BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues.	**Rulemaking 12-11-005** **(Filed November 15, 2012)**

SELF-GENERATION INCENTIVE PROGRAM SEMI-ANNUAL RENEWABLE FUEL USE REPORT NO. 20 FOR THE SIX-MONTH PERIOD ENDING JUNE 30, 2012

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December 3, 2012

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Pacific Gas and Electric Company (PG&E), on behalf of the Program Administrators[1] for the Self Generation Incentive Program (SGIP), hereby files the Twentieth Semi-Annual Renewable Fuel Use Report for completed SGIP projects that utilize renewable fuels, in compliance with California Public Utilities Commission (CPUC) Decision (D.) 02-09-051.[2]

This report provides the Energy Division of the CPUC with the required updated renewable fuel use information on completed SGIP projects using renewable fuel and helps assist the Energy Division in making recommendations concerning modifications to the renewable project aspects of the SGIP. Due to a growing interest in the potential for renewable fuel use projects to reduce greenhouse gas (GHG) emissions, the report also includes a section on GHG emission impacts from renewable fuel SGIP projects.

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1 The SGIP Program Administrators include PG&E, Southern California Edison Company, Sothern California Gas Company, and the California Center for Sustainable Energy in San Diego Gas & Electric Company's service territory.

2 D.02-09-051, September 19, 2002.

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Respectfully submitted,

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Self-Generation Incentive Program Semi-Annual Renewable Fuel Use Report No. 20 for the Six-Month Period Ending June 2012

1. Overview

Report Purpose

This report complies with Decision 02-09-051 (September 19, 2002) of the California Public Utilities Commission (CPUC). That decision requires Self-Generation Incentive Program[1] (SGIP or Program) Program Administrators (PAs) to provide updated information every six months[2] on completed SGIP projects using renewable fuel.[3] The purpose of these Renewable Fuel Use (RFU) reports is to provide the Energy Division of the CPUC with the required updated renewable fuel use information. In addition, the reports help assist the Energy Division in making recommendations concerning modifications to the renewable project aspects of the SGIP. Traditionally, these reports have included updated information on project fuel use and installed costs.

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1 The SGIP provides incentives to eligible utility customers for the installation of new self-generation equipment. The program is implemented by the CPUC and administered by Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE) and Southern California Gas Company (SCG) in their respective territories, and the California Center for Sustainable Energy (CCSE), formerly the San Diego Regional Energy Office (SDREO), in San Diego Gas and Electric (SDG&E) territory.

2 Ordering Paragraph 7 of Decision 02-09-051 states:

"Program administrators for the self-generation program or their consultants shall conduct on-site inspections of projects that utilize renewable fuels to monitor compliance with the renewable fuel provisions once the projects are operational. They shall file fuel-use monitoring information every six months in the form of a report to the Commission, until further order by the Commission or Assigned Commissioner. The reports shall include a cost comparison between Level 3 and 3-R projects…."

Ordering Paragraph 9 of Decision 02-09-051 states:

"Program administrators shall file the first on-site monitoring report on fuel-use within six months of the effective date of this decision [September 19, 2002], and every six months thereafter until further notice by the Commission or Assigned Commissioner."

3 The Decision defines renewable fuels as wind, solar, biomass, digester gas, and landfill gas. Renewable fuel use in the context of this report effectively refers to biogas fuels obtained from landfills, wastewater treatment plants, food processing facilities, and dairy anaerobic digesters.

Due to a growing interest in the potential for renewable fuel use projects to reduce greenhouse gas (GHG) emissions,[4] a section on GHG emission impacts from renewable fuel SGIP projects has been added to the reports beginning with RFU Report No. 15.

RFU Report No. 20 covers projects completed during the last six months (i.e., January 1, 2012 to June 30, 2012) as well as all renewable fuel use projects installed previously under the SGIP since the Program's inception in 2001. Results of analysis of renewable fuel use compliance presented in this RFU Report are based on the 12 months of operation from July 1, 2011, to June 30, 2012.

RFU and RFUR Projects

The incentives and requirements for SGIP projects utilizing renewable fuel have varied throughout the life of the SGIP. In this report, assessing compliance with the Program's minimum renewable fuel use requirements is restricted to the subset of projects actually subject to those requirements (i.e., Renewable Fuel Use Requirement (RFUR) projects) by virtue of their participation year, project type designation, and warranty status.[5] However, the analysis of project costs included in this report covers all projects using some renewable fuel (i.e., Renewable Fuel Use (RFU) projects). All RFUR projects are also RFU projects; however, not all RFU projects are RFUR projects. This distinction is responsible for differences in project counts in this report's tables. Differences between RFU and RFUR projects are summarized in Table 1. Similarly, Table 2 reports only on RFUR projects whereas Table 15 lists all RFU projects, including those not subject to the Program's minimum renewable fuel use requirements ("Other RFU projects").

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[4] While the SGIP was initially implemented in response to AB 970 (Ducheny, chaptered 09/07/00) primarily to reduce demand for electricity, SB 412 (Kehoe, chaptered 10/11/09) limits the eligibility for incentives pursuant to the SGIP to distributed energy resources that the CPUC, in consultation with the state board, determines will achieve reduction of greenhouse gas emissions pursuant to the California Global Warming Solutions Act of 2006.

[5] The SGIP requires such projects to limit use of non-renewable fuel to 25 percent on an annual fuel energy input basis. This requirement is based on FERC definitions of renewable energy qualifying facilities from the original Public Utility Regulatory Policy Act (PURPA) of 1978.

Table 1: Summary of RFU vs. RFUR Parameters

Parameter	RFU	
	"Other" RFU[6]	RFUR
Annual Renewable Fuel Use	0 – 100%	75% - 100%
Heat Recovery	Required	Not Required
Incentive Level	Same as non-renewable projects	Higher than non-renewable projects
No. of Projects	9	109

Directed Biogas Projects

In CPUC Decision 09 -09-048 (September 24, 2009), eligibility for RFUR incentives was expanded to include "directed biogas" projects. Deemed to be renewable fuel use projects, directed biogas projects are eligible for higher incentives under the SGIP, and subject to the fuel use requirements of renewable fuel use projects. Directed biogas projects purchase biogas fuel that is produced at another location. The procured biogas is processed, cleaned -up, and injected into a natural gas pipeline for distribut ion. Although the purchased biogas is not likely to be delivered and used at the SGIP renewable fuel project, the SGIP is credited with the overall use of biogas resources.

RFU Report No. 17 marked the first appearance of completed directed biogas proje cts under the SGIP. Each project is equipped with an on -site supply of utility-delivered natural gas. As such, the directed biogas is not literally delivered, but notionally delivered, as the biogas may actually be utilized at any other location along th e pipeline route. Nineteen directed biogas projects have been operational for one full calendar year and therefore are required to be in compliance with renewable fuel use requirements. Based on the fuel use information collected thus far, it is evident that additional information will be required to make final compliance determinations of directed biogas projects. In the meantime, preliminary compliance assessments have been developed using available data.

[6] The number of "Other" RFU projects increased from eight to nine in RFU Report No. 19 due to the completion of SCE project PY10 -003. This project was completed in December of 2010 but was not included in RFU Reports Nos. 17 and 18. The project was initially listed as non-renewable only but examination of metered data revealed the presence of renewable fuel.

Summary of RFU Report No. 20 Findings

The following bullets represent a summary of key findings from this report:

- As of June 30, 2012, there were 118 RFU facilities deployed under the SGIP, representing approximately 54.3 megawatts (MW) of rebated capacity. One hundred and nine of these facilities were RFUR projects and represented approximately 50.3 MW of rebated capacity. The remaining nine "Other" RFU projects represented approximately 4.0 MW of rebated capacity.
- RFU Report No. 20 marks the fourth appearance of completed SGIP projects utilizing directed biogas. Twelve of the fifteen RFUR projects added during the first half of 2012 were natural gas fuel cells that fulfill renewable fuel use requirements via purchase of directed biogas that is produced off-site.
- Of the 109 RFUR projects, 38 (35 percent) operated solely from on-site renewable fuels and as such inherently comply with renewable fuel use requirements. Of the remaining 71 dual-fuel RFUR facilities:
  - Five were found to be in compliance with renewable fuel use requirements,
  - Seven were conditionally in compliance until information found in directed biogas invoices can be verified,
  - One could not have its compliance determined due to a lack of information,
  - Eleven were found to have their compliance status indeterminable because information was available only at the fleet level,
  - Five were out of contract and as such were no longer subject to reporting and compliance requirements,
  - Thirty nine were found not to be applicable with respect to the requirements as they have not yet been operational for a full year, and
  - Three were found to be out of compliance.
- Of the thirty nine facilities not yet applicable with respect to the renewable fuel use requirements, 36 are directed biogas systems. Unlike prior RFU Reports, in this report there were no facilities in this category for which we could evaluate compliance.[7]
- RFU facilities are powered by a variety of renewable fuel (i.e., biogas) resources. However, approximately 82 percent of the rebated capacity of RFU facilities deployed through June 30, 2012, was powered by biogas derived from landfills or wastewater treatment facilities.

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[7] Reasons why compliance could not be evaluated are delineated in Section 3: Fuel Use at RFUR Projects

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- Prime movers used at RFUR facilities include fuel cells, microturbines, and internal combustion (IC) engines. Historically, IC engines have been the dominant prime mover technology of choice at RFUR facilities. With the emergence of directed biogas as a renewable resource, IC engines have as of this reporting period been surpassed by fuel cells. Fuel cells provide approximately 32.5 MW (about 65 percent) of the overall 50.3 MW of rebated RFUR capacity. IC engines provided 13.8 MW (about 27 percent of all RFUR capacity).
- Based on samples of costs of RFU facilities, the average costs of renewable projects appeared to be higher than the average costs of non-renewable projects. However, limited and highly variable cost data prevent the conclusion that there is a 90 percent certainty that the mean cost of renewable-powered fuel cells and IC engines is higher than the mean cost of fuel cells and IC engines powered by non-renewable resources. In the case of fuel cells, other factors such as system size and fuel cell chemistry are confounding sample comparisons to ever increasing extents.
- RFU facilities have considerable potential for reducing GHG emissions. The magnitude of the GHG emission reduction depends largely on the manner in which the biogas would have been treated in the absence of the program (i.e., the "baseline" condition). RFU facilities that would have been venting biogas directly to the atmosphere have a much higher GHG emission reduction potential than RFU facilities that would have been required to capture and flare biogas.[8]
  - In general, RFU facilities for which flaring biogas was the baseline condition decreased GHG emissions by around 0.4 tons of carbon dioxide equivalent (CO_2eq) per megawatt-hour (MWh) of generated electricity.
  - Conversely, the GHG emission reduction potential for RFU facilities for which venting biogas was the baseline condition is around five (5) tons of CO_2(eq) per MWh of generated electricity; an order of magnitude greater in GHG emission reduction potential.
- Potential for GHG emission reductions from RFU facilities may also be affected by the use of waste heat recovery at the RFU facility. In general, RFU facilities that use waste heat recovery increase the potential for GHG emission reduction if natural gas would otherwise have been used to generate process heat.

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[8] Biogas which is vented to the atmosphere has a significant amount of methane. Methane is a very powerful GHG compound with approximately 21 times the GHG impact of CO_2.

Conclusions and Recommendations

On-Site Biogas Growth and Incentives

California has substantial biogas resources that could potentially be used to generate renewable power and reduce GHG emissions. For example, there are over 1,000 landfills, 200 wastewater treatment facilities and thousands of dairies in the state that do not capture and use biogas generated by their operations. Locating RFU systems at these facilities could provide considerable GHG emission reductions; help address regional ground water quality issues; serve as new renewable energy generating capacity; and create local jobs. While past RFUR reports have focused on cost differences between technologies employing biogas and conventional fuel resources, there has not been investigation into incentive levels that may help overcome the institutional or risk factors impedeing development of on-site biogas systems in California. The CPUC and SGIP Working Group may want to examine the ability of different incentive levels of structures to increase growth of RFU systems within California.

Increased Understanding of Biogas Project Cleanup Costs

The cost breakdown conducted to date on RFU projects does not provide definitive information on the costs of gas clean-up equipment. However, such information is important in determining if there should be differences in incentive levels for RFU projects using biogas fuels. In addition, gas clean-up requirements (and therefore costs) are likely to differ between prime mover technologies (e.g., fuel cells versus microturbines).

The SGIP administrators have recently started tracking biogas cleanup costs and directed biogas premiums in their statewide project database. These are valuable additions and we continue to recommend that the CPUC / Working Group consider funding an expanded study on the capital, operating, and maintenance costs of different gas clean-up systems required on different prime movers fueled by biogas. The study should include biogas projects operating outside of the SGIP and California. This information may help with the recommended RFU incentive structure study.

