Urban Biofuels Initiative Final Report:

A Guide for Coordinating a Fryer to Fuel Collection Program

in Combined Urban/Suburban Areas

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The Fryer to Fuel program is a collaborative effort to collect used cooking oil from restaurants and convert it into biodiesel to fuel local Santa Cruz vehicle fleets. The program uses a local waste as a local fuel, and serves as a model of community-based sustainable solutions. Ecology Action coordinated this program, with a grant from the Federal Environmental Protection Agency, and with the help of several partners. The following are partners who assisted with coordinating various aspects of the Fryer to Fuel program:

- The Unites States Environmental Protection Agency (US EPA)
- Energy Alternative Solutions, Inc. (EASi), the local biodiesel production plant in Gonzales,
- Salinas Tallow stores, collects, and pretreats the fryer oil,
- Coast Oil blends and distributes the biodiesel to our local fleets, and
- The City of Santa Cruz uses biodiesel to power their fleets, and assisted with coordinating the program.

Partnering with local restaurants, Salinas Tallow, BioEAS Inc, Coast Oil, and local Public Works Departments, the Fryer to Fuel program collected 9,947 gallons or 79,592 pounds of high quality waste cooking oil from restaurants over an eight-week period. This waste vegetable oil (WVO) was turned into biodiesel and blended to make almost 32,000 gallons of B20 (20% biodiesel) fuel, and then sold to local fleets. Continuing over the next year, this will result in almost 64,600 gallons of waste vegetable oil being used to make 208,000 gallons of the B20 biodiesel blend. This is enough fuel to fill the tanks of over 4,300 City of Santa Cruz recycling trucks, or enough to fuel a fleet of school buses for an entire school district for a year. It is expected that more restaurants will participate as the program expands, resulting in higher quantities of better quality local waste feedstock to make biodiesel.

Guide to Start a Fryer to Fuel Program

Throughout the United States, there are jurisdictions similar to Santa Cruz that could achieve a local and sustainable waste to fuel economy. Based on our local experience, we suggest that the winning formula for being able to effectively coordinate a Fryer to Fuel program in other areas of the Country is:

- A commercial biodiesel plant within 200 miles (ideally),
- Liquid waste hauler(s) servicing local restaurants with vacuum trucks and bulk containers,
- Local pretreatment or environmental compliance inspectors regulating fats, oils, and grease from restaurants (typically in a wastewater or sewer agency),
- Public works, waste franchise, commercial, and/or school district fleets using diesel, who are willing to trial biodiesel and lastly
- Economic development, planning, environmental and/or sustainability professionals within the public domain to motivate, provide leadership, and oversee the program.

- This report serves as a detailed guide as to how to start a similar program in another jurisdiction.

Program Benefits

The main benefits of starting a Fryer to Fuel program are typically realized by the commercial entities that are benefiting from it and the local public officials that are attempting to improve environmental performance, promote sustainability, promote green technology sectors, and develop local, sustainable economies. This program did not realize any cost savings in biodiesel fuel to public partners. However, several other benefits were realized whose value surpasses a small discount in fuel price. It is best to regard the resulting biodiesel as a positive environmental offset, rather than seeking substantially lower purchasing price for biodiesel, although the cost benefit will fluctuate with changes in energy, petroleum and program infrastructure changes. However, in the near future, it is worth exploring a public/private partnership whereby the public implements certain controls outlined in this report to achieve higher quality and quantity of waste vegetable oil collected, and in return obtain a discounted fuel price.

In the three years that Ecology Action has been developing and coordinating the fryer to fuel program, an innovative local fuel economy has developed in tandem. In three short years a local market developed that created new businesses and jobs (in the case of EASi), enhanced long-time local businesses (in the case of Salinas Tallow, which is showing significant growth), and utilized existing distributors for infrastructure (in the case of Coast Oil). Several commercial fleets began using various biodiesel blends during that time period, including: Greenwaste Recovery, the solid waste franchise hauler for Santa Cruz County, Couch Distributors, a large trucking company, Salinas Tallow, and Coast Oil, to name a few. Ecology Action was fortunate to have joined the local biodiesel economy at a time when it was moving at a fast pace, but needed technical assistance and partnership in certain problem areas, such as ensuring high quality and quantity of the WVO collected from restaurants. Considering the increase in biodiesel demand and the diverse set of users who would be forced to source their biodiesel elsewhere, it is key, from an economic development standpoint, to consider allowing rapid and efficient commercial market development in this arena.

Restaurants are currently able to have their waste fryer oil removed for free. Previously, disposing of this waste cost money and was being used to blend with grain for protein enhancement for animal feed, or shipped overseas. Now, because of changes in the fuel and grease markets, this waste is being better utilized as a local feedstock for biodiesel. Before the Fryer to Fuel Program, Salinas Tallow was able to use 60% of the fryer oil collected as a feedstock for biodiesel. After the Fryer to Fuel Program, Salinas Tallow was yielding more than 80% of the fryer oil collected. Also, Free Fatty Acid (FFA) content came down from 8-9% to 5-7% during the program. FFA must be below 7% for EASi to accept the fryer oil, and in order for it to be a viable feedstock to produce biodiesel. Previously, the fryer oil would require significant treatment to reduce FFAs to meet the specifications. The oil collected from the Fryer to Fuel program did not need treatment for FFAs. By skipping this treatment step, less chemicals and energy are used.

Although Ecology Action only coordinated with 31 restaurants, the quantity and quality of WVO was uncharacteristically high. During a two-month period, the amount of WVO collected from Fryer to Fuel participants was half of all of the viable feedstock collected in the entire region served by Salinas Tallow (Santa Cruz and Monterey Counties). It is estimated that the Fryer to Fuel Program has tapped less than 1% of the restaurants in the Monterey Bay Area that produce WVO. Therefore, there is significant potential for further improving the quality and quantity of fryer oil collected from restaurants.

Air Emissions Reductions

New Diesel Emissions Standards that are promulgated by the U.S. EPA and enforced by the California Air Resources Board (CARB) dictate certain reductions in diesel emissions for specific vehicle types. These new regulations are significant motivators toward using biodiesel, as particulate matter and carbon dioxide can both be significantly reduced, thus assisting fleet managers to meet the new standards.

Three methodologies were used to calculate diesel emissions reductions as a result of the biodiesel produced by the Fryer to Fuel partners. One such method was the National Biodiesel Board's calculator found at www.biodiesel.org/tools. This method was capable of calculating average emissions reductions from the entire Fryer to Fuel program. Using this tool, the total amount of biodiesel produced under the Fryer to Fuel Program was entered into the calculator. This calculator uses existing EPA sources to calculate average emission reductions and does not take vehicle specifics into account[1]. A total of 31,830 gallons of fuel was entered at a 20% biodiesel blend (B20). The average reductions amount to 40.76 pounds of particulate matter, 53.41 pounds of hydrocarbons, 452.52 pounds of carbon monoxide, 94.93 pounds of nitrous oxides, and 102,626 pounds of carbon dioxide.

There is no calculator, currently, to estimate the life cycle savings of producing biodiesel from WVO compared to using virgin oils. In January 2008, the Environmental Research Web published a report by EMPA in Switzerland that assessed the life-cycles of multiple biofuels. The study determined that biodiesel made from WVO, as well as ethanol derived from manure, had the lowest impact on the environment. Brazilian soy-based diesel, on the other hand, had greater aggregate environmental costs than fossil fuels. A recent article in Science that analyzed the EMPA report concluded that subsidies and tax benefits that go to farmers for soy and corn may be misplaced because these are not desirable feedstocks from a life cycle perspective. Several recent media headlines have reported that biofuels are not the

[1] Calculator is available at http://www.biodiesel.org/tools/calculator/default.aspx. C02 reductions are calculated as 78% less than regular diesel over the life cycle of the fuel.

ideal solution for global warming, but the supportive research did not analyze the use of local feedstock, a critical factor in assessment.

Sustainability

Almost all of the inputs and outputs of this program were concentrated in an area no more than 120 miles round trip: a local feedstock was utilized, local hauler transported the grease, a local biodiesel production plant made the fuel, a local fuel distributor delivered the fuel, local public agencies used the fuel to power their fleets. However, considering the locality of program, the scale was large enough to make the program commercially feasible, while also preserving quality, quality assurance and quality control (QA/QC), permitting, and regulatory requirements of locally produced biodiesel.

The locality also makes the program much more sustainable than the alternative. In addition to the well known environmental benefits from biodiesel use, such as reduced carbon footprint, reduced regulated emissions, improved engine life, etc.; a local waste grease to fuel economy will achieve more significant life cycle emission reductions. Most biodiesel generated from virgin oils is done so by utilizing soy oil. In comparison to local waste feedstock, most soy crops originate in the Midwest. Significant energy is required to farm the crops, process the crops for oil, and then transport the oil to the West Coast. Transporting feedstock oil from the Midwest is eliminated in a local waste grease to fuel model, and waste grease that once would be sold on the open market is now kept locally.
The locality of the program makes it extremely sustainable, with very little transportation involved, and indicates the possibility and the likelihood of several such hubs throughout the State of California and beyond.

II. Introduction

The Fryer to Fuel program is a collaborative effort to collect used cooking oil from restaurants and convert it into biodiesel to fuel local Santa Cruz vehicle fleets. The program uses a local waste as a local fuel and serves as a model of community-based sustainable solutions. Ecology Action coordinated this program, with a grant from the Federal Environmental Protection Agency, and with the help of several partners. Following are the partners that assisted with coordinating various aspects of the Fryer to Fuel program:

- The Unites States Environmental Protection Agency
- Energy Alternative Solutions, the local biodiesel production plant in Gonzales,
- Salinas Tallow stores, collects, and pretreats the fryer oil,
- Coast Oil blends and distributes the biodiesel to our local fleets, and
- The City of Santa Cruz uses biodiesel to power their fleets, and assisted with coordinating the program.

The following partners use biodiesel derived from fryer oil collected from local restaurants, although not necessarily as partners of this program:

- The County of Santa Cruz uses biodiesel to power some of their fleets,
- Green Waste, the waste franchise for the County of Santa Cruz, who also uses biodiesel to power their fleet of recycling and refuse trucks,
- Couch Distributing, a large trucking company,
- Pajaro Valley School District,
- Coast Oil, and
- Salinas Tallow

Partnering with local restaurants, Salinas Tallow, BioEAS Inc, Coast Oil, and local Public Works Departments, the Fryer to Fuel program collected 9,947 gallons, or 79,592 pounds of high quality waste cooking oil from restaurants over an eight-week period. This waste vegetable oil (WVO) was turned into biodiesel and blended to make almost 32,000 gallons of B20 (20% biodiesel) fuel, and then sold to local fleets. Continuing over the next year, this will result in almost 64,600 gallons of waste vegetable oil being used to make 208,000gallons of the B20 biodiesel blend. This is enough fuel to fill the tanks of over 4,300 City of Santa Cruz recycling trucks, or enough to fuel a fleet of school buses for an entire school district for a year. It is expected that more restaurants will participate as the program expands, resulting in higher quantities of better quality local waste feedstock to make biodiesel.

A. Objectives

In September of 2005, the Unites States Environmental Protection Agency (U.S. EPA) through the Office of Solid Waste and Emergency Response, awarded Ecology Action of Santa Cruz (EA) an Innovations Workgroup grant of $75,000 to explore, develop, and test a community based sustainable biodiesel economy by exploiting under-utilized waste fryer oil for production into biodiesel. The goals of the collection pilot were to:

- Reduce vehicle emissions by working with public fleet managers to get locally produced biodiesel fueling their on-road and off-road vehicles.

- Achieve the highest rate of energy return possible from waste grease by segregating fryer oil from other kitchen greases and producing it into biodiesel[2].

- Develop a scalable, efficient, and sustainable model that can be reproduced in other suburban/rural regions.

[2] January 2008, the Environmental Research Web published a report by EMPA in Switzerland that assessed the life cycles of multiple biofuels. The study determined that biodiesel made from WVO, as well as ethanol derived from manure, had the lowest impact on the environment.

The last objective was to reduce the purchasing price of biodiesel for local public fleets, but this turned out to be unachievable during this pilot program. The overall conclusion of the project is that the harvesting of Waste Vegetable Oil (WVO) for Biodiesel production is achievable with benefits to the local community, the natural environment, and the embodied energy savings make using local WVO for biodiesel production and local use an extremely valuable endeavor. It is best to regard the resulting biodiesel as a positive environmental offset, rather than seeking substantially lower purchasing price for biodiesel. However, in the near future, it is worth exploring a public/private partnership whereby the public implements certain controls outlined in this report to achieve higher quality and quantity of waste vegetable oil collected, and in return obtain a discounted fuel price.

B. Participating Organizations

Several entities were contacted and several iterations of the program were contemplated before finally deciding on the partners below. These partnerships were developed because each provides expertise and infrastructure that encourages a simple, efficient, and sustainable model.

Local Commercial Food Service Facilities

One of the most critical participating organizations is the local restaurant association. They were able to promote using WVO as a feedstock for biodiesel at regularly planned meetings and special workshops. The key player and Chair of the local chapter, Michael Scanlon, left the region shortly before beginning the collection-side of the program and a replacement leader for the local chapter has yet to be found. However, with the right incentives, several local food service facilities were willing to partner with Ecology Action on the Fryer to Fuel Program, regardless of the lack of contact through the local restaurant association.

Energy Alternative Solutions, Inc. (EASi)

EASi was originally slated to assist the City of Santa Cruz to start up a biodiesel plant at the City's landfill as part of this grant. When it became apparent that there were several hurdles to doing this (see page 15), and that there was significant local market demand for biodiesel, EASi moved ahead with opening their own plant in Gonzales, California, as they had always intended to do. Shortly after opening the plant, EASi began working with Salinas Tallow to obtain waste vegetable oil as a feedstock for biodiesel. EASi is unique from other biodiesel production facilities in that they have chosen to employ mainly waste feedstocks, and use renewable energy to do so. EASi collects over 100,000 lbs per week of WVO for feedstock in their plant from several tallow companies, including Salinas Tallow. They are also exploring other opportunities for waste feedstocks with academia and beyond. Their focus is on producing local, community-based and sustainable fuel.

EASi Owners

Salinas Tallow Company


Salinas Tallow Staff

Most communities have a variety of vendors that collect tallow from restaurants. In Santa Cruz and Monterey, there is one business serving the majority of local restaurants. That business is Salinas Tallow. During the course of this grant, Salinas Tallow began working with EASi to provide quality waste vegetable oil at market rates. It became apparent very quickly that the reason why Salinas Tallow served most restaurants in the area is due to their customer-service oriented business approach. They remove all Fats, Oils, and Grease (FOG) from a restaurant, regardless of its quality. Their pickups are quickly and quietly done in the middle of the night with a vacuum truck, with very little interruption to business. This ranked

them in high regard with their restaurant customers. However, they were not achieving their newly realized goals for increasing the quality and quantity of waste vegetable oil, and the pretreatment process to meet the required specifications for EASi was getting costly. It was still very difficult to serve these restaurants for free, while maintaining a profit for their business. This is where the Fryer to Fuel program was able to step in and assist them.

Coast Oil

Coast Oil is the main distributor of wholesale diesel to both public and large commercial fleets in Santa Cruz and Monterey Counties. Because they were the main distributor of fuels to fleets in the area with existing contracts and highly competitive bids, they were poised to both blend the biodiesel into the various concentrations (B5, B20, or B50), and distribute the finished fuel to storage tanks or wet-fuel vehicles. This required no additional proposal, bidding, or procurement process for the local fleets.

City of Santa Cruz Public Works

The City of Santa Cruz has been using biodiesel at various blends in their vehicles since early 2005. They were engaged in the Fryer to Fuel prtgram from the beginning in figuring out how to utilize a local waste to produce a local fuel source. Throughout The program the City played a key role . Public works staff were technically involved in the program since inception, providing feedback and oversight for most of the materials and outcomes presented in this report. Particularly, Mary Arman, Public Works Operations Manager, envisioned the benefits, both commercially and publicly, of the Fryer to Fuel program, and was able to provide a keen eye in shaping the course of the program and engendering buy in from key City Departments.

Ecology Action of Santa Cruz

Ecology Action (EA) is a nonprofit environmental consultancy delivering cutting edge education services, technical assistance, and program implementation for initiatives that assist individuals, business and government to maximize environmental quality and community well being. Since 1970 Ecology Action has combined municipal, foundation, and private funding to establish cutting-edge conservation programs, prove their effectiveness financially and operationally, and establish each program as a permanent community resource. EA continually seeks innovative ways to instill environmental awareness, promote pragmatic change, and create opportunities for individuals, businesses, and community agencies to save money, create jobs, and contribute to a sustainable local economy.

The Fryer to Fuel program was a confluence of all of the Ecology Action hubs: Sustainable Transportation, Climate Protection, Pollution Prevention, Zero Waste, and Energy Efficiency. EAs role in this program was to ensure a method to collect high quality and quantity of waste fryer oil from local restaurants, turn it into biodiesel, and deliver it to local public fleets for use. EA accomplished this by partnering with the above-mentioned public and private entities.

C. Restaurant Grease 101

Types of Restaurant Grease

There are three main types of restaurant grease: (1) waste fryer oil, also known as yellow grease, (2) tallow grease from cooking meat, such as bacon grease or lard, and (3) interceptor or trap grease - otherwise known as brown grease. The criterion that tends to classify grease as white, yellow or brown will be described in this section of the report.

Figure 1. Used Fryer oil is generally the best quality waste grease found in commercial kitchens. It may also be referred to as yellow grease, but must contain free acid content below 15% by weight in order to be classified as such.

Figure 2. Picture of an interior grease trap. Small grease traps are sufficient for low volume producers and may require as frequent as weekly maintenance.

There is the possibility of being able to produce variations among those 3 main categories. For instance, there is new technology allowing for the collection of grease after it goes down the sewer drain that separates it from solids and water before it fouls, making it more like yellow grease than brown grease. Figure 3 depicts one such unit, dubbed the Goslyn. There is also high quality waste vegetable oil, dubbed white grease, with very low free fatty acids (<4%). If Best Management Practices (BMPs) are used properly and exterior boxes are kept out of the sun and not heated, a waste grease collection program may achieve white grease quality standards from collection of what would normally be yellow grease.

Figure 3. Active Grease Separation units can be installed right after a sink and remove grease and solids from effluent.

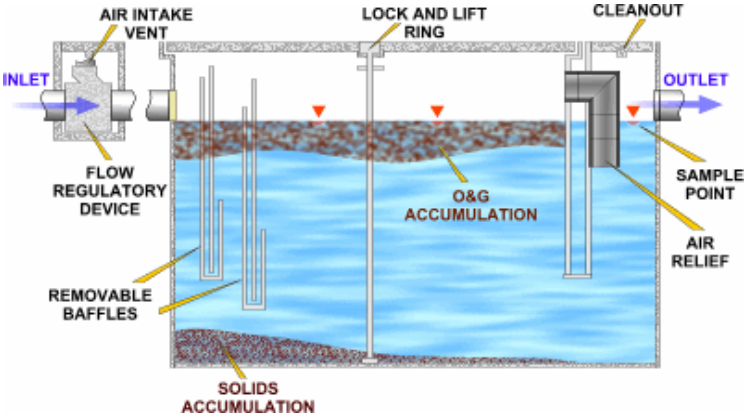

Figure 4. Process diagram of a grease interceptor

Waste fryer oil comes from deep frying food items such as tortilla chips, french fries, fish, tempura, etc. The oil eventually reaches a point where it is so high in water content, solids, or acids that its cooking characteristics are reduced or eliminated. Additionally, when the oil reaches this point, it can breed harmful bacteria. It then becomes a waste for the restaurant, but a potential feedstock for biodiesel. Grease from cooking meat comes from cooking meat in a pan, a slow cooker, or other devise that generates lard or a mixture of water and lard. This grease is generally not good feedstock for biodiesel.

A grease interceptor is a large exterior device that is designed to remove grease from wastewater as it flows out of the kitchen. Typically these devices are quite large and have multiple stages. The typical sizes for grease interceptors are 350, 500, 1000, 1500 and 3000-gallons. There are larger grease interceptors but they are uncommon since if they are much bigger than 3000 gallons, they have a tendency to produce noxious odors. Most grease interceptors have 2 or 3 stages. The interceptors are designed to retain the wastewater long enough to allow for passive separation: grease rises to the top, and solids settle to the bottom. Grease interceptors are typically designed in a series of 3 stages in order to maximize holding time and settling/separation. There are "T" shaped pipes in between each stage to draw water from the middle of the container, while allowing grease at the top and solids at the bottom to remain captured in the interceptor. When the interceptors are pumped out, they contain less than one third lipids or fats. The majority of their contents are water and solids. This grease is typically called "brown" grease and at the time of writing this report, is not a viable feedstock for biodiesel. However, research and work is being conducted toward that end.

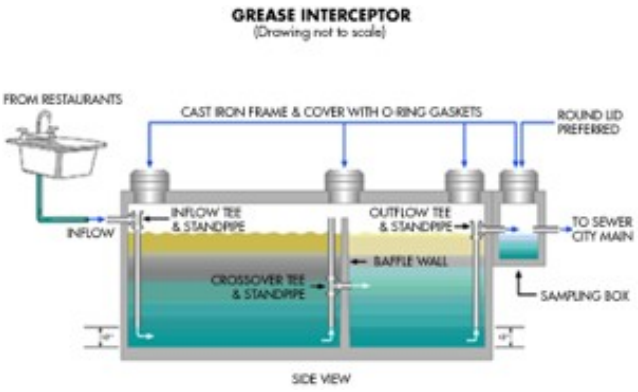

Figure 5. Inner workings of an exterior grease interceptor.

Figure 6. The top of a 1000-gallon interceptor with baffles visible through "O" ring gaskets.

Uses of Grease in Santa Cruz

In Santa Cruz, the three different greases have three different uses. Waste fryer oil (yellow/white grease) is collected in a tallow bin outside the restaurant. It is mainly collected by Salinas Tallow and occasionally by other independent liquid waste haulers. This waste oil is now used for feedstock to make biodiesel, the premise behind this Fryer to Fuel Program.

Figure 7. Fryer to Fuel Model: Oil goes from fryer to exterior bin, picked up by Salinas Tallow and treated, then taken to EASi to make into biodiesel, then to Coast Oil for blending and distribution, then to storage tanks, and then fuel for public fleets.

Figure 8. Aerial view of the City of Santa Cruz Wastewater Treatment Facility and the Neary Lagoon .

The grease water and solids contained in a grease interceptor (brown grease) is entirely removed by a liquid waste hauler typically 2-4 times a year. Over 10 liquid waste haulers are licensed to collect interceptor grease and to dispose of it at the City of Santa Cruz Wastewater Treatment Facility. There, the grease is blended with sludge and septic waste and put into an anaerobic digester. The methane generated during this process is captured and used for cogeneration power for the plant. The City Wastewater Treatment Facility (WWTF) has been generating electric power by burning the methane gas produced by the sewage treatment digestion process since 1989, using a 650 kW generator. The recently completed cogeneration system project upgraded the existing generator to 820 kW and installed a new 500 kW generator. These generators run on a combination of methane biogas and purchased natural gas. The WWTF system is expected to generate 9.5 million KwH of electric power a year, enough to power around 3,000 homes.

