CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

Clean Transportation Program

FINAL PROJECT REPORT

DEPLOYING SMALL-SCALE BIODIESEL FACILITIES THROUGHOUT CALIFORNIA

SUMMARY FINDINGS FROM INTIAL PILOT PLANT

Prepared for: California Energy Commission

Prepared by: Springboard Biodiesel, LLC

Springboard Biodiesel
The Cure for Diesel™

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California Energy Commission

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance, and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-11-601 to Deploy Small-Scale Biodiesel Facilities in California. In response to PON-11-601, the recipient submitted Application 1, which was proposed for funding in the CEC's notice of proposed awards March 23, 2012, and the agreement was executed as ARV-11-016 on June 20, 2012.

ABSTRACT

Springboard Biodiesel's goal was to use its in-house, innovative process and product technologies to build a small-scale biodiesel production plant that could serve as a model for other potential small-scale biodiesel producers to produce American Society for Testing and Materials -grade biodiesel easily and inexpensively at an affordable price. Springboard would produce American Society for Testing and Materials -grade biodiesel locally and reduce local, regional, and global greenhouse gas emissions associated with the current use of diesel fuel.

Springboard has successfully developed and built a pilot small-scale biodiesel fuel production facility in Chico, California, facility can produce 1,000 gallons of American Society for Testing and Materials grade biodiesel per day in a zero-waste, compact, and highly automated facility from a variety of feedstock sources. While the facility can convert multiple animal and vegetable feedstock sources, it has focused on locally sourced (low carbon footprint) used cooking oil that is less than 10 percent free fatty acid and two percent moisture, insoluble, and unsaponifiable.

With the help of the California Energy Commission's grant, Springboard Biodiesel has completed the facility and proven the economic viability of small-scale, local biodiesel production. In so doing, Springboard laid the groundwork to site additional facilities within California, based on the same technology, operating processes, and small footprint.

Keywords: Biodiesel, biofuels, small-scale biodiesel, zero-waste facility, sustainability, local fuel production, manufacturing, closed local loop, Springboard

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TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

EXECUTIVE SUMMARY

Purpose

This small-scale biodiesel production project sought to build, install, and operate Springboard Biodiesel's proprietary small-scale, multiple feedstocks, highly automated, zero-waste production facility. By so doing, Springboard attempted to prove that small-scale, local biodiesel production can be commercially viable in California and beyond. Springboard believes that small-scale distribution provides a flexible and complementary pathway to increase the overall availability and use of cleaner-burning biodiesel.

Location

The facility, located at 2323 Park Ave in Chico, California, houses Springboard's multimodule batch processing system. Within the system, each stage of biodiesel production is automated and executed in purpose-built modules. The facility uses locally collected used cooking oil as the primary feedstock, although it has been designed and certified to use beef tallow, chicken fat, soybeans, and camelina and canola oils, as well as other vegetable and animal oils.

Goal

The goal of the project was to build and operate the facility such that it could produce 1,000 gallons of American Society for Testing and Materials D6751, Standard Specification for Biodiesel Fuel Blend Stock, for commercial-grade biodiesel in 24 hours. This goal has been accomplished. In addition, the company has successfully registered with all relevant regulatory agencies (the U.S. Environmental Protection Agency, Internal Revenue Service, California Air Resources Board, U.S. Department of Agriculture, California Department of Food and Agriculture, California Weights and Measures, and Genscape, a third-party "auditor" of renewable identification numbers) and is therefore in the position of being able to create, report, and monetize all biodiesel-related credits that are available to larger, multimillion-gallon-per-year facilities. Management has learned that this is paramount to the economic viability of biodiesel production at any commercial scale.

Operations

During the project, Springboard Biodiesel successfully adapted an existing structure within a designated industrial redevelopment zone. This adaptation involved bringing power to the building, installing five 4,000-gallon storage tanks to city and U.S. Environmental Protection Agency (U.S. EPA)-approved containment areas, and successfully wiring and plumbing all the company's discrete modules into the final networked configuration. In addition, the company completed the design, installation, and testing of more than 20 parts of the overall system. This involved not only designing specific components and subsystems that could operate 24/7 in a lights-out environment, but it also required the development and installation of comprehensive control and measurement software. More than 6,600 lines of proprietary software code were developed to control more than 7,000 system variables such that the entire system can be monitored on site and remotely, ensuring lower-cost production and higher quality, repeatable output.

Given the company's ability to produce biodiesel during project, Springboard made a concerted effort to create a local demand base for the product. This effort remains somewhat nascent, as the substantial decline in the cost of petroleum-based diesel has made it more difficult to "match" diesel pricing for its customers. While this has always been the company's goal,

management has decided to find customers who prescribe a value to locally made, cleaner-burning fuel and the many benefits that accompany such a product. The company's buyers' club – Springboard Biodiesel Buyers' Club – has 65 members (and growing), and several local companies have expressed an interest in incorporating biodiesel into the transportation fuel mix of their fleets.

Results

The energy industry has historically emphasized a production model based on "economies of scale" and then achieved economies of scale by building very large, expensive, centralized (hub-and-spoke distribution) plants that are less able to adjust quickly and profitably to changes in commodity pricing, end-product pricing, labor pricing, and/or interest rate pricing. Springboard's facilities are relatively inexpensive to build and site (less than $800,000 per facility), are less environmentally invasive, can therefore be built quicker (less than six months from order to production), and can use a broad array of feedstock sources. Springboard believes it will be able to create a "networked" group of small-scale facilities that, when looked at as a "production source," will be able to bring on-line meaningful biodiesel production capacity in a relatively short time frame. In addition, because of the intelligent automation of the system, a broader range of employees can successfully operate the plants.

Some of the conclusions drawn from this project conducted as part of ARV-11-016 are the following:

- Small-scale production defined as 1,000 gallons per day of production can be successfully conducted in a small physical footprint.
- Independent, multiple feedstock production that meets American Society for Testing and Materials-D6751 quality can be conducted in lower-cost, regional facilities.
- Zero-waste production can meaningfully reduce production costs and, in some cases, increase overall facility revenues.
- Local transportation fleet greenhouse gas (GHG) can be reduced substantially below "status quo" levels via small-scale production.
- Small-scale production models can meet and benefit from current regulatory incentives and oversight.
- It is relatively straightforward to retrain local workforce participants to operate a small-scale biodiesel production facility.

At the conclusion of this project, Springboard Biodiesel has proven the efficacy of its small-scale system and its next step is to work with other parties to install additional systems in locations that have access to regionally inexpensive feedstock.

CHAPTER 1:
Proving the Commercial Viability of Small-Scale Regional Biodiesel Production

Building the System

This project sought to demonstrate the commercial viability of implementing a well-designed, small-scale biodiesel production facility (Figure 1), capable of producing 1,000 gallons of American Society for Testing and Materials (ASTM)-grade biodiesel every day. To expand biodiesel use throughout the California State Transportation fleet, the many challenges to biodiesel production need to be revisited: access to costly feedstocks, affordable production facilities that have reliable and repeatable production processes need to be available to more potential users/producers, and value-added coproducts that need to be produced to help offset overall costs.

During this project, Springboard Biodiesel was able to build, refine, install, test, program, operate, and network together 20 new production modules, all of which work together to produce 1,000 gallons of ASTM-D6751 biodiesel per day in a 4,000-square-foot facility as shown in Figure 2. While the company had engaged in a significant amount of research and development and design and had built several prototypes before the start of this project, the Energy Commission's grant enabled Springboard to take the next step and build the pilot commercial system. With more than 4,500 parts, 20 modules, and more than 6,600 lines of code, Springboard has produced a system that is unlike anything else in operation in California. What's more, the system was built by Springboard's 10 Chico-based employees with the help of more than 40 suppliers and service providers, the vast majority of which are located in Butte County and Northern California.

