



# Farm Energy IQ

Farms Today Securing Our Energy Future

## Biodiesel and Straight Vegetable Oil (SVO)

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## Farm Energy IQ

## Biodiesel and Straight Vegetable Oil (SVO)

### Outline

- Overview of Biodiesel and SVO – Why this matters.
- Biodiesel vs. SVO
- Making biodiesel
- Using SVO
- Using biodiesel
- What is B5, B20 and B100? And what should I use in my tractor?
- Equipment (engine) considerations when using biodiesel
- The safety considerations involved in making and using biodiesel
- Crops for SVO or biodiesel
- Basic agronomics and economics biodiesel crops
- Related equipment needed to process the crops to oil and meal.
- Examples

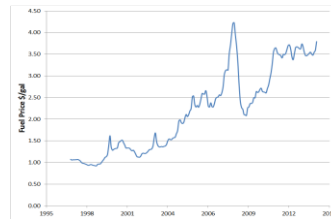
### Benefits of SVO and Biodiesel

Financial – cost of fuel

Planning – stable of cost of fuel

Efficiency – “energy return on investment”

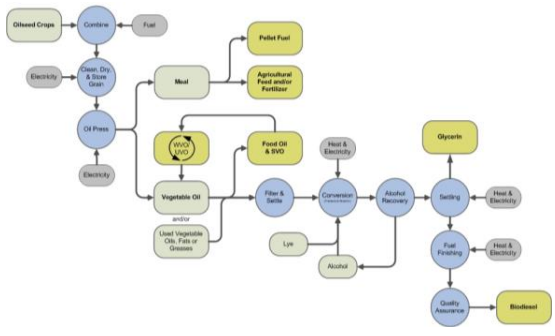
Environmental – net carbon reduction



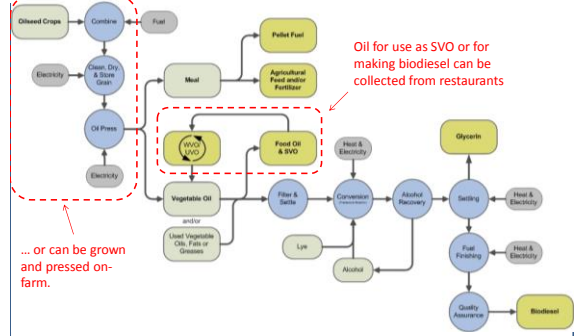
*“A hundred years ago we all grew our own fuel.”*  
John Williamson  
State Line Farm Biofuels, Shaftsbury, VT



### The Biodiesel Process Lots of places to “hop on” or “hop off”

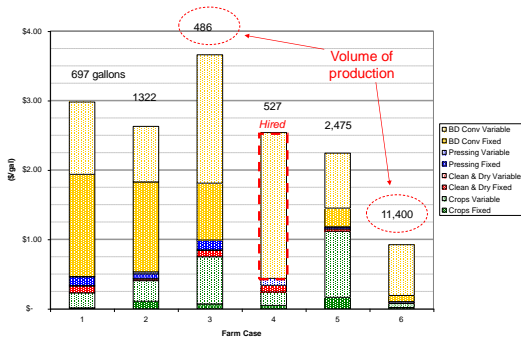


### The Biodiesel Process Lots of places to “hop on” or “hop off”



### On-Farm Biodiesel Production from Dilseeds

Case Study: Six Vermont Farms



### Straight Vegetable Oil (SVO) vs. Biodiesel

**How are these different?**

- SVO**
  - Mono, di, or triglycerides
  - Triglyceride shown:*
CC(C)OC(=O)C(C)OC(=O)C(C)OC(=O)C(C)C  - a.k.a. vegetable oil, fry oil, "grease".
  - Filtered and de-watered
  - Usually requires secondary tank and heaters for use in diesel vehicle.
- Biodiesel**
  - Mono alkyl esters, methyl esters
  - Refined oil, converted to "methyl esters":*
CC(C)OC(=O)C(C)OC(=O)C(C)OC(=O)C(C)C  - Lower viscosity, flows and sprays easier leading to better combustion
  - Lower gel and cloud point, better for winter use

### Biodiesel Blends

- "B5," "B20," and "B100"
  - Simple ways of referring to the concentration of biodiesel in a fuel blend
  - When 5% biodiesel is mixed into petroleum diesel it is called B5
- Why is it blended?
  - Cold weather properties
  - Cost balance
  - Emissions balance
  - Material compatibility
  - Solvent properties
- B20 is most common blend

### What Should I Use in My Tractor? Straight Vegetable Oil Overview

- May require engine modifications
- Oil heated to change the viscosity
- Start engine on petro-diesel fuel
- Shut down on petro-diesel fuel



Vegetable oils have high viscosity which may lead to injector coking and eventual engine failure.

Engine deposit builds up after running on straight soybean oil

Slide Credit: D. Schaufler, PSU – NewBio April 4, 2014.

