

# **SESP: The State Energy Sector Partnership Program**

The State Energy Sector Partnership Program (SESP) is a three year, six-million dollar American Recovery and Reinvestment Act (ARRA) grant awarded through the U.S. Department of Labor. The New Mexico Department of Workforce Solutions (NMDWS) administers the grant on behalf of the State Workforce Development Board (SWDB). Policy and oversight of the grant is the responsibility of the New Mexico Green Industry Council (GIC), which is a subcommittee of the SWDB

## **Training**

A key goal of the SESP grant is to provide training in renewable energy/energy efficiency occupations that is responsive to business and worker needs. The New Mexico SESP grant has identified four priority industries for training workers to meet the needs of the state's green energy sector:

- Solar
- Wind
- Green Building/Energy Efficiency
- Biofuels

Training services are being provided through the State's local workforce development boards. If you are interested in finding out more about SESP training, visit <http://www.greenjobs.state.nm.us/sespEligb.html> or visit your local Workforce Connection Center. Your nearest Workforce Connection Center can be found by visiting <http://www.dws.state.nm.us/dws-offices.html>.

Additionally, in an effort to increase the capacity of the solar, wind, green building/energy efficiency and biofuels industry sectors, and to better meet the needs of existing and incoming businesses in New Mexico, NMDWS has awarded funds to four consortia of education providers, businesses, and workforce organizations to develop statewide "Centers of Excellence" programs. The purpose of these Centers of Excellence is to enhance and expand existing green sector training programs and develop new programs in emerging green industries. The funds will assist in the development and implementation of innovative collaborations between the business, workforce, economic development and educational systems.

# Centers of Excellence

## Biofuels Center of Excellence –

Santa Fe Community College – <http://biofuels.greentraining.sfcc.edu/>

## Green Building/Energy Efficiency Center of Excellence –

Santa Fe Community College – <http://greenbuilding.greentraining.sfcc.edu/>

## Solar Center of Excellence – Central New Mexico Community College –

<http://www.cnm.edu/campus/wtc/>

## Wind Center of Excellence – Mesalands Community College –

<http://www.mesalands.edu/wind/default.htm>

Additional information about green jobs in New Mexico can be found at the NM Green Jobs Portal website [www.greenjobs.state.nm.us](http://www.greenjobs.state.nm.us)

For more information about

- **Santa Fe Community College  
Center of Excellence/Green Building & Energy Efficiency**

or

- **Central New Mexico Community College  
Center of Excellence/Solar**

Go to <http://www.dws.state.nm.us/new/SESP/>

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# Biofuels Center of Excellence (BCX)

## Curriculum Overview

### Purpose:

Provide classroom and laboratory training to workers/entrepreneurs entering Biofuels industry presented in one of four Biofuels modules: Algae; Biogas and Pyrolysis; Biodiesel; or Ethanol.

Provide health and safety training to workers/entrepreneurs entering the Biofuels industry.

Provide business plan, financing and marketing information to all BCX module trainings. Present potential workers/entrepreneurs with resource assessment tools for all Biofuels curriculum areas. Provide follow-up resources to students.

### Objectives:

1. Provide required training necessary to issue Biofuels Center of Excellence Certification from the Santa Fe Community College to workers/entrepreneurs entering the Algae, Biogas and Pyrolysis, Biodiesel, or Ethanol Biofuels industry.
2. Provide required training necessary to issue OSHA General Industry Standards 10 hour Certification to workers entering the Biofuels industry.
3. Develop skills in Biodiesel production and laboratory testing methods necessary for analysis of biofuel and biofuel feed stock for optimum production potential.
4. Introduce potential employees/employers in the developing Biofuels industry to regulations applicable and resources available for fuel testing standards.
5. Introduce potential employees/employers in the developing Biofuels industry to regulations applicable and resources available for safety and health hazards.
6. Provide an overview of the history of the Biofuels industry and the current economics, opportunities and challenges of working in this emerging market for startup and existing corporate operations.