In addition, the company has been able to successfully register with every relevant regulatory group (providing "big company" capability to a small, entrepreneurial enterprise) further underscoring the commercial viability of the company's goal, which is to produce locally and consume locally, and do both profitably.

Figure 1: Springboard Biodiesel Closed Local Loop Site Before Project Start

Source: Springboard Biodiesel, LLC

Figure 2: Springboard Biodiesel After the Start of the Project

Source: Springboard Biodiesel, LLC

Maintaining a Local Focus

Springboard partnered with a local used cooking oil collector, Smart Alternative Fuels to:

1) Assure access to local used cooking oil.
2) Further reduce the carbon intensity of the finished fuel, which is impacted by distribution distance and the fuel used by the collector (biodiesel in this case).

The company has reported its biodiesel sales to California Air Resources Board under the Low Carbon Fuel Standard program (LCFS). This program designates the carbon intensity of biodiesel made from used cooking oil to be 15.84 grams carbon dioxide per megajoule (CO_2/MJ). Springboard believes that the carbon intensity of the fuel may be even lower, based on the used cooking oil collection model (local collection with biodiesel fueled trucks) and the B-100 distribution model (local distribution with biodiesel fueled trucks). Springboard continues to coordinate and report to California Air Resources Board under the LCFS.

Local consumption of locally produced biodiesel has remained a primary focus of the company. While local knowledge of biodiesel has been minimal, the company's efforts have helped expand awareness of the alternative fuel, among individuals, companies, and local governments. To date, Springboard has grown its private buyers' club to more than 60 members.

Approach

Springboard's approach to achieving a 1,000-gallon-per-day ASTM-grade production facility in Chico was straightforward:

- Secure a small 4,000-5,000-sq.-ft. open space facility, properly zoned with good truck access.
- Complete the design of all production modules.
- Define the software controls and Human Machine Interface software that would enable the greatest level of automation and monitoring.
- Build the production modules in Chico.
- Write the software.
- Install the fuel production modules.
- Work with city permitting officials to approve proper power, access, containment, and fire safety protocols.
- Install modules and test the system.
- Address electromechanical issues.
- Make and test biodiesel.
- Achieve repeatable ASTM results.
- Define standard operating procedures, such that the system can be operated by third parties.
- Create a certification program for employees that operate the closed local loop (CLL).
- Certify existing employees to operate the CLL (based on the newly created certification program).
- Hire, train, and certify new employees.
- Register with necessary regulatory bodies.

- Make biodiesel, ultimately proving the commercial viability of 1,000 gallons per day of ASTM-grade biodiesel.
- Create, report, and monetize Renewable Identification Numbers and Low Carbon Fuel Standard credits.

CHAPTER 2:
Activities and Results

This chapter describes the activities and results of ARV-11-016 – how Springboard Biodiesel moved from an empty building, a set of "inventor drawings" and a lot of hard work to a fully operational small-scale commercial production facility capable of producing 1,000 gallons of certified biodiesel per day.

System Overview

As discussed, Springboard's closed local loop (CLL) facility in Figure 3 is a multimodule facility that relies on the successful interaction of multiple-purpose-built modules that perform the following functions:

1) Two 4,000-gallon used cooking oil tanks receive deliveries from suppliers and dispense the used oil to the system for processing. These used cooking oil tanks sit in Control Area 1, which is surrounded by a dike to provide a secondary containment volume greater than 4,400 gallons (110 percent of the volume of the largest vessel within the contained area).
2) A pump transfers used cooking oil from the storage tanks to the oil filtration module, which removes particulates larger than five microns. Oil passes through the oil filtration module continuously at a steady rate, but the reactors require large discrete volumes of oil at long intervals. So, the clean used cooking oil buffer interfaces between them, allowing oil from the oil filtration module to accumulate until a reactor is ready to receive it.
3) As the reactors receive feedstock from the clean buffer, they employ vacuum and high temperatures to extract residual water, in vapor form, from the feedstock. The chemical reactions begin with less than 0.15 percent water present in the oil. The reactors process 125 gallons of used cooking oil at least twice per day. The reactors perform esterification and transesterification reactions using methanol, sulfuric acid, and sodium methylate. Sulfuric acid (along with hydrochloric acid) is stored on a spill containment palette within the same area that the used cooking oil tanks are situated. After the chemical reactions are complete, most of the free methanol left over in the reactors is extracted in vapor form. The liquid phases that remain then stratify, with a raw biodiesel phase on top and a glycerin phase on the bottom. The automated control program of the system employs compressed air to force both phases out of the reactors.
4) The raw biodiesel phase flows into the raw biodiesel buffer. Once again, this buffer is needed because the modules downstream accept biodiesel constantly, at a steady rate, whereas the reactors discharge large quantities of biodiesel at long intervals. The raw biodiesel buffer pumps biodiesel through several T77 dry wash modules. The T77 units have columns filled with absorbent media and ion exchange resin, which trap soaps and salts. As biodiesel exits the T77 units, it contains only one final contaminant, trace methanol.

5) The BD-380 units remove trace methanol from the biodiesel stream down to a maximum allowable level of 0.2 percent. The biodiesel exiting the BD-380 is free of all contaminants above allowable levels.
6) A pump on each BD380 sends the now-clean biodiesel to the final filtration module, which performs various touch-up tasks. A resin column absorbs some of the monoglycerides present to help cushion compliance with the ASTM D6751 Total Glycerin specification. Another set of columns removes sterol glucosides, to ensure compliance with the ASTM D6751 Cold Soak Filterability specification. Oxidative stabilizer is injected to improve the stability of the fuel. Finally, the fuel passes through a last set of filters to ensure that no sediment or particles are present.
7) This finished fuel is then sent to the quality control area, where it is checked by Springboard's technicians to assure it complies with the company's known quality characteristics that indicate the CLL process remains "in-spec" versus regularly scheduled third-party test results.
8) Finished and successfully quality-controlled biodiesel is then moved to the final finished biodiesel buffers (two 4,000-gallon storage tanks), from which tanker trucks can pick up the finished product.

System Controls Overview

Given the multimodule design of the facility, system control and monitoring capability were deemed critical at the outset of the project. Multimodule design ensures that absent catastrophic failures, the plant will always be able to make biodiesel, should repairs be necessary on any part of the system. In addition, greater automation embeds proper process practices and allows workers to be more productive.

