Cellulosic (Non-Food) Ethanol and Specialty Chemicals for an Increasingly Demanding Global Economy

The Combustion Engine Drives the Global Economy: With inexpensive fossil fuel readily available and in seemingly unlimited supply, much of the world spent the 20th century developing infrastructure (highways, bridges, shipping channels, tankers, pipelines, service stations) for vehicles that run on fossil fuels. It has become clear that fossil fuels are no longer inexpensive and the supply is finite. Furthermore, fossil fuels are now known to be harmful to the environment and the world is demanding the creation of cleaner fuels. It is logical to expect that we will continue to utilize the existing infrastructure, driven by the combustion engine, for the foreseeable future or until some revolutionary technology arrives. The most efficient way to address the world's energy needs today is to develop cleaner, more environmentally friendly fuel for the combustion engine, provided the fuel can be produced economically. Ethanol, which seems to be at least part of the solution, has now become firmly entrenched in the global energy equation. As evidence of ethanol's importance, a recent report by Merrill Lynch[1] estimates that oil and gas prices would be $21 per barrel and $0.50 per gallon higher if not for ethanol. The challenge for the U.S. is that most ethanol production here utilizes corn or grain as feedstock, and the rising production cost of corn-based ethanol as well as the negative externalities associated with the food vs. fuel conundrum call the fundamental, non-subsidized, economics of corn based ethanol production into question. Given ethanol's increasingly vital role in the global energy equation, and the seemingly insurmountable economic/political/social challenges of corn/grain based ethanol production, it seems clear that cellulose based production technologies must be part of the solution.

The Demand for Energy Must Continue to Increase as Massive Portions of the World's Population Participate More Fully the Global Economy: As presented later in this report, there are approximately 765 vehicles per 1,000 U.S. citizens. The ratio in China is closer to 24 per 1,000 while India's ratio is approximately 12 vehicles per 1,000 citizens. Operating under the assumption that living and working standards and systems in developing countries will continue to move towards those of developed nations, it is reasonable to expect that there will be hundreds of millions of new vehicles added to the global fleet in the coming years and decades and that the world energy markets will continue to experience a massive demand driven phenomenon that requires a correspondingly steep adjustment in either supply or price. This simple market reality presents a huge potential opportunity for alternative fuels, with governmental intervention only serving to accelerate the economics.

RVBF's Cellulosic Ethanol Technology Provides an Economical Alternative to Corn Based Ethanol Production: Raven Biofuels International Corporation (OTCBB: RVBF), a development stage company focused on converting waste biomass into cellulosic (non-food) ethanol and derivative chemicals, was formed to capitalize on this energy

[1] http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/07/01/EDNR11F0AG.DTL&hw=t

opportunity. Formed in September 2007, RVBF is working towards the completion of several agreements that will launch the company's biofuels strategy, providing the technology and partners to build clean, renewable biorefineries in the U.S., Canada and India, with the intent to grow production globally. It must be noted that the biorefinery model to be utilized by RVBF produces not only ethanol, but also derivative chemicals, namely furfural, which has a very broad range of commercial uses, and lignin, which may serve as source of power for the biorefinery.

As evidenced by the opportunities RVBF is pursuing in Washington State and British Columbia (BC), RVBF will focus on low cost, non-food biomass as the feedstock for its biorefineries. The BC plants, to be developed in partnership with Spectrum Energy, will utilize as feedstock Mountain Pine Beetle softwood, which is experiencing a massive infestation in an area nearly the size of Texas, and the Washington State plant will utilize feedstock such as construction wood and woodchips. This focus on technologies fueled by low cost biomass puts RVBF in a position to benefit not only from governmental incentives, but also from the real economics of the global energy market.

Having secured equity funding commitments for working capital and for the project financing of the first biorefinery, an 11 million gallon / year facility to be located in Washington State, RVBF is making excellent progress towards its stated objected of reaching production capacity of 100 million gallons annually within the next five years. As illustrated later in this report, the potential economics of the RVBF biorefinery model are sufficiently attractive that it seems highly likely that the Company should be able to attract both the debt and equity necessary to ramp up to this targeted production level.

As noted in filings with the SEC and later in this report, RVBF faces all the challenges of a development stage company transitioning from startup to the execution of the business plan. However, in light of an enormous potential market opportunity, a sound strategy for attacking this opportunity, and a strong management team in place to execute the business plan, Murphy Analytics is initiating coverage on RVBF with a 12-month price target of $3.25.

RVBF Recent Stock Price	**$0.50**
RVBF – Recent Market Cap	**$26.1 million**
3-Month Average Trading Volume	**67,000**
52-Week Low	**$0.30**
52-Week High	**$1.48**
Murphy Analytics 12-Month Price Target on RVBF	**$3.25**

Please review the risk factors outlined later in this report and the important disclosures and disclaimers at the end of this report.

RVBF Initiation Report – Table of Contents

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RVBF Executive Management and Share Count

As of 8/14/08, RVBF 52,213,348 shares of Common Stock outstanding, 29,333,348, or 56.18% of which were owned by Ian Grant, former CEO and President of RVBF, which also has $524k in accounts payable to Mr. Grant in connection with consulting services rendered to RVBF.

Estimate of Outstanding and Fully Diluted Common Share Count	
Common Shares Outstanding as of 8/14/08	52,213,348
Stock Options Granted to John Sams, Nicholas DeVito (Strike at $0.50)	1,400,000
Estimate of Fully Diluted Share Count	53,613,348

John Sams – Chief Operating Officer. RVBF announced on 5/27/08 the appointment of Mr. Sams as Chief Operating Officer. Mr. Sams is a 30-year veteran in the energy, power, environmental and process sectors with specific experience in renewable fuels. Mr. Sams has over 20 years experience in senior management. He has held positions as:

- President/CEO of Environmental Elements Corporation an environmental systems public company serving the power and pulp/paper industries,
- President/CEO of Alfa Laval Celleco a private Swedish company serving the pulp/paper and process industries,
- President/COO and Co-Founder of LPP Combustion a start-up clean energy technology company and
- President of the Process Division of GTS Energy, Inc a process heating company with one of its key markets in the power sector.

Nicholas DeVito - Senior VP, Business Development. Mr. DeVito is Raven's SVP - Business Development. He was most recently Chief Operating Officer of Flex Fuels, another early stage biofuels company. Mr. DeVito has also served as Chief Operating Officer in other companies, successfully implementing growth strategies from start-up through mature development. These companies have successfully completed asset sales, transformed themselves from high cost manufacturing to licensing partnerships, and refocused their efforts on a few high growth products resulting in public stock offerings. Previously he led the Marketing, Business Development, and Product Management groups at a manufacturing company. As an early member of this 35 person startup, he was instrumental in growing the business to 550 employees and $250 Million in sales. During this time he helped raise over $400 million in private equity and IPO funding. With a BSEE and MSEE from Columbia University, Mr. DeVito began his career at Bell Laboratories and moved up the AT&T ranks through operations and product management, leading skilled teams to deploy large capital projects. He also has an MBA in Management from New York University.

Joe Titus – Vice President of Operations. Mr. Titus will be directing the engineering, construction and commercial operations of Raven's proposed Washington State and British Columbia biorefineries. Raven plans to build/own/operate one of the first commercial scale cellulosic ethanol bio refineries in North America. Mr. Titus has over 25 years operations and project execution management experience in the energy, environmental and process sectors. He has held multiple positions as Business Unit Manager and Director of Operations of Environmental Elements Corporation, an environmental process company and Alfa Laval Celleco, a Swedish pulp and paper process equipment company; Director of Operations for LPP Combustion LLC, a startup clean energy company and GTS Energy Inc., a process heating company with one of its key markets in the power sector.

Irshad Ahmed PhD – Technology Inventor. Mr. Ahmed brings more than twenty years of technological, scientific and executive management experience to Raven and will focus his energies on developing Raven's global technology platform. He was formerly in charge of alterative energy consulting for Booz Allen and advised the United States Governments National Renewable Energy Laboratories. He has a PhD in Biochemical Engineering from Cornell University, an MS in Biological and Environmental Engineering from MIT and MA from the University of New Hampshire (joint degree program in biotechnology) and a BS with Distinction in Chemical Engineering from Osmania University, Hyderabad, India. Mr. Ahmed has also completed advanced executive management programs at Harvard Business School and MIT respectively.

RVBF Strategic Overview

Through joint venture or acquisition, the RVBF strategy calls for the complementary addition of technology, partners and rights to develop plants to convert low cost sources of waste biomass into cellulosic, non-corn ethanol and derivative chemicals. The agreements that RVBF expects to form the foundation of its biofuels strategy include:

- *Technology sourced in a license agreement with Pure Energy. RVBF also has a 1st right of refusal to acquire Pure Energy and a binding agreement to merge with Pure Energy, which has recently qualified for the U.S. Department of Energy loan guarantee program.*
- *A site, feedstock and offtake agreement to sell fuel from the proposed refinery in Longview, Washington.*
- *A joint venture partner and specific British Columbia production opportunities made possible by the assignment of an agreement with Spectrum Energy. Additionally, RVBF and Spectrum have an application pending to the Innovative Clean Energy Fund in British Columbia for grant money to further explore production opportunities in British Columbia, Canada.*
- *Technology and specific production opportunity as a result of the agreement with Superior Biotechnologies Corporation.*

General characteristics of the technologies licensed to RVBF include:

- *$25 million of private capital invested in research and development after the U.S. government invested an estimated $100 million through the Tennessee Valley Authority.*
- *9 US patents held by Pure Energy in three principle areas; process patents for separating sugars to make ethanol and high value chemicals, fuel additives and diesel fuel mixtures.*
- *17 International Patents Granted to Pure Energy in Europe, Japan, China, India.*
- *Extensive independent testing of technology since 1997 with conclusively positive results.*

Some of these agreements, outlined in more detail in the following pages, have not yet been finalized, but provide a good indication of the nature of the RVBF strategy of utilizing low-cost biomass to supply the world's demand for clean, renewable energy.

