



B20 Custom Demonstration Processing Project FINAL REPORT

Executive Summary

This report concludes a series of promotional activities in support of the clean burning and renewable fuel, biodiesel. These activities were funded in part by the State of Michigan Biomass Energy Program via a \$6,000 Community Energy Project Grant.

The goals of this project were

1. The construction of a small scale biodiesel processor for use in five public demonstration/presentations,
2. The creation of a "biodiesel club" to enlist support from the public for biodiesel retail sales in southeast Michigan,
3. The promotion of biodiesel to the SE Michigan retail/wholesale fuel market in order to have five new B20 fueling sites installed.

To begin, approximately ten, one liter test batches were processed using various vegetable oils to gain experience and confidence in the base-catalyzed transesterification method. The process used was the "kitchen biodiesel" method; otherwise know as the "Dr. Pepper" method, in which a two liter plastic pop bottle serves as inexpensive lab-ware. Both virgin and used vegetable oil were catalyzed using common lye (NaOH). See below or visit www.biomich.com for a link to detailed instructions.

An educational website was created for this project and published at www.biomich.com. A second web domain will direct you to the same pages at www.biodieselmichigan.com. Please refer to Appendix A for an illustration of these web pages. Over 1,500 visits have been registered on these sites as of early December 2005.

Next, a five gallon processor was constructed containing many of the features of larger batch-process systems. This processor was only used once during a public demonstration due to the overwhelmingly positive response to the "kitchen biodiesel" demonstration. Therefore, the simple kitchen demo was utilized in most of the presentations, using materials obtainable from most any department or grocery store. Twelve public events were attended, many of which included a Powerpoint presentation with the integrated biodiesel processing demonstration. A version of this presentation is included in Appendix B. It is estimated that over 300 people took viewed a presentation or visited a display booth at one of the public events during the course of this project.

The large amount of effort and time expended on these presentations took some resources away from the biodiesel club and retail station promotion. However, a list of interested fifty-three individuals was gathered from those expressing a desired to either purchasing biodiesel or being involved with small scale production, such as a biodiesel cooperative. This list is included in Appendix C.

For marketing and promotion to retail stations, a dialog was opened with a number of wholesalers and interested parties. Contacts were made with Karbowski Oil, Wacker Oil, Atlas Oil, RKA Petroleum, and the newly reinstated Detroit Area Clean Cities Coalition (hosted by Next Energy). There are now five retail stations offering 20% biodiesel (B20) in SE Michigan. Two are located in, or near, Ann Arbor, one is located in Ida, one is located just west of Flat Rock, and one is located in Bay City. None of these stations were opened as a result of this grant.

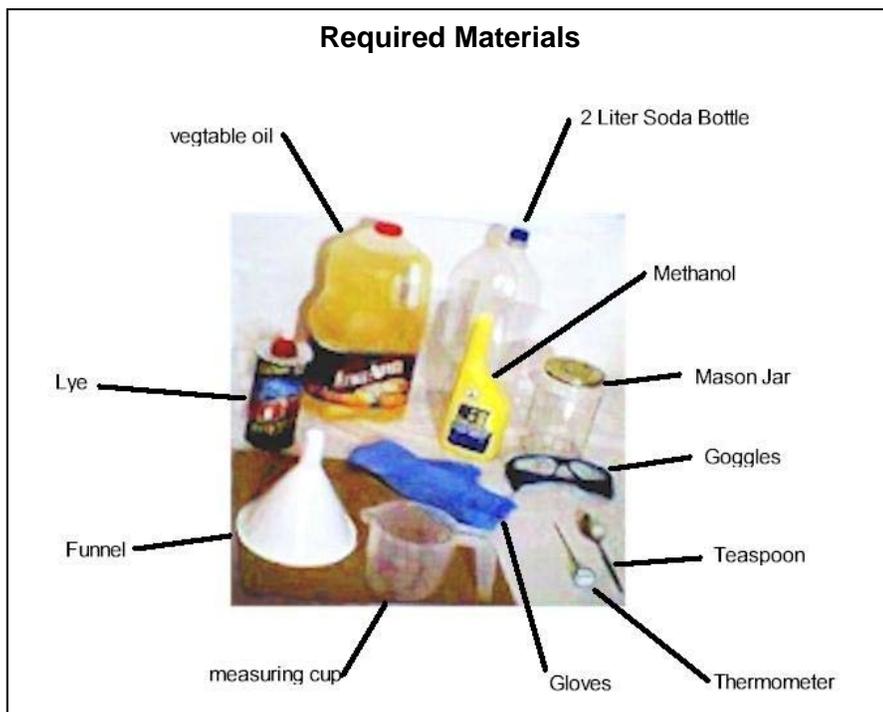
To conclude, the activities undertaken were well received and deemed very successful. A follow-up project was recently approved for funding via a 2006 Community Energy Project Grant which seeks to develop a business plan and plant design for a small scale biodiesel production cooperative.



Biodiesel Processing Activities

Ten to fifteen, one liter test batches were processed using various fresh and used vegetable oils to gain experience and confidence in the base-catalyzed transesterification method. The process used is the “kitchen biodiesel” method; otherwise known as the “Dr. Pepper” method, in which a two liter plastic pop bottle is used as inexpensive lab-ware. Red Devil lye was used as the catalyst (NaOH), and the HEET brand of automotive gas-line antifreeze was used for the required alcohol for the process (methanol). The below images are courtesy of www.kitchen-biodiesel.com.

See illustrated process flow chart on the following page.



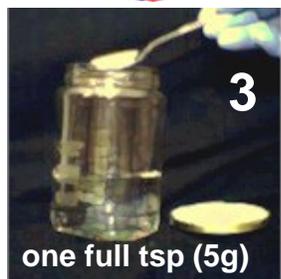
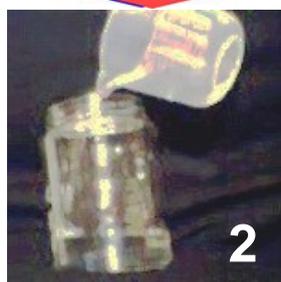
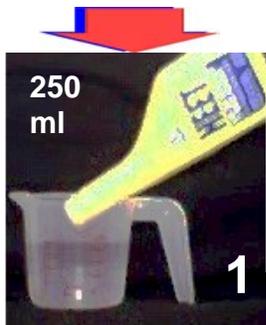
Below is an illustration of a selected few of the samples produced by the kitchen method. From left to right are samples derived from corn oil, canola oil, soybean oil, olive oil, peanut oil, and a reference sample of #2 petroleum-diesel. This table was displayed at the April 24th Ann Arbor Green Street Fair. Turn out was not particularly good due to a small blizzard that day! However, it is estimated that over 300 people took viewed a presentation or visited a display booth at one of the public events during the course of this project.