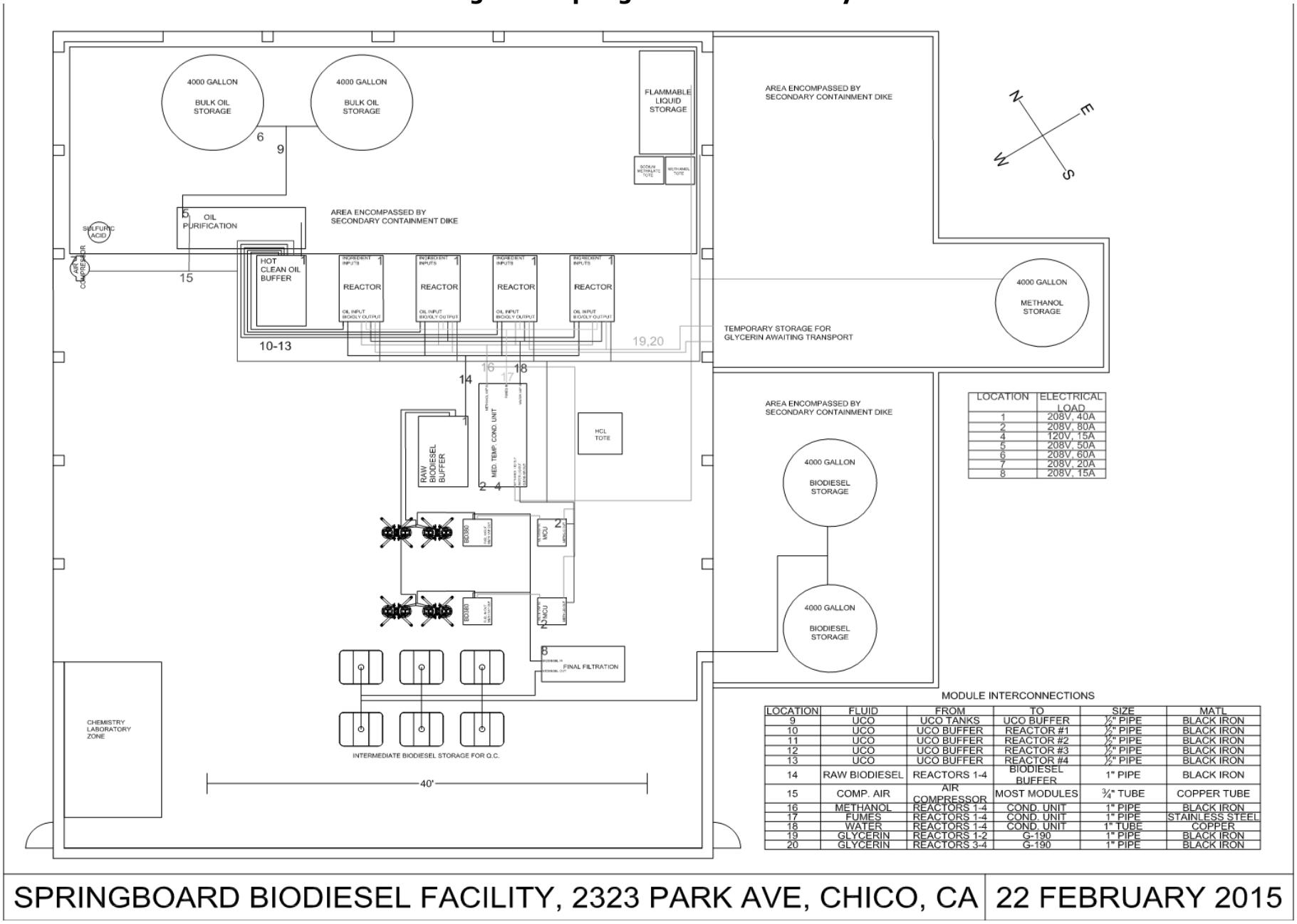
Figure 3 shows a complete system summary. From this screen, the operator can proceed to any module and start to burrow into performance and sensor information. The touch screen displays warnings (triangle with "!") and, when the icon is depressed, brings up information regarding that specific module and the current state.

Figure 4 portrays one of the four processing reactors, R475-2, in this case. The operator can view the status of ingredient tanks, the temp and pressure and all inputs and outputs into the main reaction chamber. In addition, if the system is put into "manual" mode, each valve can be manipulated for diagnostic purposes.

Figure 5 illustrates a layered look at the status of the R475-2'. Here the operator can see the characteristics of the oil, the temperature and vacuum pressure of the main chamber, and the status of the reaction in that reactor. The operator can access the "Log" to view all critical before the reaction steps. In addition, at the bottom of the screen are buttons that allow the operator to jump to other modules that may be interfacing with the reactor.

Figure 6 illustrates the necessary chemical parameters of the biodiesel batch. On this screen, operators can view the Reactor Two settings such as the temperature in the main tank and the status of the ingredient tanks.

Figure 3: Springboard's CLL Facility



LOCATION	ELECTRICAL LOAD
1	208V, 40A
2	208V, 80A
4	120V, 15A
5	208V, 50A
6	208V, 60A
7	208V, 20A
8	208V, 15A

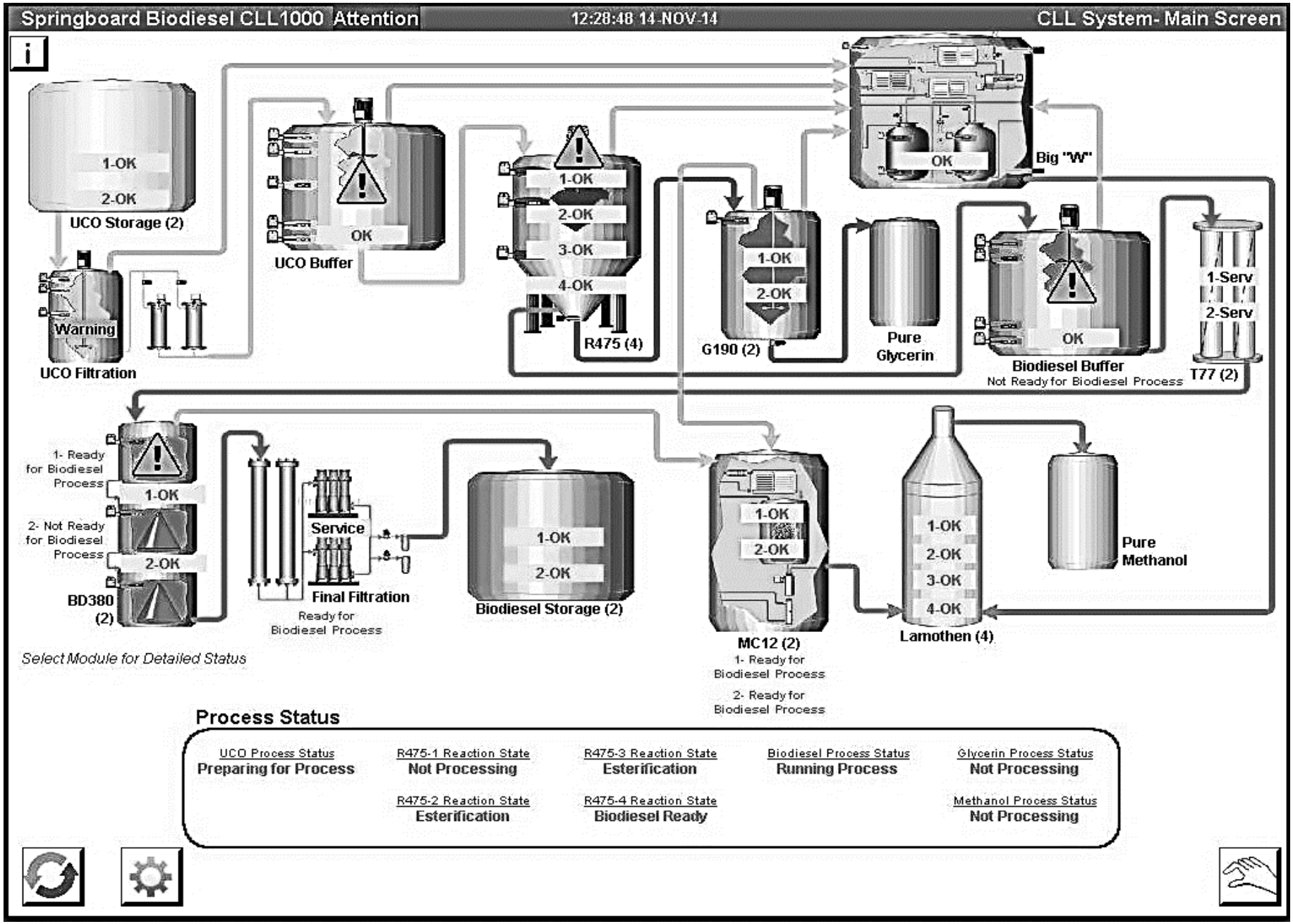
MODULE INTERCONNECTIONS

LOCATION	FLUID	FROM	TO	SIZE	MATL
9	UCO	UCO TANKS	UCO BUFFER	½" PIPE	BLACK IRON
10	UCO	UCO BUFFER	REACTOR #1	½" PIPE	BLACK IRON
11	UCO	UCO BUFFER	REACTOR #2	½" PIPE	BLACK IRON
12	UCO	UCO BUFFER	REACTOR #3	½" PIPE	BLACK IRON
13	UCO	UCO BUFFER	REACTOR #4	½" PIPE	BLACK IRON
14	RAW BIODIESEL	REACTORS 1-4	BIODIESEL BUFFER	1" PIPE	BLACK IRON
15	COMP. AIR	AIR COMPRESSOR	MOST MODULES	¾" TUBE	COPPER TUBE
16	METHANOL	REACTORS 1-4	COND. UNIT	1" PIPE	BLACK IRON
17	FUMES	REACTORS 1-4	COND. UNIT	1" PIPE	STAINLESS STEEL
18	WATER	REACTORS 1-4	COND. UNIT	1" TUBE	COPPER
19	GLYCERIN	REACTORS 1-2	G-190	1" PIPE	BLACK IRON
20	GLYCERIN	REACTORS 3-4	G-190	1" PIPE	BLACK IRON