Increased Information on Directed Biogas Compliance Protocols

This RFU Report includes an evaluation of compliance of directed biogas projects that is conditional in nature. Nineteen directed biogas projects have been operational for at least one full calendar year and therefore are required to be in compliance with renewable fuel use requirements. Based on the fuel use information collected thus far, it continues to be evident that additional information will be required to make a final compliance determination of directed biogas projects. In particular, we continue to recommend that protocols governing compliance include the following information:

- Renewable fuel invoices for each individual SGIP directed biogas project; rather than for aggregated facilities. If an invoice covers more than one SGIP RFU project then the total quantity of directed biogas purchased must be allocated to individual SGIP projects.
- Renewable fuel metering information associated with injection of directed biogas into the pipeline at the source.
- Pipeline allocation reports for transportation of directed biogas from the producer to California

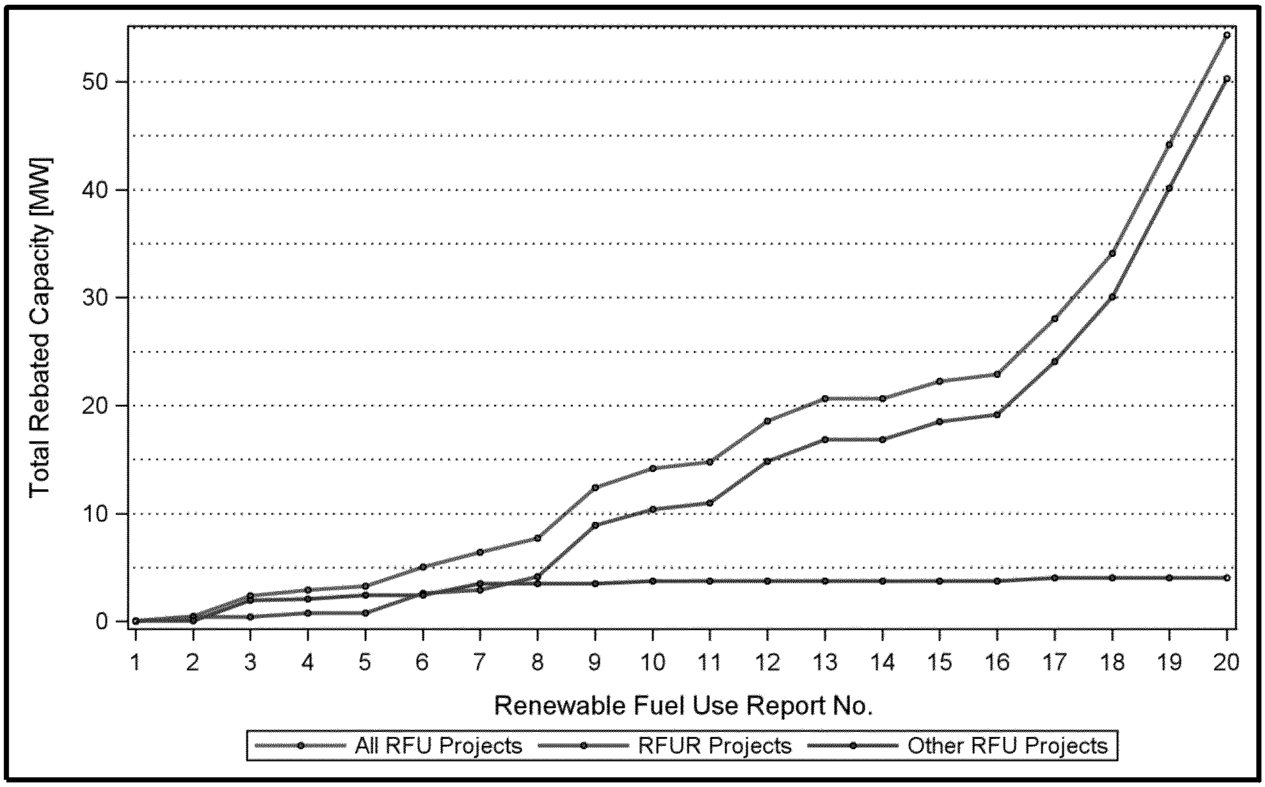
Further Studies on Projects Repeatedly Out of Compliance

This report marks the sixth consecutive occurance of non-compliance with renewable fuel use requirements. While some of these instances of non-compliance are due to projects occasionally falling below the minimum renewable fuel limit, some projects are consistently out of compliance. The CPUC / Working Group should consider further exploration into reasons why certain projects are consistently not in compliance with the SGIP standards. This information could potentially be useful to ensure higher levels of compliance in the future.

Project Capacity, Fuel Types, and Prime Mover Technology

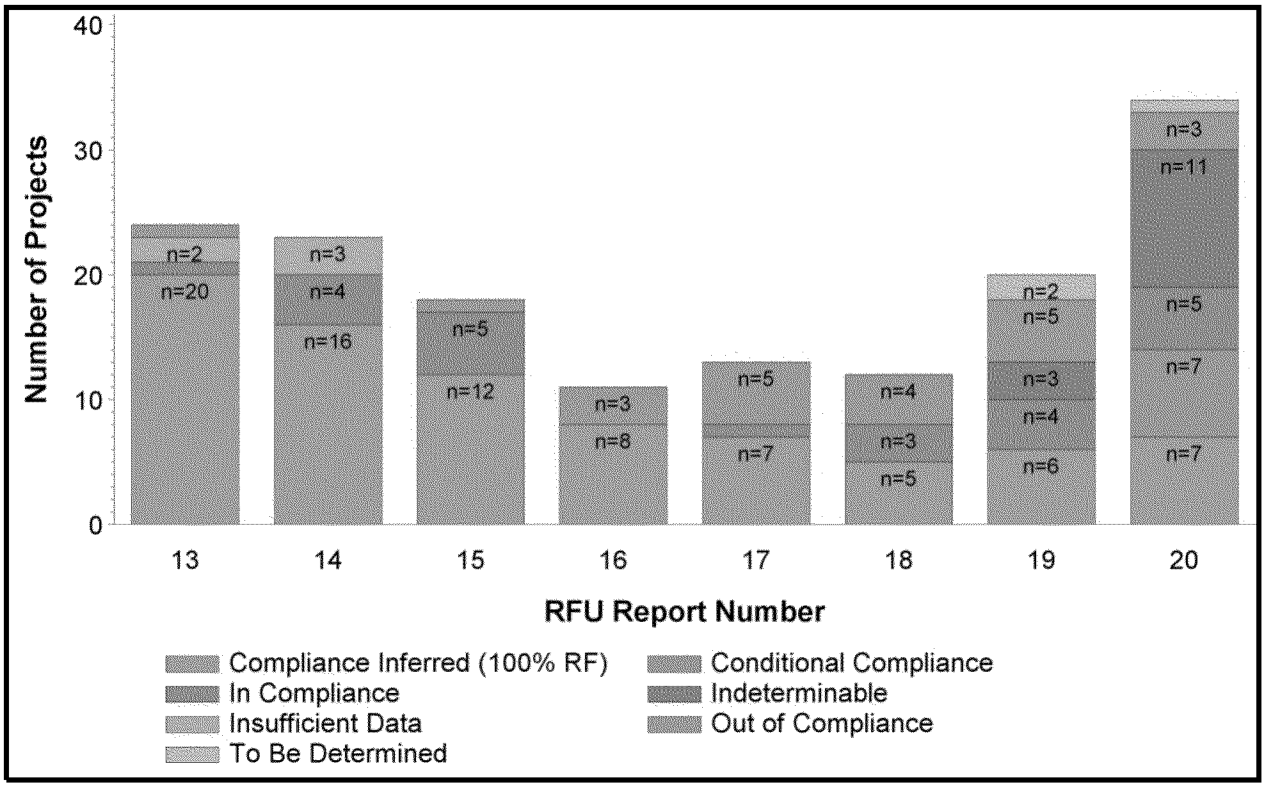
The capacity of RFUR and Other RFU projects, and the combined total (RFU projects) covered by each RFU Report is depicted graphically in Figure 1.

Figure 1: Project Capacity Trend (RFU Reports 1–20)



While all RFUR projects are allowed to use as much as 25 percent non-renewable fuel, 35 percent of RFUR projects operate completely from on-site renewable fuel resources. Up to and including RFU Report No. 12, there had been no instances where available data indicated non-compliance with the Program's renewable fuel use requirements. However, note that prior to RFU Report No. 13 some data were not available to evaluate compliance of all dual-fuel projects. The current report contains three instances of non-compliance with these requirements. Figure 2 shows the history of compliance back to RFU Report No. 13 for all projects that were subject to the renewable fuel use requirement when the respective report was written.

Figure 2: History of Compliance with RFU Requirement

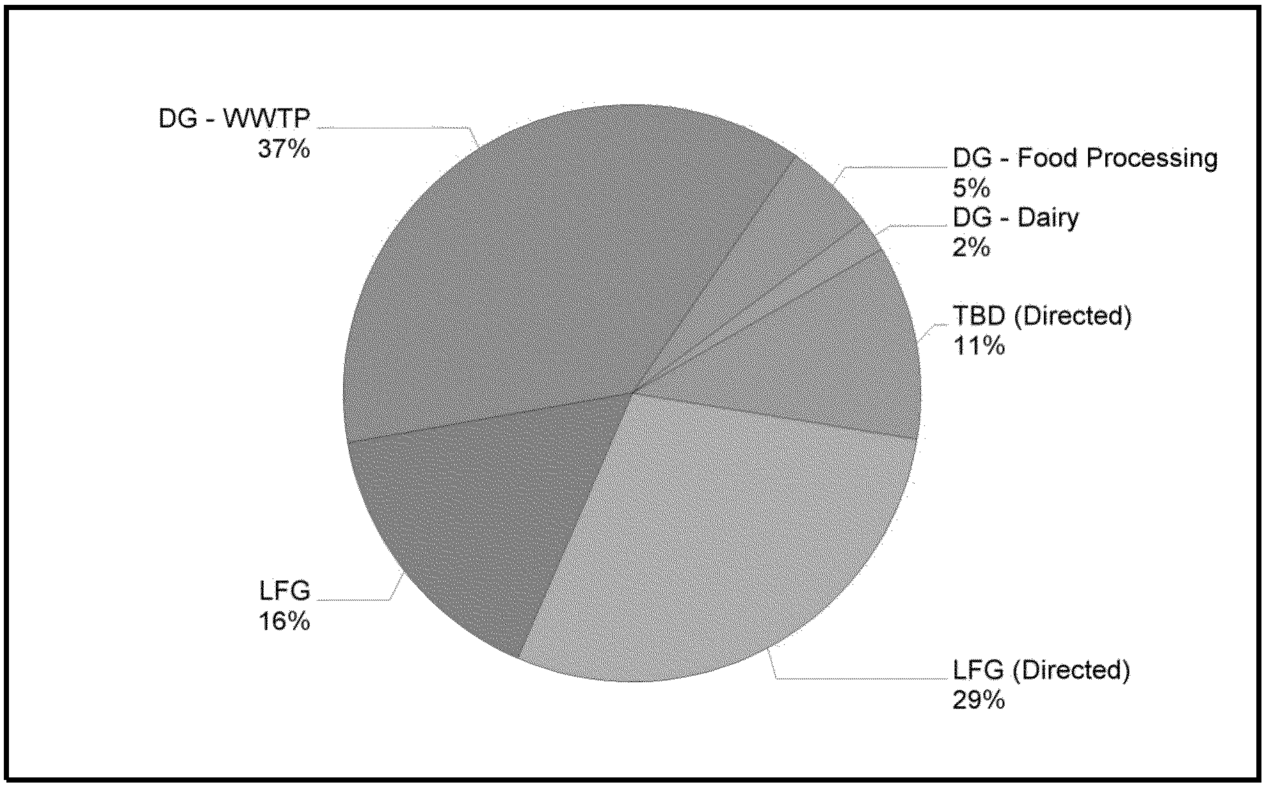


* This figure contains information limited to systems that are subject to the renewable fuel use requirement – systems under warranty and operational for at least one calendar year during each RFU Report's specific reporting period. Other systems are excluded from this figure.

** No data label is drawn when n=1

RFU projects typically use biogas derived from landfills or anaerobic digestion processes that convert biological matter to a renewable fuel source. Anaerobic digesters are used at dairies, wastewater treatment plants, or food processing facilities to convert wastes from these facilities to biogas. Figure 3 shows a breakout of RFU projects as of June 30, 2012, by source of biogas (e.g., landfill gas, dairy digester gas, food processing digester gas) on a rebated capacity basis. It illustrates that the majority of biogas used in SGIP RFU projects is derived from landfills and wastewater treatment plants, with 45 and 37 percent, respectively. The recently completed directed biogas projects have noticeably increased the proportion of projects using landfill gas. Dairy digesters provide the smallest contribution at two percent of the total rebated RFU project capacity.

Figure 3: Renewable Fuel Use Project Rebated Capacity by Fuel Type



LFG = landfill gas; WWTP = wastewater treatment plants; DG=digester gas

Figure 4 provides a breakdown of the relative contribution of the different biogas fuels by prime mover technology. Several observations can be made from examining Figure 4. Fuel cells and IC engines are the dominant technologies with 65 and 28 percent of rebated capacity, respectively. RFU Report No. 20 marks the fourth appearance of directed biogas projects installed under the SGIP; many of these projects are fuel cells utilizing directed biogas sourced from landfills. These directed biogas projects have increased the prominence of fuel cells as a prime mover technology.

