



Associate in Applied Science (A.S.) Energy Technical Specialist K-12 Outreach

PROGRAM DESCRIPTION

This degree program was developed to train students in the field of energy technology. The Energy Technical Specialist Associate in Applied Science degree will convey the skills and knowledge necessary to be successful in both the tradition and renewable energy fields.

Students enrolled in the Energy Technical Specialist program will study a 35-credit core curriculum providing a strong base in electrical, electronic, and mechanical systems. Students will select an area of specialization to complete their program of study from the following: wind Energy, Ethanol, Biodiesel, Fossil Fuels, or Power Generation.

The Energy Technical Specialist degree is offered through ten colleges in the Minnesota State Colleges and Universities system. Through this partnership, students have the opportunity to complete all of their courses online through partner institutions.

A High School outreach curriculum was developed in partnership with the degree. Two “hands-on” energy modules for use by high school science and technology instructors and students were developed in the areas of wind and biofuels.

FILE CONTENTS:

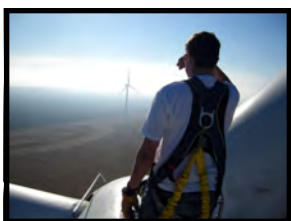
In this file, curriculum guides, materials lists, description of the hands-on activity focusing on renewable energy concepts, workshop marketing materials and surveys are provided.

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FREE

Alternative Energy Training for High School Faculty

Training in Biodiesel and Wind Energy will be offered to area High School teachers as part of the MnSCU Department of Labor funded 'Minnesota Training Partnership for a Sustainable Energy Economy' grant. This training will focus on career information and activities for YOUR classroom.



WHO SHOULD ATTEND?

High School Biology, Chemistry, Physics & Industrial Technology Instructors

WHERE?

Minnesota West Community & Technical College - Granite Falls Campus

WHEN?

Wednesday, May 19, 2010

9:00am	Registration/Welcome
10:00am	Wind Energy Training
12:00pm	Lunch provided by Minnesota West
1:00pm	Biodiesel Training
3:00pm	Wrap Up

WHY?

This is a great opportunity to learn about alternative energies. Each participant will receive FREE kits (1 kit:3 students) for their High School.

COST?

This is a FREE training session to any participating High School teacher. Reimbursement to ISD's for teacher substitutions and mileage is available.

HOW DO I REGISTER?

Complete and return the attached Registration Form. Should you have questions, please contact:

Katie Delaney, Minnesota West Wind Energy Development Coordinator at katie.delaney@mnwest.edu OR 800/658-2535 ext. 128.

Participating MnSCU Institutions:

Alexandria
Technical College

Century College

Minnesota West Community
& Technical College

NE Higher Education District

St. Cloud Community &
Technical College

South Central College

Registrations are requested by April 26, 2010.



Canby • Granite Falls
Jackson • Pipestone • Worthington

FREE

Alternative Energy Training for High School Faculty

REGISTRATION INFORMATION

High School: _____

Address: _____

ISD #: _____ Phone: _____

Number of Students per Teacher: _____

Teacher Name: _____

Email Address: _____

Subject Area: _____

Teacher Name: _____

Email Address: _____

Subject Area: _____

COST?

This is a FREE training session to any participating High School teacher. Reimbursement to ISDs for teacher substitutions and mileage will be sent upon receipt of an invoice from the ISD.

HOW DO I REGISTER?

Please return Registration Form to:

Katie Delaney, Minnesota West Wind Energy Development Coordinator

1011 First Street West

Canby, MN 56220

Phone: 800/658-2535 - Fax: 507/223-5291

katie.delaney@mnwest.edu

Registrations are requested by April 26, 2010.



Alternative Energy Survey

Circle the response which best expresses your opinion:

- SA = Strongly agree with statement
 A = Agree with statement
 D = Disagree with statement
 SD = Strongly disagree with statement

Please explain your response to the statements if you disagree or strongly disagree.

- | | | | | |
|--|----|---|---|----|
| 1. The objectives of the training were clear. | SA | A | D | SD |
| 2. The objectives of each module were clear and met. | SA | A | D | SD |
| 3. The instructors were knowledgeable about the subject. | SA | A | D | SD |
| 4. The instructors presented the materials in an organized manner. | SA | A | D | SD |
| 5. Use of technology was appropriate and helpful. | SA | A | D | SD |
| 6. The balance between discussion, demonstration, and participation was effective. | SA | A | D | SD |
| 7. The concerns and questions of the group were addressed in a timely manner. | SA | A | D | SD |
| 8. What portions of the training were the <u>most</u> useful to you? | | | | |
| 9. What portions of the training were the <u>least</u> useful to you? | | | | |
| 10. How could the training be improved? | | | | |
| 11. Will you offer this training in your classroom? Why / why not? | | | | |

General comments:



WIND ENERGY

Information on Careers & Hands-on Exercise
For High Schools in Minnesota

INTRODUCTION

- Renewable energy is energy derived from regenerative sources.
- In the last 30 years, the world's renewable energy production has increased and currently makes up a little more than 13 percent of the world's energy supply.
- From 1990-2002, wind has been the fastest-growing power source worldwide, with an annual average growth rate of over 30%.