SPRINGBOARD BIODIESEL FACILITY, 2323 PARK AVE, CHICO, CA | 22 FEBRUARY 2015

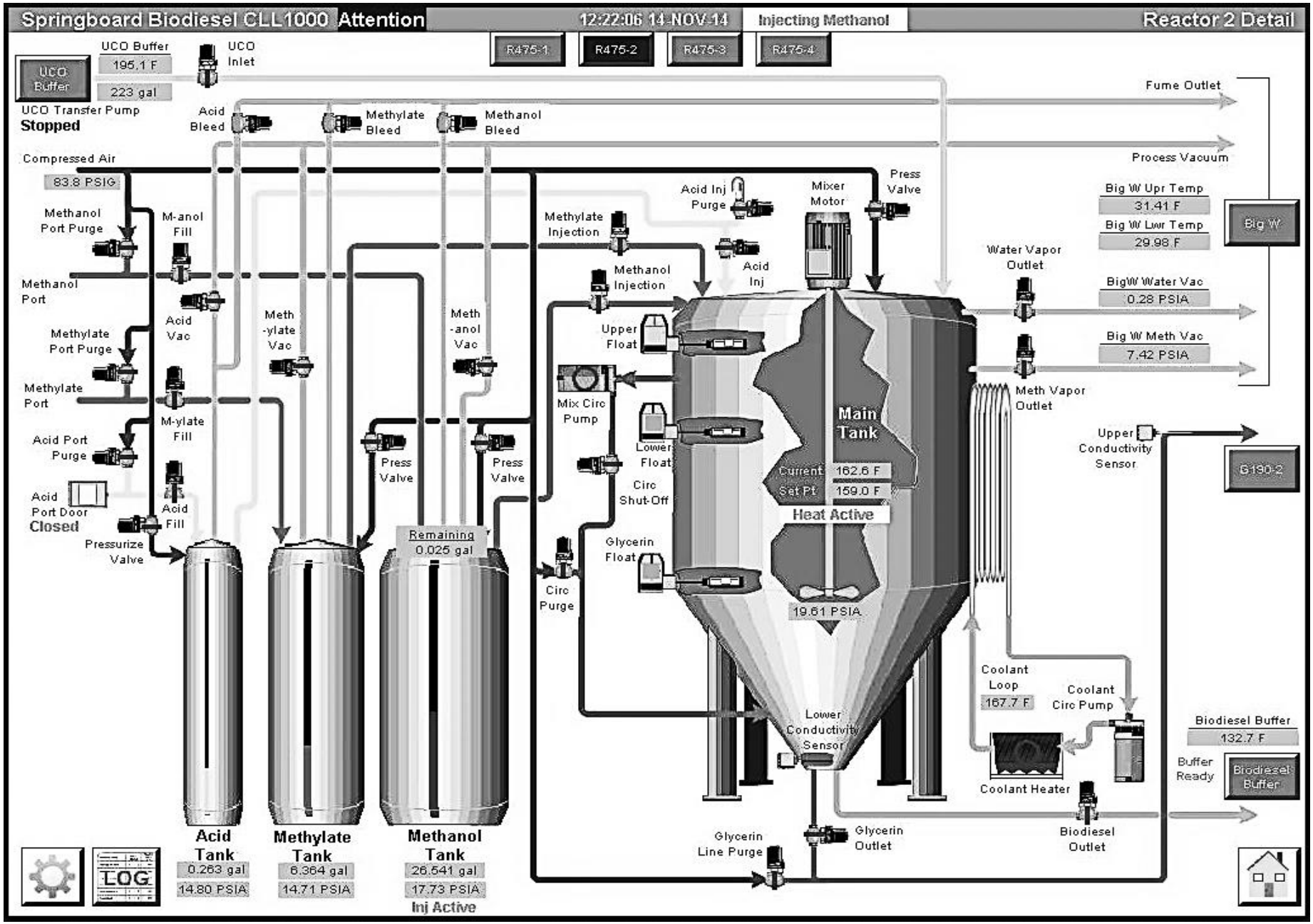
Source: Springboard Biodiesel, LLC

Figure 4: Full System Overview



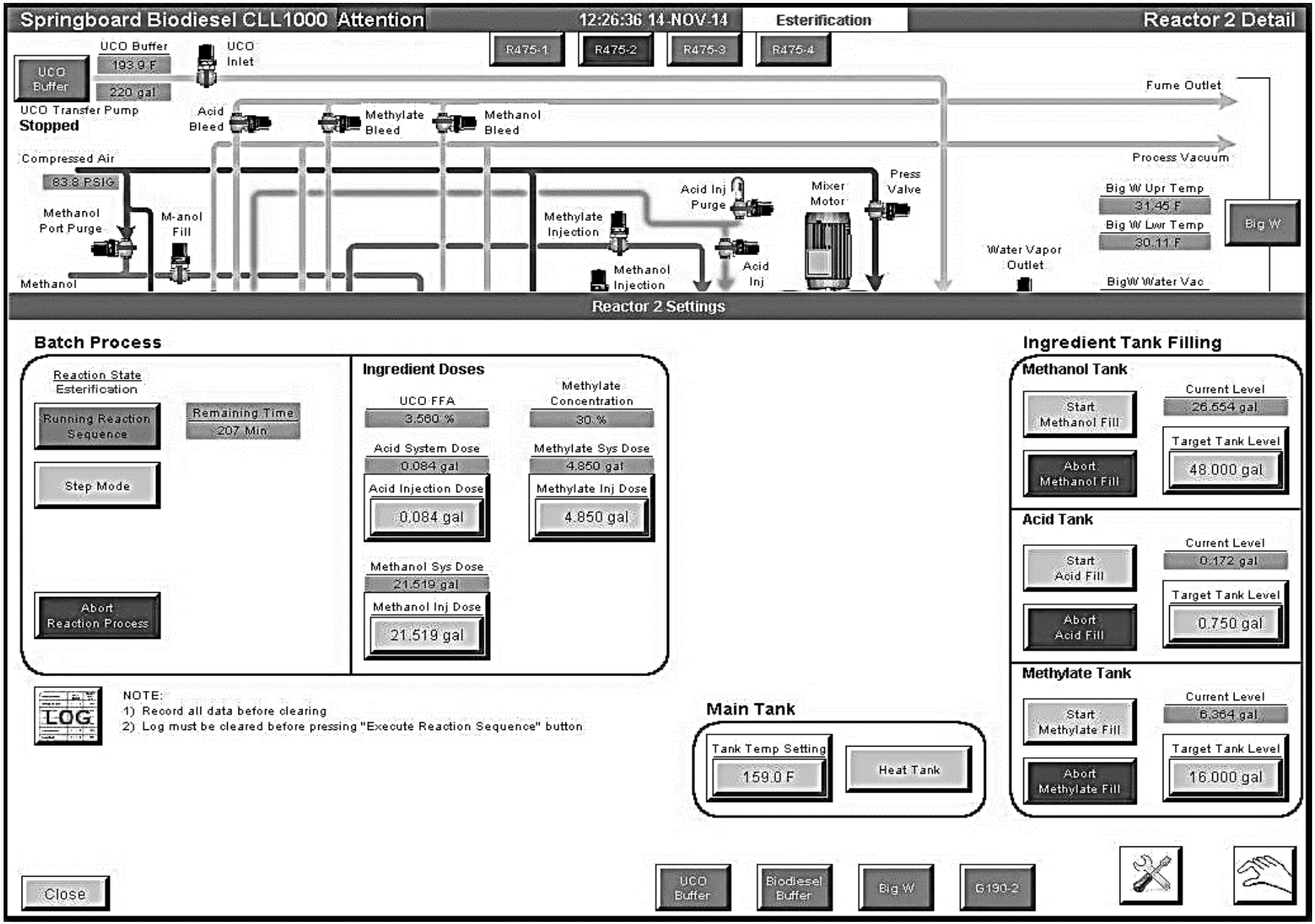
Source: Springboard Biodiesel, LLC

Figure 5: Biodiesel Reactor Status During Production



Source: Springboard Biodiesel, LLC

Figure 6: Necessary Chemical Parameters of Biodiesel Batch



Source: Springboard Biodiesel, LLC

Readying 2323 Park Ave.

