MARKET CHARACTERIZATION REPORT

SUBMITTED TO:
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E. EXECUTIVE SUMMARY

This executive summary highlights the major findings and recommendations from the Market Characterization Study of the Self-Generation Incentive Program (SGIP). The SGIP was first launched in March 2001 by the California Public Utilities Commission (CPUC). The SGIP operates in the service areas of Pacific Gas and Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), and the San Diego Gas and Electric Company (SDG&E). The SGIP is administered by PG&E, SCE, and SCG in their respective territories. The California Center for Sustainable Energy (CCSE) administers the SGIP in SDG&E's territory. This organization recently changed its name from the San Diego Regional Energy Office (SDREO).

The CPUC directed the Program Administrators (PAs) to conduct the evaluation work contained in this study. A research plan for this study was developed by Summit Blue Consulting and its research partners, Energy Insights and RLW Analytics (hereafter referred to as the Summit Blue team) through meetings with the SGIP Working Group and with the input and oversight of the Measurement and Evaluation Committee (M&E Committee) of the Working Group.[1] That research plan also covers three additional related studies — the completed Program Administrator Comparative Assessment,[2] the Market Focused Process Evaluation[3], and the Retention Study to be completed in the fall of 2007. The SGIP Working Group consists of representatives from each of the PAs, as well as representatives from SDG&E, the California Energy Commission (CEC) staff associated with the Emerging Renewables Program, and the Energy Division of the CPUC. The intended audience of this study is the SGIP Working Group and the California Public Utilities Commission.

E.1 Market Characterization Study Research Objectives

The main research objectives of the Market Characterization Study were defined to:

- Assess the market for self-generation technologies
- Identify factors that define successful installations
- Identify appropriate applications for each technology
- Identify factors that contribute to project and program success/failure in the market

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[1] Summit Blue Consulting. "Self-Generation Incentive Program Market Focused Process, Market Characterization, Retention and Program Administrator Comparative Assessment Studies, Final Research Plan." January 26, 2007.

[2] Cooney, K., P. Thompson, Summit Blue Consulting, Energy Insights, RLW Analytics. "Self-Generation Incentive Program: Program Administrator Comparative Assessment." Report to the SGIP Working Group. April 25, 2007.

[3] Cooney, K. P. Thompson, Summit Blue Consulting, Energy Insights, RLW Analytics, "Self-Generation Incentive Program: Market Focused Process Assessment." Report to the SGIP Working Group. August 9, 2007.

E.2 Evaluation Methods

The evaluation methods used included:

- A review of program participation records and reports submitted to the CPUC through December 2006 from all PAs.
- In-depth interviews with staff from each PA, with project developers across the state, and with CPUC and CEC staff.
- Surveys of program host customers and non-host customers.
- In-depth interviews with program host customers and non-participants.
- Focus groups with SGIP host customers in each of the PAs' territories.
- Review of applicable literature sources, relevant industry documents, and Internet sources.
- Quantitative analyses using data regression methods to explain the relationship between project indices – e.g., the effect of gas prices and declining incentives on cogeneration application rates.

E.3 Key Findings

Key findings from the evaluation are presented below.

- Host customers, and some project developers, define a successful SGIP project as one that yields a positive ROI or payback and that produces the amount of power that was anticipated. Other developers take a simpler approach, viewing any project that is installed and for which the incentive is paid as a success.
- Host customers; even those whose projects were withdrawn, suspended, or rejected; remain largely positive in their evaluation of the likelihood that their project will be (or would have been) a success. Nearly half of the customers with withdrawn, suspended, or rejected applications indicate that they will continue to pursue completion of the installation. Many of these projects would not have been initiated without the SGIP incentives.
- Project developers say that the most important drivers of a successful project are having a thorough understanding of the requirements of the SGIP, utility interconnection departments, local building inspectors, and other stakeholders; and being willing to be flexible in working through problems rather than taking a hard-line approach to who is right or wrong.
- From the host customers' perspective, the drivers of a successful project include having a realistic assessment of project economics up front so that expectations match reality, operationally sound equipment, the availability of program incentives, and – in some cases – the details of the specific tariffs that apply.
- Project failures are often associated with the host customer initially having an overly optimistic view of how easy permitting, installation, and interconnection will be; or not understanding departing load tariffs or other factors that negatively impact project economics. It is rarely possible to place the

blame for such misperceptions on a single party, and our review indicates that the PAs work hard to present detailed and accurate information.

- The overall success of the SGIP in the market is constrained by several factors outside the control of the PAs. These include changes in business demographics such as the flight of manufacturing facilities from California; fluctuations in equipment availability and prices (notably an issue for PV systems in recent years); changes in fuel prices (i.e., natural gas); and changes in the payback requirements of customers. These factors, along with changes in the program itself (most notably incentive reductions and eligibility requirements), account for the variability in program applications and project completions by year.

- In spite of the constraining factors described above, the SGIP has been a successful program in numerous respects:

    - Awareness of the program among the general population (as measured by a survey of non-participating customers) has increased from 15% in 2003 to 26% in 2007.

    - The rate of program applications and project completions, particularly for PV systems, has continued to increase over time.

    - The program appears to have stimulated several new business models, including the integration of PV systems into traditional roofing materials, vertical integration among project developers, and the growth of leased or outsourced self-generation systems.

E.4 Recommendations

Recommendations from the research and analyses are summarized by technology below:

Recommendations Specific to Wind Turbines

- Use all available tools to identify promising sites/host customers for wind turbines. This includes the state-wide wind resource map that the CEC has funded the creation of, as well as GIS techniques to rule out areas with high population density, proximity to airports, or other barriers to wind turbine installation.

- Given very low market activity to date for wind turbines in the 30 kW to 5 MW range, SGIP PAs should view wind projects as quasi-demonstrations and focus on public entities that are more likely to adopt such projects.

- Given the large fraction of projects that rely on project developers in the SGIP, place as much or more emphasis on engaging with vendors and project developers of wind turbines as on engaging directly with potential host customers.

Recommendations Specific to Fuel Cells

- Work with fuel cell vendors and project developers to identify project opportunities; marketing directly to customers is less likely to be effective as few of them are familiar with the technology.

- Much as with wind turbines, public entities are more likely to be early adopters for fuel cells. Three-fifths of the fuel cell applications received by the SGIP through December 2006 were from public entities.

- Market experience to date suggests that colleges and hotels are good candidates for fuel cells, though hotels that do not have an on-site laundry operation may not have enough heat load to take advantage of the CHP applications that fuel cells are best suited for.

- Landfills, dairies, and waste water treatment plants are also likely to be good targets for fuel cells given the presence of methane as a fuel.

Recommendations Specific to PV Systems

- The most effective steps to encourage additional PV system installation are likely to be target marketing toward specific host customer segments and encouraging the development of innovative business models, such as integrated PV/roofing materials.

- Based on their load shapes, the availability of flat roofs or adjacent land for installation, and (in some cases) a history of PV adoption, the most likely segments to target include agriculture, retail, offices, warehouses, schools, and the U.S. Post Office.

Recommendations Specific to Gas-Fired Cogeneration Technologies

- California's CARB 07 air quality regulations raise the cost of deploying some CHP technologies in California, thus hindering the economic competitiveness of CHP less viable. Emissions permitting aside, CHP remains an economically viable option for several customer segments, including oil and gas extraction, offices, hotels, hospitals, and colleges.

- The decision as to whether or not new gas-fired CHP installations should be encouraged, however, is a policy question outside the scope of this study.

1. INTRODUCTION AND BACKGROUND

1.1 Market Characterization Study

D.06-01-24 directed the Program Administrators (PAs) to file plans for program evaluation activities, which they did on March 6, 2006 in a responsive Joint Motion describing the M&E Plan for the Self Generation Incentive Program (SGIP). One of the studies proposed in this motion was a Market Characterization (Market Study). By ruling dated May 18, 2006, the Administrative Law Judge approved the M&E plan with minor modifications.

The main research objectives for the Market Study are described below and reflect the Joint PAs' motion, CPUC decisions, and input from the Working Group.

1.1.1 Objectives of the Market Study

The purpose of the Market Characterization study (Market Study) is to assess the market for self-generation technologies by analyzing the customers with successful SGIP installations and identifying the critical success factors. The Market Study will begin by identifying key factors that define successful installations, such as ease of equipment installation, capacity utilization, and equipment retention. Once these factors have been identified, the Market Study will identify:

- Appropriate applications for each technology, as well as those applications which are typically unsuccessful and result in underutilization or equipment removal; and

- Success factors that most contribute to program and project cost-effectiveness, and identify which factors undermine cost-effectiveness.

The analysis and reporting for the Market Study will include a comparison of SGIP penetration by technology type, by PA territory, and other meaningful geographical designations, such as county or weather zone. These geographical designations will also be compared with success factors to help facilitate an understanding of the role of local regional issues in the market. These may include different processes or requirements of local building departments, local air quality regulations, local utility rates/tariffs, or other regional factors at play.

Table 1-1 presents more detail for the activities of the Market Study — a mapping of the key objectives to various data sources. A single X indicates that a particular data source may yield useful information for addressing the corresponding objective, while XX indicates that the data source will be critical to addressing the objective.

Table 1-1. Market Study Research Objectives and Information Sources

Objectives	Issues Within Objectives	Information Source					
		PA Interviews	Developer Interviews	Participant Survey	Non-Participant Survey	Participant Interviews & Focus Groups	Non-Participant Interviews & Focus Group Style Interviews
Analyze successful SGIP projects to identify critical success factors	Successful installations & factors leading to success	XX	XX	XX		XX	
	Appropriate applications by technology category	XX	XX	X	X	XX	
	Characteristics of typical project failures		XX	XX	X	X	
What are driving forces in penetration of program and technologies?	Factors driving program and project cost-effectiveness	XX		X		XX	
	Factors driving penetration of the program and specific technologies	XX	XX	XX	XX	XX	XX

1.2 Program History and Overview

The Self Generation Incentive Program (SGIP) program was initially conceived of and approved in Assembly Bill (AB) 970, which passed in September 2000 and was implemented by CPUC decision D.01-03-073 in March of 2001. The program was reauthorized in AB 1685 and implemented in CPUC decision D.04-12-045. AB 970 called for the creation of more energy supply and demand programs. CPUC decision 01-03-073 formally created the SGIP to offer financial incentives to customers who install certain types of distributed generation facilities to meet all or a portion of their energy needs. At that time, the SGIP was designed to complement the CEC's Emerging Renewables Program by providing incentive funding to larger renewable and non-renewable self-generation units.

In October of 2003, AB 1685 extended the SGIP beyond 2004 through 2007. This bill required the CPUC, in consultation with the CEC, to administer, until January 1, 2008, the SGIP for distributed generation resources in largely the same form that existed on January 1, 2004. However, this decision notwithstanding, a number of program modifications have been made in the 2004 and 2007 periods. For example, with the funding of the California Solar Initiative (CSI), the SGIP will no longer offer incentives to photovoltaics (PV) after 2006. AB 2778, approved in September of 2006, continues the SGIP for fuel cells and wind technology until 2012. However, other renewable technologies such as micro-hydropower were not included. Moreover, cogeneration systems are no longer funded beyond 2007. The future program design details have yet to be worked out, but there is some suggestion that cogeneration may be revisited. Upon enacting AB 2778, Governor Schwarzenegger encouraged parties to revisit the eligibility of the eliminated technologies in the following signing message: "This bill extends the sunset of the Self Generation Incentive Program to promote distributed generation throughout California. However, the legislation eliminated clean combustion technologies like microturbines from the program. I look forward to working with the Legislature to enact legislation that returns the most efficient and cost effective technologies to the program. If clean up legislation is not possible, the California Public Utilities Commission should develop a complimentary program for these technologies."[4]

[4] Personal Communication SGIP administrator, Nathalie Osborne, CCSE, November 1, 2006.

2. METHODOLOGY

To adequately characterize the market in which the SGIP operates, the Market Study relied on three broad categories of research: 1) secondary research using existing data, 2) primary research (interviews) with PAs and project developers, and 3) primary research (interviews, surveys, and focus groups) with project participants and non-participants (potential host customers who did not choose to complete an SGIP project). Each of these research streams is described below.

2.1 Review of Program Data

The Summit Blue team submitted a data request on November 29, 2006 to the PAs through the evaluation project manager. The request asked for contact information, databases, business demographic information, marketing collateral examples, and other documentation. A number of other data items (for example, pointers to sites where systems are known to have been removed or the property has been sold since project development) were discussed during the in-depth PA interviews (see Section 2.4). In some cases, these interviews led to follow-on data requests for additional, administrator-specific information.

For purposes of this report, the team has used program records submitted to the CPUC up through December 2006 from each of the four PAs: PG&E, SCE, SCG, and CCSE. These records include two reports per month: the Monthly Project List and the Monthly Budget Status Report. The Monthly Project List includes a list of projects by year and a list of cumulative projects to date. For each project the list shows, among other items, the project ID, incentive level received, system type, and fuel type. The Monthly Budget Status Report contains program data on budget allocations, reallocations, program expenditures, program definitions, and rebate amounts. A summary of application statistics by year and incentive level is also included in the Budget Status Reports.

The PAs also provided additional internal program records, where available, on outreach activities, public presentations, and attendance lists. In addition, internal tracking forms and approaches used by the administrators[5] helped the team conduct a preliminary evaluation of the PAs' processes.

2.2 Other Secondary Data Reviewed

Several existing reports and sources of market data were consulted to inform the Market Study. These included a 2005 assessment of the market for combined heat and power applications in California, regional data on how various end-use segments view the acceptability of self-generation economics (data collected by Energy Insights' 2005 Distributed Energy Market Survey), government statistics on the size and growth rate of various market segments in California, and other reports that attempted to size or characterize the market for self-generation technologies. The project team reviewed these data, analyzed them for relevance and validity, and incorporated them into the market study report as appropriate.

[5] For example, CCSE was able to provide an internal procedures manual for its approach to the SGIP.

2.3 Surveys

2.3.1 Overview of Survey Process

Host customer telephone surveys were conducted by RLW Analytic's California office. Experienced RLW Analytics staff conducted the telephone data collection. All survey personnel hold college degrees in energy management and have the experience and education to speak and interact knowledgeably with survey respondents. Non-participant surveying was conducted by The Dieringer Research Group.

Surveys were pretested prior to the main data collection effort. Surveyors for the host customer survey were briefed on the SGIP nomenclature and survey goals prior to any calls. After approximately five surveys, the instrument was reviewed with the Summit Blue team to suggest improvements. All survey calls were tracked, and refusals or incomplete responses were recorded. Results of the completed surveys were entered into an electronic database designed by the project analyst. The data were reviewed by the RLW project manager to ensure quality control. Host customer calls were made from RLW's California office. At the end of this data collection task, a survey disposition report was prepared to document the outcome of each contact attempt, and the possibility of non-response bias was considered.

A detailed discussion of non-respondents is included in the appendix. The Summit Blue team concluded that, on balance, non-response bias did not substantially affect the survey results.

2.3.2 Host Customer Survey

We spoke with 289 host customers, representing 323 projects that have participated in the SGIP process — 204 projects that were active or completed and 119 projects that were withdrawn, rejected, or suspended. Appendix B in the Market Focus Process Report contains supporting information pertaining to the host customer survey, including the number of host customers, number of projects, and number of MW represented. In many cases one decision maker was responsible for multiple sample points. We collected information on the primary sample (defined by the Summit Blue team) and then attempted to capture information on additional projects where the technology, PA, or status differed from the primary sample point, or we captured information on additional projects, if there was some other substantial difference between the projects.

The sample was stratified by project characteristics of research interest: PA, technology, and project status. In addition, an effort was made to ensure a good mix of coastal and non-coastal participants in the PV sample.[6] Specific goals were set to obtain a varying amount of surveys from projects in coastal and non-coastal areas. A detailed discussion of the sample plan, including issues of statistical representation and confidence, can be found in the appendix.

[6] For this effort California's climate zones were grouped as coastal and non-coastal. The latter included the inland, mountain and desert climates.

2.3.3 Non-Participant Survey

In addition to the host customer surveys, 260 telephone surveys were conducted with qualified nonresidential customers who have not participated in the SGIP process. These surveys were stratified by PA, with 65 completes targeted from non-host customers in each of the four PA territories to provide the research team with 90/10 statistical confidence around the data for each PA's non-participant sample.

The sample frame for non-participant surveys included:

- Non-participating members of customer segments that are well-represented among program host customers (allowing us to explore the barriers to increasing program participation among segments that have already embraced the program), and
- Non-participating members of other large/growing segments with the technical capacity to adopt self-generation technologies.

This approach to defining the non-participant sample frame permits an exploration of barriers to increasing program penetration, both among those segments that have already embraced the program and among those segments that have not embraced the program but have the technical potential to do so. The non-participant surveys also provide a measure of awareness of the SGIP program among the broader customer base. The sample was purchased by SIC and zip codes from Dunn and Bradstreet and compared to the list of program host customers to identify samples that had not already applied to the SGIP.