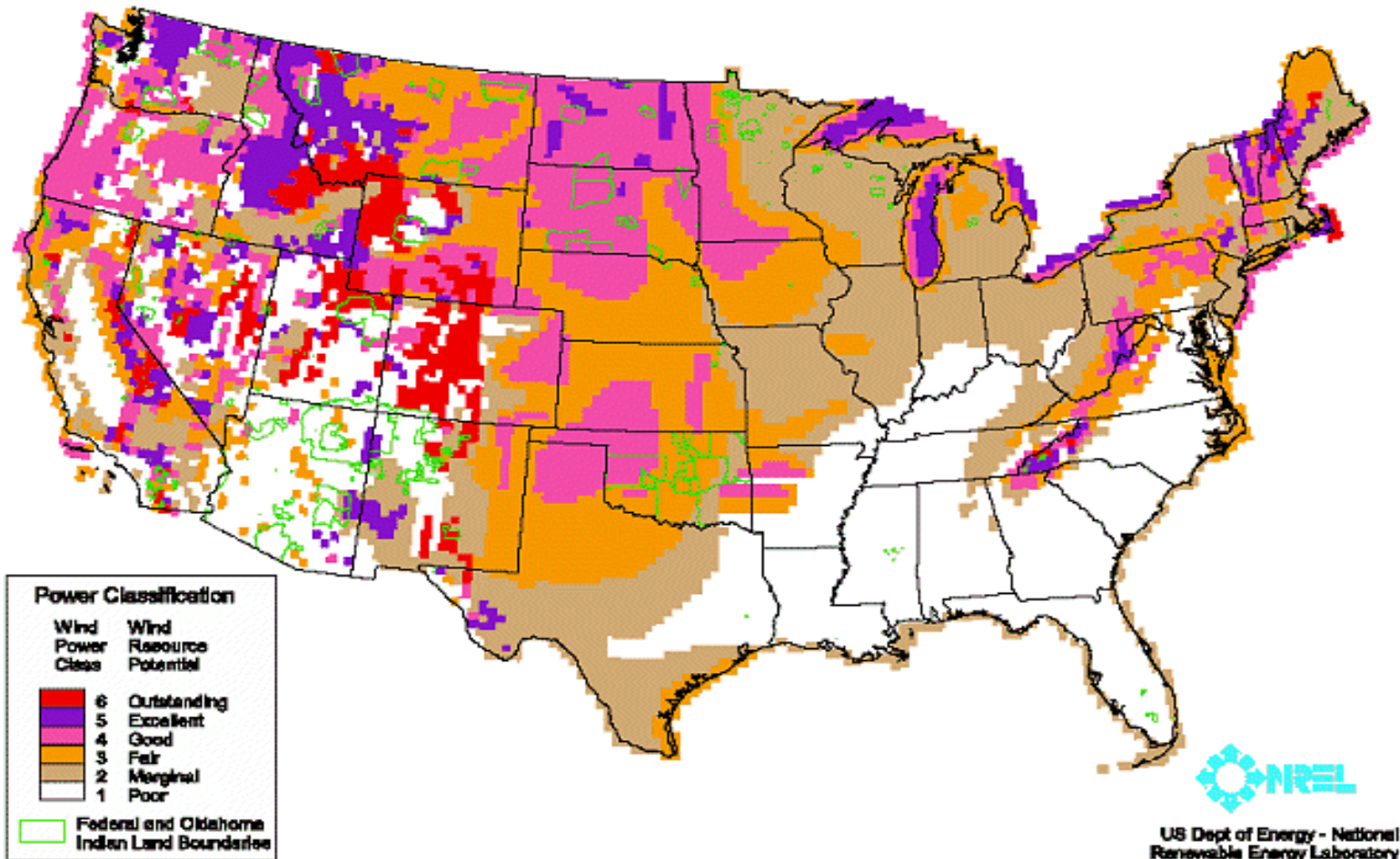
U.S WIND ENERGY

- Leaders in Wind Capacity (MW)
 - Germany 16,629
 - Spain 8,263
 - United States 6,740



BEST PLACES FOR WIND TURBINES

Figure 13. Wind Resource Potential



WIND ENERGY IN MINNESOTA

- Minnesota is ranked 5th in the nation with 1,809 wind turbines built and 60 more under construction.



JOB OUTLOOK

- Job Growth - Energy: Total projected openings from 2004 to 2014 :
 - 12,000 General & Operations Managers, 1000 Production Managers, 475 Engineers & boiler operators¹.
 - Renewable energy to grow from 900 megawatts to 5000 megawatts by 2025. Xcel energy alone will hire up to 1000 in Minnesota by 2017².



1. Minnesota Dept. of Employment and Economic Development, Projections Data 2004-14
2. Renewable Energies Opportunities Symposium, Oct. 17, 2007

JOB OUTLOOK

- Some top employers in Minnesota are Xcel Energy, Great River energy, Verasun Energy, and northern states power
- Job openings in this field:

These are some of the alternate titles for Renewable Energy Technicians:

- Alternative Energy Technician
- Energy Conservation Technician
- Energy Efficiency Technician
- Geothermal System Installer
- Geothermal Technician
- Photovoltaic Technician
- Solar Electric Practitioner
- Solar Energy Technician
- Solar Photovoltaic Installer
- Solar Thermal Installer
- Solar Thermal Technician
- Wind Energy Systems Installer
- Wind Energy Technician
- Wind Turbine Installer
- Wind Turbine Technician
- Windsmith

These occupations are NOT the same as Renewable Energy Technicians:

17-2071.00 Electrical Engineers
 11-1199.03 Energy Auditor
 11-1199.04 Energy Broker
 17-2199.03 Energy Engineers
 19-4091.00 Environmental Science and Protection Technicians, Including Health
 49-9021.01 Heating and Air Conditioning Mechanics
 49-9098.00 Helpers--Installation, Maintenance, and Repair Workers
 25-1054.00 Physics Teachers, Postsecondary
 51-8012.00 Power Distributors and Dispatchers

