STATEWIDE SMALL INDUSTRIAL CUSTOMER WANTS AND NEEDS STUDY

FINAL

Prepared for

Rafael Friedmann
Pacific Gas & Electric
245 Market Street
San Francisco, CA 94105

Prepared by

QUANTUM CONSULTING INC.
2030 Addison Street
Berkeley, CA 94704

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GLOSSARY

A glossary of terms used in this report is presented below.

AC	Air conditioner
ASD	Adjustable Speed Drive
C/I	Commercial/Industrial
CEC	California Energy Commission
CFO	Chief Financial Officer
CIS	Utility customer information systems that contain customer billing records and other information.
Demographics	Describing the distribution of customers by size, location, and operating characteristics.
Direct install program	Energy efficiency retrofits, often targeted to small commercial customers, where measures are recommended by program experts and installed by contractors selected in an RFP process.
DOE	Department of Energy
EE	Energy Efficiency encompasses all changes that result in decreasing the amount of energy used to produce one unit of economic activity or to meet the energy requirements for a given level of comfort. Energy efficiency is associated to economic efficiency and includes technological, behavioral and economic changes. Energy efficiency improvements refer to a reduction in the energy used for a given energy service (heating, lighting...) or level of activity.
Energy audit	The identification of economically-justified operating cost reduction opportunities associated with manufacturing and processing plant building, utility, and processing systems . Typically these opportunities result in significantly lowered electrical, natural gas, steam, water, and sewer costs.
EPA	Environmental Protection Agency
ESCO	Energy Services Company
Express Efficiency	Nonresidential prescriptive rebate program offered by California IOUs that offers financial incentives for installing energy-efficient equipment. The Express Efficiency program offers rebates for qualifying lighting, refrigeration, air conditioning, LED, motor, agricultural, and gas equipment. The program is targeted to the small/medium nonresidential market. Eligible nonresidential electric customers are those whose monthly, aggregated maximum demand does not exceed 500 kW and who are on applicable rate schedules. Eligible nonresidential gas customers are those whose monthly gas usage does not exceed 20,800 therms or who are currently served under a core gas rate.
Fab metals	Fabricated metals. This industry mainly shapes metals and performs metal finishing.
GWh	Gigawatt hour. Equivalent to one million kilowatt hours
HE	High efficiency
HVAC	Heating, Ventilation, and Air Conditioning
Industrial Assessment Center (IAC)	The Industrial Assessment Centers program enables eligible small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturer. eams of engineering faculty and students from the centers, located at 26 universities around the country, conduct energy audits or industrial assessments and provide recommendations to manufacturers to help them identify opportunities to improve productivity, reduce waste, and save energy.

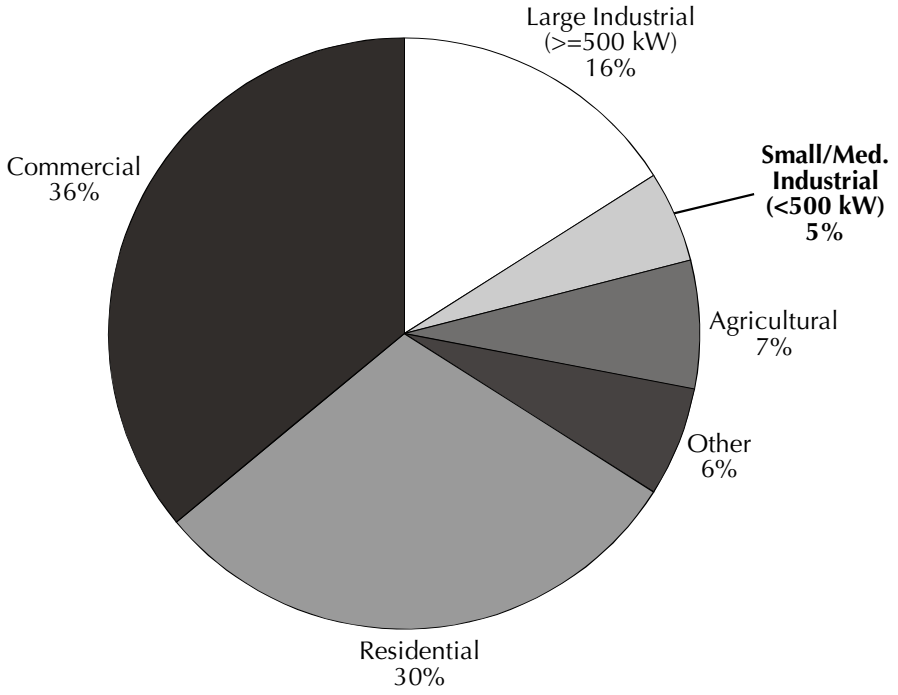
GLOSSARY - CONTINUED

IOUs	Investor-owned utilities. In California they are; Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric
kWh	Kilowatt hour. Merriam-Webster's definition: a unit of work or energy equal to that expended by one kilowatt (1000 watts) in one hour or to 3.6 million joules
Measures	Change in behavior or equpiment that reduces energy or demand
Medium customers	Those with annual usage between 500 and 1,500 MWh
MWh	Megawatt hour. Energy expended by one million watts in one hour.
NYSERDA	New York State Energy Research and Development Authority
PG&E	Pacific Gas and Electric Company
PGC Ratio	The ratio of utility funds received to PGC collected
Process heating/cooling	Energy used to heat or cool an industrial process
Program tracking data	Data collected by a utility that contains customer program participation information
Retrofits	To furnish a premise with new or modified parts or equipment
SCE	Southern California Edison
SCG (SoCalGas)	Southern California Gas Company
SDG&E	San Diego Gas and Electric Company
SIC	Standard Industrial Classification
Small customers	Those with annual electrical usage of less than 500 MWh
Spec	Specification
Standard Performance Contracting (SPC)	Standard Performance Contract (SPC) program, offered statewide by the California IOUs, pays financial incentives for energy saved from energy efficient retrofits of existing nonresidential facilities (small, medium and large commercial, industrial and agricultural customers are eligible). Unlike the Express program, in which dollars are paid for installing specific items from a pre-approved list of energy-savings equipment, SPC offers financial incentives based on verified energy savings for custom-designed projects. Retrofit projects must save at least 5,000 kWh of electricity or 500 gas therms per year to qualify under SPC. Similar projects at like facilities or multiple measures at one facility can be aggregated under one SPC project application.
Suppliers	Companies that supply equipment
Therms	Merriam-Webster's definition: a unit used to measure quantity of heat that equals 100,000 British thermal units
Vendors	Companies that sell energy-using equipment
Volatile organic compounds (VOC)	Substances containing carbon and a variety of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen. These substances easily become vapors or gases. (source http://www.atsdr.cdc.gov/glossary.html)

1. EXECUTIVE SUMMARY

The Small Industrial Customer Wants and Needs Study improves our understanding of small and medium industrial customers (the markets defined as under 500 kW and/or under 50,000 therms), with a view toward enhancing energy efficiency programs for these customers. This market comprises 94% of industrial sites and 26% of industrial energy usage in the service territories of the major California investor-owned utilities, which include Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric (hereafter, the "IOUs"). As shown in Exhibit 1-1, this under 500 kW industrial market represents roughly five percent of total IOU energy usage.

Exhibit 1-1
Small/Medium Industrial Share of California IOU Energy Consumption



Source: CEC 2000 and Quantum Consulting analysis.

The small industrial market offers substantial energy efficiency (EE) possibilities, yet little is known about small manufacturers relative to their large counterparts. Recent research suggests that insight into customer's needs and industry-specific expertise are key factors for program success. (Shipley, Elliott and Hinge, 2002; Megdal, Bensch and Schauff, 2003) Therefore, this study focuses on four specific industries that are large energy users among California's small and medium industrial customers.

Small and medium customers account for about an equal share of electric use statewide, with a slightly greater percentage of electric use accounted for by medium customers (8.7% of industrial electric use vs. 8.1% for small). Small and medium industrial customers are a promising target market for energy efficiency programs for two reasons. First, they have a simple decision tree. They tend to be owned and managed by a single individual, and this business owner is easier to access and sell to than decision makers in a corporate setting. Second, industrial customers (including renters) tend to pay their own energy bill, diminishing the likelihood of the split incentive problem faced, for example, by small commercial tenants.

The Study characterizes small and medium customers with respect to their energy use, business demographics, energy efficiency practices, equipment decision-making and needs and wants. The Study also offers program design implications, both general and industry-specific, based on findings from the market characterization and from a review of other programs targeted to the small-medium industrial customer segment.

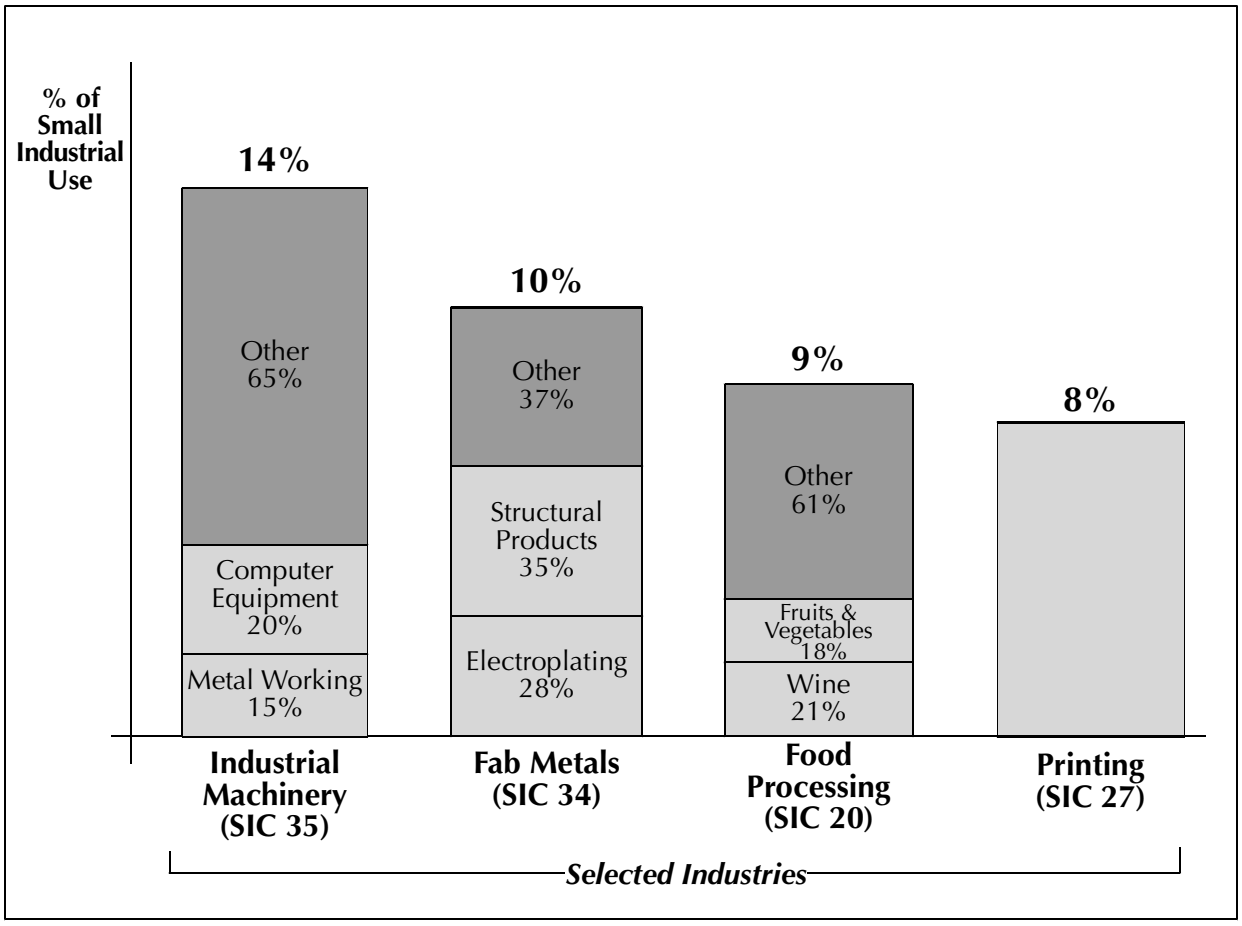
METHODOLOGY

This report presents integrated findings from an assessment of several key data sources, including customer energy use data, program participation data, surveys completed with small/medium industrial customers, supplier interviews, an extensive literature review, and interviews with program managers and industry experts. The study integrates customer (market characterization) results with a program assessment to offer program design suggestions for the small/medium industrial market. By first characterizing the small industrial market, the program assessment develops program design enhancements that are suited to customers' wants and needs.

Central to the market characterization, the report presents key findings obtained from 382 telephone interviews with small and medium California industrial customers in the food processing, printing, industrial machinery and fabricated metals industries, conducted in the fall of 2002, and 23 interviews with those customers' equipment suppliers. The study focuses on seven industry segments at the 2-, 3- and 4-digit SIC level instead of the entire small industrial market. The market characterization identifies how small and medium industrial customers use energy, the business issues they face, their energy efficiency practices, awareness and knowledge of energy efficiency.

Exhibit 1-2 shows the industries selected for inclusion in the study – Food Products, Printing, Fabricated Metals and Industrial Machinery – in terms of small/medium site electric use. Energy consumption (less than 1.5 GWh per site) was a key determinant in the industry selection process. Industries were defined for sampling using the Standard Industrial Classification (SIC) system. At the 2-digit SIC level the selected industries represent 41 percent of the under 500 kW industrial market. For all but Printing, sampling was completed at the 3- and 4-digit SIC level, representing 26 percent of all small/medium electric use.

Exhibit 1-2
Annual IOU Electric Use of Industries Selected for Study



STUDY RESULTS

What follows is a presentation of study results including discussions of small/medium industrial customer demographics, program participation findings, market characterization results and recommendations related to program design.

Customer Demographics

Exhibit 1-3 presents site-level information on business demographics (from the customer survey[1]) and electric and natural gas use (for the entire small and medium customer population, drawn from utility databases).

[1] Survey-based results presented throughout this report at the 2-digit SIC level are based on a straight average of responses from the 3- and 4-digit SIC segments sampled, and therefore are not representative of the entire 2-digit customer population.

Exhibit 1-3
Summary Statistics for Selected Industries

SIC-Based Industry	Customer Site Demographics			CIS Information	
	Average square feet	% less than 20 employees	% less than 4 locations	Average MWh/site	Average Therms/site
Food (SIC 20)	46,745	55%	89%	1294	314,966
Printing (SIC 27)	14,246	97%	93%	170	8,010
Fab Metals (SIC 34)	24,712	98%	97%	360	35,562
Industrial Machinery (SIC 35)	26,283	99%	98%	346	9,651

Food processors tend to operate the largest facilities, employ more people per site, run more locations and use more energy than the other three industries. The later is especially true with respect to natural gas use. Fabricated metals and industrial machine shops are next largest, similar in terms of their size and electric energy use, although fabricated metal shops are more energy intensive with respect to natural gas. Printers, which have the smallest facilities, also use considerably less energy than the other three industries.

Program Participation Findings

Exhibit 1-4 presents summary participation findings from utility tracking data; the two main statewide program options available are Express Efficiency and Standard Performance Contracting (SPC). SPC provides rebates for much larger projects than Express, as demonstrated by the large difference in average rebate size per participating site.

Exhibit 1-4
Program Participation Summary on Selected Industries

SIC-Based Industry	Express Efficiency (1999-2001)		SPC (1998-2001)	
	Rebates/Site ($)	Program Penetration (%)	Rebates/Site ($)	Program Penetration (%)
Food (SIC 20)	3560	2	141,744	1.5
Printing (SIC 27)	1261	4	195,932	0.1
Fab Metals (SIC 34)	1613	1	31,262	0.3
Industrial Machinery (SIC 35)	1736	2	72,598	0.2

Express program participation and rebates are statewide for PY1999 through 2001, and electric-saving measures only.
SPC program participation and rebates are PG&E and SCE participants only, for PY1998 through 2001, and electric-saving measures only.
Program penetration is the number of participants during the period specified divided by the number of customers with IOU electric service.

While food processing does not lead the others in terms of Express program penetration, average Express rebates are much greater than those secured by the other three industries. In the SPC program, penetration in food processing is by far the greatest, although a few relatively large print shop projects led to average rebate levels that exceed those secured by food processors. Under the Express program, printers exhibit the opposite characteristics, having the highest penetration levels and receiving the smallest average rebates among the selected industries.

Market Characterization Results

Small/medium industrial customers are far from homogeneous. There exist significant differences among segments within this relatively broad category – both by size and within and across industries. Company size ranges from fewer than 5 employees to well over 100; facility square footage from less than 1,000 square feet to over 100,000, and energy intensity from less than 100 MWh per premise to more than 2,000 MWh. Moreover, survey results as well as supplier and industry observer interviews all point to differences in perceptions and behavior between medium and very small customers, between participants and non-participants, and across industries.

All of this suggests that different groups need to be approached with different program elements, technologies and marketing messages, and that considerations of cost-effectiveness will necessarily help determine what elements are targeted to what sectors.

At the same time, there are a number of broad unifying threads that appear to cut across all segments in the small/medium industrial sector. These broadly applicable conclusions are discussed first, followed by segment-specific market findings.

Five ***cross-cutting findings*** have implications for program design in the small/medium industrial market and help drive the study conclusions regarding program approach.

- The **owner is the most important player** in selecting equipment for retrofit projects.
- Small customers **depend on equipment vendors** for assistance in selecting equipment.
- Small and medium customers often **lack technical knowledge**.
- Small and medium customers are **receptive to training initiatives**.
- Medium customers have shown themselves to be **willing and able to implement** energy efficiency measures when provided with detailed, actionable recommendations for cost-effective process improvements.

In the analysis of survey results, a distinction is made between small customers (those with annual electrical usage of less than 500 MWh) and medium customers (those with annual usage between 500 and 1,500 MWh). The survey results – as well as input from suppliers, industry observers, and review of the literature – provide the following ***relevant findings regarding the distinction between small and medium customers.***

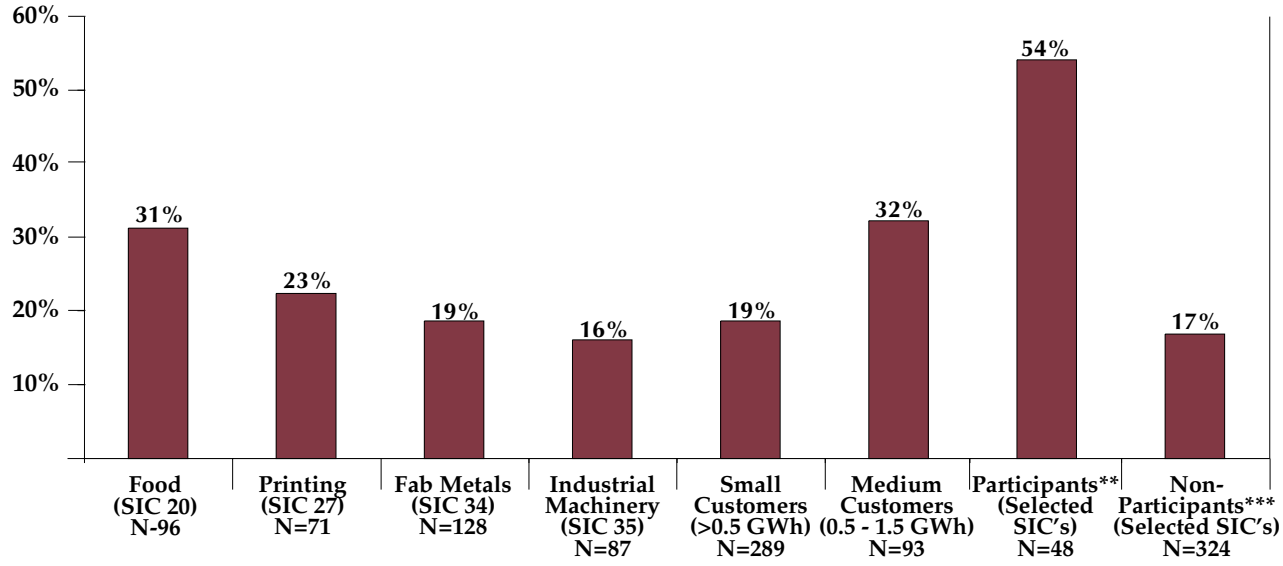
In addition to the obvious distinction of having more workers, larger facilities and higher overall energy use in comparison to small customers, ***medium sized customers***:

- are more likely to have multiple locations
- assign a higher degree of importance to several key business issues, including identifying and implementing cost-saving measures, keeping up with new technology, and keeping up with shifting market demand

- are more likely to implement cost saving measures, including the purchase of new equipment, using best practices or training, and implementing conservation measures
- are more likely to be aware of and install new technologies
- feel better-equipped to make energy efficiency decisions with internal resources
- are more likely to have an energy policy and to be aware of energy efficiency programs
- are more likely to rely on their utility to provide them with information and assign a higher value to the utility as an information source

Exhibit 1-5 shows the proportion of customers that installed high efficiency equipment in the past two years. Medium-sized customers (34%) are much more likely to adopt high efficiency equipment than small industrial customers (19%). Food processors lead the other three industries in adoptions. Finally, it is not surprising that the biggest difference in adoptions lies among non-participants (17%) and participants (54%).

Exhibit 1-5
High Efficiency Adoptions in Past Two Years by Industry Size and Participation*



* Note that these figures do not represent the *amount* of high efficiency actions taken, but the portion of customers taking at least one action. An action might be modest or extensive; the intensity is not reflected here.

** Has participated in an energy efficiency program in the last two years (self reported).

*** Has not participated in an energy efficiency program in the last two years (self reported).

A picture clearly emerges of medium industrial customers as being more pro-active, more concerned with cost savings, and more ready to take action. This makes them excellent candidates for several of the approaches being successfully used in selected programs, particularly those that provide customers with audit-based information that then gives them the ability to access a pool of screened resources, including service providers, financing, and rebates or other incentives.

In contrast, ***smaller customers***:

- are generally knowledgeable about new technologies, but less inclined to undertake cost-cutting or energy conservation actions, including installation of new equipment or use of training/best practices

- are prevented from implementing cost-cutting measures by a lack of capital, limited time and uncertain business conditions

- rely on suppliers, particularly manufacturers and contractors, to provide them with information about energy efficiency and new technologies

- often have an almost fatalistic view of their business, feeling that their success is determined by external economic conditions and that energy and other costs are beyond their control.

Furthermore, current economic conditions have created a difficult climate for energy efficiency improvements among small industrial customers. Several of the industries studied are now characterized by a predominance of subcontracting, where the largest manufacturing companies contract out all or most of their production to medium sized firms, who in turn subcontract out the manufacture of components, subsystems, and parts to small family owned businesses. The current economic slowdown has meant less business throughout the subcontracting chain, with the result that the smallest manufacturers have been particularly hard-hit as medium sized firms keep in-house much of the work they would otherwise have subcontracted out. This places severe constraints on the willingness and ability of these small firms to make energy related investments.

All of the above suggest that programs targeted to the smallest customer group should be designed so that they are easy to implement, can be delivered through those vendors whose advice the customer trusts, and take account of the capital (and even cash flow) constraints faced by small industrial businesses.

STUDY RECOMMENDATIONS FOR PROGRAM DESIGN

Drawing on the results of the surveys and interviews, a number of program elements were considered. The distinction between small and medium customers that comes out of the results suggests that different combinations of these program elements are appropriate for the small versus medium markets.

We recommend a quick-and-to-the-point approach to the small customers, offering them information, rebates, and even direct funding to install relatively simple technologies, but not a great deal of costly audit/recommendation time. This approach to small customers addresses their needs for a no-hassle program.

Medium customers, on the other hand, appear to be well suited to an "audit-based approach" encompassing audits, recommendations, and financing and other assistance to help them

implement measures through the channels of their choice. These two approaches are presented in Exhibit 1-6.

Exhibit 1-6
Recommended Program Elements by Target Market

Target Market	Program Elements									
	Onsite Assessments	Specific Recommen-dations	Direct Installs	Referrals	Implemen-tation Assistance	Financing	Rebates / Grants	Performance Contracts	Information & Education	Technology Demonstration
Small Industrial	○	○	●	○			●		●	○
Medium Industrial	●	●		●	●	●	●	○	○	●

KEY	
Major Program Element	●
Minor Program Element	○

These program approaches, though developed on the basis of customer size, can also be applied at the industry level. The industry segments studied reveal differences in perceptions and behavior, thus lending themselves to the different program approaches.

- Of the industries studied, **food processors** stand out as the most promising target for the **medium sized program approach**. Food processors have characteristics of medium sized customers: they tend to operate larger facilities, employ more people and run more locations. Moreover, food processors are the biggest natural gas users and claim the highest energy costs relative to operating costs of the industry segments studied. Because of their track record of energy efficiency actions and willingness to work with vendors to gather information, food processors would likely respond well to the **audit-based approach** recommended for medium sized customers.

- The **printing segment** does not appear to offer as much opportunity for cost-effective market interventions due to their low energy intensity, relatively small size, and prevalence of single facilities. In addition, printers demonstrated lower awareness of new technologies for their industry than other industries. Therefore, the **small customer approach** may be appropriate for printers, where equipment vendors and utilities (both regarded as reliable information sources) team up to **educate** this segment about energy efficiency. Likely partners are the Printers' National Environmental Assistance Center (PNEAC) and Quad/Tech, a highly influential vendor to the printing industry. According one source, Quad/Tech was able to get many printers in California to adopt energy efficiency measures, possibly contributing to the relatively high participation rates for printers in Express. Thus identifying and partnering with influential vendors (by industry) should be considered a high priority item for industrial segments similar to printing.

- Small facilities outnumber medium sized ones 14 to 1 in the **industrial machinery** industry, making machine shops a good fit for the **small customer program approach**. Industry observers report that small machine shops, hard hit by economic recession, have shown a willingness to change behavior to reduce energy costs, but due to these

economic conditions are the least likely of the industries studied to adopt energy efficient equipment. Therefore, machine shops are an excellent candidate for direct installations. In addition, machine shops that installed energy efficient equipment have relied more on publications and equipment vendors than in-house staff for information. These findings suggest that **information and education**, particularly about low/no-cost measures, would be useful for this industry.

- The **metal fabricating** industry lends itself to a combination of **both the small and medium approaches.** The small customer **emphasis on information and training** is appropriate for these users – whose opportunities are somewhat limited by the small size of the typical facility – because metal fabricators are responsive to training and see utilities as valuable information sources. However, metal fabricators are a relatively heavy user of both electricity and gas (their biggest electrical use is production equipment). They have shown themselves to be willing to install EE equipment, suggesting that they would respond to **audits and technical recommendations** provided by the **medium sized approach**.

A key study finding is the need to **establish partnerships with influential trade associations and vendors** when programs target a given industry. For example, food processors work closely with trade groups like the California League of Food Processors, whereas California printers apparently were influenced by Quad/Tech, and opportunities exist to partner with groups like these to move industries towards improved energy efficiency. Current programs should seek to strengthen partnerships with trade allies and trade associations.

Next specific program recommendations are developed for both the small and medium customer segments.

Small Customer Program Recommendations

As described in the analysis of survey and interview results, small customers often take a somewhat passive approach to many aspects of their business. While they are generally knowledgeable about new technologies, they lack the time, interest, and resources to investigate and install energy efficiency measures, preferring instead to rely on trusted suppliers to provide them with information.

For this group, it does not make sense to pursue a program of detailed audits and recommendations – both because of the time involved and because the scale of production processes (and resulting efficiency opportunities) are small. Instead, an appropriate program would emphasize information dissemination, rebates and direct installation services.

- Energy efficiency *information* is made available through the IOU's and suppliers – particularly suppliers of electric motors, HVAC equipment, boilers, and lighting. The supplier benefits by having a tool to "up-sell" the customer, while **the customer benefits by being able to compare the savings associated with an energy efficiency option using data from a utility source**.

- In addition to *printed materials* (the preferred medium for receiving information), small customers could be provided with *case studies* describing specific measures installed by

other small companies in their industry. For some segments, notably the metal fabricating industry, *training and best practices* presentations might also be effective.

- The program could provide *referrals* for rebates through cooperating suppliers who are knowledgeable about other available program elements.

- **For some relatively simple measures that can be easily identified (e.g., high efficiency motors, ASDs, lighting) it may be appropriate for the sponsoring organization to provide *rebates* or even to cover all or most of the cost of *installation.*** This has the benefit of minimizing the expense associated with audits and development of recommendations, and assumes that there will be some measures that justify installation under a total resource cost measure, but that have not been – and likely will not be – implemented by the small customer. A *direct install* element would deflect most time constraint barriers that are a distinct trait of small industrial customers.

The goal of this approach is to recognize the difficulty of cost-effectively delivering a complex program to the smallest customers, while still making available the information and resources that enable interested customers and their suppliers to pursue energy efficient options on their own.

Medium Customer Program Recommendations

The recommended program elements for medium customers are designed both to match the strengths and characteristics of this group of customers and to provide an appropriate level of support throughout the energy efficiency opportunity identification and implementation process. Key elements of the recommended approach include onsite assessment, specific recommendations, and referral to customer-selected, program-approved resources to provide implementation assistance, financing, and even rebates.

An *onsite assessment* presented directly to the decision maker – usually the business owner – should be the cornerstone of a medium industrial market program.

- A recent evaluation of an industrial program states that, "the key ingredient in overcoming the barriers to participation seems to be **focused one-to-one attention provided by a technically competent, independent third party**." (Shipley et al 2002, p. 24)

- Utilities should partner with a roster of pre-screened technical consultants already working in the industrial sector to identify efficiency improvements. Although California utilities have tended not to endorse providers in the past, other programs, including those being implemented by NYSERDA, have used this approach successfully.
  - Customer and supplier data suggest that **small and medium industrial customers are inclined to seek assistance from equipment vendors or contractors that they already know**
  - **Choosing technical consultants for their industry rather than technology expertise ensures that a single assessment will cover all opportunities**, rather than requiring separate reviews for process heat, compressed air, motors, etc.

- **Consultants with industry expertise are likely to be located in the same areas as their customers**, placing them in close proximity to other firms in that industry (for example, wineries in the Napa Valley)
- PG&E's Industrial Strength seminars[2] are **effective vehicles for training and building relationships with vendors and customers.**

The onsite assessment should yield audit data, payback calculations, engineering analysis, and a set of *specific recommendations* that are presented directly to the business owner.

- **Suppliers support the notion that direct presentation of findings to the owner is essential.**
- **It is easier to get in front of a single decision maker, even a meeting of several hours, to pitch an upgrade, than in a corporate setting with multiple decision makers**.

In conclusion, there are ample program-based energy efficiency opportunities for small/medium industrial customers in California. While the current Nonresidential Audit and Express Efficiency program offerings are geared towards small customers, small and Medium industrial customers remain underserved[3], which suggests the need for further development of these or other offerings. Ongoing evaluations for the Nonresidential Audit, Express Efficiency and SPC programs should shed further light on opportunities to refine these programs to better serve small and medium industrial customers. With interest from the IOU's, a formal program design, based on the above conclusions and recommendations, is needed. Furthermore, market- and existing program-based indicators suggest that such a program could be cost-effective. The later warrants further study.

The remainder of this report serves to document and support the findings presented above.

[2] PG&E's Energy Training center offers Industrial Strength courses and seminars for commercial and industrial operations of all sizes, such as industrial refrigeration and industrial equipment maintenance, including compressed air systems.

[3] The conclusion that industrial customers are underserved by the Express Efficiency program is supported in Chapter 5 of this report.

2. INTRODUCTION

This study seeks to improve understanding of small and medium industrial customers (the under 500 kW market), a market segment that comprises 94% of industrial sites and 26% of energy usage, with a view toward refining and developing programs that address small/medium customer wants and needs.[1]

Several characteristics make small and medium industrial customers a promising target market for energy efficiency programs.

- First, the smaller the company, the more likely that the decision maker is a single individual. The business owner is easier to access and sell to than a corporate structure with multiple decision makers.

- Second, industrial customers (including renters) tend to pay their own energy bill, diminishing the split incentive problem faced by other types of small tenants. This simple decision tree - the buck stops with the business owner, as opposed to a landlord, CFO or division manager - suggests real potential for moving this market toward higher efficiency processes and equipment.

- Third, energy use in industrial facilities is much broader than the HVAC and lighting measures typical of the commercial sector. This breadth is seen in the extensive set of recommendations offered to small and medium manufacturers through Industrial Assessment Center (IAC) on-site audits. Audits, like those offered through the California Statewide Nonresidential Audit program, are an excellent way to make small and medium customers aware of possible efficiency improvements to their industrial processes and equipment. This information is particularly useful to small and medium industrial customers, as they tend to be less knowledgeable about the benefits of energy efficient equipment than larger companies.

The small industrial market offers EE possibilities, yet little is known about small manufacturers relative to their large counterparts. This study:

- Characterizes small and medium customers with respect to their energy use, business demographics, EE practices, equipment decision-making and needs and wants.

- Examines whether California energy efficiency programs are serving these customers.

[1] Small customers have annual electrical usage of less than 500 MWh, while medium customers are those with annual usage between 500 and 1,500 MWh.

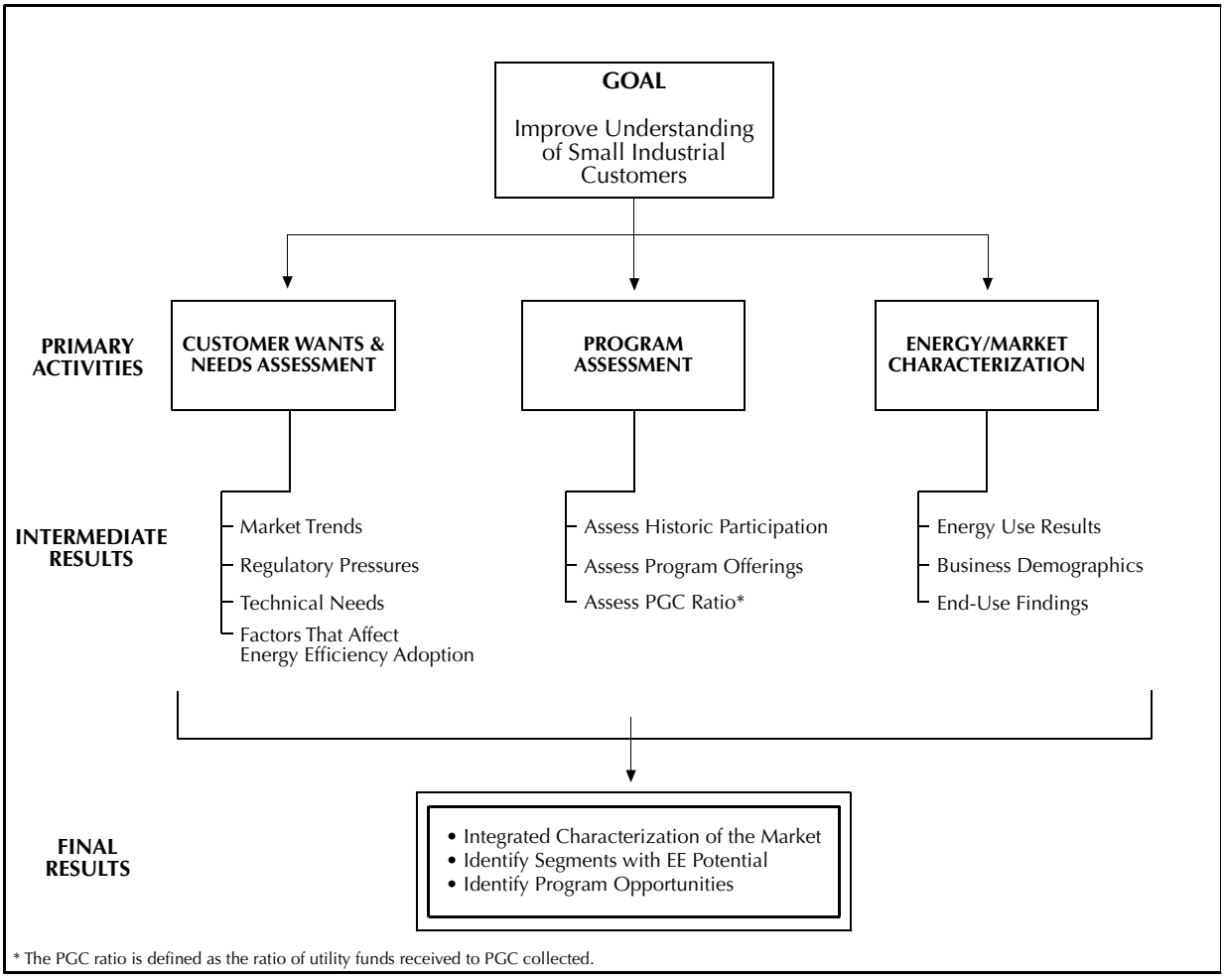
- Recommends how a utility can best target its resources in a small industrial program setting.