2.4 In-depth and Informational Interviews

A variety of qualitative, in-depth interviews as well as shorter, less formal informational interviews were conducted to capture data for the different studies. In-depth interviews were conducted with staff from each PA, project developers across the state, the CEC, and CPUC staff, host customers and non-participating customers. PA interviews were substantially conducted in-person along with follow-on telephone discussions with senior staff from the Summit Blue team. Developer, participating customer, and non-participating customer interviews were conducted by Energy Insights and Summit Blue staff by telephone at scheduled times convenient to the respondent and, with the permission of the respondent, many were tape-recorded for note-taking purposes.

In total, 26 in-depth interviews were conducted with SGIP project developers, representing the experience of 25 companies. Almost 500 different project developers have participated in the SGIP process, but only 49 have done 10 or more projects. These top 49 program host customers account for 64% of all completed projects to date.[7] The selections of best interview candidates were based on creating a good balance of interviews with: major developers, important niche players, developers that are more active in certain PA territories, and developers that represent each major self-generation technology type. In addition, one interview was conducted with a developer that had gone out of business to help understand reasons for project failure. For each PA, the interviewed developers represented between 21% and 35% of all completed projects.

Draft interview guides were prepared for comment and review by the SGIP M&E committee. Final interview guides are located in Appendix A in the Market Focus Process Report. Each survey instrument was designed to capture information needed to understand variations in PA procedures and were focused

[7] For those projects for which a developer is listed, as of November of 2006.

on those data elements unique to each respondent group (rather than duplicating effort with other data collection activities). The developers interviewed, and the number of completed projects by PA, are contained in the appendix to the current report.

In-depth interviews were also conducted with selected program host customers and non-host customers as follow-up to the telephone surveys.

In total, 45 in-depth interviews with host customers were completed. These interviews were conducted by Energy Insights and Summit Blue staff as follow-up discussions with host customers who already completed a quantitative survey (described earlier in Section 2.3.2). The interviews allowed the research team to probe much more deeply into the role that specific factors played in leading to successful or less successful installations than would have been possible in the more structured telephone survey. Each follow-up interview was tailored to focus on the factors identified in the initial telephone survey as most important to the specific installation in question. Respondents for the follow-up interviews were recruited at the time of the initial telephone survey, as part of the closing. To ensure an adequate cooperation rate, each respondent was offered a $100 contribution to the charity of their choice for the completion of a follow-up interview. This yielded a cooperation rate (percent of survey respondents who were asked to do a follow-up interview who said yes) of 61% for active/completed projects and 63% for withdrawn/rejected projects. An overview of the host customers interviewed is contained in the appendix. An additional 25 interviews were completed with non-participant utility customers. These interviews were follow-up discussions with non-host customers who completed a quantitative survey. Conducted by Energy Insights and The Dieringer Group, they probed much more deeply into why customers have not pursued self-generation opportunities. These interviews were intended to help understand if self-generation is simply not a workable option for some sites or business types, or if some non-participants had considered the SGIP but failed to apply and why. Respondents for the follow-up interviews were recruited at the time of the initial telephone survey, as part of the closing. To ensure an adequate cooperation rate, each respondent was offered a $100 contribution to the charity of their choice for interview completion. The resulting cooperation rate for non-participants (32%) was lower than the participant cooperation rate. Given the fact that non-participants were both less invested in the SGIP program and had less to say in general, this cooperation rate is neither unexpected nor problematic.

2.5 Focus Groups

Traditional "behind-glass" focus groups were held in February 2007 with SGIP host customers to gather feedback about their perspectives of the program and experience with the program. The focus groups took place in February 2007 with SGIP host customers in the programs administered by SCG (Feb. 7), SCE (Feb. 8), CCSE (Feb. 12), and PG&E (Feb. 13). Focus groups provided a means to investigate how the program outreach and processes are being received by host customers and to allow the PAs to observe what their program host customers think about their programs.

Focus groups are particularly useful at helping to understand host customer motivations and their reactions to program rules, processes, and communications. Relative to other research techniques, focus groups are particularly effective for understanding host customer motivations (e.g., regarding adoption of new or different products or ideas, such as grid-connected distributed generation). Statistical research methodologies can be less effective for studying complex decision-making processes such as new product adoption, and one-on-one interviews, while very effective at eliciting input, do not allow for the group dynamic that may be critical in understanding motivation.

The Summit Blue team provided the M&E Committee an opportunity to review and comment on the focus group discussion guide which is contained in the SGIP Program Administrator Comparative

Assessment Report.[8] A review of the recruitment process and possible sources of selection bias are presented in the appendix.

[8] Cooney, K., P. Thompson, Summit Blue Consulting, Energy Insights, RLW Analytics. “Self-Generation Incentive Program: Program Administrator Comparative Assessment.” Report to the SGIP Working Group, April 25, 2007. Despite the training provided to focus group facilitators, at least one observer from CCSE expressed concern that host customers sometimes use the term SDG&E and SDREO interchangeably, and expressed a desire for more probing on this issue.

3. PROJECT SUCCESS

3.1 Definitions of Success

3.1.1 PA and Developer Definitions of Success

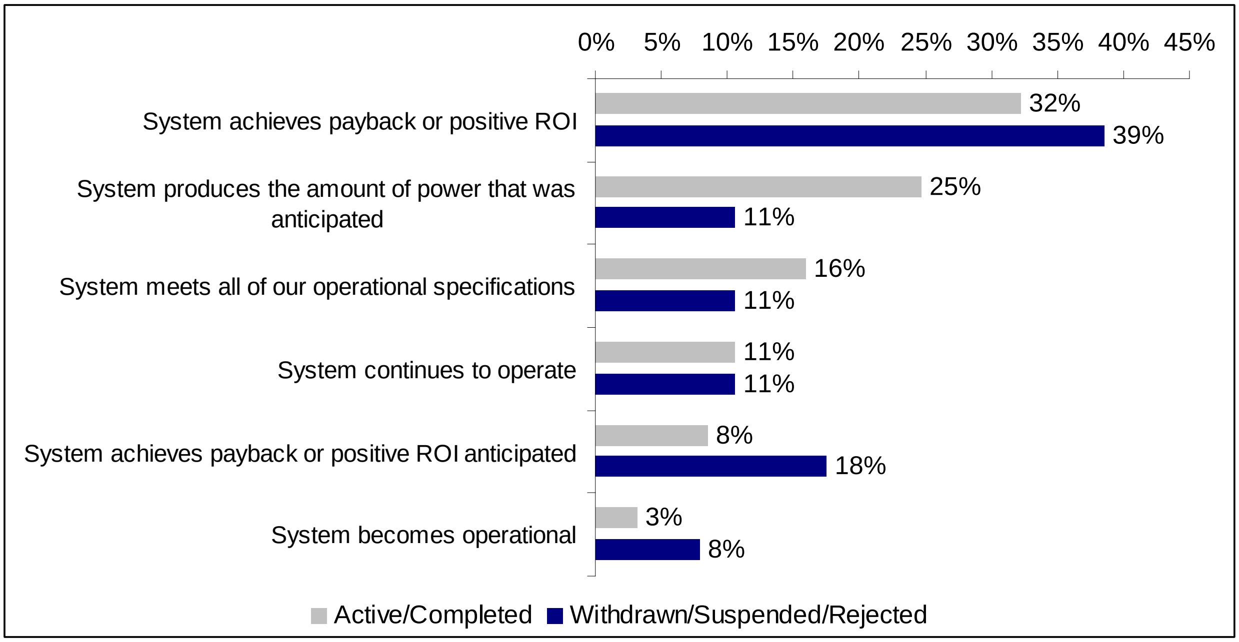
What constitutes a “successful” SGIP project varies depending on whom you ask. For the most part, both PAs and project developers have very pragmatic definitions of a “successful” SGIP project. Many developers candidly admit that a successful project is simply “one that gets built” and for which they and their host customer get paid. Interviews with PAs suggest that most view their success criteria in similar terms: whether applicants were retained throughout the process, and whether expenditures in technology categories met or exceeded the targets for those categories.

For host customer participants, however, simply getting a project installed and receiving the incentive check are typically not enough to consider a project successful. Rather, projects need to operate as anticipated and achieve payback to count as a success.

3.1.2 Success in the Eyes of Host Customers (and Some Developers)

Figure 3-1 shows the percent of host customers from the participant survey that cited various success factors as the most important criteria of project success. Several things are worth noting from this graph. First, although achieving payback or positive ROI is the most important criterion for success, the second most important criterion differs depending on whether the project being considered has either completed the SGIP process or is currently in process versus having been withdrawn, suspended, or rejected. Host customers with active or completed projects say that the second most important criterion for success is having the generator produce the amount of power that was anticipated when the project was designed.

Figure 3-1. Percent of Participants Citing Various Factors as the Most Important Criterion of Project Success



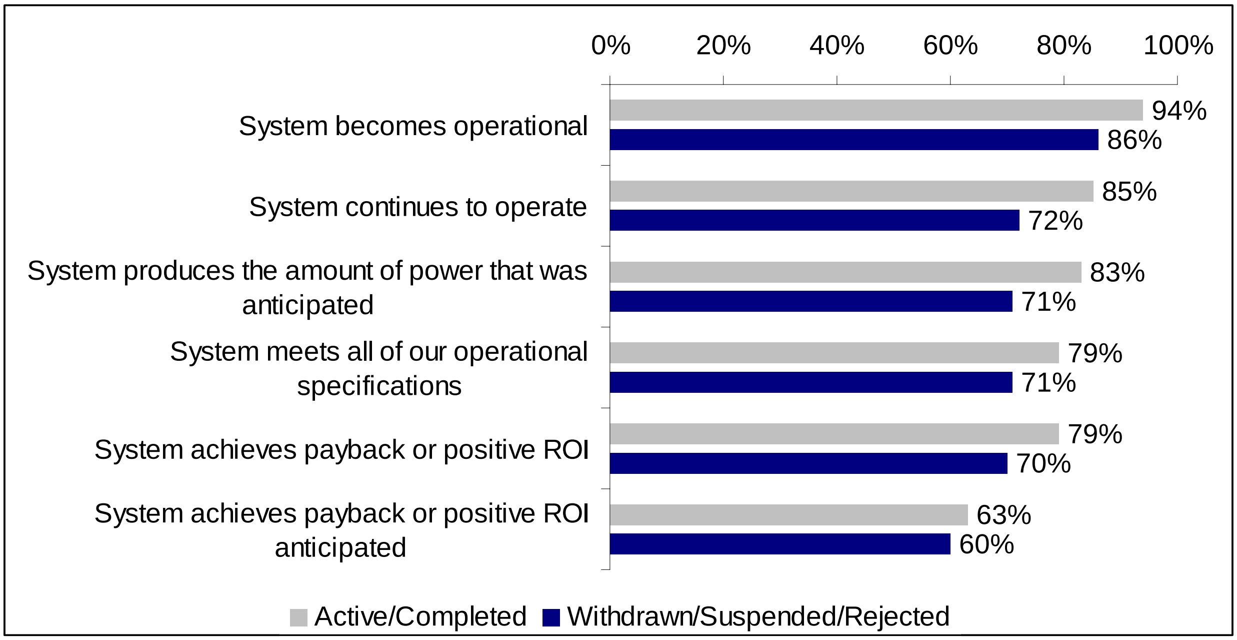
Those whose projects did not successfully complete the SGIP process, however, continue to focus on project economics. The second most important success criterion for them is that the project not only achieves payback/positive ROI, but that it achieves the payback or ROI that was anticipated. Given that project economics was the most commonly cited reason for having a project withdrawn, it is not surprising that host customers whose projects did not complete the SGIP process are more focused on economics as the definition of success.

Some of the project developers interviewed echoed the concern of host customers with active/completed projects about post-installation operation, though they defined a successful project as "one that is still producing power in a couple of years" rather than one that produces the amount of power it was expected to produce. One PV developer noted that projects that cause problems for the host customer down the line or that end up not being used are failures even if they (the developer) got paid. In his view, this is because such projects tarnish the developer's reputation in the market.

3.1.3 Host Customer Confidence in Project Success

In addition to asking host customers how important various criteria were to defining a project as successful, the survey also asked how confident they were that the project in question had met or would meet each of these success criteria. For customers whose projects were withdrawn, suspended, or rejected; the survey asked how confident they were that the project would have ultimately met each of the success criteria if it had proceeded to completion. Figure 3-2 shows the percent of respondents who were confident that their project would meet (or would have met) each of the success criteria discussed above.

Figure 3-2. Percent Confident Project has/will/would Meet Specific Success Criteria



The most striking finding evident in Figure 3-2 is that most host customers—*even those whose projects were withdrawn, suspended, or rejected*—believe in the project. Granted, those with withdrawn, suspended, or rejected projects are less likely to say that each criterion would have ultimately been met, but the majority still believe they would have been met.

Finally, when asked to rate how confident they were that their project would ultimately be (or would have been) successful (in the way they defined overall success), 84% of customers with active/completed projects and 67% of those with withdrawn, suspended, or rejected projects said they were either confident or very confident in the project's ultimate success.

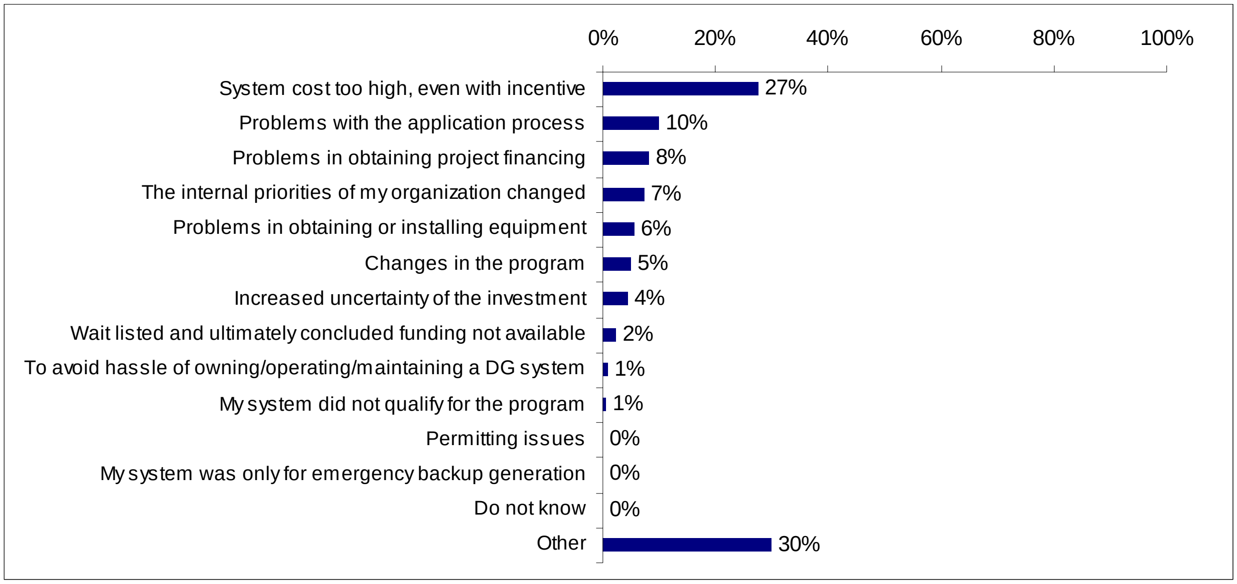
What accounts for this apparent optimism among customers whose projects "failed" to complete the SGIP process? First, almost half (43%) of the host customers whose projects had not completed the SGIP process indicated that they had either installed (14%) the system anyway or planned to do so (29%). It should be noted that many of these projects would not have been initiated without the potential of receiving funding through SGIP. About 90% of host customers with active/completed and withdrawn/rejected projects ranked the availability of rebates from the program in their initial decision to go forward with this project as very important.[9] Therefore, the availability of funding is crucial for many of the on-site generation projects to begin. Also, the surveys show that the perception and reality of the ease of different program processes can be different; thus the 29% that plan to continue with project installations may encounter logistical or economic roadblocks that stop them from installing the generation equipment.

The fact that the percentage that are confident the project would have succeeded (67%) exceeds the percentage that installed or planned to install it without the incentive (43%), however, implies that some customers believe their project's exit from the program was due to something other than it being a "bad"

[9] On a scale of 1 to 5, with 5 meaning "Very important," 1 meaning "Not at all important," and 3 meaning "Neutral."

project. This is backed up by an examination of the reasons customers gave for withdrawing their applications (Figure 3-3).

