

Can Fish Farms Use On-Farm Biodiesel Production?

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Agenda



- What is Biodiesel?
 - How do you make it?
 - What are the by-products?
 - How is it marketed and sold?
- Engine Safety
 - Will it burn in my engines?
 - Are there precautions?
- What are the production opportunities?

Biodiesel



- Biodiesel is an organic, renewable alternative fuel suitable for **diesel** engines or used as home heating oil
- Biodiesel is created by transesterification which involves the separation of glycerin from animal fats or vegetable oils
- Pure biodiesel is non-toxic and biodegradable

Feedstocks

Sugar Crops



Sugar Beets, Sugar Cane, Sweet Sorghum

Starch Crops



Corn, Sweetpotatoes, Wheat

Cellulosic Materials



Grasses, Corn Stover, Woody Fiber

Oil Seeds



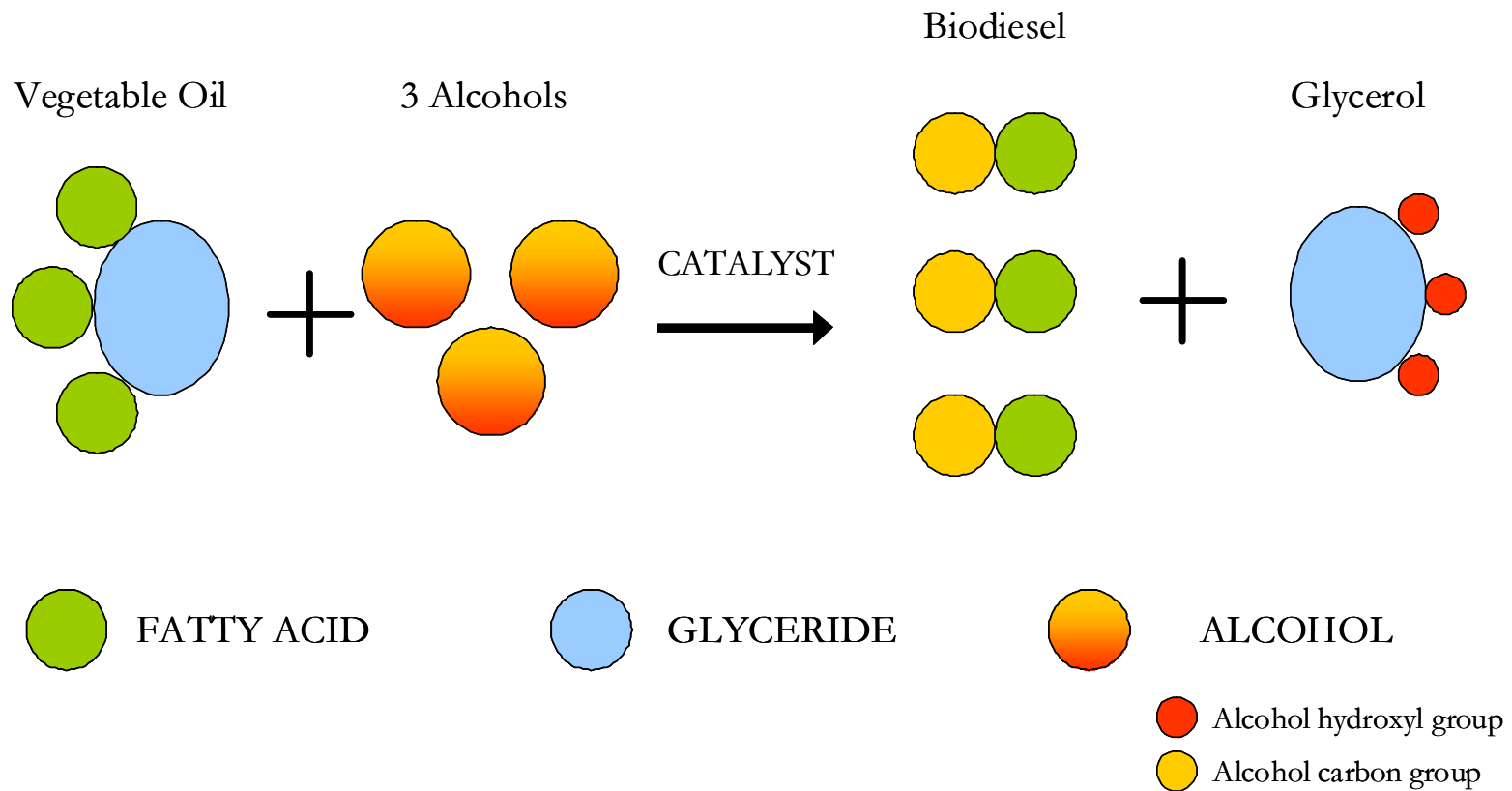
Soybeans, Canola, Safflower

Feedstock Potential

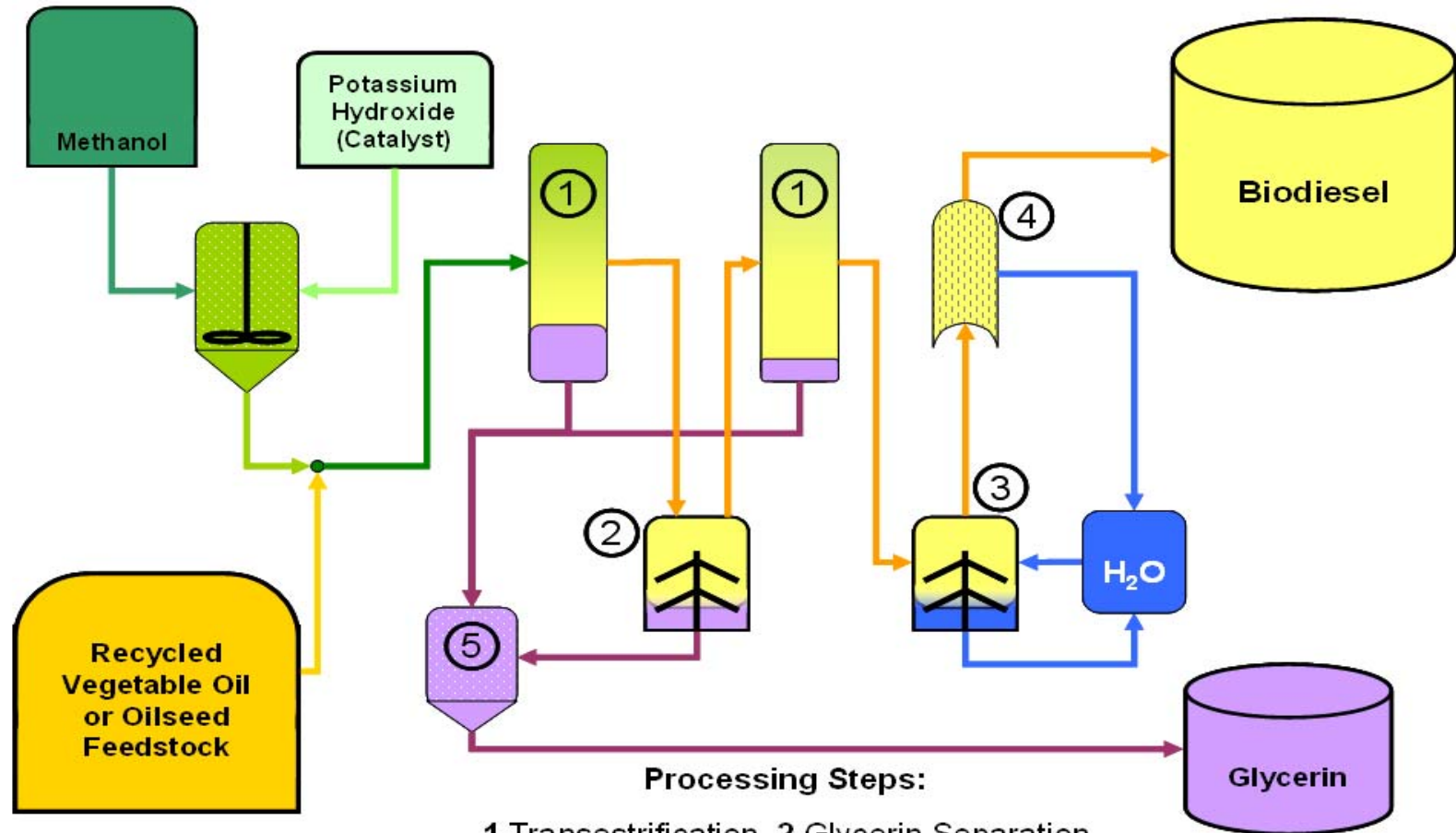
Potential Biodiesel Yields	
Feedstock	Gal/Acre
Soybeans	50
Safflower	80
Sunflower	100
Peanuts	115
Canola (rapeseed)	130
Brazil Nuts	250
Palm Oil	600+