This report presents findings from a customer survey, supplier interviews, an extensive literature review, and interviews with program managers and industry experts. The study integrates customer study results with a program assessment to offer program design suggestions for the small/medium industrial market. By first characterizing the small industrial market, our program assessment develops a program design that is suited to customers' wants and needs. Furthermore, these recommendations are developed in part based upon a review of existing programs, with a design emphasis on program elements that have proven successful in the past and proposed enhancements to current program offerings.

2.1 STUDY OBJECTIVES, ACTIVITIES AND RESULTS

The ultimate goal of the study is to complete an integrated characterization of the small/medium industrial customer market in California, with an emphasis on identifying energy efficiency program opportunities with these customers (for program planning purposes). Exhibit 2-1 identifies the study activities and objectives in support of that goal, including intermediate results and their integration into final results: a customer wants and needs assessment, an energy/market characterization and a program assessment.

Exhibit 2-1
Study Objectives, Activities and Final Results



First, the market characterization[2] identifies how small and medium industrial customers use energy, the business issues they face, their energy efficiency practices, awareness and knowledge of energy efficiency. Recent research suggests that insight into customer's needs and industry-specific expertise are key factors for program success (Jordan and Nadel, 1992; Megdal, Bensch and Schauf, 2002; Shipley, Elliot and Hinge, 2002). To make the study cost-effective this study focuses on seven industry segments at the 3- and 4-digit SIC level instead of the entire small industrial market.

The results of the market characterization are integrated with an assessment of existing programs that serve the small/medium industrial market. The objectives of the program assessment are two-fold:

[2] Exhibit 2-1 outlines the two components of the Market Characterization: a customer needs and wants assessment and energy/end-use characterization.

1. To assess how energy efficiency programs in California serve small and medium industrial customers' wants and needs, and

2. to offer program design implications, both general and industry-specific, based on market-based and technical findings from the market characterization and from a review of other programs targeted to the small-medium industrial customer segment.

2.2 REPORT OUTLINE

The report begins with a discussion of methodology in Chapter 3. The chapter begins with a discussion of how industry segments were targeted and profiles the four selected industry segments. More detailed industry assessments are presented in Appendix F. Chapter 3 then focuses on customer and supplier data collection efforts. This chapter also lays out a set of hypotheses about small industrial customer characteristics, end-uses and technologies, program participation and intervention strategies, developed from extensive literature review and informant interviews. The validity of these hypotheses are tested with customer survey data and supply chain interviews in the following chapters.

Chapter 4 presents the small industrial market characterization in four major sections. Each section begins by summarizing findings in light of expectations developed in Chapter 3.

- The first section presents an energy/market characterization, drawing on utility customer information and survey data on business demographics and energy firmographics to profile the small industrial customer's use of energy. Detailed usage statistics are presented in Appendices A-C.

- Next, customer needs and wants are examined, including a customer ranking of the business issues they face and the role of cost cutting in their businesses.

- The chapter's next section addresses small and medium customers' knowledge and awareness of programs, technologies and information sources.

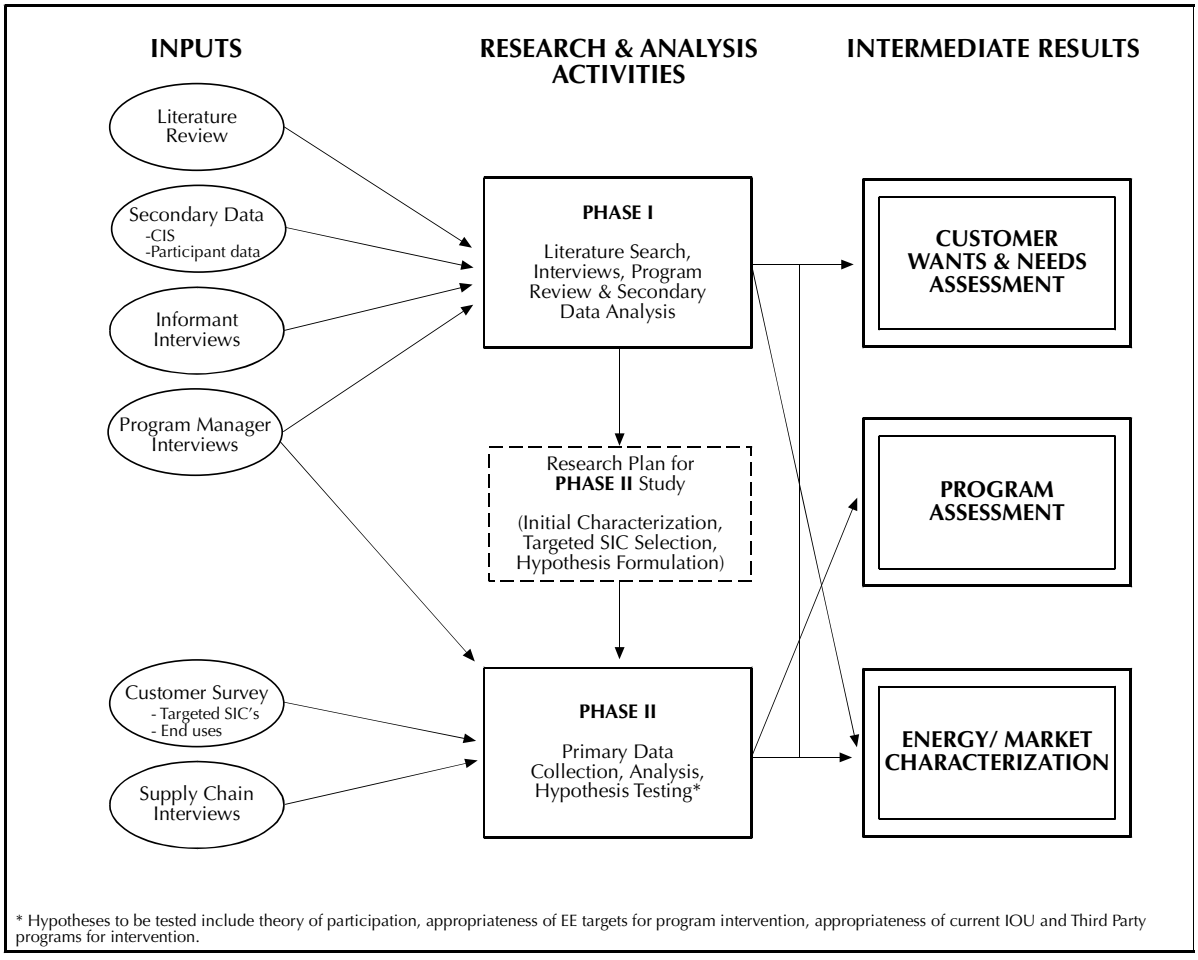
- Energy efficiency practices (both conservation actions and equipment adoptions) are investigated last, to determine main influences and market actors involved in energy efficiency adoption decisions.

The program assessment, presented in Chapter 5, begins with an assessment of current programs. Historic Express Efficiency and SPC participation and program penetration findings are presented by industry and customer size. Next, other programs targeted to the small industrial market are profiled. The next section leverages study findings – market-based, technical and participation – to offer implications for program design. The report ends with program recommendations for achieving energy efficiency savings in the small industrial market.

3. METHODOLOGY

This chapter summarizes the study approach, the industry selection process and data collection efforts. Exhibit 3-1 offers a roadmap of this two-phase Study. In Phase I the following objectives were addressed: 1) customer energy use and energy efficiency program participation data were examined in order to select SIC codes of greatest value to the study, 2) a literature search was combined with interviews to develop preliminary market assessments for the selected SIC's, and 3) a research plan was developed to guide the Phase II effort. Phase II efforts delved more deeply into the selected SIC's using a customer survey, vendor interviews and additional literature review/research to identify key programmatic elements and recommendations.

Exhibit 3-1
Study Approach



Phase I involved a literature search, program manager interviews, program review, industry expert interviews, and secondary data analysis involving energy characterization at the 2-, 3-,

and 4-digit SIC levels and program participation – all of which contributed to a detailed research plan to guide Phase II data collection and analysis.

The resulting energy/market characterization conducted in Phase I examined energy consumption (for small/medium customers, defined as those using less than 1.5 GWh[3]) at the 4-digit SIC level. Statewide electric and gas use is reported in Appendices A and B, along with an assessment of the relationship between noncoincident peak demand and energy use in Appendix C. These energy use results were also used to select industries for study emphasis, as described in *Section 3.1* below.

The program participation analysis conducted in Phase I included the number of sites participating, rebates paid and energy saved through the Express and SPC programs. Detailed participation data are included in Appendices D and E. These program participation findings also contributed to the industry selection effort, by favoring the selection of those with the higher participation levels.

Findings regarding end uses, technologies, business drivers, and other aspects of program participation that apply to the selected industries, are presented in Appendix F.

The literature review and industry expert interviews were used to formulate hypotheses about the characteristics of energy efficiency markets/customers, the probable implications of those characteristics on program participation, and enhanced intervention strategies to better address selected Study markets. Appendix G lists the industry experts interviewed, including industry association leaders and energy efficiency experts at DOE and EPA. Appendix H lists IOU program managers and third party program administrators that were interviewed in Phase I. Appendix I lists literature sources consulted.

Based on the above data sources expectations were developed about the energy efficiency outlook and business issues facing both the small industrial market and, more specifically, the four (2-digit SIC) industries selected for study. The hypotheses guided the development of Phase II data collection instruments, with individual hypotheses being tested through the use of specific questions. Exhibit 3-2 summarizes these hypotheses and links them both with indicators that can be used to test the hypotheses and with data sources that can provide input to proving or disproving them.

In Phase II the market characterization draws on customer survey data and supplier interviews to test expectations about customers' needs and wants in the small industrial market. The customer surveys were the primary source of information for hypothesis testing, with supply side interviews, program tracking data, and literature review providing corroborating evidence and additional information. Phase II activities consisted of 382 customer surveys and 23 vendor interviews to support hypothesis testing. The Customer Survey instrument is presented in Appendix J. The vendor interview guide can be found in Appendix K.

[3] 1.5 GWh annual electric use was used as a proxy for the under 500 kW market. It was necessary to use annual electric use because many small customers are not billed on demand and therefore kW data are not available for all customer classes. 1.5 GWh is equivalent to 3,000 hours of operation per year at the maximum 500 kW cutoff point for medium sized customers.

Exhibit 3-2
Hypotheses, Indicators, and Data Sources

Hypotheses	Indicators	Customer Surveys	CIS	Tracking Data	Industry Expert	Program Review	Supply-Side Interviews	Literature Review
END-USE/PROCESS/TECHNOLOGY								
Technology penetration is lower for small/medium industrial customers than large facilities	Level of adoption compared to large facilities	•		••	•		••	•
Motors of various kinds are major users of energy in almost all industrial sectors	Energy breakdown by end use	•			••			••
Upstream suppliers play an important role in influencing the level of EE incorporated into production lines	Suppliers cited as important sources of information	••			•		••	
Manufacturing end-use consumption of electricity and gas does not vary dramatically by customer size	Energy intensity				•			•
Small industrial customers use proportionately less gas than large customers	Energy breakdown by end use		•		•			••
PARTICIPATION								
Participation rates are likely to be lower for small/medium industrial customers than their large counterparts	Participation rate			••				
Customers with multiple sites are more likely to participate than those with a single site	Participation data, self-reported intentions	••		••				
Customers who have an EE champion on staff or a corporate policy to buy EE models are more likely to have participated than customers who have neither of these	Presence of on-staff energy specialist	••			•		•	
Participation in SPC programs is relatively lower among small industrial customers than participation in other programs	Participant data			••	•	•		
Small industrial customers are more likely to adopt simple, easy-to-understand measures (e.g., setback thermostats, lighting)	Measure adoption, participation rates	••		••		•		
Customers that outsource to maintenance companies (typically involves refrigeration) are unlikely to participate	Participation rates for companies that do and don't outsource	••		•	•	•		•

KEY: •• Indicates source is of primary importance for indicator; • Indicates secondary importance

Exhibit 3-2
Hypotheses, Indicators, and Data Sources (Continued)

Hypotheses	Indicators	Customer Surveys	CIS	Tracking Data	Industry Expert	Program Review	Supply-Side Interviews	Literature Review
CUSTOMER CHARACTERISTICS								
Small/medium customers should be receptive to ways to cut costs	Attitude data	••			•			•
EE is not a top priority for most small industrial customers	Relative importance assigned in survey responses	••			•		••	
With enough incentive (i.e., high prices), industrial customers have substantial flexibility in modifying their processes and schedules to reduce energy costs	Surveys (past and pending), focus groups	••			•			•
Small customers are likely to be cost-conscious regardless of whether their industry is growing or mature	Relative importance assigned in survey responses	••			•			
Industrial customers want to minimize downtime, and EE measures must be consistent with that need	Relative importance assigned in survey responses	••			•		••	•
The smaller the customer, the less educated they are about energy efficiency	Awareness rate by size	••			••			•
OTHER MARKET ACTORS								
ESCOs do not find small industrial customers profitable	ESCO attention by customer size	•			•		•	
Customers are generally skeptical or suspicious of unfamiliar suppliers offering EE benefits	Customer attitudes	••			•		••	
Specialized design engineers are less likely to play a role than distributors of off-the-shelf equipment	Importance of information sources	••			•		•	•
INTERVENTION STRATEGIES								
Small industrial customers are more likely to do O&M than capital projects like retrofits	Types of measures installed, programs participated in	•			•	•	••	
Turnkey solutions are well-suited for small industrial customers	Perceptions of industry experts, plant managers	•			••	•		•
Complex industrial processes do not lend themselves to prescriptive rebates.	Participation in rebate programs	•			••	•		••
Direct install program may be suitable for small industrials	Past participation, customer perceptions	•			•	•		•
Rebates for simple measures may encourage participation	Past participation, customer perceptions	•		••	•	•	••	

KEY: •• Indicates source is of primary importance for indicator; • Indicates secondary importance

3.1 TARGETED INDUSTRY SEGMENTS

On the basis of maximizing segment-level energy use and (relatively high) program participation levels, five industries (at the 2-digit SIC level) were initially identified for inclusion in the Small Customer Wants and Needs study. Energy consumption (less than 1.5 GWh) was a key determinant in the industry selection process. Exhibit 3-3 below shows the industry segments selected for study in Phase I, their electric use and percentage of small industry included in the study, at the 2-, 3- and 4-digit SIC levels.

The four largest industries in terms of small/medium site energy consumption – Food Products, Fabricated Metals, Industrial Machinery, and Electronics – together comprise 44% of small/medium electric use.

Exhibit 3-3
Selected Phase I Industry Segments
Annual Electric Use for Sites less than 1.5 GWh (1999)

	Electric Use by Customer Size (MWh)					Distribution of Usage by Industry	Selected Segments (% of Small Industry to Study)*
SIC-Based Industry	< .1 GWh	0.1-0.5 GWh	0.5-1 GWh	1-1.5 GWh	Total Small and Medium Industrial		
20 Food	46,946	17,328	169,332	123,067	512,628	9%	39%
203 Fruits and Vegetables	3,675	20,732	37,363	31,309	93,080		18%
2084 Wines Brandy and Brandy Spirits	12,792	42,316	30,899	20,237	106,244		21%
27 Printing	106,517	135,091	118,310	58,711	418,628	8%	100%
34 Fab Metals	76,546	224,508	163,740	98,632	563,427	10%	63%
344 Fabricated Structural Metal Products	34,166	81,098	49,467	32,721	197,451		35%
347 Electroplating Plating Polishing Coating Engraving	17,285	70,232	46,982	21,088	155,587		28%
35 Industrial Machinery	147,527	280,005	184,287	146,389	758,208	14%	35%
354 Metalworking Machinery	21,607	41,040	25,607	26,306	114,559		15%
357 Computer Equipment	9,870	37,749	43,153	63,038	153,811		20%
36 Electronics	51,414	181,971	189,254	168,575	591,215	11%	60%
367 Semiconductors and Related Electronics	26,216	110,579	112,674	104,805	354,274		60%
Other SICs	352,652	885,466	811,493	624,443	2,674,054	48%	
Total Small and Medium Industrial	**615,704**	**1,564,191**	**1,402,322**	**1,173,577**	**4,755,795**	**100%**	**29%**

* shows the SIC2 percentage represented by the SIC3 and SIC4 industries selected.

Phase 1 research activities – literature review and interviews with industry experts – were completed for the following industry groups.

- **Food Processing** (SIC 20), concentrating on fruit and vegetable processing (SIC 203) and wine (2084).

- **Metal Fabrication** (SIC 34), concentrating on fabricated structural metal products (SIC 344, notably metal finishing and sheet work) and surface finishers (SIC 347), the biggest energy-using sub-industries.

- **Industrial Machinery** (SIC 35), concentrating on its largest energy-using segments, metalworking (SIC 354, 15%) and computers (SIC 357, 20%).

- **Electronics** (SIC 36): Semiconductors (SIC 367) are by far the largest electronics segment, accounting for 60% of electronics manufacturers' electricity usage.

- **Printing** (SIC 27) or Apparel (SIC 23): These industries, though smaller energy users, have a high concentration of small customers, who may have distinct energy efficiency decision-making dynamics. To study these dynamics printing companies were included in our customer survey.

Despite the significant proportion of consumption accounted for by the electronics industry, we ultimately decided not to include this in Phase 2 of the study.

- Although the IOU customer information system database (CIS) indicates that many semiconductor companies qualify as small by our definition (based on site-level electric and gas use), closer inspection suggests that many of these establishments have ties to larger companies.
  - For example, a sample of 100 sites identified as small/medium included plants owned by Samsung, Intel, Rohm Device, Phillips and General Electric.
  - Several sites were also found to be wholly-owned subsidiaries of larger companies.

- While there are also smaller firms in the market, the facilities affiliated with larger industry players are not likely to exhibit decision making and needs that are consistent with the focus of this study.

- In addition, we found that the semiconductor industry has been well studied, and literature already available can be used to develop program designs and draw conclusions. Program design suggestions include new construction and design initiatives, incentives to offset small O&M budgets, an alliance with leading industry associations like SEMATECH[4] and efforts involving energy efficient tools and HVAC best practices.

For these reasons, electronics was not included in the Phase II effort. The semiconductor industry assessment presented in Appendix F, which was completed in Phase I, does address some hypotheses developed in this chapter and, like those mentioned above, offers some program design suggestions.

To summarize, having dropped Electronics, the Phase II research concentrated on the following industry groups: food processing (fruit and vegetable processing, wineries), metal fabrication (metal finishing and sheet work), industrial machinery and printing. A snapshot of each industry is presented at the beginning of Chapter 4. More detailed Phase I industry findings are presented in Appendix F.

[4] SEMATECH is a leading semiconductor industry research consortium. Member companies cooperate precompetitively in key areas of semiconductor technology, sharing expenses and risk. Their aim is to accelerate development of the advanced manufacturing technologies needed for the next generation of semiconductors.

In tables throughout the report, Industry segments are reported at 2-, 3- and 4-digit SIC levels. Note that the data reported at the SIC2 level for food, fab metals, industrial machinery and electronics does not represent all segments for that industry, but rather the total of the **selected industry segments** shown in Exhibit 3-3. For example, data on food processing represents all survey points for the fruit and vegetable processors and wine segments only, not all of the SIC20 industry segments.

3.2 DATA COLLECTION

The bulk of primary data collection consisted of telephone surveys with small/medium industrial customers from the four industries and supplier interviews.

Customer surveys. Customer data were collected through telephone interviews conducted with customers statewide during November-December 2002. The sample design targeted 400 small and medium sized customers in 7 industries. Primary quotas were assigned based upon industry and customer size (Final quotas are further specified by IOU service territory). Customer size is a function of annual energy use; we defined a small customer as using less than 0.5 GWh per year, and a medium sized customer as using between 0.5 and 1.5 GWh per year. 1.5 GWh annual electric use is used as a proxy for the under 500 kW market. It was necessary to use annual electric use to define customer size because many small customers are not billed on demand and therefore kW data are not available for all customer classes. Refer to Appendix C for the observed relationship between kW demand and annual kWh electric use. Primary sample quotas are shown below.

Exhibit 3-4
Statewide Sample Quotas by Industry and Customer Size

Industry	SIC Code	Small	Medium
Fruits and Vegetables	203	**35**	**15**
Wines Brandy and Brandy Spirits	2084	**40**	**10**
Printing	27	**40**	**20**
Fabricated Structural Metal Products	344	**45**	**15**
Plating Polishing Coating Engraving	347	**45**	**15**
Metalworking Machinery	354	**45**	**15**
Computer Equipment	357	**45**	**15**
Total		**295**	**105**

In order to ensure proportional representation across the four California IOUs within each industry/size category, final sample quotas were developed at the IOU service territory level. For each industry/size category shown in the table above, the statewide population distribution across IOU's was used to allocate final quotas across IOU territories. For example, 42 percent of the statewide small Fruits and Vegetables customers are in PG&E service territory. The quota for the small Fruits and Vegetables cell is 40, so PG&E is allocated 42 percent of the 40 points in this category, or 15 sites. (Some adjustments to the resulting quotas were made to compensate for rounding errors.)

The overlapping territories of SoCalGas and SCE were handled by excluding from the SoCalGas sample pool all customers in SCE service territory. This was done by zip code matching. The remaining SoCalGas customers were assigned quotas in the same manner described above. For SoCalGas customers, 'small' is defined as less than 10,000 therms per year, and medium sized customers use between 10,000 and 50,000 therms per year.

The quotas by industry, size and IOU are shown in the table below.

Exhibit 3-5
Quotas by Customer Size, Industry and IOU Service Territory

		Small					Medium				
			PGE	SCE	SDGE	SCG		PGE	SCE	SDGE	SCG
Industry	SIC Code	Total Industry/ Size Quota	0 - 0.5 GWh	0 - 0.5 GWh	0 - 0.5 GWh	0-10,000 Therms	Industry/ Size Quota	0.5 -1.5 GWh	0.5 -1.5 GWh	0.5 -1.5 GWh	10,000 - 50,000 therms
Fruits and Vegetables	203	**35**	15	12	3	5	**15**	10	4	0	1
Wines Brandy and Brandy Spirits	2084	**40**	36	2	1	1	**10**	9	0	0	1
Printing	27	**40**	16	16	5	3	**20**	7	10	2	1
Fabricated Structural Metal Products	344	**45**	14	25	3	3	**15**	6	7	1	1
Plating Polishing Coating Engraving	347	**45**	10	28	4	3	**15**	2	10	0	3
Metalworking Machinery	354	**45**	6	33	3	3	**15**	2	11	1	1
Computer Equipment	357	**45**	20	14	8	3	**15**	12	2	1	0
Total		**295**	117	130	27	21	**105**	47	45	6	7

The 382 resulting completes closely follow the sample design, as presented in Exhibit 3-6.

Exhibit 3-6
Completes by Customer Size, Industry and IOU Service Territory

		Small					Medium				
			PGE	SCE	SDGE	SCG		PGE	SCE	SDGE	SCG
Industry	SIC Code	Total	0 - 0.5 GWh	0 - 0.5 GWh	0 - 0.5 GWh	0-10,000 Therms	Total	0.5 -1.5 GWh	0.5 -1.5 GWh	0.5 -1.5 GWh	10,000 - 50,000 therms
Fruits and Vegetables	203	**32**	18	12	1	1	**14**	8	6	0	0
Wines Brandy and Brandy Spirits	2084	**40**	38	2	0	0	**10**	10	0	0	0
Printing	27	**51**	25	16	10	0	**20**	7	10	2	1
Fabricated Structural Metal Products	344	**47**	16	25	6	0	**16**	8	7	1	0
Plating Polishing Coating Engraving	347	**50**	12	28	8	2	**15**	2	10	0	3
Metalworking Machinery	354	**45**	7	34	4	0	**13**	2	11	0	0
Computer Equipment	357	**24**	9	14	1	0	**5**	3	2	0	0
Total		**289**	125	131	30	3	**93**	40	46	3	4

Supply side interviews. Interviews with supply side actors included contractors and maintenance companies, including those with design/build capabilities. The supplier sample was developed from the customer interviews. We asked customers for names of companies they use for repair or replacement of production equipment.

In all, 23 suppliers were interviewed, with the following characteristics.

- These vendors supplied boilers, compressed air, HVAC, motors, machine tools, pumps, printing equipment, winery equipment, metal canning lines for food processors,

industrial gases, bottling equipment, wet processing equipment and liquid filling machines.

- Most supply all industrial customers while also serving a few particular industries. Some targeted a single industry. Three specifically mentioned the food processing industry. Two suppliers served metal fabricators and metal finishers. Two mentioned the printing industry. Two dealt with wineries. Another targeted machine shops and job shops in manufacturing.

- The median number of people employed by a supplier (in all locations) was 48. The largest, a major supplier of industrial gases, employs 26,000 worldwide. By contrast, one refrigeration contractor employed 5 people. Suppliers were interviewed at locations ranging from a one-man shop to a facility employing 400 people. The median size at the respondent's location was 15 people. Thirty-seven percent of suppliers were based in California. The median number of people employed at these suppliers' non-California location was seven people.

- Small customers (defined as companies with less than 50 employees) usually made up less than 50% of suppliers' sales. The five suppliers for whom small customers made up over 70% of revenues tended to be fairly small companies that specialized in particular industries and technologies (such as computer-driven metal cutting machine tools or liquid filling machines for the packaging industry).

This concludes the Study methods section. Study findings are presented next.

4. MARKET CHARACTERIZATION

In this chapter, we present the results of our market characterization, integrating results from all the data sources described previously. The following aspects of the market are discussed:

- Energy/end use characterization, describing the overall electric and natural gas use of the small to medium industrial segment, as well as the usage of the selected industry groups
- Business demographics, describing the distribution of customers by size, location, and operating characteristics
- Customer needs and wants, including the perceived importance of energy efficiency relative to other business drivers
- Energy efficiency practices, including conservation actions, program participation, and purchases of energy efficient machinery
- Knowledge, awareness, and information sources regarding energy efficient technologies

For clarity of presentation, the most important findings are summarized in **bold letters** at the start of each section, with subsequent data and analysis providing support for and elaboration on these key results. As noted previously, in the tables presenting survey results in this chapter, "food" "fab metals" "industrial machinery' and electronics" refer to the industry segments selected for study, not the entire industry (at the SIC2 level). For example, fab metal data represents all survey points for the fabricated structural metal products (SIC 344) and electroplating (SIC 347) segments only, **not all** fab metal industry segments.

At the 2-digit SIC level the following are salient features of the industries selected.

FOOD PROCESSING (SIC 20)

- Food processing employs (in all size plants) more than 180,000 workers in California. Despite the overall importance of large national corporations in the food industry, there are thousands of smaller operations in both the fruit and vegetable processing and wine segments.
- Food processing tends to be a commodity business characterized by seasonal production.
- Natural gas dominates food processors' energy use, but electric use is also significant. Major end uses are process heating, process cooling and refrigeration, and motors to drive production equipment (mixers, pumps, conveyors).
- EE is generally not seen as a high priority due to the focus on maximizing throughput during the short processing season. However, recent sharp increases in energy costs

have made the food processing industry much more aware about the importance of controlling energy costs.

- Opportunities for improved EE are said to exist in all aspects of food processing, from more efficient, lower emission boilers to high efficiency motors and adjustable-speed drives (ASDs) for production equipment, and improvements in refrigeration.

PRINTING (SIC 27)

- Printing is a fairly fragmented industry characterized by small printing shops. Small printing shops account for 25% of the industry's electric use, with medium-sized establishments another 18%. Small shops alone account for 94% of customer sites.

- The printing industry is competitive with relatively low profit margins, putting the onus on cost controls. The industry has environmental and waste reduction concerns because printing solvents produce volatile organic compounds. Venting and incineration of these compounds is highly regulated.

- Energy costs for the average printer run between 1-3% of the total cost of annual sales. Motor drives are the biggest electric end use. Press operations account for about 33% of total facility use, followed by HVAC.

- EE opportunities are most readily illuminated by highlighting the link between energy use, waste reduction and quality improvement. For example, technologies that provide both an alternative to the use of expensive emission control equipment and reduced energy use. Standard measures such as lighting retrofits should be promoted. Process improvements, such as energy recovery ventilation, a variable drive for the main induction fan for the oxidizer, heat recovery from drying ovens used in heatset printers (to heat their shop) and high-efficiency dryers that use less gas than standard dryers are also good energy efficiency candidates.

FABRICATED METALS (SIC 34)

- California has more metal products businesses than any other state; 4,105 small/medium metal fabrication shops across the four California IOU's. The fabricated metal products industry typically shapes metals and performs metal finishing. The industry is characterized by many "job shops" (small, independently owned companies) as well as large metal fabricating companies.

- Small metal fabricators are fighting to survive in a commodity business in economic recession.

- The California metal fabricating industry accounts for 10% of the electricity used by small industrial customers. Exhaust fans (25%), electroplating (24%) and lighting (11%) are the biggest end uses for metal finishing, the most energy intensive industry

segment. Process tank heating and boilers are the two biggest heating end uses in metal finishing (Mazzeo, 1979).[5]

- Small shops, while cost-conscious, do not tend to be very aware of EE opportunities. Metal finishing industry experts interviewed as part of this study point to EE opportunities in process optimization (ventilation, steam, process heat).

INDUSTRIAL MACHINERY AND EQUIPMENT (SIC 35)

- The industry is broad in scope, comprising the manufacture of all types of capital equipment, from simple gears to complex computers. Metalworking (SIC 354), the "old economy" segment, is dominated by small, independent machine shops.

- The industrial machinery sector has been among those most hard-hit by the economic downturn.

- Usage varies by segment in this industry. The cost of purchased electricity amounts to less than 0.2% of the value of shipments for computer manufacturers, but almost 1.5% of the value of shipments for cutting tool and machinery manufacturers (1997 Economic Census).

- Both motor-driven production equipment and process heat are integral to metalworking equipment manufacturers, while non-process uses account for over half the electricity usage of computer and office equipment manufacturers. Industry-wide, major energy uses include process heating (10% of electricity and 33% of gas use), machine drive (44% of electricity), facility HVAC (17% of electricity; 36% of natural gas) and facility lighting (15% of electricity) (Energy Information Administration, Manufacturing Energy Consumption Survey, 1994 MECS Tables and Spreadsheets).

- Interest in EE is low because energy accounts for a small percentage of production costs. These companies face a dismal business climate, and plant managers lack the time and willingness to pursue savings opportunities.

- The most likely prospects for improved energy efficiency in the industrial machinery sector are in more efficient motors and ASDs for production equipment, process heating (primarily for metalworking equipment manufacturing) facility lighting, and HVAC. The importance of non-process end uses among computer and electronic equipment manufacturers results in opportunities for standard C/I HVAC and lighting efficiency measures.

[5] Mazzeo's findings remain relevant to the industry, as metal fabrication processes have not changed substantially in recent decades.

4.1 ENERGY CHARACTERIZATION

This energy characterization presents annual statewide electric and gas use for all customers in the targeted industries who meet our definition of small and medium sized (electricity consumption under 1.5 GWh) in the selected industries. Results are organized both by industry and by customer size. Both CIS and customer survey data contributed to this analysis.

4.1.1 Electric and Natural Gas Usage

The selected industries -- food processing, printing, fabricated metals and industrial machinery -- together account for 28% of small and medium industrial electric use and 22% of industrial natural gas consumption, with industrial equipment manufacturers accounting for the largest share of electric use because of their sheer numbers, and food processors accounting for the largest share of gas use because of their use of both direct and indirect process heat.

Usage trends are summarized below. Detailed statistics can be found in the Appendices (Exhibits A-1 and B-1).

Food processing. Food processing is the biggest energy user of any industry in California, ranking first in electricity use (accounting for 12% of industrial electricity consumption) and second only to the petroleum industry in natural gas consumption (accounting for 17% of total industrial gas consumption). The food processing industry uses a relatively larger share of gas than electricity.

Small food processing operations (that is, those with usage of less than 0.5 GWh) make up the bulk of this industry's electric sites (84%), but claim only 13% of the industry's electricity consumption. This trend holds true on the gas side as well; small processors comprise 70% of sites using natural gas, but account for less than 1% of the industry's gas consumption.

While medium sized food processors dominate the industry's usage, small processors' gas and electricity usage per site exceeds that of their printing peers, small fabricated metal shops and machine shops. Average consumption per site reveals small food processors to be the most energy-intensive segment of the four industries, using 200 MWh and 8,013 therms per site on average. Medium sized processors use about six times more electricity and 39 times more gas per site than small food processors.

Industrial Machinery. Small and medium customers in the industrial machinery industry (defined as those with energy consumption under 1.5 GWh) – claim the most sites and account for more energy usage than any the other four industries selected (758 GWh). However, customers in this segment are not very energy intensive with regard to either electricity (103 MWh/site) or gas (346 therms/site). While machine shops in the metalworking machinery segment make extensive use of motor driven equipment, many of the facilities in the computer equipment segment engage primarily in assembly and therefore use less electricity.

Fabricated Metals. Energy usage of the fabricated metals industry resembles the industrial machinery segment. The small/medium customers that are the focus of this study account for 96% of all electric sites but about one-third of electric use. Likewise, small/medium fabricators account for 90% of gas sites but only 10% of gas usage. Average consumption per

small/medium site is 137 MWh annually. Gas intensity (4,151 therms per small/medium site) is second only to food processors among the selected industries.

Printing. The printing industry is even more dominated by small operations (98% of sites consume less than 1.5 GWh annually). These small/medium printers account for 43% of that industry's electricity consumption – a larger percentage than any other industry – but their share of the industry's gas usage is much smaller (17%). Printing is not an energy intensive activity, accounting for 75 MWh per site on average – the lowest of any of the four industries selected.

4.1.2 Energy Costs

Supporting the hypothesis that gas usage is relatively lighter among small customers, survey respondents reported spending about seven times more on electricity than on natural gas, with fruit and vegetable processors and electroplating shops spending the highest proportions on gas. On average, energy costs were estimated to account for more than 10 percent of total operating costs, with energy efficiency program participants generally reporting a higher percentage than non-participants.

Self-reported survey data presented in Exhibit 4-1 confirm the previous result that each industry uses more electricity than natural gas, but that food processors are the biggest natural gas users at the SIC2 level. Fruit and vegetable processors are particularly natural gas intensive, as are metal finishers (SIC 347).