The preparation of the new facility was fairly involved, as it was originally built as a trucking depot and had sat unused for many years. As a result, it did not have adequate power at the building, which necessitated a longer-than-expected effort by PG&E to bring a new, commercially capable, power line to the building. In addition, significant tenant improvements were necessary to create an office, create approved containment for the company's various internal and external storage tanks, and install the necessary internal electrical wiring (to connect all the processing modules) and internal intra-module plumbing. Given that this was the company's first installation of its multi-modular systems, this process was longer than expected and cost more than expected. However, it was done well, and the result was as planned.

Springboard had established a productive working relationship with Chico's building inspectors, fire department, and other area regulators, such as the Butte County Air Resources Board, all of whom were very supportive and willing to work with the company on a "new" type of project (see Appendix A: Local Permits). As there are no other area biodiesel production plants in Butte County, each of these entities had to create site-specific solutions that balanced existing regulations with the operating dynamism of a small-scale biodiesel production facility.

As a result of Springboard's successful work with these groups, the company is better positioned to help other regional entities get "comfortable" with biodiesel as a now "known" and regulatable project.

Creating CLL Standard Operating Procedures

Given that the CLL system is a new and proprietary system, Springboard spent considerable time developing a set of standard operating procedures, as well as a certification program that is meant to train new employees in all aspects of biodiesel production and the CLL. Five Springboard employees received certificates of completion for the inaugural training program. While this program will evolve, Springboard believes that the base level training program will be vital to future installations.

Interaction with Certification Bodies and Springboard's Status

To maximize the profitability of the CLL, it was paramount that Springboard's systems and processes be of the highest quality, and that the facility achieves certification with all relevant regulatory bodies. This was important from a profitability perspective, and it was important from a credibility perspective – assuring Springboard's customers that it has the highest quality fuel.

Springboard is registered with the following regulatory bodies in Table 1 below:

Table 1: Regulatory Bodies

Regulatory Bodies	Registration Detail
CDX	Registered with EPA – this is the master portal for all RIN related transactions.
U.S. EPA	Registered Company #6207 Registered Facility #82619 [50,000 RINS separated to date]
BOE	Monthly Fuel Sales Tax
California Air Resources Board	Registered within the state's LCFS program and have created 227 LCFS credits to date
USDA	Quarterly reporting, contract number is 14PP0001218
California Department of Food and Agriculture	We have a variance to sell fuel that is above B-20 – one of 20 companies in California.
Internal Revenue Service	Registered as a *blender* and a *producer*
Genscape	Third-party auditor for EPA RFS-2; registered as a QAP-A RIN producer, which is Genscape's highest level of quality and oversight and which makes the monetization of RINs markedly easier on the open market

Source: Springboard Biodiesel, LLC

Fuel Production Results

During the project, Springboard encountered several logistical and timing delays associated with the repurposing a previously unused building, building permits, power requirements, and equipment changes. As a result, most the company's biodiesel production began in January 2014, and commercial sales began July 1, 2014.

Table 2 is a summary of the biodiesel at production achieved by Springboard in 2014 – January 1 - November 30:

Table 2: Monthly Production Overview 2323 Park Ave. – January – November 2014

2014 Month	Total Reactions	Biodiesel Produced	Biodiesel Sold	RINS Created	LCFS Credits Created
Jan-June	58	7,174	1,195	-	-
July	46	6,875	7,420	11,130	-
August	87	10,658	8,795	13,193	-
September	87	10,168	6,913	10,370	227
October	75	8,969	10,179	15,269	-
November	60	7,105	1,884	2,826	-
Totals	**413**	**50,948**	**36,386**	**52,787**	**227**

Source: Springboard Biodiesel, LLC

January 2014 – June 2014:

- Springboard produced 58 batches, resulting in 7,174 gallons of biodiesel.
- Springboard was able to complete the move of all production modules from its fabrication facility to 2323 Park Ave., the CLL production facility.
- All electrical, networking, and plumbing connections were completed, and all modules were tested, and processes further refined.
- The development and initial installation of the company's proprietary automation and control software was begun and refined.
- Springboard employees learned the logistics of fuel production, and five employees were certified to the company's standards for an "outside" operator.
- The Springboard Biodiesel Buyers' Club was established, and several early members were recruited.
- On May 1, 2014, the company held its official facility grand opening, which around 85 people attended, including city officials, and interested fleet managers from Butte County.
- Also in May, in-house testing discovered that a batch of fuel (500 gallons) had fallen out of spec. After initial diagnosis and additional testing, the company discovered that one of its T-77 resin columns had failed and created a reverse reaction. The Company was able to re-process the batch, such that it returned to ASTM-spec. This event validated Springboard's in-house QC standard practices.

July 2014:

- Springboard produced 46 batches, resulting in 6,876 gallons of biodiesel.
- During July, ongoing work was conducted on the software control systems.
- Springboard created its first 10,000 Renewable Identification Numbers (RINs) and successfully registered them in the EPA's reporting system.
- On July 31, 2014, the company successfully produced 1,000 gallons of ASTM-grade biodiesel in one day. This was the company's goal at the project outset.

August 2014:

- The company ran 87 batches, resulting in 10,658 gallons of biodiesel.
- Springboard installed additional control software the enabled "lights out" back-end production, making 1,000 gallons of production per day less labor-intensive.

- The company was able to make biodiesel in parallel with an upgrade to two reactors.

September 2014:

- Springboard ran 87 batches, resulting in 8,966 gallons of biodiesel.
- The company discovered and repaired a mechanical issue in one of its reactors.
- It installed an enhanced system control program to further automate the system for "lights out" production.
- It sought and received LCFS credit for production from July through September (with California Air Resources Board).
- It sought and received a variance from the California Department of Agriculture that allowed Springboard to pump blends of biodiesel directly into SBBC member vehicles. (Prior to this, SBBC members had to purchase predetermined amounts that they then had to pour into their vehicles).

October 2014:

- Springboard ran 75 batches, resulting in 7,105b gallons of biodiesel.
- The company sold several large loads of biodiesel.
- It continued upgrading modules while producing ASTM-grade fuel.
- It managed price degradation in the diesel market that directly impacted pricing power for biodiesel.

November 2014:

- Springboard ran 60 batches during a "short month," resulting in 7,105b gallons of biodiesel.
- Several planned sales to existing customers were put on hold, resulting in more production than sales.
- Renewed our biannual third-party testing protocol.

