

Study Relating to Used Cooking Oil Generation and Biodiesel Production Incentives in the County of Hawai`i

Study conducted by the Solid Waste Division of the Department of Environmental Management, County of Hawai`i under a grant from the State of Hawai`i, Department of Business, Economic Development and Tourism, Strategic Industries Division

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Executive Summary:

With the assistance of University of Hawai'i at Hilo students, the Solid Waste Division of the Department of Environmental Management of the County of Hawai'i conducted a mail-telephone survey of food handling establishments to determine the overall disposal of used cooking oil on the island and if the market could support biodiesel production. The results of the survey showed that approximately 60% of respondents employ some method of recycling or re-use of their used cooking oil resulting in an estimated 5,600 gallons per month diverted from the County's landfills. Approximately 21% of establishments, representing collection of 2,000 gallons per month, employ Pump Truck Services to dispose of their used cooking oil/grease trap waste. Approximately 15% of establishments either dispose of their used cooking oil directly into their solid waste trash or by dumping it into their septic/wastewater systems. While the number of establishments using these methods was substantial, the actual volume of oil disposed by these methods was small - approximately 300 gallons per month. Survey respondents, who were either recycling used cooking oil or willing to recycle if costs were comparable to or less than other forms of disposal, were the establishments that served the greatest number of meals and purchased the most cooking oil. Although 31% of non-recycling respondents perceived that recycling used cooking was too costly, the results of the research indicate that recycling of the used cooking oil is less expensive than permitted disposal at landfills. Another survey observation was that there is a small group of private recyclers responsible for diverting small amounts of used cooking oil from commercial establishments for use as fuel in their own vehicles.

The research presented in this report was compiled during the calendar year 2004. It represents a baseline of information regarding the generation of used cooking oil by commercial establishments in the County of Hawai'i, as well as a compilation of existing data on the land disposal and diversion of used cooking oil to the production of biodiesel. Also included is information about legislation passed by other Counties in Hawai'i, State of Hawai'i legislation, and Federal legislation directed at the promotion of a biodiesel industry as a mean of recycling waste oil.

The survey was conducted on commercial establishments and the data compiled under the oversight of the Solid Waste Division staff at the Department of Environmental Management, County of Hawai'i. University of Hawai'i at Hilo students, Brittany Smart and Christopher Chin Chance assisted with this research. C3 Consulting was contracted to assist with the compilation and reporting of the data.

RESEARCH FINDINGS:

- Response rate for the survey of commercial eating establishments was 45.5%. The data procured from these establishments was provided voluntarily and no certified weight scales or other measurements were provided to verify quantities.
- It was reported that approximately 380 tons of used cooking oil a year are disposed by the survey respondents. Although the results of the survey cannot be considered

statistically significant due to a variation in response rates for individual questions, given the overall response rate, we can estimate that more than 800 tons of waste oil a year are being generated by the target population.

- The businesses serving the most meals and purchasing the largest quantities of cooking oil showed the greatest interest in recycling the oil provided the costs are less than other forms of disposal.
- Information collected from the industry indicated that the average price per gallon paid by establishments to have used cooking oil collected and recycled into biodiesel was \$1.13. The costs to businesses to have used cooking oil collected and delivered to the West Hawai`i Sanitary Landfill, which is the only facility on the Big Island to accept and properly process waste oil for land disposal, averaged \$1.91 per gallon.
- Data collected from the County of Hawai`i's diversion grant program, landfill disposal records and data provided from off-island biodiesel production companies collecting direct from customers for off-island processing indicates 424 tons of waste oil were tracked to proper disposal and recycling methods for FY 2003-4.
- Data provided by the biodiesel industry operating in conjunction with diversion programs in the County of Maui indicated that over 900 tons of used cooking oil were received in the last calendar year. Given that the 2003 population statistics for the Counties of Maui and Hawai`i were 135,605 and 158,423 respectively, and the fact that Maui County experiences a higher visitor count, it is presumed that the volume of used cooking oil in Hawai`i County would be similar to Maui County. Maui County has actively pursued the diversion of used cooking oil over the last five years and due to the maturity of the Maui diversion program, is likely capturing most of the used cooking oil generated in that County.
- Given the comparative data from Maui County and the estimates derived from our survey, it is projected that somewhere between 320 to 475 tons of used cooking oil are being generated in Hawai`i County and are being improperly disposed. Recent anecdotal evidence of illegal disposal practices by two companies operating in Hawai`i County indicates that illegal land disposal of waste oil may be a significant problem.

