

Energy Efficiency and Co-benefits Assessment Public Reports – Public Workshop I

Refinery Sector Public Report

July 9, 2013
Sacramento, California



California Environmental Protection Agency



Air Resources Board

Overview

- ◆ Background
- ◆ Refinery Sector Summary
- ◆ Emissions and Fuel Use
- ◆ Federal, State, and Local Air District Regulatory Requirements
- ◆ Energy Efficiency Improvement Opportunities
- ◆ Equipment Types and Improvement Methods
- ◆ Next Steps
- ◆ Contacts



Background



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Background

Energy Efficiency and Co-benefits Assessment (EEA) Regulation

- ◆ Regulation developed to evaluate energy efficiency opportunities at largest industrial facilities
 - Assess opportunity for on-site reductions of GHG, criteria pollutant, and toxic air contaminant emissions
- ◆ ARB approved EEA Regulation in July 2010
- ◆ EEA Regulation became effective July 2011

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EEA Regulation Requirements

- ◆ One-time assessment of fuel and energy consumption
- ◆ Identify potential energy efficiency improvements for at least 95% of GHG emissions sources
- ◆ 43 facilities required to provide an EEA Report

Public Reports: First of a Three-phase Program

- ◆ **Phase 1: Develop Industrial Sector Public Reports**
 - Public version of reported data
- ◆ Phase 2: Develop ARB Findings Report
 - Comprehensive review of reported data
 - Include third-party review of subset of data
 - Starting point for actions/approaches to maximize on-site, greenhouse gas, criteria pollutant, and toxic air contaminant reductions
- ◆ Phase 3: Develop Energy Efficiency Implementation Program

ARB Public Reports

- ◆ ARB developing Public Reports for five sectors
 - Refineries
 - Oil and gas production/minerals
 - Cement manufacturing
 - Power generation
 - Hydrogen production
- ◆ Public Reports summarize, by sector, information provided by facilities in EEA Reports

Public Reports Have Three Parts

- ◆ Introduction and Summary
 - General overview of data received
- ◆ Part I
 - Sector-wide summary of all energy efficiency improvement projects identified
 - Includes brief project description, estimated emissions benefits and costs
 - Data aggregated consistent with public disclosure requirements under CCR section 95610
- ◆ Part II
 - Facility-specific information
 - Project data (costs and benefits) aggregated by timeframe and equipment
 - Aggregated consistent with public disclosure requirements under CCR section 95610

EEA Data Review Process

- ◆ ARB staff reviewed submitted EEA reports
 - ARB review teams drew upon in-house sector experts
 - Conducted field visits of affected sources to better understand equipment and processes
 - Review ensured information met the EEA Regulation data requirements
 - Energy consumption data
 - Emissions data
 - Projects identified for sources of at least 95% of GHG emissions
 - Contacted facility staff if clarification or additional information required

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Process for Developing Public Reports

- ◆ Facilities designated facility-specific data confidential business information (CBI)
- ◆ ARB staff aggregated data consistent with public disclosure requirements under CCR section 95610
- ◆ Public report format, including data aggregation format, was presented to both industry and environmental stakeholders for review and comment
- ◆ Public report format populated with data and submitted to industry for final review of CBI data aggregation

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Third Party Review Process

- ◆ ARB contracted with SFSU Industrial Assessment Center for third-party review
- ◆ Nine reports randomly selected for third-party review
 - Three refinery reports
 - Two power generation reports
 - Two oil & gas production/mineral reports
 - One cement manufacturing report
 - One hydrogen production report
- ◆ Third-party reviewers contacted facility staff directly to obtain supplemental/clarifying information
- ◆ Process currently in progress
- ◆ Results of third-party reviews to be provided in ARB Findings Report

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Refinery Sector Summary



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12 Refineries Subject to EEA Reporting

Refinery	Air District
Chevron – Richmond	Bay Area Air Quality Management District
Phillips66 – San Francisco	
Shell – Martinez	
Tesoro – Martinez	
Valero – Benicia	
BP – Carson	South Coast Air Quality Management District
Chevron – El Segundo	
ExxonMobil – Torrance	
Phillips66 – Carson	
Phillips66 – Wilmington	
Tesoro – Los Angeles	
Valero Ultramar – Wilmington	