Kitchen Biodiesel Process

from www.kitchen-biodiesel.com



Next, drain glycerine

Lastly, wash biodiesel, dry, filter, & use !





Presentation Events

March 21	Oakland University – Environmental Quality Forum “ Make your Own Biodiesel ”
April 11	Biodiesel Bus Tour – Oakland University lunch stop & presentation
April 15 & 16	St. Clair Community College Alt. Energy Symposium – biodiesel display. (note: this is being conducted by Oakland University, not Leidel Energy Services)
April 24	Ann Arbor Earth Day street fair – public booth (kid friendly events included)
June 9	Lansing Clean Cities Coalition Presentation / Demo
June 17	Ann Arbor Green Fair public booth
Sept 6	Oakland University Environmental Workshops
Sept 30	Detroit Clean Cities Coalition Meeting @ Next Energy, Detroit, MI
Oct 13	Atlas Oil, Taylor, MI. Technical support for presentation to fleet managers for biodiesel purchasing and information. Included site tour of terminal operations.
Oct 14	Detroit Clean Cities, Beyond a Billion press event, Taylor, MI. Displayed biodiesel samples and biodiesel vehicle.
Nov. 1	NEED Project K-12 Biofuel Curriculum Workshop, Oakland Univ. Presentation & Demo
Nov 3	NEED Project K-12 Biofuel Curriculum Workshop, Grand Valley Univ., Presentation & Demo



The five gallon biodiesel processor was completed in June, tested, and then used live at the Greater Lansing Area Clean Cities Coalition event at Lansing Community College. This was the only public operation of the unit. Five gallons of soy oil biodiesel was produced.

It is interesting to note that the small 2 liter bottle “kitchen-biodiesel” demonstration has garnered much attention and interest. This smaller scale demo is perhaps more approachable to the average “non-chemist”.

The processor is a batch unit with a temperature controlled heating system, a mix pump, timer, a mix-tank backlight, water wash piping, bubble-wash piping, and drain valves. For further information on creating a similar processor, as well as many much larger units, please visit www.biomich.com.

This is a simplified processor for demonstration purposes only. Complete processes also include auxiliary systems for methanol recovery, and often flash vaporization systems to for drying and methanol extraction.

Web Site Development

An educational website was created for this project and published at www.biomich.com. A second web domain will direct you to the same pages at www.biodieselmichigan.com. Please refer to Appendix A for an illustration of these web pages.



Retail Market Biodiesel Promotion

For marketing and promotion to retail stations, a dialog was opened with a number of wholesalers and interested parties. Contacts were made with Karbowski Oil, Wacker Oil, Atlas Oil, RKA Petroleum, and the newly reinstated Detroit Area Clean Cities Coalition (hosted by Next Energy). There are now five retail stations offering 20% biodiesel (B20) in SE Michigan. Two are located in, or near, Ann Arbor, one is located in Ida, one is located just west of Flat Rock, and one is located in Bay City. None of these stations were opened as a result of this grant. Visit www.biomich.com for more information, including links to wholesale fuel suppliers.

It is interesting to note that the web site and word of mouth from multiple presentations has created the condition where companies and individuals have sought me out for technical assistance as well as marketing / promotional assistance. I will continue to capitalize upon this recent success to promote the case for biodiesel and other renewable fuels.

1	C. Barron & Sons 3251 Lewis Avenue Ida, MI 48140
2	Carleton BP Station 974 Will Carleton Carleton, MI 48117
3	D & L Fuels, Inc. 1035 Lansing Rd. Charlotte, MI 48813
4	Jack Snaxx 3790 Euclid Bay City, MI 48706
5	Meijer Fueling Station 3145 Ann Arbor Saline Ann Arbor, MI 48103
6	Meijer Fueling Stations 3995 Carpenter Rd. Ypsilanti, MI 48197
7	Swan Fuel Service 1615 E. Mason St. Dansville, MI 48819
8	Wacker Oil 9050 Michigan St. Rd 52 Manchester, MI 48158



Conclusion

To conclude, the activities undertaken were well received and deemed very successful. The fortuitous timing of this grant enabled the work to capitalize on the present popularity of biodiesel. However, in spite of the current popularity and large amount press on the subject, it is apparent that the public's knowledge about biodiesel is seriously lacking. Continued education on biodiesel use & handling, blending, improved emission characteristics, high lubricity, and its use in non-modified diesel engines is critical to further public acceptance of this renewable, home-grown fuel.

A follow-up project was recently approved for funding via a 2006 Community Energy Project Grant which seeks to develop a business plan and plant design for a small scale biodiesel production cooperative to be located in the Detroit metro area.



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*Leidel Energy Services
- a not for profit corporation -*

Appendix A

Promotional Website

www.biomich.com

(or)

www.biodieselmichigan.com

Welcome to *BioDiesel Michigan*



What is BioDiesel ???

note: all blue items are links

BioDiesel is a renewable fuel made from vegetable oil feedstock (typically new soybean oil or waste restaurant grease). BioDiesel can be used directly in any diesel engine **WITHOUT MODIFICATION**. BioDiesel can be used straight or blended in any percentage with petroleum diesel. Typical blends are B2 (or 2% biodiesel) as a lubricity additive, and B20 (20% biodiesel). BioDiesel is produced by adding an alcohol (such as methanol) with a catalyst (such as NaOH) to the oil. This process called [transesterification](#) will split off the glycerin molecule from the triglyceride. The free fatty acid chain then bonds with the alcohol to form biodiesel (or a methyl ester).

Interested in Buying Biodiesel or Starting a SE Michigan Cooperative??

Please [email your name and contact](#) information to be added to a list of potential biodiesel users. The author of this site is campaigning for retail stations to carry B20, and a list of potential buyers will be invaluable. A business plan for a Detroit Metro cooperative is also in the works.

Show your interest, Please!! [click here to email](#); please include full name & town of residence

Why use BioDiesel ???

BioDiesel is a clean burning, renewable energy source which is grown right here in the good old US of A. Along with ethanol and other biomass fuels, biodiesel may significantly reduce our dependence on foreign oil imports. Bio-fuels are part of a closed-loop carbon cycle that significantly reduces greenhouse gas emissions which are presently warming our Earth. [Click here for an illustration.](#)

Biodiesel burns much cleaner than petro-diesel, is biodegradable, non-toxic, and is great for your diesel engine. Newly regulated low-sulfur diesel fuel has significantly less lubricity than old diesel, but a mere 2% of biodiesel adds back this needed lubricity, and then some!