Estimated energy savings are over $20,000 per month and burning the methane gas helps prevent 41 tons of CO2 emissions from polluting our air.

The smaller interior grease traps are generally serviced by the same liquid waste haulers as the larger exterior interceptors and taken to the treatment plant for cogeneration as well. However, some restaurant owners have chosen to self-clean their units, whereby they skim the grease off the top of the traps and either place it in their tallow bin or in the trash. This renders all of the grease in the tallow bin unusable for feedstock for biodiesel, since it is contaminated with water and solids to a degree that treatment is not feasible. Restaurants on the wharf and in other situations have no choice but to self-clean their grease traps, since liquid waste haulers have a hard time accessing their traps. It is actually illegal to place these wastes in the trash since landfills are not licensed to accept liquid waste. However, it is still frequently encountered that restaurants will place this waste in the trash. A small, interior grease removal device is typically referred to as a grease *trap*, whereas a large exterior grease removal device is called a grease *interceptor*.

Figure 9. An example cogeneration system that resembles the one found at the City of Santa Cruz Waste Water Treatment Plant.

Salinas Tallow also collects the lard and meat grease. This grease is typically blended with grain to make animal feed. Sometimes, it is sent to Darling Corporation. Darling Corporation generally sends this grease overseas for other uses.

D. Regulation of Restaurant Grease in Santa Cruz and Beyond

In California, most sewer utilities are now required to have a Fats, Oils, and Grease (FOG) program to prevent the amounts of FOG entering the sanitary sewer that can potentially cause sanitary sewer overflows as part of their Waste Discharge Requirements (WDRs) instated by the Regional Water Quality Control Board. Since Santa Cruz is a beach community and a great deal of attention arises from beach closures caused by sanitary sewer overflows, there has been a FOG program in place since 1978. Certified Environmental Compliance Inspectors inspect food

service facilities on an annual basis to ensure that they have the proper grease interceptor or trap that is being maintained on the cycle dictated by the inspector, and that other restaurant greases are being managed appropriately. Environmental Compliance inspectors open grease traps/interceptors, dictate pumping frequencies, and inspect tallow storage areas. Over the past few years, Environmental Compliance inspectors have also begun to look at operations that could potentially impact storm water quality, such as storage of tallow bins, and the ways that floor mats are cleaned. If it is determined that a restaurant is not managing FOG correctly, a Notice of Violation will be issued. If the problem continues, fines will be levied up until the sewer utility has the authority to shut down water supply and sewer access to the restaurant.

It was rewarding for local Environmental Compliance Inspector to realize that most restaurants are very diligent about keeping FOG from going down the drain, going so far as to scrape and wipe pans. The challenge was to get them to implement yet another Best Management Practice (BMP), and begin separating fryer oil from other restaurant FOG.

E. Value and Cost of Certain Restaurant Greases

Fryer oil is now considered a commodity, as of June 2nd, 2008 worth $0.34/lb. Previously, restaurants had to pay to have fryer oil removed from their premises. It is now collected for free by Salinas Tallow. As a result of the Fryer to Fuel program, the oil is such high quality and quantity, that participating restaurants may soon get paid for their waste fryer oil. This will provide an additional incentive to manage their restaurant grease responsibly. If a restaurant can keep fryer oil separate from all other restaurant greases, they could potentially make money off of this valuable fuel commodity.

Animal fat or lard and grease trap waste costs money to dispose of. Tallow companies must find someone willing to take this waste stream, whether it's used for animal feed or shipped overseas. This market is not as stable and generally it costs money to dispose of or transport this type of waste for reuse. Typically, restaurants will pay anywhere from $40 to $80 to have this grease removed on a regular basis. For the restaurants participating in the Fryer to Fuel program, where a bin was required for fryer oil and a separate bin for trap grease and animal fat, they were provided with free service, regardless, for their efforts to keep the different greases separate. This was negotiated with Salinas Tallow and it is expected that Salinas Tallow will continue to provide the separate bins for free for restaurants involved in the Fryer to Fuel program. For restaurants not involved in the program that do not effectively separate out the different greases from the fryer oil, they will likely need to pay for hauling and disposition.

Most notably, undesirable greases, such as lard and grease trap self-cleaning waste from restaurants in the northern California area are generally purchased by Darling Corporation and put on a ship in San Francisco and sent to Asia. The final fate of these greases is largely unknown.

Salinas Tallow Vacuum Truck

The cost to pump out a grease interceptor varies, but typically cost approximately $200-$400, depending on size. Restaurants are typically required to pump exterior interceptors 2-4 times per year. Interior interceptors are not much cheaper to clean, approximately $100-$200, and they require more frequent cleaning, generally monthly or every other month.

Types of Grease	**FFA Content**	**Water Content**	**Derived From**	**Uses**
White Grease	<4%	Extremely Low	Virgin oils, rarely from high quality WVO	Biodiesel feedstock
Yellow Grease	>4%<15%	Very Low	WVO	Biodiesel feedstock
Animal Fat	Typically >15%, but can be lower	High	Cooking meat	Protein enhancement for animal feed
Brown Grease	>15%	>30%	Grease traps and interceptors	Cogeneration for sewage treatment plants.

III. Structure of the Pilot Project

A. Initial Scoping and Evolution

This program, originally titled the Urban Biofuels Initiative, was slated to kick-off in January 2006 and wrap up in December 2006. The original plan, outlined in Table 1, was to build biodiesel processing equipment at the City of Santa Cruz Dimeo Lane landfill. City staff were to operate the plant and capture all financial benefits. Waste grease handling procedures were going to be developed and passed out to restaurants and production costs were to be tracked and a business plan developed. However, due to unforeseen challenges, like key staff leaving or changing departments at the City of Santa Cruz and timely market dynamics, the ultimate structure of the pilot was changed from the original plan.

Table 1. Original Work Plan

Task		Timeline
1)	Develop and circulate waste grease-to-fuel handling and storage procedures (*Appendix A*).	January, February
2)	Work with local biodiesel producer EASi to set up biodiesel processing units at the Dimeo Lane landfill in Santa Cruz, California	January, February
3)	Contract with a liquid waste hauler to collect and transport waste grease to landfill processing units.	January, February
4)	With consultation from EASi, coordinate and oversee training of City of Santa Cruz staff that would operate the processing equipment.	January, February
5)	City vehicles would either be fueled at the landfill or fuel would be delivered to the city yard location.	February : December
6)	Begin tracking quantity, quality, and operating costs to reveal cost margins	February : December

At the same time, the biodiesel feedstock markets were changing quickly. Figure 10, and Table 2 below, indicate yellow and white grease prices rising sharply at the end of 2006 and throughout 2007. The increases in prices have caused biodiesel producers to increasingly focus their resources on securing more feedstocks. For renderers like Salinas Tallow, this is good for business. This means more resources can be placed into collecting and improving the quality of waste grease from local kitchens. New bins have been developed for collection and collection fees have been eliminated.

Table 2. Average Annual Prices of Grease Products, 2002-2007 (USDA)

Product	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	***June 2008***
White Grease ($/lb)	$0.11	$0.16	$0.16	$0.16	$0.14	$0.24	
Yellow Grease ($/lb)	$0.09	$0.13	$0.15	$0.14	$0.13	$0.22	*$0.34*

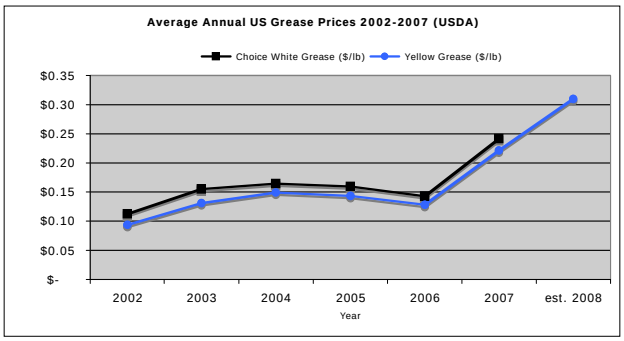

Figure 10. Average Annual Yellow Grease Prices, 2002-2007 (Source: USDA Ag Marketing News Service)

In addition to the void left in the wake of the staff changes, the City identified several other hurdles to constructing processing equipment at the landfill. The hurdles identified were as follows:

- Training existing staff to run and operate the plant seemed unlikely
- Permitting the plant proved challenging (see permitting requirements for EASi on page 29)
- Blending fuel on-site would have been problematic and a high-liability endeavor
- Storage of various biodiesel blends and waste feedstocks was also problematic
- Excess fuel needed to be "sold off" to other entities, creating more bureaucratic work
- Meeting ASTM and other QA/QC standards could be costly and time-consuming for a public entity.

After it became apparent that the City of Santa Cruz was not going to pursue publicly owned biodiesel production, EASi opened up a plant in Gonzales, California. A discussion on history and permitting process is presented in Section III.K, Stakeholder Recruitment.

High production costs caused Salinas Tallow, the local rendering company, to become more competitive, and begin early advances toward using waste vegetable oil for biodiesel. EASi's Gonzales plant opened in 2006. The combined efforts of EASi and Salinas Tallow confirmed to City staff that a waste to fuel program was more likely to be explored commercially at a faster rate than attempting to do it in the public realm. Salinas Tallow and EASi began working together to try and utilize waste vegetable oil from restaurants as feedstock for biodiesel.

Even as the two companies developed business partnerships toward production of cleaner fuels, there were still significant storage and collection problems that led to storm water quality and waste grease quality issues that needed to be addressed at the site of generation. At the heart of these issues was a coordination void that needed to be filled in order for a successful collection program to work. It became clear that it was very important for this project to be developed as a public/private partnership with EA playing a coordinative and administrative role in the project.

With our project partners, EA assessed the rapidly changing landscape and identified a revised workplan and scope to address these needs within the private sector, while utilizing resources within the City of Santa Cruz. A program was developed by Ecology Action in partnership with EASi, Salinas Tallow, Coast Oil, and the City of Santa Cruz to address these needs, dubbed the Fryer to Fuel program. Please see the final timeline of events below.

Table 3. Timeline of Events

Date	Event
14 Jan 2005	Proposal submitted
19 May 2005	Award announcement
6 June 2005	Collaboration agreement with City of Santa Cruz
7 June 2005	No collaboration with County
1 July 2005	Pacific Biofuels begins collaboration
21 Sept 2005	Formal EPA contract approval (Billing begins)
28 Nov 2005	Cal Restaurant Association sign up
21 Feb 2006	Drafting of survey instrument
30 March 2006	City provides list of restaurants for survey
25 April 2006	Interns hired to handle survey work
4 May 2006	Formal CRA participation confirmed for survey
30 June 2006	First phase of Survey wrapped up.
26 Sept 2006	First Interim report to EPA
16 Oct 2006	Pilot proposal for Landfill submitted to City
15 Nov 2006	City delays consideration on Jose Gamboa departure news

Table 4. Timeline of Events Continued

1 Dec 2006	EASi plant in Gonzales official opening. Joint PR done.
28 Dec 2006	No cost Grant extension approved by EPA
26 April 2007	Feedback from EPA progress review on delays etc.
14 July 2007	Workload for MD suggests different resource required
21 August 2007	Proposed JF to Olof as a go forward solution
9 October 2007	EA/EPA team meeting and introduction of JF
17 Oct 2007	Revised work plan submitted to EPA
15 Nov 2007	No cost extension requested from EPA
11 Dec 2007	Extension to end of June 2008 granted.
December 2007	New Stakeholders Developed
December 07 – March 2008	Restaurants recruited and trained, bins delivered, dedicated collection route established
April, and May 2008	Data Collected, Publicity conducted
May and June 2008	Final Report Generated

Survey results from April of 2006 were used, to decide how to improved quality and quantity of waste feedstock, by focusing on training and marketing the Fryer to Fuel program. Grease handling procedures were developed for commercial kitchens, new ergonomic exterior storage containers were obtained, and a collection partnership was developed with commercial kitchens, Salinas Tallow, EASi, Coast Oil, and the City of Santa Cruz. Training was the key component to the revised work plan. EA staff and local environmental regulators observed that commercial kitchens had difficulty observing or completely lacked proper waste grease handling, disposal, and storage methods, thereby leading to spills around the exterior storage areas and contaminated waste grease. Additionally, oil that was left sitting in the heat increased in FFA content and deteriorated the quality. It appeared necessary to consolidate storage of waste grease for several restaurants to allow for more frequent pickups and reduce the amount of time waste grease spent in the heat. The new work plan directed project staff to collaborate with commercial kitchens to identify optimal co-collection points to leverage resources to extend the service area.

B. Revised Workplan

Phase I - Project Design

Initial survey data and communications with public agencies were used to identify a small sample set of restaurants. Sample restaurants were asked a series of questions to identify incentives, feasibility and best methodology for a collection program. The overwhelming response was that any collection scheme must be simple, free, weekly, and storage must be available. Discussions with Salinas Tallow and EASi identified other key hurdles. Waste vegetable oil collected must meet specifications set by EASi to make their plant run effectively: water content below 0.5%, and free fatty acids (FFAs) below 7%. Salinas Tallow had concerns regarding workers' compensation and customer service. They wanted to ensure that their employees were not lifting grease containers, but rather were using vacuum trucks to minimize injuries. They also wanted to ensure that they could service these businesses from the exterior of the building at night or early morning to minimize disruption to the business. Environmental Compliance staff from local Cities and the County wanted to ensure that storage of waste vegetable oil was done without contributing to contamination of surface water runoff.

It was evident that any storage solution for waste vegetable oil needed to reduce or eliminate spills and contamination of the oil. Existing storage consisted of either (1) drums with lids that were not left on due to the difficulty of keeping them on while disposing oil, (2) storage in original containers of fryer oil which degraded quickly when left outside, or (3) bulk storage bins that were extremely tall, making it ergonomically difficult for workers. The large bulk containers also clogged frequently because it was difficult to tell when the bin was full due to the height of the filling opening and the flat grate collected solids easily. Most commonly visible on the exterior of restaurants or in their trash enclosures were an insufficient 55-gallon drum that was impossible to keep clean because the lid mechanism made grease spills inevitable. The lids are not kept sealed and sometimes are left off the drum. These spills and the open drums come into contact with storm water and are a significant threat to water quality. Additionally, high water content due to rain in the waste vegetable oil can sometimes render it useless for biodiesel feedstock.

The Problem: Tallow drums stored outside restaurants and in trash enclosures. The lids are impossible to keep on, therefore rainwater is frequently introduced into the barrel. These drums are also extremely unsightly.

Several iterations of the container were visited, including using original containers stored inside, and providing something other than a drum with an ineffective lid that led to high water and FFA content. Salinas Tallow designed and custom built a bulk container, with an attached, locking, closing lid that was lower and more ergonomically correct. The new containers had a v-shaped grate to collect solids and were easy to keep locked, preventing theft. Salinas Tallow agreed to make these new containers for all of their customers participating in this Fryer to Fuel program, at their cost. This was a significant contribution to the program, as each bin cost approximately $600, and over 20 new bins were delivered as a result of this program.

The Problem: Exterior Storage in Original Containers

The Solution! New Fryer to Fuel Consolidated Bin

A “Fryer to Fuel” insert was developed to accompany an existing Best Management Practices (BMPs) brochure for restaurants that is distributed and referenced during inspections by local Environmental Compliance staff regulating restaurant FOG. Local agencies were contacted to request inclusion of the insert in existing technical assistance BMP brochures for restaurants. The Santa Cruz County Sanitation District, the City of Scotts Valley, and the City of Santa Cruz agreed to include “Fryer to Fuel” inserts in existing materials and incorporated a “fryer to fuel” tab into their existing BMPs (*Appendix A*). During the development of the “Fryer to Fuel” insert, restaurants were contacted to provide feedback and assess the feasibility of potential management practices.

Phase II - Partnership Recruitment

Ecology Action then selected partners to accomplish various aspects of the program and assessed technical needs of the biodiesel producer, liquid waste hauler(s) and public agencies. Topics included handling requirements, economic feasibility, pretreatment of the WVO, retention of fuel quality, and consumption data. Coordination meetings were convened often with representatives from participating partners, mostly with one or two groups at a time. There was one meeting in which all partners were present to discuss achievements and ideas/plans to move forward.

Prior to selecting Salinas Tallow as a partner, EA met with several liquid waste haulers, seeking an ideal candidate for the program. The original intention was to perhaps work with liquid waste haulers that also service grease traps/interceptors, since this brown grease may eventually become a feedstock for biodiesel. It was also recognized that it would be ideal to have a hauler that worked closely with environmental compliance inspectors as well as one that has an outstanding relationship with their customers. Several liquid waste haulers were interested in pursuing partnership with EA on this program. However, none were more prepared and more willing to partner than Salinas Tallow. Salinas Tallow already had the infrastructure to complete the tasks: vacuum trucks, bulk containers, trained employees, pretreatment facilities, and a loyal customer base. They were willing to work together to problem-solve obstacles, and demonstrated such willingness by providing the newly designed bulk containers to the program for free. These containers cost approximately $600 to make each and at least 20 new containers were constructed as a result of the Fryer to Fuel program. Salinas Tallow was also a very stable organization that was able to serve all FOG needs of a restaurant: two of the key things identified as being important for restaurants during the survey.

Pumping grease at Salinas Tallow

Pretreatment Tanks

Control Panel for Pretreatment Processes

Based on initial survey data and knowledge from environmental compliance inspectors, it was expected that 50 – 100 restaurants would be recruited. Recruits were targeted based on the quality and/or quantity of WVO. For instance, restaurants that serve Mexican and Japanese foods were selected based on the quality of their WVO, and fast food and other larger cafeteria-type restaurants were selected based on the volume of their WVO generated. Business recruitment was further enhanced by coordinating with established programs, such as the Green Business and Food Waste Collection Programs, to reach to the most likely candidates that were already participating in environmental programs. The Green Business program incorporated "Fryer to Fuel" collection requirements into its criteria for participating restaurants. Therefore, all certified green restaurants will participate in the program upon recertification (every 3 years) and newly certified restaurants will participate.

Phase III - Implementation

As part of the program, restaurants received the free bulk storage bins for storage of WVO, and free containers to transport the fryer oil to the bulk bins, as well as free collection. In many instances, where restaurants also produced varying degrees of brown grease, a separate container was provided. This ensured that all restaurant FOG was collected; trap grease and pan grease, keeping it away from sink drains and out of the sanitary sewer. Plaques were made to clearly distinguish fryer oil bins from brown grease bins and affixed to the lids of the bins. In most cases fryer oil bins were painted red, whereas brown grease bins were painted black.

Figure 11. Plaque affixed to Collection Bins stating proper disposal methods in English and Spanish.

To ensure proper handling and quality of waste grease, restaurant staff were trained on proper handling and storage requirements for waste grease; to keep it separate from other solids and "brown" grease. The Fryer to Fuel insert that accompanied existing BMP's was also turned into a large poster to place on a wall directly above the storage containers and fryers, and used as a reference when filling oil (*Appendix B*). EA staff ensured that pickups were completed? on a more frequent basis than in the past?, thereby preventing the build-up of FFAs in the waste grease. Shared collection (as in multiple restaurants?) was done by working with restaurants and property managers to identify proper locations for bulk bins, so that they were less of an impact to a commercial area and so that they would fill up more quickly. EA brokered these types of shared consolidated bins at several shopping centers, a downtown area with several nearby restaurants, and the Santa Cruz Municipal Wharf. Pickups were either weekly or biweekly, depending on how frequently the bins filled up. All waste grease collected from Fryer to Fuel participants was done on a dedicated route with a dedicated truck to maintain the quality of the waste grease and also to make data collection for each batch easier.

During the collection trail, EA made themselves available to restaurant staff for technical questions or to assist with any unforeseen or anticipated challenges to collection. One of the main challenges that arose was that, as a result of replacing multiple bins in a shopping center with one bulk storage bin, some restaurant staff were required to walk a little further to dispose of their waste grease than was required previously. When carrying one or two containers of oil that each weighs well over 30 pounds, this can be a genuine concern for employees. In these situations, EA

provided dollies with wheels to prevent hardship on restaurant staff. Many restaurants already had such dollies. EA also provided 2.5 gallon containers with lids to empty fryer oil into for easy, spill-free transport to an exterior bin. These containers were purchased cheaply through partnership with an existing used oil collection program coordinated by the County of Santa Cruz. Because the containers were bought in extremely large quantities for the used oil collection program, EA was able to secure enough for the Fryer to Fuel program at an extremely low cost.

Once weekly pick-ups had begun, EA provided oversight to ensure quality control and document challenges and successes. Weekly data collection documented such factors as how much fryer oil was collected and how many businesses were serviced. Data was also collected on yield of the fryer oil to actual viable feedstock and free fatty acids. This data was compared to previous data on waste vegetable collected prior to the Fryer to Fuel Program. Please see Section IV, Implementation and Operation, and Section V, Pilot Data, for data results.

To ensure long-term operation of the collection program, Environmental Compliance inspectors, in partnership with Salinas Tallow, will take on coordination of the "Fryer to Fuel" collection scheme as part of their fats, oils, and grease (FOG) program. While framing the workplan, EA expected results from a 6-8 week trial pilot that were broken down into three tiers base on 10% participation, 20% participation, and 50% participation. Initial survey data indicated more than 50 gallons of waste grease were available from each restaurant each month. Based on that data, EA anticipated collecting up to 50 gallons of oil per restaurant, with 50 participating restaurants (2,500 gallons), resulting in an 80% conversion to B100 biodiesel (2,000 gallons), blended to make B20 biodiesel, resulting in 10,000 gallons of fuel for public fleets (see the chart on the following page). EA actually collected about 9,947 gallons of WVO from 31 restaurants, exceeding the estimated quantity, while utilizing fewer restaurants than expected. EA explicitly targeted restaurants that produced higher volume of waste grease, and therefore was able to get more fryer oil from fewer participating restaurants than expected.

It is very important to point out that most waste grease from restaurants in Santa Cruz is currently being used for local biodiesel feedstock. The numbers and data collected for this program pertain to restaurants that participated in the additional steps; such as improved storage, training, and Best Management Practices - required by the Fryer to Fuel program to solve problems pertaining to using WVO as biodiesel feedstock. It is estimated that Salinas Tallow is serving well over 400 restaurants and their WVO is being pretreated to make it a viable feedstock for biodiesel.

