Global Biodiesel Market Trends, Outlook and Opportunities

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BIODIESEL 2020: A GLOBAL MARKET SURVEY

- 685 page study, February 2008
- **Country Studies**
  - US, Brazil, EU, China, India
- **Feedstock Markets and Trends**
  - Soy, Rapeseed, Palm, Jatropha, Castor, Yellow Grease, Fats
- **2nd Generation Projects and Trends**
  - Algae, Renewable Diesel, BioCrude, Biomass to Liquids, Green Diesel
- **Outlook and Opportunities**
GLOBAL BIODIESEL MARKET OUTLOOK

Today’s Presentation:

1. Global Biodiesel Growth
2. Emerging Feedstock Trends
3. Outlook & Opportunities to 2020
1. GLOBAL BIODIESEL GROWTH

Courtesy of bp.com
What Are They Key Drivers of Global Biodiesel Market Growth?

- Energy Independence
- Economic Security
- National Security
- Environmental Security
- Tax Incentives
- Government Mandates

Source: Biodiesel 2020: A Global Market Survey
Global Biodiesel Production and Capacity


Global biodiesel production is expanding rapidly, along with increasing production capacities. Feedstocks are a major concern. High prices and feedstock shortages in Europe, the US and Asia are contributing to a growing delta between production and capacity in each region.

sources: Emerging Markets Online, Biodiesel 2020, NBB, EBB, USDA, FAS, Oil World
Europe produces and consumes 80% + of biodiesel world-wide

SOURCE - BIODIESEL 2020: A GLOBAL MARKET SURVEY
EUROPEAN BIODIESEL GROWTH
**EU Biodiesel Market Growth Trends**

- **EU Biofuels Targets:**
  - Target 1 - 2% by 2005
  - Target 2 - 5.75% by 2010
  - Proposals: 10% by 2020 (EU Revision)

- **EU Biofuels Markets:**
  - More than 50% of cars run on diesel
  - 70% of biodiesel from rapeseed
  - *Increasing growth in imports*
    - Soy from USA, Brazil, Argentina; palm from Asia, eventually Jatropha from Asia, Africa
  - Feedstock sustainability concerns #1 for 2008

*Source - Biodiesel 2020: A Global Market Survey*
Europe Biodiesel Production and Capacity

EU BIODIESEL MARKET GROWTH TRENDS

European Biodiesel Growth by Country


Source: Biodiesel 2020: A Global Market Survey
Europe is the largest producer and consumer of rapeseed, accounting for 75% of biodiesel consumption.

Growing imports of soybean oil and SME biodiesel from Americas, and palm oil/PME from Asia are blending in.
USA BIODIESEL MARKET GROWTH
USA Biofuels Targets

- Federal RFS – 36 billion gallons by 2022
- 22 Billion Gallons from “2nd Generation” Fuels

USA Biofuels Market Growth

- Production growth: 25mgy 2004 to 450 mgy 2007
- Retail Growth: 350 pumps 2005 to 1000+ 2007
- Biodiesel Export Growth to Europe
- Increase in multiple feedstock uses
USA BIODIESEL MARKET OVERVIEW

US Biodiesel Production 2004 to 2007

Million Gallons per Year

2004 2005 2006 2007

In the USA, *soybean oil* SME accounted for 64% of dedicated biodiesel production in 2005, but only 44% in 2006.

Trend in USA is moving toward **multi-feedstock** plants. A move towards diversity of feedstock is the primary choice among new biodiesel producers, and expanding operations.
BRAZIL’S EMERGING BIODIESEL MARKETS
Brazil Biodiesel Targets:

- National program starts with 2% blend in 2008 approximately 211 million gallons
- Next target – 5% by 2013 (660 million gallons)
- Government, Petrobras, Farmers harmonize production in collaborative framework
- Socio-economic benefits for rural farmers

Brazil Biodiesel Markets:

- Growth of 100+ biofuels plants by 2012
- Biodiesel export growth plans for soy, jatropha

SOURCE - BIODIESEL 2020: A GLOBAL MARKET SURVEY
BRAZIL BIODIESEL MARKET OVERVIEW

Biodiesel Feedstock Options by Region - Brazil

Source: Petrobras, Biodiesel 2020: A Global Market Survey
**China’s Biodiesel Targets**

- **2010** - to increase biofuels production to nearly 4 million MT by 2010
- **2020** - produce 12 million tons of biofuels, targeted to replace 15 percent of China’s transportation energy needs
- Socio-economic benefits for rural farmers

**China’s Biodiesel Markets**

- Traditional use of waste vegetable oil
- Plans for bigger plants using non-food sources such as jatropha, recycled waste and sewage feedstock
- **China’s enormous Jatropha project at 13 million hectares or the size of England**

*Includes natural gas liquids.*

SOURCE - BIODIESEL 2020: A GLOBAL MARKET SURVEY
China – Fast Growth in Diesel Market In Last 25 Years