Green Berets Prefer Biodiesel by Wired News, Sept 28, 2005

When Erwin Rommel's Panzer tanks ran out of diesel fuel in North Africa in World War II, the German general poured cooking oil into their gas tanks to keep the vehicles fighting.... [click here](#)

Michigan House Bill 4235 (2005) would mandate 2% BioDiesel Statewide

Representative Neal Nitz has introduced a bill to the Michigan State House in which nearly all of the diesel fuel sold in the state of Michigan beginning in 2007 would require 2% biodiesel. [click here for info on HB 4235](#)

[Minnesota Law Requires 2% Biodiesel Statewide](#) - Audio story on NPR (note: the high lubricity of biodiesel is wonderful for diesel engines)

[Listen to Mike Pelly, owner of Olympia Green Fuels on NPR](#), Mike uses bio-diesel fuel to power his two cars. He makes the mixture from used vegetable oil discarded by Chinese restaurants and fast-food joints. Pelly tells NPR Morning Addition how it works.

[Olympia Green Fuels Website](#) or [click here for the Pelly "Model A" processor](#)

Check this out !!! History Channel Video Clip

Modern Marvels series discusses George Washington Carver and Henry Ford's contribution to the science of peanuts, soybeans, and biodiesel.



Links:

- [State of Mich. Biomass Energy Program](#)

- [National BioDiesel Board](#)

- [Michigan Soybean Promotion Committee](#)



- [US DOE BioMass Program](#)

- [KitchenBiodiesel](#)

- [April 2005 Biodiesel Bus Tour Presentatn.](#)

- [Iowa State Univ. web biodiesel course](#)

- [Homebrew Tutorial](#)

- [Historical Perspective on Veggie Oil Fuels](#)

- [Oakland University Energy Management](#)
(creator of this site)



School Districts are Using BioDiesel

St. John's schools found that reduced oil changes from biodiesel was a NET cost savings (including the higher cost of B20 biodiesel fuel at the time). [Read this article](#) in PDF

From fryer to fuel tank: UM students use waste grease

University of Michigan engineering students demonstrated that junk food does have a good side?

Make Your Own BioDiesel (try this cool Tutorial)

Click here to learn how wasted vegetable oil can be transformed into a clean, renewable fuel to be used in any diesel engine. All modern diesels can use biodiesel directly with no modifications and similar operation & performance to dinosaur diesel.

BioDiesel, VW, and Diesel Forums

www.biodieselnow.com
www.tdiclub.com
www.michiganvw.org
www.vwvortex.com

Where to Buy BioDiesel?

[NREL Alternative fuels locater](#)

Where to buy BioDiesel in SE Michigan?

- BP station, Walz, MI on Will Carlton just east of I-275, B20
- Meijer Gas Stations, Ann Arbor and Ypsilanti, B20
- BP station, Bay City, MI at intersection of Euclid & S Huron Rd
- ** [Atlas Oil](#), Taylor, MI (distributor & wholesaler)
- GE Wacker, Manchester, MI B20, B99 & other (also wholesale)
- [Karbowski Oil](#), Bay City, MI (distributor & wholesaler)

Email Web Page Author: [Jim Leidel](#), Energy Manager, Oakland Univ.

My best mileage on my TDI so far was [46.5 MPG](#) for my 50 mile commute from Brownstown Township south of town to Oakland University in Rochester. It usually ranges from 38 to 42 MPG. This morning, in Oct 2005, it was cool, and I took Telegraph Rd north, hitting all the stoplights, averaging about 45 MPH for the trip.

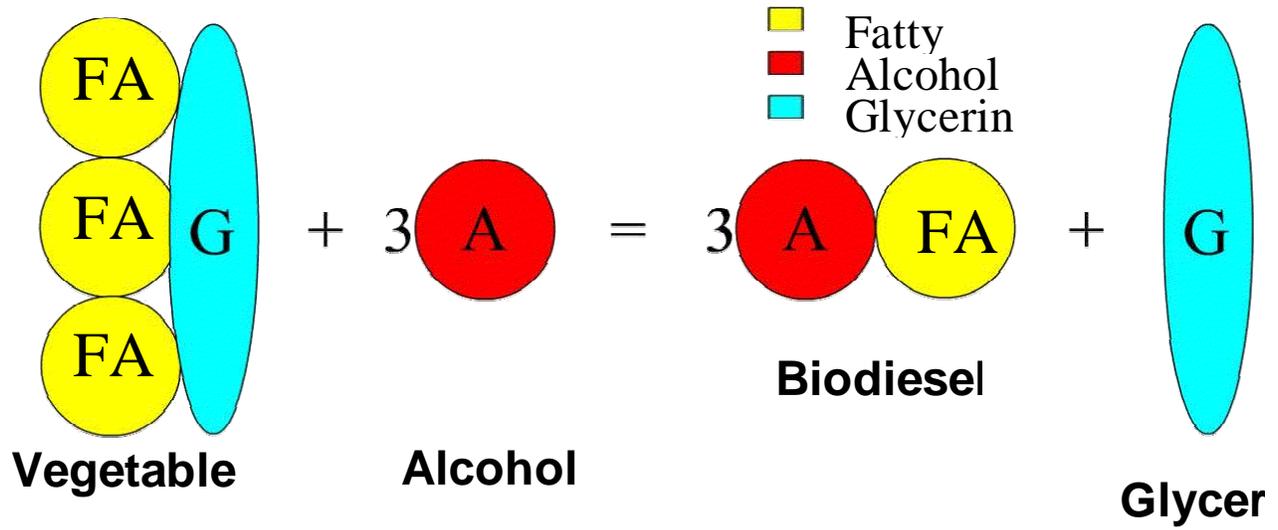


Retail pump: BP station on Will Carlton Rd exit of I-275 just west of Flat Rock



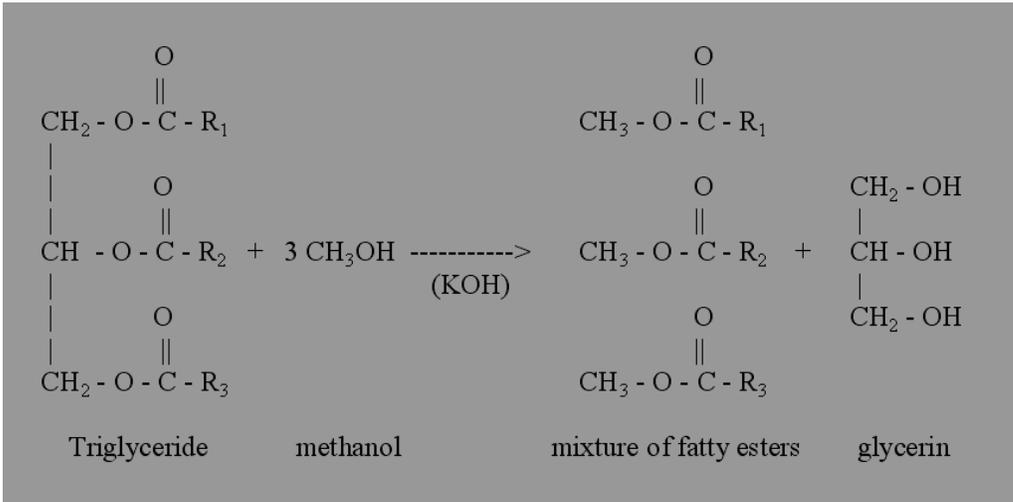
Web site author's biodiesel fueled Turbo Diesel with 250 ft-lbs of torque and 40 miles per gallon