The Free Market Case for a New Fuel Source

The View from the Demand Side: The following table provides an estimate of the approximate # of vehicles per 1,000 citizens in a sampling of countries as well as the number of vehicles necessary for that country to reach a ratio comparable to that found in the U.S.:

Country	Vehicles per 1,000 Citizens	Approximate Population[2]	Approximate # of Vehicles	# of Vehicles Added Applying U.S. Ratio
India[3]	12	1,148,000,000	13,776,000	864,444,000
China[4]	24	1,330,000,000	31,920,000	985,530,000
Russia[5]	148	141,000,000	20,868,000	86,997,000
Japan[6]	543	127,000,000	68,961,000	28,194,000
United States[7]	765	304,000,000	232,560,000	n/a
Total		3,050,000,000	368,085,000	1,965,165,000

This table, which captures less than 50% of the world's total population, is in no way meant to provide a prediction of how many new vehicles will be added to the global fleet, but rather serves as a simple illustration to convey the potentially enormous economic impact of the convergence of living and working standards between developed and developing nations. While U.S. dollar policy and speculators may help to create some of the volatility and uncertainty in oil markets, it also reasonable to conclude that oil prices are being pushed higher by what may be only the beginning of a massive wave of global oil demand that requires a substantial supply of new fuel.

Even ignoring for the moment the relative environmental impact of alternative fuels, it seems clear that there simply is a need for more fuel, period. Assuming it is not reasonable to expect that living standards in developing countries will improve quickly to a level comparable with the U.S., at least if measured in terms of the use of vehicles, there still is likely to be an addition of hundreds of millions of vehicles to the global fleet, and, of course, energy demanded by vehicles represents only a portion of total energy demands. Regardless of any governmental intervention designed to protect the environment or to reduce the dependence on fossil fuels, there is an opportunity for alternative fuels simply as a result of the world's growing demand for energy balanced against a finite supply of fossil fuels, which, of necessity, are becoming increasingly expensive.

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[2] https://www.cia.gov/library/publications/the-world-factbook/
[3] http://www.thetrumpet.com/?q=4800.3063.0.0
[4] http://www.greencarcongress.com/2006/05/percapita_car_o.html
[5] http://www.unece.org/stats/trends2005/Sources/145_Number%20of%20passenger%20cars%20(per%201000%20pop).pdf
[6] http://www.thetrumpet.com/?q=4800.3063.0.0
[7] http://www.greencarcongress.com/2006/05/percapita_car_o.html

The View from the Supply Side: In response to governmental mandate, consumer preferences, and recently as a reaction to the high prices of fossil fuels, alternative fuels are being supplied in increasing quantities. Following are various data address historical and potential future supplies:

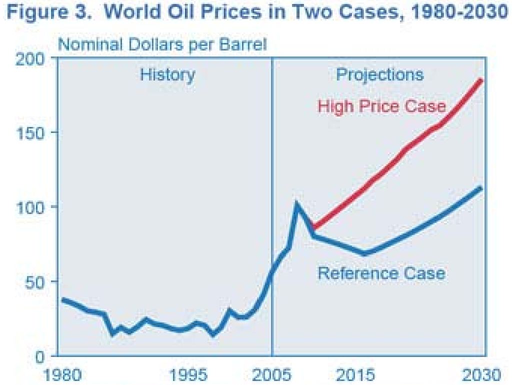
- **Recent history:** The Energy Information Administration[8] reports that the U.S. consumed 0.414 quadrillion BTU of biofuels in 2003 and 1.018 quadrillion BTU in 2007, an increase of 145%, or 25% annually. Biofuels includes biodiesel, biodiesel feedstock, ethanol and ethanol feedstock. The increase for ethanol specifically for the same time frame was 142%.

- **EIA Energy Consumption Projections:** In a release on 6/25/08[9], the EIA announced "World marketed energy consumption is projected to grow by 50 percent between 2005 and 2030, driven by robust economic growth and expanding populations in the world's developing countries, according to the reference case projection from the *International Energy Outlook 2008* (*IEO2008*) released today by the Energy Information Administration (EIA)."

- **EIA Biofuels Projections[10]:** "Biofuels, including ethanol and biodiesel, will be an increasingly important source of unconventional liquids supplies, largely because of the growth in U.S. biofuels production. In the *IEO2008* reference case, the United States accounts for nearly one-half of the rise in world biofuels production, at 1.2 million barrels per day in 2030."

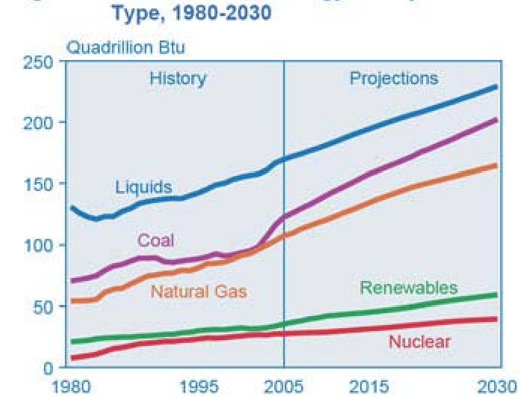
EIA Forecasts for World Oil Prices and Energy Use by Fuel Type

Figure 3. World Oil Prices in Two Cases, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo.

Figure 2. World Marketed Energy Use by Fuel Type, 1980-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

http://www.eia.doe.gov/oiaf/ieo/highlights.html

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8 http://www.eia.doe.gov/cneaf/alternate/page/renew_energy_consump/table1.pdf
9 http://www.eia.doe.gov/neic/press/press302.html
10 http://www.eia.doe.gov/oiaf/ieo/highlights.html

Governmental Support of Alternative Fuels in the U.S.

The Energy Independence and Security Act of 2007[11] has two core objectives:

1. Increasing the supply of alternative fuel sources by setting a mandatory Renewable Fuel Standard (RFS) requiring fuel producers to use at least 36 billion gallons of biofuel in 2022. Although the President proposed a more ambitious alternative fuels standard in his State of the Union Address, the RFS in the bill he signed represents a nearly five-fold increase over current levels.

2. Reducing U.S. demand for oil by setting a national fuel economy standard of 35 miles per gallon by 2020 – which will increase fuel economy standards by 40 percent and save billions of gallons of fuel. Last January, the President called for the first statutory increase in fuel economy standards for automobiles since they were enacted in 1975, and the bill he signed today delivers on that request. The bill also includes an important reform the President has called for that allows the Transportation Department to issue "attribute-based standards," which will ensure that increased fuel efficiency does not come at the expense of automotive safety.

As evidenced by the 2/07 announcement[12] of $385 million in funding for six cellulosic ethanol plants, the Department of Energy expects cellulosic technologies to be an important part of achieving the first objective of the Energy Act of 2007:

U.S. Department of Energy (DOE) Secretary Samuel W. Bodman today announced that DOE will invest up to $385 million for six biorefinery projects over the next four years. When fully operational, the biorefineries are expected to produce more than 130 million gallons of cellulosic ethanol per year. This production will help further President

[11] http://www.whitehouse.gov/news/releases/2007/12/20071219-1.html
[12] http://www.energy.gov/news/4827.htm

Bush's goal of making cellulosic ethanol cost-competitive with gasoline by 2012 and, along with increased automobile fuel efficiency, reduce America's gasoline consumption by 20 percent in ten years.

"These biorefineries will play a critical role in helping to bring cellulosic ethanol to market, and teaching us how we can produce it in a more cost effective manner," Secretary Bodman said. "Ultimately, success in producing inexpensive cellulosic ethanol could be a key to eliminating our nation's addiction to oil. By relying on American ingenuity and on American farmers for fuel, we will enhance our nation's energy and economic security."

The Department of Energy's general commitment to biofuels is confirmed again in a 6/11/08 Fact Sheet[13] entitled: "*Gas Prices and Oil Consumption Would Increase Without Biofuels*", which makes such assertions as:

- *"Without biofuels, gas prices would increase $0.20 to $0.35 per gallon.*
- *Biofuels are reducing America's dependence on oil.*
- *Biofuels are reducing greenhouse gas emissions.*
- *Today's biofuels account for only a small percentage of the increase in global food prices.*
- *Future biofuels will alleviate much of the concern about the competition between food and fuel."*

The Fact Sheet, derived from a letter to Senator Jeff Bingaman from Secretary of Energy Bodman and Secretary of Agriculture Schafer, calls specific attention to the importance of cellulosic biofuels:

"The next generation of biofuels—cellulosic—made from switchgrass, corn stover, wood chips and other non-food sources promises even more significant reductions in greenhouse gas emissions than corn-based ethanol – reductions of more than 86 percent compared with gasoline."

"Cellulosic biofuel feedstocks can be produced on land not suitable for crops or it can be collected from forest residues. The Administration has announced more than $1 billion for the research, development, and demonstration of new biofuels technology, with a special focus on cellulosic biofuels"

Although not yet signed into law, the 2008 Farm Bill, passed by both the House and Senate, calls for a tax credit of up to $1.01 per gallon of cellulosic ethanol produced.

