Vision 2015

• By 2015, biodiesel will be viewed as an integral component of a national energy policy which increasingly relies on clean, domestic, renewable fuels. Positive market dynamics coupled with federal policy will support a significant and stable market. **Sales, primarily in the form of low level biodiesel blends, will replace 5% of diesel demand by 2015.** Energy security and environmentally driven uses, such as B20, remain a significant and visible source of demand. Grassroots involvement remains a strong & vital strength of the industry.
Is 5% Significant

- Five year average of on-highway diesel fuel demand in the U.S. is 37.8 billion gallons
  - Replacing 5% with biodiesel = 1.88 billion gallons of biodiesel

In 2010, the United States imported 1.93 billion gallons of ULSD from other countries.

In 2010, the United States imported the equivalent of 1.52 billion gallons of diesel from Iraq crude oil and 3.6 billion gallons from Venezuela crude oil.
Policy and Feedstocks Linked
Volume Standards as Set Forth in RFS2

(Reminder: EPA Sets Standards Each November – These are the standards published in the Act)

<table>
<thead>
<tr>
<th>Year</th>
<th>Conventional Renewable Fuels (Grandfathered Or 20% Reduction)</th>
<th>Advanced Biomass Based Diesel (50% Reduction)</th>
<th>Non Cellulosic Advanced (50% Reduction)</th>
<th>Cellulosic Biofuel (60% Reduction)</th>
<th>Total Advanced Biofuel</th>
<th>Total Renewable Fuel</th>
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</thead>
<tbody>
<tr>
<td>2008</td>
<td>9.00</td>
<td></td>
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<td>2009</td>
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<td>0.6</td>
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<tr>
<td>2010</td>
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<td>0.2</td>
<td>0.1</td>
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<td>2011</td>
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<td>3.0</td>
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<tr>
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<td>5.5</td>
<td>9.0</td>
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<tr>
<td>2018</td>
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<td>3.00</td>
<td>7.0</td>
<td>11.0</td>
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<tr>
<td>2019</td>
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<td>8.5</td>
<td>13.0</td>
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<td>10.5</td>
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<td>3.50</td>
<td>13.5</td>
<td>18.0</td>
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<tr>
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<td>1.0</td>
<td>4.00</td>
<td>16.0</td>
<td>21.0</td>
<td></td>
</tr>
</tbody>
</table>

Total Renewable Fuel = Total Advanced Biofuel + Total Renewable Fuel
Feedstock Options
EPA approved pathways or those under review

- Palm Oil
- Canola Oil
- Soybean Oil
- Animal Fats
- Yellow Grease
- Camelina
- Cottonseed Oil
- Distillers Corn Oil
EPA Pathways

• March, 2010 EPA rule finalized a pathway for soybean based biodiesel.
  – EPA stated, “We did not analyze all pathways that might be feasible through 2022. In some cases, we did not have sufficient time to complete the necessary lifecycle GHG impact assessment for this final rule.”

• EPA finalized the canola pathway in August, 2010.

• EPA finalized the camelina pathway in January, 2012.
  – Direct final rule pulled due to adverse comments

  – Recommended palm would not qualify
Sustainable Feedstocks

Feedstock Use, 2011

- Soybean Oil: 52%
- Canola Oil: 15%
- Distillers Corn Oil: 8%
- Animal Fats: 11%
- Recycled Oils: 4%
- Other: 10%
Where do we expect growth?

- Virtual Acres
- Non-traditional Agricultural Land
- Algae
Expansion of Winter Annuals

Winter Canola

- Significant Potential
  - Oklahoma now the #2 state in terms of acreage.

- Key Questions
  - Will canola compete in winter wheat production areas?
  - Will farmers recognize rotation benefits?
    - KSU reports 20% increases of wheat yields following canola

4,200 lbs/acre winter canola in Kentucky
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)?

Top 5 Performing Genuity® Roundup Ready 2 Yield® vs. Top 5 Performing Roundup Ready® Varieties

4.5 bu/ac Advantage

1 Data as of October 29, 2010. Yield advantage of the Top 5 Performing Genuity® Roundup Ready 2 Yield® varieties versus the Top 5 Performing Genuity Roundup Ready® varieties by location, and averaged across regions within a state and across 77 locations.