Triglyceride to Methyl Ester Process: Trans-ester-ification



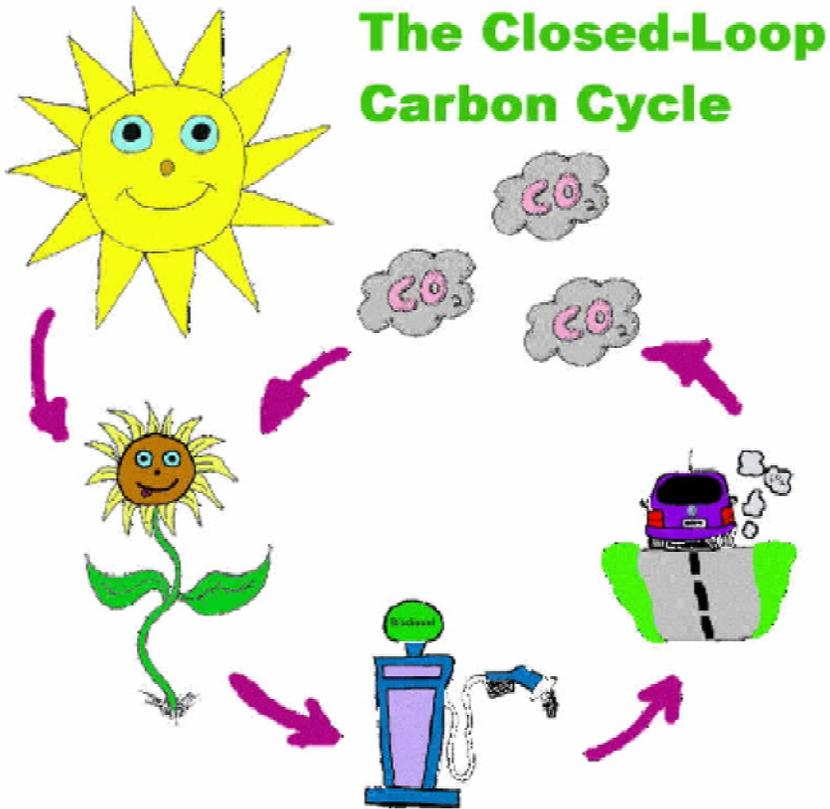
[for those of you who took high school chemistry, click here!](#)

Triglyceride to Methyl Ester Process: Trans-ester-ificiation



100 lbs. of veggie
 oil
 +
 10 lbs. methanol
 =
 100 lbs. biodiesel
 (B100)
 +
 10 lbs. of glycerin

[home page](#)



Although burning any fuel other than hydrogen (H₂) sends carbon dioxide in the atmosphere, bio-fuels remove this CO₂ during the growth of the plants via photosynthesis. Although this process does consume some conventional petroleum energy for fertilizer, harvesting, etc... there is a NET energy gain. For ethanol the net energy gain is somewhere around 1.5 to 1, and for biodiesel this is somewhere around 3.5 to 1 (energy OUT vs. energy IN). Carbon dioxide is the most prolific of the global warming gasses that are slowly but surely warming our Earth.

From fryer to fuel tank:

U-M students reclaim waste grease as renewable fuel

University of Michigan engineering students demonstrated that junk food does have a good side? It can be used to make biodiesel fuel for U-M buses. For their environmental sustainability course, a student team demonstrated that it is economically and technically feasible to harvest the 10,700 gallons of waste grease produced in the 10 campus dining halls to make an effective biodiesel fuel, which they produced and then tested out on a small U-M tractor. The University purchases 60,000 gallons of biodiesel per year for its diesel bus fleet; replacing 10,700 gallons of that purchase with waste grease will achieve an estimated \$28,000 annual cost savings. Savings could be increased to about \$150,000 by incorporating waste greases from the University Health System cafeterias and area restaurants.

[click here for the full article](#)

[home page](#)



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Appendix B

Biodiesel Presentation

BioDiesel & Issues About Our Energy Future



Jim Leidel
Energy Manager

**National Energy Education Development
BioFuels Workshop**
November 2005

Today's discussion.....

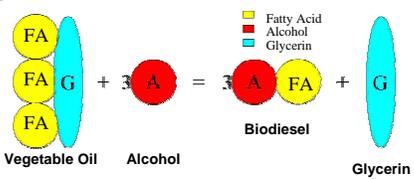
- What is BioDiesel? Quick overview?
 - How is it made?
- Home-Brew
 - Biodiesel in Your kitchen
 - Demonstration Processor
- Why use alternative fuels?
 - What's wrong with Oil?
 - Why should we care?
- Energy & Climate change
- What Do We Do?
- Lastly, we'll check back on our "kitchen biodiesel demonstration"



Background Photo: Canola Plant

What is Biodiesel ?