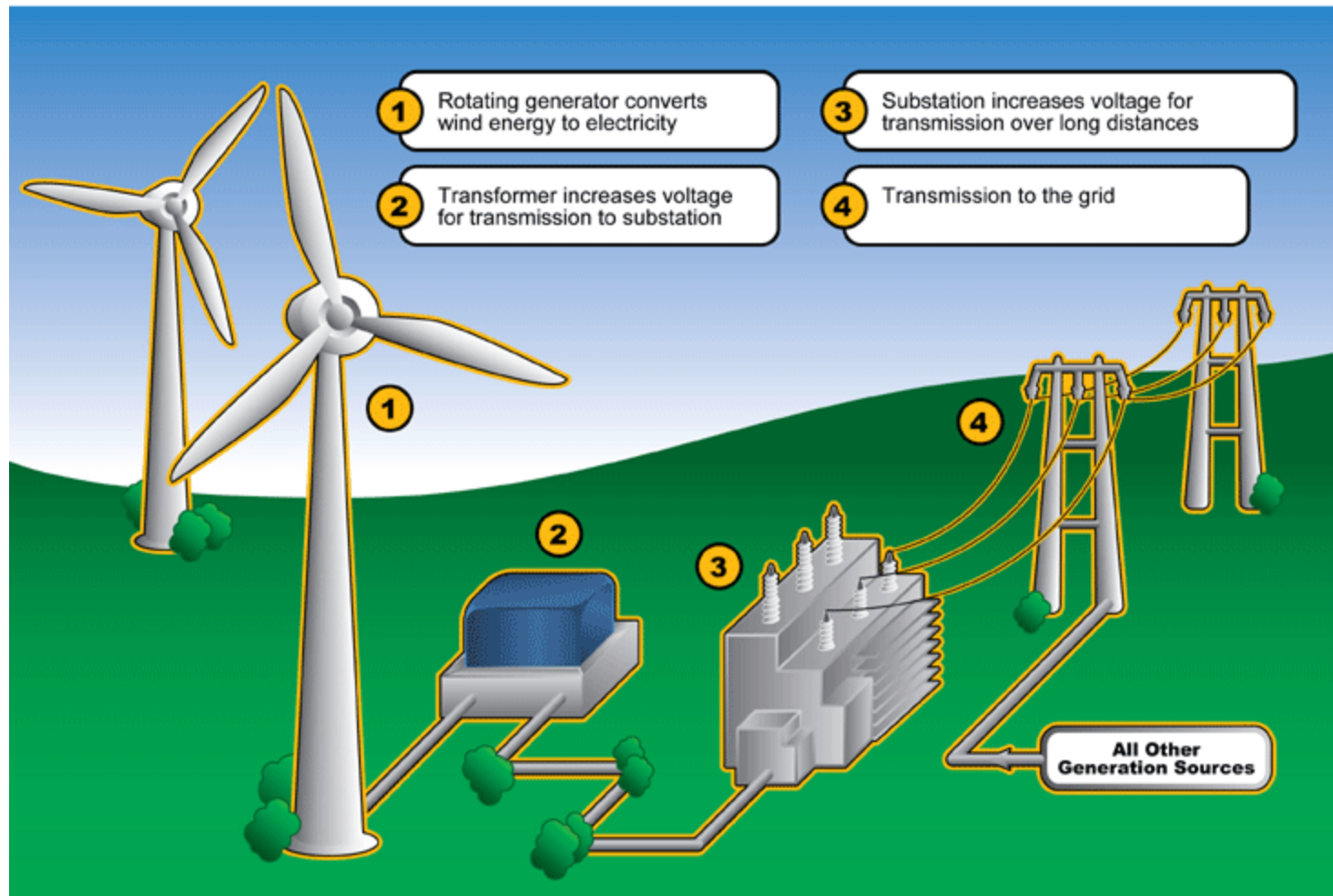


LINKS

- http://www.willyoujoinus.com/discussion/topics/?d=25&utm_campaign=Yahoo!Paid&utm_medium=cpc&utm_source=Yahoo!&utm_term=wind_energy_power
- http://www.awea.org/faq/wwt_statistics.html#In%20what%20states%20is%20there%20significant%20wind%20power%20development%20Are%20there%20any%20utility-scale%20wind%20turbines%20in%20my%20state
- <http://www.awea.org/projects/Projects.aspx?s=Minnesota>

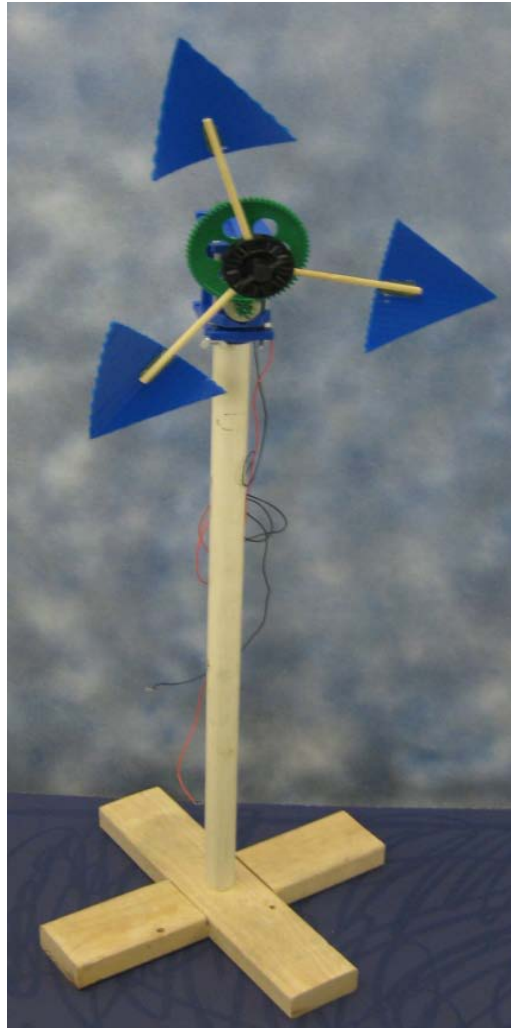


WIND ENERGY SCIENCE



Wind Turbine Assembly

Instructions



Composed By:

Carissa Butterfield

Samantha Burns-Morrell

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Gear Motor Mount Instructions.....3-4

