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UBC Biodiesel Initiative

Helping Communities To Help Their Future

Presented By:

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Geoff Hill and Brenda Sawada
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Dear Geoff Hill and Brenda Sawada:

It has been our pleasure to aid you in creating a business development plan for your Biodiesel venture. We hope that our business plan will assist you in your goal of creating a Biodiesel production facility on campus and transferring the idea to other communities through awareness and education.

It has been a pleasure working with your organization we look forward to working with you again sometime in the future.

Sincerely,

Jessica Chou Doug McLeod Marcy Pozar

Jessica Yee Ada Yeung

Executive Summary

Project Goal

Provide working transferable model for creation of Biodiesel lab and promote awareness and understanding of Biodiesel process through education

Target Customers

Canadian universities and geographically isolated, tightly knit communities

Operating Structure

Project functions as non-profit, independent, self-contained unit answerable to UBC central authority

Competition

UBC first community-sized Biodiesel production facility of its kind; main product substitutes are ethanol-blended fuel and Biodiesel made from pure vegetable oil

Entry and Growth Strategy

Project considered fully "grown" when all waste oil is processed into fuel in community; growth is in form of transferring model to other communities

Pricing Strategy

UBC Food Services pays same rate for removal of waste oil; Plant Ops pays rate of conventional diesel

Marketing Plan

First contact other campus Environmental departments and secondly educate through provision of Transferability package to interested communities

Organization

Core management and fuel production staff will be paid; student club on campus will be base for volunteer assistance

Key Risks

Dependency on price of conventional diesel; non-profit structure makes it difficult to financially support satellite communities; pending government legislation may alter key assumptions made which are necessary for viability of Project

Project Goals and Aspirations

As you will see, Biodiesel is an exciting alternative fuel that has the potential to fundamentally improve the environmental sustainability of communities. This Business Development Plan outlines our unique Biodiesel solution to community waste, and provides a working model for setting up new Biodiesel projects.

The UBC Biodiesel Initiative Pilot Project (hereafter referred to as the "UBI" or the "Project") is comprised of two main goals. First, we wish to create a working model for the creation of a Biodiesel lab that can be transferred to other communities with minimal alteration. This is our goal of "Transferability". Second, we hope to increase both the awareness and understanding of the Biodiesel process through an active program of "Education". In the report that follows, we have highlighted the key components of our transferable business model.

History and Development of the Venture

Geoff Hill, a UBC Environmental Science undergraduate student, along with his partner Peter Doig, co-founded the Project in January 2002. Eventually, a myriad of UBC organizations including the Sustainability Office, the Alma Mater Society (AMS) and UBC Plant Operations, as well as the Environmental Youth Alliance (EYA) joined the project in various capacities.

The Process

The process of making Biodiesel from WVO is called "Transesterification" (**see Exhibit 1 for chemical process details)**. In this process, hydrocarbon chains are bonded together to form Biodiesel. A vegetable oil molecule is a *triglyceride* that is comprised of three *esters* and a molecule of glycerine. In order to process WVO into Biodiesel, the esters in the waste oil must be broken apart and separated from the glycerine molecule. During the process of transesterification, the glycerine molecule is replaced with a molecule of alcohol, which is methanol in our case. In order to break down the triglycerides, a catalyst—potassium hydroxide (KOH)—is added which releases the esters, allowing them to attach to the methanol. The KOH then combines with the glycerine and both substances fall to the bottom of the container with the remaining Biodiesel floating on top. If the glycerine by-product is heated at a temperature high enough to burn off the remaining alcohol and catalyst content, it can be further processed into epidermis products such as soap.

With limited financial resources, the main drawback is the efficiency of the production. The equipment acquired and the system designed are not considered to be the most effective method of making Biodiesel, although it is the most conventional, environmental way. There are many other processes that are being used around the world; however, they are designed purposely for commercialization. Although the UBI does not align with the goal of profit making, refining the Biodiesel production is still one of our on-going responsibilities because if costs are minimized, the likelihood of starting up this process in other communities will definitely increase.

Currently, more than 2000 Litres production of Biodiesel has been created by the system and combusted in a 91 Volkswagen Jetta diesel car, an 82 Volkswagen Westfalia diesel van, and a home heating oil furnace.

Advantages of Biodiesel: What Makes This Product Saleable?

Biodiesel fuel has numerous advantages over conventional diesel that make it desirable to consumers. First, the molecular construction of Biodiesel relative to conventional diesel will, when burned, increase engine lubricity (a measure of an engine's efficiency at performing the essential task of lubrication). Given the importance of lubrication in both the efficiency and lifespan of an engine, this is a significant benefit of the fuel. Second, Biodiesel has a high ignition temperature compared to regular petroleum diesel fuel (150°C vs. 52°C), which means that it can be transported quite safely with normal vehicles. Third, as a result of its organic origins, Biodiesel is both biodegradable and non-toxic; in fact, 100% Biodiesel is as biodegradable as sugar and less toxic than table salt. Therefore, in the event of a fuel spill, there would be far less damage to the affected environment than would occur with conventional diesel. Finally, although not an advantage of the fuel itself, it should also be noted that Biodiesel can be used in any diesel engine without major engine or fuel tank modifications. This is significant because it means that consumers will have negligible switching costs in adopting Biodiesel for their vehicles.