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13 http://www.energy.gov/news/6335.htm

Governmental Support of Alternative Fuels in British Columbia

Like the U.S. plan, The BC Energy Plan[14] establishes various mandates, incentives and targets for the use of renewable, clean energy and the reduction / elimination of greenhouse gas emissions. In terms of specific references to incentives relevant for RVBF, the Plan states:

- *"The new $25-million Innovative Clean Energy Fund will encourage the development of clean energy and energy efficient technologies in the electricity, alternative energy, transportation and oil and gas sectors. The new BC Bioenergy Strategy will take advantage of B.C.'s abundant sources of renewable energy, such as beetle-killed timber, wood wastes and agricultural residues."*

The BC Energy Plan also has a mandate to blend 5% of the transportation fuel with ethanol by 2010. RVBF and Spectrum Energy have submitted a proposal to the Innovative Clean Energy Fund, and although RVBF will pursue all governmental incentives in the U.S., Canada or wherever its biorefineries are located, RVBF seeks to build a biorefinery model that stands alone in terms of its economics.

RVBF Announcement of Biorefinery in Washington State

Project:	11 million gallons / year biorefinery to be located in Washington State.
Feedstock:	500 tons per day of wood waste, such as construction wood, demolition wood, woodchips.
Technology:	Two state diluted acid hydrolysis initially developed by the Tennessee Valley Authority and accessed by RVBF through the pending merger with Pure Energy, which has spent another $24 million in developing the technology.
Projected Biorefinery Cost:	$30 million.
Financing:	RVBF expects to finance $20 million with debt and $10 million with equity.

[14] http://www.energyplan.gov.bc.ca/factsheet/default.htm

Expected Revenues:	$35 million annually.
Payback Period:	3+ years once placed in service.
Timing:	Construction is expected to take 14 months.

RVBF's Planned Merger with Pure Energy[15]

Following are some of the key terms of the agreement as noted in the 10-Q filed 5/15/08 by RVBF and in the press release dated 3/13/08:

Parties:	Raven Biofuels International Corp Pure Energy Corporation of Paramus, New Jersey
Purpose:	The construction of cellulosic ethanol plants worldwide.
Payment to Pure Energy:	$3 million in cash and approximately $50 million of RVBF common shares (approximately 50 million shares currently).
Technology:	Pure Energy CEO Dr. Irshad Ahmed states that Pure Energy has spent 14 years and $25 million developing technology to convert agricultural wastes and other feedstocks into ethanol. Dr. Ahmed also states that Pure Energy holds a portfolio of 30 patents in the U.S. and internationally.

RVBF's 5/21/08 Assignment Agreement with Spectrum Energy

Following are some of the key terms of the assignment agreement referenced in the Form 8-K filed by RVBF on 6/3/08 and announced by RVBF on 5/21/08:

Parties to the JV:	Tribune Capital Partners SA[16] Spectrum Energy Company Ltd.

[15] http://www.pure-energy.com/pureindex.html

[16] http://www.tribunepartners.com/

Purpose:	The construction of bio-fuel plants that will convert Mountain Pine Beetle softwood into ethanol for the use as low-carbon transportation fuel and high value chemicals.
Location:	Plants to be developed in the Province of British Columbia.
Capacity:	The plants will be designed to convert a minimum of 165,000 dry metric tones of Mountain Pine Beetle softwood into 6.6 million gallons/year of ethanol, with the balance to be converted into high value chemical derivatives.
Timing:	Spectrum estimates that the first refinery could be in production by 2010 if immediate governmental commitments were received.
RVBF Contributions:	a) The exclusive rights for Cellulosic Ethanol Technology. b) Technology and engineering expertise. c) Management and operational expertise. d) Pro-rata capital required for the construction and operation of the plant. e) Expertise in structuring project debt financing.
Spectrum Contributions:	a) Spectrum will enter into agreements for harvesting rights for Mountain Pine Beetle softwood and other suitable feedstock in quantities sufficient to meet the operating requirements of the BC biofuel plant. b) The identification of site locations with proximity to the feedstock and transportation routes. Spectrum has several sites identified for further due diligence. c) Experience in building four lumber plants, totaling $900 million, from procurement to design to final build and operation. d) Management and operational expertise. e) Pro-rata capital required for the construction and operations of the plant. f) Initial funding of the feasibility studies to be raised through government funding, based upon an agreed budget.
Initial Project Budget:	$500,000 for the planning of feasibility studies, travel expenses, testing expenses, feedstock, logistical analyses, engineering studies.

RVBF's 5/26/08 Letter of Intent with Superior Biotechnologies Corporation

Following are some of the key terms of the Letter of Intent referenced in the Form 8-K filed by RVBF on 6/3/08:

Parties:	Raven Biofuels International Corp Superior Biotechnologies Corporation
Purpose:	RVBF seeks to acquire certain contractual rights and intellectual property rights from Superior, particularly as it relates to a Technology License Agreement between Superior and Pure Energy Corporation.
Cost:	RVBF will make a payment of $75,000 to Superior. RVBF also will assume liability for an $875,000 loan made by Tribute Capital Partners SA to Superior.
Plant Location:	The agreement between Superior and Pure Energy provided rights, to be acquired by RVBF, to build a bio-fuel plant in India.
Technology:	RVBF's acquisition of the Technology License Agreement will allow RVBF to deploy two-stage dilute acid hydrolysis globally. This agreement also will enable RVBF to construct bio-refineries for the production of ethanol and other high value chemicals worldwide.
Completion:	RVBF completed this agreement on 8/26/08.

RVBF 7/9/08 Announcement of $10 Million in Equity Funding Commitments

RVBF has filed and 8-K related to two term sheets for the private placement financing of up to $10 million in gross proceeds, 80% of which RVBF expects to utilize as the equity component of the project financing for the construction of its first biorefinery, with the balance expected to be used as working capital for RVBF operations. Following are highlights from the "Memorandum of Terms" with Blackhawk Investments Ltd. and Clean Energy Holding Corp.

Units:	Up to a combined 10 million Units priced at $1.00 per unit. Each Units consists of one RVBF common share and one

	warrant priced at $1.50 with a tenor of two years from closing. Units offered via exemption of Registration, to accredited investors only.
Expected Timing:	July 27, 2008 for Blackhawk (up to 8mm units), August 2, 2008 for Clean Energy Holding (up to 2mm units).
Escrow or Proceeds:	The proceeds from the 8 million Blackhawk units will be held in escrow until RVBF has organized a project financing for the 1st biorefinery. Proceeds will be returned if the financing is not organized within 12 months.

An Introduction to Ethanol from the DOE[17]

Definition and Alternative Feedstocks: Ethanol is a clear, colorless alcohol fuel made from the sugars found in grains, such as corn, sorghum, and wheat, as well as potato skins, rice, and yard clippings. Ethanol is a renewable fuel because it is made from plants. There are several ways to make ethanol from biomass. The most commonly used processes today use yeast to ferment the sugars and starch in corn. Corn is the main ingredient for ethanol in the United States due to its abundance and low price. Most ethanol is produced in the corn-growing states in the Midwest. The starch in the corn is fermented into sugar, which is then fermented into alcohol. Other crops such as, barley, wheat, rice, sorghum, sunflower, potatoes, sugar cane and sugar beets can also be used to produce ethanol.

Sugar cane and sugar beets are the most common ingredients for ethanol in other parts of the world. Since alcohol is created by fermenting sugar, sugar crops are the easiest ingredients to convert into alcohol. Brazil, the country with the world's largest ethanol production, makes most of its ethanol this way. Today, many cars in Brazil operate on ethanol made from sugar cane.

A new experimental process which breaks down cellulose in woody fibers, is called "cellulosic ethanol". With this process we can make ethanol from trees, grasses, and crop wastes. Trees and grasses need less energy than grains, which must be replanted every year. Scientists have developed fast-growing trees that grow to size in ten years. Many grasses can produce two harvests a year for many years. Someday, you may find yourself driving by huge farms that are not producing food or animal feed, but feedstock for ethanol. Feedstock is the raw material used to make a product.

History: Ethanol is not a new fuel. In the 1850s, ethanol was a major lighting fuel. During the Civil War, a liquor tax was placed on ethanol to raise money for the war. The tax increased the price of ethanol so much that it could no longer compete with other fuels such as kerosene in

[17] http://www.eia.doe.gov/kids/energyfacts/sources/renewable/ethanol.html

lighting devices. Ethanol production declined sharply because of this tax and production levels did not begin to recover until the tax was repealed in 1906.

In 1908, Henry Ford designed his Model T to run on a mixture of gasoline and alcohol, calling it the fuel of the future. In 1919, when Prohibition began, ethanol was banned because it was considered a liquor. It could only be sold when it was mixed with petroleum. With the end of Prohibition in 1933, ethanol was used as a fuel again. Ethanol use increased temporarily during World War II when oil and other resources were scarce. In the 1970s, interest in ethanol as a transportation fuel was revived when embargoes by major oil producing countries cut gasoline supplies. Since that time ethanol use has been encouraged by offering tax benefits for producing ethanol and for blending ethanol into gasoline. In 1988, ethanol began to be added to gasoline for the purpose of reducing carbon monoxide emissions.