**Course Description:** Biofuels courses will be offered in classroom and laboratory format, simulating a hands on, work place environment of current Biofuels industry production facilities. Individual courses descriptions and hourly requirements as follows for each module in Algae; Biogas and Pyrolysis; Biodiesel; and Ethanol. Each module includes a prerequisite OSHA for Biofuels training class of 14.5 hours and a self contained Business Development component.

# BCX Modules

OSHA 10 for Biofuels

Biomass Energy: Biogas & Gasification

Algae for Biofuels

Ethanol Production

Biodiesel Production

Business Development for Biofuels

## Biodiesel Production Module Overview

### Purpose:

Provide Classroom and laboratory training to workers/entrepreneurs entering the Biodiesel Industry.

### Objectives:

1. Provide required training necessary to issue Biofuels Center of Excellence Certification from the Santa Fe Community College to workers/entrepreneurs entering the Biodiesel Industry.
2. Provide information to potential employees/employers regarding production systems found in the Biodiesel Industry.
3. Develop skills in biodiesel production and laboratory testing methods necessary for analysis of biodiesel and biodiesel feed stock for optimum production potential.
4. Introduce potential employees/employers in the developing Biodiesel Industry to regulations applicable and resources available for ASTM fuel testing standards.
5. Introduce potential employees/employers in the developing Biodiesel Industry to regulations applicable and resources available for safety and health hazards.
6. Provide an overview of the history of the Biodiesel Industry and the current economics, opportunities (including information on tax credits and RINS) and challenges of working in this emerging market for startup and existing corporate operations.

**Course Description:** A minimum of 18 hours of classroom curriculum and lab training curriculum in 5 sessions. Classroom curriculum will include but not be limited to such topics as history of biodiesel, how to collect feedstock, feedstock choices: pros and cons, how to safely handle chemicals and perform titrations, how to make fuel grade biodiesel how to analyze fuel quality, tax credits and RINS, and the economics of biodiesel production and marketing.

## Applications for Biodiesel in Industry, Small Business, and Entrepreneurial Start-Ups

Currently, the biodiesel industry is growing rapidly despite its slow adoption in the United States. This rapid and mandated growth provides job opportunities in all aspects of the industry including feedstock providers, producers, marketers, and distributors.

“Biodiesel production in the United States is assumed to increase to 1 billion gallons by 2012. Less than half this volume is assumed to be from domestic first-use vegetable oils, partly due to the equalization of the biodiesel tax credit across all feedstock.” (USDA) However, the biodiesel \$1.00/per gallon tax credit lapsed at the end of 2011 and it is yet to be determined whether it will be reinstated in 2012. To make up for the loss of subsidy, the industry expects market equalization from the continued rise of RIN values and increased mandated production of biodiesel under the RFS2.

There are many factors that will play a role in the rate of growth for the biodiesel industry, not the least of which is crude oil prices. The predicted rise in crude oil price directly affects feedstock costs, transportation costs, and production costs in the biodiesel industry.

Aside from crude oil price, there are a myriad of obstacles; the path for growth in the biodiesel industry has been and will undoubtedly be rocky, but biodiesel’s place in our country’s plan for domestic energy production and use is here to stay.

The jobs created by the biodiesel industry will require individuals to become knowledgeable of the process of making biodiesel, the fuel’s characteristics, current and future feedstock to be used, lab tests and analytics, and distribution and marketing.

### B CX Biodiesel Module Learning Goals:

This course was developed to provide hands on training in the field of biodiesel production for the workforce in the State of New Mexico. The Topics covered are broad and will establish a baseline of knowledge with which students can discover an area of work that suits their skills and interests. Topics include history and procedures for biodiesel fuel testing feedstock and economic analysis. Emphasis is placed on providing experience in the laboratory where students can practice new skills in a working environment. Students will produce a mini-batch of biodiesel and perform tests on the results as well as the initial feedstock to develop a comprehensive understanding of the processes involved in production and assessment of biodiesel. Results of their findings will be presented to the class.