EEA Applicability Criteria

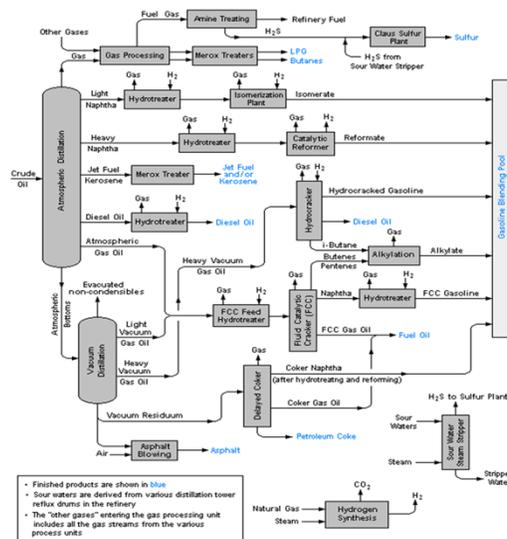
- ◆ General facility applicability based on 2009 annual GHG stationary source emissions of 0.5 MMTCO₂e or more
- ◆ California petroleum refinery applicability:
 - Produce transportation fuel for release into commerce
 - 2009 annual GHG stationary source emissions of 0.25 MMTCO₂e or more

California Transportation Fuel Refineries

- ◆ Annual Refining Capacity:
 - 1,850,000 barrels per day
- ◆ Ten percent of US crude oil distillation unit capacity
- ◆ Typically more complex due to product mix and feedstock characteristics



Refinery Processes



Emissions and Fuel Use



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Emissions and Fuel Use

Refinery GHG Emissions (2009)

Refinery	2009 GHG Emission (MMT _{CO₂e})
BP – Carson	4.4
Chevron – El Segundo	3.2
Chevron – Richmond	4.5
Phillips66 – Carson	0.8
Phillips66 – Wilmington	1.8
Phillips66 – San Francisco	2.0
ExxonMobil – Torrance	2.7
Shell – Martinez	4.3
Tesoro – Los Angeles	1.5
Tesoro – Martinez	2.3
Valero Ultramar – Wilmington	1.0
Valero – Benicia	2.9
Total	31.4

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Refinery Criteria Pollutant Emissions (2009)

Criteria Pollutant	Total mass emissions (tons/day)
Total Organic Gases (TOG)	9.1
Reactive Organic Gases (ROG)	10.1
Carbon monoxide (CO)	22.2
Oxides of Nitrogen (NO _x)	24.7
Sulfur Oxides (SO _x)	23.6
Particulate Matter (PM10)	7.4

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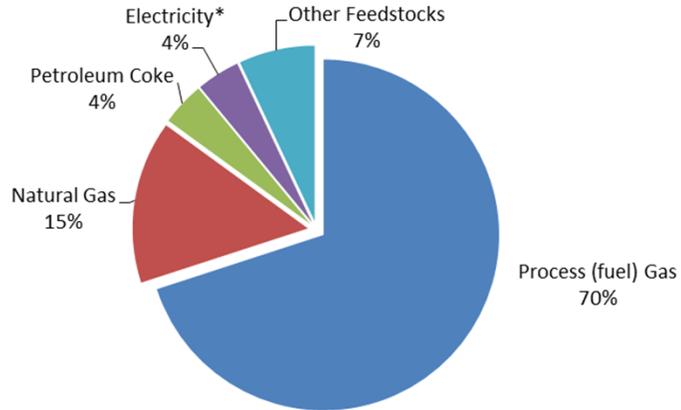
Refinery Top Ten Toxic Air Contaminant Emissions (2009)

Toxic Air Contaminant*	Total mass emissions (pounds/year)
Chromium, hexavalent (& compounds)	57
Polycyclic Aromatic Hydrocarbons (total)	2,589
Benzene	49,498
Cadmium	173
Formaldehyde	117,241
1,3-Butadiene	3,413
Nickel	1,354
Arsenic	77
Naphthalene	3,422
Diesel, particulate matter	166

* Listed in rank order on mass times cancer potency

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Refinery Energy Consumption (2009)



