

A REVIEW OF BIOFUEL & SPECIALTY
BIOCHEMICAL BUSINESS
DEVELOPMENT POTENTIAL IN
CENTRAL OREGON

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Executive Summary

The Central Oregon Intergovernmental Council (COIC) is interested in understanding the key attributes biofuels and bio-based specialty chemical companies require in order to attract them to Central Oregon. This report summarizes the responses of five different biofuel and five biomass/biofuel industry experts that were interviewed. Of the 10 individuals and organizations interviewed, 8 said that feedstocks were the most important attribute when deciding to locate in a particular region. Feedstock quantity and economics (<\$50 a bone dry ton) were mentioned most frequently. Companies did not express a preference for feedstock types. The majority said they can use forest biomass. Although biofuels companies prefer private (non-federal) sources of biomass because the Environmental Protection Agency excludes federal lands from being used for compliance with the Renewable Fuels Standard. Other key attributes expressed by biofuels companies were proximity to existing gas refineries (for blending biofuels), permitting requirements, and community support. No interviewees indicated a trained workforce, R&D assistance, grants, or university partnerships, were compelling reasons to locate to a particular region.

It is recommended that COIC focus on attracting specialty bio-chemical companies rather than commodity scale biofuels given that Central Oregon has no existing oil refineries and 60% of forestland is federally owned. Specialty biochemical products made from forest biomass and/or spent brewery grains in Central Oregon may offer good near-term potential for business development in the region.

COIC could jump-start the process of developing specialty biochemical opportunities by compiling information on 1) types and quantities of specific forest and agriculture biomass feedstocks, 2) organizing suppliers of biomass materials and gauge their interest in entering into supply contracts, and 3) compiling a list of permits that would be needed so that companies can understand state and local requirements (zoning, water, air permits, etc.) for biochemical facility development.

1.0 Introduction

Since 1972, the Central Oregon Intergovernmental Council (COIC) has worked to provide education, retraining and economic development services to positively affect regional employment, individual lives, the business community and local government in Central Oregon¹. COIC efforts include a variety of programs—such as economic development, transportation, workforce development, community forestry, food systems, water resources, and sustainable energy.

For the past 14 years, COIC has worked to support and develop opportunities to convert low-value forest biomass into higher-value uses. During this time, the organization has helped establish several biomass based initiatives including two biomass energy projects. COIC seeks to build up on this success, and support additional businesses to produce biofuels and specialty biochemical products in Central Oregon.

In the past, efforts to produce biofuels from woody biomass were not successful because the price and incentives for the product were not high enough, because the technologies and production processes were not mature enough, and because facilities were being proposed at scales where annual feedstock requirements were not scaled to local production capacity.

COIC believes that Central Oregon has the feedstocks, workforce, and other key attributes to attract biofuel and specialty biochemical product companies to the region. With funding from the USDA Rural Biomass Enterprise Grant program² COIC initiated an effort to better understand biofuel & specialty biochemical company needs and determine a strategy to bring one or more of these organizations to Central Oregon. Understanding the needs of bio-based companies will prepare Central Oregon to attract advanced biofuels and biochemical opportunities in the near term. The first step in the process is to collect information from biofuels & biochemical companies in order to understand the types of key attributes these companies look for when deciding to invest in a region. This report is a summary of the results of those interviews.

1.1 Organizations contacted

This work involved interviewing five different companies and five different individuals. The five companies interviewed were:

- Blue Marble Biochemicals (Seattle, WA)
- Cool Planet (California, Colorado, Louisiana)
- EcoReps (Prineville, OR)
- Earth Energy and Environment LLC (Kansas)
- Red Rock Biofuels (Colorado company with a biofuels project in Lakeview, OR)

¹ About COIC: <http://coic2.org/about/>

² USDA RBEG: http://www.usda.gov/wps/portal/usda/usdahome?contentid=kyf_grants_rd6_content.html

A brief description of each company can be found in Appendix A. The five industry experts interviewed were:

- Weyerhaeuser related personnel at Oregon State University Bend campus and Washington State University at Pullman (2)
- Biomass and biofuels industry consultants in Eugene and Portland (2)
- OSU researchers (1)

In addition, inquiries were made to Abengoa, Gevo, POET-DSM, and Renmatrix. Unfortunately, none of those companies responded to emails or phone calls.

