VERMONT BIOENERGY INITIATIVE

A program of the Vermont Sustainable Jobs Fund

COMMERCIAL BIODIESEL

U.S. DOE Award #DE-FG36-08GO88182

ABOUT THE VERMONT BIOENERGY INITIATIVE

The purpose of the **Vermont Bioenergy Initiative** (VBI) was to foster the development of sustainable, distributed, small-scale biodiesel from oilseeds and algae and grass/mixed fiber industries in Vermont that would enable the production and use of bioenergy for local transportation, agricultural, and thermal applications. Our investments in feasibility analyses, research and development, and demonstration projects for various bioenergy feedstocks were intended to lead to their commercialization over 7 year time horizon. This initiative was a statewide market building approach to sustainable development that may be replicated in other rural states around the country.

As a grant-making entity, project manager, and technical assistance provider, the Vermont Sustainable Jobs Fund (VSJF) solicited and selected the best sub-recipient proposals for bioenergy related projects through a competitive Request for Proposal process and conducted a number of staff directed investigations, all designed to support the four key priorities of the U.S. Department of Energy's EERE Strategic Plan:

1.) Dramatically reduce dependence on foreign oil;
2.) Promote the use of diverse, domestic and sustainable energy resources;
3.) Reduce carbon emissions from energy production and consumption;
4.) Establish a domestic bio-industry.

Thank you to the office of U.S. Senator Patrick Leahy for securing three U.S. Department of Energy congressionally directed awards (FY08, FY09, FY10) to financially support the Vermont Bioenergy Initiative.

Learn more at

VERMONT BIOENERGY INITIATIVE

http://vermontbioenergy.com

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Vermont Sustainable Jobs Fund

WWW.VSJF.ORG

The Vermont Sustainable Jobs Fund (VSJF) is a 501 (c) (3) nonprofit based in Montpelier, Vermont. VSJF was created by the Vermont Legislature in 1995 to nurture the sustainable development of Vermont's economy.

VSJF provides business assistance, network development, research, and financing in food system, forest product, waste management, renewable energy, and environmental technology sectors.

COMMERCIAL BIODIESEL SUMMARY

Distillate consumption in Vermont increased 48% from 1960 to 2013 and is equal to 29% of petroleum consumption. About 28% of distillate consumption in Vermont is for transportation, with the rest used for heating. The Vermont Bioenergy Initiative marked the first strategic effort to reduce Vermont's dependency on distillate fuel—mainly used for home heating and transportation—through the development of homegrown alternatives. Biodiesel is a commercially available, renewable, low carbon diesel replacement fuel that is widely accepted in the marketplace.

The VBI worked with commercial fuel dealers to support commercialization of blended biodiesel through investment in:

1. Establishing blending infrastructure at existing fuel dealers in Vermont,
2. Development of commercial scale biodiesel production infrastructure, and
3. Facilitation and support of biofuels network development in the state and region

In particular, this task was intended to complement the research and development work in algal and oilseed biodiesel production on farms by providing for the development of commercial processing and distribution channels which could support a locally produced bioenergy market once it matured in the state.

THE OPPORTUNITY

A 2011 study commissioned by the Vermont Bioenergy Initiative explored challenges to increased biodiesel adoption by interviewing stakeholders from four key sector groups: commercial end-users, residential end-users, fuel dealers, and biodiesel producers (Spring Hill Solutions, 2011). According to these stakeholders, the primary challenges were:

- Fuel availability
- Convenience of use and delivery
- Price of biodiesel
- Technical issues

However, the fact that fuel availability, technical issues, and convenience of use were cited by users as challenges suggested that this is not just a "demand-side" problem. For their part, Vermont fuel dealers that had carried biodiesel in previous years cited four main reasons for no longer doing so:

- Infrastructure issues
- Supply issues
- Low customer demand
- Expiration of the federal biodiesel tax incentive in 2009

Given the status of commercial biodiesel distribution systems and past experiences by both dealers and customers, there was a need for support of further development.