ACTIONS TO PROMOTE BIODIESEL PRODUCTION:

- Conduct a request for proposals (RFP) to divert used cooking oil and other organics from the island's waste stream. (Completed 2003)
- Increase the diversion grants from \$40/ton to \$60/ton based on information obtained from the RFP process. (Completed 2004)

- As carried out in other counties, initiate legislation to waive the County fuel tax on diesel fuels containing 20% or greater biodiesel. (TBA)
- Pass legislation at the County level requiring the use of grease trap interceptors for all waste oil generators and strictly monitor compliance. (TBA)
- Implement receiving stations for used cooking oil drop-off on each side of the island. (TBA)
- Educate the population of Hawai'i County about the benefits of recycling used cooking oil and the negative impacts to the environment of improper disposal. (Proposed 2nd round of funding from DBEDT)
- Educate the target population of waste oil generators about the costs and benefits of recycling used cooking oil and grease trap waste. (Proposed 2nd round of funding from DBEDT)

Methodology:

The survey method employed a mail survey sent to the entire population of commercial food handling establishments with a follow-up telephone interview to increase the response rate and verify information written on returned surveys. We obtained a population list from the State of Hawai'i Department of Health – Sanitation and Food and Drug Branches on food handling establishments that were licensed in the County of Hawai'i. Establishments that were omitted from the Department of Health listing for purposes of our survey included: Gas/Convenience stations, school cafeterias, coffee-only establishments, bars/liquor only establishments, public institutional (i.e. hospitals, prisons, etc.) eating establishments. These establishments were omitted due to a determination that their generation of used cooking oil was minimal. We submitted a draft of our survey to the Department of Business, Economic Development & Tourism (DBEDT) for approval along with a scope of our purpose. A cover letter explaining the purpose of the survey, a stamped self addressed envelope and the DBEDT approved survey were sent to all qualified establishments on our population listing. The final population-recipient list after the qualified omissions contained 725 commercial food handling establishments. Upon return of undeliverable surveys, analysis of surveys from respondents who replied that their businesses were no longer in operation, and multiple telephone contact attempts resulted in an additional 33 listings being eliminated as “Out-of-Business” listings. The initial population listing obtained from the State of Hawai'i Department of Health appeared to have been last updated two years ago and contained establishments that were no longer in business and multiple wrong addresses; both factors may have contributed to a higher than anticipated non-response rate to the survey.

Surveys were returned to our office and tracked as “complete” or “requiring” follow-up as some responses lacked complete information. As incomplete surveys were returned, the students commenced follow-up telephone calls to verify information and obtain more complete survey responses. Upon reaching the deadline for submission of the surveys the response rate was below the projected and desired 35% rate. Telephone interviews were conducted of non-responding establishments and to obtain more complete survey information from the surveys that had been returned. In order to obtain a relevant baseline of data on used cooking oil generation, follow-up telephone interviews were largely conducted on fast food establishments and resorts which were hypothesized to generate the most used cooking oil. After final mail surveys were returned, initial and follow-up telephone interviews were completed that resulted in an overall 45.5% response rate, or 314 responses from a total qualified population of 692. Due to the variation of response rates for particular questions on the survey instrument and the uncertainty regarding characteristics of the non-respondents, the results cannot be considered statistically accurate and are to be used for baseline information only.

Survey Responses:

Microsoft Excel and SPSS statistical/data functions were used to analyze the data obtained from our survey. To more easily understand the following tables, please note the following definitions and explanations.

1. Valid responses = Total number of responses to that question. (Excludes multiple responses.)
2. Frequency = Number of records that match the various answer options for the survey question.
3. Percent = Percentage rate of the valid sample responses to the question.
4. For the frequency distribution tables all Valid response options to the question are listed on the left hand side and are tallied in rows.
5. For the cross tabulation tables, variables under comparison are listed in the title of the table with the various response options listed on the left side and top row of the table and the number of responses and their corresponding percentage rates are shown for each Valid outcome.

Response Item – Check here if you do not use cooking oil in your operation and mail in the questionnaire.

COOKING OIL USED

		Frequency	Percent	Valid Percent
Valid	BLANK	165	23.8%	52.5%
	CHECK	149	21.5%	47.5%
	Total	314	45.4%	100.0%
Missing		378	54.6%	
Total		692	100.0%	

Our total response rate for our full population sample was 45.4% or 314 out of 692 qualified population listings with 165 respondents, or 52.5% of returned surveys replying that their establishments used cooking oil (BLANKS). Our non-response rate (“Missing”) to our survey was rather large (54.6%) due possibly to a less than perfect population listing from the Department of Health, establishments ignoring our survey, proprietors unable to understand the survey due to foreign language difficulties, or a general reluctance to divulge proprietary business information that could reveal inappropriate disposal methods.