1.2 Biofuels and biochemical technology approaches

There are a variety of technological pathways to produce biofuels and specialty biochemical products. The three main pathways involve: gasification, pyrolysis, and hydrolysis (Figure 1).

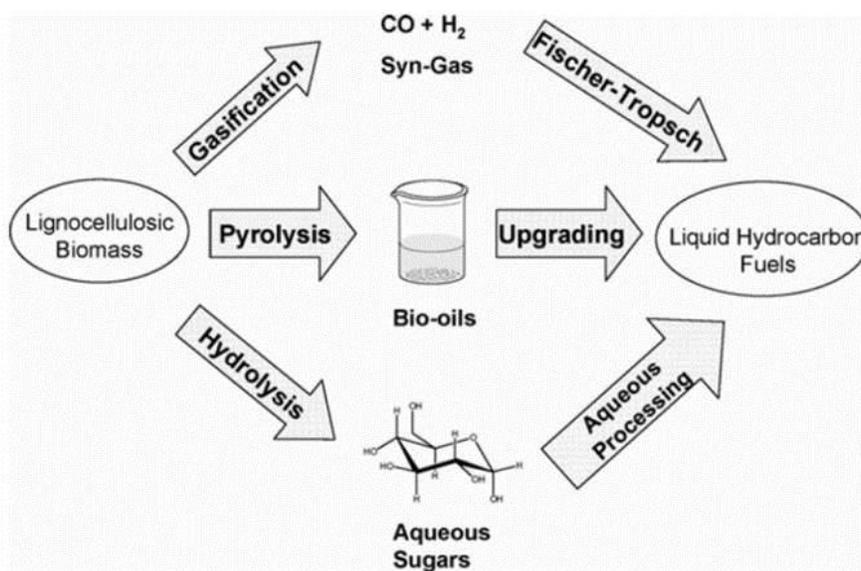


Figure 1. Process pathways for biofuels and specialty biochemical production (courtesy of TSS Consultants³)

Gasification involves burning biomass at a high temperature (>700 degrees C) which produces syngas that can be converted into hydrocarbon fuels. Remnant materials left over from gasification are mainly ash. Pyrolysis is a similar yet distinct process (limited oxygen and lower temperatures than gasification). Pyrolysis operating temperatures are typically 500 to 700 degrees C, and as an “incomplete combustion” process creates bio-oils and a material called biochar⁴. Hydrolysis is a water based approach to biofuels manufacturing (fermentation is one example). Hydrolysis typically includes adding enzymes or chemical reagents to break down biomass to produce sugars. These sugars and other chemicals can be upgraded into hydrocarbon biofuels products.

³ TSS Consultants biofuels presentation: <http://www.tssconsultants.com/presentations.php>

⁴ Biochar information: <http://www.biochar-international.org/>

2.0 Factors that influence biofuel & biochemical investments

The biofuels and biochemical industries are diverse and complex. Biofuels include ethanol, biodiesel, jet fuel, and naphtha fuels. Biochemical products include dozens of specialty products like candy flavoring, natural cosmetic ingredients, and lignin based char. Each segment of these diverse industries have variables which influence their viability, profitability, and potential for Central Oregon.

The main factors that influence investment decisions of biofuels and biochemical companies, are as follows:

1. Policy: state low carbon fuel standards, Renewable Identification Numbers (RINs), local support
2. Feedstocks: price, quantity, sustainability
3. Infrastructure: Distance to markets, roads, pipelines, existing refineries

In the following sections we describe each of these three categories in detail.

2.1 Federal policy

State and Federal policies have a significant impact on the biofuels industry in the United States. At the Federal level, this is done via the Renewable Fuels Standard (RFS) as implemented by the Environmental Protection Agency (EPA). The RFS is a federal program that requires transportation fuels sold in the United States to contain minimum volumes of renewable fuels. Fossil fuel industries (fuel refiners, blenders, and importers) are required by the EPA to blend at least 10% of their transportation fuels with biofuels. To ensure compliance with this standard, refineries can document how many gallons of biofuels (like ethanol) that they blend into their finished products. A second option to demonstrate compliance is through the generation of a certificate called a Renewable Identification Number⁵ (RIN). The EPA describes RIN's as follows:

“As a hypothetical example, Refiner A has already fulfilled its annual RFS requirement, but continues to buy and blend renewable fuels and, therefore, has excess RINs. Refiner A can sell the excess RINs to Importer B, who has not purchased sufficient renewable fuels to meet its RFS requirement. RIN prices are determined by market factors typical of other commodities.