Figure 3-3. Reasons for Withdrawn Applications (All Technologies)

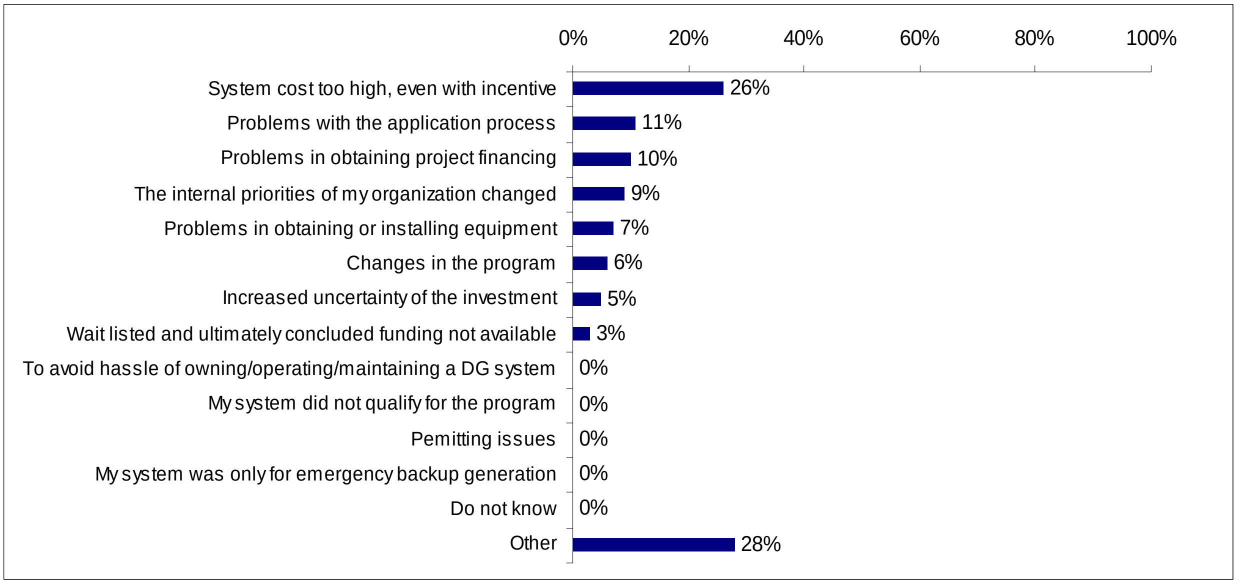


"Other" includes problems with the contractor/consultant, lack of guaranteed SGIP rebate, lack of response from the utility, delays, metering, tax reasons, time constraints, issues with the ownership of the system, better rebates in 2007, too many requirements, and initially unknown additional fees.

As shown in Figure 3-3, many customers whose projects were withdrawn cite issues other than the system cost being too high as the reason for withdrawal (although high system costs are the most commonly cited reason). The smaller number of customers whose projects were suspended or rejected tend to cite missed deadlines as the reason or say that they do not know why the project exited the program. Note that most host customers rely on a service provider or DG vendor to manage their participation in the SGIP program, so a degree of ignorance of the drivers of project failure on the part of host customers is to be expected.

Figure 3-4 shows that the reasons customers cite for having withdrawn their projects are essentially the same when looking only at those who withdrew PV applications.

Figure 3-4. Reasons for Withdrawn PV Applications



3.2 Key Factors Contributing to Project Success and Cost-Effectiveness

The most important factors contributing to project success vary depending on whether success is defined as simply completing the installation and navigating the SGIP process, or whether success includes the performance and economics of the on-site generator after installation.

3.2.1 Success Factors from the Developer's Perspective

From the developer's perspective there are two key factors that contribute to project success and cost effectiveness. The most important is a thorough understanding of the (often changing) requirements of the SGIP, utility interconnection departments, local building inspectors, and other stakeholders. One reason it is so important for the developer to understand project requirements and be able to successfully navigate them is that host customers are typically unwilling or unable to do so. Almost 90% of the developers interviewed said that their host customers "essentially take a hands-off approach to the [SGIP] application process, leaving [the developer] to make most of the decisions." A key reason for this is that several aspects of the process (notably permitting, interconnection, and obtaining the necessary proofs of insurance) are "over the heads" of many host customers. This is particularly true for PV projects, where the host customer is often fairly unsophisticated about energy and utility matters. One PV developer did note that some of his customers find PV "interesting" and thus want to be involved in the process. In his view, however, their involvement is not typically helpful, because their interest outstrips their knowledge.

The second factor commonly cited by developers as contributing to project success is a pragmatic approach to resolving problems, where completing the project is more important than proving that you are right and they (e.g., the PA, building inspector, or interconnection department) are wrong. Importantly, the PAs interviewed believe that they take a pragmatic, "let's figure out how to make this work" approach as well, at least once a project has passed the PPA milestone. For the most part, developers agree that the PAs are helpful and genuinely interested in making projects happen. Given this, it is not surprising that strong relationships with the PAs are another factor developers perceive as driving project success:

"Developing a good working relationship with the PAs is a key factor leading to a successful project. If you have a good relationship with them, your projects are more likely to succeed."

—Sun Edison

As a caveat, many developers noted that while the PAs want to help, they have little or no control over some of the most problematic aspects of the process, including interconnection and local permitting.

As noted, some developers define project success not only in terms of completing the installation and obtaining the incentive but also in terms of post-installation performance. These developers tend to place great importance on how they address problems that arise after the installation is complete. Many of them take the long view and see their job as helping the market gain confidence in self-generation technologies.

"We provide ongoing maintenance contracts; we don't cut costs on the construction side of things; we provide remote monitoring of the systems and reporting back to the customer; and sometimes we supply our own natural gas to the project, so we have more control over that cost. The bottom line for us is that our eye is on trying to legitimatize cogen technology, so we have to deliver on the promise of cogen."

—Advanced Energy Systems

Remote monitoring and scheduled inspections were strategies cited by many developers.

"For most commercial systems (over 30 kW), we put online monitoring . . . equipment on them. We pretty much just include it as a job expense at this point. We also usually do semi-annual inspections for at least the first five years."

—SolarCraft Services, Inc.

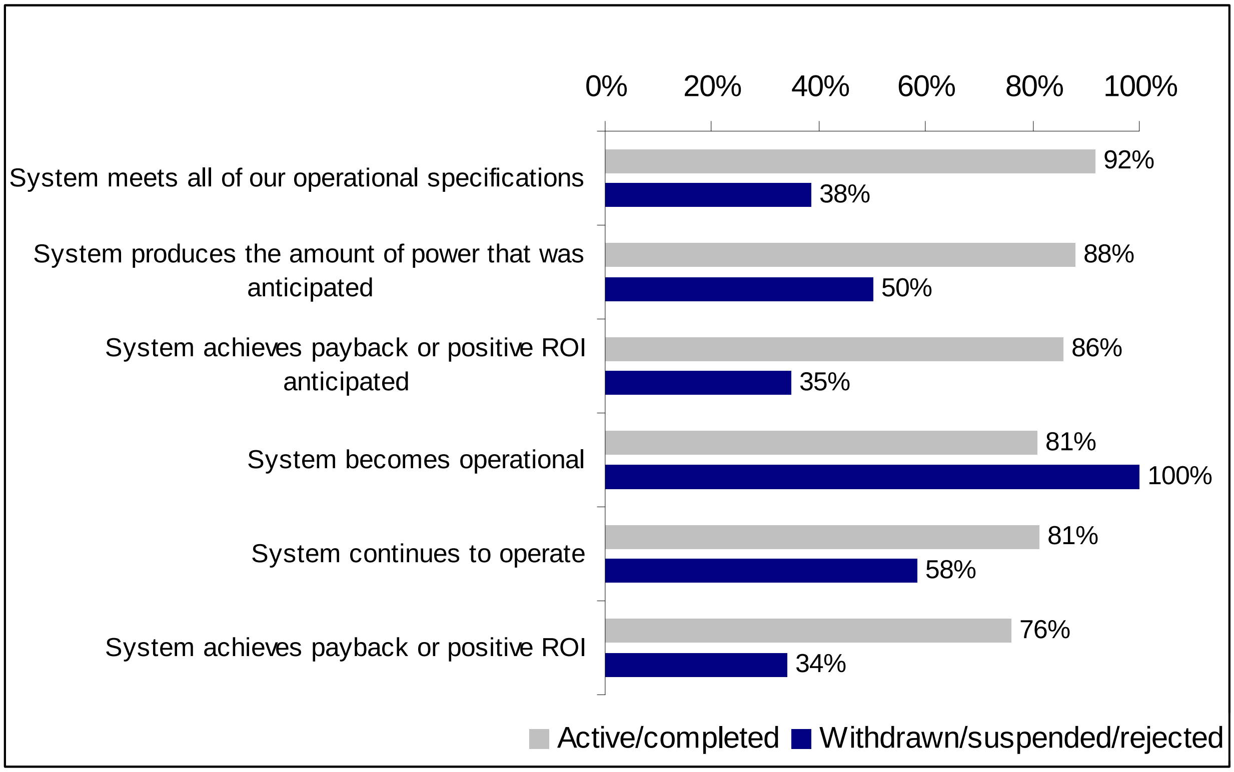
3.2.2 Success Factors from the Customer's Perspective

One way of understanding which factors are most closely associated with successful projects in the customers' eye is to use the participant survey data to see whether customers' confidence that their project will be (or is) a success depends on the factor they see as the most important component of success.

Figure 3-5 shows the percentage of participants who were confident or very confident that their project was or would be successful—broken out by the specific factor each customer saw as most defining success. Respondents with active or completed projects tend to be confident of project success regardless of the criteria they view as most important, though there are minor differences. At the "low" end, only 76% of respondents who defined success in terms of achieving a positive ROI or payback were confident of success. At the high end, 92% of customers with active/completed projects were confident of project success if they defined success in terms of meeting their operational specifications.

Confidence is much more dependent on the definition of success for participants whose application was withdrawn, suspended, or rejected, however. Of those who thought that meeting operational specifications, achieving a positive ROI or payback, or achieving the anticipated ROI/payback were the definition of success, fewer than 40% believed their project would have been successful. This is consistent with the reasons that applications were withdrawn, which had more to do with project economics than with whether the unit would actually function and produce the anticipated power output (see Figure 3-3 above).

Figure 3-5. Percent of Host Customers who were Confident their Project would Succeed by their Most Important Criterion for Success



3.2.3 Project Successes and Challenges

The Summit Blue team completed a series of vignettes representing both successful and unsuccessful projects from discussions with host customers in the SGIP. These vignettes are presented below and provide specific examples of successful and unsuccessful experiences with the SGIP. Table 3-1 below outlines the projects that are discussed further. Note that applicants tend to think of the SGIP processes as being defined by the PAs rather than the Working Group or CPUC. Because this report is designed to understand the market perceptions around SGIP we report the comments as made by the customers below, *even though customer attribution as to the source of program rules can be inaccurate*. Additionally, while these vignettes are illustrative of "typical" success and failures, they do not capture every variety of experience in the program. Failure of the self-generation equipment, for example, is not unheard of, and will be dealt with explicitly in the Retention Study report.

Table 3-1. Project Examples of Successes and Challenges

Example Project	Sector	Technology
Number 1	Water District	Microturbine
Number 2	Wastewater Treatment Plant	Fuel Cell
Number 3	Sanitary District	Photovoltaics
Number 4	City	Photovoltaics
Number 5	Plastic Extrusion Company	Microturbine

Example Project Number 1: Microturbines and CHP at Water District, Successful

Project Background

A water district installed four 30-kW Capstone microturbine generators (total of 120 kW) that burn digester gas produced onsite from the wastewater treatment plant. The South Coast Air Quality Management District (SCAQMD), which was offering microturbines to qualifying entities, granted the district two turbines for free if the district would operate them during peak hours. The additional two turbines were purchased with rebates under the SGIP. The agreement with the water district was to operate them during week days (Monday-Friday), but the district runs them around the clock (24/7) as base load plants.

The digester gas, which the district previously burned off, now can be fed into turbines as a fuel source. Waste heat from the microturbines is then used to heat the anaerobic digesters. In the words of the host customer, the district is in the wastewater business. "If energy prices were not so high and if there were no SGIP rebates available, the district would not have pursued onsite generation."

By operating its original microturbines as base load units, the district realized significant monthly cost savings and thus decided to independently acquire its second two microturbines (in Phase 2). The systems are all base loaded at full electrical power and typically deliver 26 to 30 kW each. Waste heat from the first two microturbines was sufficient to allow the facility to shut down the two boilers that originally fed hot water to the digesters, although one boiler is kept in standby mode. The district's energy bill averages $24,000 per month. If two microturbines are operating, it saves $4,000 per month, and if all four are operating, it saves $8,000 per month (over 30% of previous monthly costs).

Phase 1 Activity

The Phase 1 installation generated net operating cost savings of $4,000 to $5,000 per month. As of May 2003, after 11 months of continuous operation, the district estimated total operating savings from the microturbines to be approximately $58,300. Also as of May 2003 these two microturbines had each logged approximately 10,800 operating hours.

Phase 1 construction costs added up to $83,666, not including change order costs. Other costs included interconnection ($1,400 for four turbines), SCAQMD permits ($1,611 for two turbines) and emissions source testing ($9,520 to test one representative turbine). Total Phase 1 installation costs ultimately added up to $114,020. These costs excluded the cost of the equipment donated by SCAQMD.

In March 2003, the district was granted a location-specific permit exemption by SCAQMD. The host customer points out that burning anaerobic digester gas in microturbines is more environmentally friendly than the alternatives, including fueling boilers, reciprocating internal combustion engines, or simply flaring the gas.

Phase 2 Activity

The Phase 2 microturbines and Microgen hot water generator were commissioned in October 2003. Total installation costs for Phase 2 were $160,582. In Phase 2, the host customer worked directly with CCSE to apply for SGIP funding. Although the customer found CCSE to be very responsive and helpful in determining heat loads and heat capture formulas, the process was lengthy and onerous. “We are a public entity and could not take advantage of tax benefits.”

The engineering firm that the host customer had worked with during the SGIP application process went out of business after the district received funding approval from SGIP. This created administrative headaches, as every check and cancelled check had to be faxed to CCSE as part of the paperwork requirements. Generating a new RFP and finding a new contractor cost the district an extra nine months.

The host customer’s only major complaint is that the district did not receive SGIP funding as a renewable energy source, which would have been a larger amount of money. Digester gas is methane and is not considered renewable by CCSE.[10] “We got 20% of the microturbine costs, rather than 30%. To fight the decision, we would have had to start the entire process over again.” The host customer also believes that the utility needs to recover their capital expenditures for new plants they built for customers.

It was difficult to make the business case internally, according to the host customer. It was also described as very difficult working with the electric utility to connect the four units to the grid. According to the host customer, the application paperwork for the grid interconnection was the most difficult part of the process. “It felt like they just didn't want to do it.” It took 16 weeks to finalize an interconnection agreement with San Diego Gas and Electric.

The district was going to pursue two additional units (in Phase 2), whether or not it would receive the incentive from SGIP. The ROI on Phase 2, without the SGIP incentive, would have been roughly four years. The SGIP incentive brought the ROI down to roughly two years. This ROI is so low in part because Phase 2 is able to “piggyback” off of some of the equipment that was gifted in Phase 1. The district was prepared to go forward with Phase 2 without SGIP funding. The district did apply for funding from the SGIP, their project was accepted, and they did complete Phase 2 with SGIP funding.

The host customer estimates 99% availability for the microturbines. The most common reliability problems are centered on the fuel cleanup and fuel delivery system. The net fuel to electric efficiency is approximately 20% to 22%. Fuel compression requirements represent significant parasitic power loss. Emissions tests performed in 2002 indicated emissions levels of 1.25 ppm of NO_X and 138.5 ppm CO from one microturbine operating at full power.

Lessons Learned

Technical lessons learned from both project phases include:

- Installation costs and time for these systems are very significant in relation to the cost of the generators themselves.

- Placing a fuel treatment system upstream of the microturbines is important. (The new installation includes a refrigerated dryer and filter system for cleaning and drying the anaerobic digester gas.)

[10] This is an example of how customers can inaccurately perceive PAs as defining the program rules.

- Integration of the heat exchanger with the microturbines can be challenging.
- Surprise at designation of waste gas as renewable.

Example Project Number 2: Fuel Cell at Wastewater Facility, Successful

Project Background

A fuel cell host customer sought to reduce its energy bills by using methane gas it produces to generate electricity. As the wastewater treatment plant neared 25 years in age, there were numerous demands on capital funds. Consequently, the city sought a public/private partnership in which the private partner would provide the facilities and the city would contract to purchase electricity. The project provides overall value by reducing electricity costs while balancing environmental impact and expenses and provides the city with positive exposure.

The host customer's fuel cell is one of the first commercially operated fuel cell cogeneration plants in California. With a continuous output of 500 kW of power, the fuel cell annually generates approximately 3,750 MWh of electricity (equal to 50% of base load power for the treatment plant). It also produces 5,184 MMBtu/year of thermal energy in the form of hot water (equal to 50% of treatment plant needs). The overall rated electrical efficiency of the fuel cell is 45% (typical efficiency of reciprocating engines is approximately 30%).