NOTE: 7.3 lbs of animal fat or spent vegetable oil is needed to make one gallon of biodiesel.

Transesterification



Production of Biodiesel through **TRANSESTERIFICATION** Conversion



Processing Steps:

1. Transesterification 2. Glycerin Separation

3. Biodiesel Wash 4. Biodiesel Drying 5. Glycerin Refining

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Advantages of Biodiesel Production



1. **Fuelstock flexibility** - can use the best feedstock available at a location and time, animal fats, crop oils, aqua oils, etc
2. **Fuel output flexibility** – diesel engine fuels, aviation fuel, biodiesel additive, and even extendibility to gasoline
3. **Fuel spec flexibility** - current fuel specs achieved for compatibility with engines and fuels infrastructure.

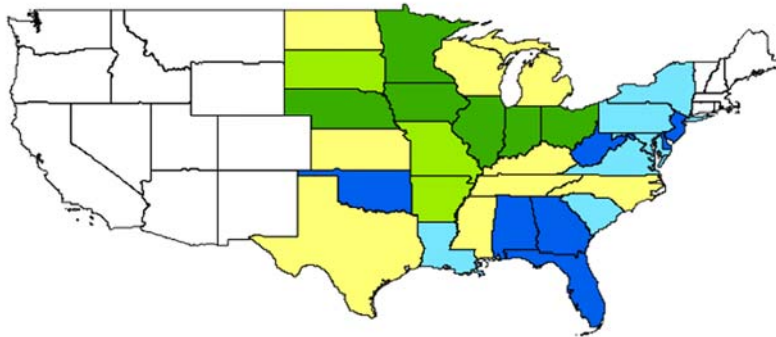
Co-Products



- There is one important by-product created:
 - Glycerin
- Glycerin is used in many personal care products like toothpaste and soaps, food products, medical products, and explosives.
- If glycerin is pure it can be feed to livestock.
- Oversupply as the amount of crude glycerin available for sale has dramatically increased as biodiesel production has increased

Biodiesel Production

2006 Total Soybean Production by State



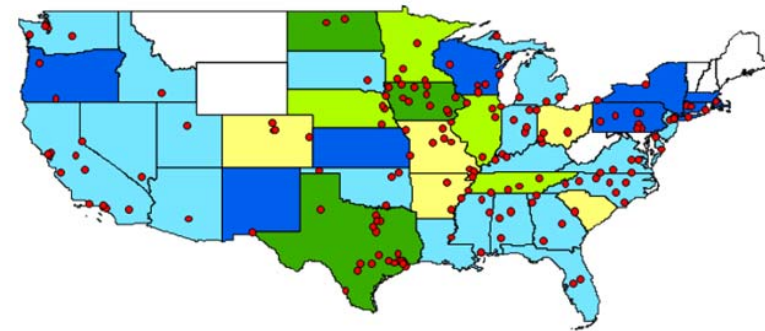
2006 Soybean Production By State



Top 5 Soybean States

1. Iowa: 510 mil bu
2. Illinois: 482 mil bu
3. Minnesota: 319 mil bu
4. Indiana: 284 mil bu
5. Nebraska: 250 mil bu
16. North Carolina: 44 mil bu

