Straight Vegetable Oil (SVO)
The French experience

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Intern - Purpan University
Toulouse, France
with CSU Crops Testing
• World daily consumption: 82 million barrels of crude oil
• Oil currently available: 1081 billion barrels
• Hence: 36 years of capacity at this level of consumption

• Time to find solutions
Outline

1. Definitions
   - Bioethanol, Biodiesel, SVO,..,
   - Characteristics

2. Macro economic bioenergy environment in France

3. Installation of a crushing and filtering facility for SVO
   - Characteristics of SVO (definitions, ecological balance and energy efficiency ...)
   - How To Use SVO?
   - Standards
   - Economic model

4. 2 Case Studies
   - Let’s brainstorm!
Ethanol

- Ethanol production in France
  - From cereal (contracts with OS): wheat.
  - From sugar beat.

- ETBE (Ethyl Tertiary Butyl Ether): Ethanol + Isobutene
  - Is profitable for oil companies such as Total

![2004 World Ethanol Production](chart.png)

Source: Ministère de l'économie, des finances et de l'industrie

- Brasil: 36%
- USA: 36%
- Asia: 16%
- Europe: 10%
- Other: 2%
Biodiesel

- Vegetable oil + methanol + catalyst = Biodiesel + glycerine

- Production Contracts with OS or Crusher.
  - Industrial fallow
  - Out fallow, with subsidies ($23/ac)
CETIOM: Technical institute

ONIDOL: Coordination of all the professional organizations

FOP: Federation of oilseed growers

PROLEA

SOFIPROTEOL: Run the financial aspect
French energy situation

- Gas tax (TIPP): 6.6% of the government income.
- 79% of gas price is tax.
- 70% of cars use diesel.
- 97.2% of fossil fuel is imported in Europe vs 60% in US
In France

- **Goal for 2010:** 7% of fuel consumption from biofuels which would require 6 millions acres or 16% of the agricultural lands.
- Keep in mind that before the Industrial Revolution, farmers used approx. 30 to 40% of their land for animal traction feed.

- **French government supports:**
  - **Direct Tax credit:**
    Ethanol: $1.85/gal (to ethanol plant)
    Biodiesel: $1.65/gal (to biodiesel plant)
  - **Indirect tax credit:**
    Common Agricultural Policy (CAP) European Union

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### French biofuel consumption

<table>
<thead>
<tr>
<th>Years</th>
<th>2005</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuel</td>
<td>Biofuel</td>
<td>Fossil fuel</td>
</tr>
<tr>
<td>Diesel</td>
<td>7,750,000</td>
<td>92,500</td>
</tr>
<tr>
<td>Unleaded</td>
<td>2,750,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Total</td>
<td>10,500,000</td>
<td>122,500</td>
</tr>
</tbody>
</table>
US Situation

- **Total gasoline tax in Colorado**: 40.4 cents/gal and will increase 30 cents/gal in the next 10 years.
- 20% of cars use diesel - not including freight, trucks
- **Energy policy Act of 2005**:
  - Section 1501: promote the use of biofuels
  - **Goal 2006**: 4 billion gallons
    (In 2006 more than 4 billion gallons of ethanol produced plus ~300 million gallons of biodiesel)
  - **Goal 2012**: 7.5 billion gallons
- **Tax credit**:
  - Biodiesel: $1/gal for B100 or 1 cent per percent of biodiesel in the blend.
  - Ethanol: 51 cents/gal until 2010
Straight Vegetable Oil (SVO) from canola/ sunflower.

- "SVO: Oils obtained from oilseed crops by simple cold pressure, without solvant, clarified and filtered, and without chemical modification"

- SVO is considered biofuel according to the European Directive 2003/30/CE (May, 2003).

- However, SVO is not recognized as biofuel by the French Legislation. Currently, agricultural uses are tolerated but are not legally accepted.

- As of January 1, 2007, SVO will be authorized as an agriculture fuel

- Why should we develop SVO?
  - Community based development
  - Improve energy security
  - Decrease production costs for growers
  - To change the public image of growers
SVO, the key to limit air pollution.

<table>
<thead>
<tr>
<th></th>
<th>Regular Unleaded</th>
<th>Diesel</th>
<th>EMHV Canola</th>
<th>EMHV Sunflower</th>
<th>SVO Canola</th>
<th>SVO Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restutued energy/ Non renewable energy used</td>
<td>0.873</td>
<td>0.917</td>
<td>2.99</td>
<td>3.16</td>
<td>5.45</td>
<td>6.33</td>
</tr>
<tr>
<td>Green house gas emissions (q eq. CO2/kg)</td>
<td>3650</td>
<td>3390</td>
<td>888</td>
<td>745</td>
<td>660</td>
<td>498</td>
</tr>
</tbody>
</table>

No dangerous pollutants, such as benzène, lead or other heavy metals

Sources: Valbiom - Direction générale de l’agriculture Région Wallonne ; Jacques Lambert ADVA 31 et IFHVP
Oilseed Product and Properties

