Refinery Allocation Under Cap-and-Trade
Proposed 2013 Amendments
Participation and Comments

- Presentation and proposed CWB language posted at [http://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm](http://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm)

- Email questions to coastalrm@calepa.ca.gov

- Comment period on this workshop ends 10/14, but 45 day comments accepted until October Board Hearing
Regulatory Context

• Today’s workshop is within the 45-day comment period which precedes the October 24-25 Board Hearing
  • All comments received will be included in FSOR

• Staff will make a proposal regarding the refinery sector at the October Board Hearing
  • Board can direct staff to make 15-day changes
Mandatory Reporting
Regulatory Deadlines

- Updates to MRR requirements to allow CWB would need to be presented at October 24-25 Board Hearing for MRR amendments
- Proposed changes would be included in 15-day review of modified text language
- To ensure MRR is effective by January 1, 2014, the 15-day review period would start October 28
Process to Date

- Received proposal in May
- Conducted a survey to collect information from California refineries to evaluate CWB proposal and determine benchmark
- Conducted workshop in August to discuss initial staff thinking
- Revised proposal based on input from workshop, final data gathering, and further data analysis
Outline

- CWB Analysis
- Proposal as a Whole
- Process Units
- Electricity and Steam
- Typical vs. Atypical Refineries
- Hydrogen
- Calcining
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CWT and CWB As Basis for Allocation

- The Complexity Weighted Barrel (CWB) methodology is proposed as the basis for refinery allowance allocation starting in the 2\textsuperscript{nd} compliance period
- If adopted, would replace Carbon Dioxide Weighted Tonnes (CWT)
- Both are methods of assessing GHG emissions associated with each “process unit” at a refinery
- The “CWB factor” for each process unit is multiplied by the throughput for that unit and these are summed to get the total CWB
- Both rely on data and CWB factors from Solomon Associates
CWB vs. Emissions

- California refineries’ CWB is closely related to their emissions under the benchmark:
  - CWB = 0.8476 * (emissions in benchmark)
  - $R^2 = 0.9813$
Fuel-Based Emissions and CWB by Process Unit

- Atmospheric Crude Distillation
- Vacuum Distillation
- Delayed Coker
- Fluid Catalytic Cracking
- Naphtha/Distillate Hydrocracker
- Naphtha Hydrotreater
- Kerosene Hydrotreater
- Diesel/Selective Hydrotreater
- VGO Hydrotreater
- Reformer - including AROMAX
- Alkylation/Poly/Dimersol
- C4 Isomer Production
- C5/C6 Isomer Production - including ISOSIV
- Hydrogen Production: Steam-Methane Reforming
- Sulfur (recovered)
- Asphalt Production
- Special Fractionation
- Flare Gas Recovery

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### Comparing CWT and CWB Alignment with Fuel-Based Emissions

<table>
<thead>
<tr>
<th>Process</th>
<th>CWB</th>
<th>EU CWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Crude Distillation</td>
<td>30.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Vacuum Distillation</td>
<td>10.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Delayed Coker</td>
<td>-30.0%</td>
<td>-20.0%</td>
</tr>
<tr>
<td>Fluid Catalytic Cracking</td>
<td>-10.0%</td>
<td>-10.0%</td>
</tr>
<tr>
<td>Naphtha/Distillate Hydrocracker</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Naphtha Hydrotreater</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Kerosene Hydrotreater</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Diesel/Selective Hydrotreater</td>
<td>17%</td>
<td>16%</td>
</tr>
<tr>
<td>VGO Hydrotreater</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>Reformer - including AROMAX</td>
<td>22%</td>
<td>21%</td>
</tr>
<tr>
<td>Alkylation/Poly/Dimersol</td>
<td>10%</td>
<td>9%</td>
</tr>
<tr>
<td>C4 Isomer Production</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>C5/C6 Isomer Production -...</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Hydrogen Production: Steam-...</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Sulfur (recovered)</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Asphalt Production</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Special Fractionation</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Flare Gas Recovery</td>
<td>7%</td>
<td>6%</td>
</tr>
</tbody>
</table>

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## Comparing CWT and CWB Net Impacts on Refineries

<table>
<thead>
<tr>
<th></th>
<th>All Refineries</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weighted</td>
<td>Unweighted</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Percent</td>
<td>Average Percent</td>
<td>SD of Percent of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of Obligation</td>
<td>of Obligation</td>
<td>Obligation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covered</td>
<td>Covered</td>
<td>Covered</td>
<td></td>
</tr>
<tr>
<td>CWB</td>
<td>83%</td>
<td>76%</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>CWT</td>
<td>85%</td>
<td>81%</td>
<td>23%</td>
<td></td>
</tr>
</tbody>
</table>

CWB values above are as defined in WSPA proposal
CWT values are based on EU CWT definitions and ARB survey data
Outline

- CWB Analysis
- Staff Proposal as a Whole
- Process Units
- Electricity and Steam
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- Hydrogen
- Calcining
Staff Proposal: Summary

