

Use of Biodiesel in Non-Road Equipment

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Biodiesel Overview

Outline

- Biodiesel Glossary
- Current Deere Position
- Present Global Situation
- Trade Association Positions
- Major Issues Impacting Industry Growth – Rate Limiters
- Steps for Successful Growth
- Questions



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Biofuels Glossary

Biodiesel

- Comprised of Mono-alkyl esters of long chain fatty acids (Fatty Acid Methyl Esters or FAME)
- Derived from vegetable oils or animal fats
- In the United States, designated as B100 meeting ASTM D6751.
- **Transesterification:** standard process to make biodiesel

Raw Seed Oil / Fat / Grease + Methanol => Biodiesel (FAME) + Glycerin

- Soybean Methyl Ester – SME, predominantly in SA and US
 - Rapeseed (or Canola) Methyl Ester – RME, predominantly in Europe
 - Palm Methyl Ester – PME, predominantly in Asia
 - Animal fats (beef tallow, pork lard)
 - Yellow greases (waste cooking oil or recycled greases)
 - Other feedstocks (jatropha curcas, cottonseed, sunflower, coconut, sesame, etc.)
- Energy content of biodiesel (B100) is ~90% of petroleum diesel



John Deere Leadership in Biodiesel

5% biodiesel blend (B5) approved for general use in all John Deere products - December 2001



2% biodiesel blend (B2) for U.S. factory fill when equipment leaves John Deere factories - March 2005

Why B2 as a Factory Fill?

Readily available at a competitive price

Meets the high quality fuel standards that we have set for our engines

Deere requires that the Biodiesel fuel blended into the B2 must be from a BQ 9000 Accredited producer

