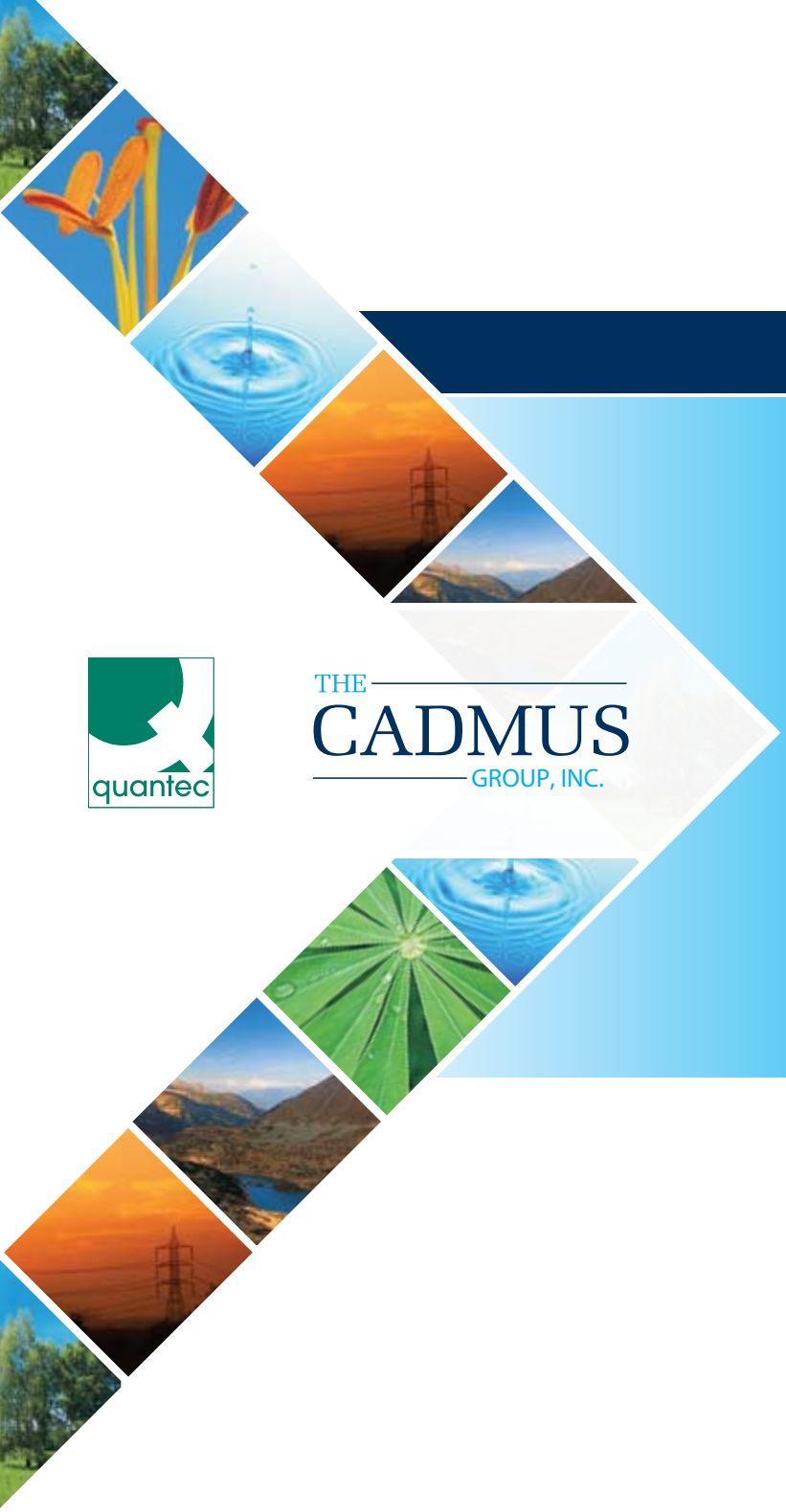

Process Evaluation of PG&E's Agricultural and Food Processing Program

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FINAL REPORT

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Table of Contents

APPENDICES (Separate Volume)

Executive Summary

This report summarizes the process evaluation for Pacific Gas and Electric Company's (PG&E) Agricultural and Food Processing (AFP) Program for the 2006-2008 program cycle. The 2006-08 PG&E AFP Program offers a diverse portfolio of energy-efficient products and services for the company's agricultural and food processing customers. The Program's primary objective is to provide the most cost-effective, comprehensive, and relevant portfolio of program offerings for target customers to help achieve PG&E's energy efficiency goals. The AFP Program offerings are administered through a direct delivery (Core) program and six third-party implemented programs.

The AFP Program process evaluation was primarily focused on determining the effectiveness of relationships among staff and between staff and customers, examining market barriers, and providing current market information. The evaluations findings and conclusions were informed by a number of data collection activities including: a literature review; staff interviews; trade ally and market actor surveys; and participant, nonparticipant and withdrawn participant surveys.

Major Findings

Based on data collected as part of this evaluation, Cadmus found that AFP Program operates successfully and achieves its savings goals. Participants are generally satisfied with their participation experience. Participants also reported high satisfaction levels with measure costs and performance, expected savings, PG&E staff's technical knowledge, and their interaction with PG&E staff. These findings reflect Core Program participants only, as third-party participant data were unavailable because PG&E had difficulty incorporating third-party participant data in its central database, and did not resolve the issue until 2008, after Cadmus had already been provided the sample frame for the analysis.

The most effective marketing and outreach channel appears to be direct contact between agricultural and food processing customers and PG&E representatives; direct contact has been the Program's primary outreach activities. Participants and staff also find value in workshops offered through the program. The PG&E AFP Program also appears to offer a comprehensive list of measures for their target market. Cadmus also observed that Program staff, in general, communicate and coordinate effectively with other PG&E and third-party program staff.

Conclusions and Recommendations

Conclusion 1: Close coordination between PG&E and trade allies could further enhance marketing channels and increase market penetration. Data suggest that trade ally promotion of the AFP Program would be beneficial to both trade allies and the Program. Based on our analysis of available data, closer collaboration with trade allies represents the most promising opportunity for the AFP Program to improve the scope and depth of its delivery.

Recommendation: The AFP Program should explore developing and implementing a formal program to engage trade allies in the promotion of the AFP Program.

Conclusion 2: Direct customer contact appears to be the most effective way to motivate customer participation, though extended marketing and outreach activities would broaden the Program's reach in the market. Feedback from participants, trade allies, and program staff indicates that any activities focused on increasing person-to-person interactions with customers have a positive impact on customer participation.

***Recommendation*:** To further increase market penetration, the AFP Program could consider the following actions: expand workshop offerings; continue to leverage person-to-person contact to involve participants; pursue a more detailed market characterization to determine which target markets have more potential; and create additional marketing materials, such as more specific and targeted case studies, to help Sales and Service Account Representatives (S&S) and Project Managers promote the program.

Conclusion 3: PG&E's internal data tracking system produced incomplete data. Cadmus found that the required measure level detail data and/or participant contact information were frequently missing or incomplete in data extracts from Management Data Service System MDSS, PG&E's data tracking system. The data sets also lacked consistent application of data flags which made it difficult to identify unique customers and/or projects. However, based on feedback from AFP Project Managers, the discrepancies observed by Cadmus are likely due to challenges in extracting and compiling a comprehensive data set out of several unconnected databases, not due to field staff not entering data.

Recommendation: PG&E is currently addressing data and database issues as part of the Process Improvement (PI) project. During PI project implementation, Cadmus recommends addressing the following database improvements: validate data fields; add identification flags at company and site level; include meaningful measure level detail; and add an end-use or measure classification field.

Conclusion 4: Communication between S&S Representative and Project Managers could be improved. While S&S Representatives and Project Managers generally are satisfied with their interactions, staff interviews revealed that occasionally communication responsibilities with the client are unclear.

***Recommendation*:** Cadmus recommends that, either in the first instance of working together or at the beginning of a project, the S&S Representative and Project Manager should have a brief conversation establishing communication expectations between themselves and between them and the customer. These communication preferences can then be recorded as part of the project file or incorporated into some existing documentation. This record would also provide continuity in the case of staff turnover or absence.

1 Introduction

Overview

In December 2007, Pacific Gas and Electric Company (PG&E) awarded Quantec, LLC (now The Cadmus Group, Inc.) a contract to conduct a process evaluation of the Agricultural and Food Processing (AFP) Program (2006–2008 program cycle). To complete this work, Cadmus teamed with experts from Research Into Action (RIA), Nexus Market Research (NMR), and Strategic Energy Group (SEG).

The AFP Program offers a range of products and services intended to enhance the adoption of demand-side management (DSM) measures and practices among PG&E's food processing and agricultural customers. The AFP Program's primary objective is to provide the most cost-effective, comprehensive, and relevant portfolio of program offerings for target customers to help achieve PG&E's energy-efficiency goals. Seven program components are offered; PG&E implements the Core Program, while third-party implementers offer six different specialized programs.

Research Objectives

As outlined in the Evaluation plan, this evaluation was designed to focus on three main objectives:

- Determine the effectiveness of existing relationships, specifically those between: PG&E and its target market customers; PG&E staff and third-party implementers; and third-party implementers and target market customers.
- Determine current market barriers and opportunities, with a focus on identifying optimal approaches to addressing market barriers, including recommendations for effective marketing approaches.
- Perform a market characterization of the agricultural and food processing market in the PG&E service territory.

In addition to these objectives, PG&E requested Cadmus conduct a cursory review of the likely changes to codes and standards applicable to this market.

To inform these study objectives, Cadmus conducted a number of primary data collection activities, including: interviews with PG&E and third-party program staff; surveys of program participants, nonparticipants, and withdrawn participants; and surveys of trade allies and professional organizations operating in this market.

Report Overview

This report is organized into six chapters. Chapter 2 provides a description of the Core AFP Program activities as well as the third-party implemented programs. Chapter 3 summarizes the

evaluation approach and data collection activities. Chapter 4 provides a market characterization of the agricultural and food processing sectors in California and PG&E's service territory, and a discussion of current market barriers. Chapter 5 reports the findings from the data collection activities. Chapter 6 summarizes the conclusions and recommendations for the Program as it proceeds into its next implementation cycle. Appended to this report are copies of all data collection instruments as well as summary tables of collected data.

2 Program Descriptions

Overview

The 2006-08 PG&E AFP Program offers a diverse portfolio of energy-efficient products and services for the company's 89,000 agricultural and food processing customers. The Program's primary objective is to provide the most cost-effective, comprehensive, and relevant portfolio of program offerings for target customers to help achieve PG&E's energy efficiency goals.

The AFP Program offerings are administered through a direct delivery (Core) program and six third-party implemented programs, including:

- PowerLight's Combined Approach to Solar and Efficiency (CASE) Program
- Resource Solutions Group Wine Industry Efficiency Solutions (WIES) Program
- VaCom Technology's' Industrial Refrigeration Performance Plus Program (IRRP)
- Onsite Energy's Industrial Cold Storage/Food Processing Efficiency Program
- EnSave's Multi-Measure Farm Program For Dairies (Dairy Energy Efficiency Program)
- RHA's Light exChange Program (LCP)

Segment Logic Model

The segment logic model covers all activities that occur in the Core and third-party programs. The Program was designed to address three major market barriers: awareness, information, and first costs. As shown in the logic model, Figure 1, the key activities conducted in the AFP segment include:

- Marketing and outreach
- Technology analysis and support
- Program management
- Cash incentives
- Review, verification, and monitoring
- Education and training

Marketing and outreach utilizes multiple channels to reach the target market. Outputs range from seminars and conferences to mailings and print collateral. The technology analysis and support activities address participation barriers related to lack of awareness and/or lack of time to implement energy-efficiency measures. Outputs include technology assessment reports, audits, and design and calculation assistance. Education and training offer similar services, with training sessions and peer-group discussions that support the advancement of energy efficiency. Outputs from program management include applications and agreements, while review, verification, and

monitoring provide monitoring reports and verification of measure installations. To address barriers related to high first costs, the program offers cash incentives for qualifying measures.

There are a number of short-term outcomes that result from AFP segment activities. First, program awareness increases, and knowledge of energy-efficiency opportunities and the likelihood of investing in energy efficiency also increase. Second, energy-efficient measures are installed, and more efficient buildings are constructed. Third, education and training result in increased knowledge of equipment operations and maintenance (O&M).

Intermediate outcomes include increased energy-efficiency awareness and reduced energy use as well as adoption of energy-efficient design, construction, and O&M practices and other environmental and non-energy benefits (NEB). Long-term outcomes are expected to be an increased penetration of energy-efficient construction, energy code changes, permanent reduction in energy use, and long-term increases in NEBs. For details on program theory and logic model link explanations, see Table 1.

While the overall segment logic model encompasses all Core and third-party program activities, each program has unique processes, organization, and program strategies. The following seven sections provide summaries of the Core program and the six third-party implemented programs, including a description of activities and program goals. Logic models for each program are located in Appendix A.

Figure 1. PG&E AFP Segment Logic Model

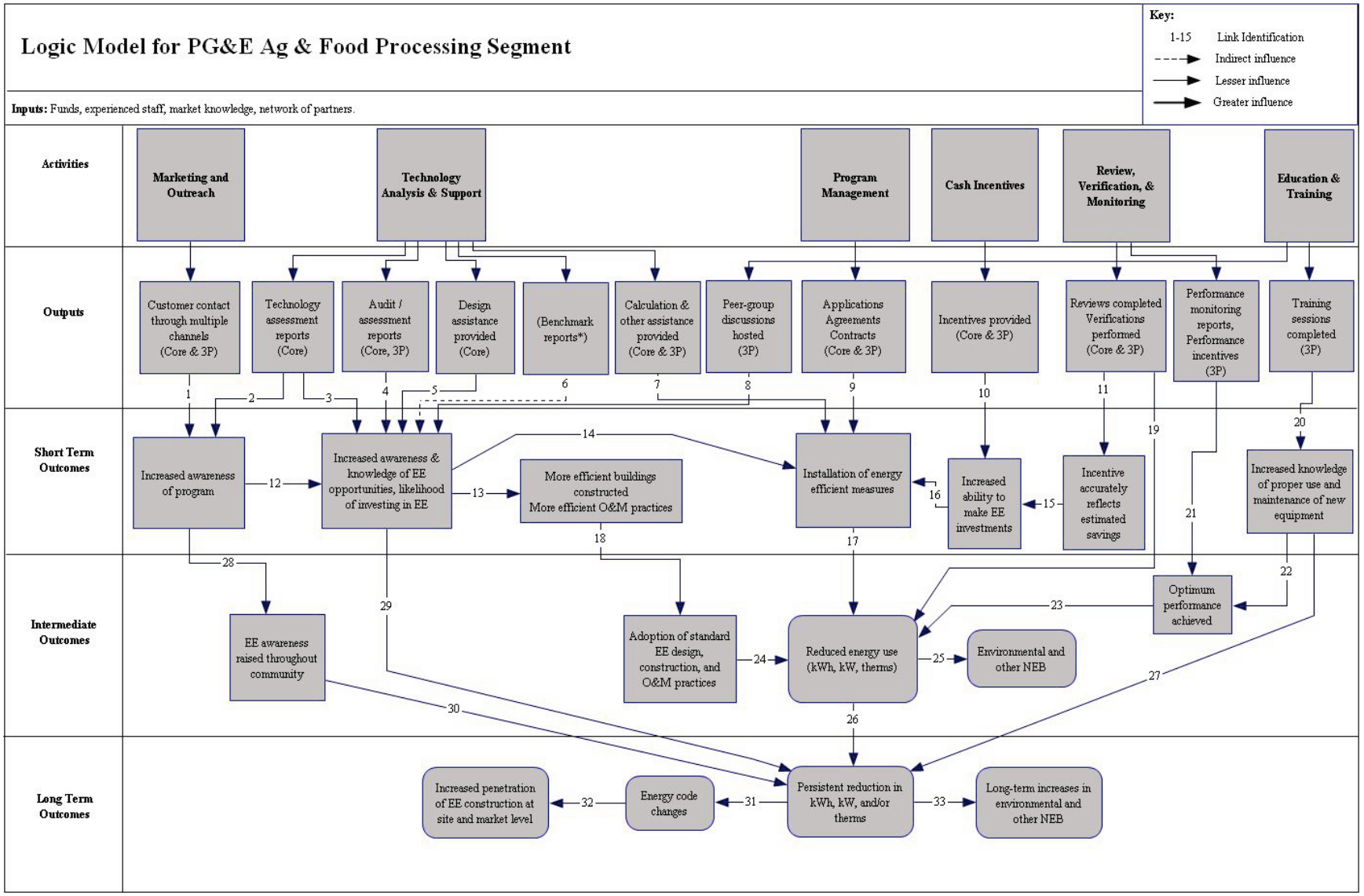


Table 1. AFP Segment Program Theory and Link Explanations

Link #	Impact	Program Theory	Potential Indicators
1	Awareness of program is increased through customer contact.	Ag and Food Processing customers have specific energy-related concerns and are more likely to respond to messages targeted to those concerns. Carrying out segment-specific marketing and outreach through conference attendance, workshops, and seminars enables PG&E and its third-party contractors to effectively reach these customers. PG&E S&S representatives have direct contact with these customers, allowing them to provide detailed program information.	- Number of events (conferences, workshops, etc.) attended or held - Awareness and assessment of events & collateral - Number of partnerships established - Number of customer contacts through each channel, including S&S representatives, program partners, vendors - Percentage of surveyed customers reporting program awareness
2	Awareness of program is increased through dissemination of technology assessment reports.	Customers are interested in learning about new technologies to reduce energy costs. PG&E performs assessments of new and emerging technologies for which program incentives are available and makes the reports publicly available. This is another avenue for customers to become aware of the core program.	- Number of reports - Number and types of technologies described - Percentage of surveyed customers reporting that reports were a source of program awareness
3	Awareness and knowledge of energy-efficiency opportunities is increased by technology assessment reports	For customers who already are aware of the core program, the technology assessment reports will be a source of increased awareness and understanding of specific energy-efficiency opportunities.	- Number of reports - Number and types of technologies described - Percentage of surveyed customers reporting awareness of covered technologies
4	Awareness and knowledge of energy-efficiency opportunities is increased by audits.	Customers planning energy-efficiency projects want to get the maximum savings for their investments. Energy audits yield reports detailing energy savings opportunities. By maximizing savings, this assistance increases the likelihood of program participation.	- Number of audits conducted - Number of measures recommended - Estimated total savings associated with recommendations
5	Awareness and knowledge of energy-efficiency opportunities is increased by integrated design assistance.	Customers planning energy-efficiency projects want to get the maximum savings for their investments. Reviews of new construction plans result in design assistance to optimize savings. By maximizing savings, this assistance increases the likelihood of program participation.	- Number of customers provided design assistance - Estimated total savings associated with recommendations
6	Likelihood of energy-efficiency investment is increased by benchmark reports.	Customers are motivated to undertake energy-efficiency upgrades if they know they are using more energy than other, similar facilities. Benchmark reports provide feedback on energy use, motivating energy-efficiency investments. NOTE: This activity was not implemented in the program	- Number of benchmark reports - Number of participants citing a benchmark report as a reason for participation - Evaluation of/response to benchmark results by participants and nonparticipants

Link #	Impact	Program Theory	Potential Indicators
		cycle covered by this evaluation.)	
7	Ease of completing project applications is increased.	Lack of familiarity with or aversion to calculating energy savings for retrofit (NRR) projects is a barrier to participation. By offering assistance with savings estimates, the core program and some 3P programs overcome this barrier.	- Number of potential participants that request calculation assistance - Number of times calculation assistance results in projects
8	Awareness of energy-efficiency opportunities and benefits increased.	Small and medium-sized wineries and grape growers are interested in learning from each other. One 3P program hosts peer group discussions to provide opportunities for participants and nonparticipants to discuss best practices and share knowledge. This will encourage participation by nonparticipants and will improve energy management among participants.	- Number of discussions held - Number of participants and nonparticipants attending - Participant and nonparticipant evaluations of discussions - New participation resulting from discussions - New energy-management activities resulting
9	Applications, agreements, and/or contracts are completed.	Completing an application increases a customer's commitment to a project and begins the review process, which determines the level of incentive provided. Additional agreements or contracts reduce uncertainty on the customer's side and/or increases commitment. These documents allow the program to track progress.	- Number of applications, agreements, and/or contracts completed - Number of each type of measure authorized or agreed to
10	Ability to make energy-efficient investments is increased.	Up-front cost is a barrier to investing in energy efficiency. Providing financial incentives tied to energy savings increases the ability to make energy-efficiency investments, reducing that barrier.	- Percent participants that report amount of rebate or total first costs was their main reason for participating
11	Incentive accurately reflects estimated savings.	Review of project documentation ensures incentives accurately reflect estimated savings.	- Number of reviews completed - Number resulting in revised savings estimates
12	Increased awareness of the program leads to increased awareness and understanding of energy-efficiency opportunities.	Effectively addressing informational barriers by providing potential participants with information about program offerings is expected to increase the likelihood of participation.	- Participant awareness and knowledge of technologies and program offerings
13	More efficient building design & construction and O&M practices.	By demonstrating that integrated design leads to increased energy savings, the program will induce more efficient building design and construction, and the adoption of more efficient O&M practices.	- Number of participants that changed building designs as a result of program influence - Number of energy-efficiency buildings constructed

Link #	Impact	Program Theory	Potential Indicators
			- Increase in the adoption of energy-efficiency O&M practices
14	Increased understanding of energy-efficiency leads to increased likelihood of installation of energy-efficiency measures.	Effectively addressing informational and attitudinal barriers by providing potential participants with information about energy-efficiency options is expected to increase the likelihood of measure installation.	- Participant awareness and knowledge of specific energy-efficiency options - Number and type of measures installed
15	Accurate estimation of savings leads to payment of proper incentive amount.	Ensuring that incentives accurately reflect estimated savings results in cost-effective energy efficiency.	- Amount of incentives paid on verified savings compared to estimated incentive levels
16	Increased ability to make energy efficient investments leads to increased likelihood of installation of energy-efficiency measures.	Up-front cost is a barrier to investing in energy efficiency. Providing financial incentives tied to energy savings reduces that barrier, increasing likelihood of participation.	- Amount of incentives paid on verified savings compared to estimated incentive levels - Number and type of measures installed
17	Reduction in energy use.	Installing cost-effective measures offered through the program is expected to generate real energy savings.	- Average reduction in kWh, kW, therms (per unit of output if data are available)
18	More efficient building construction leads to adoption of energy-efficiency design, construction, and O&M practices.	PG&E advocates improvements to energy-efficiency building codes and appliance standards through the statewide C&S Program. Projects resulting in more efficient building design & construction are used to create case studies that are presented to standards and code-setting bodies.	- Number of case studies written - Increase in the adoption of energy-efficiency O&M codes & standards
19	Project review and verification leads to reduced energy use.	Review of project documentation and verification of proper installation of measures ensures optimal performance and energy efficiency of measures.	- Number/percent of reviews completed - Number/percent of reviews resulting in revised savings estimates - Number/percent of verifications performed - Number/percent requiring project revisions
20	In-house staff and contractors are trained to maintain optimum efficiency of equipment.	The affected systems are complex and require adequate monitoring by trained staff to maintain optimum efficiency. Providing training to customers' staff and contractors will help ensure equipment is maintained at optimum efficiency.	- Number of trainings conducted - Evaluation of trainings
21	Maintenance of optimum equipment performance.	In addition to the initial incentives paid on installation, one third-party program pays performance incentives over the two years following installation. This will motivate proper equipment maintenance to optimize energy savings.	- Benchmarking equipment operation against known standards - Periodic assessment of staff's knowledge and maintenance activities
22	Maintenance of optimum equipment performance.	Monitoring by trained staff ensures that equipment operates at optimum efficiency.	- Benchmarking equipment operation against known standards - Periodic assessment of staff's knowledge

Link #	Impact	Program Theory	Potential Indicators
			and maintenance activities
23	Reduction in energy use.	Maintenance of equipment at optimum efficiency delivers the best possible savings.	- Average reduction in kWh and kW (per unit of output if available)
24	Adoption of codes and standards leads to reduced energy use.	Improvements to energy-efficiency building codes and appliance standards through the statewide C&S Program are expected to generate real energy savings.	- Ex post estimates of gross and net energy and demand impacts and spillover
25	Environmental and other NEBs.	By reducing energy use, the program is expected to produce environmental and other non-energy benefits.	- Reduction of CO2, NOX, SOX per kWh reduced
26	Persistent reduction in energy use.	Continued use and proper maintenance of energy-efficient measures is expected to produce long-term reduction in energy use.	- Ex post estimates of gross and net energy and demand impacts
27	Persistent reductions in energy use	Continued maintenance of the installed measures will contribute to the sustainability of savings.	- Ex post estimates of long-term energy savings
28	Awareness of energy-efficiency opportunities is increased throughout the segment.	The agricultural and food processing segment is tightly knit. Information is shared among businesses by word of mouth. Success at saving energy costs (and for raising funds for community organizations through participation in one third-party program) will raise interest within the entire segment.	- Program awareness among other businesses and community organizations - Number of businesses/organizations reporting of word-of-mouth information about the program
29	Persistent reduction in energy use.	Even if a customer decides not to participate in the current program cycle, increased awareness and understanding of energy-efficiency opportunities is expected to result in increased energy-efficiency behavior, leading to long-term reduction in energy use.	- Ex post estimates of gross and net energy and demand impacts
30	Persistent reduction in energy use.	Increase awareness within the segment will lead to eventual participation in energy reduction activities by others.	- Ex post estimates of gross and net energy and demand impacts
31	Adoption of stricter energy codes.	By demonstrating that persistent reduction in energy use can be brought about by installation of energy-efficiency measures and more efficient building design and construction, the program is expected to influence policymakers to adopt stricter energy codes.	- Number of codes made more strict
32	Adoption of energy-efficiency principles by market actors.	Stricter energy codes are expected to influence market actors (vendors, architect, and construction contractors) to recommend and install more efficient equipment and use more efficient design and construction principles.	- Number of vendors reporting sales of increased efficiency equipment - Number of design/construction firms adopting increased efficiency principles
33	Long-term increases in environmental and other NEBs.	By reducing energy use in the long term, the program is expected to produce long-term environmental and other non-energy benefits.	- Reduction of CO2, NOX, SOX per kWh reduced

Core Program[1]

PG&E's core program targets a range of customer types within the AFP segment including agriculture, dairies, food processing, greenhouses, irrigation, refrigerated warehouses, and wineries. The AFP integrates offering from the system-wide Nonresidential New Construction (NRNC) and Nonresidential Retrofit (NRR) programs, offering both custom and prescriptive rebates. Where applicable, the Core program also integrates offerings from PG&E's demand response and distributed generation programs. A list of measures offered through the Core program is located in Appendix B.