STATEMENT OF PROJECT OBJECTIVES

The Vermont Sustainable Jobs Fund, through its Vermont Bioenergy Initiative, made a series of grants to sub-recipients (Table 1) in the area of commercial biodiesel focused on research and development, systems feasibility and demonstrations, and education and outreach ("Task G").

To address the question of biodiesel and bioheat adoption as viable options for Vermont, this project developed four objectives:

Task G: Expansion of Commercial Biofuels Availability

SUB-TASK G.1: RESEARCH AND DEVELOPMENT

The objective of this task was to provide sub-recipient award funding to Vermont fuel dealers to complete land use and/or engineering feasibility studies and/or analyze financing options for new or improved capacity (e.g., to comply with new EPA rules, to provide biodiesel and bioheat in underserved areas of the state) or to expand into other renewable fuels.

- There were no sub-recipients under this sub-task.

SUB-TASK G.2: DEMONSTRATION / BIODIESEL

The objective of this task was to provide sub-recipient award funding to enhance biodiesel blending capacity in the state.

- **Bourne's Energy:** The objective of this project was to renovate an existing facility to provide the capability of blending biodiesel for sale to end-users of on-road, off-road diesel and home heating fuel.
- **D&C Transport, Inc.:** The objective of this project was to provide B2 to B100 to customers in northern Vermont.
- **Nava Bioenergy:** The objective of this project was to improve processing technology, refine the process chain, and maximize production in order to lower production costs and profitability of biodiesel production in Central Vermont.

SUB-TASK G.3: DEMONSTRATION / BIOMASS FUEL

The objective of this task was to provide sub-recipient award funding to enhance bulk distribution of biomass heating fuel in the state.

- There were no sub-recipients under this sub-task.

TABLE 1: COMMERCIAL BIODIESEL SUB-RECIPIENTS

Fiscal Year(s)	Sub-Recipient	DOE Funds	Total Cost Share	Total Project Cost
FY08	Bourne's Energy	$45,000	$98,370	$143,370
FY08	D&C Transportation	$32,500	$126,911	$159,411
FY09	Nava Bioenergy	$45,000	$49,077	$94,077
	TASK TOTAL	**$122,500**	**$274,358**	**$396,858**

Establishing Blending Infrastructure

The VBI provided funding support to two commercial fuel dealers for the development of blending infrastructure. Blending systems enable the proper mixing of 100% biodiesel (B100) with petroleum diesel that provides important technical and economic benefits for the early adoption of biodiesel. At the time of these projects, a blending tax credit was being provided to distributors of fuel to incentivize biodiesel purchase and use while also not exposing the market to increased risk from a complete switch. The use of a blended fuel helps to minimize technical risk that comes along with the use of 100% biodiesel (e.g., engine fuel system issues, suspension of sediment in old tanks, cold-weather performance challenges).

Bourne's Energy

The goal of this project was to renovate an existing facility to give Bourne's Energy the capability of blending biodiesel for sale to end-users of on-road and off-road diesel and home heating fuel. In 2011, a 36'x 30' heated steel building was constructed in Morrisville around a 20,000 gallon tank moved from Bourne's Waterbury facility. Biodiesel injection blending equipment was purchased and installed with necessary valves and controls to allow proper