Current Users of Ethanol: As a transportation fuel, ethanol can be used as a total or partial replacement for gasoline. Gasoline containing ten percent ethanol - E10 - is used in many urban areas that don't meet clean air standards. Some states promote more widespread use of E10. Minnesota, for example, requires almost all gasoline sold in the state to contain 10 percent ethanol. All vehicles that run on gasoline can use E10 without making changes to their engines. Over 99 percent of the ethanol produced in the United States is mixed with gasoline to make E-10.

E85 is an alternative fuel that is 85 percent ethanol and 15 percent gasoline, used mainly in the Midwest and South. Vehicles are not modified to run on E85; they are specially manufactured as flexible fuel vehicles (FFV). Flexible Fuel Vehicles can use any mixture of ethanol and gasoline up to E85. There are about 146,000 cars and trucks using E85. Most of these are fleet vehicles.

Ethanol and the Environment: Using ethanol means that we use a little bit less oil (a nonrenewable fuel) to make gasoline. Unlike gasoline, ethanol is nontoxic (safe to handle) and biodegradable, it quickly breaks down into harmless substances if spilled. When small amounts of ethanol are added to gasoline, usually less than 10 percent, there are many advantages. Ethanol reduces carbon monoxide and other toxic pollution from the tailpipes of vehicles, making the air cleaner. It keeps engines running smoothly without the need for lead or other chemical additives. Because ethanol is made from crops that absorb carbon dioxide and give off oxygen, it has the potential to reduce greenhouse gas emissions and help maintain the balance of carbon dioxide in the atmosphere. This process is called the carbon cycle.

Ethanol Quick Facts[18]

- **Domestic Ethanol and Gas Production and Consumption:** In 2005, the U.S. produced about 4 billion gallons of ethanol from corn grain, equaling approximately 2% of the 140 billion gallons of gasoline consumed.
- **Ethanol is widely used as a fuel additive**: The oxygen contained in ethanol improves gasoline combustibility.
- **The Energy Policy Act of 2005 Mandate:** Established a renewable fuels standard which requires using 7.5 billion gallons of ethanol by 2012.
- **E85**: (85% ethanol and 15% gasoline blend) Can be used as a substitute for gasoline in vehicles that have been modified to use E85.
- **Energy content of E85:** 70% that of gasoline, so about 1.4 gallons of E85 are needed to displace one gallon of gasoline.
- **Corn vs. cellulosic feedstock:** Starch in corn grain is readily degraded into glucose sugar molecules that are fermented to ethanol. The complex structural carbohydrates in cellulosic biomass are more difficult to break down, and they yield a mix of glucose and other sugar molecules that are not as efficiently converted to ethanol.
- **Corn yield:** An acre of corn generates about 4.5 tons of grain; 66% (3 tons) is starch that can be converted to 400 gallons of ethanol. Ethanol yield could be increased to roughly 700 gallons per acre by using corn stover (stalks and leaves) in addition to corn grain.
- **Alternative yields:** Potential energy crops include perennial grasses like switchgrass or woody crops such as fast growing poplar. For these crops, average annual yield per acre is about 5 dry tons of cellulosic biomass; at a current conversion rate of 65 gallons per dry ton, an acre generates about 325 of gallons of ethanol. Goals include increasing biomass yield to 10-15 dry tons per acre and ethanol yield to 80-100 gallons per dry ton of biomass.

An Introduction to Cellulosic Ethanol, Goals and Projections from the DOE[19]

Cellulose Degradation and Conversion: Understanding the conversion of biomass to ethanol begins with understanding the structural and chemical complexity of the three primary polymers that make up plant cell walls: Cellulose, hemicellulose, and lignin (see Cellulose Structure and Hydrolysis Challenges). Depending on plant species and cell type, the dry weight of a cell wall typically consists of about 35 to 50% cellulose, 20 to 35% hemicellulose, and 10 to 25% lignin (Saha 2004). Cellulose is the most abundant biomaterial on earth. Each cellulose molecule is a linear polymer of glucose residues. Depending on the degree of hydrogen bonding within and between cellulose molecules, this polysaccharide is found in crystalline or paracrystalline (amorphous) forms. Cellulose exists within a matrix of other polymers, primarily hemicellulose

[18] http://genomicsgtl.energy.gov/biofuels/ethanol_quick_facts.shtml

[19] http://genomicsgtl.energy.gov/benefits/cellulosicethanol.shtml

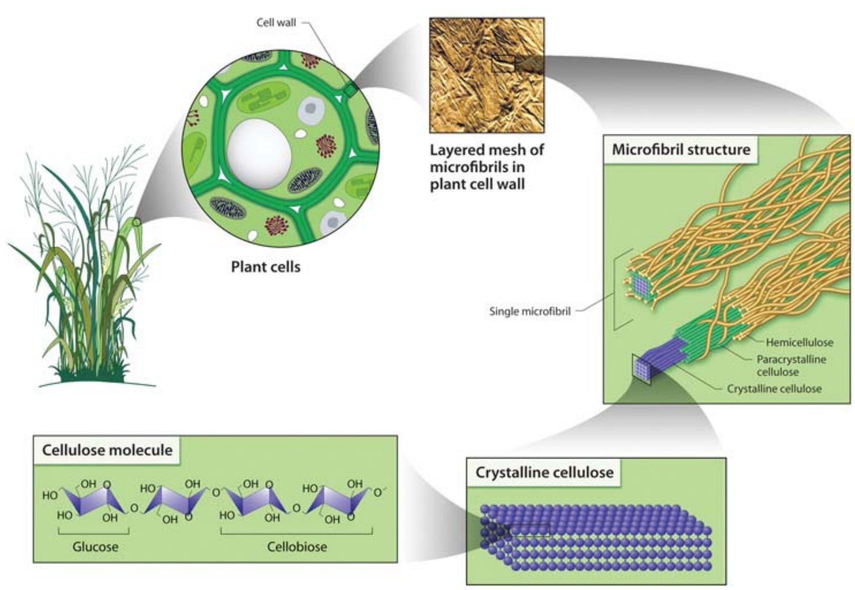
and lignin. Hemicellulose is a branched sugar polymer composed of mostly pentoses (five-carbon sugars) and some hexoses (six-carbon sugars). Lignin is a complex, highly cross-linked aromatic polymer that is covalently linked to hemicellulose, thus stabilizing the mature cell wall. These polymers provide plant cell walls with strength and resistance to degradation, which also makes these materials a challenge to use as substrates for biofuel production.

Enzymes such as cellulases, hemicellulases, and other glycosyl hydrolases synthesized by fungi and bacteria work together in a synergistic fashion to degrade the structural polysaccharides in biomass. These enzyme systems, however, are as complex as the plant cell-wall substrates they attack. For example, commercial cellulase preparations are mixtures of several types of glycosyl hydrolases, each with distinctly different functions (exocellulases, endocellulases, exoxylanases, endoxylanases, cellobiases, and many others). Optimization of these enzymes will require a more detailed understanding of their regulation and activity as a tightly controlled, highly organized system. The biochemical conversion of biomass to ethanol currently involves three basic steps:

1. Thermochemical treatments of raw lignocellulosic biomass to make the complex polymers more accessible to enzymatic breakdown;

2. Production and application of special enzyme preparations (cellulases and hemicellulases) that hydrolyze plant cell-wall polysaccharides to a mixture of simple sugars; and

3. Fermentation, mediated by bacteria or yeast, to convert these sugars to ethanol. A more complete understanding of enzymes and microbes involved in biomass conversion to ethanol is needed to overcome many current inefficiencies in the production process.



CELLULOSIC ETHANOL GOALS AND IMPACTS*

Factors	Today	Interim	Long-Term**
Billion gallons	4	20	30 to 200
Fossil fuel displaced***	2%	10%	15 to 100%****
CO_2 reduced	1.8%	9%	14 to 90%
Feedstock	Starch (14% energy yield)	Waste cellulose	Cellulosic energy crops (>37% energy yield)
Process	Starch fermentation Little cellulose processing	Acid decrystallization: Transition to enzymes Cellulases Single-sugar metabolism Multiple microbes Some energy crops	Enzyme decrystallization and depolymerization Cellulase and other glycosyl hydrolases Sugar transporters High-temperature functioning Multisugar metabolism Integrated processing Designer cellulosic energy crops Carbon sequestration through plant partitioning
Deployment	Large, central processing	Large, central processing	Distributed or centralized, efficient processing plants
Other impacts: Energy dollars spent at home, third crop for agriculture, land revitalization and stabilization, habitat, soil carbon sequestration, yield per acre roughly tripled (cellulose over corn starch).			

*Adapted from Smith et al. 2004.
**Enabled by GTL.
***Current U.S. consumption of gasoline is about 137 billion gallons per year, which corresponds to about 200 billion gallons of ethanol (Greene et al. 2004) because a gallon of ethanol has 2/3 the energy content of a gallon of gasoline.
****Assumes improvements in feedstocks, processes, and vehicle fuel efficiency.