Question 1: What type of establishment is it?

EST. TYPE		Frequency	Percent
DINE-IN		110	66.7%
TAKEOUT/DELIVERY		88	53.3%
FOOD PRODUCT		28	17.0%
RESORT		9	5.5%
Total		235	142.4%
	Valid	165	

The large majority of the food handling establishments in the County of Hawai'i were DINE-IN facilities, and TAKEOUT/DELIVERY operations were the second most common response, with many establishments conducting both types of activities. Since establishments had the option of marking more than one category, the total number of responses exceeds the Valid number of total survey respondents who answered that they used cooking oil in their operations.

Question 1A: How many meals does your establishment serve on average per week?

MEALS/WK		Frequency	Percent
1 - 349		23	17.8%
350 - 1999		68	52.7%
≥ 2000		38	29.5%
Total		129	100.0%

While a significant number of establishments (36) failed to provide an estimate of the number of meals served, the data provided a useful comparison variable to compare high volume establishments versus low volume establishments with other variables.

Question 1B: What is the primary type of food offered?

MEAL TYPES		Frequency	Percent
PLATE LUNCH		75	45.5%
NATURAL / VEG		14	8.5%
DINER		25	15.2%
STEAK / SEAFOOD		28	17.0%
FAST FOOD		52	31.5%
FULL-SERVICE		55	33.3%
BUFFET		21	12.7%
FOOD PRODUCT		35	21.2%
ETHNIC		31	18.8%
Total		336	203.6%
	Valid	165	

According to the survey responses, establishments were asked to check all categories that apply resulting in total percentage being greater than 100%.

Question 1C: Does your establishment have a grease trap?

GREASE TRAP		Frequency	Percent
NO		26	16.3%
YES		134	83.8%
Total		160	100.0%

Even though there is no County mandate for food handling establishments that requires a grease trap in their operations, the responses to our survey indicate most (83.8%) businesses have one. Legislation proposing a required grease trap for such establishments is under consideration to prevent costly maintenance of the County’s wastewater system.

Question 2: How much cooking oil does your establishment purchase monthly? (Gallons)

OIL – PURCHASED (Gallons/Mo.)		Frequency	Percent
< 50		88	55.7%
50 – 149		43	27.2%
≥ 150		27	17.1%
Total		158	100.0%

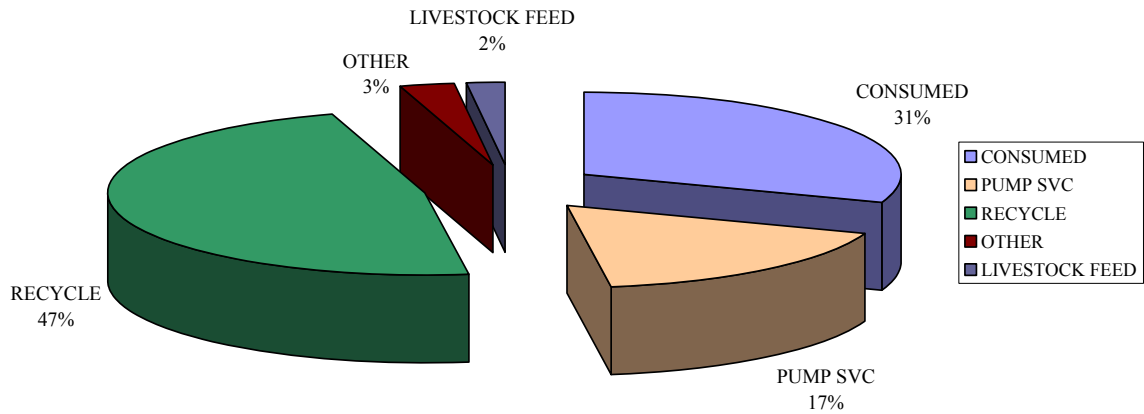
The majority (55.7%) of establishments report that they purchase less than 50 gallons of cooking oil per month, and only a small proportion (17.1%) use cooking oil in volumes greater than 150 gallons per month.

Question 3: How much used cooking oil does your establishment dispose of monthly? (Gallons)

OIL – DISPOSED (Gallons/Mo.)		Frequency	Percent
< 50		81	57.9%
50 - 149		45	32.1%
≥ 150		14	10.0%
Total		140	100.0%

As expected, the levels of cooking oil disposed by the establishments are less than the purchased amount, and according to our survey respondents, over 3,000 gallons per month are consumed in the food they prepare. Both the OIL-PURCHASED and OIL-DISPOSED variables will be compared with other variables to extrapolate data that may be relevant to survey non-responders.

