An Introduction to The U.S. Biodiesel Industry

Ryan Lamberg
California Biodiesel Initiative
National Biodiesel Board (NBB)

- Represents industry 90+ % of U.S. biodiesel producers.
- Recently opened membership to renewable diesel companies.
- 75% of budget allocated to research and education. (-Fuel Quality/Sustainability)
- Offices in Missouri and Washington, DC.
- California Biodiesel Alliance (CBA)– In state producers and members
- California Biodiesel Initiative (CBI) – Environmental partnership b/w NBB and CBA
Meeting Objectives

- Provide the latest information on:
  - U.S. Production and Policy update
  - New Technologies as related to Biodiesel
  - Biodiesel sustainability and GHGs/air quality

- Overview how biodiesel is a cost effective, immediate option to help ensure Clean Fuel Standard and LCFS success

- Discuss innovative avenues to ensure smooth and successful implementation of biodiesel as the first commercially available advanced biofuel for diesel engines
Liquid Fuel is a Necessity
Advantages of Embracing B20

- Biodiesel is an “advanced biofuel”. It is the easiest, lowest cost, most diverse commercially available low carbon replacement fuel on the market today.

- Clean Fuel Standards stimulates volumes of low CI fuels. These lower CI biodiesel fuels would be pulled into the Pacific markets.

- CI values of biodiesel will continue to improve with improved biodiesel processing and farming practices

- State mandates, incentives and other states consideration of a LCFS

- Illinois today, is reducing CO2 by 8% in diesel pool. 1.3 billion diesel with 140 million biodiesel. 170 million in Texas. 60 million in CA. . . .

- Pacific states could capture a greater portion of more than 62,000 US jobs and contributed nearly $17 billion in total economic value to the US economy in 2013.[1]

- Plus billions of dollars of biodiesel investments. Besides cost savings, energy security and cleaner air. . .
National Production Update
Addressable Market – 57.24 Billion Gallons

2011 U.S. Distillate Fuel Market (bn gallons)

- On-Highway: 36.16
- Commercial & Industrial: 5.06
- Residential: 3.63
- Farm: 2.94
- Railroad: 3.12
- Vessel Bunkering: 2.13
- Off-Highway: 1.38
- Oil Company: 0.76
- Other: 0.76

Source: EIA
Feedstock Diversity

Biodiesel is the world’s most diverse fuel with a continually expanding array of feedstocks.
U.S. Biodiesel Production

Volume - MGPY

- 1.7 Billion (Est.)
- 1.1 Billion
- 1 Billion
- 691 Million
- 500 Million
- 545 Million
- 315 Million
- 224 Million
- 112 Million

Loss of Federal Policy
Feedstock Use - 2012

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

Soybean Oil: 55%
- Animal Fats: 14%
- Canola Oil: 11%
- UCO: 12%
- Inedible Corn Oil: 12%
Feedstock Use - 2013

- Soybean Oil: 48%
- Animal Fats: 16%
- Other recycled grease: 3%
- Used Cooking Oil: 13%
- Canola Oil: 5%
- Inedible Corn Oil: 15%

Source: http://www.eia.gov/biofuels/biodiesel/production/
Monthly Soybean Oil Prices and Biodiesel Production Volumes (2012 to present)

Canola tracks a few cents less than soy

Soybean Oil Prices (Illinois) crude/degummed ¢/lb
Biodiesel Production (DOE-EIA)

2012
2013
Co-products of Food Production

- 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.
Soybean Oil Use in the US


- Other edible products
- Salad or cooking oil
- Margarine
- Baking or frying fats
- Total soybean oil domestic consumption
- Biodiesel
Monthly Soybean Oil Prices and Biodiesel Production Volumes (2013 ytd)

- Soybean Oil (Illinois) crude/degummed ¢/lb
- Biodiesel Production (DOE-EIA)

Canola tracks a few cents less then soy
• No increase in crop acres in US since 1959

• American farmers produce more each year on the same or less land

• We can meet our biodiesel goals with no increase in crop acres.
Biodiesel Enhances Food Security

- Renewable energy is needed for farming and food distribution

- Producing food and energy side-by-side may offer one of the best formulas for boosting countries' food and energy security while simultaneously reducing poverty, according to a new FAO report.