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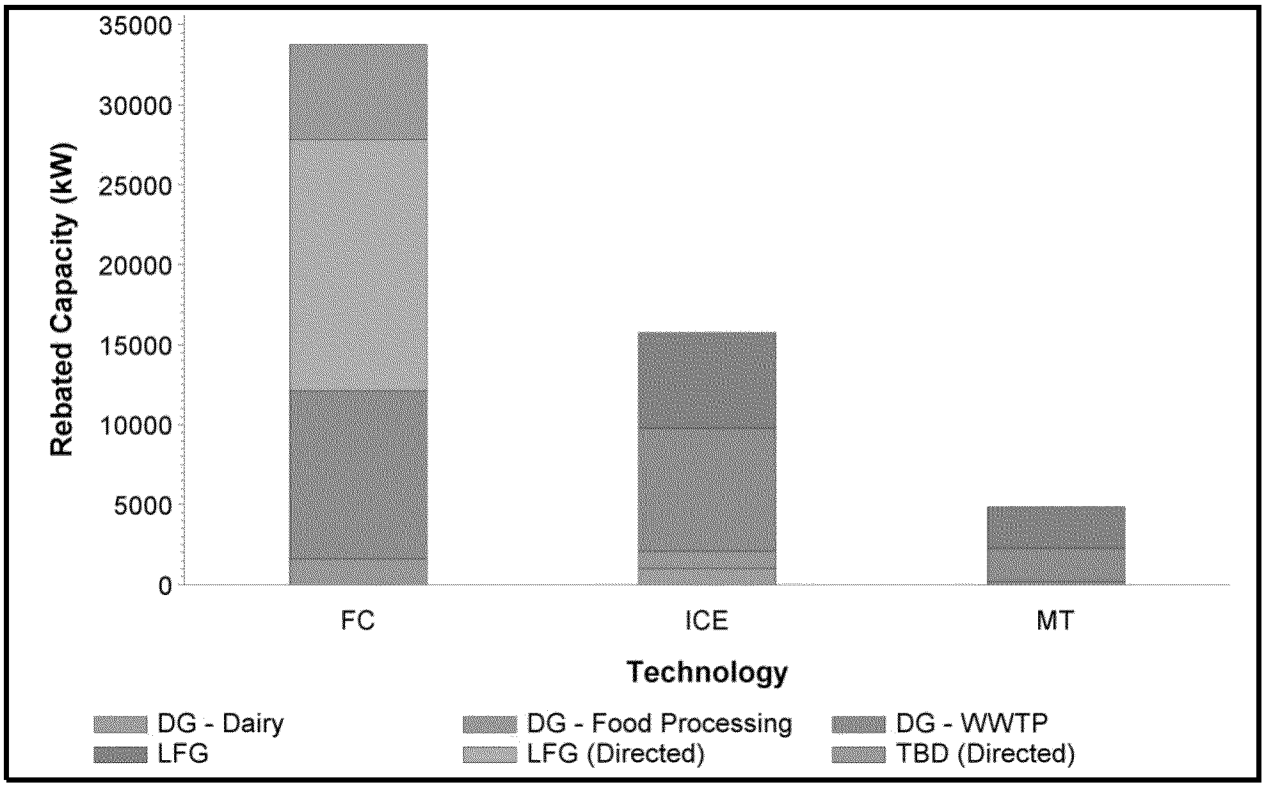
Figure 4: Contribution of Biogas Fuel Type by Prime Mover Technology



LFG = landfill gas; WWTP = wastewater treatment plants; MT = micro-turbines; ICE = internal combustion engine; FC = fuel cells; DG = digester gas

Cost Data

Itron also analyzed project cost data available for the renewable and non-renewable SGIP projects completed to date. Average costs of renewable projects were higher than the average costs of non-renewable projects – however the combined influence of relatively small sample sizes and substantial variability preclude us from estimating incremental costs for future SGIP participants that are accurate enough to be used directly for program incentive design purposes.

Confidence intervals estimated for the entire population of SGIP participants (both past and future) are very large. There was a limited quantity of cost data for fuel cells and IC engines. This limited amount of data increases the uncertainty associated with estimates of population mean costs of fuel cells and IC engines. As a result, it is impossible to say with 90 percent confidence that the population mean costs of renewable IC engines and fuel cells are any higher than the population mean costs of non-renewable IC engines and fuel cells. This lack of confidence suggests that data for past projects should not be used as the sole basis for SGIP design elements affecting future participants. Engineering estimates, budget cost data, and rules-of-thumb likely continue to be more suitable for this purpose at this time.

2. Summary of Completed RFUR Projects

There were fifteen new RFUR SGIP projects completed during the subject six -month reporting period. Fourteen of the fifteen projects were fuel cells ranging in size from 210 kW to 2,800 kW. A total of 1 09 RFUR projects had been completed as of June 30, 2012. A list of all SGIP projects utilizing renewable fuel (RFUR and Other RFU) is included as Appendix A.

The 109 completed RFUR projects represent approximately 50.3 MW of rebated generating capacity. The prime mover technologies used by these projects are summarized in Table 2. Fuel cells and IC engines together account for over 92 percent of RFUR rebated capacity, with microturbines making up the remaining 8 percent. The average sizes of fuel cell a nd IC engine projects are almost three times as large as the average microturbine project size.

Table 2: Summary of Prime Movers for RFUR Projects

Prime Mover	Num. of Projects	Total Rebated Capacity (kW)	Average Rebated Capacity Per Project (kW)*
FC	66	32,490	493
MT	19	3,970	179
ICE	24	13,846	577
Total	**109**	**50,306**	**460**

FC = fuel cell; MT = micro-turbine; ICE = internal combustion engine
* Represents an arithmetic average

Many of the RFUR projects recover waste heat even though they are exempt from heat recovery requirements. Waste heat recovery incidence by renewable fuel type is summarized in Table 3. Verification inspection reports obtained from PAs and information fro m secondary sources such as direct contact with the participant, technical journals, industry periodicals, and news articles indicate that 40 of the 109 RFUR projects recover waste heat. All but three of the 39 on -site digester gas systems include waste h eat recovery.[9] Waste heat recovered from digester gas systems is generally used to pre-heat waste water sludge prior to being pumped to digester tanks. Conversely, 4 of 15 on -site landfill gas systems include waste heat recovery. In addition, those landfill gas systems that do recover heat do not use it directly at the landfill site. Instead, the landfill gas is piped to an adjacent site that has both electric and thermal loads, and the gas is

9 In several RFU Reports up to and including RFU Report No. 15 three (3) projects were incorrectly reported as not including heat recovery. This error resulted from misinterpretation of contents of Installation Verification Inspection Reports.

used in a prime mover at that site. [10] None of the 40 complet ed directed biogas projects whose fuel source is known include waste heat recovery.

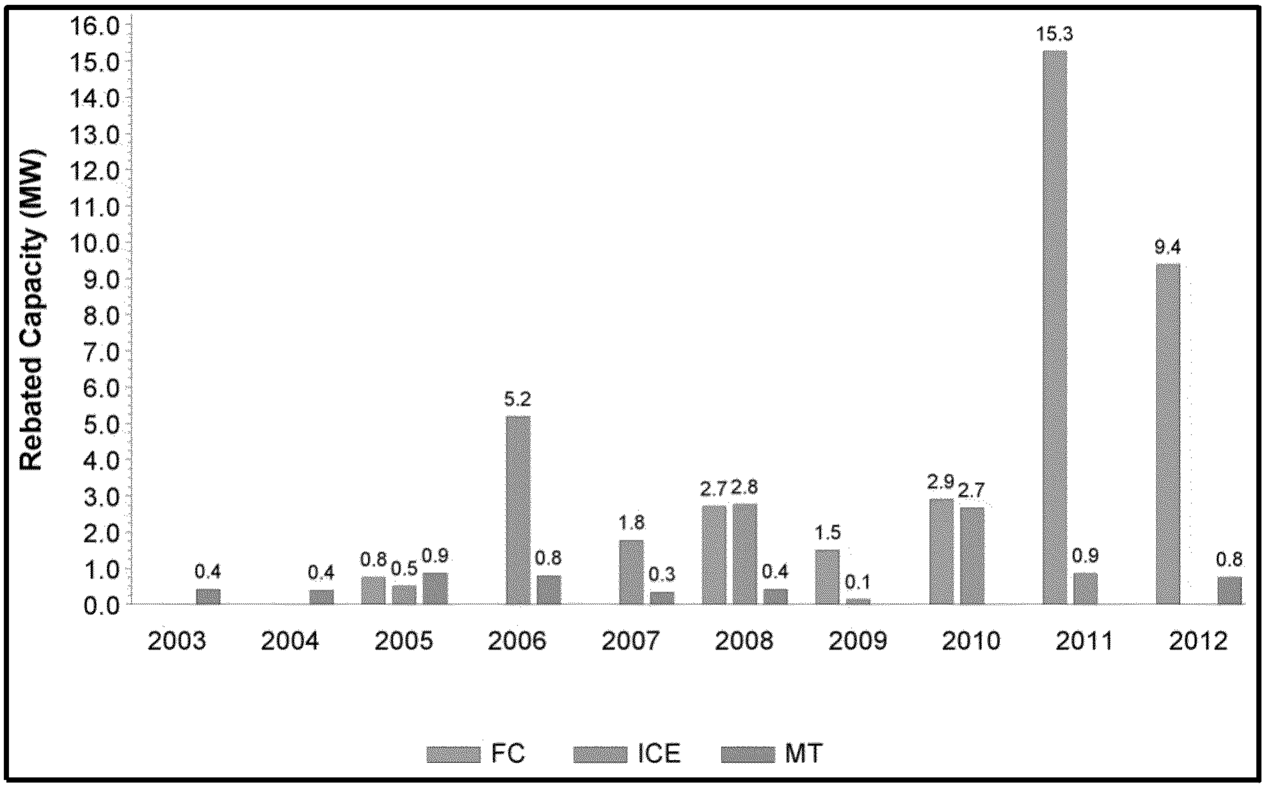
Table 3: Summary of Waste Heat Recovery Incidence by Type of Renewable Fuel for RFUR Projects

Renewable Fuel Type	Total No. of Sites	Sites With Heat Recovery	Sites Without Heat Recovery
Digester Gas	39	36	3
Digester Gas (Directed)	2	0	2
Landfill Gas	15	4	11
Landfill Gas (Directed)	38	0	38
TBD (Directed)	15	0	15
Total	**109**	**40**	**69**

Figure 5 shows the total renewable fuel capacity for each year by technology. The peak project year for internal combustion engines was 2006 for a total capacity of 5.2 MW. Fuel cells were by far the most common renewable fuel projects introduced in 2011 with over 15 MW of rebated capacity completed. Over 9 MW of RFU R fuel cell capacity was completed in the first half of 2012.

[10] In general, above-ground digesters have a built-in thermal load as they operate better if heated. Landfill gas and covered l agoon operations do not typically use recovered waste heat to increase the rate of the anaerobic digestion process.

Figure 5: Rebated RFUR Capacity by Technology and Project Completion Year



3. Fuel Use at RFUR Projects

RFUR projects are allowed to use a maximum of 25 percent non-renewable fuel; the remaining 75 percent must be renewable fuel. The period during which RFUR projects are obliged to comply with this requirement is specified in the SGIP contracts between the host customer, the system owner, and the PAs. Specifical ly, this compliance period is the same as the equipment warranty requirement. For PY01 -PY11 applications, microturbine and IC engine systems must be covered by a warranty of not less than three years. Fuel cell systems must be covered by a minimum five-year warranty. For PY12 projects, all generation systems must have a minimum 10 year warranty. [11] Therefore, the fuel use requirement period is three, five, or ten years, depending on the technology type. The SGIP applicant must provide warranty (and/or maintenance contract) start and end dates in the Reservation Confirmation and Incentive Claim Form.

[11] No such projects applying to the program in 2012 have been completed yet.

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Facilities are grouped into three categories in assessing renewable fuel use compliance:

- "Dedicated" RFU facilities located where biogas is produced (e.g., wastewater treatment facilities, landfill gas recovery operations) and the biogas is the only fuel source used for powering the RFU system;
- "Blended" RFU facilities located where biogas is produced that use a blend of biogas and non-renewable fuel (e.g., natural gas); and
- "Directed" RFU facilities, located somewhere other than where biogas is produced and not necessarily directly receiving any of the biogas.

For the 38 RFUR facilities where biogas was produced and acted as the only fuel source for the RFUR system, the facility was automatically in compliance. For dual-fueled RFUR facilities using both renewable and non-renewable fuel, assessing compliance requires information on the amount of biogas consumed relative to the amount of non-renewable fuel consumed on-site. It is not possible to use the same method in assessing compliance of directed biogas projects as that used for assessing compliance of "blended" RFUR projects. In "blended" RFUR projects using biogas produced on-site, the metered amount of non-renewable fuel is used to determine if it is less than or equal to 25% of the total annual energy input to the RFUR facility. However, in directed biogas RFUR projects, metering of SGIP systems captures total fuel use only; it provides no information on how much biogas was actually produced and allocated to the project.