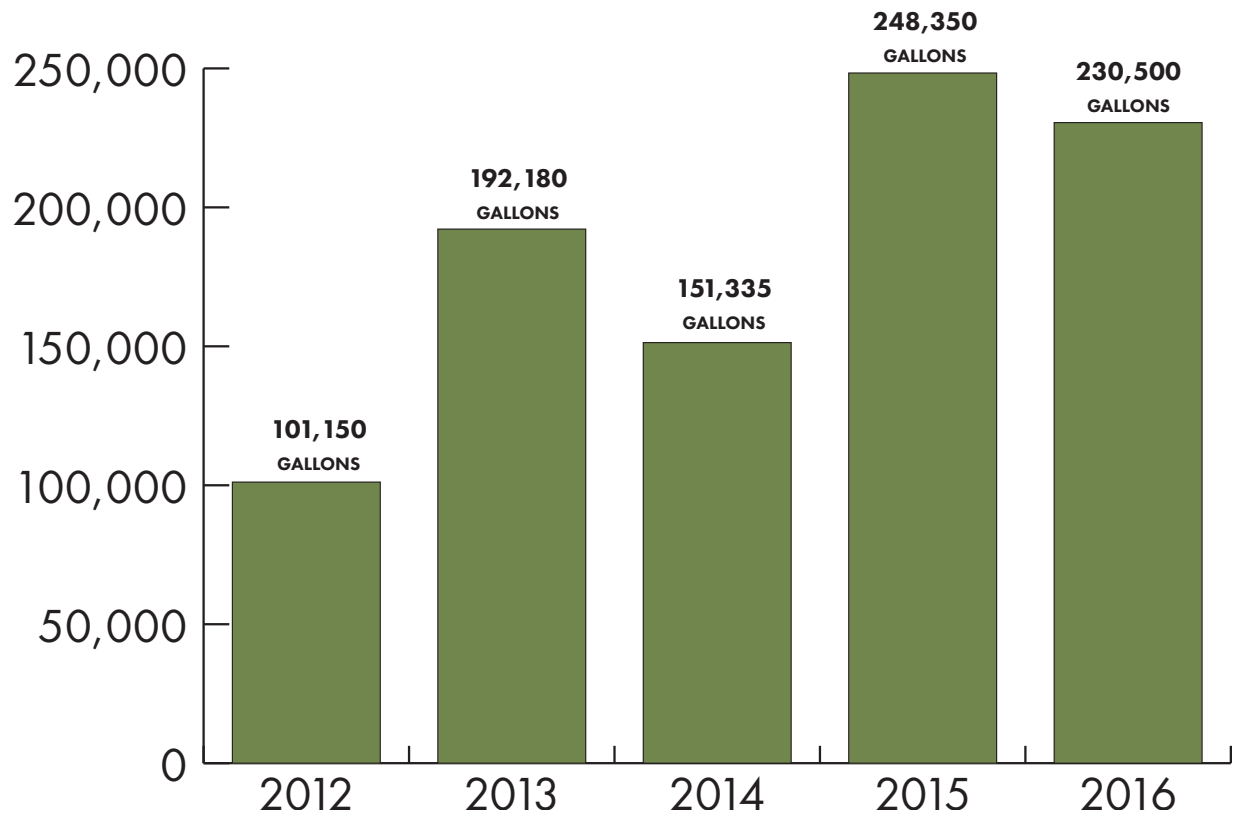
Ribbon cutting at Bourne's Energy's biodiesel blending facility. Left to Right: Elizabeth Miller (then the Commissioner of Vermont Department of Public Service), Netaka White (VBI), Tom Berry (U.S. Senator Leahy's Office), Peter Bourne (owner of Bourne's Energy)

blending for heating fuel and diesel in the desired percentage. This developed the firm's capability of increasing their customer base by providing a desired blend and increasing the use of biodiesel for transportation and heating oil, thereby reducing CO_2 emissions. Bourne's biofuel has replaced about 1,000,000 gallons of fossil fuel oil with clean, high-quality, certified ASTM D6751 low sulfur biodiesel for home heating, vehicles, and equipment since 2012 (Figure 1).

Bourne's Energy biodiesel blending facility.

The grant gave us the ability, to what will be in 2016, a million gallons of totally renewable products to our customers and prove that traditional oil heat can easily be replaced with a better product while using existing infrastructures. — Peter Bourne, Bourne's Energy

FIGURE 1: BOURNE'S ENERGY BIODIESEL SUPPLY



Bourne's credits the VBI funding with expediting the project; the facility was operational after a short seven-month time frame enabling Bourne's to provide product to end-users. The construction and installation of equipment was completed at a total cost of $143,370 and was completed in May 2011.