Core Program

Elec. Savings Forecast: 167,347 MWh
Elec. Savings Achieved: 116, 888 MWh
Gas Savings Forecast: 3,082,952 therms
Gas Savings Achieved: 6,743,091 therms
Target Market: 89,000 Ag & FP customers

In addition to financial incentives, the Core program' provides resources for energy audits and pump testing, engineering support and design assistance, energy modeling tools, commissioning and retro-commissioning assistance, and access to market resources and industry benchmarking information. PG&E also conducts education and training on energy efficiency through workshops, technology demonstrations, and seminars.

Program Theory

While the mechanics of the system-wide NRNC and NRR processes—the Core program delivery channels—have been historically different, the two processes share similar program theory. The Core program's key activities include: marketing and outreach; technology analysis and support; program management; cash incentives; and review/verifications. The Core program conducts marketing and outreach primarily through direct contact between sector customers and Sales and Service (S&S) representatives. Events such as workshops, conferences, and seminars facilitate meetings where S&S representatives can deliver program information focused on sector-specific energy concerns. Technology assessments and audits, which act as a marketing and outreach channel and a support service, provide technology assessment reports, audit reports, and integrated design assistance to potential participants. Outputs from program management activities include applications and owner agreements. The application and approval process ensures that participants' incentives accurately reflect the estimated savings of their projects. While incentive calculations through the NRNC process are generally straightforward, the NRR process provides calculation assistance for more complex custom projects. In both cases, offering incentives tied to energy savings addresses high first-cost barriers, which often inhibit the installation of energy-efficient measures. Reviews and verification activities ensure participants install the correct measures and claim the appropriate energy savings.

Short-term outcomes are similar to the segment logic model outcomes. Activities result in an increased awareness of the program as well as increased awareness of energy-efficiency opportunities. Technology support increases the likelihood of customer investment in energy-

[1] The forecasts included in the summary boxes are taken from the Program Implementation Proposals; the savings achieved are from PG&E's net program impact summary (Annual Net Impacts).

efficient measures, and, in the case of the NRNC program, increases energy-efficient building and O&M practices. Program activities also lead to an increase in the installation of energy-efficient measures.

Intermediate outcomes include: reduced energy use, environmental and non-energy benefits, and, in the NRNC process, the adoption of energy-efficient design, construction, and O&M practices. Proliferation of energy-efficient new construction and retrofit projects in the long-term will influence building codes and appliance standards, as well as market actors, toward more energy-efficient design and construction principles. Other long-term outcomes include persistent energy reduction and long-term increases in environmental benefits. For more details, refer to the Core program logic model located in Appendix A.

Organization and Management

The information reported in this section reflects the organization and management that functioned during the 2006-2008 cycle. Information is based on staff interviews conducted in January 2008 and February 2009. Cadmus recognizes that some staff roles and responsibilities will change as part of the Process Improvement (PI) project, but does not report on the PI project activities in this report.[2]

In general, S&S representatives own the primary customer relationship for all company services, including energy-efficiency programs, and carry the primary responsibility for generating project leads and applications. The S&S department is managed separately from the Customer Energy Efficiency department and is organized into three regions. Some regions are segmented by target market, while others are not. Typically, each region is serviced by assigned account representatives, who meet large customers, and unassigned account representatives, who address the needs of small to medium customers.

The AFP Segment Manager plans and oversees marketing and outreach activities and program planning for programs within the segment. The Segment Manager is assisted by a Program Manager from Marketing and Outreach, and also coordinates with the S&S division to keep PG&E's Account Representatives informed of program activities, including new technologies and program offerings. The Segment Manager supervises five Project Managers, who oversee all NRNC projects in the AFP segment, from initial planning through the application and review process to project completion and incentive payments, and who assist with NRR projects as needed.

The Project Managers are located in different geographic areas of the PG&E service territory: two are in the southern part, while the others cover the central and northern areas. They also have differing areas of knowledge and experience: one focuses on refrigeration, while the others have greater experience with greenhouses, wineries, breweries, dairies, or food processing. Each one

[2] In December 2007, PG&E began working with consultants at Newcomb, Anderson, McCormick to develop and implement a series of organization improvements under a process improvement (PI) project. The PI project is primarily focused on streamlining both the NRNC and NRR application processes. These improvements also involve reorganization of staff roles and responsibilities, some of which may have changed after initial staff interviews in January 2008.

oversees projects within his or her area of expertise. An explicit decision was made to allow each Project Manager to focus on a particular area and develop a specific knowledge base. Some Projects Managers are located in the same field office as the S&S Representative responsible for the majority of their target market accounts (e.g. the Fresno office) facilitating direct contact and communication between S&S and Project Managers. However, many S&S representatives are at separate offices from Project Managers that oversee projects for many of the same customers, and most contact occurs via email or phone.

Most aspects of administration and implementation of NRR projects are managed at a cross-segment level. The Portfolio Management Resource (PMR) group, located within the Targeted Markets Section of the Customer Energy Efficiency department and headed by the Program Manager Supervisor, oversees the application review process to ensure consistent application of the statewide policies.[3] The PMR group is comprised of several Program Managers and Project Managers who individually manage different aspects of the technical review process and coordinate with PG&E data entry and field staff. One of its chief roles is interpreting the policies and procedures governing project qualification and calculation of energy savings.

The Review Engineers review applications, perform pre- and post-installation (pre- and post-field) inspections, and analyze savings. The review engineers for NRR projects may be from one of six outside consultants, PG&E's Technical Product Support Group (TPS), or PG&E's Applied Technology Services (ATS). They are assigned to a project by PMR, and they interact with Account Representatives, Project Managers, and customers in the review process.

The IPC provides company-wide data entry and data process services. This group records application information in the company-wide Management Data Service System (MDSS), serves as the central hub for processing of all project documents, and updates project records based on input from PMR.

Marketing and Outreach

The scope of PG&E's AFP Program outreach and marketing activities include: (1) direct marketing efforts; (2) sponsorships and educational seminars at events and conferences within the agricultural and food processing industry; (3) earned media; and (4) targeted educational seminars. In addition, the agricultural programs are promoted by PG&E S&S representatives through the PG&E website and customer service phone line, and informally by vendors and contractors.

Primary marketing and outreach activities are conducted by S&S representatives. S&S representatives operate under a sales/energy savings-oriented incentive structure that places high priority on measurable energy and demand savings among other criteria (such as customer satisfaction). The AFP Program has in the past relied primarily on the person-to-person connections established by S&S representatives to promote the Program. More comprehensive marketing and outreach is planned for the next Program cycle.

[3] From 1998-2005, NRR projects were part of the Standard Performance Contract (SPC) program. In 2006, the SPC program was renamed NRR, but it is still part of the Stateside SPC program and abides by statewide rules.

Program staff have developed a variety of general and targeted direct marketing fact sheets, case studies, brochures, and other collateral for distribution to AFP customers. Direct mail letters and postcards carry information on a variety of measures and services. Articles have been either placed or arose as 'earned media' in several magazines, newspapers, and trade journals. Radio ads about PG&E's new construction program and segment specific energy-savings opportunities, and a television news story about PG&E's incentives were produced. Case studies focus on typical or widely applicable projects for major end-uses (e.g. pumps) or market segments (dairies).

A variety of activities has allowed AFP segment staff and S&S staff, in coordination with PG&E's third-party programs, to promote the programs directly to AFP customers. They included presentation at numerous workshops and conferences, staffed conference booths, and targeted educational seminars held throughout PG&E's service territory.

PG&E's AFP marketing and outreach activities resulted in recognition from ACEEE, ENERGY STAR, and Flex Your Power for its effectiveness at educating the segment about energy efficiency.

Program Implementation and Project Tracking

In the Core program, incentives are delivered through PG&E's system-wide NRNC and NRR programs, and each have a separate application process.[4] Overall, the 2006-08 Program application and review process—particularly for NRR—had multiple stages, could take several months, and often required additional information beyond what the customer supplied in the initial application.

The NRNC application process for the 2006-08 Program, shown in Figure 2, is a relatively straightforward process. Once S&S Representatives have engaged with a customer and have received an application, they turn the project over to the appropriate AFP Project Manager. It is up to the Project Manager and S&S Representative to establish the level of coordination and communication between themselves and the customer. After the application is filed, Project Managers have "ownership" of the project, which provides them with control and awareness during all stages of the application and review process. Project Managers guide the project through engineering review with the Applied Technology Services (ATS) group and ensure project information is delivered to IPC for entry into MDSS. With the information centralized through one person, it is relatively easy for program staff to track project status and respond to the applicant's need. For more details, refer the NRNC process flow, Figure 2.

In contrast, the NRR application process, shown in Figure 3, is a fairly complex process, largely due to the complexities in calculating savings from retrofit projects. Though the PI project is addressing many of the application process complexities, in general, NRR information is routed through multiple departments and people, and Project Managers have a less central role in this process. The PMR group oversees the review process and only involves the Project Manger if

[4] The PI project, which is being implemented over the next few years, will affect multiple aspects of the program application processes. Cadmus is reporting primarily on application processes implemented during the 2006-2008 program cycle.

extra information is needed. The IPC is also more involved in the NRR application process; they route information between participants and program staff. Also, because NRR calculations are more complicated than NRNC savings calculations, the application process requires more documentation. The amount of documentation and number of people handling the documentation make the application process longer and susceptible to error and delays. Some staff indicated that the NRR process often takes longer than an application process should. Such delays can be problematic for AFP segment customers as they usually have only a brief window of time to complete upgrades. For more details, refer the NRR process flow, Figure 3.

Figure 2. Application Process Flow Diagram – NRNC

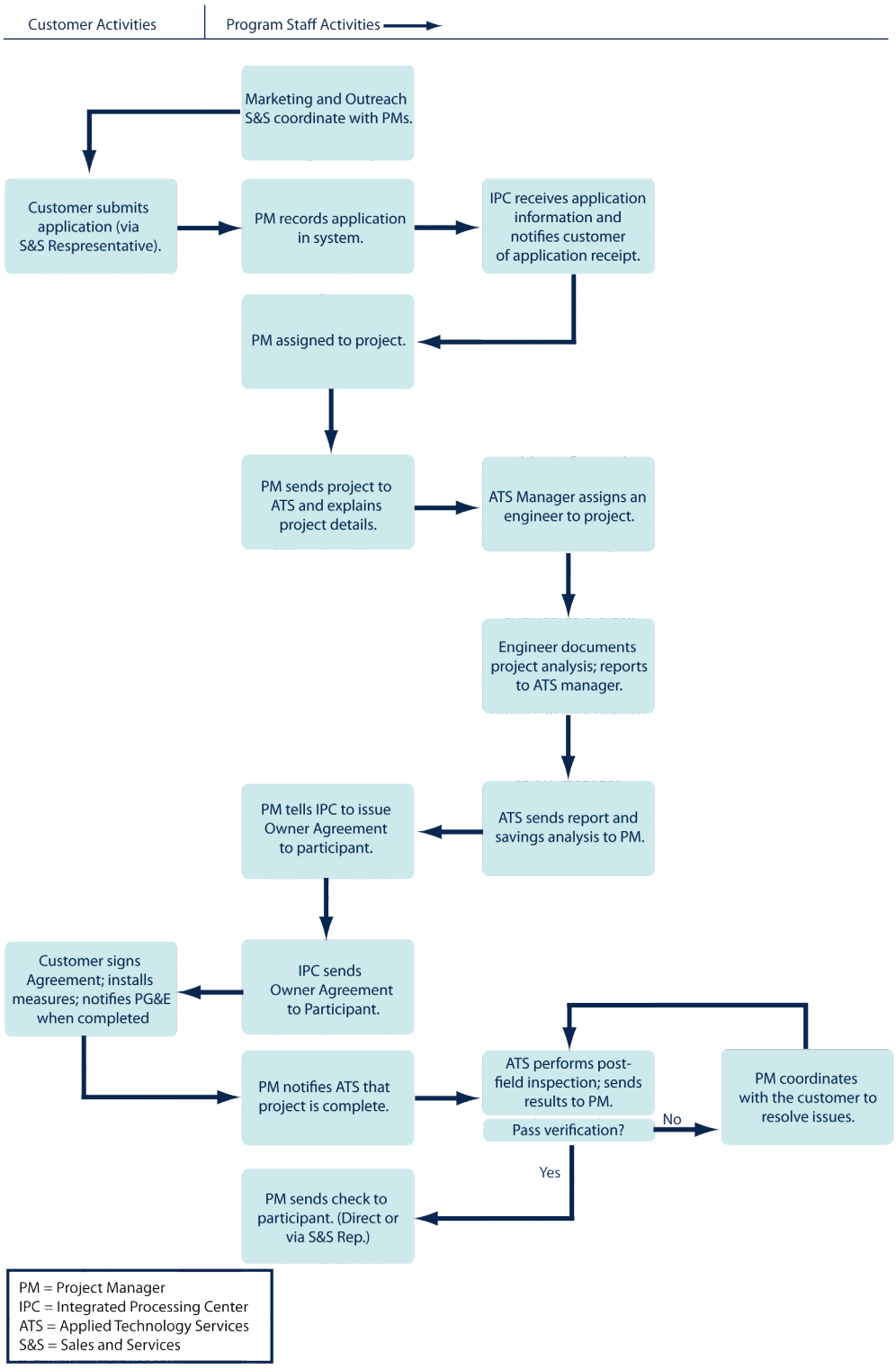
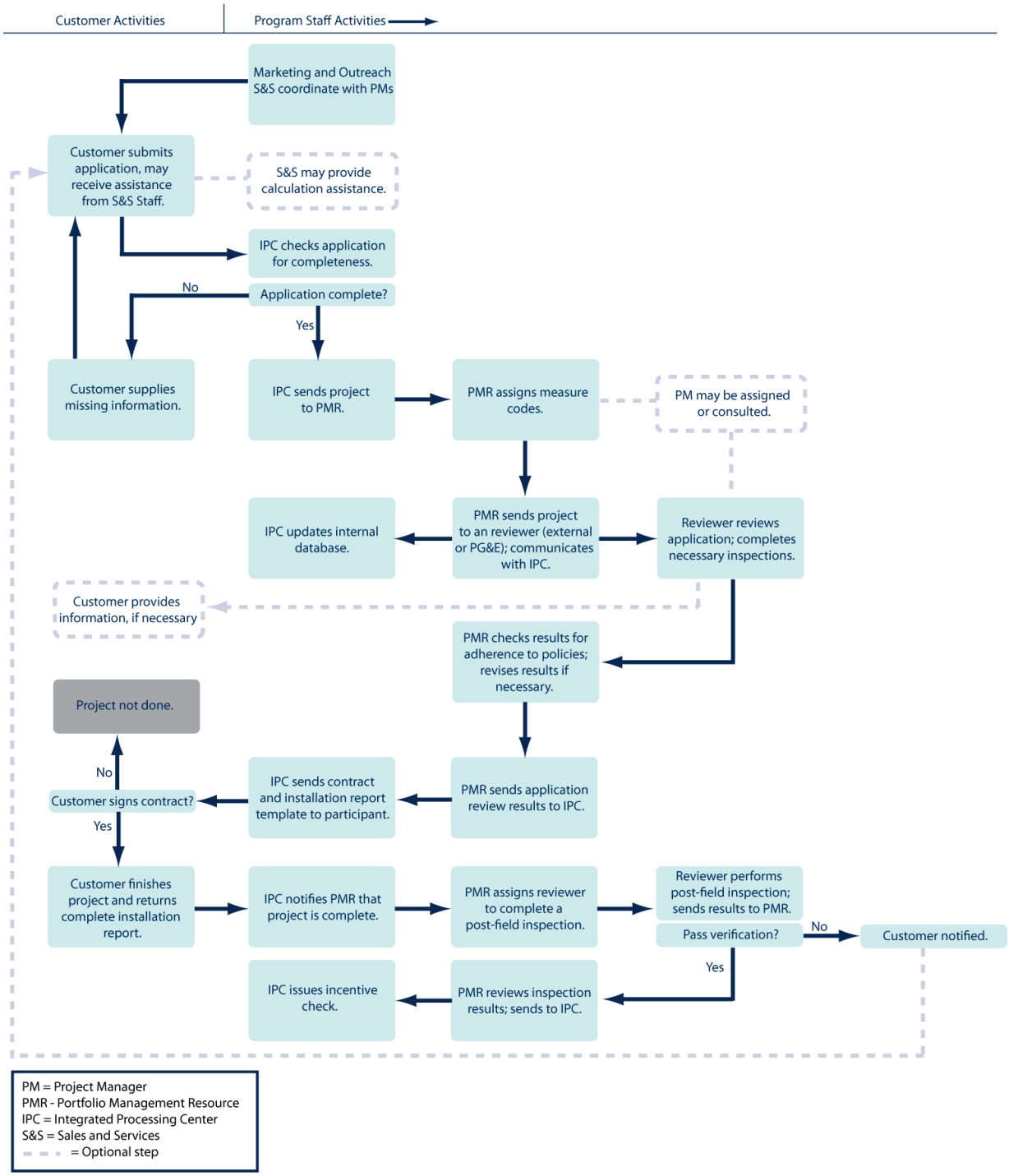


Figure 3. Application Process Flow Diagram – NRR



Third Party Programs

The AFP Program third party programs are currently managed by Program Managers in the Third Parties Group of Customer Energy Efficiency (CEE); this group manages all third party contracts for PG&E energy efficiency programs. Historically, the California Public Utilities Commission (CPUC) managed all third party contracts but, prior to the 2006-2008 Program cycle, the CPUC handed third party contract management back to the utilities.[5] This transfer of responsibilities delayed the RFP and proposal vetting and selection process, and most third party programs did not start running until the end of 2006.

Third party Program Managers manage the relationship between the third party implementer and PG&E, as well as monitor the implementer's contractual obligations and progress in the field. Third party implementers generally check in with their Program Manager once a month to report on participation and savings. The Program Managers also support implementers by updating customer lists, coordinating activities with the Core Program, and reviewing measure mix and cost effectiveness. While contracts vary between third party programs, most are performance based contracts and reward third party implementers based on their savings contribution.

Third party implementers generally manage projects from start to finish and only involve PG&E in the project if they need assistance or more customer information. S&S and third party implementers may sometimes interact and coordinate, but in general, they operate independently. Most third party implementers offer vendor coordination and services, and thus may offer an advantage over Core Program projects, which require participants to coordinate vendors on their own. The following sections describe each AFP third party program's scope, theory/logic, and organization and management.

1. Wine Industry Efficiency Solutions (WIES)

Wine Industry Efficiency Solutions (WIES)

Elec. Savings Forecast: 2,310 MWh
Elec. Savings Achieved: 3,739 MWh
Gas Savings Forecast: 162,472 therms
Gas Savings Achieved: 105,660 therms
Target Market: small- and mid-sized wineries

Resource Solutions Group (RSG), the Wine Industry Efficiency Solutions program implementer, provides a range of energy-efficiency related services, including program design and implementation. RSG identifies efficiency improvement opportunities and offers financial incentives to complete the installation. The program focuses on small- and medium-sized wineries and wine grape growers, providing them with support on all aspects of energy-efficiency projects, such as equipment specifications, bid package development, contractor selection, project financing, and project management.

Program Theory

The key program activities for WIES include marketing and outreach, energy analysis support, education, program management, installation support services, and incentives. The primary

[5] Information gathered from the February 2009 staff interviews.

marketing and outreach activities are events and meetings that establish person-to-person contact with customers. The majority of leads are generated through coordination with PG&E's S&S staff. Other more passive marketing and outreach channels, such as a website, are also used. The implementer conducts audits at wineries to design a comprehensive energy-management strategy. Further education is delivered through peer-group discussions.

To facilitate project-tracking, implementation agreements—with targeted measures and installation timelines—are signed by participants. To address participant barriers related to time and cash restrictions, the program offers installation services and cash incentives. The installation support services guide customers through the entire installation process.

Short-term outcomes for the WIES program include increased awareness of the program and energy-efficiency opportunities, and increased measure installation. Intermediate and long-term outcomes are reduced energy use and persistent energy reductions. For more details, refer to the WIES logic model located in Appendix A.

Organization and Management

A Project Director provides oversight of marketing outreach activities, project management, and project reporting. The Senior Project Manager, assisted by an Associate, leads overall project and customer management. The Technical Director oversees technical support activities, including engineering analysis, energy audits, database development, and measure-level reporting. Two in-house engineers and two subcontractor firms assist with the range of technical duties. The Database Manager ensures proper tracking and reporting of program activities.

2. Industrial Refrigeration Performance Plus (IRPP)

The Industrial Refrigeration Performance Plus program is offered by VaCom Technologies, which is headquartered in La Verne, California. VaCom designs and implements high-payback industrial refrigeration systems using energy-efficient control technologies. The IRPP program promotes energy efficiency to companies in the cold storage and food processing market, for which large-scale refrigeration systems are a significant portion of the electric load. VaCom targets larger facilities where the refrigeration plants are often complex systems that have evolved through numerous modifications and additions. Existing facilities are retrofitted, emphasizing refrigeration system improvements as well as addressing lighting, envelope, pumping, air handling, and related process equipment.

Industrial Refrigeration Performance Plus (IRRP)

Elec. Savings Forecast: 28 MWh
Elec. Savings Achieved: 9,693 MWh
Target Market: Customers with large, complex refrigeration systems.

Program Theory

The key program activities for IRPP are: marketing and outreach; technology analyses; program management; installation; cash incentives; third-party inspections; training; and two-year performance monitoring and reporting. Marketing and outreach is conducted via phone, mailings, website, and printed materials. Scoping studies/audits are conducted for potential

participants; these audits provide specific project proposals and information on appropriate measures, costs, incentives, energy savings, and other benefits. After completing the application and approval process, the program offers participants operation and maintenance training to maximize the savings over the measure's life. Subcontractors perform third-party inspections to confirm measure installation. Performance monitoring and reporting provide a forum to track project progress. Multiple participation barriers are addressed with the combination of cash incentives, technical assistance, and training, which engage participants and ensure the installation of appropriate energy-efficient equipment.

Short-term outcomes include: increased awareness of energy efficiency, installation of efficient refrigeration systems, and more efficient equipment use and maintenance. Intermediate and long-term outcomes are reduced energy use, optimal equipment performance, and, eventually, persistent reductions in energy use. For more details, refer to the IRPP logic model located in Appendix A.

Organization and Management

The President of VaCom serves as Program Manager for this program, assisted by the IRPP Lead Analysis Engineer, the IRPP Program Analyst, the IRPP Program Coordinator, and the Operations Manager. In addition, various engineering staff perform IRPP project development and analysis work. The IRPP Sales Manager is responsible for marketing and sales.

3. Dairy Energy Efficiency Program (DEEP)

The Dairy Energy Efficiency Program is administered by EnSave, Inc., a Vermont-based company that previously ran the EnSave California Multi Measure Farm Program. Dairy is one of the most energy-intensive agriculture processes. As such, the overall goal of the program is to lower producers' energy costs and help them remain competitive in the dairy industry. DEEP offers cash incentives to PG&E dairy producers for the following measures: variable speed drives, plate coolers, scroll compressors, premium efficiency motors, time clocks, ventilation, lighting, and compressor heat recovery units.

Dairy Energy Efficiency Program (DEEP)

Elec. Savings Forecast: 4,620 MWh
Elec. Savings Achieved: 8,285 MWh
Target Market: 1,300 dairy producers

Program Theory

The key program activities for DEEP include: marketing and outreach, customer assistance, program management, cash incentives, and verification. To increase program exposure to dairy producers, DEEP employs two program outreach and delivery approaches: direct contact through EnSave activities, and indirect contact through dairy equipment dealers. EnSave contacts dairy producers directly, while also informing dealers, who then pass program information on to customers. Marketing and outreach outputs are printed materials, articles, and seminars. To streamline the process for customers, the program offers five prescriptive measures, and one calculated custom lighting package. Information and assistance is provided via phone, website, mail, fax, and e-mail, and applications can be completed over the telephone. To address financial resource barriers, the participant receives cash incentives for installed measures. Confirmation of

installations occurs through signed affidavits and random site visit checks for five percent of the install sites.

Short-term outcomes for DEEP include increased program awareness and knowledge of energy efficiency, and installation of measures. Intermediate and long-term outcomes are reduced energy use, and persistent energy reductions. For more details, refer to the DEEP logic model located in Appendix A.

Organization and Management

DEEP is managed by an EnSave Program Manager, and until recently, all customer contact was handled by three telephone-based representatives working from a call center. A marketing/outreach representative was also added in January 2008 to visit farms, dealers, and the extended agricultural community, to support the program. The representative also attends agricultural shows and PG&E's marketing/outreach activities.

4. Industrial Cold Storage/Food Processing Efficiency (ICS/FPE)

Industrial Cold Storage/Food Processing Efficiency (ICS/FPE)

Elec. Savings Forecast: 13,542 MWh
Elec. Savings Achieved: 16,389 MWh
Target Market: Refrigerated Warehouses and Food Processors

Onsite Energy administers the Industrial Cold Storage/Food Processing Efficiency Program, which promotes energy efficiency among refrigerated warehouses and food processors, and offers comprehensive audits, followed by recommended energy-efficiency improvements and cash incentives for completed projects. Focus is put on the following technologies: comprehensive refrigeration system retrofits, lighting retrofits involving new T-5 fluorescent fixtures, variable frequency drives on process pumps and fans, and comprehensive compressed air system measures. Onsite puts specific emphasis on projects that have a short pay-back period and a high return on investment (ROI) to capture the attention of key decision makers in this hard-to-penetrate target market.