As mentioned above, switching costs to Biodiesel are low. However, they do exist: while the use of Biodiesel does not require major infrastructure changes to the engine, deterioration of rubber fuel hoses may occur with the use of Biodiesel due to the methanol content in the fuel. As a result, rubber fuel hoses and seals may need to be replaced with synthetic fluroelastomer equivalents such as *Viton®.* These products can, however, be found in most auto supply stores or replaced easily by any auto mechanic for a nominal charge.

Industry

The Industry In Canada

The Biodiesel industry in Canada is in its infancy stages. There are only two Canadian companies involved with Biodiesel, *Topia Energy: Green Incubator* and *Biox*. Nevertheless, there is a lot of interest surrounding Biodiesel; especially with regard to the benefits it could provide communities. Generally, efforts to educate people and grow the Biodiesel industry have fallen under the umbrella of an association called *The Canadian Renewable Fuels Association* (http://www.greenfuels.org). This association is dedicated to promoting and researching the use of renewable bio-fuels for transportation through consumer and government awareness. However, this association is mainly focused on more established alternative energy sources such as ethanol, so its impact on the Biodiesel industry has thus far been minor. In Ontario, a few small communities currently run city buses of Biodiesel as a pilot test project.

Generally, however, all of the initiatives mentioned above have been either minimal in their impact on Biodiesel (such as the association and the bus program), or serve a fundamentally different purpose from that of our project (such as the two commercial enterprises). Of greater significance to our project is the final initiative, the *Talloires Declaration*, which has been signed by several Canadian universities. This declaration, while not limited specifically to Biodiesel, has committed its signatories to pursuing sustainability, which directly fosters the market for our project (**see Exhibit 2 for complete declaration**).

The Industry in the United States

Given that the availability of Biodiesel in Canada is currently very limited, many people who are interested in using Biodiesel have looked to the United States. Relative

to Canada's miniscule industry, the American Biodiesel industry is booming. Biodiesel is available in all 50 states through suppliers, and more than 50 public pumps dispense Biodiesel in the U.S.

Factors Affecting Industry Growth

Due to the rising interest of Canadians and the federal government in environmental issues and reduction of fossil fuels, the Biodiesel market is expected to increase substantially over the next few years. Already the government has made the move to reduce federal taxes to encourage both the production and sale of Biodiesel. The growing environmental concern over the earth's greenhouse effect coupled with increasingly stringent governmental regulations on emissions standards translates into the need for more environmentally friendly fuel sources. In fact, some governments, especially in the EU, are also offering tax exemptions, which would normally be assessed on diesel fuel, to encourage the use of Biodiesel[1]. Conflicts in the Middle East, where most of the worlds supply of fossil fuels can be found, further increases the governmental pressures to find fuel sources, which can be domestically produced. This is evidenced by President George W. Bush's recent State of the Union Address, in which he explicitly called out for alternative fuel development.

Legislation Favouring Biodiesel

In the United States, significant pro-Biodiesel legislation includes the Clean Air Act of 1990 (which called for reduced sulphur content in diesel fuel and reduced diesel exhaust emissions) and the Energy Policy Act of 1992 (which established a goal of replacing 10 percent of motor fuels with non-petroleum alternatives by year 2000 up to 30 percent by year 2010). In Canada, the Alternative Fuels Act requires that 50 percent

of *all government vehicles* purchased are able to run on alternative fuels, and it is likely that the requirement will rise to 75 percent by the year 2004[1].

Customers

The Biodiesel Project is completely local in concept and design, with a single community providing supply and demand. This community-based design currently exists at UBC. However, the Project *will* grow. This growth will be accomplished through *exporting* our business plan. Our current strategy is designed to appeal to other Canadian universities, and it may eventually be adopted for use in non-campus communities such as Bowen Island. Our emphasis in this project will be on geographically concentrated and tightly knit communicates. These communities will allow for a high degree of communication amongst project members, and the logistical simplicity that comes from small distances. Most importantly, such communities (and especially university campuses) will allow us to achieve "integration," which we now explain.

"Closing the Loop:" The Concept of Integration

Generally, in its day-to-day operations the UBI will function as an independent, self-contained unit. However, the Project *will* be ultimately answerable to the UBC administration, just as all other businesses and projects that operate out of the UBC campus are. Although the specifics of central university control will obviously vary across universities, it can be generally assumed that all other UBI sponsored projects will be answerable to their respective university administrations.

[1] Biodiesel Industry Facts. (1996). In *Canadian Renewable Fuels Association*. Retrieved Feb. 9, 2003 from http://www.greenfuels.org/biopress.html.

In order to understand the integrated nature of the UBI, it is important to realize that not only will the *Project* fall under the central university administration, but so will control of our waste vegetable oil (WVO) *suppliers* and our *customers*. For example, at UBC, UBC Food Services will provide the WVO supply, and UBC Plant Ops will use all of the Biodiesel output. Both these entities are ultimately divisions of the central UBC administration, just as the UBI is. As a result, the relationship between the UBI and its suppliers and customers will be relatively free of all entanglements, simply because all of the entities are essentially one and the same. The significance of all involved being answerable to the same authority is that the need for extensive contracts is avoided and incentive problems are minimized.