Cooking Oil End Products (by volume)

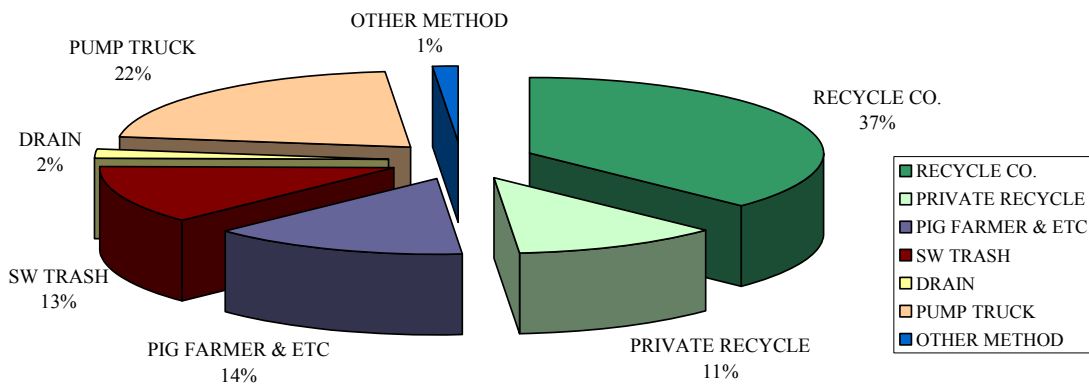


Question 4: How does your establishment dispose of its used cooking oil?

DISPOSAL METHODS	Frequency	Percent
RECYCLE CO.	59	37.3%
PRIVATE RECYCLE	18	11.4%
PIG FARMER, ETC	22	13.9%
SW TRASH	20	12.7%
DRAIN	3	1.9%
PUMP TRUCK	34	21.5%
OTHER METHOD	2	1.3%
Total	158	100.0%
Valid	165	

Methods of disposing of an establishment's used cooking oil varied widely but a majority (60%) employ some type of recycling or reuse of the byproduct. The results of this question can be compared to the various establishment types, number of meals served, and establishment's reasons for not recycling, to yield information that will facilitate determination of appropriate incentives to encourage recycling.

Methods of Used Cooking Oil Disposal
(by number of establishments)



A critical factor to note here is that the 59 establishments that employ RECYCLE COMPANIES represent approximately 83% of the actual number of establishments that recycle by that method according to the RECYCLE COMPANIES' internal business records. These response rates indicate that self-selection was a significant factor for establishments the use RECYCLE COMPANIES compared to establishments that may employ other methods of disposal.

Question 5: If you dispose of your used cooking oil by means of a Pumping Truck Service, which company is collecting the used cooking oil?

PUMP TRUCK SVC		Frequency	Percent
West HI Pump Truck Cos. (4)		33	100.0%
Total		33	100.0%

According to the survey responses most of the establishments that use a Pump Truck Service reside on the Westside of Hawai`i County, and this has been confirmed with internal Department data from the West Hawai`i Sanitary Landfill. Four Pump Truck Companies service the Westside with 94% of the establishments utilizing two of the companies. East Hawai`i Sanitary Landfill does not accept waste oil for disposal.

Question 5A: Do you pay a service fee for the collection of your used cooking oil? If yes, approximately how much?

	SVC FEES	Frequency	Percent
PUMP TRUCK FEE	< \$ 1.00	1	3.0%
	\$ 1.00 - \$ 1.99	22	66.7%
	\$ 2.00 - \$ 2.99	7	21.2%
	≥ \$ 3.00	2	6.1%
	N/E (no estimate)	1	3.0%
Total		33	100.0%

The results of this question are compared to other disposal methods in the “Cooking Oil Disposal Volume & Mean Disposal Cost” chart on page 25.

Question 6: If you don't have a recycler pick up your used cooking oil what are the reason(s) why?