2007 Total Biodiesel Production by State



● Biodiesel Plant Locations

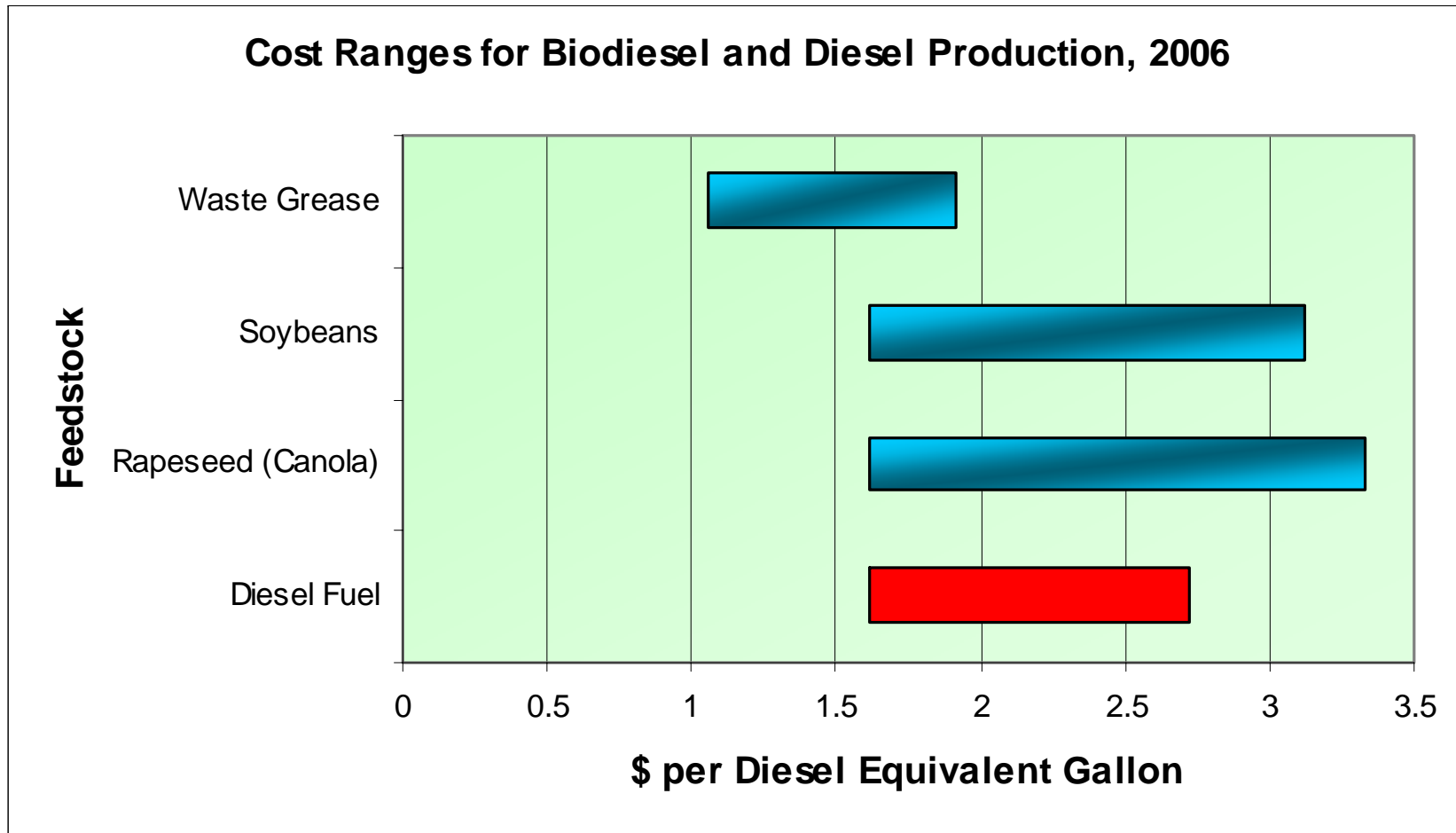
2007 Biodiesel Production Capacity



Top 5 Biodiesel States

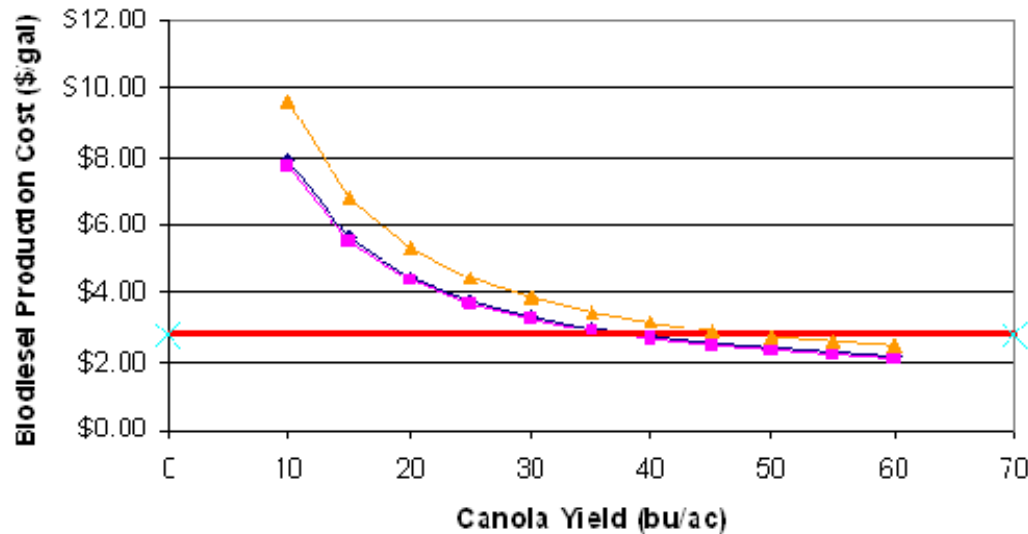
1. Iowa: 138 mil gal
2. Texas: 121 mil gal
3. Tennessee: 64 mil gal
4. Minnesota: 63 mil gal
5. Illinois: 53 mil gal
21. North Carolina: 8 mil gal

Economics of Production



Source: DOE, IEA

Economics of Production



\$195/ac Production Cost							
Cost \$/ac	Yield (bu/ac)	Yield (lbs/ac)	% Oil 0.45	Oil Volume (Gallons/ac)	Production cost for oil (\$/gal)	Biodiesel Input Cost (\$/gal)	Total Biodiesel Cost (\$/gal)
\$195.00	10	500	225.00	28.85	\$6.76	\$1.00	\$7.76
\$195.00	15	750	337.50	43.27	\$4.51	\$1.00	\$5.51
\$195.00	20	1000	450.00	57.69	\$3.38	\$1.00	\$4.38
\$195.00	25	1250	562.50	72.12	\$2.70	\$1.00	\$3.70
\$195.00	30	1500	675.00	86.54	\$2.25	\$1.00	\$3.25
\$195.00	35	1750	787.50	100.96	\$1.93	\$1.00	\$2.93
\$195.00	40	2000	900.00	115.38	\$1.69	\$1.00	\$2.69
\$195.00	45	2250	1012.50	129.81	\$1.50	\$1.00	\$2.50
\$195.00	50	2500	1125.00	144.23	\$1.35	\$1.00	\$2.35
\$195.00	55	2750	1237.50	158.65	\$1.23	\$1.00	\$2.23
\$195.00	60	3000	1350.00	173.08	\$1.13	\$1.00	\$2.13