Slide Courtesy of Monsanto Yield Review on Nov 8, 2010
Non-Traditional Agricultural Land (NTAL)
Non-Traditional Agricultural Lands

- **10 Million Acres??**
  - Roadways ≈ 4 million miles
    • Approx. 4 million acres
  - Railroads ≈ 140,000 miles
    • Approx. 0.5 million acres
  - Airports ≈ 19,820
    • If 100 acres @ 50% of the airports
      • ≈ 1 million acres
  - Urban/Public Spaces
    • if 10,000 acres in 50 states ≈ 0.5 million acres
  - Department of Defense owns 30 million acres of arable land in the United States
    • If 13% of areas are used ≈ 4 million acres

*Source: Center for Agronomic and Woody Biofuels*
DoD Lands could potentially produce over 400 Million gallons of Biodiesel

abstract

Growing biodiesel feedstocks on military land presents an opportunity for the Department of Defense to reduce their annual maintenance and operation costs, move toward alternative fuel usage goals, and maintain their role as an environmental steward. This paper demonstrates that land managed by the military could become an asset in biodiesel production. Application of this strategy on suitable military lands could significantly reduce DoD carbon footprints, produce economic, sustainable, and environmentally friendly biodiesel feedstock. Estimates suggest that this method could sustainably displace over 400 million gallons of conventional fuel per year.

The cultural practices associated with growing and converting biodiesel feedstocks on traditional agronomic lands are well established. The unique objective of this project is to assess the economical and environmental potential for biodiesel feedstock production on military land.

DoD is one of the largest US land stewards, managing ~30 million acres. Much of this land requires considerable maintenance and costs. With proper sustainable agronomic practices, an estimated 10 million acres of land could produce more than 400 million gallons of renewable biofuels. These fuels could be used by the military in ground, air, and aquatic vessels. Such action could save ~$2 billion annually, depending on production costs, while increasing national security and environmental sustainability. This could be a significant additional resource for military biofuel production.

An economic model, demonstrating utilization of oilseed feedstock grown on military land and used to produce biodiesel fuel, is presented in this paper. Assuming a yield of 1100 pounds/acre of oilseed (with 40% oil content and federal tax credit), the model predicts a positive net return of $69/acre or more. In many areas of the country, actual production yields are expected to be much higher than this assumption. Additional benefits are the result of reduced land and overhead costs for DoD when compared with private operations. Growth, collection, transportation, and storage of these feedstocks would utilize public-private partnerships. Implementation of this program should be rapid (within 3-4 years) because conventional farming equipment and cultural practices can be used.

Estimated Costs and Returns - Oilseed Production/Acre on Roadsides

<table>
<thead>
<tr>
<th>Production Operating Costs taken from 2011 Iowa Farm Custom Rate Survey</th>
<th>Pub. A3-10  <a href="http://www.extension.iastate.edu/publications/a310.pdf">http://www.extension.iastate.edu/publications/a310.pdf</a></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue/Acre</strong></td>
<td>Units</td>
</tr>
<tr>
<td>B100 seed (92% oil to biodiesel conversion)</td>
<td>gallon</td>
</tr>
<tr>
<td>Seed</td>
<td>pound</td>
</tr>
<tr>
<td>Fertilizer from County</td>
<td>ton</td>
</tr>
<tr>
<td>Fertilizer from Private Source</td>
<td>ton</td>
</tr>
<tr>
<td>Harbison (gallons)</td>
<td>gallons</td>
</tr>
<tr>
<td>Fuel Consumption</td>
<td>cents</td>
</tr>
<tr>
<td>Application</td>
<td>acres</td>
</tr>
<tr>
<td>Cultivating</td>
<td>acres</td>
</tr>
<tr>
<td>Harvesting</td>
<td>acres</td>
</tr>
<tr>
<td>Total Operating Costs/Acre</td>
<td><strong>$1046.62</strong></td>
</tr>
</tbody>
</table>

**Assumptions:**
- Oil Yield: 40%
- Extraction Efficiency: 67%
- Value of Catalysis: $20.00
- Cost of Maintenance: $30.00
- Yield Balance: $100.00
- C02 gallons: 27.6
- Weight of Obligation per acre: 7.8
- Cost of Land: $1.00
- Insurance, Taxes, etc.: $1.00
- Width of Growing Area: 75
- Acres per mile: 9.1

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Ralph Whitesides - ralph.whitesides@usu.edu