REASONS		Frequency	Percent
TOO COSTLY		13	31.0%
NOT ENOUGH STORAGE SPACE		7	16.7%
NO STORAGE CONTAINERS		8	19.0%
OTHER REASONS		30	71.4%
Total		58	138.1%
	Valid	42	

Establishments were able to answer “Yes” to more than one reason in response to this question resulting in the greater than 100% cumulative response rate. Too many surveys were blank in response to this question to make any statistically significant conclusion as to why establishments did not employ a recycler to dispose of their used cooking oil. The most common response was in the OTHER category where many of the establishments were unaware of the opportunity to recycle their used cooking oil. This lack of information will hopefully be addressed in the follow-up public education campaign to inform the businesses as well as the public of the recycling opportunities available to them. Many of the responders to our survey, who already were recycling their used cooking oil, used this section of the survey to complain about the process of recycling even though this question did not apply to them, and their responses were thus not tallied in the above table. The number one complaint cited by establishments that

recycle was the cost of recycling. While many of the establishments' eligible responses were "Too Costly" to this question and many establishments who recycle complained of the cost of their current service, it is worthwhile to note that proper disposal of fat, oil, and grease (FOGs) by means of Pump Truck Services is actually about equal in price per gallon, and in many cases more expensive, depending on which Recycle Company is available to service them.

Question 7: How much would you be willing to pay per gallon to dispose of used cooking oil by means of a recycler instead of your current method?

		Frequency	Percent
ALTERNATIVE COST \$	\$ 0.00	20	47.6%
	\$ 0.01 - \$ 0.99	4	9.5%
	\$ 1.00 - \$ 1.99	13	31.0%
	\$ 2.00 - \$ 2.99	4	9.5%
	≥ \$ 3.00	1	2.4%
Total		42	100.0%

The non-response rate to this question prevents any statistically significant conclusion to be drawn from the data, although a large plurality (47.6%) of those who did respond wanted the ALTERNATIVE COST to be \$0.00. Many establishments who responded with \$0.00 said they thought the Recycle Companies should pay them for their used oil, an unlikely situation given all the costs involved in handling the used cooking oil and processing it into biodiesel. With proper legislation, diversion credits and a

biodiesel production facility on the Big Island, it may be possible to reduce the costs to businesses to recycle their used cooking oil.

Question 8: Which reason(s) would convince you to consider recycling your establishment's used cooking oil?

REASONS		Frequency	Percent
ENVIRONMENT	YES	44	81.5%
ALTERNATIVE FUEL	YES	49	90.7%
LANDFILL SPACE	YES	40	74.1%
ILLEGAL DRAIN	YES	30	55.6%
Total		163	301.9%
	Valid	54	

The responses to this question yielded a fairly even distribution for the listed reasons: It is environmentally friendly; it is used to produce locally made alternative fuel, which reduces dependency on foreign oil; it conserves our declining landfill space; it becomes illegal to dispose of used cooking oil down the drain. Many surveys cited more than one reason which resulted in the Total exceeding the 54 survey responses to this question, and the percentage exceeding 100%.

Question 9: If you dispose of your cooking oil by means of a recycling company, which company is collecting the used cooking oil?

RECYCLERS		Frequency	Percent
Diversion Grant Program Participants		42	54.5%
Biodiesel Producers		15	19.5%
Other/Private Individuals		14	18.2%
Unknown/No Name Given		6	7.8%
Total		77	100.0%

The companies that participate in the County of Hawaii’s Diversion Grant Program together collect from 54.5% of the establishments that recycle. Another 19.5% of establishments have their used cooking oil directly shipped to Biodiesel Producers. The Diversion Grant Program Participants and the Biodiesel Producers together collect approximately 82% of the recycled used cooking oil by volume. Another 18.2% of the establishments responded that Other Users or Private Individuals collected their used cooking oil for purposes of fuel oil; this represented a much smaller proportion by volume of the used cooking oil recycled.

Question 9A: Do you pay a service fee for collection of your used cooking oil? If yes, approximately how much?

	SVC FEES	Frequency	Percent
RECYCLER FEE	< \$ 1.00	16	24.2%
	\$ 1.00 - \$ 1.99	27	40.9%
	\$ 2.00 - \$ 2.99	20	30.3%
	≥ \$ 3.00	1	1.5%
	Varies	1	1.5%
	N/E	1	1.5%
Total		66	100.0%

While many establishments were able to provide us with reliable costs of their SERVICE FEES, others were unsure or unaware of the precise per-gallon cost and provided an estimate. These cost estimates may be influenced by the amounts respondents are “willing to pay” as ALTERNATIVE COSTS described in Question 7.

Question 10: Do you have any additional comments or suggestions regarding used cooking oil?

The responses to this question varied with many of the respondents saying that they supported the concept of recycling used cooking oil and they liked the idea of the County conducting the survey to gauge the business and public interest. Some respondents even asked where to obtain the used cooking oil or processed biodiesel for use in their businesses or for personal use.

Analysis:

In order to make projections and discover trends for used cooking oil production covering the non-respondents and the entire population of food handling establishments, cross tabulations of variables of interest were attempted. By using the cross tabulation tables we were able to determine a few trends with respect to volume of cooking oil purchased/disposed, meals served, cooking oil disposal methods and types of establishments.