Competition

Generally, competition for supply and customers will not be a concern for the Project, due to the fact that all three entities (suppliers, UBI, and customers) fall under the control of the same entity. In other words, since it would not be rational for the central administration to support a UBC Project on one level while undercutting it on another, this type of competition is not an issue. However, competition may be a problem with regards to initially obtaining WVO supply, since WVO suppliers will likely have existing relationships with private WVO handlers. In the case of UBC Food Services, they are *not* under contract with regards to WVO removal, so they are able to support the Project without complication.

Also, it should be noted that in the Lower Mainland, rational, privately organized WVO handlers would not feel threatened by this Project. This is because if the UBI *did* ever grow to a large enough size that would affect a significant amount of the handlers' volume, we would need to use their distribution services anyways.

Direct Competition

Currently no other universities in Canada are pursuing Biodiesel projects similar to ours. Also, given our project goals (education and transferability), it should be noted that even if other universities *were* to launch similar projects, they would hardly be regarded as competition!

As mentioned earlier, two companies currently produce Biodiesel in Canada. However, given that these companies are solely focused on selling Biodiesel commercially, and given that our goal is to increase Biodiesel's prominence, we would likely be *encouraged* by them, so we don't regard these companies as competitors either.

Indirect Competition

The major competition that we will encounter is Biodiesel substitutes. The main substitute will of course be conventional diesel. Of course, since the fundamental goal driving our project is the usage of conventional diesel, this has already been taken into account. A more relevant comparison is between Biodiesel and other alternative, "green" fuels.

The most prominent of these is ethanol-blended fuel. There are currently 238 million litres produced annually and over 929 retailers are selling ethanol-blended fuel in Canada. Ethanol-blended fuel is made from several different types of grain and is produced through fermenting starch and sugar. Although this type of fuel is more established in the market, it is not as effective at environmental conservation as Biodiesel. Ethanol blended fuel is a combination of regular fuel with 10% of ethanol. The blend is not nearly as effective at reducing emissions, carbon dioxide, and air pollutants because of the low mixture quantity. However, ethanol can only amount to

10% of a fuel blend because any higher amount would require engine modifications, unlike Biodiesel where no changes in engine are needed. Furthermore, ethanol blended fuel also has several more by-products to content with and is not biodegradable. Thus, there are many limitations to the use of ethanol-blended fuel.

Although a much less prominent market in Canada, the other type of substitute for our Biodiesel, which is made from waste vegetable oil, are other forms of Biodiesel. Biofuel can also be produced from pure vegetable products such as soybeans, corn, or sunflower oil. The difference between fuel made from pure vegetable oil and used vegetable oil is that Biodiesel does not go through the process of transesterification when using pure vegetable oil. Although it is easier to find or create large amounts of material in one place for fuel, using pure oil eliminates the environmental goal of recycling waste products. As well, in order to use Biofuel made from pure vegetable oil, it requires engine modifications and has a much higher "clouding temperature" as compared to Biodiesel made from waste vegetable oil. Pure vegetable oil also makes a diesel engine run less effectively and can easily clog fuel lines.

Most substitutes require engine modification, which is a major reason why many types of alternative fuels are not readily accepted due to the substantial costs. In order for an alternative fuel to effectively penetrate the market, the benefits must exceed the costs of using the fuel from the consumers' perspective. To distinguish our Biodiesel with other substitutes, we focus on these selling points: producing same output as regular diesel fuel along with environmental benefits and avoidable engine modification costs. Apparent benefits can be seen by consumers, which are definitely unattainable by all other types of alternative fuels.

Entry & Growth Strategy

The nature of the UBI prevents it from growing organically since the main idea behind the project is to 'close the loop' within a community by recycling the WVO. The project can be considered 'fully grown' once all WVO is being reprocessed. For example, since the lab size of 1000L/week already uses all of the WVO at UBC, there is no room for the project to grow organically.

The UBI *will* grow however in the sense that the idea will spread to other universities and communities. However, to gain acceptance from those communities, we must first well establish ourselves at UBC by providing a successful role model for other communities and universities. As our Marketing plan explains in greater detail, one of the major goals of the Project at UBC is to help other communities to implement similar systems of their own, effectively creating a multiplier effect across Canada.

Pricing & Accounting Strategy

The highly integrated relationship that the UBI has with its suppliers and customers has interesting implications for pricing strategy and accounting. There are numerous possibilities for structuring the revenues and costs of the Project, as explained in **Exhibit 3.** For the reasons given in that exhibit, we have decided to use the following accounting structure for the UBI:

a. Supply: UBC Food Services will pay the UBI the same rate they were previously paying to have their WVO removed.
b. Demand: UBC Plant Ops will pay the UBI the same rate they were paying for conventional diesel, and will consume the entire 1000 litre/week output of the

Project. Plant Ops currently uses well in excess of 1000 litres/week, so demand can be regarded as constant for the purposes of the Project.

c. Rates for both supply and demand will remain in sync with the market rates, so neither suppliers nor buyers will experience any expense changes as a result of supporting the UBI.

