



PROMOTING RENEWABLE ENERGY IN VERMONT

Vermont Biofuels Association

Alternatives for On-Farm Energy Enhancement in Vermont: Oilseeds for Feed and Fuel



Photo by Dorn Cox, Tuckaway Farm, 2006

Executive Summary

Prepared for
Vermont Sustainable Agriculture Council
Vermont Sustainable Jobs Fund



Prepared by
Netaka White, Executive Director, Vermont Biofuels Association

With additional research and reporting by
Emily J. Stebbins, UVM Dept. of Community Development & Applied Economics
Dr. Vern Grubinger and Dr. Heather Darby, University of Vermont Extension
Dr. Kenneth Mulder, Green Mountain College

August 2007

Oilseeds for Feed and Fuel in Vermont

The year 2006 brought major breakthroughs in public awareness of the problems posed by climate change and depleting oil reserves. Liquid biofuels—ethanol and biodiesel—are seen widely as part of the solution for reducing greenhouse gas emissions and buffering future oil shortages. While controversy is emerging around industrial scale practices associated with biofuels; from the destruction of rainforests to biofuels' impact on food production, sustainable biofuel production methods hold the promise of yielding environmentally friendly, renewable fuel, feed and food, leading to reductions in greenhouse gas and other emissions and new economic opportunities in rural areas.

Production of oilseed crops (such as soy, canola and sunflower) to produce biodiesel, livestock feed and food-grade oil is technically feasible in Vermont. Recent crop trials from Vermont, Maine, and New Hampshire indicate that yields for oilseed crops at or exceeding the national average are achievable in Vermont's climate and agricultural soils, but additional experience with appropriate harvesting equipment and perfecting oilseed harvesting techniques, as well as adequate drying and storage facilities are required. In response to farmer's interest and global forces affecting energy and agriculture, University of Vermont Extension, the Vermont Biofuels Association (VBA), Vermont Sustainable Jobs Fund (VSJF), UVM Center for Sustainable Agriculture and others have independently and collectively been researching oilseed crop production and value-adding scenarios to further establish the agricultural and economic feasibility of small-scale oilseed enterprises. This On-Farm Energy Enhancement initiative of the Vermont Sustainable Agriculture Council (VSAC) is one such project aimed at improving the viability of Vermont's family farms.

Project Goals

This report to the Vermont Sustainable Agriculture Council comes as the result of decisions by VSAC to study on-farm energy enhancement opportunities and partner with other Vermont organizations working to develop new sustainable agricultural enterprise. The Scope Of Work for this project includes these four goals:

1. Update information from the 2004 Biomass Research and Development Initiative's "Evaluation of the Economic Benefits to Farmers" of producing biodiesel from oil seed in Vermont with data to reflect current markets.
2. Determine the potential on-farm market for biodiesel by identifying the current level of diesel and heating oil use in Vermont in: tractors, other farm field equipment, and on-farm vehicles; greenhouse heaters; farm building oil furnaces; maple syrup production; and any other activities.
3. Determine the potential on-farm market for livestock feed derived from oilseed crops grown in Vermont by identifying the current level of demand for these feed components among the state's dairies, beef, bison, poultry and other livestock operations.

4. List and describe the current tax and environmental rules (both state and federal) pertaining to the production, sale and use of biodiesel made on Vermont's farms.

Acknowledgments

The Vermont Biofuels Association would like to acknowledge the many farmers, business owners, and other members of the local agricultural community who donated their time, assistance, expertise, and, in some cases, funds, land, and equipment. This study has also benefited greatly by the generous contributions and collaborations of several researchers and their recent reports on the prospects for sustainable biofuel production in Vermont; the VBA would like to thank Emily J. Stebbins, for her work on the, "Feasibility of Farm-Scale Biodiesel Production in Vermont", to be published in September 2007, Dr. Heather Darby, UVM agronomist and Dr. Vern Grubinger, UVM Extension, for their report "On-Farm Oilseed Production and Processing", published in May 2007, Dr. Kenneth Mulder, for his 2004 research on "An Ecological Economic Assessment of a Proposed Biodiesel Industry for the State of Vermont", and the follow-up work to the 2004 project, "Economic Feasibility of Commercial-Scale Biodiesel Production in Vermont: A Dynamic Ecological-Economic Assessment", by Dr. K. Mulder, Galen Wilkerson, and E. Stebbins, to be published in September 2007. Special thanks are also given to Scott Sawyer, VSJF, for his steadfast assistance with writing and layout. Without the significant contributions of these individuals' combined research and reporting, the On-Farm Energy Enhancement initiative would not have been possible.