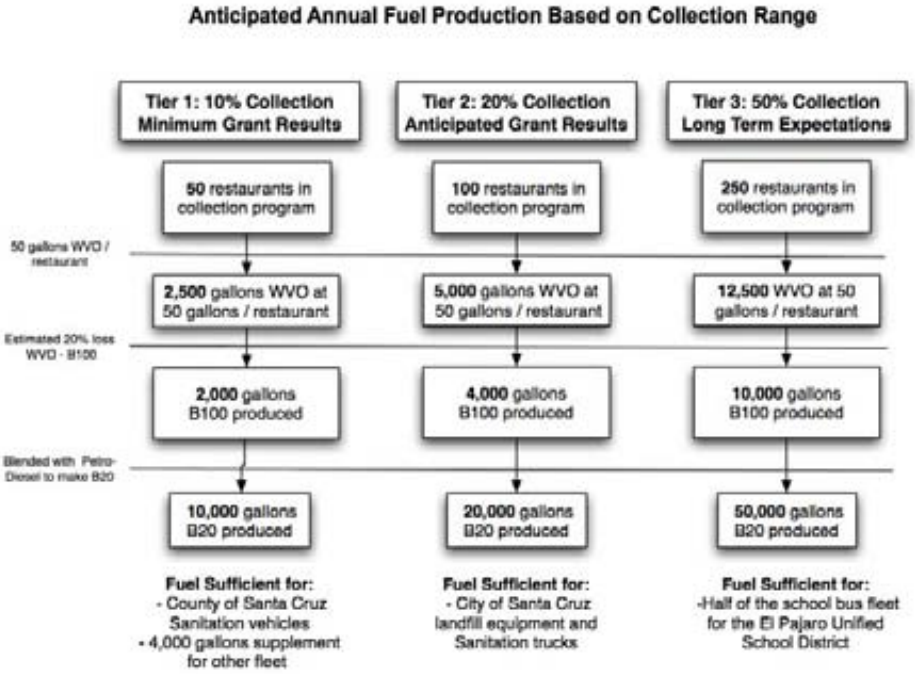

Figure 12. Project anticipated grease collection based on survey data and crude metrics.

Phase IV - Stakeholder recognition, Kick Off and Publicity

EA was able to take advantage of significant interest from local media on the program. Articles covering the program were printed in the Santa Cruz Sentinel, the Metro, and the Register Pajaronian (*Appendix D*). These articles generated interest from several local businesses also wanting to participate in the program. They also generated interest from neighboring jurisdictions in California wanting to replicate the program in their regions. An article in a public works newsletter to be printed later this summer, dubbed "One Person's Trash" and distributed to all residents of the City of Santa Cruz, as well as another such newsletter, dubbed "The Curbsider" to all residents in the unincorporated areas of Santa Cruz County will be published promoting the Fryer to Fuel Program to the general public. These articles promoted the participating restaurants for further recognition.

Fryer to Fuel Partners on Earth Day. From left to right: Mary Arman, Public Works Operations Manager for the City of Santa Cruz, Bill Ottone, owner of Salinas Tallow, Phil Ottone, Manager of Salinas Tallow, Kevin Larson, Southern Territory Manager for Coast Oil, Vinicio Vides and Richard Gillis, owners of Energy Alternative Solutions, Inc. (EASi), and Olof Hansen, Environmental Protection Specialist and Fryer to Fuel Grant Manager for the U.S. EPA.

Several articles were generated by doing a Fryer to Fuel presentation at a high profile Earth Day event in downtown Santa Cruz on April 27th, 2008. Several speakers presented their role in the program, including former Assemblyperson Fred Keeley, representatives from the Environmental Protection Agency, the Executive Director of Ecology Action, City of Santa Cruz, the owners of Energy Alternative Solutions, Coast Oil, and Salinas Tallow. At that event, the Fryer to Fuel program was announced and its various attributes celebrated by the speakers.

A presentation was also made to the Public Works Commission for the City of Santa Cruz. Another such presentation was made to a group of public officials in both the City and County of Monterey.

Phase V – Documentation

This final report serves as documentation for the program. Due to the grant cycle closure before full collection benefits can be measured and overall importance of quality data in program reproduction, Ecology Action will provide, at their cost, an updated document thirteen months from completion of the pilot. This document will provide data relevant to a suburban "Fryer to Fuel" collection program for the one-year period following the pilot. Metrics will include: qualitative and quantitative measurements of grease supply, any changes to the program, number of restaurants enrolled, and any increases in the use of biodiesel by public agencies. This report will include a satisfaction survey as well.

C. Making a Decision: Government Collected & Produced VS. Commercially Collected & Produced

Aside from the well-known and documented emissions reductions of biodiesel use, the importance of this project was to demonstrate that a waste-to-fuel economic system could in fact be achievable in a combined urban/suburban/rural setting.

Around the same time this project was being contemplated, the San Francisco Public Utilities Commission was diving into a waste-to-fuel economy itself. Their program, titled SFGreasecycle (www.sfgreasecycle.org), has significant economies of scale and implementation differences when compared to that of the "Fryer-to-Fuel" program of the Monterey Bay area. This is because SFGreasecycle services 350 restaurants in a concentrated urban area, while the Fryer to Fuel program has enrolled 31 restaurants spread out over a large geographic area. Thus, to achieve the best results, Fryer to Fuel had to rely on large quantity generators. The SFGreasecycle program took the work a step further by taking the steps necessary to turn waste grease collection into a public utility to produce their own biodiesel.

In the three years that Ecology Action has been developing and coordinating the fryer to fuel program, an innovative local fuel economy has developed in tandem. In three short years a local market developed that created new businesses and jobs (in the case of EASi), enhanced long-time local businesses (in the case of Salinas Tallow, which is showing significant growth), and utilized existing distributors for infrastructure (in the case of Coast Oil). Several commercial fleets began using various biodiesel blends during that time period, including: Greenwaste Recovery, the waste franchise for Santa Cruz County, Couch Distributors, a large trucking company, Salinas Tallow, and Coast Oil, to name a few. Ecology Action was lucky to have joined the local biodiesel economy at a time when it was moving at a fast pace, but needed technical assistance and partnership in certain problem areas, such as ensuring high quality and quantity of the WVO collected from restaurants.

It is key, from an economic development standpoint, to consider allowing commercial market development in this arena, rather than taking control of this market in the public sector. Given the environmental awareness in certain local communities and the world at large, which has lead to many green business and sustainable economic successes; it's prudent to encourage local decision-makers to motivate success in the private sector, rather than taking control in the public sector. There are also efficiencies and timeliness that can only be realized in the private sector to effectively move a program toward success. Additionally, infrastructure costs, liability, and quality control responsibilities and costs are shared among the 3 commercial partners, not borne by the government.

However, if a region were not seeing economic development in this area or if significant positive externalities could be identified and realized, like reduced biodiesel fuel prices, it would be worthwhile to explore utilizing a waste stream for local fuel development. Condensed, urban areas tend to be the best model for this. In this instance, the San Francisco program provides an excellent template to develop such a program. Below is a table comparing the program in San Francisco with the program in Santa Cruz.

Table 5. Program Comparison of Fryer to Fuel, Santa Cruz and SFGreasecycle Programs

Program Elements	SFGreasecycle (San Francisco)*	Fryer to Fuel (Santa Cruz)
Budget	$1.2 million	$75,000
Number of Participating Restaurants	350	31 of the highest volume restaurants
Total Number of Restaurants in Area	>3000	Approximately 1000
Average quantity of fryer oil generated per week per restaurant		40-50 gallons/week
Waste Vegetable Oil (WVO) Collected/month		~5200 gallons/month (from 31 Fryer to Fuel customers only)
Total Quantity of WVO used for biodiesel feedstock from the region		50,000 pounds/week or 6500 gallons/week
Population served	~750,000	~250,000
Geographics	Dense urban	Suburban/urban/ rural combination
Staff	3 Full-time employees	1 full-time employee for the duration of the grant, work absorbed by existing public works staff, Environmental Compliance Inspectors
Number of liquid waste haulers picking up fryer oil in region	More than 10.	Less than 3 licensed haulers, one main hauler.
QA/QC requirements	Same requirements as private enterprise (below)	None for government, borne by private entities (below).
	Biodiesel plant: ASTM standard 6751, B2-9000 Certification, other 3rd party certifications Hauler: Pretreatment must meet specifications for biodiesel feedstock (<7% FFA, <0.5% water, eliminate solids) Blender/Distributor: ASTM standard 6751, testing to ensure proper blends	
Energy Requirements for pretreatment of fryer oil	Done with energy from co-generation at the sewage treatment plant, using methane produced by the digester of sludge and brown grease.	Done with energy from the local utility and partially in transit with heated trucks.

*** SF Greasecycle Staff were contacted verbally in generating information for this table but did not respond when asked to verify information. Therefore, some of the information may not be entirely accurate.**

D. Developing a closed loop system

The key to building a sustainable biodiesel economy is to get stakeholder buy-in from the public, private companies, and government. The other key is to build off of existing infrastructure, where available. Like any sustainable business, make every attempt to keep the inputs and outputs as centralized as possible. All of the aspects of this program were concentrated in a tri-county area and a less than 120 mile round trip from point A to point B of most inputs and outputs. Local feedstock was utilized, a local hauler, local production, local distribution, and local public use. This allowed for enough scale to make the program commercially feasible, while also preserving quality, QA/QC, permitting, and regulatory requirements of locally produced biodiesel. The locality of the program makes it extremely sustainable, with very little transportation involved, and indicates the possibility and the likelihood of several such hubs throughout the State of California and beyond.

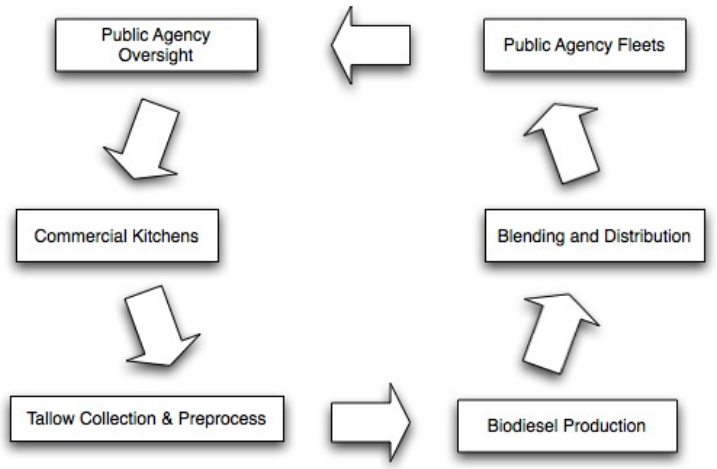

Figure 13. Diagram of market actors in a Community Based Closed Loop biodiesel economy.

E. Initial Data Collection (Restaurant Surveys)

Survey Results

A cornerstone of the project was to establish the quantity of WVO that is actually collectable as a viable feedstock for local conversion to biodiesel. This drives later choices for production. A survey was conducted with the aim of contacting as many local businesses as possible, to characterize the current situation locally and to collect data on the potential for and willingness of local food service business owner/operators to participate more fully in the harvesting of WVO.

The majority of sites initially contacted were in the City of Santa Cruz and the County of Santa Cruz.

The survey instrument contained questions designed to ascertain:

- How much and what type of cooking oil/fat is used,
- What type of cooking the oil is used for,
- Disposal quantities,
- Storage methods after use and before collection/disposal,
- What services/fees are involved in collection/disposal,
- Frequency of collection/disposal, and
- Motivation of business owner/operator to recycle segregated WVO.

The survey was conducted in person to assure the best possible response rate and provide an opportunity for the business owner/operator to ask questions and express opinions. A proportion of the surveys were conducted while accompanying local environmental inspectors on their routine visits to restaurant businesses to check for compliance with local codes and ordinances. The inspection staff were informally interviewed for their opinions and ideas about potential additions to BMPs.

It should be noted that, in the near term, the supply of waste vegetable oil is finite. Unlike virgin soybean oil and other oil-bearing crops, the supply of waste vegetable oil is not driven by Biodiesel demand. An accurate assessment of the available resource is therefore crucial to the success of any intended program.

Potential limitations as to the quantity of available waste oil might be addressed by increasing the size of the collection area. Depending on the particular setting, this may degrade the sustainability of the program when extra vehicle journeys for collection and delivery are taken into account. Regional yellow grease generation estimates were conducted by using two separate ways: using a National assessment and using a local survey. The two results were then compared.

Using the 1998 National Renewable Energy Laboratory (NREL) waste grease assessment, estimates were calculated using population and number of restaurants as indicators. According to the study, regional population is a slightly better indicator of waste grease generation than number of restaurants; population has an R2 of .90 as opposed to .85for restaurant numbers[3]. Using population as the indicator, grease generation would be:

- 8.87 lbs/person/year x 249,705 people in Santa Cruz County[4] = 2,214,883 lbs per year
- 2,214,883 lbs ÷ 7.7 lbs / gallon of yellow grease = 287,647 gallons per year

Currently, Salinas Tallow is realizing between 135,000 and 168,000 gallons per year of that potential.

Using these calculations, there is potentially 287,647 gallons of WVO available for collection in Santa Cruz County. After yield loss, biodiesel processing and blending 287,647 gallons of waste grease could make 920,000 gallons of B20[5].

Survey data were also used to estimate average fryer oil disposal quantities. 151 businesses were surveyed, 79 filled out the questionnaires (52% response), 24 responded as having fryer oil, and 19 responded as having disposal quantities. Of the 19 respondents having disposal quantities, 1 was omitted for validation reasons. The respondent noted grease disposal on the order of 1500 gallons - apparently confusing fryer oil with grease interceptor grease, as most grease interceptors are 1500 gallons.

The remaining 18 restaurants had an average monthly disposal amount of 65.3 gallons[6]. The total number of restaurants was obtained from local environmental regulators and was estimated to be 780 for Santa Cruz County (excluding the City of Watsonville). Based on survey data, only 33.8% produce waste grease. Using this method, grease generation would be:

- 65.3 gallons/restaurant/month x 12 months/year = 783.6 gallons/restaurant/year
- 780 restaurants/region x 0.338 producing fryer oil = 263.64 restaurants producing waste grease
- 783.6 gallons/restaurant/year x 263.64 restaurants producing waste grease = 206,588.3 gallons per year.

[3] Wiltsee, G., 1998. Urban Waste Grease Resources Assessment. Prepared for National Renewable Energy Laboratory, US Department of Energy, Subcontract No. ACG-7-17090-01 under Prime Contract No. DE-AC36-83CH10093.

[4] United States Census Estimate, 2006. Accessed from: <insert URL here>. <date>.

[5] Conversions made using an 80% yield loss due to pretreatment, 80% loss due to biodiesel production, and linear blending with petrol diesel.

[6] Conversions made using USDA commodity rate of 7.7lbs/gallon

Using the survey method to calculate waste grease generation, after yield loss, processing, and blending, 660,000 gallons of B20 would be available. The numbers generated using the NREL survey and the local surveys are relatively, but not statistically, similar. See the table below for comparison.

Table 6. Survey Method Comparisons

Survey	WVO Generated (gallons)	B20 Produced (gallons)
NREL	287,647	920,000
Local Restaurants	206,588	660,000

No regional estimates have been conducted assessing the availability or quality of brown grease – waste grease with >15% FFA by weight. Trap grease, a major supply of brown grease, is generated in the presence of large quantities of water and solids. Anecdotal evidence suggests usable lipid content can be as low as 33%. The composition of the other material is water, solids, detergents, and other chemicals. Grease traps hold these materials in place for an extended period of time, and, if not pumped properly or on time, grease may overflow and become a significant burden on the sanitary sewer system. It is for this reason that local sanitation districts have regulations governing the installation and use of pretreatment devices such as grease traps and interceptors. The County of Santa Cruz has had a successful pretreatment program in place for the better part of 30 years. These regulations mandate the installation of an approved exterior grease interceptor or interior grease trap at any facility producing waste grease. The regulations further require an approved pump cycle. These regulations require a significant amount of money to achieve compliance as well as to regulate.

Brown grease must be pumped by a licensed liquid waste hauler and is typically disposed of at a wastewater treatment facility. A study by the National Renewable Energy Laboratory calculated a national average for brown grease generation by population, but specific analysis of lipid content in brown grease discharged at the treatment plant has not been conducted[7]. Further, technologies to convert brown grease to a form usable for biodiesel are in their infancy[8]. However, active grease separation technologies do exist that remove lipids and waste grease from the waste stream inside the commercial kitchen before it fouls, such as the Goslyn grease removal unit.

Commercial kitchens that already dispose of waste fryer oil may find active grease separation a cost effective way to meet the pretreatment regulations and increase regional grease supply. Further work is required to assess the quality and quantity of grease being produced by active separation units and the cost effectiveness of replacing passive traps/interceptors with active separation units.

F. Stakeholder Recruitment

Government Agencies

The City of Santa Cruz signed on to the original grant proposal, and therefore was an active partner. However, Environmental Compliance Inspectors from the City of Scotts Valley, the City of Watsonville, and the Santa Cruz County Sanitation District were all engaged in the program, and were participants at varying degrees. Inspectors plan to carry the program forward now that the grant has ended by promoting the program to local restaurants, and providing training, although it is unclear as to whether all jurisdictions are willing and able to spend the time required to coordinate with restaurant staff and property managers to broker shared bins in certain locations. Nor is it clear if the inspectors intend to train ALL restaurant staff on proper grease segregation, which is critical from a quality standpoint.

Before the grant began, the City of Santa Cruz was using B50 in their vehicles. More recently, the City has begun using B20 during the colder winter months. During the course of this grant, the County of Santa Cruz has begun

[7] Wiltsee, G., 1998. Urban Waste Grease Resources Assessment. Prepared for National Renewable Energy Laboratory, US Department of Energy, Subcontract No. ACG-7-17090-01 under Prime Contract No. DE-AC36-83CH10093.

[8] url: http://www.ebdailynews.com/article/2008-1-9-eb-biosludge , accessed on June 9th.

using B5 in their landfill equipment. The Pajaro Valley School District and Santa Cruz City School District also use B20 in their school buses. The waste franchise for the County of Santa Cruz, Green Waste utilizes B20 in all waste, recycling, and yard waste trucks. When prompted by local fleets, EA provided an in depth analysis of the use of biodiesel blends verses petroleum derived diesel. A Biodiesel Use Proposal and FAQ document was produced to address the mounting list of questions that public administrators and fleet managers might have regarding the use of biodiesel (*Appendix E*).

Biodiesel Production Facility

It was relatively easy to select a biodiesel production facility. Since there were too many hurdles in locating a plant at a City facility such as the landfill, EA chose to partner with a commercial producer. There is only one commercial facility nearby: the EASi facility in Gonzales, California in Monterey County. Richard Gillis, one of the owners of the company, proved to be a wealth of information, and a very strong collaborator.

Energy Alternative Solutions, Inc. was founded in March 2006 with the goal of reducing environmental pollution, lessening the country's dependence on foreign oil, and providing new crop opportunities for local farmers. Their vision is to create community-based closed-loop operations in which each community utilizes its own renewable resources—such as waste vegetable oil and locally grown oilseed crops—to produce its own energy and reduce dependency on petroleum fuels. EASi wanted to see local feedstocks benefit local populations.

In partnership with Salinas Tallow Company, San Jose Tallow, Ecology Action, and thousands of restaurants on the California Central Coast and in the San Francisco Bay Area, Energy Alternative Solutions, Inc. recycles 150,000 pounds of waste vegetable oil into biodiesel each week. This produces 21,000 gallons of B100 and 105,000 gallons of B20. This B20 fuel is in turn utilized by local government and partnering commercial entities.

The permitting process to begin operation of the plant involved the following agencies: the Monterey Bay Unified Air Pollution Control District, the Certified Unified Program Agency (CUPA) or Environmental Health for the County of Monterey, the local Fire Department in Gonzales, and the City of Gonzales for business licensing. They do not have a wastewater discharge permit, since wastewater is collected and hauled off-site for treatment at $0.15/gallon. Ecology Action participated in joint publicity to open the plant in December of 2006. The plant has been very well received throughout Northern California.

Liquid Waste Haulers

Although Salinas Tallow collects WVO from the majority of food establishments in Santa Cruz County, it was not assumed that EA would work with them on the Fryer to Fuel program. Meetings were held with three other companies who had obtained their liquid waste hauling licenses: Pacific Biofuel, Pioneer Liquid Transport and Pete's Outflow. While all of them were enthusiastic about participating in the program, each of them had missing infrastructure. Salinas Tallow was the only licensed liquid waste hauler that could provide the appropriate, newly designed free storage bins, vacuum trucks that made it easy to quickly pump out the bulk bins, while simultaneously pretreating the WVO in transit by heating it, and the pretreatment necessary for WVO to become a biodiesel feedstock. The previously mentioned liquid waste haulers were all missing one or all of those necessary elements. Salinas Tallow was more than willing to work with EA, and the owners, Phil and Bill Ottone, proved to be valuable partners.

Food Service Facilities

Food service facilities were selected based on their potential to generate large amounts of WVO, their proximity to each other to allow for bulk storage and more frequent pick-ups, and their willingness to participate. Some were selected from the survey results as having reported high volumes of WVO generation (*see Appendix F for a list of participating restaurants.)*

Fuel Blending and Distribution

The fuel blending and distribution company, Coast Oil, was selected based on its ability to win public contracts to wholesale and distribute fuel to public agencies. Coast Oil is also the exclusive wholesaler of biodiesel from the EASi plant. Coast Oil has won contract bids with most of the local agencies to provide fuels such as diesel and biodiesel blends.

IV. Implementation and Operation

A. Setting up the Collection System

Enrollment in the collection program began in December 2007 and continued through March 2008. EA opted to start solicitations by focusing first on large quantity generators, then by focusing on co-location or areas where many restaurants could feed into one storage container. Kitchen managers at the University of California Santa Cruz (UCSC) were contacted first, due to the volume of oil produced at their dining facilities, then restaurants at the Capitola Mall food court, various strip malls with multiple restaurants, a few local hotels, and the Santa Cruz Municipal Wharf. It was estimated that each dining facility at UCSC produced an annual average of 200 gallons of waste oil. This number is approximately 4 times higher than the average. As of the time of writing this report, 31 commercial kitchens or restaurants have been enrolled in the pilot (*see Appendix F for a list of restaurants*). This number is below the original estimates, but due to focused enrollment, grease generation targets were exceeded.

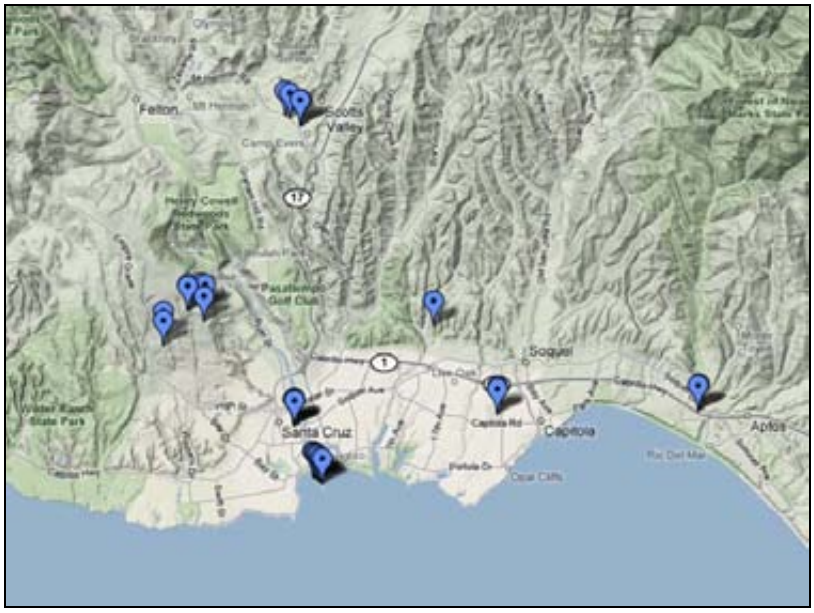

Figure 14. All 31 Participating Restaurants, in Clustered Collection Points in the Santa Cruz Area (source: Google Maps)

Much of the work done during the four-month enrollment period was spent coordinating centralized collection. This involved identifying premium sites with multiple commercial kitchens, and contacting or meeting with property managers to gain input prior to contacting each kitchen. Each restaurant had to be contacted individually, and meetings set. Cold calling was the method chosen, and more often than not a few minutes had to be spent describing the collection program. In almost every case, after the initial puzzlement, restaurants and kitchens enrolled with no further issues. Meetings were made with kitchen staff to cover the basics of the program and train chefs and other staff. Due to the varied and hectic schedule of kitchen managers, application meetings and trainings were held separately. In hindsight, if the kitchen is small enough, the application and training could be condensed into one meeting. At the initial meeting, an application for the Fryer to Fuel program was filled out along with a short survey.