Marketing Plan

Our target market consists of Canadian universities and small communities. Specifically, we hope to target Canadian universities who are signatories of the *Talloires Declaration* and who have made their express commitment to sustainable practices on their campuses. There are currently 23 universities across Canada who have signed on to this agreement **(see Exhibit 4 for a complete list)**. With respect to these universities, our awareness strategy consists of a two-pronged attack. First, it is the duty of the UBI to build the initial interest in creating a community-sized Biodiesel facility on campus. Second, it is the responsibility of those interested to further spread awareness of the subject on their own campuses, with the added assistance of the UBI.

In building the initial awareness, our first point of contact with these universities will be with the departments of Environmental Engineering and/or Environmental Science. We will send out an informative brochure to respective department heads and interested parties requesting further information. Then they can apply for a complete marketing package including:

- 40L sample of Biodiesel (sufficient to run one diesel car engine)
- A complete description of our business model outlining all major components of the project, along with equipment and materials specifications and facilities diagrams

- A costing spreadsheet with all relevant variables accounted for such that the university can test the feasibility of such a project on their own
- Campus and adjustable target variables as necessary to ensure feasibility
- An educational video

We suggest that those spearheading the project also start a student club. This not only lends a voice to Biodiesel project, but it also serves to build a volunteer support base, which can be helpful during the initial operating stages of the venture. Other suggestions include the implementation of a student co-op program or an academic research project examining and refining the process so as to earn the support of the faculty and university administration. The UBI will readily supply the university with informational media such as posters and brochures as per request, to aid in the awareness campaign**.** Furthermore, the UBC Project Coordinator can be outsourced to act as an on-site consultant during the initial start-up phase for communities trying to implement their own Biodiesel production system.

Organization

A Coordinator is needed to oversee operations locally and act as a spokesperson for the project. A Director of Finances is needed to manage and redirect funds so as to keep the project economically sustainable. One laboratory technician is also needed to supervise the production of fuel. All of the above are paid positions **(see Exhibit 5 for wage levels)**. Indirect involvement has been in the form of UBC Bike Cartage staff, UBC Plant Operations Staff, UBC Food Services staff, UBC Sustainability SEEDS students and TransLink Bus Operator and customers. UBC Food Services staff stores waste vegetable oil and animal fat from deep fryers into containers where it is then

picked up by currently voluntary Bike Cartage Staff and transported to the laboratory for fuel processing. Although the Project is succeeding without it, we hope to obtain the cooperation of Plant Operations vehicles in the future to help with WVO pick-ups (running on Biodiesel, of course).

Additionally, although not directly a part of the Biodiesel Project organization, it is recommended that parties interested in adopting a Biodiesel project on their own campus should contact the supply and demand organizations they will be integrated with at a very early stage, since these organizations play such a key role in the Project.

Distribution Methods

As mentioned above, WVO is currently transported via Bike Cartage carts from UBC Food Service outlets to the laboratory for fuel processing. Currently there are no regulations with regards to the transportation and storage of Biodiesel on campus. Given the non-toxic nature of the fuel, as well as the high "flashpoint" (ignition temperature), the fuel can be transported quite safely. Biodiesel will be made available to UBC Plant Ops vehicles via a central fuelling station located outside the laboratory. Here, all UBC diesel engine vehicles can refuel their tanks easily without having to travel outside of campus. This ease of distribution is one of the key advantages of promoting the Project in geographically concentrated communities.

UBC Health, Safety & Environmental Regulations

Ray Hryciuk, Manager of Environmental Programs, has given approval for the safe operation of the production of Biodiesel as this process and its inputs are not in violation of UBC Environmental and Safety regulations. Any wastes produced as a result, can be disposed without the intervention of UBC Environmental Services Facility,

since they are not hazardous. As well, the transporting of Biodiesel is not a concern as long as this is done within UBC and not on public roads.

Facilities

Research conducted by Geoff Hill shows that a batch size of 1000L of Biodiesel run once a week would effectively recycle *all* of UBC's WVO. Laboratory space on UBC campus has been procured. The main reactor is a closed system with a capacity of 500L (one batch) per run. Materials for the reaction are loaded into the vessel where they undergo the basic transesterification process and all excess methanol and catalyst can be recycled. The resulting fuel is then washed to remove the excess catalyst and stored outside (see **Exhibit 6 for Biodiesel Pilot Plant Schematic**). Rent for the laboratory is discussed in the financing section.

Regulatory, Legal & Control Issues

The Biodiesel Project will be registered as a non-profit organization as it meets the following conditions outlined in the Excise Tax Act subsection 123(1)

- It was organized solely for non-profit purposes;
- It is in fact operated solely for non-profit purposes; and
- It does not distribute or otherwise make available for the personal benefit of any member any of its income

Financing Issues

The initial UBI was made possible through a $25,000 grant from the VanCity Credit Union. This grant was awarded based on the educational and environmental potential of the Biodiesel Project, and it has been sufficient to launch the initial costs of

the project. However, given that subsequent Biodiesel projects in other jurisdictions will not be as groundbreaking as the initial UBC project that it is undesirable to rely on grant funding, an important aspect of our transferability goal has been to ensure that subsequent Biodiesel projects can be financed under more stringent conditions:

The first of these adjustable statements is **Exhibit 7,** entitled "The Transferability Package." This exhibit shows the operating profit from the UBC Biodiesel Project, based upon the raw inputs and prices being paid at UBC. Working from the operations calculations in **Exhibit 7,** we have put together a set of financial statements (balance sheet, income statement, and statement of cash flows), and made projections for these statements under 'good' and 'bad' scenarios. These financial statements, as well as the scenario analysis, are elaborated further in **Exhibits 8a-c.**