Alliance Power and FuelCell Energy initiated a joint venture to sell the electric power and provide recovered thermal energy to the facility under a long-term power purchase agreement (PPA). Alliance Power is the turnkey provider of the project while FuelCell Energy manufactured the fuel cell units and provides operations and maintenance services.

The project involved careful planning and management of utility interconnection applications and construction targets to meet the requirements of the SGIP. All work was completed within a one-year time frame, from conceptual design to a fully operational cogeneration facility. Site work included construction of the concrete equipment pads, underground piping for anaerobic digester gas, natural gas and water connections, and 480-volt electrical service. Thermal energy recovered from the fuel cell exhaust is used to supplement the heating of the anaerobic digesters that create the methane gas used by the fuel cells.[11]

Alliance Power managed all of the project activities associated with obtaining funding through Southern California Edison's SGIP, including completing all applications and working closely with utility staff. All operations and maintenance activities are performed by the Alliance–FuelCell venture, and the on-site training for operations and maintenance personnel was provided as part of the contract. The fuel cell's performance is continuously observed through FuelCell Energy's web-based control and monitoring system, while the balance of plant equipment is monitored by a custom system equipped with Internet access. The monitoring system provides staff immediate access to cogeneration system information about electricity production, waste heat recovery, and fuel consumption.

Alliance Power provided development services and project management from inception to final completion. In addition to the fuel cell equipment, Alliance Power contracted for electrical interconnection equipment, anaerobic digester gas cleanup systems, and hot water heat recovery

11 The host customer still has to augment the waste heat a little bit occasionally. According to a staff member, "We had trouble getting the amount of heat we needed initially, but it's been fixed since."

equipment, which captures the fuel cell's exhaust heat byproduct. The fuel cell plant is connected to and operates in parallel with the local utility grid. It has a 25-year design life, excluding routine maintenance and stack replacements.

Findings

The total project cost was $5.2 million, and total incentives paid were equal to $2.75 million. Annual net energy cost savings (electric + thermal) is estimated to be $76,000. Net cost savings over 25 years is expected to be $1.9 million.

In addition to saving money, the power plant substantially reduces air pollution emissions by using the wastewater treatment facility's methane gas as the hydrogen source for its fuel cells rather than simply flaring this gas. The power plant reduces annual emissions by up to 1,274 pounds of oxides of nitrogen (NO_x) pollutants and 7,561 pounds of carbon monoxide annually by using fuel cells. Compared to burning anaerobic digester gas in a flare, the fuel cell achieves large reductions in emissions (an 89% reduction in NO_x, 97% reduction in CO, 99.9% reduction in SO_x, 96% reduction in VOC, and 100% reduction in particulate emissions).

According to the host customer, obtaining the air permit (from SCAQMD) took a considerable length of time. Originally, the host customer received an exemption for a permit, but the state decided that it did need a permit. The contractor was able to work within the SGIP timeline, though it was not easy. If the host customer had to submit the paperwork itself, it would have been much more difficult. "One of the big challenges here is that we're in the coastal zone, so we have a lot of permitting issues that we have to go through, which really adds a lot of time."

The host customer has natural gas as a back-up fuel. "We had hoped to blend (fuels) if we were ever low on digester gas, but we can't with this system. Natural gas prices affected the size of our project: we might have sized it to meet all of our power needs if gas prices had been lower."

Because the REC market was not in place at the time of the project, the host customer did not pursue RECs. Moreover, the host customer does not own the project, so selling RECs would not be its decision. The host customer is looking into solar panels, probably through another PPA and some kind of public/private partnership.

Lessons Learned

PPAs can be an effective approach.

Fuel mix assumptions can affect system economics.

The equipment has mostly operated reliably and according to specifications. There was pretreatment equipment that had some problems, some O&M issues, and some stability issues initially, but they have all been fixed.[12] "Overall," reported the host customer, "it's been pretty good."

[12] The carbon filter in the pretreatment was changed out, the chiller water needed to be replaced, one of the fuel cells needed to be re-stacked once, and there was a problem with the piping of the hot water. Because of the PPA, it is all under warranty for the host customer.

Example Project Number 3: PV at Wastewater Facility, Successful

Project Background

This sanitary district in California treats 2.5 million gallons of wastewater every day on average. The cost of purchasing power for its electric pumping and processing motors was very high, prompting the district to explore whether solar PV would be an economic solution for meeting energy needs. The environmental leadership on the district's board of directors also had a keen interest in sustainable technologies.

Ultimately, the district completed two PV projects that were funded by the SGIP program. For the first project (89 kW), completed early in the SGIP program, the district received an incentive equal to $4/watt. The success of Phase 1 prompted the district to apply for and receive an incentive equal to $3.50/watt during Phase 2 (485 kW) for additional PV. Composed of forward-thinking people, the board knew the rebates were going down over time and acted quickly to replace grid power. Now, almost 575 kW is in place, which is most of the onsite load. Currently the PV panels are meeting 100% of the wastewater treatment plant's load because this has been a very dry year (and thus there is less wastewater to pump and process).

Activities

The water district installed PV panels manufactured by BP Solar and Sharp. An energy management consultant wrote the specifications and evaluated the bids. A project developer installed the panels and interfaced with PG&E. The SGIP program requires a warranty of five years, which was offered, as well as a performance guarantee that is based on energy output at the meter and is not weather-normalized (based on kWh generated at the meter annually). The panels have operated as projected.

Monies from SGIP were the only financial assistance given to the projects, and these rebates were one of several critical success factors. **The district would not have installed these panels without the incentives, which accounted for close to 45% of total project costs.**

Net metering is critical as well, because it allows the district to sell its excess energy to the grid. It gets paid for the power it sells at the time of sale, and it pays for the power it purchases at the time it's needed. **The TOU rates have a big (and in this case positive) impact on the value of the projects.**

Because the district, as owner, is a public entity, it could not take advantage of tax benefits. Nonetheless, the internal rate of return is about 14% for Phase 1, and about 8% for Phase 2.

The district does its own maintenance, but almost none is required (besides inspecting the equipment). The equipment manufacturers warranty the PV modules for 25 years and the inverters for 10 years.

Interfacing with SGIP was a smooth and relatively easy process for the district and its partners, which dealt directly with PG&E. There was no delay on the side of the utility to complete the grid interconnection. These projects will not be affected by the transition to CSI.

The district is aware of the RECs, or green tags, associated with the projects, but does not want to sell them because it wants to use them to maintain its status as environmentally friendly with its customers.

Even though the district is a fairly large energy user, it switched to a small commercial rate (an A-6 tariff) and gets a very good rate for the PV energy it sells to the grid. It also purchases power at an attractive tariff and is not being charged any standby or supplemental power rates. Though it is still connected to the grid, the district is on a rate that does not have a demand charge component, so it pays PG&E only for actual kWhs used. In peak summer time periods, the electricity produced by the PV panels may be worth up to 30 cents/kWh. During off-peak periods, the district can sell/purchase power for as low as 9-10 cents/kWh.

Wastewater treatment plants in California are unique in that they typically peak in the mornings and in the evenings, unlike most customers. Moreover, they peak in the wintertime when a flux of rainwater flows into their system. There are large fluctuations in water flow and related energy use. On average, the district processes 2.5 million gallons per day but can process up to 12 million gallons per day in the wintertime (when energy prices are lower).

Lessons Learned

The three critical success factors for district's projects are: 1) the rebates, 2) the net metering rule, and 3) the tariff the district was able to get. In PG&E's service territory, the customer can choose from one of five tariff programs, and the district picked the best one for PV.

Example Project Number 4: PV for City Government, Unsuccessful

Project Background

In 2002, the host customer city was going through budget cuts and was looking for a way to reduce expenses rather than lay off staff. The city is located in the desert and its staff imagined that PV ought to be a viable energy-saving and cost-saving technology. It would also provide good public relations benefits in terms of environmental stewardship.

Activities

The city evaluated a solar PV system, working with WorldWater, the project developer, and submitted an application to SCE for SGIP rebate monies. As part of the application process, the city had to pay a small percentage of total project costs. Not long after submitting the application, the city realized that the ROI time period would be longer than it could tolerate—17 to 20 years—because of SGIP program rules. The city withdrew its application and lost the application fees.

The host customer believes that primary barrier the city faced was a SGIP rule that limits the number of projects that could be granted rebate monies to one meter. The city has nine meters in the park where it had hoped to develop solar energy. SCE interpreted SGIP rules to suggest that the city could only have one PV project per meter. The city looked at how it could combine meters together and studied various configurations, but that greatly escalated the cost (which is what brought the ROI up to 17 to 20 years).

The city was even considering building a larger PV plant that would serve much of the entire city's power needs. The monies from SGIP would have made a tremendous difference and the city would not have considered it without financial assistance from SGIP. The 17-year ROI was based on assuming the project would be owned by a taxable, private third-party.

Lessons Learned

The fact that the city did not go through with the project can be considered an unfortunate result because the political and economic will was strong to develop PV in a climate and region very favorable for PV development.

Better communication among PA, project developer, and host customer early in the process might have clarified the rules before the city had invested in the application process.

Example Project Number 5: Cogeneration, Unsuccessful

Project Background

A plastic extrusion company, which produces plastic bottles for commercial use, installed microturbines and intended to install waste heat-capturing equipment to develop a cogeneration system. Though the company was able to secure financing from SGIP and installed generation equipment that functioned according to its specifications, the project was a financial failure.

Activities

Early in the SGIP program, Southern California Edison (SCE) presented a series of workshops and participated in trade shows where they invited power equipment suppliers to talk to SCE's customers about self-generation. According to the host customer company, the gas companies were pressing self-generation, but SCE also had displays that showed the benefits of micro-generators. When the price of electricity nearly tripled (in 2001 and 2002), the plastic extrusion company wanted to reduce its electric power purchases. Moreover, at that time, natural gas was in the range of $2-$4 per MMBtu, which looked attractive.

The company estimated electricity production costs from the microturbines would be roughly 6 cents/kWh (levelized). The concept was to capture the waste heat from the microturbines using absorption chillers. It initially calculated, based on estimates from vendors, that investment costs would add up to $700,000-$1,000,000. But once the host customer got past the initial conversations with the company providing the package and began interfacing with SCE, project costs increased to almost $2 million.

The cause behind these high costs were, *according to the host customer,* the requirements that SCE imposed on the project regarding switchgears, location of the equipment, etc. SCE also required the company to assume standby or interruptible energy rates. For the company to remain on the grid and conform to SCE's requirements meant costs were going to almost double. The generator would be on a parallel system with SCE power. "The switchgears and Edison's needs for us to be in parallel added the extra million dollars of cost to the project," according to the host customer, reducing system viability. The company decided to pursue a non-parallel (completely off-grid) system.

"Once I found out that the total costs were closer to $2 million, I withdrew the application to SGIP and decided to self-generate myself. The way Edison specified the installation had to be for SGIP drove the cost up by two times."

The company was led to believe (for example, at shows with manufacturers of cogeneration products) that it could produce onsite power in a non-parallel (off-grid) system. "We got a generation unit in for $500,000, and the absorption chillers were another $250,000, but we weren't going to do that initially. So we did not install the chiller, decided to self-generate only with the microturbines we had purchased, signed a year contract with our natural gas provider, and looked at renewing that every year, which we ended up doing." The company pulled the fuses and brought the facility 100% off-grid.

The company waited before buying the absorption chiller. "We wanted to get a year under our belt before buying the absorption cooler. Our costs were about 8 cents/kWh for about 6 months."

After a few months, a number of extra charges starting appearing on its utility bill. “Unbeknownst to us, Edison continued to bill us for no service when we were off the grid.” Edison told the company that the PUC had a rule that customers needed to continue “paying for charges we never really understood—decommissioning nuclear in California and paying back the loan for the contract former Governor Gray Davis had signed for using electricity.”

The company tried to fight what it considered unfair charges and approached attorneys to petition against them. The company president also wrote letters to the PUC, and “everyone told us to pound sand.” It was his interpretation that neither the PUC nor SCE wanted to set a precedent of smaller businesses to go off grid, but “there was not enough money in this for any attorney to take this case.”

Admitting economic defeat from these “extra” charges, the company went back on the grid. “Yet I continued to pay those fees,” the company president said, “and they had accumulated so much that it no longer made sense to power ourselves off our generator. The waste heat also was never used because we never put in an evaporative cooler. We talked to a neighbor who very much needs heat to preheat their water, but the PUC and SCE said we can’t cross the boundaries into another customer’s property, so that good idea went away too.

“They continued to bill me, at the highest possible rate they could find (very unfair and almost put me out of business). We were off-grid for almost three years. The fuses were removed from my building. I was 100% off-grid. Yet we were charged all kinds of things that I still don’t understand.”

The equipment vendor, Marson Energy, installed roughly 750 kW in total generating capacity at the host customer’s site. The host customer believes PUC rules prevented them from installing a larger system. “What would have been ideal is what we originally tried to do: be on the grid, have this unit supply energy, get the rest from Edison, and sell back when we didn’t utilize it all. That was our original vision. We could have used most of the heat through the chiller to create cool water, for process cooling.”

The extra charges the company was paying were equal to the cost of buying grid power from SCE, so the company sold its generator at a great loss and now is a customer again back on the grid. “If those extra charges are still embedded in our current normal utility bill, we can’t see them, and we didn’t understand them when they were charged to us as self-generators.”

According to the company president, “It was the extra charges we were billed by Edison for not using their service that brought us down. We would have thought SCE would have been happy to have some customers reduce the load on the grid.”

The company president said that once his facility got off the grid, the new rules should not have applied to his company. “We went 100% off-grid. I said I don’t want standby, or parallel, and they worked hard to make me suffer for this.” He believes that SCE was charging him for the extra cost for procuring energy because of former Governor Grey Davis’ signing contracts with Enron and other IPPs. “Because I was using energy, I needed to continue paying for those charges. My answer was: I am off-grid, so I am not using the energy. Why would they continue charging me when I am helping California’s energy crisis and I was paying someone else (the gas company) for the services I wasn’t using. So I paid for energy twice.”

Lessons Learned

As in Project Example Number 4, the key factor leading to failure here seems to have been an inadequate understanding of the rules and tariffs on the part of the host customer, leading to unrealistic financial expectations. It is not clear where communications broke down between PA, developer, and host customer; but a clearer understanding of the rules on the part of the host customer from the outset might have prevented a contentious situation.

4. PROGRAM SUCCESS IN THE MARKET

4.1 Changing Market Context

Any attempt to evaluate or understand the success of the SGIP in promoting self-generation in California must take into account the dynamics of California's economy over the past few years. For example, the number of projects successfully completed is viewed in the context of both the overall market potential for self-generation, along with other economic and demographic forces that may have constrained this market potential. These market factors affect each of the key drivers in distributed generation technology adoption rates, including the *Product, Price, Placement, and Promotion* of SGIP-eligible technologies.

4.1.1 Solar Photovoltaic Prices

Solar PV has been a primary technology involved in the SGIP, both in the number of applications (75%) and in the number of completed systems (67%). Applications reached a peak in 2005, and declined in 2006 to levels below the number of applications received in 2004. Factors driving penetration of PV in the market (*Product and Price*) include two dependent factors: the *cost* of modules/installation and the *availability* of the PV panels.

In the 2005 "Annual Photovoltaic Module/Cell Manufacturers Survey, "[13] the Energy Information Administration (EIA) found that the average price for modules increased from 2004 to 2005 by more than 6%: from $2.99/peak Watt in 2004 to $3.19/peak Watt in 2005. The price of cells also increased during this time, from $1.92/peak Watt in 2004 to $2.17/peak Watt in 2005 (see Figure 4-1). This survey data is not entirely consistent with findings from an LBNL report on PV cost trends in California, which found that installed costs under the SGIP have been flat with a slight increasing trend, though since 2002 costs have appeared to decline. The LBNL study also finds that systems installed in areas outside of PG&E's territory report higher pre-rebate costs than systems installed within PG&E's region. However, according to the authors, the reasons for this discrepancy are unclear and would require further analysis**.**[14]

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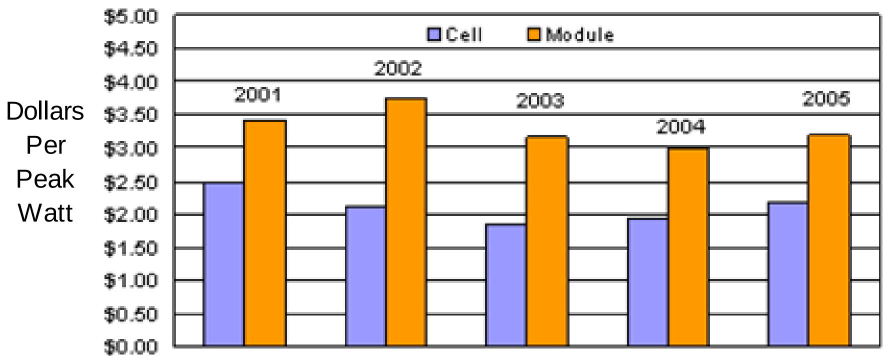
[13] http://www.eia.doe.gov/cneaf/solar.renewables/page/solarreport/solar.html

[14] Wiser, R., M. Bolinger, P. Cappers, R. Margolis. "Analyzing Historical Cost Trends in California's Market for Customer-Site Photovoltaics." Report Prog. Photovolt. Res. Appl. 15. 69-85. June 2005.