Program Theory

The key ICS/FPE program activities include marketing and outreach, audits, program management, cash incentives, and EM&V inspections. The ICS/FPE program utilizes multiple marketing channels, such as presentations, calls, and brochures, to raise awareness of the program. Program representatives pursue face-to-face meetings with interested customers to present specific program features. Implementers also network with vendors to raise program awareness and address informational barriers. Energy efficiency is generally not a high priority for companies in the refrigerated warehouse and food processing segment; thus, implementers conduct audits with customers to identify projects with short payback periods and high ROIs. Once the effective measures are identified and the program application is approved, participants can choose a contractor of their choice to complete the work. The combination of technical audits and cash incentives increase the likelihood of participation and measure installation. After installation, site visits are conducted to ensure that only properly installed and documented measures result in incentives.

Short-term outcomes include increased awareness of the program and energy efficiency opportunities, and an increase in measure installation. Intermediate program outcomes are a reduction in energy use and non-energy benefits resulting from measure installation, such as reduced maintenance. Long-term benefits include continued awareness of energy efficiency within the sector and persistent energy reductions. For more details, refer to the ICS/FPE logic model located in Appendix A.

Organization and Management

Onsite's CEO, assisted by the company's Vice President for Business Development and Senior Program Manager, provides overall program oversight. The Vice President for Project Implementation, who reports directly to the CEO, is responsible for general program management. He is supported by the Senior Project Engineer, who leads field activities, as well as another energy engineer and a data analyst. The company's CFO, the contracts administrator, a senior accountant, a program coordinator, and office managers provide contract and administrative support.

5. Light exChange Program (LCP)

The Light exChange Program (LCP) is a relatively small pilot program to replace mercury vapor yard lights (MVYL) with 70-watt high-pressure sodium yard lights (HPSYL) on photocells in rural areas of northern California. The program offers free direct install of lighting measures and conducts outreach via partnerships with community and non-profit organizations. Richard Heath & Associates (RHA), the program administrator, is a project design and management and social marketing firm that focuses on the areas of energy, health, and telecommunications. RHA is headquartered in Fresno, California.

Program Theory

The key LCP activities are: marketing and outreach, training, program management, assessment, and installation. For marketing and outreach, the LCP relies on word-of-mouth to recruit and enroll participants from rural agriculture communities. To facilitate this, the LCP partners with community and school organizations, and trains them to generate leads and pitch the program to the target market. Organizations conducting marketing and outreach receive a financial bonus for every lead that results in a successful measure installation. Marketing and outreach activities also include keeping regular contact with PG&E S&S staff. The program representatives answer questions through a toll-free phone line, and process and approve applications. The program also offers lighting assessments to identify the appropriate yard lights for installation.

Short-term outcomes include increased program awareness, community involvement in the program, outreach partners developing sales skills, and the installation of lighting measures. Increased program awareness among community groups, increased energy-efficiency awareness among the agriculture community, and reduction of energy use are intermediate program outcomes. Long-term outcomes are persistent energy reductions and higher levels of energy-efficiency program participation. For more details, refer to the Light exChange program logic model located in Appendix A.

Organization and Management

A Program Director provides overall program oversight. She is assisted by one Project Coordinator, two Outreach Coordinators, two Project Assistants, and two Energy Technicians. The Outreach Coordinators perform outreach to non-profit organizations, with the goal of recruiting them to market the program directly to the local agricultural community. The Project Assistants schedule the direct installs, and the Energy Technicians install the measures.

6. Combined Approach to Solar and Efficiency (CASE)

Combined Approach to Solar Efficiency (CASE)

Elec. Savings Forecast: 9,839 MWh
Elec. Savings Achieved: none
Target Market: Solar customers in the agriculture and food processing sector

SunPower Corporation, headquartered in San Jose, California, provides large-scale solar power systems using high-efficiency photovoltaic (PV) cell technology for residential, commercial, and utility-scale power plant customers. In its *Combined Approach to Solar and Efficiency*, SunPower was to offer additional DSM services to its existing and prospective PV system clients in the agricultural and food processing segments. These additional services included: energy balance analyses, industry benchmarking, equipment retrofits, and project management services. Equipment retrofits were going to be offered for a number of typical end uses, such as lighting, motors, pumps, air compressors, HVAC, and refrigeration. However, based on reports from PG&E staff, this program was never able to get off the ground due to a shift in the agricultural market potential and focus over the course of the program cycle. Though the program was not formally discontinued, it did not report any projects or savings during the 2006-2008 program cycle.

Program Theory

Key program activities for CASE include: marketing and outreach; technical assessments; program management; design, installation and verification; and cash incentives. CASE uses a combination of marketing and outreach strategies, such as advertisements, events and trade shows, website information, and brochures, to reach the target audience. The primary output of the technical assessments is a feasibility report, which helps participants identify potential measures and the associated return on investment, incentive amounts, and energy savings. The marketing and outreach and technical assessments ideally lead to increased awareness of CASE and encourage program participation. Once the customers decide to participate, they complete applications, install the measure(s), and receive a cash incentive. Cash incentives for the energy-efficient equipment help address participation barriers related to high first costs. Participants have the option of bundling measure installments and allowing the implementer to oversee multiple measure and contractor installations to reduce the customer's time burden. Program officials also conduct measure verification inspections.

Short-term outcomes from CASE include: increased awareness of the program and energy efficiency, and an increase in energy-efficient equipment installations. Overall, the simultaneous investment in renewable energy and energy efficiency leads to significant long-term energy

savings for agriculture and food processing customers. For more details, refer to the CASE logic model in Appendix A.

Segment and Program Logic Coordination

Based on an analysis of the Core Program and six third-party program logic models, Cadmus found that the AFP Program offerings are consistent with the overall Segment logic. While each individual program has unique characteristics that help direct messages to targeted audiences, all programs have similar implementation activities and outputs. Each individual program is targeted at similar short- and long-term outcomes that will advance the overall segment goals.

3 Data Collection Activities

Overview

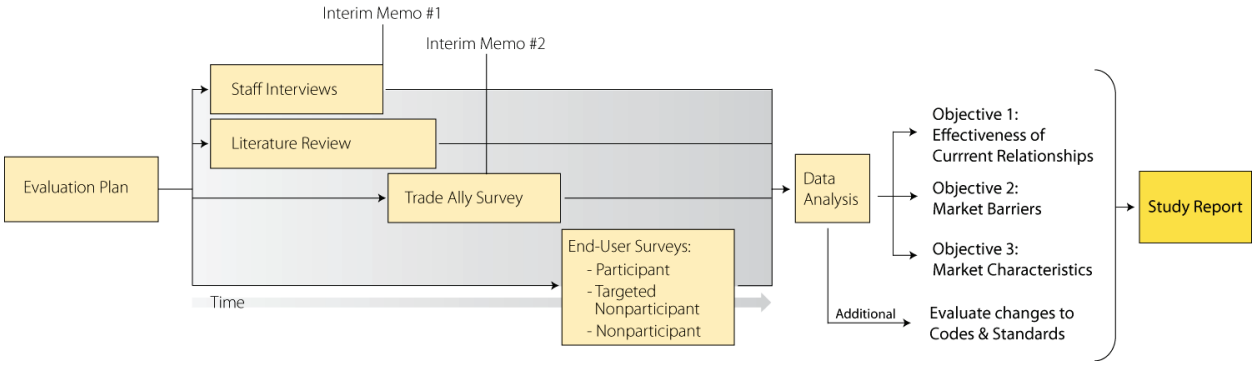
The following chapter provides a description of the methodological approach and data collection activities conducted as part of this evaluation. As outlined in the evaluation plan, the key tasks addressed during this process evaluation were:

- Determine the effectiveness of existing relationships, specifically those between PG&E and its target market customers, PG&E staff and third-party implementers, and third-party implementers and target market customers.
- Examine current market barriers and opportunities, with focus on identifying optimal approaches to addressing market barriers, including recommendations for effective marketing approaches.
- Perform a market characterization of the agricultural and food processing market in the PG&E service territory.

In addition to these objectives, PG&E requested Cadmus conduct a cursory review of the likely changes to codes and standards applicable to this market.

To accomplish these tasks, our team developed a comprehensive research plan designed to provide PG&E's Program staff with relevant information about its target market, feedback on its current Program implementation efforts and strategies, and tangible suggestions regarding new strategies and opportunities. Figure 4 provides an overview of the evaluation approach.

Figure 4. Overview of Evaluation Approach



As shown in Figure 4, the major data collection activities during the process evaluation included: Literature and Program Document Review, Codes and Standards Review, Staff Interviews, Trade Ally Surveys, Participant Surveys, Withdrawn Participant Surveys, and Nonparticipant Surveys. A detailed description of each data collection activity follows.

Literature and Program Document Review

At the outset of the study, our team conducted a detailed document review of available program documents, including the sector logic model completed by Heschong Mahone Group, marketing materials, activity logs, and measure data.

In addition to reviewing program-specific documents, our team collected and reviewed a number of statistical reviews, market characterizations, technology assessments, and other industry-related documents to inform the market characterization aspect of this study. See Appendix D for a list of cited and consulted sources.

Codes & Standards Review

A part of the evaluation commitments was a review of potential changes to California's Codes & Standards (C&S) and how they might impact the AFP sector. Specifically, our research focused on identifying potential changes to California Title 20 Appliance Standards and Title 24 Building Standards that might affect PG&E's food processing and agricultural sector between 2009 and 2011. Data collection activities for this review included three elements:

- Detailed review of the relevant documents available from online sources;
- Phone interviews with three subject matter experts at three primary Investor Owned Utilities (IOU) in California; and
- Review of technical documents provided by subject matter experts.

A complete copy of the C&S review memo is located in Appendix C.

Staff Interviews

To gather information about current implementation practices, challenges, and successes, Cadmus conducted 39 in-depth interviews with PG&E Program and third-party implementation staff using structured interview guides. Cadmus developed the draft interview guides based on a review of program documents and the program theory. Following review and comment from the PG&E evaluation manager and the AFP Segment Manager, the interview guides were finalized and fielded. The final interview guides are located in Appendix E.

The staff interviews explored four general topic areas:

- Program processes
- Implementer engagement
- Customer-service culture
- Market response

Cadmus used the interview data to inform three tasks. First, we used the data to review and update the sector logic model as well as to develop detailed logic models and process flow diagrams for the individual programs. Second, the staff interviews helped us identify key trade allies and market partners as well as issues for further investigation as part of the trade ally and

end-user surveys. Third, the staff interviews informed our analysis of existing market barriers and perceived implementation inefficiencies. A detailed report summarizing the findings from the staff interviews (Interim Memorandum #1) is attached in Appendix F for reference.

Sample Disposition

Overall, the evaluation team completed 39 staff interviews. For the Core Program, priority focus was placed on interviewing the Segment Manager, the Consolidated Support Contact[6] and as many Project Managers, engineers, and industry-assigned telephone representatives as possible. Cadmus also attempted interviews with 20 out of approximately 100 Service & Sales Account Representatives (hereafter, Account Representatives). Of those Account Representatives, ten had been identified as being in frequent contact the Segment Manager and ten as "low-contact" representatives. We also interviewed the Program Manager Supervisor for the Portfolio Management Review (PMR) group, as it became evident during the course of the interviews with other staff that this person had knowledge and understanding of program processes. For third-party programs, priority was placed on interviewing Program Managers and other key program staff.

Table 2 provides a summary of completed interviews by respondent type. As shown, we met all interview targets, except for those with Account Representatives. Although the total number of Account Representatives interviewed was slightly lower than originally planned, we found that little new was being added by the last several interviews and did not attempt any additional interviews in this group.

Table 2. Staff Interview Sample Disposition

Group	Known Population[c]	Targeted Number of Completed Interviews	Completed Interviews
Segment Manager	1	1	1
Program Manager, Research and Marketing	1	1	1
AFP Project Managers	5	5	5
Review Engineers	6	6	6
Consolidated Support Contact	1	1	1
Service & Sales Representatives, High-Contact[a]	10	10	8
Service & Sales Representatives, Low-Contact[b]	90	10-15	9
Service & Sales Representatives, Phone-Based	3	3	1
Program Manager Supervisor, PMR Group	1	1	1
3P Program Manager	6	6	6
Total	**124**	**42-47**	**39**

a. Account Representatives identified as being in frequent contact with the Segment Manager.
b. Account Representatives not identified as being in frequent contact with the Segment Manager.
c. Per information provided by PG&E in October 2007.

[6] The Consolidated Support Contact (CSC) assists the Account Representatives with reports, campaign program support, and technical application processing support. The CSC liaises between Service & Sales and the management of each target market (i.e., each segment) and distributes marketing information from the target market managers to the Account Representatives in the field.

Staff Interviews – February 2009

Cadmus also conducted ten additional staff interviews in February 2009 to collect information on the following topics: 1) changes in program implementation or staff roles, 2) opinions on data collection and input, and 3) additional problems that may have arisen or were overlooked. In total, Cadmus interviewed 11 PG&E staff members; Table 3 provides a summary.

Table 3. 2009 Staff Interviews Completed

Group	Completed Interviews
Segment Manager	1
Research and Marketing	2
AFP Project Managers	4
Service & Sales Representatives	3
3P Program Manager	1
Total	**11**

Trade Ally and Market Actor Survey

The evaluation team conducted a survey of trade allies and other industry market actors, such as the International Association of Refrigerated Warehouses and the California League of Food Processors. In addition to collecting feedback on program implementation issues, the trade ally and market actor survey was a primary data source for the market characterization.

The trade ally surveys were targeted at mechanical contractors, refrigeration design/build contractors, compressed air service providers, and industrial equipment vendors (e.g., pumps, motors, etc.). Specifically, the survey was designed to collect data on the following topics:

- Effectiveness of relationships (between customer and ally and between ally and program);
- Market barriers and opportunities (technological, economic, and informational);
- Awareness (ally of program and inferred customer of program);
- Satisfaction;
- Emerging trends and untapped potentials; and
- Potential improvements to program offerings and implementation approaches.

Copies of the survey instruments are located in Appendix G.

Sample Disposition

Due to the lack of a comprehensive trade ally list for PG&E's service territory, Cadmus developed a sample frame based on the following six sources:

- A preliminary trade ally list provided by PG&E (created by Swirl Integrated Marketing);
- A list of trade allies attending PG&E's workshops or other outreach events;
- A list of attendees of industry conferences where the Program has been represented;

- Information gathered during the staff interviews;
- Information gathered during the literature review; and
- Cadmus' knowledge of industry trade allies.

Given the wide range of technologies and products used by PG&E customers within the seven targeted subsectors, the trade allies and market partners serving these subsectors make up a varied and geographically dispersed group. Because of this diversity, Cadmus chose to focus the surveys on trade allies and market actors providing products and services for the major energy end-uses (i.e., motors, fans, refrigeration, boilers, and pumps). As shown in Table 4, Cadmus completed 38 interviews with trade allies and market actors.

Table 4. Trade Ally and Market Actor Survey Sample Disposition

Survey Audience	Population	Targeted Number of Completed Interviews	Completed Interviews
Trade Allies	~750	50	31[a]
Market Actors	212	5	7
Total		**55**	**38**

a. 21 vendors and 10 contractors

End-User Surveys

To collect feedback from program participants, nonparticipants, and withdrawn participants (drop-outs), Cadmus designed and implemented three separate surveys. Nexus Market Research designed these survey instruments, specifying data collection methods and standards, and monitoring data collection for the end-user surveys. The draft survey instruments were provided to PG&E for review and comment. Partnering with the survey firm Research Data Design (RDD), Cadmus fielded the surveys starting in April and completed the survey effort in May 2008. Copies of each survey instrument are located in Appendix H.

No third-party participants were included in the sample frame due to limited data. Third-party participant data were limited for the following reasons: 1) third-party programs had a late start on implementation, and 2) PG&E had difficulty incorporating third-party participant data in MDSS, and did not resolve the issue until 2008, after Cadmus had pulled a sample frame.

Participant Surveys

The primary goal of the participant survey was to collect information on the following topics:

- **Participation.** How did the participant learn about the Program? What were the primary drivers for participation?
- **Enrollment**. Was the application process straightforward? Did it take a lot of time? Were materials easy to understand?
- **The efficiency measures**. How has the measure performed? Have you noticed energy savings? Were measures installed as a replacement on a burn-out, early replacement, new application, etc.?

- **Interactions with PG&E or third-party staff**. Were questions about the Program answered promptly and sufficiently? Did the Program incentive arrive promptly?
- **Satisfaction.** Was the participant satisfied with the quality of installation, price, efficiency, savings on bills, contractor's knowledge, interactions with PG&E, and overall experience?
- **Market effects.** What is the likelihood the participant would have installed measures in the program's absence? Have additional measures been installed?

Sample Disposition

Based on a January 2008 download from the program database, Cadmus developed a proposed sampling plan (Table 5). The final participant sample frame was smaller than anticipated due to limited contact information; the database lacked both names and phone numbers for many participants. In addition, there were limited data on third-party program participants. Given the limited sample population for the participants, Cadmus did not employ any formal stratification.

As shown in Table 5, the final number of completed surveys (n=92) slightly exceeds the number of targeted completes (n=85). The number of completed interviews achieves the 90 percent confidence and 10 percent precision for the overall sample, and the 20 percent response rate stated in the initial sampling plan.

It took more effort than originally anticipated to complete the surveys. For instance, many sample records were called ten times—compared to the industry standard of five to seven calls. The dairy and food processing contacts, which were particularly hard to reach, were called more than ten times. Because the survey firm could not reach the targeted number of completes in those subsectors, Cadmus obtained additional contact information from PG&E and completed two more dairy surveys and four food processing surveys.

Table 5. Participant Sample Disposition

Subsector	Population[7]	Targeted Number of Completed Surveys	Completed Surveys
Agricultural	135	28	31
Dairies	9	2	3
Food processing	119	27	26
Greenhouses	32	6	6
Irrigation	12	3	3
Refrigerated warehouses	48	9	12
Wineries	50	10	11
Total	**405**	**85**	**92**

Nonparticipant Surveys

Similar to the participant survey, Cadmus contracted with RDD to collect the nonparticipant survey data. The surveys were completed in May 2008. The primary goal of the nonparticipant survey was to collect information on the following topics:

- **Awareness and understanding**. Are nonparticipants aware of the Program? How well do they understand energy efficiency?
- **Barriers to participation**. For those aware of the Program, why have they chosen not to participate? Are they likely to participate in the future? Why or why not?
- **Market effects**. For those aware of the Program, have they installed any energy-efficiency measures as a result of the Program? Has the Program somehow changed the dynamics of the market?
- **Barriers to installation of efficient equipment**. If applicable, why has energy-efficient equipment not been installed? Is it due to up-front cost, other priorities, lack of awareness, etc.?

Sample Disposition

Given the limited data for Program participants and the relatively higher importance of the participant surveys, Cadmus, with approval from PG&E, scaled down the nonparticipant sample to use resources to maximize participant responses. The final nonparticipant sample was designed to achieve 80 percent confidence and 10 percent precision within each subsector and 95 percent confidence and 5 percent precision for the overall sample. We also stratified each subsector by consumption, as shown in Table 6, and attempted to reach as many contacts as possible in the top 10 percent of consumption. We stratified the sample to ensure we had enough respondents in the top 10 percent of consumption to compare differences between large consumers and the remainder of the population.

As shown in Table 6, the total number of completes (n=454) was reached; however, for three of the subsectors (irrigation, refrigerated warehouses, and wineries) the actual completes are slightly below the targeted completes. The primary reason for this result is due to the limited

[7] Based on January 2008 program data provided by PG&E.

sample frames for these particular subsectors. Additional completes were achieved in the agriculture, greenhouse, dairy, and food processing subsectors to reach the overall survey target.

Table 6. Nonparticipant Sample Disposition

		Targeted Samples			Actual Completes		
Subsector	Population	Total	Top 10% of Consumption	Bottom 90% of Consumption	Total	Top 10% of Consumption	Bottom 90% of Consumption
Agriculture	11,741	190	20	170	198	20	178
Irrigation	556	50	10	40	39	6	33
Greenhouses	584	37	5	32	40	4	36
Dairies	329	40	5	35	46	6	40
Food processing	948	40	5	35	46	5	41
Refrigerated warehouses	3,949	62	7	55	53	8	45
Wineries	207	35	5	30	32	2	30
Total	**18,314**	**454**	**57**	**397**	**454**	**51**	**403**

Withdrawn Participant Survey

Cadmus conducted interviews with withdrawn participants in April and May 2008. The interview objectives were to assess:

- **Motivation to participate.** What were their motivations to initially participate in PG&E's energy-efficiency programs in the agricultural and food processing segment?
- **Reason for withdrawing from program.**
- **Market effects**. Have they installed any agricultural or food processing equipment since withdrawing from the program?
- **Satisfaction.** Were they satisfied with their interactions with the program staff and enrollment process?
- **Sources of information about energy efficiency**.

Sample Disposition

Based on the data underlying the sampling plans included in the M&E Plan, Cadmus had proposed conducting a census of all withdrawn and rejected participants from the Core and third-party Programs, which at the time were assumed to have included 152 participants.[8] Detailed analysis of an updated data set resulted in a final population of 17 withdrawn and rejected participants. Due to the reduced sample frame, Cadmus was only able to conduct in-depth interviews with five withdrawn participants. Of the five interviews, two were complete interviews, and three were partially complete interviews. Two of the three partial interviews

[8] The number of withdrawn and/or rejected participants was lower than expected because a number of participants were removed from the sample. Participants were removed from the sample if the available data indicated that they only adopted Mass Market measures, if the record was incomplete or lacked contact information, or if it appeared that the participant resubmitted their application.

were abbreviated because respondents were willing to speak for a brief period of time but could not complete the full interview. For the third partial interview, the respondent only confirmed the efficiency measure he had applied for and provided a reason for withdrawing from the program. Of the five respondents, two were dairy operations, two were refrigerated warehouses, and one was a winery.

Data Analysis

Data analysis included a mix of qualitative and quantitative methods that are employed in social science research. Qualitative analysis involved the summarizing and interpretation of interviews and open-ended questions. Quantitative analyses involved statistical analyses of survey responses using univariate or multivariate distributions and displays. Table 7 provides an overview of how the three major tasks for this evaluation map to the data collection activity. The marked boxes indicate which data collection activities we used to inform the study object. While basic data analysis was conducted using Excel, the evaluation team also used SAS to analyze participant and nonparticipant survey data.

Table 7. Matrix of Objectives and Data Collection Activities

Study Objectives/Key Needs	Staff Interviews	Literature Review	Trade Ally Survey	Participant Survey	Nonparticipant Survey
Objective 1: Determine effectiveness of existing relationships					
Determine market awareness & customer satisfaction	x		x	x	x
Determine areas of inefficiency	x		x	x	x
Update/create logic models	x				
Create process flow diagrams	x				
Objective 2: Determine market barriers and opportunities	x	x	x	x	x
Objective 3: Complete market characterization					
Identify new strategies	x	x	x	x	x
Baseline penetration of top five measures					x
Potential changes in codes & standards		x			

4 Market Characterization

Overview

The market characterization chapter is organized into the following sections:

- Overview of the statewide agricultural and food processing industries;
- Market description for targeted subsectors, with a focus on PG&E service territory;
- End-use technology markets;
- Emerging technologies; and
- Description of market barriers.

Each section is informed by a literature review of related market characterizations, media and technical documents, and the results from 38 trade ally (industry associations, service contractors, and vendor/distributors) interviews.

Statewide Market

California boasts a large, diverse economy, with the agricultural and food processing industries making up an important component of the state's economic base. In 2006 alone, the value of the agricultural output was $31.4 billion, which represents 13.1 percent of the U.S. total. California agricultural revenues are more than the combined total receipts for Texas and Iowa, which are ranked two and three in the nation for agricultural commodities, respectively.[9] Food processing revenues added another $55.8 billion to the California economy in 2006.[10] Overall, the two sectors account for roughly five percent of the gross state product.[11]

Employment

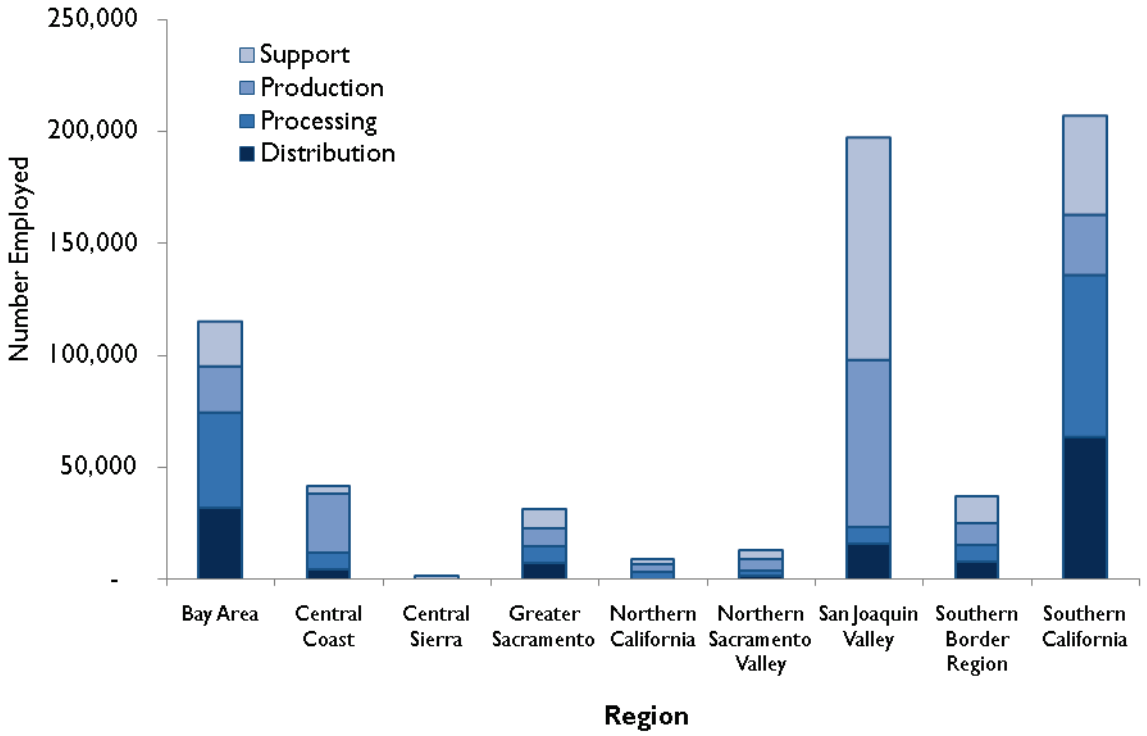
In addition to gross receipts, the agricultural and food processing sectors support millions of California jobs throughout the entire product chain, from production and processing to distribution and other related services. Based on the employment numbers shown in Figure 5, the bulk of food processing in California is conducted in the Bay Area and Southern California. Production (crop cultivation) is dominated by the San Joaquin Valley and the Central Coast regions.