Assessing compliance of directed biogas projects requires information about off-site biogas production and subsequent allocation to customers that may or may not be SGIP participants. In this report, compliance of these projects was assessed by comparing a project's total metered natural gas consumption data to the biogas amount purchased as shown by invoices. Compliance of directed biogas projects was found to fall into one of three categories:

- In Compliance (Conditional): Analysis of metered natural gas consumption data and renewable fuel invoices for the reporting period indicate that renewable fuel was purchased to account for at least 75% of the project's total fuel consumption. A final compliance finding would require collection of substantially more information to validate contents of renewable fuel invoices. Collection of this information was outside the scope of this report.
- Compliance Indeterminable: Compliance could not be determined at the site-specific level based on currently available information. This was found to be the case when the renewable fuel invoices provided to Itron applied to a fleet of projects rather than a specific project.

- Compliance to be Determined: Directed biogas invoices and/or metered fuel consumption data required to make a compliance assessment are not yet available from the program participant. These data are expected to become available in the future.

A detailed discussion of the transactions and complications that arise when evaluating compliance of directed biogas projects was presented in RFU Report No. 17.

Fuel supply and contract status for R FUR projects are summarized in Table 4. Only 73 of the total 109 RFUR projects had active warranty status. Thirty -six RFUR projects (one third of all RFUR projects) had an expired warranty status. Of the 73 RFUR projects with active warranties, seven operated solely on renewable fuel. By definition, all seven of those RFUR projects are in compliance with SGIP renewable fuel use requirements.

Table 4: Summary of Fuel Supplies and Warranty Status for RFUR Projects

Fuel Supply	Warranty/Renewable Fuel Use Requirement Status					
	Active		Expired		Total	
	No. Projects (n)	Rebated Capacity (kW)	No. Projects (n)	Rebated Capacity (kW)	No. Projects (n)	Rebated Capacity (kW)
Renewable only	7	3,705	31	11,523	38	15,228
Nonrenewable & Onsite Renewable	11	6,590	5	2,648	16	9,238
Nonrenewable & Offsite, Directed Renewable	55	25,840	-	-	55	25,840
Total	**73**	**36,135**	**36**	**14,171**	**109**	**50,306**

In addition, Table 4 shows that 38 of the total 109 RFUR sites (both those with expired or active warranties) obtain 100 percent of their fuel from renewable resources. Information on fuel use for the remaining 71 blended renewable and directed biogas projects (both active a nd expired) is presented below.

Dual-fueled RFUR Projects In Compliance

During this reporting period, five of the dual-fueled projects were found to be in compliance with SGIP renewable fuel use requirements based on analysis of metered data.

- **SCE PY06-062.** This 900 kW fuel cell system came on -line in March 2008. The system is located at a wastewater treatment facility and utilizes renewable fuel produced by a digester system. Metered electric generation and natural gas consumption data were obtained from the SGIP participant. Itron assumed an electrical conversion efficiency of 33 percent to estimate total fuel use during periods of electricity generation. Based on these estimates, Itron believes natural gas usage during the current reporting period did not exceed 20 percent of the total annual fuel input. The system was found to be in compliance with SGIP renewable fuel use provisions for this reporting period.

- **PG&E A-1490**. This 600 kW fuel cell project came on-line in April 2008. Metered electric generation and natural gas consumption data were obtained from the SGIP participant. Itron assumed an electrical conversion efficiency of 33 percent to estimate total fuel use during periods of electricity generation. Based on these estimates, Itron believes natural gas usage during the current reporting period did not exceed 15 percent of the total annual fuel input and the system was in compliance with SGIP renewable fuel use provisions.
- **SCG 2006-036.** This 1200 kW fuel cell system came on-line in October 2008 and is located at a wastewater treatment facility and utilizes renewable fuel produced by a digester system. A fuel blending system controls the mix of renewable and non-renewable fuel. Metered electric generation and natural gas consumption data were obtained from the SGIP participant. Itron assumed an electrical conversion efficiency of 33 percent to estimate total fuel use during periods of electricity generation. Based on these estimates, Itron believes natural gas usage during the current reporting period did not exceed 8 percent of the total annual fuel input. The system was found to be in compliance with SGIP renewable fuel use provisions for this reporting period.
- **PG&E A-1749.** This 130 kW IC engine system came on-line in November 2009. The system uses renewable fuel from a wastewater treatment plant digester and recovers waste heat from the engine to preheat the digester sludge. Itron assumed an electrical conversion efficiency of 31 percent to estimate total fuel use during periods of electricity generation. Based on these estimates and an estimated biogas energy content of 650 Btu/SCF, Itron believes natural gas usage during the current reporting period did not exceed 1 percent of the total annual fuel input. The system was in compliance with SGIP renewable fuel use provisions for this reporting period.
- **CCSE-0351-07.** This 560 kW IC engine system came on-line in April 2010. The system is located at a waste water treatment facility and utilizes the anaerobic digester gas from five digesters on-site to provide base load electric power to the treatment facility. When sufficient digester gas is not available to run this system at full load, natural gas is mixed in. Electrical output, natural gas consumption, and digester gas consumption data are being collected by the host customer and were provided to Itron. Based on the data provided, the natural gas usage during the reporting period did not exceed 20 percent of the total energy consumed. The project was in compliance with SGIP renewable fuel use provisions for this reporting period.

Dual-fueled RFUR Projects Not In Compliance

Three projects were found to be using more non-renewable fuel than allowed on an annual fuel input basis. For some of these projects it was necessary to estimate the electrical conversion efficiency because metered biogas consumption data were not available.[12]

- **SCG 2008-003.** This 600 kW fuel cell project came on-line in December 2009 and consists of two 300 kW fuel cells. The system utilizes renewable fuel produced from onion feedstock and natural gas from SCG. At the time of the SCG installation verification inspection, the fuel cells were using a 21 percent natural gas and 79 percent renewable fuel mix. Metered electric generation and natural gas consumption data were obtained from the SGIP participant. In addition, the participant is monitoring biogas usage. Itron assumed an electrical conversion efficiency to estimate total fuel use during periods of electricity generation. Based on these estimates, the natural gas usage during the current reporting period exceeded 41 percent. The system was not in compliance with SGIP renewable fuel use provisions for this reporting period.
- **SCG 2006-012.** This 900 kW fuel cell project came on-line in December 2009 and consists of three 300 kW fuel cells. The system is located at a wastewater treatment facility and utilizes renewable fuel produced from two digesters and natural gas from SCG. These digesters are provided sewage sludge and fat, oil, and grease as feedstock. The fat, oil, and grease feedstock comes from local restaurants and is supplied by a vendor under a contractual agreement. No description of how or when natural gas is used by this system was included in SCG's installation verification inspection report. Itron received metered electric generation and natural gas consumption data from the SGIP participant. In addition the participant is monitoring biogas usage. Itron assumed an electrical conversion efficiency to estimate total fuel use during periods of electricity generation. Based on these estimates, the natural gas usage during the current reporting period exceeded 32 percent. The system was not in compliance with SGIP renewable fuel use provisions for this reporting period.
- **SCE PY10-002.** This project is a 750 kW fuel cell system consisting of three 250 kW stacks, of which only two are rebated as dual fueled systems. The system is located at a waste water treatment plant and at the time of the SCE installation verification inspection was capable of producing sufficient anaerobic digester gas (ADG) to run two of the units using 100% ADG. Itron assumed an electrical conversion efficiency of 33 percent to estimate total fuel use during periods of electricity generation. Based on these estimates,

[12] In these calculations an electrical conversion efficiency of 33 percent was assumed. The intent was to develop an efficiency likely to be lower than the actual efficiency. If the actual efficiency is higher than 33 percent (which is likely), then the actual non-renewable fuel use is higher than the estimated percent.

Itron believes natural gas usage during the current reporting period exceeded 43 percent of the total annual fuel input. The system was not in compliance with SGIP renewable fuel use provisions for this reporting period.

Dual-Fueled RFUR Project in Conditional Compliance

A dual-fueled directed biogas RFUR project is assigned conditional compliance if analysis of metered natural gas consumption data and renewable fuel invoices for the reporting period indicate that renewable fuel was purchased to account for at least 75 percent of the project's total fuel consumption. A final compliance finding would require collection of substantially more information to validate contents of renewable fuel invoices. Seven projects fell into this category during this reporting period.

- **PG&E 1802.** This 400 kW fuel cell project utilizes directed biogas from a landfill and natural gas. The system became operational in December 2010 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.
- **SDREO-0369-10.** This 400 kW fuel cell project utilizes directed biogas from a landfill and natural gas. The system became operational in December 2010 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from July 2011 through June 2012. Itron has also obtained natural gas consumption data from the gas utility from July 2011 through May 2012. Using electric data received from the utility company, fuel consumption for the month of June 2012 was estimated based on a previously observed electrical efficiency of 42%. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.
- **SDREO-0370-10.** This 400 kW fuel cell project utilizes directed biogas from a landfill and natural gas. The system became operational in December 2010 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from July 2011 through June 2012. Itron has also obtained natural gas consumption data from the gas utility from July 2011 through May 2012. Using electric data received from the utility company, fuel consumption for the month of June 2012 was estimated based on an observed electrical efficiency of 41%. Based on a review of the metered data and invoices, it appears that enough renewable fuel was

procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.[13]

- **PG&E 1805.** This 200 kW fuel cell project utilizes directed biogas and natural gas. The system became operational in January 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.
- **PG&E 1859.** This 500 kW fuel cell utilizes directed biogas and natural gas. The system became operational in March 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.
- **PG&E 1871.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in March 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.
- **PG&E 1878.** This 500 kW fuel cell utilizes directed biogas and natural gas. The system became operational in June 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. Based on a review of the metered data and invoices, it appears that enough renewable fuel was procured to satisfy the SGIP's renewable fuel use requirements. This project is found to be in conditional compliance until the contents of the renewable fuel invoices have been verified.

[13] SDREO projects 0369 -10 and 0370 -11 became operational in December 2010 but were not included in RFUR reports Nos. 17 and 18. Due to ongoing improvements to the statewide project tracking system, Itron was not aware of these completions until after report # 18 was submitted.

Dual-Fueled RFUR Project Site-Specific Compliance Status Indeterminable

A dual-fueled RFUR project is assigned compliance status "Indeterminable" if its compliance verification is required but information necessary to draw conclusions about site-specific compliance was not available. The available information was sufficient to enable calculating renewable fuel use at the fleet level only. Eleven projects fell into this category during this reporting period.

- **PG&E 1810, PG&E 1811, and PG&E 1812.** These three 400 kW fuel cell projects (1,200 kW total) utilize directed biogas from a landfill and natural gas. The projects became operational in November 2010 and therefore are required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for each individual project, the directed biogas purchases are made for all three projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 80% renewable fuel, but its compliance at the project level is indeterminable.
- **SCG 2010-012.** This 1 MW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1849.** This 500 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1856.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific

differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.

- **PG&E 1853.** This 600 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1882.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1886.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1885.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in May 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.
- **PG&E 1851.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in June 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from the SGIP participant and natural gas consumption data from the manufacturer. While the metered data are available for this individual project, the directed biogas purchases are

made for a larger fleet of projects combined and do not provide a project-specific differentiation. Based on the information available this fleet of projects appears to be using 75% renewable fuel, but its compliance at the project level is indeterminable.

Dual-Fueled RFUR Project Compliance Status To Be Determined

A dual-fueled RFUR project is assigned compliance status “To Be Determined” if its compliance verification is required but Itron did not have sufficient information to make a determination. There is one directed biogas project in this category.

- **SCE PY10-004.** This 800 kW fuel cell utilizes directed biogas and natural gas. The system became operational in March 2011 and therefore is required to comply with SGIP renewable fuel use requirements. Itron has obtained directed biogas invoices from July 2011 through June 2012 from the SGIP participant. Itron has been unable to collect metered data for this system from the utility companies. The information available at the time this report was prepared is not sufficient to determine compliance with renewable fuel use requirements. Metered data is expected to become available in the future.

Dual-Fueled RFUR Project Compliance Status Not Applicable

A dual-fueled RFUR project is assigned compliance status “Not Applicable” if it has not yet been operational for a complete calendar year, or if its warranty has expired. There are 36 directed-biogas fuel cells and eight blended renewable projects in this category. A preliminary compliance assessment was not attempted for any project in this category.

The following is a summary of projects that are not yet applicable with respect to renewable fuel use requirements.

Not Yet Operational for a Complete Calendar Year

- **SCE PY10-009.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in August 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY10-012.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in August 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY10-022.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in August 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.

- **SCE PY10-023.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in August 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY09-003.** This 300 kW fuel cell is one of four systems installed at the City of Tulare water pollution control facility. The system utilizes a combination of waste water digester gas and natural gas. The system became operational in August 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1850.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1874.** This 500 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1892.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1893.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCG 2010-005.** This 100 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCG 2010-011.** This 900 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1855.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in September 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCG 2010-018.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCG 2010-019.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCG 2010-020.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.