Exhibit 4-1
Distribution of Energy Bill (Self-Report)

SIC-Based Industry	Average Percent of Annual Energy Bill				Number of Respondents
	Electricity	Natural Gas	LP Gas	Fuel Oil/Other	
Food (SIC 20)	75%	16%	8%	1%	94
203 Fruits and Vegetables	67%	28%	5%	0%	45
2084 Wines Brandy and Brandy Spirits	82%	5%	11%	2%	49
Printing (SIC 27)	92%	7%	1%	0%	67
Fab Metals (SIC 34)	85%	13%	2%	1%	120
344 Fabricated Structural Metal Products	90%	6%	3%	1%	59
347 Electroplating Plating Polishing Coating Engraving	80%	19%	1%	0%	61
Industrial Machinery (SIC 35)	88%	9%	1%	3%	83
354 Metalworking Machinery	86%	9%	2%	3%	55
357 Computer Equipment	90%	9%	1%	1%	28
Small customers (less than 0.5 GWh)	85%	10%	3%	1%	276
Medium customers (0.5 - 1.5 GWh)	81%	16%	3%	1%	88
Total	84%	12%	3%	1%	364

Exhibit 4-2
Energy Cost as Percentage of Total Operating Cost

SIC-Based Industry	Energy cost are what percentage of total operating costs?											Number of Respondents
	<1%	1-2%	2-3%	3-4%	4-5%	5-6%	6-10%	10-15%	16-25%	26-50%	>51%	
Food (SIC 20)	38%	7%	1%	5%	3%	9%	4%	7%	7%	16%	2%	96
203 Fruits and Vegetables	22%	9%	0%	9%	2%	11%	7%	7%	11%	22%	2%	46
2084 Wines Brandy and Brandy Spirits	52%	6%	2%	2%	4%	8%	2%	8%	4%	10%	2%	50
Printing (SIC 27)	31%	4%	11%	10%	4%	8%	6%	7%	4%	8%	6%	71
Fab Metals	23%	6%	4%	3%	1%	17%	3%	12%	13%	11%	6%	128
344 Fabricated Structural Metal Products	22%	11%	5%	5%	0%	17%	3%	13%	10%	13%	2%	63
347 Electroplating Plating Polishing Coating Engraving	25%	2%	3%	2%	2%	17%	3%	11%	17%	9%	11%	65
Industrial Machinery (SIC 35)	26%	7%	5%	6%	0%	18%	6%	13%	9%	8%	2%	87
354 Metalworking Machinery	29%	3%	5%	5%	0%	14%	9%	14%	9%	10%	2%	58
357 Computer Equipment	21%	14%	3%	7%	0%	28%	0%	10%	10%	3%	3%	29
Small customers (less than 0.5 GWh)	31%	6%	4%	6%	1%	14%	5%	9%	9%	10%	4%	289
Medium customers (0.5 - 1.5 GWh)	24%	6%	5%	5%	3%	13%	3%	12%	10%	15%	3%	93
Participant*	21%	2%	2%	15%	2%	10%	4%	13%	13%	15%	4%	48
Non-Participant**	30%	6%	5%	4%	2%	15%	5%	10%	9%	10%	4%	324
Total	111	24	18	21	7	53	17	38	35	42	16	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

One of the hypotheses formulated for this study was that the energy intensity of production processes would be relatively similar for small and large customers. However, the survey results do not support this hypothesis.

- According to the U.S. Census 2000 annual survey of manufacturers, for manufacturers of all sizes nationwide the cost of energy (purchased fuels and electricity) amounted to 3.8% of value added shipments for all manufacturing and 3.3% for fruit and vegetable processors.

- Exhibit 4-2 presents survey responses to questions regarding energy cost as a percentage of total operating cost. These results indicate that, on average, perceived costs are slightly higher among small industrial users than medium-sized customers. At the same time, it appears that as many as a third of respondents (the 135 who estimate energy at less than 2% of operating costs) do not appear to place a high importance level on their energy costs.

- Exhibit 4-2 suggests that high energy cost segments among those studied include fruit and vegetable processors and metal finishers. These data, while not entirely reliable, offer directional findings. For example, one-third of fruit and vegetable processors report that energy accounts for 16-50% of their operating costs (metal finishers estimate this percentage 26% of the time). Wineries claim much lower energy costs: 58% report that energy bills are less than 2% of their operating costs. Again, these self-reports indicate the relative importance that survey respondents place on their energy costs.

Energy efficiency program participants[6] seem to be responding to price signals. A comparison of participants and non-participants shows that non-participants tend to report lower energy costs than participants. While 36% of non-participants report energy costs that are less than 2% of operating costs, participants report this just 23% of the time. And while 19% of non-participants report energy costs that account for between 16 to 50% of their operating costs, participants report this 28% of the time.

4.1.3 End-Use Distributions

The most important electric end uses among small manufacturing customers are production machinery, refrigeration (for food processors only), lighting, and to a lesser extent space cooling and heating. Since most production machinery is motor-driven, this tends to confirm the hypotheses that motors are an important end use. The leading gas end use is process heating for SIC 203 (fruit and vegetable processing) and SIC 347 (electroplating, polishing, and engraving); with space heating for all other segments.

[6] Participants are respondents who indicated they participated in an energy efficiency program offered by their utility in the last two years.

Self-reported data on customers' biggest two end-uses is presented in Exhibit 4-3a and b[7]. Exhibit 4-3a presents electric end uses; Exhibit 4-3b shows natural gas usage.

This self-report data, representing customer perceptions of their largest end uses, can help determine the areas in which customers are most likely to make energy efficiency improvements. It is important to keep in mind that lighting, as a "visible" end use, tends to be over-reported, in comparison with motors or HVAC. Also, these end-use data do not capture the true importance of motors. Motors are a component common to many end uses – production machinery, heating and cooling, compressors, pumps, ventilation and refrigeration all rely heavily on motors yet because they are embedded in equipment, their contribution is easy to underestimate.

[7] All the data presented in this section comes from customers self-reported energy use, which can be less accurate than other data sources. In both cases, responses were given to an open-ended question asking for the facility's two biggest end uses.

Exhibit 4-3a
Two Largest Electric End Uses by Industry and Size (Self-Reported)

SIC-Based Industry	Biggest Uses of Electricity																Number of Respondents
	Lighting	Space Heating/ Cooling	Ventilation	Production Machinery	Motors	Compressors	Pumps	Process Heat	Fans/ Blowers	Refrigeration	Production Tools	Process or Hydro Cooling	Computers	Rectifier	Welding	Other	
Food (SIC 20)	35%	23%	2%	52%	7%	7%	16%	2%	2%	45%	0%	2%	0%	0%	0%	1%	96
203 Fruits and Vegetables	39%	11%	4%	70%	9%	2%	4%	2%	4%	43%	0%	0%	0%	0%	0%	0%	46
2084 Wines Brandy and Brandy Spirits	32%	34%	0%	36%	6%	12%	26%	2%	0%	46%	0%	4%	0%	0%	0%	2%	50
Printing (SIC 27)	61%	25%	1%	82%	8%	8%	0%	1%	0%	1%	1%	0%	3%	0%	0%	0%	71
Fab Metals (SIC 34)	60%	5%	0%	81%	13%	14%	1%	8%	0%	2%	5%	2%	0%	2%	2%	1%	128
344 Fabricated Structural Metal Products	68%	2%	0%	87%	13%	14%	0%	0%	0%	0%	10%	0%	0%	0%	3%	0%	63
347 Electroplating Plating Polishing Coating Engraving	52%	8%	0%	75%	12%	14%	2%	15%	0%	3%	2%	3%	0%	3%	0%	2%	65
Industrial Machinery (SIC 35)	72%	16%	2%	78%	6%	10%	1%	1%	0%	0%	0%	0%	3%	0%	0%	1%	87
354 Metalworking Machinery	67%	5%	0%	93%	9%	14%	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	58
357 Computer Equipment	83%	38%	7%	48%	0%	3%	0%	0%	0%	0%	0%	0%	10%	0%	0%	3%	29
Small customers (less than 0.5 GWh)	58%	16%	0%	72%	7%	10%	6%	5%	0%	12%	2%	1%	1%	0%	1%	1%	289
Medium customers (0.5 - 1.5 GWh)	52%	16%	4%	76%	14%	11%	1%	0%	1%	12%	1%	1%	1%	1%	0%	1%	93
Total Responses	217	60	5	280	34	40	17	14	2	46	8	4	5	2	2	3	382

Exhibit 4-3b
Two Largest Natural Gas End Uses by Industry and Size (Self-Reported)

SIC-Based Industry	Biggest uses of Natural Gas										Number of Respondents
	Space Heating	Space Cooling	Direct Process Heat	Indirect Process Heat	Cogeneration	hot water	oven	production machinery	Other	Don't know	
Food (SIC 20)	42%	4%	57%	23%	2%	11%	0%	2%	0%	2%	53
203 Fruits and Vegetables	35%	3%	65%	26%	0%	9%	0%	3%	0%	3%	34
2084 Wines Brandy and Brandy Spirits	53%	5%	42%	16%	5%	16%	0%	0%	0%	0%	19
Printing (SIC 27)	71%	17%	11%	6%	0%	14%	3%	0%	0%	3%	35
Fab Metals (SIC 34)	59%	16%	36%	5%	2%	4%	1%	7%	0%	0%	81
344 Fabricated Structural Metal Products	84%	31%	16%	3%	0%	3%	0%	3%	0%	0%	32
347 Electroplating Plating Polishing Coating Engraving	43%	6%	49%	6%	4%	4%	2%	10%	0%	0%	49
Industrial Machinery (SIC 35)	69%	17%	15%	4%	4%	10%	6%	2%	4%	0%	48
354 Metalworking Machinery	61%	6%	19%	6%	6%	13%	6%	3%	3%	0%	31
357 Computer Equipment	82%	35%	6%	0%	0%	6%	6%	0%	6%	0%	17
Small customers (less than 0.5 GWh)	64%	13%	28%	9%	1%	11%	2%	3%	1%	1%	151
Medium customers (0.5 - 1.5 GWh)	48%	15%	42%	11%	5%	5%	3%	5%	0%	2%	66
Total Responses	128	29	70	20	5	19	5	8	2	2	217

Food Processing. The biggest reported uses of electricity are production machinery, refrigeration, lighting and space heating/cooling. Natural gas end uses are dominated by direct and indirect process heat and space heating. Among fruit and vegetable processors, 70% cited production machinery as one of their top two electric uses and 65% mentioned process heat as a top natural gas use. Wineries were the most likely among all segments studied to mention pumps (26%) and refrigeration (46%) as major electric uses and the least likely to cite lighting (32%). Space heating (53%) and direct process heat (42%) were most often mentioned among the top natural gas uses.

Printing. On the electric side, most printers included production machinery (82%) and lighting (61%) in their top two end uses. Many of the 35 printers surveyed were able to report only a single major natural gas use, with responses dominated by space heating (71%) cooling (17%), and hot water (14%).

Fabricated Metals. Like printers, fab metal shops' biggest electrical uses lie in production machinery (81%) and lighting (60%). However, this industry was more likely to cite specific types of equipment, with the highest percentage of respondents citing compressors (13%) and/or motors (14%) among their two top electric uses. Natural gas use tends toward space heat (59%) and direct process heat (36%), the latter particularly among surface finishers.

Industrial Machinery. End use patterns in the industrial machinery industry vary significantly between metalworking machine shops and computer equipment makers. Machine shops had the highest proportion of respondents citing production machinery as a major end use (93%), compared to fewer than half of computer makers (48%). In contrast, computer makers had the highest percentage reporting lighting (83%) and space conditioning (38%) among their top two electric uses. Computer equipment makers are also the only segment in which 10% of respondents mentioned computers as a major end use (10%). The industrial machinery sector's natural gas usage is dominated by space heating.

Small Versus Medium Customers. Comparing size without regard for business type may not offer meaningful insight on customer end-use, but a few differences are worth reporting. Medium customers were more likely to report motors and compressors as major end uses, perhaps because their scale of operation made it easier to identify these as distinct from production machinery. With regard to natural gas, space heating figures far more prominently into small customers' usage (64%) than medium-sized customers (48%), while medium customers (42%) lead small in direct process heat (28%).

4.2 BUSINESS DEMOGRAPHICS

Key findings regarding respondent demographics include:

- **Small to medium sized users vary in size from fewer than 5 to more than 100 employees; from less than 2,500 square feet to more than 100,000. Facility size is positively correlated with program participation, i.e., the larger the facility, the more likely it is to have participated in an EE program.**

- **Fruit and vegetable processors most often had more than 50 employees (30%) and facilities over 100,000 square feet (16%), while metalworking machine shops most often had 5 or fewer workers (49%) and less than 5,000 square feet (46%).**

- **The larger a customer is the more likely they are to have multiple locations, and the more likely they are to participate at a higher rate. Almost 90% of small/medium manufacturers are local in scope, with either a single location or operations concentrated in one part of the state. Only 16% of small customers reported multiple locations, compared to 42% of medium customers.**

- **Facilities with year-round operations were somewhat less likely to have participated in programs. Most small/medium industrial plants run year-round, and even two-thirds of food processors reported operations 12 months a year. This is understandable as EE retrofits would likely require shutting down the facility or parts of it—something that is easier to do while the facility is unused.**

Exhibit 4-4 presents customer-provided estimates of their facility square footage. Note that two-thirds of small customers occupy facilities less than 10,000 square feet, compared to only 11% of medium-sized customers. Across industries, fruit and vegetable processors were most likely to occupy facilities over 100,000 square feet (20%), while the metalworking machinery segment had the highest concentration under 2,500 square feet (24%).

Larger area occupied appears to create opportunities for participation through such standard measures as lighting and HVAC; among participants, 27% had more than 100,000 square feet, among non-participants, only 4%. Half of the 26 respondents with more than 100,000 square feet had participated in programs, but only 2 of the 56 customers with less than 2,500 square feet had done so.

Exhibit 4-4
Floor Area of Facility

SIC-Based Industry	Total square footage of the facility									Average square footage	Number of Respondents
	Less than 2,500	2,500 but less than 5,000	5,000 but less than 10,000	10,000 but less than 20,000	20,000 but less than 50,000	50,000 but less than 100,000	Greater than 100,000	Ag/Non-facility-Outdoors	Don't know		
Food (SIC 20)	6%	16%	20%	10%	20%	10%	16%	1%	1%	46,745	96
203 Fruits and Vegetables	9%	9%	22%	4%	24%	9%	20%	2%	2%	52,477	46
2084 Wines Brandy and Brandy Spirits	4%	22%	18%	16%	16%	12%	12%	0%	0%	41,700	50
Printing (SIC 27)	21%	18%	21%	13%	20%	4%	1%	0%	1%	14,246	71
Fab Metals (SIC 34)	15%	19%	19%	16%	12%	13%	5%	0%	3%	24,712	128
344 Fabricated Structural Metal Products	14%	16%	14%	10%	17%	21%	8%	0%	0%	34,075	63
347 Electroplating Plating Polishing Coating Engraving	15%	22%	23%	22%	6%	5%	2%	0%	6%	15,043	65
Industrial Machinery (SIC 35)	18%	23%	20%	11%	16%	7%	5%	0%	0%	26,283	87
354 Metalworking Machinery	24%	22%	17%	14%	12%	7%	3%	0%	0%	16,308	58
357 Computer Equipment	7%	24%	24%	7%	24%	7%	7%	0%	0%	46,231	29
Small customers (less than 0.5 GWh)	18%	25%	24%	13%	12%	3%	3%	0%	1%	16,040	289
Medium customers (0.5 - 1.5 GWh)	3%	1%	8%	12%	28%	28%	18%	0%	2%	67,986	93
Participant*	4%	6%	17%	13%	17%	15%	27%	2%	0%	82,094	48
Non-Participant**	17%	21%	20%	13%	16%	8%	4%	0%	2%	20,725	324
Total	56	72	75	49	62	35	26	1	6	28,646	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Not surprisingly, medium-sized customers employ far more staff at their facilities. As Exhibit 4-5 shows, 85% of medium-sized customers employ more than 20 people, compared to just 19% of small industrial businesses.

Among the industry segments, fruit and vegetable processors are the most labor-intensive operations, with 30% having over 50 employees. Nearly half of the metalworking machinery shops surveyed, on the other hand, employ five or fewer people. While over half of printers employ 10 or fewer people, 10% of those surveyed employ over 100.

Exhibit 4-5
Number of Employees

SIC-Based Industry	Number of employees at the given facility							Number of Respondents
	1-5	6-10	11-20	21-50	51-100	Over 100	Don't know	
Food (SIC 20)	27%	11%	17%	26%	10%	8%	0%	96
203 Fruits and Vegetables	22%	9%	13%	26%	15%	15%	0%	46
2084 Wines Brandy and Brandy Spirits	32%	14%	20%	26%	6%	2%	0%	50
Printing (SIC 27)	37%	15%	13%	13%	8%	10%	4%	71
Fab Metals (SIC 34)	35%	13%	20%	16%	10%	5%	0%	128
344 Fabricated Structural Metal Products	35%	8%	19%	22%	10%	6%	0%	63
347 Electroplating Plating Polishing Coating Engraving	35%	18%	22%	11%	11%	3%	0%	65
Industrial Machinery (SIC 35)	38%	19%	14%	19%	7%	2%	1%	86
354 Metalworking Machinery	49%	18%	9%	12%	9%	2%	2%	57
357 Computer Equipment	17%	21%	24%	31%	3%	3%	0%	29
Small customers (less than 0.5 GWh)	45%	17%	19%	13%	2%	3%	1%	288
Medium customers (0.5 - 1.5 GWh)	0%	6%	9%	35%	31%	16%	2%	93
Total	130	55	63	71	35	23	4	381

Of the industries surveyed, Exhibit 4-6 shows that food processors are most likely to have more than one location, and 11% of food processors have 5 or more locations. Metalworking machinery shops, on the other hand, tend to be single-site businesses (88%). Medium-sized customers tend to have more multiple locations than small; only 16% of small customers reported multiple locations, compared to 42% of medium customers.

Exhibit 4-6
Number of Locations

SIC-Based Industry	Number of locations					Number of Respondents
	1	2-4	5-10	11-25	Over 25	
Food (SIC 20)	65%	24%	11%	0%	0%	96
203 Fruits and Vegetables	65%	24%	11%	0%	0%	46
2084 Wines Brandy and Brandy Spirits	64%	24%	12%	0%	0%	50
Printing (SIC 27)	83%	10%	4%	0%	3%	71
Fab Metals (SIC 34)	80%	16%	2%	1%	1%	128
344 Fabricated Structural Metal Products	83%	13%	2%	2%	2%	63
347 Electroplating Plating Polishing Coating Engraving	78%	20%	2%	0%	0%	65
Industrial Machinery (SIC 35)	83%	15%	1%	0%	1%	87
354 Metalworking Machinery	88%	12%	0%	0%	0%	58
357 Computer Equipment	72%	21%	3%	0%	3%	29
Small customers (less than 0.5 GWh)	84%	13%	3%	0%	0%	289
Medium customers (0.5 - 1.5 GWh)	58%	29%	9%	1%	3%	93
Total N	296	64	17	1	4	382

As shown in Exhibit 4-7, almost 90% of small/medium manufacturers are local in scope, with either a single location or operations concentrated in one part of the state..

- Not surprisingly, small customers employ fewer people and occupy fewer locations.
- Medium-sized businesses are much more likely (18%) to have locations outside California than small customers (3%).
- Of the industry segments represented in the study, computer equipment makers are more likely than any other segment to have facilities outside California – not surprising, given the global nature of the computer manufacturing industry. Winemakers tend to either have one facility (64%) or be concentrated in one part of California (28%), consistent with the state's wine growing regions.

Exhibit 4-7
Type of Location

SIC-Based Industry	Location of the firms facilities*				Number of Responses
	We only have one facility	Concentrated in one part of California	Located in various parts of California	Within and outside California	
Food (SIC 20)	65%	20%	10%	5%	96
203 Fruits and Vegetables	65%	11%	17%	7%	46
2084 Wines Brandy and Brandy Spirits	64%	28%	4%	4%	50
Printing (SIC 27)	83%	7%	3%	7%	71
Fab Metals (SIC 34)	80%	10%	2%	8%	128
344 Fabricated Structural Metal Products	83%	6%	2%	10%	63
347 Electroplating Plating Polishing Coating Engravi	78%	14%	2%	6%	65
Industrial Machinery (SIC 35)	83%	8%	3%	6%	87
354 Metalworking Machinery	88%	9%	2%	2%	58
357 Computer Equipment	72%	7%	7%	14%	29
Small customers (less than 0.5 GWh)	84%	10%	4%	3%	289
Medium customers (0.5 - 1.5 GWh)	58%	17%	6%	18%	93
Total	296	44	17	25	382

"Concentrated in one part of California" refers to geographically concentrated businesses that have more than one location.

Exhibit 4-8 shows that about a third of food processors' business is seasonal, while the other industries produce the entire calendar year. Fruit and vegetable processors are busiest from July through November, while wineries report that their peak production occurs in September and October. For customers with varying production schedules over the course of the year, operations at peak production involve 15-hour shifts on weekdays, 12 hours on Saturdays and 8 hours on Sundays.

Respondents with operations 12 months a year were somewhat less likely to have been program participants; among participants, 10% reported less than year-round operations, compared to 15% for non-participants. These results suggest that the opportunity to implement measures without shutting down the production line more than offsets any increase in payback attributable to reduced operating hours during part-year operation.

Exhibit 4-8
Number of Months A Facility Produces Output

SIC-Based Industry	Number of months facility produces output					Number of Respondents
	1 to 3	4 to 6	7 to 9	10 to 11	12	
Food (SIC 20)	15%	9%	3%	4%	67%	96
203 Fruits and Vegetables	13%	9%	4%	4%	67%	46
2084 Wines Brandy and Brandy Spirits	16%	8%	2%	4%	66%	50
Printing (SIC 27)	1%	0%	0%	3%	96%	71
Fab Metals (SIC 34)	0%	0%	1%	2%	98%	128
344 Fabricated Structural Metal Products	0%	0%	2%	2%	97%	63
347 Electroplating Plating Polishing Coating Engraving	0%	0%	0%	2%	98%	65
Industrial Machinery (SIC 35)	0%	0%	0%	0%	100%	87
354 Metalworking Machinery	0%	0%	0%	0%	100%	58
357 Computer Equipment	0%	0%	0%	0%	100%	29
Small customers (less than 0.5 GWh)	3%	3%	1%	2%	90%	289
Medium customers (0.5 - 1.5 GWh)	4%	0%	2%	1%	91%	93
Total	14	10	4	352	344	382

In conclusion, there appear to be substantial firmographic differences within the small/medium-sized industrial sector both across industries and size categories. In the following section, the relationship between these differences and customer wants, needs, and perceptions are explored.

4.3 CUSTOMER NEEDS AND WANTS

In this section we present the analysis of customer and supplier information on customers' needs and wants with regard to energy and energy efficiency in the context of broader business issues. The survey questionnaire is included in Appendix J.

4.3.1 Importance of Business Issues

For all customers, maintaining product quality, having a reliable electric supply, and meeting production schedules were the most important business issues, while keeping up with competitors technologically and keeping up with shifting market demand were perceived as less important. Medium sized customers generally ranked these issues higher than small customers, and program participants generally ranked these issues higher than non-participants.

Customers were asked to rank the importance of nine factors to their business on a 1 to 10 scale, where 10 means very important, as shown in Exhibit 4-9. (Note that each respondent was asked to rank the importance of 5 (randomly selected) of the 9 issues rather than the complete list, in the interest of holding down the length of time customers were kept on the phone.). In addition to comparing business attitudes by size and participation, we also consider a customer's economic position. A company's production relative to the previous year offers a rough measure of its economic outlook.

Exhibit 4-9
Customer Ranking of Business Issues

SIC-Based Industry	Average 1 to 10 rating of importance (1=Not at all important, 10=Very important)									Number of Respondents
	Maintaining Product Quality and Consistency	Meeting Your Production Schedule	Meeting Regulatory Requirements	Keeping Up Technologically with Competitors	Keeping Up with New or Shifting Market Demands	Having a Reliable, High Quality Supply of Electricity	Maintaining Your Market Niche	Maintaining a Happy and Productive Staff	Identifying and Implementing Cost Saving Measures	
Food (SIC 20)	9.6	9.1	9.0	6.5	7.6	9.3	8.9	9.0	8.4	59
203 Fruits and Vegetables	9.2	9.3	8.4	7.2	7.5	8.9	8.7	8.7	8.9	31
2084 Wines Brandy and Brandy Spirits	9.9	9.0	9.4	5.6	7.6	9.8	9.1	9.3	8.0	32
Printing (SIC 27)	9.3	9.1	8.6	7.2	7.0	9.6	8.2	9.3	8.1	43
Fab Metals	9.7	9.1	8.3	7.5	7.0	9.3	8.4	9.1	8.4	76
344 Fabricated Structural Metal Products	9.7	9.1	7.6	7.2	6.9	9.3	8.5	8.9	8.4	40
347 Electroplating Plating Polishing Coating Engraving	9.8	9.1	8.9	7.7	7.2	9.4	8.3	9.2	8.4	42
Industrial Machinery (SIC 35)	9.4	9.2	7.5	7.8	7.8	9.2	8.9	9.2	7.4	57
354 Metalworking Machinery	9.3	9.3	7.2	7.7	7.6	9.4	9.1	9.5	7.3	37
357 Computer Equipment	9.7	9.2	7.9	8.2	8.5	8.9	8.6	8.7	7.5	22
Small customers (less than 0.5 GWh)	9.6	9.1	8.2	6.9	7.1	9.4	8.4	9.2	8.0	175
Medium customers (0.5 - 1.5 GWh)	9.4	9.4	8.9	8.2	8.0	9.2	9.2	9.0	8.5	55
Participant*	9.8	9.4	9.0	8.4	7.9	9.2	9.2	9.2	8.8	32
Non-Participant**	9.5	9.1	8.2	7.1	7.2	9.4	8.5	9.1	8.0	198
This years production is MORE than last years production	9.5	9.3	8.3	7.8	7.2	9.1	8.0	8.9	7.7	52
This years production is LESS than last years production	9.6	9.1	8.4	7.1	7.4	9.3	8.7	9.3	8.2	109
This years production is about the SAME as last years production	9.6	9.1	8.3	7.2	7.3	9.6	8.8	9.1	7.9	75
Total Responses	210	216	216	223	204	219	201	187	191	223

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

While customers tended to rank most factors 8 or 9, there is some interesting variation among the different factors between industries, small versus medium customers and participants.

- **Maintaining product quality** topped the list overall. Wineries (9.9), metal finishers (9.8) and computer equipment manufacturers (9.7) ranked maintaining product and quality and consistency higher than any other segment and any other factor.

- **Reliable energy supply** was a close second in importance to customers. Winemakers (9.8) and printers (9.6) considered reliable, high quality energy more important than any other segment; less so for fruit and vegetable processors (8.9) and computer equipment makers (8.9). Reliability may be top of mind due to energy supply concerns in 2001.

- **Meeting production schedules** was important across the board, for each industry segment. Responses to this question varied little. As a machine tool supplier observed that, "These customers don't care about EE in their punch presses, shears, brakes. What they care about is throughput of the metal. Productivity is the name of the game. Throughput is main concern for the larger customer and price – what is my initial output for the machine – for the smaller customer."

- **Maintaining a happy and productive staff** was similarly important. The printing and industrial machinery industries ranked these staffing issues slightly higher than other segments. A shortage of trained machinists may explain this concern among machine shops (see Appendix F). Conversely, fruit and vegetable processors, metal fabricators and computer equipment makers displayed slightly less concern. Staffing may be a lower priority for computer makers, who, due to the recession, have a large supply of skilled labor to draw on. The same might apply to fruit and vegetable processing operations.

- **Keeping a market niche** resonated most with winemakers (9.1) – whose marketing often turns on unique flavor and quality – and metalworking machinists (9.2). Printers were the least concerned about maintaining a market niche (8.2), perhaps because their output is considered a commodity.

- **Shifting market demands** were not top of mind for these customers, with the exception of computer equipment makers. Keeping pace with technological change is a business requirement for computer makers. The useful life of a chip-making facility may be as short as three years because continuous innovations that will make the current product obsolete (see Appendix F and the Large Customer Needs and Wants Study).

- **Cost saving** did not rank as high as the production and market demands discussed above. Machine shops (7.4) and wineries (8.0) were least concerned with identifying cost saving measures, while fruit and vegetable processors (8.9) appear to be more cost conscious than any other industry segment. As a commodity priced business, it is not surprising that cost competitiveness drives fruit and vegetable processors (Appendix F and the Large Customer Needs and Wants Study). Small metal fabricators, fighting to survive in a commodity business in economic recession, ranked cost cutting above machine shops (8.4 versus 7.4).

- **Keeping pace technologically with competitors** was less important to most industries, with the notable exception of computer equipment manufacturers (8.2) – not surprising given their rapid development and production cycle. Winemakers (5.6) and printers (7.2) were least concerned about technological competition.

- **Regulatory demands** occupy food processors and printers more than any other segment. Food quality standards in the US are recognized as some of the toughest in the world, and regulatory oversight and product recall risk drives food processors' industry standards and business practices (Large Customer Needs and Wants Study). Environmental regulations drive the printing industry because printing solvents produce volatile organic compounds. Machine shops seemed to be least affected by regulatory concerns.

Small versus Medium-sized Customer Needs. Compared with small customers, medium-sized customers are more interested in keeping pace technologically with competitors (8.2 versus 6.9), keeping up with shifting market demands (8.0 versus 7.1), maintaining their market niche (9.2 versus 8.4) and finding ways to reduce costs (8.5 versus 8.0). These differences suggest that medium-sized customers are more attuned to their industry, both in terms of market and technology, and staying competitive in that market by cutting costs. It runs contrary to our expectation, however, that medium-sized customers are more cost-conscious than small customers; we expected cost concerns to resonate with both because of their generally low profit margin and acute need to stay competitive.

Participants versus Non-participants. Some key differences exist between customers that participate in utility programs and those that do not.

- The biggest difference is in the importance assigned by participants to keeping pace technologically (8.4 versus 7.1). In fact, both participant/non-participants and small/medium customers differed more on their perception of this issue than any other.

- In addition, participants tend to be more concerned with cost cutting (8.8 versus 8.0). It is not surprising that these cost-conscious customers are making use of utility rebates to reduce their costs.

- Market concerns figure more prominently for participants; they rank the shifting market 7.9 (as opposed to 7.2 for non-participants) and maintaining their market niche ranks 9.2 (versus 8.5 for non-participants).

- Finally, regulatory demands matter substantially more to participants (9.0 versus 8.2).

Some of these market concerns mirror the differences found among small and medium customers, and therefore may be more a function of size than participation, but others appear to reflect a more "proactive" approach to business that leads customers to be more aggressive in their production, marketing, and in addressing technology and regulation. It may be possible to take advantage of this finding by tailoring program marketing messages to concerns that resonate with participants.

4.3.2 Other Important Business Factors

When asked what other factors they consider to be very important to their businesses, 222 respondents offered open-ended responses that fell into the categories presented in Exhibit 4-10. Note that some of these concerns overlap with those discussed above, since some of the respondents were not asked, for example, about regulations or energy reliability, and raised those issues without prompting.

Exhibit 4-10
Additional Factors That Customers Consider Important

	Timeliness of production	Regulations	Reliable energy	Customer satisfaction	Product quality/ service	Costs	Energy cost	Staff	Economy/ market/ stay in business	Other
%	5%	5%	6%	12%	12%	12%	12%	14%	18%	19%
N	10	10	13	27	26	27	26	32	40	42

These responses reflect serious concerns among small business owners about the viability of their business. Despite the relatively low importance assigned to identifying and implementing cost saving measures, costs – either costs in general or the cost of energy -- were mentioned by 24% of the respondents. The economy and a poor market – "staying in business" – are also critical concerns, mentioned by 18% of those surveyed, echoing the concerns of several industry observers who emphasized how profoundly small business in California has been affected by the economic downturn of the past several years. Staff (both worker safety and skilled personnel) (12%), product quality (12%), and customer satisfaction (12%) were mentioned before reliable energy (6%), regulations (5%) and the importance of timely production (5%).

Concerns regarding costs and economic conditions generally do not bode well for energy efficiency investments, particularly among the smallest of the small/medium industrial customers.

To further investigate the apparent contradiction between the relatively low priority assigned to implementing cost-saving measures and the concerns about costs cited above, the following section explores what cost saving measures customers are likely to implement and what prevents them from controlling costs.

4.3.3 The Role of Cost Savings

Overall, customers are most likely to try to control costs through energy conservation and least likely to downsize their facilities or lay off workers. Customers were far more likely to conserve energy and improve business practices/training. Customers are more inclined to implement relatively low-cost, straightforward measures – training, energy conservation – than those that are costly (purchase equipment), complex (shift production) or severe (downsizing).

Implementation of Cost Saving Measures. As shown in Exhibit 4-11 below, respondents ranked their likelihood of implementing seven cost saving measures on a 1 to 10 point scale, where 10

was considered to be extremely likely to implement. Mean responses by segment ranged from 1.7 to 7.9.

Exhibit 4-11
Customers' Likelihood of Implementing Cost Saving Measures

SIC-Based Industry	Average 1 to 10 rating of likelihood of implementing these measures (1=Not at all important, 10=Very important)							Number of Respondents
	Extend or shorten production schedule	Shift production schedule	Make use of best industry practices/ training to improve productivity	Purchase equipment to improve productivity	Implement energy conservation	Layoffs and other staffing-based considerations	Downsize our production facility	
Food (SIC 20)	4.7	4.0	7.0	6.3	7.4	3.5	1.8	96
203 Fruits and Vegetables	5.5	4.3	6.7	6.2	7.5	4.0	2.0	46
2084 Wines Brandy and Brandy Spirits	4.0	3.6	7.2	6.4	7.4	3.1	1.7	50
Printing (SIC 27)	4.7	3.4	6.8	6.0	7.1	3.7	2.5	71
Fab Metals	5.1	4.4	7.2	5.7	7.3	3.9	3.0	128
344 Fabricated Structural Metal Products	4.6	4.3	7.0	6.1	7.0	3.5	2.9	63
347 Electroplating Plating Polishing Coating Engraving	5.6	4.5	7.5	5.2	7.6	4.3	3.1	65
Industrial Machinery (SIC 35)	5.2	4.4	6.6	5.5	6.7	4.2	3.7	87
354 Metalworking Machinery	5.4	4.4	6.1	5.7	6.9	3.9	3.3	58
357 Computer Equipment	4.9	4.3	7.5	5.3	6.2	4.7	4.4	29
Small customers (less than 0.5 GWh)	4.9	4.0	6.7	5.6	6.9	3.7	2.8	288
Medium customers (0.5 - 1.5 GWh)	5.1	4.4	7.7	6.6	7.8	4.2	2.7	93
Participant*	5.7	4.9	7.8	6.5	7.9	4.9	2.6	48
Non-Participant**	4.8	3.9	6.8	5.7	7.0	3.6	2.8	323
This years production is MORE than last years production	5.6	4.9	7.6	6.7	7.0	3.8	2.7	80
This years production is LESS than last years production	5.2	4.3	6.8	5.2	7.0	4.3	3.2	177
This years production is about the SAME as last years production	4.3	3.3	6.7	6.2	7.5	3.3	2.3	122
Total Responses	376	377	378	381	377	373	379	381

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Responses to each cost cutting measures are discussed below, in order of importance.

- **Energy Conservation.** Food processors (7.4), fab metals (7.3) and printers (7.1) consider themselves fairly likely to undertake conservation activities, while machine shops (6.7) are less likely to do so.

- **Training and Best Practices to Improve Productivity.** Training initiatives are popular, particularly among the fab metal (7.2) and food processing industries (7.0). In particular, metal finishers (7.5) and winemakers (7.2) responded to this possibility, while metalworking shops (6.1) are less inclined.

- **Purchase Equipment to Improve Productivity.** Customers are somewhat likely to buy equipment that improves productivity. Winemakers (6.4) and structural metal fabs (6.1)

led their peers in this regard, while metalworking shops (5.7) and computer equipment manufacturers (5.3) are less likely to make such investments. However, there is little variation among these industry segments.

- **Extend or Shorten Production Schedule.** Metal finishers (5.6), fruit and vegetable processors (5.5) and metalworking shops (5.4) are more likely than any other industry segment to change their production schedules. Such a change is improbable for winemakers (4.0).

- **Shift Production Schedule**. Production flexibility is not in evidence among these industrial customers. Printers are least likely to shift their production (3.4), while metal fabs and machine shops (both 4.4) are more likely to do so.

- **Layoffs or Staffing-based Changes.** Customers are generally disinclined to lay off workers, although some variation exists among industry segments. As above, machine shops (4.2) and metal fabricators (3.9) are slightly more likely to cut staff than printers (3.7) and food processors (3.5).

- **Downsize Facilities**. Customers do not look favorably upon downsizing. Of the selected segments, computer equipment makers are most likely to downsize production at their facilities (4.4), while wineries are the least likely (1.7). Machine shops (3.0) and fab metal shops (3.7) are more likely than food processors (1.8) or printers (2.5) to scale back production.