- Renewable fuel for diesel engines
- Made from vegetable oil or animal fat
- Lower emissions, biodegradable, non-toxic and less safer than petroleum diesel
- High centane number, high lubricity, good for your engine

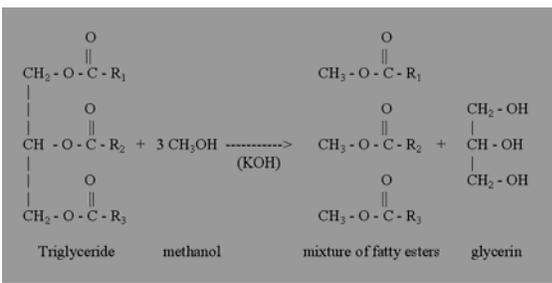


Vegetable Oil + Alcohol = Biodiesel + Glycerin




100 lbs. of veggie oil
+
10 lbs. methanol
=
100 lbs. biodiesel (B100)
+
10 lbs. of glycerin

Transesterification



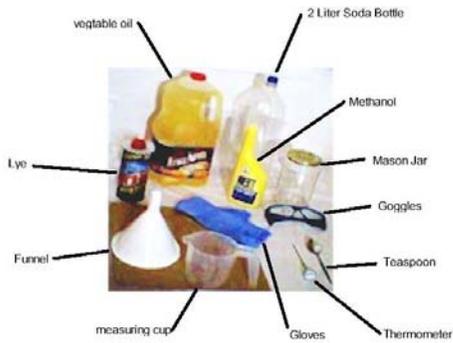
Existing diesel engines & Existing fuel infrastructure

- Pure Biodiesel (B100) or blended with petroleum diesel (example: B20, 20% biodiesel)
- Rudolf Diesel: peanut oil (the earth nut)
- No engine modifications required
- Use existing fuel distribution network
- Available now
- US grown





Kitchen Biodiesel



Images courtesy of www.kitchen-biodiesel.com



Vegetable oil

any oil will work, but Canola is one of the best for cold weather properties



Catalyst

NaOH - Sodium Hydroxide

Sold as Drain Cleaner in Hardware and Grocery Stores. Look by the Drano. Make sure the can reads "Contains Sodium Hydroxide"



ALCOHOL

HEET gas line antifreeze = 335mL of Methanol per bottle

"other cheaper brands are available. Look on back label for "methyl alcohol"

(methanol is a race car fuel, also used as model airplane fuel)



Safety First!



Images courtesy of www.kitchen-biodiesel.com

More about biodiesel

- Shake our “processors” for 5-10 minutes
- And then, set on table to allow glycerin to settle out
 - we'll return to it at the end of the discussion
- Now, some more on biodiesel!



our friend, the soybean

Background Photo: Canola Plant

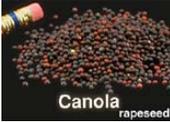
- European biodiesel uses **canola**: a genetically modified rapeseed plant, or “Canada Oil” from the mustard family
- US biodiesel industry uses the **soybean**
- Yellow Grease: **recycled cooking oil**



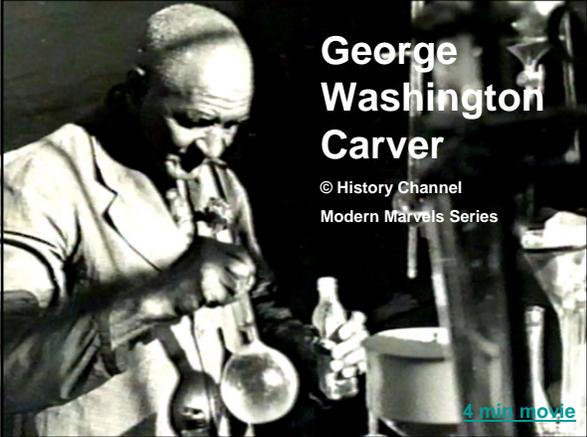
Canola rapeseed



Soybean



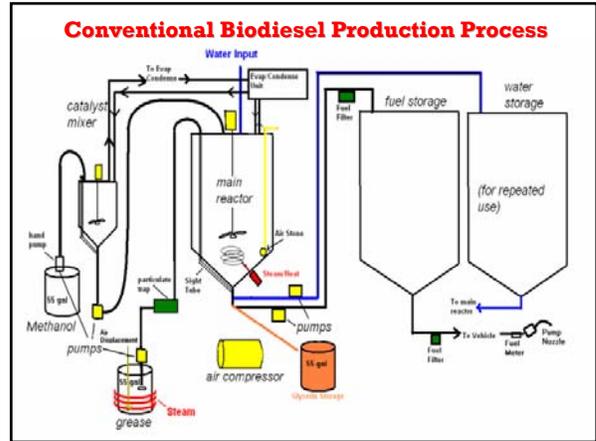
Canola rapeseed



George Washington Carver

© History Channel
Modern Marvels Series

4 min movie



Small Scale Processors

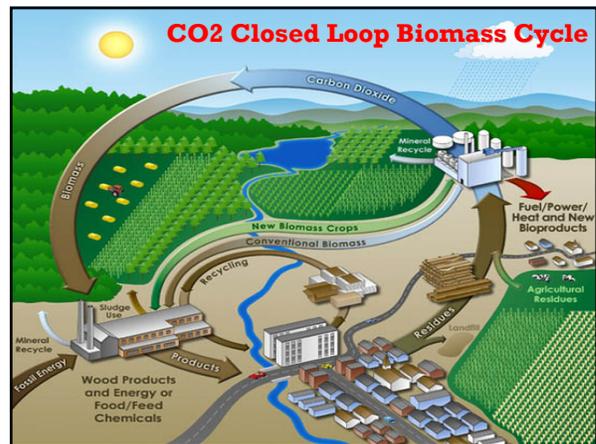


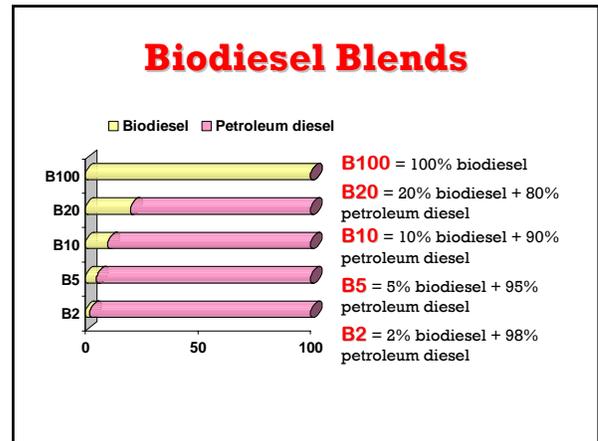
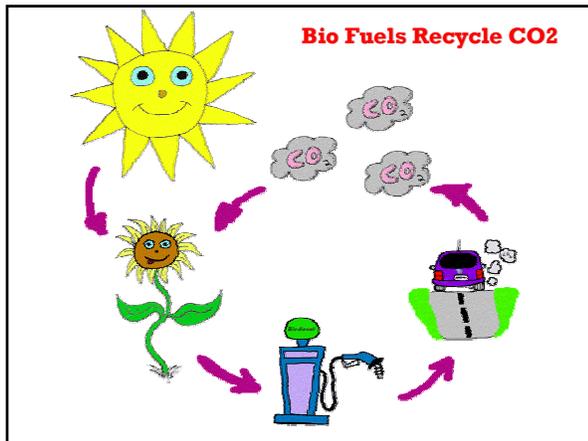
Better yet.... make your own!