Cross Tabulation of Number of Meals vs. Used Cooking Oil Purchased.

OIL PURCHASED (Gallons/mo.)		MEALS (per week)			Total
		1 - 349	350 - 1999	≥ 2000	
< 50	Count	20	38	8	66
	%	95%	57%	22%	53%
50 - 149	Count	1	26	13	40
	%	5%	39%	35%	32%
≥ 150	Count		3	16	19
	%	0%	4%	43%	15%
Total	Count	21	67	37	125
	%	100%	100%	100%	100%

Cross Tabulation of Number of Meals vs. Used Cooking Oil Disposed.

OIL DISPOSED (Gallons/mo.)		MEALS (per week)			Total
		1 - 349	350 - 1999	≥ 2000	
< 50	Count	18	40	8	66
	%	95%	63%	23%	56%
50 - 149	Count	1	21	17	39
	%	5%	33%	49%	33%
≥ 150	Count		2	10	12
	%	0%	3%	29%	10%
Total	Count	19	63	35	117
	%	100%	100%	100%	100%

In both cross tabulations of number of MEALS served per week vs. OIL PURCHASED and DISPOSED, there is a correlation between an increasing number of meals served and the volume of used cooking oil purchased and disposed.

Cross Tabulation of Number of Meals vs. Used Cooking Oil Disposal Methods.

METHODS OF DISPOSAL		MEALS			Total
		1 - 349	350 - 1999	≥ 2000	
RECYCLE CO.	Count	1	22	24	47
	%	4%	32%	63%	36%
PRIVATE RECYCLE	Count	1	10	3	14
	%	4%	15%	8%	11%
PIG FARMER, ETC	Count	3	14	1	18
	%	13%	21%	3%	14%
SW TRASH	Count	8	5		13
	%	35%	7%		10%
DRAIN	Count	1	1		2
	%	4%	1%		2%
PUMP TRUCK	Count	7	15	10	32
	%	30%	22%	26%	25%
OTHER METHOD	Count	2			2
	%	9%			2%
Total	Count	23	67	38	128
	%	100%	100%	100%	100%

In this tabulation there is a possible relationship whereby, as the number of MEALS served increases, establishments are more likely to employ RECYCLE COMPANIES and less likely to dispose of used cooking oil by means of SOLID WASTE TRASH, pouring it down the DRAIN or OTHER METHODS.

Cross Tabulation of Purchased Cooking Oil Volume vs. Disposal Methods.

METHODS OF DISPOSAL		OIL PURCHASED (gallons/month)			Total
		< 50	50 - 149	≥ 150	
RECYCLE CO.	Count	18	19	21	58
	%	22%	44%	78%	38%
PRIVATE RECYCLE	Count	9	7	2	18
	%	11%	16%	7%	12%
PIG FARMER & ETC	Count	19	3		22
	%	23%	7%		14%
SW TRASH	Count	16	3		19
	%	19%	7%		12%
DRAIN	Count	2			2
	%	2%			1%
PUMP TRUCK	Count	17	11	4	32
	%	20%	26%	15%	21%
OTHER METHOD	Count	2			2
	%	2%			1%
Total	Count	83	43	27	153
	%	100%	100%	100%	100%

Cross Tabulation of Used Cooking Oil Volume vs. Disposal Methods.

METHODS OF DISPOSAL		OIL DISPOSED (gallons/month)			Total
		< 50	50 - 149	≥ 150	
RECYCLE CO.	Count	20	26	10	56
	%	24%	57%	71%	39%
PRIVATE RECYCLE	Count	12	4	1	17
	%	14%	9%	7%	12%
PIG FARMER & ETC	Count	16	0	0	16
	%	19%	0%	0%	11%
SW TRASH	Count	15	3	0	18
	%	18%	7%	0%	13%
DRAIN	Count	2			2
	%	2%	0%	0%	1%
PUMP TRUCK	Count	16	13	3	32
	%	19%	28%	21%	22%
OTHER METHOD	Count	2			2
	%	2%	0%	0%	1%
Total	Count	83	46	14	143
	%	100%	100%	100%	100%