Small versus Medium-sized Customer Needs. Customer rankings indicate that small customers are less likely (6.9) to implement cost saving measures than medium-sized customers (7.8). This trend runs contrary to our expectation that the smaller the customer, the more cost conscious they will be. We hypothesized that small and medium customers should be receptive to ways to cut costs because smaller businesses often have lower profit margins and lower sales volume, creating pressure to cut costs. The largest gap is found in likelihood of purchasing new equipment (5.6 versus 6.6), not surprising given the capital constraints of the smallest customers.

To some extent the difference between the two groups may be explained by the observation of industry observers that small customers are more likely to view business conditions somewhat fatalistically, noted in Appendix F. For example, energy and other costs are often viewed as "a part of doing business", while suppliers who suggest changes that could reduce costs are viewed with suspicion. Put differently, smaller customers may be more risk-averse and therefore less likely to invest.

Additionally, medium sized customers may be more sophisticated about cost savings than small companies. A machine tools supplier explains that, "Larger customers are more sophisticated in their purchasing department. They figure out the true cost of manufacturing a part on the machine we supply (i.e. mean time between failures, productivity, cost of equipment). They come up with a cost per part to make something whereas the smaller customer says, 'how much does the machine cost?' 'I have this one for 50,000 and this one for $80,000. I am going to buy the $50,000 machine.'"

Participants versus Non-Participants. A comparison of participants and non-participants in energy efficiency programs yields an interesting trend. Participants are more likely to implement cost saving measures across the board (with the exception of downsizing production, which every type of customer is reluctant to do). Participation, more than customer size or type of industry, determines willingness to cut costs – not surprising, since participants have already taken such an action.

4.3.4 Obstacles to Controlling Costs

When asked about factors preventing them from implementing cost-saving measures, 39% of customers cited a lack of capital; no other factor was cited by more than 6%, and 22% said there were no obstacles.

Customers' open ended responses indicate that while costs are a key concern, as indicated in Exhibit 4-10, customers believe they are largely unable to control those costs. Lack of capital was cited most frequently (39%) as a barrier to cost reduction. For example, medium-sized customers acknowledged the usefulness of purchasing new equipment to improve productivity (rating the likelihood of new equipment 6.6 out of 10) but it is largely capital constraints that stand in the way of such purchases.

Twenty-two percent claimed that nothing stood in the way of reducing costs, a trend that may be interpreted as lack of interest. As one customer said, "Nothing, really – if we wanted to do something, we would do it." In the words of another, "Never given it any thought."

Six percent of customers mentioned higher utility rates as an obstacle to reducing costs; many customers view higher rates as a "fixed cost;" "electrical is out of my control." Other costs of doing business that customers felt unable to control fell into "other category," such as raw material costs, insurance, workers' compensation, supplies. In sum, customers feel at the mercy of their suppliers – including the utilities – who provide goods and services required for production.

Poor economic conditions factored into the "other" category ("poor business projections" "lack of profit"). For customers caught up in a "downturn in business," cost cutting takes a backseat to sales ("we need more business first"), particularly when up-front cost is involved.

Government regulations (3%) took two forms: regulations that increased the cost of doing business, such as air quality, and permits for equipment that are an impediment to replacing that equipment.

Lack of knowledge (3%), time (3%), hassle (2%), and staff (1%) were also mentioned. A few customers (3%) were concerned about payback and uncertain of the cost savings (1%).

While cost is a key concern for customers, some customers view higher utility rates not only as an obstacle to reducing costs, but as a fixed cost, like the cost of raw material and health insurance. As one customer commented, "Electrical is out of my control." While comments like these run contrary to the conventional wisdom that increased energy costs will drive customers to reduce their usage, these customers' energy efficiency practices, presented in the next section, suggest that they are indeed attempting to reduce energy costs.

4.4 KNOWLEDGE, AWARENESS AND INFORMATION

In this section, issues of small/medium industrial customer awareness and information gathering are discussed, including new technologies generally as well as those that enhance energy efficiency.

4.4.1 Technology Awareness

Awareness of specific new technologies is low at about 70 to 80% across the board. For the remainder that are aware, installation of those technologies is almost twice as high among participants than non-participants, and more than twice as high among medium than small customers.

Reponses regarding awareness of new production technologies are presented in Exhibit 4-12. Computer equipment makers and food processors stand out as being most aware of new production technology, while printers are less inclined to keep pace with technological innovation. Small customers report being more aware of new technologies than medium-size customers.

Exhibit 4-12
New Technology Awareness

SIC-Based Industry	Aware of any specific new technologies in your industry?				Number of Respondents
	Yes			No	
	Total Aware	Aware and installed	Aware and planning to install	Unaware of any new technology	
Food (SIC 20)	20%	13%	3%	80%	96
203 Fruits and Vegetables	20%	15%	0%	80%	46
2084 Wines Brandy and Brandy Spirits	20%	10%	6%	80%	50
Printing (SIC 27)	34%	15%	6%	66%	71
Fab Metals (SIC 34)	24%	7%	6%	76%	128
344 Fabricated Structural Metal Products	25%	8%	8%	75%	63
347 Electroplating Plating Polishing Coating Engraving	23%	6%	5%	77%	65
Industrial Machinery (SIC 35)	23%	9%	6%	77%	87
354 Metalworking Machinery	28%	7%	9%	72%	58
357 Computer Equipment	14%	14%	0%	86%	29
Small customers (less than 0.5 GWh)	23%	8%	5%	77%	289
Medium customers (0.5 - 1.5 GWh)	29%	19%	5%	71%	93
Participant*	29%	19%	2%	71%	48
Non-Participant**	24%	10%	6%	76%	324
Total	94	40	20	288	382

*****This only contains the first technology****

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

While we had hypothesized that overall awareness and knowledge of energy efficiency would be lowest among the smallest customers, who have less staff and time to educate themselves about energy issues, Exhibit 4-13 offers only mixed support for this hypothesis.

Exhibit 4-13
Number of Employees by Awareness and Energy Management

SIC-Based Industry	Have an energy efficiency policy	Have an energy manager	Aware of new technology	Aware of programs provided by utility	Number of Respondents
Food (SIC 20)	50%	56%	20%	50%	96
203 Fruits and Vegetables	46%	63%	20%	59%	46
2084 Wines Brandy and Brandy Spirits	54%	50%	20%	42%	50
Printing (SIC 27)	37%	56%	34%	38%	71
Fab Metals (SIC 34)	38%	59%	24%	37%	128
344 Fabricated Structural Metal Products	41%	56%	25%	35%	63
347 Electroplating Plating Polishing Coating Engraving	35%	63%	23%	38%	65
Industrial Machinery (SIC 35)	25%	49%	23%	28%	87
354 Metalworking Machinery	26%	48%	28%	26%	58
357 Computer Equipment	24%	52%	14%	31%	29
Small customers (less than 0.5 GWh)	36%	56%	23%	31%	289
Medium customers (0.5 - 1.5 GWh)	45%	56%	29%	60%	93
Participant*	50%	56%	29%	81%	48
Non-Participant**	36%	56%	24%	32%	324
1-5 employees	**35%**	**63%**	**24%**	**28%**	**130**
6-10 employees	**40%**	**45%**	**25%**	**31%**	**55**
11-20 employees	**40%**	**46%**	**17%**	**32%**	**63**
21-50 employees	**32%**	**48%**	**25%**	**45%**	**71**
51-100 employees	**37%**	**69%**	**37%**	**57%**	**35**
Over 100 employees	**61%**	**74%**	**22%**	**83%**	**23**
Total	145	213	94	146	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

As shown in the exhibit, technology awareness does not vary substantially by customer size as measured by the number of employees, but medium sized customers are far more likely to be aware of utility programs than small customers. One supplier observes that, "Larger companies seem to understand it better. A big company will have a manager that looks at this stuff all the time, a small company may be dealing with an owner who has to deal with electricians, salespeople, insurance agents, and they just don't have the time to understand the benefits of energy savings." Another believes that "It's a matter of education, of letting smaller users understand the benefits of more efficient equipment. Rebates don't seem to be that effective for smaller customers, because there's just too much paperwork and they don't have the time or the staff to deal with that."

Moreover, the percentage of customers with an energy efficiency policy or an energy manager does not increase significantly as size increases from less than 5 to up to 50 employees. However, the results support our hypotheses in that customers with over 100 employees are more likely to have an energy policy, have an energy manager, and be aware of utility programs.

4.4.2 Sources of Assistance for Energy Efficiency

Utilities remain the preferred source of information related to energy efficiency and energy conservation, particularly among program participants, indicating that small/medium

customers remain receptive to future initiatives targeted to this sector. Among industries, wineries were much less likely than any other segment to rely on utilities for information, and more likely to look to design firms.

Customers were asked what types of companies or organizations they would call on for help or information related to energy efficiency or energy conservation, and the results are reported in Exhibit 4-14. Utilities are by far the preferred choice for energy efficiency information.

Exhibit 4-14
Sources of Assistance for Energy Efficiency

SIC-Based Industry	Companies or organizations used when seeking information related to energy efficiency/conservation											Number of Respondents
	Engineering/ Architectural Design Firms	Energy Equipment Contractors and Installers	Energy Service Companies	Electric Distribution Company	Equipment Manufacturers	Internal – Facilities Manager/Custodial	No one	Consultant	Electrician	Other	Don't know	
Food (SIC 20)	16%	11%	5%	41%	18%	3%	2%	5%	2%	2%	7%	96
203 Fruits and Vegetables	11%	7%	2%	50%	20%	7%	0%	7%	0%	2%	7%	46
2084 Wines Brandy and Brandy Spirits	20%	16%	8%	32%	16%	0%	4%	4%	4%	2%	8%	50
Printing (SIC 27)	6%	8%	0%	63%	7%	3%	1%	4%	1%	4%	8%	71
Fab Metals (SIC 34)	2%	7%	0%	58%	13%	2%	2%	2%	0%	6%	13%	128
344 Fabricated Structural Metal Products	3%	8%	0%	57%	13%	2%	3%	0%	0%	5%	14%	63
347 Electroplating Plating Polishing Coating Engraving	0%	6%	0%	58%	14%	3%	2%	3%	0%	8%	12%	65
Industrial Machinery (SIC 35)	2%	8%	3%	53%	10%	2%	1%	2%	1%	3%	15%	87
354 Metalworking Machinery	2%	5%	3%	53%	10%	2%	2%	2%	2%	3%	16%	58
357 Computer Equipment	3%	14%	3%	52%	10%	3%	0%	3%	0%	3%	14%	29
Small customers (less than 0.5 GWh)	4%	9%	3%	52%	13%	3%	2%	3%	1%	3%	12%	289
Medium customers (0.5 - 1.5 GWh)	11%	8%	0%	59%	11%	1%	1%	4%	0%	8%	8%	93
Participant*	13%	8%	0%	63%	13%	2%	2%	4%	0%	6%	6%	48
Non-Participant**	5%	8%	2%	52%	13%	3%	2%	3%	1%	4%	12%	324
Total	23	33	8	204	48	10	7	12	4	16	43	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

- **Industry Differences.** Wineries were much less likely than any other segment (32%) to rely on their utility, and more likely to turn to design firms (20%), contractors/installers (16%) and equipment manufacturers (16%). Printers overwhelmingly look to their utilities (63%), with contractors a distant second (8%). Both industrial machinists and metal fabricators rely on utilities and, to a much lesser extent, manufacturers.

- **Small versus Medium Customers**. Small customers are less likely than medium-sized customers to turn to specialized design firms (4% versus 11%) and utilities (52% versus 59%) for information. About one in eight small customers (12%) don't know where they would look for information, compared with 8% of medium customers.

- **Participants versus Non-participants**. Participants were more likely than non-participants to cite utilities as an information source (63% versus 52%). Participants also favor design firms, contractors and installers more than non-participants. Non-participants are twice as likely (12%) than participants (6%) to not know where to look for energy efficiency assistance.

When installing new equipment, customers rely on themselves and equipment vendors for information. However, Exhibit 4-14 shows that customers turn to their utility in seeking energy efficiency and conservation information. In short, customers turn to vendors for information on equipment, but look to utilities for information on conservation.

4.4.3 Preferred Way of Receiving Information

Printed matter remains the preferred medium for energy-related information across all segments and size groups. Even among the least print-oriented groups, printers and computer equipment manufacturers, printed materials were the most popular medium, exceeding the Internet and email combined.

Survey respondents were asked how they would like to have information provided to them. Exhibit 4-15 shows that printed materials remain most popular, consistent with the findings of the 2001 Statewide Nonresidential Customer Needs and Wants Study.

Exhibit 4-15
Preferred Way of Receiving Information

SIC-Based Industry	In what form would you prefer to receive energy-related information?												Number of Respondents
	Internet	Printed Materials	In person conversation	Email	Mail	Group setting	Fax	By request	Phone	Through the Utility	Other	Don't Want/Don't Know/Refused	
Food (SIC 20)	8%	59%	15%	23%	15%	4%	1%	1%	0%	1%	0%	1%	96
203 Fruits and Vegetables	4%	63%	15%	20%	20%	4%	0%	0%	0%	0%	0%	0%	46
2084 Wines Brandy and Brandy Spirits	12%	56%	14%	26%	10%	4%	2%	2%	0%	2%	0%	2%	50
Printing (SIC 27)	10%	54%	13%	21%	10%	4%	3%	0%	6%	0%	0%	3%	71
Fab Metals (SIC 34)	12%	63%	12%	9%	14%	6%	2%	1%	2%	1%	1%	4%	128
344 Fabricated Structural Metal Products	10%	67%	8%	6%	16%	8%	2%	2%	2%	0%	2%	2%	63
347 Electroplating Plating Polishing Coating Engraving	14%	60%	15%	11%	12%	5%	2%	0%	3%	2%	0%	6%	65
Industrial Machinery (SIC 35)	14%	60%	9%	20%	5%	1%	3%	0%	3%	0%	2%	6%	87
354 Metalworking Machinery	9%	62%	9%	19%	5%	0%	3%	0%	3%	0%	0%	5%	58
357 Computer Equipment	24%	55%	10%	21%	3%	3%	3%	0%	3%	0%	7%	7%	29
Small customers (less than 0.5 GWh)	12%	60%	11%	15%	12%	3%	2%	1%	3%	1%	1%	4%	289
Medium customers (0.5 - 1.5 GWh)	6%	59%	15%	25%	8%	6%	2%	0%	2%	0%	1%	2%	93
Total	42	228	46	65	43	16	8	2	10	2	3	13	382

Industry Differences. Interestingly, printers were the least likely to prefer printed materials of any industry (54%). Of the four industries, fabricated metals and industrial machinery manufacturers seem least interested in receiving energy efficiency information; 6% of industrial machinery segment surveyed did not want, did not know or refused to answer how they would prefer to receive information.

Electronic channels are somewhat popular, but inconsistencies are puzzling. For example, of all industries, food processors are least disposed to the Internet but favor email more than any other. Equally inconsistent is the overall preference for printed over electronic information, but the overall preference (with the exception of the fabricated metals industry) for email over regular mail. Fax and phone are not desired delivery channels.

Small versus Medium Customers. Small customers (12%) favor the Internet more than medium-sized customers (6%), yet 25% of medium-sized customers prefer receiving emails to 15% of small customers. Small customers are less likely to attend seminars than larger counterparts, probably due to lack of staff – although the level of interest in attending group gatherings is low for both groups.

4.4.4 Use of Selected Information Sources

For small/medium customers, utilities are generally viewed as only somewhat helpful, with medium customers and program participants assigning higher rankings than small customers and non-participants. Medium customers and participants are more likely to use the internet for accessing energy-related information, while medium customers also perceive trade associations as a more effective information source than do small customers.

Three sources of information in particular – utility, Internet and trade organizations – are examined below.

Utility. Customers rated their utility's helpfulness in providing support for their energy efficiency decisions and actions on a 1 to 10 scale. While a robust comparison of utilities' scores is difficult because SCG and SDG&E have relatively few sample points, the data in Exhibit 4-16 offers some directionality.

Exhibit 4-16
Helpfulness of Utility in Supporting EE Decisions and Actions

SIC-Based Industry	Average rating of helpfulness of your utility in providing support for your energy efficiency decisions and actions (1=Not at all helpful, 10=Extremely helpful)					Number of Respondents
	PG&E	SDG&E	SCE	SCG	Total	
Food (SIC 20)	5.3	1.0	6.1	1.0	5.4	93
203 Fruits and Vegetables	6.7	1.0	6.2	1.0	6.2	43
2084 Wines Brandy and Brandy Spirits	4.6	.	5.5	.	4.7	50
Printing (SIC 27)	4.2	5.5	5.7	8.0	5.0	69
Fab Metals (SIC 34)	4.8	6.3	5.3	9.0	5.4	120
344 Fabricated Structural Metal Products	4.9	5.4	5.5	.	5.2	60
347 Electroplating Plating Polishing Coating Engraving	4.7	7.0	5.1	9.0	5.5	60
Industrial Machinery (SIC 35)	6.1	8.0	5.5	.	5.8	74
354 Metalworking Machinery	6.0	8.0	5.3	.	5.6	50
357 Computer Equipment	6.1	.	6.0	.	6.0	24
Small customers (less than 0.5 GWh)	4.8	6.5	5.1	4.0	5.1	266
Medium customers (0.5 - 1.5 GWh)	5.9	1.3	6.6	9.3	6.2	90
Participant*	6.2	4.3	7.4	.	6.5	45
Non-Participant**	4.8	6.2	5.2	7.6	5.2	302
Total	158	32	160	6	356	356

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Mean scores by segment across all utilities ranged from 4.7 to 6.2. Overall, utilities received highest marks from the industrial machinery industry. Wineries, which are somewhat concentrated in PG&E's service territory, indicated some dissatisfaction, giving PG&E a rating of 4.6.

Medium-sized customers (6.2) gave their utility a higher rating than small customers (5.1). Participants were more inclined to view utilities as helpful (6.5) than non-participants (5.2).

Internet usage. The Internet is an increasingly popular means of disseminating information, with about one-third of respondents having used the Internet for energy efficiency information.

Exhibit 4-17
Energy-Related Web Usage

SIC-Based Industry	Web access				
	Have used the internet for EE info***	Number of Res-pondents	Have used my utilities website	Have not used my utilities website	Number of Res-pondents
Food (SIC 20)	43%	96	56%	41%	41
203 Fruits and Vegetables	41%	46	74%	26%	19
2084 Wines Brandy and Brandy Spirits	44%	50	41%	55%	22
Printing (SIC 27)	38%	71	52%	48%	27
Fab Metals (SIC 34)	26%	128	67%	33%	33
344 Fabricated Structural Metal Products	24%	63	73%	27%	15
347 Electroplating Plating Polishing Coating Engraving	28%	65	61%	39%	18
Industrial Machinery (SIC 35)	32%	87	57%	43%	28
354 Metalworking Machinery	33%	58	53%	47%	19
357 Computer Equipment	31%	29	67%	33%	9
Small customers (less than 0.5 GWh)	29%	289	51%	48%	85
Medium customers (0.5 - 1.5 GWh)	47%	93	73%	27%	44
Participant*	56%	48	70%	30%	27
Non-Participant**	30%	324	56%	43%	98
PG&E	37%	165	54%	44%	61
SDG&E	33%	33	73%	27%	11
SCE	32%	177	61%	39%	56
SCG	14%	7	0%	100%	1
Total	129	382	75	53	129

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)
***Have used the internet to obtain information about and/or to purchase energy related products or services

- The food industry has the highest overall incidence of Internet usage, while the fabricated metals industry has the lowest. However, of those customers in the fabricated metals industry who have used the Internet, two-thirds have used their utility's website.

- Medium customers are more likely to use the internet, but small customers who have used the internet for EE information are more likely to use their utility's website.

- Participants have a higher percentage use of the Internet and of their utility's website than non-participants.

Trade Organizations. Exhibit 4-18 shows that customers, both members and non-members, believe trade organizations to be effective sources of information on energy efficiency.

Exhibit 4-18
Effectiveness of Trade Groups as A Source of Energy Efficiency Information

SIC-Based Industry	Trade or industry organization member					Not a member of a trade or industry organization				
	How effective are trade groups as a source of information									
	Very	Some-what	Not at all	Don't know	Number of Res-pondents	Very	Some-what	Not at all	Don't know	Number of Res-pondents
Food (SIC 20)	17%	44%	39%	0%	66	12%	50%	23%	15%	26
203 Fruits and Vegetables	17%	43%	39%	0%	23	10%	50%	20%	20%	20
2084 Wines Brandy and Brandy Spirits	16%	44%	40%	0%	43	17%	50%	33%	0%	6
Printing (SIC 27)	16%	48%	30%	7%	44	11%	59%	19%	11%	27
Fab Metals (SIC 34)	21%	53%	23%	3%	62	5%	56%	24%	16%	63
344 Fabricated Structural Metal Products	8%	56%	28%	8%	25	6%	53%	31%	11%	36
347 Electroplating Plating Polishing Coating Engraving	30%	51%	19%	0%	37	4%	59%	15%	22%	27
Industrial Machinery (SIC 35)	12%	58%	24%	6%	33	12%	47%	22%	20%	51
354 Metalworking Machinery	8%	58%	29%	4%	24	12%	47%	24%	18%	34
357 Computer Equipment	22%	56%	11%	11%	9	12%	47%	18%	24%	17
Small customers (less than 0.5 GWh)	15%	54%	31%	1%	142	8%	50%	26%	17%	141
Medium customers (0.5 - 1.5 GWh)	22%	41%	27%	10%	63	15%	69%	4%	12%	26
Total	35	102	61	7	205	15	88	37	27	167

- Seventy-four percent of metal fabricators (including 81% of metal finishers) indicate that their trade group provides energy-related information in a very or somewhat effective manner. Industrial machinists were similarly disposed.

- Food processors offered a lower approval rating (61% very/somewhat effective) than any other segment.

- There was a small gap between small and medium customers; five percent more small customers believed their trade group to be very or somewhat effective at providing information.

Despite a fairly positive outlook on trade groups, a boiler supplier says that while food processors tend to exchange information through their associations, some smaller firms are more isolated and less aware of trends in the industry.

In summary, customers tend to make equipment decisions internally, most often relying on equipment vendors and publications. When energy efficiency information is sought, the utility is the most likely source, although trade organizations also offer a promising vehicle for delivering information. While the Internet has made inroads in popularity, even among small customers, customers still prefer printed materials to any other kind.

4.5 ENERGY EFFICIENCY PRACTICES

In this section, energy efficiency practices reported by the surveyed small and medium industrial customers are discussed, including conservation actions and equipment adoptions.

4.5.1 Conservation Actions

High levels of conservation actions persist after the energy crisis, with fruit and vegetable processors, medium customers, and program participants reporting the highest levels of conservation activity. About 80% of customers indicated they were conserving energy, and over 20% installed energy efficient equipment. Exhibit 4-19 presents conservation actions and adoptions by industry segment, customer size and participation. Customers continue to conserve in large numbers. At the height of the energy crisis in 2001, 86% of industrial customers surveyed reported that they took conservation actions (Statewide Nonresidential Customer Needs and Wants Study).

Exhibit 4-19
Conservation Actions and Adoptions
by Industry Segment, Customer Size and Participation

SIC-Based Industry	Taken energy conservation action(s)***	Installed high efficiency equipment****	Number of Respondents
Food (SIC 20)	80%	31%	96
203 Fruits and Vegetables	80%	41%	46
2084 Wines Brandy and Brandy Spirits	80%	22%	50
Printing (SIC 27)	85%	23%	71
Fab Metals	80%	19%	128
344 Fabricated Structural Metal Products	76%	14%	63
347 Electroplating Plating Polishing Coating Engraving	83%	23%	65
Industrial Machinery (SIC 35)	75%	16%	87
354 Metalworking Machinery	79%	17%	58
357 Computer Equipment	66%	14%	29
Small customers (less than 0.5 GWh)	78%	19%	289
Medium customers (0.5 - 1.5 GWh)	84%	32%	93
Participant*	85%	54%	48
Non-Participant**	78%	17%	324
This years production is MORE than last years production	73%	31%	80
This years production is LESS than last years production	84%	18%	177
This years production is about the SAME as last years production	77%	22%	123
Total	304	84	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

***Taken energy conservation action(s) over the past year (other than new equipment purchases)
****Installed high efficiency equipment over the past two years

Business conditions affect customers' EE practices. Customers that are producing less than last year tend to undertake no-cost conservation actions rather than investing in high efficiency equipment, compared with those enjoying higher year-over-year production. Nearly one-third of customers producing more than last year installed high efficiency equipment, compared with 18% of those whose production declined. Customers cited lack of capital as the biggest obstacle to cost savings, so it stands to reason that more successful firms are better able to invest in high efficiency equipment.

Some variation exists among industry segments. Printers are the most conservation-oriented industry segment (85%), and, while computer equipment makers lag the rest (66%). More fruit and vegetable processors adopted high efficiency equipment than any other industry segment. Computer equipment makers and structural metal fabricators were least likely to adopt efficient equipment (both 14%).

Small versus Medium. Exhibit 4-19 shows that medium sized customers are over 1.5 times more likely to have made an efficient equipment upgrade. Most suppliers agree that larger firms buy more efficient equipment than smaller industrial customers. According to a printer equipment supplier, "Larger firms tend to be looking for more efficient ways to do things." One boiler supplier tends to sell higher end, more efficient boilers to larger customers "who are more likely to take a life cycle view of their purchase and therefore spend a little more for greater efficiency." Likewise, a large motor supplier observes that large firms see value in EE motors, but small businesses "are just going to replace with whatever is the cheapest."

Another supplier argues that smaller companies are less efficient because they have fewer resources, less automation and tend to be more labor intensive. An AC contractor believes larger companies have more efficient equipment than small facilities for three reasons: newer buildings, larger budgets and energy management systems.

Supplier interviews suggest that high efficiency purchasers are distinguished by their technical knowledge (not so much the presence of an EE champion), financial resources and an appreciation for lifecycle costs.

In considering what separates small customers that select high efficiency from those that do not, suppliers acknowledged the importance of engineering and technical knowledge. "Usually the smaller companies who buy high efficiency tend to have more of an engineering bent; the owner may be an engineer or they may have someone on staff who is knowledgeable about that. It also helps if the decision maker is aware of both the operating and capital budgets and doesn't look just at upfront cost. That's why some knowledgeable small companies can be very oriented to efficiency."

For small customers, financial resources are as important as technical knowledge in making high efficiency decisions. One supplier noted that more profitable companies will have more high efficiency equipment. "Because of the capital investment, people that are not making as much money don't have the money to upgrade, they don't have the money to save either."

4.5.2 Types Of Conservation Actions

Analysis of the types of conservation actions taken reveals that customers were most likely to turn off unused lights and production equipment, and least likely to shift energy use to off-peak hours or modify production to use less energy, although participants were much more likely than non-participants to make the latter two adjustments to their production process. Lower operating costs were overwhelmingly cited as the main reason for taking conservation actions.

Customers were asked whether they undertook a specific set of energy conservation actions, presented in Exhibit 4-20 below. Several findings emerged. First, customers were most likely to turn off lights, turn off unused equipment and adjust thermostats. Second, customers were

reluctant to make changes to their production processes, whether by shifting usage off-peak or modifying processes to reduce usage. Program participants were the exception; they were far more flexible about production changes than non-participants. For example, 39% of participants shifted energy usage off-peak compared to 15% of non-participants. Printers were least likely to modify their production processes in any way, while fruit and vegetable processors were the most likely industry segment to do so.

Exhibit 4-20
Major Types of Conservation Activities Taken

SIC-Based Industry	Percent of customers that reported taking energy conservation actions						Number of Respondents
	Turn Off Equipment Nights/Weekends	Turn Off Equipment During Day	Shift Energy Use Off-peak	Turn Off Unused Lights	Modify Production to Use Less Energy	Adjust Thermostats	
Food (SIC 20)	68%	62%	21%	83%	27%	52%	77
203 Fruits and Vegetables	65%	65%	27%	84%	41%	49%	37
2084 Wines Brandy and Brandy Spirits	70%	60%	15%	83%	15%	55%	40
Printing (SIC 27)	72%	70%	12%	78%	15%	52%	60
Fab Metals	81%	70%	19%	78%	26%	42%	102
344 Fabricated Structural Metal Products	79%	73%	13%	88%	19%	58%	48
347 Electroplating Plating Polishing Coating Engraving	83%	67%	24%	70%	33%	28%	54
Industrial Machinery (SIC 35)	68%	68%	23%	89%	29%	55%	65
354 Metalworking Machinery	72%	72%	24%	91%	35%	52%	46
357 Computer Equipment	58%	58%	21%	84%	16%	63%	19
Small customers (less than 0.5 GWh)	74%	67%	16%	81%	24%	45%	226
Medium customers (0.5 - 1.5 GWh)	71%	68%	26%	86%	28%	62%	78
Participant*	73%	66%	39%	85%	37%	59%	41
Non-Participant**	72%	68%	15%	82%	23%	48%	253
This years production is MORE than last years production	71%	66%	19%	83%	33%	45%	58
This years production is LESS than last years production	77%	67%	21%	83%	25%	49%	149
This years production is about the SAME as last years production	68%	69%	16%	80%	21%	52%	95
Total Responses	222	205	57	249	76	150	304

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

There was little consistent difference in conservation behavior between customers experiencing a downturn in production and those that had maintained or increased production levels. Small industrial customers lagged their medium-sized counterparts in nearly every type of conservation activity but one – turning off unused equipment on nights and weekends. That is, smaller customers prefer no cost actions over other energy efficiency options.

Reducing cost is the primary driver of these conservation activities, as shown in Exhibit 4-21. More small customers (92%) mention reducing cost than medium-sized customers (87%), yet small customers tend to do less of these activities. In addition, participants are no more cost-conscious than non-participants.

Prolonging equipment life was a distant second, coming into play for food processors in particular. In contrast to the findings of the 2001 Small Customer Needs and Wants Survey, the energy crisis did not play a role in conservation actions for this group of respondents, although the industrial machinery industry was somewhat interested (11%) in preventing blackouts.

Exhibit 4-21
Reasons for Energy Conservation Actions

SIC-Based Industry	Percent of those customers that reported taking energy conservation actions Most important reasons for taking energy conservation actions to reduce energy use										Number of Respondents
	Lower energy (operating) cost	Shift load to off-peak hours	Help avoid blackouts	None	Energy Crisis	Rebate	Equipment was in poor condition	To prolong equipment life	Other	Don't know	
Food (SIC 20)	90%	4%	3%	1%	0%	1%	0%	30%	0%	1%	77
203 Fruits and Vegetables	95%	8%	3%	3%	0%	3%	0%	24%	0%	3%	37
2084 Wines Brandy and Brandy Spirits	85%	0%	3%	0%	0%	0%	0%	35%	0%	0%	40
Printing (SIC 27)	88%	0%	7%	0%	2%	0%	0%	18%	0%	0%	60
Fab Metals	94%	1%	5%	2%	0%	2%	1%	22%	0%	0%	102
344 Fabricated Structural Metal Products	98%	0%	10%	2%	0%	4%	2%	25%	0%	0%	48
347 Electroplating Plating Polishing Coating Engraving	91%	2%	0%	2%	0%	0%	0%	19%	0%	0%	54
Industrial Machinery (SIC 35)	88%	0%	11%	2%	2%	0%	0%	25%	0%	0%	65
354 Metalworking Machinery	89%	0%	11%	2%	0%	0%	0%	26%	0%	0%	46
357 Computer Equipment	84%	0%	11%	0%	5%	0%	0%	21%	0%	0%	19
Small customers (less than 0.5 GWh)	92%	0%	6%	1%	0%	1%	0%	23%	0%	0%	226
Medium customers (0.5 - 1.5 GWh)	87%	4%	5%	1%	1%	0%	0%	26%	0%	0%	78
Participant*	90%	2%	7%	0%	0%	0%	0%	24%	0%	0%	41
Non-Participant**	91%	1%	6%	2%	1%	1%	0%	23%	0%	0%	253
This years production is MORE than last years production	91%	2%	9%	3%	0%	0%	2%	28%	0%	0%	58
This years production is LESS than last years production	93%	1%	5%	0%	0%	1%	0%	21%	0%	0%	149
This years production is about the SAME as last years production	88%	1%	6%	2%	1%	2%	0%	24%	0%	1%	95
Total	275	4	18	4	2	3	1	72	0	1	304

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

4.5.3 Equipment Adoptions

The majority of respondents said they had installed high efficiency equipment for their major end uses, whether production equipment, lighting, or refrigeration. About two thirds of those adopting efficient equipment did so to reduce their operating costs; about one-third to improve their productivity.

Customers reported that their biggest uses of electricity are production machinery, refrigeration, lighting and space heating/cooling (Exhibit 4-3). This section examines whether customers have taken actions to reduce their usage in these areas. For example, respondents that indicated that refrigeration was their biggest end use were asked whether they had installed, or if not, whether they were likely to install high efficiency refrigeration in the next two years. This question was asked of respondents that indicated that their biggest electrical end uses were lighting, refrigeration, industrial equipment or space heating/cooling.[8]

Exhibit 4-22
High Efficiency Industrial Equipment Adoptions and Intentions

SIC-Based Industry	Of those who mentioned process machinery as one of their biggest uses of energy, the percent who are likely to install **High Efficiency Industrial Machinery or Equipment**				Number of Respondents
	Installed	Likely to Install	Not LIkely to Install	Don't know	
Food (SIC 20)	53%	6%	35%	6%	17
203 Fruits and Vegetables	62%	8%	23%	8%	13
2084 Wines Brandy and Brandy Spirits	25%	0%	75%	0%	4
Printing (SIC 27)	55%	36%	9%	0%	11
Fab Metals	61%	0%	39%	0%	18
344 Fabricated Structural Metal Products	71%	0%	29%	0%	7
347 Electroplating Plating Polishing Coating Engraving	55%	0%	45%	0%	11
Industrial Machinery (SIC 35)	50%	0%	42%	8%	12
354 Metalworking Machinery	60%	0%	30%	10%	10
357 Computer Equipment	0%	0%	100%	0%	2
Small customers (less than 0.5 GWh)	54%	3%	41%	3%	37
Medium customers (0.5 - 1.5 GWh)	57%	19%	19%	5%	21
Total	32	5	19	2	58

Overall, the majority of respondents for whom industrial machinery or equipment is a major electrical end-use have adopted some type of high efficiency equipment. Structural metal fabs (71%), fruit and vegetable processors (62%), and metalworking shops (60%) led the pack, while winemakers were least likely to have adopted high efficiency industrial equipment. The rest did not intend to install any such HE equipment, with the exception of a few printers and fruit and vegetable processors. Small and medium-sized customers adopted HE equipment at similar rates, but medium-sized customers were far more likely to install in the future (19%) than small industrial customers (3%).

[8] Only 12 big HVAC users offered information on their high efficiency HVAC adoptions and intentions, so that data is not presented here.

Exhibit 4-23 shows that the majority of lighting-intensive businesses have made efficiency upgrades.

Exhibit 4-23
High Efficiency Lighting Adoptions and Intentions

SIC-Based Industry	Of those who mentioned lighting as one of their biggest uses of energy, the percent who are likely to install **High Efficiency Lighting**				Number of Respondents
	Installed	Likely to Install	Not LIkely to Install	Don't know	
Food (SIC 20)	56%	11%	33%	0%	9
203 Fruits and Vegetables	50%	0%	50%	0%	6
2084 Wines Brandy and Brandy Spirits	67%	33%	0%	0%	3
Printing (SIC 27)	64%	0%	36%	0%	11
Fab Metals	58%	25%	17%	0%	12
344 Fabricated Structural Metal Products	0%	75%	25%	0%	4
347 Electroplating Plating Polishing Coating Engraving	88%	0%	13%	0%	8
Industrial Machinery (SIC 35)	75%	0%	25%	0%	8
354 Metalworking Machinery	80%	0%	20%	0%	5
357 Computer Equipment	67%	0%	33%	0%	3
Small customers (less than 0.5 GWh)	58%	13%	29%	0%	24
Medium customers (0.5 - 1.5 GWh)	69%	6%	25%	0%	16
Total	25	4	11	0	40

Of those who have not installed, fabricated metal shops are most likely to install in the future. A gap exists in the adoption rates of small (58%) and medium-sized customers (69%).