Blade instructions.....5

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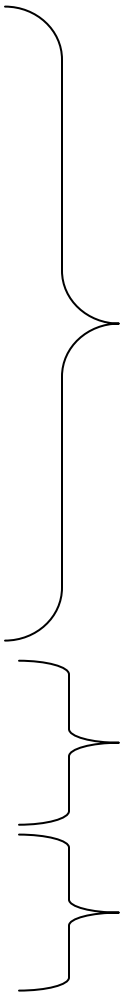
Water pump instructions.....6

Device operation.....6

Alternative testing possibilities.....6

Materials List:

- 2- 2x4s
- 1- 3 foot piece of PVC pipe
- Blue mount
- 2- 4 inch bolts
- 4- wing nuts
- 2-standard nuts
- Motor mount
- 2 motors
- Hub and driveshaft
- Gearing
- Blade materials
- Dowels
- Water pump
- Beaker
- Tube
- Tupperware
- Hot glue gun
- Hot glue
- Duct tape
- Box cutters/scissors
- Table fan
- Screwdrivers
- Stopwatch



ALTurbine Kit Contents

Supplied

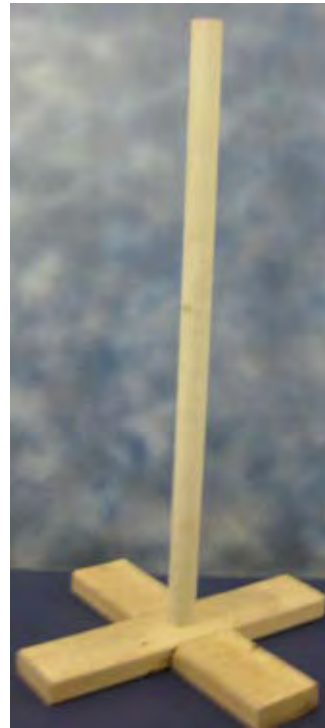
Not supplied. But needed

Stand Instructions:

Assemble both 2x4s in an X shape. The two slots should be facing each other to make the bottom level.



Insert the PVC into the hole in the 2x4s.

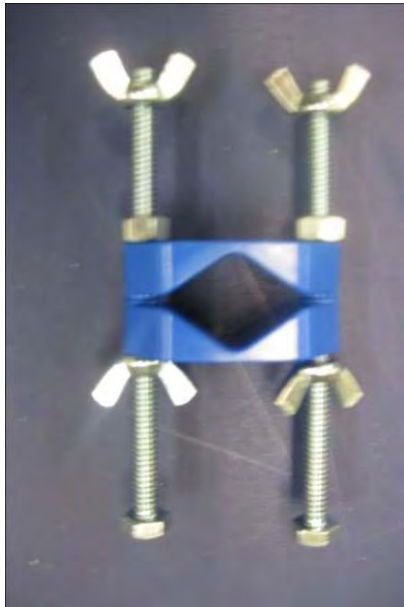


Gear Motor Mount Instructions:

1) Assemble the two bolts to either sides of the motor mount.

Sequence:

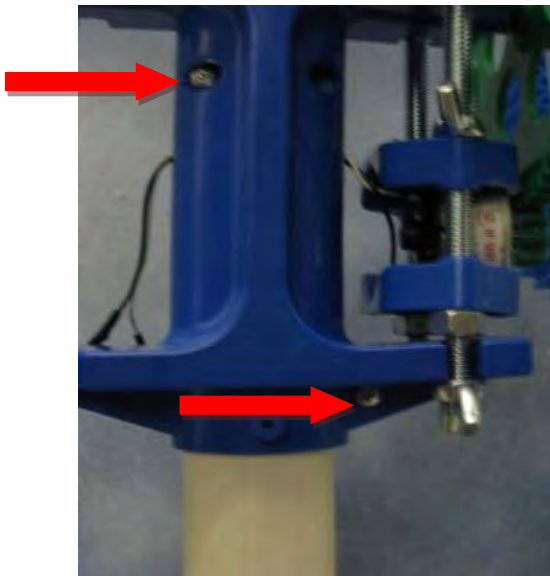
1. Bolt
2. Wing nut
3. Motor mount
4. Motor mount
5. Nut
6. Wing nut



2) Insert small screws where the arrows point.



3) Insert small screws where arrows point.
***Remember to apply to both sides



4) Attach the motor mount assembly to the blue mount.



5) Insert motor between the two motor mounts and run the wires through the slit in the blue mount.



6) Attach the gear and the key (to hold the gear in place) to the hub's drive shaft. Take care not to bend the shaft.



7) Go to Page # 5 and build the blades and the hub assembly.

Insert drive shaft in the hole in the top of the blue mount.



8) Align gearing so they mesh well easily without too much friction or too much slipping. The teeth of both the gears should also mesh well along the width.

****You may need to adjust the height of the motor to get this alignment right.**



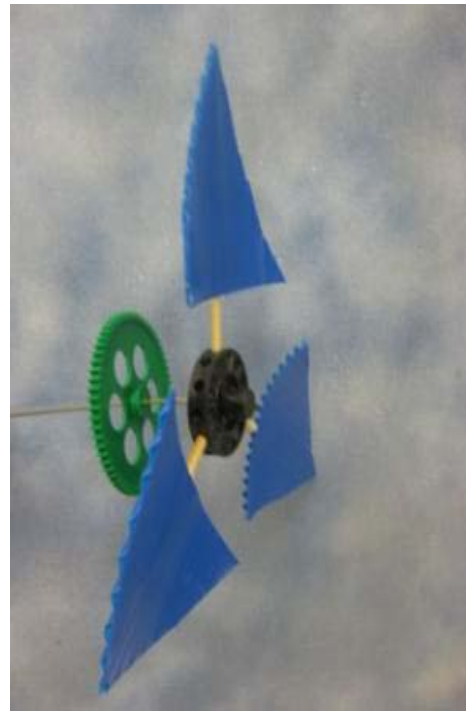
*****When everything is set, tighten the nuts so the motor mount stays in that position***. Always use your judgment to prevent excessive force or torque that can cause permanent damage.**

Blade Instructions:

§Cut the shape of blade you would like. Glue to the backside of your blade. You can test with alternative materials like cardboard, thick paper, plastic sheet etc.