Based upon the operating profit calculated in **Exhibit 7,** and the financial statements calculated in **Exhibit 8**, we have made the following conclusions about the UBC Biodiesel Project:

a. The UBI will have enough of a positive cash flow to fund the second goal of Biodiesel education and there will still be money left over. Also, although it is not needed in the UBC case because of the aforementioned grant, this remaining money shows that the UBI would be able to cover payments on a loan for those universities using debt financing.

b. With the importance of obtaining a start-up loan in mind, we have also performed a valuation of the Project, shown in **Exhibit 9.** As the exhibit demonstrates, the UBI produces enough revenue to have a positive NPV $ 16,484.20. For a detailed explanation of this valuation, please refer to the exhibit.

Transferability of the Financial Statements

One of the key goals of our Project is *transferability,* meaning that our business plan must be easily exportable to other communities. Therefore, although the financial analysis we have performed on the UBC location is useful, it is not sufficient for our purposes, since input prices will undoubtedly fluctuate across time and space. With this in mind, we have designed all our financial statements to perform *two* functions. First, in their "hard" printout form, they function as statements for the *UBC* Project, since all the amounts and variables in the exhibit are equivalent to those at UBC. Second, there is a "live" computer version of exhibits 7 and 8 (which we will provide to new start ups), which can be automatically re-calculated simply by changing the raw input amounts in **Exhibit 7.** By preparing our statements to be adjustable in this fashion, we have maintained our goal of transferability.

Taxes

There are different ways to account for the taxes involved in a non-profit organization. First, by registering with Revenue Canada, we are exempt from paying income tax. Thus, as can be seen in the Projected Financial Statements (**Exhibits 8a-c**), accounts such as Future Income Tax Asset/Liability, Taxes Payable and Income Tax Expense are not applicable. Second, as a small non-profit organization, with revenue less than $50,000 per year, we have chosen not to register for GST/PST. This means that we do not charge GST/PST to our customers (UBC Plant Operations) and we will not be claiming any input tax credits for the tax on purchases and operating expenses. However, we are entitled for a rebate of 50% of the GST/PST on eligible purchases and general operating expenses. Such purchases and expenses include rent, utilities,

administration expenses, goods and services used, consumed, or supplied, and capital property.

Milestone Events

As already mentioned, Geoff Hill founded the Biodiesel Project in January 2002. Then in October 2002, the VanCity Environment Fund Grant of $25,000 was awarded. An HRDC wage grant was also granted for a Coordinator to run the project 3 days a week from July to December 2002.

The first Biodiesel fuel was created during the spring of 2002 in a small Bio-Resource Engineering lab and during the summer of 2002 in a building far south on campus. However, since the conditions of the South Campus building did not meet the requirements necessary to produce the amount of fuel desired, a new lab was needed. Fortunately, in January 2003, a new production facility was provided by John Grace in the Gas Gunn Building, which allowed for the production of a 500 litre pilot system.

In March 2003, after discussions with UBC Plant Operations, they indicated their commitment to the purchase of 1000 litres of Biodiesel per week. Recall that the current batch size is 500 litres. This means an output of two batches per week is needed to satisfy the demand. However, legal contracts of this agreement are yet to be finalized.

As for the future, finalized contracts are expected to be negotiated by the end of April, as a better estimate for the price of Biodiesel will be established. By the end of 2003, continuing efforts towards cost minimization will result in economies of scale. Starting in 2004, our goal is to market this concept to other communities, mainly the Canadian universities who have committed themselves to sustainability. By this time, it is hoped that further research and development will make these developments possible.

Key Risks

Although Biodiesel is currently a positive Net Present Value (NPV) Project, our system of determining profitability based on the price of conventional diesel is, obviously, highly dependent on the price of diesel. Therefore, we are vulnerable to fluctuations that may occur across time and space in the price of diesel. Another possibility is that invention of better substitutes for Biodiesel may one day be created; although Biodiesel is currently by far the best use of WVO, a better substitute use would negate one of the fundamental goals of the Project. Also, since one of our goals is to promote the production and consumption of Biodiesel elsewhere, we are concerned with the resources necessary to fund such a project. As the UBI is a not for profit organization, there are limited funds available to support our "franchisees". Thus, they will have to look to their universities for financial support, which may not be granted. Lastly, since Biodiesel is fairly new in Canada, and there has been little to no legislation regarding it. As more research is done on Biodiesel, the government may feel the need to intervene in either the production or the consumption of Biodiesel, thus altering our current assumptions, those of which has allowed for the viability of the Project.

Future Potential

It is our hope that the UBC Pilot Project will lead to an increased awareness and usage of Biodiesel systems, even if this impact is only on a small scale. It is important not to overlook these small communities as they provide the ideal conditions under which a business model such as the one laid out in this report would best operate within. Through a greater understanding about environmentally friendly fuels, we hope to improve the environment at large, one community at a time.