A contract was also filled out to ensure grease ownership was transferred once it was emptied into the box (*Appendix G*). Transfer of ownership is a key point. It ensures that financial investments made on part of the collection company are properly secured. As the value of yellow grease increases, so too does the risk of theft. After all the paper work was completed, bins were delivered and plaques affixed to the top of the bins to indicate which bins were for fryer oil and which were for other fats, oils and greases produced by the restaurant.

Tracking spreadsheets were developed that included restaurant name, contact information, date enrolled, and notes during training. Weekly phone calls were made with Salinas Tallow to coordinate bin delivery, additions to program enrollment, and general logistical concerns. After bins were delivered, in all but a few cases no further assistance was needed. In the few instances that assistance was needed, the issue always revolved around the size, color, or location of the box.

B. The City of Santa Cruz Municipal Wharf

The Santa Cruz Municipal Wharf was a case where a confluence of issues presented themselves. Environmental sensitivity (the area resides directly over the Monterey Bay National Marine Sanctuary), and high visibility also raised the stakes for this site. The wharf is a highly seasonal commercial location. Patronage spikes with the increased tourism during the warmer months. Because of this spike in patronage, grease generation is varied. There were three exterior tallow storage locations at the beginning, middle and end of the wharf. Since many of the restaurants self-clean their grease traps, out of necessity, additional bins were needed to store the brown grease.

Figure 15. Collection Sites at the Santa Cruz City Municipal Wharf in Santa Cruz, California

Working with High Volume Publicly Maintained Locations

- Contact maintenance crews and operations supervisors. Confirm the feasibility of a collection system and needs from the City/municipality's perspective. Inform maintenance and/or operations staff that yellow grease will be segregated from brown grease under the collection program and may need an extra waste grease storage container. Obtain letter of support from management and solicit them to promote the program to businesses in their jurisdiction.
- Collection sites are probably already established. Verify space for extra collection bin. Make sure collection location is not less convenient than current location. If staff has to work harder and travel longer to dispose of wastes, they may be less likely to cleanly and safely dispose of grease.
- If a restaurant is producing trap grease, determine proper disposal methods. Check with local sanitation districts for regulations.
- Contact each restaurant during off hours, usually from 8am to 11am, and 2pm to 4pm.
- Train kitchen staff on proper segregation, handling, and storage practices and provide transportation containers if available. Do a practice run with kitchen staff to make sure they "experience" best practices. If restaurant is receptive, have BMP placed in standard training packet.
- Coordinate storage container delivery and collection period with liquid waste hauler.
- Follow up with restaurants 2-4 weeks after bin delivery.

Figure 16. Santa Cruz City Municipal Wharf collection site 1 prior to the Fryer to Fuel Program.

Figure 17. Santa Cruz Municipal Wharf Collection Site 1 after Fryer to Fuel Program.

Prior to enrolling, each location had two large bulk collection bins. During the colder months, restaurant staff and Salinas Tallow confirmed that each week bins would fill to 20-40% of capacity. During the summer months, it would be common for each location to be 90% or more of capacity. The original bins at the wharf were developed to be easily emptied during the colder months. This involved a refuse like lift gate attached to the front of a collection truck. The lift gate would pick up the box and place it in a tank of hot water thereby loosening the congealed grease from the sides of the box and making it able to be pumped out. These containers can be 4’ to 5’ tall and vary in length and width; the effect of which is that disposing grease into the container can be extremely difficult and if trying to empty a large amount, as is often the case, can present worker health and safety problems. To compensate for the height, and frequency of disposal during the warmer months, kitchen staff would often not close the lid. Seagulls would be attracted to the tallow containers and perch on the open containers further contaminating the storage containers and vicinity. Additionally, because the containers were in a highly visible and public space, and they looked like refuse dumpsters, it would be common for other unrelated contaminates to be found in the containers, such as prophylactics, diapers, cloth rags, cardboard, cigarette butts, and other materials. After many years of having the same collection bins affected by the issues stated above, only a few bins remained in working condition.

Table 6. Benefactor Analysis for Santa Cruz City Wharf

Conflicting Needs	Who Benefited	Who Paid
Irregular grease generation required a large volume to be available to disposal	Patronage Commercial Kitchens	Liquid Waste Hauler
Weathering and biological elements over time degraded the functionality and sightlines of exterior storage containers	Nobody	Maintenance Crew Salinas Tallow
Kitchen staff had to be trained to keep lids closed and area maintained	Maintenance Crew Salinas Tallow	Commercial Kitchens
A more ergonomic container had to be developed	Salinas Tallow	Commercial Kitchens
Eliminating foreign materials found in grease storage containers.	EASi Salinas Tallow	Commercial Kitchens Maintenance Crew

Scotts Valley Center

The Scotts Valley Center is located in the 220 block of Mt. Hermon Road in Scotts Valley California. This location consists of about 20 different businesses. Taco Bell, Taqueria Los Gallos, and Bruno's BBQ were solicited at this location. After this location was identified as a potential collection site, the property manager was contacted. Meetings were held to determine the ideal collection site and gain stakeholder buy-in. The best location was determined to be in the center of the three locations, about 40 paces from each location. Prior to enrollment, each location used individual 55-gallon drums to collect their tallow. The Property manager was extremely amenable to the program, so that they could eliminate the eyesore of several tallow drums scattered throughout the property. In this sense, they were able to promote the Fryer to Fuel program to their tenants.

Taqueria Los Gallos was already giving their oil to a home based biodiesel producer but was more than happy to enroll because pickups would be more frequent and consistent. On the other hand, Taco Bell was willing to enroll, but because oil had to be transported across the parking lot, raised occupational health issues. Upon request, a dolly was purchased for Taco Bell and transportation containers delivered. Bruno's BBQ initially enrolled, but later withdrew due to the extra distance to carry the fryer oil. EA staff offered to purchase a dolly similar to the one purchased for Taco Bell, but no reply was ever made. They returned to having their own container to the exterior of their kitchen. This grease is still collected by Salinas Tallow and is still being used as biodiesel feedstock.

Working with Strip Malls

- Identify largest waste grease generators and potential waste grease storage locations.
- Contact property management and work with them to identify most appropriate collection locations. Make sure collection location is not less convenient than current collection location. If staff have to work harder and travel longer to dispose of wastes, they may be less likely to perform their job well. Inform management that waste grease will be segregated under the collection program and may need an extra waste grease storage container. Obtain letter of support from management.
- Enlist property managers to promote the program to their tenants.
- Contact each restaurant at the location to get them enrolled in the collection program. In certain circumstances transportation containers may need to be provided to improve worker health and safety and reduce grease spillage.
- Train kitchen staff on proper segregation, handling, and storage practices and provide transportation containers if available. Do a practice run with kitchen staff to make sure they experience "best practices." If restaurant is receptive, have BMP placed in standard training packet.
- If restaurant is producing brown grease, determine proper storage locations.
- Coordinate storage container delivery and collection period with liquid waste hauler.

Capitola Mall

The Capitola Mall is a major commercial center in the City of Capitola. There are multiple restaurants on the premises but they are not all necessarily in the food court. Therefore, a shared collection point was not feasible. A Chili's Restaurant and a Carl's Junior at this location were enrolled. The Capitola Mall food court was also solicited but only one location produced viable fryer oil. This location also stored their waste oil inside was and it was picked up at irregular intervals. Again, the property managers were contacted prior to contacting the restaurants. Management was very excited to have been approached about the Fryer to Fuel program. An assistant was given the responsibility of informing all restaurants on the premises that management was behind the fryer to fuel program and encouraged each to enroll. This helped speed up the enrollment and training process for each restaurant.

Figure 18. Collection Sites and vicinity at the Capitola Mall, Capitola, California

Due to the individual needs of each restaurant, each was given their own container. Carl's Junior only produced waste fryer oil and requested to keep their original collection box as no segregation was needed. Chili's, on the other hand, produced a significant quantity of pan grease and needed additional collection capacity.

Working with Commercial Malls

- Identify largest waste grease generators and potential waste grease storage locations.
- Contact Mall Management and work with them to identify most appropriate collection locations. Inform management that waste grease will be segregated under the collection program and may need an extra waste grease storage container. Obtain letter of support from management.
- Enlist management to promote the program to their tenants.
- Contact each restaurant in the Mall to get them enrolled in the collection program.
- Train kitchen staff on proper segregation, handling, and storage practices and provide transportation containers if available. Do a practice run with kitchen staff to make sure they experience "best practices." If restaurant is receptive, have BMP placed in standard training packet.
- If restaurant is producing brown grease, determine proper storage locations.
- Coordinate storage container delivery and collection period with liquid waste hauler.

Downtown Santa Cruz

The downtown Santa Cruz location is a highly visible location, located adjacent to a parking lot at the southern end of Pearl Alley. Downtown Santa Cruz has many kitchens and eateries producing grease. Grease storage in Downtown Santa Cruz has been problematic. For many years, City trash enclosures were used for grease storage. However, due to mismanagement, the unsanitary nature of grease disposal, and constant unresponsiveness to city staff requests by restaurant staff, grease storage was removed and placed outside. A 55-gallon drum was placed in a black steel container adjacent to the enclosure. The effects of this switch turned out to be undesirable as well. Individual "bad actors" were not being held responsible for proper disposal and the drum was too small for high volume seasons. As the Fryer to Fuel program developed, it seemed like it could alleviate some of the mismanagement and storage obstacles presented at this taxing location.

Figure 19. Collection Site and vicinity for Downtown Santa Cruz, California

The situation at the downtown location was difficult because there were many differing and sometimes conflicting needs that had to be addressed. Any change to grease disposal had to be more convenient that current disposal methods. In discussions with city staff the factors in Table 7 were considered.

Table 7. Bin Setup Considerations for Downtown Santa Cruz

Element
Location
Size of Bin
Lighting
Proximity to storm drains
Pedestrian Traffic
Ascetics and Aroma

Many locations were considered for a collection box, including: City owned trash enclosures, inside restaurants, outside restaurants, a parking garage, and swapping bins at the original disposal location. Each location presented obstacles to be overcome.

City owned trash enclosures have limited space because they were initially intended to only house large trash and recycling bins, and in some cases trash compactors. In addition, these common spaces become cluttered and dirty quickly due to lack of maintenance by users. It was common to see cardboard boxes and small 5 gallon waste grease containers lying around the enclosure. This presented a problem because waste grease was improperly being placed in the enclosures.

Inside restaurants were preferred by sanitation inspectors but would not be feasible for collective disposal or collection during non-business hours. In downtown Santa Cruz space is at a premium, restaurants typically maximize space usage to keep costs low. Further, if large waste grease storage containers were placed inside they could block exits and spillage would make the floors slippery and increase employee health risk.

Outside restaurants would be a feasible collection point if restaurants were adjacent to one another, there was sufficient lighting out back, and containers could be bermed or spillage could somehow be rerouted away from storm drains.

Parking garages had space available, but the location was in between a wall and preexisting bicycle lockers. Pedestrian traffic was significant and the lighting was meager. The location was also situated in such a way that would allow vehicle traffic to inconspicuously come right up to the bin and thus increase the risk of theft.

The Original location for fryer oil disposal was highly visible, alongside a major pedestrian route, and not enclosed. However, the location had previous approval and would be easy to argue for a larger grease container. Local environmental regulators and parking lot maintenance staff expressed a few concerns revolving mostly around liability, aesthetics, and mobility. These concerns were addressed and this was the eventual location chosen for placement of the bin to serve five restaurants.

Working with Highly Visible Locations

- Contact City staff to make sure collective disposal is an option. Inform staff that under the collection program, waste grease will need to be segregated and exterior areas maintained.
- Identify largest waste grease generators and location of pre-enrollment waste grease storage containers. If relocating storage, make sure to address liability, security, convenience, and ascetics.
- It may help to obtain written letters of support from city staff. This will convey to restaurants that the City is on board and help make sure requests from restaurants will be channeled to the appropriate city staff person.
- Contact each restaurant in the area and enroll them in the collection program.
- Train kitchen staff on proper segregation, handling, and storage practices and provide transportation containers if available. Do a practice run with kitchen staff to make sure they experience “best practices.” If restaurant is receptive, have BMP placed in standard training packet.
- If restaurant is producing brown grease, determine proper storage locations.
- Coordinate storage container delivery and collection period with liquid waste hauler.
- Follow up with restaurants 2-4 weeks after bin delivery.

The new Fryer to Fuel bin was a good replacement of the original 55-gallon drum. Grease spillage was addressed by placing oil pads along the base of the collection box. These pads absorb oils but not water and are disposed of as they reach capacity. An increase in bin size and lower, more ergonomic lid were favorable outcomes for the restaurants. Liability issues were still a concern to City staff. The location is highly visible, located in close proximity to bars and night clubs, and a young transient population. It was feared that the bin could be knocked over or even removed. Measures were taken to alleviate this problem by chaining the bin to adjoining bicycle lockers and affixing a padlock to the lid. To date no problems have arisen.

Figure 20. Downtown Santa Cruz waste grease collection bin before Fryer to Fuel

Figure 21. Downtown Santa Cruz waste grease collection bin after Fryer to Fuel

V. Pilot data

As discussed in Section II.C., Restaurant Grease 101, yellow grease (<15% FFA) used for biodiesel production must meet certain quality specifications. FFA's must be no greater than 7%, moisture must be no larger than 0.5%, and solids must be reduced to a micron scale. These quality indicators were used to assess the effectiveness and economics of the program. To ensure quality data, QA/QC was performed during a two-month collection phase lasting from April 4th through the end of May. Periodic site visits verified the quality of waste grease and Salinas Tallow conducted periodic grease analyses. To ensure data were accurately tracked, bins were emptied in early April, to begin at a zero baseline point. Data points were taken weekly or almost weekly throughout the two-month period. Data was entered into a spreadsheet and graphs produced.

Data was kept intact by means of a dedicated route for all Fryer to Fuel waste grease. A 3,000 gallon vacuum, or pump truck began its collection route in Salinas and proceeded to Scotts Valley where it made two pickups, then to UCSC, the Santa Cruz Municipal Wharf, Downtown Santa Cruz, the Capitola Mall, Rancho Del Mar in Aptos, and then back to Salinas. The total distance traveled round trip is 97.5 miles and takes approximately 3 hours to complete. Upon arrival to Salinas Tallow, the WVO is pretreated in a process that involves running the waste grease through a series of filters to remove solids, and heating the grease to evaporate off any moisture. If necessary, a third step could be performed that would reduce the amount of free fatty acids, but to date this process has not been necessary for Fryer to Fuel waste grease.

A. Quantity of fryer oil collected/time period

No restaurants were added during the two-months to ensure constant data representative of a consistent collection program. However, Salinas Tallow has indicated that WVO generation in Santa Cruz is somewhat seasonal. For instance, tourism is high in the summertime, and therefore WVO generation is high. In contrast, fewer students are at UCSC for the summer, so WVO generation is lower. Since the Fryer to Fuel data was collected in the spring, it

should be representative of an average collection volume. Table 8 below summarizes the quantity of waste grease collected during the 8-week data collection phase.

Data collection was zeroed out (all bins were emptied) on April 3rd 2008. On April 10th, 1,680 gallons were collected. Later, on April 24th, 2,606 gallons were collected. On May 8th, an additional 2,014 gallons were collected. Then on May 15th, 1,426 gallons were collected, and 922 on gallons May 22nd, and 1,299 on May 29th for a total of 9,947 gallons or 76,592 pounds of waste grease. April 10th was the largest single collection point during the data phase. UCSC and the Santa Cruz Wharf are the largest contributors of waste grease to the program so this is most likely indicative of the high volumes of food consumed by students and tourists during spring break.

Table 8. Collection Summary and Yield Analysis

Date	4/3	4/10	4/17	4/24	5/1	5/8	5/15	5/22	5/29	Total
Individual Collection Events (gal)*	0	1680	*1303*	*1303*	*1007*	*1007*	1426	922	1299	
Aggregate (gal)	0	1680		4,286		6300	7726	8648	9947	**9,947**
F2F route yield (estimated)	*0*	*1344*	*1042*	*1042*	*806*	*806*	*1141*	*738*	*1039*	***7,958***
*NonF2F route yield (estimated)***	*0*	*1050*	*814*	*814*	*629*	*629*	*891*	*576*	*812*	***6,217***

* These were extrapolated to be make the data appear to be weekly collection events, although the collection was not always weekly. Some occurred after 9 days, some after 5 days, depending on whether the bins were filling up. The year of collection was 2008

** These data were taken were taken from separate routes to the Fryer to Fuel Program for comparison purposes**.**

To identify trends in the data two elements must be considered:

- UCSC has 7 kitchens feeding an undergraduate population of just about 15,000 students. The Fryer to fuel program collects all of the oil from these seven UCSC kitchens.

- Tourism spikes during the warmer months, increasing the number of patrons visiting local restaurants, and increasing the frequency of grease disposal.

Considering these trends, we would expect there to be lower volumes produced during the cooler months when school is in session and tourism is very low. We would expect a spike when the weather starts getting warmer, a dip slightly over the summer when school is out of session, and a spike again in late summer and into autumn when students return and tourism is still high. We would then expect generation to drop off as cool weather settles in. This leads to the conclusion that waste grease generation follows a periodic cycle with maximum production occurring in June and September.

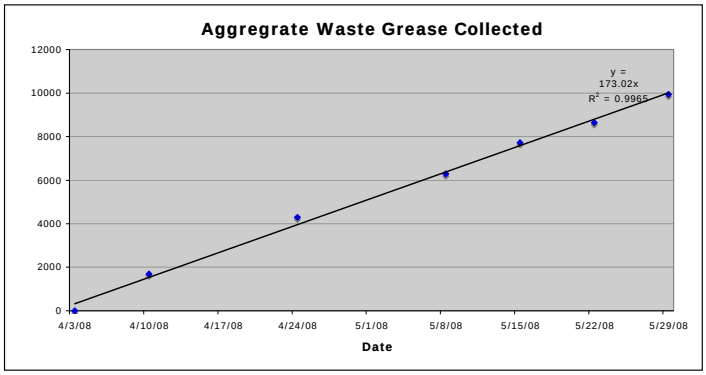

Figure 22. Aggregate Waste Grease Collected taken at weekly intervals. Amounts were reported in pounds and were converted using USDA commodity rate of 7.7 pounds per gallon.

Grease generation was expected to increase at a near constant rate throughout the data collection phase, but this is not what actually happened. There was a slight decline in the rate of collection over the 8-week period with each week alternating between higher and lower volumes. Figure 20 illustrates the rate of collection during the 8-week period. It should be noted that collection amounts corresponding to April 17th, April 24th, May 1st, and May 8th, were not actual collection amounts reported, but were data points extrapolated from aggregate waste grease amounts. Including the extrapolated points, the data indicate a downward trend, for which there are several explanations.

Based on these trends it can be concluded that waste grease production is varied during different times of the year. The total amount collected over an entire year would be needed to identify a representative average. Annual data would be sufficient to explain trends in some data and will be available in a follow up report due in July 2009.

Figure 21 below maps aggregate collection for the 8-week period. A regression analysis shows there was very little variation in the data with an R^2 of 0.9967. Using this regression, the average collection volume is 1,200 gallons per week.

It's worth noting that, if the final product is not blended with lower quality feedstocks, the increase in yield associated with fryer to fuel storage and handling procedures represents an increase in revenue of $4,500 using current yellow grease commodity prices of $0.34 per pound as noted by the USDA Department of Agricultural News Service[9]. Additionally, the lower FFAs in the Fryer to Fuel oil (<7%) eliminates a step that requires the use of sulfuric acid and generates a waste. The extra training and set up time required for the Fryer to Fuel program is a worthwhile endeavor to increase revenue, lower the cost of treatment, minimize waste, and prevent pollution.

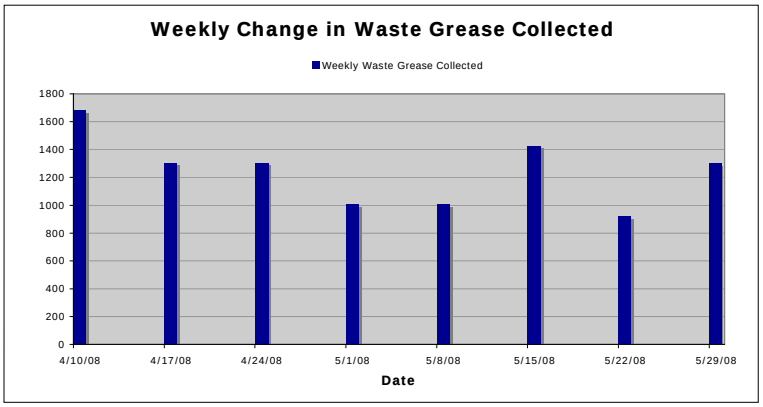

Figure 23. Weekly WVO Collection Quantities. Note that April 17, Aril 24, May 1, and May 8 were extrapolated from aggregate data and may not reflect actual collection amounts.

B. Quality of fryer oil collected

Grease yield is an important indicator of quality because lower yields signal that excessive solids and/or moisture are getting into the collection bins. This presents problems for many reasons. When waste grease is heated in the presence of water, a chemical process takes place called hydrolysis. This is where a normal triglyceride molecule, a.k.a waste grease, is broken down to produce a Free Fatty Acid (FFA) molecule and other bi-products. Both water and high concentrations of FFA's reduce the efficiency of the biodiesel production process (transesterification) and make waste grease an uneconomical substitute for other naturally derived oils. These oils do not have the same pretreatment requirements as waste grease. When produced from virgin form, biological oils, palm, soy, rapeseed, etc. have negligible moisture and solids.