- Makes the business of growing food more stable
The primary drivers of recent food market changes are:

- Population and income growth
- Rising energy prices
- Increases in agricultural production costs
- Changes in the value of the dollar
- Foreign accumulation of exchange reserves
- Loss of agricultural land to non-agricultural uses
- Financial speculation in commodity markets
- Changes in the agricultural and trade policies
- Declining preference for inventory in favor of just-in-time delivery
- Adverse weather conditions
- Increasing difficulty to obtain water for agriculture
- Impacts of climate change
Canola Acreage and Production in Washington and the Pacific Northwest, 2010-2013

Canola, Area Planted, 2010-2013

1,000 acres

- Washington
- Oregon
- Montana
- Idaho

PNW Canola Production by State, 2010-2012

(1,000 lbs)

- Washington
- Oregon
- Montana
- Idaho

* Washington acreage not separately reported in 2010.

* Washington production not separately reported in 2010.
<table>
<thead>
<tr>
<th>Date</th>
<th>ULS Heating Oil Prompt, NY Barge Average</th>
<th>Soy Biodiesel NY Harbor Average</th>
<th>Federal Tax Credit</th>
<th>RIN Value Average</th>
<th>Net Difference</th>
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<td>$43.50</td>
<td>B - $40.50</td>
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**22-MONTH AVERAGE**

B - 27.50
Historical RIN Prices

†Data provided by Argus Air Daily
National Policy Update
Advanced Biofuel means renewable fuel w/ 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.
Statewide Mandates

Currently Implemented

- CT: 20
- MA: 5
- RI: 5
- VT: 3

Implemented after 2013

- CT: 20
- MA: 5
- RI: 5
- VT: 3

* Not Enforced

B5

B5*

B2

B10

* Not Enforced
Consumption Incentives

1 to 3 cents

4 to 6 cents

> 7 cents
Correlation or Causation?

**Best Policies**
1. California*
2. Illinois tax exemption
3. Minnesota mandate
4. Missouri incentive
5. Washington*
6. Pennsylvania mandate
7. Iowa incentives
8. Texas Tax Exemption
9. Oregon mandate

* If fully implemented

**Top Producers**
1. Iowa
2. Illinois
3. Missouri
4. Texas
5. California (potential)
6. Connecticut
7. Minnesota
8. Washington**
9. Pennsylvania

** If at full production
Job Creation

- Fossil fuel supply chain “among the least employment intensive in the economy”

- Conversely, the Bioenergy sector requires skilled workers at all levels of production.
  - Primary – engineers, biologists, biochemists, laborers, mechanics, etc.
  - Secondary - farmers, agricultural workers, railcar operators, truck drivers, etc.
  - Tertiary - workers to manufacture new and maintain existing equipment.
  - Specialists are also required at all levels to conduct research, education, and community outreach

- Environmental Entrepreneurs estimates that each million gallons of advanced biofuels produced will generate 2.24 permanent jobs, 10.29 construction jobs, and nearly 15 indirect jobs, including feedstock production

- Pacific states could capture a greater portion of more than 62,000 US jobs and contributed nearly $17 billion in total economic value to the US economy in 2013.[1]

- The biodiesel sector brings numerous high paying jobs to Pacific states, all the while helping to mitigate climate change and the reliance on out-of-state and foreign energy sources.
Climate Change symmetry between:
- Alaska
- British Columbia
- Washington
- Oregon
- California

Central to the plan is an agreement by Oregon and Washington to join California and British Columbia in adopting low-carbon fuel standards, and work together to build an integrated West Coast market for low-carbon fuels.
Growth of Calif. Biodiesel Industry Across the Full Value Chain

- Research & Development
- Feedstock
- Collection
- Production
- Blending
- Retail & Distribution

Locations of biodiesel facilities in California

Biodiesel Fuel...
has the highest energy balance of any transportation fuel
is a diverse biofuel because of the variety of feedstocks available
can be used in any diesel vehicle without modification
is the first advanced biofuel commercially produced nationwide, according to EPA’s definition
improves air quality by reducing emissions
reduces waste in landfills and waterways by creating an additional market for used cooking oil

Graphic provided by EDF
Sources of Greenhouse Gases that Contribute to Climate Change

Year 2009

- Transportation: 38%
- Electricity Generation: 23%
- Industrial: 18%
- Commercial & Residential: 9%
- Agriculture & Forestry: 7%
- High-Global Warming Potential Gases: 4%
- Recycling & Waste: 2%

457 MMTCO2e

Graphic provided by EDF
California Transportation Numbers

- **30** million vehicles drive on California roads every day
- Approximately **17** billion gallons of gasoline and diesel sold annually
- **$53** billion cost in 2012

Over 2 billion gallons of gasoline and 77 million gallons of diesel have been displaced so far. This is the equivalent of removing 2.8 million metric tons of carbon from the atmosphere or taking 500,000 cars off the road.
AB 32: California’s path to 2020 goals

California Greenhouse Gas Emissions By Year

Estimated 2012 emissions = 459 MMT

Graphic provided by EDF
How will California achieve these goals?