Exhibit 1: *Chemical Process of Transesterification*

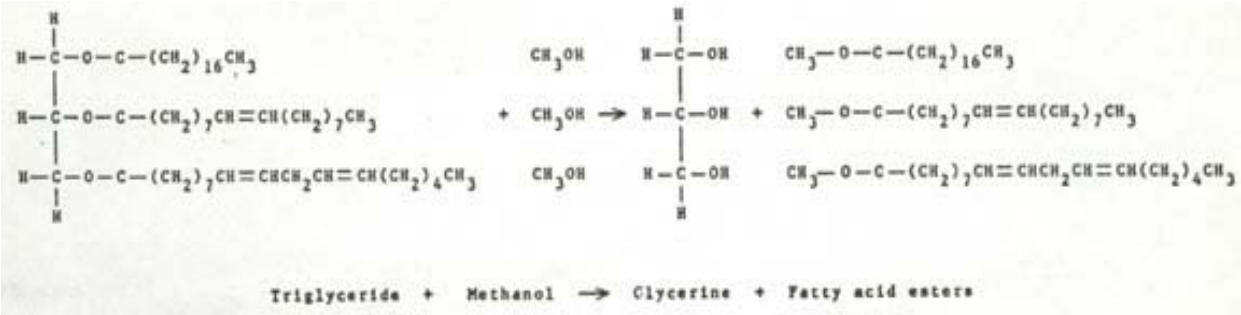


Exhibit 2: *The Talloires Declaration*

We, the presidents, rectors, and vice chancellors of universities from all regions of the world are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer and emission of "green house" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

We, therefore, agree to take the following actions:

1. Increase Awareness of Environmentally Sustainable Development
Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2. Create an Institutional Culture of Sustainability
Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.

3. Educate for Environmentally Responsible Citizenship
Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4. Foster Environmental Literacy For All
Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional students.

5. Practice Institutional Ecology
Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6. Involve All Stakeholders
Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and nongovernmental organizations to assist in finding solutions to environmental problems.

7. Collaborate for Interdisciplinary Approaches
Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8. Enhance Capacity of Primary and Secondary Schools
Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.

9. Broaden Service and Outreach Nationally and Internationally
Work with national and international organizations to promote a worldwide university effort toward a sustainable future.

10. Maintain the Movement
Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

Exhibit 3: *Various Structures for the UBI*

The fact that the UBI will be integrated with its sources of supply and demand means that much of the operating costs and revenues associated with the Project are essentially *transfer prices* within a single organization. This means that there is a great deal of leverage in deciding how to account for the gains and losses from the UBI. In fact, there are numerous ways in which revenues and costs of the Project can be structured. We have outlined two such examples below and have explained which model we are following, and why.

Model #1: The Project Operates for "Free"

Under this model, the UBI would take waste vegetable oil (WVO) from the community at no charge and would also give away the processed Biodiesel to designated customers at no charge. Under this model, all the gains of the UBI project would accrue to the suppliers and customers within the community. The benefit of this approach will be the improved financing of the suppliers and customers. The downside, however, is that this system would resign the Project to being a heavy money loser, and would require constant injections of capital from a central authority to maintain the UBI. We have chosen *not* to adopt this model, for two reasons. First, by widely spreading the benefits of the UBI, it becomes very difficult to value the Project itself. Second, the heavy reliance on a central authority would weaken the long-term prospects for the UBI and lower the attractiveness of this Project to other communities.

Model #2: The Project Operates as a Business

Under this model, the UBI will charge market rates to both its WVO suppliers and its Biodiesel customers. In other words, the implementation of the UBI would have *no* impact on the finances of the suppliers or the customers. These parties will be committing to the UBI not for financial reasons but rather for the belief in UBI and also at the behest of the ruling central administration. We prefer this model to others because it allows us to quantify the costs and benefits of the Project. With clear valuation of the project, the benefits will be obvious to the public.