Table 9. Spot Sample Quality Comparison

Quality Element	Fryer to Fuel	Non Fryer to Fuel
FFA (%)	6.7	8.2
Moisture (%)	0.4	Unavailable
Yield (%)	85	60

To ensure the Fryer to Fuel grease stays an attractive substitute to virgin oils, extensive quality control mechanisms were developed. In addition to the waste grease storage and handling procedures (*Appendix A*) other quality control techniques were employed. To reduce undesirable and prolonged heating, grease collection bins were positioned in areas with minimum sunlight. Ergonomic bins with lids were developed to keep out moisture. Additionally, to eliminate the duration of the oil in the bins, collection points were consolidated to allow more restaurants to use one bin so that it became full quicker and pickups could be done more frequently.

[9] United States Department of Agriculture, Missouri. Department of Ag Market News Service, St. Joseph, MO, www.ams.usda.gov/LSMarketNews

Waste Grease Quality Guidelines:

Free Fatty Acids are increased by prolonged exposure to heat and water. Therefore, a collection system should consider:

- Frequent collection (weekly). This can be done by consolidating bins and having more than one restaurant use a bin so that they fill up quicker.
- Position collection bins as to reduce or eliminate exposure to sunlight
- Design collection lids that are hinged and fitted as to disallow water and/or moisture from entering the container
- Use waste grease handling procedures (*Appendix A*) to train staff to keep out solids and brown grease.

To monitor (1) FFA's, (2) Moisture, and (3) Yield, periodic data points were taken during the data-gathering phase. Though not all data was obtained through the 8-week period, a spot sample was taken to compare Fryer to Fuel to non-Fryer to Fuel grease. Table 7 shows that a Fryer to Fuel grease can have as many as 22% less FFA's and yields can be up to 25% higher compared to regular grease, indicating a significant reduction in water content.

Table 10 FFA's versus Temperature

Date	4/3	5/8	5/15	5/22	5/29
F2F FFA(% of total by weight)		4.4	5.5	5.7	6.7
Non-F2F FFA(% of total by weight)		5.4	6.7	7.0	8.2
Change in Ave Daily Temp (1971-2000, Degrees)	0	3	4	5	5

Table 10 summarizes FFA content versus daily temperature averages taken between 1971 and 2000. Temperature was graphed taking the daily average for April 3rd as zero.

Figure 22 shows FFA of Fryer to Fuel grease and FFA of non-Fryer to Fuel grease versus temperature. As is expected, FFAs rise with temperature. Fryer to Fuel FFAs are significantly less than that of non Fryer to Fuel waste grease. However, data taken during this period must be supplemented by annual figures to fully support any conclusions mentioned.

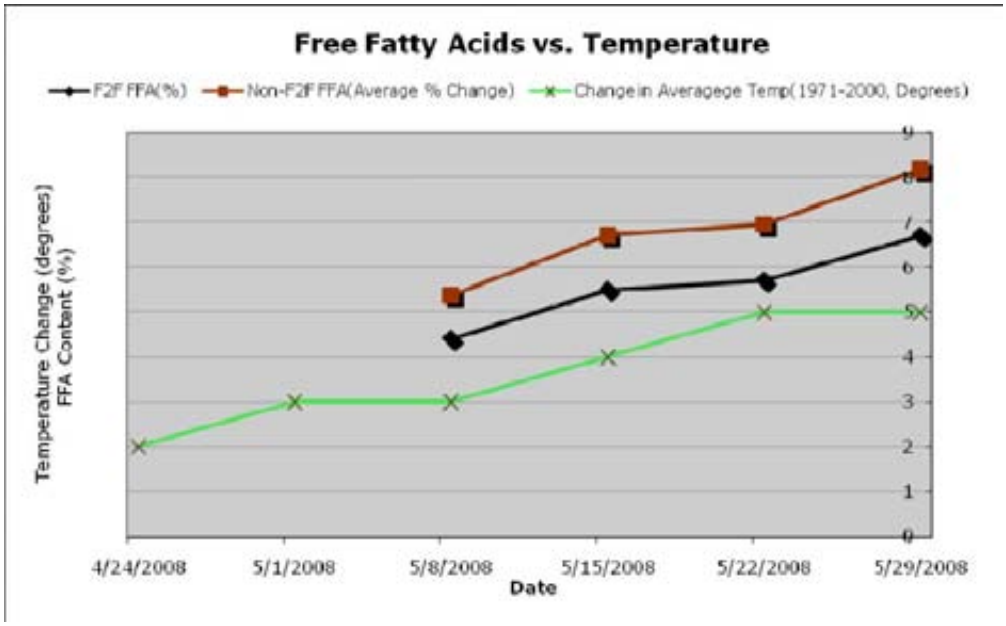

Figure 24. Figure depicts correlation between Free Fatty Acid Content (%) in WVO versus Average daily temperatures taken from 1971-2000 at the Santa Cruz Yacht Harbor (Source: National Weather Service)

C. Estimated Emissions Reductions

In addition to data on quality and quantity of waste vegetable oil collected, the project estimated tail pipe emissions reductions due to the utilization of biodeisel in three different ways. The first method used vehicle-specific data obtained from the City of Santa Cruz fleet maintenance database to estimate vehicle specific emissions reductions. The calculator for this method was the EPA Office of Transportation Air Quality Diesel Emission Quantifier found at http://cfpub.epa.gov/quantifier/view/welcome.cfm. The City of Santa Cruz staff estimated the second method. Proprietary software recommended by the National Association of Counties was used that calculated reductions based on similar information used in method 1. The third method estimated total reductions based on total volume of fuel produced and used, based on the National Biodiesel Board's emission calculator found at www.biodiesel.org/tools. The calculated emissions reductions for each method are presented individually below.

Method 1 – EPA Diesel Emission Quantifier

Vehicle specific data was obtained from the City of Santa Cruz Fleet Maintenance Office for all diesel powered vehicles and equipment fueled at the city's operation yard. This office and yard is responsible for all of the vehicles that utilize B20 fuel secured through the Fryer to Fuel program. Data from 169 vehicles or equipment was obtained. It was necessary to omit 85 of those vehicles because hours of operation and horsepower are not tracked in the fleet database. Additionally, off-road and stationary equipment such as generators, chippers, paving equipment, mowers, air compressors, and other maintenance and construction equipment was not included because specific run-time and horsepower are not typically tracked in the fleet maintenance system. Of the remaining 84 vehicles, 19 were omitted for reporting 0 miles driven during the past 12 months. Another 25 were omitted because of inaccurate data being reported for either the 12-month vehicle miles traveled (12MoVMT) or 12-month gallon (12MoGal) inputs required for the calculations. The remaining 50 vehicles were compartmentalized into 13

different types of vehicle technology profiles and entered into EPA Office of Transportation Air Quality Diesel Emission Quantifier found at http://cfpub.epa.gov/quantifier/view/welcome.cfm.

Table 11. City of Santa Cruz Vehicle Technology Profiles.

Type	Year	Qt	AveVMT	ProfileVMT	AveGal	ProfileGal
Aerial ladder	1991	1	7756	7756	268	268
School Bus	2006	8	8,361	66,888	1,429	11,432
Dump	1987	4	11,741	46,964	1,601	6,404
Fire Unit-aerial ladder	2005	2	267	534	48	96
Fire Unit-pumper	1994	2	2,627	5,254	1,337	2,674
Flat bed, dumping	1994	2	7,037	14,074	1,644	3,288
Four wheel mechanical sweeper	1996	1	1,245	1,245	127	127
Mobile unit-library	1998	1	3,288	3,288	1,251	1,251
Refuse Compactor (front, side, read loading)	2006	21	6334	133,005	2983	62,652
Tractor with fifth wheel	1997	2	9,683	19,366	3,759	7,518
Utility	2003	3	4,350	13,050	1,073	3,219
Four wheel vacuum sweeper, with broom(s)	2002	1	360	360	182	182
Van	2000	2	937	1,608	402	804

In total 99,507 gallons of fuel were used to travel 313,654 miles in a year. According to the EPA Diesel Emission Quantifier, this would result in an annual decrease in particulate matter by 0.19 tons, hydrocarbons by 0.78 tons, carbon monoxide by 2.1 tons, carbon dioxide by 241.19 tons, and an annual increase in NOx emissions by 2.49 tons.

Method 2 – City of Santa Cruz Estimates

City of Santa Cruz staff used a software package from the International Council for Local Environmental Initiatives to estimate vehicle emissions reductions, based on all vehicles fueling at the City Corporation yard – additional information available at http://www.iclei.org/). Vehicles used in this estimate include the City of Santa Cruz Schools bus and van fleet and all heavy equipment fueling at the Corporation Yard. Stationary equipment, such as generators, agricultural, and forestry equipment were not included in the estimates because biodiesel blends were not used in most stationary equipment. The following is an excerpt from a City press release:

> "The City of Santa Cruz switched our diesel-fueled City fleet vehicles and heavy equipment to B-20 biodiesel in July 2007…The diesel trucks and equipment at the City Resource Recovery Facility have already been using biodiesel for several years. Now all City diesel vehicles, including refuse and recycling trucks, fire engines, wastewater vactor trucks, dump trucks, and heavy equipment such as backhoes, excavators, loaders, bulldozers and landfill compactors are operating on B-20. In addition to City of Santa Cruz diesel vehicles, the Santa Cruz City School District school buses fuel at the City's Corporation Yard, so they are also now using B-20 biodiesel.
>
> … In the eight months between July 2007 and March 2008, the City's diesel fleet used 105,600 gallons of B-20 biodiesel. The Santa Cruz City Schools buses used an additional 5,300 gallons, for a total of 110,900 gallons of B-20. The use of B-20 biodiesel during that eight-month period resulted in a reduction in GHG emissions of 247 tons of CO2 ... Since the City uses ultra-low sulfur diesel in our B-20 blend, a much cleaner-burning fuel, we have greatly reduced diesel particulate emissions and other air pollutants, such as nitrous oxide, in addition to greenhouse gas emissions."

Method 3 – Fryer to Fuel Program-wide emission reductions

The third method used to calculate emissions reductions as a result of the Fryer to Fuel program, was the National Biodiesel Board's calculator found at www.biodiesel.org/tools. The total amount of biodiesel produced under the Fryer to Fuel Program was entered into the calculator. This calculator uses existing EPA sources to calculate average emission reductions and does not take vehicle specifics into account[10]. A total of 31,830 gallons of fuel was entered at a 20% biodiesel blend (B20). The average reductions amount to 40.76 pounds of particulate matter, 53.41 pounds of hydrocarbons, 452.52 pounds of carbon monoxide, 94.93 of nitrous oxides, and 102,626 pounds of carbon dioxide.

Discussion

Each of the three methods used to calculate emission reductions has their advantages and drawbacks.
The data resolution for each method decreases as the emission source gets less specific. Results using method 1 provide the most complete picture of emissions because the data is taken from each specific vehicle type or technology profile. This means that if emissions profiles were generated for each individual vehicle, these results would be more accurate than those from method 3. This also means that, while method 3 provides us with a general picture, the data point is many degrees away from the individual vehicles, thereby lessening the accuracy of the results. A disadvantage to accurate reporting is that accurate records must be kept. Emissions results will only be made more accurate by improved fleet maintenance tracking systems. As human error is reduced, more variables are tracked, and costs are kept low, emissions data will be improved.

Further discrepancies are inherent in these results due to the lack of data on biodiesel made from waste grease feedstocks. There is anecdotal evidence to suggest lifecycle emission from waste grease biodiesel is far less than lifecycle emissions from virgin biodiesel. This is because transportation is largely eliminated. At its highest point during the two month collection phase, the Fryer to Fuel Program collected 1,600 gallons of waste grease by driving less than 120 miles. Each trip has the ability to collect up to 3,000 gallons of waste grease, which is only limited by the amount of participants in the collection program. Using a biodiesel blend to fuel waste grease collection trucks further reduces lifecycle emissions. In comparison, most soy crops originate in the Midwest. Significant energy is required to grow and process the crops, and then transport the oil to the West Coast.

At the time writing, no calculators were available specifying waste grease as a biodiesel feedstock. Therefore, any estimated reductions in emissions are expected to be higher, from a lifecycle perspective. If any calculators did exist they must necessarily take into account the geographic range of collection, as a larger range might decrease the carbon efficiency of a collection program.

In addition to the lack of quantifiers for the locality, or sustainability of a waste to fuel program, such as the Fryer to Fuel Program, there are significant discrepancies in the change in NOx emissions when comparing biodiesel to petrodiesel. Method 1 demonstrated an increase in NOx emissions, whereas Method 3 demonstrated a decrease. Subsequent NREL testing of biodiesel blends from B5 to B50 show decreases in NOx emissions when using biodiesel in longer time-weighted averages and on engines tested in the vehicle rather than on a lab bench. Results from these latest studies indicate a 5% reduction in NOx emissions when using B20, as opposed to the 2% increase reported by the EPA. Results from these tests indicate that at the very least, the jury is still out on whether biodiesel use actually affects NOx emissions. However, the results could infer that NOx emissions remain neutral when using a B20 blend of biodiesel.[11]

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[10] Calculator is available at http://www.biodiesel.org/tools/calculator/default.aspx. C02 reductions are calculated as 78% less than regular diesel over the life cycle of the fuel.

[11] NREL *Effects of Biodiesel Blends on Vehicle Emissions* http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/40554.pdf

D. New Diesel Emissions Standards

New Diesel Emissions Standards that are promulgated by the U.S. EPA and enforced by the California Air Resources Board (CARB) dictate certain reductions in diesel emissions for specific vehicle types. These new regulations are significant motivators toward using biodiesel, as particulate matter and carbon dioxide can both be significantly reduced, thus assisting fleet managers to meet the new standards.

In 1998, California identified diesel exhaust particulate matter (PM) as a toxic air contaminant based on its potential to cause cancer, premature death, and other health problems. Diesel engines also contribute to California's fine particulate matter (PM 2.5) air quality problems. Those most vulnerable are children whose lungs are still developing and the elderly who may have other serious health problems.

As a result, in January of 2001, the U.S. EPA promulgated a Final Rule to reduce emission standards for 2007 and subsequent model year heavy-duty diesel engines (66 FR 5002, January 18, 2001). These emission standards represent a 90 percent reduction of oxides of nitrogen emissions, 72 percent reduction of non-methane hydrocarbon emissions, and 90 percent reduction of particulate matter emissions compared to the 2004 model year emission standards[12].

The Rule for On-Road Heavy-Duty Diesel-Fueled Public and Utility Fleets is one of the California Air Resources Board's efforts to reduce both criteria pollutant emissions and exposure to toxic air contaminants. The rule mandates Public Agency and utility vehicle owners reduce diesel PM emissions from their affected vehicles through the application of Best Available Control Technology or BACT on these vehicles by specified implementation dates. Implementation is phased-in by engine model year groups[i].

On July 26, 2007, the Air Resources Board (ARB) adopted a regulation to reduce diesel particulate matter (PM) and oxides of nitrogen (NOx) emissions from in-use (existing) off-road heavy-duty diesel vehicles in California. Such vehicles are used in construction, mining, and industrial operations. California's solid waste collection vehicle rule was also passed in September 2003 to reduce the harmful health impacts of exhaust from diesel-fueled waste collection trucks. The solid waste collection vehicle regulation (SWCV) will reduce cancer-causing particulate matter and smog-forming nitrogen oxide emissions from these trucks by requiring owners to use ARB verified control technology that best reduces emissions, following a phased-in schedule from 2004 through 2010[13].

The Air Resources Board (ARB) staff is developing a regulation to reduce diesel particulate matter (PM) and other emissions from in-use heavy-duty diesel powered vehicles operating in California. A proposed regulation is planned to be presented to the Air Resources Board in October 2008. The proposed regulation would apply to diesel shuttle buses, vehicles greater than 14,000 pounds Gross Vehicle Weight Rating (GVWR), and does not include pickups[14].

Software and software upgrades are available to reduce NOx emissions. The low NOx software upgrade is computer programming for electronic control modules, and is available for certain heavy-duty engines that reduce excess emissions of oxides of nitrogen (NOx). Owners of most 1993-1998 model year California registered heavy-duty trucks, school buses, and motor homes, and interstate vehicles that visit California, with engines manufactured by Caterpillar, Cummins, Detroit Diesel Corporation, Mack/Renault, Volvo and International can reduce the emissions of their vehicles by having low NOx software installed. When installed, the low NOx software reduces NOx, a component of smog that acts as a precursor for ozone, and can damage lungs. Fleet managers with older (1993-1998) vehicles that do not have the chip are encouraged to install the low NOx software[15]. Several problems arose from using biodiesel with this software, as it was only able to tolerate a biodiesel blend of B5 (5%). The

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12 California Air Resources Board, On-Road Heavy-Duty Diesel Engine Reduced Emission Standard, available at http://www.arb.ca.gov/diesel/mobile.htm, Accessed on June 5th, 2008

13 California Air Resources Board, CARB Off Road heavy duty diesel standards (existing) and Solid Waste Collection Vehicle Rule, available at http://www.arb.ca.gov/diesel/mobile.htm, Accessed on June 5th, 2008.

14 California Air Resources Board, On Road heavy duty diesel standards, available at http://www.arb.ca.gov/diesel/mobile.htm, Accessed on June 5th, 2008

15 California Air Resources Board, CARB Software Upgrade for Diesel Trucks, information available at http://www.arb.ca.gov/diesel/mobile.htm, Accessed on June 5th, 2008.

software can be changed to tolerate B20 or even B50. Public agencies are encouraged to ensure that the chip in their vehicle is able to tolerate the higher blends of biodiesel, such as B20 and B50. At times, emissions of NOx from using biodiesel can be higher and/or lower than conventional No. 2 diesel. It has been demonstrated that there is marginally higher emissions of NOx from using blends of biodiesel, but these are very little increases in blends under B50, and devices are available to reduce the NOx in higher blends. Some University of California campuses are using biodiesel at various blends; for example UCI uses B100 with a device that results in lower NOx[16]. The National Renewable Energy Laboratory (NREL) is measuring the extent of the NO_x emissions increase in fully modern engines, and is working to develop fuel formulation, fuel additive, and engine operational strategies to eliminate NOx increases as a result of using biodiesel[17].

[16] Environmental Financial Center – Region 9, Biodiesel Roundtable 2008 Story 26, pg.21
[17] National Renewable Energy Lab, Maximizing Environmental Benefits: Reducing NOx

VI. Looking Forward

A. Leverage Resources to Reduce Costs of Fryer to Fuel Diesel to Public Fleets

During the course of this program, it became apparent that the commercial entities that had established themselves around the program could realize significant benefits from Fryer to Fuel coordination, directly affecting their profits. It seems that if public agencies took over the concerted coordination of waste vegetable oil collection from restaurants, that they should receive benefits for doing so, whether it's a discount in fuel for their public fleets, or funding to coordinate the program. There was no benefit received to public agencies, other than improving environmental performance.

It would be extremely advantageous for a liquid waste hauler, like Salinas Tallow, to conduct an organized coordination of restaurants to improve the quality and the quantity of the waste vegetable oil collected. Since typical liquid waste haulers have based their success on customer service, they were reluctant to tell their customers what to do. However, staff at EA have experienced that restaurants were very receptive to the additional work required to implement BMPs, provided they were getting recognition for it. It seems that a company like Salinas Tallow would want to use the Fryer to Fuel program to continue increasing the quantity and quality of the WVO collected, as a good business practice, and would want to provide recognition and incentives to participating restaurants.

B. Provide Financial Incentives for Participating Kitchens

WVO values have changed dramatically over the past few years. Yellow grease (<15%FFA) and white grease (<4%FFA) prices rose dramatically at the end of 2006 and throughout 2007 (See figure 10). The effect of this has caused the biodiesel producers to increasingly focus their resources on securing more feedstocks. For renderers like Salinas Tallow, this meant that collection of yellow and white grease from local restaurants became a more lucrative business. The incentive that Salinas Tallow needs to encourage restaurants to adequately segregate the different types of restaurant grease is monetary. Now that it has become very lucrative to trade white grease, Salinas Tallow will likely start paying restaurants for this commodity. This would maintain their sense of customer service, and motive the extra effort required in the BMPs on the part of the restaurant.

C. Explore Brown Grease as Possible Feedstock- Goslyn

There is new technology allowing for the collection of grease after it goes down the sewer drain that separates it from solids and water before it fouls, making it more like yellow grease than brown grease. One such unit is dubbed the Goslyn.

San Francisco recently received funding to install many of these units in City restaurants. The California Energy Commission (CEC) granted $1 million to the San Francisco Public Utilities Commission (SFPUC) to build the City's first pilot grease-to-biodiesel production facility. The CEC is looking closely at this and similar projects to help cover California's anticipated one billion-gallon shortfall of biodiesel by 2022. The shortfall is anticipated even with a growing number of yellow grease recycling programs like the *SFGreasecycle*, which the City launched in November 2007 to collect yellow grease from restaurants to fuel City vehicles, buses and fire trucks. The SFPUC, which manages the *SFGreasecycle* program, will also manage the brown grease pilot project. The construction of the brown grease biodiesel facility should be complete in December 2008. [18]

[18] City and County of San Francisco, Office of the Mayor Press Release, Thursday May 29th, San Francisco Receives $1 Million State Grant to Build City's First Grease-to-biodiesel Facility.

D. Expand Program to Tri-County Area

Although EA only coordinated with 31 restaurants, the quantity and quality of WVO was extremely high. Therefore, during a two-month period, the amount of WVO collected from Fryer to Fuel participants was half of all of the viable feedstock collected in the entire region served by Salinas Tallow (Santa Cruz and Monterey Counties). If the Fryer to Fuel program were able to expand into Monterey and San Benito Counties, as well as additional areas in Watsonville, there would be significant gains in the amount of WVO collected to be used as biodiesel feedstock. Initial survey data (see page 27) as well as an NREL study suggest that there should be over 200,000 gallons of WVO to collect in Santa Cruz County alone. Since San Benito and Monterey Counties are somewhat similar in demographics, there could be over 600,000 gallons of WVO that could be utilized for biodiesel feedstock, should proper BMPs and coordination be instituted throughout the tri-County area.

Monterey has already expressed a great deal of interest in the program. On May 12th, 2008, EA staff met with several people from the several cities in Monterey County, the County itself, the University, and other utilities in Monterey County to explain the program and educate on biodiesel use in public fleets. Staff from the City of Los Angeles Bureau of Sanitation also called to inquire about the program, and were provided with material.

E. Promote the Program Widely

The Fryer to Fuel program will be shared widely with other jurisdictions, utilizing this report. A presentation was made to a neighboring jurisdiction: the City and the County of Monterey. Several telephone discussions with the City of Los Bureau of Sanitation have explained the program. This report, as well as the program budget has been shared with staff from the District. EA staff intend to present the program the Western Regional Pollution Prevention Conference in Monterey in October 2008.

F. Follow-up Report

A follow-up report will be provided to the EPA and partners by July 31st, 2009. Due to the grant cycle closure before full collection benefits can be measured and overall importance of quality data in program reproduction, Ecology Action will provide, at their cost, an updated document thirteen months from completion of the pilot. This document will provide data relevant to a suburban "Fryer to Fuel" collection program for the one-year period following the pilot. Metrics will include: qualitative and quantitative measurements of grease supply, any changes to the program, number of restaurants enrolled, and any increases in the use of biodiesel by public agencies. This report will include a satisfaction survey as well.