Graphic provided by EDF
California LCFS Structure

Emissions values are based on lifecycle assessment (LCA) of carbon released during the production, shipping and use of fuel.

Graphic provided by EDF
A Performance-Based Standard

![Diagram showing the process of carbon intensity and credits](Image)

**Carbon Intensity Cap on Fuel Pollution**

**Excess CO₂**

**Crude Oil** → **Shipping** → **Refinery** → **Combustion** → **CREDITS** → **Ethanol** → **Electric** → **Low Carbon Gasoline**

**Businesses that sell fuel with carbon intensity ABOVE the cap must buy credits.**

**Businesses that sell fuel with carbon intensity BELOW the cap can sell excess credits.**

An LCFS limits the amount of lifetime carbon emissions from fuels (the intensity cap) and allows clean fuel producers to sell their carbon credits to businesses that do not meet the carbon intensity target.
California LCFS Progress

CARB certifies fuel pathways for individual fuel types based on information developed either by the agency or by the fuel producer.

Average CI for certified Biodiesel pathway: 34.84 gCO2e/MJ
Average LCFS value adder per gallon of biodiesel

Information updated November 25, 2013
http://www.arb.ca.gov/fuels/lcfs/reportingtool/registeredfacilityinfo.htm
IN-STATE BIODIESEL PRODUCTION

- Biodiesel introduction fleet trials.
- Unfavorable biodiesel feedstock/diesel market economics. State policy interpretation leading to restricted underground biodiesel storage, uncertainty over continuation of Federal tax credits.
- Federal Blenders Credit/Federal Renewable Fuel Standard.
- California Low Carbon Fuel Program.

Data source: California Energy Commission and National Biodiesel Board
Low Carbon Fuel Standard

Fig. 1. Total Credits and Deficits (All Fuels) Reported, Q1 2011 -- Q2 2013
Low Carbon Fuel Standard

Fig. 4. Credits By Fuel Type

- ETH(90<Ci<95)
- ETH(85 < Ci < 90)
- ETH(80<Ci<85)
- ETH(Ci < 80)
- Natural Gas
- Biodiesel
- Other (electricity, renewable diesel, etc.)

Year:
- 2011 Q1, Q2, Q3, Q4
- 2012 Q1, Q2, Q3, Q4
- 2013 Q1, Q2

Credit (MT):
- 0, 20000, 40000, 60000, 80000, 100000, 120000, 140000, 160000, 180000, 200000
Carbon Reduction from the Use of Biodiesel B20 Blends in California

Based on the market reality LCFS to reach B20
Conclusions on Pricing
By John MacLean
NW New Energy

1. We are almost 3 years in for California’s LCFS and evidence clearly show it’s generating the kinds of demand for alternative fuels needed to drive scale in this industry.

2. So far there are zero indications that California’s LCFS has created fuel price spikes and negatively impacted economic growth or jobs in the state.

3. California’s economy has been through turmoil over the last several years like other states but not due to the rollout of the LCFS in 2011.
Biodiesel Technical Update
Technical Efforts

- BQ 9000
- ASTM specifications (1993 to present)
- OEM Update
- New Diesel Technology Engines
Fuel Quality & BQ-9000

• Biodiesel Industry’s equivalent to an ISO 9000 program for biodiesel production & distribution companies as well as testing labs

• There are now three BQ-9000 designations:
  • Producer (make it to spec)
  • Marketer (buy spec, keep it in spec, blend it right)
  • Certified Laboratories (test it to ensure it is in spec)

• New BQ-9000 Retailer program currently in development

• We now have 81 total companies BQ-9000 certified
  • 49 Producers, 20 Marketers, 12 Laboratories

• 87% of the B100 produced in the US is by a BQ-9000 Producer
Biodiesel % Better than Petroleum

<table>
<thead>
<tr>
<th>Unburned Hydrocarbons</th>
<th>Carbon Monoxide</th>
<th>Particulate Matter</th>
<th>Sulfates</th>
<th>PAH (Polycyclic Aromatic Hydrocarbons)**</th>
<th>nPAH (nitrated PAH’s)**</th>
<th>NOx*</th>
<th>Ozone potential of speciated HC's</th>
</tr>
</thead>
<tbody>
<tr>
<td>B20</td>
<td>B100</td>
<td>Range</td>
<td></td>
<td></td>
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</tbody>
</table>