Figure 4-1. Photovoltaic Cell and Module Average Prices, 2001-2005



Source: Directly taken from Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

The EIA attributes the reasons for this recent increase in PV costs primarily to the increase in material costs and the shortage of refined silicon. In-depth interviews with developers involved with the SGIP also mentioned the effects of the shortage of PV panels. When asked about meeting the one year deadline, one developer responded “This has been a problem recently because of the shortage in PV modules. The shipping schedule [for modules] slips as often as the paper is delivered." Another developer noted that his company could not get PV panels in 2005 and 2006 because they were too expensive.

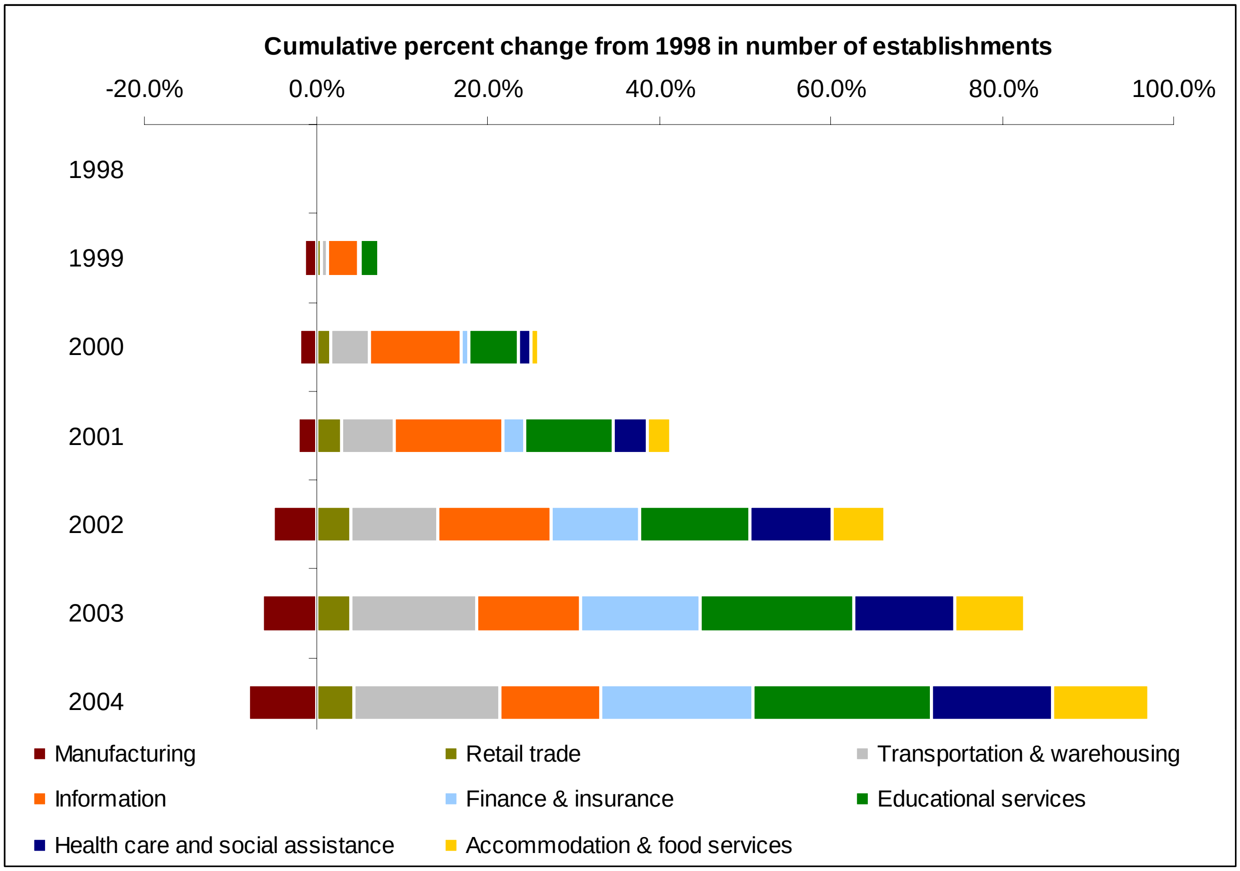
4.1.2 Changes in Business Demographics

One candidate for a factor constraining self-generation market potential would be the much discussed “flight” of businesses (notably manufacturing) from California. Companies experiencing “negative growth,” whether through shutting down facilities or relocating them to another state or country, are unlikely to invest in self-generation. Thus, a declining number of establishments in a given sector clearly constrains the market opportunity for self-generation within that sector.

Figure 4-2 illustrates how statewide business demographics changed between 1998 and 2004 in several segments that are, in other respects, promising candidates for self-generation.[15]

[15] 2004 is the last year for which data on the number of business establishments is available from the Census Bureau’s County Business Patterns database (www.censtats.census.gov).

Figure 4-2. Cumulative Percent Change in Number of Business Establishments in California Since 1998 (Selected Segments)

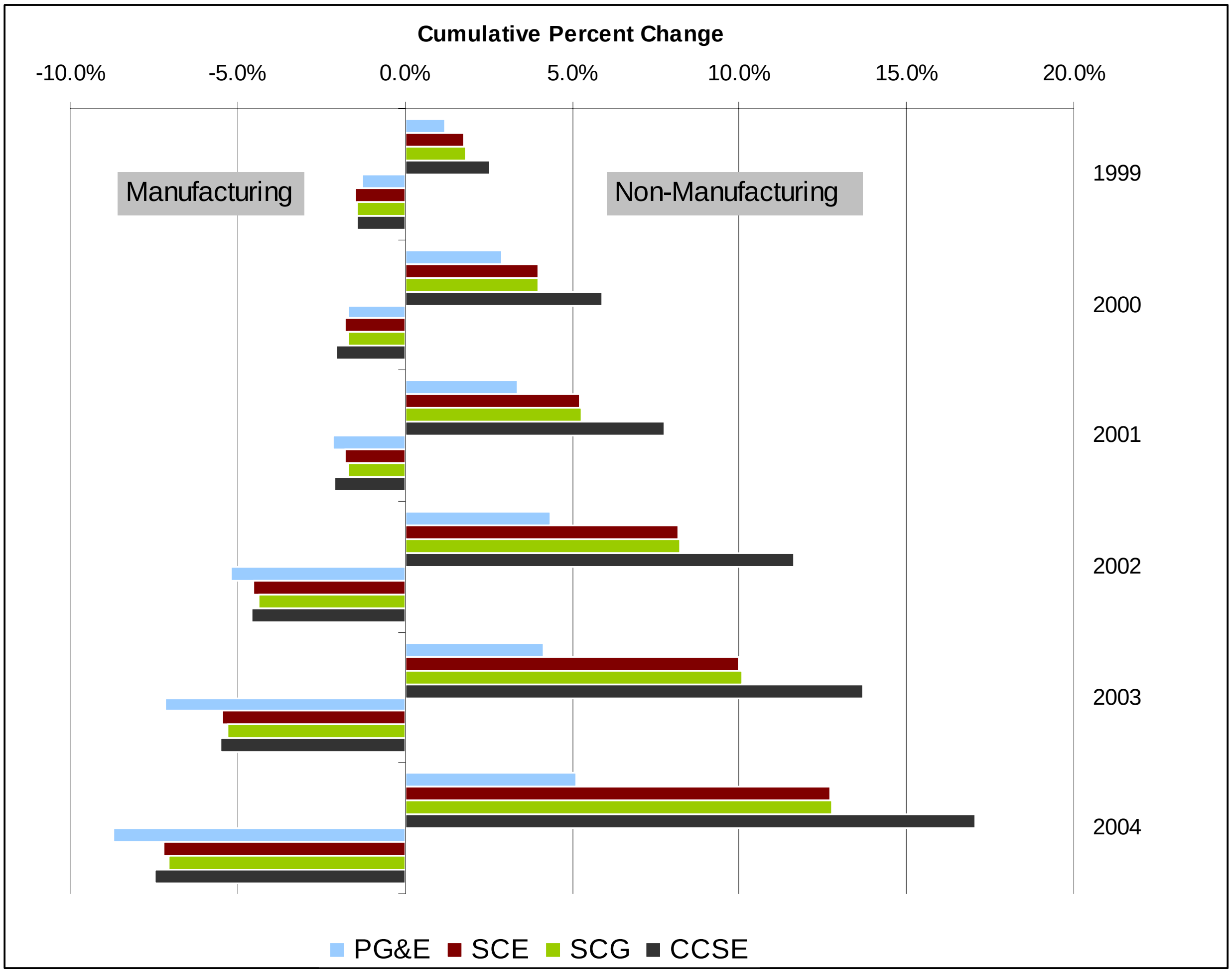


Source: US Census Bureau data

Note that while there was an 8% reduction in the number of manufacturing establishments in California in the six years from 1998 to 2004, other sectors with self-generation potential continued to grow (albeit slowly). This was particularly true for education, finance, and transportation and warehousing. The education sector has traditionally been a strong candidate for both PV and CHP applications, while finance and warehousing are good candidates for PV (particularly warehousing, with its large, flat roofs).

By breaking down the statewide data from Figure 4-2 by county, then re-aggregating it by PA territory, it is possible to view the changing business demographics faced by each PA (see Figure 4-3).

Figure 4-3. Cumulative Percent Change in Number of Manufacturing and Non-Manufacturing Establishments by PA Territory

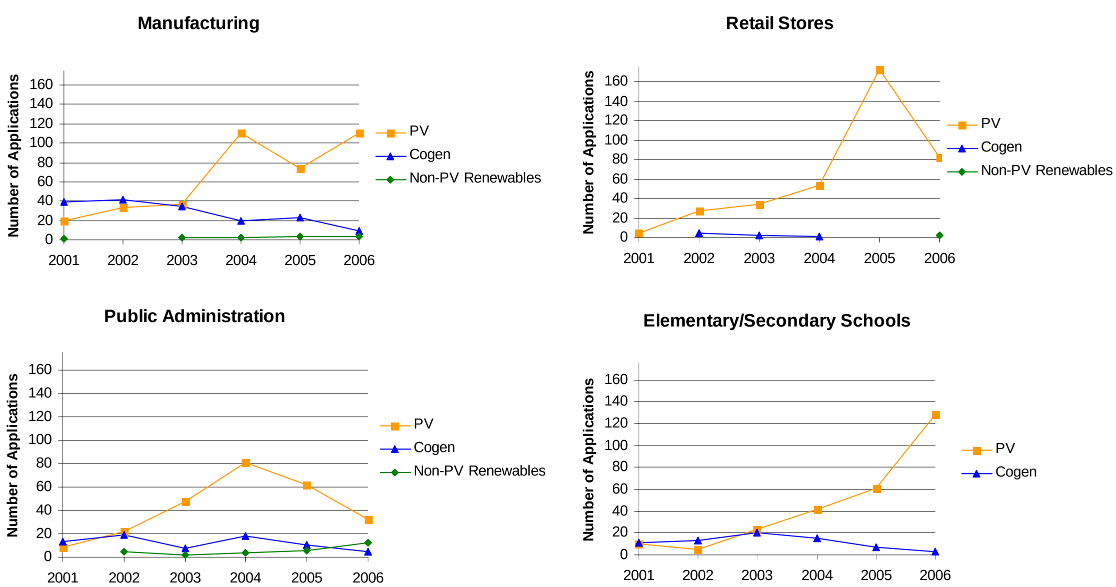


Between 1998 and 2004, all four PAs experienced a loss of manufacturing facilities from their territories; this accelerated in 2001. These losses amounted to roughly 7% of the 1998 manufacturing base for SCE, SCG, and CCSE and almost 9% for PG&E.

The number of non-manufacturing facilities in California grew during this same period, but at different rates within the different PA territories. CCSE saw the largest growth in the number of non-manufacturing establishments, adding 17% from 1998 to 2004. SCE and SCG each saw roughly a 13% increase in their non-manufacturing base, while PG&E only experienced 5% growth. The implication of these numbers is that PG&E has faced a somewhat more challenging business climate for promoting self-generation than have the other PAs, at least as far as industry growth/decline is concerned.

These demographic changes provide a context for understanding how program applications have grown and declined by sector over time. Figure 4-4 shows annual SGIP applications by technology for the four market segments that account for the largest percentage of SGIP applications (manufacturing, retail stores, public administration (mostly city governments), and elementary and secondary schools). Each point on the charts represents the total number of applications by year of application. From this data it is apparent that PV applications have increased over time in general, although with some differences by segment. Elementary and secondary schools have shown the sharpest and steadiest increase, and this trend is true even absent the large number of school applications received by CCSE to the program. Similarly, the increase in applications in the retail stores segment is consistent, even if you discount the impact of a single retail chain (Walgreen's) that submitted 70 applications in 2005.

Figure 4-4. Yearly Applications to SGIP by Technology and Market Segment



The decline in the number of PV applications coming from the public administration sector after 2004 is worth noting. Most of the applications in this segment came from city governments. There is at least anecdotal evidence that around 2004 California municipalities may have shifted from a strategy of installing their own PV projects to one of requiring developers of new construction projects to include PV in their plans.

While Figure 4-4 charts the number of applications by technology and sector over time, Figure 4-5 and Figure 4-6 show the number of completed PV and cogeneration projects in each year that were accounted for by the top four segments.[16] Comparing these data with Figure 4-4 reveals some interesting patterns. For PV projects, we see that that growth trends in program applications from Figure 4-4 are mirrored in the project completion data. Here again, we see the growth in PV projects in the public administration sector dropping off after 2004.

[16] The small number of project completions other than PV and cogeneration made a breakout for the former technologies impractical.

Figure 4-5. Top 4 Market Sectors—Number of Completed PV Projects By Year

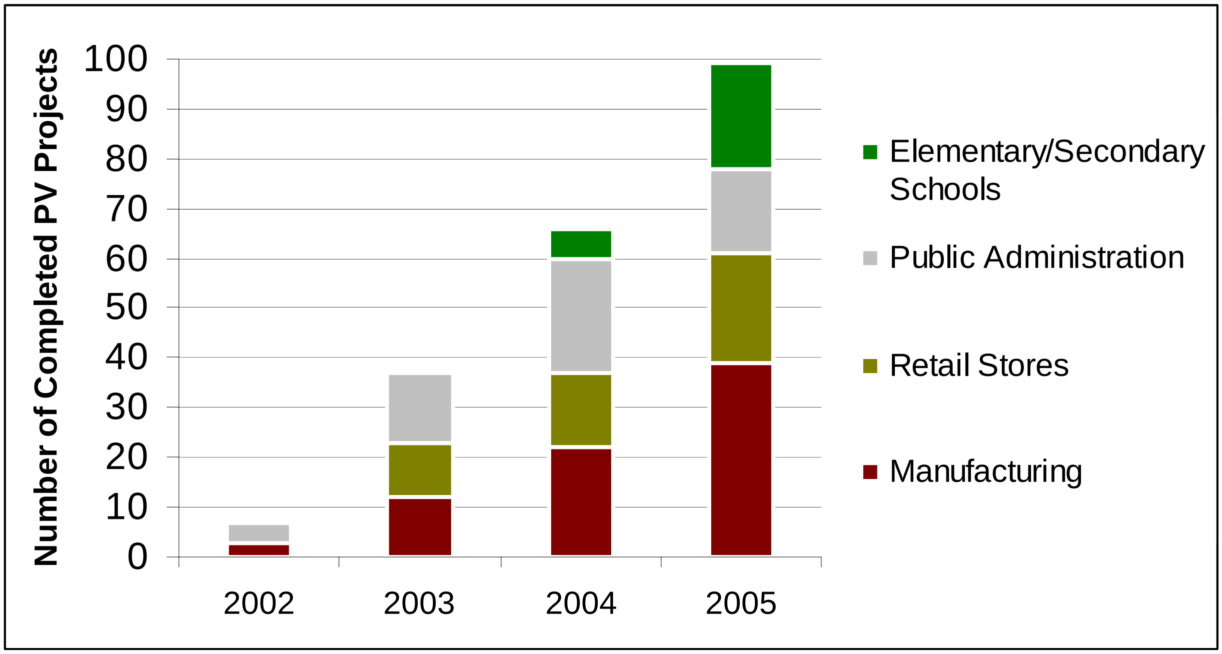
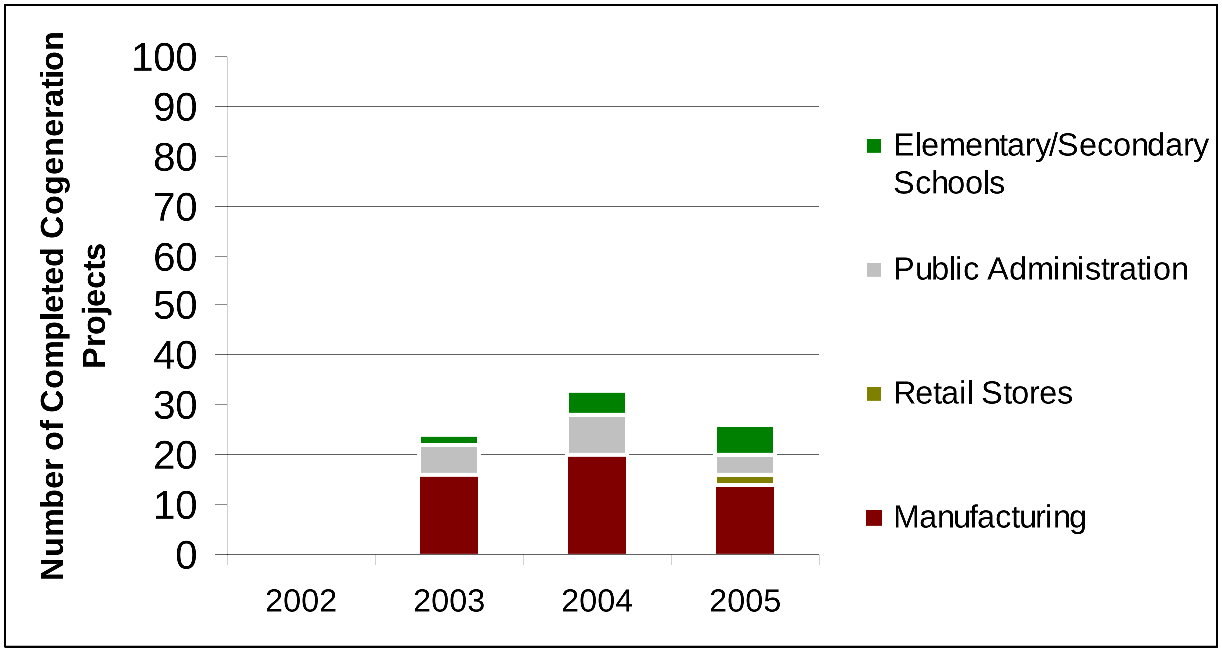