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**Bases to Biofuels**

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**Utah State University Cooperative Extension**
**University of Idaho Extension**
**Michigan State University**
**Biogas Digest**
**CTED**
**Washington State University Extension**
**USDA Engineers Research & Development Center**
Feasibility of Energy Crops Grown on Army Lands

The Louis Berger Group, Inc., and Utah State University September 2011

- Viable growing areas on U.S. Army Bases
- National Award Winning Project

Source: Center for Agronomic and Woody Biofuels
Algae
Growing Algae

• Several production pathways being pursued
  – Photobioreactors (PBR)
    • High capital investment
    • Lower risk of contamination with other strains
  – Open Ponds/Raceway Pond Systems
    • Lower capital investment relative to PBRs
    • More prone to environmental factors such as temperature and evaporation
  – Enzymatic Fermentation
    • Industrial fermentation
    • Utilizes carbon source as nutrient
Algae and Ag Production

• Algae Production and “HeteroBoost”
  – Algae are grown in open ponds phototrophically, harvested and placed into fermentation-like heterotrophic conditions and supplemented with plant-derived carbohydrate feedstocks, which the algae very efficiently convert to useable oil.

• Greatly reduces the capital and operating costs for large algal bioreactors or ponds by potentially increasing productivity by more than 30-fold
Where do we expect growth?

- Yield Growth
- Winter Canola
- Highway ROW
- Low Ricin Castor
- Camelina
- Pennycress
- Seashore Mallow
- Algae

Thinking outside the box.
Crop Value and Rotation Value
Three Crops in Two Years?

- Achieving harvest dates of late May/early June
Can New Crops Play a Role?
Points to Ponder as we Look Forward

Myths versus Facts
Myth: If the market share of sbo (for biodiesel) drops it doesn’t help me as a farmer

• REALITY: BIODIESEL SERVES AS AN EFFECTIVE HEDGE AGAINST RISING ENERGY PRICES
  – It has been estimated that more than $\frac{3}{4}$ of our farm expenditures are linked to energy prices
Crude Oil and Soybean Oil

Soybean Oil (Illinois) crude/degummed  Cushing, OK WTI Spot Price FOB
• The “new world” is one in which vegetable oils trade in a price band created by biofuels which links vegetable oils to petroleum prices (laurics have an independent life). Old fashioned drivers of supply-demand and stocks still matter but they just determine the PREMIUM within the price band.

James Fry, LMC
Myth: Biodiesel hurts livestock producers

• REALITY: Livestock producers are beneficiaries of at least three significant benefits for every gallon of biodiesel produced:
  1. lower relative meal prices,
  2. access to crude glycerine as an energy source for feed rations, and
  3. higher values per head due to increased animal fat prices.
Biodiesel’s Diversity Generates Additional Returns for Livestock Producers

- Multiple fats & oils are used to produce biodiesel; ranging from soybean oil to yellow grease to distillers corn oil to animal fats. Animal fats and tallow have increasingly have been used as a feedstock for biodiesel since 2007.

<table>
<thead>
<tr>
<th></th>
<th>Yield (^1) (lbs/cwt)</th>
<th>Price Low (^2) ($/cwt)</th>
<th>Price High (^3) ($/cwt)</th>
<th>Value per cwt Low (^2) ($/cwt)</th>
<th>Value per cwt High (^3) ($/cwt)</th>
<th>Value per head Low (^2) ($/hd(^4))</th>
<th>Value per head High (^3) ($/hd(^4))</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edible Tallow</td>
<td>1.20</td>
<td>$21.75</td>
<td>$45.25</td>
<td>$0.26</td>
<td>$0.54</td>
<td>$3.33</td>
<td>$6.92</td>
<td>$3.60</td>
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<tr>
<td>Inedible Tallow</td>
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<td>$0.93</td>
<td>$1.97</td>
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<tr>
<td>Total</td>
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<td>$1.19</td>
<td>$2.51</td>
<td>$15.23</td>
<td>$32.02</td>
<td>$16.79</td>
</tr>
</tbody>
</table>

1 Source: USDA AMS NW_LS441 Report, 05.01.12
2 Source: USDA AMS NW_LS441 Report, 01.02.07
3 Source: USDA AMS NW_LS441 Report, 03.29.12
4 For typical slaughter beef animal weighing 1,275 lbs
Oilseeds for Biodiesel

J. Alan Weber

September 27, 2012