Exhibit 4: *Tallories Signatories List*

Canada

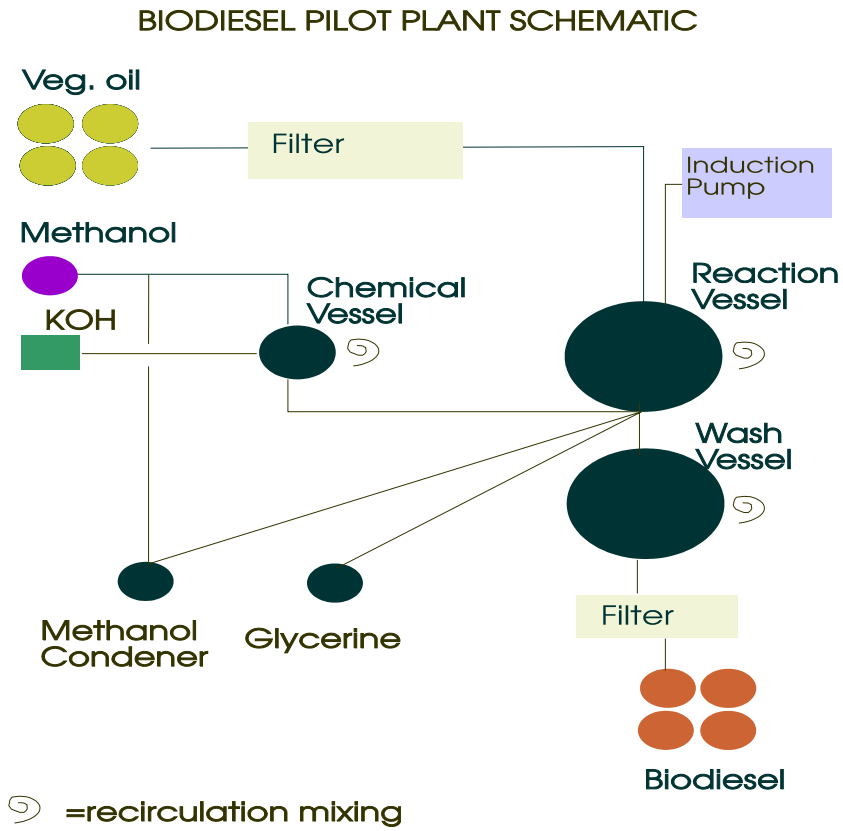
1. Atlantic School of Theology, Halifax, Nova Scotia
2. Carleton University, Ottawa, Ontario
3. Concordia University, Montreal, Quebec
4. Dalhousie University, Halifax, Nova Scotia
5. Lakehead University, Thunder Bay, Ontario
6. McGill University, Montreal, Quebec
7. Mount Saint Vincent University, Halifax, Nova Scotia
8. Ryerson Polytechnical Institute, Toronto, Ontario
9. Saint Francis Xavier University, Antigonish, Nova Scotia
10. Saint Mary's University, Halifax, Nova Scotia
11. Saint Thomas University, Fredericton, New Brunswick

12. Simon Fraser University, Burnaby, British Columbia
13. University College of Cape Breton, Sydney, Nova Scotia
14. University of British Columbia, Vancouver, British Columbia
15. University of Guelph, Guelph, Ontario
16. University of Lethbridge, Lethbridge, Alberta
17. University of Manitoba, Winnipeg, Manitoba
18. University of Ottawa, Ottawa, Ontario
19. University of Saskatchewan, Saskatoon, Saskatchewan
20. University of Victoria, British Columbia
21. University of Western Ontario, London, Ontario
22. University of Windsor, Windsor, Ontario
23. York University, Toronto, Ontario

Exhibit 5: *Wage Levels*

Management/Administrative Positions:
Coordinator – 12 hours/week, $13.50/hour
Director of Finances – 12 hours/week, $13.50/hour
Production Staff:
WVO Pickup – 1.265 hours/1 L, $0.1898/L
Lab Technician – 1.4.75 hours/1 L, $0.1425/L

Exhibit 6: *Facilities Diagram*



Source: Geoff Hill

Exhibit 7: SAMPLE TRANSFERABILITY PACKAGE, PAGE 1

Input Data (* Can Be Adjusted)

Section A: Input Schedule:

Input Costs (Revenues)	$/unit	Units	Adjustable Field
Waste Oil	($0.13)	Litres	*
Methanol	$1.11	Litres	*
KOH	$3.60	Kilograms	*
Phos.Acid	$4.65	Litres	*
Labour	$8.25	Hours	*
Electricity	$0.06	KiloWattHou	*

Section B: Variable Input Amounts (Per 1L Biodiesel Unless Noted)

Chemical	Amount	Units	
Waste Oil	1.000	Litres	
Methanol	0.170	Litres	
KOH	0.005	Kilograms	
Phosphoric Acid	0.010	Litres	
Electricity	0.446	KiloWattHour	
Labour A	1.265	Hours	*
Labour B	4.750	Hours	

Labour A: Per 100L - Labour Involved In Pickup

Labour B: Per Batch Size; to monitor lab reaction

Fixed Inputs/Month	Amount	Units	Rate
Lab Space	200	Square Feet	$ 326.00
Coordinator	52	Hours	$ 13.50
Director of Finance	52	Hours	$ 13.50

Section C: Other Variables

Variable	Amount	Units	
Batch Size	500	Litres	*
Batches Per Week	2	Batches	*
Avg. Weeks/\Month	4.3	Weeks	
Avg. Output/month	4,333	Litres	
Mkt.Price Conv. Diesel	$0.7890	Litres	

Initial Equipment Investment Cost (500L Lab)

Description of parts	Unit Cost	Qnty.	S/H	Total
Welding Machine	$ 1,600.00	1	$ 200.00	$ 1,800.00
Reactor Tank	$ 1,300.00	1	$ 162.50	$ 1,462.50
Wash Tank	$ 800.00	1	$ 100.00	$ 900.00
Methanol NaOH Tank	$ 400.00	1	$ 50.00	$ 450.00
Pump Methanol	$ 580.00	1	$ 72.50	$ 652.50
Pump Biodiesel	$ 1,126.00	1	$ 140.75	$ 1,266.75
Pump Water	$ 1,085.00	1	$ 135.63	$ 1,220.63
Pump Circulation	$ 1,810.00	1	$ 226.25	$ 2,036.25
Condensor	$ 300.00	1	$ 37.50	$ 337.50
Spill Basin	$ 200.00	1	$ 25.00	$ 225.00
Misc. Other Parts	$ 500.00	1	$ 62.50	$ 562.50
Viscosity Test Kit	$ 201.00	1	$ 25.13	$ 226.13
Glycol Test Kit	$ 119.00	1	$ 14.88	$ 133.88
Filters (strainer)	$ 300.00	1	$ 37.50	$ 507.32
Misc. Safety Equip.	$ 300.00	1	$ 37.50	$ 337.50
Drum Heaters	$ 212.00	2	$ 26.50	$ 238.50
Thermometer	$ 52.75	2	$ 6.59	$ 59.34
Drums	$ 28.00	20	$ 3.50	$ 31.50
pH probe	$ 134.50	1	$ 16.81	$ 151.31
		Total Equipment Cost		**$ 12,599.10**