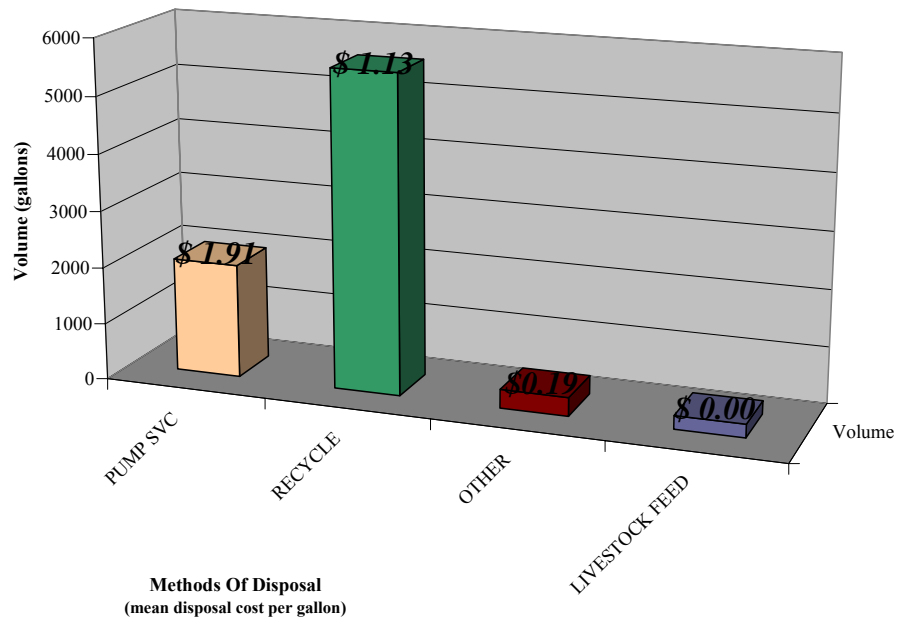
In both the cross tabulation tables of OIL PURCHASED and OIL DISPOSED vs. DISPOSAL METHODS a similar correlation between increasing volume of cooking oil and a higher rate of usage of recycling companies to dispose of the used cooking oil is observed. The options of disposal by means of SW TRASH, down the DRAIN and OTHER METHODS showed a decline in usage as OIL PURCHASED and DISPOSED increased.

Cross Tabulation of Recycling Method vs. Type of Establishment

METHODS OF DISPOSAL		DINE-IN	TAKEOUT	FOOD PRODUCT	RESORT
RECYCLE CO.	Count	41	33	7	6
	%	37.6%	37.5%	31.8%	66.7%
PRIVATE RECYCLE	Count	15	8	2	0
	%	13.8%	9.1%	9.1%	0.0%
PIG FARMER	Count	15	14	5	0
	%	13.8%	15.9%	22.7%	0.0%
SW TRASH	Count	9	9	6	0
	%	8.3%	10.2%	27.3%	0.0%
DRAIN	Count	1	3	0	0
	%	0.9%	3.4%	0.0%	0.0%
PUMP TRUCK SVC	Count	27	19	2	3
	%	24.8%	21.6%	9.1%	33.3%
OTHER	Count	1	2	0	0
	%	0.9%	2.3%	0.0%	0.0%
TOTAL	Count	109	88	22	9
	%	100.0%	100.0%	100.0%	100.0%

RECYCLE COMPANIES was the top choice among all establishment types for disposal of their used cooking oil with RESORTS employing their services at the highest rate. FOOD PRODUCT manufacturers were the most likely to dispose of their used cooking oil by means of PIG FARMERS and in their SOLID WASTE TRASH.

Cooking Oil Disposal Volumes & Mean Disposal Costs



In the “Cooking Oil Disposal Volumes & Mean Disposal Costs” chart, we summarize the average disposal costs for the various methods. The results according to our survey showed that Recycling/Reuse of cooking oil was the method used to dispose of the greatest volume of oil while Pump Truck Services was the most costly method of disposal for the establishments. Disposal by use of the cooking oil as a livestock feed, though very economical, may have limitations in the volume that can be disposed, and may additionally be constrained by sanitation and livestock health impacts.

Cumulative Volume of Recycling Diversions & Landfilling of Used Cooking Oil
Tracked by the County of Hawai'i (tons)

	FY2001	FY2002	FY2003	FY2004
July	0.00	22.29	49.71	33.99
August	0.00	19.73	30.39	16.59
September	0.00	12.60	16.63	32.82
October	11.63	28.57	24.40	23.73
November	12.60	14.64	15.62	23.94
December	10.66	9.69	27.97	27.68
January	7.75	16.78	22.65	24.74
February	8.72	20.07	21.93	32.36
March	10.66	36.15	22.89	40.77
April	30.56	27.55	14.89	38.99
May	12.60	19.95	20.72	31.41
June	15.50	29.07	27.29	35.34
FY Total	120.68	257.09	295.09	362.35

Est. direct shipments to Island Commodities	50.00
Est. direct shipments to Pacific BioDiesel	12.00
Total direct shipments to Off-Island Recyclers	<u>62.00</u>
Estimated Total Cooking Oil Disposal for FY03-04 *	424.35

* Note: FY 2002, 2003 and 2004 tonnage adjusted to account for only used cooking oil disposal at the Pu'uana'hulu Landfill based on estimates by Pump Truck Service companies.