### BCX Biodiesel Module Evaluation:

Through testing and demonstration of competence.

## BCX Biodiesel Module at a Glance: (syllabus)

|           | Lecture                                                                                                                                                                           | Lab                                                                                                                                                           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Class I   | <p>Introductions</p> <p>Background of Biodiesel (What is it/History/Applications)</p> <p>How is Biodiesel Made/Transesterification (Lab 1 Intro)</p> <p>Questions/Conclusions</p> | <p>Lab 1: Titrations (2-3 types of oil)</p>                                                                                                                   |
| Class II  | <p>Lab 2 Introduction: How to Make Biodiesel</p> <p>Introduction to Bio-Pro 190</p> <p>BioLyle Bio-Pro 190 Video</p>                                                              | <p>Lab 2: Biodiesel Mini-Batch</p> <p>Lab 3: 3/27 Quality Test</p> <p>Lab 4: Bio-Pro 190 Usage</p>                                                            |
| Class III | <p>ASTM Standards</p> <p>Feedstocks</p> <p>Regulations</p> <p>Biodiesel Economics</p> <p>Business Development</p> <p>Evaluation</p>                                               | <p>Lab 4: Bio-Pro 190 Usage (cont.)</p> <p>Drain glycerin from Bio-Pro 190</p> <p>Lab 5: Soap and Flashpoint Quality Testing</p> <p>Infrared Spectrometer</p> |

## BCX Biodiesel Module: Suggested Schedule

The curriculum is suited for a 3-day weekend workshop.

### Friday/Day One

|       |                                                               |
|-------|---------------------------------------------------------------|
| 9-10  | Introductions                                                 |
| 10-11 | Background of Biodiesel (What is it/History/Applications)     |
| 11-12 | How is Biodiesel Made/Transesterification (Lab 1 Intro)       |
| 12-1  | <i>Lunch Break</i>                                            |
|       | Introduction to Lab Procedures: Lab rules, notebooks, reports |
| 1-3   | Lab 1: Titrations (2-3 types of oil)                          |
| 3-4   | Questions/Conclusions                                         |

### Saturday/Day Two

|            |                                           |
|------------|-------------------------------------------|
| 9-9:45     | Lab 2 Introduction: How to Make Biodiesel |
| 9:45-11:15 | Lab 2: Biodiesel Mini-Batch               |
| 11:15-12   | Lab 3: 3/27 Quality Test                  |
| 12-1       | <i>Lunch Break</i>                        |
| 1-1:30     | Introduction to Bio-Pro 190               |
| 1:30- 2:30 | BioLyle Bio-Pro 190 Video                 |
| 2:30-4     | Lab 4: Bio-Pro 190 Usage                  |

### Sunday/Day Three

|         |                                                   |
|---------|---------------------------------------------------|
| 9-9:30  | Lab 4 (continued) Drain glycerin from Bio-Pro 190 |
| 9:30-12 | Lab 5: Soap and Flashpoint Quality Testing        |
| 12-1    | <i>Lunch</i>                                      |
| 1-1:30  | ASTM Standards                                    |
| 1:30-2  | Feedstock                                         |
| 2-2:30  | Regulations                                       |
| 2:30-3  | Biodiesel Economics                               |
| 3-4     | Business Development, Evaluation/Certification    |

## BCX Biodiesel Module Classroom Requirements:

Days: Suggested 3 day weekend workshop. Hours: 9am-4pm—7 hours—with one hour lunch break.

Hours: 3 x 7 classes in laboratory space:

- Space should include desks and chairs for a maximum of 20 seats, computer with internet access for the instructor and a projector or screen for presentations and/or videos. Some classes may require electrical outlets and power strips for student laptop use.
- Lab space for a maximum of 20 students with access to water and electrical connections and ventilation-- such as biology lab with hood or ventilation area and eye wash/ safety shower. Biofuels lab activities may include use of methanol, KOH, ethanol.
- Appropriate space for equipment to be safely operated. Access to indoor/ outdoor space as required for larger equipment demonstrations.