- **SCG 2010 -015.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is n ot required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1858.** This 300 kW fuel cell utilizes directed biogas from a landfill and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1852.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1857.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1868.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1869.** This 600 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1876.** This 200 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not r equired to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1877.** This 200 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1929.** This 420 kW fuel cell utilizes directed biogas and natural gas. The system became operational in December 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY10 -014.** This 500 kW fue l cell utilizes directed biogas and natural gas. The system became operational in December of 2011 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1860.** This 800 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **PG&E 1926.** This 400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 20 12 and therefore is not required to comply with SGIP renewable fuel use requirements yet.

- **PG&E 1950.** This 500 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY09-013.** This 600 kW fuel cell operates on a blend of digester gas from a waste water treatment plant and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY10-011.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **SCE PY10-028.** This 600 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0374-10.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0376-10.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0398-10.** This 210 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0399-10.** This 630 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0361-09.** This 1,400 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0362-09.** This 300 kW fuel cell utilizes a blend of digester gas from a waste water treatment plant and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0363-09.** This 2,800 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.
- **CCSE 0375-10.** This 300 kW fuel cell utilizes directed biogas and natural gas. The system became operational in January 2012 and therefore is not required to comply with SGIP renewable fuel use requirements yet.

Warranty Expired

- **SCE PY03-092.** This 500 kW fuel cell project uses natural gas for backup fuel supply and piloting purposes. The fuel cell system is composed of two molten carbonate fuel cells, each of which is rated for 250 kW of electrical output. Renewable fuel used by this system is produced as a by-product of a municipal wastewater treatment process. A natural gas metering system has been installed by SCG to monitor natural gas usage. Biogas use is not metered. In December 2010 the fuel cells were removed and decommissioned after the warranty period had lapsed. During the period when data were provided and the system was under contract the actual contribution of non-renewable fuel never exceeded 25 percent on an annual fuel input basis.
- **SCE PY03-017.** This IC engine system was designed to use natural gas for back-up and piloting purposes. The SGIP participant provided metered electric generation, biogas consumption, and natural gas consumption data for previous reporting periods. However, in Q2 2008 the participant's SGIP contract reached the end of its term and data were no longer available from this participant. During the period when data were provided and the system was under contract the actual contribution of non-renewable fuel never exceeded 25 percent on an annual fuel input basis.
- **SCE PY04-158 and SCE PY04-159.** These two systems are located at the same wastewater treatment facility and utilize renewable fuel produced by the same digester system. The two projects are grouped together here because they share a common fuel blending system. The fuel blending system controls the mix of renewable and non-renewable fuel. In the second quarter of 2008 the participant's SGIP contract reached the end of its term and no metered data have been available to assess the actual fuel mix since this time. In SCE's September 2006 installation verification inspection reports, the participant reported that the systems were using 80 percent digester gas and 20 percent natural gas.
- **PG&E 1313**. This 240 kW system consists of eight 30 kW microturbines installed at a wastewater treatment facility and uses heat recovered from the system to warm the digesters. Metered daily electric generation, biogas consumption, and natural gas consumption data were obtained from the SGIP participant for this microturbine system. The system has been off during the last four reporting periods.

A summary of renewable fuel use compliance for the 71 dual-fuel systems is presented in Table 5.

Table 5: Fuel-Use Compliance of Dual-Fueled RFUR Projects (Projects Utilizing Non-Renewable Fuel)

PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
SCE	PY06-062	Level 2	FC	DG - WWTP	900	3/4/2008	10,484	80%	Active	Yes
PG&E	1490	Level 2	FC	DG - WWTP	600	4/24/2008	6,186	85%	Active	Yes
SCG	2006-036	Level 2	FC	DG - WWTP	1200	10/27/2008	326	91%	Active	Yes
PG&E	1749	Level 3R	ICE	DG - WWTP	130	11/9/2009	5,667	99%	Active	Yes
SCG	2008-003	Level 2	FC	DG - Other	600	12/14/2009	14,606	59%	Active	No
SCG	2006-012	Level 2	FC	DG - WWTP	900	12/18/2009	14,963	68%	Active	No
CCSE	0351-07	Level 2	ICE	DG - WWTP	560	4/16/2010	9,889	80%	Active	Yes
SCE	PY10-002	Level 2	FC	DG - WWTP	500	10/31/2010	8,389	57%	Active	No
PG&E	1810	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	24,464	Indeterminable	Active	Indeterminable
PG&E	1811	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	24,368	Indeterminable	Active	Indeterminable
PG&E	1812	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	24,680	Indeterminable	Active	Indeterminable
PG&E	1802	Level 2	FC	Landfill Gas (Directed)	400	12/22/2010	24,041	82%	Active	Conditionally

PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
CCSE	0369-10	Level 2	FC	Landfill Gas (Directed)	400	12/31/2010	28,817	81%	Active	Conditionally
CCSE	0370-10	Level 2	FC	Landfill Gas (Directed)	400	12/31/2010	29,634	79%	Active	Conditionally
PG&E	1805	Level 2	FC	Landfill Gas (Directed)	200	1/18/2011	10,379	190%	Active	Conditionally
SCG	2010-012	Level 2	FC	Landfill Gas (Directed)	1000	1/24/2011	58,213	Indeterminable	Active	Indeterminable
PG&E	1859	Level 2	FC	Landfill Gas (Directed)	500	3/11/2011	30,396	81%	Active	Conditionally
PG&E	1871	Level 2	FC	Landfill Gas (Directed)	300	3/14/2011	17,779	106%	Active	Conditionally
SCE	PY10-004	Level 2	FC	Landfill Gas (Directed)	800	3/23/2011	TBD	TBD	Active	TBD
PG&E	1849	Level 2	FC	Landfill Gas (Directed)	500	5/9/2011	28,823	Indeterminable	Active	Indeterminable
PG&E	1856	Level 2	FC	Landfill Gas (Directed)	300	5/9/2011	17,726	Indeterminable	Active	Indeterminable
PG&E	1853	Level 2	FC	Landfill Gas (Directed)	600	5/24/2011	35,461	Indeterminable	Active	Indeterminable
PG&E	1882	Level 2	FC	Landfill Gas (Directed)	400	5/24/2011	17,445	Indeterminable	Active	Indeterminable

PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
PG&E	1886	Level 2	FC	Landfill Gas (Directed)	300	5/24/2011	17,802	Indeterminable	Active	Indeterminable
PG&E	1885	Level 2	FC	Landfill Gas (Directed)	300	5/31/2011	17,569	Indeterminable	Active	Indeterminable
PG&E	1851	Level 2	FC	Landfill Gas (Directed)	300	6/29/2011	17,782	Indeterminable	Active	Indeterminable
PG&E	1878	Level 2	FC	Landfill Gas (Directed)	500	6/29/2011	30,956	106%	Active	Conditionally
SCE	PY10-009	Level 2	FC	Landfill Gas (Directed)	300	8/8/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-012	Level 2	FC	Landfill Gas (Directed)	300	8/8/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-022	Level 2	FC	Landfill Gas (Directed)	400	8/8/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-023	Level 2	FC	Landfill Gas (Directed)	400	8/8/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY09-003	Level 2	FC	DG - WWTP	300	8/30/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1850	Level 2	FC	Landfill Gas (Directed)	420	9/7/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1874	Level 2	FC	Landfill Gas (Directed)	500	9/7/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1892	Level 2	FC	Landfill Gas (Directed)	210	9/7/2011	Not Available	Not Available	Active	Not Applicable ‡‡

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PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
PG&E	1893	Level 2	FC	Landfill Gas (Directed)	210	9/7/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-005	Level 2	FC	Landfill Gas (Directed)	100	9/20/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-011	Level 2	FC	Landfill Gas (Directed)	900	9/21/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1855	Level 2	FC	Landfill Gas (Directed)	300	9/29/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-018	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-019	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-020	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCG	2010-015	Level 2	FC	Landfill Gas (Directed)	420	12/16/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1858	Level 2	FC	Landfill Gas (Directed)	300	12/29/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1852	Level 2	FC	TBD (Directed)	400	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1857	Level 2	FC	TBD (Directed)	300	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1868	Level 2	FC	TBD (Directed)	400	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡

PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
PG&E	1869	Level 2	FC	TBD (Directed)	600	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1876	Level 2	FC	TBD (Directed)	200	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1877	Level 2	FC	TBD (Directed)	200	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1929	Level 2	FC	Landfill Gas (Directed)	420	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-014	Level 2	FC	TBD (Directed)	500	12/31/2011	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1860	Level 2	FC	TBD (Directed)	800	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1926	Level 2	FC	Landfill Gas (Directed)	400	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
PG&E	1950	Level 2	FC	Landfill Gas (Directed)	500	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY09-013	Level 2	FC	DG - WWTP	600	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-011	Level 2	FC	TBD (Directed)	210	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY10-028	Level 2	FC	TBD (Directed)	600	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0374-10	Level 2	FC	TBD (Directed)	210	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0376-10	Level 2	FC	TBD (Directed)	210	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡

PA	Res No.	Incentive Level	Technology	Fuel Type	Size (kW)	Date Operational*	Annual Natural Gas Energy Flow (MMBtu) †	Renewable Fuel Use (% of Total Energy Input)	SGIP Warranty Status	Meets Program Renewable Fuel Use Requirements?
CCSE	0398-10	Level 2	FC	TBD (Directed)	420	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0399-10	Level 2	FC	TBD (Directed)	630	1/1/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0361-09	Level 2	FC	DG - WWTP	1400	1/10/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0362-09	Level 2	FC	DG - WWTP	300	1/10/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0363-09	Level 2	FC	DG - WWTP	2800	1/10/2012	Not Available	Not Available	Active	Not Applicable ‡‡
CCSE	0375-10	Level 2	FC	TBD (Directed)	300	1/10/2012	Not Available	Not Available	Active	Not Applicable ‡‡
SCE	PY03-092	Level 1	FC	DG - WWTP	500	3/11/2005	Not Available	Not Available	Expired	Not Applicable ‡
SCE	PY03-017	Level 3R	ICE	DG - WWTP	500	5/11/2005	Not Available	Not Available	Expired	Not Applicable ‡
SCE	PY04-158	Level 3R	ICE	DG - WWTP	704**	10/25/2006††	Not Available	Not Available	Expired	Not Applicable ‡
SCE	PY04-159	Level 3R	ICE	DG - WWTP	704	10/26/2006	Not Available	Not Available	Expired	Not Applicable ‡
PG&E	1313	Level 3R	MT	DG - WWTP	240	3/6/2007	Not Available	Not Available	Expired	Not Applicable ‡

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* Since assignment of a project's operational date is subject to individual judgment, the incentive payment date as reported by the PAs is used as a proxy for the operational date for reporting purposes.

† This field represents the natural gas consumption during the 12-month period ending June 30, 2012. The basis is the lower heating value (LHV) of the fuel.

‡ SGIP renewable fuel use requirements are not applicable to projects no longer under warranty

** In RFU Reports No. 9 and No. 10 this project's size was reported as 296 kW. That was the capacity used in incentive calculations. The actual physical size of the system is 704 kW. In this particular circumstance, there were two separate applications, both 704 kW of physical capa city, for a total combined capacity of 1,408 kW. The maximum total incentive is one MW. As a result, one application was rebated in full (rebated capacity of 704 kW) while the second application was rebated up to the remainder of the eligible kW (296 kW). The result was a much lower value for rebate d capacity than physical capacity.

†† In RFU Reports No. 9 through No. 13 this project's Operational Date was incorrectly reported as 11/15/2005. That date is an estimate of when the system began operating. For this report the basis of Operational Date values is incentive payment date as described above in footnote 13.

‡‡ This site has not been operational for a year, thus the issue of compliance is not yet applicable.

¥ A final compliance finding would require collection of s ubstantially more information to validate contents of renewable fuel invoices. Collection of this information was outside the scope of this report.

4. Greenhouse Gas Emissions Impacts

Due to increased interest in the GHG emission aspects of biogas projects, information regarding GHG emission impacts is presented in this section. The GHG emission information presented here is derived from data used to prepare the SGIP Eleventh -Year Impact Evaluation Final Report. Additionally, key factors that could influence GHG emission impacts from renewable fuel projects in the future are discussed.

Table 6 presents capacity-weighted average GHG emission results developed for 2011. Results in Table 6 suggest one important observation: The assumed baseline for the biogas (i.e., whether the biogas would have been vented to the atmosphere or flared) is the most influential determinant of GHG emission impacts.[14] This is due to the global warming potential of methane (CH_4) vented directly into the atmosphere, which is much higher than the global warming potential of CO_2 resulting from the flaring of CH_4.