All 15 customers who offered information on their high efficiency refrigeration equipment decisions were food processors. 60% of these customers had installed high efficiency refrigeration measures.

Exhibit 4-24
High Efficiency Refrigeration Adoptions and Intentions

SIC-Based Industry	Of those who mentioned refrigeration as one of their biggest uses of energy, the percent who are likely to install **High Efficiency Refrigeration**				Number of Respondents
	Installed	Likely to Install	Not LIkely to Install	Don't know	
Food (SIC 20)	60%	7%	20%	13%	15
203 Fruits and Vegetables	56%	11%	33%	0%	9
2084 Wines Brandy and Brandy Spirits	67%	0%	0%	33%	6
Printing (SIC 27)	.	.	.	.	0
Fab Metals	.	.	.	.	0
344 Fabricated Structural Metal Products	.	.	.	.	0
347 Electroplating Plating Polishing Coating Engraving	.	.	.	.	0
Industrial Machinery (SIC 35)	.	.	.	.	0
354 Metalworking Machinery	.	.	.	.	0
357 Computer Equipment	.	.	.	.	0
Small customers (less than 0.5 GWh)	62%	0%	23%	15%	13
Medium customers (0.5 - 1.5 GWh)	50%	50%	0%	0%	2
Total	9	1	3	2	15

Customers offered a number of reasons for installing high efficiency equipment or new technologies, displayed in Exhibit 4-25 below. As with energy conservation, lowering energy costs topped the list of motivations. Food processors (79%) were most interested in reducing costs; printers (58%), less so. Productivity gains and competitiveness factored in most prominently for all four industries, printers in particular. Competitiveness was cited by 23% of printers.

Exhibit 4-25
Reasons for Installing High Efficiency Equipment and New Technologies

SIC-Based Industry	Most important reasons for installing high efficiency equipment or new technologies													Number of Respondents
	Lower Energy (operating) Cost	Enhance Productivity	Improve Quality of Worker Environment	Improve Product Quality or Consistency	Competitiveness	Reduce Downtime	Equipment was Old	Reduce Organizations Environmental Impact	Required by Law	Rebate	Water Conservation	Other	None	
Food (SIC 20)	79%	29%	12%	9%	6%	3%	3%	0%	0%	0%	3%	0%	0%	34
203 Fruits and Vegetables	68%	37%	11%	11%	5%	5%	5%	0%	0%	0%	0%	0%	0%	19
2084 Wines Brandy and Brandy Spirits	93%	20%	13%	7%	7%	0%	0%	0%	0%	0%	7%	0%	0%	15
Printing (SIC 27)	58%	42%	4%	15%	23%	4%	0%	4%	0%	0%	0%	0%	4%	26
Fab Metals (SIC 34)	65%	32%	8%	5%	3%	3%	5%	3%	5%	3%	0%	0%	11%	37
344 Fabricated Structural Metal Products	67%	44%	6%	6%	0%	0%	6%	6%	6%	6%	0%	0%	17%	18
347 Electroplating Plating Polishing Coating Engraving	63%	21%	11%	5%	5%	5%	5%	0%	5%	0%	0%	0%	5%	19
Industrial Machinery (SIC 35)	68%	27%	14%	0%	14%	0%	5%	0%	0%	0%	0%	5%	0%	22
354 Metalworking Machinery	75%	31%	13%	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	16
357 Computer Equipment	50%	17%	17%	0%	50%	0%	17%	0%	0%	0%	0%	0%	0%	6
Small customers (less than 0.5 GWh)	69%	33%	12%	4%	8%	3%	3%	0%	1%	1%	1%	1%	4%	75
Medium customers (0.5 - 1.5 GWh)	66%	32%	5%	14%	14%	2%	5%	5%	2%	0%	0%	0%	5%	44
Participant*	66%	31%	10%	14%	7%	7%	10%	3%	0%	3%	0%	0%	3%	29
Non-Participant**	70%	35%	9%	6%	12%	1%	1%	1%	2%	0%	1%	1%	3%	86
Total	81	39	11	9	12	3	4	2	2	1	1	1	5	119

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Printers were motivated by reducing cost, enhancing productivity, and staying competitive. Food processors first mentioned lower costs, followed by enhanced productivity and improved work environment. The industrial machinery and fab metal segments were also motivated by lower costs and enhanced productivity. Water conservation figured into a few winemakers' equipment decisions. Environmental impacts drove a few printers and fab metal shops to install equipment.

4.5.4 Important Sources of Information

In making their decision to install new energy efficient equipment, over half of medium sized customers were most likely to rely on in-house resources as their most important source of information and influence. Small customers also used internal resources, but were more likely than medium customers to have used equipment manufacturers, vendors, and publications as information sources.

Customers that installed high efficiency equipment were asked what were the most important sources of information and influence in making the decision to install equipment. Their responses are presented in Exhibit 4-26. While, as expected, many small and medium sized industrial firms rely on suppliers of process technologies as a primary *external* source of information on energy efficient equipment selection, internal resources were the most important influence on the equipment selection process.

Exhibit 4-26
Most Important Source of Information and Influence for High Efficiency Equipment

SIC-Based Industry	Most important sources of information and influence for the new high efficiency equipment																Number of Respondents
	Contractor	Electric utility	Equipment Manufacturer	In-house	Design Engineers	Energy Consultants	Equipment Vendors	ESCO	Publications	Internet	People in the Industry	Trade Associations	Customers	Word of Mouth	Other	Don't know	
Food (SIC 20)	12%	6%	21%	47%	3%	6%	12%	3%	12%	6%	3%	0%	0%	0%	3%	3%	34
203 Fruits and Vegetables	5%	5%	5%	53%	5%	11%	16%	5%	5%	0%	0%	0%	0%	0%	5%	5%	19
2084 Wines Brandy and Brandy Spirits	20%	7%	40%	40%	0%	0%	7%	0%	20%	13%	7%	0%	0%	0%	0%	0%	15
Printing (SIC 27)	4%	0%	19%	42%	0%	0%	12%	0%	15%	0%	4%	0%	12%	0%	0%	0%	26
Fab Metals (SIC 34)	8%	8%	3%	46%	5%	0%	14%	3%	11%	3%	8%	3%	0%	0%	0%	8%	37
344 Fabricated Structural Metal Products	11%	0%	6%	39%	6%	0%	22%	6%	11%	0%	11%	0%	0%	0%	0%	11%	18
347 Electroplating Plating Polishing Coating Engraving	5%	16%	0%	53%	5%	0%	5%	0%	11%	5%	5%	5%	0%	0%	0%	5%	19
Industrial Machinery (SIC 35)	5%	5%	9%	32%	0%	0%	14%	0%	18%	0%	5%	5%	0%	9%	5%	9%	22
354 Metalworking Machinery	0%	0%	6%	31%	0%	0%	13%	0%	19%	0%	6%	0%	0%	13%	6%	13%	16
357 Computer Equipment	17%	17%	17%	33%	0%	0%	17%	0%	17%	0%	0%	17%	0%	0%	0%	0%	6
Small customers (less than 0.5 GWh)	7%	5%	15%	37%	4%	1%	15%	1%	17%	3%	5%	1%	3%	3%	1%	4%	75
Medium customers (0.5 - 1.5 GWh)	9%	5%	9%	52%	0%	2%	9%	2%	7%	2%	5%	2%	2%	0%	2%	7%	44
Total	9	6	15	51	3	2	15	2	16	3	6	2	3	2	2	6	119

Industry Segments. High efficiency equipment decisions tended to originate within food processing companies (47% cited in-house staff, a corporate decision, or the respondent's decision), but they also sought information and advice from equipment manufacturers (21%) and vendors (12%), contractors (12%) and publications (12%).

Like food processors, printers tend to make their own decisions, but also involve trusted equipment manufactures and vendors. Utilities could select highly influential equipment suppliers to become program partners in their area of specialization, providing a joint information source for recommendations that is considered credible by the industry. Likely partners for the printing industry are the Printers' National Environmental Assistance Center (PNEAC) and Quad/Tech, a highly influential vendor to the printing industry. According one source, Quad/Tech was able to get many printers in California to adopt energy efficiency measures, possibly contributing to the relatively high participation rates for printers in Express.

Metal fabs tend to make EE equipment purchase decisions internally, but also turn to equipment vendors (33%), publications (11%), contractors (8%), industry peers (8%) and contractors (8%). Industrial machinery manufacturers were the least likely to report in-house staff or themselves as the most important source of information for the EE purchase, citing publications (18%), vendors (14%), and manufacturers (9%).

Small versus Medium-sized Customers. More medium-sized customers (52%) used internal information sources to install high efficiency equipment than small customers (37%). Small customers that installed high efficiency equipment tended to go to equipment vendors, manufacturers and publications more than medium-sized customers. Design engineers, consultants and ESCOs did not figure into the decision process or information gathering for either group.

4.5.5 Changes to Production and Facility

Regarding changes to production processes and the facility generally, in-house resources – particularly business owners themselves – typically drive those decisions, although small/medium manufacturers also rely on suppliers, including equipment manufacturers' representatives and other vendors. The central role played by owners provides an opportunity in that energy efficiency initiatives can be presented directly to the decision maker.

The importance of different market actors was assessed by asking both customers and suppliers about important players in the equipment selection process.

When suppliers were asked to name the most important players in the equipment selection process in retrofit projects for small customers, the business owner was the most common answer. As a food and beverage supplier succinctly put it, "Depending on size, it can be the owner, the plant manager, or the engineer. The smaller the company, the more likely it is to be the owner." This view was repeatedly corroborated by other suppliers. "For small companies now with 50 or under employees, the owner is the key decision maker, he is going to decide yes we do this or no we don't, so the buck stops there [because] the owner signs the check."

Direct owner involvement is critical to "Mom and Pop installations" because an owner is also more likely to take a broader, long-term view than an employee. "The guy paying the bills and making the selection … is demanding higher efficient equipment." Conversely, this supplier points out that companies are less concerned about efficiency when the plant manager does not pay the bills or know how much is paid for electricity or water.

Customers were asked what companies they typically use to implement changes to their production process or facility that affects their energy usage. Customers in the industries studied tend to rely on themselves, equipment vendors and manufacturers' reps over consultants, contractors, utilities and ESCOs, as shown in Exhibit 4-27 (note that multiple responses were accepted, so that percentages in a row can total more than 100%).

Exhibit 4-27
Companies Typically Used to Implement Production and Facility Changes

SIC-Based Industry	Companies typically used to implement changes (that would affect energy usage) to production process or facility												Number of Respondents
	Consultants	Architect/ Engineering companies	Equipment vendors	Installation contractors	ESCOs/ ESPs	Utilities	Manufacturers representative	None/ In house staff	Other business owners	Other	Refused	Don't know	
Food (SIC 20)	23%	32%	44%	20%	17%	21%	30%	14%	1%	0%	0%	5%	96
203 Fruits and Vegetables	30%	24%	41%	20%	13%	24%	28%	17%	0%	0%	0%	9%	46
2084 Wines Brandy and Brandy Spirits	16%	40%	46%	20%	20%	18%	32%	10%	2%	0%	0%	2%	50
Printing (SIC 27)	11%	6%	45%	8%	6%	13%	20%	25%	0%	1%	0%	3%	71
Fab Metals (SIC 34)	11%	6%	32%	9%	2%	16%	23%	24%	1%	2%	0%	7%	128
344 Fabricated Structural Metal Products	5%	2%	33%	5%	2%	14%	30%	24%	0%	2%	0%	6%	63
347 Electroplating Plating Polishing Coating Engraving	17%	11%	31%	14%	3%	17%	15%	25%	2%	2%	0%	8%	65
Industrial Machinery (SIC 35)	6%	5%	23%	6%	1%	7%	18%	29%	0%	0%	2%	13%	87
354 Metalworking Machinery	0%	2%	28%	5%	2%	7%	19%	29%	0%	0%	3%	12%	58
357 Computer Equipment	17%	10%	14%	7%	0%	7%	17%	28%	0%	0%	0%	14%	29
Small customers (less than 0.5 GWh)	12%	12%	35%	10%	7%	13%	22%	25%	1%	0%	1%	8%	289
Medium customers (0.5 - 1.5 GWh)	15%	14%	37%	14%	5%	19%	26%	15%	0%	2%	0%	4%	93
Participant*	27%	27%	38%	23%	10%	31%	27%	10%	0%	2%	0%	2%	48
Non-Participant**	10%	10%	35%	9%	6%	11%	22%	25%	1%	1%	1%	8%	324
Total	49	47	135	42	24	55	88	87	2	3	2	27	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Industry Segments. The industrial machinery segment was most likely to rely on in-house staff, with equipment vendors and manufacturer reps providing added support. Consultants, engineers, contractors and ESCOs do not come into the picture for these customers. Printers mainly rely on equipment vendors (45%), in-house staff (25%), manufacturers' reps (20%), and, to some extent, utilities (13%). Of the four industries, food processors are less inclined to rely on themselves (14%), choosing instead to hire equipment vendors (44%), manufacturers (30%), engineering companies (32%), consultants (23%), IOUs (21%) and contractors (20%).

Small versus medium-sized customers. Small customers were more likely than medium-sized customers to say they would use only in-house staff to make changes (25% versus 15%) and also were less likely to rely on all kinds of vendors to implement changes. This contrasts with the findings presented in Exhibit 4-26, which showed a greater proportion of medium

customers using in-house resources. The difference may reflect the more general nature of this question compared to the question regarding a specific equipment installation.[9] That is, small customers may view themselves as more self-reliant until they are faced with an actual purchase decision, at which point they are more likely to rely on equipment vendors and manufacturers' reps. The two tables are consistent, however, in that smaller customers are less likely to engage the services of specialized design or process engineers. Industry literature suggested that energy service companies stay away from small industrial customers because of the small scale of projects and generally higher risk associated with smaller companies, and the difficulty of verifying savings. Both small (7%) and medium-sized customers (5%) turn to ESCOs less than any other type of vendor, confirming that ESCOs have indeed not penetrated this market.

Participant/Non-participant. Participants tend to rely on consultants, engineering companies, utilities and contractors over non-participants, who turn to their own staff to make facility changes.

Equipment Vendors. Supplier interviews corroborate the importance of equipment vendors from customer data presented in Exhibits 4-26 and 4-27. Suppliers unequivocally agreed that smaller customers were more likely to depend on them for assistance in selecting equipment or designing a production line. As a boiler supplier commented, "They definitely rely on us -- and all their vendors -- more. Some of them don't have the staff, a lot don't have the budget to hire a design engineer, and may not be that knowledgeable about technical issues."

Overall, both competitive bids and established relationships play an important role in the retrofit market. Suppliers in niche markets (metal canning lines, pumps in corrosive chemical applications, bottle fillers and capping machines) tend to rely on established relationships in the retrofit market, whereas competitive bidding figures more prominently in the supply of cross-cutting technologies (boilers, compressors). Vendors see little difference in selling equipment to the retrofit and new construction markets, although some are more likely to ask a contractor for a competitive bid in new plants or expansions.

While suppliers usually claim to take the same approach with both large and small customers ("We try to treat every customer with the same level of service and marketing"), a few acknowledged that they pay more attention to larger customers. "On larger ones we tend to use local representatives more …it gives a person somebody local that they can talk to about their purchases or whatever issues come up." A winery supplier noted that, "Our marketing approach is different, especially in the upper end like the Gallos and the Mondavi's, the further up the chain you go the more political it is."

[9] The question for 4-21 was: "Which of the following kinds of companies do you typically use to implement changes to your production process or facility that would affect your energy usage? Compared to the questions regarding a specific equipment installation." The question for 4-20 was: "Who were the most important sources of information and influence in helping you make the decision to install this equipment?"

4.5.6 Barriers to Energy Efficiency

Overall, barriers to energy efficiency were lowest for program participants and highest for customers whose production had declined in the past year. There was little difference between the perceived barriers of small and medium customers.

Small and medium customers generally face barriers to energy efficiency to a much greater extent than their larger industrial counterparts. The long list of barriers that confront small customers has been mentioned in the literature: time constraints, cost considerations, lack of awareness of energy efficiency service providers (EESPs) and information on EE technologies, cost of financing, split incentives, skepticism of contractors and information provided by vendors, complicated measurement and verification (M&V) requirements, and lack of vendor penetration (energy service providers avoid the small business market due to higher transaction costs and lower profit margins).

Exhibit 4-28 provides definitions of the various barriers that may prevent small and medium customers from adopting energy efficiency measures.

Exhibit 4-28
Barriers Defined

Statement	Description
Uncertain bill savings	When considering a new energy efficiency investment, I am concerned that the actual bill savings will be less than what was estimated.
Poor business climate	In the current business climate, I don't see much point in making investments in energy efficiency.
Not informed	I don't have the information I need to make an informed decision about energy efficient investments.
O&M	I'd rather improve energy efficiency by properly adjusting existing systems instead of buying new equipment
Unreliable information	I feel uncertain about the reliability of information provided by non-utility firms proposing energy-efficient investments for my business.
Satisfied	I am satisfied with the energy conservation decisions I have made in my business.
Time and hassle	There is too much time and hassle involved in selecting a qualified energy efficiency contractor.
No financing	Lack of financing is a barrier to our organization making energy efficiency investments that we want to make.
Self-interested vendors	People who try to sell me energy efficiency investments are just out to advance their own self- interest.
Too expensive	The added cost of energy efficient equipment is more than we can afford.
Installation downtime	Trying to install energy efficient equipment would lead to excessive downtime for my production line.

To assess the extent of these barriers, customers were asked to rate their agreement with statements listed in Exhibit 4-28 on a scale of 1 to 10. Results are presented in Exhibit 4-29, with the barriers summarized across the top of the exhibit.

Exhibit 4-29
Barriers to Energy Efficiency

SIC-Based Industry	Average 1 to 10 rating of beliefs about efficient investments (1=Don't agree at all, 10=Agree completely)											Number of Respondents
	Uncertain Bill Savings	Poor Business Climate	Not Informed	O&M	Unreliable Information	Satisfied	Time and Hassle	No Financing	Self-interested Vendors	Too Expensive	Installation Downtime	
Food (SIC 20)	6.3	3.2	4.4	7.0	4.8	7.7	4.9	5.1	4.7	5.3	4.4	61
203 Fruits and Vegetables	6.4	3.3	4.8	7.2	4.7	7.9	4.5	5.5	5.0	5.5	4.3	32
2084 Wines Brandy and Brandy Spirits	6.2	3.1	3.9	6.7	4.9	7.4	5.2	4.8	4.4	5.0	4.5	32
Printing (SIC 27)	6.9	5.3	5.5	7.4	5.5	7.8	5.1	6.9	6.0	6.6	3.8	44
Fab Metals	6.6	5.0	5.5	8.0	5.2	8.0	4.8	6.3	5.1	6.8	5.0	72
344 Fabricated Structural Metal Products	6.4	4.8	5.5	7.7	5.3	7.6	4.5	6.3	5.3	6.7	4.2	41
347 Electroplating Plating Polishing Coating Engraving	6.7	5.2	5.4	8.2	5.0	8.4	5.0	6.3	5.0	7.0	5.9	39
Industrial Machinery (SIC 35)	7.2	5.6	5.7	7.8	6.2	7.2	4.7	6.2	4.8	5.6	3.9	56
354 Metalworking Machinery	7.0	5.4	5.2	8.0	5.9	7.3	5.0	5.9	4.4	5.2	4.4	39
357 Computer Equipment	7.6	5.9	6.5	7.4	6.6	6.9	4.1	6.7	5.5	6.6	2.5	18
Small customers (less than 0.5 GWh)	6.8	4.9	5.1	7.6	5.2	7.7	5.1	6.1	5.1	6.1	4.4	172
Medium customers (0.5 - 1.5 GWh)	6.5	4.0	5.5	7.5	5.6	7.7	4.2	6.1	4.9	6.3	4.1	55
Participant*	6.6	3.3	4.1	7.6	5.7	7.9	4.3	6.3	4.4	5.9	4.0	30
Non-Participant**	6.7	5.0	5.4	7.6	5.3	7.7	5.0	6.1	5.3	6.2	4.4	183
This years production is MORE than last years production	6.5	3.9	5.6	8.0	5.3	7.5	4.4	5.4	4.9	6.1	4.2	45
This years production is LESS than last years production	6.9	5.8	5.2	7.8	5.6	7.9	4.9	6.7	5.8	6.4	4.4	105
This years production is about the SAME as last years	6.5	3.7	5.1	7.1	5.1	7.4	5.3	5.7	4.0	5.6	4.3	74
Total Respondents	189	200	213	189	196	219	200	199	187	187	177	219

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Overall, customers indicated that they were fairly satisfied with their energy conservation decisions. The first cost barrier resonated somewhat with customers, confirming earlier findings about obstacles of cost savings. For example, lack of capital was cited most frequently (39%) as a barrier to cost reduction. Yet customers were lukewarm on the importance of financing in enabling them to make EE investments. Access to capital and financing was of particular concern for customers experiencing a production slowdown: customers whose production was less than last year rated lack of financing a 7.9, compared with a 5.4 rating by customers enjoying increased production levels. Customers with reduced production over year-ago levels also saw greater barriers in uncertain bill savings, the poor business climate, unreliable information, and self-interested vendors.

While some industry observers interviewed noted that small industrial customers view any unfamiliar vendor of energy-related products or services with suspicion, results in Exhibit 4-29 suggest otherwise, lending support to the earlier finding that third party vendors do not pose a serious barrier to participation (Exhibit 4-26).

These responses also suggest that customers are largely uninterested in efficiency upgrades beyond low-cost process tune-ups. This lack of enthusiasm may be driven by skepticism about promised bill savings; this holds true for industrial machinery segment in particular (9.2).

Customers are more inclined to improve efficiency through tune-ups rather than replacing equipment. This fits with customer adoption patterns shown in Exhibits 4-19 to 4-21. Customers indicated that, for their major electrical end uses, they had already adopted high efficiency measures to reduce their energy usage.

Food processors. Cost was a less important barrier to food processors, who are less inclined to view adverse business conditions, the cost of EE equipment and lack of financing as a deterrent to EE investment. Nor did lack of information present a stumbling block. Winemakers in particular felt more confident that they had the information needed to make EE decisions than fruit and vegetable processors. Food processors displayed no strong feeling (positive or negative) toward the efficacy of information and services offered by third parties (4.7), but they did question whether actual savings would meet claims (6.3). The time and hassle of selecting a contractor (4.9) did not seem to strongly register with food processors.

Printing. Printers, largely satisfied with the energy conservation actions they have taken, indicated they would be more likely to tune-up their systems than buy new equipment. Lack of financing, capital and uncertainty over savings – not concern with excessive downtime – seemed to drive their position.

Metal fabricators. More than any other industry, metal fabricators put tune-ups before equipment retrofits. These customers were satisfied with their energy conservation efforts, concerned about first cost and uncertain about promised savings.

Industrial Machinery. Machine shops tended to prefer tune-ups to equipment replacement. The poor business climate registered with this industry more than any other. Computer equipment makers were less concerned with production downtime than any other industry segment, but felt satisfied with their conservation decisions.

Small versus Medium-Sized Customers. Perceptions of most barriers do not differ substantially by size. There are two exceptions: small customers more strongly believe that the current business climate will deter them from investing in energy efficiency (4.9 versus 4.0) and they find selecting qualified contractors a bigger hassle than medium-sized customers (5.1 versus 4.2).

Participant versus Non-participant. Participants generally had lower perceived barriers than non-participants; they were far less deterred by business conditions, inadequate information, the hassle of selecting a contractor, and self-interested vendors. However, there was little that separated the opinions of participants and non-participants on matters of first cost and financing.

This concludes the market characterization section. These findings are summarized in the next chapter (Section 5.2.1). The program assessment is presented next.

5. PROGRAM ASSESSMENT

This chapter presents findings that have direct implications for a small/medium industrial customer program design in California, and culminates in the synthesis of those findings to inform public policy. This chapter begins with an assessment of existing California and related industrial energy efficiency programs, followed by a summary of market and technical findings, and concludes with our recommendations for programs, including next steps and related research.

5.1 CURRENT PROGRAM ASSESSMENT

This section presents a participation summary for existing California programs, followed by an examination of barriers to participation, self-reported participation levels and examination of other programs and their design implications.

5.1.1 California Industrial Program Portfolio

Small and medium industrial customers participate in several different energy efficiency programs in California.

- **Statewide Nonresidential Audit Program**. The IOU's offer energy audits to their nonresidential customers, resulting in a set of energy efficiency recommendations provided to each customer in a report. These audit services are provided to commercial, industrial and agricultural customers, using audit data collection channels that include telephone surveys, mail-in forms, CD-ROM, on-line audits and on-site audits. For example, in 2001, 4750 audits (phone and onsite) were conducted with PG&E nonresidential customers. Small and medium industrial customers accounted for 4% of these audits (196 <500 kW customers). IOU audit recommendations cover rebated Express measures (i.e. refrigeration, HVAC, lighting, motors and some gas measures). However, the audit tool does not address industrial processes or complex technical systems like compressed air.

- The 2002 **Express Efficiency Rebate Program** is a statewide, nonresidential retrofit program offering financial incentives for installing energy-efficient equipment. The Express Efficiency program offers rebates for qualifying lighting, refrigeration, air conditioning, LED, motor, agricultural, and gas equipment. The program is targeted to the small/medium nonresidential market. Eligible nonresidential electric customers are those whose monthly, aggregated maximum demand does not exceed 500 kW. Eligible nonresidential gas customers are those whose monthly gas usage does not exceed 20,800 therms or who are currently served under a core gas rate.

- The 2002 **Standard Performance Contract** (SPC) program pays financial incentives for energy saved from energy efficient retrofits of existing nonresidential facilities (small, medium and large commercial, industrial and agricultural customers are eligible). Unlike the Express program, in which dollars are paid for installing specific items from a pre-approved list of energy-savings equipment, SPC offers financial incentives based

on verified energy savings for custom-designed projects. Retrofit projects must save at least 5,000 kWh of electricity or 500 gas therms per year to qualify under SPC. Similar projects at like facilities or multiple measures at one facility can be aggregated under one SPC project application.

- **Industrial Strength Seminars**. PG&E's Energy Training center offers courses and seminars for commercial and industrial operations of all sizes, such as industrial refrigeration and industrial equipment maintenance, including compressed air systems.

- **Savings By Design.** This statewide new construction program for commercial, industrial and agricultural customers encourages energy-efficient building design and construction through design assistance, owner and design team incentives. As part of this new construction initiative, PG&E is completing a number of relevant baseline studies for dairies and other food processing facilities, compressed air and clean rooms.

In addition to the IOU programs, the California Public Utility Commission (CPUC) has recently funded energy efficiency programs implemented by third party contractors. This includes the CPUC 2002 Local programs and California Energy Commission (CEC) Summer Peak Demand Reduction programs sponsored during the state's 2000-2001 energy crisis. Several of these third-party programs, geared towards industrial customers, are summarized in Exhibit 5-1[1]. Four of the five offer tune-ups for industrial refrigeration and compressed air systems, emphasizing the importance of good O&M practices to save energy. Both compressed air programs feature on-site plant assessments to large industrial customers. One very specific prescriptive rebate program offers incentives to California dairy farmers for installing VSDs on milking vacuum pumps. The later measure has been moved to the Statewide utility program portfolio under Express.

Exhibit 5-1
California Third-Party Industrial Programs

Program	Sponsoring Organization Type	Scope	Elements
EnSave Energy Performance Inc	California State Public Benefits Charge program	California dairy industry	Information and incentives for installation of variable speed drive milking vacuum pumps.
SBW's CAMP Program	California State Public Benefits Charge program	Customers with >200 horsepower in service (2,000 plants statewide)	Measurement-based free compressed air system assessments and related rebates
Xenergy's Comprehensive Compressed Air Program	California State Public Benefits Charge program	Commercial/industrial customer facilities with a total compressor load greater than 500 horsepower in PG&E service territory	Information, audit and incentives for improved efficiency of compressed air systems.
Rocky Research's Glycol Heat Transfer Program	California State Public Benefits Charge (Summer Peak Reduction program)	C/I facilities	Industrial refrigeration program implements glycol heat transfer fluid optimization project
XDX Innovative Refrigeration	California State Public Benefits Charge (Summer Peak Reduction program)	C/I facilities	Retrofit program upgrades DX-type refrigerant valve assemblies in industrial refrigeration

[1] Varying levels of success (and failure) were obtained with third-party industrial programs.

5.1.2 California Participation Assessment

Exhibit 5-2 presents participation results drawn from data tables in Appendices A and D. This brings two data sources to bear – CIS and participant tracking data – in assessing participation in the small industrial market for the Express program. Exhibit 5-3 presents similar results for the SPC program, compiled from Appendices A and E. These programs are two of the largest offered by California utilities. Express participation data is for the three electric IOU's. SPC data is for PG&E and SCE only; there were no SDG&E industrial participants for the program years examined (1998-2001).

Overall industrial customers are under-served by the Express program; for example, relative to the commercial/industrial/agricultural (CIA) customer population, industrial customers receive about 23% of the Express incentives expected, based on Public Purpose Program (PPP) charges paid (through utility rates). Small/medium industrial customers fair somewhat better than their large competitors, receiving 46% of the Express incentives expected, compared with just 18% for large. However, relative to their larger counterparts in a given industry, Express program penetration for small and medium customers is low. These findings suggest that an alternate program offering may be needed to better serve small/medium industrial customers. That is, even though the Express program is designed to serve smaller customers, *small industrial* customers still slip through the cracks. Large industrial customers on the other hand, as described next, do have the SPC program to turn to, and appear to be well served there.

Overall industrial customers are over-served by the SPC program; for example, relative to the CIA customer population, industrial customers receive SPC incentive payments that are about 27% larger than expected, based on PPP charges paid.

Historic Participation. The distribution of rebate dollars among large and small customers (rebates/participant) shows that overall, rebates for large Express are four times larger than rebate awards for small/medium participants. Large food processors captured more SPC incentives relative to small/medium participants, whereas large metal fabs did not participate at all. The biggest gap is found in the printing industry, where large participants' Express rebates are 11 times bigger than small printers. Moreover, ten big printers claimed 36% of that industry's Express rebates. The smallest difference lies with food processors ($2,944 rebate per small/medium Express participant versus $4,013 for a large participant).

Overall Express participation is dominated by small and medium customers (72%), which reflects the distribution of industrial customer sites. This reflects industry in general which is largely composed of small/medium customers (Appendix, Exhibit A-2 and B-2). Food processing is one exception: more large processors participated in Express than small and medium (Express 58% large processors, 42% small and medium).

Exhibit 5-2
Express Participation Analysis

SIC-Based Industry	Customer Size	Express Participation*		Express Rebates*		Rebates / Participant ($)	Program Penetration (%)	PGC Ratio**	First Year Savings (MWh)	First Yr Savings to Use Ratio***
		No. of Participants	Distribution by Small/Med. and Large	Thousands of Dollars	Distribution by Small/Med. and Large					
20 Food	sm/med	50	42%	147	35%	2,944	2	0.67	776	0.27
	large	68	58%	273	65%	4,013	14	0.22	1,821	0.09
	total	118	-	420	-	3,560	4	0.29	2,597	0.12
27 Printing	sm/med	207	95%	176	64%	852	4	1.00	1,296	1.00
	large	10	5%	97	36%	9,724	9	0.50	114	0.04
	total	217	-	274	-	1,261	4	0.74	1,409	0.26
34 Fab Metals	sm/med	42	78%	54	62%	1,285	1	0.24	306	0.10
	large	12	22%	33	38%	2,760	6	0.10	85	0.02
	total	54	-	87	-	1,613	1	0.15	391	0.04
35 Industrial Machinery	sm/med	145	90%	198	71%	1,368	2	0.63	2,651	0.61
	large	16	10%	81	29%	5,068	5	0.12	1,426	0.13
	total	161	-	280	-	1,736	2	0.28	4,076	0.27
All Industries	sm/med	753	72%	1,025	38%	1,362	2	0.46	9,136	0.29
	large	286	28%	1,692	62%	5,916	9	0.18	11,859	0.08
	total	1,039	-	2,717	-	2,615	2	0.23	20,995	0.11

* Participation and rebates are for PY1999-2001 statewide, electric-saving measures only.

** To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program rebate that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program rebate received was also determined for the entire participant population and for a number of customer segments. The ratio of rebate to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.

The overall ratio of 0.46 indicates that small/medium industrial customers receive about 46 percent of the incentives they deserve, based on PGC charges paid.

The overall ratio of 0.18 indicates that large industrial customers are underserved relative to their small/medium counterparts.

*** To determine if certain customer segments are underserved, comparisons were drawn between the total annual electric use for a customer segment and the amount of annual energy savings that the customer segment received. Using CIS data, the electric use for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of annual electric savings was also determined for the entire participant population and for a number of customer segments. The ratio of annual electric savings to contribution was then calculated for the population, and for each customer segment. This ratio (termed the First Year Savings to Use Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (annual electric savings) per electric use than the population on average. Similarly, a ratio less than one indicates that the customer segment received less benefit per electric use than the population on average.

The ratio of 0.29 indicates that small/medium industrial customers, on average, receive electric savings that are about one-third the size they deserve, based on the electric use of that segment.

The overall ratio of 0.08 indicates that large industrial customers are underserved relative to their small/medium counterparts.

Exhibit 5-3
SPC Participation Analysis

SIC-Based Industry	Customer Size*	SPC Participation**		SPC Rebates**		Rebates / Participant ($)	Program Penetration (%)	PGC Ratio***	First Year Savings (MWh)	First Yr Savings to Use Ratio****
		No. of Participants	Distribution by Small/Med. and Large	Thousands of Dollars	Distribution by Small/Med. and Large					
20 Food	sm/med	35	71%	1,812	26%	51,782	-	-	15,200	-
	large	14	29%	5,133	74%	366,650	-	-	42,186	-
	total	49	-	6,945	-	141,744	1.7	2.64	57,386	2.23
27 Printing	sm/med	5	50%	574	29%	114,872	-	-	3,384	-
	large	5	50%	1,385	71%	276,992	-	-	11,157	-
	total	10	-	1,959	-	195,932	0.2	2.98	14,541	2.50
34 Fab Metals	sm/med	11	100%	344	100%	31,262	-	-	4,588	-
	large	0	0%	0	0%	-	-	-	0	-
	total	11	-	344	-	31,262	0.3	0.33	4,588	0.47
35 Industrial Machinery	sm/med	15	94%	1,065	92%	70,985	-	-	7,819	-
	large	1	6%	97	8%	96,795	-	-	1,936	-
	total	16	-	1,162	-	72,598	0.2	0.64	9,755	0.60
All Industries	sm/med	377	88%	11,341	42%	30,083	-	-	107,104	-
	large	52	12%	15,771	58%	303,295	-	-	146,514	-
	total	429	-	27,112	-	63,199	1.1	1.27	253,617	1.23

* Size reported for participation and rebates is based on project size in terms of energy savings, not the amount of revenue meter-based usage.

** Participation and rebates are for PY1998-2001, for electric-saving measures installed by PG&E and SCE only.

*** To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program rebate that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program rebate received was also determined for the entire participant population and for a number of customer segments. The ratio of rebate to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.

The overall ratio of 1.27 indicates that industrial customers receive incentives that are 27 percent greater than they deserve, based on PGC charges paid.

**** To determine if certain customer segments are underserved, comparisons were drawn between the total annual electric use for a customer segment and the amount of program annual energy savings that the customer segment received. Using CIS data, the electric use for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program annual electric savings was also determined for the entire participant population and for a number of customer segments. The ratio of annual energy savings to contribution was then calculated for the population, and for each customer segment. This ratio (termed the First Year Savings to Use Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (annual electric savings) per electric use than the population on average. Similarly, a ratio less than one indicates that the customer segment received less benefit per electric use than the population on average.

The ratio of 1.23 indicates that industrial customers, on average, obtain program savings that are 23 percent greater than those received in the CIA population.