Figure 4-6 shows that the manufacturing sector dominates in installed projects even more than it did in program applications. Schools and public administration applied for cogeneration projects at about half the rate that the manufacturing sector did between 2001 and 2003 (Figure 4-4), but neither sector has achieved half as many completed projects as the manufacturing segment has. This could be due to a combination of a lower rate of project completion among non-manufacturing sectors or a longer lag time between application to the program and project completion. The impact of lag time for cogeneration projects can be seen by comparing the manufacturing lines in Figure 4-4 and Figure 4-6; cogeneration project applications began to decline after 2002, but the number of projects being completed did not start declining until 2004 (as the pipeline of active projects were completed).

Figure 4-6. Top 4 Market Sectors—Number of Completed Cogeneration Projects by Year



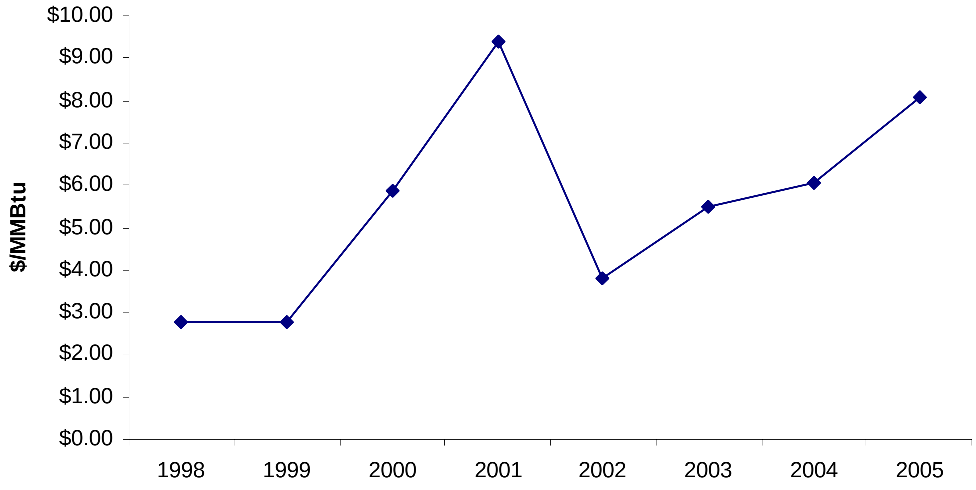
It is important to note that some, but not all, of these trends in applications and completions by segment may be partially accounted for by changes in business demographics. The steady growth in PV applications and completions, and cogeneration completions, among schools, for example, is consistent with the growth trajectory in the number of educational facilities in California up to 2004 (Figure 4-2). In other cases the success of the SGIP program in a segment defies demographics. This is particularly true for manufacturing, where a steady downward trend in the number of manufacturing establishments would seem to be at odds with the up and down trends over the past five years in both PV and cogeneration projects.

Another contextual factor affecting the number of applications and projects for cogeneration technologies is the change in natural gas prices over time.

4.1.3 Changes in Natural Gas Prices

For natural gas fired applications (that is, most self-generation projects other than PV or wind), fluctuations in fuel prices during the years that the SGIP has been in place present another external constraint on market potential. Figure 4-7 shows the trend in California natural gas prices from 1998 to 2005. The spike from 1999 to 2001, and the steady rise since 2002, have substantially worsened the economics for gas-fired self-generation projects.

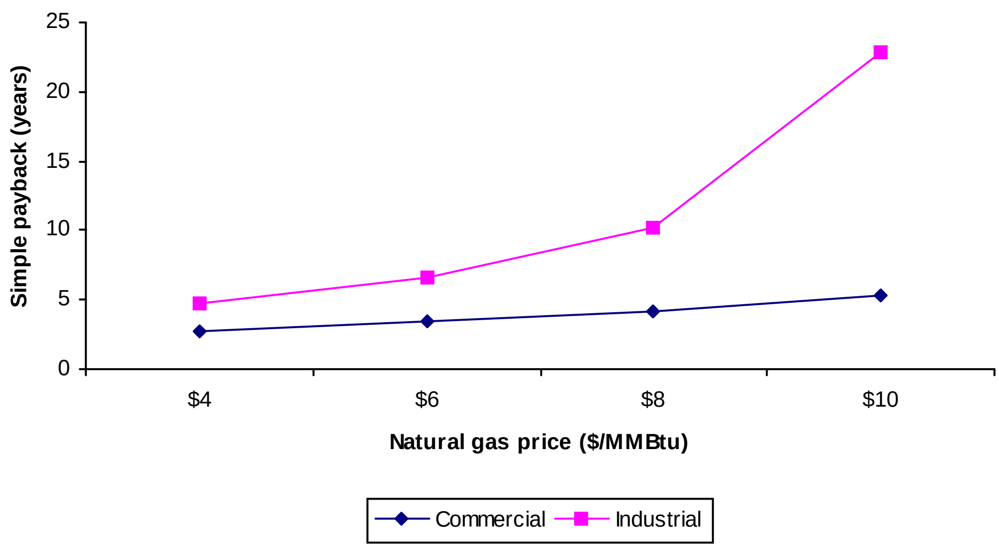
Figure 4-7. California Natural Gas Prices from 1998 to 2005



Source: Energy Information Agency. Values shown are prices charged to electricity consumers.

Figure 4-8 illustrates how substantially gas prices affect the economics of CHP applications, in this case using the example of a 1-MW gas turbine. Although the specific values would be different for different CHP technologies, the overall pattern is the same—with the largest increases in payback occurring once gas prices reach $8/MMBtu.

Figure 4-8. Simple Payback on a 1-MW Gas Turbine CHP Application as a Function of Natural Gas Prices



Source: Energy Insights' DE Analyzer economic model.[17]

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[17] This model assumes a host customer that is able to use the full electrical and thermal output of the turbine. Commercial customers are assumed to be paying $0.121/kWh for electricity, while industrial customers are assumed to be paying $0.086/kWh.

As significant as natural gas prices are, however, they are only one factor that may have affected the rate of cogeneration applications over time. Other candidates include reductions in incentives, changes in air permitting requirements, changes in the requirements for waste heat recovery, the flight of manufacturing facilities from California, and a softening of retail electricity prices following their historic highs in 2002.

A regression analysis of factors affecting cogeneration system applications indicates that the strongest driver of the drop in applications over time was the reduction in incentives in January 2005. Increasing natural gas prices was the second strongest driver of the decline in applications. No other factors emerged as statistically significant predictors in the model. Details of this regression analysis can be found in section 2.1 of the appendix.

4.1.4 Customers' Payback Thresholds

According to host customers in focus groups and in-depth interviews, payback periods for cogeneration systems that had once been two to three years in 2001–2003 increased to seven to ten years after 2003 because of the change in natural gas and electricity prices. Data from the participant and non-participant surveys indicate that most SGIP participants are willing to accept paybacks of this length, but most non-participants are not. The respondents for 80% of the active/completed projects said that they would be willing to accept a simple payback of six or more years for any future on-site generation projects they might undertake. The percentage of respondents for withdrawn/rejected projects that would accept paybacks of this length in the future was slightly lower, but still high (71%). We have no way of knowing if the percentage is lower in this group because of their experiences with the SGIP program to date, or if those host customers whose projects were ultimately withdrawn or rejected had more stringent payback requirements from the beginning.

When we look at the data for non-participants, however, the picture is much different. Only 24% said they would be willing to accept a payback of six or more years for an on-site generation project. Thirty-one percent of non-participants required a payback of no more than five years, and 45% required a payback of four years or less. Based on Energy Insights' prior research with business customers, we believe that non-participants have shorter payback requirements for two reasons. First, they are less familiar with the actual economics of on-site generation systems and thus have somewhat unrealistic expectations that would likely change with education. Second, they simply have stricter payback requirements, which is one reason why they are not already participating in the program.

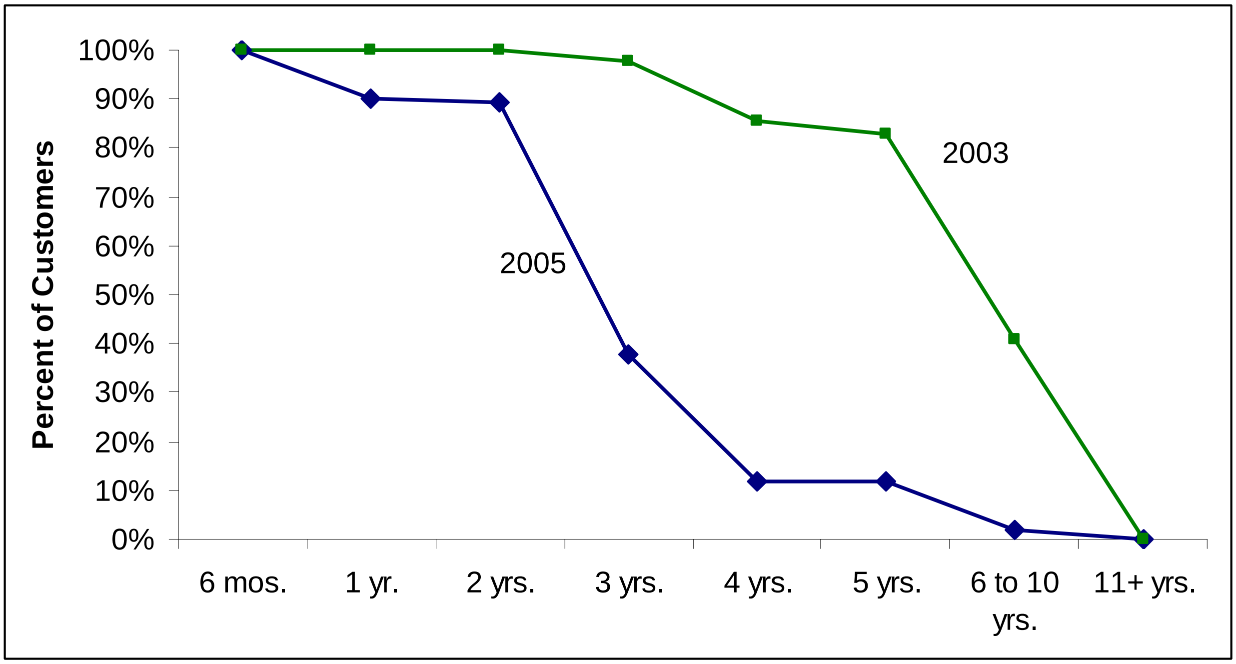
A comparison of participant and non-participant survey data with data from prior surveys of energy users indicates that customers' payback requirements shift over time. A study sponsored by the California Energy Commission recently concluded that the payback threshold that California energy users apply is very demanding, with less than half of all energy users willing to accept a payback of even two years for a CHP project.[18] In fact, this study concluded that most would require a payback of one year or less.

However, the strongest prospects for CHP applications—those energy users that were already actively investigating CHP options—were somewhat more tolerant of longer paybacks (though even within this group the majority expected a payback of less than five years). Although this indicates that a niche target market for CHP exists in California, even these "strong prospects" were less tolerant of longer payback periods in 2005 than they were in 2003. This troubling trend is shown below (see Figure 4-9). The data on customer payback thresholds were collected as part of Energy Insights' 2003 Distributed Energy Market

[18] "Assessment of California Combined Heat and Power Market and Policy Options for Increased Penetration," California Energy Commission, Nov. 2005, CEC-500-2005-173.

survey, which was repeated in 2005. The 2003 data were included in the CHP study Energy Insights conducted for the CEC.

Figure 4-9. Payback Requirements for Self-Generation Among the Strongest Prospects for Self-Generation Adoption



Source: Energy Insights' 2003 and 2005 Distributed Energy Market Studies

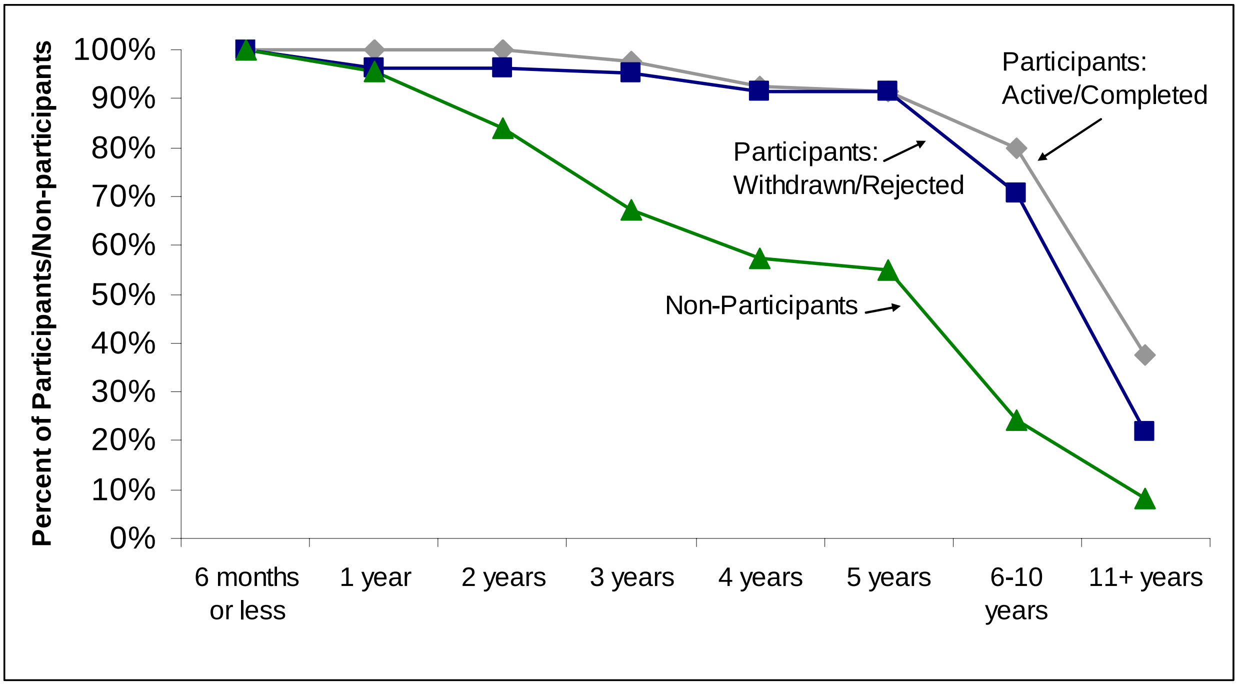
In 2005, energy users who were considering CHP applications and had begun actively investigating their options (called "strong prospects" in this study) were substantially less willing to accept "longer" paybacks than such companies were in 2003. In fact, less than 12% of strong prospects were willing to accept paybacks of even four years in 2005, whereas 90% had been willing to accept such paybacks just two years earlier. The average acceptable payback threshold went from 6.1 years in 2003 to 2.5 years in 2005.