Due to the low availability of cellulosic ethanol, EPA sets waiver credit prices for cellulosic ethanol in order to allow obligated parties to meet their required volumes. Cellulosic waiver credit prices were \$0.49 and \$0.64 per gallon in 2014 and 2015”

Over the last couple of years, Federal policy discussions have focused on raising the 10% biofuel blending requirement. The ethanol industry and others have pushed for it and it appears that the fossil fuel industry has been against it. This policy discussion/disagreement has been coined “the blend wall”⁶. To date, EPA has decided not to increase the 10% biofuels blending requirement. Despite the EPA's decision, numerous biofuels companies interviewed as part of the work for this report indicate that RIN

⁵ EPA RIN-- <http://www.afdc.energy.gov/laws/RIN.html>

⁶ Renewable Fuels Association: <http://www.ethanolrfa.org/pages/big-oil-builds-the-blend-wall>

revenues were important for their businesses. The good news for Central Oregon is that as a national program, RIN biofuel revenue can be generated anywhere. In other words, every state can (potentially) generate biofuel RIN revenue. The bad news is that EPA rules exclude the generation of RINs if the biofuels are made from federal biomass feedstocks. Since the federal government owns approximately 60% of the forestland in Central Oregon—this could present a challenge for biofuels companies considering investing in the region as RIN revenue could not be generated if forest biomass feedstocks are sourced from federal lands. One biofuels company interviewed said, “we typically skip federal biomass feedstocks because we can’t generate RIN revenue from those sources.” When asked what Central Oregon stakeholders could do about this, he said, “I would encourage you to talk to the EPA and try to get them to change their regulations”.

2.2 State policy

In addition to national policy programs, state level programs are also important to biofuels companies. Several western states, most notably California have passed “Low carbon fuel standards” which are policies designed to lower the carbon intensity of emissions created while extracting, refining, and transporting oil products. This has created a demand for low-carbon intensive products (like biofuels). Three out of the five biofuels companies interviewed for this report indicated that the low-carbon fuel standard in California was an important revenue source for their businesses.

In March of 2015, Oregon governor Kate Brown signed a bill extending Oregon’s low-carbon fuel standard⁷. Although the program (and any associated market) has yet to be implemented. During the interview process, biofuels companies were asked if Oregon’s low-carbon fuel standard would be an enticement for them to locate to Central Oregon. The companies indicated they were not aware of Oregon’s new law and would have to gather more information before commenting.

In summary—national and state policies are important drivers of biofuel market demand. Federal policy via the RFS (and by proxy the RIN program) represent a source of revenue for biofuels companies. However the federal blending requirements have not increased in recent years and there does not appear to be any plans to change that in the near future. State policies in California (and recently in Oregon) via the low-carbon fuel standards are also important drivers of biofuel demand. Many biofuels companies interviewed for this work indicated they were either selling into the California market or had plans to do so in the near future. Oregon policy incentives are nascent and it is still unclear what (if any) impact the state’s low-carbon fuels program will have on biofuels investment in the region.

2.3 Feedstocks

Of the 10 biofuel & biochemical companies and individuals interviewed, 8 indicated that feedstocks were at the top of the list of attributes that influence biofuel investment decisions to locate in a particular region. As one biofuel company mentioned during the interview process, “If you are trying to get our business to move to Oregon, you have to keep in mind that I can get supply agreements on

⁷ Oregon Governor clean fuels bill:
http://www.oregonlive.com/politics/index.ssf/2015/03/kate_brown_makes_it_official_s.html

forest biomass all day long in the southeast for less than \$50 per bone dry ton. If you have feedstocks that are more expensive than that, we won't be interested".

The importance of feedstocks is not surprising, since it can represent a significant portion of the operating costs of a biofuels refinery. Kyle Atlohff (President of Equinox <http://www.equinox8.com/>) said in a BBI webinar titled "Developing a Successful Plan and Attracting Investors to Your Bioenergy Project"⁸, that biomass feedstocks can represent 50% to 75% of the operating costs of a biofuels plant on an annual basis (Figure 2).