## BCX Biodiesel Module Equipment and Materials Requirements & Hazard/Safety Overview:

Proper Disposal of lab Materials for BCX Biodiesel Module: The following list of lab materials that need proper disposal is based on 20 students per class.

### Lab 1 Titrations

Mixture: Less than 1 Liter of distilled water mixed with 1 gram of KOH

- Mixture:
- 600mL isopropyl alcohol
- 60mL of vegetable oil
- 300 drops of phenolphthalein solution combined with
- up to 200mL of distilled water/KOH mixture

60 10mL syringes

60 100mL poly beakers

### Lab 2 Biodiesel Mini Batch

20 count 1 Liter HDPE bottles (the bottles will contain a combination of methyl esters (biodiesel) and glycerin and the chemicals)

- 350ml of vegetable oil
- 3 grams of KOH
- 70 mL of methanol.

### Lab 3 3/27 Test

20 count closed 100mL beaker containing

- 27mL of Methanol
- 3mL of methyl esters (biodiesel)

### Lab 3 3/27 Test (continued)

40 syringes

- 20 used for methanol transfer
- 20 used for methyl ester (biodiesel) transfer

Less than 1 litre of methanol in HDPE container

Less than 1 litre of methyl esters (biodiesel) in HDPE container

### Lab 4 BIO PRO

50 gallons of methyl esters (biodiesel)

10 gallons of glycerin containing methanol and soaps

### Lab 5 Soap Test

20 count mixture:

- 100mL isopropyl alcohol
- 20 drops bromophenol blue
- 10mL methyl esters
- up to 100mL of hydrochloric acid

### Lab 6 Flash Point

Up to 1 Liter of spent methyl esters (biodiesel)

## BCX Biodiesel Module Materials

### Materials

- Student/Teacher Manual
- Lab notebook
- Biodiesel Student Manual PowerPoint
- DVD - "BioLyle's Biodiesel Workshop" Lyle Rudensey

### Equipment

- Biodiesel Basic Starter Kit
- Deluxe Biodiesel Titration Kit
- Deluxe 1000 mL Separatory Funnel Kit-
- Deluxe Water Test kit with digital gauge
- Bonanza Mini Scan Testing System

- MyWeigh KD7000 Digital Scale
- Z Line Methanol Barrel Pump
- Microwave

### Supplies

- Ultimate Syringe Pack
- 5 gallon Carboy HDPE-
- Sampling Cups
- 1-Liter HDPE Bottle
- 100mL Poly Beakers
- 500mL Wash Bottles
- Soft-Sided Safety Goggles
- OSHA Compliant PVC Safety Gloves
- Dust masks

### Chemicals

- 15 mL 1% Phenolphthalein
- 950 mL 99% Isopropyl Alcohol
- 190 mL Sulfuric Acid Bottles
- 2350 Gram KOH Resealable Mini-Buckets
- 120 mL 0.01 Normal Hydrochloric Acid (HC
- 120 mL 0.04% Bromophenol Blue
- Methanol (15 gallons)
- Vegetable Oil (50 gallons)