D&C Transport

D&C Transportation's objective was to provide B2 to B100 to an existing customer base in northern and north central Vermont. Biofuel products were neither offered nor readily available in this area of Vermont at the time of this VBI supported project. The project objective was to install a 12,000 gallon above ground tank (AGT) to store B100 product. In order to facilitate the need for keeping the B100 heated in the colder months, the AGT was housed inside an existing heated storage building. The tank was piped underground to the loading rack through a computerized blending/control valve bank.

By modifying existing equipment and installing ratio blending controls at their Newport facility, D&C Transportation expanded and diversified their product line by providing blended biodiesel to retail customers, state and municipal customers and other vendors. The VBI funds were used to offset the costs of the purchase of the Junge Controls Inc. Fuel Manager system that provides the blending function.

D&C found the Junge Controls Fuel Manager system to be user friendly. The biggest challenge was to overcome the effect of the colder ambient temperatures on the B100. Early on, the firm blended fuel only in the warmer months when the ambient air temperatures were above 48 degrees. They applied heat tape and insulated the exposed B100 piping to assist with this need.

Development of Commercial Scale Biodiesel Production

The VBI provided grant support to a small-scale commercial biodiesel production facility during its start-up phase. This was done in parallel with investments in farm-based, oilseed production systems to foster market development at multiple scales and along multiple channels. The work done at the farm scale was considered relatively novel and higher risk, whereas the work done at the commercial scale was well-established at the time in other parts of the country and offered a higher chance of success and volume impact.

Nava Bioenergy, LTD

The purpose of this project was to improve processing technology, refine the process chain, and maximize production in order to lower production costs and profitability of biodiesel production in Central Vermont. Nava Bioenergy purchased processing equipment to improve the separation of the biodiesel and glycerin, and a methanol recovery unit to improve fuel quality, lower its environmental footprint and reduce expenses. *Note: this sub-recipient was originally reviewed by US DOE and NEPA as a Task F – Oilseed Program project.*

Nava's primary business was to process used vegetable oil and oils produced from locally grown crops for conversion into biodiesel using the transesterification method. They also focused on the use of machinery and process equipment that would be economical, energy efficient and that would enhance the production process and improve the quality of final product.

Interior of Nava Bioenergy facility.

The VBI grant enabled Nava to purchase process equipment that was needed to meet and surpass the firm's goals and objectives and to produce a high quality product that exceeds the U.S. Standard for Biodiesel, ASTM D6751. Nava also improved the filtering system and quality control using batch glycerin testing. They also designed and built an easy, convenient and practical used oil collection system that was tested and approved by New England Culinary Institute.

A biodiesel hose, new gear pump and custody transfer metering system were added to the customer delivery system. Additionally, Nava purchased two double wall insulated/heated stainless steel tanks; 400 gallons for pre-mixing and 1,000 gallons for final product storage.

While Nava's customer base was starting to grow, feedstock supply did not parallel this growth. Locally produced vegetable oils were not available at volumes necessary for high volume biodiesel production and used oil from restaurants likewise became scarce due to commoditization. While there is sufficient used oil for biodiesel production in Vermont, competition from out of state companies developed (White Mountain Biodiesel opened in 2008 in Haverill, NH) and used oil started to command much higher prices.

Although Nava anticipated moving into a new, larger building in mid- 2012, it never materialized. This sub-recipient has since closed its doors.