Feedstock Supply Chain Costs:

Feedstock Annual Cost	Starch	Cellulose
Plant Size	30 MMGY	30 MMGY
Unit Cost	\$4.00 per bushel	\$80 per US ton
Conversion Yield	2.80 gallons/bu	75.00 gallons/ton
% of Total Costs	75%	50%
Cost in \$ per Gallon	\$1.43	\$1.07
Cost in \$ per Liter	\$0.38	\$0.28
Total Cost per Year	\$42,857,143	\$32,000,000

Feedstock is the leading cost in most biorefineries – is the supply chain setup for success?

www.equinox8.com Equinox ©

Figure 2. Feedstock supply chain costs (slide courtesy of Kyle Atlohff)

In our discussions with biofuels companies as part of work for this report, one company said that feedstocks costs of 50% to 75% were in the ballpark for ethanol plants that use corn feedstocks. However for cellulosic biofuels which use a less expensive gasification process to process material, feedstock costs are typically 30% to 50% of annual operating costs.

Companies also indicated that they prefer to work with a biomass broker or a single entity when it comes to securing their biomass feedstock supplies. One of the companies interviewed said that in the past they went out and collected forest biomass material themselves. However, it was a headache for them and it was not part of their core business. Therefore they gave up trying to collect and transport biomass material directly. The preferred model is to work with a single biomass broker who can coordinate supply delivery with loggers, mill operators, or others in the forest product industry via a biomass contract. Companies typically seek a seven year biomass supply contract (at minimum) with a

⁸ BBI webinar: <http://150128-power-data-ethanol-profit-series1.bbiprojectdevelopment.com/ema/DisplayPage.aspx?pageId=Home>

preference for 10 year terms. Companies also indicated that they like to contract for 1.5 times their annual feedstock needs.

Biofuels facilities also vary on their annual feedstock requirements. Most companies indicated that forest biomass was acceptable to them as a feedstock, so long as it was economical and sourced from non-federal sources. Red Rock Biofuels announced plans to build a \$200 million dollar biofuels facility⁹. Their web site indicates feedstock needs will be 140,000 tons of biomass per year. They plan to produce approximately 20 million gallons of biofuels annually. Earth Energy and Environment LLC operates a biofuels facility in Nebraska that has a 24 million gallon annual capacity. In addition, Cool Planet CEO Howard Janzen recently announced a \$91 million dollar loan guarantee¹⁰ from the USDA to build a 10,000 gallon commercial biofuels facility in Louisiana. Construction is supposed to start in 2015 and be online in 2016. The amount of feedstocks required for the facility have not been publicly disclosed.

Based on information collected for this report, it appears that a “typical” commodity biofuels company facility produces approximately 20 million gallons of fuels per year, and requires about 100,000 tons of (non-federal) biomass material on an annual basis.

Biofuels companies indicated their customers are increasingly asking them to provide documentation that shows sourced forest biomass is from sustainably managed forests. These companies therefore like to source forest biomass from private forests that are certified by the American Tree Farmer System, the Forest Stewardship Council, and the Sustainable Forestry Initiative. Federal forests typically do not participate in forest certification programs, however some kind of verifiable statement around the sustainable aspects of forest restoration thinning treatments or other forest management activities would be desired by biofuel companies.

Biochemical companies that produce specialty biochemical products appear to have much lower annual feedstock requirements. Based on our surveys, specialty biochemical products typically require 3,000 to 5,000 tons of biomass feedstocks annually. Forestry feedstocks (both federal and non-federal) are desired feedstocks according to companies interviewed for this report. In addition, specialty biochemical companies are typically not interested in RIN revenue (since they are not producing biofuels) hence the biomass feedstocks can come from federal land sources. Biochemical companies that were interviewed for this project indicated that agricultural based bioenergy crops (such as sorghum) and the waste products from brewery operations (spent hops grains) were also desirable as feedstocks for specialty biochemical product manufacturing.

