Growing Your Own Fuel

Feasibility of Mobile Processing
Chris Callahan – Callahan Engineering, PLLC

Funded by The High Meadows Fund and The Vermont Sustainable Agriculture Council
The Vermont Sustainable Jobs Fund (VSJF) was created by the Vermont Legislature in 1995 to identify and fund market driven solutions to our pressing economic, social, and environmental issues.

- Current efforts focus on the intersection between the biofuels / renewable energy, sustainable forestry and agricultural sectors.

The purpose of the Vermont Biofuels Initiative (VBI) is to foster the development of a viable biomass-to-biofuels industry in Vermont that uses local resources to supply a portion of the state’s energy needs. *It is a component of sustainable, diversified agriculture.*
VBI Objectives

• Support the expansion of the supply and demand for locally produced and commodity level biofuels in Vermont
• Reduce the state’s dependency on petroleum;
• Promote entrepreneurial activity in the emerging biofuels sector through grant funding and technical assistance
• Stimulate farm-based biofuels production efforts as a means of enhancing farm viability and local fuel and food security; and
• Educate the public about the benefits of sustainably and locally produced biofuels.
Outline of Presentation

• Why mobile processing makes sense
• How it might work
• Financial modeling
• Energy return
• Next steps

Piedmont Biofuels Educational Trailer
Why Mobile Processing?

• New equipment is needed to process oilseeds into meal, oil and/or biodiesel
• Capital investment required
• Risk associated with crop production, and
• Risk associated with new equipment / processing.
• Mobile processor allows risk to be:
  – Spread among several farmers, and/or
  – Assumed by an independent contractor
• Maximize use of a equipment
How It Might Work

Mobile Oilseed Processing - Responsibility and Equipment Allocation

Responsibilities and Workflow

- Purchase Seed
- Soil Preparation
- Planting Seed
- Cultivation
- Harvesting

- Grain Drying
- Grain Storage

- Pressing Oil
- Primary Filtration
- Charge $/bushel

- Raw Oil Storage
- Meal Storage

- Provide Catalyst
- Produce Biodiesel
- Primary Filtration
- Charge $/gal oil

- BD / Glycerin Settling
- Biodiesel Storage
- Glycerin Disposal
- Final Filtration

Key:
- Farmer Responsibility
- Processor Responsibility

Equipment Needed

- Tractors
- Attachments
- Seed Drill
- Cultivator
- Combine and Head

- Grain Bin w/ Small Grain Floor
- Drying Fan
- Possibly more than one bin for batch drying

- Trailer
- Truck
- Press & Filter
- Receiving Tank
- Transfer Pump

- Poly Oil Tank
- Meal Bin / Bags
- Pelletizer for Meal (if needed)

- Trailer
- Truck
- Receiving Tank
- Transfer Pump
- Catalyst Tank
- Reaction Vessel

- Settling Tank (Cone Bottom), may be same as Oil Tank
- Fuel Tank with SPCC, filter and pump station
How It Might Work

• Study explored
  – Stand-alone pressing trailer
  – Stand-alone biodiesel trailer
  – Combined service provider

• Combined service is a reasonable assumption
  – Pressing and biodiesel production likely occur at different times
  – Same trailer can be used for both operations
  – Maximizes use of resources

• Approached as business modeling activity
Business Modeling

- Consider two central operations
  - Montpelier
  - Rutland
- 1 and 2 hour drive time windows
- Reach entire state and beyond
Platform and Major Components

Press

Processor

Trailer

Generator

Pace American – Summit SL714TA2, Landscaper’s Trailer

Capital Investment and Split Capacity:

All new: $138-290k, 78-180k gal oil / yr & 439-1013 ton meal / yr

Mostly used: $64k, 78k gal oil / yr & 439 ton meal / yr
Business Modeling

• Breakeven and Profit (or Loss)

Profit = Price – Breakeven Cost

Price is set by market (free market), but operator can choose market to some degree

Breakeven Cost is the combination of all fixed and variable costs relative to the volume of production.
**Business Modeling**

**Farmer Costs**

- $32k in fixed costs (20 yr life)
- $240/acre production (cons.)
- 1500 lbs/acre yield or 50 bu/acre (cons.)
- 31 acres (or 1550 bu)

  - ⇒ 17 tons meal
  - ⇒ 3000 gallons oil

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**Results (Breakeven)**

- $2.00/gal Oil
- $3.69/gal Biodiesel
- $439/ton Meal
Business Modeling

- Comparison of business models based on cost breakdown of outputs
- Both oil and meal are considered valued outputs
- Single enterprise provides pressing and biodiesel conversion service.

### Considering Oil / Biodiesel

<table>
<thead>
<tr>
<th>Percent of Market Value for Diesel Fuel ($4.00/gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Operation / Sole Proprietor</td>
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<tr>
<td>Automated Operation / Multiple Operator</td>
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<tr>
<td>On the Cheap</td>
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<tr>
<td>$0.31</td>
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<tr>
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<tr>
<td>$0.59</td>
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<tr>
<td>$1.41</td>
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### Considering Meal

<table>
<thead>
<tr>
<th>Percent of Market Value for Organic Meal ($599/ton)</th>
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<td>Manual Operation / Sole Proprietor</td>
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<tr>
<td>Automated Operation / Multiple Operator</td>
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<td>On the Cheap</td>
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- Processor Profit
- BD Conversion Breakeven
- Pressing Breakeven
- Farmer's Costs
Energy Return on Energy Invested

- How much energy is used to convert oilseed to oil, biodiesel and meal?

<table>
<thead>
<tr>
<th>Process</th>
<th>gal / gal</th>
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</thead>
<tbody>
<tr>
<td>Travel (Round Trip)</td>
<td>0.009</td>
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<tr>
<td>Pressing</td>
<td>0.002</td>
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<tr>
<td>Biodiesel Conversion</td>
<td>0.014</td>
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<tr>
<td>Methanol</td>
<td>0.049</td>
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<tr>
<td>Lye</td>
<td>0.011</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>0.085</strong></td>
</tr>
<tr>
<td><strong>EROEI</strong></td>
<td><strong>11.8 to 1</strong></td>
</tr>
</tbody>
</table>

- Energy Return on Energy Invested (EROEI) is calculated to be 11.8 to 1.
Next Steps / Future Work

• Quick Survey of Audience
  – Who is growing oil seed crops?
  – How many acres?
  – Interest in using this sort of service?
  – Interest in operating this sort of service?
  – Any other biofuel plans?
Q&A / Contacts for More Info

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