LIQUID SOLAR ENERGY

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What makes Biodiesel Sustainable?

- Real Environmental Benefits
- Increases Energy Security
- Supporting Jobs and Economic Benefits
- Commitment to Fuel Quality and Performance
- Emphasis on Science and Quantified Analysis
- Education and Outreach
- Responsible Goal Setting
- Successful Public Policy
Environmental Benefits of Biodiesel

● Reduces CO, PM, Ozone, Smog, & PAHs
● Nontoxic & Biodegradable
● Reduces Wastewater & Hazardous Waste Production
● Superior Energy Efficiency
● Lifecycle Carbon Reduction
● Improves Food Security
Biodiesel is the most efficient diesel substitute available

- Renewable Energy Ratio = 5.5:1
- Stores net energy from the Sun.
- Getting better all the time
Sustainable Energy Needs to Come from the Sun

- Choices: fossil fuels, nuclear, geothermal, & solar
- Solar = wave, wind, hydroelectric, & biomass
- Biomass is the only solar energy packaged for transport.
- Fats & Oils are nature’s favorite storage device for rapid release of energy for mobile uses.
Efficient Production/Conversion = GHG Savings

- Biodiesel recycles Carbon
- Net emissions come from fossil energy used in production
- 5:1 energy ratio corresponds to 80% GHG reduction.
- Biodiesel direct GHG reduction = 85%
Advanced Biofuel means renewable fuel with lifecycle greenhouse gas emissions that are at least 50 percent less than baseline lifecycle greenhouse gas emissions.

Renewable Fuel (i) fuel that is produced from renewable biomass.

Renewable Biomass
1. Planted crops and crop residue harvested from existing agricultural land cleared or cultivated prior to December 19, 2007 and that was nonforested and either actively managed or fallow on December 19, 2007.
Indirect Land Use Change

- Promoting biofuels in the U.S. makes it economically attractive for farmers to grow more food anywhere in the world.

- Producing more food results in GHG emissions that are attributed (by policy) to U.S. biofuels.
What does this all mean?

- We can meet our goals for domestic biodiesel production.
  - We can produce more food internationally.
- We can do all this and still lower GHG emissions.
Biodiesel is the most bio-diverse fuels in the world, with an expanding array of feedstocks.

- Yellow Grease
- Canola Oil
- Animal Fats
- Soybean Oil
- Corn Oil from ethanol production
- Algae
- Cottonseed Oil?
- Camelina Oil?
Feedstock Use - 2012

- Soybean Oil: 55%
- Animal Fats: 14%
- Used Cooking Oil: 12%
- Canola Oil: 11%
- Inedible Corn Oil: 12%
Biodiesel Enhances Food Security

Protein meal for livestock feed is the primary driver for soybean production.

Better utilization of the oil coproduct can reduce the price of the protein meal.
What makes Biodiesel Sustainable?

- Real Environmental Benefits
- Increases Energy Security
- Supporting Jobs and Economic Benefits
- Commitment to Fuel Quality and Performance
- Emphasis on science, quantified analysis, and tackling challenges head-on
- Education and Outreach
- Responsible Goal Setting
- Successful Public Policy
What else does the biodiesel industry need to be Sustainable?

- Growth
- Flexibility
- Diversity
Sustainable Growth

- Biodiesel keeps getting more efficient.
- Energy demand continues to grow.
- Fossil Fuels become more carbon intensive.
- Static volume would mean layoffs and closing plants.
- Incentivizes collection/treatment of wastes.
- Incentivizes new crops w/ potential food, environmental, and economic benefits.
- Biodiesel growth goals match feedstock production.
- Oilseed production matches growing protein demand.
Use multiple feedstocks
Use lowest cost feedstock
Locally available (or not?)
Use surplus oils/fats
Use waste or product that is not wanted by other industries.
Growth Comes From Increasing Diversity of Feedstocks

- Get more efficient collecting waste
- More corn oil from ethanol
- Find lower cost methods to convert low-quality grease
- Incentivize new crops like:
  - Double cropping: Canola, soy
  - Winter cover crops: pennycress
  - New rotations: camelina
  - Halophytes
  - Algae
Where do we expect growth?

- Virtual Acres
- Non-traditional Agricultural Land
- Algae
Distillers Corn Oil

• Significant Potential
  – Achieving the RFS2 target of 15 billion gallons of corn-based ethanol could mean more than 300 million gallons of biodiesel potential from de-oiled corn oil, even with only $\frac{1}{2}$ pound per bushel recovered.

• Key Questions
  – Does installed technology equate to continuous production?
  – Can extraction efficiencies improve?
New Winter Annuals

Field Pennycress

- Significant Opportunity
  - As a winter annual, could be drilled on millions of acres in the Midwest typically left underutilized during the winter.
    - Key will be harvest window and yield drag on the following soybean crop.

- Key Research Questions
  - Adoption by producers (insurance, timing)?
Additional Lipid Sources

- Increased recovery of yellow grease
- Increased domestic supplies of animal fats and used cooking oil
- Camelina *(now approved)*
- Brown Grease
- Brassica Juncea
Biodiesel Mimics Natural Processes

- Biodiesel stores solar energy.
- Plants store energy in natural oils.
  - Annual crops concentrate energy in seed
  - Liquid fuels are energy-dense
  - Oils release energy easily
- Plants capture carbon from the air.
- Hydrocarbons (H, C, & O) do not mine nutrients (N, P, & K) from soil