VII. Conclusion

Guide to Start a Fryer to Fuel Program

Throughout the United States, there are jurisdictions similar to Santa Cruz that could achieve a local and sustainable waste to fuel economy. Based on our local experience, we suggest that the winning formula for being able to effectively coordinate a Fryer to Fuel program in other areas of the Country is:

A commercial biodiesel plant within 200 miles (ideally),
Liquid waste hauler(s) servicing local restaurants with vacuum trucks and bulk containers,
Local pretreatment or environmental compliance inspectors regulating fats, oils, and grease from restaurants (typically in a wastewater or sewer agency),
Public works, waste franchise, commercial, and/or school district fleets using diesel, who are willing to trial biodiesel and lastly
Economic development, planning, environmental and/or sustainability professionals within the public domain to motivate, provide leadership, and oversee the program.

Program Benefits

The main benefits of starting a Fryer to Fuel program are typically realized by the commercial entities that are benefiting from it and the local public officials that are attempting to improve environmental performance, promote sustainability, promote green technology sectors, and develop local, sustainable economies. This program did not realize any cost savings in biodiesel fuel to public partners. However, several other benefits were realized whose value surpasses a small discount in fuel price. It is best to regard the resulting biodiesel as a positive environmental offset, rather than seeking substantially lower purchasing price for biodiesel, although the cost benefit will fluctuate with changes in energy, petroleum and program infrastructure changes. However, in the near future, it is worth exploring a public/private partnership whereby the public implements certain controls outlined in this report to achieve higher quality and quantity of waste vegetable oil collected, and in return obtain a discounted fuel price.

In the three years that Ecology Action has been developing and coordinating the fryer to fuel program, an innovative local fuel economy has developed in tandem. In three short years a local market developed that created new businesses and jobs (in the case of EASi), enhanced long-time local businesses (in the case of Salinas Tallow, which is showing significant growth), and utilized existing distributors for infrastructure (in the case of Coast Oil). Several commercial fleets began using various biodiesel blends during that time period, including: Greenwaste Recovery, the solid waste franchise hauler for Santa Cruz County, Couch Distributors, a large trucking company, Salinas Tallow, and Coast Oil, to name a few. Ecology Action was fortunate to have joined the local biodiesel economy at a time when it was moving at a fast pace, but needed technical assistance and partnership in certain problem areas, such as ensuring high quality and quantity of the WVO collected from restaurants. Considering the increase in biodiesel demand and the diverse set of users who would be forced to source their biodiesel elsewhere, it is key, from an economic development standpoint, to consider allowing rapid and efficient commercial market development in this arena.

Restaurants are currently able to have their waste fryer oil removed for free. Previously, disposing of this waste cost money and was being used to blend with grain for protein enhancement for animal feed, or shipped overseas. Now, because of changes in the fuel and grease markets, this waste is being better utilized as a local feedstock for biodiesel. Before the Fryer to Fuel Program, Salinas Tallow was able to use 60% of the fryer oil collected as a feedstock for biodiesel. After the Fryer to Fuel Program, Salinas Tallow was yielding more than 80% of the fryer oil collected. Also, FFA content came down from 8-9% to 5-7% during the program. FFA must be below 7% for EASi to accept the fryer oil, and in order for it to be a viable feedstock to produce biodiesel. Previously, the fryer oil would require significant treatment to reduce FFAs to meet the specifications. The oil collected from the Fryer

to Fuel program did not need treatment for FFAs. By skipping this treatment step, less chemicals and energy are used.

Although Ecology Action only coordinated with 31 restaurants, the quantity and quality of WVO was uncharacteristically high. During a two-month period, the amount of WVO collected from Fryer to Fuel participants was half of all of the viable feedstock collected in the entire region served by Salinas Tallow (Santa Cruz and Monterey Counties). It is estimated that the Fryer to Fuel Program has tapped less than 1% of the restaurants in the Monterey Bay Area that produce WVO. Therefore, there is significant potential for further improving the quality and quantity of fryer oil collected from restaurants.

Air Emissions Reductions

New Diesel Emissions Standards that are promulgated by the U.S. EPA and enforced by the California Air Resources Board (CARB) dictate certain reductions in diesel emissions for specific vehicle types. These new regulations are significant motivators toward using biodiesel, as particulate matter and carbon dioxide can both be significantly reduced, thus assisting fleet managers to meet the new standards.

Three methodologies were used to calculate diesel emissions reductions as a result of the biodiesel produced by the Fryer to Fuel partners. One such method was the National Biodiesel Board's calculator found at www.biodiesel.org/tools. This method was capable of calculating average emissions reductions from the entire Fryer to Fuel program. Using this tool, the total amount of biodiesel produced under the Fryer to Fuel Program was entered into the calculator. This calculator uses existing EPA sources to calculate average emission reductions and does not take vehicle specifics into account[19]. A total of 31,830 gallons of fuel was entered at a 20% biodiesel blend (B20). The average reductions amount to 40.76 pounds of particulate matter, 53.41 pounds of hydrocarbons, 452.52 pounds of carbon monoxide, 94.93 pounds of nitrous oxides, and 102,626 pounds of carbon dioxide.

There is no calculator, currently, to estimate the life cycle savings of producing biodiesel from WVO compared to using virgin oils. In January 2008, the Environmental Research Web published a report by EMPA in Switzerland that assessed the life-cycles of multiple biofuels. The study determined that biodiesel made from WVO, as well as ethanol derived from manure, had the lowest impact on the environment. Brazilian soy-based diesel, on the other hand, had greater aggregate environmental costs than fossil fuels. A recent article in Science that analyzed the EMPA report concluded that subsidies and tax benefits that go to farmers for soy and corn may be misplaced because these are not desirable feedstocks from a life cycle perspective. Several recent media headlines have reported that biofuels are not the ideal solution for global warming, but the supportive research did not analyze the use of local feedstock, a critical factor in assessment.

Sustainability

Almost all of the inputs and outputs of this program were concentrated in an area no more than 120 miles round trip: a local feedstock was utilized, local hauler transported the grease, a local biodiesel production plant made the fuel, a local fuel distributor delivered the fuel, local public agencies used the fuel to power their fleets. However, considering the locality of program, the scale was large enough to make the program commercially feasible, while also preserving quality, quality assurance and quality control (QA/QC), permitting, and regulatory requirements of locally produced biodiesel.

The locality also makes the program much more sustainable than the alternative. In addition to the well known environmental benefits from biodiesel use, such as reduced carbon footprint, reduced regulated emissions, improved engine life, etc.; a local waste grease to fuel economy will achieve more significant life cycle emission reductions. Most biodiesel generated from virgin oils is done so by utilizing soy oil. In comparison to local waste feedstock, most soy crops originate in the Midwest. Significant energy is required to farm the crops, process the crops for oil, and then transport the oil to the West Coast. Transporting feedstock oil from the Midwest is

[19] Calculator is available at http://www.biodiesel.org/tools/calculator/default.aspx. C02 reductions are calculated as 78% less than regular diesel over the life cycle of the fuel.

eliminated in a local waste grease to fuel model, and waste grease that once would be sold on the open market is now kept locally. The locality of the program makes it extremely sustainable, with very little transportation involved, and indicates the possibility and the likelihood of several such hubs throughout the State of California and beyond.

Appendix A. Fryer to Fuel Best Management Practices (English/Spanish)

Fryer to Fuel

COLLECTION PROGRAM

The Fryer to Fuel (F2F) collection program is a FREE weekly service provided to restaurants throughout Santa Cruz County. The program was developed in collaboration with environmental agencies, food service industry and liquid waste haulers with funding from the United States EPA Urban Biofuels Initiative. Collection of used fryer oil for biodiesel production offers many benefits to the community including: improved water quality, reduced fossil fuel use, economic opportunity, and free grease disposal for restaurants.

1 ASIDE FROM FREE OIL COLLECTION, WHAT ARE THE OTHER BENEFITS TO MY BUSINESS?

With enrollment in the F2F collection program, your kitchen will be publicized in local newspapers, will be able to use F2F logos highlighting your kitchen to fuel commitment, and satisfy a significant portion of the Monterey Bay Area Green Business Program criteria.

2 FRYER OIL MAINTENANCE AND STORAGE:

F2F program and partners will provide your kitchen or facility with free exterior grease storage containers. These containers have lockable lids and angled screens for solids removal. Containers and free collection will be provided as long as handling and storage requirements are met.

3 EXTERIOR STORAGE

In addition to segregating waste fryer oil from other wastes in the restaurant, be careful when emptying oil into the exterior storage container. Please do not contaminate surrounding areas with grease spillage. In the City and County of Santa Cruz, it is illegal to pour waste grease or brown grease from grease traps down the drain.

4 AS A PROGRAM ENROLLEE, YOUR KITCHEN MUST KEEP FRYER OIL SEPARATE

from other oils used and follow specific guidelines outlined below.

- ONLY WASTE FRYER OIL is to be discarded in the container
- Always keep container lid closed and locked
- Do not allow excessive water, moisture, or solids to get in the exterior grease storage
- Train all kitchen staff in storage requirements for the F2F collection program
- Use a container with lid for transporting fryer oil to exterior storage and pour grease slowly and cautiously to minimize spillage.

5 COLLECTION

The F2F collection program works closely with tallow haulers to make collection as seamless as possible. Waste grease will be collected on dedicated routes. This means that if waste fryer oil from one kitchen is contaminated, it could contaminate the entire load. Collection schedule will be established during the application process.

Fryer to Fuel Collection Program

Programa de recolección de aceite de la sartén para convertirlo en biodiesel

El programa de recolección de aceite de sartén para convertirlo en biodiesel (Fryer to Fuel - F2F-) es un servicio semanal GRATUITO, proporcionado a los restaurantes del condado de Santa Cruz. El programa, desarrollado en colaboración con las agencias medioambientales, la industria de servicios alimentarios y los transportadores de desechos líquidos, ha sido financiado por la EPA Urban Biofuel Initiative de los Estados Unidos. La recolección de aceite de cocina usado para la producción de biodiesel ofrece muchas ventajas a la comunidad que incluyen: una mejor calidad del agua, una disminución del uso de combustibles fósiles, oportunidades económicas y servicio gratuito de desecho de basura para los restaurantes.

1 ¿ADEMÁS DE LA RECOLECCIÓN GRATUITA DEL ACEITE, CUÁLES SON LAS OTRAS VENTAJAS PARA MI NEGOCIO?

Con la inscripción en el programa de recolección "F2F", su restaurante aparecerá publicado en los periódicos locales, usted podrá utilizar los logos de "F2F" que destacan el compromiso de su restaurante con el uso de combustibles alternativos y podrá satisfacer una porción significativa de los criterios del programa de negocios verdes del área de la bahía de Monterey o "Monterey Bay Area Green Business Program".

2 MANTENIMIENTO Y ALMACENAJE DEL ACEITE DE SARTÉN:

El programa y los socios de "F2F" proveerá gratuitamente a su cocina o negocio los envases para el almacenaje externo de grasa. Estos envases tienen tapas bloqueables y rejillas en ángulo para la extracción de sólidos. Los envases y la recolección gratuita serán proporcionados mientras se cumpla con los requisitos de manejo y almacenaje.

3 ALMACENAJE EXTERNO

Además de separar el aceite de sartén de otros desechos del restaurante, tenga cuidado al vaciar el aceite al envase de almacenaje externo. Por favor, no contamine los alrededores con derramamiento de grasa. En la ciudad y en el condado de Santa Cruz, es ilegal verter grasa desechable o grasa marrón de las rejillas por los drenajes.

4 COMO MIEMBRO DEL PROGRAMA, SU COCINA DEBE MANTENER EL ACEITE DE SARTÉN SEPARADO de otras grasas que se usen y seguir las pautas específicas resumidas a continuación:

- SOLAMENTE EL ACEITE DESECHABLE DE SARTÉN debe ser vertido en el envase mantener
- siempre la tapa del envase cerrada y bloqueada
- no permitir que exceso de agua, de humedad o de sólidos se introduzca en el envase externo de grasa
- entrenar a todo el personal de cocina en los requisitos de almacenaje para el programa de recolección "F2F"
- utilizar un envase con tapa para transportar el aceite de sartén al almacenaje externo y verter la grasa lentamente y con cuidado para reducir al mínimo la posibilidad de derramamiento.

5 RECOLECCIÓN

El programa "F2F" colabora estrechamente con los transportadores de grasa para lograr que la recolección se haga, en lo posible, sin problemas. La grasa será recogida en las rutas designadas. Esto significa que si el aceite de sartén de una cocina sale contaminado, podría contaminar la carga entera. El horario de la recolección será establecido durante el proceso de solicitud.

Fryer to Fuel Collection Program

Appendix B. Fryer to Fuel Poster (English/Spanish)

6 pasos para convertir el aceite de sartén en biodiesel

Mantenimiento y almacenaje de grasas desechables

Paso 1

SOLAMENTE GRASA DE SARTEN en el contenedor:

Grasa de sartén OK

Ningún desecho de grasa de la estufa

Nada de desechos sólidos de la rejilla

Paso 2

Mantenga siempre la tapa del envase de almacenaje cerrada y bloqueada.

Paso 3

Cerciórese de que el aceite no contenga sólidos. Si es necesario, desengrase la sartén.

Paso 4

Transporte siempre el aceite de sartén en un envase con tapa.

Paso 5

Nunca contamine la grasa de la sartén con exceso de humedad o con sólidos.

Paso 6

Nunca contamine los contenedores externos con derramamiento de grasa.
Si ocurre un derramamiento, límpielo inmediatamente con trapos.

Si necesita servicio de recolección de emergencia por favor póngase en contacto con Salinas Tallow en el número de teléfono: (800) 621-9000

Appendix C. Logo

Appendix D. Sample Press Release, Articles Written by the Press

Unites States EPA Press Release

United States
Environmental Protection
Agency

Regional Administrator
75 Hawthorne Street
San Francisco, CA 94105-3901

Arizona, California, Hawaii
Nevada, Guam, and
Pacific Territories

EPA Environmental News

For Immediate Release: xxxxx
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Santa Cruz "Fryer to Fuel" Reports First Successes on Community-Based Biodiesel Production

SAN FRANCISCO – With grant funding from the U.S. Environmental Protection Agency, Ecology Action, a Santa Cruz, California nonprofit, will be sharing the new results of the first community-based biodiesel production initiative in the United States at the Earth Day celebration on April 27, 2008

Biodiesel is a renewable fuel that reduces emissions of Green House Gases such as carbon monoxide, asthma causing particulate matter and acid rain forming sulfur dioxide and help reduce dependency on imports of fossil fuels.

Ecology Action, with support from the U.S. EPA, has created an economic sustainable market model for biodiesel derived from used cooking oil for local communities. This pilot is a partnership program spanning the whole process from post-consumer feedstock to the consumer of the fuel:

- Restaurants give their used fryer oil to grease haulers free of charge. The costs are now being paid by the biodiesel manufacturers.
- Biodiesel manufacturers use a low-cost, recycled waste feedstock instead of virgin vegetable oil, increasing the sustainability of biodiesel.
- The biodiesel produced in this initiative is used in equipment of the City and County of Santa Cruz Department of Public Works and the County's waste franchise Green Waste, Inc.

So far, Ecology Action has collected at least 5,500 gallons of high quality used cooking oil from restaurants, and continuing over the next year, will collect almost 47,000 gallons. That amount of used fryer oil when blended to make B20 (20% biodiesel), can fill the tanks of over 4000 City of Santa Cruz recycling trucks, or enough to fuel a fleet of school buses for the Santa Cruz school district for a year.

"We are excited to be simultaneously encouraging biodiesel production from post-consumer feedstock, reduced air pollution, and increased diversion of waste oils which could end up polluting Monterey Bay," said Tom Huetteman, Associate Director of Pollution Prevention and Strategic Partnerships at the Waste Division in EPA Region 9. "We hope this community-based project will be a model for other cities and counties across the country."

Ecology Action's Executive Director, Virginia Johnson, claims, "This program exemplifies the wide breadth of partnership and problem solving that Ecology Action has always endeavored to embrace. This project was a confluence of all of the Ecology Action hubs: Sustainable Transportation, Climate Protection, Pollution Prevention, Zero Waste, and Energy Efficiency."

Organizations interested in establishing their own urban waste to biodiesel initiative are welcome to contact Ecology Action or the U.S. EPA Region 9 with questions about developing their own successful and cost-effective environmental projects.
For more information go to: **http://www.epa.gov/region09/biodiesel/**

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Santa Cruz Sentinel:

EPA lauds fryer-to-fuel initiative

JONDI GUMZ - Sentinel staff writer
Santa Cruz Sentinel

Article Launched:

A project to convert cooking oil from local restaurants into biodiesel is filling the tanks of public and private fleets and earning praise from the federal Environmental Protection Agency.

The Fryer to Fuel initiative collected at least 5,500 gallons of "high-quality" waste cooking oil over the past six weeks and produced 22,000 gallons of biodiesel for local customers, according to Jo Fleming, coordinator of Monterey Bay Green Business.

Customers include Santa Cruz city and county public works departments, Green Waste, the company that holds the county contract for trash pickup, and Salinas Tallow, the firm that handles cooking oil pickups. Local restaurants that used to pay for waste oil pickups now give it away to Salinas Tallow, which sells it to the biodiesel manufacturer.

"We hope this community-based project will be a model ultimately replicated across the country," said Jeff Scott of the EPA.

Virginia Johnson, executive director of Ecology Action, which built the public-private partnership, said it exemplifies problem-solving in arenas such as sustainable transportation, climate protection, pollution prevention, zero waste and energy efficiency.

She will be among the speakers talking about the project at 1:40 p.m. Sunday during the Earth Day celebration at the corner of Lincoln and Cedar streets in downtown Santa Cruz.

Others include EPA representatives, the owners of Energy Alternative Solutions Inc. of Watsonville, and participating restaurants.

train service as an example of the compromise anti-train activists had made, and added that she would have liked to see more compromise on the part of the environmentalists.

"I'm not surprised the campaign will organize against it because they want everything their way," says Pirie, referring to Elerick's organization. "All the experts say an organized campaign against [a tax measure] can bring it down, and I believe it's true. Then none of us will have anything. No money for a train, no money for rail trail, no money for road repairs, and no money for buses."

Yes, whiskey. And make it a double.

Fa-la-la-la-loo

Ah, the holiday shopping season. Time to head downtown and spend the day shopping, eating and drinking—and holding it, unless you happen to be near Bookshop Santa Cruz, the only decent **PUBLIC RESTROOM** facility on the mall. It's tough to find a place to tinkle in this town. God help you should more serious business call.

It's an uncivilized state of affairs, in Nuz's view. But this time next year, public sanitation in Surf City could be much improved. After downtown merchants shot down the idea of a self-cleaning kiosk-style public restroom—nobody wanted what might have turned into a tiny little brothel or shooting gallery on the sidewalk in front of their business—city officials are taking a different approach and turning to the business owners themselves. **MARK DETTLE**, director of public works for the city, explained to Nuz that the latest idea, modeled on a program in Santa Barbara and other cities, is to offer a stipend or a break on city fees to any business owner who opens up a loo to John Q. Public. Signs would point mallgoers to these facilities, which would presumably be more pleasant than the rank city-run public toilets in the Soquel and Locust street garages.

JOHN LISCHER, owner of Artisans gallery in downtown Santa Cruz and a member of several city committees on public restrooms, is a big advocate of community restrooms downtown. "You can see where it would curtail commerce," he says, not to have any facilities at all.

But Lischer is leery of asking individual business owners to take on the cost and hassle of providing what he thinks should be a public service. "I think the community has a responsibility to install public restrooms," he says. "They should be in the public domain, so everyone shares the cost."

Lischer adds that public toilets take a beating. He points to Bookshop Santa Cruz, which he says "should be nominated for sainthood" for opening its restrooms to the public at great expense. (Nuz is inclined to agree.)

Vice-Mayor **RYAN COONERTY**, whose sister Sheila Coonerty now runs the family business, says between toilet paper, water, cleaning, visits by the plumber and vandalism, Bookshop Santa Cruz spends $40,000 to $50,000 a year keeping its restrooms open.

The city-run toilets also cost a pretty penny, says Dettle. People showering at the sink, stuffing things down the toilet, tearing out fixtures and worse all help boost the maintenance cost to $150,000 a year.

And still nobody wants to use them.

Will business owners want to sign up for this? Will people be shamed into good behavior if they have to traipse through somebody's shop to reach the can? Maybe. Nuz is pleased to learn that the city is not planning on relying solely on the stipend-for-privies plan, which is still in the exploratory phase. Coonerty says another part of the program is to start making sure establishments that serve food and drink—which are required to have restrooms—are making them available to their customers, if not the general public. And some sprucing up of the garage restrooms, possibly including video cameras outside to deter vandalism, is also on the list.

It's a subject that Coonerty, who officially becomes mayor this month, greets dutifully, if not joyously.

"For something that affects everybody, it's a tough problem to solve," he says, adding, "but I think we can make some progress on it."

Grease Is the Word

Who says there's no guilt-free eating? Ordering up a big basket of onion rings at Aldo's restaurant, or picking up a juicy piece of fried chicken glistening with grease from a UCSC dining hall tray, will help some in the community reduce their reliance on foreign oil. A growing fleet of vehicles in the county, from Budweiser delivery trucks to UCSC shuttles, are running on recycled deep-fryer oil coming from local restaurants. Restaurateurs and local environmentalists herald this recycling process as a great way to prevent overburdening of the sewer system while supporting an emerging enviro-friendly industry.

"It just makes sense with everything we're heading towards. We're trying to do the best environmental practices across the board," says **UCSC FOOD SERVICES** manager **CLINT JEFFRIES**, whose participation in this "fryer to

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NUZ <15

fuel" conversion process won his department a "green certification" award from the Santa Cruz City Council on Nov. 13. "We really want to do our part, and this is one more thing we can do. We're producing this oil anyhow, so we might as well turn it into a sustainable fuel source."

Upon hearing of this development, Nuz wondered what the trip was like for used frying oil making the journey from the fries pan to the gas tank of a diesel-powered car.

Nuz caught up with **JOSEPHINE FLEMING**, a contractor for Ecology Action working on expanding and improving "fryer to fuel" arrangements throughout the county. Fleming notes that while all grease should be kept out of the sewer system, it can't all realistically be made into biodiesel. Existing biofuel production technology can only handle oil coming from deep fryers, so UCSC Dining workers and those working at other participating restaurants are asked to put oil from these fryers into a different container than the one holding bacon grease, leftover oil from cooking pans and other excess fats and grease.

"That way we get better feed stock for biodiesel," says Fleming. "Research is occurring to develop technologies that could convert the other grease, known as 'brown grease,' to biofuels, but that isn't available now."

This unusable "brown grease" gets mixed in with animal feed, while the frying oil is picked up by **BILL OTTONE** and the rest of the gang at **SALINAS TALLOW** for free.

Salinas Tallow also picks up frying oil from Shadowbrook, Miramar, Stagnaro's and many other restaurants in Santa Cruz and San Luis Obispo counties, all free of charge. Once they get all the used fryer oil collected, Ottone and Co. recook it until the water and leftover bits of fried matter ("chitterlings," we believe they're called) settle and can be extracted from the oil.

