Agenda

✦ Introductions
✦ Implementation Discussions
  – Phase 3 RFG
  – Diesel Fuel Lubricity
✦ Potential Regulatory Activities
  – Phase 4 RFG
  – Diesel fuel for locomotive and marine diesel engines
  – Diesel fuel deposit control additives and diesel engine lubricating oils
  – Clean Fuels Outlets - Hydrogen
  – Biodiesel
✦ Presentations by Others
✦ Open Discussion
✦ Closing Remarks
Implementation Issues

Implementation of Phase 3 RFG Regulation
Phase 3 RFG Implementation Issues

- Documentation for transfer of denatured ethanol for use in California gasoline
- Blending small amounts of finished gasoline into CARBOB terminal tanks
- Blending small amounts of transmix into CARBOB terminal tanks
- Other issues may exist

Documentation for Transfer of Denatured Ethanol

- Importers and producers of ethanol must provide the following information with the product transfer documents:
  - Name, location and operator of the facilities at which the ethanol was produced or denatured
- Concerns about the practicality of this requirement
  - commingling of denatured ethanol
  - commingling of neat ethanol before it reaches a California production facility that adds the denaturant
Blending Finished Gasoline into CARBOB Terminal Tank

- Blending of CARBOB with California gasoline is prohibited except for specific situations that involve a changeover in service.
- Address the blending of small amounts of finished gasoline into CARBOB terminal tanks:
  - After calibration of ethanol meters
  - After pulling gasoline from service station tank
  - After aborted loading of ethanol and CARBOB to tanker truck

Blending Transmix into CARBOB Terminal Tanks

- CaRFG3 regulations include provisions for enforcement protocols for blending transmix with finished gasoline but none for blending transmix with CARBOB.
CaRFG3 Implementation Refinements

- Plan proposed amendments for October 2004 hearing
  - Identify conditions under which returning small amounts of gasoline to CARBOB terminal tanks is allowed
  - Allow protocols for blending transmix into CARBOB terminal tank
  - Allow ethanol shipper to maintain all sources of ethanol instead of providing on each transfer document
- ARB staff to announce interim policy on website pending completing of rulemakings

Implementation of Diesel Regulation
Diesel Fuel Lubricity

ARB Diesel Fuel Lubricity Standard
Phase I: Protect Existing Equipment

- 520 micron maximum WSD based on HFRR @60 deg C
- Time frame: 90 day phase-in commencing August 1, 2004
ARB Diesel Fuel Lubricity Standard
Phase 2: Protect Advanced Technology Fuel Injection Systems

- Placeholder in regulation for 2006 lubricity standard
- Board resolution direction to staff:
  - Conduct technology assessment by 2005
  - Propose new lubricity standard to Board for 2006 if assessment determines:
    • HFRR maximum WSD of 460 microns, or more appropriate standard, should be implemented in 2006 with proposed 15 ppmw sulfur limit
- Time frame:
  - Technology assessment complete 2005
  - 2006 standard: 90 day phase-in commencing June 1, 2006

Deference to ASTM Lubricity Standard

- ARB lubricity standards will defer to ASTM standards if:
  - For 2004:
    • ASTM establishes a standard at least as protective as ARB adopted standard
  - For 2006:
    • ASTM establishes a standard that is protective of advanced technology fuel injection systems
  - Division of Measurement Standards adopts
Status of ASTM Ballot

✦ Current ballot is identical to ARB 2004 standard
  – Received negative votes
✦ Current plans:
  – Reballot prior to June meeting

National Lubricity Standard for Diesel Fuel

✦ EPA is considering pursuit of lubricity regulation to align with ARB standard
Potential Regulatory Activities

Phase 4 RFG
Suggested Measures for Further Evaluation

- SIP commitment includes examination of feasibility and scope of further gasoline specifications

Suggested Measures for Further Evaluation (cont.)

- Sulfur: 5 ppm
- Oxygen: 0 %wt.\(^a\)
- Aromatics: 25 %vol.
- Olefins: 6 %vol.
- T50: 200°
- T90: 300°
- RVP: 6.4 \(^b\) - 6.5 psi
- Benzene: 0.1% vol.
## Comparison of Flat Limits

<table>
<thead>
<tr>
<th></th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Suggested Measure</th>
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<tr>
<td>Sulfur ppm</td>
<td>40</td>
<td>20</td>
<td>5</td>
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<tr>
<td>Oxygen %wt.</td>
<td>2(^a)</td>
<td>2(^b)</td>
<td>0</td>
</tr>
<tr>
<td>Aromatics</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Olefins %vol.</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>T50 °F</td>
<td>210</td>
<td>213</td>
<td>200</td>
</tr>
<tr>
<td>T90 °F</td>
<td>300</td>
<td>305</td>
<td>300</td>
</tr>
<tr>
<td>RVP psi</td>
<td>7.0</td>
<td>7.0(^c)</td>
<td>6.5(^c)</td>
</tr>
<tr>
<td>Benzene %vol.</td>
<td>1.0</td>
<td>0.8</td>
<td>0.1</td>
</tr>
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</table>

\(^a\) Federal CAA RFG areas to have at least 2% oxygen
\(^b\) RVP flat limit is 6.9 if CaRFG3 Predictive Model is used
\(^c\) U.S. EPA minimum 6.5 psi

## Estimated Potential Benefits

The estimated potential benefits associated with suggested measure in 2010:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>15</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>35</td>
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</tbody>
</table>
Significant Issues

✦ Costs
✦ Supply

Significant Issues (cont.)