Fuel Production Conclusions

With more than 400 successful batches of ASTM-grade biodiesel produced and more than 35,000 gallons of fuel sold, Springboard was able to prove that its small-scale system and production model is a viable approach to proliferating biodiesel throughout California. The primary lessons learned during this production period are the following:

- Building a new, proprietary, small-scale biodiesel production system is complicated. While this project was affected by external and internal factors that delayed total system production and resulted in total project production that was less than initially forecast, the amount of work successfully completed was significant. The company's internal expenses were almost 40 percent higher than initially budgeted. However, despite the delays, the result proves commercial viability of the small-scale production model.
- Automation is an important piece of the production model. It allows for an optimized labor component; reduces production errors; and allows for parallel processing, such that the entire system need never be brought down for maintenance or equipment fixes.
- Designing a multimodule, parallel path production system proved invaluable, as it allowed simultaneous production and technical improvements. Had the system been designed simply using a single processing module, it would have been impossible to troubleshoot, enhance,

and improve the system and make biodiesel. With four production lines, the company was able to maximize production while working on identified system "fixes."

- Local production needs local consumption, and the current market awareness of biodiesel as a viable (and internationally commoditized) fuel is not where it should be. Springboard will continue to work with local fleet managers and individuals to organically build its local retail and distribution, as relying on third-party fuel brokers is not in the interest of the small-scale producer. Customers include several local fleets and larger resellers in the Bay Area. Springboard's goal is to increase the former type of customer and reduce the latter.

2014 Biodiesel Industry Pricing Overview

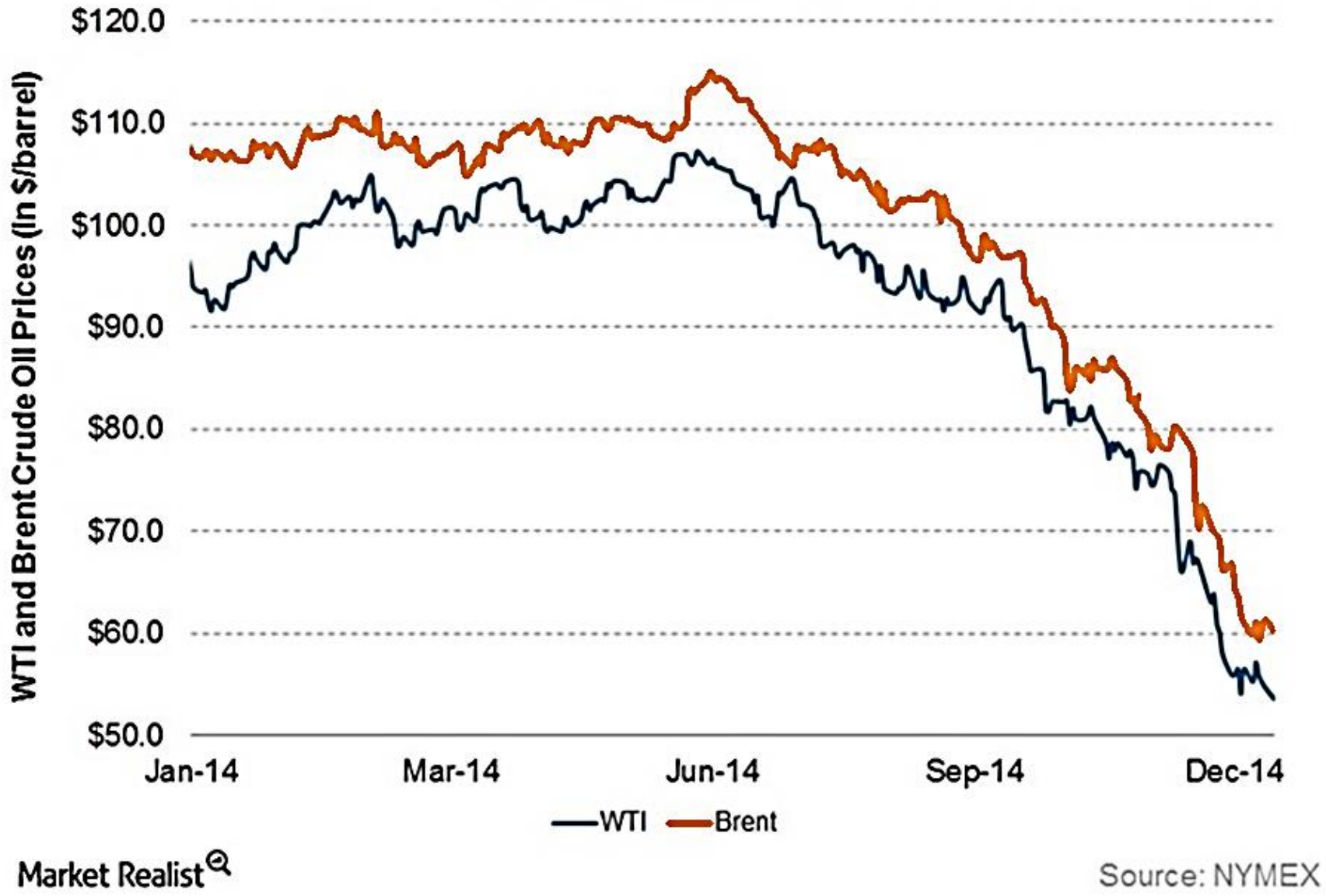
Biodiesel pricing is strongly correlated to diesel #2 pricing. In California, since May 1, 2014 – the date of Springboard Biodiesel's official facilities opening ceremony—the price of crude oil has plunged more than 40 percent, resulting in substantially lower retail diesel prices throughout California. Given the meaningful level of state and local taxes applied to each gallon of diesel sold, the biodiesel producer that is asked to match the diesel price of fuel has seen margins affected substantially. Table 3 shows average retail prices for California from May through December 2014.

Table 3: Falling Oil Prices Reduce California Diesel Prices and Hinder Biodiesel Adoption

Date	Price/Gallon Retail CA
May	$4.12
June	$4.10
July	$4.11
August	$4.09
September	$4.05
October	$3.94
November	$3.81
December	$3.54

Source: US Energy Information Administration

Figure 7: Crude Oil Prices



Source: Springboard Biodiesel, LLC

Figure 8 shows the breakdown of before-tax (base price) pricing to the producer, assuming that retail biodiesel is sold at the same price as retail diesel. (All prices are from Springboard Biodiesel transactions.)

Figure 8: Biodiesel Pricing Breakdown – What the Producer Gets vs. Retail Pricing

		5/1/14	12/10/14
Retail Price		**$4.130**	**$2.580**
plus CA road	$0.11	$4.020	$2.470
Sales tax	9.25%	$3.680	$2.261
plus Federal	$0.24	$3.44	$2.02
Base price to Producer		$3.436	$2.017
Percentage decline		*NA*	*41%*
RINS (multiply by 1.5)		**0.48**	**0.59**
LCFS		**0.21**	**0.25**
Total		**$4.37**	**$3.15**

Source: Springboard Biodiesel, LLC

Because of these pricing dynamics, the state and federal programs that are meant to provide the relatively young biodiesel industry with some financial support and incentives are critical to the financial well-being of producers.

Two programs affect the viability of California's biodiesel industry: the EPA's Renewable Fuel Standard – two programs, which defines a process by which biodiesel producers can produce, report, and monetize Renewable Identification Numbers (RINs); and California's Low Carbon Fuel Standard, which allows Californian producers to monetize LCFS credits. Together these two programs represent up to 36 percent of the total return that biodiesel producer can earn. It is very difficult to envision any biodiesel production without the support of and access to these two programs.

CHAPTER 3:
Industry Advancements and Overall Successes of the Project

Industry Advancements

Successful completion of a viable small-scale biodiesel processing facility that can use multiple feedstocks and comply with all local, state, and federal regulations provides another avenue for the proliferation of cleaner-burning biodiesel throughout California.

While biodiesel is a well-understood product, and the commercial production of biodiesel has been ongoing for 10 years, the industry has traditionally spent very little research and development on the development of small-scale production solutions.

Springboard's CLL represents an important step forward for reliable, safe, and affordable small-scale production.

Of particular note, Springboard's CLL had to undergo the very same regulatory scrutiny that a much larger facility would receive. In the past, small-scale producers were either not administratively equipped or internally incented to undergo the certification processes that are demanded by the U.S. EPA, California Air Resources Board, USDA, and the Internal Revenue Service, in particular.