Program Penetration. Program penetration (the percentage of participants in a customer segment) shows the 1999-2001 Express program[2] reached only 2% of all small industry (versus 9% for large customers), suggesting plenty of potential for energy-saving efforts. Large food processors enjoy the highest program penetration rate (14%). Program penetration rates for SPC (1998-2000) are lower overall for industry than those for Express, at 1.1%.

Benefit-Contribution (PGC) Ratio. We assessed recent program rebates paid out to industries compared to the public goods charge (PGC) contribution made by each industry (through utility bill payments). The CPUC has placed significant emphasis on targeting HTR customer segments, which includes small businesses. This emphasis is based on the belief that there have been inequities among these customer segments that have contributed to the PGC funds, but have not explicitly benefited from the energy efficiency programs funded by the PGC.

The PGC ratio describes the relative success of the program in distributing incentives equally, based on total dollars paid in public purpose program (PPP) charges[3]. A ratio of 1 indicates that a given segment is on equal footing with the entire commercial, industrial and agricultural (CIA) population. For a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.

To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program rebate that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of PGC program rebate received was also determined for the entire participant population and for a number of customer segments. The ratio of rebate to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. For a given customer segment, a PGC ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.

This ratio was calculated for two separate programs: Express Efficiency and SPC. The benefit component of the PGC ratio is based on rebates received under the Express or SPC program, respectively. For example, the **Express Efficiency PGC ratio for industrial customers overall suggests that they only receive about 23% of the Express incentives expected**, based on PPP charges paid. In sum, industrial customers are not getting their fair share of Express rebates. *Small industrial Express customers (46%) are less underserved relative to large (18%). Analysis of Express program participation versus PGC contribution indicates that industry in general, especially*

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[2] Electric saving measures only.

[3] PPP charges on utility bills include funds collected for energy efficiency, low income and renewable energy programs. The PGC ratio is calculated using total PPP due to difficulties encountered in extracting the funds collected for energy efficiency programs alone.

large industry, is an underserved market. This, of course, is counter to the conclusion one might draw, as suggested above, based on pure site-level penetration because large customers pay a higher PGC proportion due to their larger use of energy.

However, **industrial customers are not underserved with respect to the SPC program. The overall ratio of 1.27 indicates that industrial customers receive 27 percent more benefit than expected**. This result is expected because the SPC program is geared toward large engineered projects that are typical of efficiency improvements undertaken by industrial customers. Unfortunately, for the SPC program, we were unable to isolate large and small/medium customer benefit ratios (nor impact ratios[4], as described next).

Impacts. Ideally all customers would receive program benefits equitably. To measure the equality of program benefits we express impacts as a saving-to-usage ratio. Savings are first year program measure MWh savings for 1999-2001. It is important to note that the ratio is not calculated using participant electric use, but the use of an entire customer segment. The resulting ratio is not impacts per participating site, but a measure of how much a segment is saving relative to electric use for the entire population that makes up each segment. Therefore, the measure is most useful in comparing across segments (i.e. one industry's savings relative to another industry, or small versus large customers within an industry).

For the Express program, industrial customers are underserved overall, receiving just 11% of the benefit expected, based on the ratio of savings to usage. Small industrial customers receive a larger share of impact relative to their usage (0.29) than large industrial competitors (0.08), but this is still far below the CIA population overall (1.00). The biggest impacts of any segment are found in small printing shops, which have an impact ratio of 1.00, well above 0.11, representing all industries. Second to small printers are small/medium industrial machine shops, with a savings ratio of 0.61.

Industrial customers are reasonably "served," as measured using the savings ratio for SPC. The overall ratio of 1.23 indicates that industrial customers receive 23 percent more benefit relative to electric use than the CIA population overall. Similar to the PGC ratio, this result is expected because the SPC program is geared toward large engineered projects that are typical of efficiency improvements undertaken by industrial customers.

5.1.3 Customer Participation Findings

Based on customer survey results, medium sized customers participate in energy efficiency programs more often than small customers. Medium sized customers appear to be more likely to participate because 1) they are more likely to have an energy efficiency policy, and 2) tend to have more sophisticated decision making than than their smaller counterparts (i.e., life cycle cost vs. first cost considerations alone). However, neither small nor medium sized customers – even participants – tend to devote staff resources to energy efficiency.

[4] SPC program tracking systems used for this study did not always contain an account-level merge key to obtain customer size data from the appropriate IOU customer information system (CIS).

Customer Size and Participation. An initial study hypothesis was that smaller customers would be less likely to participate in energy efficiency programs. Survey results support this hypothesis, finding that larger (medium-sized) customers are more likely to participate than smaller customers. While comparing small to medium-sized customers is informative, a truer test would be to assess participation rates among large customers versus small/medium.

Multiple Sites. We hypothesized that customers with multiple sites are more likely to participate than those with a single site. Exhibit 5-4 shows the distribution of participation by number of locations, based on survey responses. Overall, the vast majority (77%) of small/medium customers run single-site businesses.

Exhibit 5-4
Number of Locations by Industry, Size and Participation

SIC-Based Industry	Number of locations					Number of Respondents
	1	2-4	5-10	11-25	Over 25	
Small customers (less than 0.5 GWh)	84%	13%	3%	0%	0%	289
Medium customers (0.5 - 1.5 GWh)	58%	29%	9%	1%	3%	93
Participant*	63%	21%	13%	0%	4%	48
Non-Participant**	80%	16%	3%	0%	1%	324
Total N	296	64	17	1	4	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Responses confirm our hypothesis that there is increased likelihood of participation for customers with multiple sites. Participants are more likely to run multiple-site businesses (47%) than non-participants (20%), while a much higher percentage of non-participants fall into the single-site category (80%) than participants (63%). In addition, a higher percentage of businesses with 2-4 locations are participating (21% of participants versus 16% of non-participants). Customers with 5-10 locations are much more likely to participate (13% vs. just 3% for non-participants). However, no meaningful conclusions can be drawn for businesses with more than 11 locations because sample sizes are too small.

Location of Facilities. The above trend is also evident in Exhibit 5-5, which shows the distribution of participation by the location of facilities owned by each firm.

Exhibit 5-5
Location of Facilities by Industry, Size and Participation

SIC-Based Industry	Location of the firms facilities				Number of Responses
	We only have one facility	Concentrated in one part of California	Located in various parts of California	Within and outside California	
Small customers (less than 0.5 GWh)	84%	10%	4%	3%	289
Medium customers (0.5 - 1.5 GWh)	58%	17%	6%	18%	93
Participant*	63%	15%	8%	15%	48
Non-Participant**	80%	11%	4%	5%	324
Total	296	44	17	25	382

*Has participated in an energy efficiency program offered by their utility in the last two years (self reported)
**Has not participated in an energy efficiency program offered by their utility in the last two years (self reported)

Firms with facilities in various parts of California and those located both within and outside California are multiple-site businesses. Those multiple-location businesses boast a higher percentage of participants than non-participants.

Since smaller customers with multiple sites are more likely to participate than single-premise customers, it may be possible to increase participation of single-premise customers by providing technical assistance to groups of similar small industrials through industry associations and vendors.

Outsourcing and Participation. Customers that rely on outside contractors for routine maintenance (particularly of refrigeration systems) are hypothesized to be less likely to participate in energy efficiency programs, both because they lack the in-house knowledge and expertise and because the outside contractor has little incentive to encourage its customers to participate. By outsourcing maintenance functions to a contractor, these customers may forego in-house EE knowledge.

Exhibit 5-6
Outsourcing and Participation

SIC-Based Industry	Which aspects of facility maintenance are outsourced?													Number of Res-pondents
	Refrigeration Equipment	Production Equipment	Motor/ Compressor/ Pump	HVAC	Lighting	Overall Facility	Electrical	Vehicle	Landscaping/ Vineyard	Janitor	Other	Refused	Don't Know	
Food (SIC 20)	30%	11%	11%	21%	5%	5%	1%	3%	2%	0%	0%	0%	0%	96
203 Fruits and Vegetables	24%	15%	9%	20%	9%	7%	0%	0%	0%	0%	0%	0%	0%	46
2084 Wines Brandy and Brandy Spirits	36%	8%	14%	22%	2%	4%	2%	6%	4%	0%	0%	0%	0%	50
Printing (SIC 27)	1%	14%	1%	18%	0%	4%	0%	1%	0%	1%	0%	0%	1%	71
Fab Metals	2%	11%	6%	12%	2%	2%	2%	0%	1%	0%	0%	0%	1%	128
344 Fabricated Structural Metal Products	2%	10%	2%	10%	0%	0%	0%	0%	2%	0%	0%	0%	0%	63
347 Electroplating Plating Polishing Coating En	3%	12%	11%	14%	3%	3%	3%	0%	0%	0%	0%	0%	2%	65
Industrial Machinery (SIC 35)	0%	14%	3%	21%	7%	6%	0%	0%	0%	1%	2%	0%	0%	87
354 Metalworking Machinery	0%	14%	5%	10%	2%	3%	0%	0%	0%	0%	0%	0%	0%	58
357 Computer Equipment	0%	14%	0%	41%	17%	10%	0%	0%	0%	3%	7%	0%	0%	29
Small customers (less than 0.5 GWh)	8%	12%	6%	11%	3%	3%	1%	1%	1%	0%	1%	0%	0%	289
Medium customers (0.5 - 1.5 GWh)	12%	13%	6%	35%	5%	5%	0%	1%	1%	1%	0%	0%	1%	93
Participant*	13%	10%	6%	33%	4%	10%	0%	0%	0%	2%	0%	0%	2%	48
Non-Participant**	8%	12%	6%	15%	3%	3%	1%	1%	1%	0%	1%	0%	0%	324
This years production is MORE than last years pr	11%	11%	8%	21%	4%	3%	1%	1%	3%	3%	1%	0%	0%	80
This years production is LESS than last years prod	8%	13%	6%	15%	3%	5%	0%	1%	1%	0%	1%	0%	1%	177
This years production is about the SAME as last y	8%	12%	5%	17%	4%	2%	2%	2%	0%	0%	0%	0%	0%	123
Total	33	47	23	66	13	15	3	4	3	2	2	0	2	382

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Respondents were asked which aspects of facility maintenance they outsourced. Exhibit 5-6 shows that outsourcing is not widespread. HVAC is most often outsourced. Production equipment is outsourced less than 15% of the time. About one-third of food processors outsource their refrigeration equipment.

Furthermore, the evidence does not support the notion that outsourcing discourages participation. Customers that outsource HVAC are twice as likely to participate than those that do not. Perhaps those that outsource are more interested in or predisposed to cost-saving opportunities, including the act of outsourcing itself and investments in energy efficiency. The HVAC contractor responsible for routine maintenance may also inform customers of program opportunities or even push for program qualifying efficiency improvements.

In-house Energy Efficiency Expertise. Several industry experts that were interviewed emphasized the importance of an in-house energy efficiency champion to a company's receptivity to energy efficiency initiatives. We therefore hypothesize that the presence of such an efficiency champion would be positively correlated with program participation. Exhibit 5-7 shows the presence of energy efficiency policies and energy managers among small and medium customers. In the small/medium context, we take "energy manager" to mean an employee whose partial responsibility is dealing with energy matters, not a dedicated staff member. Full-time energy managers are more likely to be found among large customers.

Exhibit 5-7
Energy Efficiency Policy and Management Structure
by Industry, Size and Participation

SIC-Based Industry	Have an energy efficiency policy		Have an energy manager on staff		Don't have an energy manager on staff, but have an energy efficiency guru	
	%	N	%	N	%	N
Food (SIC 20)	50%	96	56%	96	17%	42
203 Fruits and Vegetables	46%	46	63%	46	12%	17
2084 Wines Brandy and Brandy Spirits	54%	50	50%	50	20%	25
Printing (SIC 27)	37%	71	56%	71	16%	31
Fab Metals	38%	128	59%	128	17%	52
344 Fabricated Structural Metal Products	41%	63	56%	63	18%	28
347 Electroplating Plating Polishing Coating Engraving	35%	65	63%	65	17%	24
Industrial Machinery (SIC 35)	25%	87	49%	87	14%	44
354 Metalworking Machinery	26%	58	48%	58	10%	30
357 Computer Equipment	24%	29	52%	29	21%	14
Small customers (less than 0.5 GWh)	36%	289	56%	289	14%	128
Medium customers (0.5 - 1.5 GWh)	45%	93	56%	93	22%	41
Participant*	**50%**	**48**	**56%**	**48**	**24%**	**21**
Non-Participant**	**36%**	**324**	**56%**	**324**	**15%**	**141**
Total	145	382	213	382	27	169

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

The difference between participants and non-participants offers some confirming evidence. Half of participants have a policy that emphasizes the selection of high efficiency versions of energy-using equipment rather than standard-efficiency, whereas 36% of non-participants report having such a policy. However, 56% of participants and non-participants report having an energy manager on staff. For participating companies without an energy manager, 24% employ an energy efficiency champion, whereas only 15% of non-participants claim in-house expertise. One HVAC contractor observed that, for companies that purchase high efficiency, "Usually there will be a manager who is an energy guru and knows about energy efficiency and requests it."

There also exists variation among industries with respect to EE policies and expertise. Food processors (50%), particularly wineries (54%), are more likely to have an energy efficiency policy in place than any other industry segment. Machine shops tend not to adopt EE policies (only 25%), while printers (37%) and the fabricated metal segment (38%) are relatively similar. Energy managers are more common than EE policies; there is not as wide a gap to be found between food (56%) and industrial machinery (49%) with respect to energy managers. This type of staffing is most likely to be found at fruit and vegetable processors and metal finishers (both 63%). De facto expertise – respondents who indicated they have an "energy efficiency champion," but not an energy manager, on staff – tends to be found in wineries (20%) and computer equipment makers (21%).

As one would expect, according to survey responses, medium sized industrial customers are more likely to have an energy efficiency policy and staff that address energy efficiency related topics.

Sources of Program Awareness. Exhibit 5-8 reports on participants' sources of program awareness.

Exhibit 5-8
Customers' Sources of Program Awareness

SIC-Based Industry	How did you hear about the program that you participated in?											Number of Respondents
	Utility Bill Inserts	Utility Mailing	Utility Rep	Utility Walk thru Representati	Radio Advertising	Word of Mouth	Contractor/ AC Person	Internet	Trade Association	Consultant	Don't know	
Food (SIC 20)	19%	19%	29%	14%	5%	10%	10%	5%	10%	5%	0%	21
203 Fruits and Vegetables	13%	13%	40%	7%	7%	13%	13%	7%	7%	7%	0%	15
2084 Wines Brandy and Brandy Spirits	33%	33%	0%	33%	0%	0%	0%	0%	17%	0%	0%	6
Printing (SIC 27)	33%	0%	33%	0%	11%	0%	11%	11%	0%	0%	11%	9
Fab Metals (SIC 34)	8%	23%	23%	8%	8%	23%	8%	8%	0%	0%	15%	13
344 Fabricated Structural Metal Products	0%	33%	33%	0%	0%	33%	0%	33%	0%	0%	0%	3
347 Electroplating Plating Polishing Coating Engraving	10%	20%	20%	10%	10%	20%	10%	0%	0%	0%	20%	10
Industrial Machinery (SIC 35)	20%	0%	20%	0%	40%	0%	20%	20%	0%	0%	0%	5
354 Metalworking Machinery	0%	0%	0%	0%	50%	0%	50%	0%	0%	0%	0%	2
357 Computer Equipment	33%	0%	33%	0%	33%	0%	0%	33%	0%	0%	0%	3
Small customers (less than 0.5 GWh)	24%	14%	19%	5%	14%	10%	10%	14%	10%	5%	5%	21
Medium customers (0.5 - 1.5 GWh)	15%	15%	33%	11%	7%	11%	11%	4%	0%	0%	7%	27
Participant*	19%	15%	27%	8%	10%	10%	10%	8%	4%	2%	6%	48
Non-Participant**	-	-	-	-	-	-	-	-	-	-	-	0
Total	9	7	13	4	5	5	5	4	2	1	3	48

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Overall, participants tended to learn of programs from the utilities themselves – primarily reps (27%), bill inserts (19%), and mailings (15%). Contractors (10%), radio advertising (10% and word of mouth (10%) accounted for substantial awareness. The Internet and utility walk-throughs (or audits) each accounted for about 8%. Trade associations (4%), however, were a less important channel in general.

Industry Differences. Utility coverage – the combination of bill insert, mailing, representative, walk-through – varied by industry. Only 40% of industrial machinery participants learned of the programs through the utilities. Two-thirds of printing participants and 81% of food processors credited their program awareness to utility sources. Trade associations did not come into play for any industry except food processors, which benefits from the active involvement of the California League of Food Processors in energy issues[5].

Small versus medium. Substantial differences exist in the ways small and medium-sized participants became aware of the programs. About 74% of medium-sized customers learned of programs through utility channels, as opposed to 62% of small participants. Smaller customers

[5] Quantum Consulting, Large Customer Wants and Needs Study, prepared for Southern California Edison, February 2001.

receive less personal attention by utilities than medium-sized ones; one-third of medium-sized customers learned of the program through a utility rep whereas only 19% of small customers. Likewise, 11% of medium customers mentioned a walk-through, whereas only 5% of small participants reported this utility representative source. Trade associations played a bigger role for small customers (10%) than medium-sized ones (0%). A gap between small and medium participants also exists with respect to radio advertising (14% versus 7%), the Internet (14% versus 4%) and consultants (5% versus 0%).

5.1.4 Other Program Designs

Program elements for small industrial customers are presented in this section by examining other non-IOU programs serving the industrial market.

Several innovative program approaches in the US reaching the small/medium industrial market are presented below[6].

- The Industrial Assessment Center (IAC) program[7] approaches energy efficiency in the context of the overall production process, evaluating medium[8] sized industrial plants for a variety of process upgrades and waste reduction opportunities. While participants receive a detailed analysis of the costs and returns associated with each recommendation, they do not receive financing or rebates; it is assumed that if the business case makes sense, the necessary investment will be made. As an added market transformation benefit, the program's use of college engineering students to conduct the audits develop human capital to foster an infrastructure of energy efficiency providers.

- The National Grid[9] Industrial System Optimization Services program works with existing audit and technical assistance program, including the IAC, to find industrial customers with an interest in improved energy efficiency. In addition to an audit and technical analysis, the program provides funding and other services offered by National Grid's industrial retrofit and new construction programs. National Grid also has a program oriented to small industrial (and commercial) customers, with electric use less than 300 MWh per year. This program features direct installation of lighting and other C/I measures, with the utility covering 80% of costs directly and financing the balance for up to 24 months.

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[6] CPUC- and CEC-funded programs were presented earlier in Section 5.1.1.

[7] Rutgers State University, the DOE Industrial Assessment Database, User Information Version 8.1, January 2001.

[8] The IAC program specifically targets medium rather than small customers by requiring that participating facilities have annual energy bills of at least $75,000.

[9] Shipley, A., Elliott, N., and Hinge, A., Energy Efficiency Programs for Small and Medium-Sized Industry, Report Number IE002, February 2002.

- The NYSERDA Flex Tech[10] program is a custom-tailored technical assistance program that seeks to lower facility operating costs and make industrial and environmental improvements. The program provides audit services (and leverages the availability of IAC audits), and features a roster of prescreened energy consultants who are well known in the industrial community, as well as ties to financial institutions that are willing to provide financing for energy efficiency and productivity upgrades.

- A variety of programs offered through the Energy Center of Wisconsin (ECW) are effective in that they build on existing relationships and services in the industrial sector to integrate energy efficiency consideration into free and fee-based services designed to increase the competitiveness and productivity of Wisconsin industries. ECW also builds relationships with DOE to leverage its national industry roadmap and best practices programs.

- The Northwest Energy Efficiency Alliance has developed a number of programs that are designed to influence energy efficiency practices for industrial customers surrounding motor selection, speed drives and compressed air systems, as well as some innovative elements involving the microelectronics industry and waste water facilities.

- The Office of Industrial Technologies (OIT; through a collaborative effort involving the Energy Efficiency and Renewable Energy Network and the US DOE) offers the Industries of the Future program. OIT maximizes its technology investments through collaborative R&D partnerships in nine vital industries. These nine industries necessarily use large amounts of heat and energy to physically or chemically transform materials.

- The Environmental Protection Agency (EPA) offers a number of relevant programs, such as Laboratories for the 21st Century (Labs21) program and the ENERGY STAR program. Labs21 is a voluntary program dedicated to improving the environmental performance of U.S. laboratories by improving laboratory energy and water efficiency, encouraging the use of renewable energy sources, and promoting environmental stewardship. Through the ENERGY STAR label manufacturers can increase sales and consumer loyalty by promoting the energy-saving and environmental benefits associated with their ENERGY STAR products.

- The Compressed Air Challenge is a voluntary collaboration of industrial users; manufacturers, distributors and their associations; consultants; state research and development agencies; energy efficiency organizations; and utilities. This group works to improve the performance of compressed air systems through a national training and education initiative.

- The Consortium for Energy Efficiency runs the Motor Decisions Matter program, a national campaign encouraging the use of sound motor management and planning as a tool to cut motor energy costs and increase productivity. The campaign is sponsored by

[10] Ibid.

a consortium of motor industry manufacturers and service centers, trade associations, electric utilities and government agencies.

The above is by no means a comprehensive list of industrial programs, but points to the many opportunities there are to either leverage existing program resources or refine aspects of those initiatives through the development of a California program to better reach small/medium industrial customers. Also not to be overlooked are opportunities to use or link with (mandatory and voluntary) appliance efficiency standards that affect a variety of technologies.

5.2 STUDY FINDINGS AND IMPLICATIONS FOR PROGRAM DESIGN

5.2.1 Market Characterization Results

The following is a summary of integrated results stemming from the Chapter 4 Market Characterization. This section presents industrial end user attributes as they relate to energy use and energy efficiency, including an examination of small and medium customer differences, and difference by industry (targeted in this study).

Small/medium industrial customers are far from homogeneous. There exist significant differences among segments within this relatively broad category – both by size and within and across industries. Company size ranges from fewer than 5 employees to well over 100; facility square footage from less than 1000 square feet to over 100,000 square feet, and energy intensity from less than 100 MWh per premise to more than 2000 MWh. Moreover, survey results as well as supplier and industry observer interviews all point to differences in perceptions and behavior between medium and very small customers, between participants and non-participants, and across industries.

All of this suggests that different groups need to be approached with different program elements, technologies and marketing messages, and that considerations of cost-effectiveness will necessarily help determine what elements are targeted to what sectors.

At the same time, there are a number of broad unifying threads that appear to cut across all segments in the small/medium industrial sector. These broadly applicable conclusions are discussed first, followed by segment-specific market findings.

Cross-cutting Findings

Five findings have vital implications for program design in the small/medium industrial market and help drive the program design approach outlined in Section 5.3.1.

1. The owner is the most important player in selecting equipment for retrofit projects. Suppliers confirm:

- "The smaller the company, the more likely it is to be the owner."
- "The owner is the key decision maker, he is going to decide yes we do this or no we don't, so the buck stops there [because] the owner signs the check."

- Direct owner involvement is critical to "Mom and Pop installations" because an owner more likely to take a broader, long-term view than a hired manager.

2. Small customers depend on equipment vendors for assistance in selecting equipment.

   - Customer survey data confirms that small and medium customers tend to rely on themselves and their equipment vendors for information on new equipment efficiency.

   - As a boiler supplier commented, "They definitely rely on us – and all their vendors – more than larger customers."

3. Small and medium customers often lack technical knowledge.

   - As suppliers suggest, "some of them don't have the staff, a lot don't have the budget to hire a design engineer, and may not be that knowledgeable about technical issues."

   - "Small customers are more dependent on us because they need our expertise they don't have engineers or experienced people to help with their problems," reports another supplier.

   - Customers themselves acknowledge a lack of awareness in their open-ended responses about controlling costs, uncertainty about cost savings and payback periods.

4. Small and medium customers are receptive to training initiatives.

   - Customers are quite interested in training and best practices as a way to cut costs.

   - Suppliers acknowledged the importance of educating customers on lifecycle benefits, efficiency and payback, but admitted they were unlikely to undertake such efforts. "It's a small account you can't afford to spend a lot of time trying to educate them."

5. Medium customers have shown themselves to be willing and able to implement energy efficiency measures when provided with detailed, actionable recommendations for cost-effective process improvements. For example, the IAC audit database of small/medium manufacturing plants indicates a 50% implementation rate for measure recommendations within the first year following each audit[11]. It is likely that implementation would continue beyond the first year and that it would involve measures in addition to those recorded during each IAC audit.

[11] According to the IAC database, about half the measures that cost less than $1000 have been adopted and a third of measures over $10,000 have been installed.

Small versus Medium Customers

In the analysis of survey results, a distinction is made between small customers (those with annual electrical usage of less than 500 MWh) and medium customers (those with annual usage between 500 and 1,500 MWh). The survey results – as well as input from suppliers, industry observers, and review of the literature – provide the following relevant findings regarding the distinction between small and medium customers.

In addition to the obvious distinction of having more workers, larger facilities, and higher overall energy use, in comparison to small customers, medium customers:

- are more likely to participate in utility programs
- are more likely to have multiple locations
- assign a higher degree of importance to several key business issues, including identifying and implementing cost-saving measures, keeping up with new technology, and keeping up with shifting market demand
- are more likely to implement cost saving measures, including purchasing new equipment, using best practices or training, and implementing conservation measures
- are more likely to be aware of and install new technologies
- feel better-equipped to make energy efficiency decisions with internal resources
- are more likely to have an energy policy and to be aware of energy efficiency programs
- are more likely to rely on their utility to provide them with information and assign a higher value to the utility as a source of information

A picture clearly emerges of medium industrial customers as being more pro-active, more concerned with cost savings, and more ready to take action. This makes them excellent candidates for several of the approaches successfully used in past programs, particularly those that provide customers with audit-based information and access to a pool of screened resources, including service providers, financing, and rebates or other incentives.

In contrast, smaller customers:

- are generally knowledgeable about new technologies, but less inclined to undertake cost-cutting or energy conservation actions, including installation of new equipment or use of training/best practices
- are prevented from implementing cost-cutting measures by a lack of capital, limited time and uncertain business conditions
- rely on suppliers, particularly manufacturers and contractors, to provide them with information about energy efficiency and new technologies

- often have an almost fatalistic view of their business, feeling that their success is determined by external economic conditions and that energy and other costs are beyond their control.

Furthermore, current economic conditions have created a difficult climate for energy efficiency improvements among small industrial customers. Several of the industries studied are now characterized by a predominance of subcontracting, where the largest manufacturing companies contract out all or most of their production to medium sized firms, who in turn subcontract out the manufacture of components, subsystems, and parts to small family owned businesses. The current economic slowdown has meant less business throughout the subcontracting chain, with the result that the smallest manufacturers have been particularly hard-hit as medium sized firms keep in-house much of the work they would otherwise have subcontracted out. This places severe constraints on the willingness and ability of these small firms to make energy related investments.

All of the above suggest that programs targeted to the smallest customer group should be designed so that they are easy to implement, can be delivered through those vendors whose advice the customer trusts, and take account of the capital (and even cash flow) constraints faced by small industrial businesses. The National Grid Small Commercial and Industrial Program incorporates several of these program elements by tying in with other manufacturing assistance programs, and providing design assistance, rebates and financing[12].

Industry Differences

While the cross-cutting findings and distinctions between small and large customers generally held across industries, there were some differences in perceptions and behavior among the industry segments studied that could lead to differences in program approaches to better target a given industry.

The **food processing** industry (SIC 20) stands out as one of the biggest natural gas users and claims the highest energy cost relative to operating costs of the industry segments studied. It has also been less dramatically affected by the business downturn than other industries. In addition:

- Fruit and vegetable processors most often have more than 50 employees and facilities over 100,000 square feet; two thirds of food processors operate 12 months a year

- Food processors are more likely than other segments to have undertaken energy conservation measures and installed high efficiency equipment, and are also more willing to shift their production schedule or modify their process to save energy

- To implement production changes, food processors are inclined to rely on equipment vendors, manufacturers, engineering companies, consultants and contractors for assistance.

[12] Shipley, A., Elliott, N., and Hinge, A., Energy Efficiency Programs for Small and Medium-Sized Industry, Report Number IE002, February 2002.

Because of their track record of energy efficiency actions and willingness to work with vendors to gather information, food processors would likely respond well to an approach developed for medium sized customers.

The small/medium **printing industry** (SIC 27) is characterized by many small, single site facilities that use relatively less energy per site than other segments. In addition, printers have:

- The highest percentage (63%) who rely on utilities for energy efficiency information
- Lower awareness of new technologies for their industry than other industries
- The highest use (45%) of equipment vendors to implement changes
- The highest percentage who claim to have undertaken equipment upgrades, but the lowest percentage turning off lights, shifting production, or modifying processes to save energy

The **printing segment** does not appear to offer as much opportunity for cost-effective market interventions due to their low energy intensity, relatively small size, and prevalence of single facilities. In addition, printers demonstrated lower awareness of new technologies for their industry than other industries. Therefore, the **small customer approach** may be appropriate for printers, where equipment vendors and utilities (both regarded as reliable information sources) team up to **educate** this segment about energy efficiency. Likely partners are the Printers' National Environmental Assistance Center (PNEAC) and Quad/Tech, a highly influential vendor to the printing industry. According one source, Quad/Tech was able to get many printers in California to adopt energy efficiency measures, possibly contributing to the relatively high participation rates for printers in Express. Identifying and partnering with influential vendors (by industry) should be considered a high priority item for industrial energy efficiency program development.

The **metal fabricating industry** (SIC 34) is a relatively heavy user of both electricity and gas overall, but also has a preponderance of very small users (there are 12 times more small than medium facilities). Fab metal shops' biggest electrical uses lie in production machinery and lighting, but metal fabricators are more likely to cite specific types of equipment, such as compressors or motors among their top two electric uses. In addition, compared to other industries, metal fabricators:

- Assign the highest priority to maintaining product quality and consistency
- Have the highest likelihood of implementing training/best practices programs
- Have the highest percentage of respondents turning off equipment on nights and weekends, with 94% of those who took conservations action doing so to reduce energy cost
- Are most likely to install EE production machinery
- Are very likely to use their utilities for information

As with the printing industry, the opportunities in this industry are somewhat limited by the small size of the typical facility. On the other hand, metal fabricators are responsive to training and have shown themselves to be willing to install energy efficient equipment. Since they see utilities as valuable information sources, a utility-led program of information and training may be appropriate for these users.

There are almost 7,000 small (under 500 MWh) **industrial machinery manufacturers** (SIC 35) in California, representing 15 percent of all industrial sites in the state. Small facilities outnumber medium sized ones 14 to 1. The industry includes both machine shops and computer equipment assembly, two segments with very different energy uses and production processes. Characteristics of the industry include:

- Industrial machinery manufacturers who had installed energy efficient equipment were less likely to cite in-house staff as an information source and more likely to cite publications and equipment vendors

- The industry has a higher incidence of adoption of energy efficient lighting than any other

- They were less likely than any other industry to have an energy policy or an energy manager

- They were most likely to say they would not rely on any other company to implement changes that would affect production

A representative of a statewide trade association noted that small machine shops are particularly difficult to organize or draw into programs, and that even seemingly attractive investments might be ignored because they are perceived to be too much trouble. This has become even more evident in light of current poor business conditions. On the other hand, the industry has shown a willingness to adopt conservation measures to help reduce blackouts as well as reduce energy costs. Programs targeted to this industry should recognize their economic concerns and limited access to capital, focusing instead on low/no-cost measures similar to those the industry has already taken.

5.2.2 Technical Findings

This section of the report presents technical opportunities for efficiency improvements, beginning with a brief overview of the technical and economic potential for efficiency improvements, followed by a drill-down analysis of the technologies that have the greatest promise for success.

A recent California energy efficiency potential study funded by the Energy Foundation and Hewlett Foundation[13] has found that the economic potential to save electric energy in California industry by 2011 is 10,000 GWh/year, while the technical potential approaches

[13] XENERGY, California's Secret Energy Surplus: The Potential for Energy Efficiency, September 2003.

15,000 GWh/year[14]. By end-use, this potential consists of 31% motors, 27% process, 23% lighting, 11% compressed air and 8% space cooling.

The purpose of this technical assessment is to inform the program design process and, given utility interest in targeted energy efficiency programs for industries, to highlight the importance of continuing such efforts. If program design and implementation are likely, then a key area for ongoing research is technology assessments that focus on the specific industry and end-use targets of a given program.

End-use energy efficiency targets are presented below as a function of industry, with a concentration on medium sized customer response to energy efficiency opportunities[15]. The results presented are based on detailed IAC database assessments completed for each industry included in this study. Those details are presented in Appendix F in conjunction with brief industry assessments.

For **medium sized customers**, technical opportunities exist in all end uses in a given plant, including compressed air and production machinery. As illustrated in Exhibit 5-9, the review of the IAC database highlights promising combinations of market segments and technologies. The exhibit summarizes both the percentage of IAC recommendations to a specific industry segment (accounted for by each major end-use) and the percentage of recommendations implemented by industry and end-use.

Exhibit 5-9
Potential and Likelihood of Measure Implementation by Industry and End-Use

		IAC Database Results	Compressed Air		Lighting		HVAC		Production Equipment		Production Processes		Natural Gas Process Heating	
Segment	SIC	Total Energy Measures Recom-mended	Potential	Likelihood of implemen-tation	Potential	Likelihood of implemen-tation	Potential	Likelihood of implemen-tation	Potential	Likelihood of implemen-tation	Potential	Likelihood of implemen-tation	Potential	Likelihood of implemen-tation
Fruit & Veg. Processing	203	170	M	H	H	M	L	H	M	M	L	M	M	M
Fabricated Metals	344	128	M	H	H	M	L	L	M	H	M	L	M	M
Printing	27	119	M	M	H	M	M	M	H	H	M	L		
Metal Finishing	347	71	M	H	H	H	L	M	M	M	M	H	L	H
Metalworing Equipment	354	51	M	H	H	H	L	M	M	M	M	H	L	L
Computer Equipment	357	25	M	H	H	H	M	L	M	M	L	M		

Potential (based on % of recommendations for a segment)
Low = 0-10%
Medium = 11-25%
High = 26%+

Likelihood (based on percentage of recommendations implemented)
Low = 0-33%
Medium = 34-66%
High = 67%+

The optimum combination – and recommended areas of focus for an audit-based program targeted to medium-sized customers -- would be those end uses or technologies that have both high potential and a high likelihood of implementation.

[14] To put this in perspective, current statewide energy use for industry is just under 33,000 GWh/year, across all four IOU's, with small industry using about 5,500 GWh/year.

[15] Medium sized industrial facilities are highlighted in this section because the results presented are based upon customer follow-through with IAC database recommendations. The IAC offering targets medium sized industrial facilities.

- This is the case for lighting measures in the metal finishing, metalworking equipment, and computer equipment industries. Lighting is also a high potential measure in other industries, although the likelihood of implementation in those industries is not as high.

- The only other combination of high potential and a high likelihood of implementation is production equipment in medium-sized printing facilities. No other end-use had a high likelihood of implementation for this industry, even though printing establishments showed higher rates of participation in Express for the 1999-2001 period than did other industries. This finding may be driven by the influence of Quad/Tech, a vendor pushing energy efficiency solutions for the printing industry.

A second area of recommended focus comprises both measures with medium potential and a high likelihood of implementation and measures with high potential and medium likelihood of implementation.

- Compressed air accounted for 16-23% of recommendations for all industry segments studied, and 73% of the compressed air recommendations were later implemented – the highest percentage of any end use. Recommendations included both low/no-cost measures and equipment replacement. Consistent with current Compressed Air Challenge suggestions (and many others), compressed air program design should consider both equipment efficiency and system efficiency improvements. The Third Party programs (previously offered by PG&E and) currently being offered by SBW and Xenergy appear to have these characteristics.

- Both production equipment and production processes show significant potential across most segments, and both are recommended for consideration in a program targeted to medium-size customers. Fabricated metals shops are more likely to implement production equipment recommendations, while metal finishing and metal working establishments are more apt to implement process improvements. There are also opportunities for efficiency improvements in natural gas process heating in the food and fabricated metals sectors.