Excellent lubricity characteristics

Easily blended

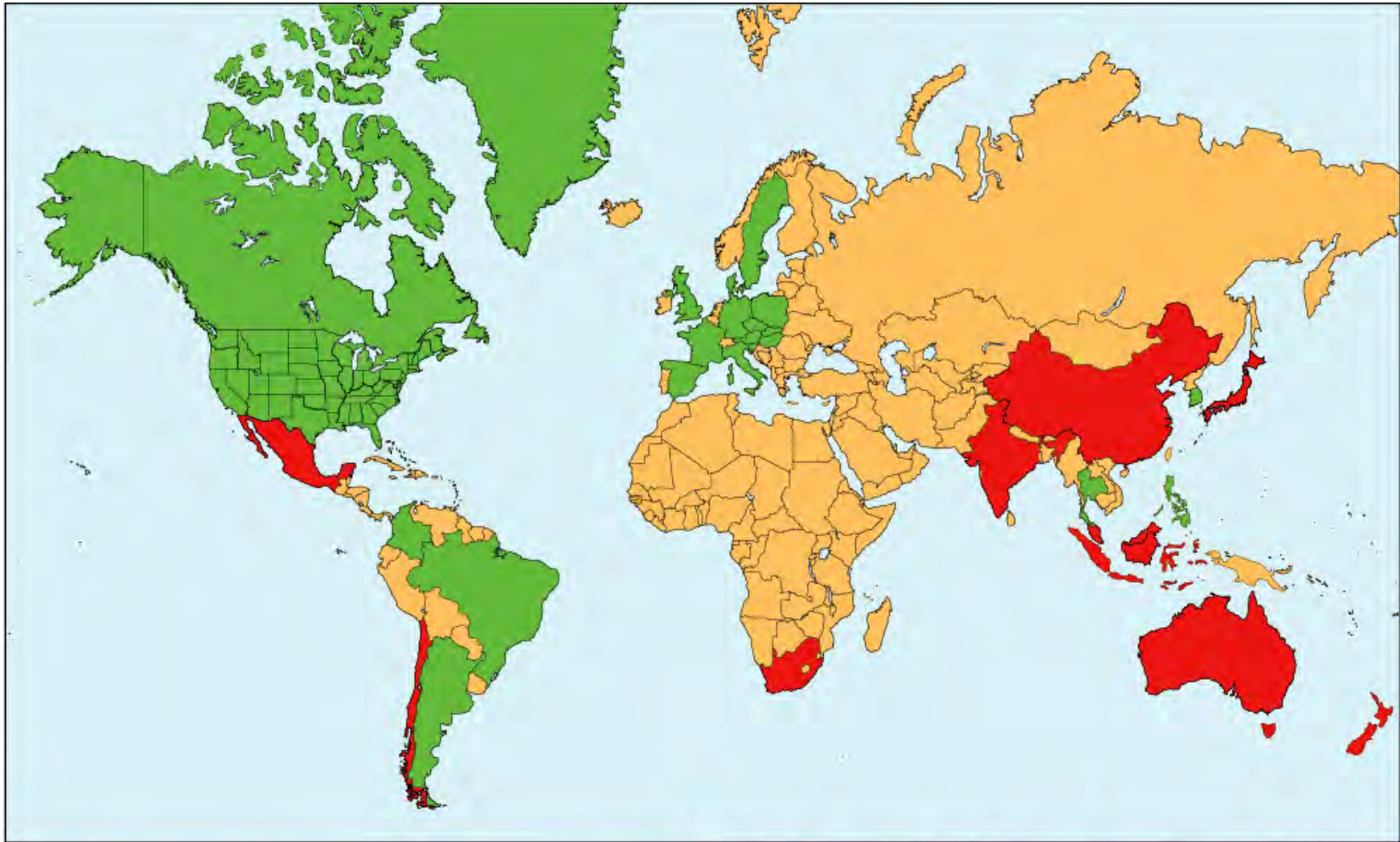
Can be used year round

Positive step toward adoption of renewable fuels

If B2 were used in all diesel fuel we could displace 1 billion gallons of foreign oil per year



Global View of Biodiesel Usage, 2006



Biodiesel blending exists within country

Trials, Pilot Projects or Studies underway

Source: IFQC Global Biofuels Center, August 2006.

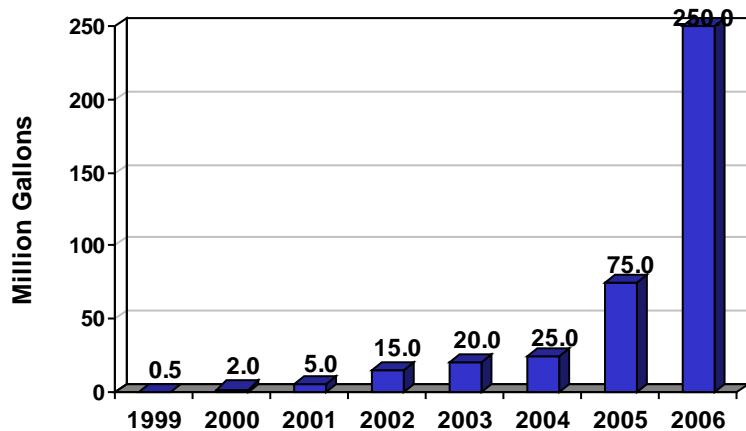
Source: IFQC, 2006.