[9] California Department of Agriculture. *Agricultural Statistical Review*. 2006.

[10] U.S. Census Bureau. *Annual Survey of Manufactures.* 2006.

[11] California Department of Finance. California Statistical Abstract. January 2007. http://www.dof.ca.gov/HTML/FS_DATA/STAT-ABS/Toc_xls.htm

Figure 5. California Food Chain Regional Employment in 2006



Source: California Economic Strategy Panel. California's Food Chain at Work. 2006 & California Regional Economies Employment Series.

Employment in the agricultural sector follows a cyclical pattern; with peak employment approaching nearly 450,000 people during the summer and early fall, as shown in Figure 6. In 2006, the food processing industry employed nearly 160,000 people, with the largest number of workers employed in the bakeries and tortilla manufacturing subsector.[12]

Figure 6. Employment in California's Agricultural Sector

Source: California Employment Development Department

[12] U.S. Census Bureau. 2006 Annual Survey of Manufactures. Data shown in Table 2.

Economic Performance

The top five agricultural commodities in California are milk/cream, grapes, nursery/greenhouse products, almonds, and cattle, as shown in Table 8, which displays the top ten agricultural commodities in 2006 and their change in value from the previous year. The overall value of the top commodity, dairy, decreased in 2006 due to a fluctuation in the price of milk. The top three agricultural exports are almonds, wine, and dairy products, as shown in Table 9, which lists the top ten agricultural exports and percent change in value from 2005 to 2006. The U.S. Department of Agriculture expects farm income to remain historically high through 2011, driven in large part by a projected 5.5 percent increase in food demand, increased demand for biofuels, and exports boosted by a weakening U.S. Dollar.[13]

Table 8. Top California Agricultural Commodities

	Top Ten Agricultural Commodities (2006)	Commodity Value ($1000)	Change from 2005 Value
1	Milk/Cream	4,492,229	-14%
2	Grapes	3,032,655	-5%
3	Nursery/Greenhouse Products	2,775,000	14%
4	Almonds	2,040,357	-19%
5	Cattle and Calves	1,676,354	-4%
6	Lettuce	1,607,572	14%
7	Strawberries	1,194,379	6%
8	Tomatoes	1,138,641	24%
9	Floriculture	1,020,453	0%
10	Hay	1,045,885	-15%

Source: California Department of Food and Agriculture.

Table 9. Top California Agricultural Exports

	Top Ten Agricultural Exports (2006)	Export Value ($1000)	Change from 2005 Value
1	Almonds	1,898,839	3%
2	Wine	735,835	28%
3	Dairy	603,799	7%
4	Cotton	553,825	-21%
5	Table Grapes	499,363	-8%
6	Walnuts	365,453	15%
7	Oranges (Fresh and Juice)	359,230	-2%
8	Pistachios	287,072	-4%
9	Tomatoes, Processed	286,276	9%
10	Strawberries	273,441	17%

Source: California Department of Food and Agriculture.

In the California food processing industry, the total value of shipments was $55.8 billion in 2006, as reported by the 2006 Annual Manufactures Survey. A summary of the 2006 Manufactures Survey data for California is provided in Table 10. In California, dairy products and fruit and vegetable products contribute significantly to the overall revenue in the food processing industry.

[13] U.S. Department of Agriculture. 2008 Farm Income Forecast

Overall, food processors saw an increase in the cost of materials from 2005 to 2006, as illustrated in Table 10. This trend continues, as corn, rice, wheat and soybeans all, at minimum, doubled in price from the 2005/2006 marketing year to 2008, according to the USDA.[14] By comparison, overall fruit and vegetable input prices have increased by approximately 20 percent in the same time period.[15] In some cases, the rising price of grains diminished food processor profit margins, as prices affect them both directly, through the purchase of grains, and indirectly, through other suppliers (e.g., dairy) passing on cost increases.

Table 10. California Food Processing Industry Profile For 2006

Subsector (based on NAICS codes)	Employees	Total Cost of Materials ($1,000)	Total Value of Shipments ($1000)	% Δ from 2005 Cost of Materials	%Δ from 2005 Total value of Shipments
Animal Food Mfg	4,907	2,059,151	3,768,819	20.4%	14.0%
Grain & Oilseed Milling	3,419	1,801,688	2,911,660	-2.2%	-7.3%
Sugar & Confectionery Product Mfg	7,763	1,367,607	3,091,173	3.2%	4.2%
Fruit & Vegetable Preserving & Specialty Food Mfg	31,977	5,583,239	10,939,055	2.9%	4.0%
Dairy Product Mfg	13,711	7,578,933	10,130,457	8.1%	3.3%
Animal Slaughtering & Processing	20,533	3,499,924	5,719,232	16.1%	10.6%
Seafood Product Preparation & Packaging	2,280	794,455	1,140,752	9.3%	3.6%
Bakeries & Tortilla Mfg	41,749	2,160,518	6,180,699	0.4%	-2.9%
Other Food Mfg	31,417	5,868,339	11,916,245	15.2%	9.2%
All Food Manufacturing	157,757	30,713,853	55,798,093	8.5%	4.7%

Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures.

Energy Use Trends

According to the California Department of Energy, agriculture consumes 4 percent of the state's electricity, and food processors consume 2 percent of the state's electricity and 5 percent of its natural gas,[16] though climbing energy costs are forcing agricultural and food processing operations to actively examine fuel sources, fuel costs, and energy efficiency. The American Council for an Energy Efficient Economy predicts that California agricultural operations could potentially save 5.4 trillion BTUs of annual direct use of natural gas in the fruit/nut tree industry alone.[17]

[14] The United States Department of Agriculture Economic Research Service. Agricultural Outlook: Statistical Indicators. http://www.ers.usda.gov/publications/agoutlook/aotables/2008/10Oct/aotab36.xls (Accessed 11/21/08).

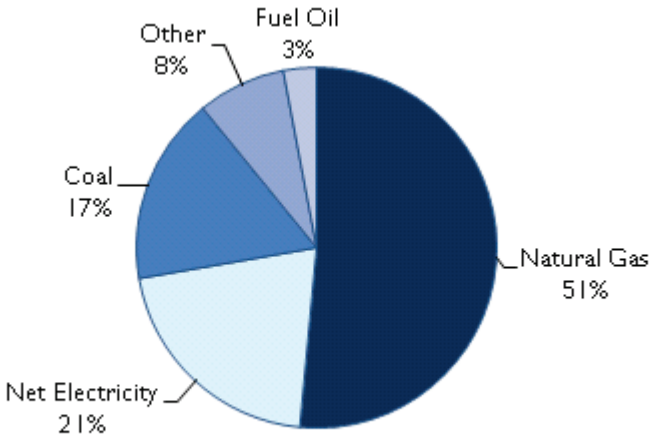
[15] Economic Research Service, US Department of Agriculture. "Table 7 Producer Price Indices (Crude Materials: Fruits, Melons, Fresh/Dry Veg. & Nuts)." Agricultural Outlook: Statistical Indicators. November 2008. Note we report an aggregate fruit and vegetable index; individual fruit and vegetable prices may fluctuate.

[16] California Energy Commission. http://www.energy.ca.gov/process/agriculture/index.html (15 April 2008).

[17] American Council for an Energy Efficient Economy. *Potential Energy Efficiency Savings in the Agriculture Sector*. March 2005.

Energy generally ranks as the third-highest input cost for the food processing sector, coming in behind labor and raw materials.[18] Among national food processors, natural gas is the largest fuel input (52 percent), followed by electricity (21 percent), shown in Figure 7. Moreover, if fuel costs remain high, the cost of transportation will place additional pressure on food processors margins.[19] In the agricultural sector, direct (fuel) and indirect (fertilizer) energy costs account for approximately 15 percent of production costs.

Figure 7. Primary Fuel Inputs for the National Food Processing Sector in 2002



Source: U.S. EPA. Energy Trends in Selected Manufacturing Sectors. 2007

As reported in the Department of Energy's Manufacturing Energy Consumption Survey (MECS), total energy consumption in the western United States food processing industry decreased during the period from 1998 to 2002, Table 11.[20] This decrease was observed despite a 2001 spike in natural gas prices, which caused some food processors to switch their thermal processes to electrical technologies. Increasing gas prices, relative to electricity costs, could cause additional fuel switching—from gas to electricity—in the future.

Table 11. Trend in Energy Use for Food Processing Industry, Western Region

Year	Total Energy Consumption (trillion Btu)	Net Electricity (million kWh)	Natural Gas (billion cu ft)
1998	194	9,671	111
2002	171	9,848	102
% Change	-12%	2%	-8%

Source: Energy Information Administration, MECS

[18] U.S. Environmental Protection Agency. *Energy Trends in Selected Manufacturing Sectors*. March 2007, 3-31.

[19] New York Mercantile Exchange. July 2008

[20] U.S. Department of Energy, Energy Information Administration. *Manufacturing Energy Consumption Survey*. 1998 and 2002. Note: The Energy Information Administration collects detailed energy use data from the manufacturing sector on a four-year cycle. Statistics for 2002 were published in June 2005. The report for 2006 is yet to be published.

The rising cost of energy makes the food processing sector prime for energy-efficiency measures. These energy concerns are confirmed by the Food Processing 2008 Annual Manufacturing Trends Survey, where food processors across the nation ranked energy costs as their second greatest concern.[21] The number one concern is still food safety, which comes as no surprise—2007 was a bad year for the food industry, with widespread recalls of beef, bagged salad, and peanut butter, among other products.[22]

Sustainability Trends

Rising environmental awareness combined with climbing energy prices have also pushed environmental issues to the foreground for food processors and agricultural operators.[23] The Food Processing 2008 Annual Manufacturing Trends Survey reports that 71 percent of surveyed food processors consider environmental issues as "extremely" or "very important."[24] To "green" their business, many are targeting energy management and conservation. However, businesses are considering more than the typical energy-efficiency measures—20 percent of the food processing survey respondents said they were considering alternative energy sources.

AFP Program Subsector Focus

In general, food processing and agriculture are inextricably linked markets; this informs why PG&E targets both sectors under the same program. The AFP Program specifically targets the following subsectors: dairies, greenhouses, irrigation, refrigerated warehousing, and wineries. The remaining companies fall into the broad categories of food product manufacturing and agriculture. Irrigation and refrigerated warehouses are broad-reaching subsectors among agricultural and food processing customers, and, as such, the program subsectors are not mutually exclusive for all customers. For example, some customers may be targeted in both the food processing and refrigerated warehouse program subsectors. In this study, Cadmus categorized the subsectors based on the NAICS code provided in the PG&E data; the categorization key is displayed in Table 12.

[21] Grant Thornton/Food Processing Online. 2008 Annual Manufacturing Trends Survey. http://www.foodprocessing.com/articles/2008/015.html

[22] Ibid

[23] Agricultural Marketing Resource Center. http://ww.agmrc.org/agmrc/markets/Food/organicfoodtrendsprofile.htm, (15 April 2008).

[24] Grant Thornton. *Food Processing 2008 Annual Manufacturing Trends Survey*. March 2008.

Table 12. Subsector Categories by NAICS code

Subsector	NAICS code	Description
Agriculture	111, 112	Crop Production (excluding greenhouses); Animal Production (excluding dairies)
Dairy	112120	Dairy, Cattle, and Milk Production
Food Processing	311	Food Manufacturing
Greenhouses	11141	Crops Grown Under Cover
Irrigation	22131	Water Supply and Irrigation Systems
Refrigerated Warehouses	493120	Refrigerated Warehousing and Storage
Wineries	31213	Wineries

2006-08 Program Participation & Energy Savings

To provide an overview of AFP Program participation, Cadmus summarized electricity and gas savings from PG&E's program database for 2006-08 as of December 12, 2008, shown in Table 13. Most of the PG&E AFP Program participants fall into the agricultural and food processing subsectors, and, as such, these subsectors have shown the highest amount of electricity savings, as shown in Table 13. Refrigerated warehouses also have significant electricity savings, due in large part to the optimization potential of refrigeration systems. The food processing subsector also contributes the most gas savings, as their relative use is so much higher than the other subsectors.

Table 13. Subsector Electricity and Gas Savings for 2006-08 Program, ordered by electricity savings.[25]

Subsector	No. of Unique Applications	Gross Electricity Savings (kWh)	Gross Gas Savings (thm)
Food Processing	319	50,657,312	8,284,568
Agriculture	262	24,062,702	520,344
Wine	128	18,320,950	83,794
Refrigerated Warehouse	54	17,769,901	30,000
Dairy	44	5,669,227	2
Irrigation	105	2,668,530	1
Greenhouse	40	906,604	1,682,833
Other*	318	35,770,036	971,269
Total	1,270	155,825,261	11,572,811

*NAICS code not available

Field Agriculture

The field agriculture subsector focuses primarily on open-air crops such as lettuce, vineyards, and tomatoes. California produces the most diverse range of field crops in the nation and maintains vast agricultural output due in part to mild climate regions and ready access to

[25] The numbers reported in this table are based on raw energy savings data for paid incentives (variables p_kwh and p_thm). Totals only include savings from NRNC and NRR Calculated incentives; mass market/deemed measures were excluded. The total savings may differ from official program filings as the data are further refined. Third Party information was unavailable for this analysis.

irrigation. In 2006, 76,000 farms cultivated crops on 26.1 million acres, and each earned an average of $413,000 on 446 acres. Hay, cotton lint, rice, potatoes (excluding sweet potatoes), and wheat were the top field crop producers. Field crop receipts grew by 8.2 percent in 2006 to total $2.779 billion.[26]

When California's agricultural production is broken down by county, as shown in Table 14, the San Joaquin Valley, the majority of which is located in PG&E service territory, stands out as California's most agriculturally intensive region.

Table 14. Leading Field Crop Producing Counties

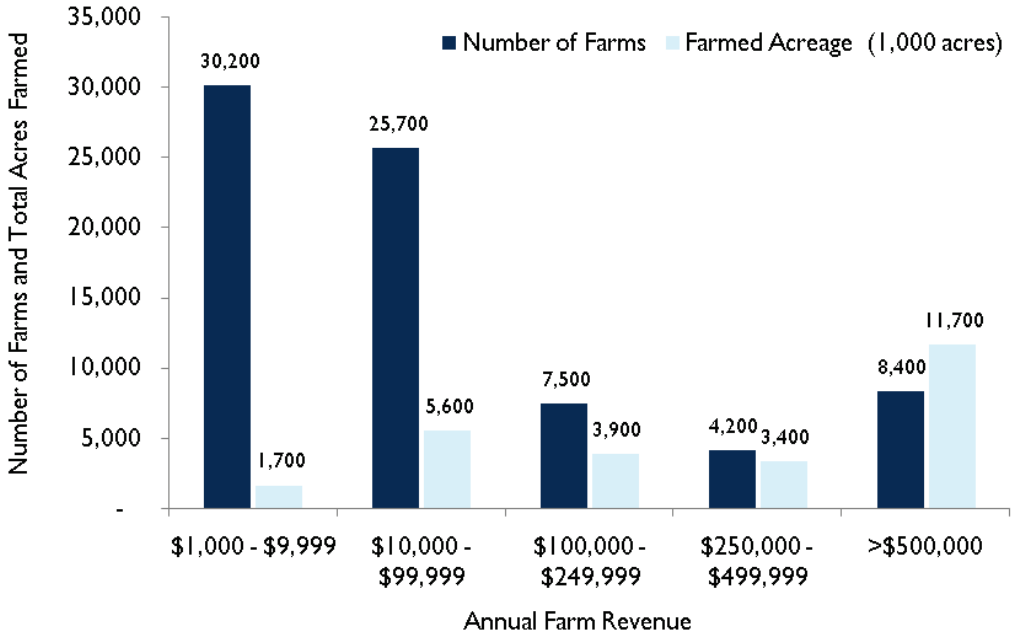
County	Gross Receipts ($ billions)	% Change from 2006	Region
Fresno	$4.84	+4.4%	San Joaquin (Central) Valley
Tulare	$3.87	-11.2%	San Joaquin (Central) Valley
Monterey	$3.49	+4.3%	Central Coast
Kern	$3.48	-2.1%	San Joaquin (Central) Valley
Merced	$2.28		San Joaquin (Central) Valley

Source: California Department of Food and Agriculture. Agricultural Statistics Review 2008.

Figure 8 shows statewide farm size distribution, with farm size categorized by annual farm revenue. Many farms are relatively small and unlikely to individually support a household (30,200 operations, which farm 1.7 million total acres, earn $1,000–$9,999 in annual revenue). This suggests field crop farming is becoming increasingly consolidated into larger operations (8,400 operations, which farm 11.7 million total acres, earn >$500,000 in annual revenue).

[26] California Department of Food and Agriculture. Agricultural Statistics Review. 2008

Figure 8. Farm Size Distribution.



Source: California Department of Food and Agriculture. Agricultural Statistical Review. 2008

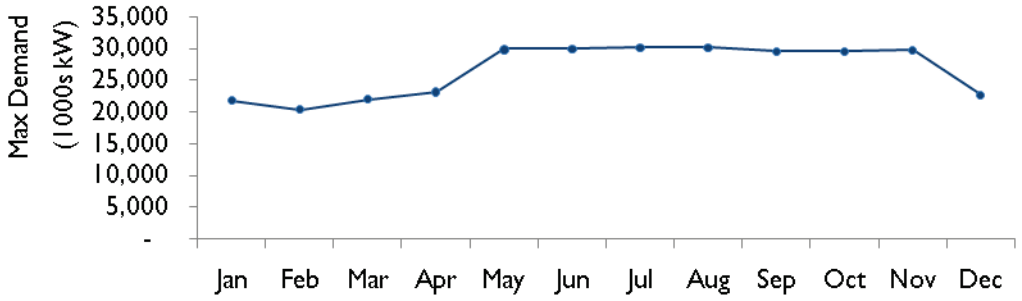
Field crop cultivation uses diesel and gasoline for pumps, tractors, and other farm equipment. Irrigation is increasingly converting from diesel engine powered pumps to electric motor driven pumps, due to the high cost of fuel. According to the California Energy Commission's *Agricultural Industry Profile*, agricultural crop production accounts for approximately 3 GWh of electricity consumption and 140 million therms of natural gas.

Rising fuel costs have wide-reaching implications. Energy markets are turning to biofuels to supplement gasoline and diesel supplies. Moreover, the price of fertilizer has increased due to the energy-intensive nature of its production. These energy strains are motivating many farmers in California and nationally to switch to crops requiring less input, such as soybeans.[27]

To gain a better understanding of energy use trends among food processing and agricultural customers in PG&E's service territory, Cadmus summarized PG&E's customer gas and electric billing data for 2007 by the subsectors targeted in the AFP Program. The agricultural subsector has by far the highest subsector non-coincident peak energy demand. Agriculture has a distinct energy-use pattern, with elevated demand during the summer months and lower demand during the winter, as shown in Figure 9, which displays monthly 2007 maximum electricity demand.

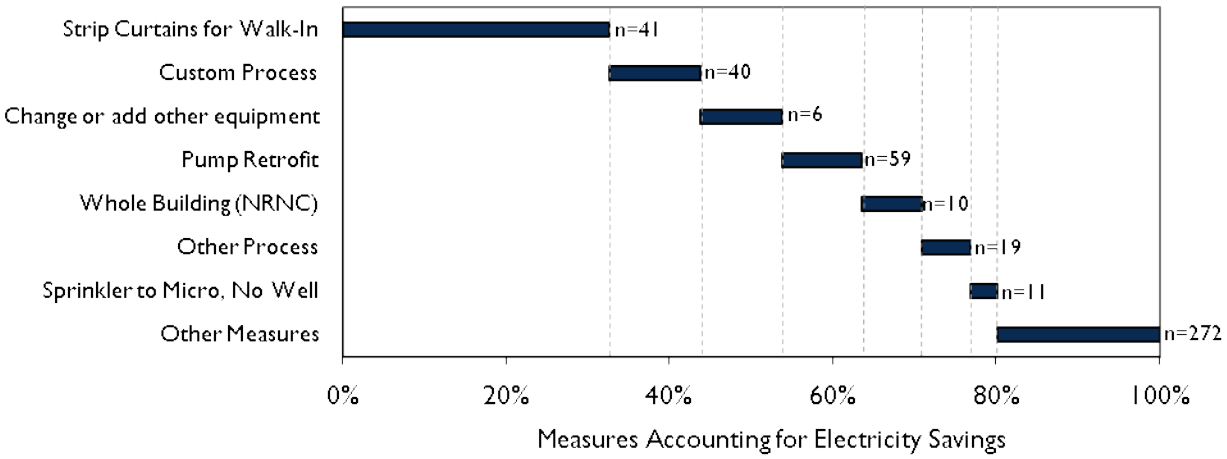
[27] U.S. Department of Agriculture. National Agricultural Statistics Service. *High Fuel, Fertilizer Prices to Lead to....*2006.

Figure 9. 2007 Monthly Peak Non-Coincident Demand: Agriculture



In the PG&E AFP Program, agricultural participants implemented a wide array of measures types, with the vast majority of measures decreasing electricity consumption. Figure 10 shows top electricity-saving measures in the agricultural sector, according to PG&E AFP Program data.[28] The greatest amount of Program electricity savings came from the installation of strip curtains (32 percent). Custom processes, equipment changes, or pump retrofits accounted for another 30 percent of the electricity savings. Cadmus was unable to obtain specific information for projects categorized as "Custom Process" or "Other Process."

Figure 10. Measures Accounting for Electricity Savings: Agriculture



Dairies

There are 2,038 dairy farms in California with an average size of 602 cows.[29] PG&E's service territory has 1,778 dairies with an average size of 801 cows,[30] which consume 42 kWh per cow

[28] Data from January 2008 (covers years 2006-2007).

[29] California Energy Commission. Anaerobic Digestion. http://www.energy.ca.gov/pier/renewable/biomass/anaerobic_digestion/index.html. 2008.

[30] California Dairy Statistics. California Department of Food and Agriculture. 2007.

per month.[31] In 2007, average annual milk production per cow was 22,440 pounds.[32] Table 15 shows 2007 milk production by county; eight of the ten top milk producing counties fall within PG&E service territory.

Despite a downturn of 14 percent in 2006 due to low milk prices, milk products continue to be California's largest farm commodity, growing from $5.23 billion in 2005 to $7.33 billion in 2007.[33] In 2006, California's dairy industry employed 17,700.[34] Moreover, dairy exports have been increasing over the past five years, for a total value of $3.09 billion.[35]

Table 15. Grade A Milk Production County Ranking and Growth

County (by rank)	Pounds of Milk Produced (in thousands of pounds)	% Change from 2006
Tulare*	10,344,367	3.10%
Merced	5,398,367	6.32%
Stanislaus	3,953,656	1.38%
Kings	3,846,756	8.34%
Kern*	3,790,960	12.47%
Fresno	2,705,243	19.61%
San Joaquin	2,438,989	14.29%
San Bernardino**	1,940,695	-22.67%
Madera	1,602,612	12.57%
Riverside**	1,167,917	-5.90%

*County is partially covered by PG&E service
**County is located outside PG&E service territory

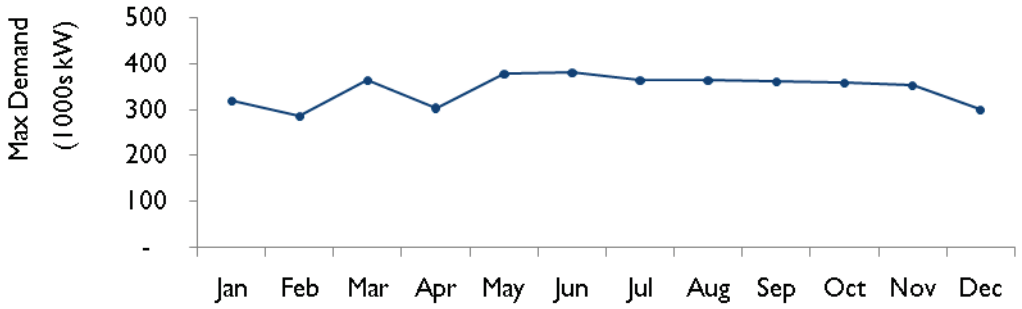
Aside from milk prices, environmental regulation and increasing feed prices are chief concerns among dairy farmers. Water quality regulations are requiring more groundwater monitoring, and the rise in global demand for ethanol and meat has dramatically increased the price of feed corn. This makes the prospect of a drought in the Midwest and the California Central Valley even more worrisome because of the double impact it would have on feed and fuel prices. The California Department of Food and Agriculture says, "Analysts are estimating that if a drought hit the Corn Belt this summer, corn could reach $8 a bushel from $5.46 now. The next drought will be the first to affect gas prices because ethanol—mostly refined from corn—will make up about six percent of the nation's gasoline supply this year, and that's expected to rise to ten percent over the next five years. The amount of ethanol used in California gasoline is expected to grow at a faster rate, reaching ten percent by 2010." Fuel costs are currently 28 percent of operating costs and utility costs are approximately 2 percent of total operating costs. As a point of comparison, basic services such as veterinary medicine cost 6.6 percent.[36] The comparatively

[31] California Energy Commission. http://www.energy.ca.gov/process/pubs/calif_dairy_energy.pdf. 2008.
[32] California Dairy Statistics. California Department of Food and Agriculture. 2007.
[33] California Department of Food and Agriculture. Agricultural Statistic Review 2008. Cash Receipts from Farm Marketing of Dairy Products.
[34] California Economic Strategy Panel. California Agricultural Employment. 2006.
[35] California Department of Food and Agriculture. California Dairy Review. Vol. 12. Issue 4. 2008.
[36] California Department of Food and Agriculture. Cost of Production 2007 Annual.

small costs associated with energy in this subsector may make energy-efficiency improvements a lower priority.