www.biodieselsolutions.com

www.biodieselgear.com

www.journeytoforever.org





Biodiesel Performance

- Startup, range, cold weather performance similar to petroleum diesel
- Fuel consumption, horsepower, torque, haulage rates similar to petroleum diesel

images courtesy of the National Biodiesel Board

Biodiesel Performance

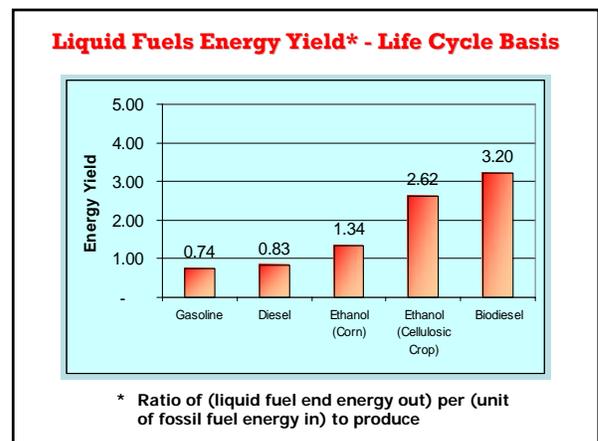
- High Lubricity
 - 2% biodiesel improves fuel lubricity by up to 66%
 - Protects, extends engine life
- High Flash Point
 - 260°F vs. 125°F diesel
 - **Safest** fuel to use, handle, and store
- Biodegradable

images courtesy of the National Biodiesel Board

Biodiesel Performance

- Operates in conventional diesel engines and fuel injection equipment
- Cold Flow
 - For B2-B20 use same precautions as #2 petroleum diesel
 - No special storage required

images courtesy of the National Biodiesel Board

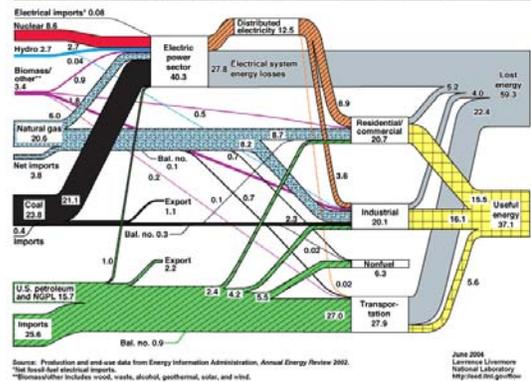


Why use alternative fuels?

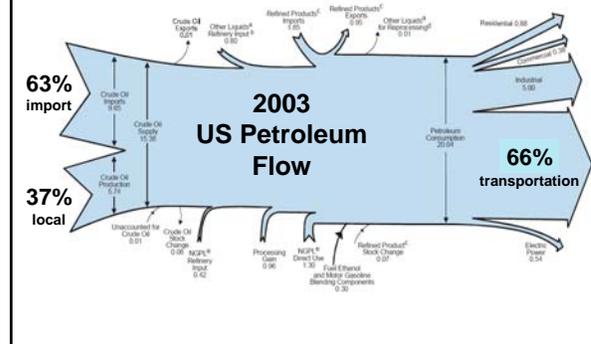
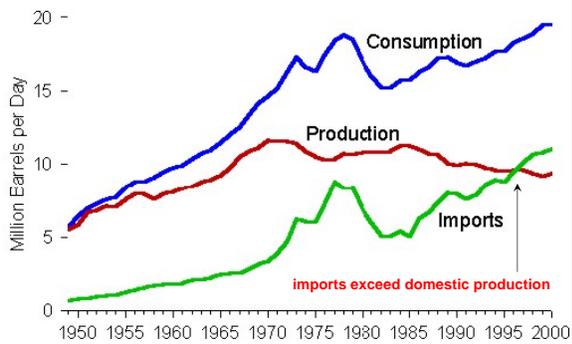
- **Dependence on foreign sources**
 - National security
 - US based jobs & profits
 - Lets produce our energy here at home
- **Environmental issues**
 - Coal: for electricity
 - emissions yield acid rain, mercury, CO₂ & climate change
 - Oil: for transportation
 - emissions = smog, CO₂ & climate change

Background Photo: Canola Plant

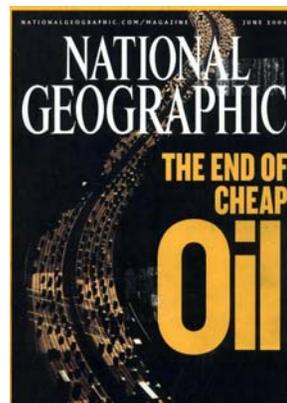
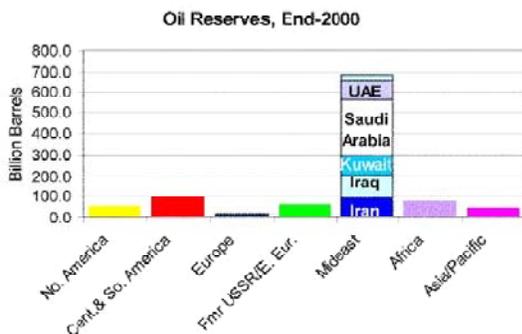
U.S. Energy Flow Trends – 2002 Net Primary Resource Consumption ~103 Exajoules



US Petroleum Overview



Estimates of World Petroleum Reserves



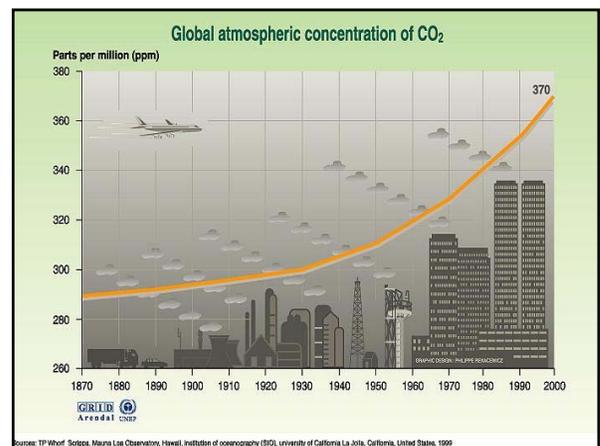
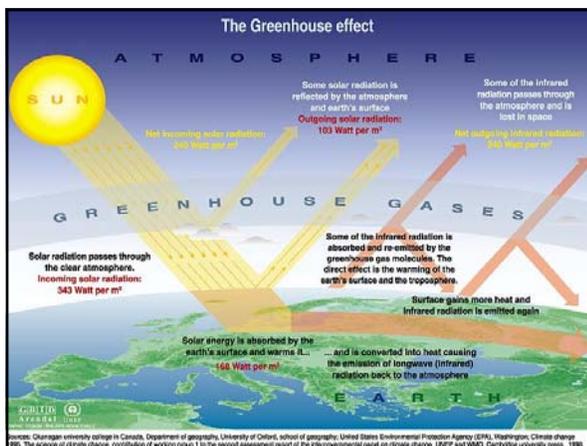
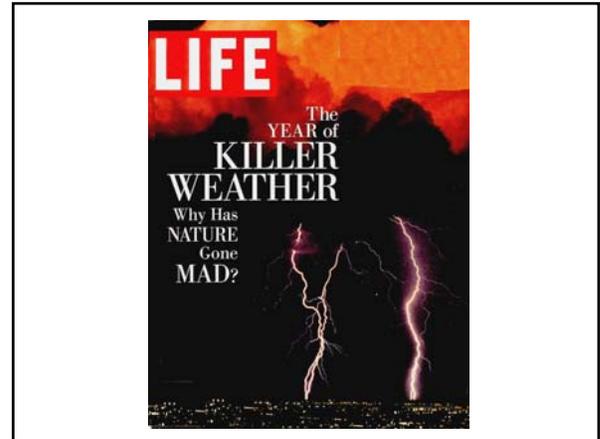
June, 2004 Issue