Funders

This work is funded by the Vermont Sustainable Jobs Fund, the High Meadows Fund, the Maverick Lloyd Foundation, the Orchard Foundation, the Frank and Brinna Sands Foundation, the J. Warren and Lois McLure Foundation, Department of Energy funds secured by U.S. Senator Patrick Leahy, University of Vermont Extension, and the University of Vermont Center for Sustainable Agriculture.

Contributors and Project Partners

Emily J. Stebbins, UVM Department of Community Development & Applied Economics
 Dr. Vernon Grubinger, University of Vermont Extension
 Dr. Heather Darby, University of Vermont Extension
 Dr. Robert Parsons, Dept of Community Development & Applied Economics, UVM
 Dr. Matthew Waldron, Department of Animal Science, University of Vermont
 Dr. Peter Sexton, University of Maine
 Dr. Becky Grube, University of New Hampshire Extension
 Dr. Kenneth Mulder, University of Michigan
 Galen Wilkerson, Gund Institute for Environmental Economics, UVM
 Allen Matthews, Vermont Center for Sustainable Agriculture
 Netaka White, Vermont Biofuels Association
 Ellen Kahler, Vermont Sustainable Jobs Fund
 Scott Sawyer, Vermont Sustainable Jobs Fund
 Greg Strong, Vermont Sustainable Jobs Fund

Nancy Wasserman, Sleeping Lion Associates

Farmers

John Williamson and Steve Plummer, State Line Farm

Roger Rainville, Border View Farm

Andrew Knafel and Matthew Patterson, Clearbrook Farm

Farmers...continued

Brent Beidler, Beidler Family Farm

Spencer Blackwell, Intervale Bean & Grain

Paul Boivin, No-Mo-Ne Farm

David Cadreact, Sr.

Dorn Cox, Tuckaway Farm

Eric Dandurand

Robert Foster, Foster Brothers Farm

Ben Gleason, Gleason Grains

Joe Hescock

Tom Kenyon

Jack Lazor, Butterworks Farm

Guy Palardy

Larry Scott

Ken Van Hazinga

Businesses & Other Organizations

Jacob Bourdeau, Bourdeau Bros., Inc.

Jim Bushey, Bourdeau & Bushey, Inc.

Eric Dutil, Green Mountain Feeds

Gardner Merriam, Feed Commodities International

Les Morrison, Morrison's Custom Feeds

Greg Mruk, Chittenden Bank

Northeast Organic Farming Association of Vermont

Todd Pinkham, Vermont Soy

Scott Gordon, Green Technologies, LLC

Bill Whitney, Blue Seal Feeds

Executive Summary

In the summer of 2006 the Vermont Biofuels Association and Vermont Sustainable Jobs Fund organized a research team under the Vermont Feed, Food & Fuel Project (VFFF) that would take the next two years to help evaluate and demonstrate the feasibility of small-scale production of livestock feed, food grade oil and biodiesel from oilseed crops in Vermont. The project partners have been accompanied by University of Vermont Extension and the UVM Center for Sustainable Agriculture, which launched the On-Farm Oilseed Production and Processing and Farm Energy Enhancement initiatives, respectively, in 2005. This collaborative and the farms they work with are exploring whether Vermont communities could sustainably produce some portion of their liquid fuel, food grade oil and livestock feed supply, the requirements for and characteristics of Vermont-scale biofuel production, and whether Vermont entrepreneurs could create a replicable, economically viable model of local production of feed, food and fuel for local use, as an alternative to industrial biofuels and feed production.

Although farmers and biodiesel enthusiasts have been excited about the potential for these products, the full extent of the equipment, capital, and acreage needed has been unknown. Determining the economic feasibility for farmers of such activities is also vitally important at this early stage. Discussions with over a dozen farmers who are at various stages of growing and processing oilseed crops have indicated that market and economic viability data and decision-making tools will be of great value.

Vermont produces far fewer oilseed co-products than it consumes

Vermonters import over 100,000 tons of livestock meal, 78.6 million gallons of diesel fuel, and 147 million gallons of No. 2 heating oil per year, and an as-yet-to-determined amount of food-grade vegetable oil. Demand for fuel is expected to remain strong, and to continue to increase in the short term. Furthermore, volatility and increases in the price of crude oil are expected to continue to raise the prices that farmers and consumers pay for liquid fuels, fertilizers, and livestock feed.