Insert blades into the holes on the hub. **make sure to space them evenly.

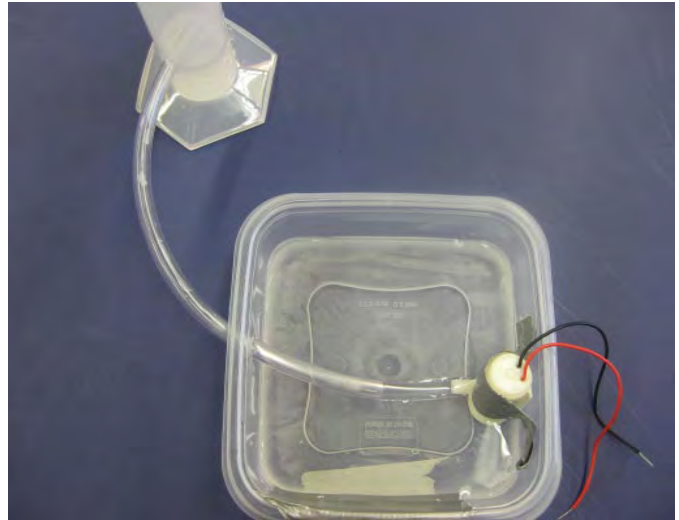
**Tips on Blade Design:**

- Shorten blades
- Change angle
- Use less or more blades
- Use lighter material
- Use smooth material
- Change blade shape

Water Pump Instructions:

Attach water pump to the side of the Tupperware dish. Thread hose through hole in Tupperware (or) take the tube over. Attach one end to water pump and the other through the hole into the beaker.

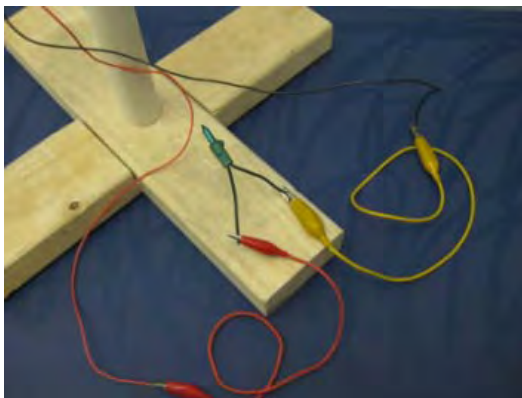
Connect the wires from the pump to the corresponding wires on the motor.



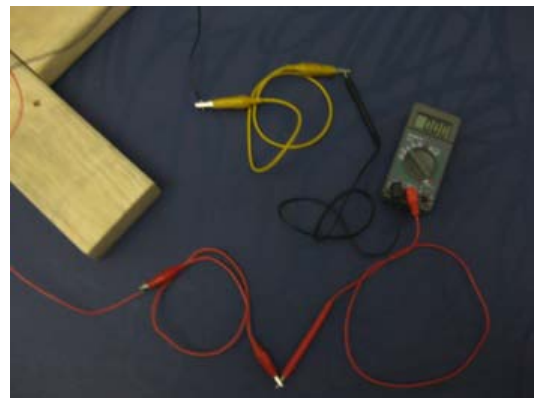
Congratulations. You have now completed the assembly. Here is how you test your windmill.

Device Operation:

- Direct the wind flow from wind device like a table fan (not included in the kit) towards the wind turbine.
- Angle blades as needed to maximize power output.
- Test your turbine. See how much water your design can pump in one minute. Use the graduated beaker to make measurements

Alternative Testing Possibilities:

Light Bulbs



Multi Meter

Biodiesel

ICC Engineering

Introduction

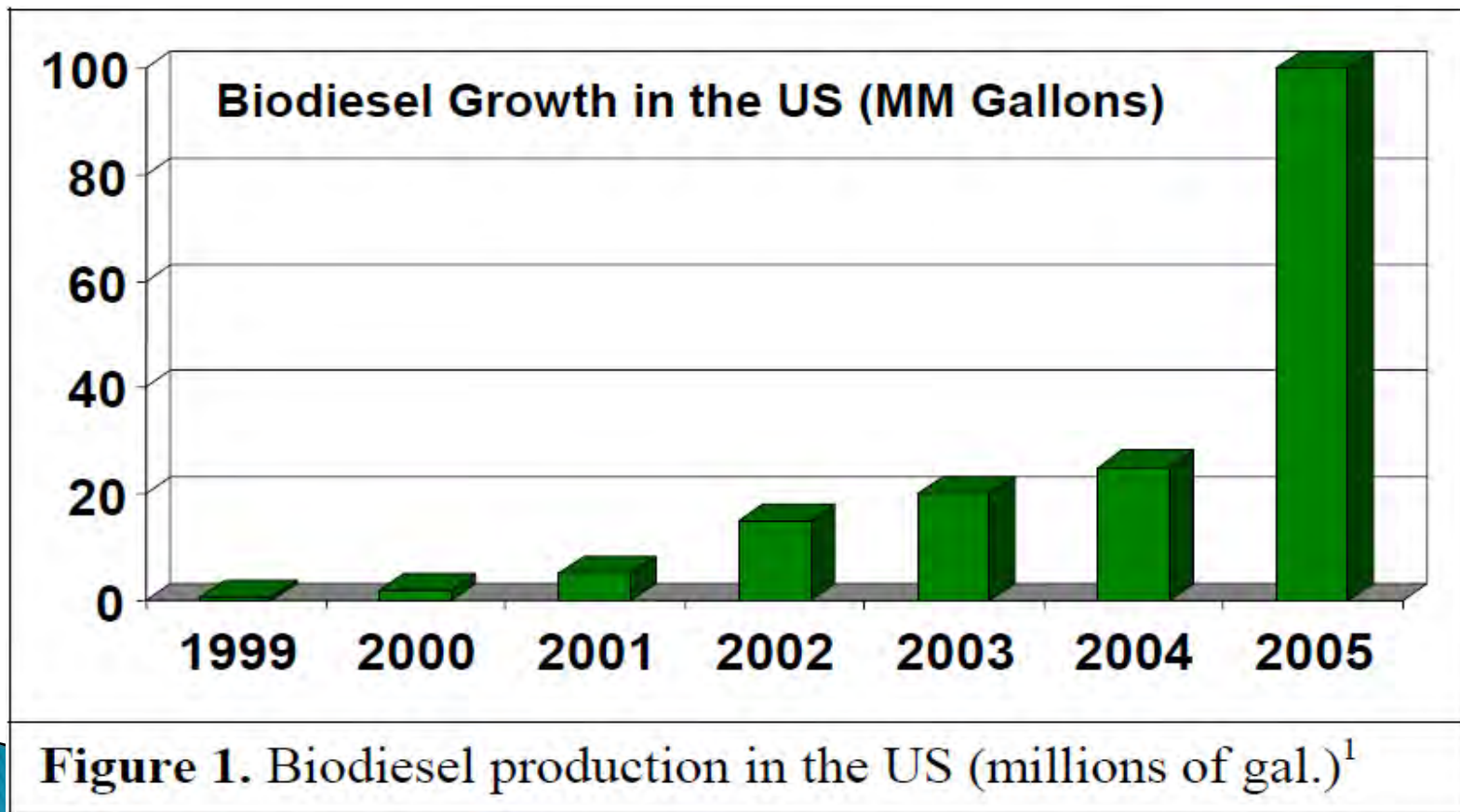
- ▶ Renewable energy is energy derived from regenerative sources.
- ▶ In the last 30 years, the world's renewable energy production has increased and currently makes up a little more than 13 percent of the world's energy supply.