<table>
<thead>
<tr>
<th>Capital</th>
<th>cents per gallon</th>
<th>$/lb. controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested Measure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 to 6 Billion dollars</td>
<td>10 - 20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>45 - 90&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>CaRFG2: 4 Billion</td>
<td>10</td>
<td>6.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>CaRFG3: 1 Billion</td>
<td>3</td>
<td>NA&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

a. Depends on costs of imports
b. Only HC and NOx emissions reductions used to calculate cost effectiveness
c. Intended to eliminate MTBE
Significant Issues (cont.)

✦ Production and Imports
  – Could further reduce in-state production by about 15%
  – Require more imports

Significant Issues (cont.)

✦ Availability of Imports
  – Limited due to specifications that are radically different from federal RFG for rest of the nation
    • Sulfur - 5 ppm cap vs 30 ppm average for federal RFG
    • Benzene - 0.1% by volume vs 1% by volume for federal RFG
Other Significant Issues

- Proposed 0% Oxygen Content
  - Federal CAA requires 2% oxygen content
  - Federal CAA oxygen requirement applies to 80% of all fuel sold in California
  - Would require a waiver of the federal oxygen requirement
  - Wintertime oxygen content requirement still in effect for the South Coast and parts of Imperial County

Other Significant Issues (cont.)

- Proposed 6.5 psi RFG limit makes production of complying fuel difficult if not impossible
  - Federal RVP minimum limit for fuel 6.4 psi
  - Leaves only 0.1 psi of flexibility
  - Reproducibility of test method is 0.2 psi
Conclusions

- Significant supply and production issues to be addressed
- Feasibility assessments require additional investigation
- Potential for emissions benefits for gasoline

CARB DIESEL FUEL USE WITH INTRASTATE
# Why Evaluate Intrastate Marine and Locomotives?

- ARB Public Hearing - July 24, 2003
- ARB Status Report - October 23, 2003
- ARB SIP Summit - January 13-14, 2004
  - ARB staff directed to prepare an evaluation of potential concepts to reduce emissions from intrastate marine and locomotives

## Line Haul Locomotive and Oceangoing Ship Fueling Patterns

- Operate nationally and internationally.
- Low quality fuels with high sulfur content.
- Can fuel prior to arriving in California.
- Fuel storage capacity sufficient to avoid fueling in California.
- Most fuel dispensed in California consumed out-of-state.
Intrastate Harbor Craft and Locomotive Fueling Patterns

- Operate locally and regionally.
- Fueled primarily at California locations.
- Already some use of higher quality fuels.
- Opportunities for additional use of cleaner fuels.

<table>
<thead>
<tr>
<th>In-Use Sulfur Levels of Transportation Fuels Consumed in California (ppmw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Type</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>CARB Diesel</td>
</tr>
<tr>
<td>EPA Diesel</td>
</tr>
<tr>
<td>On-Road</td>
</tr>
<tr>
<td>Non-Road</td>
</tr>
<tr>
<td>Marine Distillate</td>
</tr>
<tr>
<td>Marine Bunker Fuel</td>
</tr>
</tbody>
</table>

* Currently unregulated. US EPA has proposed regulations.
Cleaner Fuel Opportunities Under Evaluation for Marine Vessels

- **CARB Diesel**: Harbor craft
  - ~25% PM Reduction
  - ~10% NOx Reduction
  - Greater use of add-on controls

- **Marine Distillate**: Ships at Dockside (auxiliary engines)
  - ~60% PM Reduction
  - ~10% NOx Reduction
  - ~90% SOx Reduction

- **Lower Sulfur Marine Bunker Fuel**: Oceangoing ships at sea (main engines)
  - ~20% PM Reduction
  - ~40% SOx Reduction

Cleaner Fuel Opportunities Under Evaluation for Locomotives

- **Use of CARB Diesel**: Short Haul and Switchers
  - ~5% NOx Reductions
  - ~20% PM Reductions
  - Greater use of add-on controls

- **USEPA’s Proposed Non-Road Diesel**: Line Haul Locomotives
  - ~90% SOx reductions
  - ~5% NOx reductions
  - ~20% PM reductions
ARB Evaluation Process

- Gather information on intrastate marine and locomotives (e.g., engines, fuel use)
- ARB survey of marine and locomotives
- Conduct future workshops
- ARB Board Meeting (4th Quarter 2004)?