Springboard began this project, knowing that to build a sustainable small-scale production model, it would have to have access to the biodiesel credits and incentives; otherwise, it would not succeed financially. Because Springboard was able to successfully navigate all these obstacles, not only has it demonstrated financial viability, but it has also created a valuable "package" of transferable know-how that will help its future CLL customers to navigate more quickly a complex set of agencies.

Local Benefits

This project was also successful in several ways that helped the local economy of Northern California.

The project allowed Springboard Biodiesel to retain all its employees, despite a slowdown in its base manufacturing business; a steep decline in the price of biodiesel; the disappearance of a key federal stimulus program for biodiesel producers, the blender's credit and a distinct lack of education regarding biodiesel and related benefits within the local commercial economy, all of which resulted in lower revenues than were anticipated at the beginning of the project. The biodiesel blender's credit has been a key support mechanism for the biodiesel industry over the years. It must be renewed annually by Congress, and in 2014 was not renewed until December 31, 2014. This created substantial uncertainty in the producer market and hindered both outside investment and producer economics.

Springboard had initially anticipated hiring an additional CLL three-person operating team to manage day-to-day production after initial installation and testing. However, due to a constrained biodiesel market and a slowdown in the company's main equipment business,

rather than hire new employees, the company reassigned several employees to operate the CLL business. This strategy has proven advantageous, as having part of the team that designed and built the system; has resulted in more efficient system repairs and diagnoses; and has enabled quicker enhancements/evolution of parts of the overall system.

In addition, by using local suppliers for the more than $1 million investment in the facility and equipment, Springboard was able to contribute meaningfully to the local economy.

- Renovating an unoccupied building in "The Wedge" of Chico, an identified urban improvement area, has helped accelerate and compliment other new projects slated for this area.
- Spending more than $150,000 with area manufacturing, machinists, powder coaters, and light assembly and subcontractors helped keep manufacturing dollars in the community.
- Using local parts distributors further expanded the positive impact of Springboard's investment.

Finally, while uptake has been slower than Springboard anticipated, the ability to offer local fleets, farmers and Chico cleaner-burning biodiesel will benefit the region from an emissions standpoint. Also, during the project, three Northern Californian biodiesel companies went out of business, leaving Springboard as one of only two Northern Californian biodiesel producers. This should increase focus on the company as a local source for cleaner-burning biodiesel.

CHAPTER 4:
Project Observations, Conclusions, and Recommendations

Observations

The biodiesel industry faces several challenges, chief among which is a lack of public education and policy support. However, by reducing upfront investment costs, expanding the feedstock options of a facility, and locating an "easier-to-permit-and-jump-start" Springboard CLL facility near cheaper raw materials, the small-scale model is actually advantageous.

During this project, the price of petroleum-based diesel fell more than 40 percent. As a result, the price of commercial biodiesel fell precipitously. In addition, the lack of cohesive federal fuel policy meant that the $1/gallon biodiesel tax credit also disappeared. On December 17, 2014, this tax credit was reinstated retroactively for 2014 but will again expire on January 1, 2015. In large part, these two factors have led to a production contraction in the biodiesel industry with some reports suggesting that almost half of the active U.S. biodiesel production plants in 2013 have paused or ceased operations. In Northern California, three small biodiesel producers disappeared in 2014 due to financial pressures.

Given Springboard's small-scale local focus and the success of the CLL project, management learned several lessons that will make future CLL systems more efficient. Specifically, with the benefit of hindsight, any CLL system should budget for a small biodiesel delivery vehicle. The "turnkey" nature of small-scale biodiesel is a critical attribute, one not as fully understood by the company at the outset of this project and being able to deliver small loads to multiple users at a reasonable price will be increasingly important. In addition, the "lessons learned" with regards to successfully navigating the multiple regulatory bodies that oversea biodiesel production and sales are both valuable and relatively easy to "package" for future installations.

Recommendations

1. It is critical that the Energy Commission remove the penalty for grantees to access biodiesel-related tax credits. If this is not fixed, Energy Commission-funded companies will not have a chance to compete on a level playing field**,** after having invested their match funds.
2. In the future, it might be valuable to create a networking process for grant winners; as in some cases, there is potentially synergistic overlap of the ability to share lessons learned and to pool knowledge.
3. Biodiesel has the quickest and most dramatic impact on GHG levels associated with the state's transportation fleet, but the percentage of grant money allocated to biodiesel in no way reflects the opportunity. More money should be allocated to projects that can increase the availability of reasonably priced ASTM-grade biodiesel throughout the State.
4. Given the critical importance of agriculture throughout California and the reliance farmers have on diesel-powered equipment, it is disappointing that there is not stronger

outreach, nor an educational framework, to alert farmers (and potentially reward them) to the benefits of biodiesel.

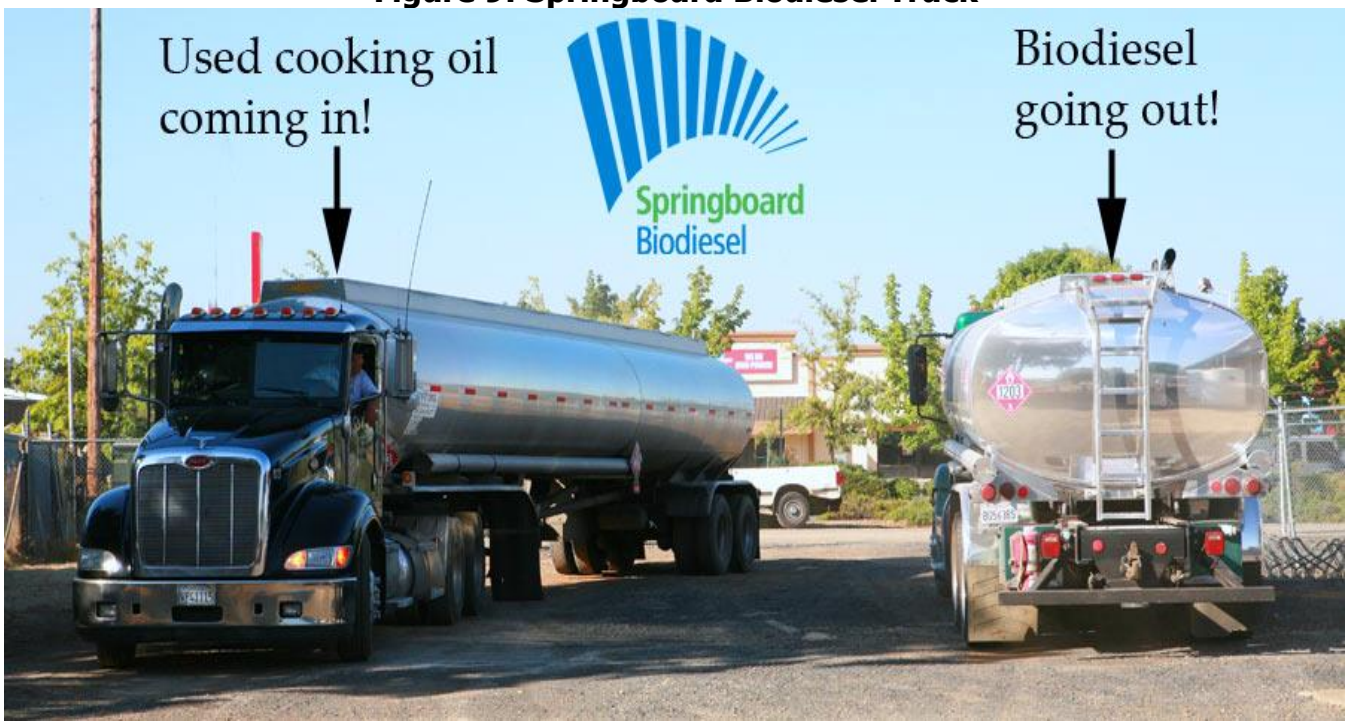
5. Springboard Biodiesel was honored to receive this grant from the Energy Commission. The company's experience was extremely positive, and it completes the project stronger than when it began with more products, services, and biodiesel acumen to help promote biodiesel throughout California.