Biodiesel in Minnesota

- ▶ MN mandates diesel fuel to contain 5% biodiesel on May 1, 2009
- ▶ Gov. Pawlenty signs bill to increase mandate to 20% by 2015

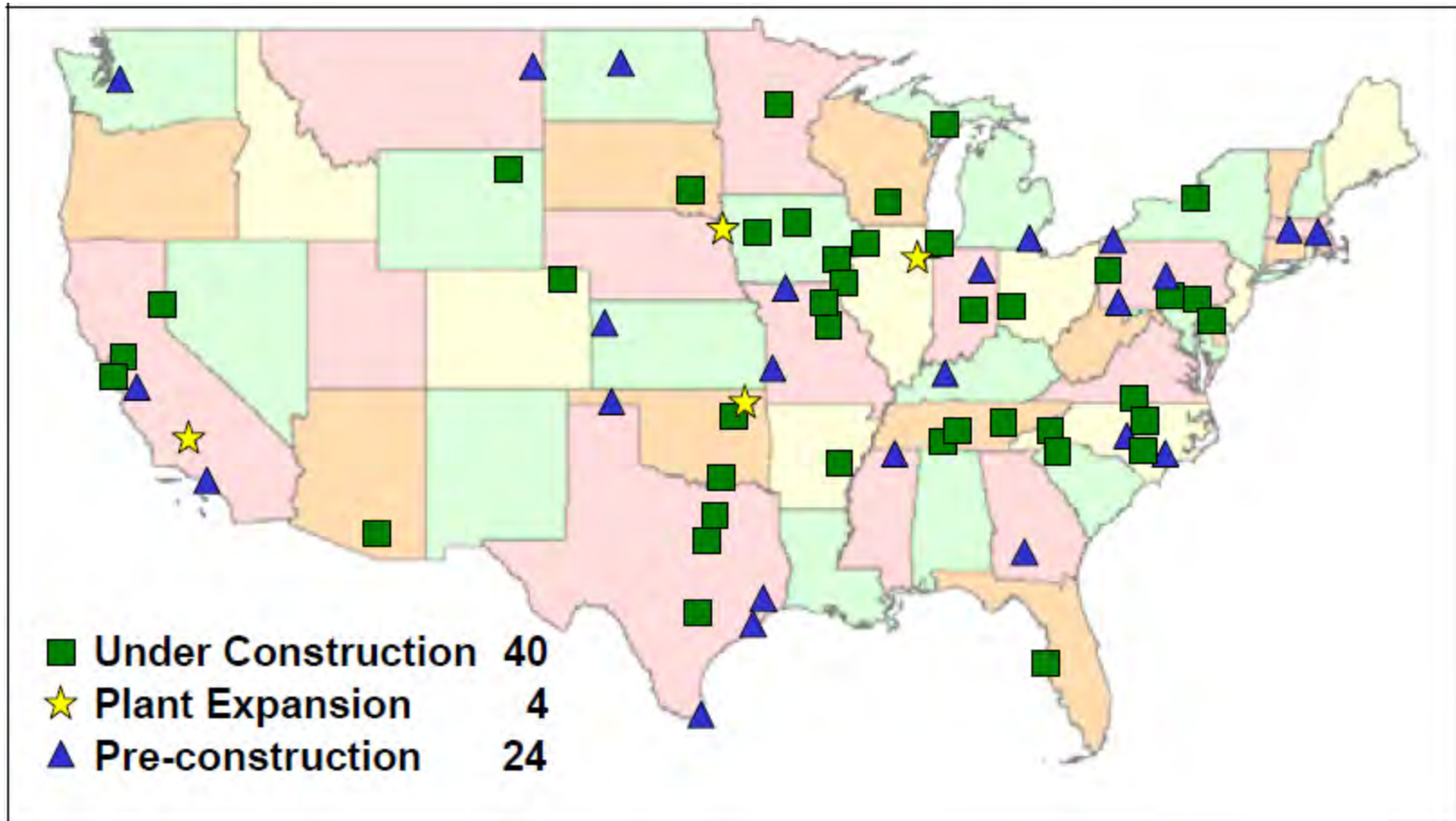
Biodiesel in the U.S.

