Food-Feed-Fuel: A Closed Loop Model for Regional Sustainability

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A significant negative issue relating to biofuels is its negative impact on food prices, which creates a consequential burden on consumers. In the United States, current production of biofuels is sustainable based on government subsidies, incentives, other market dynamics, and not necessarily on regionally available feedstock. The unfortunate burden of higher prices of food can be addressed by adopting non-food crops dedicated to biofuels, or by creating a closed-loop system whereby any food crop used as a feedstock for fuel must meet the criteria of: Food-Feed-Fuel (3F-model). The process must also avoid using food-crop acreages to produce a more profitable bioenergy crops. In the 3F-model, farmers continue to grow the usual food crops; however, the first use of the harvest is food and either by direct or indirect human consumption. Through the waste-stream in the form of fiber, residue and stover, feed and fuel will provide added-value to the region. In this presentation, the use of winter canola as a regional oilseed crop for the food, feed fuel model is demonstrated.

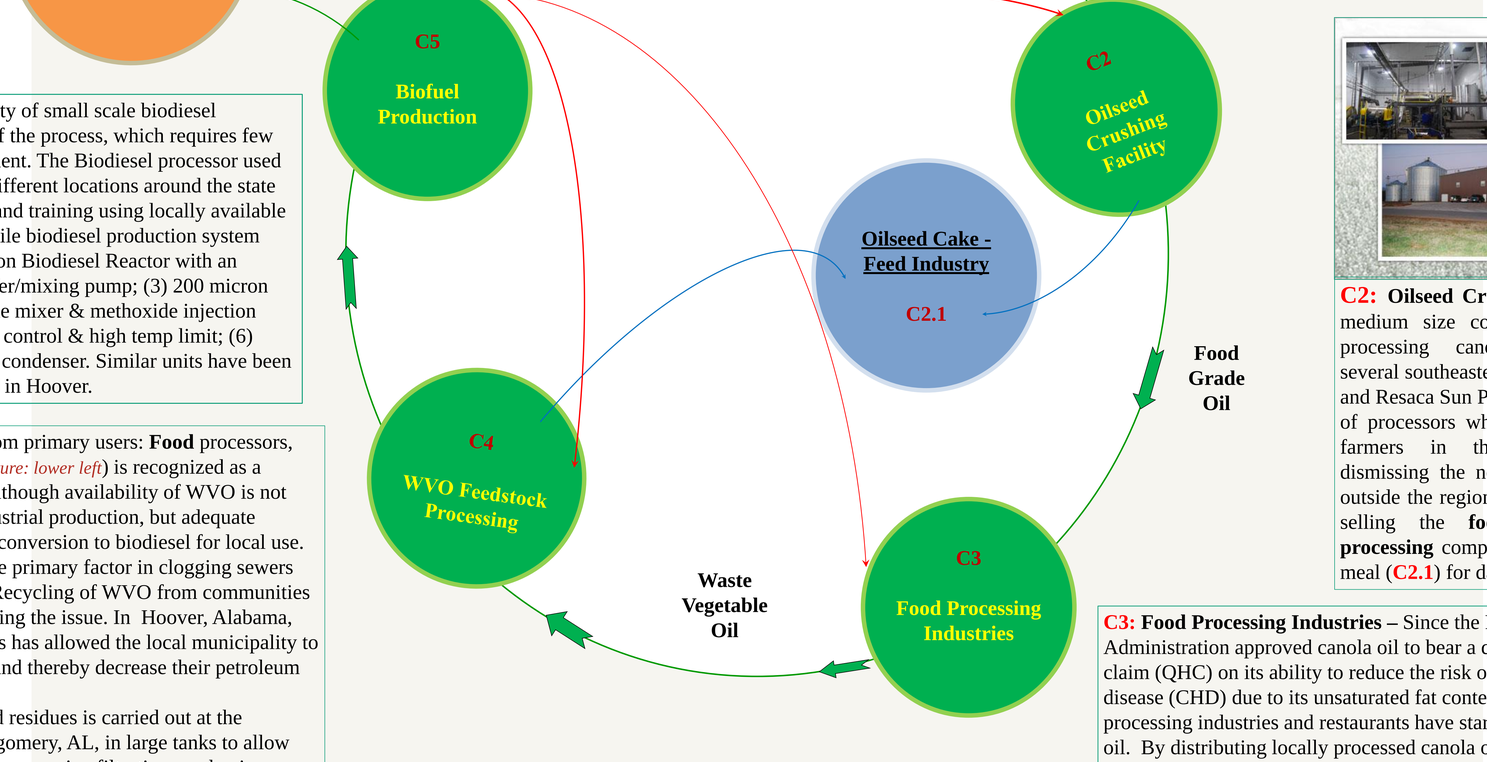
Winter Canola field in North Alabama

C1: Feedstock Production – Locally produced winter canola and/or sunflower are purchased at market price. Collaboration with growers are assessed in order to obtain all input data necessary to determine the economic impact of obtaining the crops locally versus being shipped-in from other locations. Assessment of feedstock production potential to sustain a pre-determine capacity of oil can be made based on the extent of current crop production in the region. During the 2010-11 growing season, 3,100 acres of winter canola was harvested in northern Alabama with and average production of 54 bu/ac. Economically, the receipt to farmers was greater than 2 million dollars.

Biomass residue from commercially harvested winter canola in Alabama

C1.1: Biobased Co-products – A potential source of biomass is generated from agricultural waste including canola for lignocellulosic conversion to renewable energy. Interests in nontraditional sources like agricultural wastes have great potential, because it could help meet the nation's need for energy by supplementing petroleum based fuels with locally produced biofuels.

C5.1: Added Value Products: New uses and innovative products are being evaluated with the use of glycerin, the waste stream product in the production of biodiesel. Besides its importance in the food and hygiene industries, glycerin has the potential to be converted to other forms of energy and even as a soil amendment and other agricultural products. The potential to convert the meal of winter canola and other summer oil seed crops into a variety of pelletized energy and/or feed products suitable for combustion and/or fish farming, poultry or small ruminants production (goats, sheep and goats) must be assessed.