Fewer than 2,000 acres are planted in oilseeds in Vermont today, mostly in soybeans that are roasted whole and fed to dairy cows, with several farms growing less than 200 acres of canola and sunflowers for crop trials and feed and fuel production.

Demand for oilseed meal in Vermont is driven by the dairy industry, with dairy cows estimated to account for approximately 97% of the market potential. Demand is particularly strong for organic livestock meals and vegetable oils, which are in short supply and command substantial price premiums. In general, the more value added to the end product, the higher the return per bushel or acre. The absence of genetically modified organisms (GMOs) is also an important criterion for organic feed mills and farmers, and could present additional opportunities for Vermont farmers interested in meeting this demand. Area purchasers of vegetable oil and meal expressed a willingness to buy and sometimes pay more for these if locally produced, provided they met quality and consistency standards and could be supplied reliably.

Farm-scale production of oilseed products is technically feasible

Production of oilseed crops and co-products is technically feasible in Vermont. Oilseed crops can grow well, and good yields are achievable given improved harvesting equipment and techniques. Crop trials from Vermont, Maine, and New Hampshire indicate that yields for oilseed crops at or exceeding the national average are achievable in Vermont's climate and agricultural soils. The primary factors necessary to increase yields to average levels are appropriate harvesting equipment, additional experience to perfect oilseed harvesting techniques, and adequate drying and storage facilities. Custom combining could represent a new business opportunity if more farms add oilseeds to their crop rotations.

Farm-scale processing techniques can produce high-value, good-quality oilseed co-products, but further refinement and testing are needed. Thus far, the quality of the oil and oilseed meal produced at the farm scale appears promising. As much as 3 lbs per day of this meal, depending on the type of oilseed, could be included in a ration for a high-producing dairy cow. To be able to sell this meal to other farmers or a feed dealer at a competitive price, however, the meal producer must be able to ensure that the meal is of a consistent quality. Further refinement and standardization of batch-processing techniques are needed, and additional, regular testing of the farm-pressed meal is recommended to establish quality and consistency.

A farm-scale seed pressing operation, including seed cleaner, press, and storage facilities is estimated to cost approximately \$30,000. Fixed costs to establish a farm-scale biodiesel production facility, with a 40,000 gallon per year output, are estimated at \$35,000, with an additional \$35,000 in annual operating costs. From a technical perspective, these operations are relatively easy to establish, but require careful site planning to ensure adequate safety measures and maximum efficiency. Some farmers and entrepreneurs are exploring the use of mobile biodiesel processing facilities that could travel from site to site, and this practice bears further study.

35,000 to 90,000 acres in Vermont could be shifted to oilseed crops per year provided farmers were paid prices just slightly higher than national averages for their oilseed crops. If there were no change in the size of Vermont's dairy herd and given the amount of land needed to support the state's dairy-centered agricultural system, it is estimated that approximately 50,000 acres could be rotated to oilseed crops in any given year. However, over the next 10 years, assuming an 18% decline in Vermont's dairy herd, which is consistent with trends over the past 40 years, an estimated 180,000 acres per year (or 90,000 acres on a rotational and sustainable basis) could be shifted to oilseed and other energy crops. This would produce sufficient quantities to meet the total on-farm demand for distillate fuels (6.4 million gallons per year) and as much as 50 percent (78,000 tons) of the anticipated meal demand in 2017.

Economic feasibility of a commercial-scale biodiesel production facility depends heavily on plant capacity. The ecological-economic simulation model, used in this study to simulate plant feasibility, consistently predicts a 500,000-gallon plant has only a small chance of being profitable, whereas a 2.5-million gallon plant will be profitable under every scenario.

In the commercial-scale model, plant revenues, and especially profitability, increase as the price of crude oil rises. Although a rise in the price of crude oil also causes the price of the oilseed feedstock to rise, the fractional increases in input prices are more than offset by the higher value of the biodiesel product.

The greatest potential employment gains can be achieved when Vermont farmers make a strong transition to oilseed crop production, and the commercial-scale biodiesel plant is able to obtain part of its oilseed feedstock from Vermont sources. Biodiesel production alone is predicted to produce 25 to 100 jobs, whereas high levels of oilseed production have the potential of tripling the employment impact.