Lignin based char (a form of activated carbon) is another specialty biochemical product under development in the Pacific Northwest. The principal program supporting the development of these products is the Northwest Advanced Renewable Alliance (NARA¹¹). The NARA project is a \$40 million dollar grant that is being funded by US Department of Agriculture. According to the NARA website:

⁹ Red Rock Biofuels announcement: <http://www.xconomy.com/boulder-denver/2015/03/17/red-rock-biofuels-raises-cash-gets-ready-for-first-refinery/>

¹⁰ Cool Planet USDA loan guarantee: <http://www.coolplanet.com/Cool-Planet-USDA-91-Million-Loan-Guarantee>

¹¹ NARA project: <https://www.nararenewables.org/>

“NARA is an alliance of public universities, government laboratories and private industry that provides technologies, resources and analyses for stakeholders interested in using forest residuals to create bio-based alternatives to petroleum-based products such as jet fuel. The Alliance is funded through a five-year grant provided by USDA National Institute of Food and Agriculture (source NARA)”. The project involves Washington State University, Oregon State University, and several other public and private organizations.

In addition to their focus on aviation biofuel, the NARA project also involves exploring the development of specialty biochemical products, for example lignin-based char. This material is made from the remnant products of biofuel fermentation processes. The spent material is treated with various chemicals and carbon dioxide streams to make a type of activated carbon. Activated carbon is used in industrial processes as an absorbent of heavy metal pollution such as mercury in coal-fired energy plants.

The work to develop lignin based char¹² is being led by Ian Dallymayer professor at Washington State University, Pullman. As part of the work for this report, we contacted him for more information about his research. He indicated that commodity activated carbon can sell for \$1.00 to over \$15 a pound (depending on quality and grade). According to Mr. Dallymayer, his tests have shown that lignin based char can have twice the activation (and absorptive) potential compared to activated carbon made from regular biomass feedstocks (such as coconut coir). However, work on lignin-based chars are currently at the lab scale. It is likely to be some period of months or years before these products would be ready for commercial production. However, this type of R&D effort may be suitable for development in Central Oregon.

Two specialty biochemical companies contacted as part of the work for this report, indicated they would be interested in more detailed discussions with COIC about developing biochemical products in Central Oregon (Blue Marble Biochemicals and Earth Energy & Environment LLC).

2.4 Infrastructure

Two of the five biofuel companies interviewed indicated that proximity to refineries or pipeline infrastructure was important to their investment decisions. Customers for biofuel products are the oil industry, since these fossil fuel industries are required by the EPA to blend biofuels into their gasoline and other fuel products. Hence, biofuel companies (jn some cases) like to locate in close proximity to existing oil refinery businesses. For example, one biofuel company that was interviewed indicated that the southeast U.S. is an ideal location for biofuels facilities because of the existing oil refinery capacity in that region. In other cases, proximity to pipelines or rail system infrastructure is desired for moving biofuel products into locations like California. Since California has an active low carbon fuel standard, biofuel companies are seeking to sell their products into that market. Two biofuels companies interviewed indicated that rail and road transportation infrastructure as well as the proximity to California’s low-carbon fuel market were factors in their decisions to locate in a particular area.

¹² Lignin based char product development: <http://nararenewables.org/feature/newsletter-12#story3>

Infrastructure is important to biochemical companies as well, however proximity to California and/or existing oil refineries are not typically part of their decision process. The focus of biochemical companies tends to be more locally focused at the specific site of a new potential facility. For example, does the site have sufficient amounts of clean water, does the proposed location have the proper industrial zoning designation, are their good road and rail networks, etc.

2.5 Other important factors

Two of the companies interviewed indicated that local community support was important to them. During the interview process one company said, “We don’t want to move to an area where we aren’t welcome”. In addition, companies indicated that before considering a move to a new area they would need to know about the permit process (water permits, air, Oregon Department of Environmental Quality regulatory requirements, local build permits, etc.) before they would consider Central Oregon.

3.0 Conclusions

There is a great deal of potential to develop biofuels and biochemical facilities in Central Oregon. Both should be considered by COIC and other interested stakeholders over time. However, given the relatively large feedstock requirements of biofuels facilities (approximately 100,000 tons of biomass annually) and the relatively high percentage of federal land ownership in Central Oregon, COIC should focus on the specialty biochemical industry in the near term. RIN’s are a key source of revenue for biofuel facility operators, however biomass sourced from federal lands does not qualify according to current EPA regulations. In addition, it is likely too expensive to have biofuels shipped from Central Oregon to California, for sale into that state’s low-carbon fuel standard program. Oregon’s own low-carbon fuel standard is just getting started and it will be some time before it is clear what (if any) economic incentives it creates for the regions biofuels industry. Central Oregon also has no existing refinery facilities, which is another key attribute desired by biofuels companies.

