Emission Reduction Measures

- Refineries
  - “Bottom-up” approach: Refinery specific evaluation
    - Permit reviewing (Cooperating w/ the Districts, CEC, and U.S. EPA)
    - Working to identify the major emission sources
    - Evaluating fuel production and consumption, electricity and steam usage
    - Evaluating process efficiencies within each facility
  - “Top-down” approach: Reviewing refinery modeling for GHG
    - Evaluating modeling work being performed by the oil industry
Potential Emission Reduction Measures

• Waste
  – Composting
    • Net reduction in GHG emissions if greenwaste is composted and applied as a soil amendment vs. landfill
  – Commercial recycling programs
    • Requires commercial sector to increase collection of recyclable materials
  – Waste technology demonstration, assessment, and development
    • Demonstrate viability of commercial scale waste technologies currently used in Europe (including waste conversion and biogas-to-fuel technologies)
  – Expand awareness of AB 1969
    • AB 1969 requires purchase specified amounts of renewable energy
    • CPUC/CIWMB funding to expand awareness to qualifying landfill gas facilities
Potential Emission Reduction Measures

• Semiconductor Industry
  – Process Optimization
    • Reduces the amount of PFCs used
  – Alternative Chemistries
    • Substitute gases for hexafluoroethane (C₂F₆) in the chamber cleaning process
  – Emissions Abatement
    • Commercially available technologies
    • Performance of abatement systems varies
  – Recovery/Recycling
    • More costly or require more maintenance than other measures
    • Recovered compounds contain more impurities than virgin chemicals
Maximum feasible and cost effective technologies to be analyzed

Strategy dependent upon industry
  - Increases in energy efficiency
  - Process modification
  - Product reformulation
  - New technologies

These industries will also be evaluated for possible inclusion in a cap and trade system

Some industries could become sources for offsets
High-Global Warming Potential Sources

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Overview

• What Are High-Global Warming Potential (GWP) Greenhouse Gases (GHGs)?
  – HFCs, PFCs, SF$_6$
    • Kyoto Protocol Gases
    – Class I and II Ozone Depleting Substances (ODSs): CFCs, HCFCs, Halons, et al.
      • Montreal Protocol Gases
        – New Production, Imports, Exports Controlled; Emissions Not Controlled
  – Other High-GWP GHGs
    • NF$_3$, HFEs, PFPEs
    • Controlled Neither by Montreal Nor Kyoto Protocols
• How are High-GWP GHGs Accounted for under AB 32?
  – Kyoto Gases are Directly Included in 1990 Baseline and 2020 Target
  – Several non-Kyoto gases with climate impact are not in baseline but are being evaluated for mitigation
Overview

• High-GWP GHG “Sector” End-Use Categories
  – Mobile Sources
    • Motor Vehicle Air Conditioning (MVAC) Systems
  – Stationary Sources
    • Refrigeration and Air Conditioning (RAC), Foams, Fire Extinguishing, Solvent Cleaning, Industrial Applications, Electrical Transmission
  – Consumer Products
    • Propellants
California Emission Inventory (EI) Approaches

• USEPA Vintaging Model (VM) Estimates
  – VM Between IPCC Tier 2 and Tier 3 Inventory Development Approaches; VM is a Bottom-Up Model, but is Also Compared with Top Down Data
  – National Estimates Distributed from US to CA Based on Population Fraction
• Verification Based on Ambient Monitoring
  – Mt. Wilson Study, NOAA, MLD Network, Walnut Grove Study, AGAGE Network, Mobile Monitoring
• California-Specific Inventory Development
  – Numerous Inventory Studies and Surveys Underway for Stationary, Mobile, and Consumer Product High-GWP GHG Sources
• SCAQMD Rule 1415: ODS Leak Rate Data
  – Leak Rates for Large, Stationary RAC Systems Available from SCAQMD Rule 1415 Data
CA High-GWP GHG Emissions

*Note: 3.5 MMT CO2E in 1990 represents all Kyoto gases, mostly SF$_6$
Major CA High-GWP GHG Emissions Sources