Present Global Situation – Biodiesel Production Increasing

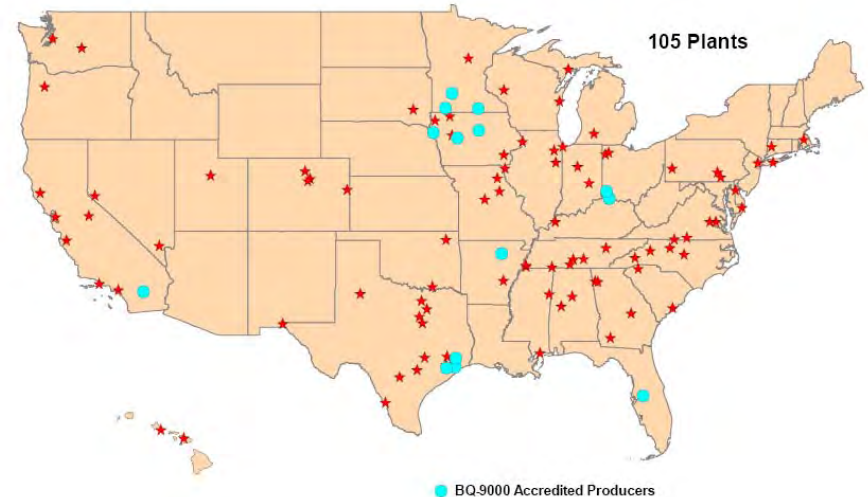
United States

- 2006 production capacity is approximately 600M gallons
- Production capacity is projected to be 1.7B gallons by mid-2008
- Soybeans are primary feedstock
- Seven (7) BQ9000 Certified Marketers
- Eighteen (18) BQ9000 Accredited Producers

1999-2006 US Biodiesel Production



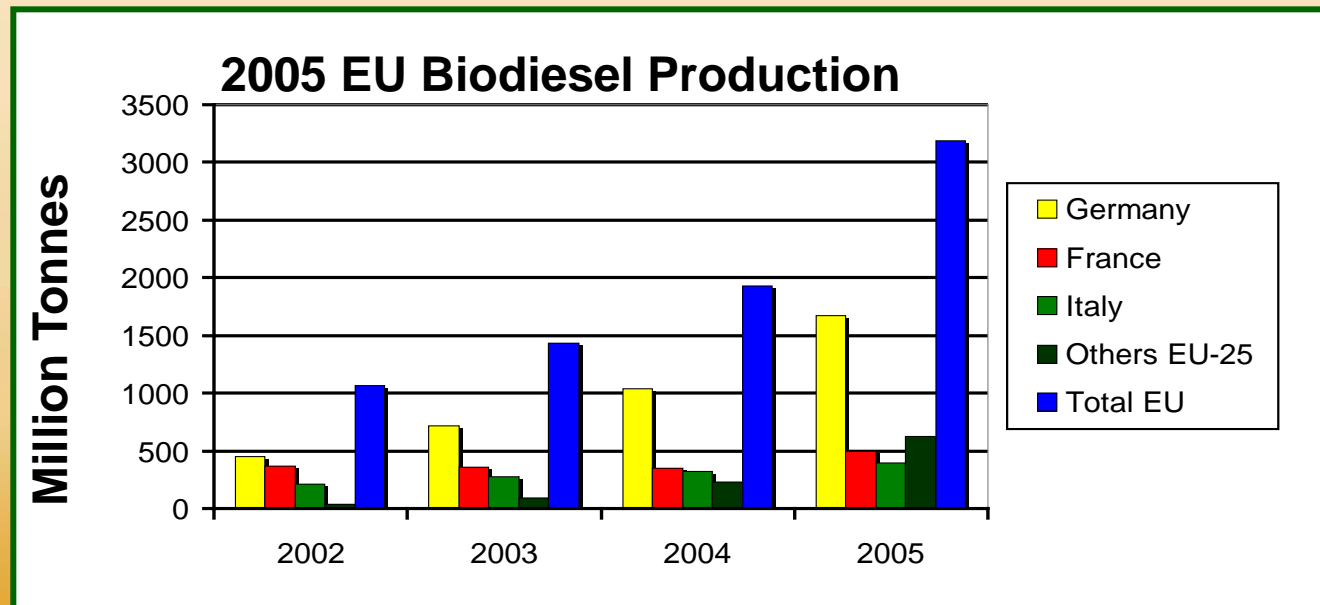
Commercial Biodiesel Production Plants (January 31, 2007)



2006 Europe Situation – Biodiesel Production Increasing

Europe

- EU 2004 to 2005 production increased 65% to 935M gallons (3.2M tonnes)
 - German production increased more than 50% per year from 2003 to 2005
 - 2005 German production was 490M gallons (1.7M tonnes)
- EU 2006 production capacity is 1.7B gallons (5.8M tonnes)
- Rapeseed is primary feedstock



Source: European Biodiesel Board

Trade Association Positions on Biodiesel

Association	Position
Fuel Injection Equipment Manufacturers	approves up to B5
Engine Manufacturers Association (EMA)	approves up to B5