Table 6: Summary of CO_2 Emission Impacts from SGIP Biogas Projects in 2011

Baseline Biogas Assumption	Prime Mover Technology	Capacity-Weighted Average (Metric Tons CO_2/MWh)
Flare	FC	-0.35
	IC Engine	-0.46
	MT	-0.45
Vent	IC Engine	-4.50

FC = fuel cell; IC Engine = internal combustion engine; MT = microturbine

Simplifying assumptions underlying the above results include:

- Heat recovered from RFUR projects was used to satisfy heating load that otherwise would have been satisfied using biogas (e.g., in a boiler)[15]

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[14] The baseline treatment of biogas is an influential determinant of GHG emission impacts for renewable -fueled SGIP systems. Baseline treatment refers to the typical fate of the biogas in lieu of use for energy purposes (e.g., the biogas could be vented directly to the atmosphere or flared).

[15] Heat recovered from non-RFUR projects utilizing renewable fuel was assumed to displace natural gas. There are very few such projects. The first Program Year of the SGIP (2001) was the only one in which renewable -fueled systems were required to recover heat and meet system efficiency requirements of Public Utilities Code 218.5 (now 216.6).

- A single representative electrical conversion efficiency was assumed for each technology.
  - Fuel Cell: 46%
  - IC Engine: 31%
  - Microturbine: 23%

All SGIP annual impact evaluations (Impact Evaluations) prior to the Ninth -Year (2009) Impact Evaluation assumed biogas baselines by type of biomass input and rebated capacity of system. Requirements regarding venting and flaring of biogas projects are governed by a variety of regulations in California. At the local level, venting and flaring at the different types of biogas facilities is regulated by California's 35 air quality agencies. [16] At the state level, the California Air Resources Board (CARB) provides guidelines for control of methane and other volatile organic compounds from biogas facilities. [17] At the federal level, New Source Performance Standards and Emission Guidelines regulate methane capture and use.[18]

Biogas baseline assumptions used to calculate GHG impact estimates for 2007 -2009 were based on previous studies. [19] [20] Because of the importance of the baseline treatment of biogas in the GHG analysis, SGIP biogas facilities were contacted in 2009 to gather baseline-related information. This research suggested a venting baseline for dairy digesters and a flaring baseline for all other project types. For the 2009 through 2011 Impact Evaluations the biogas baseline was modified for WWTP and food processing SGIP projects smaller than 150 kW.

The evolution of biogas baseline assumptions is summarized in Table 7.

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[16] An overview of California's air quality districts is available at: http://www.capcoa.org

[17] In June of 2007, CARB approved the Landfill Methane Capture Strategy. See http://www.arb.ca.gov/cc/landfills/landfills.htm for additional information.

[18] EPA's Landfill Methane Outreach Program provides background information on control of methane at the federal level. See: http://www.epa.gov/lmop/

[19] California Energy Commission, *Landfill Gas-to-Energy Potential in California*, CEC Report 500-02-041V1, September 2002.

[20] Simons, G., and Zhang, Z., "Distributed Generation From Biogas in California," presented at Interconnecting Distributed Generation Conference, March 2001.

Table 7: Biogas Baseline Assumptions

Renewable Fuel Source	Facility Type*	Size of Rebated System (kW)	Impact Report	
			PY07-08	PY09-11
Digester Gas	WWTP	<150	Vent	Flare
		≥150	Flare	Flare
Digester Gas	Food Processing	<150	Vent	Flare
		≥150	Flare	Flare
Landfill Gas	LFG	All Sizes	Flare	Flare
Digester Gas	Dairy	All Sizes	Vent	Vent

* WWTP = Waste Water Treatment Plant; LFG = Landfill Gas

The equivalent tons of CO_2 emissions associated with SGIP systems for which flaring and venting baselines were assumed for 2011 are presented in Figure 6 and Figure 7. GHG emission impacts are depicted graphically as the difference between SGIP emissi ons and the total baseline emissions. Total baseline emissions exceed SGIP emissions in these two cases; hence a reduction in GHG emissions is attributed to participation in the SGIP.

Figure 6: Equivalent Tons of CO_2 Emissions - Flaring Baseline

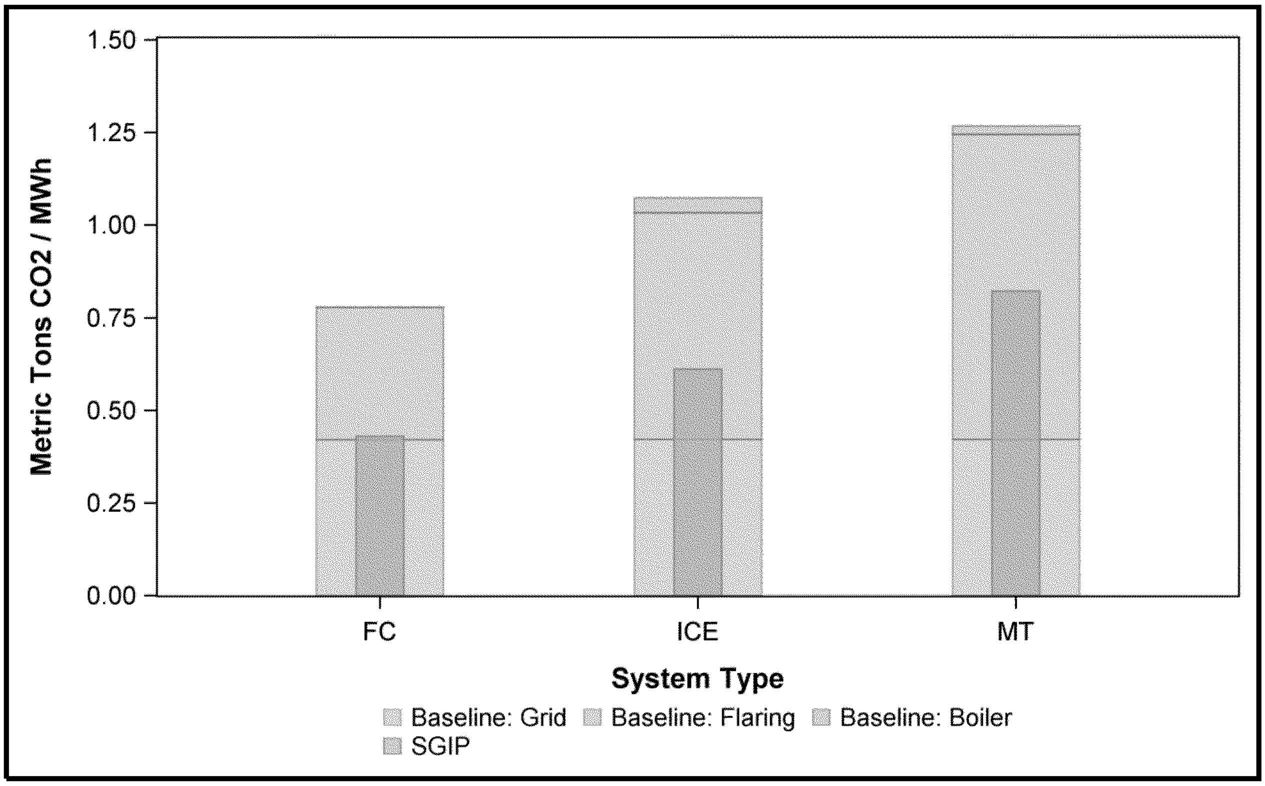

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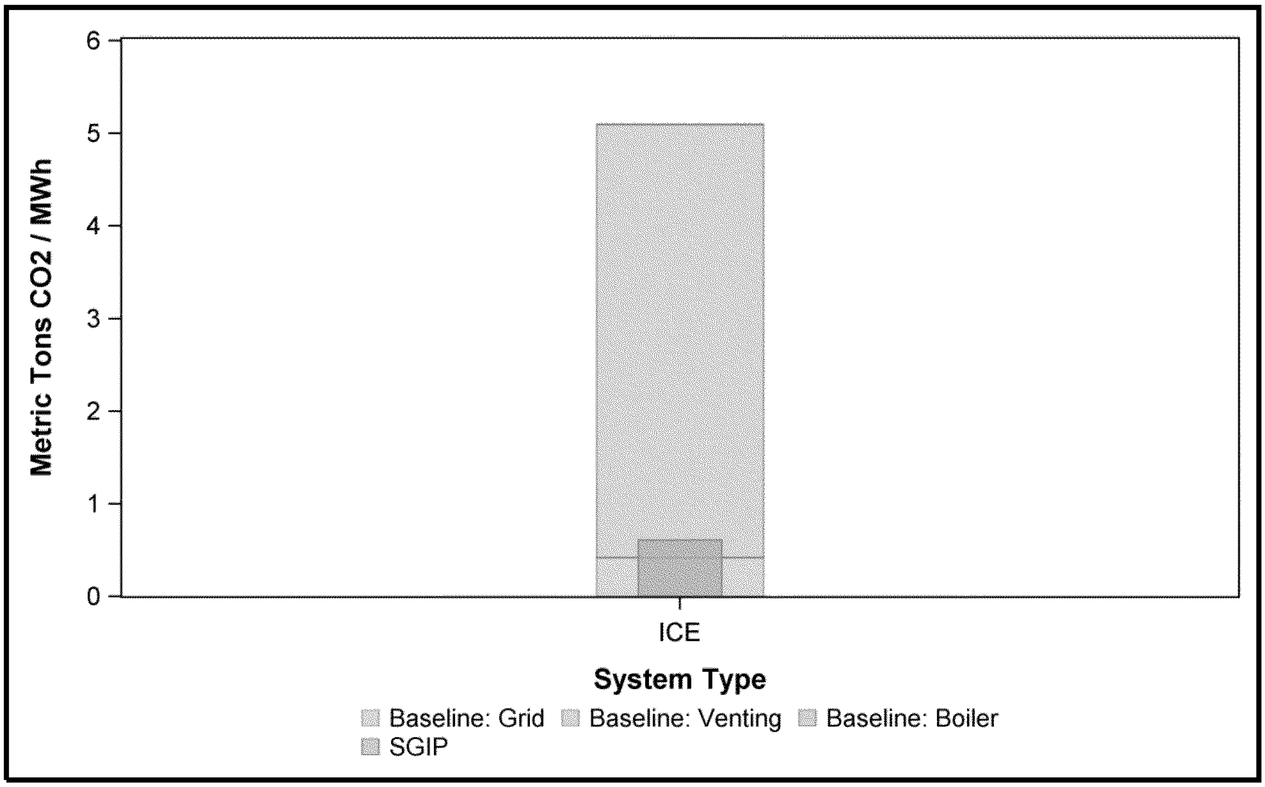
Figure 7: Equivalent Tons of CO_2 Emissions – Venting Baseline



The baseline assumption (i.e., flaring versus venting) made for biogas used in SGIP systems is the factor exerting the greatest influence over estimates of GHG impacts. Biogas projects for which a venting baseline is assumed achieve significantly greater GHG reductions than those for which a flaring baseline is assumed.

5. Cost Comparison between RFU and Other Projects

Beginning in September 2002, RFUR projects were eligible for a higher incentive level than non-renewable projects.[21] The size of this incentive premium was designed to account for numerous factors, including:

- RFUR projects face higher fuel pre-treatment costs
- RFUR projects might not face heat recovery equipment costs
- RFUR projects do not face fuel purchase expenses

[21] In September 2002 RFUR projects were classified as "Level 3 -R" projects. Since that time the definitions of Levels have changed numerous times. Itron has moved away from using incentive levels in the annual Impact Evaluation and Renewable Fuel Use reports because of the confusion caused by these changes

Concerns were expressed in CPUC Decision 02-09-051 that RFUR project costs could fall below non-renewable project costs as RFUR projects are exempt from waste heat recovery requirements. As a result, RFUR projects could potentially be receiving a greater-than-necessary incentive, which could lead to fuel switching. To address this concern, the CPUC directed SGIP PAs to monitor non-renewable project and RFUR project costs.

Eligible project costs from all completed SGIP projects provide the data for monitoring and analyzing differences in project costs. However, these are historical costs, raising a key question faced by the CPUC and other Program designers:

How accurately do the cost differences calculated for projects completed in the past represent the cost differences that are likely to be faced by Program participants in the future?

This question is difficult to answer and the answer depends on many factors, including:

1. The number of projects completed in the past.
2. The variability exhibited by cost data for the projects completed in the past.
3. The possible changes in system costs through time yielded by experience, economies of scale, and/or technology innovation.

The following analysis provides insight into mean costs and cost differences due to renewable fuel use and heat recovery.

Eligible installed costs for all fuel cell, microturbine, and IC engine projects operational as of June 30, 2012, are summarized in Table 8, along with simple statistics of the data. The summary distinguishes between fuel type and heat recovery incidence to facilitate independent examination of the principal factors influencing costs of projects utilizing renewable fuel. Several of the groups comprise only a few projects and others have extreme variability in project costs, greater than an order of magnitude. Sample sizes and overall cost variability play a very important role in the ability to draw conclusions from the data. The combined influence of sample size and sample variability on the inferential statistics is discussed below in the section titled *Uncertainty Analysis*.