What could account for such a shift? The likely explanation lies in the volatility that was introduced into natural gas prices during this period. When fuel prices are perceived as more stable, customers are more willing to invest capital on the basis of an analysis that shows payback within five years. However, the more unpredictable fuel prices become, the less confidence customers have in payback estimates that extend beyond the next year or two—where fuel prices can be hedged.

The survey data collected from SGIP participants and non-participants in 2007, however, suggests that the tightening of payback requirements between 2003 and 2005 was a temporary reaction to fuel price fluctuations. Figure 4-11 shows the percent of participants with active or completed projects, participants with withdrawn, suspended, or rejected projects, and non-participants who would find various payback levels acceptable for on-site generation. Both participant groups show payback acceptability thresholds reminiscent of the ones found among strong prospects in the 2003 Energy Insights survey. Note that the payback requirements among participants whose applications were withdrawn, suspended, or rejected are not substantially different than those whose applications were successful. This argues that the reason many participants stated for withdrawing their applications (system cost too high even with incentive) was not due to these applicants having stricter requirements for project economics, but to their original estimates of likely project economics being too optimistic.

Non-participants have stricter payback requirements, though even among non-participants roughly half would find a payback of five years acceptable. There are doubtless multiple reasons for non-participants having shorter payback requirements than program participants. Part of the difference is undoubtedly self-selection; customers with more demanding payback requirements are less likely to apply to install on-site generation or apply for SGIP funds. It is also likely that the process of familiarizing themselves with on-site generation technologies that program participants go through leads them to have more realistic (i.e., less stringent) expectations for achievable project paybacks.

Figure 4-10. Payback Requirements for Self-Generation Among SGIP Participants and Non-Participants



Source: Participant and non-participant surveys.

Overall, the data on customers' payback requirements from 2003, 2005, and 2007 show a tightening of customer requirements around 2005 that made the market environment for SGIP more challenging. This aspect of the market environment seems to have become more favorable, however, since 2005.

Acknowledging that project economics and customer payback requirements affect customers' decisions to install self-generation technologies does not imply that these are the only factors driving such decisions. Anecdotal evidence, as well as prior research conducted by Energy Insights, indicates that numerous decision factors play a role. These include the number of decision layers, the length of time it takes to get a decision made, the urgency to act as a function of the age of the building stock or equipment, the lack of corporate delegation of responsibility to front-line managers, the corporate lack of understanding of the impact of their energy costs on their O&M budgets, and their lack of understanding of their ability to control those costs.

4.2 Market Measures of Program Success

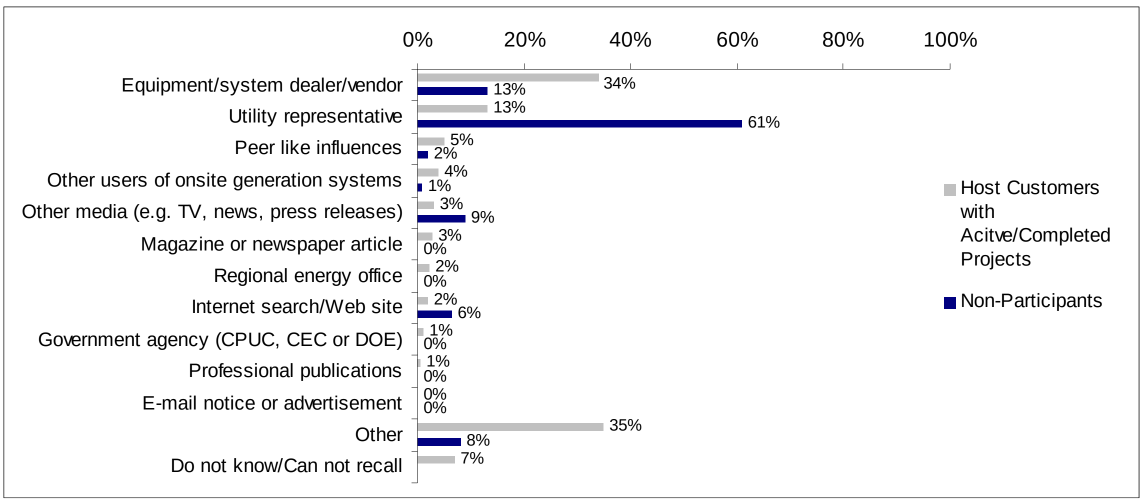
4.2.1 Awareness

Non-participants in the SGIP were asked about their knowledge of the program, providing insight about the magnitude and diversity of awareness in the market. Data from non-participant and host customer surveys also illustrate the avenues by which these two groups become aware of the program.

Results from the non-participant surveys shows that about 26% of non-participants have heard of the SGIP; 66% have not heard of the program; and 8% did not know or were not sure. Awareness of the program has increased since the Self-Generation Incentive Program Second Year Process Evaluation.[19] In 2003, it was found that 15% of non-participants were aware of the SGIP.

The main methods in which non-participants and host customers heard about the program differ. For those non-participants that are aware of the SGIP, the majority (61%) heard about the program from a utility representative; however, the majority of host customers with active or completed projects learned about the program from an equipment dealer/developer (34%). Hearing about the SGIP from a developer is a much smaller channel through which non-participants become aware of the program (13%) (see Figure 4-11). Because developers do play a substantial role in most projects that apply to the SGIP—about 80% of projects have the help of a developer in some fashion— the fact that only about 13% of non-participants heard about the program through developers indicates that developers are not reaching these non-participants, and thus this population is less likely to apply to the SGIP.

Figure 4-11. How Program Host Customers and Non-Participants Learned About the Program



4.2.2 Penetration

A basic measure of SGIP success is market penetration of SGIP technologies, which is often driven by product *Placement* (in this case through developers), and *Promotion* (often driven by developers as well). That is, the number of self-generation projects (or how many MWs) the program has helped put in place as a proportion of the number of "potential" projects or MWs in the market.

[19] RER. "Self-Generation Incentive Program, Second Year Process Evaluation." April 25, 2003.

Penetration can be calculated in many ways. For example, should all projects be counted, or only those that are currently active or completed? In defining the universe of “potential” projects against which actual projects are judged, should one look at all potential host customers? Just those who have the technical potential for a particular technology? Just those likely to achieve an acceptable payback?

A high level look at penetration would simply involve dividing the number of applications (or completed projects) by the number of non-residential accounts. Table 4-1 shows this view, collapsing across technologies and sectors. PG&E shows the highest number of application per one thousand non-residential accounts, where CCSE shows the highest number of completed projects per one thousand non-residential accounts.

Table 4-1. Program Penetration Rates[20]

	PG&E	SCE	SCG	CCSE
Number of applications through December 2006*	1737	867	540	346
Completed projects through December 2006	439	243	146	120
NRA 2002**	588,052	550,456	207,820	133,022
Number of applications per 1,000 NRA	2.95	1.58	2.60	2.60
Number of completions per 1,000 NRA	0.75	0.44	0.70	0.90

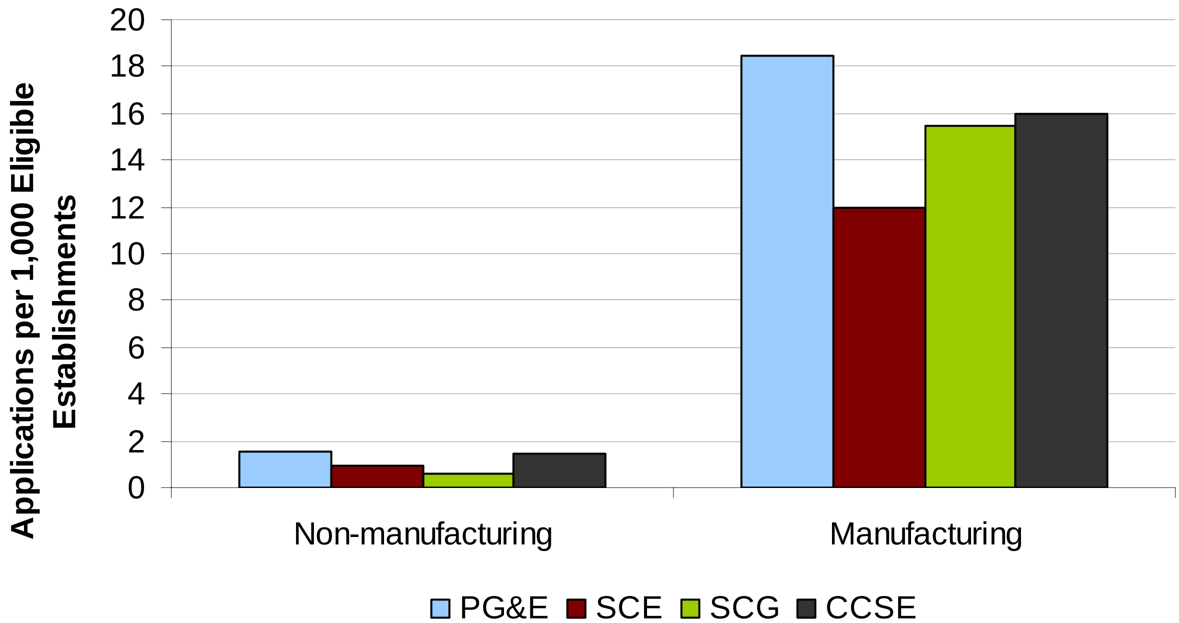
NRA = nonresidential accounts
** Note that applications rate may not be a useful metric in that many phantom applications occurred 2001 through 2005*
***All account numbers based on CEC reports for 2002. SCG accounts 2001 data*

To better judge penetration as a measure of program success, however, it is important to consider that for some technologies (notably cogeneration applications) all non-residential accounts is not a realistic base upon which to judge success. Figure 4-12 shows penetration defined as the number of cogeneration applications, divided by the number of “cogeneration eligible” establishments. The latter number is calculated by combining overall counts of business establishments with data on typical electrical and thermal loads in various segments and sizes of facilities. Cogeneration eligible establishments are those that could use the full electrical and thermal output of at least one type of cogeneration technology currently available in the market.

[20] In calculating the number of residential accounts per PA, there are inevitable overlaps. Some business establishments are electric customers of one PA and natural gas customers of another (particularly true for SCE and SCG). These customers have the option of applying to the program through either utility. The number of customers who *could* apply to a given PA is a reasonable base for calculating PA specific penetration rates, regardless of overlaps. Where aggregated penetration rates across PA’s are reported, however, these overlaps were accounted for.

As shown in Figure 4-12, over the life of the program there have been between 13 and 33 cogeneration applications per one thousand cogeneration eligible manufacturing establishments. The penetration rate for non-manufacturing establishments is much lower – both because the manufacturing sector has lead the way and because the number of eligible non-manufacturing establishments is much greater than the number of eligible manufacturing establishments (for example, in PG&E's territory we estimate that there were 172,681 eligible non-manufacturing establishments as of December 2006, but only 1,755 eligible manufacturing establishments). In other words, the denominator is much larger, making high penetration rates more difficult.

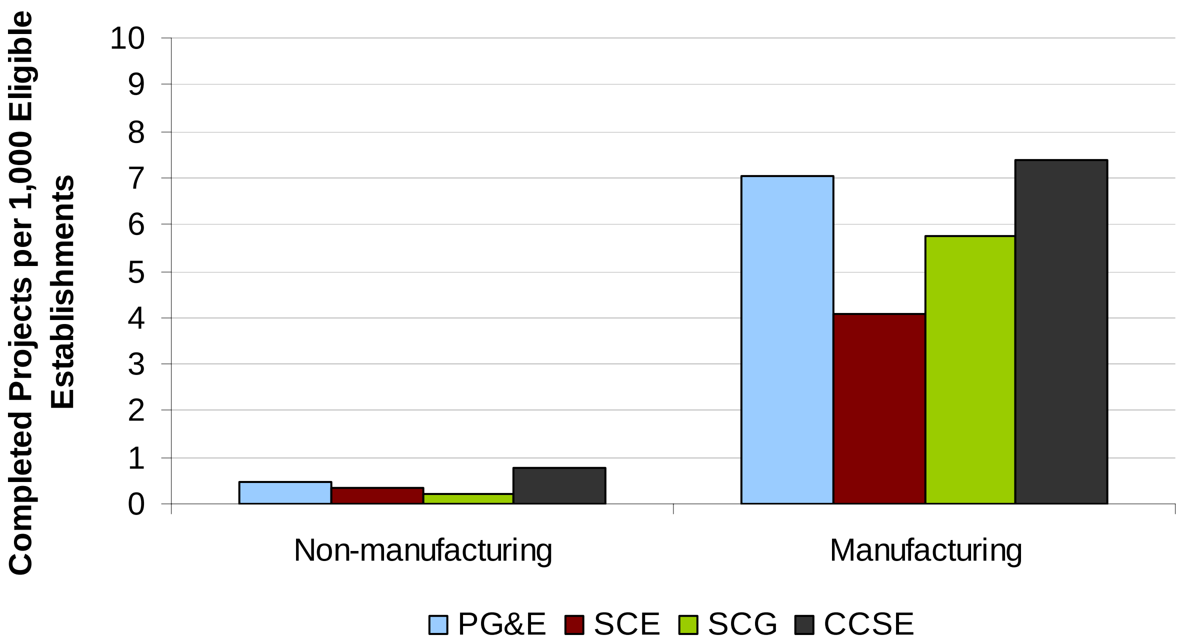
Figure 4-12. SGIP CHP Penetration by PA – total applications per 1,000 eligible establishments



Source: Project counts from December 2006 PA reports. Number of CHP eligible establishments calculated from census data and Energy Insights' proprietary electrical and thermal load data.

Figure 4-13 shows the same analysis, but looking only at completed projects. The pattern is similar with higher penetration rates in the manufacturing sector and with the highest penetration among PG&E's manufacturing base. CCSE, in contrast, has the highest penetration among non-manufacturing customers.

Figure 4-13. SGIP CHP Penetration by PA – completed projects per 1,000 eligible establishments



Source: Project counts from December 2006 PA reports. Number of CHP eligible establishments calculated from census data and Energy Insights' proprietary electrical and thermal load data.

The next two figures show the same two definitions of penetration – applications and completed projects – for PV applications.[21] Note that for PV we defined the base of establishments to be penetrated as all manufacturing and non-manufacturing establishments in the PA territories. In other words, the base of "PV eligible" establishments is larger than the base of "cogeneration eligible" establishments, and the corresponding penetration rates for PV are lower. This makes direct comparisons of PV versus cogeneration penetration somewhat problematic.

For PV, the penetration rates are much more comparable between the manufacturing and non-manufacturing sectors. Once again we see that PG&E and CCSE have higher penetration rates, particularly among manufacturing establishments.

[21] The small number of applications other than PV and cogeneration made breaking out penetration for these technologies impractical.

