Engine Manufacturers Association

- Domestic and foreign manufacturers of diesel, gasoline and alternatively-fueled internal combustion engines
- Principally, non-integrated manufacturers of loose engines
- Wide range of engine sizes, from 1 hp to 7000 + hp
- Wide range of industry applications
<table>
<thead>
<tr>
<th>Company Name</th>
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<tbody>
<tr>
<td>Briggs &amp; Stratton Corporation</td>
<td>Case New Holland</td>
<td>Caterpillar Inc.</td>
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<td>Cummins Inc.</td>
<td>DaimlerChrysler Corporation</td>
<td>Deere &amp; Company</td>
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<tr>
<td>Detroit Diesel Corporation</td>
<td>Deutz Corporation</td>
<td>Ford Motor Company</td>
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<td>General Motors Corporation</td>
<td>Hino Motors, Ltd.</td>
<td>International Truck &amp; Engine Corporation</td>
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<td>Isuzu Motors America, Inc.</td>
<td>Kohler Company</td>
<td>Komatsu Ltd.</td>
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<td>Kubota Engine America Corporation</td>
<td>Mitsubishi Engine North America, Inc.</td>
<td>Mitsubishi Fuso Truck of America, Inc.</td>
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<tr>
<td>Onan – Cummins Power Generation</td>
<td>PACCAR</td>
<td>Scania CV AB</td>
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<td>Tecumseh Products Company</td>
<td>Volkswagen of America, Inc.</td>
<td>Volvo Powertrain Corporation</td>
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<tr>
<td>Waukesha Engine, Dresser, Inc.</td>
<td>Yamaha Motor Corporation</td>
<td>Yanmar Diesel America Corporation</td>
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*EMA Membership Roster*
EMA Objectives

- Achieve air quality improvements through cost-effective, technologically feasible measures
- Promote/maintain global alignment of standards, programs, and procedures: design once, certify once, sell worldwide
- Maintain customer satisfaction and product acceptability
Fuel Quality

- Fuels must meet established specifications
- High quality fuels are essential to:
  - achieve emission reduction goals
  - enable advanced aftertreatment technologies
  - provide expected engine performance
  - achieve expected efficiency
  - maintain engine durability
  - meet customer expectations consistently
Rationale For Alternative Diesel Fuels

- Reduce energy dependency on petroleum-based fuels
- Potential to provide emission reductions
  - Direct emission advantages for current engines
  - Retrofit of older technology engines
- Boost domestic industries, (e.g. farming, fuel production facilities)
Alternative Diesel Fuel Challenges

- Emission reduction trade-offs
- Fuel specifications, quality and consistency
- Performance
- Infrastructure and fuel availability
- Cost
- Impact on additive package/consistency
- Impact on engine components (compatibility)
Alternative Diesel Fuels

- Water/diesel emulsion
- Ethanol/diesel fuel blends
- Gas to liquid (GTL) fuels
- Biodiesel fuels
Water/Diesel Emulsion

Benefits
- NOx emission decrease
- PM emission decrease

Concerns
- Lack of industry-wide fuel specification
- Need for special handling (self-contained fuel unit)
- Special storage required to prevent water/fuel separation
- Reduced energy content
- Potential adverse interaction between emulsion and aftertreatment control technology
- Increased separation/freezing potential in cold weather operation
- Durability/corrosion effects
Ethanol/Diesel Fuel Blends

- **Benefits**
  - PM emission decrease

- **Concerns**
  - Lack of industry-wide fuel specification
  - Flammability (dispensing, maintenance and storage)
  - Reduced energy content
  - Potential adverse interaction between ethanol and aftertreatment control technology
  - NOx emission levels are engine and/or application dependent
Gas to Liquid (GTL) Fuels

**Benefits**
- NOx emission decrease possible
- PM emission decrease possible
- High cetane
- No sulfur or aromatics
- Good blending stock for diesel fuel

**Concerns**
- Lack of industry-wide fuel specification
- Reduced energy content
- Fuel flow impairment in cold weather operation
Biodiesel Fuels

- 100% biodiesel and various biodiesel blends
- Several feedstock options with varying benefits and concerns
Conclusions

- Each alternative diesel fuel has unique characteristics
  - Decrease in engine-out emissions for some criteria pollutants
  - Increase or no change in other pollutants
  - Potential performance, durability, cost, and customer satisfaction concerns

- Infrastructure and availability issues must be resolved
  - Avoid “boutique” fuels
  - Fuel blending at the refinery for consistency

- Engines are designed to operate on specified fuels
- Significant time and resources are required to conduct performance/emission testing on a host of potentially feasible fuels and fuel formulations
- EMA is committed to working with other stakeholders in industry and government to develop a common understanding of the role of alternative diesel fuels in California’s overall air quality strategy