Table 8: Summary of Project Costs by Technology, Heat Recovery Provisions & Fuel Type

Tech	Includes Renewable Fuel?*	Includes Heat Recovery?	Num. of Projects	$/Watt Eligible Installed Costs				
				Range	Median	Mean	Std. Dev.	Size - Wtd. Avg.
FC	Yes	Yes	12	4.51 – 11.00	9.41	8.13	2.37	6.93
FC	Yes	No	1	--	--	--	--	--
FC	Yes	Yes or No	13	4.51 – 11.00	8.28	8.02	2.30	6.92
FC	No	Yes	20	5.06 – 18.00	7.18	8.19	3.27	7.20
FC	No	No	22	8.71 - 11.30	10.00	10.10	0.72	7.81
FC	No	Yes or No	42	5.06 – 18.00	9.56	9.08	2.58	7.53
FC	DBG	No	55	6.08 - 18.20	11.20	10.60	2.30	7.34
ICE	Yes	Yes	24	1.08 - 7.58	2.76	3.00	1.51	2.92
ICE	Yes	No	2	1.71 - 2.87	2.29	2.29	0.82	2.71
ICE	Yes	Yes or No	26	1.08 - 7.58	2.76	2.94	1.47	2.90
ICE	No	Yes	229	0.85 - 10.70	2.30	2.60	1.32	2.30
MT	Yes	Yes	13	2.26 - 11.30	3.99	5.13	2.69	4.55
MT	Yes	No	10	1.23 - 5.39	3.61	3.47	1.27	2.89
MT	Yes	Yes or No	23	1.23 - 11.30	3.75	4.40	2.30	3.78
MT	No	Yes	116	0.70 - 8.40	3.21	3.34	1.31	3.25

FC = fuel cell; MT = microturbine; ICE = internal combustion engine; DBG = directed biogas.

* To assess the difference in costs between those technologies using renewable fuel resources versus those using only non-renewable fuels, fuel types are differentiated in Table 8 by identifying those using any amount of renewable fuel with a "Yes" classification.

The cost of waste heat recovery equipment and fuel clean-up may account for much of the difference between renewable and non-renewable project costs. The basis for heat recovery equipment and fuel clean-up equipment cost comparisons are described below.

Heat Recovery Equipment Costs

The c ost difference due to heat recovery equipment can be evaluated by comparing costs of projects with heat recovery to the costs of otherwise similar projects without heat recovery. The analysis is limited to projects that use renewable fuel to keep that var iable constant and since those are the projects of most interest in this report. Additionally, analysis is performed separately for each technology type. For example, the cost difference due to heat recovery equipment for microturbine projects is calculated as \$5.13 minus \$3.47, or \$1.66.

$$\Delta Heat\text{Recov}ery = \left(\frac{RFU}{w/HR}\right) - \left(\frac{RFU}{w/o\,HR}\right)$$

Equation 1

Where

RFU = renewable fuel use

HR = heat rate

w/ = with

w/o = without

Table 9: Cost Effect of Heat Recovery

Tech	Includes Renewable Fuel?	Includes Heat Recovery?	Num. of Projects	\$/Watt Eligible Installed Costs: Range	Median	Mean	Std. Dev.	Size - Wtd. Avg.
FC	Yes	Yes	12	4.51 – 11.00	9.41	8.13	2.37	6.93
ICE	Yes	Yes	24	1.08 - 7.58	2.76	3.00	1.51	2.92
	Yes	No	2	1.71 - 2.87	2.29	2.29	0.82	2.71
	Increase due to Heat Recovery		-	-	0.47	0.71	0.69	0.21
MT	Yes	Yes	13	2.26 - 11.30	3.99	5.13	2.69	4.55
	Yes	No	10	1.23 - 5.39	3.61	3.47	1.27	2.89
	Increase due to Heat Recovery		-	-	0.38	1.66	1.42	1.66

The mean costs for heat recovery is higher than non -heat recovery systems. The statistical significance of these differences is examined later in this report with uncertainty analysis. Note there there was only one renewable fueled fuel cell that did not include heat recovery, so it is not possible to perform this analysis for fuel cells.

Fuel Treatment Equipment Costs

Renewable fueled projects utilize fuel treatment equipment, which is usually used for gas clean-up, such as removal of hydrogen sulfide. To examine whether this fuel treatment equipment significantly increases project costs, the differences in costs between renewable and non-renewable fueled projects are analyzed. However, we must take into account whether the project also includes heat recovery equipment to avoid influencing the results. The analysis is limited to projects with heat recovery for this reason and to maximize the sample size of non-renewable fueled projects. Any difference observed between the costs of these two groups could be due to the difference in provisions for fuel treatment. For example, the cost difference for fuel treatment equipment in IC engine projects is calculated as \$3.00 minus \$2.60, or \$0.40.

$$\Delta FuelTreatment = \begin{pmatrix} RFU \\ w/HR \end{pmatrix} - \begin{pmatrix} NG \\ w/HR \end{pmatrix}$$

Equation 2

Where

NG = natural gas

Table 10: Cost Effect of Renewable Fuel Treatment Equipment

Tech	Includes Renewable Fuel?	Includes Heat Recovery?	No. Projects	\$/Watt Eligible Installed Costs: Range	Median	Mean	Std. Dev.	Size-Wtd. Avg.
FC	Yes	Yes	12	4.51 – 11.00	9.41	8.13	2.37	6.93
	No	Yes	20	5.06 – 18.00	7.18	8.19	3.27	7.20
	Increase due to RF Equipment		-	-	2.23	(0.06)	(0.90)	0.27
ICE	Yes	Yes	24	1.08 - 7.58	2.76	3.00	1.51	2.92
	No	Yes	229	0.85 - 10.70	2.30	2.60	1.32	2.30
	Increase due to RF Equipment		-	-	0.46	0.40	0.19	0.62
MT	Yes	Yes	13	2.26 - 11.30	3.99	5.13	2.69	4.55
	No	Yes	116	0.70 - 8.40	3.21	3.34	1.31	3.25
	Increase due to RF Equipment		-	-	0.78	1.79	1.38	1.30

The mean and median costs of renewable fueled ICE and MT projects are higher than non-renewable fueled projects. Interestingly, for renewable fueled fuel cells, the mean cost is lower while the median cost is higher than non-renewable systems. This is due to a skewed distribution of fuel cell project costs. Costs for all technology and fuel types display great variability, making it difficult to draw significant conclusions about cost differences for renewable fueled systems. Statistical significance of the results is further explored via uncertainty analysis later in this report.

Overall RFU Costs

An alternative and more general analysis of cost differences between renewable and non-renewable fueled projects is to compare costs of the two groups without regard to heat recovery provision. Note that all of the non-renewable fuel projects include heat recovery equipment, with the exception of a few fuel cell projects, and many of the renewable fuel projects include heat recovery even though many were not required to do so. By looking at the observed difference in costs of these two groups, it is possible to see the average overall influence of the different SGIP requirements for renewable and non-renewable projects. For example, the cost difference between renewable and non-renewable fueled IC engine projects is calculated as $2.94 minus $2.60, or $0.34.

$$\Delta RFU = \left(\frac{RFU}{w/or\,w/o\ HR} \right) - \left(\frac{NG}{w/HR} \right) \qquad \textbf{Equation 3}$$

Table 11: Cost Effect of Renewable Fuel Use

Tech	Includes Renewable Fuel?	Includes Heat Recovery?	No. Projects	$/Watt Eligible Installed Costs: Range	Median	Mean	Std. Dev.	Size-Wtd. Avg.
FC	Yes	Yes or No	13	4.51 – 11.00	8.28	8.02	2.30	6.92
	No	Yes or No	42	5.06 – 18.00	9.56	9.08	2.58	7.53
	Increase due to RFU		-	-	(1.28)	(1.06)	(0.28)	(0.61)
ICE	Yes	Yes or No	26	1.08 - 7.58	2.76	2.94	1.47	2.90
	No	Yes	229	0.85 - 10.70	2.30	2.60	1.32	2.30
	Increase due to RFU		-	-	0.46	0.34	0.15	0.60
MT	Yes	Yes or No	23	1.23 - 11.30	3.75	4.40	2.30	3.78
	No	Yes	116	0.70 - 8.40	3.21	3.34	1.31	3.25
	Increase due to RFU		-	-	0.54	1.06	0.99	0.53

Uncertainty Analysis

This section augments the difference of means analysis with an uncertainty analysis that provides a confidence interval for the mean differences. The confidence intervals are calculated with the sample statistics (e.g., n, mean, and std. dev.) presented in Table 8. The presented confidence intervals are based on a 90 percent confidence level, meaning there is 90 percent confidence that the true mean difference falls within the stated range. Note that if the range spans across zero, it is possible that there is no difference in cost between the two groups being analyzed.

Microturbine Project Cost Comparisons

Cost comparison results for microturbines are summarized in Table 12. These data show, for instance, that the average incremental cost associated with presence of heat recovery was $1.66 per watt for SGIP participants with completed projects. When this value is used to estimate the incremental cost of heat recovery not only for completed projects but also for projects that will be completed in the future, it is necessary to summarize the uncertainty of the estimate.[22]

Table 12: Microturbine Project Cost Comparison Summary

Physical Difference	Difference of Means ($/Watt)	90% Confidence Interval ($/Watt)
Heat Recovery	1.66	0.07 to 3.25
Fuel Treatment	1.78	1.06 to 2.51
RFU	1.06	0.49 to 1.63

The 90 percent confidence intervals presented in Table 12 summarize uncertainty in estimates of the incremental costs associated with several key physical differences for the population comprising projects already completed as well as those that will be completed in the future. For heat recovery, the lower bound of the confidence interval is just seven cents per watt. This counterintuitive result implies that systems without heat recovery might be nearly the same cost as those with it. The possibility of this unlikely result, along with the very large confidence interval, are likely simply due to the small quantity of, and considerable variability exhibited by cost data available for SGIP projects completed in the past. This is a representative example of the general rule that caution must be exercised when interpreting summary statistics when sample sizes are small.

[22] Uncertainty is assessed by calculating confidence intervals around the point estimates. Standard statistical tests are used to describe the likelihood that the two samples underlying the two means used to calculate each incremental difference came from the same population. When n_1 & $n_2 \geq 30$, a z -Test is used to determine confidence intervals. When n_1 or $n_2 < 30$, a t-Test is used.

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IC Engine Project Cost Comparisons

Cost comparison results for IC engine projects are summarized in Table 13. The differences between means are small in comparison to the variability exhibited by past costs of renewable fuel projects. This variability, combined with relatively small numbers of renewable fuel projects, results in very large confidence intervals. Each of the confidence intervals span across zero, meaning there is not 90% confidence that there is a difference in cost for the factors analyzed.

Table 13: IC Engine Project Cost Comparison Summary

Physical Difference	Difference of Means ($/Watt)	90% Confidence Interval ($/Watt)
Heat Recovery	0.71	-1.16 to 2.58
Fuel Treatment	0.40	-0.08 to 0.87
RFU	0.34	-0.11 to 0.80

Fuel Cell Project Cost Comparisons

Due to the sensitivity of fuel cells to contaminants in the gas stream, gas clean-up costs for fuel cells powered by renewable fuels—which contain sulfur, halide, and other contaminants—should be higher than gas clean-up costs for fuel cells operating with cleaner fuels, such as natural gas. Cost comparison results for fuel cells are summarized in Table 14. Results for the incremental difference due to heat recovery are not presented because all but one of the renewable fuel cell projects completed to date have included heat recovery even though they were not required to by the SGIP. The 90 percent confidence interval for fuel cells is very large, which is not surprising given the emerging status of this technology and the small number of facilities. Again, the confidence intervals span across zero and there is not 90% confidence that cost differences exist for the analyzed factors.

Table 14: Fuel Cell Project Cost Comparison Summary

Physical Difference	Difference of Means ($/Watt)	90% Confidence Interval ($/Watt)
Heat Recovery	---	---
Fuel Treatment	-0.06	-1.91 to 1.78
RFU	-1.06	-2.40 to 0.27

Cost Comparison Summary

Comparison of the installed costs between renewable- and non-renewable-fueled generation systems operational as of June 30, 2012, reveals that average non-renewable generator costs have typically been lower than average renewable-fueled generator costs. However, these averages pertain to past Program participants. The fundamental question motivating examination of RFUR project costs is stated explicitly below:

Do SGIP project cost data for past participants suggest that project costs are changing in ways that could necessitate modification of incentive levels received by future SGIP participants?

Confidence intervals calculated for populations comprising both past *and* future SGIP participants are very large. In fact, these confidence intervals prevent drawing conclusions about cost differences in IC Engine and Fuel Cell projects; only Microturbine projects exhibit cost differences at 90% confidence. This suggests that data for past projects should not be used as the sole basis for SGIP design elements affecting future participants. Engineering estimates, budget cost data, and rules-of-thumb likely continue to be more suitable for this purpose at this time.

Appendix A

List of All SGIP Projects Utilizing Renewable Fuel

All SGIP projects supplied with renewable fuel are listed in Table 15. Renewable Fuel Use Requirement (RFUR) projects subject to renewable fuel use requirements and exempt from heat recovery requirements are identified in the column titled "RFUR Project?" Only a portion of these projects (64 percent) are also equipped with a non-renewable fuel supply. These projects are identified in the "Any Non-Renewable Fuel Supply?" column.