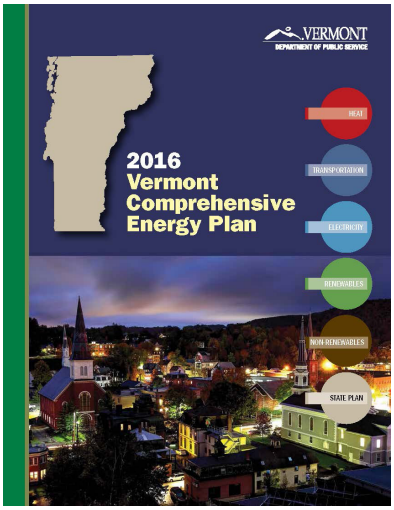
Education and Outreach

Renewable Energy Vermont

The purpose of this project (2009-2010) was to improve communication and networking opportunities within the emerging commercial biofuels sector. Renewable Energy Vermont (REV) convened a Biofuels Working Group comprised of a cross-section of key biofuels players from the following local businesses: Green Technologies and Biocardel (biodiesel producers), Bourne's Energy (fuel distributers), Green Mountain Coffee Roasters (biodiesel fleet operators), a biofuels consultant, Vermont Sustainable Jobs Fund, the Vermont Fuel Dealers Association (VFDA), REV (fuel and renewable energy industry trade groups), and AgRefresh (private sector business involved in biofuels and carbon policy work). The goal of the Biofuels Working Group was to address the strategic growth of the Vermont biofuels industry with an emphasis on identifying gaps in marketing, public relations, and public policy, and to initiate activities to fill identified gaps.

In addition, REV staff provided biofuels education to its members and the community at large through its website, newsletter, and annual conference, and by representing the biofuels industry at other renewable energy-advocacy meeting and ensuring bioenergy was included in reports, energy planning and projections, legislative strategizing, and so on. REV also assisted the VSJF in conducting a survey of biofuel producers and consumers to help determine ways of increasing demand and supply (Spring Hill Solutions, 2011). The project was not sustained after the grant period ended.

Vermont's Comprehensive Energy Plan input (2011 and 2016)



The VSJF Bioenergy Program Director worked closely with Vermont bioenergy stakeholders in the public, private and nonprofit sectors to prepare recommendations for the Vermont Department of Public Service' (DPS) twenty year Comprehensive Energy Plan (released in December 2011). Responsibilities included participation in a number of meetings and forums with the public, DPS staff, and state government officials, convening a VSJF led agricultural biomass stakeholder

group forum, and completing several policy papers to DPS with crosscutting recommendations for bioenergy market development. Comprehensive Energy Plan pages 205 – 217 were written by VSJF staff.

For the 2016 update to **Vermont's Comprehensive Energy Plan**, VBI consultant Chris Callahan and VSJF staff member Scott Sawyer, contributed important bioenergy industry updates, graphics, and maps to what became the final plan document (pp. 352-366).

NEXT STEPS

In 2016, the Vermont Department of Public Service released the **Vermont Comprehensive Energy Plan**, which calls for obtaining 90% of the state's energy from renewable sources by 2050 and reducing greenhouse gas emissions 50% from a 1990 baseline. The plan calls for major decreases in petroleum use through the electrification of vehicle fleets, wider use of heat pumps, and increased use of bioenergy. The VBI set the stage for increasing the production and consumption of biodiesel— the commercial biodiesel infrastructure supported by the VBI has helped to orient two large fuel dealers in Vermont to the handling and mixing of this biofuel. This improved integration of a new fuel into the distribution channel sets the stage for future growth in the use of biodiesel. but Vermont will have to overcome several obstacles to accomplish that state's long-term energy goals. Despite all of its benefits as a renewable, low-emission fuel with strong potential local economic development, biodiesel remains an underutilized resource with low market penetration in Vermont. Vermont biodiesel consumption peaked in 2008 at 5,632,000 gallons and fell in 2009 to 1,885,500 gallons. In addition, the number of fuel dealers carrying biodiesel fell from 18 in 2008, to eight currently.

REFERENCES

Spring Hill Solutions. (April 2011). *Vermont Biodiesel Supply Chain Survey*. Retrieved from: http://vermontbioenergy.com/wp-content/uploads/2013/09/VSJF-Vermont-Biodiesel-Supply-Chain-Survey-Final-Report.pdf.