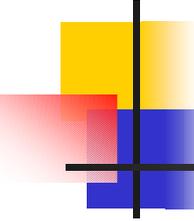


# California Air Resources Board Alternative Diesel Fuels Symposium

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Presentation of the  
Engine Manufacturers Association

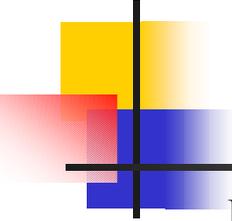
Sacramento, California  
August 19, 2003



# Engine Manufacturers Association

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- 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



# EMA Membership Roster

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Briggs & Stratton  
Corporation

Cummins Inc.

Detroit Diesel Corporation

General Motors Corporation

Isuzu Motors America, Inc.

Kubota Engine America  
Corporation

Onan – Cummins Power  
Generation

Tecumseh Products  
Company

Waukesha Engine, Dresser,  
Inc.

Case New Holland

DaimlerChrysler Corporation

Deutz Corporation

Hino Motors, Ltd.

Kohler Company

Mitsubishi Engine North  
America, Inc.

PACCAR

Volkswagen of America, Inc.

Yamaha Motor Corporation

Caterpillar Inc.

Deere & Company

Ford Motor Company

International Truck &  
Engine Corporation

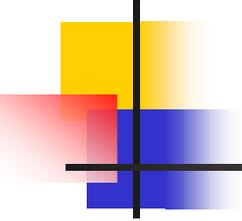
Komatsu Ltd.

Mitsubishi Fuso Truck of  
America, Inc.

Scania CV AB

Volvo Powertrain  
Corporation

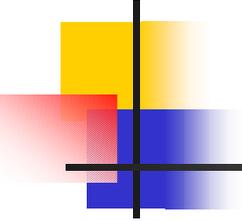
Yanmar Diesel America  
Corporation



# EMA Objectives

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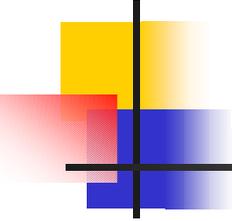
- Achieve air quality improvements through cost-effective, technologically feasible measures
- Promote/maintain global alignment of standards, programs, and procedures: design once, certify once, sell worldwide
- Maintain customer satisfaction and product acceptability



# Fuel Quality

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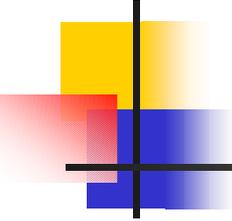
- Fuels must meet established specifications
- High quality fuels are essential to:
  - achieve emission reduction goals
  - enable advanced aftertreatment technologies
  - provide expected engine performance
  - achieve expected efficiency
  - maintain engine durability
  - meet customer expectations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



# Rationale For Alternative Diesel Fuels

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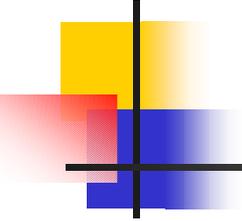
- Reduce energy dependency on petroleum-based fuels
- Potential to provide emission reductions
  - Direct emission advantages for current engines
  - Retrofit of older technology engines
- Boost domestic industries, (e.g. farming, fuel production facilities)



# Alternative Diesel Fuel Challenges

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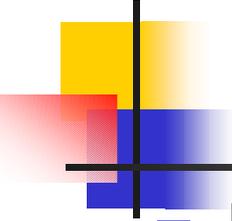
- Emission reduction trade-offs
- Fuel specifications, quality and consistency
- Performance
- Infrastructure and fuel availability
- Cost
- Impact on additive package/consistency
- Impact on engine components (compatibility)



# Alternative Diesel Fuels

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



# Water/Diesel Emulsion

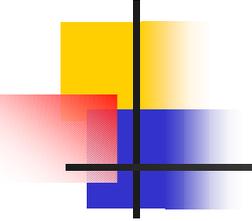
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## ■ Benefits

- 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

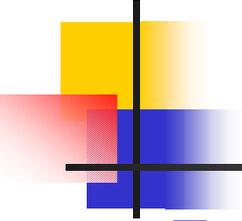
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- Benefits

- 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

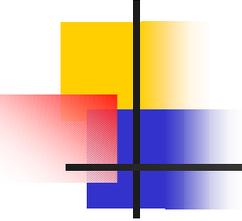
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## ■ Benefits

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

## ■ Concerns

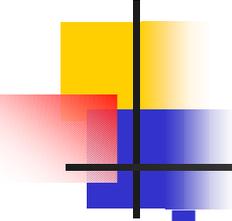
- Lack of industry-wide fuel specification
- Reduced energy content
- Fuel flow impairment in cold weather operation



# Biodiesel Fuels

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



# Conclusions

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- 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