Engine Safety



- Most diesel engine manufacturers are comfortable recommending burning B5 and lower blends in their engines.
- The lubricating properties of biodiesel are very good
- The inclusion of biodiesel into fuel blends is being driven in part by the need to add lubricity to low-sulfur diesel fuel

Engine Safety

- ❑ Biodiesel will dissolve rubber fuel lines and fuel pump gaskets in older engines.
- ❑ These rubber components should be replaced
- ❑ Biodiesel acts like a solvent and break-up any petroleum build up in the fuel system
 - ❑ The service life of a fuel filter may be reduced



Engine Safety



- The engine warranty is often a concern
- Warranties cover engine failures that result from “materials and workmanship” issues
- Fuel is not a concern of the engine manufacturer
- Any engine failure related to a contaminated or poor quality fuel would not be covered by the warranty

Up to B5 Blends Only



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Up to B20 Maybe!



The manufacturer's
have a some
engines that are
B20 approved.

For example, GM
has a SEO or
special equipment
option that allows
B20

Up to B20



JOHN DEERE



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International leaves it up to the user to decide. They recommend B5, but you are allowed to run up to B20.

B100



NEW HOLLAND

Engine Safety



- Biodiesel gels at a higher temperature
 - Affects cold flow characteristics
 - May require additives
 - No. 1 Diesel
 - Kerosene
 - Underground storage may be required

Power and Fuel Economy

- ❑ B2 fuel causes a drop in gas mileage that will probably not be noticeable
- ❑ B20 fuel blend will lead to a 2% drop in fuel economy
- ❑ B100 fuel will drop fuel economy by 10%.



Fuel Storage



- Storage is essentially the same as petroleum diesel
- Algae growth can occur especially if water is present in the fuel
 - ▣ Use Anti-Microbial Agent
- May require use of additive to improve oxidation stability
- Biodiesel Flash Point > 270°F
 - ▣ Petroleum Diesel F.P. = 125°F
- Methanol Flash Point = 55°F

Environmental Issues



- ❑ Pure biodiesel is non-toxic and biodegradable
- ❑ The U.S. Department of Energy has concluded that biodiesel poses less of a threat to the environment than table salt and can biodegrade faster than sugar
- ❑ Biodiesel is often used as a solvent to clean up oil spills
- ❑ Reduces most harmful environmental pollutants from tail pipe

Aquaculture Contributions

- Three potential feedstocks
 - ▣ Fish processing wastes
 - ▣ Fish wastes/uneaten food
 - ▣ Algae
- Fish Processing Waste
 - ▣ Heat heads, internal organs, skin and crush
 - 10% oil, 70% water
 - ▣ Energy intense → heat, press, centrifuge
 - ▣ Salmon: 35 gallons oil/ton of waste



Aquaculture Contributions

- Fish wastes/uneaten food
 - ▣ Filter out environmental contaminants
 - ▣ Use to fertilize oil producing plants
 - Neptune Industries, FL – Algae
 - Western U.S. - Jatropha Cultivation



Aquaculture Contributions

□ Algae

▣ A lot of attention, but.....

■ Algae usually produced for low quantity but \$\$\$ products

- Pharmaceuticals, nutraceuticals, etc

■ Numerous hurdles

- Cultivation → must surpass photosynthetic limits
- Maintain a monoculture
- Oil Extraction is not optimized

■ Why the interest?

- 9.5 million acres needed to meet U.S. transportation fuel demand (1 billion acres in crop/livestock production)

Closing Remarks



- **Biodiesel is a safe fuel for use on-farm**
 - “Easily” made
 - Should check with engine manufacturers
 - The purer the blend or harder it is to find, the greater the precautions

- **Feedstock Opportunities**
 - Waste Vegetable Grease
 - Agricultural Oilseeds
 - Aquaculture Residues

Thank You and Any Questions?