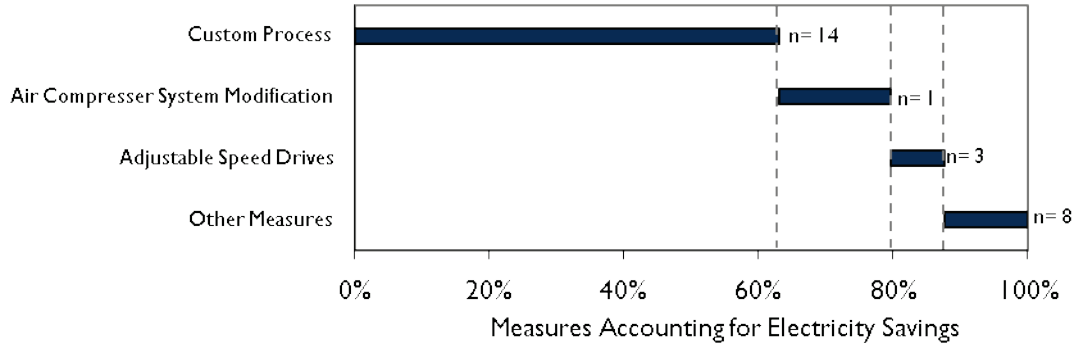
Though many dairies are located within PG&E territory, their non-coincident peak electricity demand is much less than the agricultural or food processing subsectors, averaging around 300,000 kW each month. The dairy subsector also tends to have a fairly constant electricity demand profile, as shown in Figure 11.

Figure 11. 2007 Monthly Peak Non-Coincident Demand: Dairies



Among dairy participants, implementing custom projects is more common than installing prescriptive measures, according to PG&E AFP Program data.[37] As displayed in Figure 12, a majority of the electricity savings comes from the "Custom Process" measures, for which Cadmus was not able to get more detailed information regarding specific equipment installed. One dairy customer project involving air compressor modifications resulted in over 15 percent of the total electricity savings recorded for the dairy sector; adjustable speed drives accounted for another 8 percent.

Figure 12. Measures Accounting for Electricity Savings: Dairies



[37] Data from January 2008 (covers years 2006-2007).

Food Processing

As mentioned previously, food processors in California are among the most competitive in the nation and the world, with over $50 billion in annual receipts. California food processors manufacture products such as tomato paste, canned and frozen fruits and vegetables, cheeses, and breads. In 2006, California processed 12 million tons of tomatoes; Colusa, Contra Costa, Fresno, and Glenn counties are the top processing counties, all of which are located in PG&E service territory.

California food processing consumes 3.7 GWh of electricity and 600 million therms of natural gas.[38] Process heating and cooling systems are the greatest energy users, accounting for over 75 percent of energy use. Motor-driven systems account for 13 percent of the sector's energy use, and facility operations approximately 8 percent.[39] Electricity is used primarily for industrial refrigeration, pumps, and other mechanical systems, and natural gas is used for heating processes, such as steam and hot water for cooking.

The fierce competition in food processing is driving innovation. Even small percentage reductions in natural gas consumption for a tortilla maker, for instance, can have profound impacts on overall cost performance. In the trade ally survey, service contractors reported that food processors are often guarded about their processes and system configurations due to the competitive market. With boilers and refrigeration though, food processors generally use off-the-shelf technologies, rather than customized, proprietary systems. Still, the key industry association, the California League of Food Processors, does not currently offer any programs that specifically target energy efficiency within their member companies.

As evidence of the industry's competitive and influential nature, California food processors have considerable control over their supply chain. For example, Cadmus conducted interviews with trade allies and market partners and found that the field departments of the major food processors specify growing conditions, specifically with regard to irrigation practices. Additionally, boiler emissions and refrigeration efficiency innovations are driven in part by the demands of food processors.

The trade-ally survey responses further indicate vendors and distributors have found sales efforts are best applied not to plant engineers, who are looking solely to meet production designs, but to the financial analysts of their capital projects. When rebates and energy are factored into an operating cost forecast, the full value of energy-efficient system components is realized.

Food processing has the third-highest total electricity demand (after agriculture and irrigation), and, like agriculture, food processors' demand is higher during the summer, as shown in Figure 13. This result is expected, as food processors rely heavily on the inputs from agriculture and have elevated electricity demand during the harvest months. Food processors are also significant natural gas users. As with electricity, food processors' natural gas usage peaks during the

[38] California's Food Processing Industry Energy Efficiency Initiative: Adoption of Best Practices. California Energy Commission. 2008

[39] Energy Trends in Selected Manufacturing Sectors. EPA March 2007

summer months; refer to Figure 14 for cumulative monthly gas usage among PG&E's food processing customers.

Figure 13. 2007 Monthly Peak Non-Coincident Demand: Food Processing

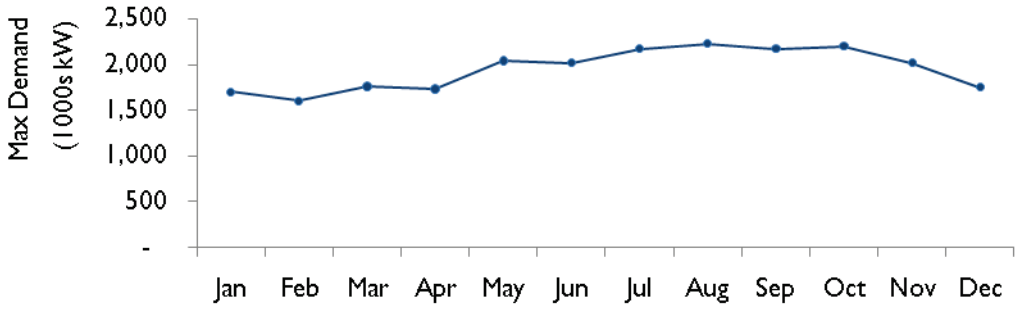
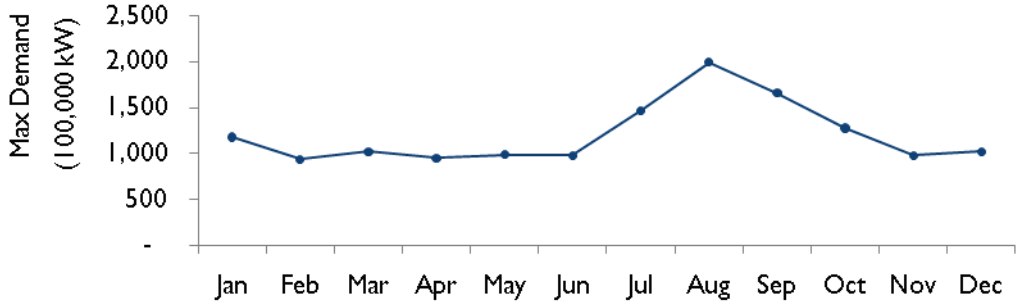


Figure 14. 2007 Monthly Gas Demand: Food Processing



As shown in Figure 15, 42 percent of the electricity savings in the food processing sector are Custom Process measures, for which Cadmus was unable to get measure level details. Food processing participants also commonly claimed incentives for lighting, strip curtains, air compressor modifications, and adjustable speed drives. For natural gas, incentives and savings were generally claimed for boiler measures, see Figure 16.

Figure 15. Measures Accounting for Electricity Savings: Food Processing

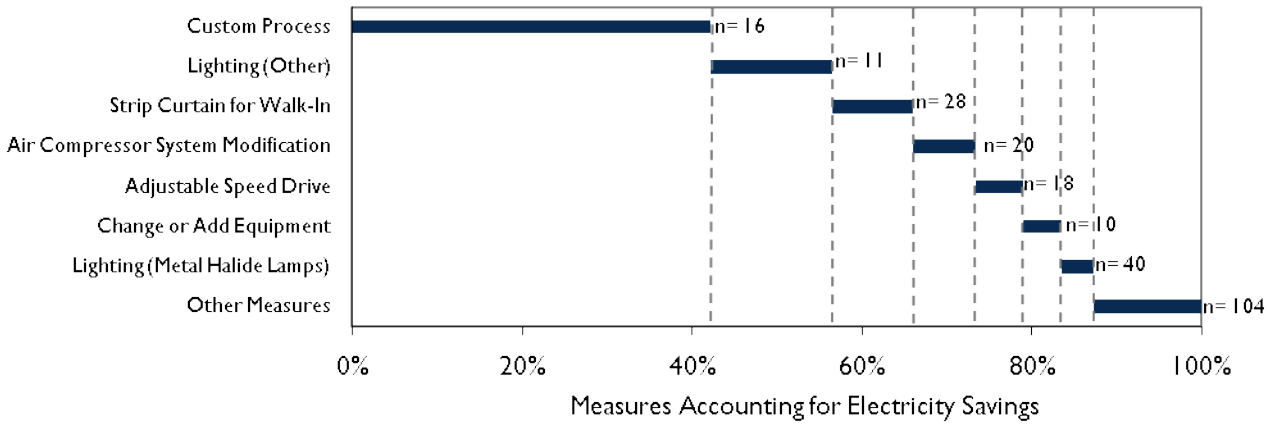
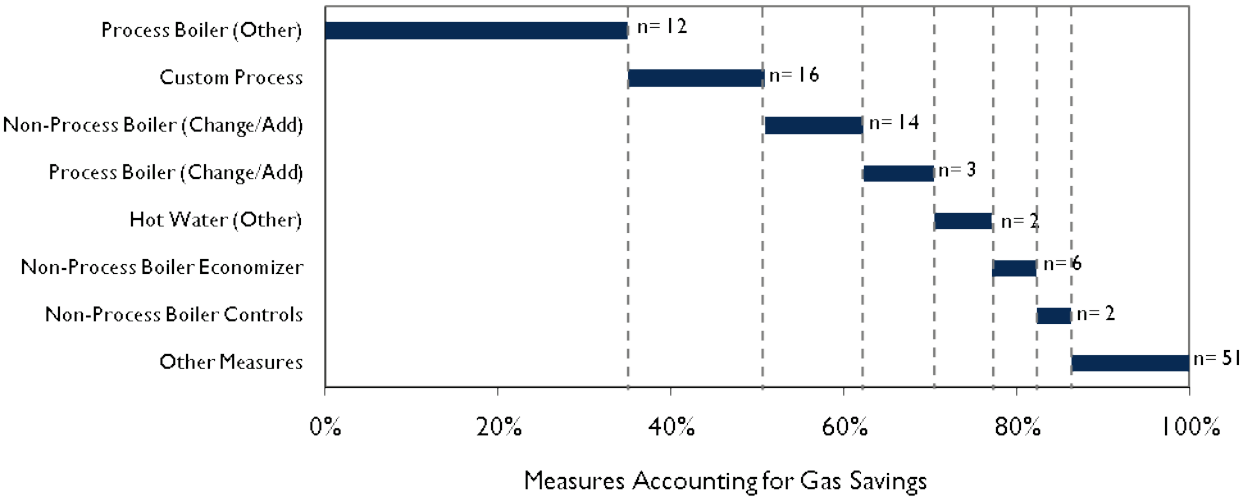


Figure 16. Measures Accounting for Gas Savings: Food Processing



Greenhouses

As of 2005, California greenhouse crops were valued at $2,433,346,[40] which roughly accounts for 20 percent of the value of U.S. greenhouse commodities. Greenhouse, Nursery, and Floriculture contributes 33,100 jobs to California's agricultural sectors,[41] and, according to the USDA, California's 820 greenhouses used 2,138 covered acres in 2005. Most covered acreage is located in the top producing counties of San Diego, Monterey, Riverside, Ventura, and Orange, all of which are located outside PG&E's territory, except Monterey County.[42] Thus, while

[40] California Agricultural Resource Director. California Department of Food and Agriculture. 2006.
[41] California Department of Food and Agriculture. Agricultural Statistic Review. 2008.
[42] California Department of Food and Agriculture. Agricultural Statistic Review. 2008.

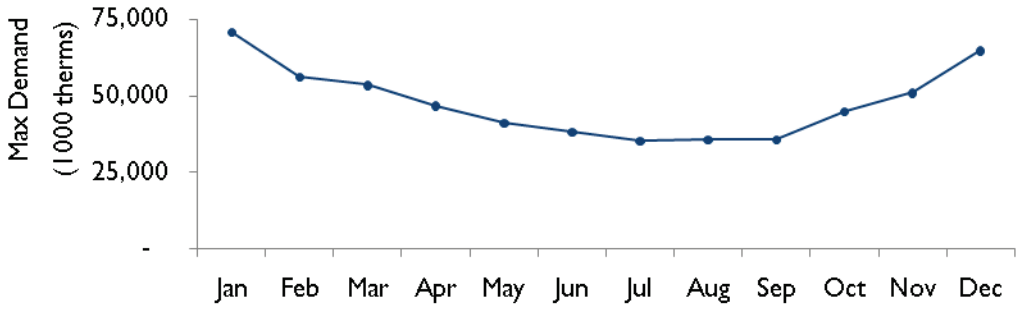
greenhouses are a significant contributor to California agriculture, they are less of a factor in PG&E's service territory compared to food processors, dairies, and field agriculture.

California greenhouses are consolidating faster than the other major greenhouse producing state, Florida. Nationally, the production area of small growers continues to shrink, while the production area of large growers continues to expand through acquisition and construction. Large growers in Florida had the most floriculture acreage under cultivation, while California has greater sales revenue with less acreage under cultivation.[43]

While the quality of insulation has increased in greenhouses, heating remains the largest energy use. Heat is generated by hot water boilers fueled by natural gas, which continue to have approximately 80 percent efficiency. Secondarily, process cooling and circulation continues to employ standard efficiency fans. While greenhouse growers understand the impact energy has on their variable operating costs, their high relative labor costs remain the focus of most cost-reduction efforts.[44]

The use of boilers in greenhouse operations contributes to their sizable consumption of natural gas over electricity. Figure 17 displays monthly natural gas consumption among PG&E's greenhouse customers. Gas usage peaks in the winter, when boilers are used more heavily. Electricity demand stays fairly constant throughout the year.

Figure 17. 2007 Monthly Gas Demand: Greenhouses



AFP Program participants in the greenhouse subsector most commonly receive incentives for heat curtains, which account for over 30 percent of the gas savings. Figure 18 displays gas savings associated with various measures. Thirty-seven percent of the gas savings resulted from one installation of an industrial high-pressure steam trap. While electrical end uses are less common, greenhouse participants have installed strip curtains, lighting, and chillers, as shown in Figure 19.

[43] Floriculture and Nursery Crops Yearbook. USDA. 2006.
[44] Trade ally interviews. 2008.

Figure 18. Measures Accounting for Gas Savings: Greenhouses

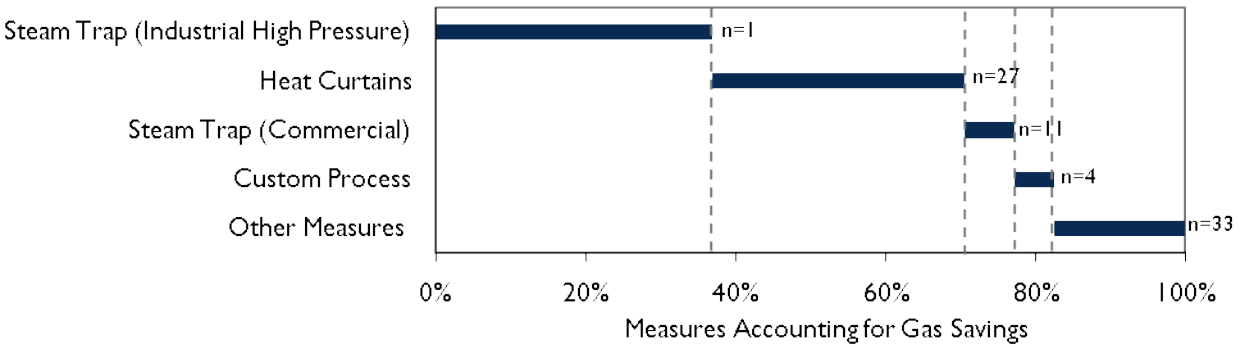
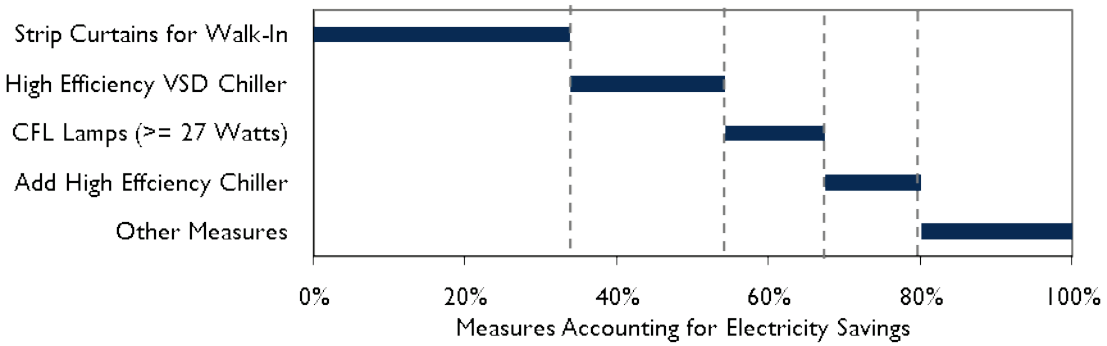


Figure 19. Measures Accounting for Electricity Savings: Greenhouses



Irrigation

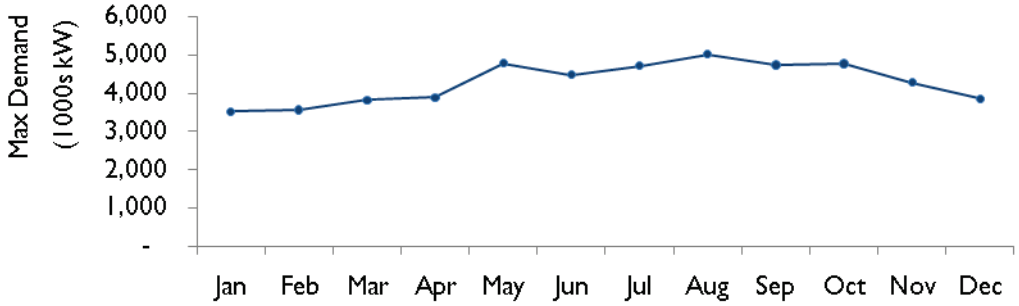
Irrigation is essential to agriculture in the Central Valley. While it is known that irrigation water is pumped from a combination of public and private wells and surface sources, aggregated irrigation pumping volumes are not known. The California Department of Water Resources maintains detailed statistics on public irrigation systems, but not on private wells. Well drilling in the San Joaquin Valley is at a frenetic pace to accommodate production demands and dry conditions.[45] The irrigation subsector, though, is less concerned with water prices than with energy prices. Irrigators are concerned with drought, but they generally have confidence in the water supply.[46]

Pumps continue to be run to failure, despite the wide availability of pump testing services, which are also promoted and offered as part of the AFP Program. Pump testing contractors, supported by the Fresno State Center for Irrigation Technology, are by all accounts improving pumping efficiencies, through proper pump sizing, energy-efficient motors, and pump upgrades.[47]

[45] Sacramento Bee. Water-shortage fears pump up well-drilling business in Central Valley. 2008.
[46] Trade ally interviews. 2008.
[47] Trade ally interviews. 2008.

Irrigation customers have the second highest monthly peak demand out of the targeted subsectors. Energy use among PG&E's irrigation subsector mirrors that of agriculture, as the two subsectors are closely linked. Figure 20 shows peak monthly demand for the irrigation subsector. Natural gas consumption is minimal.

Figure 20. 2007 Monthly Peak Non-Coincident Demand: Irrigation



The majority of the energy savings among irrigation participants come from pump retrofits and other pump-related measures.

Refrigerated Warehouses

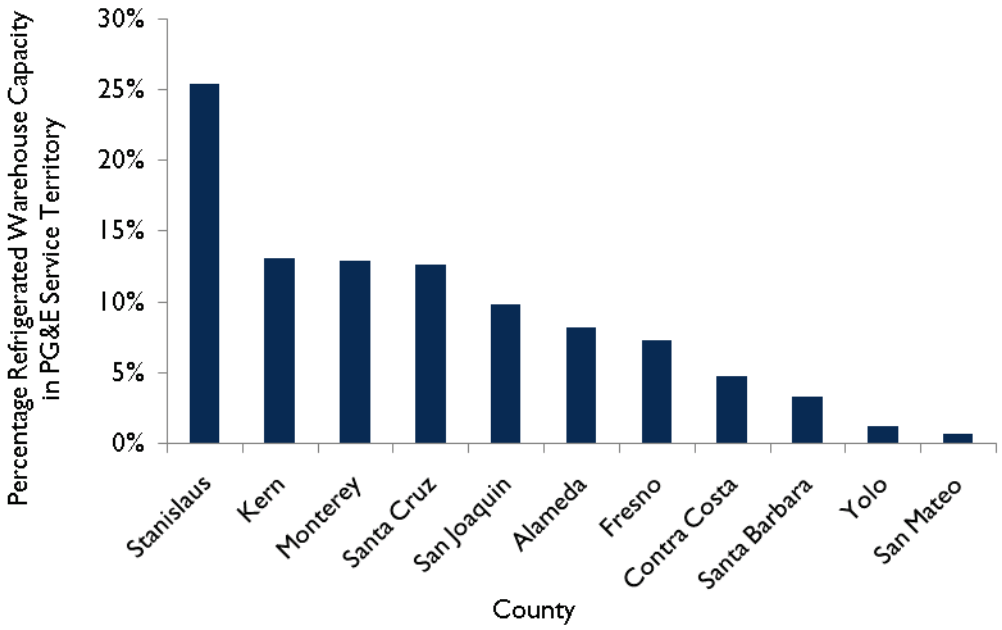
According to PG&E's 2006 Industrial Cooling and Refrigeration Baseline study, "…industrial refrigeration accounts for ten percent of the electricity required by motor systems and 26 percent of the electricity (just over 1,000 GWh) consumed in the state's food processing industry."[48] Nearly all of the energy used by refrigeration systems is electricity.[49] According to the USDA, in 2007 California led the nation in the number of refrigerated warehouses, with 105 public facilities and 96 private and semiprivate facilities. Together they account for 400 million cubic feet of gross refrigerated space. Florida, with the second largest capacity, maintains only 240 million cubic feet.

The International Association of Refrigerated Warehouses accounts for 275 million cubic feet of California capacity within its membership. According to their self-reported statistics, PG&E services approximately 75 million cubic feet of refrigerated warehouse capacity. This capacity can be further broken down by county to reveal the geographic distribution of refrigeration capacity, as shown in Figure 21.

[48] California Industrial Energy Efficiency Market Characterization Study. PG&E, Xenergy. 2001.

[49] Adams, Nathan and K. Pritz. "Delivering Energy and Energy Services to the Food Processing Sector." Financial Times Energy. December 2000. Boulder, Colorado.

Figure 21. County Percentage of Refrigeration Capacity in PG&E Service Territory



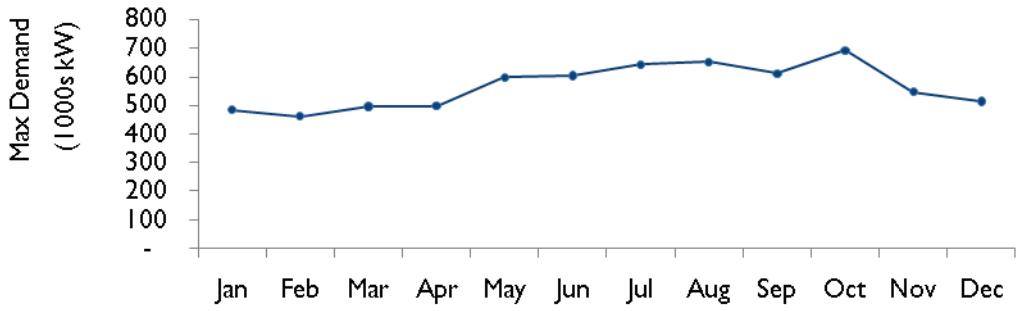
Refrigerated warehouse employment has grown from 123 establishments, employing 3,104 in 1992, to 201 entities, employing an estimated 7,000 in 2007.[50] The industry generates an estimated $5 billion in sales each year for food product storage.

Privately operated refrigerated warehouses are commonly collocated with food processors. Food processors may own the refrigeration equipment and third-party contractors service and maintain it. The contractors have influence over replacement equipment, but, like food processors, plant engineers are generally only concerned with returning the plant to regular production conditions after equipment failure events. Therefore, energy efficiency is not the primary concern.

Refrigerated warehouses rely on built-up ammonia refrigeration because of performance and cost advantages over refrigerants, such as R-22. Compressors, evaporator fans, and condenser fans are the primary consumers of electricity. Peak electricity demand among PG&E's refrigerated warehouse subsector follows the pattern of agriculture and food processing, with a slight rise during the summer and fall and drop during the winter.

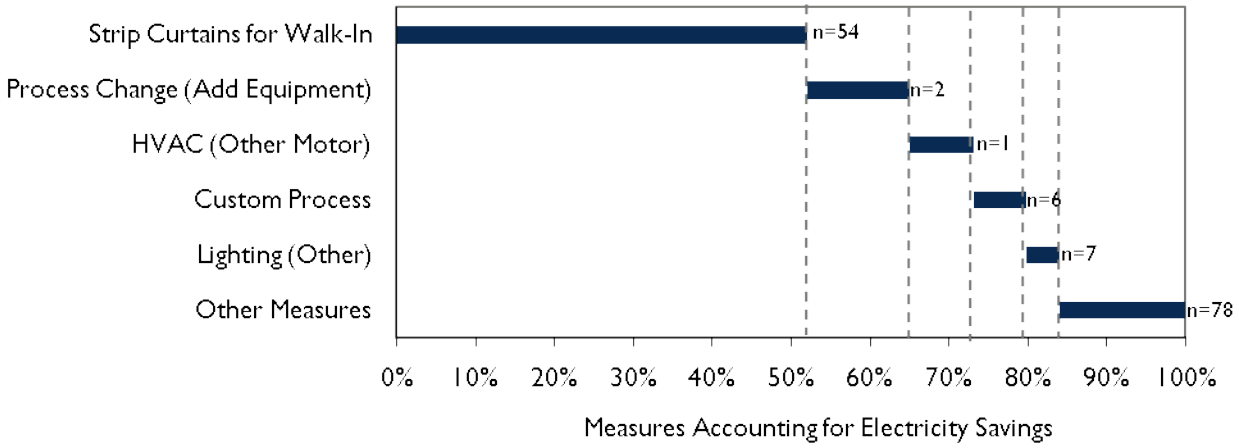
[50] U.S. Economic Census. 1992 & 2002. USDA 2007. Estimate based on national growth trends.