C5: Biofuel Production - The popularity of small scale biodiesel production is due to the simplicity of the process, which requires few inputs and minimum capital investment. The Biodiesel processor used by Alabama A&M can be taken to different locations around the state to provide hands-on demonstration and training using locally available feedstock.The fully operational mobile biodiesel production system consists of: (1) BDL-55-SS, 84-gallon Biodiesel Reactor with an internal 2250 watt heater; (2) Transfer/mixing pump; (3) 200 micron pre-filter; (4) A 15-gallon meth-oxide mixer & methoxide injection system; (5) Control panel with temp control & high temp limit; (6) Relief valve; (7) Methanol recovery condenser. Similar units have been used at the Montgomery facility and in Hoover.

C4: Waste vegetable oil (WVO) from primary users: **Food** processors, restaurants and private citizens (*picture: lower left*) is recognized as a potential feedstock for biodiesel. Although availability of WVO is not sufficient to sustain large scale industrial production, but adequate volume is available for small scale conversion to biodiesel for local use. WVO often is often identified as the primary factor in clogging sewers that result in local street flooding. Recycling of WVO from communities have been shown to help in addressing the issue. In Hoover, Alabama, WVO collection from local citizens has allowed the local municipality to include Biodiesel as a supplement and thereby decrease their petroleum usage.
Processing of WVO to remove food residues is carried out at the Alternative Energy Center in Montgomery, AL, in large tanks to allow settling which decrease the need for expensive filtration mechanisms

C2: Oilseed Crushing Facility– Small to medium size companies are engaged in processing canola and sunflower oil in several southeastern states. AgStrong, LLC and Resaca Sun Products, LLC are examples of processors who are working with local farmers in the southeast, therefore, dismissing the need to import seeds from outside the region. The companies profit by selling the **food-grade** oil to **food processing** companies and the high protein meal (**C2.1**) for dairy and poultry **feed**.

C3: Food Processing Industries – Since the Food and Drug Administration approved canola oil to bear a qualified health claim (QHC) on its ability to reduce the risk of coronary heart disease (CHD) due to its unsaturated fat content, many food processing industries and restaurants have started using canola oil. By distributing locally processed canola oil to local users, one resulting benefit will be the availability of the **waste oil.**

The Closed-Loop Renewable Energy Model **A new concept being tested by Alabama A&M University** ***E. Cebert and L. Hauck (2008)***