"We basically remove the impurities," says Ottone.

After that, the cleaned-up oil is sent off to the **ENERGY ALTERNATIVE SOLUTIONS INC. (EASI)** production plant in Gonzalez, located not far south of Salinas. This is where Salinas Tallow finally gets paid for its services. Restaurants no longer have to pay for fryer oil pickup because Salinas Tallow makes so much money unloading the stuff on EASI.

Once in the hands of EASI workers, the oil is further refined through a process known as transesterification. Nuz understands this isn't the most user-friendly term, so we'll let EASI CEO **RICH GILLIS** explain.

"We use a catalyst and an alcohol to extract certain molecules out of the vegetable oil," he says. "These molecules are mostly free fatty acids and glycerol [a water-soluble sugar alcohol]. What's left is good vegetable oil that's clean so it doesn't clog the lines and other parts of diesel engines."

Once the biofuel is ready for sale, it goes to the San Jose–based biofuel distributor Coast Oil, which sells a portion of it back to, you guessed it, UCSC. UCSC then uses it to help power its fleet of shuttles. This circular arrangement is known in biofuel industry lingo as a "community-based closed loop."

Mama Nuz always used to say, "You reap what you sow."

Give Early, Give Often

Retail stores aren't the only ones that make up ground at this time of year. The holidays are crucial for **SECOND HARVEST FOOD BANK OF SANTA CRUZ AND SAN BENITO COUNTIES** as well. And a little can go a long way toward helping this organization meet its goal of 1.6 million pounds of food this year, as Nuz recently learned.

CHRISTINE WOODARD, development director for the organization, stresses that all donations are welcome. Canned vegetables, canned stews and all forms of canned protein, including peanut butter, are critical to the success of the food bank, which provides groceries to 1,200–1,500 area families per month as well as 160 member agencies like the Salvation Army.

But cash! Now there's a way to stretch your philanthropic dollar. Because of the food bank's incredible buying power—think of semis full of apples, potatoes or rice—$1 of donated cash can buy $9 worth of food. That's a 900 percent return on warm fuzzies, by Nuz's calculation.

The food bank could use the help. The holiday drive is always important—so far this year it has raised 450,000 pounds of food, or almost a third of the goal for the year—but donations are down slightly. Woodard attributes this to the fire in Southern California and the warm weather. "People start thinking about us with the first cold snap," she says.

Meanwhile, more people than ever are feeling the pinch of rising prices. "Gasoline costs put a whole new bracket of folks in need," she says, adding that big winter electric bills and even the rising cost of milk are hurting people. Recent regional layoffs are also intensifying the problem, she says.

"Today we have 50 people who were formerly employed with BirdsEye," she says. "A lot of them were employed for 20 years."

Donations may be dropped off at libraries, fire stations, Coast Commercial banks and Goodwill. Donate cash online at www.thefoodbank.org or by sending to 800 Ohlone Pkwy., Watsonville, 95076-7005.

Biofooled

Written by Chris J. Magyar

Wednesday, 23 January 2008

Biofuels: a cure worse than the disease?

Scientist David Fridley is currently the leader of a group from Lawrence Berkeley National Laboratory that's attempting to help China increase its energy efficiency and make better energy policies. He's also an outspoken opponent of biofuel as a large-scale alternative to gasoline. In a talk he's been giving to civic and cultural groups around the state, and which he's bringing to Santa Cruz on Thursday, Jan. 24, he says, "The hopes put on biofuels are way overstated. The reason that we are so addicted to petroleum is because of its basic characteristics: it's liquid, energy dense, and stable enough to be easily converted. Biomass needs to be converted to liquid form, does not have the same energy density, and requires much more energy to refine."

While the costs of shifting to a less-efficient fuel source are known—they are the reason gasoline was used so widely in the first place—Fridley argues that they outweigh the benefits, particularly in the case of corn ethanol, the most widely used biofuel in America. "We have 80 million acres under production for corn in this country," he says. "If we converted all of that to ethanol, it would only supply 12 percent of our current gasoline demand. To add acreage to get to 50 or 85 percent simply isn't possible. You have to ask the question: do you want fuel, or do you want food?"

Ray Newkirk is the co-founder and president of Pacific Biofuel, a Santa Cruz-based business that distributes biodiesel. He says the first goal should always be reduction of fuel consumption. "Higher fuel efficiency is available," he says. "Car manufacturers have been dragging their feet for 50 years. My father-in-law had vehicles during World War II that got 50 miles per gallon on alcohol." His main concentration at the moment is on replacing diesel, since those engines are already equipped to run biofuel.

Right now, Pacific gets its fuel from a refinery in Las Vegas, which produces both 20 percent and 100 percent biodiesel from a combination of soy and recycled food oil from casinos. Newkirk admits that this method of generating and distributing biofuel isn't ideal, but a mere step in the right direction. "The movement largely relies on getting the right type of feedstock, grown in the right manner on the right land: organic farming methods on marginal lands where food is not produced, using crops that don't require fertilizer." Pacific Biofuel ran a pilot program this year with local mustard seed producers, to explore the viability of generating fuel from that crop.

Most biofuel proponents point to Brazil as the world model of conversion. That country has mandated and subsidized biofuel to the extent that 80 percent of the cars on Brazilian roads are now capable of running on ethanol (mostly sugar-based), and air quality has dramatically improved as a result. However, activist groups such as the Rainforest Action Network have taken to labelling the Brazilian method 'agrofuel' instead of biofuel, as it requires propping up large, monocultured farms that intrude on rainforest habitat. Newkirk says, "We're staying very far away from foreign sources, not importing sugar cane from Brazil or palm oil from Malaysia or Indonesia that affect rainforests. We need to get away from that and turn it around. I'm very aware of all the problems in the biodiesel industry, and I'm still doing it for free, because I feel it does have a place in making our society sustainable."

But, as with so many other green technologies, the idea of scaling 'sustainable' up to 'replacement for how things work now' is the rub. Fridley often points out that the amount of energy used by fossil fuels in America exceeds the amount of energy captured from the sun by every plant in America, including the roots—not how much can be converted back out, but how much is absorbed in the first place. When looking at biofuels as an overnight solution to petroleum dependence, he argues, the math simply doesn't work.

David Fridley's free talk, "The Myths of Biofuels," takes place at 7 p.m. Thursday, Jan. 24, at the Louden Nelson Center, 301 Center St., Santa Cruz. For more information, call 425-0665 or visit peoplepowersc.org .

{mos_fb_discuss:2}

Register Pajaronian
‘Grease’ is the word for local company

Posted: Monday, Apr 28th, 2008
By ROGER SIDEMAN

SANTA CRUZ — Watsonville businessman Richard Gillis sees one answer to the energy crisis in the ordinary french fry.

Gillis is president of Energy Alternative Solutions Inc., a producer of biodiesel, one of only a handful of manufacturers of the fuel in California.

Biodiesel is made from refining vegetable oils or animal fats, and is usually mixed with petroleum diesel to form a cleaner-burning fuel that can be used in most diesel engines.

Gillis’ business model is simple: collect used fryer grease from restaurants, and take it to a rendering plant where it is converted to biodiesel, to be sold back to consumers.

Restaurants like Aptos Burger and several taquerias are on one end of the production line.

Customers of the fuel, a processed blend of 20 percent vegetable oil and 80 percent standard diesel fuel, called B20, include Santa Cruz city and county public works departments. They use it in fire trucks and other heavy vehicles.

Investors in the company include the federal government, in the form of a $75,000 grant funneled though Ecology Action, a Santa Cruz nonprofit that built a public-private partnership between the company and its customers.

The partnership is considered a pilot program for others to follow. It’s predicated on the belief that vegetable oil might someday prove a viable source of fuel.

“(Energy Alternative Solutions) serves as a model of a local experiment to achieve a clean energy future,” said Tom Huetteman of the federal Environmental Protection Agency, speaking Sunday at Earth Day festivities in Santa Cruz, where the company was recognized for its innovative partnership.

The EPA says that biodiesel is better for the environment than conventional diesel. Huetteman said that burning biodiesel in a car reduces climate change gases by half, acid producing sulfates by 99 percent, and limits particulate matter.

The company also partners with Salinas Tallow, the firm that handles cooking oil pickups, and Coast Oil, which sells the fuel from its pumps on Lee Road in Watsonville. Energy Alternative Solutions, with offices on Green Valley Road, produces the biodiesel at a plant in Gonzales, and is seeking to open another plant next to Coast Oil.

The company was lauded at the Earth Day event as a perfect example of a business that reflects dual desires: to protect the environment and build an economy around conservation and renewable energy. The company and its partners employ about 40 people, including drivers, refining technicians, researchers and accountants.

The original idea for the company was planted over five years ago when two of the company’s founders, Gillis and Bernie Weiss, were traveling on business and became stranded at an airport in Mexico following the 9/11 attacks. The two began discussing the U.S.’s dependence upon foreign oil at the risk of nation’s energy security and what could be done about it. For Gillis and Weiss, the answer was biodiesel.

Gillis, who formerly directed a small business program at Gilroy’s Gavilan College, said there are 1 million cars in California running on dirtier, old-fashioned diesel.

“If we can put a dent in that, I’d be very happy,” Gillis said.

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For more information, visit www.EASi.com.

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(Published in 4/28/08 edition)

Earth Day Fryer to Fuel Press Release

At 1:40pm on April 27th, at the Earth Day event located in downtown Santa Cruz on the corner of Lincoln and Cedar Streets (where the Farmers' Market is usually located), a new collaborative local program will be announced: the Fryer to Fuel Program. This program involves several public, commercial, and non-profit partners. The Fryer to Fuel program is a collaborative effort to collect used cooking oil from restaurants, turn it into biodiesel to fuel local Santa Cruz vehicle fleets. The program uses a local waste as a local fuel, and serves as a model of community-based sustainable solutions. Several speakers will be present to talk about their role in the program, including former Assemblyperson Fred Keeley, representatives from the Environmental Protection Agency, the Executive Director of Ecology Action, City of Santa Cruz staff, the owners of Energy Alternative Solutions, Coast Oil, Salinas Tallow, and some local restaurant owners.

Partnering with local restaurants, Salinas Tallow, BioEAS Inc, a biodiesel plant, Coast Oil, and local Public Works Departments, Ecology Action has collected at least 5,500 gallons of high quality waste cooking oil from restaurants and turned it into biodiesel which was then blended to make 22,000 gallons of B20 (20% biodiesel) fuel and sold to local fleets over the past six weeks. Continuing over the next year, this will result in almost 47,000 gallons of waste vegetable oil being used to make 190,000 gallons of the B20 biodiesel blend. This is enough fuel to fill the tanks of over 4000 City of Santa Cruz recycling trucks, or enough to fuel a fleet of school buses for an entire school district for a year. It is expected that more restaurants will participate as the program expands, resulting in higher quantities of biodiesel made from a local waste feedstock.

Biodiesel fuel generated from waste feedstock is more sustainable and far less polluting than petroleum diesel. Biodiesel significantly reduces green house gases, particulate matter (soot), carbon monoxide, and sulfur dioxide in air emissions. Produced from renewable resources such as waste cooking oil or soybean oil, biodiesel reduces dependence on limited energy resources and foreign oil. The "Fryer to Fuel" process recovers energy and recycles waste oils that end up in wastestreams or flushed down drains, clogging pipes and causing costly sewer overflow spills in wastewater treatment plants and sewer lines.

Ecology Action, with support from the U.S. EPA has created an ongoing large scale, cost-effective market for biodiesel from waste cooking oil with a local, community-based solution. **This pilot is a true partnership program from feedstock to consumer:**

- The California Restaurant Association, whose members usually pay to haul away their

waste oil, now gives its waste to grease haulers free of charge. The grease haulers are paid by the biodiesel manufacturers.

- Biodiesel manufacturers use a low-cost, recycled waste feedstock instead of virgin vegetable oil, increasing the sustainability of biodiesel.
- The pilot program's biodiesel fuel consumer market has expanded to the City of Santa Cruz Department of Public Works, the County of Santa Cruz Department of Public Works, the County of Santa Cruz waste franchise Green Waste, Inc., and finally the local oil waste hauler, Salinas Tallow, all of whose vehicle fleet will be running on the alternative fuel.

The U.S. EPA Region 9 would like to help organizations follow Santa Cruz's example. "We are excited

to be simultaneously encouraging alternative fuel use, reduced air pollution, and increased diversion of wastes from landfills," said Jeff Scott, director of the Waste Division in EPA Region 9. "We hope this community-based project will be a model ultimately replicated across the country."

Ecology Action's Executive Director, Virginia Johnson, claims, "This program exemplifies the wide breadth of partnership and problem solving that Ecology Action has always endeavored to embrace. This project was a confluence of all of the Ecology Action hubs: Sustainable Transportation, Climate Protection, Pollution Prevention, Zero Waste, and Energy Efficiency."

Voluntary partnerships with the U.S. EPA produce environmentally sustainable and profitable results. The U.S. EPA works with organizations to develop guidelines for increasing environmental performance, by exploring various low-cost resource options and energy saving strategies. In addition to offering its expert technical assistance in environmental protection, the U.S. EPA provides public recognition for green achievements. In one year, over 11,000 partners in an array of EPA Offices' and Regions' programs saved nearly $6 billion from EPA's environmental management assistance.

Appendix E. Biodiesel Use Proposal and FAQ for Fleet Managers

Biodiesel Blend Fuel for Santa Cruz County Sanitation District Vehicles Pilot Program Proposal

Environmental Compliance Unit, Department of Public Works, County of Santa Cruz

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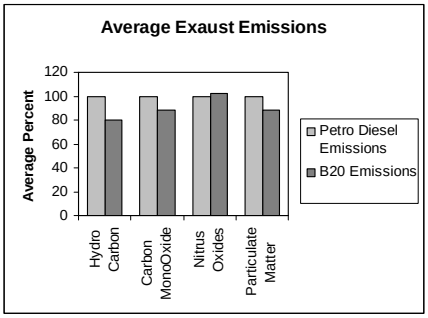
Needs Summary:

The Santa Cruz County Sanitation District, in partnership with the Department of Public Works, Roads Division, would like to establish a pilot program to use a biodiesel blend fuel B20 (20% biodiesel 80% petrol-diesel) in its diesel powered vehicles at the Lode Street facility. This pilot project would be concurrently administered with Ecology Action's "Fryer to Fuel" waste vegetable collection program funded by the USEPA. The proposed programs would work in conjunction to collect used fryer oil, process it into a Biodiesel blend, and fuel Sanitation's equipment.

The pilot programs are aimed to manage a variety of environmental problems. The use of Biodiesel blends would meet the County's emissions reductions policy (*Procedures Manual Section 304*). The conversion of diesel to Biodiesel B20 blend would result in a reduction in regulated air emissions of the following pollutants: unburned hydrocarbons (20%), carbon monoxide (12%), and particulates smaller than 10 microns (12%). However, results on Nitrous Oxides are inconclusive (-2% / +2%). Additionally, polycyclic aromatic hydrocarbons and nitrated polycyclic aromatic hydrocarbons, which have been identified as potential cancer causing compounds, have been reduced by 13% and 50%, respectively[20].

Source: EPA report EPA420-P-02-001, 2002



[20] [20] National Biodiesel Board, accessed < http://www.biodiesel.org/pdf_files/fuelfactsheets/emissions.pdf >

The County of Santa Cruz would not only receive benefits from the use of a cleaner burning fuel, but by using fuel produced from waste fryer oil, it can simultaneously solve a water quality problem. Waste Grease in the sanitary sewer is a major contributor to sewer overflows. By reducing the amount of waste grease going to sewer and raising awareness of the effects of grease in food service establishments, water quality would be improved, county employees will be less exposed to harmful diesel emissions, and the County may experience lower costs associated with sanitary sewer overflow cleanup.

Other benefits from a conversion from petrol-diesel to biodiesel B20 may also include, support to our local economies, increases in engine life, and improvements in public image. Many municipalities, state agencies, and transportation departments in California and around the country have been converting their diesel-powered vehicles to biodiesel blends without complications. Several concerns about the use of Biodiesel have been raised. These concerns have been researched and are addressed at the end of this proposal in Appendix A.

Goals and Objectives:

- Establish the pilot program for all 11 diesel powered vehicles at the Lode Street Facility.
- Numbers are: 04-03, 04-32, 04-50, 04-80, 04-88, 04-90, 04-99, 04-105, 04-106, 04-107, and 07-59. Vehicles include: heavy-duty service trucks (with cranes), Vacuum Trucks, and a Dump Truck.
- Historically, the diesel vehicles at Lode Street have used between 4,000 and 6,000 gallons of diesel fuel per year. The initial term will be for 6-months with 3000 gallons of B20 per term. We will plan for additional terms, but implement only upon a positive evaluation.

Table 1 – Sanitation Equipment

Equip No.	Year	Make	Model
04-03	2000	STERLING	L7501
04-105	2006	IHC	
04-106	2006	FORD	F550
04-107	2006	FORD	F550
04-32	1986	CHEVROLET	CC7D042
04-50	1988	FORD	FT900
04-80	2001	STERLING	L7501
04-88	2001	KENWORTH	T800
04-90	2003	STERLING	LT7500
04-99	2004	STERLING	L7501
07-59	2003	JOHN DEERE	310SG

Method:

FUELING AND PROCUREMENT

- Two fueling options were considered: 'wet-fueling' and onsite storage. Wet fueling is a process by which vehicles are fueled directly from a tanker truck with no storage requirements. 'Wet-fueling' would have required less commitment but would have been logistically difficult. Lode Street trucks have a very limited timeframe from which to be fueled, and must be maintained with a full

tank prior to on-call or emergency periods. Therefore, it is more practical to store the fuel onsite to enable fueling on an as-needed basis.

- The Lode street facility currently has a 4000 gallon underground storage tank used for on site diesel fueling. Any petrol-diesel currently stored in this tank will be moved to Brommer. At the same time this tank will be cleaned and prepped for B20 storage.
- The Periodic Maintenance schedule currently includes verifying fuel tank levels and purchasing more if needed. Under this proposal, verification of fuel level and procurement process will not change.
- Coast Oil works closely with a Watsonville based company (EASi) specializing in biodiesel production from waste vegetable oil. The Lode Street facility currently has a contract with Coast Oil to supply all Diesel #2. Under this proposal, fuel suppliers will not change. By procuring B20 from Coast Oil, it may also be ensured that waste vegetable oil collected by Ecology Action's Fryer to Fuel program will be fueling public fleets.
- Engine manufactures have publicly available warranty statements available from http://www.nbb.org. The warranty statement from Caterpillar state that "the use of biodiesel does not affect the Caterpillar warranty for materials and the warranty for workmanship"[21]. International and Ford have similar statements. Please See Appendix B for specific warranty statements.

RETROFITS, FUNDING, AND REGULATIONS

No retrofits are required to run any biodiesel mixture. However, there are expected mechanical issues that may arise. These issues are as follows:

- **Fuel Filters** - Solvency properties may cause release of sediments into the fuel system. Fuel filters may need to be replaced within the first few weeks of use. The National Biodiesel Board recommends that filters be changed after 1000 miles of use, or as a reduction in vehicle performance is noticed. This number will depend on age and mileage of vehicle. Older vehicles will have more built up sediments and may require fuel filter replacement more than once.
- **Fuel Lines** - Older vehicles (older than 1996) may require fuel hose replacements. 9 of the 11 pilot vehicles are model year 2000 or newer, therefore **we only expect to replace fuel hoses on 2 vehicles**. Many pre 1996 models use natural rubber

[21] Caterpillar, Caterpillar Machine Fluids Recommendations, Report: SEBU6250-14, April 2005.
< http://www.biodiesel.org/pdf_files/OEM%20Statements/2005_OEM_CatVersion9.pdf >

compounds for fuel hoses and seals. Biodiesel molecules are smaller than petrol-diesel and may permeate natural hoses, causing swelling and potential leaking. Therefore natural hoses must be replaced with a synthetic rubber on the older vehicles.

- **Particulate Matter (PM) Filters** - State mandates for retrofit technologies like the PM filters are not affected by low percentage biodiesel blends. It is expected that filter life will be increased in part due to lower emissions. Discussions with individuals in industry have concluded that a common problem associated with PM filters is inaccurate settings for the blend being used. As a result PM filters would shut down simulating a malfunction. PM filters should be accurately programmed to work correctly with biodiesel blends. Grant funding is unavailable for implementation or mechanical upgrades required for a B20 fuel for on-road vehicles. Funding may be available for off-road vehicles.

CRITERIA FOR EFFECTIVENESS

To evaluate the performance of the pilot program the following criteria will be considered: (1) cost differential between B20 and petrol-diesel based on historical and observed data and (2) additional vehicle maintenance costs relating to the fuel system (if any). Mileage data and maintenance will be tracked through the Public Works vehicle maintenance office at Brommer Yard. It would be ideal to consider an absolute change in emissions, but due to variability in machine type, uncertain hours of use, and insufficient methods for testing end-of-pipe emissions, the calculations will be neither accurate nor consistent.

- Cost Differential – A change in fuel usage has been projected based on EPA data. Using the most conservative estimate, there is an expected reduction in fuel economy (mpg) of 2-3% for use of B20. Due to the varied nature of sanitation operations, exact comparisons of historical and projected usage will be inconsistent. Upon completion of the pilot cycle, fuel usage data will be gathered and compared to evaluate cost effectiveness.

- Initially there are expected vehicle maintenance requirements. It is expected that fuel filters will need replacement within the first 1,000 miles of operation. Vehicles, numbered 4-32, and 4-50 may require synthetic rubbers fuel lines to replace natural lines. One type of synthetic rubber used is Viton©. Depending on vendor, Viton© hoses cost between $75 and $125 for different types of

on road vehicles. The total cost for retrofitting vehicles 4-32 and 4-50 will be cost of materials (hoses and clamps) plus labor (to be done at the Santa Cruz County's Bromer yard).

Timeline:

The pilot to trial the B20 blend of Biodiesel in the existing diesel vehicles at the Lode Street facility will take place over 6 months. After six months, staff will take approximately 2 months to report on the evaluation of the pilot. If it is considered a feasible and beneficial alternative fuel for diesel vehicles and its use gains approval from the Director and Assistant Director of Public Works, then the Public Works vehicle maintenance supervisor will begin procurement of B20 for additional vehicles.

Conclusion:

Biodiesel B20 is a viable alternative to regular petrol-diesel fuel. Local production facilities will increase the availability of Biodiesel in the future. In addition, B20 has known reduction is regulated and unregulated emissions that when compared to petro diesel will reduce global green house gas emissions and potential cancer causing compounds. The feasibility of a switch to biodiesel has already been proven with Santa Cruz County sourcing a Biodiesel blend of 5% for many of its diesel vehicles and the City of Santa Cruz useing a B20 for some of its equipment.

Additionally, by partnering with Ecology Action's Fryer to Fuel collection program the Sanitation District may be more capable to meet it pollution prevention directives. A conversion of sanitation fleet vehicles is expected to have a marginal impact in operating costs and with expected gains in engine life, human health, and community image.