* NOx does NOT increase in NTDE CARB Diesel testing is less known
Heavy Duty PM and NOx

Clean Diesel Progress: Heavy-Duty Diesel Trucks

98% NOx REDUCTION
98% PM REDUCTION

g/Bhp-hr=grams per brake-horsepower hour
NOx = Oxides of Nitrogen
PM = Particulate Matter

www.epa.gov/otaq
Originally published in 2002: ASTM D6751-02

-03: **Added 15 ppm sulfur grade**
-03a: Modified ‘middle distillate’ term, lubricity note
-06: **Reduced AV from 0.8 to 0.5; added limit on Na+K.**
-06a: Added limit on Ca+Mg
-06b: **Addition of oxidation stability**
-07: Modified language and added test methods
-07a: Added alcohol control and modified flashpoint
-07b: Added DCN and sulfur test methods
-08: **Addition of cold soak filterability**

*Introduction of B5 into D975 and publication of D7467 (B6 to B20 Standard)*
-09: Added cloud point test methods
-09a: Added cloud point test methods
-10: Added EN15751 as referee method for stability
-11: Added test methods and appendix on low temperature operability
-11a: Replaced cold soak filterability annex with D7501
-11b: Added new test methods
-12: **Addition of 1B Grade, updated scope, new test methods**

Continuous evolution to address OEM and end-user concerns

RED: COLD FLOW
Over 90% of the medium- & heavy-duty truck markets support B20.
Technical Issues Addressed by NBB

- Engine manufacturers support Biodiesel
- Underground Storage Tanks approved
- Fuel dispensers UL approved
- Leak detectors UL approved
- Ocean-going marine use
- Acceptance by railroads
- Compatibility in pipelines
- MSDS, TSCA, spill prevention, & emergency response
Currently at B5

- BMW
- Volkswagen/Audi
  - Approve B20 in Illinois.
- Mercedes
- PACCAR (Peterbilt/Kenworth)
Growing Diesel Vehicle Market

- 36 new clean diesel vehicle models available now or launching soon in the 2014 model year
- Automotive industry experts predict that consumers will have more than 54 diesel vehicle models to choose from in North America by 2017
- Majority of those vehicles are expected to be approved by the automakers for use with B20 biodiesel blends
New Technology Diesel Engines (NTDE)

- NTDEs employ a sophisticated combination of diesel engine and fuel system controls, ultra low sulfur diesel fuel, and exhaust after-treatment catalysts to achieve low emissions:
  - Closed loop control systems constantly measure emissions or other parameters on the vehicle and adjusts operation in real time regardless of fuel
  - 15 ppm sulfur or lower fuel (i.e. on-road petrodiesel, biodiesel)
  - Oxidation catalysts and particulate traps reduce PM, HC, CO
  - Selective catalytic reduction (SCR) reduces NOx through addition of DEF (diesel exhaust fluid)
New Technology Diesel Engines (NTDE)

- Today’s (2010 and newer model year) New Technology Diesel Engines (NTDE) reduce major diesel tailpipe emissions by over 90% compared to 2004 diesel engines (PM, NOx): 95% to 98% reduction over older engines cited in recent studies.

- NTDE are ~30% more efficient and provide ~30% better mpg than comparable gasoline or natural gas engines: This means new diesel engines can be a major contributor to reducing tailpipe carbon emissions and climate change.

- If biodiesel is used in a NTDE, the beneficial carbon effects of biodiesel adds to the carbon advantages of diesel technology.
Biodiesel Sustainability Update
<table>
<thead>
<tr>
<th>Environmental Benefits</th>
<th>Sustainability Benefits</th>
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<tbody>
<tr>
<td>Reduces CO, PM, Ozone, Smog, &amp; PAHs</td>
<td>Increases Energy Security - Reduces Petroleum imports. Fuel Diversity = Price Stability</td>
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<tr>
<td>Nontoxic &amp; Biodegradable</td>
<td>Supports Jobs and Economic Benefits</td>
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<tr>
<td>Reduces Wastewater &amp; Hazardous Waste Production</td>
<td>Commitment to Fuel Quality and Performance</td>
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<tr>
<td>Superior Energy Efficiency</td>
<td>Improves Health</td>
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<tr>
<td>Lifecycle Carbon Reduction</td>
<td>Increases Safety</td>
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<tr>
<td>Improves Food Security</td>
<td>Creates a “roadmap ” for more AFs to follow</td>
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</tbody>
</table>
Becoming More Efficient