Cellulosic Ethanol Challenges, Scale, and Complexity	
Research and Analytical Challenges	**Scale and Complexity**
• Screening of databases for natural variants of cellulases (generally glycosyl hydrolases) and other enzymes or molecular machines in metabolic networks and characterization of variants • Analysis of modified variants to establish design principles and functional optimization • Modeling and simulation of cellulase, sugar transport, and multiple sugar-fermentation processes and systems • Integration of processing steps into single microbes or stable cultures	• Thousands of variants of all enzymes; screening of millions of genes, thousands of unique species and functions • Production and functional analysis of potentially thousands of modified enzymes, hundreds of regulatory processes and interactions • Models at the molecular, cellular, and community levels incorporating signaling, sensing, regulation, metabolism, transport, biofilm, and other phenomenology and using massive databases in GTL Knowledgebase • Incorporation of complete cellulose-degradation and sugar-fermentation processes into microbes or consortia-hundreds of metabolic, regulatory, and other interconnected pathways

General Motors (GM) Flex Fuel Vehicle Production and Comments

As noted recently in the BioFuels Journal[20], GM will offer 18 flexible fuel vehicles (FFV) in the model year 2009, including a range of models in the Chevrolet, GMC, Cadillac, Hummer and Buick lines. GM vehicles represent approximately 3 million of the 7 million FFV in the U.S. The article also estimates that there are 1,600 E85 stations in the U.S., representing progress in the development of the requisite ethanol infrastructure reference by Beth Lowery, GM's Vice President of Environment, Energy and Safety Policy:

> *"We continue to believe that biofuels, specifically E85, is the most significant thing we can do in the near-term to offset future energy demands..We are on target to make 50 percent of our vehicles flex-fuel capable by 2012 providing the infrastructure is in place."*
>
> *"We believe ethanol used as fuel, not just as a gasoline additive, is the best near-term alternative to surging global demand for oil because ethanol is renewable and it reduces CO2 emissions compared to gasoline."*[21]

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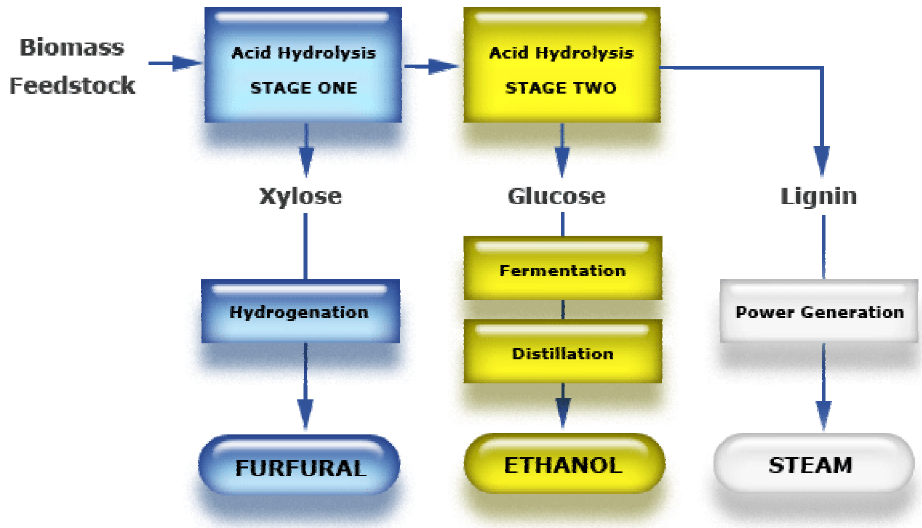
[20] http://www.biofuelsjournal.com/articles/General_Motors_to_Offer_18_New_Flex_Fuel_Vehicles_in_Model_Year_2009-59556.html; Note: this article also is the source of the 1st quotation from Beth Lowery.
[21] http://www.chevrolet.com/biofuels/articles/index.jsp?id=1

Two Stage Dilute Acid Hydrolysis – the Process Driving the RVBF Biofuels Strategy

While many companies have attempted to produce ethanol from cellulosic (non-corn) waste feedstocks during the past 10 years, Raven, through the license from Pure Energy, has access to a proven technology that can successfully produce fuel-grade ethanol in commercial quantities. The process is known as "two-stage dilute acid hydrolysis." Pure-Energy's proprietary process works by breaking down biomass (agricultural waste products such as wood chips, corn stover and sugarcane bagasse) into three primary streams that are then converted into a suite of derivative chemicals, ethanol, and energy producing lignin. The chart below[22] illustrates this process:



STAGE ONE: After cellulosic feedstock is ground into a fine stream mass, it passes into a first stage acid hydrolysis process where it is treated with a weak sulfuric acid solution to separate residual xylose (C5 sugars). Since xylose does not easily ferment into ethanol, Pure Energy's patented process converts the xylose into a derivative chemical product (furfural) which can be sold into the petrochemical and biotechnology industries at significantly higher prices than ethanol.

STAGE TWO: The remaining feedstock is again treated with a sulfuric acid solution. The second stage acid separates glucose (C6 sugars) from the basic feedstock stream. The glucose is then subjected to a standard fermentation process which ultimately produces ethanol.

The final step in the process involves the utilization of lignin. Lignin is considered the "backbone" of all cellulosic waste material and represents only 15% by weight of the original

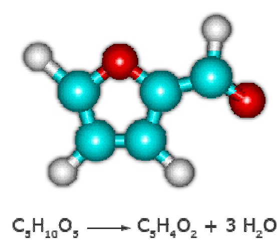
[22] http://www.ravenbiofuelsinternational.com/cellusosic.html

feedstock, but contains about 80% of the heat energy content. Pure-Energy's process takes advantage of this energy source by using high efficiency boilers to generate energy for the plant - saving significant energy costs.

The End Products Created from The Two Stage Acid Hydrolysis

Cellulosic Ethanol[23]: Cellulosic ethanol is an alternative fuel made from a wide variety of non-food plant materials (or feedstocks), including agricultural wastes such as corn stover and cereal straws, industrial plant waste like saw dust and paper pulp, and energy crops grown specifically for fuel production like switchgrass. By using a variety of regional feedstocks for refining cellulosic ethanol, the fuel can be produced in nearly every region of the country. Though it requires a more complex refining process, cellulosic ethanol production requires less energy and therefore results in lower greenhouse emissions than traditional corn-based ethanol. E-85, an ethanol-fuel blend that is 85-percent ethanol, is already available in more than 1,000 fueling stations nationwide and can power millions of flexible fuel vehicles already on the roads.

Furfural: an industrial chemical derived from a variety of agricultural byproducts like sugar cane bagasse and corn cobs. Its chemical formula is $C_5 H_4 O_2$. In its pure state, it is a colorless oily liquid with the odor of almonds, but upon exposure to air it quickly becomes yellow. Many plant materials contain the hemicellulose, a polymer of sugars containing five carbon atoms each. When heated with sulfuric acid, hemicellulose undergoes hydrolysis to yield these sugars, principally xylose. Under the same conditions of heat and acid, xylose and other five carbon sugars become dehydrated, losing three water molecules to become furfural.



Furfural is used as a solvent in petrochemical refining and is used to create various lubricants. Furfural, as well as its derivative furfuryl alcohol, can be used either by themselves or together with other chemicals to make solid resins. Such resins are used in making fiberglass, some aircraft components, and automotive brakes. There is a worldwide market for this chemical in many industries.

Lignin[24]: "Lignin, from Latin meaning wood, is a natural amorphous polymer. It acts as the essential glue that gives plants their structural integrity. Of the three major natural polymers that make up ordinary plants—cellulose, lignin and hemicellulose—lignin is the second most abundant and the only biomass constituent based on aromatic units.

Opportunities that arise from utilizing lignin fit into three categories:

[23] http://www.energy.gov/news/4827.htm

[24] "Top Value Added Chemicals from Biomass"; http://www1.eere.energy.gov/biomass/pdfs/pnnl-16983.pdf

- Power, fuel and syngas (generally near-term opportunities)
- Macromolecules (generally medium-term opportunities)
- Aromatics and miscellaneous monomers (long-term opportunities)

In the first "product type" (power—fuel—gasification) lignin is used purely as a carbon source and aggressive means are employed to break down its polymeric structure. In the second "product type" (macromolecules) the opposite extreme is considered and advantage of the macromolecular structure imparted by nature is retained in high-molecular weight applications. The third "product type" (aromatics) lies somewhere between the two extremes and employs technologies that would break up lignin's macromolecular structure but maintain the aromatic nature of the building block molecules.

Lignin offers a significant opportunity for enhancing the operation of a lignocellulosic biorefinery. It is an extremely abundant raw material contributing as much as 30% of the weight and 40% of the energy content of lignocellulosic biomass. Lignin's native structure suggests that it could play a central role as a new chemical feedstock, particularly in the formation of supramolecular materials and aromatic chemicals.

DOE recently completed a study that suggests 1.3 billion tons of biomass is available annually in the United States. This amount of biomass could potentially produce 130 billion gallons of liquid transportation fuels (ethanol, mixed alcohols, green gasoline, biodiesel and green diesel). Significant new technology developments are needed to maximize production and capture the resources. Interestingly, the same resource is sufficient in size to supply virtually all of the raw materials now required for the chemical industry.

Origins of the Two Stage Dilute Acid Process

History[25]: Dilute acid hydrolysis of biomass is, by far, the oldest technology for converting biomass to ethanol. As indicated earlier, the first attempt at commercializing a process for ethanol from wood was done in Germany in 1898. It involved the use of dilute acid to hydrolyze the cellulose to glucose, and was able to produce 7.6 liters of ethanol per 100 kg of wood waste (18 gal per ton). The Germans soon developed an industrial process optimized for yields of around 50 gallons per ton of biomass. This process soon found its way to the United States, culminating in two commercial plants operating in the southeast during World War I. These plants used what was called "the American Process" — a one-stage dilute sulfuric acid hydrolysis. Though the yields were half that of the original German process (25 gallons of ethanol per ton versus 50), the throughput of the American process was much higher. A drop in lumber production forced the plants to close shortly after the end of World War I[1]. In the meantime, a small, but steady amount of research on dilute acid hydrolysis continued at the USDA's Forest Products Laboratory.