SUPPLEMENTARY FAQ

1. Any retrofit needed for B20?
    a. "…B20 or lower blends can be used without changes." Biofuels may release accumulated deposits in the fuel system that increases fuel filter replacement frequency until built-up deposits are released. Contact with certain compounds (natural rubber, Buna-N, nitrite) may cause swelling or softening of seals causing fuel system leaks, although, "this affect has NOT been observed with blends of B20 and lower over the last 10 years". When in contact with certain metals (brass, bronze, copper, lead, tin, and zinc) B20 may degrade and create sediments. Parts made out of these metals should be replaced with steal or aluminum. System should be monitored closely for leaks or reductions in power immediately following transition from petrodiesel to biodiesel.

2. B20 use preclude vehicle from petrodiesel use?
    a. No. A diesel motor may use anywhere from 100% petrodiesel to 100% biodiesel or any combination of the two. A conversion to biodiesel doesn't require any modifications; therefore a reversion back to petro-diesel would also not require modifications.

3. Grant funding for retrofit.
    a. Use of B20 requires no retrofit technologies

4. Engine life expectancy difference?
    a. Strictly from a technical standpoint, **Biofuels should increase engine life expectancy**. It has a higher lubricity than petrodiesel. National Biodiesel Board (NBB) states that a 2% biofuel mixture can have a 10% increase in lubricating properties. Complications may arise out use of a 'neat' (100%) biofuel mixture. Cummins states, "Biodiesel [B100] is an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging…consult your fuel and additive supplier for assistance." Two years **after converting to B100 the City of Berkeley cut its pure biofuel program short reverting to B20 after two engine failures due to microbial build up in fuel filers and injectors**. Since reverting to B20 problems ceased.

5. Cost Differential Between Petrodiesel and Bio-Diesel
    a. Data is limited for the central coast. The best projections will come directly from local providers. Nature's fuel has quoted a standard delivery price of $2.499 while Pacific Biofuel gave a phone quote of $3.24. Actual prices will depend on contract negotiations.

6. Mileage difference and performance difference
    a. The EPA has found that energy content in petrodiesel is on average 129,500 btu/gal while soy/rapeseed biodiesel [**B100**] is 119,200 btu/gal; roughly **an 8% decrease in energy content**. Blending is expected to be linear so a B20 blend will have a reduction in energy of **1.6%**:

        0.2 x 0.8 x 100 = 1.6%

    b. Based on emissions testing B20 has been shown to **decrease fuel economy (mpg) by 0.9-2.1%**
    c. Under cold conditions biodiesel is at a performance disadvantage. It has a higher 'cloud point'– the temperature at which wax crystals start to form potentially clogging fuel filter and injectors - and 'pour-point' – the temperature at which the fuel is unable to flow normally. The specific cloud point should be obtained from the distributor. **This analysis**

was for B100 and not for blends of B20 and lower. The cloud and pour points should not vary significantly with blends B20 and lower.

d. According to statistics for lode street trucks 4-80, 4-90, 4-105, a switch to B20 will only increase fuel usage by approximately 4 gallons per month. *See Appendix A for calculation.*

7. Availability and Storage
    a. Pacific Biofuels and Nature's Fuel have both confirmed availability of 'wet-fueling' in the Santa Cruz area and down to Buena Vista. Both suppliers have confirmed they can blend and test a B20 mixture if requested.

8. Mileage Tracking:
    a. If we proceed with the 'wet-fueling' option an invoice should be supplied at the time of fueling. If not we could request one. If mileage tracking services are not provided by the fuel distributor, at time of refuel mark mileage and fuel added. A spreadsheet could be made to then calculate mileage. This would be feasible because data acquisition would be simple and fueling would occur frequently making any data collected more accurate.

9. OEM Warranties:
    a. The Magnuson Moss Act 1976 prohibits voiding of an OEM warranty just because an aftermarket additive (or biodiesel) was used. *See Appendix B for publicly available warranty statements from: Cummins, Caterpillar, and International. Also available at www.biodiesel.orgl*

Appendix F. Participating Restaurants

Restaurant Name	Address	City	Zip	Phone
Stevenson/Cowell Dining Hall	1156 High Street	Santa Cruz	95061	(831) 459-4618
Crown / Merril Dining Hall	1156 High Street	Santa Cruz	95061	(831) 459-4618
College 9/10 Dining Hall	1156 High Street	Santa Cruz	95061	(831) 459-4618
College 8 Dining Hall	1156 High Street	Santa Cruz	95061	(831) 459-4618
Kresge/Porter Dining Hall	1156 High Street	Santa Cruz	95061	(831) 459-4618
Moreno's at Merrill	1156 High Street	Santa Cruz	95061	(831) 459-4618
Terra Fresca	1156 High Street	Santa Cruz	95061	(831) 459-4618
Taqueria Sofia's	112 Rancho del Mar	Aptos	95006	(831) 688-1417
Aptos Burger	106 Rancho Del Mar	Aptos	95006	(831) 688-1282
Carls Junior	1855 41st. Ave.	Capitola	95010	(831) 476-7511
Chili's	1855 41st Ave.	Capitola	95010	(831) 462-1813
Taqueria los Gallos	243 Mount Hemon Rd	Scotts Valley	95066	(831) 439-9507
Taco Bell #2356	233 Mt. Hermon Road	Scotts Valley	95066	(831) 440-9455
99 Bottles	110 Walnut Avenue	Santa Cruz	95060	(831) 459-9999
Pearl Ally Bistro	110 Pearl Alley	Santa Cruz	95060	(831) 429-8070
Fallafel House	113 Walnut Ave	Santa Cruz	95060	(831) 459-9770
Bad Ass Coffee	1207 Pacific Ave	Santa Cruz	95060	(831) 460-1007
El Palomar	1336 Pacific Avenue	Santa Cruz	95060	(831) 425-7575
Hanks on the Hook	800 41st Avenue	Santa Cruz	95062	(831) 479-3662
Pink Godzilla	830 41st Avenue	Santa Cruz	95062	(831) 464-2586
Miramar	45 Municipal Wharf	Santa Cruz	95060	(831) 423-4441
Gilda's Family Restaurant	37 Municipal Wharf	Santa Cruz	95060	(831) 423-2010
Dolphin	71 Municipal Wharf#A	Santa Cruz	95060	(831) 426-5830
Olitas Canitna and Grill	49 Municipal Wharf #B	Santa Cruz	95060	(831) 458-9393
Carniglia's	49 Municipal Wharf # A	Santa Cruz	95060	(831) 458-3600
Gilbert's	460 Municipal Wharf	Santa Cruz	95060	(831) 423-5200
Riva Fish House	31 Municipal Wharf # 500	Santa Cruz	95060	(831) 429-1223
Stagnero Brothers Fish Market	Municipal Wharf	Santa Cruz	95060	(831) 423-2180
Chaminade	1 Chaminade Lane	Santa Cruz	95062	(800) 283-6569
Falafel of Scotts Valley	3105 Scotts Valley Drive	Scotts Valley	95066	(831) 430-9754
Maya Restaurant	3115 Scotts Valley Drive	Scotts Valley	95066	(831) 438-7004

Appendix G. Fryer to Fuel Application

Fryer to Fuel Collection Program Application

Please enroll my restaurant in the Fryer to Fuel collection program. Our restaurant voluntarily agrees to have waste vegetable oil removed, treated, and recycled into biodiesel at no cost to my restaurant and adhere to the best environmental management practices for fryer to fuel collection. Our restaurant would like to be recognized as a restaurant participating in this environmentally beneficial program.

Section I – Enrollee Information

*Information from Section I will be used to contact you and publicize your business*Restaurant Name:_____

Mailing Address:_____

Street Address:_____

Phone Number:_____

Contact Name:_____

Contact Phone Number:_____

Section II –Fryer Oil Quality

1. What types of food do you fry (check all that apply)?

☐ Beef ☐ Pork ☐ Fries

☐ Fish ☐ Chips ☐ Pastries

☐ Vegetables ☐ Other:_____

1. What type of fryer oil do you use? (soy, canola, palm, etc.):_____
2. How much fryer oil do you use monthly (throw away)? _____
3. How often will you need your fryer oil collected

☐Weekly

☐Monthly

☐Other:)? Before signing, be sure read the attached contract and agree to the terms and conditions set by the liquid waste hauler

Signature:_____ Date:_____

Appendix H. Fryer to Fuel Contract

FRYER TO FUEL COLLECTION PROGRAM
GREASE REMOVAL CONTRACT

This CONTRACT is made on _____between <COMPANY NAME OF LIQUID WASTE HAULER>, LLC ("<Company Name of Liquid Waste Hauler>") and _____("Customer").

RECITALS

Customer is a _____located at _____ _____, and desires have their Waste Kitchen Grease be removed so that they may participate in the Fryer to Fuel Collection Program.

<Company Name of Liquid Waste Hauler> desires to provide Waste Kitchen Grease removal services to Customer and Customer desires to obtain such services from <Company Name of Liquid Waste Hauler>.

THEREFORE, in consideration of the mutual promises set forth below, the parties agree as follows:

1. TERM OF CONTRACT

Section 1.01. The term of this Contract shall commence on _____ and shall continue in full force and effect thereafter for a period of one (1) year, terminating on _____.

2. SERVICES TO BE PERFORMED

Section 2.01. <Company Name of Liquid Waste Hauler> agrees to perform the following service:

(a) Exclusive removal of Waste Kitchen Grease per a schedule to be agreed upon between the Customer and <Company Name of Liquid Waste Hauler> for participation in the Fryer to Fuel collection program.

(b) <Company Name of Liquid Waste Hauler> shall supply Customer with the appropriate container for storage of Waste Kitchen Grease, and shall provide Customer with assistance in the location of such container within Customer's business.

3. COMPENSATION/ BREACH OF CONTRACT

Section 3.01. During the term of this Contract, <Company Name of Liquid Waste Hauler> shall remove all of Customer's Waste Kitchen Grease per the agreed upon schedule at no charge.

Section 3.02. If, during the term of this Contract, Customer uses any other entity to provide grease removal services, Customer shall be considered in breach of this Contract.

Section 3.03. If Customer is in breach of this Contract, Customer shall reimburse <Company Name of Liquid Waste Hauler> $25.00 per month for each and every month that <Company Name of Liquid Waste Hauler> provided grease removal services under this Contract.

4. EXCUSABLE DELAYS AND FAILURES

Section 4.01. Neither party shall be liable for any delay or failure in its performance under this Contract (except for payment obligations) caused by events beyond the reasonable control of the party, including, but not limited to, terrorism, war, riots, labor strikes, interruption of utility services, fires, floods, earthquakes, and other natural disasters.

5. ENTIRE AGREEMENT

Section 5.01. This Contract supersedes any and all other contracts, either oral or in writing, between the parties with respect to the subject of this Contract. This Contract contains all of the covenants and agreements between the parties with respect to the subject of this Contract, and each party acknowledges that no representations, inducements, promises, or agreements have been made by or on behalf of any party except the covenants and agreements embodied in this Contract. Any agreement, statement, or promise not contained in this Contract shall not be valid or binding between the parties with respect to the subject of this Contract, except for a subsequent written modification signed by the party to be charged.

6. AMENDMENT OF CONTRACT

Section 6.01. This Contract may be amended or modified at any time with respect to any provision by a written instrument executed by <Company Name of Liquid Waste Hauler> and Customer.

7. SUCCESSORS AND ASSIGNS

Section 7.01. Neither party may assign or transfer this Contract, in whole or in part, without the prior written consent of the other party. This Contract shall be binding on, and inure to the benefit of, each party's heirs, executors, administrators, successors, and permitted assigns.

8. MEDIATION/ATTORNEYS' FEES

Section 8.01. If any dispute, controversy, or claim arising out of or relating to this Contract or any claimed breach thereof has not been resolved through direct negotiation between the parties, the parties shall endeavor to settle the dispute through mediation. The prevailing party shall be entitled to recover reasonable attorneys' fees from the other party. These fees are in addition to any other relief to which the prevailing party may be entitled.

9. GOVERNING LAW

Section 9.01. This Contract shall be governed by and construed in accordance with the laws of the State of California.

<COMPANY NAME OF LIQUID WASTE HAULER>, LLC	CUSTOMER
_____	_____
Printed name:	Printed name:

Appendix I. Window Decals

Restaurant Type	Primary Food type	Average Number of Meals/Customers per Week	Grease Trap	Type of Vegetable Oil	Other Oil Type	Monthly Veg. Oil Purchase	Monthly Veg. Oil Disposal	Waste Oil Storage	Waste Oil Disposal	Collection Service Name	Collection Frequency
Dine-in/Takeout/Delivery	Plate Lunch/Ethnic/Steakhouse/Seafood	Lunch & Dinner: 875-1000 per week	Y	High stability canola oil	Boiled Chicken fat & Marinades	14-16 gal	10 gal	In Container Provided by collection Service/In Shared Coontainer	Tallow Service	Salinas Tallow	Monthly
Dine in/Take Out/Product Manufacturing/Bar with Food	Steakhouse/Seafood/Full Service	450 total per week	Y	Canola, Olive Oil		100 gal	60 gal	In Drum With Other Grease/Container Provided by Collection Service	Tallow Service	Salinas Tallow	2x Pe Month
Dine In	Diner/Steakhouse/Seafood	L:600; D:2000	Y	Canola Oil		80 gal	80 gal	In Container Provided by Collection Service	Recycling Service	Salinas Tallow	Less Than Once Month
Take Out/Dine In	Natural Foods/ Take Out/ Fast Food/ Ethnic										
Dine In	Full Service	D:30 tables, L:25 tables	Y	Canola Oil; Frying Shortening		60 gal	50 gal	In Container Proviced By Service	Tallow Service	Salinas Tallow	Monthly
Dine In/Take Out	Plate Lunch/EthnicNatural Foods/ Vegetarian		Y	Canola Oil				In Container Provided by Collection Service/In Shared Container	Tallow Service	Salinas Tallow	Monthly

Dine In/Take Out	Plate Lunch/EthnicNatural Foods/ Vegetarian		Y	Non-Hydrogenated Canola Oil		45 gal	30 gal	In Container Provided by Collection Service/In Shared Container	Tallow Service	Salinas Tallow	Monthly
Take Out/ Dine In	Fast Food	B:10, L:80, D:110, O: 20	Y	Soy	Beef Fat/Waste	50 gal	48 gal	In Drum With Other Grease	Tallow Service	Salinas Tallow	Weekly
Dine In/ Take Out/Buffet	Plate Lunch Diner/Buffet Ethnic Natural Foods Vegetarian Seafood Full Service	L:420, D:350		vegetable, sunflower, corn		86 gal	86 gal	Container Provided by Collection Service	Tallow Service	Salinas Tallow	Monthly
Dine-In	Plate Lunch/Full-Service	No Count; Breakfast and Lunch	Y	Liquid Fry Shortening	Use canola oil, olive oil, and butter in food.	30 gal off season/32 gal peak	Same	In Container Provided by Collection Service/In Shared Container	Tallow Service	Salinas Tallow	Less Than Once Month
Café/Dine In	Diner/Breakfast & Lunch	No Count; Breakfast and Lunch	y	Vegetable Oil		8 gal	approx. 8 gal.	In Drum With Other Grease	Tallow Service	Salinas Tallow	Less Than Once Month
Café	Other; Coffee/sandwiches, etc.		Y	N/A	Dairy grease				Tallow Service	Salinas Trap Recyclers	2x Pe Month
Dine In	Diner/Steak-house/ Seafood/ Full Service	L:1000+, D:1500+	Y	Canola Oil & Soybean Oil		1500-1800lbs	0	In Drum With Other Grease	Other: Biodiesel manu.		Other: persona use
Dine In/Take Out	Plate Linch/Diner/Buffet/Ethnic/Full Service	700+ for both Lunch and Dinner	Y	Vegetable Oil		1500 gal	200 gal	in Original Container/Container Provided by Collection Service	Tallow Service	Pete Tallow	Every Months

Dine-In/Bar with Food	Steakhouse/Seafood/Full Service	D: 400	y	Liquid Fryer Oil, Olive Oil, Canola Oil	Duck Fat, Bacon Fat	10 gal	10 gal	In Container Oil Came In	Tallow Service	Pioneer Liquid 7 Salinas Tallow	Monthly for Both
Dine In/Take Out	Plate Lunch/Ethnic/Seafood/Full Service	Lunch/Dinner; No Count	y	varies by availability; Canola and Vegetable Oil		13-15 gal	13-15 gal	In Container Provided by Collection Service	Recycler	Scraps	Weekly
Café/Bakery	Plate Lunch/ Natural Foods/ Vegetarian		y	Olive Oil, Canola	Bacon Grease, Pork Fat	20 gal			Disopose of with trash/ Pour down the drain		
Dine In	Diner/Full Service	Brunch:250 D:1450	Y	Canola Salad Oil & Melfry(made from canola)	Olive Oil	150gal of all oil	80 gal	In Drum With Other Grease	Tallow Service	Salinas Tallow	2x Pe Month
Dine-In	Full-Service	D:810	Y	Olive Oil, Canola, Rice Bran Oil	Butter, Duck Fat	5 gal	5 gal	In Shared Container	Tallow Service	Unknown	
Dine In	Full Service		Y			70 gal	70 gal	In Container Fresh Oil Came In	Recycling Company	Salinas Tallow	Weekly, 2x pe week summe
Dine In/Take Out	Ethnic (Mexican)	Lunch/Dinner	Y	Soybean		200 lbs (Approx. 26 gal)		In Drum	Tallow Service	Salinas Tallow	Monthly
Dine In	Plate Lunch/Fast Food		Y	Soybean Oil	None	16-18 35 lb. Containers per Month (Approx. 72 to 81 gal)	55 gal	In Drum With Other Grease/In Container Provided by Collection Service	Tallow Service	Salinas Tallow	Monthly
Dine In	Full-Service	Dinner; not reported	Y	Soybean Oil	Creamy liquid fryng shortening	11lb (Approx. 1.4 gal)	5lb (Approx. 0.645 gal)	In Container Provided by Collection Service	Tallow Service	Salinas Tallow	every 4 months
Dine In/Take Out	Ethnic (Thai)/Full Service	L:25, D:40-60, O (to go):15	Y	Soybean Oil; Soybean Shortening		25 gal	25 gal	In Drum With Other Grease/Container Provided By Service	Tallow Service	Salinas Tallow	Less Than Once Month

Appendix K. Sample Survey

Waste Vegetable Oil Survey Questionnaire

Contact Information

Establishment Name: _____

Mailing Address: _____

_____

Street Address: _____

_____

Phone Number: _____

Contact Name: _____

Contact Phone Number: _____

_____ **CHECK HERE IF YOU DO NOT USE WASTE VEGETABLE OIL IN YOUR OPERATION AND MAIL IN THE QUESTIONNAIRE. IF YOU USE WASTE VEGETABLE OIL, PLEASE COMPLETE QUESTIONNAIRE PER INSTRUCTIONS AND RETURN BY MAIL.**

Background Information on Food Establishment

4. What type of establishment is it? (check all that apply)

Dine-In Restaurant _____

Takeout/Delivery Establishment _____

Food Product Manufacturing Facility _____

Resort with multiple eating establishments _____

Other (specify) _____ _____

A) How many meals does this establishment serve on average per week?

Breakfast _____ Lunch _____

Dinner _____ Other _____

B) What is the primary type of food offered? (check all that apply)

Plate Lunch _____ Natural Foods/Vegetarian _____

Diner _____ Steakhouse/Seafood _____

Fast Food _____ Full-Service Restaurant _____

Buffet _____ Packaged Food Product _____

Ethnic _____

C) Does this establishment have a grease trap? (Please circle one) Y / N

D) What type of Vegetable oil is used? (check all that apply)

E) What other types of oil/fat are used for Waste Vegetable?

Handling of Waste Vegetable Oil in Food Establishment

5. **How much Waste Vegetable oil does this establishment purchase monthly? _____**
   Gallons
6. **How much used Waste Vegetable oil does this establishment dispose of monthly? _____**
   Gallons
7. **How is the waste Vegetable Oil stored after use and before final disposal?**
   In a drum out back with all the other fat/grease/oil
   In a container the fresh oil originally came in.
   In a container provided by my collection service
   In a large container shared with other businesses in the neighborhood.
   Other (please specify)

8. **How does this establishment dispose of its used Waste Vegetable oil? (Please check method)**
   Recycling Company _____(go to Q10) Dispose with regular trash _____ (go to Q7)
   Pour down the drain _____(go to Q7) Tallow Collection Service _____(go to Q6)
   Other Method (please specify) _____ (go to Q7)

9. **If Waste Vegetable oil is disposed of by means of a Tallow Collection service, which company is collecting the used Waste Vegetable oil?**

   Name: _____ Phone: _____

A) Is a service fee paid for the collection of the used Waste Vegetable oil? Y / N

If yes, approximately how much? $_____ /Gallon

B) How often is the used Waste Vegetable oil collected (check the appropriate frequency below)?

Weekly _____

Monthly _____

Less often than once a month _____

10. If you don't have a recycler pick up your used Waste Vegetable oil, what are the reason(s) why (check all that apply)?

Too costly _____

Insufficient storage space _____

Lack of suitable storage containers _____

Other (specify) _____

11. How much would you be willing to pay per gallon to dispose of used Waste Vegetable oil by means of a recycler instead of your current method? $_____/Gallon

12. Which reason(s) would convince you to consider recycling your establishment's used Waste Vegetable oil? (check all that apply then go to Q10)

A) It is environmentally friendly. _____

B) It is used to produce locally made alternative fuel, which reduces dependency on foreign oil. _____

C) It conserves our declining landfill space. _____

D) It becomes illegal to dispose of used Waste Vegetable oil down the drain. _____

13. If you dispose of your used Waste Vegetable oil by means of a recycling company, which company is collecting the used Waste Vegetable oil?

Name: _____ Phone: _____

A) Do you pay a service fee for the collection of your used Waste Vegetable oil? Y / N

If yes, approximately how much? $_____ /Gallon

B) How often is your used Waste Vegetable oil collected?

Weekly _____

Monthly _____

Less often than once a month _____

14. Do you have any additional comments or suggestions regarding used Waste Vegetable oil?

Please return survey in the enclosed postage-paid envelope postmarked no later than XXXXXXX. Thank you for your participation in our study. The data that we collect will be important in developing a plan to manage the used Waste Vegetable Oil generated locally for use in the production of Biodiesel.

Appendix L. Contact Information for Program Partners

Program Partner	Organization	Email	Phone
Olof Hansen	EPA	Hansen.olof@epa.gov	(415)972-3328
Jo Fleming	Ecology Action of Santa Cruz	Jo.fleming@envirocentives.com	(831)706-7384
Richard Gillis	EASi	rich@bioeasi.com	(831)359-4499
Phil and Bill Ottone	Salinas Tallow	salinastallowco@yahoo.com	(800)621-9000
Kevin Larson	Coast Oil Company	klarson@coastoil.com	(408)342-0222
Mary Arman	City of Santa Cruz, Department of Public Works	marman@ci.santa-cruz.ca.us	(831)420-5030