Biodiesel Rate Limiters / Issues

Standards, quality, and handling issues are primary reasons engine and fuel injection equipment manufacturers limit approval levels

- Some B100 standards are incomplete
- Biodiesel blend standards above B5 do not exist
- Quality control for B100 and blended fuels are lacking
 - Filter plugging w/ B2 in Minnesota due to out of spec B100 (high glycerin level)
 - 50% of B100 samples checked by NREL in a recent study did not meet ASTM D 6751

Production capacity and feedstock availability to meet growing demand

Long-term tax incentives required for industry survival

Long term performance, emissions, and durability impact unknown



Steps for Successful Biodiesel Growth

Promote B2 as the preferred blend while the industry solves quality, distribution, supply, and performance issues, then expand to higher blends

Engage with Engine Manufacturers Association, National Biodiesel Board, Euromot, ASTM and other industry groups to advance biodiesel standards, promote production quality, handling and distribution of biodiesel fuels

Work with federal and state authorities to craft / refine renewable energy policies

Continue testing to ascertain the severity of potential performance and durability problems and evaluate / develop solutions



What is John Deere Doing?

Advocating development of Biodiesel Quality Standards.

Recommending customers use BQ9000 Certified Biodiesel Suppliers.

Participating in CARB and EPA programs to understand emissions impact of biodiesel.

Using B2 as a US Factory Fill.

Approved use of B5 in all John Deere products.

Conducting lab and field tests.

- Targeting for B20 approval in North America by Nov 2007.



Purchasing Quality Biodiesel

Purchase biodiesel from BQ-9000 accredited producers. A list of certified producers can be found on the National Biodiesel Board Website, www.nbb.org, under Fuel Quality Information/BQ-9000 Website/Accredited Producers.

If no BQ-9000 accredited producers are in your area, ask if the bio portion of the biodiesel being sold meets ASTM D6751 and request a Certificate of Analysis.

Ask biodiesel supplier the age of the biodiesel. Since the bio portion of biodiesel is biodegradable, it has a much shorter shelf life than petroleum-based fuels. Ideally, biodiesel should be used within three months of production, with six months being the absolute maximum.



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Fuel Quality Complaints

On the National Biodiesel Board Website, www.nbb.org, information is provided on how to file a fuel quality complaint:

Access www.nbb.org website. Click on “Fuel Quality Information.”

Click on “Fuel Quality Enforcement Guidelines.”

Click on “NBB Fuel Quality Enforcement Guide → **ASTM D6751 Enforcement.**”



ASTM D6751

Biodiesel (B100) Standards (Updated 18 December 06)

Property	Test Methods		Units	ASTM D 6751 USA
	ASTM	EN & ISO		
Cloud Point	D 2500		°C	Report
Carbon Residue (on 100% Sample)	D 4530		% mass	0.050 max
Water and Sediment	D 2709		% volume	0.050 max
Free Glycerin	D 6584		% mass	0.020 max
Total Glycerin	D 6584		% mass	0.240 max
Distillation Temperature, 90% Recovered	D 1160		°C	360 max
Flash Point	D 93	3679	°C	130.0 min
Kinematic Viscosity at 40°C	D 445	3104	mm ² /s	1.9 - 6.0
Sulfated Ash	D 874	3987	% mass	0.020 max
Copper Strip Corrosion	D 130	2160 (3 h at 50°C)	Rating	No.3 max
Cetane Number	D 613	5165		47 min
Acid Number	D 664	14104	mgKOH/g	0.50 max
Phosphorous Content	D 4951	14107	% mass	0.001 max
Sulfur Content	D 5453	20846 or 20884	% mass	0.0015 max (S15) 0.05 max (S500)
Group I Metals (Na + K)	UOP 391	14108 or 14109	mg/kg	5 max
Group II Metals (Ca + Mg)	UOP 391	14538	mg/kg	5 max
Oxidation Stability, 110°C		14112	hours	3.0 min



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Questions



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