Table 15: SGIP Projects Utilizing Renewable Fuel

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
0007-01	CCSE	Level 3	MT	DG - WWTP	84	8/30/2002	No	No
PY02-055	SCE	Level 3R	MT	Landfill Gas	420	5/19/2003	Yes	No
PY01-031	SCE	Level 3	ICE	Landfill Gas	991	9/29/2003	No	No
110	PG&E	Level 3	ICE	DG - WWTP	900	10/23/2003	No	Yes
PY02-074	SCE	Level 3R	MT	Landfill Gas	300	2/11/2004	Yes	No
0026-01	CCSE	Level 3	MT	DG - WWTP	120	4/23/2004	No	No
514	PG&E	Level 3R	MT	DG - WWTP	90	5/19/2004	Yes	No
0023-01	CCSE	Level 3	MT	DG - WWTP	360	9/3/2004	No	No
379	PG&E	Level 3R	MT	Landfill Gas	280	1/14/2005	Yes	No
PY03-092	SCE	Level 1	FC	DG - WWTP	500	3/11/2005	Yes	Yes
640	PG&E	Level 3R	MT	Landfill Gas	70	4/14/2005	Yes	No

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
641	PG&E	Level 3R	MT	Landfill Gas	70	4/14/2005	Yes	No
PY03-045	SCE	Level 1	FC	DG - WWTP	250	4/19/2005	Yes	No
PY03-008	SCE	Level 3R	MT	Landfill Gas	70	5/11/2005	Yes	No
PY03-017	SCE	Level 3R	ICE	DG - WWTP	500	5/11/2005	Yes	Yes
842A	PG&E	Level 3R	MT	DG - WWTP	60	5/27/2005	Yes	No
PY03-038	SCE	Level 3R	MT	DG - WWTP	250	7/12/2005	Yes	No
747	PG&E	Level 3R	MT	DG - WWTP	60	7/18/2005	Yes	No
653	PG&E	Level 2	FC	DG - Other	1000	8/9/2005	No	Yes
833	PG&E	Level 3N	MT	DG - Other	70	11/7/2005	No	Yes
483	PG&E	Level 3R	ICE	DG - Dairy	300	1/13/2006	Yes	No
313	PG&E	Level 3R	MT	DG - WWTP	300	3/16/2006	Yes	No
1297	PG&E	Level 3R	MT	DG - WWTP	280	4/7/2006	Yes	No
856	PG&E	Level 3R	MT	Landfill Gas	210	5/5/2006	Yes	No
658	PG&E	Level 3R	ICE	DG - Dairy	160	5/22/2006	Yes	No
1222	PG&E	Level 3R	ICE	Landfill Gas	970	7/5/2006	Yes	No
1316	PG&E	Level 3R	ICE	Landfill Gas	970	10/2/2006	Yes	No
PY04-158	SCE	Level 3R	ICE	DG - WWTP	704	10/25/2006	Yes	Yes
PY04-159	SCE	Level 3R	ICE	DG - WWTP	704	10/26/2006	Yes	Yes
1308	PG&E	Level 3R	ICE	DG - Dairy	400	11/17/2006	Yes	No
1505	PG&E	Level 2	ICE	Landfill Gas	970	11/24/2006	Yes	No

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
298	PG&E	Level 3R	MT	DG - WWTP	30	1/31/2007	Yes	No
1313	PG&E	Level 3R	MT	DG - WWTP	240	3/6/2007	Yes	Yes
PY05-093	SCE	Level 3R	ICE	Landfill Gas	1030	3/16/2007	Yes	No
1559	PG&E	Level 2	ICE	DG - WWTP	160	5/16/2007	Yes	No
1298	PG&E	Level 3N	MT	DG - WWTP	250	6/11/2007	No	Yes
1528	PG&E	Level 2	MT	DG - Other	70	6/15/2007	Yes	No
PY06-094	SCE	Level 2	ICE	DG - WWTP	500	11/8/2007	Yes	No
1577	PG&E	Level 2	ICE	DG - Dairy	80	12/31/2007	Yes	No
2005-082	SCG	Level 3R	ICE	DG - Other	1080	1/15/2008	Yes	No
2006-014	SCG	Level 2	ICE	Landfill Gas	1030	2/21/2008	Yes	No
PY06-062	SCE	Level 2	FC	DG - WWTP	900	3/4/2008	Yes	Yes
0270-05	CCSE	Level 3R	MT	Landfill Gas	210	4/4/2008	Yes	No
1490	PG&E	Level 2	FC	DG - WWTP	600	4/24/2008	Yes	Yes
1640	PG&E	Level 3R	ICE	DG - WWTP	643	7/29/2008	Yes	No
1498	PG&E	Level 3R	MT	Landfill Gas	210	8/5/2008	Yes	No
2006-036	SCG	Level 2	FC	DG - WWTP	1200	10/27/2008	Yes	Yes
1749	PG&E	Level 3R	ICE	DG - WWTP	130	11/9/2009	Yes	Yes
2008-003	SCG	Level 2	FC	DG - Other	600	12/14/2009	Yes	Yes
2006-012	SCG	Level 2	FC	DG - WWTP	900	12/18/2009	Yes	Yes
1775	PG&E	Level 2	ICE	DG - Dairy	75	2/3/2010	Yes	No

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
0351-07	CCSE	Level 2	ICE	DG - WWTP	560	4/16/2010	Yes	Yes
PY10-002	SCE	Level 2	FC	DG - WWTP	500	10/31/2010	Yes	Yes
PY10-003	SCE	Level 3	FC	DG - WWTP	250	10/31/2010	No	Yes
1810	PG&E	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	Yes	Yes
1811	PG&E	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	Yes	Yes
1812	PG&E	Level 2	FC	Landfill Gas (Directed)	400	11/10/2010	Yes	Yes
1802	PG&E	Level 2	FC	Landfill Gas (Directed)	400	12/22/2010	Yes	Yes
1761	PG&E	Level 2	ICE	DG - WWTP	330	12/23/2010	Yes	No
1759	PG&E	Level 2	ICE	DG - WWTP	1696	12/24/2010	Yes	No
0369-10	CCSE	Level 2	FC	Landfill Gas (Directed)	400	12/31/2010	Yes	Yes
0370-10	CCSE	Level 2	FC	Landfill Gas (Directed)	400	12/31/2010	Yes	Yes
1805	PG&E	Level 2	FC	Landfill Gas (Directed)	200	1/18/2011	Yes	Yes
2010-012	SCG	Level 2	FC	Landfill Gas (Directed)	1000	1/24/2011	Yes	Yes
1859	PG&E	Level 2	FC	Landfill Gas (Directed)	500	3/11/2011	Yes	Yes
1871	PG&E	Level 2	FC	Landfill Gas (Directed)	300	3/14/2011	Yes	Yes
PY10-004	SCE	Level 2	FC	Landfill Gas (Directed)	800	3/23/2011	Yes	Yes
1849	PG&E	Level 2	FC	Landfill Gas (Directed)	500	5/9/2011	Yes	Yes
1856	PG&E	Level 2	FC	Landfill Gas (Directed)	300	5/9/2011	Yes	Yes
1853	PG&E	Level 2	FC	Landfill Gas (Directed)	600	5/24/2011	Yes	Yes
1882	PG&E	Level 2	FC	Landfill Gas (Directed)	400	5/24/2011	Yes	Yes

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
1886	PG&E	Level 2	FC	Landfill Gas (Directed)	300	5/24/2011	Yes	Yes
1885	PG&E	Level 2	FC	Landfill Gas (Directed)	300	5/31/2011	Yes	Yes
1851	PG&E	Level 2	FC	Landfill Gas (Directed)	300	6/29/2011	Yes	Yes
1878	PG&E	Level 2	FC	Landfill Gas (Directed)	500	6/29/2011	Yes	Yes
2007-013	SCG	Level 2	ICE	DG - WWTP	150	7/13/2011	Yes	No
PY10-009	SCE	Level 2	FC	Landfill Gas (Directed)	300	8/8/2011	Yes	Yes
PY10-012	SCE	Level 2	FC	Landfill Gas (Directed)	300	8/8/2011	Yes	Yes
PY10-022	SCE	Level 2	FC	Landfill Gas (Directed)	400	8/8/2011	Yes	Yes
PY10-023	SCE	Level 2	FC	Landfill Gas (Directed)	400	8/8/2011	Yes	Yes
PY09-003	SCE	Level 2	FC	DG - WWTP	300	8/30/2011	Yes	Yes
1850	PG&E	Level 2	FC	Landfill Gas (Directed)	420	9/7/2011	Yes	Yes
1874	PG&E	Level 2	FC	Landfill Gas (Directed)	500	9/7/2011	Yes	Yes
1892	PG&E	Level 2	FC	Landfill Gas (Directed)	210	9/7/2011	Yes	Yes
1893	PG&E	Level 2	FC	Landfill Gas (Directed)	210	9/7/2011	Yes	Yes
2010-005	SCG	Level 2	FC	Landfill Gas (Directed)	100	9/20/2011	Yes	Yes
2010-011	SCG	Level 2	FC	Landfill Gas (Directed)	900	9/21/2011	Yes	Yes
PY07-017	SCE	Level 2	ICE	DG - WWTP	364	9/27/2011	Yes	No
1855	PG&E	Level 2	FC	Landfill Gas (Directed)	300	9/29/2011	Yes	Yes
2007-036	SCG	Level 2	ICE	DG - WWTP	340	11/1/2011	Yes	No
2010-018	SCG	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Yes	Yes

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
2010-019	SCG	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Yes	Yes
2010-020	SCG	Level 2	FC	Landfill Gas (Directed)	420	12/15/2011	Yes	Yes
2010-015	SCG	Level 2	FC	Landfill Gas (Directed)	420	12/16/2011	Yes	Yes
1858	PG&E	Level 2	FC	Landfill Gas (Directed)	300	12/29/2011	Yes	Yes
1852	PG&E	Level 2	FC	TBD (Directed)	400	12/31/2011	Yes	Yes
1857	PG&E	Level 2	FC	TBD (Directed)	300	12/31/2011	Yes	Yes
1868	PG&E	Level 2	FC	TBD (Directed)	400	12/31/2011	Yes	Yes
1869	PG&E	Level 2	FC	TBD (Directed)	600	12/31/2011	Yes	Yes
1876	PG&E	Level 2	FC	TBD (Directed)	200	12/31/2011	Yes	Yes
1877	PG&E	Level 2	FC	TBD (Directed)	200	12/31/2011	Yes	Yes
1929	PG&E	Level 2	FC	Landfill Gas (Directed)	420	12/31/2011	Yes	Yes
PY10-014	SCE	Level 2	FC	TBD (Directed)	500	12/31/2011	Yes	Yes
1860	PG&E	Level 2	FC	TBD (Directed)	800	1/1/2012	Yes	Yes
1926	PG&E	Level 2	FC	Landfill Gas (Directed)	400	1/1/2012	Yes	Yes
1950	PG&E	Level 2	FC	Landfill Gas (Directed)	500	1/1/2012	Yes	Yes
PY09-013	SCE	Level 2	FC	DG - WWTP	600	1/1/2012	Yes	No
PY10-011	SCE	Level 2	FC	TBD (Directed)	210	1/1/2012	Yes	Yes
PY10-028	SCE	Level 2	FC	TBD (Directed)	600	1/1/2012	Yes	Yes
0374-10	CCSE	Level 2	FC	TBD (Directed)	210	1/1/2012	Yes	Yes
0376-10	CCSE	Level 2	FC	TBD (Directed)	210	1/1/2012	Yes	Yes

Res. No.	PA	Incentive Level	Tech	Renewable Fuel Type	Capacity (kW)	Operational Date*	RFUR Project?	Any Non-Renewable Fuel Supply?
0398-10	CCSE	Level 2	FC	TBD (Directed)	420	1/1/2012	Yes	Yes
0399-10	CCSE	Level 2	FC	TBD (Directed)	630	1/1/2012	Yes	Yes
0361-09	CCSE	Level 2	FC	DG - WWTP	1400	1/10/2012	Yes	Yes
0362-09	CCSE	Level 2	FC	DG - WWTP	300	1/10/2012	Yes	Yes
0363-09	CCSE	Level 2	FC	DG - WWTP	2800	1/10/2012	Yes	Yes
0375-10	CCSE	Level 2	FC	TBD (Directed)	300	1/10/2012	Yes	Yes
PY07-006	SCE	Level 2	MT	Landfill Gas	750	6/12/2012	Yes	No

* Since assignment of a project's operational date is subject to individual judgment, the incentive payment date as reported by the PAs is used as a proxy for the operational date for reporting purposes.

† In Renewable Fuel Use Reports No. 9 through No. 13 this project's Operational Date was incorrectly reported as 11/15/2005. That date is an estimate of when the system began operating. For this report the basis of Operational Date values is incentive payment date. In Renewable Fuel Use Reports No. 9 and No. 10 this project's size was reported as 296 kW, the capacity used in incentive calculations. The actual physical size of the system is 704 kW.