Staff propose 15-day regulatory amendments which would:

- Use Complexity-Weighted Barrel (CWB) instead of Carbon Dioxide-Weighted Tonne (CWT)
- Not change any process unit factors, including off-site adjustment, from those provided by Solomon Associates
- Exclude electricity purchased and sold and include steam consumption in ARB benchmark, consistent with other benchmarks
- Calculate separate CWB benchmark for “atypical” refineries
- Allocate for hydrogen production separately from CWB
  - Same benchmark and thus consistent incentives for on-site and off-site hydrogen
- Allocate for calcining separately from CWB, using standard process to calculate benchmark
Staff Proposal: Mandatory Reporting

- Staff propose new CWB Data Reporting & Verification Requirements

- Updates needed in MRR to accommodate CWB reporting (document handouts)
  - CWB reporting and verification language,
  - Table of CWB functions and factors, and
  - Definitions (necessary for reporting consistency and verification)

- Definitions and table developed in conjunction with stakeholders and the cap and trade benchmarking group.
## Main Refinery Benchmark

<table>
<thead>
<tr>
<th>Benchmark Production Unit</th>
<th>Benchmark (Allowances/CWB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWB with all modifications</td>
<td>4.08</td>
</tr>
</tbody>
</table>

CWB units reflect the use of 1,000’s of barrels per year as units for most process units
Refinery Distribution Under This Proposal

CWB Benchmark Curve

MT CO2e / CWB

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Staff Proposal: Process Unit Factors Under CWB

- Staff proposes no amendments to Solomon Associates’ values for process unit factors

- Combining process units for cokers and catalytic crackers was considered
  - Variation in products makes combining them problematic

- Removing the off-site and non-process steam adjustments was previously considered
  - This small factor is related to refinery size (but not complexity per se), but including it is supported by refineries of all levels of complexity
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Staff Proposal: Treatment of Steam and Electricity

- Staff proposes to follow ARB Standard Benchmarking Approach
  - Direct emissions plus steam and electricity purchased emissions minus steam and electricity sold emissions included by Solomon in CWB factors
  - Direct emissions plus steam purchased and minus steam and electricity sold included in ARB benchmark
  - Electricity purchased emissions handled by CPUC – assume similar approach to their proposal for other sectors

- Considered proposal to calculate one benchmark and use a ratio to divide up the allocation between ARB and CPUC
## Comparison with “Ratio” Approach for Steam and Electricity

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable Treatment of On and Off-site Steam and Electricity Sources</td>
<td>Partially</td>
<td>Yes</td>
</tr>
<tr>
<td>Conceptual Consistency with CWB Creation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Consistency with ARB and CPUC Treatment of Other Sectors</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Consistent Incentives to Reduce Direct and Indirect Emissions</td>
<td>Partially</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimize Unnecessary Calculations</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Ratio and ARB Approaches Under Ideal v. Realistic Conditions

- The ratio approach and ARB standard approach will both accomplish the same thing, if:
  - All purchased electricity has same emissions intensity
  - CPUC valuation of an allowance exactly equals actual allowance value

- If these conditions do not hold,
  - The ratio approach creates idiosyncratic effects
  - The standard approach creates equitable results
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Staff Proposal: Typical and Atypical Benchmarking

- Staff proposes to benchmark atypical refineries separately under CWB

- Atypical proposal:
  - Defined as having < 12 process units and < 20 million barrels crude through the atmospheric distiller / year (during allocation year)
  - If jointly operated with another refinery, must meet those criteria for the combined facilities
  - Includes 5 refineries, based on 2008 and 2010 data
Emissions of Typical and Atypical Refineries

<table>
<thead>
<tr>
<th>Portion of Total Emissions</th>
<th>Atypical Refineries (N = 4)</th>
<th>Typical Refineries (N=13)</th>
<th>Total of 17 Refineries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2%</td>
<td>98%</td>
<td>100%</td>
</tr>
<tr>
<td>Total Emissions</td>
<td>510,800</td>
<td>31,467,055</td>
<td>31,977,855</td>
</tr>
</tbody>
</table>

One refinery which was non-operational in 2010 was omitted from this analysis.
Refinery Benchmark Curve by Atypical and Typical Refinery Type

CWB Benchmark Curve

MT CO2e / CWB

“Atypical” “Typical”
Comparing Benchmark Performance by Refinery Type

<table>
<thead>
<tr>
<th></th>
<th>Atypical Refineries Only (N=4)</th>
<th>Typical Refineries Only (N = 13)</th>
<th>Percent that Typical is Lower Than Atypical</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWB</td>
<td>6.78</td>
<td>4.08</td>
<td>40%</td>
</tr>
<tr>
<td>CWB Best in Class</td>
<td>X</td>
<td>X</td>
<td>9%</td>
</tr>
<tr>
<td>CWT</td>
<td>46.18</td>
<td>33.10</td>
<td>28%</td>
</tr>
</tbody>
</table>