- ▶ For 2008, U.S. Biodiesel Production approaches 700 million gallons





Future Biodiesel Plants in U.S.



http://www.pioneer.com/CMRoot/Pioneer/media_room/biofuels/documents/biodiesel.pdf

Making Biodiesel

- ▶ Biodiesel can be synthesized from renewable materials such as soybean oil and canola oil.
 - Used sources of oil (waste fryer oil) can also be used, but need to be treated chemically before the reaction can take place.
- ▶ Biodiesel is produced by chemically reacting triglycerides and lipids from the oil with methanol in a transesterification reaction
- ▶ Chemicals needed: soybean oil, methanol, sodium hydroxide, magnesium sulfate

Transesterification of soybean oil

▶ Chemicals needed:

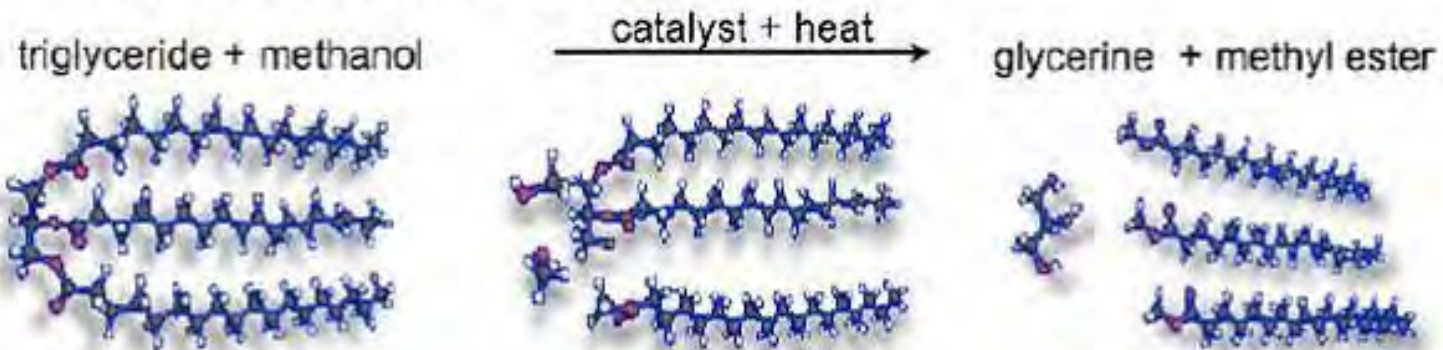
- soybean oil
- methanol (CH_3OH)
 - Highly flammable. Colorless flame. Use caution when using open solvent bottle near flame, sources of heat, and electric devices.
- sodium hydroxide (NaOH)
 - Highly caustic. Do not expose skin to this chemical. Will cause chemical burn.
- magnesium sulfate anhydrous (MgSO_4)

▶ Safety equipment:

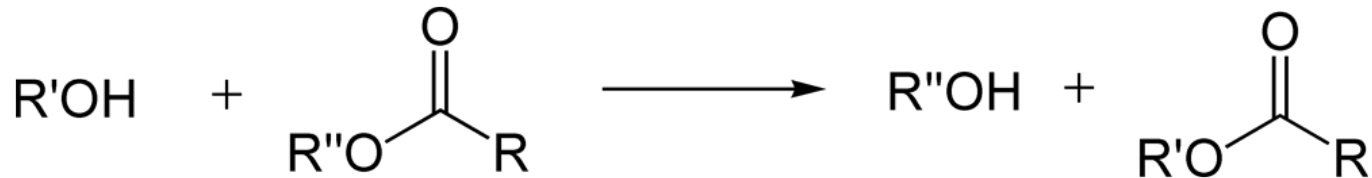
- Wear eye protection throughout and nitrile gloves when handling the NaOH .

Transesterification of soybean oil

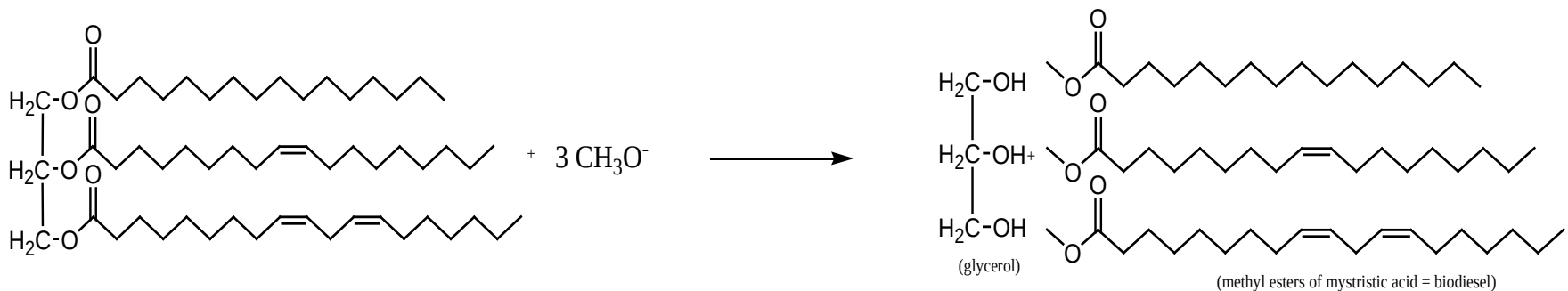
The transesterification process



Transesterification



- ▶ (A) Production of sodium methoxide
 - $\text{NaOH} + 3\text{CH}_3\text{OH} \rightarrow \text{Na}^+ \text{ } ^-\text{OCH}_3 + \text{H}_2\text{O}$
- ▶ (B) Production of methyl esters of multiple fatty acids (palmitic acid, oleic acid, and linoleic acid) .