Explanatory Note: The two spreadsheets shown on this page include the "Input the "Initial Lab Investment Costs." The data for both of these sheets has been ta the actual costs and rates associated with the UBC Biodisesl Project. Figures wi **star** next to them (*) may vary across time and space, and should be analysed b new projects in other communities. The figures **without** the red stars can be exp remain constant. **These adjustable charts, along with the "Profit-Loss" state the following page, comprise our "Transferability package that would be di to individuals interested in starting up a Biodiesel Project, so that they cou localised inputs in order to determine whether or not a Project would be w

Adjustable Field
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Exhibit 8a

UBC Biodiesel Initiative
Forecasted Balance Sheet
Good Scenario

	2003	2004	2005
Assets:			
Cash	$ 12,682	$ 14,274	$ 18,115
Accounts Receivable	$ 3,419	$ 3,419	$ 3,590
Inventory	$ -	$ 1,426	$ 1,498
Equipment	$ 12,599	$ 12,599	$ 12,599
Accumulated Amortization	-$ 378	-$ 882	-$ 1,386
Total Assets	$ 28,322	$ 30,836	$ 34,415
Liabilities and Net Assets:			
Liabilities			
Accounts Payable	$ 1,437	$ 1,437	$ 1,509
Total Liabilities	$ 1,437	$ 1,437	$ 1,509
Net Assets			
Restricted	$ -	$ -	$ -
Unrestricted	$ 26,885	$ 29,399	$ 32,906
Total Net Assets	$ 26,885	$ 29,399	$ 32,906
Total Liabilities and Net Assets	$ 28,322	$ 30,836	$ 34,415

UBC Biodiesel Initiative
Projected Income Statement
Good Scenario

	2003	2004	2005
Revenue	$ 30,769	$ 41,025	$ 43,076
Less: Cost of Goods Sold	-$ 12,935	-$ 17,247	-$ 18,109
Gross Margin	$ 17,833	$ 23,778	$ 24,967
Expense			
Rent	$ 2,934	$ 3,912	$ 4,108
Depreciation	$ 378	$ 504	$ 504
Salary (Coordinator and Director of Finance)	$ 12,636	$ 16,848	$ 16,848
Total Expenses	$ 15,948	$ 21,264	$ 21,460
Net Income	$ 1,885	$ 2,514	$ 3,507

Assumptions:

1. Operations begin in April of 2003.
2. Capital Assets are being depreciated straight-line over 25 years.
3. Accounts Receivable and Accounts Payable are for a period of one month.
4. Inventory in year 2004 and 2005 is for supplies one month in advance.
5. Input prices and revenue stream will be stable for at least the next three years.
6. **Revenue, Cost of Goods Sold, and Rent increases by 5% in 2005 due to inflation.**

Exhibit 9: *Valuation of the BioD*

The following is a financial valuation of the BioD project, as it exists at the UBC site. This is a net present value (NPV) type valuation. The basic components of this valuation are as follows:

a) An annual profit of $2,517.12. This is based on the monthly profit of $209.76 that was calculated in **Exhibit 7.** We have given this rate of profit a 20-year lifespan, after which we have assumed that the project will cease (due to the fact that society will have embraced clean sources of energy by that time).
b) A discount rate of 5.91%. This is the Bank of Canada rate on a 10-year T-bill as of March 22, 2003.
c) The $12,599.10 cost of lab equipment as shown in **Exhibit 7.**

The creditors who will be making loans to new BioD's in other jurisdictions will be community-oriented financial institutions such as credit unions, and even university administrations themselves. The attraction of the BioD to credit unions will be that it is a non-profit, environmentally progressive and educational project. In other words, the high profile the project will generate through our educational efforts means that institutions will be motivated to fund BioD's as an act of corporate citizenship. For university administrations, the project is attractive because it is in the spirit of the commitments that most universities have made with regards to sustainability (such as the TALLOIRES Declaration mentioned in the BDP). The BioD also furthers general university goals such as a sense of community and generally contributes to an academic environment. Given these alternative motivations for credit unions and universities, we feel that the low discount rate is justified for our project.

Using these figures, we have arrived at a valuation of:

$2,517.12 * [1-(1.0591^{20})]/0.0591 = $2,517.12* 11.5542 =	$29,083.30
Less equipment purchase costs:	(12,599.10)
BioD Valuation Equals:	**$16,484.20**

This evaluation shows that the UBC BioD site would have had a positive NPV even if it had not received grant funding.

As has been mentioned elsewhere in this report, costs and prices will vary across time and space. With that in mind, this valuation should not be taken as a definitive statement of the value of a BioD project, but rather as evidence that BioD is reasonably likely to be self-financing, which, when combined with the other non-monetary benefits of BioD, should make it a saleable investment.