* Includes both purchased and internally produced electricity

Federal, State, and Local Air District Regulatory Requirements



Refinery Regulatory Requirements

- ◆ Refineries subject to local, State, and federal air pollution control regulations
- ◆ Local
 - BAAQMD & SCAQMD permitting and air toxics
- ◆ State (GHG focused)
 - Low Carbon Fuel Standard
 - Cap and Trade
 - GHG Mandatory Reporting
 - AB32 Cost of Implementation Fee
- ◆ Federal
 - Performance standards
 - National Emission Standards for Hazardous Air Pollutants (NESHAPS)

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Energy Efficiency Improvement Opportunities



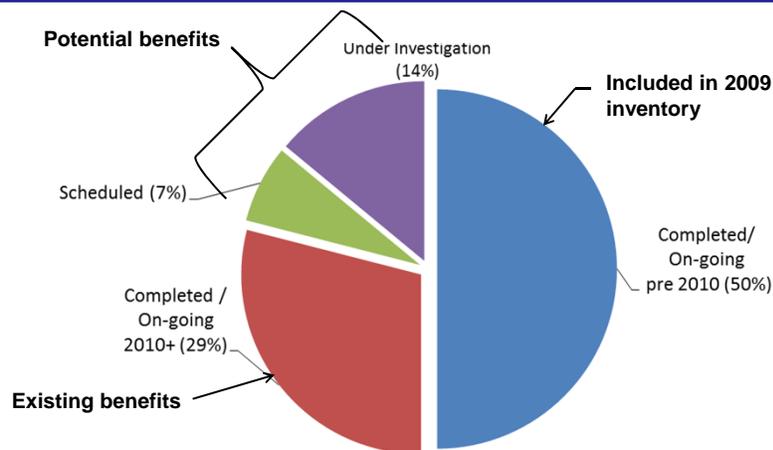
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Over 400 Energy Efficiency Projects Identified

- ◆ GHG reductions of 2.8 MMTCO₂e
 - 9% of sector emissions
 - Excludes projects not being implemented
 - Completed or on-going projects: 2.2 MMTCO₂e (78% of reductions)
 - Scheduled projects: 0.20 MMTCO₂e (7% of reductions)
 - Under investigation: 0.40 MMTCO₂e (15% of reductions)
- ◆ Co-benefits:
 - NOx 2.5 tpd (10% of sector inventory)
 - 88% completed or on-going
 - PM10 0.6 tpd (7.6% of sector inventory)
 - 80% completed or on-going

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Half of Project GHG Reductions Included in 2009 Inventory



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\$2.6 Billion of One-Time Costs

Number of Projects	One Time Cost (million \$)	Annual Cost (million \$/year)	Annual Savings (million \$/year)
401	\$2,600	\$17	\$200

Does not include projects identified as "Not Implementing"

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Equipment Types and Improvement Methods



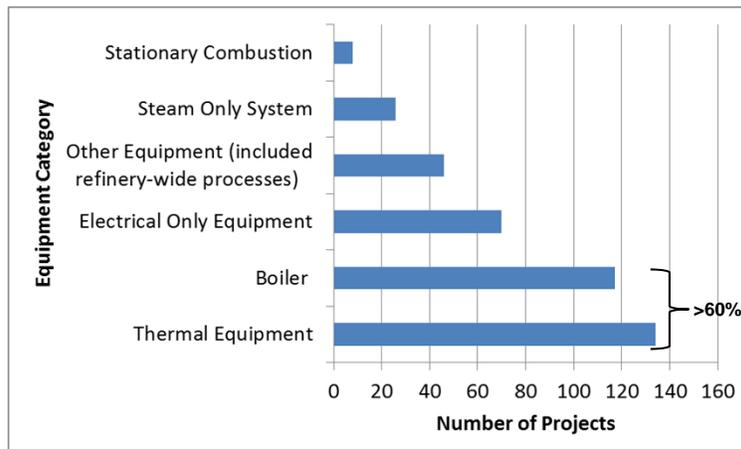
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Equipment Categories and Project Descriptions of Types of Projects