Figure 4-14. SGIP PV Penetration by PA – applications per 1,000 establishments

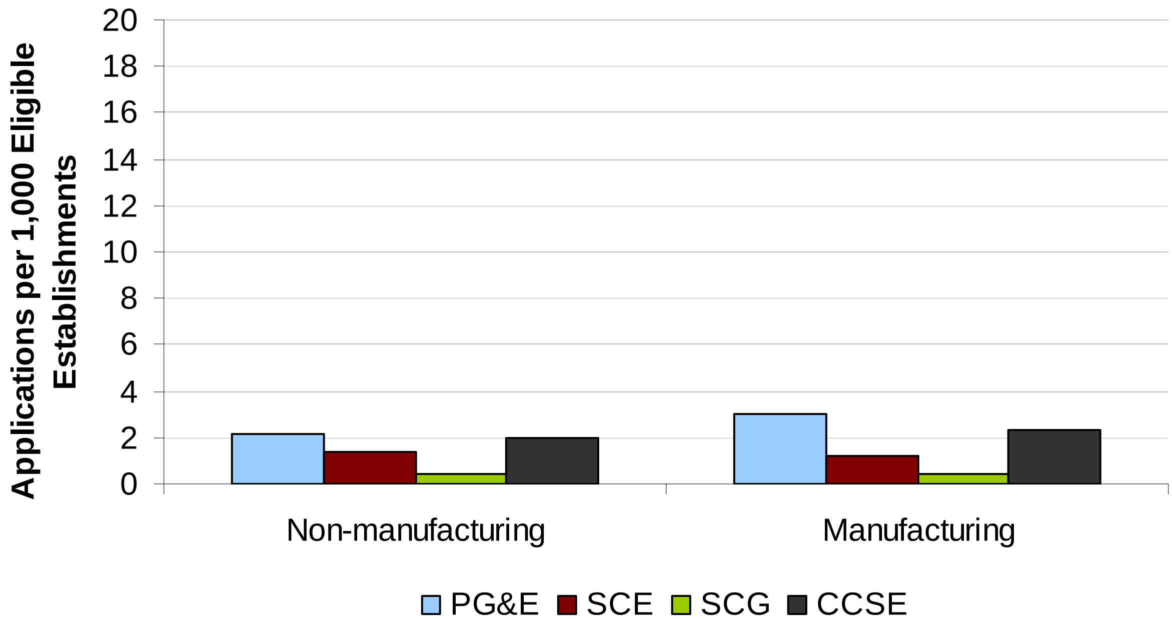
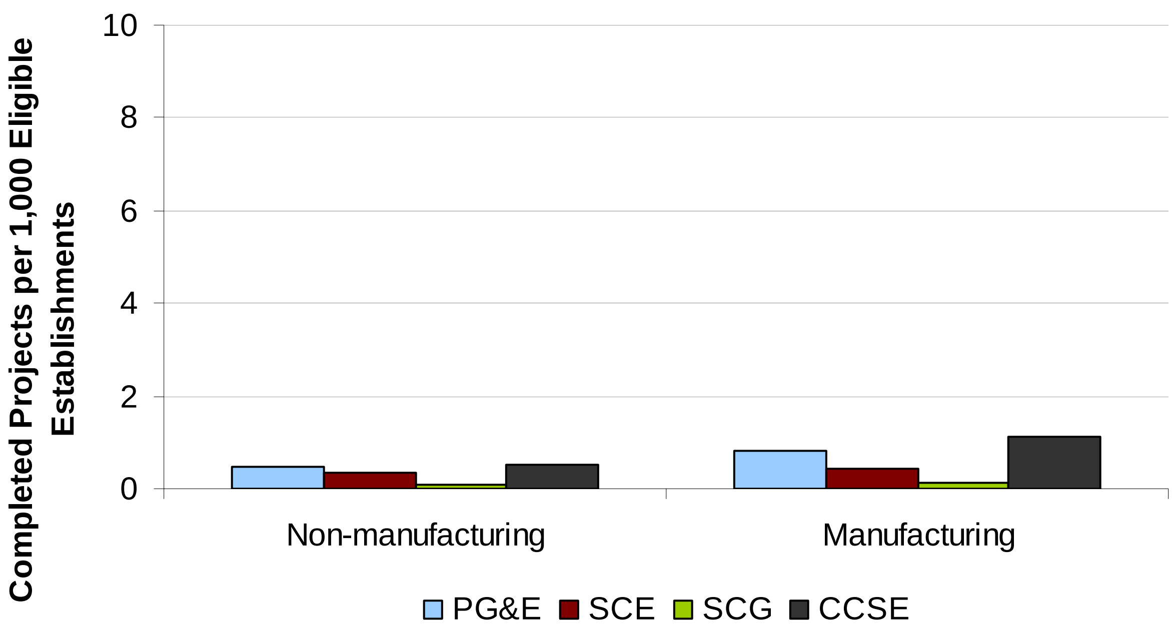


Figure 4-15. SGIP PV Penetration by PA – completed projects per 1,000 establishments



Tables 4-2 and 4-3 show program penetration (both applications and completed projects) for several more specific segments. Table 4-3 takes the manufacturing segment from Table 4-2 and breaks it out further. The estimated number of establishments by segment comes from data maintained by Dunn & Bradstreet, and excludes those portions of California that are not eligible to participate in the SGIP. Because these segment specific analyses are not broken out by technology, we struck a balance between PV and cogeneration project requirements in defining the base number of establishments. In Tables 4-2 and 4-3, the base is defined as the number of establishments with average electrical demands of at least 30 kW. This excludes most, but not all, facilities that would be ineligible for cogeneration (i.e., some 30 kW plus facilities would not have sufficient heat loads).

Table 4-2. Penetration Rates for Selected Segments

	Applications through Dec. 2006	Completed Projects through Dec. 2006	Number of Facilities 2006*	Applications per 1,000 Facilities	Completions per 1,000 Facilities
Manufacturing	565	181	13,914	40.61	13.01
Retail	386	66	63,474	6.08	1.04
Public Administration	385	104	6,292	61.19	16.53
Elementary/Secondary Schools	338	77	9,747	34.68	7.90
Real Estate	266	66	23,589	11.28	2.80
Colleges	155	37	958	161.80	38.62
Lodging	98	30	4,690	20.90	6.40
Hospitals/Nursing Homes	78	15	2,799	27.87	5.36
Wholesale Trade	71	14	37,386	1.90	0.37
Health Clubs	57	18	1,678	33.97	10.73
Grocery Stores	56	17	11,554	4.85	1.47
Military Bases	20	8	379	52.77	21.11
Amusement Parks	1	0	69	14.49	0.00
All Segments Combined**	**3,490**	**948**	**488,482**	**7.14**	**1.94**

**Facilities with average electrical demands of 30 kW or greater.*
***All commercial and industrial segments, including some not broken out in the table*

Table 4-2 reveals several interesting patterns. First, the four segments that emerged as the top four in terms of total applications vary considerably in their penetration rates for completed projects. Retail, for example, had the second-highest number of applications of any segment, but its penetration rate is roughly one completed project per one thousand establishments. The penetration rates for the other three of the top four segments – manufacturing, public administration, and elementary/secondary schools – are considerably higher.

Furthermore, there are clearly some smaller segments that have been heavily penetrated even if they have not contributed as heavily to the total number of applications. The segments with the highest penetration rates (defined as completed projects per thousand establishments) are colleges/universities and military bases. Other smaller segments with relatively healthy penetration rates include lodging, hospitals/nursing homes, and health clubs.

Table 4-3. Penetration Rates for Specific Manufacturing Segments

	Applications through Dec. 2006	Completed Projects through Dec. 2006	Number of Facilities 2006*	Applications per 1,000 Facilities	Completions per 1,000 Facilities
Food Processing	233	77	1,243	187.45	61.95
Electronics	43	15	1,792	24.00	8.37
Chemical	39	10	719	54.24	13.91
Metal Fabrication	35	10	1,275	27.45	7.84
Industrial Machinery	30	8	1,666	18.01	4.80
Rubber and Plastics	29	10	679	42.71	14.73
Primary Metals	28	7	311	90.03	22.51
Stone, Clay, Glass, & Concrete	22	5	490	44.90	10.20
Transportation equipment	20	8	571	35.03	14.01
Lumber	17	9	485	35.05	18.56
Instruments & controls	16	4	973	16.44	4.11
Textiles	11	3	228	48.25	13.16
Furniture	9	3	445	20.22	6.74
Paper	8	5	332	24.10	15.06
Misc. manufacturing	7	2	589	11.88	3.40
Printing	6	2	1,325	4.53	1.51
Petroleum	5	1	69	72.46	14.49
Apparel	4	0	655	6.11	0.00
Tobacco	2	1	2	1,000.00	500.00
Leather products	1	1	65	15.38	15.38
All Manufacturing	**565**	**181**	**13,914**	**40.61**	**13.01**

**Facilities with average electrical demands of 30 kW or greater.*

Table 4-3 shows a breakdown of penetration rates within the manufacturing sector. Food processing plants account for both the largest number of projects and the highest penetration rate by a wide margin.[22] The other segment with substantially above average penetration is primary metals (e.g., foundries).

Electronics manufacturing accounts for the second highest number of completed projects, but its penetration rate is below average for the manufacturing sector; given the number of electronics manufacturing plants in California, the number of SGIP projects to date is somewhat low.

[22] Ignoring tobacco products, where the penetration rate is skewed by a very small base number of establishments (i.e., two).

4.3 Stimulating New Business Models

4.3.1 Example of a New Business Model- OCR Solar Solutions

Figure 4-16. OCR Solar Solutions roofing material, http://www.oldcountryroofing.com

Old Country Roofing, Northern California's largest roofing company, recently introduced their new division- OCR Solar Solutions. OCR is partnering with BP Solar, Xantrex Technologies and Fat Spaniel Technologies to offer turn-key combined roofing and solar solutions to homebuilders and homeowners. By offering the design, installation, warranty and customer service for both the roofing and solar photovoltaics, OCR Solar Solutions has created a unique business model in the solar industry.

During focus group discussions on the Self Generation Incentive Program, program participants discussed having to lose the warranty on their roof in order to install a solar system. Most participants indicated in the survey, though, that roof warranty was not a major problem. There was also mention of other partnerships forming between traditional roofing companies and PV installers and developers.

OCR Solar Solutions may provide one solution to roofing issues, because they remain accountable for both the roof and the solar array, thus maintaining the integrity of the roof. Another benefit of the combined roofing material may be the ability for homeowners to spread the up-front cost of solar into the mortgage.

New business models like this one may be important to the future growth of on-site generation. However, early acceptance may be needed in order for these business models to gain traction in California.

4.3.2 Other emerging business models

a) Vertically integrated developers (like Sunpower, who after acquiring Powerlight, has access to all aspects of the solar supply chain).

b) Leased (or outsourced) systems: Unlike PPA's which are another vehicle for host customers to avoid large capital expenditures, some interest is being shown by large manufacturers and retailers in the concept of leasing rooftop PV systems to homeowners and small businesses.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

At the program level, the SGIP has continued to be successful in building awareness of self-generation and promoting new self-generation installations, in spite of sometimes unfavorable changes in business demographics, equipment availability and cost, fuel prices, and customers' payback requirements. At the same time the program has accumulated substantial knowledge of how to ensure success at the individual project level that is likely to be useful in the future, regardless of what technologies fall under which programs.

5.2 Recommendations

One of the largest challenges for SGIP is how to prepare for its post-2007 role, and what target marketing the PAs can do to expand market uptake of SGIP technologies. AB2778, which was signed by the governor in September 2006, extended the SGIP through 2011, but only for two technologies: wind turbines and fuel cells. Solar PV was moved to the CSI, and CHP was eliminated. Though there remains the possibility that CHP might be included again in the future, and legislators have proposed adding other technologies (e.g., solar thermal heating and cooling, among others), as of August 2007, the outlook for SGIP in the 2008-2011 timeframe only includes wind and fuel cells.

Both of these technologies have to date experienced extremely low levels of market adoption in the size ranges required by the SGIP (30 kW – 5 MW), as wind turbines tend to be either smaller, individually sited turbines, or more commonly, multi-megawatt scale "wind farms". Fuel cells, meanwhile, have slowly entered commercialization, with only two companies offering commercial products and a handful of others in the pre-commercial demonstration phase. Indeed, only 1 wind and 12 fuel cell projects have been completed (as of December 2006) under SGIP since inception, with another 4 and 16, respectively, considered active. (These projects are from a total for 14 wind applications and 51 fuel cell applications.)

That being the case, what can the SGIP PAs do to expand efforts to increase market adoption and SGIP incentive payouts for projects deploying wind turbines and fuel cells?

5.2.1 Wind Turbines

For wind turbines, PA focus will necessarily need to be on geographic areas that are less densely populated and have viable wind regimes for economically viable projects. The CEC has funded the creation of a state-wide wind resource map, which would provide a first step into identifying those regions within a PA's territory where sufficient wind exists for viable projects. Further refinement using GIS techniques could then eliminate areas unfit for wind turbines, based on density of development, proximity to airports, and other factors. Lists of potential host customers in remaining areas deemed suitable for wind development could then be developed, with an eye toward discovering segments that might be more amenable to actually becoming SGIP applicants.

Still, given the low market activity in wind projects in the 30 kW – 5 MW scale, SGIP PAs should almost consider wind projects as quasi-demonstration projects until uptake of the approach reaches critical mass for broader adoption. Pursuing public entities as potential host customers of wind projects, rather than private sector host customers, could be a viable approach. Similarly, engaging with vendors and project developers of wind turbines that would qualify for SGIP incentives would be a recommended step for PAs.

5.2.2 Fuel Cells

Fuel cell are a fundamentally different technology than wind turbines, and therefore require a different strategy for increasing their market adoption within the SGIP framework. Fuel cell installations in the 30 kW – 5 MW range are typically done in a CHP configuration, as they produce heat as a byproduct to electricity generation. So exploring market opportunities for fuel cells share much of the characteristics necessary for CHP projects, including a thermal load that is coincident with the electrical load. But fuel cells have some characteristics different from internal combustion engines, microturbines, and other standard CHP prime movers, including higher capital cost, an inability to load follow (meaning electric generation capacity should be size to the minimum electrical load of a host customer), and extremely low emission levels.

Prior analyses by our team of fuel cell markets have found that segments such as colleges and universities, and lodging are potentially good markets for the technology, given their load shapes, payback requirements, and other characteristics. Additional markets may present themselves as a result of the combined effects of proposed AB 1064 and CARB's adoption of early actions under AB 32, The Global Warming Solutions Act of 2006. Landfills were particularly identified as an early action target under AB32 because of the relative persistence of methane as compared to other Greenhouse Gases.[23] A recent study for California's Integrated Waste Management Board reported that over 50 percent of landfills surveyed do not have landfill gas collection systems. Also, it should be noted that landfills, particularly older post-closure landfills may not have set aside sufficient funds to implement responses to the new requirements that will be developed under AB 32. Thus, though the lack of native load is a barrier, it is likely that some would welcome an incentive that could assist in developing an alternate to flaring the methane. CARB is currently working with the CIWMB to recommend technologies and best management practices. Note that landfills represent just one potential target market. Dairies, and the nearly ubiquitous waste water digesters could also represent markets of interest.

And as with wind turbines, fuel cells are a novel enough technology, and their payback typically lengthy enough, that public entities are likely to be more willing to adopt fuel cells in their early stages than private entities. But PAs should not focus just on targeting specific host customer segments for generating interest in and applications for fuel cell projects. Rather, PAs would be wise to engage more with fuel cell vendors and project developers, which is likely to result in greater SGIP fuel cell project applications than focusing on host customers, who typically know little about the novel technology.

SGIP experience with the 52 applications for fuel cells confirms these observations. Three-fifths of all fuel cell SGIP applications were to be hosted by public entities: 12 projects with the public administration sector, 9 projects with the utilities sector, 6 projects with the national security sector (military), 5 projects with the lodging sector, and 5 projects with the manufacturing sector. Also, of the 33 applicants not submitted by utilities, 26 were made by project developers, and only 7 by host customers, indicating that

[23] Waste gas definition under proposed AB 1064 includes landfill, dairy and other biogases. See, e.g. latest version at http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1051-1100/ab_1064_bill_20070625_amended_sen_v95.pdf. Thus the type and number of potential waste gas systems that could participate under the SGIP would be expanded. Under AB 32, the California Air Resources Board has adopted increasingly stringent methane capture requirements for landfills. See, e.g. California Air Resources Board, Press Release, June 21, 2007. Or see latest version at http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1051-1100/ab_1064_bill_20070625_amended_sen_v95.pdf.

it would be more fruitful for SGIP PAs to work with fuel cell companies and project developers than the broader host customer population.

5.2.3 Photovoltaics

Although the responsibility for supporting PV systems has shifted from the SGIP to the California Solar Initiative (CSI), the experience of the SGIP with regard to PV suggests various approaches for those charged with stimulating this market now and in the future. One approach to increasing program penetration is to target market segments that either a) have already shown a propensity to adopt on-site generation, but where much untapped potential remains; or b) where penetration rates are low in spite of apparently favorable conditions (such as daytime load peaking and the availability of rooftop space for PV).

Segments with significant potential for PV systems include agriculture, retail, offices, warehouses, elementary and secondary schools, and the Post Office. Agricultural establishments that operate year-round may have attractive load profiles for PV systems. Farms that have taken land out of production on a long-term basis, or that have adjacent land available, may be particularly well-suited for PV applications. Walgreen’s commitment to install 96 PV systems on their stores in California illustrates the potential of the retail segment. Retail electrical demand tends to peak during the hottest part of the day, making solar PV an attractive option. Office buildings have similar load shapes, though they tend to have smaller roofs. Warehouse operations typically have large, flat roofs, though their load profile is not as consistently favorable as retail loads. Schools combine day-peaking loads and flat roofs, and can also find educational value in PV installations. Although schools already account for a large number of PV applications, the segment continues to hold potential. Finally, the U.S. Post Office has the combination of large, flat roofs and daytime load peaks that favor PV.

In addition to targeting particular host customer segments, program administrators or policy makers seeking to promote PV should do everything possible to encourage the growth of the integrated PV/roofing industry, as well as other innovative business models.

5.2.4 Gas-Fired Cogeneration Technologies

As with PV systems, the responsibility for promoting cogeneration technologies (other than fuel cells) does not rest with the SGIP after 2007. Furthermore, California’s CARB 07 air quality regulations provide a formidable barrier to the installation of most CHP systems in the state. Notwithstanding the emissions issues, however, traditional cogeneration technologies remain technically and economically viable in several segments with coincident electrical and thermal loads.

One segment that has already engaged in significant CHP activity in California outside of the SGIP is the oil and gas extraction segment. These applications take advantage of the presence of natural gas within the extraction process to generate power for export to California utilities. Offices, hotels, hospitals, and colleges all have attractive electric and thermal loads for cogeneration, and demonstrated a willingness to adopt these technologies in the past.

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