Highlighted cells show proposed benchmark values.
Atypical v. Typical by Process Unit

At typical

-40.0%-30.0%-20.0%-10.0% 0.0% 10.0% 20.0% 30.0% 40.0%

Atmospheric Crude Distillation
Vacuum Distillation
Delayed Coker
Fluid Catalytic Cracking
Naphtha/Distillate Hydrocracker
Naphtha Hydrotreater
Kerosene Hydrotreater
Diesel/Selective Hydrotreater
VGO Hydrotreater
Reformer - including AROMAX
Alkylation/Poly/Dimersol
C4 Isomer Production
C5/C6 Isomer Production - including ISOSIV
Hydrogen Production: Steam-Methane...
Sulfur (recovered)
Asphalt Production
Special Fractionation
Flare Gas Recovery

Percent of Atypical Refineries Total Fuel Emissions

-40.0%-30.0%-20.0%-10.0% 0.0% 10.0% 20.0% 30.0% 40.0%

“Typical”

-40.0%-30.0%-20.0%-10.0% 0.0% 10.0% 20.0% 30.0% 40.0%

Atmospheric Crude Distillation
Vacuum Distillation
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Naphtha Hydrotreater
Kerosene Hydrotreater
Diesel/Selective Hydrotreater
VGO Hydrotreater
Reformer - including AROMAX
Alkylation/Poly/Dimersol
C4 Isomer Production
C5/C6 Isomer Production - including ISOSIV
Hydrogen Production: Steam-Methane...
Sulfur (recovered)
Asphalt Production
Special Fractionation
Flare Gas Recovery

Percent of Typical Refineries Total Fuel Emissions

-40.0%-30.0%-20.0%-10.0% 0.0% 10.0% 20.0% 30.0% 40.0%

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Percent of Atypical Refineries Total CWB

Percent of Typical Refineries Total CWB

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Staff Proposal: Separate Hydrogen Benchmarking

• Staff proposes to benchmark hydrogen separately from CWB

• Refinery hydrogen would be allocated not under CWB but under separate hydrogen benchmark based on California specific hydrogen data

• Achieves policy goals:
  • Consistent incentives between on-site and off-site hydrogen production
  • Avoiding over-allocation to off-site hydrogen that would occur if off-site hydrogen allocated through CWB
Hydrogen Issues Under CWB

- Merchant hydrogen would be over-allocated under CWB relative to its GHG efficiency
- Therefore it would not have same degree of incentive to increase efficiency
- CWB factors are designed to work together, but hydrogen factor needs to work separately to appropriately allocate to off-site hydrogen
Same Benchmark for Liquid Hydrogen

- Staff proposes to give liquid hydrogen the same benchmark as gaseous hydrogen

- Liquid hydrogen direct GHG emissions come primarily from producing hydrogen, not from condensing it to liquid

- Therefore, it is equitable to provide the same benchmark
## Hydrogen Benchmark

<table>
<thead>
<tr>
<th>Hydrogen Benchmark, Calculated Using Standard Benchmarking Approach</th>
<th>Gaseous Hydrogen Benchmark (allowances / m scf)</th>
<th>Liquid Hydrogen Benchmark (allowances / m scf)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.00</td>
<td>20.00</td>
</tr>
</tbody>
</table>
Outline

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Staff Proposal: Calcining Benchmarking

- Staff proposes to benchmark calcining separately from CWB

- Rationale:
  - Calcining can be done separately from refinery operations
  - Calcined coke is not a fuel, unlike most refinery products
Calcining Benchmark

Calcining Benchmark, Calculated Using Standard Benchmarking Approach (allowances / MT calcined coke) 0.632
## Summary – Proposed Benchmarks

<table>
<thead>
<tr>
<th>Product</th>
<th>Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWB (typical refineries, allowances / CWB, using 1000’s per year for throughputs)</td>
<td>4.08</td>
</tr>
<tr>
<td>CWB (atypical refineries, allowances / CWB, using 1000’s per year for throughputs)</td>
<td>6.78</td>
</tr>
<tr>
<td>Gaseous Hydrogen (allowances / m scf)</td>
<td>20.00</td>
</tr>
<tr>
<td>Liquid Hydrogen (allowances / m scf)</td>
<td>20.00</td>
</tr>
<tr>
<td>Calcining (allowances / MT calcined coke)</td>
<td>0.632</td>
</tr>
</tbody>
</table>

Benchmarks are subject to change after final calculations completed
Next Steps

- Most helpful if comments are submitted by October 14th, 5 PM:  
  http://www.arb.ca.gov/lispub/comm/bclist.php

- Comments may be submitted during the entire 45-day comment period
  - If after October 14, it may be difficult to react to before Board Hearing

- Board Hearing October 24-25th for both MRR and Cap and Trade

- MRR amendments would need to be in effect Jan. 1, 2014
Contacts

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