Figure 22. 2007 Monthly Peak Non-Coincident Demand: Refrigerated Warehouses



The most common measure installed in the refrigerated warehouse subsector is strip curtains for walk-in refrigerated areas; this measures account for over 50 percent of the electricity savings.

Figure 23. Measures Accounting for Electricity Savings: Refrigerated Warehouses



Wineries

California's Napa Valley is recognized worldwide for its premium wines. In 2007, the California wine industry generated $51.8 billion in economic value and provided 309,000 jobs in California. Exports rose by 28 percent from 2005 to an all-time high of $736 million in 2007. California's 2,687 wineries processed 527,000 tons of wine grapes,[51] while keeping prices stable, despite a smaller crop than the 2005 bumper crop.[52]

For this study, Cadmus made a distinction between wineries and food processing, and considered vineyard irrigation to be part of the Irrigation subsector. Despite the California wine industry's economic size, its energy consumption is relatively low. However, the industry has been very

[51] The Wine Institute and MKF Research LLC. 2008.

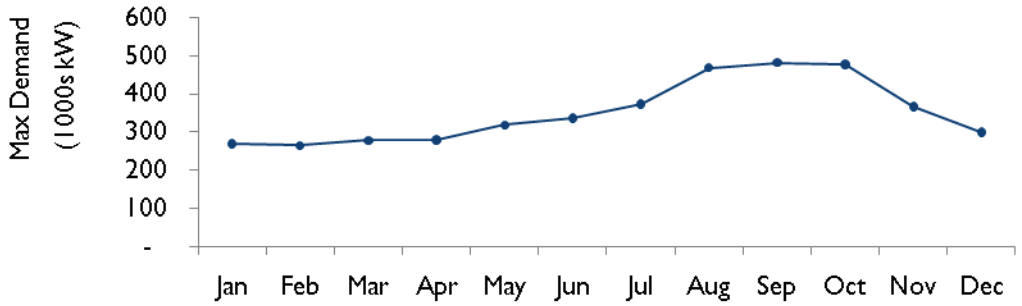
[52] California Department of Food and Agriculture. Agricultural Statistic Review. 2008.

outspoken about its efforts to promote sustainability. The industry appears to be more driven by sustainability, with a demonstrated ability to differentiate its products on environmental branding. It is the only subsector where the main industry association, The Wine Institute, runs a fully funded and staffed sustainability program that includes energy efficiency.

Wineries can be compared to food processors in their energy use patterns, although their load requirements are considerably less. During fermentation, industrial refrigeration is used for cooling, and pasteurization requires modest amounts of heating—a relatively small amount of energy compared to the wider food processing subsector.

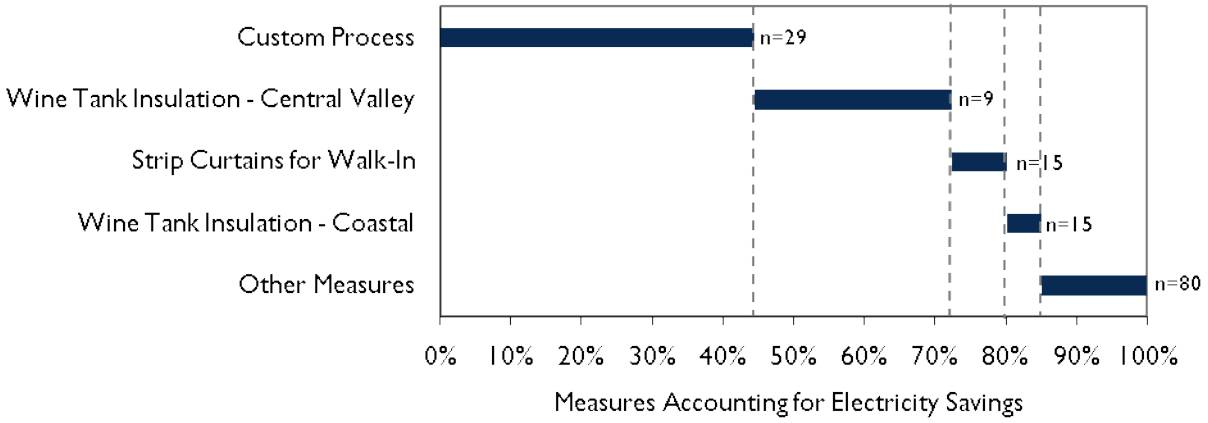
While their overall load is not as sizeable as other subsectors, wineries have a distinct load profile. Maximum electricity demand spikes during the harvest season in late summer/early fall and remains lower throughout the rest of the year, as shown in Figure 24.

Figure 24. 2007 Monthly Peak Non-Coincident Demand: Wineries



Custom Process measures, for which Cadmus was unable to get specific details, account for 45 percent of the electricity savings in the winery subsector. Wine tank insulation and strip curtains account for an additional 40 percent of electricity savings. The remaining participants, who account for the remaining 15 percent of electricity savings, implemented a variety of measures, ranging from lighting to refrigeration measures.

Figure 25. Measures Accounting for Electricity Savings: Wineries



Key Sector End-Use Technologies

The end-use technology markets intersect the subsectors by their process needs. For instance, field agriculture requires motors and pumps to irrigate crops in regions where rainfall is insufficient to sustain their growth. Food processing is so diverse that all equipment is utilized, whereas greenhouses have greatly simplified operations, which primarily require hot water boilers and fans for air circulation. Industrial refrigeration requirements include: motors, fans, pumps, and compressors for both built-up and packaged systems. Table 16 describes the end-use technologies used in each subsector.

Table 16. End-Use Technologies Used in the Subsectors

Subsector	Industrial Refrigeration	Fans & Blowers	Pumps	Motors	Boilers
Field Agricultural		√	√	√	
Dairies	√		√	√	
Food Processing	√	√	√	√	√
Greenhouses		√			√
Irrigation			√	√	
Refrigerated Warehouses	√	√		√	
Wineries		√	√	√	

The California energy-efficient technologies markets operating within the agricultural and food processing sectors are an outgrowth of traditional technologies markets. For example, the premium energy-efficient motor market operates much as the traditional motors market. Manufacturers, distributors, original equipment manufacturers (OEM), and contractors are diversifying their products and services to accommodate demand for energy-efficient equipment.

Vendors, distributors, and service contractors have the opportunity to promote energy-efficient equipment. Responses from the trade ally surveys indicate that vendors and distributors include energy-efficient options in nearly all proposals, and they report energy-efficient equipment accounts for approximately 36 percent of sales revenue. Vendors and distributors are aware of the cost benefits of premium-efficient technologies. They push the technologies in direct sales opportunities, but customers seldom contact vendors and distributors with energy-efficient equipment in mind.

To better understand market processes and structure, the Cadmus team developed schematic representations of each end-use technology market (Figure 27 to Figure 32). The information presented in this report is specific to the end-use markets serving the seven subsectors targeted in PG&E's AFP Program. Therefore, the market diagrams do not capture the markets in their entirety—only the portion that pertains to the AFP Program's target audience. The companies named in the figures are examples of market actors, and, while we made every effort to identify the key market actors, the companies listed do not necessarily represent the entire market.

The market diagrams feature four market tiers—manufacturers, distributors, contractors, and subsectors—with key examples in each tier. Additional market information on the total market size in sales revenue and energy use, the number of market actors, and the direction and

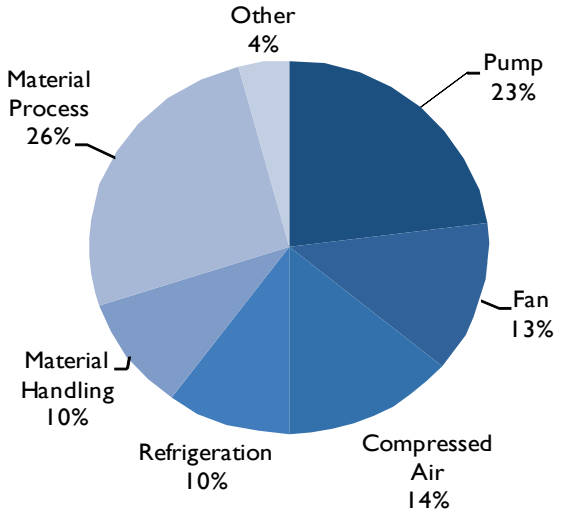
approximate volume of the services and materials transferred in the market, is also presented in each diagram.[53] Refer to the key in each figure for arrow and symbol explanations.

Electric Motors

General Market Overview

Electric motors are fundamental to every end-use technology and sector targeted in this study. As shown in Figure 26, their ubiquity means the motor market is difficult to characterize distinctly from the other end-use technologies. Motors typically drive pumps, fans, or conveyors, and are rarely sold separately except as motor replacements. In pump-motor systems, motor energy consumption is relatively small; pumps generally account for 80 percent of energy losses, whereas the motor drives typically lose no more than 20 percent. As such, investing in more efficient pumps generally has greater efficiency returns per dollar. When motors are viewed in aggregate though, their impact on energy demand is noticeable; nationally, machine drives consume 457,344 million kWh.[54]

Figure 26. Motor Electricity Consumption by Application



Source: MECS, Utility Billing Data, and DOE U.S. Industrial Motor Systems Market Opportunities Assessment Study (Xenergy, December 1999)[55]

Since the Energy Policy Act (EPAct) of 1992 and subsequent National Electrical Manufacturers Association standards, distributors and vendors of these value-added products consider *all*

[53] Data collected from trade-ally interviews and www.hoovers.com.
[54] MECS. 1998.
[55] California Industrial Energy Efficiency Market Characterization Study – Final Report, PG&E. Xenergy. 2001.

motors sold as "efficient." The semantic distinction is drawn through the use of "premium efficient" motors that have a higher efficiency than EPAct standards.

As shown in Figure 27, motor manufacturing is generally dominated by large international companies that can leverage economies of scale (e.g., Toshiba, GE, and Baldor, who recently purchased the high-end Reliant motors). Smaller regional companies compete in niche applications. Motors are sold to various groups in the supply chain, including OEMs, distributors, and end-users. In addition, manufacturers sell their electric motors into many other markets outside of California's agricultural and food processing sectors.

Distribution is composed of OEMs, traditional distributors, and full service distributor/contractors. Distributors are predominately based in California. OEM direct sales are restricted to food processors, whereas irrigation and dairies receive their motor/pumping systems through traditional distribution.

Contractors are primarily comprised of motor service centers that rewind and repair motors,[56] and sell new equipment. End-users replace burnt-out motors, take larger and unique motors to a service center for repair, or outsource the management of their motors. More than half of repairs require major work, such as rewinding. Despite incorrect perceptions that rewinding reduces motor efficiency, rewinding remains essential to the California motor market. In fact, precision rewinding can achieve greater efficiencies than when the motor was originally manufactured. For motors under 55 horsepower, rewinding can significantly advance the total lifecycle energy performance but it generally is not cost effective.[57, 58]

Typical Motor Applications

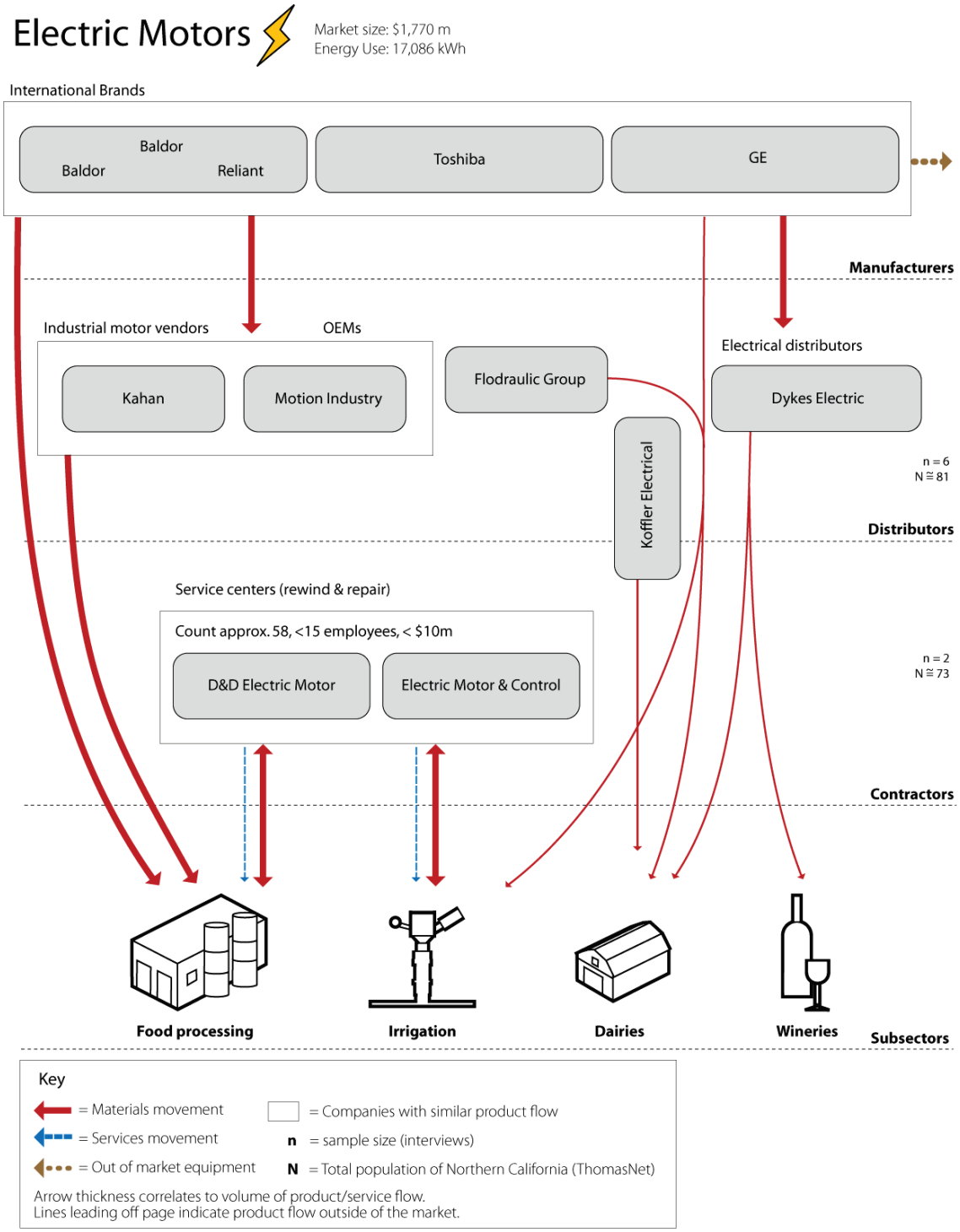
OEMs integrate motors into various end products, such as fans, blowers, irrigation pumping systems, compressors for industrial refrigeration, and conveyors for food processing. Direct sales are less common.

[56] Motor rewinding includes the replacement of electrical wire wound around the stator. The most common cause is heat damage to the wire insulation, resulting in short circuiting and a diminished electro-magnetic field.

[57] As reported in an informal interview with a motor service center representative.

[58] Green Motors Practice Group. Quality Motor Rewinding an Energy Efficiency Measure. July 2007. http://www.greenmotors.org/downloads/RTFSubmittalMay_08%20_2_.pdf

Figure 27. The Electric Motor End-Use Market.



Natural Gas Boilers

General Market Overview

The natural gas boilers market is mature and heavily consolidated, with only a handful of national manufacturers, the majority of which are located in the Midwestern United States. Service providers "tune" aging boilers and replace system components. Within the scope of this study, greenhouses and food processors utilize boilers the most.

Over the past 20 years, energy prices and regulations have pushed boiler efficiency up by as much as 20 percent. Energy efficiency, emissions mitigation, and installation services are the primary points of differentiation for boiler distributors. However, this study has discovered that corporate budgeting staff are the critical decision makers for energy-efficient equipment rather than engineering staff. As one specialty distributor/engineer said, "Plant engineers are just looking for a design solution. Energy efficiency is too often an afterthought." However, in plants where energy is the single greatest operational expense, efficiency is central to design. Service contractors indicate that, as an added benefit to energy-efficient design, product quality also increases.

As shown in Figure 28, manufacturing is highly consolidated. Central Boiler & Industrial Service is a vertically integrated California-based company, while other major manufacturers are located in the Midwest. Circulation pumps incorporated into boiler systems are supplied by the pump market.

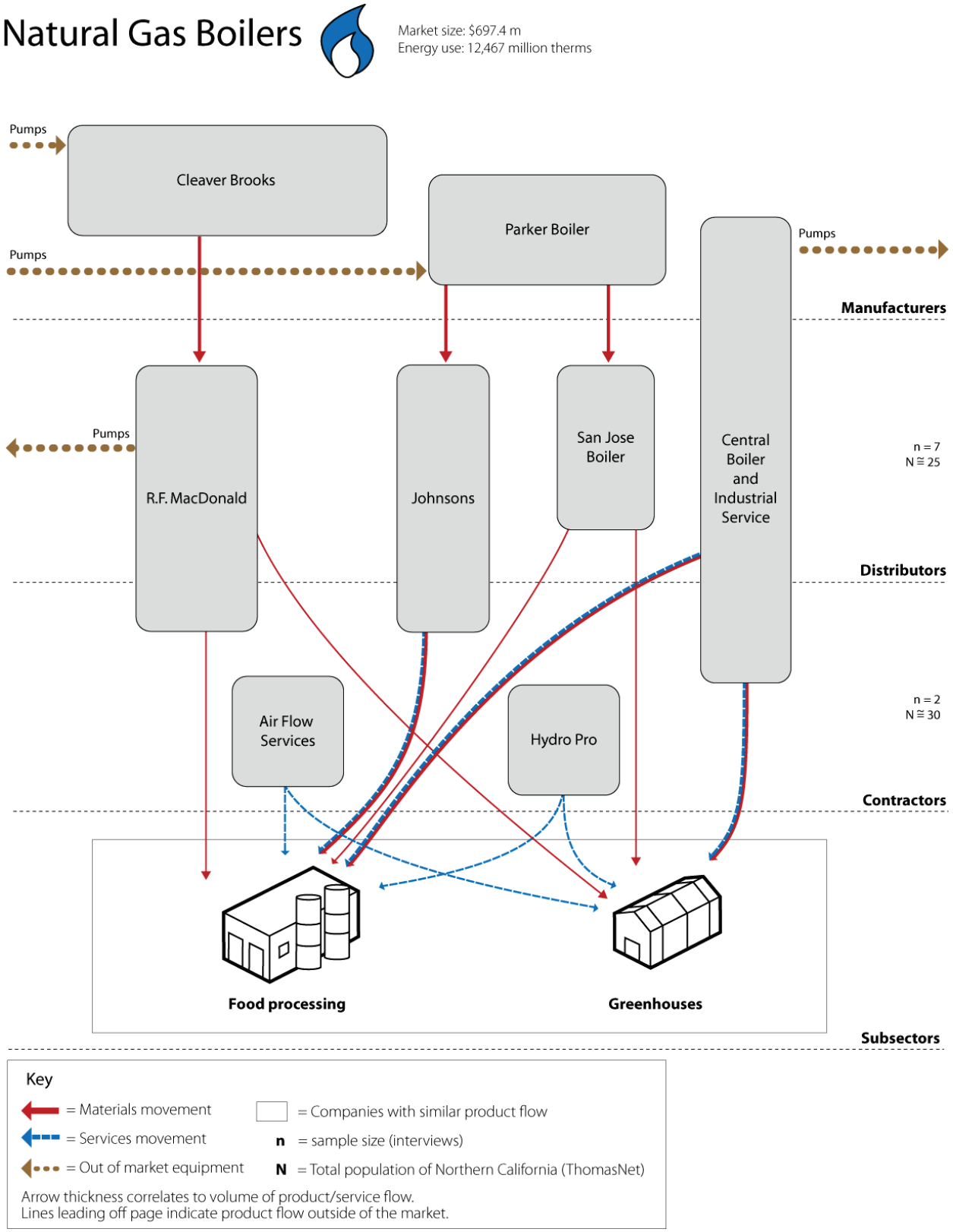
Distributors are commonly national companies, but some smaller distributors serve California markets exclusively. Direct sales to end-use customers are uncommon. Contractors provide installation and tune-up services as well as assistance with custom engineered systems, if necessary.

Typical Applications

Greenhouses typically utilize hot water boilers for their heating needs. Once the load characteristics are determined, off-the-shelf hot water boilers are purchased. These systems are engineered by manufacturers and require little or no third-party engineering. However, optimization of premium efficient boilers requires the installation of control systems and operational procedures (often automated), which require additional technical resources.

On the other hand, food processors are more inclined to use process steam in their operations, which requires more sophisticated boilers that provide high-pressure steam. The larger food processors have plant engineering staff that can work directly with the manufacturers or specialty distributor/engineering companies to design customized systems.

Figure 28. The Natural Gas End-Use Market.



Irrigation Pumps

General Market Overview

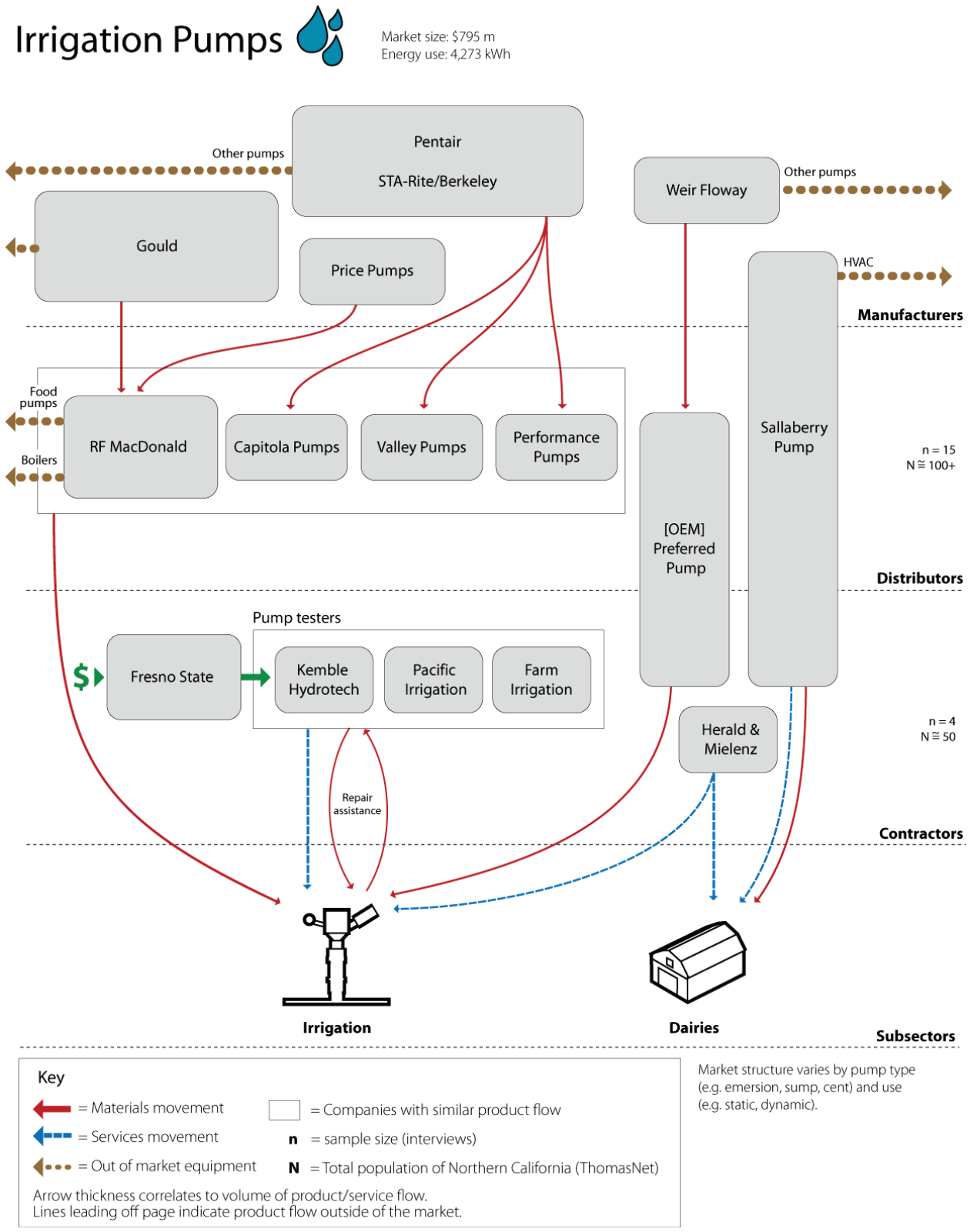
Irrigation pump manufacturing is dominated by diversified multi-national companies, such as Goulds and Pentair. The distributors, however, are a mixture of small niche players and large horizontally integrated companies. For instance, RF MacDonald distributes pumps in a variety of specifications for irrigators and boiler systems nationally, while Valley Pump distributes principally to Alameda and San Joaquin counties. Other distributors have integrated vertically to encompass the engineering and construction markets.

PG&E's partnership with Fresno State University through the Center for Irrigation Technology (CIT) has created a cottage industry of pump and well testers that, by all accounts, has been instrumental in transforming this subsector. While these approximately 30 pump testing businesses act as roving energy champions, their benefit is threatened by increasing costs to work in the field, with both administrative and transportation costs steadily rising.

Typical Applications

As its name indicates, irrigation pumps are used almost exclusively to irrigate field crops. However, dairies also have a need for irrigation pumps to water cows and handle waste. Manufacturers of irrigation pumps serve other markets, such as municipal water, food processing, and petrochemicals.

