

# Introduction to Biodiesel

Presentation to the Mobile Source  
Technical Review Subcommittee

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October 16, 2002

# Purpose of Briefing

- To provide information on the many issues relating to the use of biodiesel
- Responding to recent developments
  - increased use of biodiesel in heavy duty fleets (due to EPA Act changes, diesel fuel rules)
  - interest in biodiesel to address energy supply issues
  - lobbying by biodiesel industry for favorable tax legislation and blending mandates
- This briefing addresses the multiple uses of biodiesel
  - additive (B2)
  - diesel replacement (B20)
  - alternative fuel (B100)

*However*, most comments refer to B20 unless otherwise noted

# Biodiesel - What Is It?

- **Biodiesel is a domestic renewable fuel made from vegetable and animal fats/oils**
- To make biodiesel, ethanol or methanol is combined with animal or plant oils or fats to form ethyl esters or methyl esters. Most commonly, the oils are soybean oil or animal fats (used restaurant grease).
- Alcohols can be reacted with oils to form esters, which are another class of oxygenates like alcohols and ethers.
- Biodiesel is either 100% esters (B100) or, more typically, a combination of esters (usually around 20%) mixed with petroleum diesel fuel.

# Biodiesel Properties

- Biodiesel can be made from a wide range of feedstocks. It is not clear if these varying sources have significant impacts on fuel properties or performance.
- Neat biodiesel (B100) has a high cetane, no sulfur, and a high oxygen content.
- B100 has a high cloud point which causes cold start probs.
- Biodiesel is a good solvent, which leads to maintenance concerns. Special components and maintenance are recommended for both vehicles and the distribution system
- Biodiesel is biodegradable, safer to handle than petroleum, and less toxic. Toxicity of emissions may be an issue.

# Issues for discussion

- Emission characteristics
- Energy Balance
- Impacts on Vehicle Operation
- Fuel Costs
- Issues specific to biodiesel
- Current Policy
- Potential areas for further attention

# BD Energy Balance, Renewability

- Biodiesel is produced domestically, making it attractive energy policy.
- DOE analysis indicates biodiesel decreases lifecycle emissions of CO<sub>2</sub> by 15% (B20) to 78% (B100).
- Note that biodiesel production is slightly less efficient than petroleum diesel production (2.5%). However, biodiesel produces 3x as much energy from the same amount of fossil fuel. If ethanol is used instead of methanol, this energy ratio is even greater.
- Oil conversion is the step which requires the greatest amount of fossil energy (87% of total primary energy). This step requires the use of electricity and methanol as fossil fuels.

# Biodiesel Impacts on Vehicle Operation

- Biodiesel blends up to 20% (B20) can be used in diesel engines with no modification.
- Vehicles operating on B20 have been reported to have similar performance and fuel economy to petro diesel. (due to lower energy content, fuel economy is 2% lower).
- Due to properties as a solvent, prolonged use of biodiesel may soften or corrode rubber components, and requires more frequent changes of fuel filters. Proper maintenance can help in avoiding these problems.

# Engine Durability and Compatibility Issues

- Engine warranty issue in US
  - % biodiesel blend limited to less than 5% by many US HD engine manufacturers
- Some European manufacturers allow 100% biodiesel fuels
  - frequency of oil change doubled for some applications
- Durability issues are primarily dependent on fuel quality and production processes
  - Durability/lubricant oil issues
  - Materials compatibility issues



# Biodiesel as Lubricity Additive

- Low volume of BD gives substantial diesel lubricity improvement
  - Touted by marketers as ideal answer to replace lost lubricity associated with diesel desulfurization to 15 ppm
  - Number of marketers offer soy-based biodiesel lubricity additive
- Some States are considering bills that would mandate use of 2 percent biodiesel
  - Suggestion for national mandate in comments to 2007 diesel rule
- Cost - higher than for other lubricity additives
  - ~1-4 c / gal ... If biodiesel \$2.00 / gallon
  - Cost of other lubricity additives ~0.2-0.5 c / gal

# Biodiesel Fuel Cost

- Methyl soyate currently costs over \$2 per gallon
- Feedstock costs account for over 90 percent of direct production costs, including cost of capital and return of capital.
  - It takes about 7.3 pounds of soybean oil, for example, costing about 20 cents per pound, to produce a gallon. Feedstock costs alone, therefore, are at least \$1.50 per gallon of methyl soyate, not counting processing, marketing and overhead expenses and profit.
- Producers are trying to reduce costs by developing higher oil-content soy hybrids.

# Distribution Issues

- Volume of biodiesel used is currently insufficient to support distribution by common system (pipeline)
- Some concern that solvent activity of biodiesel could dislodge deposits in storage tanks and pipelines leading to contamination concerns
- Biodiesel manufacturers state that biodiesel could be blended into diesel fuel at the refinery or downstream
  - Common distribution system should be able to handle biodiesel blends of 20% and less without contamination concerns
  - Biodiesel's affinity to water is no greater than neat diesel fuel
  - Plan confirmatory testing with pipeline company when volume sufficient

# Current Policy

- EPA has already addressed Biodiesel issues in a number of areas
- Biodiesel is a registered additive and allowable oxygenate
- While there is no Subim for diesel, EPA policy has effectively created a ‘subsim’ approach
- For a variety of reasons, several States have or are considering policies to encourage or even require the use of biodiesel; many municipal fleets already use it
- Biodiesel qualifies as an alternative fuel for EPAct
- **NOTE:** DOD recently committed to purchase 1.3 million gallons of biodiesel; the fuel will be made available to other Agencies.

# Current Policy - Registration

- Section 211 Testing, already received from the National Biodiesel Board, consists of:
  - Characterization and effects of exhaust toxics emissions
  - Tier 1 Literature search and emissions speciation
  - Tier 2 Short-term toxicology testing
- The National Biodiesel Board conducted the health-effects testing for biodiesel, and biodiesel is a legal, registered diesel fuel.

# Current Policy - Other Actions

- The politics for biodiesel are similar to those for ethanol.
  - Supported by industry, agriculture as domestic economic benefit
  - pushed heavily, claiming broad ‘3E’ benefits
- Biodiesel qualifies as an alternative fuel under EPA Act. Because biodiesel can be used in conventional diesel engines, there is a volume standard for the credit.
- DOE indirectly supports the use of biodiesel through grants to fleets, but there are no direct subsidies for the production or use of biodiesel.
- The biodiesel industry is seeking fuel mandates (at state and federal level) and tax subsidies similar to those for ethanol.

# Current Policy - State Programs

- States are beginning to consider bills that would require low volumes (2-5%) of biodiesel in all diesel sold in the state. (MN, ND)
- Several States have considered requiring the use of biodiesel (B20) in all State fleet vehicles (expanding on EPAct requirements). (IA, KS, GA)
- As a result of EPAct, several state and local fleets currently use blends of biodiesel (mostly B20, which can be used in truck and bus engines with no modification).
  - EG: Cedar Rapids, GA DOT, LexTran, NJ Transit, Cincinnati Metro, ID & MT municipal fleets, etc.....

## Areas for future attention

- Development and communication of uniform EPA policy re: biodiesel
  - (limited environmental benefit, better for energy and perhaps economic reasons)
- Assessment of European experience with biodiesel
- Further testing of emissions and engine impacts