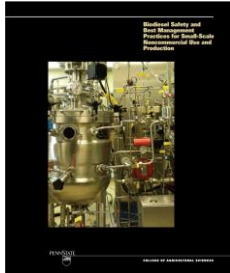
### What Should I Use in My Tractor? Biodiesel Overview

- National Biodiesel Board hosts an OEM statement summary Chart: <http://www.biodiesel.org/using-biodiesel/oem-information/oem-statement-summary-chart>
- Generally B20 is recommended
  - Some OEM's have fully embraced B100 and their design process focuses on this
- B100 has been successfully used in tractors in the Northeast through winter
  - Farm-based production; i.e., from sunflower and canola oil
- If purchasing, seek BQ-9000 certification: <http://www.bq-9000.org/>

### What Should I Use in My Tractor?

- Things to watch for...
  - Engine may run more quietly
    - Biodiesel has lubrication properties
  - May have reduced power
    - Biodiesel has lower Btu content per gallon
    - Generally 2% reduction in power, 3% reduction in fuel economy (B20)
  - Filters may clog more frequently
    - Generally because biodiesel is "kicking up" sediment in tanks
    - Can also be due to off-spec biodiesel
  - Cold weather gelling and poor flow can occur
    - Depends on feedstock

### Safety Guidelines



- Penn State Guide
- Small scale
- Somewhat PA specific, but extremely helpful
- Best single source for this sort of info

<http://pubs.cas.psu.edu/FreePubs/pdfs/agrs103.pdf>

### PPE: Personal Protective Equipment

- Eyes
- Ears
- Mouth and nose
- Skin



Material safety data sheets (MSDS's) for each material or chemical will provide guidance on proper PPE. Copies of MSDS's for each chemical in use should be on-hand and easily accessible by all personnel.

### Crops for SVO or Biodiesel What are Oilseeds?



Grains and Oilseeds:

*"Grains are identified as cereals suitable as food for human beings. Oilseeds are those grains that are also valuable for the oil content they produce."*

- Soybeans
- Canola
- Sunflower
- Camelina
- Crambe
- Flax
- Mustard
- Pennycress
- Rapeseed
- Safflower

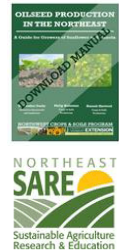


### Crop Production

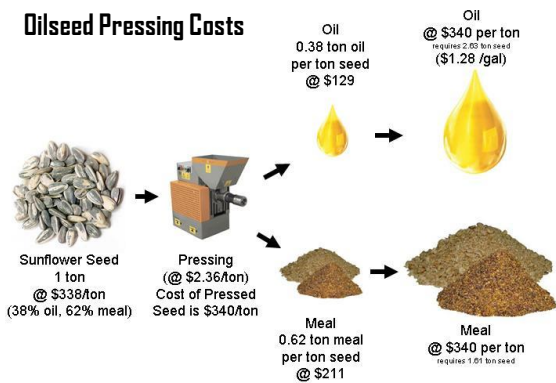
- Recently published handbook for Northeast oilseed production

Darby, H., P. Halteman, and H. Harwood, 2013. **Oilseed Production in the Northeast: A Guide for Growers of Sunflower and Canola.** University of Vermont Extension Northwest Crops and Soils Program, St. Albans, VT

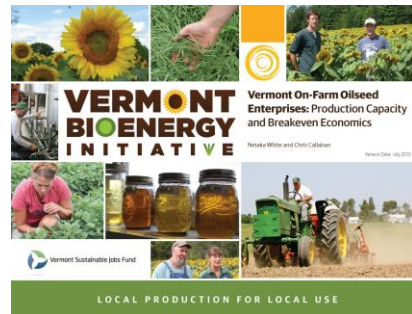
Available: <http://www.uvm.edu/extension/cropsoil/wp-content/uploads/OilseedManualFINAL.pdf>



### Oilseed Pressing Costs



### Vermont On-Farm Biodiesel—Cost of Production and Breakeven



Available: [http://www.vsi.org/assets/files/VBI/VT%20Oilseed%20Enterprises\\_July\\_2013.pdf](http://www.vsi.org/assets/files/VBI/VT%20Oilseed%20Enterprises_July_2013.pdf)

## Economics and Breakeven of On-Farm Biodiesel Enterprises

- 2013 report explored 2 scales of farm-based production
- As with most farm operations, highly dependent on cost of crop production and yield
- Analysis is provided in step-by-step form
- Calculator is available to aid in assessing potential

Breakeven Pricing for Sunflower Products at Various Costs of Crop Production and Yield

Recurring costs (of crop production)	1,000	1,500	2,000	Units
	pounds per acre	pounds per acre	pounds per acre	
\$100/acre	295	204	158	Seed, 5/ton
	296	206	161	Meal, 5/ton
	1.12	0.77	0.60	Oil, \$/gallon
	1.98	1.64	1.47	Biodiesel, \$/gallon
	1,974	1,316	987	Acres required
\$150/acre	395	271	208	Seed, 5/ton
	396	273	211	Meal, 5/ton
	1.49	1.02	0.79	Oil, \$/gallon
	2.36	1.89	1.66	Biodiesel, \$/gallon
	1,974	1,316	987	Acres required
\$200/acre	495	337	258	Seed, 5/ton
	496	340	261	Meal, 5/ton
	1.87	1.27	0.98	Oil, \$/gallon
	2.73	2.14	1.84	Biodiesel, \$/gallon
	1,974	1,316	987	Acres required

☐ = not profitable at assumed market prices

Note: Unless otherwise noted, all acreage above are net acres. These figures do not account for necessary rotation acres (i.e. 5x annual net oilseed acres), which will be necessary for sustained production as well as increased per-net-acre production. If the oilseed production is integrated with a diversified crop-rotation, this may not be a large factor in the operation.

## State Line Farm

John Williamson - Shaftsbury, VT

Maple Sugar & Honey  
Formerly a Dairy Farm  
Oil Seeds since 2005

Operate at 2k gal/yr with ~300k gal/yr capacity



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## Borderview Farm

Roger Rainville - Alburgh, VT

Crop Research Farm  
Formerly a Dairy Farm  
Oil Seeds since 2005

Establishing ~150k gal/yr capacity



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## Biodiesel and SVO

Questions?

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