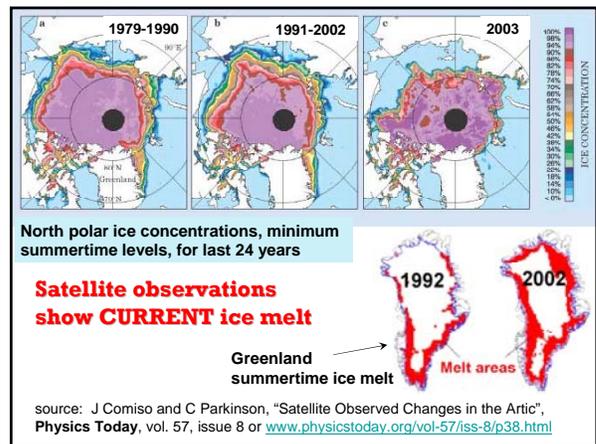
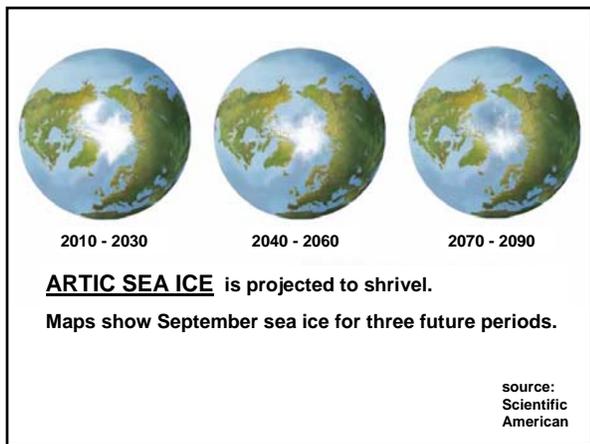
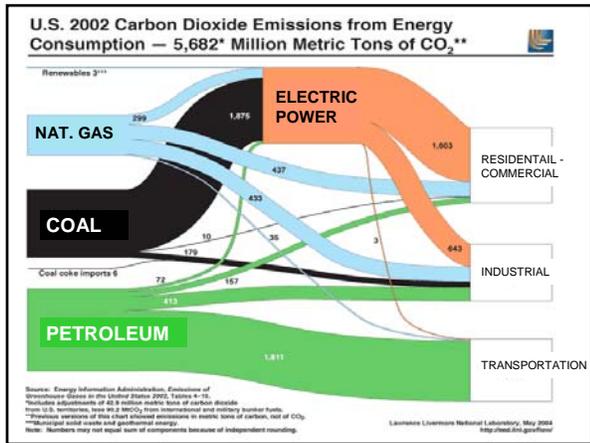
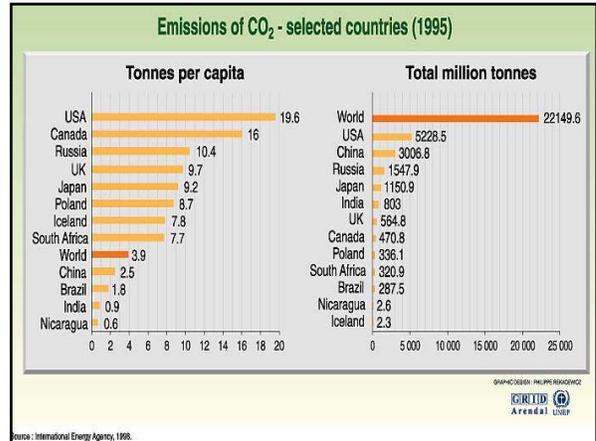
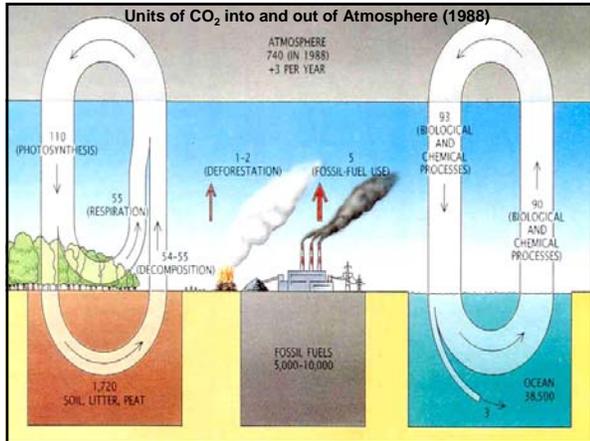
“Humanity’s way of life is on a collision course with geology – with the stark fact that the Earth holds a finite supply of oil. The flood of crude from fields around the world will ultimately top out, then dwindle. It could be 5 years from now or 30, no one knows for sure.”