1 ton of oilseed ⇒ 1/3 SVO + 2/3 meal

1 acre of canola (2500 lbs/ac) = 95 gal oil + 1,600 lbs meal
1 acre of sunflower (2000 lbs/ac) = 75 gal oil + 1,200 lbs meal

- Excellent miscibility with diesel
- Flash point is higher than diesel
  - Decreases with oil oxidation
- Corrosive nature:
  - Advantages/Disadvantages
- High viscosity, decrease with temp
- Variable concentration of gum and wax (or phospholipids) can be a problem for the engine (especially for low/freezing temps).
European SVO Standards

Using standardized SVO
- German norm DIN 51605 -

- Phosphorus content ≤ 12 mg/kg
- Contamination total ≤ 24 mg/kg
- Moisture content ≤ 0.075%
- Acid value ≤ 2 mg KOH/g

No warranty on engine if SVO is not standardized
Crusher and Filter

Seed

Meal

SVO

Unfiltered oil

Filtered oil
Using SVO as Fuel

First Step - An adapted diesel engine

- If, **indirect** injection engine with low pressure system fuel will need to be blended:
  - 30% SVO in winter, 50% SVO in summer (without modification)
  - 70% SVO by modifying the injectors
  - 100% SVO by modifying the injectors and adding a fuel filter heater
  
  **Fuel filter heater price:** $50 to $100.

- If, **direct** injection engine low pressure system fuel will need to be blended:
  - 0 to 25% SVO if injection pump is weak (ex: Lucas)
  - 30% SVO in winter, 50% SVO in summer if adapted pump
  - 100% SVO with a Bi-Fuel Kit
  - 100% SVO if modifications of the engine
  
  **Bi-Fuel Kit Elsett price:** $3,500

- Direct injection engine high pressure fuel will need to be blended (lastest development):
  - 25% SVO in winter, 30% SVO in summer
  - 100% SVO with a Bi-Fuel Kit or after engine modifications
### Press: 100 lbs/h
- **Investment**: $26,000
- **Surface**: 40.8 ac
- **Oilseed production**: 42 T
- **Utilisation time**: 940 h
- **SVO**: 3,925 gal
- **Meal**: 27 T

### Press: 250 lbs/h
- **Investment**: $61,000
- **Surface**: 312 ac
- **Oilseed production**: 325 T
- **Utilisation time**: 7,200 h
- **SVO**: 30,000 gal
- **Meal**: 205 T

### Press: 250 lbs/h
- **Investment**: $193,750
- **Surface**: 768 ac
- **Oilseed production**: 790 T
- **Utilisation time**: 7,200 h
- **SVO**: 75,000 gal
- **Meal**: 490 T = 41 T/month

### Yield (assuming 2,500 lbs/ac)

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>Description</th>
<th>Press</th>
<th>Investment</th>
<th>Surface</th>
<th>Oilseed production</th>
<th>Utilisation time</th>
<th>SVO</th>
<th>Meal</th>
<th>Net return per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>meal sale for livestock</td>
<td>100</td>
<td>$26,000</td>
<td>40.8</td>
<td>42 T</td>
<td>940 h</td>
<td></td>
<td></td>
<td>- $39</td>
</tr>
<tr>
<td>2</td>
<td>meal sale such as combustible</td>
<td>100</td>
<td>$26,000</td>
<td>40.8</td>
<td>42 T</td>
<td>940 h</td>
<td></td>
<td></td>
<td>- $80</td>
</tr>
<tr>
<td>3</td>
<td>without meal sale</td>
<td>100</td>
<td>$26,000</td>
<td>40.8</td>
<td>42 T</td>
<td>940 h</td>
<td></td>
<td></td>
<td>- $203</td>
</tr>
<tr>
<td>4</td>
<td>Meal sale and DPU $130/ ac</td>
<td>250</td>
<td>$61,000</td>
<td>312</td>
<td>325 T</td>
<td>7,200 h</td>
<td></td>
<td></td>
<td>$91</td>
</tr>
<tr>
<td>5</td>
<td>proceeds from oilseed sale</td>
<td>250</td>
<td>$61,000</td>
<td>312</td>
<td>325 T</td>
<td>7,200 h</td>
<td></td>
<td></td>
<td>- $60</td>
</tr>
</tbody>
</table>

### Average plant under-exploited
- **Optimal use**
  - **Scenario 1**: $250/T
  - **Scenario 2**: $187/T
  - **Scenario 3**: without meal sale
  - **Scenario 4**: Meal sale and DPU $130/ ac
  - **Scenario 5**: proceeds from oilseed sale

### Centralized plant
- **Optimal use**
  - **Scenario 1**: $160/T
  - **Scenario 2**: $187/T
  - **Scenario 3**: $155
  - **Scenario 4**: $198
  - **Scenario 5**: $250/T

### Net return per acre
- **Scenario 1**: - $39
- **Scenario 2**: - $80
- **Scenario 3**: - $203
- **Scenario 4**: $91
- **Scenario 5**: - $60
Two Case Studies of Oilseed Crushing Systems

Mr. Gérard Donlencourt:

- Acreage: 804 acres rainfed
- Livestock:
  - 50 dairy cows
  - 80 head beef cattle
  - 440 sows
- Labor: 5 full-time employees
- Crops - 432 acres canola, wheat and corn
Canola Production for Shared Crusher