Figure 29. The Irrigation Pump End-Use Market



Food Processing Pumps

General Market Overview

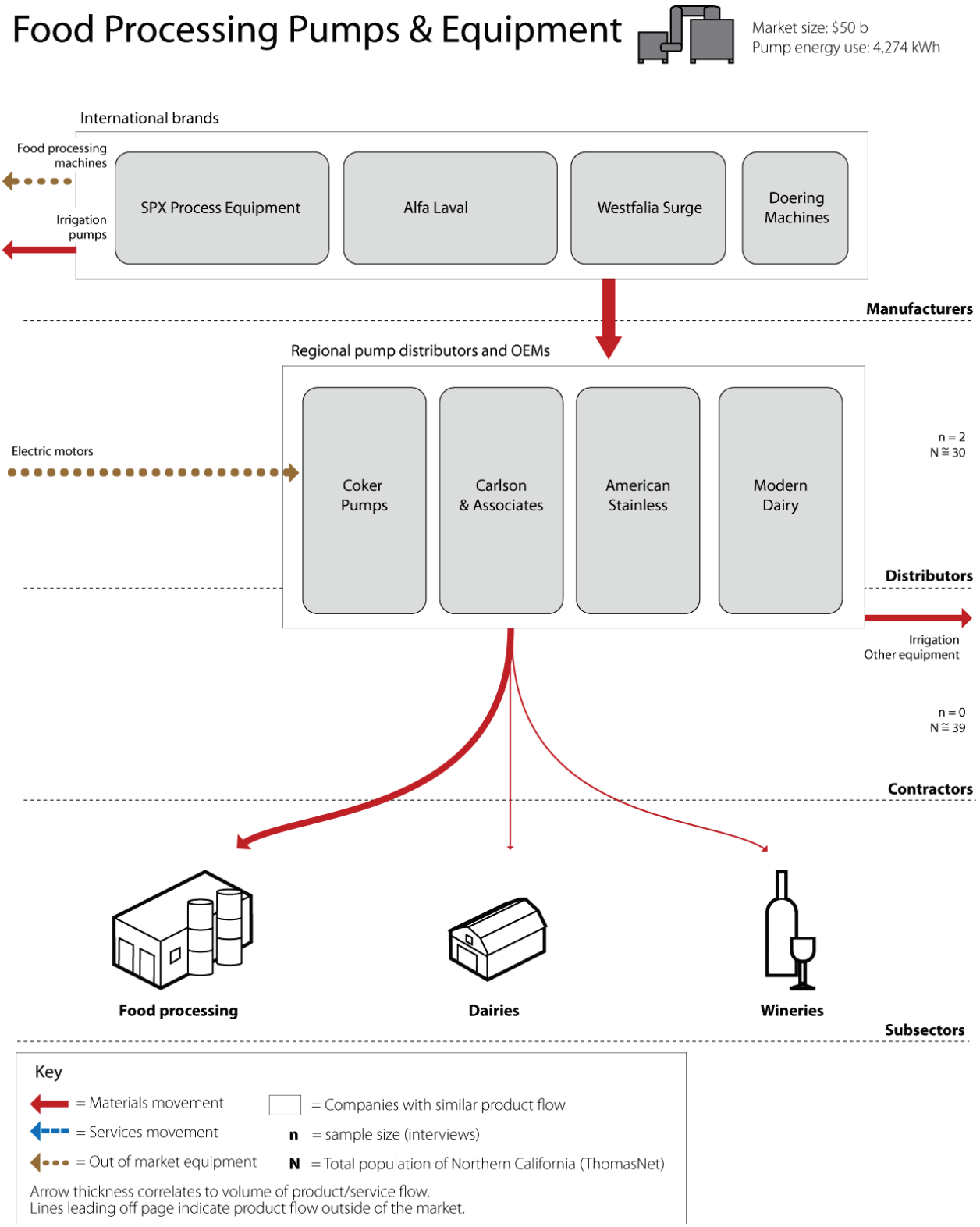
Food processing pump manufacturing and design is dominated by large diversified international companies. They sell their pumps to OEMs for integration into customized food processing systems whose design is dependent upon the commodity being processed. Distributors are regional and often involved in installation and maintenance. Very few if any service contractors were identified in this study. Rather, OEM distributors offered many of the maintenance and upgrade services. In some cases, in-house maintenance and machining departments fabricate and install replacement parts where parts are not manufactured or readily available.

Typical Applications

Food processing pumps are a distinct market from irrigation pumps. While irrigation pumps move water, food processing pumps handle a surprising range of viscous liquids and semi-solid fluids. Often these pumps are integrated into highly customized systems with proprietary designs. For example, a pump designed to move cottage cheese is unlikely to have any other application.

In the case of dairies, milk product pumps are more consistent and therefore subject to greater standardization, much like the irrigation industry. Dairies use pumps in the milking, chilling, separating, pasteurization, and transport processes.

Figure 30. The Food Processing Pump End-Use Market



Industrial Refrigeration

General Market Overview

Industrial refrigeration only consists of built-up ammonia systems. Equipment manufacturing is dominated by national companies with California companies playing a more limited role. Direct selling is uncommon. Industrial refrigeration systems are highly customized by distributors for specific applications in the food processing, dairy, and winery industries.

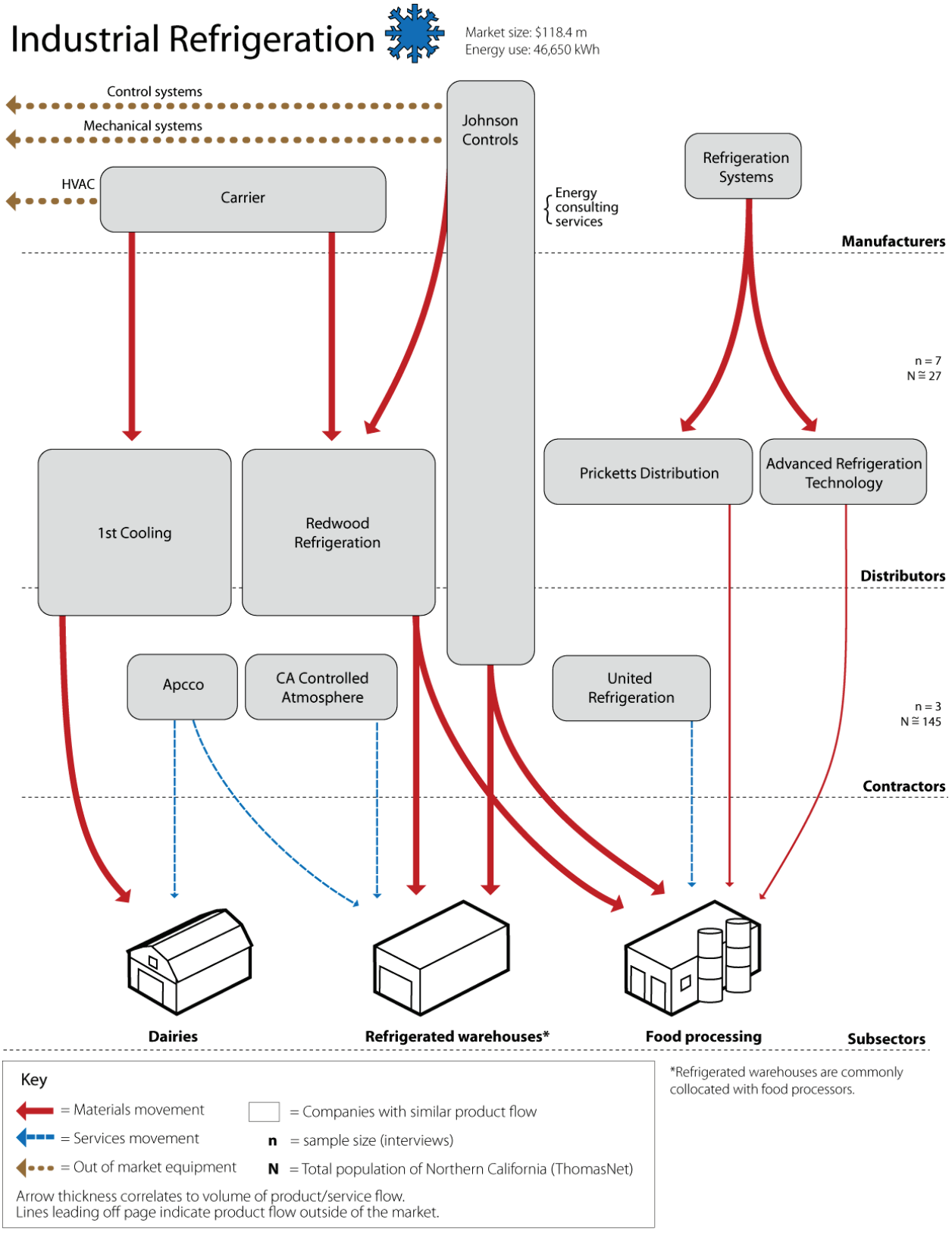
Distributors are regionally based and sometimes provide maintenance services. They also serve other industries that require industrial refrigeration, such as the pharmaceutical and restaurant markets. Refrigeration contractors are both local and regional, and they provide maintenance, repair, installation, and design services where distributors do not. Contractors typically are more specific by subsector market than the distributors. Regional servicing contractors usually specialize in ammonia systems used in the food processing industry.

Industrial refrigeration is essential to the processing and storage of many agricultural commodities. Thus, the vast majority of industrial refrigeration capacity is sold into food processing and refrigerated warehousing. These facilities are often collocated and operated independently. The dairy industry also utilizes industrial refrigeration to cool and preserve milk prior to processing.

Typical Applications

Built-up ammonia systems are used in circumstances where large temperature differentials must be overcome and/or large volumes of air or liquid must be cooled quickly. A typical application may be the flash freezing of vegetables following blanching. Built-up ammonia systems are also employed in refrigerated warehouses, where large volumes are held at freezing temperatures. These facilities often hold inventory prior to shipping.

Figure 31. The Industrial Refrigeration End-Use Market



Fans and Blowers

General Market Overview

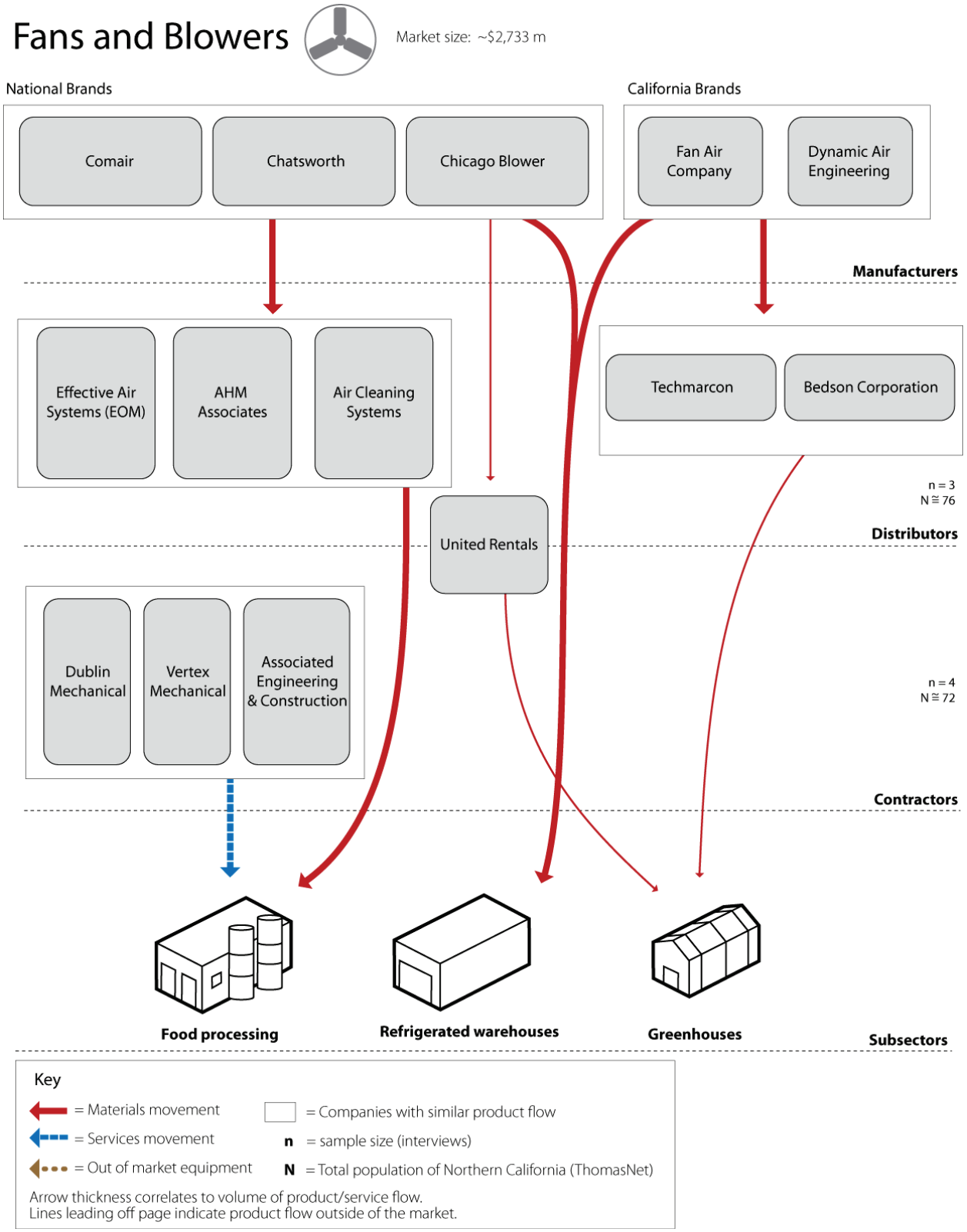
Fan and blower manufacturing, as part of industrial HVAC and drying systems, is usually performed by consolidated national companies. Manufacturers and distributors are typically diversified, either into electronics cooling systems or into HVAC equipment such as dampers and air conditioning. Smaller, regionally located companies sell less complex systems (e.g., specialized overhead fans). There is much greater fragmentation downstream in the distributors and contractors, and sales are becoming increasingly direct. Niche systems, such as oversized overhead fans, rely on direct sales. Most fans and blowers are purchased by OEMs and integrated in other products.

Contractors are locally based and closely allied with motor service centers. Contractors conduct installation and fabricate sheet metal ducts. Engineering services are uncommon for the agricultural and food processing sectors.

Typical Applications

Fans and blowers are used in a variety of ventilation, cooling, and drying applications. Food processors, greenhouses, and refrigerated warehouses are the largest users of fans and blowers. Food processors may use fans to dry commodities following washing. Greenhouses use fans for ventilation, and refrigerated warehouses employ fans as part of built-up ammonia systems.

Figure 32. The Fans & Blowers End-Use Market



Emerging Technologies

When trade allies were asked to identify any emerging energy-efficient technologies, no truly novel technologies were identified. Rather, existing technologies were singled out as having undergone incremental improvements. One such example is the variable frequency drive (VFD). VFDs are becoming increasingly sophisticated and tolerant of extreme environments. Efficient motor rewinding is another example of an improved existing technology, and the motor rewinding market is vibrant and growing. For instance, the Bonneville Power Administration has contracted with the Green Motor's Practices Group to implement the Green Motor Initiative, offering incentives for rewinding motors to their original efficiency values. Motors rewound to their original nominal efficiency values are known as "Green Rewinds."[59] While the majority of members are located in the Pacific Northwest, at least four motor rewind shops in California have joined the Initiative.

Market Barriers

In their scoping study of energy-efficiency market transformation programs, Eto, Prahl, and Schlegel defined market barriers as: "…any characteristic of the market for an energy-related product, service, or practice that helps explain the gap between the actual level of investment in or practice of energy efficiency and an increased level that would appear to be cost beneficial."[60] To assist PG&E in better understanding and addressing key market barriers facing the agricultural and food processing sectors, Cadmus collected data from program participants, nonparticipants, withdrawn participants, program staff, and trade allies to identify pertinent barriers.

In total, Cadmus identified 17 market barriers (Table 17), three of which were consistent across respondent types: the cost of equipment, the expected length of payback or expected energy savings from the energy-efficient equipment, and the program application process. These findings were further validated by the key reasons for participation, which included payback on investment, saving money, the PG&E rebate, and reducing energy use.

Several new market barriers, not previously identified by HMG,[61] appear to have emerged since the development of the first program theory. The following barriers were not identified by HMG:

- Program application process (length of the process, delays, poor communication and estimated savings).
- Program requires too much staff time.
- Lack of time; seasonality of operations.

[59] http://www.greenmotors.org/

[60] Eto, Joseph, Ralph Prahl, and Jeff Schlegel. *A Scoping Study on Energy Efficiency Market Transformation by California Utility DSM Programs.* Berkeley, CA: Lawrence Berkeley National Laboratory, prepared for the California Demand-Side Measurement Advisory Committee. July 1996.

[61] Heschong Mahone Group. 2006. *Draft Agricultural and Food Processing Segment Full Program Theory and Logic Model*. Prepared for Pacific Gas & Electric Company.

- Organizational structure - no single party in charge of making decision on energy efficiency.
- Fear of callbacks for service and repairs.
- Making energy-efficient activities marketable to justify costs.
- Inefficient, used equipment sells at a significant discount.

Some of these barriers are related to program implementation (i.e., program application process), while others are related to information costs and lack of time, organizational practices that impede decisions to adopt energy-efficient technologies (i.e., there is no single person in charge of making decisions related to energy efficiency), and potential hidden costs of servicing and repairing energy-efficient technologies.

Table 17. Barriers Identified by Market Actors

Market Barrier	Market Actor					
	Non participants	Participants	Withdrawn Participants	Trade Allies	Program staff	Program Theory
Cost of equipment	√		√	√		√
Length of payback; insufficient energy savings	√		√	√		√
Program application process: lengthy process, delays, poor communication, inconsistent savings estimation	√	√	√	√	√	
Lack of awareness of PG&E programs	√			√		√
Program requires too much staff time	√	√				
Lack of time; seasonality of operations	√			√	√	
Lack of awareness of energy-efficient technologies	√			√		√
Perceive operation as energy efficient	√		√			√
Other priorities demand resources	√			√		√
Approval from ownership or financial decision makers is difficult to obtain	√				√	√
Organizational structure - no single party in charge of making decision on energy efficiency				√		
Fear of callbacks for service and repairs				√		
Consumer lack of knowledge and technical skill to maintain complex energy-efficient equipment				√		√
Few firms are able to maintain facility-level energy managers				√		√
Need for technology demonstrations				√		√
Making energy-efficient activities marketable to justify costs				√		
Inefficient, used equipment sells at a significant discount				√		

For a more clear presentation of the identified barriers, Cadmus grouped the barriers into six categories put forth by Eto, Prahl, and Schlegel:

- Organizational practices: Organizational behavior or systems of practice that discourage or hamper cost-effective energy-efficiency investments and decisions.
- Information costs: Costs associated with the time required to identify and learn about energy-efficient products or services.
- Hassle or transaction costs: Indirect costs associated with acquiring energy-efficient technologies and practices, including time, materials, and labor needed to acquire and install equipment or learn new practices.
- Product unavailability: The inadequacy of the supply of energy-efficient equipment and expertise.
- Performance uncertainties: The challenges customers face in evaluating claims of future savings and benefits derived from energy-efficient equipment and practices.
- Hidden costs: Unexpected costs associated with the installation and operation of energy-efficient equipment.

Table 18 presents a map of how each market barrier identified by survey respondents in this study maps to the six market barrier categories. Barriers are discussed in further details after the table.

Table 18. Market Barriers Identified in the Process Evaluation

Market Barriers, Process Evaluation	Organizational practices	Information costs	Hassle or transaction costs	Product unavailability	Performance uncertainties	Hidden costs
Cost of equipment	√					
Length of payback; insufficient energy savings	√					
Program application process: lengthy process, delays, poor communication, inconsistent savings estimation			√			
Lack of awareness of PG&E programs		√				
Program requires too much staff time			√			
Lack of time; seasonality of operations			√	√		
Lack of awareness of energy-efficient technologies		√			√	
Perceive operation as energy efficient	√	√				
Other priorities demand resources	√					
Approval from ownership or financial decision makers is difficult to obtain	√					
Organizational structure - no single party in charge of making decision on energy efficiency	√					
Fear of callbacks for service and repairs						√
Consumer lack of knowledge and technical skill to maintain complex energy-efficient equipment					√	
Few firms are able to maintain facility-level energy managers	√	√				
Need for technology demonstrations		√			√	
Making energy-efficient activities marketable to justify costs	√					

Organizational Practices

Organizational practices generally encompass organizational behavior or systems of practice that impede cost-effective energy efficiency investments and decisions. This barrier occurs, for example, when only the first costs of the equipment are considered and long-term paybacks or return on investments are ignored or undervalued; thus, future savings from efficiency gains do not appear to offset first costs. The same barrier manifests itself in customers' decisions to prioritize other needs over efficiency gains or to misjudge the efficiency of their operations. Organizational practices can also hamper efficiency investments when decision making is fractured among multiple parties within the organization and when those responsible for managing energy-related functions do not have the power to make decisions about energy-efficient equipment investments. Further impediments to investments in energy efficiency include the inability of some customers to maintain energy managers, and some customers' beliefs that they need to be able to justify investment in energy efficiency not in terms of savings but in terms of being able to market efficiency to their customers.

Cost of Equipment and Payback Barriers

Cost of equipment and the expected length of payback (from energy savings) remain two critical, interrelated barriers to the adoption of energy-efficient technologies in the agricultural and food processing sectors. When asked to rate the importance of a variety of factors in their decisions to not participate in the program, nonparticipants who were aware of the program rated cost of equipment and estimated energy savings as the most important reasons for not participating; 39 percent rated cost as seven or higher on an 11-point scale where ten was extremely important, and 45 percent rated estimated energy savings as seven or higher (Table 19). In contrast, getting approval from ownership or management was rated by 38 percent of respondents as a one or a zero on the same 11-point scale, where zero was not at all important.

Table 19. Factors in Decision to not Participate in the Program, Nonparticipants Aware of the Program, (n = 84)

Factor in Decision to NOT participate	Not at All Important (0 to 1)	Not Important (2 to 3)	Neutral (4 to 6)	Important (7 to 8)	Extremely Important (9 to 10)	Don't Know/ Refused
The final cost of the equipment, including the program rebate	13%	6%	19%	20%	19%	23%
Length of time it takes to get program approval	18%	5%	23%	14%	15%	25%
The estimated energy savings from the program approved equipment	11%	5%	19%	24%	21%	20%
Getting approval from ownership or management to participate in the program	38%	4%	11%	14%	20%	13%
Staff time and resources required to participate in the program	21%	11%	25%	19%	12%	12%

Cost and energy savings were critical factors in the decision to withdraw from the program for three of five withdrawn participants. One withdrawn participant described his reason as follows:

I would spend a lot of money for a new unit, but the payback wasn't very good. So we canceled the program. The rebate did not warrant buying the more expensive equipment.... We ended up buying an air compressor from a company that we work with. They sold us one because they upgraded. We basically bought one for really cheap, instead of buying a new bells and whistles kind of thing.

When asked to identify the major barriers to increasing the market share of energy-efficient equipment,[62] trade allies[63] most commonly identified payback requirements (11 respondents) and higher first costs as major barriers (eight respondents), Table 20.

Table 20. Major Barriers to Increasing the Market Share of Energy-Efficient Equipment, Trade Allies (n = 41)

Barrier	Number of Trade Allies
Payback requirements	11
Higher first cost for energy-efficient equipment	8
Lack of consumer/contractor awareness[64]	5
More complex systems need more service; reliability	4
At the limits of efficiency (pumps)	3
End consumer lacks technical skill to maintain the energy-efficient equipment	3
Lack of staff/resources	2
Manufacturers	2
Program paperwork	2
Customer lack confidence in technology due to past experience	1
Capital not available	1
Competing priorities	1
Time: immediate need and equipment not available	1

Organizational Structure and Decision-Making Barriers

Getting approval from ownership is a less common barrier as 35 percent of nonparticipants aware of the program rated it as a seven or higher on an 11-point scale (where ten is extremely important) and 42 percent rated it as three or less (where zero was not at all important) (Table 19). In addition, some trade allies reported that it can be difficult to identify the party in charge of making decisions pertaining to energy efficiency.

Few Firms Have Facility Level Energy Managers

Several trade allies reported that end-use consumers often lack the technical skill to maintain energy-efficient equipment, creating a barrier to the adoption of energy-efficient technology. Further evidence of this barrier is that only 25 percent of nonparticipants report having an energy manager, and 31 percent report not having adequate technical resources to manage energy needs.

[62] Trade allies were asked to list barriers to increasing the market share of energy efficient equipment.

[63] Trade allies are defined as industry associations, service contractors, and vendors/distributors.

[64] Two trade allies added that there is a need for technology demonstrations to improve awareness of energy-efficient technologies (and overcome lack of awareness)

Other Organizational Practices Barriers

Trade allies identified several other market barriers related to organizational practices, including: other priorities that demand resources (and thus prevent investment in energy-efficient technologies); the need for wineries to make energy-efficient activities marketable to justify the costs; and the impact of inefficient, used equipment on the market as it sells at a significant discount and discourages investment in energy-efficient equipment.[65]

Information Costs

Information costs are associated with the time required to identify and learn about energy-efficient products or services. While such costs may be real, the perception that they are not worthwhile is due to a lack of knowledge regarding the value of energy-efficient technologies, practices, and support programs as well as misperceptions of current efficiency levels in customers' operations. Lack of awareness can be linked to insufficient efforts to educate customers about energy efficiency through means such as technology demonstrations.

Lack of Awareness; Perception of Operation as Energy Efficient

Nearly half (46 percent) of nonparticipants who were not aware of PG&E's program said they did not need energy-efficient equipment because they were already energy efficient, although it was unclear whether their facilities really were efficient or whether they were unaware of energy-efficient technologies. In addition, ten percent of nonparticipants aware of the program had not participated because they believed their operations were already efficient.

When asked to identify major barriers to increasing the market share of energy-efficient equipment, trade allies identified lack of consumer awareness (of energy-efficient technologies) as a barrier, while several vendors of pumps commented that pumps have reached their limits of efficiency (Table 20).

Technology Demonstrations

Trade allies identified a need for technology demonstrations to improve awareness of energy-efficient technologies as a barrier to the adoption of energy-efficient technologies (Table 20).