HVAC-related measures were much more likely to be recommended for the computer and printing industries than for other sectors; however they were implemented no more than half the time for these segments.

Regarding **small** industrial customers, several conclusions can be drawn regarding appropriate end uses and technologies for this market segment.

- The compressed air end use offers opportunities for low-cost/no-cost measures that could be effectively implemented through a direct installation program. Leak detection and repair and, to a lesser extent, pressure reduction, are clear examples.

- Lighting appears to offer potential across industries, and can be easily addressed with the small industry approach described earlier in this Chapter. This approach should be easy to implement, delivered through vendors whose advice the customer trusts, and should address the capital and cash flow constraints that many small industrial customers face.

- Several production equipment efficiency measures could be relatively easily adapted to a small customer program, including selection of premium efficiency motors, replacement of worn drive belts, and shutting off equipment when not in use. In the printing industry in particular, there are both opportunities for and receptivity to improvements in equipment efficiency.

- Process changes are likely to be expensive, time consuming to implement and ultimately resisted by small facilities. For this reason a process-based program element for small customers is not recommended.

With a firm understanding of the market in question and the technology opportunities, study conclusions and recommendations are presented next.

5.3 STUDY RECOMMENDATIONS

The market and technical findings discussed in the previous two sections are integrated here to present a set of recommendations for first, program design, followed by a brief list of items that may warrant further study.

5.3.1 Program Design

Drawing on the review of successful programs described earlier as well as the results of the surveys and interviews, a number of program elements were considered. Potential intervention strategies are presented in Exhibit 5-10, and are designed to span the process by which decisions are made – starting with the gathering of information in an onsite assessment, through the development of recommendations and referrals, to the provision of financing or rebates to help with the installation. We believe all these interventions are potentially valuable for a small/medium program.

Exhibit 5-10
Small/Medium Industry Intervention Strategies

Program Elements	Description
Onsite assessments	Audits or feasibility analyses to determine opportunities for and benefits from energy efficiency improvements
Recommendations	Specific recommendations resulting from an audit are presented, together with costs and projected savings
Referrals	Referrals to technical resources or vendors that can help implement recommended measures
Direct Installs	Program pays for all or most of measure installation
Implementation Assistance	Direct technical assistance provided to implement recommended measures
Financing	Loans to finance the acquisition of a product or service
Rebates/grants	Per measure dollars provided to market participants (generally either end users or contractors) to encourage measure installation.
Performance contracts	Third party implements efficiency measures and lets customer pay for them from bill savings
Information & education	Passive provision of information to market participants as well as training, usually at below market cost.
Technology demonstration	Demonstration of energy-efficient technologies in real-world situations to make customers aware and overcome uncertainty

The distinction between small and medium customers that comes out of the results suggests that different combinations of these program elements are appropriate for the small versus medium markets. Our recommended program strategies for the two groups of customers are presented in Exhibit 5-11. Broadly stated, we recommend a rather quick-and-to-the-point approach to the small customers, offering them information, rebates, and even direct funding to install relatively simple technologies, but not a great deal of costly audit/recommendation time. Medium customers, on the other hand, appear to be well suited to an audit-based approach encompassing audits, recommendations, and financing and other assistance to help them implement measures through the channels of their choice. Each approach is discussed below.

Exhibit 5-11
Recommended Program Elements by Target Market

	Program Elements									
Target Market	Onsite Assessments	Specific Recommen-dations	Direct Installs	Referrals	Implemen-tation Assistance	Financing	Rebates / Grants	Performance Contracts	Information & Education	Technology Demonstration
Small Industrial	○	○	●	○			●		●	○
Medium Industrial	●	●		●	●	●	●	○	○	●

KEY	
Major Program Element	●
Minor Program Element	○

For the audit-based approach to medium sized customers, we recommend that an engineer with industry expertise (experience in that particular facility) conduct a comprehensive site audit. Based on audit recommendations, the utility then refers medium sized customers to implementation assistance, financing sources and rebates and grants. Utilities develop alliances with these providers, such as banks for financing.

The program approach for small customers is end-use specific direct installation. Instead of auditing a small facility, a contractor upgrades a facility's lighting, HVAC or compressed air system.

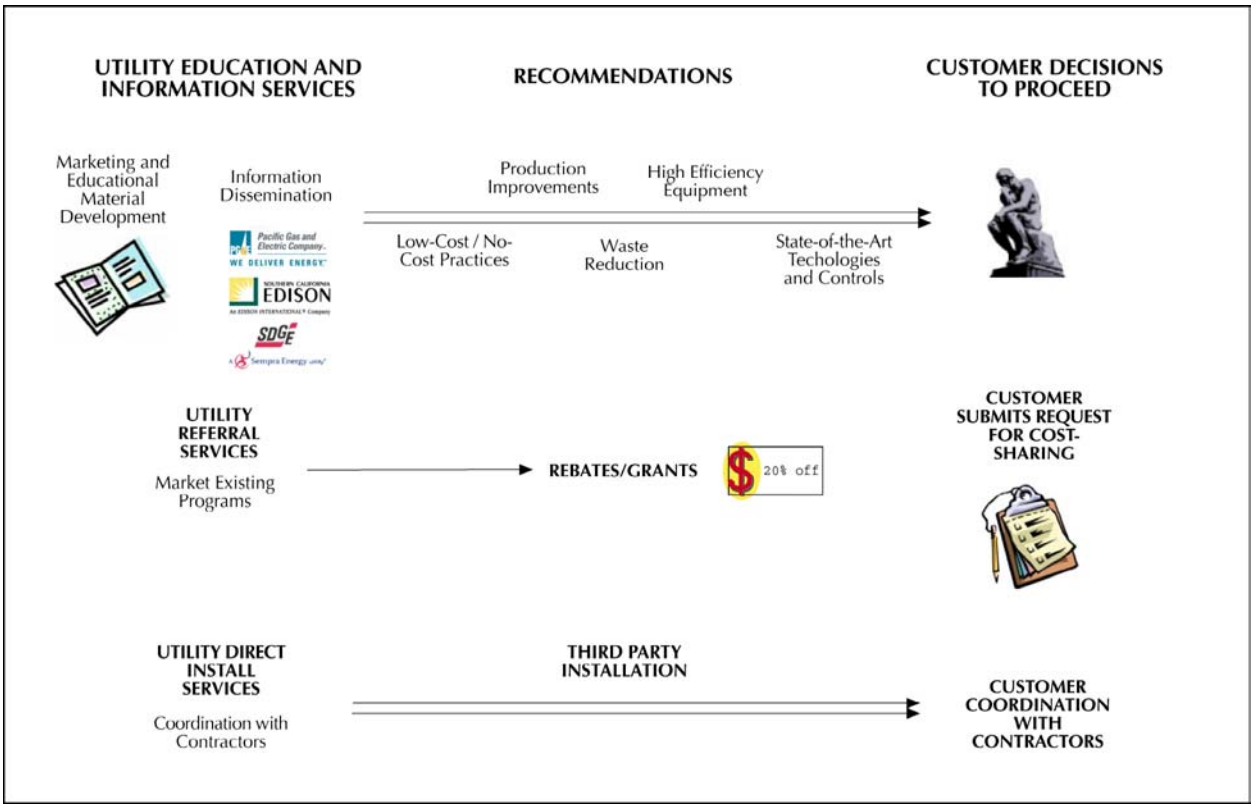
While the current Nonresidential Audit and Express program offerings are geared towards small customers, small industrial customers remain underserved, which suggests the need for further development of these or other offerings. Ongoing evaluations for the Nonresidential Audit, Express and SPC programs should further shed light on opportunities to refine these programs.

Small Customer Program Recommendations

As described in the analysis of survey and interview results, small customers often take a somewhat passive approach to many aspects of their business. While they are generally knowledgeable about new technologies, they lack the time, interest, and resources to investigate energy efficiency measures, preferring instead to rely on trusted suppliers to provide them with information.

For small industry, it does <u>not</u> make sense to pursue a program of detailed audits and recommendations – both because of the time involved and because the scale of production processes (and resulting efficiency opportunities) are small. For example, average Express program first year savings are under $1,500 per year, making the expense of an audit and report difficult to justify from a pure cost-effectiveness point of view. Instead, an appropriate program would emphasize the elements detailed in Exhibit 5-16 and described below.

Exhibit 5-12
Small Industrial Customer Program Diagram



- Energy efficiency *information* is made available through the IOU's and suppliers – particularly suppliers of electric motors, HVAC equipment, boilers, and lighting. The supplier benefits by having a tool to "up-sell" the customer, while **the customer benefits by being able to compare the savings associated with an energy efficiency option using data from a utility source**.

- In addition to *printed materials* (the preferred medium for receiving information), small customers could be provided with *case studies* describing specific measures installed by other small companies in their industry. For some segments, notably the metal fabricating industry, *training and best practices* presentations might also be effective.

- The program could provide *referrals* to cooperating suppliers who agree to distribute the energy efficiency information and who are knowledgeable about other available program elements.

- **For some relatively simple measures that can be easily identified (e.g., high efficiency motors, ASDs, lighting) it may be appropriate for the sponsoring organization to provide *rebates* or even to cover all or most of the cost of *installation***, as is done in California's Express and the National Grid Small C/I program, respectively. This has the benefit of minimizing the expense associated with audits and development of recommendations, and assumes that there will be some measures that justify installation

under a total resource cost measure, but that have not been – and likely will not be – implemented by the small customer. Because a large percentage of industrial customers rent their facilities, it may be necessary to work with facility owners, such as operators of industrial parks, to secure participation for measures like lighting and HVAC that are part of the building itself.

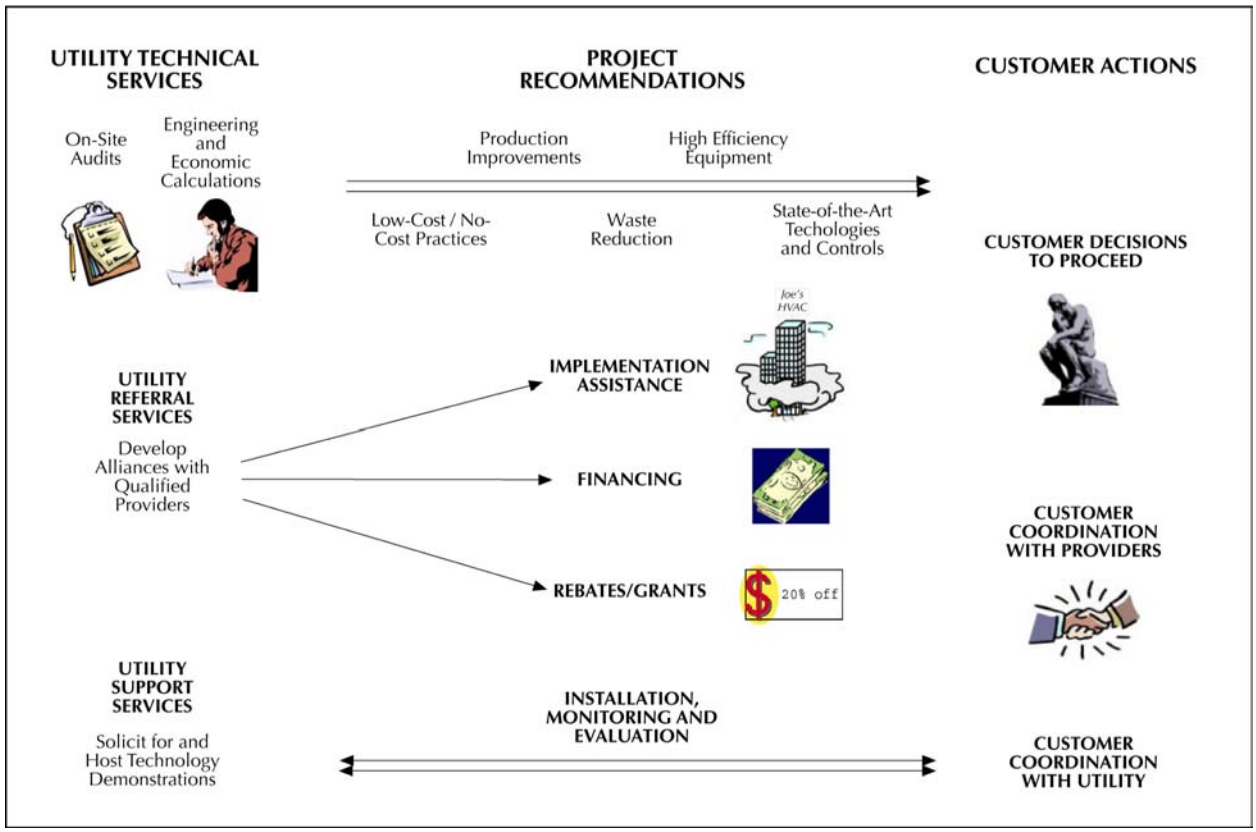
The goal of this approach is to recognize the difficulty of cost-effectively delivering a complex program to the smallest customers, while still making available the information and resources that enable interested customers and their suppliers to pursue energy efficient options.

Medium Customer Program Recommendations

The recommended program elements for medium customers are designed both to match the strengths and characteristics of this group of customers and to provide an appropriate level of support throughout the energy efficiency opportunity identification and implementation process. Our approach builds upon the California programs that already serve industrial customers, most notably the Nonresidential Audit, Express and SPC programs, by drawing on the features of the IAC program and several programs in other states that leverage the availability of IAC resources.

As shown in Exhibit 5-13, key elements of the recommended approach include onsite assessment, specific recommendations, and referral to customer-selected, program-approved resources to provide implementation assistance, financing and rebates.

Exhibit 5-13
Medium Industrial Customer Program Diagram



An *onsite assessment* presented directly to the decision maker – usually the business owner – should be the cornerstone of a medium industrial market program.

- "The key ingredient in overcoming the barriers to participation seems to be **focused one-to-one attention provided by a technically competent, independent third party**." (Shipley, Elliott and Hinge, ACEEE Report Number IE002, 2002, p. 24).

- Utilities should partner with a roster of pre-screened technical consultants already working in the industrial sector to identify efficiency improvements. Although California utilities have tended not to endorse providers in the past, other programs, including those being implemented by NYSERDA, have used this approach successfully.

  - Customer and supplier data suggest that **small and medium industrial customers are inclined to seek assistance from equipment vendors or contractors that they already know**

  - **Choosing technical consultants for their industry rather than technology-specific expertise ensures that a single assessment will cover all opportunities**, rather than requiring separate reviews for process heat, compressed air, motors, etc.

  - **Consultants with industry expertise are likely to be located in the same areas as their customers**, placing them in close proximity to other firms in that industry (for example, wineries in the Napa Valley)
  - PG&E's Industrial Strength seminars should be considered as a **vehicle for training and building relationships with vendors.**

- **The success of IAC assessments – overall, about *half* the recommendations are implemented – is testament to how receptive medium-sized manufacturers are to a stand-alone audit**. A comprehensive turkey program is not warranted for these customers, who often have established relationships with contractors. Moreover, customer survey data confirm that both small and medium customers, while open to industry vendors, have not responded to ESCOs and their performance contracting solutions.

The onsite assessment should yield audit data, payback calculations, engineering analysis, and a set of *specific recommendations* that are presented directly to the business owner.

- **Suppliers support the notion that direct presentation of findings to the owner is essential,** noting that "The best source is to go into the actual owners of these businesses and show them how they can save money," and "The most effective way is to give a good explanation and data to prove they will save money."

- **It is easier to get in front of a single decision maker, even a meeting of several hours, to pitch an upgrade, than in a corporate setting with multiple decision makers**. As one supplier noted, "Bigger firms may be more receptive, but we may have a more direct contact with the smaller buyers so that we're able to explain it rather than just respond to a spec."

An industry observer, formerly with an ESCO in the small industrial market, observed that, "If it's economically viable, they'll do it." "Opportunity identification and payback is the important part. The owner will run with the rest of it."

In addition to providing findings and recommendations to the owner, **it may also be important to ensure that the program provides *linkages to resources* needed to follow up on the recommendations**. Just as the program has a roster of prescreened consultants, it can equally well provide access to relevant utility or other programs that offer **rebates, suppliers who offer needed equipment, and financial institutions** that have agreed to finance energy efficiency upgrades.

Finally, as successful projects are implemented, it can be useful to use them as *case studies* or, in the case of new technologies, *demonstration projects*. According to industry sources, for maximum impact, these should be targeted only to other firms in the same industry and of the same general size; owners tend to be frustrated by case studies or demonstrations that have no direct relevance to their situation. Involvement of well-known technical experts or equipment vendors can enhance the credibility of such information.

Industry Recommendations

As stated above, a key study finding is the need to establish partnerships with influential trade associations and vendors when programs target a given industry. For example, of the medium industries studied, food processors stand out as the most promising target for energy efficiency programs. Food processors tend to operate larger facilities, employ more people, run more locations and use more energy (particularly natural gas). Importantly, these customers are positively disposed toward trade groups, and the food processing industry also benefits from an active trade association, the California League of Food Processors. A partnership between the PGC program implementers and the California League of Food Processors potentially offers an information clearinghouse and training platform for moving the food processing industry towards more energy efficient operations.

Recent sharp increases in energy costs have made the food processing industry much more aware about the importance of controlling energy costs. Opportunities for improved EE exist in all aspects of food processing – more efficient, lower emission boilers, high efficiency motors, ASDs for production equipment, improvements in refrigeration, new technologies for efficient thermal processing, steam recycling and intelligent process control.

Other high potential industries include printing shops which, based on study survey results, have the following promising attributes: 1) demonstrate the highest reliance on utilities for energy efficiency information, 2) have lower awareness of new technologies for their industry than other industries, 3) have the highest use of equipment vendors to implement changes, and 4) the highest percentage that claim to have undertaken equipment upgrades.

5.3.2 Further Study

Additional research needed to help develop effective programs for the small/medium industrial sector should focus on specific technologies, their adaptation to the needs of the targeted customer group and likelihood of adoption. Additional research should also examine program cost-effectiveness and best practices for mobilizing market actors (to maximize energy efficiency promotion and implementation in this sector). Additional research should focus on:

- Suitability of new technologies to the small/medium market.
- Willingness and ability of suppliers to become partners in the delivery of programs and information to promote EE in small/medium facilities.
- Identification and recruitment of specific engineers/consultants to form a "stable" of pre-approved vendors to conduct audits and accurately identify savings opportunities.
- Further mine the IAC database, utility tracking systems (for the Nonresidential Audit, Express Efficiency and SPC programs) and other literature/database sources for technology assessments that focus on the industry and end-use targets of a given program design. Furthermore, these sources should be used to develop case studies for dissemination to similar customers in, for example, a given industry.
  - Extract as much information as possible (from the IAC database, utility tracking systems and various literature sources) to strengthen our understanding of

technology-specific technical and achievable potential[16], and details surrounding the cost-effectiveness of various technologies under a retrofit, renovation and new construction scenario. For industry-based end uses in particular, the effectiveness of a given technology is tied to its adoption under each scenario. It is clear, for example, that certain technologies are best suited to a new construction application, where the greatest level of potential can be reaped. All such research should strive to examine potential by industry, end-use and measure, where possible.

  - Mine information regarding estimated energy (and cost) savings for each recommended measure, and the estimated first cost to implement each strategy. These data would also prove useful in an evaluation of the appropriateness of a given measure from a cost-effectiveness perspective.
  - Analyze how project cost and customer size (or other parameters) affects the likelihood of implementing recommendations.
  - Study end-use targets and implementation rates in industries beyond those included in this study.

- Conduct additional research to better quantify market willingness and technical potential for energy efficiency improvements in industrial facilities, focusing on opportunities in new construction.

With the above recommendations now stated and additional research identified, this concludes the presentation of opportunities for energy efficiency in California's small industrial markets. Supporting appendices are presented next.

[16] From this same perspective, we are encouraged by the ongoing statewide case study research now underway in California, which, among other objectives, will compare and contrast large baseline and state-of-the-art facilities, from both a technical and behavioral energy efficiency perspective. Such research would also prove valuable for program design; in this particular case, in a large industrial setting.

APPENDIX A.
STATEWIDE ELECTRIC USE SUMMARY

Exhibit A-1
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Annual Electric Use
Statewide

SIC-Based Industry	Electric Use by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	29	62	47	36	37	24	1,730	1,966
20 Food	47	173	169	123	118	102	3,214	3,946
21 Tobacco	0	-	-	-	-	-	-	0
22 Textiles	4	19	22	16	12	7	240	319
23 Apparel	64	65	39	21	17	9	28	243
24 Lumber	29	68	44	25	24	33	600	823
25 Furniture	23	66	38	24	17	16	100	282
26 Paper	6	36	47	39	41	46	1,312	1,528
27 Printing	107	135	118	59	44	47	458	968
28 Chemicals	25	88	80	61	50	55	1,736	2,093
29 Petroleum	3	12	25	31	24	14	1,884	1,993
30 Rubber/Plastics	26	100	106	99	79	83	1,786	2,279
31 Leather	2	4	6	1	-	-	5	19
32 Stone/Clay/Glass	24	78	57	60	19	27	2,732	2,997
33 Primary Metals	10	42	51	47	43	46	1,759	1,997
34 Fab Metals	77	225	164	99	111	50	824	1,548
35 Industrial Machinery	148	280	184	146	115	109	1,666	2,648
36 Electronics	51	182	189	169	131	128	2,737	3,588
37 Transportation Equipment	43	109	98	75	53	58	1,323	1,760
38 Instruments	32	93	107	75	60	75	1,024	1,466
39 Miscellaneous Manufacturing	33	44	45	15	36	9	121	302
TOTAL	782	1,880	1,636	1,220	1,033	937	25,277	32,765

SIC-Based Industry	Percent of Electric Use by Customer Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.1	0.2	0.1	0.1	0.1	0.1	5.3	6.0
20 Food	0.1	0.5	0.5	0.4	0.4	0.3	9.8	12.0
21 Tobacco	0.0	-	-	-	-	-	-	0.0
22 Textiles	0.0	0.1	0.1	0.0	0.0	0.0	0.7	1.0
23 Apparel	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.7
24 Lumber	0.1	0.2	0.1	0.1	0.1	0.1	1.8	2.5
25 Furniture	0.1	0.2	0.1	0.1	0.1	0.0	0.3	0.9
26 Paper	0.0	0.1	0.1	0.1	0.1	0.1	4.0	4.7
27 Printing	0.3	0.4	0.4	0.2	0.1	0.1	1.4	3.0
28 Chemicals	0.1	0.3	0.2	0.2	0.2	0.2	5.3	6.4
29 Petroleum	0.0	0.0	0.1	0.1	0.1	0.0	5.7	6.1
30 Rubber/Plastics	0.1	0.3	0.3	0.3	0.2	0.3	5.5	7.0
31 Leather	0.0	0.0	0.0	0.0	-	-	0.0	0.1
32 Stone/Clay/Glass	0.1	0.2	0.2	0.2	0.1	0.1	8.3	9.1
33 Primary Metals	0.0	0.1	0.2	0.1	0.1	0.1	5.4	6.1
34 Fab Metals	0.2	0.7	0.5	0.3	0.3	0.2	2.5	4.7
35 Industrial Machinery	0.5	0.9	0.6	0.4	0.4	0.3	5.1	8.1
36 Electronics	0.2	0.6	0.6	0.5	0.4	0.4	8.4	11.0
37 Transportation Equipment	0.1	0.3	0.3	0.2	0.2	0.2	4.0	5.4
38 Instruments	0.1	0.3	0.3	0.2	0.2	0.2	3.1	4.5
39 Miscellaneous Manufacturing	0.1	0.1	0.1	0.0	0.1	0.0	0.4	0.9
TOTAL	2.4	5.7	5.0	3.7	3.2	2.9	77.1	100.0

Exhibit A-2
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Sites with Electric Service
Statewide

SIC-Based Industry	Number of Sites by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	1,191	294	67	30	22	11	96	1,711
20 Food	1,493	738	238	100	69	45	366	3,049
21 Tobacco	4	-	-	-	-	-	-	4
22 Textiles	148	72	30	13	7	3	40	313
23 Apparel	2,407	306	56	17	10	4	7	2,807
24 Lumber	1,584	296	63	21	14	15	50	2,043
25 Furniture	868	286	54	20	10	7	17	1,262
26 Paper	214	142	66	32	24	20	121	619
27 Printing	4,738	618	171	48	26	21	65	5,687
28 Chemicals	803	371	110	50	28	24	121	1,507
29 Petroleum	149	49	36	25	14	6	35	314
30 Rubber/Plastics	848	406	153	82	45	37	211	1,782
31 Leather	89	17	9	1	-	-	1	117
32 Stone/Clay/Glass	950	348	84	49	11	12	88	1,542
33 Primary Metals	300	163	69	39	25	21	98	715
34 Fab Metals	2,812	977	234	82	64	22	105	4,296
35 Industrial Machinery	5,700	1,272	258	119	67	49	178	7,643
36 Electronics	1,585	772	263	138	74	58	282	3,172
37 Transportation Equipm	1,694	474	135	62	30	26	108	2,529
38 Instruments	999	400	148	62	35	34	129	1,807
39 Miscellaneous Manufa	1,537	201	67	12	21	4	15	1,857
TOTAL	30,113	8,202	2,311	1,002	596	419	2,133	44,776

SIC-Based Industry	Percent of Sites by Customer Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	2.7	0.7	0.1	0.1	0.0	0.0	0.2	3.8
20 Food	3.3	1.6	0.5	0.2	0.2	0.1	0.8	6.8
21 Tobacco	0.0	-	-	-	-	-	-	0.0
22 Textiles	0.3	0.2	0.1	0.0	0.0	0.0	0.1	0.7
23 Apparel	5.4	0.7	0.1	0.0	0.0	0.0	0.0	6.3
24 Lumber	3.5	0.7	0.1	0.0	0.0	0.0	0.1	4.6
25 Furniture	1.9	0.6	0.1	0.0	0.0	0.0	0.0	2.8
26 Paper	0.5	0.3	0.1	0.1	0.1	0.0	0.3	1.4
27 Printing	10.6	1.4	0.4	0.1	0.1	0.0	0.1	12.7
28 Chemicals	1.8	0.8	0.2	0.1	0.1	0.1	0.3	3.4
29 Petroleum	0.3	0.1	0.1	0.1	0.0	0.0	0.1	0.7
30 Rubber/Plastics	1.9	0.9	0.3	0.2	0.1	0.1	0.5	4.0
31 Leather	0.2	0.0	0.0	0.0	-	-	0.0	0.3
32 Stone/Clay/Glass	2.1	0.8	0.2	0.1	0.0	0.0	0.2	3.4
33 Primary Metals	0.7	0.4	0.2	0.1	0.1	0.0	0.2	1.6
34 Fab Metals	6.3	2.2	0.5	0.2	0.1	0.0	0.2	9.6
35 Industrial Machinery	12.7	2.8	0.6	0.3	0.1	0.1	0.4	17.1
36 Electronics	3.5	1.7	0.6	0.3	0.2	0.1	0.6	7.1
37 Transportation Equipm	3.8	1.1	0.3	0.1	0.1	0.1	0.2	5.6
38 Instruments	2.2	0.9	0.3	0.1	0.1	0.1	0.3	4.0
39 Miscellaneous Manufa	3.4	0.4	0.1	0.0	0.0	0.0	0.0	4.1
TOTAL	67.3	18.3	5.2	2.2	1.3	0.9	4.8	100.0

Exhibit A-3
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Annual Electric Use per Site
Statewide

SIC-Based Industry	Average MWh per Site by Customer Size							AVERAGE
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	25	212	708	1,204	1,683	2,203	18,017	1,149
20 Food	31	235	711	1,231	1,708	2,262	8,782	1,294
21 Tobacco	13	-	-	-	-	-	-	13
22 Textiles	26	259	743	1,220	1,665	2,319	5,996	1,019
23 Apparel	27	211	690	1,216	1,709	2,261	4,014	86
24 Lumber	18	230	694	1,187	1,730	2,207	11,990	403
25 Furniture	26	230	696	1,185	1,733	2,239	5,863	224
26 Paper	30	253	707	1,231	1,725	2,297	10,847	2,469
27 Printing	22	219	692	1,223	1,693	2,234	7,051	170
28 Chemicals	31	236	727	1,213	1,781	2,287	14,343	1,389
29 Petroleum	21	249	699	1,248	1,741	2,267	53,823	6,349
30 Rubber/Plastics	31	246	692	1,209	1,752	2,249	8,466	1,279
31 Leather	24	242	675	1,233	-	-	5,020	159
32 Stone/Clay/Glass	25	225	682	1,220	1,687	2,242	31,044	1,944
33 Primary Metals	34	255	733	1,208	1,716	2,193	17,944	2,793
34 Fab Metals	27	230	700	1,203	1,732	2,255	7,845	360
35 Industrial Machinery	26	220	714	1,230	1,719	2,223	9,358	346
36 Electronics	32	236	720	1,222	1,771	2,211	9,707	1,131
37 Transportation Equipment	25	231	728	1,212	1,780	2,237	12,249	696
38 Instruments	32	233	721	1,206	1,728	2,216	7,935	811
39 Miscellaneous Manufacturing	21	217	673	1,229	1,736	2,182	8,050	163
AVERAGE	26	229	708	1,217	1,732	2,237	11,850	732

APPENDIX B.
STATEWIDE NATURAL GAS USE SUMMARY

Exhibit B-1
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Annual Natural Gas Use
Statewide

SIC-Based Industry	Gas Use in Thousands of Therms by Customer Size							TOTAL
	<2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,00 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm	
13 Oil/Gas	93	166	319	194	361	631	607,216	608,979
20 Food	499	2,287	4,629	6,618	11,230	11,646	751,137	788,044
21 Tobacco	1	3	-	-	-	-	-	3
22 Textiles	140	496	627	683	1,805	2,049	100,428	106,228
23 Apparel	482	1,729	1,363	758	792	1,003	538	6,665
24 Lumber	335	379	313	549	713	412	47,419	50,121
25 Furniture	295	379	524	539	1,409	846	4,587	8,580
26 Paper	111	338	451	467	1,083	963	381,603	385,018
27 Printing	1,526	1,619	1,012	1,213	1,665	977	23,590	31,601
28 Chemicals	391	1,119	1,409	2,350	3,577	3,558	217,369	229,773
29 Petroleum	39	85	179	333	1,013	931	1,465,917	1,468,498
30 Rubber/Plastics	382	962	1,315	1,572	2,370	1,422	43,239	51,262
31 Leather	58	53	31	-	-	-	561	702
32 Stone/Clay/Glass	291	741	905	2,373	3,707	2,344	275,678	286,040
33 Primary Metals	199	612	1,130	2,431	3,769	2,758	158,007	168,906
34 Fab Metals	1,058	2,566	3,622	4,779	10,304	6,996	85,469	114,794
35 Industrial Machinery	2,404	3,787	3,363	3,883	5,841	2,766	36,267	58,312
36 Electronics	922	2,609	2,964	3,380	4,665	4,006	64,137	82,683
37 Transportation Equipment	427	987	1,163	1,529	2,003	2,111	83,498	91,719
38 Instruments	498	1,288	1,482	1,153	2,095	1,213	23,711	31,440
39 Miscellaneous Manufacturing	409	824	890	761	635	823	2,425	6,768
TOTAL	10,559	23,029	27,689	35,565	59,039	47,457	4,372,799	4,576,137

SIC-Based Industry	Percent of Gas Use by Customer Size (%)							TOTAL
	<2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,00 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm	
13 Oil/Gas	0.0	0.0	0.0	0.0	0.0	0.0	13.3	13.3
20 Food	0.0	0.0	0.1	0.1	0.2	0.3	16.4	17.2
21 Tobacco	0.0	0.0	-	-	-	-	-	0.0
22 Textiles	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.3
23 Apparel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
24 Lumber	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.1
25 Furniture	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
26 Paper	0.0	0.0	0.0	0.0	0.0	0.0	8.3	8.4
27 Printing	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7
28 Chemicals	0.0	0.0	0.0	0.1	0.1	0.1	4.8	5.0
29 Petroleum	0.0	0.0	0.0	0.0	0.0	0.0	32.0	32.1
30 Rubber/Plastics	0.0	0.0	0.0	0.0	0.1	0.0	0.9	1.1
31 Leather	0.0	0.0	0.0	-	-	-	0.0	0.0
32 Stone/Clay/Glass	0.0	0.0	0.0	0.1	0.1	0.1	6.0	6.3
33 Primary Metals	0.0	0.0	0.0	0.1	0.1	0.1	3.5	3.7
34 Fab Metals	0.0	0.1	0.1	0.1	0.2	0.2	1.9	2.5
35 Industrial Machinery	0.1	0.1	0.1	0.1	0.1	0.1	0.8	1.3
36 Electronics	0.0	0.1	0.1	0.1	0.1	0.1	1.4	1.8
37 Transportation Equipment	0.0	0.0	0.0	0.0	0.0	0.0	1.8	2.0
38 Instruments	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7
39 Miscellaneous Manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
TOTAL	0.2	0.5	0.6	0.8	1.3	1.0	95.6	100.0

Exhibit B-2
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Sites with Gas Service
Statewide

SIC-Based Industry	Sites by Customer Size							TOTAL
	<2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,00 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm	
13 Oil/Gas	188	39	22	6	6	5	55	321
20 Food	814	472	279	186	159	93	499	2502
21 Tobacco	1	1	-	-	-	-	-	2
22 Textiles	315	102	40	19	25	17	111	629
23 Apparel	1,193	368	93	20	11	8	2	1695
24 Lumber	720	86	19	15	10	3	22	875
25 Furniture	670	90	33	15	19	7	14	848
26 Paper	219	73	30	13	15	8	104	462
27 Printing	3,375	398	69	34	25	8	36	3945
28 Chemicals	733	241	93	66	51	30	115	1329
29 Petroleum	78	21	11	8	14	8	123	263
30 Rubber/Plastics	798	220	86	43	34	12	67	1260
31 Leather	107	10	2	-	-	-	1	120
32 Stone/Clay/Glass	627	152	57	65	50	19	107	1077
33 Primary Metals	369	125	70	67	53	23	123	830
34 Fab Metals	1,989	547	227	134	146	58	127	3228
35 Industrial Machinery	4,672	896	212	107	84	24	47	6042
36 Electronics	1,618	551	181	96	66	32	82	2626
37 Transportation Equipment	810	227	71	43	27	18	53	1249
38 Instruments	888	278	93	32	29	10	36	1366
39 Miscellaneous Manufacturing	946	167	56	21	9	7	4	1210
TOTAL	21,130	5,064	1,744	990	833	390	1,728	31879

SIC-Based Industry	Percent of Sites by Customer Size (%)							TOTAL
	<2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,00 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm	
13 Oil/Gas	0.6	0.1	0.1	0.0	0.0	0.0	0.2	1.0
20 Food	2.6	1.5	0.9	0.6	0.5	0.3	1.6	7.8
21 Tobacco	0.0	0.0	-	-	-	-	-	0.0
22 Textiles	1.0	0.3	0.1	0.1	0.1	0.1	0.3	2.0
23 Apparel	3.7	1.2	0.3	0.1	0.0	0.0	0.0	5.3
24 Lumber	2.3	0.3	0.1	0.0	0.0	0.0	0.1	2.7
25 Furniture	2.1	0.3	0.1	0.0	0.1	0.0	0.0	2.7
26 Paper	0.7	0.2	0.1	0.0	0.0	0.0	0.3	1.4
27 Printing	10.6	1.2	0.2	0.1	0.1	0.0	0.1	12.4
28 Chemicals	2.3	0.8	0.3	0.2	0.2	0.1	0.4	4.2
29 Petroleum	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.8
30 Rubber/Plastics	2.5	0.7	0.3	0.1	0.1	0.0	0.2	4.0
31 Leather	0.3	0.0	0.0	-	-	-	0.0	0.4
32 Stone/Clay/Glass	2.0	0.5	0.2	0.2	0.2	0.1	0.3	3.4
33 Primary Metals	1.2	0.4	0.2	0.2	0.2	0.1	0.4	2.6
34 Fab Metals	6.2	1.7	0.7	0.4	0.5	0.2	0.4	10.1
35 Industrial Machinery	14.7	2.8	0.7	0.3	0.3	0.1	0.1	19.0
36 Electronics	5.1	1.7	0.6	0.3	0.2	0.1	0.3	8.2
37 Transportation Equipment	2.5	0.7	0.2	0.1	0.1	0.1	0.2	3.9
38 Instruments	2.8	0.9	0.3	0.1	0.1	0.0	0.1	4.3
39 Miscellaneous Manufacturing	3.0	0.5	0.2	0.1	0.0	0.0	0.0	3.8
TOTAL	66.3	15.9	5.5	3.1	2.6	1.2	5.4	100.0

Exhibit B-3
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Annual Natural Gas Use per Site
Statewide

SIC-Based Industry	Average Therms per Site by Customer Size							AVERAGE
	<2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,00 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm	
13 Oil/Gas	494	4,252	14,489	32,387	60,087	126,221	11,040,288	1,897,131
20 Food	613	4,845	16,590	35,578	70,627	125,227	1,505,285	314,966
21 Tobacco	584	2,631	-	-	-	-	-	1,607
22 Textiles	443	4,865	15,666	35,945	72,206	120,554	904,760	168,884
23 Apparel	404	4,698	14,653	37,920	71,990	125,400	268,935	3,932
24 Lumber	465	4,411	16,482	36,609	71,303	137,464	2,155,409	57,281
25 Furniture	440	4,213	15,880	35,924	74,183	120,878	327,675	10,118
26 Paper	508	4,637	15,042	35,932	72,226	120,375	3,669,260	833,372
27 Printing	452	4,067	14,661	35,670	66,606	122,121	655,279	8,010
28 Chemicals	534	4,642	15,149	35,613	70,136	118,597	1,890,166	172,892
29 Petroleum	506	4,052	16,256	41,667	72,366	116,403	11,918,023	5,583,642
30 Rubber/Plastics	479	4,372	15,288	36,554	69,716	118,487	645,362	40,684
31 Leather	538	5,251	15,278	-	-	-	561,217	5,849
32 Stone/Clay/Glass	464	4,876	15,881	36,512	74,149	123,355	2,576,433	265,590
33 Primary Metals	539	4,897	16,144	36,276	71,113	119,924	1,284,610	203,501
34 Fab Metals	532	4,691	15,957	35,662	70,573	120,621	672,988	35,562
35 Industrial Machinery	515	4,226	15,864	36,291	69,542	115,263	771,639	9,651
36 Electronics	570	4,734	16,374	35,203	70,687	125,195	782,155	31,486
37 Transportation Equipment	527	4,349	16,379	35,567	74,200	117,259	1,575,443	73,434
38 Instruments	561	4,634	15,934	36,042	72,227	121,310	658,643	23,016
39 Miscellaneous Manufacturing	432	4,937	15,888	36,230	70,599	117,605	606,308	5,593
AVERAGE	500	4,548	15,877	35,925	70,875	121,684	2,530,555	143,547

APPENDIX C.
PEAK DEMAND TO ELECTRIC USE SUMMARY

Exhibit C-1

Statewide Small Industrial Wants and Needs Study

Phase 1 Customer Characterization

Demand-to-Energy Relationship to Assess Small-to-Large Transition

Statewide

SIC-Based Industry	Number of Sites by Electric Use			
	< 1 GWh		>1 GWh	
	kW <500	kW>500	kW <500	kW>500
13 Oil/Gas	768	7	60	95
20 Food	1,285	25	166	403
21 Tobacco	-	-	-	-
22 Textiles	139	1	23	37
23 Apparel	845	-	23	14
24 Lumber	567	9	28	70
25 Furniture	548	2	24	27
26 Paper	275	2	62	127
27 Printing	1,416	11	78	80
28 Chemicals	700	3	87	128
29 Petroleum	104	12	21	55
30 Rubber/Plastics	813	4	145	217
31 Leather	42	-	1	1
32 Stone/Clay/Glass	612	10	46	113
33 Primary Metals	324	8	57	120
34 Fab Metals	1,921	6	130	138
35 Industrial Machinery	2,699	11	199	212
36 Electronics	1,426	9	236	300
37 Transportation Equipment	998	8	94	125
38 Instruments	770	4	112	145
39 Miscellaneous Manufacturing	491	5	24	26
Total	16,743	137	1,616	2,433

* kW is the maximum account-level kW at each premise.