Conclusions

With the right equipment, small-scale biodiesel production based on locally available feedstock sources can be an important and valuable addition to California's cleaner-burning biodiesel production portfolio.

Springboard Biodiesel's CLL system has successfully demonstrated that small-scale production is commercially viable, and the company is well-positioned to build additional systems and integrate them into a networked capacity mode.

Figure 9: Springboard Biodiesel Truck



Source: Springboard Biodiesel

GLOSSARY

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)—A non-profit organization that provides a forum for producers, consumers and representatives of government and industry to write laboratory test standards for materials, products, systems, and services. ASTM publishes standard test methods, specifications, practices, guides, classifications, and terminology.

CLOSED LOCAL LOOP (CLL)—A zero-waste, integrated, automated, multi-modular processing system. It allows an operator to produce the highest quality biodiesel from the lowest priced, regionally sourced feedstock.[1]

GREENHOUSE GAS (GHG)—Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

LOW CARBON FUEL STANDARD (LCFS) — A set of standards designed to encourage the use of cleaner low-carbon fuels in California, encourage the production of those fuels, and therefore, reduce greenhouse gas (GHG) emissions. The LCFS standards are expressed in terms of the "carbon intensity" (CI) of gasoline and diesel fuel and their respective substitutes. The LCFS is a key part of a comprehensive set of programs in California to cut greenhouse gas emission and other smog-forming and toxic air pollutants by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options.

RENEWABLE IDENTIFICATION NUMBER (RIN)—The credits used for compliance and are the "currency" of the Renewable Fuel Standard program.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S. EPA)—A federal agency created in 1970 to permit coordinated governmental action for protection of the environment by systematic abatement and control of pollution through integration or research, monitoring, standards setting, and enforcement activities.

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA) — The Department of Agriculture provides leadership on food, agriculture, natural resources, and related issues.[2]

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[1] Springboard Biodiesel webpage https://www.springboardbiodiesel.com/cll-biodiesel-production-system.html#:~:text=The%20CLL%20biodiesel%20production%20system%20Overview%20Springboard%20Biodiesel%E2%80%99s,biodiesel%20from%20the%20lowest%20priced%2C%20regionally%20sourced%20feedstock.

[2] U.S. Department of Agriculture https://www.usa.gov/federal-agencies/u-s-department-of-agriculture

Appendix A:
Local Permits

Figures A-1 through A-3 are the local permits needed for this project.

Figure A-1: Fire Prevention and Life Safety Bureau Permit

Fire Prevention & Life Safety Bureau
PERMIT
FLAMMABLE, COMBUSTIBLE LIQUIDS/TANKS

Permit No:	**FCL-13-61**	**Facility:**	**SPRINGBOARD BIODIESEL**
Applicant:	**SAME**	**Bus Phone:**	**(530) 894-1793**
Site:	**2323 PARK AVENUE**		
Description:	To transport, store and use flammable, combustible materials, as defined in the fire regulation standards adopted by the Chico Municipal Code, Chapter 16.48.020, subject to all necessary inspections.		

THIS PERMIT IS ISSUED AND ACCEPTED ON CONDITIONS THAT ALL REGULATIONS NOW ADOPTED, OR THAT MAY BE ADOPTED, SHALL BE COMPLIED WITH

THIS PERMIT DOES NOT TAKE THE PLACE OF ANY LICENSE REQUIRED BY LAW AND IS NOT TRANSFERABLE	**Date of Issue:**	**Valid From:**	**Authorized Signature:**
	08/13/13	**07/01/13-06/30/14**	

THIS PERMIT MUST AT ALL TIMES BE POSTED ON THE PREMISES MENTIONED ABOVE

Source: Fire Prevention and Life Safety Bureau

Figure A-2: Letter from Butte County Air Quality Management District

629 Entler Avenue, Suite 15
Chico, CA 95928

(530) 332-9400
(530) 332-9417 Fax

W. James Wagoner
Air Pollution Control Officer

Robert McLaughlin
Asst. Air Pollution Control Officer

March 7, 2014

Dear Permit Holder:

Enclosed is the Butte County Air Quality Management District (District) Permit(s) to Operate for the equipment or permitted activity as listed. The permit(s) shall be valid for the period as listed on each permit. The equipment or permitted activity will be evaluated for compliance with District rules on or before this period has elapsed for the purpose of permit renewal.

Please carefully review the permit(s) to ensure that the correct information has been incorporated into the new permit(s). If you have any questions or need clarification about the permit(s) or conditions, please contact this office at the telephone number listed below.

The permit(s) shall be available for review at the source if requested by the Air Pollution Control Officer (APCO) or the APCO's representative. The District must be notified prior to any modifications or alterations to the equipment listed on the permit(s). In addition, the permit(s) may be suspended or revoked for violations of District Rules and Regulations.

PLEASE ALSO NOTE: *A Production Data or Gasoline Throughput Form(s) and Facility Questionnaire have been enclosed for calendar year 2014.* ***PLEASE SAVE THESE FORMS TO COMPLETE AND RETURN IN JANUARY 2015.*** *These forms must be received by JANUARY 31, 2015.* Copies of these forms are also available on the District's website at http://www.bcaqmd.org under the Forms/Applications Tab on the left-hand side of the Home page.

An invoice is included for the Permit to Operate fee which has been prorated for the remainder of the permitted period.

If you need any additional information, please contact this office at (530) 332-9400.

Sincerely,

W. James Wagoner
Air Pollution Control Officer

by

David Lusk
Senior Air Quality Engineer

T:\Source Permits_General Correspondence\Letters\PO Cov Ltr LH-DL AC to new PO.docx

Source: Butte County Air Quality Management District

Figure A-3: Certificate of Occupancy

BUILDING AND DEVELOPMENT
SERVICES DEPARTMENT

411 Main Street - 2nd Floor
P.O. Box 3420
Chico, CA 95927
http://www.ci.chico.ca.us

BUILDING
(530) 879-6700
Fax (530) 895-4726

CERTIFICATE OF OCCUPANCY
Commercial
(Authority: 16.12.030 CMC)

No. 6803

DO NOT REMOVE

Building Address: 2323 PARK AVENUE CHICO St: STE 125

Master Plan:

Assessor's Parcel No.: 005480020000

Plan/Permit No.: 12-02857

OWNER H L S
144 MEYERS ST STE 160
CHICO CA
ZIP: 95928

CONTRACTOR SICKE STEVE
31 GARDENIA LANE
CHICO CA
ZIP: 95928

Lot: Block: Subdivision: Zoning: ML

On Sewer: N No. of Units: 0 Type of Const: V-B Square footage: 1217

Remarks:

Cnvrt Whse to Biodiesel Plant
F-1 & B Occupancy - 6033 S.F.
Tenant: Springboard Biodiesel

Sprinklered: N
Occupancy Load: 37

This is to certify that the building described hereon and located as noted above has been inspected and complies with the occupancy and use requirements of the (2010) California Building Code and Chapters 16 and 16R of the Chico Municipal Code.

The following type occupancy is hereby authorized for this building:

F-1, B

No change in this authorized occupancy shall be made until the Building official has issued a Certificate of Occupancy authorizing such change.

Date: 02/24/2014 Building Official:

THIS CERTIFICATE OF OCCUPANCY SHALL BE POSTED IN A CONSPICUOUS PLACE AND SHALL NOT BE REMOVED EXCEPT BY THE BUILDING OFFICIAL, CITY OF CHICO, BUILDING & DEVELOPMENT SERVICES DEPARTMENT.

BADS 11/07
Distribution: FILE / OWNER / CONTRACTOR / CHRONO / POSTING

Source: Building and Development Services Department