Hassle or Transaction Costs

These are indirect costs associated with acquiring energy-efficient technologies and practices, including time, materials, and labor needed to acquire and install equipment or learn new practices. Customers' general lack of time to learn about and acquire energy-efficient technologies as well as limited times during the year during which equipment can be installed exemplify this barrier. Time constraints are amplified by lengthy and complex program application processes that can include delays and requires staff time.

[65] At least one withdrawn participant withdrew from the program because he was able to find very inexpensive used equipment

Program Related Barriers: Program Application Process, Program Awareness, Staff Time

The program application process and program awareness were identified as key barriers to the adoption of energy-efficient equipment by nearly all groups interviewed. For example, only 19 percent of nonparticipants were aware of PG&E's program, while only 24 percent of those nonparticipants had spoken to their account representative about the program over the past two years. The application process as a barrier to participation was rated as seven or higher on an 11-point scale, where ten was extremely important, by 30 percent of the nonparticipants who were aware of the program, while program staff time and resources required to participate in the program were rated as seven or higher by 31 percent of nonparticipants aware of the program (Table 19).

One former participant withdrew from the program because the process took too long and PG&E staff did not follow up on his application in a timely manner:

> *I tried to [apply to the program] but nobody came out. But I had to have the pump installed for irrigation for the vineyard. I had to proceed, but PG&E was taking three months.... Once I made the commitment to buy the VSD [variable speed drive], I had to have it installed and PG&E was dragging their feet because they were too busy. I needed to have it installed because the pump irrigates the vineyard and the vineyard needed the water. I couldn't wait. [Respondent self-installed the VSD without the rebate.]*

Similarly, program staff identified the length and complexity of the application process as a barrier, particularly for the Nonresidential Retrofit (NRR) program. One staff interviewee noted that the amount of documentation required for the program often outweighs the value of the rebates to the customer, while another described the NRR application process as follows:

> *NRR has too many black holes, where things go in to disappear or die.*

Delays in the application and review process are often attributed to poor communication and coordination as well as an inefficient process of alerting applicants when they have submitted applications with incomplete or incorrect information.

When asked to identify major barriers to increasing the market share of energy-efficient equipment, two trade allies identified program paperwork and lack of staff and resources as barriers (Table 20). In addition, nine other trade allies identified the program application process as a barrier when responding to other questions in the interview, such as when they were asked to identify program weaknesses or suggest program changes. One vendor commented that he refused to work with the program because the application process added more work. Nearly half (ten of 21) of all vendors did not work with the program, while three of 11 contractors and two of nine trade association representatives were not aware of the program. In addition, when asked to identify ways in which the program could be improved or changed, trade allies responses included:

- Simplify the application process; reduce the paperwork
- Speed up the application process

- Increase program awareness
- Clarify how to calculate rebate levels
- Increase rebate values

It should be noted, however, that nine trade allies reported that they work with the program because the program helps them to increase sales and differentiate their business from their competitors. One vendor described the application process as “effortless.”

5 Findings

Overview

Key findings from the data collection activities—namely the participant, nonparticipant, withdrawn participant, and staff surveys—are highlighted in this chapter. Findings report on the following topic areas:

- General market findings
- Codes and standards changes
- Marketing and outreach
- Participation and enrollment
- Communication and Coordination
- Program offerings
- Participant satisfaction
- Market effects

For third-party program participants, data were limited; hence we were unable to obtain feedback on their participation in the AFP Program. Complete summaries of the participant and nonparticipant survey data are located in Appendix H and Appendix I, respectively.

General Market Findings

The majority of interviewed participants and nonparticipants reported energy efficiency is an important part of their firms' operations and management. When asked to rate how important energy efficiency is to the operation and management of their company**,** 93 percent of the participant and 72 percent of nonparticipant respondents selected a ranking of seven or higher on an 11-point scale where ten meant "extremely important." In addition to their concerns about energy efficiency, respondents identified controlling costs and ensuring safety as other primary operations and management concerns within their firms.

Participant firms are more likely to have someone that manages daily energy issues than nonparticipants. When asked if their firms had someone who manages day-to-day energy issues, nearly 40 percent of participants reported having an energy champion, compared to only 20 percent of nonparticipant respondents. The majority of respondents reported their firm's energy champion has either a college or graduate-level degree, with half specifying the degree is in engineering. Analysis of participant data by subsector revealed that food processor (14 of 25) and winery (six of 11) participants were generally more likely to have a designated energy manager than participants in the agricultural subsector (seven of 31). During the staff interviews, Program staff noted the application process and project implementation tends to proceed much

smoother when the participant firm has someone focused and engaged in overseeing the application and measure installation.

Nearly one-third of respondents reported their firm lacks the necessary technical resources to manage energy costs. When asked if they had sufficient technical resources to actively manage and address energy costs, 34 percent of participants and 28 percent of nonparticipants said they lack such resources. When asked to identify where they look for information on energy efficiency, nonparticipants most frequently cited the Internet (28 percent) or PG&E (25 percent).

Codes and Standards Changes

PG&E's AFP Program target market will likely be affected by California Title 24 Building Standard changes, but not by California Title 20 Appliance Standards. Based on our review of available data, potential changes in California Title 24 Building Standards are primarily most likely to impact refrigerated warehouses. Specifically, the building codes are expected to change for the following applications: insulation levels, evaporator fan controls, condenser fan controls, compressor plant controls, and interior light levels. The proposed changes have a potential of impacting all targeted subsectors except irrigation. Cadmus does not expect the proposed changes to California Title 20 Appliance Standards to affect the agricultural and food processing sectors before 2011. Refer to Appendix B for the complete Codes and Standards memo.

Marketing and Outreach

Feedback on PG&E workshops was generally positive. Of the participants who indicated having participated in a workshop (42 percent), the majority (89 percent) rated the usefulness of the workshops at a seven or higher on an 11-point scale, where ten was extremely useful. The remaining respondents were neutral or did not have an opinion on the workshop. Workshop attendance appears to be higher among the food processing and winery participants, with over 50 percent of subsector respondents indicating that they attended a workshop. Sixteen participants (17 percent) also indicated that the workshops directly influenced their participation in the AFP Program. Fifteen nonparticipants indicated that they attended a PG&E workshop or seminar; seven of those rated the event at a seven or better.

A majority of participants learned about the Program through direct contact with Program Staff and S&S Representatives. More than half of the surveyed AFP Program participants (54 percent) reported that they learned about the Program through their S&S Representatives or Program Staff. This is unsurprising, as the AFP Program has largely relied on S&S representatives to reach their target market, and did not conduct a major marketing campaign during the 2006-2008 program cycle. The remaining participants learned about the program through a variety of channels, including PG&E's website, trade allies, and industry organizations. Finally, when asked how Program awareness could be increased among customers, many trade allies indicated direct contact with customers would be the most effective way.

The impact of printed marketing materials appears to be limited. Feedback from program staff, trade allies, and participants suggests the distribution and impact of the Program's printed marketing materials—such as bill inserts and brochures—is minimal. For instance, 45 percent of

participants could not recall seeing any marketing materials from the Program. However, of those who recalled seeing printed marketing materials, 57 percent of surveyed participants (26 respondents) rated the materials as being very to extremely informative. When asked about the effectiveness of their marketing materials, staff indicated that they generally considered mass mailings to be the least effective AFP Program marketing and outreach activity. Staff feedback further commented on a lengthy internal approval process for marketing materials that, at times, can make quick adjustments and updates difficult. Trade allies further confirmed these sentiments and said they thought contact with Program representatives at an event was more effective than marketing items, such as bill inserts. Finally, feedback from S&S staff further suggests they would benefit from additional or better marketing materials to give to interested customers.

Feedback from trade allies suggests a positive correlation between sales in energy-efficiency equipment and services, and their promotion of the AFP Program. Of the contractors and vendors who indicated that they actively promote the Program, 86 percent reported their customers were aware of the AFP Program, and 64 percent reported an increase in energy-efficient equipment sales in the past year. Of the contractors and vendors not promoting the Program, 50 percent reported that their customers were aware of the Program, and 44 percent reported an increase in energy efficiency equipment sales over the past year.

The majority of nonparticipants were unaware of PG&E's AFP Program. Of 454 nonparticipant respondents, only 19 percent were aware of PG&E's AFP Program prior to the survey call.

Participation and Enrollment

Interest in saving money and energy are the primary factors motivating customers to participate. When asked why they decided to participate in the Program, respondents most commonly cited the following reasons: save money on utility bills (30 percent), obtain a rebate (30 percent), and save energy (23 percent).

Nonparticipants cite high first costs (even with the rebate) and low expected energy savings as primary reasons for not participating. When asked to rate various factors in their decision to not participate in the AFP Program, 45 percent of nonparticipants who were aware of the program (38 respondents) rated lack of sufficient energy savings from incented measures as seven or higher on an 11-point scale, where ten was extremely important, and 39 percent rated high first costs, even when accounting for the program rebate, as a seven or higher. Additional reasons listed by nonparticipants included: limited time and resources, and the perception that the energy-efficient equipment in question was unnecessary for their business type and/or size. Nonparticipants in the top 10 percent of energy consumption who were aware of the Program cited similar reasons for not participating as the rest of the population. Two withdrawn participants reported that they dropped out of the Program because the measures under consideration turned out to be not cost-effective. When asked about their perception of key barriers to increase the market share of energy-efficiency equipment, 30 percent of the trade allies cited high first costs or payback requirements as barriers. Other barriers trade allies mentioned were lack of awareness, competing priorities, and lack of staff resources.

Participants consider application and enrollment processes as straightforward and satisfactory. Of the participant respondents, 64 percent applied through NRR, six percent through NRNC, and 30 percent through a program strategy categorized as downstream mass market.[66] Most participants (83 percent) reported no delays or difficulties in the application process. Only 31 percent of the participant respondents said Program Staff came back to request more information. In such cases, 70 percent of respondents noted that staff clearly communicated the needed materials and appropriate timeline. The majority of respondents (87 percent) also indicated that application materials were easy to understand.

Only 15 percent of participant respondents—the majority of whom had used the NRR process—indicated that they had encountered problems, delays, or difficulties during the application process, and, of the participants who encountered delays or difficulties, 64 percent (nine respondents) felt the application process took too much time. Three participants cited a lack of coordination and communication among program staff. In addition, a handful of participants (five respondents) mentioned the only thing they would change about the program was to make a clearer, briefer application.[67]

Communication and Coordination

Customer Energy Efficiency (CEE) staff appear to communicate and cooperate well. Data collected from staff interviews indicated there was effective communication and coordination internal to the AFP Program staff in the CEE group. The interviews further indicated the Segment Manager has been easily accessible and communicates effectively with Project Managers and S&S Representatives.

Some S&S Representatives and AFP Project Managers reported an occasional disconnect between the two groups on client communication responsibilities. Interactions between S&S Representatives and AFP Project Managers were generally reported as good. However, some staff members indicated that at times communication responsibilities with the client are unclear because each S&S Representative prefers a varying level of control over the client relationship. Officially, S&S Representatives own the customer relationship and the majority of customer contact. However, after the initial sale has been made, some S&S Representatives not only feel comfortable with AFP Project Managers having close customer contact but even expect it. Based on feedback provided during the staff interviews, these expectations are not always communicated to the AFP Project Managers. Some interviewed S&S Representatives reported that lack of communication regarding this issue have, in some cases, resulted in inefficiencies, insufficient communication with the customer, and frustration on behalf of S&S Representatives. Because expectations, personal preferences, and past experiences vary by person, this communication disconnect can potentially occur when two individuals who are new to working with each other team up on a given customer project.

[66] Categorized based on a "Program Strategy" variable in PG&E data.

[67] PG&E is working with Newcomb, Anderson, McCormick to reform the NRR application processes as part of their Process Improvement (PI) Project.

Knowledge transfer and coordination between S&S Representatives and Project Managers appears to work well when they are located in the same office. In instances where S&S Representatives and Project Managers service similar territory and are located in the same office, staff feedback indicates that communication and knowledge sharing increases because the two staff teams have more contact and connections with each other. Other staff members suggested that more frequent contact, preferably face-to-face interaction, between Project Managers and S&S Representatives could further improve coordination of AFP Program activities, though such meetings may be limited by time and budget.

Communication and coordination between PG&E and third-party staff appears to be effective. Findings from staff interviews clearly indicate good working relationships and effective communication between PG&E and third-party program staff. During interviews, third-party contacts generally reported good communication and coordination with the PG&E core program staff, and S&S Representatives confirmed similar sentiments about third-party implementers. In addition, all third-party implementers reported having participated in PG&E outreach and education events and felt it was a beneficial experience.

Areas of possible improvements reported by third-party implementers included being provided with more information about PG&E's organizational structure, S&S Representative contact information, the results of integrated audits, and the range of incentives offered through the Core Program.

Insufficient coordination on incentive levels appears to have caused some competition between the Core and third-party programs. Program and third-party staff commented that several third-party programs were able to offer higher incentives than PG&E's core program. EnSave, On Site, and RSG all reported that overlap and incentive discrepancies can cause confusion, and, in some cases, frustration among customers. Based on feedback provided during the February 2009 staff interviews, PG&E has been aware of this issue and has plans to deal with these challenges for the 2009-2011 Program cycle.

All third-party implementers regard PG&E's energy savings tracking template as cumbersome. Each program is required to use the same general template despite large differences in how each program tracks and reports data. Respondents from each of the six third-party programs reported that compliance with the data tracking protocols and, specifically, usage of the energy savings tracking template was challenging and time-consuming. While none questioned the need for accurate and detailed data tracking, most indicated they would welcome a data tracking process that fit with their program.

Program Offerings

The current set of incented program measures appears to meet customer needs. Cadmus conducted a review of the various measures offered by the Core and all third-party programs and compared them to those of similar programs.[68,69,70] PG&E's rebate catalog appears to thoroughly cover the measures applicable to the agricultural and food processing sectors. In addition, PG&E's offering are similar, and, in some cases, more comprehensive than other California IOU programs. There are a few measures, such as cool roofs, that other IOUs highlight but are not visibly promoted in PG&E's AFP Program. However, the AFP Program offers special focus in other areas, such as wineries and refrigerated warehouses, which are not a focus of other regional incentive programs.

Trade allies familiar with the AFP Program reported that they viewed the measures offered by the program as comprehensive and suited for current customer demand and available technologies. The common energy end-uses of the targeted subsectors appear to be aligned with the suite of measures provided for each (e.g., VSD milk pump measures for dairy producers, pump-related measures for irrigations, efficient boilers for greenhouses, etc.). When asked to identify anything PG&E could do to encourage their participation, none of the nonparticipants indicated PG&E should offer additional measures.

Satisfaction

Participants were satisfied with measure cost and performance. Sixty-nine percent of participants indicated they were satisfied or extremely satisfied with the final cost of the energy-efficient measure (after the rebate), with only four percent of respondents expressing dissatisfaction with the overall cost. Regarding equipment performance, 57 percent of participants reported being extremely satisfied, and another 29 percent reported being satisfied.

Measure savings met participant expectations. Of participants expecting electric or gas savings, the majority (72 percent electric, 68 percent gas) indicated that the energy savings from the installed measure(s) met their expectations. When asked if they expected additional energy savings in the future, 84 and 71 percent of respondents indicated that they anticipated additional electricity or gas savings, respectively. A majority of the respondents (58 percent) were unsure when they would realize future savings, though 19 percent expected the savings within six months and 10 percent expected savings within the next year.

Better equipment performance was the most commonly cited non-energy benefit. When asked to identify any additional non-energy benefits they observed as a result of installing one or more program measures, 43 percent of interviewed participants cited improved equipment

[68] Industrial Efficiency Alliance. Industrial Refrigeration Best Practices Guide. December 2004.

[69] Greenhouse Energy Conservation. Accessed 6/24/2008 <http://www.greenhousegarden.com/energy.htm>

[70] Ontario Ministry of Agriculture, Food & Rural Affairs. Accessed 6/24/2008 <http://www.omafra.gov.on.ca/english/engineer/facts/reduce.htm>

performance. Specifically, participants noted better equipment performance led to a reduced need for equipment maintenance, increased productivity, and increased product quality.

Participants expressed satisfaction with AFP Program staff. When asked to comment on their interactions with Program staff, the majority of participants reported being satisfied (30 percent) or extremely satisfied (62 percent). Respondents further reported that Program staff were generally prompt to answer customer questions and inquiries. While the frequency of contact with Program staff varied among participants, 95 percent of participants (86 respondents) responded that their frequency of contact with staff was appropriate.

Participants regarded Program staff as having sound technical knowledge of Program measures. When asked to rate their satisfaction with Program staff's technical understanding of program measures, the majority (86 percent) of participants reported being satisfied or extremely satisfied. Only one respondent indicated s/he was "extremely dissatisfied" with the program staff's level of technical knowledge.

The AFP Program provides participants with necessary technical resources. Of the participants who indicated they did not have sufficient in-house technical resources (34 percent), 62 percent (21 respondents) reported that PG&E was able to provide the necessary technical assistance. Feedback from nonparticipants suggests 45 percent were unaware that PG&E offers technical support during the participation process. Of the interviewed nonparticipants, 41 percent stated they were more likely to participate if the AFP Program provided them with more technical resources. Though, 72 percent of those nonparticipants requesting additional technical resources were not aware that PG&E's offers technical resources; 26 percent were aware but wanted additional services from PG&E.

Nearly all participants were satisfied with their participation experience. When asked to rate their overall satisfaction with participating in the program, 87 percent of participant respondents reported that they were either satisfied (36 percent) or extremely satisfied (51 percent). Survey respondents were asked to report how long it took them to receive a rebate, and answers ranged from 14 days to 90 or more days. Despite this range, the majority (64 percent) of respondents indicated they were satisfied or extremely satisfied with the time it took for their rebate to arrive. On the whole, participants did not have many complaints about the Program, and 96 percent said they would participate again.

Detailed tracking of participant and project data was challenging. As part of our evaluation activities, Cadmus requested a download of the program database. We found the required measure level detail data and/or participant contact information were frequently missing. The data sets also lacked consistent application of data flags which made it difficult to identify unique customers and/or projects.[71] However, based on feedback from AFP Project Managers, the discrepancies observed by Cadmus are likely due to challenges in extracting and compiling a

[71] Cadmus is aware of PG&E's ongoing process improvement project, which will likely resolve these data-tracking difficulties. The process improvement project is currently addressing the role of the IPC and looking at a replacement for PG&E's MDSS. Based on interviews with Newcomb, Anderson, McCormick associates and PG&E staff in October 2008, it appears the process improvements will result in more efficient data tracking and a higher level of data quality and integrity.

comprehensive data set out of several unconnected databases, not due to field staff not entering data.

Market Effects

Over 40 percent of nonparticipants reported having installed energy-efficient equipment on their own. When asked if they had installed and/or are currently installing energy-efficient equipment on their own, 42 percent of the nonparticipants responded in the affirmative. However, Cadmus was not able to confirm that the equipment installed was as efficient as the measures incented through the AFP Program. Furthermore, nearly half of nonparticipant respondents (48 percent) noted they are planning additional measure installations in the future. When asked about the likely time frame for these installations, 58 percent of respondents indicated that they planned on installing the measures within a two-year time frame. Another 21 percent indicated that they planned on installing additional measures within a two-plus year time span. In response to the question "what type of equipment do you plan to install," approximately a quarter of the nonparticipant respondents indicated they did not know what they will be installing, though many are installing efficient pumps and motors (25 percent) or solar panels (18 percent). The remaining respondents indicated a variety of other equipment, such as HVAC systems and refrigeration.

The majority of participants replaced working equipment with more efficient program measures. Of the participants reporting to have replaced equipment (77 percent), 60 percent indicated that the old equipment was in working condition without problems, 24 percent reported their equipment was problematic but still working, and 10 percent replaced problematic or broken equipment.

6 Conclusions and Recommendations

Based on data collected as part of this evaluation, Cadmus found that AFP Program participants (specifically Core Program participants) are generally satisfied with their participation experience. Participants also reported high satisfaction levels with measure costs and performance, expected savings, PG&E staff's technical knowledge, and their interaction with PG&E staff. Cadmus also observed that Program staff, in general, communicate and coordinate effectively with other PG&E staff and third-party program staff.

While the AFP Program appears successful overall, Cadmus has the following conclusions and recommendations to improve future iterations of the Program:

Conclusion 1: Close coordination between PG&E and trade allies could further enhance marketing channels and increase market penetration. Feedback from trade allies indicates that 64 percent of trade allies that actively promote the AFP Program reported an increase in sales. In comparison, only 44 percent of trade allies not engaged with the AFP Program reported an increase in sales. This suggests that a more formal partnership between PG&E and trade allies would be mutually beneficial. Trade allies promoting the AFP program reported that nearly 90 percent of their customers are aware of the Program offerings compared to 50 percent of customers of trade allies who do not promote the AFP Program. Feedback from trade allies further suggests the AFP Program could assist trade allies in their efforts to promote the Program by providing updated and more targeted marketing materials. Based on our analysis of the available data, closer collaboration with trade allies represents the most promising opportunity for the AFP Program to improve the scope and depth of its delivery. In addition, incorporating trade allies into technology demonstration programs may help alleviate vendor concerns about the hidden costs of energy-efficient technologies due to callbacks for service and repairs.

Recommendation: Although Cadmus is aware of AFP Program staff exploring opportunities to work with trade allies**,** Cadmus recommends that PG&E consider developing a formal strategy to engage trade allies in the promotion of the AFP Program. Because trade allies—vendors, contractors, and associations—generally know how and whom to target energy efficiency within different sectors (accountants vs. engineers vs. corporate decision makers), close collaboration with trade ally partners could benefit the AFP Program in three ways: a) increase the amount of face-to-face time during which customers hear about the program and can ask questions; b) increase the amount of technical resources and staff promoting the AFP Program in a knowledgeable and targeted fashion; and c) tap into existing market intelligence and customer contacts maintained by trade allies.

Cadmus recommends AFP Program staff consider the following:

- Coordinate with existing S&S Representatives dedicated to trade ally outreach, and increase their knowledge and ability to target agriculture and food processing sector trade allies.

- Develop a value proposition that will engage trade allies and ensure their support and promotion of the Program. The partnership "pitch" may be different between trade allies (e.g., associations vs. vendors).
- Consider co-branding program materials, such as brochures and case studies, which trade allies can distribute to their customers. For example, PG&E could collaborate with wine industry trade allies to develop marketing materials linking energy efficiency to sustainability in order to help the industry continue to differentiate its products through environmental branding.

Conclusion 2: Direct customer contact appears to be the most effective way to motivate customer participation, though extended marketing and outreach activities would broaden the Program's reach in the market. Feedback from participants, trade allies, and program staff clearly indicates any activities focused on increasing person-to-person interactions with customers have a positive impact on customer participation. More than half of the interviewed participants reported they had learned about the program from their S&S representative or other Program staff. Comparatively, only 14 percent of nonparticipants reported being told about the program by PG&E staff, with the majority obtaining information about the Program from marketing materials. The data further suggest that workshops and presentations as well as direct interaction with S&S representatives have been particularly effective. In addition to exposing customers to program offerings, nearly 90 percent of participants who attended a workshop rated them as being very useful. Staff and trade ally considered workshops as an excellent venue to meet customers and network, and indicated they support an expansion of these outreach activities.

***Recommendation*:** To further increase market penetration, the AFP program could consider the following actions:

- Expand existing offerings of high-quality and targeted workshops in coordination with S&S.
- Continue to rely heavily on person-to-person outreach and interactions with customers and try to increase face time with customers whenever possible.
- Continue pursuing a more detailed market characterization on subsectors, technologies, and end-uses would enhance workshop recruitment as well as general marketing and outreach activities. Cross-referencing the market data with the program database would allow more effective targeting and/or prioritized outreach and marketing activities.
- Create additional targeted marketing materials to help S&S Representatives and Project Managers promote the program. Project Managers mentioned that case studies for smaller customers would be helpful; as larger, traditional projects are generally not applicable to smaller operations (small wineries were specifically mentioned). Short video testimonials from past participants, who are respected in the industry, would also reinforce the value of participating in the AFP Program.

Conclusion 3: PG&E's internal data tracking system produced incomplete data sets. Cadmus found that the required measure level detail data and/or participant contact information were frequently missing or incomplete in data extracts from MDSS. The data sets also lacked consistent application of data flags which made it difficult to identify unique customers and/or projects. However, based on feedback from AFP Project Managers, the discrepancies observed by Cadmus are likely due to challenges in extracting and compiling a comprehensive data set out of several unconnected databases, not due to field staff not entering data.

Recommendation: PG&E is currently addressing data and database issues as part of the Process Improvement (PI) project. During PI project implementation, Cadmus recommends addressing the following database improvements:

- Require and validate crucial data fields such as measure detail, contact names, addresses, and phone numbers when entering new projects. Consistent record-keeping will help eliminate problems with missing data.

- Add identification flags for customers' company and site level. While PG&E provided a flag to identify unique applications, there was no simple way to aggregate applications belonging to the same site. It was also difficult to determine how many entries traced back to the same company. While this may not always be possible due to complicated corporate structures, some attempt to identify different sites would be useful during evaluation data collection activities that require contacting different participants.

- Include useful measure level detail. In many cases, a "custom process" was recorded in the database. Further detail is needed to determine what type of measure or end-use was installed.

- Add a validated field that categorizes the project into an end-use or other appropriate classification. These types of variables help aggregate data in a meaningful way for program evaluators and implementers.

Conclusion 4: Communication between S&S Representative and Project Managers could be improved. While S&S Representatives and Project Managers generally are satisfied with their interactions, staff interviews revealed that occasionally communication responsibilities with the client are unclear. Cadmus also noted that in instances where S&S Representatives and Project Managers are located in the same office, communication and knowledge sharing appears to increase because the two staff teams have more contact and connections with each other.

***Recommendation*:** Cadmus recommends that, either in the first instance of working together or at the beginning of a project, the S&S Representative and Project Manager should arrange a five minute conversation to establish communication expectations between themselves and between them and the customer. These communication preferences can then be recorded as part of the project file or incorporated into some existing documentation. To further streamline the process, staff members can identify typical communication expectations, list them as checkbox items, and keep a record of the communication expectations with the project file. This record would also provide continuity in the case of staff turnover or absence.

Another effective way to facilitate contact between S&S Representatives and Project Managers is to place S&S Representatives that service similar areas as Project Managers in the same office. Staff collocation may help build inter-staff relationships and create a more natural dialogue and information flow between the two teams.

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