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[25] http://www1.eere.energy.gov/biomass/printable_versions/dilute_acid.html

In 1932, the Germans developed an improved "percolation" process using dilute sulfuric acid, known as the "Scholler Process." These reactors were simple systems in which a dilute solution of sulfuric acid was pumped through a bed of wood chips. Several years into World War II, the United States found itself facing shortages of ethanol and sugar crops. The U.S. War Production Board reinvigorated research on wood-to-ethanol as an "insurance" measure against future worsening shortages, and even funded construction of a plant in Springfield, OR. The board directed the Forest Products lab to look at improvements in the Scholler Process[2]. Their work resulted in the Madison Wood Sugar process, which showed substantial improvements in productivity and yield over its German predecessor[3]. Problems with start up of the Oregon plant prompted additional process development work on the Madison process at TVA's Wilson Dam facility. TVA's pilot plant studies further refined the process by increasing yield and simplifying mechanical aspects of the process[4]. The dilute acid hydrolysis percolation reactor, culminating in the design developed in 1952, is still one of the simplest means of producing sugars from biomass. It is a benchmark against which we often compare our new ideas. In fact, such systems are still operating in Russia.

In the late 1970s, a renewed interest in this technology took hold in the United States because of the petroleum shortages experienced in that decade. Modeling and experimental studies on dilute hydrolysis systems were carried out during the first half of the 1980s. DOE and USDA sponsored much of this work. By 1985, most researchers recognized that, while the dilute acid percolation designs were well understood, these systems had reached the limits of their potential. Their comparatively high glucose yields (around 70%) were achieved at the expense of producing highly dilute sugar streams. Kinetic models, based on pseudo first order kinetics, and process design work showed that the most effective designs would require both high solids concentration and some form of countercurrent flow. The former is a consequence of equipment size and energy cost and the latter is a consequence of the reactor kinetics. Both requirements involve significant equipment design problems. Studies shifted to alternative designs, such as plug flow reactors[5],[6] and so-called progressing batch systems that mimicked countercurrent operation[7]. Optimal operation of the plug flow reactors required very short residence time (6 to 10 seconds) and high temperature (around 240°C)[8]. On scale up, these systems encountered some difficulties with solids handling, even at lower-than-optimal concentrations[9]. Plug flow systems in the lab and the pilot plant produced yields of glucose of around 50%. These yields are approaching the theoretical limits for such continuous reactor systems.

The Cost Advantage of RVBF's Production Technology

Production Plant Costs

The 2/28/07 announcement by the U.S. Department of Energy[26] regarding the investment of $385 million in six cellulosic ethanol plants provides some insight into construction costs. The release states that the total cost of the six plants is approximately $1.2 billion, and that the total aggregate annual production capacity will be $130 million gallons of ethanol. This translates into a construction cost of approximately $9.23 per gallon.

The 6/10/08 announcement by RVBF regarding the plan to build a biorefinery in Washington State calls for an 11 million gallon capacity plant to be built at an approximate cost of $30 million or approximately $2.72 per gallon of total output. However it must be noted that the RVBF production output is expected to be comprised of 7 million gallons per year of ethanol and 4 million gallons per year of specialty chemicals, especially furfural. Dividing the plant cost by only the ethanol output translates into a cost of approximately $4.29 per gallon.

The particular cellulosic ethanol production technology utilized drives the differences among plant construction costs, with RVBF's two stage dilute acid process clearly providing a cost advantage relative to other approaches. Challenges such as hazardous waste recovery and treatment, a significant source of plant construction and operating cost for alternative technologies, is less of an issue for RVBF. Similarly, differing reaction speeds require more processing and storage space relative to the two stage dilute acid process.

Operating Costs

In the simplest terms, the technology utilized by RVBF results in faster reaction time than competing technologies, allowing RVBF to use lesser amounts of power and process materials, especially sulfuric acid. The RVBF approach also utilizes continuous processing rather than batch processing – again creating an advantage in terms of processing speed and quantity of energy consumed. To illustrate the magnitude of the differences among reaction times for competing technologies, RVBF estimates that a typical enzyme based ethanol production technology takes 7 days, a typical gasification technology takes perhaps 8 hours, and the RVBF two stage dilute acid process produces a reaction in 20 minutes.

[26] http://www.doe.gov/news/4827.htm

U.S. Energy Official Comments on Corn vs. Cellulosic Ethanol

Given the significant increases in global prices, and people fighting in the streets of Mexico and Asia about the cost of food, it has become increasingly clear that burning food for fuel is not a viable economic model that can address the world's energy demands. Comments from U.S. Department of Energy officials confirm both the promise of cellulosic ethanol and the problems with corn based ethanol production.

Secretary of Energy Samuel Bodman: "Although the situation is complex, the bottom line is that we need more energy from all sources. We must use fossil energy, which will continue to dominate world energy supplies for the next several decades at least. We must increase our use of currently available renewable energy technologies like solar and wind power and develop new ones like cellulosic ethanol, which could offer a more cost competitive alternative transportation fuel than ethanol currently produced from corn."[27]

Deputy Energy Secretary Clay Sell: "I'm not going to predict what the price of corn is going to do, but I will tell you the future of biofuels is not based on corn" U.S. Deputy Energy Secretary Clay Sell said in an interview.[28]

Andy Karsner - Assistant Energy Secretary for Energy Efficiency and Renewable Energy: "You mentioned a concern over the cost of food. Until now, most ethanol has been produced from corn. But President Bush's Biofuels Initiative provides leadership and funding for developing what we call cellulosic ethanol - ethanol produced from non-edible portions of food and agricultural waste. The President's Biofuels Initiative aims to make cellulosic ethanol cost competitive with gasoline by 2012 – and this isn't just pie in the sky; we're funding major projects that will help get us there.

Just last month, I joined the Secretary of Energy as he announced DOE will fund up to $385 million for the construction of biorefineries, which produce cellulosic ethanol. Extremely promising groups were selected for this work and we're eager to see how they'll play a critical role in helping to bring cellulosic ethanol to market, in addition to teaching us how we can produce it in a more cost effective manner.

And we need to keep in mind that as cellulosic ethanol becomes cost-competitive with traditional ethanol and the cost of gasoline, the market will find a natural ceiling for corn-based ethanol. I should point out though, that multiple studies by the USDA show that growth in ethanol will have little long-term impact on food prices – additionally, a joint USDA-DOE study found that enough biomass feedstock could be sustainably produced to replace 30% of transportation fuel.

[27] http://www.energy.gov/print/3663.htm
[28] http://www.reuters.com/article/scienceNews/idUSN2830990020070328

We are making a substantial impact today, with enormous and unprecedented rates growth and have every reason to be confident that renewable sources will contribute significantly to our clean, secure energy future."

SRI Consulting March 2008 Report on the Global Furfural Market[29]

SRI Consulting is a California based business research service specializing in the global chemical industry. Following are excerpts from a March 2008 report by SRI researchers Ralf Gubler and Kasuteru Yokose on the global furfural market:

Overview and Consumption: "Furfural is produced from agricultural wastes that contain pentosans, which are hydrolyzed to furfural and other by-products. Pentosans are hemicelluloses (complex carbohydrates) that are present within the cellulose in many woody plant tissues. The most common raw materials for furfural production include corncobs, bagasse from sugarcane processing, and by-product streams from tanning and cellulosic fiber production.

Most furfural plants are located close to available raw materials. Few operate on a twelve-month basis, with most operating on a seven- to eight-month schedule, coinciding with the harvest of agricultural products. Most of the output is either converted to furfuryl alcohol for furan resin production, used as such in lube oil refining or butadiene extraction, or exported.

About 74% of the world's furfural production capacity is located in China, as of January 1, 2008. Other important countries with furfural production include the Dominican Republic and South Africa. Together, these three countries account for about 90% of worldwide installed furfural production capacity.

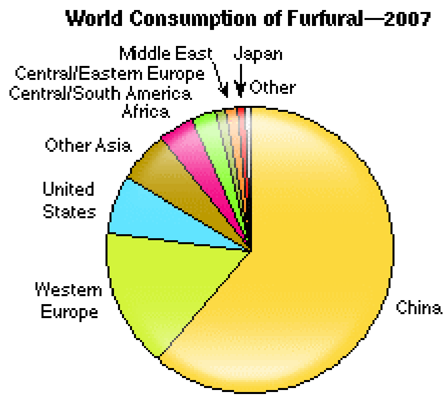
The global furfural market was in large imbalance over the past couple of years, driven mostly by the uncontrolled growth of Chinese furfural capacity. To bring the global furfural market back into balance, China needed to build alternative markets for furan resins and to consume large amounts of the material domestically. China's move in this direction began during 2006 and 2007, when three furfural-to-tetrahydrofuran/PTMEG plants came on stream.

In 2007, furfural supply to its traditional main market outlet—furfuryl alcohol—got even tighter as a result of the combined effect of increased regulations in China leading to a temporary shutdown of a significant amount of furfural production capacity, significant domestic

[29] http://www.sriconsulting.com/CEH/Public/Reports/660.5000/; http://www.sriconsulting.com/CEH/Public/Reports/661.5000/#xml=http://www.sriconsulting.com/cgi-bin/texis/webinator/search/pdfhi.txt?query=furfural&pr=super&prox=page&rorder=500&rprox=500&rdfreq=500&rwfreq=500&rlead=500&sufs=0&order=r&id=48668a844e

consumption of furfural for PTMEG production and increasing competition for pentosan-containing raw materials with domestic xylitol producers.