According to our survey, our respondents who employ Recyclers or Pump Truck Services were responsible for approximately 353.32 tons (\approx 91,000 gallons) of the Total Used Cooking Oil Disposed in Hawai'i County. Given that our internal Department accounting of used cooking disposal by all establishments yielded an estimated 424.35 tons (\approx 110,000 gallons) in FY2004, the respondents to our survey seem to account for about 83% of the volume generated. This observation could be the result of a strong self-selecting response factor by those establishments with high volumes of used cooking oil that already recycle and this factor may skew any extrapolation based on these results.

Projection:

In order to determine whether there is a sufficient used cooking oil volume market for a biodiesel production facility on the Big Island of Hawai`i, an extrapolation based on the survey results was calculated. Assumptions were applied to the survey non-respondents to characterize their establishments and develop a projection of used cooking oil generation in the County of Hawai`i. Similar qualifying criteria were applied to the Department of Health listings of non-respondents to obtain only commercial food handling establishments under consideration. Further, remaining establishments were then characterized by Dine-In, Takeout/Delivery, Food Product and Resort facility types or those that did not use cooking oil based on similarities to respondents to the survey that marked the “do not use cooking oil” option. An average volume of used cooking oil per type of establishment was then calculated from the survey respondents. An extrapolation based on the number of survey non-respondents by establishment type multiplied by the average used cooking oil generation per establishment was calculated and the results are displayed in the following table.

Extrapolation of Used Cooking Oil Generation for Survey Non-Respondents

	Dine-In	Takeout	Product	Resort
Survey Respondents	110	87	27	9
Oil per Establishment Type (gallons/mo.)	5601	4558	902	1420
Mean per Establishment	51	52	33	158
Survey Non-Respondents	161	55	18	1
Oil per Establishment Type (gallons/mo.)	8198	2882	602	158
Extrapolated Mean	51	52	33	158

Note: Non-Respondents were categorized into a single Establishment Type to avoid double counting and simplify the extrapolation.

The Mean Used Oil per Establishment was calculated for the four types of food handling establishments by dividing the Total Oil per Establishment Type by the number of establishments. Establishments that marked multiple categories were tallied in those columns. An interesting result of this calculation is that DINE-IN and TAKEOUT establishments have similar per establishment used cooking oil generation while the RESORTS had the highest volumes generated. Total used cooking oil generated by survey respondents was 8,163 gallons per month, which translates into ≈ 380 tons per year. The Mean per Establishment used cooking oil volumes were then multiplied by the number of survey non-respondents that matched those establishment types to yield an extrapolation of 11,839 gallons per month, which translates into ≈ 550 tons per year. An estimate of the total generation of used cooking oil in the County of Hawai'i based on this extrapolation would yield 20,002 gallons per month, which translates into ≈ 930 tons per year.

This extrapolation is based on responses from the cooking oil survey and assumes that the respondents and non-respondents had similar cooking oil usage characteristics. Estimates for DINE-IN and TAKEOUT establishments could be affected by the above average survey response rates from establishments generating larger amounts of used cooking oil (e.g. Fast Food franchises categorized as both DINE-IN and TAKEOUT facilities), self-reporting by respondents more concerned with recycling used cooking oil or establishments not responding to our survey due to possible non-legal disposal or perceived negligible amounts. The calculation was also dependent on the surveyor's assumptions of establishment characteristics of the non-respondents to the survey. The surveyor was unable to determine if non-respondent establishments were out-of-business

based on the Department of Health listing. Given these factors and assumptions, the extrapolation result should be considered a high estimate of the used cooking oil generated by survey non-respondents.

Since this survey was not a simple random survey but a mix of a population and purposive sampling, extrapolations based on survey data may be biased and could affect the outcome. Statistical analysis of the results is not possible as a result of our methodology, but the purposes of the survey were to gauge the interest in used cooking oil recycling and provide a baseline estimate of the volume of used cooking oil generated on the Big Island. As such, the survey yielded some interesting results and provided insights with regard to amounts of used cooking oil generated, recycling costs, and local recycling options. The information gathered in this survey will be helpful in developing a public outreach/education program to promote the recycling of commercially generated used cooking oil for use in the local production of biodiesel.