ARB Webpages and List Serves

- Http://www.arb.ca.gov/offroad/
- Locomotives - loco/loco.htm
- Marine Vessels - marinevess/marinevess.htm
Diesel Fuel Deposit Control Additives

Diesel Deposit Control Additives

- SIP keep clean measure
- No current deposit control additive requirement for diesel fuel
- Issue may gain significance for 2007 engine designs
Deposit Control Additives

Potential Benefits

- Could reduce potential deposit formation in fuel systems and engines
- Keep engines closer to factory tolerances
- Minimize deterioration rate of engine-out emission levels

Diesel Engine Lubricating Oils
Diesel Engine Lubricating Oils

- Diesel engines consume (combust) lubrication oils as part of their normal operation
- Need to consider lubricating oil sulfur and ash content
  - Emissions
  - Impact on after treatment control technology

Industry Efforts to Study Lubricant Effects on Aftertreatment Devices

- Government/Industry workgroup
  - DOE Advanced Petroleum-Based Fuels - Diesel Emissions Control (APBF-DEC) Program
- Private consortium
  - Southwest Research Institute Diesel Aftertreatment Sensitivity to Lubricants (DASL) / Non-Thermal Catalyst Deactivation (N-TCD)
ASTM Heavy Duty Engine Oil Classification Panel

- Industry developing HD engine oil specifications for use with aftertreatment technology
  - Proposed Category 10 (PC-10)
  - Lower sulfur, phosphorous, and sulfated ash
  - Engine durability issues to be addressed
- Target API licensing: late 2005/early 2006
- Oils in market 3rd quarter 2006

Summary of Potential Diesel Measures

- Diesel deposit control additives
  - Need to investigate feasibility of deposit control additives - effectiveness and cost
  - Time frame: 2010+
- Diesel engine lubricating oils:
  - Industry efforts may preclude regulatory need
  - Licensing of new API engine oil category targeted for late 2005/early 2006
Clean Fuels Outlets

Objective

- To ensure that clean fuels are available for alternative fueled vehicles to operate and achieve the emissions benefits attributed from these vehicles
Key Points of Program

- Require certain owners/lessors of gasoline stations to install clean fuel outlets
- Requirement is triggered when 20,000 vehicles are certified to California LEV standards on a specific fuel

Considering Program Updates

- Current program does not consider:
  - New fuel/vehicle technologies
    - hydrogen fuel cells
    - hybrids
  - Infrastructure requirements
  - Lead time
  - Demand Needs
  - Mechanisms to adjust for market conditions
Tentative Schedule

- Board hearing September 2004

Biodiesel
Background

- Generally refers to methyl and ethyl esters of fatty acids that are derived from natural products
  - Vegetable, animal, and grease
- ASTM D6751 establishes fuel specification for biodiesel as a blending component.
  - Excludes fatty acids
  - Glycerol, moisture, cold flow, others
- US Production capacity: 150 million gallons/yr
- US Sales 2002: 20 million gallons/yr

Use of Biodiesel

- Pure Biodiesel B100
- Blends of Biodiesel
  - Common blends B2, B5, B20
Biodiesel Properties Compared to Diesel

<table>
<thead>
<tr>
<th></th>
<th>Biodiesel</th>
<th>Average California Diesel</th>
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</thead>
<tbody>
<tr>
<td>Energy Content</td>
<td>119,000 (Soy) 116,000 (Animal)</td>
<td>131,000</td>
</tr>
<tr>
<td>btu/gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cetane No.</td>
<td>53</td>
<td>50</td>
</tr>
<tr>
<td>Sulfur ppm</td>
<td>&lt;1</td>
<td>≤15</td>
</tr>
<tr>
<td>Aromatics %vol.</td>
<td>Below detection limit</td>
<td>19 %vol.</td>
</tr>
</tbody>
</table>

Biodiesel Emissions Compared to Diesel (cont.)

- Lowers greenhouse gas emissions well to wheel
  - 3.2 units of energy produced per unit of energy used to produce biodiesel as compared to 0.8 units energy produced per unit of energy used for diesel

- Generally reduces tail pipe emissions of PM, HC, CO
  - B100: reduces PM and CO 40%, THC 68%
  - B20 reduces PM and CO 12%, THC 20%
Biodiesel Emissions Compared to Diesel (cont.)

- Increase in NOx emissions
  - B100 10% increase
  - B20(soybean) 2-4% increase in NOx
  - Feedstock affect NOx (soybean highest)

Issues with Biodiesel

- Engine durability and impact on lubrication oil
- Fuel quality
- Fuel stability
- Cold flow characteristics
- Seal and material compatibility
- NOx
Presentations by Others

Open Discussion
Closing Remarks