The following pie chart shows world consumption of furfural:



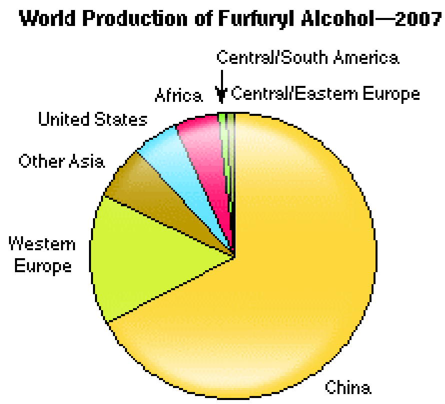
Albeit significant import tariffs protect the U.S. and EU markets, imported furfural from Chinese producers is still threatening domestic producers in Western Europe (domestic production of furfural in the United States has been forced out of business).

Significant amounts of furfural could be by-produced from biorefineries in the medium-term future via depolymerization of the hemicellulosic content of cellulosic material."

Furfuryl Alcohol Overview and Supply: **"**The majority of furfuryl alcohol is used primarily in the production of furan resins for foundry sand binders in the metal casting industry. *Furan* is a generic term for binders containing furfuryl alcohol and either urea or phenol-formaldehyde, or mixtures of both. Today, furfuryl alcohol is used mainly in binders for the traditional furan no-bake system and in smaller quantities in furan hot-box, warm-box, and gas-hardened processes. In its main application—the foundry business—furfuryl alcohol competes primarily with phenol, the feedstock for phenolic resins.

China is the world's largest producer and consumer of furfuryl alcohol, accounting for 67% of worldwide supply and 32% of worldwide demand in 2007. A huge trade surplus of furfuryl alcohol in China in 2007—representing over half of worldwide demand outside of China—challenged producers around the globe by putting prices under pressure.

The following pie chart shows world production of furfuryl alcohol:



Furfuryl alcohol prices have a fairly broad fluctuation bandwidth, mainly because about 40% of the buyers are small domestically operating companies that buy the material on the spot market. Price movements around the globe are largely dictated by Chinese producers and mainly influenced by the Chinese domestic supply/demand situation."

Potential Cash Flows from RVBF Biorefineries

RVBF has stated that it expects to build out 100 million gallons of annual production over the next five years, and that the initial biorefineries will have a capacity of approximately 10 million gallons per year. RVBF also projects production costs at under $1.00 per gallon of ethanol. RVBF expects that approximately 65% of production will be ethanol while the other 35% will be furfural and other derivative chemicals, which RVBF expects to sell at between $4 and $5 per gallon. As of 9/12/08, ethanol futures are trading at approximately $2.20 per gallon on the CBOT.[30]

The following simplified cash flow model utilizes analyst estimates as well as those highlighted in the 6/10/08 release regarding the plan to build an 11 million gallon capacity biorefinery in Washington State. Please note that this model created by Murphy Analytics is driven by a combination of estimates by the analyst and/or RVBF, and there are a number of simplifying assumptions with regard to taxes, the tax deductibility of interest payments, capital improvements to the plant, etc. Additionally the potential impact of rising or falling future prices is ignored, as are the potential impact of inflation and the potential benefit of government incentives. Plant construction costs are assumed to capture such potential expenses as capitalized interest, transaction and financing costs. Lastly, these projections illustrate only the production plant, and ignore all of the corporate operating expenses of RVBF.

[30] http://www.cbot.com/cbot/pub/page/0,3181,1754,00.html

Although intended to serve solely as a simplified overview of the magnitude of the opportunity before RVBF, the model paints an extremely compelling return on equity picture in which the technology utilized by RVBF keeps production costs low and produces a very profitable stream of revenue from the sale of derivative chemicals from only one 11 million gallon production facility – the RVBF strategy calls for the build out over the next five years of 100 million gallons of production capacity.

Utilizing a combination of RVBF and analyst estimates, including $2.20 for ethanol and $4.00 for derivative chemicals (RVBF estimates a range between $4.00 and $5.00), the 11 million gallon production plant generates approximately $15.7 million in annual ethanol revenue, $15.4 million in annual derivative chemical revenue, and $20.1 million in operating revenue. Ignoring the tax deductibility of interest payments, and assuming that these cash flows are taxed at 35%, the plant produces $10.7 million in net cash flow annually. Making this assumption with regard to taxes is, of course, overly simplistic and certainly inaccurate - the 2008 Farm Bill (not yet signed into law, but passed by both the House and Senate), calls for a tax credit of up to $1.01 per gallon of cellulosic ethanol produced, but simply illustrates the magnitude of the cash flow opportunity from RVBF's biorefinery approach. As should be expected, generating $10.7 million in annual cash flow on an equity investment of $9.9 million produces an internal rate of return over 100%. Holding constant the chemical and ethanol price assumptions, but assuming production costs are 100% higher than RVBF expects, the plant still produces an IRR on equity of approximately 36%.

Simplified Overview of Potential Cash Flows for RVBF Initial Washington State Biorefinery		
Operating Assumptions:		**Note:**
Gallons of Ethanol/Chemical Produced Annually	**11,000,000**	*RVBF Initial Capacity*
% of Gross Production that is Ethanol	**65%**	*RVBF Estimate*
% of Gross Production that is Chemcials	**35%**	*RVBF Estimate*
Gallons of Ethanol Produced Annually	**7,150,000**	
Gallons of Chemicals Produced Annually	**3,850,000**	
Sales Price / Gallon of Ethanol	**$2.20**	*Analyst Estimate*
Sales Price / Gallon of Chemicals	**$4.00**	*Analyst Estimate*
Cost / Gallon for Ethanol	**$1.00**	*RVBF Estimate*
Cost / Gallon for Chemicals	**$1.00**	*RVBF Estimate*
Service Life of Production Plant	**30**	*Analyst Estimate*
Tax Rate	**35%**	*Analyst Estimate*
Financing Assumptions:		
Cost / to Build the Refinery	**$30,000,000**	*RVBF Estimate*
% Financed with Debt	**67%**	*RVBF Estimate*
% Financed with Equity	**33%**	*RVBF Estimate*
$ Amount of Debt	**$20,100,000**	
$ Amount of Equity	**$9,900,000**	
Amortization Years for Debt	**20**	*Analyst Estimate*
Interest Rate	**10%**	*Analyst Estimate*
Annual Debt Payment	$2,360,938	
Potential Cash Flows:		
Annual Ethanol Revenue	$15,730,000	
Annual Chemical Revenue	$15,400,000	
Gross Revenue	$31,130,000	
Annual Ethanol Production Cost	($7,150,000)	
Annual Chemical Production Cost	($3,850,000)	
Total Production Costs	($11,000,000)	
Net Annual Operating Revenue	$20,130,000	
Taxes	($7,045,500)	*Ignoring government incentives*
Annual Debt Payment	($2,360,938)	*Includes principal and interest*
Net Cash Flow After Debt Payment	$10,723,562	*Ignoring interest deduction*
Potential Return on Equity:		
Net Annual Cash Flow During Amort. Of Debt:	$10,723,562	*Years 1 - 20 in this case*
Net Annual Cash Flow - Remain. Service Life:	$13,084,500	*No adjustment for inflation, etc.*
Internal Rate of Return on Equity:	**108%**	*Assuming capital improvements captured in production costs*
Net Present Value of Cash Flows Discounted at:	25%	
Net Present Value to Equity =	**$33,038,334**	

Select Biofuels Comparables

Verenium Corporation (NASDAQ GM: VRNM) (www.verenium.com): A leading developer of cellulosic ethanol technology and a pioneer in the development of high-performance specialty enzymes for applications within the biofuels, industrial, and health and nutrition markets. The Company possesses the full set of capabilities needed to make cellulosic ethanol a commercial reality. Verenium currently operates one of the nation's first cellulosic ethanol pilot plants, an R&D facility, in Jennings, Louisiana and expects to achieve mechanical completion of a 1.4 million gallon-per-year, demonstration-scale facility to produce cellulosic ethanol by the end of the first quarter of 2008.

Bluefire Ethanol (OTCBB: BFRE) (www.bluefireethanol.com): BlueFire is established to deploy the proven Arkenol Process Technology ("Technology") for the profitable conversion of cellulosic waste materials to ethanol. BlueFire is the exclusive North America licensee of the Technology for use in the production of ethanol for the transportation fuel market. BlueFire's goal is to develop and operate high-value carbohydrate-based transportation fuel production facilities to provide a viable alternative to fossil fuels on a world-wide basis. These "biorefineries" will convert widely available, inexpensive, organic materials such as agricultural residues, high-content biomass crops, wood residues, and cellulose in municipal solid wastes into ethanol.

AE Biofuels (OTCBB: AEBF) (www.aebiofuels.com): AE Biofuels, Inc. is a global vertically integrated biofuels company developing sustainable solutions to the world's renewable energy needs. The company is commercializing its patent-pending next-generation cellulosic ethanol technology that enables the production of biofuels from both non-food and traditional materials. AE Biofuels owns or has optioned five permitted ethanol plant sites in the United States, and its Universal Biofuels subsidiary owns a 50 million gallon biodiesel facility on the east coast of India.