Source: BIODIESEL 2020: A GLOBAL MARKET SURVEY – China Planning Committee Report
China – Fast Growth in Biodiesel Market

China Biodiesel Production Capacity and Output 2002-2005

SOURCE - BIODIESEL 2020: A GLOBAL MARKET SURVEY - estimates from GTZ China report
INDIA’S EMERGING BIODIESEL MARKETS
**India’s Biodiesel Targets:**

- National Biodiesel Program started 2006
- Two Phases – jatropha plantation program
- Target – 20% of diesel fuel by 2012
- Growth for rural, city and regional areas
- Socio-economic plans for growth in marginal areas to benefit rural farmers

**India’s Biodiesel Markets:**

- Key focus: Jatropha plantation, production
- Biodiesel Export Interest in Jatropha

*SOURCE - BIODIESEL 2020: A GLOBAL MARKET SURVEY*
INDIA’S BIODIESEL MARKET OVERVIEW

PROJECT GREEN
JATROPHA PLANTATION DEMONSTRATION
Adopted by TERI-December 2006

FARMER: SRI K. PVARA PRASAD
AREA: 1 ACRE (BIT1) + 1 ACRE (BIT2) = 2.1 ACRE.
VILLAGE: JAGANMADHAPURAM.
MANDAL: PEDAVEGI.
YEAR OF PLANTATION: JANUARY 2008 (BIT1) / FEBRUARY 2008 (BIT2).

SPACING: 2M X 2M.
NO. OF PLANTS (EXISTING) = 85 (BIT1) + 746 (BIT2).
NO. OF MISSING PLANTS PLANTED = 43 (BIT1) + 4 (BIT2).
TOTAL PLANTS = 900 (BIT1) + 770 (BIT2) = 1670.

CONTACT NO.: 9444321520, 9441282155, 9444032155.
2. EMERGING FEEDSTOCK TRENDS
Europe Biodiesel Feedstock Prices
Feedstock (Rapeseed Oil) Prices 1993 to 2008


For 12+ years, rapeseed oil prices FOB in Rotterdam averaged $615 USD/mt. The 1999-2008 trend demonstrates long term, sustained price increases.

Source: Feedstock Price Trends, by William Thurmond, Biodiesel International, May/June 2007 issue
USA BIODIESEL FEEDSTOCK MARKET TRENDS

U.S. Biodiesel Feedstock Prices
Feedstock (Soybean oil) Prices 1980 to 2008


The graph illustrates 27 years of US soybean oil prices. Historically, prices have varied from an annual change of 5% to over 40%. The trend from 2002-2008 illustrates soaring costs of soy.
**FEEDSTOCK TRENDS**

**National Feedstock Trends**
from Soybeans/Rapeseed to Multi-Feedstock

USA – 2005
majority of existing biodiesel plants
64% use soybean SME exclusively

USA – 2006
only 42% of existing biodiesel plants
use soybean SME exclusively

**Global Feedstock Trends**
Price Trends Driving Growth in *Lower Cost Feedstocks*

2006 – 2007: EU, USA
Higher feedstock prices for soy, rapeseed, and palm oil

2008 + Future - Global
Demand for alternative feedstocks from Waste Grease, Jatropha, Algae
Lower Cost Feedstocks for Biodiesel?

Soybean Oil
Palm Oil
Tallow
Yellow Grease

Lower Cost Feedstocks for Biodiesel?

Soybean Oil, Palm Oil, Tallow and Yellow Grease Prices
2006-2007

source: National Biodiesel Board, Jacobsen Publishing
Lower Cost Feedstocks - “Renewable Diesel”

Renewable Diesel:
“Grease” is the word
Renewable Diesel Technologies – Waste and Grease to Diesel and Bio-Oil

- Pyrolysis
- Gas To Liquids
- Fischer-Tropsch
The thermal depolymerization process can convert a wide range of waste materials into oil and other useful by-products, in proportions that vary according to the specific type of feedstock run through the works:

**100 POUNDS OF:**

**PLASTIC BOTTLES:** Clear (polyethylene terephthalate) and translucent (high-density polyethylene)

**MUNICIPAL LIQUID WASTE:** 75 percent sewage sludge, 25 percent grease-trap refuse

**TIRES:** All kinds, including standard rubber and steel-belted radials

**HEAVY OIL:** Refinery residues, heavy crude, and tar sands

**MEDICAL WASTE:** Transfusion bags, needles and razor blades, and wet human waste

**PLASTIC BOTTLES:** 70 pounds oil, 16 pounds gas, 6 pounds carbon solids, 8 pounds water

**MUNICIPAL LIQUID WASTE:** 26 pounds oil, 9 pounds gas, 8 pounds carbon and mineral solids, 57 pounds water

**TIRES:** 44 pounds oil, 10 pounds gas, 42 pounds carbon and metal solids, 4 pounds water

**HEAVY OIL:** 74 pounds oil, 17 pounds gas, 9 pounds carbon solids

**MEDICAL WASTE:** 65 pounds oil, 10 pounds gas, 5 pounds carbon and metal solids, 20 pounds water

Source: Discover Magazine, April 2006, “Anything Into Oil”
Renewable Diesel – Super Sized Projects Using Lower Cost Feedstocks
GLOBAL BIODIESEL FEEDSTOCK TRADE TRENDS:
Growth of The Emerging Markets