Equipment Category	Description of Types of Projects
Boilers	Projects associated with cogeneration, steam, and combined cycle plants
Electrical Equipment	Projects dealing with electric motors powering air compressors, HVAC equipment, refrigeration equipment, pumps, fans, and other types of equipment
Other (refinery-wide)	Projects that did not fall into another category including refinery-wide projects and flare system projects
Stationary Engines	Projects involving stationary gas turbines
Steam Equipment	Projects dealing with steam motors powering air compressors, fans, or pumps
Thermal Equipment	Projects dealing with furnaces and heat exchangers

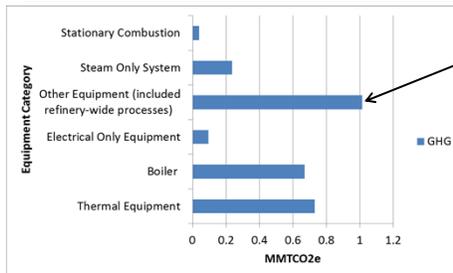
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Thermal Equipment and Boilers Account for Over 60% of Projects



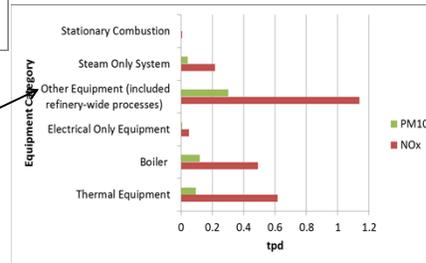
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~90% of Reductions from Three Equipment Categories



>1/3 of GHG Reductions from "Other" Equipment Projects

~50% of Criteria Pollutant Reductions from "Other" Equipment Projects

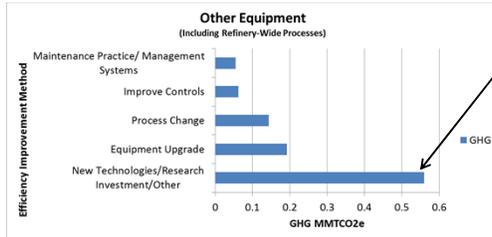


Projects Categorized by Energy Efficiency Improvement Method

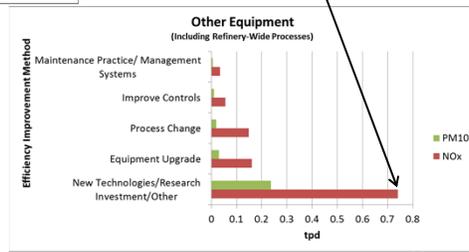
- ◆ Equipment modification
- ◆ Equipment upgrade
- ◆ Investment in new technologies
- ◆ Process change
- ◆ Improve controls
- ◆ Improve monitoring
- ◆ Change in maintenance practices
- ◆ Change in management systems
- ◆ New technologies
- ◆ Research investment
- ◆ Other

Equipment Types and Improvement Methods

Benefits for "Other Equipment Including Refinery-Wide Processes"