Pacific Ethanol (NASDAQ: PEIX) (www.pacificethanol.net): Pacific Ethanol is the largest West Coast-based marketer and producer of ethanol. Pacific Ethanol has ethanol plants in Madera, California; Boardman, Oregon; and Burley, Idaho and has an additional plant under construction in Stockton, California. Pacific Ethanol also owns a 42% interest in Front Range Energy, LLC which owns an ethanol plant in Windsor, Colorado. Central to Pacific Ethanol's growth strategy is its destination business model, whereby each respective ethanol plant achieves lower process and transportation costs by servicing local markets for both fuel and feed. Pacific Ethanol's goal is to achieve 220 million gallons per year of ethanol production capacity in 2008 and to increase total production capacity to 420 million gallons per year in 2010. In addition, Pacific Ethanol is working to identify and develop other renewable fuel technologies, such as cellulose-based ethanol production and bio-diesel.

VeraSun Energy (NYSE: VSE) (www.verasun.com): VSE, headquartered in Brookings, S.D., is a leading producer of renewable fuel. Founded in 2001, the company has more than one billion gallons of annual ethanol production capacity through 11 operating facilities. Six additional facilities are currently either under construction or development with a combined capacity of 660 million gallons. Upon completion of the new facilities, VeraSun Energy will have an annual production capacity of approximately 1.75 billion gallons. The company announced it started construction at its Aurora facility to extract oil from dried distillers' grains for use in biodiesel production. VeraSun markets E85, a blend of 85 percent ethanol and 15 percent gasoline for use in Flexible Fuel Vehicles (FFVs), directly to fuel retailers under the brand VE85(R).

ALL Fuels & Energy Company (OTCBB: AFSE) (www.allenergycompany.com) ALL Fuels & Energy Company operates as a development-stage ethanol company in the United States. It intends to produce ethanol and its co-products through its production facilities primarily in the Midwestern United States. The company, through its subsidiary, Venus Associates, Inc., also involves in Web page publishing. ALL Fuels & Energy Company was founded in 2006 and is based in Johnston, Iowa. On 6/18/04, AFSE announced it had received a $20 million term sheet for the funding of its growth strategy.

Select Publicly Traded Comparables

Ticker	Company Name	Recent Price	Market Cap	TTM Revenue	TTM Net Income	52 Week High	52 Week Low	Price / Revenue
AEBF	AE Biofuels	$7.00	$595,000,000	$0	($14,520,000)	$15.00	$1.80	n/a
AFSE	ALL Fuels & Energy	$0.05	$2,580,000	$0	($8,354,000)	$1.11	$0.05	n/a
BFRE	Bluefire Ethanol Fuels	$2.65	$74,360,000	$193,000	($16,723,000)	$5.25	$2.45	385
PEIX	Pacific Ethanol Inc.	$1.70	$98,390,000	$608,017,000	($63,015,000)	$11.24	$1.40	0.16
RVBF	Raven Bioefuels International	$0.53	$27,670,000	$0	($163,000)	$1.48	$0.30	n/a
VRNM	Verenium Corporation	$1.72	$112,180,000	$57,369,000	($81,798,000)	$6.20	$1.05	1.96
VSE	VeraSun Energy Corp	$5.27	$828,160,000	$2,065,000,000	$44,000,000	$17.75	$3.75	0.40
*Data from QuoteMedia as of 9/12/08; Analyst Estimates								

RVBF Risks

As noted in the company's SEC filings, which should be read in conjunction with this report, following are comments related to various risks to consider in the evaluation of the prospects for RVBF:

- **Some critical agreements not yet completed.** RVBF's plan is dependent upon the execution of various agreements to obtain technology rights and finalize joint ventures. There is no reason to expect these will not be completed as RVBF expects, but also no assurance regarding if or when these agreements will enable RVBF to launch its strategy.

- **Competition and technology.** RVBF faces existing and potential competition not only from producers of cellulosic ethanol and derivative chemicals, but also from entirely different alternative fuel technologies as well as fossil fuels.

- **Capital intensive model and the potential for dilution.** In addition to capital for corporate operations, RVBF estimates that its biorefineries will require approximately $3 per gallon capacity ($30 million cost for 11 million gallon capacity facility) in construction financing, presumably comprised of 1/3 equity and 2/3 debt. There is therefore the potential for dilution of common equity, including as a result of the Pure Energy merger, which may require the issuance of up to 50 million shares of RVBF common stock.

- **No revenue before 2010.** Given a biorefinery construction timeframe of no less than 14 months, it is highly unlikely that RVBF will generate revenue before 2010, and therefore is likely to experience operating losses for at least the next two years.

RVBF Q2 2008 Results

Balance Sheet: As of 6/30/08, RVBF reported virtually no cash on hand or assets against current / total liabilities of $795k, which includes $524k in accounts payable to the former CEO and President, $206k in unsecured notes payable to related parties and $46k in account / advances payable. RVBF reported an accumulated deficit of $1 million and total stockholders equity of $795k. As noted in the 8/29/08 8-K filing, RVBF now has acquired certain contractual and intellectual property rights from Superior Biotechnologies Corporation in exchange for a cash payment of $75k and the assumption of an $875k loan made by Tribune Capital Partners to Superior.

Income Statement: The legacy business of RVBF is still generating a limited amount of revenue, including $15k in Q2 2008. RVBF also reported $89k in total expenses for Q2 2008, including $40k in general and administrative expense and $49k in consulting expense to a related party.

RVBF reports that it expects to require $193k in financing to sustain operations from 6/30/08 to 6/30/09. As a result of this dependence on financing to sustain operations, the audit for 12/31/07 included an explanatory paragraph about the auditor’s concern regarding the ability of RVBF to continue as a going concern.

RVBF Historical Price Chart

Conclusion

The global energy market: While there may be periodically significant quarterly or perhaps even annual reductions in global energy demand, the Energy Information Administration and others state that the long term trend is clear – there will be significant increases in demand over the coming decades. As massive portions of the world's population move into cities, buy vehicles and participate in the global economy, it seems intuitive to agree with the case for long term increases in energy demand. As fossil fuel prices continue to reflect this trend, innovators like RVBF have a unique opportunity to provide alternative fuels to an increasingly demanding global energy market.

The technology: The dilute acid process utilized by RVBF for creating cellulosic ethanol from waste wood dates as far back as the late 1890's in Germany. RVBF's access to the two stage dilute acid process is a result of the TVA's effort in the 1990's to advance the technology by relying upon commercial development. This technology now presents RVBF with an opportunity to build a highly profitable biorefinery model fueled by low cost, non-controversial, non-food, waste wood processed in a production facility that is significantly less expensive than alternative cellulosic ethanol production facilities. This biorefinery model being developed by RVBF is driven by market based economics rather than governmental incentive, and by incorporating specialty chemical production as a core driver in the business model, RVBF is capturing the highest and best use of the natural output of the two stage dilute acid production process.

The team: Although still in the development stage, RVBF has brought in seasoned management with the addition of John Sams, who brings several decades of highly relevant plant construction and operation experience from the power and pulp/paper markets. Similarly, RVBF has assembled a solid team of bankers, advisors and investors whose industry knowledge and networks create significant opportunity for RVBF.

The strategy: As reflected in RVBF's recent press releases and filings, the company's plans seem to be coming together as projected. With the announcement of the 11 million gallon plant to be developed in Washington State, RVBF has provided insight into the magnitude of the economic opportunity – Murphy Analytics estimates that this facility alone may generate as much as $10.7 million in annual free cash flow against an initial equity investment RVBF expects to be approximately $10 million. With plans to reach 100 million gallons in annual production capacity within the next 5 years, RVBF is positioning itself for significant revenue and free cash flow growth.

Conclusion: As noted in the table of comparables, there is a wide range of market capitalizations for biofuels stocks, even development stage companies like RVBF. Although a company like AE Biofuels (AEBF), which had a recent market cap of nearly $600 million, is further along in its development than RVBF, the company reports no revenue for 2008 against $9.5 million in expenses for the 6 months ended 6/30/08, and property/plant/equipment of $22.4 million. Clearly the market is valuing AEBF on metrics other than current book value or multiples applied to historical earnings. As with any investment, the critical question is the present value of expected future cash flows.

Murphy Analytics (MA) is estimating that RVBF's first biorefinery, to be located in Washington State, has the potential to generate $10.7 million in net cash flow annually on production capacity of 11 million gallons per year. RVBF's stated objective is to increase production capacity to 100 million gallons. Assuming RVBF corporate selling / general / administrative expenses double to $700k per year from the current run rate, the Washington State biorefinery alone has the potential to generate $10 million per year in net cash flow. This estimate includes many simplifying assumptions, including ignoring the significant potential tax benefits to RVBF. In light of the company's growth objectives, a multiple of 20x net cash flows seems supportable, implying a potential market cap of $200 million. Discounting this market cap to reflect the uncertainty of the timing of the potential cash flows produces a market cap of approximately $175 million assuming a 15% discount rate is reasonable. With a fully diluted share count of 53.6 million, this implies a potential share price of $3.25, again based only on production from the Washington State biorefinery. Although there are numerous significant risks and uncertainties related to RVBF's potential performance, Murphy Analytics is initiating coverage on RVBF with a 12-month price target of $3.25 driven by the global market opportunity for cellulosic ethanol and RVBF's strategy for executing against this opportunity.

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Overview of the OTC Bulletin Board[31]

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[31] http://www.otcbb.com/investorinformation/investorinfo.stm