- 2007 - only 20 oil producers in the world supplying the demands of 200 nations
- 2010 – over 100 nations will produce biofuels and supply to more than 200 nations
FORECAST: GROWTH IN GLOBAL BIODIESEL TRADE 2007-2020
Export-Import of Canola, Soy, Palm, Jatropha, Sunflower, Castor Oils
FUTURE FEEDSTOCKS FOR BIODIESEL
JATROPHA FEEDSTOCK FOR BIODIESEL
High-Yield, Non-Food Oil, Non-Ag and Non-Rainforest areas, Low Water Use
Jatropha Curcas Commercial Projects

- **India**: 1 Million + hectares, DI, BP, Mission, Local Projects
- **Cambodia**: 20k hectares, VanDerHorst
- **Malaysia**: 22k hectares, Mission
- **Indonesia**: 200,000 hectares, BP, Bioenergy
- **Burkina Faso**: 25k hectares, D1
- **Mozambique**: 300,000 hectares, ESV, Duelco, Energem
- **Malawi**: 55k hectares, D1
- **South Africa**: 15k hectares, Duelco
- **Madagascar**: 17k hectares, D1
- **Brazil**: 100k + hectares, BDT, others

Source: Biodiesel 2020: A Global Market Survey
**Jatropha Feedstock for Biodiesel**
High-Yield, Non-Food Oil, Non-Ag and Non-Rainforest areas, Low Water Use

### Power Prices
Estimated cost per barrel of fuel produced by selected biofuel feedstocks

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Estimated Cost</th>
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<tbody>
<tr>
<td>Cellulose</td>
<td>$305</td>
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<tr>
<td>Wheat</td>
<td>125</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>125</td>
</tr>
<tr>
<td>Soybean</td>
<td>122</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>100</td>
</tr>
<tr>
<td>Corn</td>
<td>83</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>45</td>
</tr>
<tr>
<td>Jatropha</td>
<td>43</td>
</tr>
</tbody>
</table>

*Source: Goldman Sachs*
Jatropha feedstock for biodiesel
High-yield, non-food oil, non-ag and non-rainforest areas, low water use

Source: Xenerga estimates, high-yield Jatropha seeds
ALGAE - BASED BIODIESEL
Offers The Promise of High-Yield, Commercial-Grade, Non-Food Based Fuel
# Algae Projects Reported Under Development

High-Yield, Non-Food Oil, Non-Ag and Non-Rainforest areas, Low Water Use

<table>
<thead>
<tr>
<th>Company Name</th>
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</tr>
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<tbody>
<tr>
<td>Solix</td>
<td>Solazyme</td>
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<td>Green Star Products, Inc.</td>
<td>PetroAlgae</td>
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<td>Algae BioFuels</td>
<td>Seambiotic</td>
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<tr>
<td>Icon Energy</td>
<td>LiveFuels Inc</td>
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<tr>
<td>Inventure</td>
<td>GreenFuel Technologies Corporation</td>
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<td>Aquaflow Bionic Corporation</td>
<td>Infinifuel Biodiesel</td>
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<td>Valcent / Vertigro Joint Venture</td>
<td>Algoil</td>
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<tr>
<td>Enhanced Biofuels &amp; Technologies</td>
<td>OriginOil</td>
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<td>Kwikpower International</td>
<td>Alga Technologies</td>
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<td>Bio Fuel Systems</td>
<td>SQC</td>
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</tbody>
</table>
A Look at The Future - Algae Farms
High-Yield, Non-Food Oil, Non-Ag and Non-Rainforest areas, Low Water Use

Source: Solix Biofuels
3. BIODIESEL OUTLOOK AND OPPORTUNITIES
Short-Term Outlook, Opportunities to 2010

- Growth in Multiple Feedstocks
- Export Growth From Alternative Feedstocks
- Big Plants Open Near Ports, Refineries
- Renewable Diesel Growth - Recycled Waste
Medium Term Outlook, Opportunities to 2015

- Emergence of Commercial Scale Jatropha
- Export Growth from Latin America, Africa, Asia
- Algae Commercial Scale Production Increases
- Growth in Renewable Diesel Projects for Commercial and Community/Muni Projects
Long-Term Outlook, Opportunities to 2020

- Algae Becomes Mainstream Commodity
- Global Supply Balance Shifts North to South
- Global Demand Balance Increase From Asia
- Community Projects Increase Significantly
For more information
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