By contrast, feedstock requirements of specialty biochemical companies are typically a fraction of those in the biofuels sector (3,000 to 5,000 tons per year). Importantly, biochemical companies do not express a preference for federal versus non-federal sources of biomass. In some cases (for example the lignin-based char products)—COIC could bring their existing relationships with university partners forward and help develop these products via an R&D initiative. Specialty biochemical companies do not sell their products to oil-refineries, hence a lack of existing refinery capacity in Central Oregon is not a hindrance.

COIC could jump-start the process of developing biochemical opportunities by compiling information on 1) types and quantities of specific forest and agriculture biomass feedstocks, 2) organizing suppliers of biomass materials and gauge their interest in entering into supply contracts, and 3) compiling a list of permits that would be needed so that companies can understand state and local requirements (zoning, water, air permits, etc.) for biochemical facility development.

Appendix A. Biofuel company descriptions (from company websites and press releases)

Blue Marble Biochemicals: This Missoula, Montana based biochemical company¹³ has developed “*proprietary liquefied gas extraction, distillation, and fractionation technologies designed to allow for the production and creation of US and EU natural novel extracts and chemical fractions*”. They achieve this by managing “*ecosystems of bacteria to produce complex chemical compounds. We refine our compounds using green chemistry processes.*”

Cool Planet: this California based firm—which also has offices in Colorado and Louisiana—is focused on biofuels and biochar products. According to their web site—“*Biomass is processed through a mechanical system that uses pressure and heat to create streams of useful hydrocarbon components. Cool Planet’s sources of biomass include corn stover, wood chips, and fast growing, non-food energy crops such as miscanthus*”¹⁴. Cool Planet CEO Howard Janzen recently announced a \$91 million dollar loan guarantee¹⁵ to build a 10,000 gallon commercial biofuels facility in Louisiana. Construction is supposed to start in 2015 and be online in 2016.

Earth Energy and Environment LLC: This Company is based in Kansas and has a project called “AltEn LLC” which is an integrated biofuels/biochar/biodigester facility¹⁶ in Nebraska. According to information provided—“*AltEn, LLC (“AltEn”) initiated commercial biofuel production at its 24MMGPY {million gallon per year} Advanced Biofuel Refinery in Mead, NE, in January of 2015. The plant is the first application of a “Closed Loop” patent that integrates an ethanol refinery, anaerobic digester and feedlot. The integrated design harnesses biological waste streams to produce biogas that powers the Advanced Biofuel Refinery and produces environmentally friendly biological fertilizers and other bio-co-products.*”

Ecoreps: This company has a biochar production machine in Prineville, OR which is capable of producing a type of activated carbon. The company was formerly known as International Tech Corporation however they have a new arrangement with an Australian company called “Ecoreps” which sells their Thermal Recovery Unit (TRU)¹⁷. The company is based in Prineville, Oregon and are interested in engaging with COIC and other Central Oregon stakeholders for potential project partnerships.

Red Rock Biofuels: the company announced plans to build a \$200 million dollar biofuels facility¹⁸ in the town of Lakeview, Oregon. The company¹⁹ intends to use a “*Fischer-Tropsch*” unit to gasify 140,000 dry tons of biomass, produce syngas, then refine the syn-gas into 12 million gallons of jet, diesel, and naphtha fuels.

¹³ Blue Marble Biochemicals: <http://bluemarblebio.com/technology>

¹⁴ Cool Planet process: <http://www.coolplanet.com/how-it-works/GreenFuels>

¹⁵ Cool Planet USDA loan guarantee: <http://www.coolplanet.com/Cool-Planet-USDA-91-Million-Loan-Guarantee>

¹⁶ AltEn LLC facility <http://www.ethanolproducer.com/articles/7180/alten-llc-to-restart-closed-loop-ethanol-plant>

¹⁷ Ecoreps and the TRU <http://www.ecoreps.com.au/thermalrecoveryunit.html>

¹⁸ Red Rock Biofuels announcement: <http://www.xconomy.com/boulder-denver/2015/03/17/red-rock-biofuels-raises-cash-gets-ready-for-first-refinery/>

¹⁹ Red Rock Biofuels <http://www.redrockbio.com/Home.html>