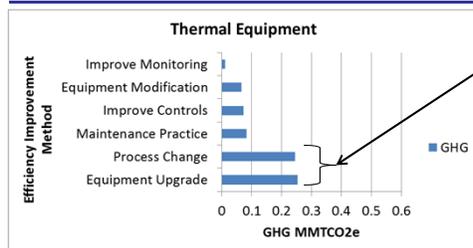


New Technologies/Research/Other Provide 60-80% of Benefits for "Other" Equipment

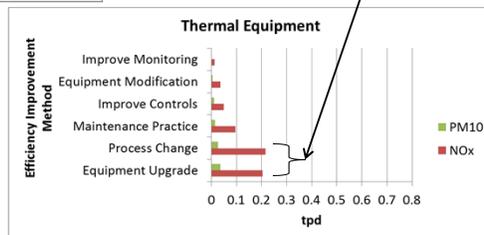


Equipment Types and Improvement Methods

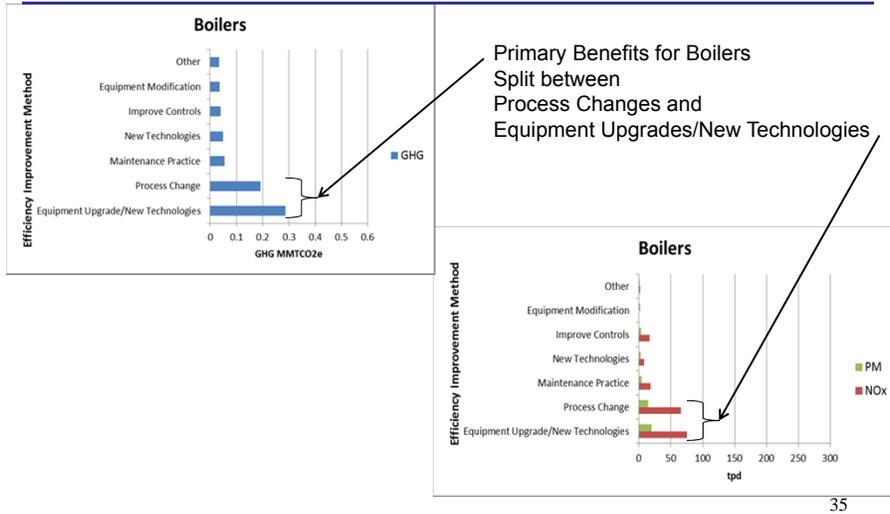
Thermal Equipment Benefits



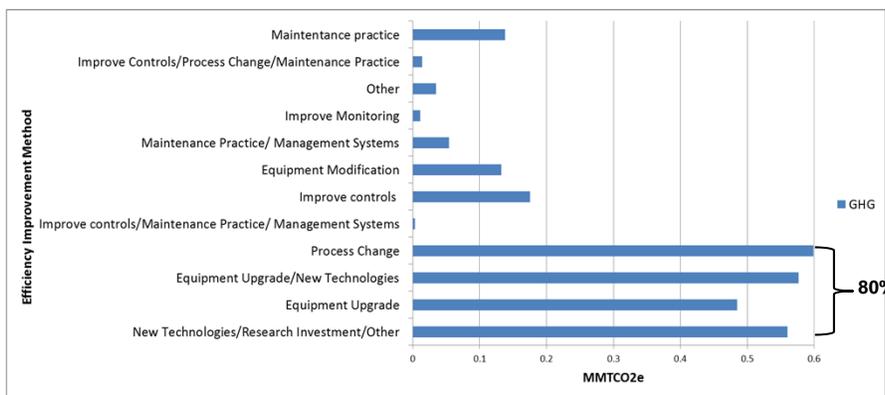
Primary Benefits for Thermal Equipment Split between Process Changes and Equipment Upgrades



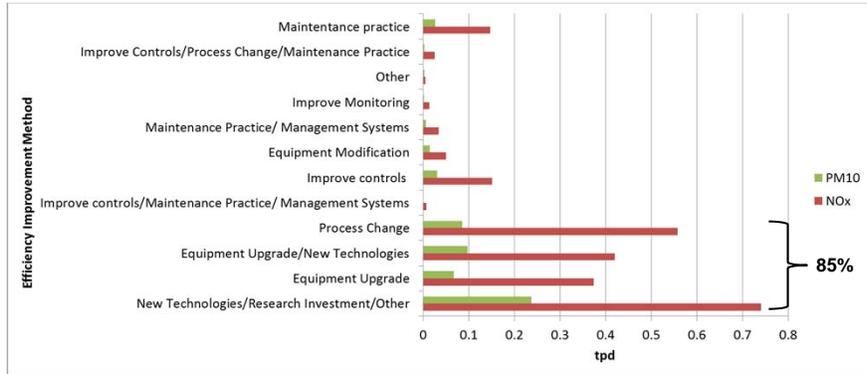
Boiler Benefits



80% of GHG Reductions Attributed to New Technologies/Research/Other, Process Change, Equipment Upgrade



85% of Criteria Reductions Attributed to New Technologies/Research/Other, Process Change, Equipment Upgrade



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Next Steps



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Next Steps

- ◆ Finalize other sector reports
 - Cement manufacturing
 - Hydrogen production
 - Power generation
 - Oil & gas production/minerals
- ◆ Complete ARB Findings Report with recommendations for further action
- ◆ Public process



Contacts



Contacts:

- ◆ **Dan Donohou, Chief**
Emissions Assessment Branch
e-mail: ddonohou@arb.ca.gov
phone: (916) 322-6023
- ◆ **Cherie Rainforth, Manager**
Control Strategies Section
e-mail: crainfor@arb.ca.gov
phone: (916) 327-7213

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