Biodiesel production under every scenario produces a positive energy return on energy investment (EROEI). The EROEI of soybeans is consistently higher than the EROEI of canola, largely due to the leguminous nature of soybeans and the obviated need for nitrogen fertilizers. Canola, however, produces more net energy per acre, due to canola's higher oil yield.

Biodiesel production has a strong potential to reduce Vermont's carbon footprint, provided that land is shifted into oilseed production from other crops. The model predicts that a 2.5-million gallon plant can reduce carbon loading by over 15,000 tons a year of CO₂ equivalent.

The model indicates the highest level of Vermont oilseed production would yield enough net energy to fuel about 10% of total agricultural energy demand, which includes all fuel, electricity and heating. When combined with other on-farm energy enhancements such as increased energy efficiency and the use of other renewables, oilseed crops become an important component in reducing Vermont's dependence on fossil fuels and non-renewable energy to power the state's agricultural sector.

The recent release of two energy industry assessments, point to global petroleum demand outpacing supply from conventional sources as early as 2010-2011. Though vast amounts of oil (and gas) remain underground, "complex challenges" and "global uncertainties" could destabilize the "the sufficient, reliable and economic energy supplies upon which people depend", with oil production becoming a "significant challenge as early as 2015". This assessment, contained within the 420-page report from the National Petroleum Council corresponds with the latest International Energy Agency's prediction that oil supplies could become "extremely tight" in five years. This information highlights the importance of considering Vermont's on-farm fuel demand in context with global projections for crude oil and refined petroleum products.

Small-scale producers have important safety and environmental issues to consider. The farmer/producer needs to be aware of the air-quality, taxation and environmental issues pertaining to on-farm fuel production. In addition, since the production of biodiesel involves the storage and use of hazardous and flammable materials, it should only be undertaken with adequate property and liability insurance.

Recommendations

The following are recommendations for further action and research related to the development and study of farm and small-scale oilseed crop production in Vermont.

1. **Continue to build a network of farmers, processors, and other business owners involved in oilseed crop production, processing, distribution, and sales.** Developing and sharing local experience and expertise in oilseed production, processing, and marketing will be key factors in the success of new growers and processors.
2. **Establish systematic processes for testing, refining, and recording results of on-farm meal production to establish consistent quality standards.** The key determinants of a livestock meal's value to feed dealers and farmers are quality and consistency. Unless quality control can be established, the price of farm-processed meal will be discounted significantly. Farm-scale processors seeking to sell their meal must establish a standard process that consistently creates a product of a certain quality. Regular testing of meal batch samples is recommended until a process is established, as well as an in situ amino acid test to establish the protein characteristics of the meal.
3. **Investigate small cooperative enterprise models for oilseed processing and biodiesel production.** Several farmers have expressed interest in sharing investment in larger-scale oilseed-processing or biodiesel-making facilities. Dividing capital and operating costs among five to ten neighboring farms could lower barriers to entry of these markets, but the economic feasibility of such a model has not been studied in-depth. In addition, the costs and benefits of establishing mobile processing of oil seeds should be evaluated as another means to reduce start-up costs and increase economies of scale for small producers.
4. **Conduct further research on additional potential markets for oilseed co-products.** The following potential markets for oilseed co-products were beyond the scope of this study, but should be investigated further:
 - Food-grade oil sales, including analysis of Vermont's vegetable oil consumption, future price projections, and estimation of the extent to which Vermont farmers or entrepreneurs could penetrate local markets.
 - "Lease" of filtered, unrefined vegetable oil to restaurants, with subsequent collection by fuel processors for biodiesel production. This opportunity to use the oil for both food and fuel production is being explored in Canadian and New England markets, but has not been studied in Vermont.
 - Use of oilseed meal as a crop fertilizer, and comparison of the value of this end-use to the value of the meal for livestock feed, require further investigation.
 - Use of Glycerin (a biodiesel production by-product) as an anaerobic digester feedstock and/or livestock feed supplement.

explore the creation of a distributed liquid biofuels, livestock feed, and organic food-grade oil co-production system in strategic locations around the state.

These farm initiatives are designed to improve Vermont's feed and fuel security over the next 10 years. Their purpose is to foster locally owned, community- and/or farm-based biofuels and feed/food projects that will increase Vermont's renewable energy capacity and generate revenue and alternative sources of livestock feed for farmers. These efforts, combined with other complimentary activities, now underway or in the planning stage, are helping to create new job opportunities, localize energy production, and protect and improve Vermont's natural and social environments.