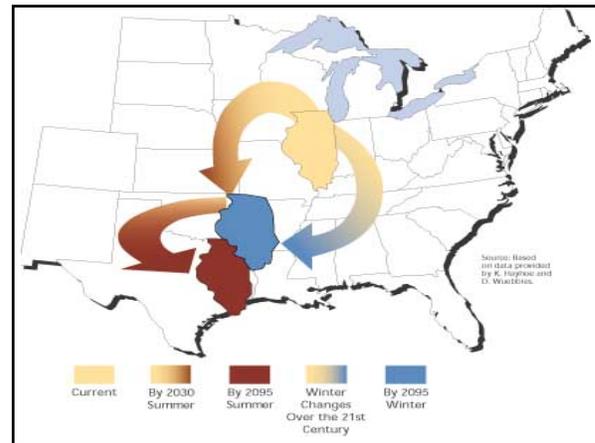
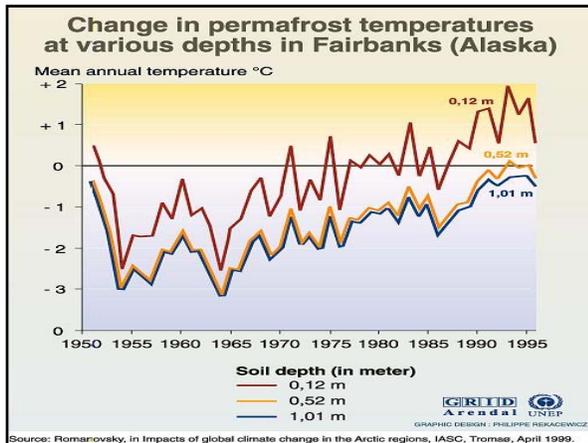
Why use alternative fuels?

- Dependence on foreign sources
 - National security
 - US based jobs & profits
 - Lets produce our energy here at home
- Environmental issues
 - Coal: for electricity
 - emissions = acid rain, mercury, CO₂ & **CLIMATE CHANGE**
 - Oil: for transportation
 - emissions = smog, CO₂ & **CLIMATE CHANGE**

Background Photo: Canola Plant







What To Do?

- At Home, At Work, in your Car
- Cheapest Path – Energy Conservation
- Renewable Energy
 - solar, wind, & biomass
- Renewable Fuels
 - ethanol, gasahol (E10), E85, methanol
 - natural gas
 - biodiesel B20 (let's start with B2)
- Technology to the Rescue
 - hybrid vehicles
 - diesels (30-40% more efficient than gas)

Background Photo: Canola Plant

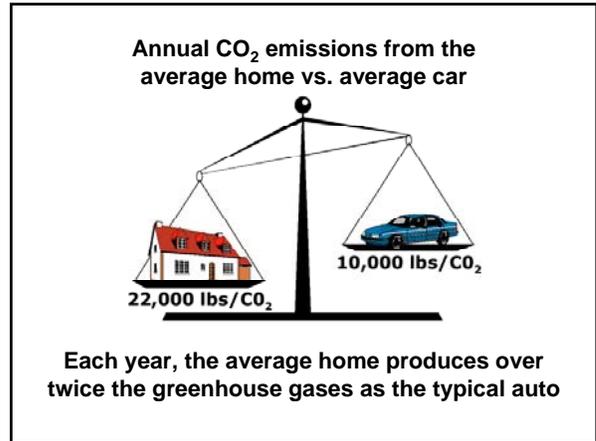
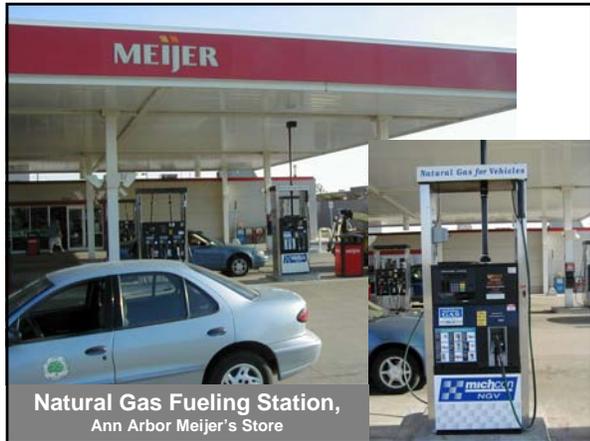
The top 10 vehicles that get the best fuel economy in America

The vehicles that achieve the best fuel efficiency in city and highway driving are made by foreign automakers.

2004 Vehicles

Vehicle	Transmission	Mileage per gallon	Engine Type
Honda Insight	Manual	49/61	Gasoline
Honda Insight	Automatic	57/56	Gasoline
Toyota Prius	Manual	52/45	Gasoline
Honda Civic	Manual	49/47	Gasoline
VW New Beetle	Manual	42/49	Diesel
Volkswagen Jetta	Manual	42/49	Diesel
Honda Civic	Manual	48/53	Gasoline
Volkswagen Golf	Manual	42/48	Diesel
Honda Civic	Manual	36/44	Gasoline
Toyota Echo	Manual	35/43	Gasoline





Thanks for listening...

for more info, please visit
www.ouenergy.com
and
www.biomich.com



Jim Leidel
Energy Manager
Chris Kobus
Professor



Grant PLA-05-43
B20 Custom Demonstration Processing Project
FINAL REPORT

Leidel Energy Services
- a not for profit corporation -

Appendix C

Biodiesel Interest Group List

<u>Name</u>	<u>Hometown</u>	<u>Name</u>	<u>Hometown</u>
Jim Leidel	Brownstown	John Oswell	St. Clair
John Batdorf	Rochester	David Van Nostrand	Bay City
John Carroll	New Boston	Mitchell Dombrowski	Grosse Pointe Farms
Joe Martelle	Sterling Heights	Bryon Matthews	Grand Blanc
Steve Hounshell	Flat Rock	Bob Miller	Brighton
Jacob Stevens Corvidae	Detroit	Rob Noack	Ann Arbor
Kevin Bingham	Detroit	Janet Kiley	Lansing
Adam Saganski	Sterling Heights	Kevin Conway	Ann Arbor
Andy		Andrew Watchorn	Flint
Bob Barden	Ann Arbor	Lynn Couck	St. Clair Shores
Chris Bowron		Darin T. LaCoursiere	Midland
Jim Johnston	Royal Oak	Mathew Glenn	Benton Harbor
Mark Hergott	Ypsilanti	Mitch Cann	Brooklyn
Kevin Dombrowski		Keith Ramthun	Hart
Wes McKenzie	Waterford	Marvin Bulas	Eastpointe
Mike Strelecki		mark & linda	
Chris Blunt	Howell	Tower Marine	Saugatuck
Kyle Koester	Davison	Tim Scott	Lansing
Robert Noack	Ann Arbor	Matt Miller	Dearborn
Joshua Bukoffsky	Flint	Nick Sioma	Clarkston
Jim Rink	Dearborn	Robert W. Lay	Romulus
Kendra Schmoekel	Grand Rapids	Justin Tryles	Ortonville
Jonathan Wright	Grand Rapids	Jud (A.J.) Cole	Detroit
Jack Wright	Muskegon		
John Ramey	Wayne County		
Don Qualls	Carlton		
Louis Pierce	Auburn Hills		
Karl Kennedy	Southfield		
Shawn Champion	Ortonville		