Job Outlook

Related Careers in Biodiesel Industry

- ▶ Chemist
- ▶ Chemical Engineer
- ▶ Biodiesel Technician

Links

- ▶ <http://mnbiodiesel.com>
- ▶ http://www.pioneer.com/CMRoot/Pioneer/media_room/biofuels/documents/biodiesel.pdf



Biodiesel Module

Department of Labor / MnSCU Project

Career information and student activity training

Faculty: Derek Fox (Chemistry), Gordy Savelle (Chemistry), Trichy Pasupathy (Engineering)

Engineering students: Grant Roy, Jacob Goodell



Itasca Community College

This procedure was adapted from research performed by **Sally A. Meyer and Mark A. Morgenstern** in the department of chemistry at The Colorado College, Colorado Springs, CO.
Chem. Educator, **2005**, 10, 1–3

Biodiesel Preparation**Materials**

- 1 – 100 g bottle of sodium hydroxide
- 1 – 500 mL bottle of methyl alcohol
- 10 – test tubes
- 10 – 250 mL glass beakers
- 10 – 150 mL plastic bottles
- 44 – squares of para-film
- 15 – pieces of filter paper
- 3 – thermometers
- 1 – alcohol wick burner
- 1 – stand
- 3 – plastic funnels
- 10 – glass stirring rods
- 1 – metal spatula
- 1 – 5 g vial of magnesium sulfate

Eye protection must be worn at all times during the activity.

Methoxide Preparation

- Find the plastic bottle with the screw cap that is provided in the kit and deliver approximately 15 mL of methanol to it.
- Measure out 0.5 grams of NaOH (about 5 pellets of the Flynn NaOH) and add it to the methanol.
- Stir and gently shake the bottle until all of the NaOH dissolves. This will take about 15 minutes. Think of this as the “methoxide” solution.

Vegetable Oil Preparation

- Prepare the alcohol burner for use by filling the glass chamber about 1/3 full with fresh methanol.
- Tip the burner upside-down to saturate the wick and tip back over when a drop of methanol comes off of the wick.
- Place metal screen on stand and place the alcohol burner beneath the stand.
- Measure out 60 ml of vegetable oil in the 250 mL beaker and place it on the stand.
- Light the burner and heat the vegetable oil. Do not exceed 50°C.
- When the vegetable oil temperature approaches 50°C, extinguish the burner flame.

Transesterification Reaction

- Once the NaOH is dissolved, pour the methoxide (the methanol NaOH solution) into the beaker containing the warm vegetable oil.
- Stir the mixture, 5 – 10 minutes, until there is an emulsion (an emulsion occurs when the organic vegetable oil has mixed thoroughly with the aqueous NaOH producing a homogeneous mixture.)
- Place the beaker in an isolated place and let the Biodiesel mixture cool in the beaker over night.
- Wash the plastic bottle from the methoxide step for later use.

Separation of Biodiesel and Glycerol

- Take one of the disposable Pipettes provided in the kit and remove the top layer of biodiesel. (The bottom layer consists of glycerol and water)
- Carefully transfer all of the biodiesel into the plastic bottle from the beaker, while taking care not to transfer any of the bottom layer. (Note: This biodiesel is still wet and impure.)
- Pour out glycerol from bottom of beaker and thoroughly wash and dry the beaker.

Removing Water from the Biodiesel Product

- Get the vial of anhydrous MgSO_4 from the kit and put approximately 1g of MgSO_4 into the bottle with the biodiesel. Gently stir this mixture until the MgSO_4 /biodiesel takes on a cloudy appearance.
- Take one piece of filter paper and fold it in half twice then open one flap to create a cone shape.

- Place filter paper in funnel and place funnel over the (clean) 250-mL beaker.
- Slowly pour the Biodiesel MgSO_4 mixture into filter paper and let it sit until all liquid has dripped through.
(The biodiesel product that is collected in the beaker should now be “dry” and pure.)
- Thoroughly wash and dry the plastic container and the screw cap.
- Once the container and cap are completely dried, pour your dry biodiesel product into the plastic bottle and tighten the cap.

Purification Test

- Take one of the disposable pipettes provided and fill it with methanol.
- Take one of the glass test tubes provide and put 90 drops of methanol into the tube.
- Take a new pipette and get some of the “dry” Biodiesel.
- Put 10 drops of the biodiesel into the test tube with the methanol.
- Place a piece of the Para film provided and cover the test tube.
- Place your thumb on top of the tube and shake the mixture.
- Hold the tube up and observe it. (if it is clear you have pure biodiesel)

Combustion Test

- Place the metal screen on the stand.
- Fill pop can with 100 mL of water and place on the metal screen.
- Fill the burner with the (dry) biodiesel product.
- Tip the burner upside-down and saturate the wick; tip back over when one drop of biodiesel drips.
- Weigh the burner and biodiesel and record the mass.
- Place under the metal screen.
- Record the temperature of the water in the pop can.
- Light the burner and let burn for 2 minutes.
- Extinguish the burner flame and record the maximum temperature the water in pop can reaches.
- Record the mass of the burner + remaining biodiesel.

Calculations:

- $q = m \times c \times \Delta T$
- m (mass of water in pop can) = 100g
- c (specific heat of water) = 4.18 J/g*°C
- $\Delta T = T_{\text{final}} - T_{\text{initial}}$
- Molar mass of Biodiesel is 270.5g
- $(\text{mass final}_{\text{burner}} - \text{mass initial}_{\text{burner}}) / 270.5\text{g} = \text{moles of biodiesel}$
- $q / \text{moles of biodiesel} = \text{experimental enthalpy value(KJ/mole)}$
- Expected value for enthalpy of biodiesel - 10820.4 KJ/mole

Biodiesel chemistry

(A) Production sodium methoxide - $\text{NaOH} + 3\text{CH}_3\text{OH} \rightarrow \text{Na}^+\text{OCH}_3 + \text{H}_2\text{O}$

(B) Production of methy esters of multiple fatty acids.

Biodiesel procedure schematic