- Soybean yield rising:
  - 15% increase 2000-2009

- Farm energy use decreasing:
  - 20% decrease 1998-2010

- Biodiesel processing more efficient:
  - 45% improvement 1998-2009
# Biodiesel GHG Studies

<table>
<thead>
<tr>
<th>Year</th>
<th>Source</th>
<th>GHG Reduction Better than Petroleum</th>
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<tbody>
<tr>
<td>1998</td>
<td>U.S. Department of Agriculture/National Renewable Energy Lab.</td>
<td>78%</td>
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<tr>
<td>2008</td>
<td>U.S. Department of Energy/Argonne National Laboratory</td>
<td>66-94%</td>
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<tr>
<td>2010</td>
<td>U.S. Environmental Protection Agency</td>
<td>85%</td>
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<tr>
<td>2010</td>
<td>California Air Resources Board</td>
<td>78%</td>
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<td>2010</td>
<td>U.S. Department of Energy/Argonne National Laboratory</td>
<td>89-122%</td>
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<td>2010</td>
<td>GHGenius/Natural Resources Canada</td>
<td>86%</td>
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<tr>
<td>2012</td>
<td>U.S. Department of Agriculture/University of Idaho</td>
<td>85%</td>
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Biodiesel GHG Studies

USDA 2012
NR Canada 2010
US DOE 2010
CARB 2010
US EPA 2010
US DOE/Argonne 2008
USDA/NREL 1998

0% 20% 40% 60% 80% 100% 120% 140%

% Better than Petroleum
Range of Reductions
With ILUC*

* ILUC considered part of the total score
Biodiesel WTW results depend on the method of dealing with co-products

- Each co-product method has weaknesses
  - Displacement: co-product yields are larger than main product yields.
  - Energy allocation: co-products are not energy products.
  - Market allocation: market values (prices) vary over time.
  - Mass allocation: values in the products of the same mass are different.
## RFS2 “Advanced” Feedstocks

<table>
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<tr>
<th>Qualified</th>
<th>Not Qualified</th>
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<td>Palm Oil</td>
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<td>Canola Oil</td>
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<td>Waste Oils</td>
<td>Biodiesel is 17% better than petro</td>
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<tr>
<td>UCO, Inedible Corn Oil</td>
<td>Renewable Diesel is 11% better than petro</td>
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<td>Animal Fats</td>
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<tr>
<td>Camelina</td>
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<tr>
<td>Pennycress (pending)</td>
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Biodiesel Uses Less Than 2% of Vegetable Oil Production (thousand kilograms)
<table>
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<tr>
<th>BCG</th>
<th>Facts. . . .</th>
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<tbody>
<tr>
<td>No Availability</td>
<td>• 1+ billion and 2.5+ billion by 2015</td>
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<td></td>
<td>• Biodiesel produced today could meet 2020 diesel goals of LCFS</td>
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<tr>
<td>Higher Prices</td>
<td>• More credits then demanded- and prices not spiking</td>
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<tr>
<td></td>
<td>• Renewable price equivalency</td>
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<td>Market Disruptions</td>
<td>• Market stability– AFs provide low-cost insurance against volatility of petroleum</td>
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<tr>
<td></td>
<td>• Exporting oil– Petroleum is exporting and maintaining profits</td>
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</tbody>
</table>
What Does This All Mean?

- Low carbon/advanced biofuel available today - can blend immediately with diesel and be used in existing fleets and fuel infrastructure.
- Emissions from biodiesel are trending down while Petroleum emissions are trending up.
- We can create domestic jobs.
- We can produce more food.
- We can do all this and still lower GHG emissions at a LOWER COST at the pump and for our future.
Advanced Biofuel

- From birth to maturation: quality/commercialization
- Changing Landscape:
  - China, RFS, CAFÉ standards, Climate change policy, the move from trans-fats
- When all factors considered, biodiesel is one of the most cost-effective low carbon fuels
  - Technology – New Diesel Technology Engines (NTDE)
  - Feedstock – diversity, research
  - Self-sufficiency – regional approach, recycling, jobs
What does this all mean?

- Emissions from biodiesel are trending down.
- Petroleum emissions are trending up.
- We can bring diversity to our sources of energy.
- We can use cleaner, renewable fuel.
- We can create domestic jobs.
- We can produce more food internationally.
- We can do all this and still lower GHG emissions.
Questions & Comments?
Thank you!

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