- 96 rainfed acres among 4 growers
- Ave yield: 2500 lbs/ac
- SVO production: 10,000 gal/yr
- Investment: $17,000 (4 growers)
- Blend: From 30% to 80% SVO with diesel and 2% unleaded gasoline and requires heater around the diesel filter.
- Tractor brand: CASE III 130 horsepower
- Meal utilization: 9lbs/day/cow & 8% of the pig ration
Characteristics:
• >100 lbs/hr
• Manufacturer: La Mécanique Moderne
• Price: $7,437.5
Auger of the Crusher

Characteristics:
• Clean after use
• Maintenance: replacement of bearing
Bulk Bag

Low Level Detector to turn off the crusher and the auger
Filter (3 microns)

Characteristics:
• >100 gal/day
• Cleaning: 800 gal/hr
Manufacturer: G & P,
Un rue hector berlioz
38210 Tullins,
Tel: 0033 04 76 07 88 88

Price: $3,875

Perlit: improves the cleaning

SVO flow
Heater on the Tractor

Diesel Filter

Hot water flow from radiator
## How Profitable for Gerard?

<table>
<thead>
<tr>
<th>Fixed Cost</th>
<th>Purchase cost</th>
<th>Mortage (years)</th>
<th>Annual cost</th>
<th>$/gal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crusher</td>
<td>$7 438</td>
<td>7</td>
<td>$1 063</td>
<td>$0.06</td>
</tr>
<tr>
<td>Filter</td>
<td>$3 875</td>
<td>7</td>
<td>$554</td>
<td>$0.055</td>
</tr>
<tr>
<td>Tank</td>
<td>$1 450</td>
<td>7</td>
<td>$207</td>
<td>$0.021</td>
</tr>
<tr>
<td>Silo</td>
<td>$1 375</td>
<td>7</td>
<td>$196</td>
<td>$0.020</td>
</tr>
<tr>
<td>Installation</td>
<td>$3 000</td>
<td>7</td>
<td>$429</td>
<td>$0.043</td>
</tr>
<tr>
<td><strong>Total equipment</strong></td>
<td><strong>$17 138</strong></td>
<td></td>
<td><strong>$2 448</strong></td>
<td><strong>$0.245</strong></td>
</tr>
</tbody>
</table>

| Annual Fixed Cost | $17 138 | $2 448 | $0.245 |

<table>
<thead>
<tr>
<th>Variable Cost</th>
<th>Electricity</th>
<th>Maintenance</th>
<th>Meal Storage</th>
<th>Oil Analysis</th>
<th>Annual Variable Cost</th>
<th>TOTAL Crushing Cost</th>
<th>Value of seed per gal of oil $ based on oilseed price and meal price ($260 and $160)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$171</td>
<td>$56</td>
<td>$148</td>
<td>$150</td>
<td>$525</td>
<td>$2 973</td>
<td>$1.56</td>
</tr>
</tbody>
</table>

| Total Cost Per Gallon $ | $2.11 |
| Diesel Price for Farmers (tax credit) | $3 |
Marc Lebaillif

- Acreage: 480 acres
- Production:
  - 80 dairy cows
  - Crops: canola, wheat, bean, corn.
- Marc has been crushing since 1998.
- Canola production for SVO: 8.8 acres.
- Oilseed crushed: 12 tons.
- SVO: 1,000 gal/years.
- Investment: $4,000
- Blend: two Case tractors run with 100% of SVO and others at 30%
- His Volkswagen Golf runs with 30% of SVO
Crusher from Germany

Heater to increase yield

SVO
Settling tank: 15 days
Filter (20 microns)

Second filter: 5 microns

Pump to inject in the one micron filter
# How Profitable for Case 2?

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment mortgage (10 years)</td>
<td>437.5</td>
</tr>
<tr>
<td>Electricity (years consumption)</td>
<td>250</td>
</tr>
<tr>
<td>Canola yield lbs/acre</td>
<td>4,000</td>
</tr>
<tr>
<td>Total production tons</td>
<td>12</td>
</tr>
<tr>
<td>Canola production cost per ton</td>
<td>144</td>
</tr>
<tr>
<td>Meal market $/ton</td>
<td>160</td>
</tr>
<tr>
<td>Meal production (ton/year)</td>
<td>8</td>
</tr>
<tr>
<td>SVO production (gal)</td>
<td>1,000</td>
</tr>
<tr>
<td>Cost/gal $ based on market price for oilseed and meal</td>
<td>2.5515</td>
</tr>
<tr>
<td>Farmers Diesel price $</td>
<td>3</td>
</tr>
<tr>
<td>Save per gallon $</td>
<td>0.4485</td>
</tr>
<tr>
<td>Red fuel price $</td>
<td>3</td>
</tr>
<tr>
<td>Save per gallon $</td>
<td>1.86</td>
</tr>
</tbody>
</table>
Freedom Questions?

Thanks!

Nicolas Enjalbert
Intern - Purpan University
Toulouse, France
with CSU Crops Testing