## BCX Biodiesel Module:

### Equipment, Supplies and Materials for each lecture/lab:

|                               |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Class I: Lecture and Lab 1    | Lecture: Introductions                                                                                                                                                 | Student /Teacher Manual<br>PowerPoint Slides                                                                                                                                                                                                                                                                                                                      |
|                               | Lecture: Background of Biodiesel (What is it/History/Applications)                                                                                                     | Student /Teacher Manual<br>PowerPoint Slides                                                                                                                                                                                                                                                                                                                      |
|                               | Lecture: How is Biodiesel Made/ Transesterification (Lab 1 Intro)                                                                                                      | Student /Teacher Manual<br>PowerPoint Slides                                                                                                                                                                                                                                                                                                                      |
|                               | Lecture: Introduction to Lab Procedures (Exercise 1): Lab Etiquette and Safety<br>Exercise 2): How to set up a Lab notebook<br>(Exercise 3): How to write a Lab report | Lab notebook<br>Student /Teacher Manual                                                                                                                                                                                                                                                                                                                           |
|                               | Lab 1: Titrations (2-3 types of oil)                                                                                                                                   | Lab notebook<br>Student /Teacher Manual<br>1 Liter of distilled water in a HDPE bottle<br>Scale<br>Foil paper cup<br>1gram KOH<br>Magnetic stirrer<br>Isopropyl Alcohol<br>100mL Used vegetable oil (2-3 types)<br>10mL pipettes<br>Phenolphthalein solution * see safety info<br>10mL syringes<br>Potassium Hydroxide (KOH).<br>Safety gloves and safety glasses |
| Class II Lecture and Labs 2-4 | Lecture: Introduction to Lab 2: How to Make Biodiesel                                                                                                                  | Student Manual<br>Teacher's Manual<br>PowerPoint Slides                                                                                                                                                                                                                                                                                                           |



|  |                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                     |
|--|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Lab 5: Quality Testing<br>Soap Test (continued)                                                       | 100ml isopropyl alcohol as a solvent<br>200 mL + beaker<br>10 mL graduated cylinder<br>Pipettes and/or Syringes<br>Calculator (optional)<br>*instructional manual/ ppe goggles and gloves                                                                                                                                                                                           |
|  | Lab 5: Quality Testing<br>Flash Point Testing                                                         | Lab notebook<br>Student /Teacher Manual<br>PowerPoint Slides<br>Closed cup flash point tester with stirrer, heater,<br>and flame source. * see safety information<br>Biodiesel sample* see safety information<br>Electric thermostat (on flash pt tester)<br>Thermometer<br>Goggles and gloves should be used during this<br>test.<br>*instructional manual/ ppe goggles and gloves |
|  | Lecture:<br>ASTM Standards<br>Feedstock<br>Regulations<br>Biodiesel Economics<br>Business Development | Lab notebook<br>Student /Teacher Manual<br>PowerPoint Slides (30-33)                                                                                                                                                                                                                                                                                                                |
|  | Evaluation                                                                                            | Lab notebook<br>Student /Teacher Manual<br>LHA<br>BCX Biodiesel Module Certification Test                                                                                                                                                                                                                                                                                           |

## BCX Biodiesel Module References and Additional Material

NREL- Biodiesel Handling and Use Guidelines

available as a PDF: <http://www.nrel.gov/vehiclesandfuels/pdfs/43672.pdf>

U.S. Department of Commerce National Technical Information Service

5285 Port Royal Road Springfield, VA 22161

phone: 800.553.6847 fax: 703.605.6900 email: [orders@ntis.fedworld.gov](mailto:orders@ntis.fedworld.gov)

online ordering: <http://www.ntis.gov/ordering.htm>

Suggested Reading-

Biodiesel Basics and Beyond. Kemp, William H. 2006

Biodiesel Power: The Passion, The People, and the Politics of the next Renewable Fuel. Estill, Lyle 2005

Biodiesel America: How to Achieve Energy Security, Free America from Middle-East Oil Dependence, and Make Money Growing Fuel. Tickell, Joshua 2006

# Introduction to Lab Procedures

## Exercise 1: Lab Etiquette and Safety

Keep your workspace clean.

No eating or drinking in laboratory space.

Keep aisles clear of chairs, equipment and personal items.

Always leave workspace and equipment clean and stored properly for the next persons use.

Do not put chemicals or trash down the sinks.

Follow instructions and procedures when using equipment.

Do not interfere with other's work or experiments.

Take your time when working.

Follow safety standards for fire safety, chemical safety and equipment safety.

Place broken glass or sharp wastes in designated waste container.

Know where safety equipment is located and how to use it.

**Observe these guidelines to help ensure that the lab is a safe and enjoyable environment to work in.**

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