- Largest Sources Known From USEPA, IPCC/TEAP

2006 Emissions (MMT CO$_2$E)

- HFCs
- ODSs

- Domestic Refrigeration
- Commercial & Transport Refrigeration
- Industrial Process Refrigeration/Cold Storage
- Mobile Air Conditioning
- Large Commercial AC (chillers)
- Small Commercial AC
- Residential AC
- Fire Extinguishing
- Foams
CA High-GWP GHG Banks

Note: Bank Estimates Exceed Total CO2E Estimates in 2004
Major CA High-GWP GHG Bank Sources

- Largest Sources Known From USEPA, IPCC/TEAP

2006 Banks (MMT CO$_2$E)
Existing Controls

- Existing Controls
  - HFCs Subject to “No Venting” Only
    - AB 1493 Will Reduce HFC-134a Emissions from MVACs
  - ODSs Have Some Sales, Record-Keeping, Technician/Handler, and Emissions Restrictions
    - Section 608 and 609 of CAAA and SCAQMD Rule 1415
  - ARB Regulates ODP of Consumer Products
Emission Reduction Approaches

• Existing Systems: Emissions and Bank Management
  – Extend Sections 608 – 609 of CAAA and Rule 1415 to All High-GWP GHGs
  – New EOL Rules and Enforcement of Existing Rules
  – Capture/Recycling/Destruction Where Applicable
  – Voluntary or Mandatory ODS Destruction

• Existing and New Systems
  – Deposit and Return
    • Increased Leak Repair and Equipment Turnover, EOL Stewardship
Emission Reduction Approaches

• New Production: High-GWP GHGs and Equipment
  – Improved Containment
  – Lower-GWP Substitutes
  – NIK Technologies/Lower Charge Systems
  – Improved Energy Efficiency (LCCP Considerations)
  – Deposit and Return
    • EOL Stewardship
## Board-Approved Related Early Actions

<table>
<thead>
<tr>
<th>EA ID</th>
<th>SECTOR</th>
<th>STRATEGY NAME</th>
<th>2020 Reduction, MMTCO2E</th>
<th>2020 Cost Estimates, MTCO2E</th>
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<td>12</td>
<td>Consumer Products</td>
<td>Reduction of high GWP GHGs used in consumer products</td>
<td>0.25</td>
<td>$4-$5/MTCO2E</td>
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<td>Mobile</td>
<td>Reduction of HFC-134a from DIY MVAC servicing</td>
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<td>Stationary</td>
<td>SF₆ reductions from the non-electric sector</td>
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<td>Add AC leak tightness test and repair to Smog Check</td>
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<td>32</td>
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<td>Specifications for commercial refrigeration</td>
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<td>$10-$20/MTCO2E</td>
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<td>Mobile</td>
<td>Requirement of low-GWP GHGs for new MVACs</td>
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<td>36</td>
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<td>Reduction of SF₆ in electricity generation</td>
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<td>37</td>
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<td>High GWP refrigerant tracking, reporting, and recovery program</td>
<td>1.25 - 12+</td>
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<td>38</td>
<td>Stationary</td>
<td>Foam recovery/destruction program</td>
<td>0.9 - ?</td>
<td>$6.5/TCO2E for automated; $48/MTCO2E for manual</td>
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<td>39</td>
<td>Stationary</td>
<td>Alternative suppressants in fire protection systems</td>
<td>0.1</td>
<td>$40/MTCO2E</td>
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<td><strong>Totals</strong></td>
<td></td>
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<td><strong>11 - 23+</strong></td>
<td><strong>$4 - $48</strong></td>
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Activities Underway

• Continuing to Move Forward with Analyses, Working with Stakeholder Groups (2/08 Workshop)

• Research Projects Underway
  – MVAC Indirect, Direct, and EOL Emissions Studies
  – Inventory Development
    • All End-Use Categories (non-1493 MVACs, RAC, Foam, Solvent, Propellant, Electrical Transmission, and Fire Extinguishing/Chemical Stockpile Inventories)
  – LCA of High-GWP GHG Destruction
Summary

• High-GWP GHG “Sector” Contains a Diverse Array of Chemicals and End-Use Categories
• Control Strategies Include High-GWP GHG Emission and Bank Management (Especially HFCs and ODSs)
• Good Potential for Cost-Effective Emission Reductions
• Potential to Include as Source of Offsets will be evaluated
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