Exhibit C-2

Statewide Small Industrial Wants and Needs Study

Phase 1 Customer Characterization

Demand-to-Energy Relationship to Assess Small-to-Large Transition

Statewide

SIC-Based Industry	Number of Sites by Electric Use			
	< 1.5 GWh		>1.5 GWh	
	kW <500	kW>500	kW <500	kW>500
13 Oil/Gas	790	13	38	89
20 Food	1,365	43	86	385
21 Tobacco	-	-	-	-
22 Textiles	150	2	12	36
23 Apparel	860	2	8	12
24 Lumber	585	12	10	67
25 Furniture	564	4	8	25
26 Paper	304	5	33	124
27 Printing	1,458	16	36	75
28 Chemicals	744	7	43	124
29 Petroleum	115	25	10	42
30 Rubber/Plastics	890	7	68	214
31 Leather	43	-	-	1
32 Stone/Clay/Glass	644	27	14	96
33 Primary Metals	353	18	28	110
34 Fab Metals	1,988	18	63	126
35 Industrial Machinery	2,807	22	91	201
36 Electronics	1,536	31	126	278
37 Transportation Equipment	1,057	11	35	122
38 Instruments	828	8	54	141
39 Miscellaneous Manufacturing	501	7	14	24
Total	17,582	278	777	2,292

* kW is the maximum account-level kW at each premise.

APPENDIX D.
EXPRESS PROGRAM PARTICIPATION SUMMARY

Exhibit D-1
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Express Participants in 1999, 2000 and 2001- Electric Saving Measures
Statewide

SIC-Based Industry	Number of Participants by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	7	3	2	-	-	-	2	14
20 Food	15	17	9	9	2	4	62	118
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	2	1	-	-	-	-	2	5
23 Apparel	17	1	-	-	-	-	-	18
24 Lumber	44	7	4	2	1	1	11	70
25 Furniture	8	2	2	-	-	1	2	15
26 Paper	1	4	2	2	-	1	9	19
27 Printing	189	14	4	-	-	2	8	217
28 Chemicals	5	2	1	2	2	2	17	31
29 Petroleum	2	-	1	1	-	1	7	12
30 Rubber/Plastics	15	7	4	3	1	-	17	47
31 Leather	1	-	-	-	-	-	-	1
32 Stone/Clay/Glass	12	7	5	1	-	-	14	39
33 Primary Metals	3	1	1	4	1	-	6	16
34 Fab Metals	21	15	3	3	5	3	4	54
35 Industrial Machinery	105	28	7	5	1	2	13	161
36 Electronics	16	17	6	5	4	9	42	99
37 Transportation Equipment	9	7	-	-	1	4	8	29
38 Instruments	13	8	8	3	1	2	9	44
39 Miscellaneous Manufacturing	21	4	3	-	2	-	-	30
TOTAL	506	145	62	40	21	32	233	1,039

SIC-Based Industry	Percent of Participation by Customer Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.7	0.3	0.2	-	-	-	0.2	1.3
20 Food	1.4	1.6	0.9	0.9	0.2	0.4	6.0	11.4
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.2	0.1	-	-	-	-	0.2	0.5
23 Apparel	1.6	0.1	-	-	-	-	-	1.7
24 Lumber	4.2	0.7	0.4	0.2	0.1	0.1	1.1	6.7
25 Furniture	0.8	0.2	0.2	-	-	0.1	0.2	1.4
26 Paper	0.1	0.4	0.2	0.2	-	0.1	0.9	1.8
27 Printing	18.2	1.3	0.4	-	-	0.2	0.8	20.9
28 Chemicals	0.5	0.2	0.1	0.2	0.2	0.2	1.6	3.0
29 Petroleum	0.2	-	0.1	0.1	-	0.1	0.7	1.2
30 Rubber/Plastics	1.4	0.7	0.4	0.3	0.1	-	1.6	4.5
31 Leather	0.1	-	-	-	-	-	-	0.1
32 Stone/Clay/Glass	1.2	0.7	0.5	0.1	-	-	1.3	3.8
33 Primary Metals	0.3	0.1	0.1	0.4	0.1	-	0.6	1.5
34 Fab Metals	2.0	1.4	0.3	0.3	0.5	0.3	0.4	5.2
35 Industrial Machinery	10.1	2.7	0.7	0.5	0.1	0.2	1.3	15.5
36 Electronics	1.5	1.6	0.6	0.5	0.4	0.9	4.0	9.5
37 Transportation Equipment	0.9	0.7	-	-	0.1	0.4	0.8	2.8
38 Instruments	1.3	0.8	0.8	0.3	0.1	0.2	0.9	4.2
39 Miscellaneous Manufacturing	2.0	0.4	0.3	-	0.2	-	-	2.9
TOTAL	48.7	14.0	6.0	3.8	2.0	3.1	22.4	100.0

Exhibit D-2
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Express Rebates (Thousands of Dollars) In Program Years 1999, 2000, 2001
Statewide

SIC-Based Industry	Express Rebates (Thousands of Dollars) by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	17	7	16	-	-	-	3	43
20 Food	6	115	16	10	4	3	266	420
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	1	10	-	-	-	-	12	23
23 Apparel	11	1	-	-	-	-	-	11
24 Lumber	28	11	5	1	0	0	22	67
25 Furniture	9	2	0	-	-	3	20	34
26 Paper	1	9	1	7	-	9	43	70
27 Printing	137	27	13	-	-	1	96	274
28 Chemicals	3	0	0	1	1	5	59	70
29 Petroleum	2	-	2	3	-	1	46	54
30 Rubber/Plastics	12	11	2	8	0	-	77	110
31 Leather	0	-	-	-	-	-	-	0
32 Stone/Clay/Glass	16	2	2	2	-	-	26	48
33 Primary Metals	1	0	4	2	1	-	38	46
34 Fab Metals	12	13	14	15	20	2	11	87
35 Industrial Machinery	99	58	16	26	4	9	68	280
36 Electronics	29	46	10	16	22	106	506	736
37 Transportation Equipment	5	11	-	-	2	29	59	105
38 Instruments	15	20	43	10	0	13	94	194
39 Miscellaneous Manufacturing	15	4	17	-	11	-	-	46
TOTAL	418	346	160	102	65	181	1,446	2,717

SIC-Based Industry	Percent of Total Rebates Paid to Industrial Customers (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.6	0.2	0.6	-	-	-	0.1	1.6
20 Food	0.2	4.2	0.6	0.4	0.2	0.1	9.8	15.5
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.0	0.4	-	-	-	-	0.4	0.8
23 Apparel	0.4	0.0	-	-	-	-	-	0.4
24 Lumber	1.0	0.4	0.2	0.0	0.0	0.0	0.8	2.5
25 Furniture	0.3	0.1	0.0	-	-	0.1	0.7	1.3
26 Paper	0.0	0.3	0.0	0.3	-	0.3	1.6	2.6
27 Printing	5.0	1.0	0.5	-	-	0.1	3.5	10.1
28 Chemicals	0.1	0.0	0.0	0.1	0.0	0.2	2.2	2.6
29 Petroleum	0.1	-	0.1	0.1	-	0.0	1.7	2.0
30 Rubber/Plastics	0.5	0.4	0.1	0.3	0.0	-	2.8	4.0
31 Leather	0.0	-	-	-	-	-	-	0.0
32 Stone/Clay/Glass	0.6	0.1	0.1	0.1	-	-	1.0	1.8
33 Primary Metals	0.0	0.0	0.2	0.1	0.0	-	1.4	1.7
34 Fab Metals	0.4	0.5	0.5	0.6	0.7	0.1	0.4	3.2
35 Industrial Machinery	3.6	2.1	0.6	1.0	0.2	0.3	2.5	10.3
36 Electronics	1.1	1.7	0.4	0.6	0.8	3.9	18.6	27.1
37 Transportation Equipment	0.2	0.4	-	-	0.1	1.1	2.2	3.9
38 Instruments	0.5	0.7	1.6	0.4	0.0	0.5	3.5	7.2
39 Miscellaneous Manufacturing	0.5	0.1	0.6	-	0.4	-	-	1.7
TOTAL	15.4	12.7	5.9	3.7	2.4	6.7	53.2	100.0

Exhibit D-3
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Average Express Rebate per Site - Program Years 1999, 2000, 2001
Statewide

2.4548085

SIC-Based Industry	Average Rebate Dollars Paid per Participant by Customer Size							AVERAGE
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	2,455	2,207	7,864	-	-	-	1,496	3,038
20 Food	389	6,784	1,783	1,112	2,167	698	4,287	3,560
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	624	9,548	-	-	-	-	5,903	4,520
23 Apparel	645	500	-	-	-	-	-	637
24 Lumber	636	1,572	1,149	535	204	166	2,032	963
25 Furniture	1,165	815	143	-	-	3,105	10,015	2,291
26 Paper	1,190	2,287	306	3,572	-	8,974	4,776	3,687
27 Printing	722	1,902	3,315	-	-	690	11,982	1,261
28 Chemicals	536	212	325	705	264	2,567	3,499	2,258
29 Petroleum	863	-	1,977	2,964	-	969	6,618	4,497
30 Rubber/Plastics	819	1,617	454	2,525	137	-	4,501	2,333
31 Leather	453	-	-	-	-	-	-	453
32 Stone/Clay/Glass	1,337	245	319	2,379	-	-	1,853	1,223
33 Primary Metals	405	458	4,450	441	590	-	6,313	2,897
34 Fab Metals	562	873	4,597	5,100	3,956	663	2,839	1,613
35 Industrial Machinery	941	2,062	2,227	5,254	4,352	4,477	5,214	1,736
36 Electronics	1,817	2,704	1,694	3,199	5,521	11,770	12,056	7,430
37 Transportation Equipment	514	1,513	-	-	2,000	7,245	7,329	3,615
38 Instruments	1,130	2,503	5,344	3,270	218	6,298	10,468	4,416
39 Miscellaneous Manufacturing	694	958	5,608	-	5,318	-	-	1,529
AVERAGE	827	2,383	2,578	2,542	3,089	5,655	6,207	2,615

Exhibit D-4
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
First Year Express Measure MWh Savings for Program Years 1999, 2000, 2001
Statewide

SIC-Based Industry	First Year MWh Savings by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	116	37	107	-	-	-	17	277
20 Food	56	412	133	174	153	30	1,639	2,597
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	4	16	-	-	-	-	63	83
23 Apparel	118	29	-	-	-	-	-	147
24 Lumber	189	104	30	7	1	1	232	565
25 Furniture	79	123	5	-	-	-	2	209
26 Paper	6	93	14	80	-	53	145	391
27 Printing	823	369	104	-	-	6	108	1,409
28 Chemicals	27	2	6	15	3	-	224	278
29 Petroleum	16	-	12	49	-	13	1,090	1,180
30 Rubber/Plastics	63	90	17	94	4	-	249	516
31 Leather	7	-	-	-	-	-	-	7
32 Stone/Clay/Glass	58	27	12	55	-	-	330	483
33 Primary Metals	21	5	26	18	-	-	152	222
34 Fab Metals	55	137	89	25	67	12	6	391
35 Industrial Machinery	1,072	886	313	380	123	245	1,058	4,076
36 Electronics	128	375	200	214	526	417	3,275	5,134
37 Transportation Equipment	20	83	-	-	-	-	260	363
38 Instruments	84	102	680	214	3	-	1,194	2,276
39 Miscellaneous Manufacturing	99	103	28	-	158	-	-	388
TOTAL	3,040	2,994	1,777	1,325	1,037	776	10,045	20,995

SIC-Based Industry	Percent of MWh Savings (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.6	0.2	0.5	-	-	-	0.1	1.3
20 Food	0.3	2.0	0.6	0.8	0.7	0.1	7.8	12.4
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.0	0.1	-	-	-	-	0.3	0.4
23 Apparel	0.6	0.1	-	-	-	-	-	0.7
24 Lumber	0.9	0.5	0.1	0.0	0.0	0.0	1.1	2.7
25 Furniture	0.4	0.6	0.0	-	-	-	0.0	1.0
26 Paper	0.0	0.4	0.1	0.4	-	0.3	0.7	1.9
27 Printing	3.9	1.8	0.5	-	-	0.0	0.5	6.7
28 Chemicals	0.1	0.0	0.0	0.1	0.0	-	1.1	1.3
29 Petroleum	0.1	-	0.1	0.2	-	0.1	5.2	5.6
30 Rubber/Plastics	0.3	0.4	0.1	0.4	0.0	-	1.2	2.5
31 Leather	0.0	-	-	-	-	-	-	0.0
32 Stone/Clay/Glass	0.3	0.1	0.1	0.3	-	-	1.6	2.3
33 Primary Metals	0.1	0.0	0.1	0.1	-	-	0.7	1.1
34 Fab Metals	0.3	0.7	0.4	0.1	0.3	0.1	0.0	1.9
35 Industrial Machinery	5.1	4.2	1.5	1.8	0.6	1.2	5.0	19.4
36 Electronics	0.6	1.8	1.0	1.0	2.5	2.0	15.6	24.5
37 Transportation Equipment	0.1	0.4	-	-	-	-	1.2	1.7
38 Instruments	0.4	0.5	3.2	1.0	0.0	-	5.7	10.8
39 Miscellaneous Manufacturing	0.5	0.5	0.1	-	0.8	-	-	1.8
TOTAL	14.5	14.3	8.5	6.3	4.9	3.7	47.8	100.0

Exhibit D-5
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Penetration of the Express Program - Ratio of Participants to Sites
Statewide

SIC-Based Industry	Penetration by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.01	0.01	0.03	-	-	-	0.02	0.01
20 Food	0.01	0.02	0.04	0.09	0.03	0.09	0.17	0.04
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.01	0.01	-	-	-	-	0.05	0.02
23 Apparel	0.01	0.00	-	-	-	-	-	0.01
24 Lumber	0.03	0.02	0.06	0.10	0.07	0.07	0.22	0.03
25 Furniture	0.01	0.01	0.04	-	-	0.14	0.12	0.01
26 Paper	0.00	0.03	0.03	0.06	-	0.05	0.07	0.03
27 Printing	0.04	0.02	0.02	-	-	0.10	0.12	0.04
28 Chemicals	0.01	0.01	0.01	0.04	0.07	0.08	0.14	0.02
29 Petroleum	0.01	-	0.03	0.04	-	0.17	0.20	0.04
30 Rubber/Plastics	0.02	0.02	0.03	0.04	0.02	-	0.08	0.03
31 Leather	0.01	-	-	-	-	-	-	0.01
32 Stone/Clay/Glass	0.01	0.02	0.06	0.02	-	-	0.16	0.03
33 Primary Metals	0.01	0.01	0.01	0.10	0.04	-	0.06	0.02
34 Fab Metals	0.01	0.02	0.01	0.04	0.08	0.14	0.04	0.01
35 Industrial Machinery	0.02	0.02	0.03	0.04	0.01	0.04	0.07	0.02
36 Electronics	0.01	0.02	0.02	0.04	0.05	0.16	0.15	0.03
37 Transportation Equipment	0.01	0.01	-	-	0.03	0.15	0.07	0.01
38 Instruments	0.01	0.02	0.05	0.05	0.03	0.06	0.07	0.02
39 Miscellaneous Manufacturing	0.01	0.02	0.04	-	0.10	-	-	0.02
TOTAL	0.02	0.02	0.03	0.04	0.04	0.08	0.11	0.02

Exhibit D-6
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
*Ratio of Express Rebate to PGC charges - Shown Relative to the Average C/I/A Ratio**
Statewide

SIC-Based Industry	Express Rebate Ratio by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	1.30	0.26	0.82	-	-	-	0.01	0.06
20 Food	0.25	1.55	0.23	0.20	0.09	0.07	0.23	0.29
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.76	1.33	-	-	-	-	0.15	0.21
23 Apparel	0.39	0.02	-	-	-	-	-	0.12
24 Lumber	1.96	0.38	0.26	0.10	0.02	0.01	0.11	0.23
25 Furniture	0.97	0.07	0.02	-	-	0.58	0.59	0.34
26 Paper	0.43	0.63	0.03	0.46	-	0.54	0.10	0.13
27 Printing	2.69	0.48	0.28	-	-	0.08	0.60	0.74
28 Chemicals	0.24	0.01	0.01	0.06	0.03	0.25	0.10	0.10
29 Petroleum	1.20	-	0.19	0.25	-	0.18	0.08	0.09
30 Rubber/Plastics	1.06	0.29	0.04	0.20	0.00	-	0.13	0.14
31 Leather	0.47	-	-	-	-	-	-	0.06
32 Stone/Clay/Glass	1.42	0.05	0.07	0.10	-	-	0.03	0.05
33 Primary Metals	0.28	0.03	0.23	0.10	0.04	-	0.07	0.07
34 Fab Metals	0.35	0.15	0.22	0.40	0.46	0.11	0.04	0.15
35 Industrial Machinery	1.46	0.50	0.21	0.44	0.09	0.21	0.11	0.28
36 Electronics	1.26	0.61	0.13	0.23	0.42	2.15	0.52	0.56
37 Transportation Equipment	0.26	0.26	-	-	0.10	1.47	0.13	0.17
38 Instruments	1.02	0.52	1.00	0.32	0.01	0.44	0.26	0.36
39 Miscellaneous Manufacturing	1.01	0.23	0.97	-	0.80	-	-	0.41
TOTAL	1.17	0.45	0.25	0.21	0.16	0.52	0.17	0.23

* To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program benefit (in terms of program rebates) that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of rebates received) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.

The overall ratio of 0.23 indicates that industrial customers receive about 23 percent of the incentives they deserve, based on PGC charges paid. On average, small industrial customers are better served by Express than their large industrial counterparts.

Exhibit D-7
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Ratio of First Year Express kWh Savings to Annual kWh Usage
*Shown Relative to the Average C/I/A Ratio**
Statewide

SIC-Based Industry	First Year MWh Savings by Customer Size							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	0.70	0.11	0.39	-	-	-	0.00	0.02
20 Food	0.21	0.42	0.14	0.25	0.23	0.05	0.09	0.12
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	0.18	0.15	-	-	-	-	0.05	0.05
23 Apparel	0.32	0.08	-	-	-	-	-	0.11
24 Lumber	1.14	0.27	0.12	0.05	0.01	0.01	0.07	0.12
25 Furniture	0.61	0.33	0.02	-	-	-	0.00	0.13
26 Paper	0.16	0.45	0.05	0.36	-	0.20	0.02	0.04
27 Printing	1.35	0.48	0.15	-	-	0.02	0.04	0.26
28 Chemicals	0.19	0.00	0.01	0.04	0.01	-	0.02	0.02
29 Petroleum	0.87	-	0.09	0.28	-	0.16	0.10	0.10
30 Rubber/Plastics	0.42	0.16	0.03	0.17	0.01	-	0.02	0.04
31 Leather	0.56	-	-	-	-	-	-	0.07
32 Stone/Clay/Glass	0.42	0.06	0.04	0.16	-	-	0.02	0.03
33 Primary Metals	0.37	0.02	0.09	0.07	-	-	0.02	0.02
34 Fab Metals	0.13	0.11	0.10	0.04	0.11	0.04	0.00	0.04
35 Industrial Machinery	1.27	0.55	0.30	0.45	0.19	0.39	0.11	0.27
36 Electronics	0.44	0.36	0.18	0.22	0.70	0.57	0.21	0.25
37 Transportation Equipment	0.08	0.13	-	-	-	-	0.03	0.04
38 Instruments	0.46	0.19	1.12	0.50	0.01	-	0.20	0.27
39 Miscellaneous Manufacturing	0.53	0.42	0.11	-	0.76	-	-	0.23
TOTAL	0.68	0.28	0.19	0.19	0.18	0.15	0.07	0.11

* To determine if certain customer segments are underserved, comparisons were drawn between the total annual electric use for a customer segment and the amount of program benefit (in terms of annual energy savings) that the customer segment received. Using CIS data, the electric use for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of annual electric savings) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the First Year Savings to Use Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (annual electric savings) per electric use than the population on average. Similarly, a ratio less than one indicates that the customer segment received less benefit per electric use than the population on average.

The ratio of 0.11 indicates that industrial customers, on average, receive electric savings that are about one-tenth the size they deserve, based on the electric use of that segment. On average, small industrial customers are better served by Express than their large industrial counterparts.

APPENDIX E.
SPC PROGRAM PARTICIPATION SUMMARY

Exhibit E-1
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Sites Participating in SPC Program in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Number of Participating SPC Sites by Project Size							TOTAL	Percent Penetration (%)
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	4	15	5	2	4	2	6	38	1.99
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	73	40	1	-	-	1	-	115	9.43
25 Furniture	-	1	-	-	-	-	-	1	0.66
26 Paper	-	6	1	1	-	-	-	8	4.68
27 Printing	1	1	-	1	1	-	-	4	0.17
28 Chemicals	-	1	-	-	-	-	1	2	0.46
29 Petroleum	1	2	-	-	-	-	-	3	1.73
30 Rubber/Plastics	2	3	1	2	-	-	-	8	1.69
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	1	4	-	1	1	-	1	8	1.28
33 Primary Metals	1	1	1	1	-	-	-	4	2.27
34 Fab Metals	2	-	2	-	-	-	-	4	0.36
35 Industrial Machinery	1	4	1	3	1	-	-	10	0.36
36 Electronics	-	2	1	-	1	-	1	5	0.44
37 Transportation Equipment	-	-	2	-	-	-	-	2	0.60
38 Instruments	2	3	2	-	-	-	-	7	1.27
39 Miscellaneous Manufacturing	1	-	-	-	-	-	-	1	0.39
TOTAL	89	83	17	11	8	3	9	220	1.44

SIC-Based Industry	Percent of Participating SPC Sites by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	1.8	6.8	2.3	0.9	1.8	0.9	2.7	17.3
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	33.2	18.2	0.5	-	-	0.5	-	52.3
25 Furniture	-	0.5	-	-	-	-	-	0.5
26 Paper	-	2.7	0.5	0.5	-	-	-	3.6
27 Printing	0.5	0.5	-	0.5	0.5	-	-	1.8
28 Chemicals	-	0.5	-	-	-	-	0.5	0.9
29 Petroleum	0.5	0.9	-	-	-	-	-	1.4
30 Rubber/Plastics	0.9	1.4	0.5	0.9	-	-	-	3.6
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.5	1.8	-	0.5	0.5	-	0.5	3.6
33 Primary Metals	0.5	0.5	0.5	0.5	-	-	-	1.8
34 Fab Metals	0.9	-	0.9	-	-	-	-	1.8
35 Industrial Machinery	0.5	1.8	0.5	1.4	0.5	-	-	4.5
36 Electronics	-	0.9	0.5	-	0.5	-	0.5	2.3
37 Transportation Equipment	-	-	0.9	-	-	-	-	0.9
38 Instruments	0.9	1.4	0.9	-	-	-	-	3.2
39 Miscellaneous Manufacturing	0.5	-	-	-	-	-	-	0.5
TOTAL	40.5	37.7	7.7	5.0	3.6	1.4	4.1	100.0

Exhibit E-2
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Total Rebates (thousands of dollars) from SPC Program Participation in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Thousands of Rebate Dollars by Project Size							TOTAL	Normalized Rebate to PGC Funds Ratio*
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	232	545	338	428	1,331	596	2,936	6,405	3.41
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	459	809	73	-	-	198	-	1,538	3.16
25 Furniture	-	21	-	-	-	-	-	21	0.72
26 Paper	-	131	66	132	-	-	-	330	0.80
27 Printing	26	39	-	300	158	-	-	523	1.66
28 Chemicals	-	54	-	-	-	-	400	454	0.93
29 Petroleum	2	71	-	-	-	-	-	73	0.11
30 Rubber/Plastics	12	59	65	161	-	-	-	297	0.65
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	3	153	-	118	164	-	358	796	0.95
33 Primary Metals	7	22	78	111	-	-	-	218	0.52
34 Fab Metals	14	-	103	-	-	-	-	118	0.33
35 Industrial Machinery	4	92	36	684	97	-	-	913	0.69
36 Electronics	-	47	144	-	318	-	369	878	0.70
37 Transportation Equipment	-	-	158	-	-	-	-	158	0.70
38 Instruments	14	59	260	-	-	-	-	332	0.71
39 Miscellaneous Manufacturing	4	-	-	-	-	-	-	4	0.11
TOTAL	778	2,100	1,322	1,935	2,067	794	4,062	13,058	1.27

SIC-Based Industry	Percent of Rebates by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	1.8	4.2	2.6	3.3	10.2	4.6	22.5	49.1
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	3.5	6.2	0.6	-	-	1.5	-	11.8
25 Furniture	-	0.2	-	-	-	-	-	0.2
26 Paper	-	1.0	0.5	1.0	-	-	-	2.5
27 Printing	0.2	0.3	-	2.3	1.2	-	-	4.0
28 Chemicals	-	0.4	-	-	-	-	3.1	3.5
29 Petroleum	0.0	0.5	-	-	-	-	-	0.6
30 Rubber/Plastics	0.1	0.4	0.5	1.2	-	-	-	2.3
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.0	1.2	-	0.9	1.3	-	2.7	6.1
33 Primary Metals	0.1	0.2	0.6	0.9	-	-	-	1.7
34 Fab Metals	0.1	-	0.8	-	-	-	-	0.9
35 Industrial Machinery	0.0	0.7	0.3	5.2	0.7	-	-	7.0
36 Electronics	-	0.4	1.1	-	2.4	-	2.8	6.7
37 Transportation Equipment	-	-	1.2	-	-	-	-	1.2
38 Instruments	0.1	0.4	2.0	-	-	-	-	2.5
39 Miscellaneous Manufacturing	0.0	-	-	-	-	-	-	0.0
TOTAL	6.0	16.1	10.1	14.8	15.8	6.1	31.1	100.0

* To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program benefit (in terms of program rebates) that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of rebates received) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.
The overall ratio of 1.27 indicates that industrial customers receive incentives that are about 30 percent greater than they deserve, based on PGC charges paid.

Exhibit E-3
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
First Year MWh Saving from SPC Program Participation in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Total MWh Saved by Project Size							TOTAL	Normalized Savings to Usage Ratio*
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	215	4,145	3,504	2,302	8,059	4,517	25,548	48,290	2.92
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	3,411	7,028	643	-	-	2,195	-	13,276	2.90
25 Furniture	-	258	-	-	-	-	-	258	1.17
26 Paper	-	1,825	692	1,449	-	-	-	3,966	1.00
27 Printing	72	488	-	1,428	1,969	-	-	3,957	1.60
28 Chemicals	-	205	-	-	-	-	3,636	3,841	0.89
29 Petroleum	12	915	-	-	-	-	-	927	0.14
30 Rubber/Plastics	133	682	726	2,558	-	-	-	4,099	1.03
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	19	1,593	-	1,185	1,823	-	4,473	9,094	1.06
33 Primary Metals	42	243	978	1,200	-	-	-	2,463	0.60
34 Fab Metals	151	-	1,265	-	-	-	-	1,416	0.50
35 Industrial Machinery	21	946	655	3,856	1,936	-	-	7,415	0.65
36 Electronics	-	453	687	-	1,927	-	3,200	6,267	0.60
37 Transportation Equipment	-	-	1,262	-	-	-	-	1,262	0.57
38 Instruments	172	731	1,511	-	-	-	-	2,414	0.62
39 Miscellaneous Manufacturing	23	-	-	-	-	-	-	23	0.08
TOTAL	4,273	19,511	11,923	13,978	15,715	6,712	36,858	108,969	1.18

SIC-Based Industry	Percent of MWh Savings by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	0.2	3.8	3.2	2.1	7.4	4.1	23.4	44.3
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	3.1	6.4	0.6	-	-	2.0	-	12.2
25 Furniture	-	0.2	-	-	-	-	-	0.2
26 Paper	-	1.7	0.6	1.3	-	-	-	3.6
27 Printing	0.1	0.4	-	1.3	1.8	-	-	3.6
28 Chemicals	-	0.2	-	-	-	-	3.3	3.5
29 Petroleum	0.0	0.8	-	-	-	-	-	0.9
30 Rubber/Plastics	0.1	0.6	0.7	2.3	-	-	-	3.8
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.0	1.5	-	1.1	1.7	-	4.1	8.3
33 Primary Metals	0.0	0.2	0.9	1.1	-	-	-	2.3
34 Fab Metals	0.1	-	1.2	-	-	-	-	1.3
35 Industrial Machinery	0.0	0.9	0.6	3.5	1.8	-	-	6.8
36 Electronics	-	0.4	0.6	-	1.8	-	2.9	5.8
37 Transportation Equipment	-	-	1.2	-	-	-	-	1.2
38 Instruments	0.2	0.7	1.4	-	-	-	-	2.2
39 Miscellaneous Manufacturing	0.0	-	-	-	-	-	-	0.0
TOTAL	3.9	17.9	10.9	12.8	14.4	6.2	33.8	100.0

* To determine if certain customer segments are underserved, comparisons were drawn between the total annual electric use for a customer segment and the amount of program benefit (in terms of annual energy savings) that the customer segment received. Using CIS data, the electric use for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of annual electric savings) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the First Year Savings to Use Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (annual electric savings) per electric use than the population on average. Similarly, a ratio less than one indicates that the customer segment received less benefit per electric use than the population on average.

The ratio of 1.18 indicates that industrial customers, on average, obtain program savings that are about 20 percent greater than those received in the CIA population.

Exhibit E-4
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Sites Participating in SPC Program in 1998 through 2001
Southern California Edison Service Territory

SIC-Based Industry	Number of Participating SPC Sites by Project Size							TOTAL	Percent Penetration (%)
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	3	-	4	2	1	1	-	11	1.13
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	4	-	-	-	-	-	4	1.70
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	43	22	-	1	-	-	-	66	10.25
25 Furniture	-	1	1	-	-	-	-	2	0.20
26 Paper	1	-	2	-	-	-	1	4	1.00
27 Printing	1	-	-	1	2	-	2	6	0.23
28 Chemicals	1	2	-	1	-	-	1	5	0.58
29 Petroleum	3	1	-	-	-	1	1	6	4.55
30 Rubber/Plastics	5	9	7	6	-	-	3	30	2.73
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	1	2	3	2	-	1	3	12	1.57
33 Primary Metals	-	-	-	-	-	1	-	1	0.21
34 Fab Metals	2	2	2	1	-	-	-	7	0.25
35 Industrial Machinery	2	3	-	1	-	-	-	6	0.15
36 Electronics	-	3	2	-	-	-	-	5	0.35
37 Transportation Equipment	-	5	3	2	4	2	2	18	0.95
38 Instruments	8	8	2	1	-	4	2	25	3.02
39 Miscellaneous Manufacturing	-	1	-	-	-	-	-	1	0.09
TOTAL	70	63	26	18	7	10	15	209	0.86

SIC-Based Industry	Percent of Participating SPC Sites by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	1.4	-	1.9	1.0	0.5	0.5	-	5.3
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	1.9	-	-	-	-	-	1.9
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	20.6	10.5	-	0.5	-	-	-	31.6
25 Furniture	-	0.5	0.5	-	-	-	-	1.0
26 Paper	0.5	-	1.0	-	-	-	0.5	1.9
27 Printing	0.5	-	-	0.5	1.0	-	1.0	2.9
28 Chemicals	0.5	1.0	-	0.5	-	-	0.5	2.4
29 Petroleum	1.4	0.5	-	-	-	0.5	0.5	2.9
30 Rubber/Plastics	2.4	4.3	3.3	2.9	-	-	1.4	14.4
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.5	1.0	1.4	1.0	-	0.5	1.4	5.7
33 Primary Metals	-	-	-	-	-	0.5	-	0.5
34 Fab Metals	1.0	1.0	1.0	0.5	-	-	-	3.3
35 Industrial Machinery	1.0	1.4	-	0.5	-	-	-	2.9
36 Electronics	-	1.4	1.0	-	-	-	-	2.4
37 Transportation Equipment	-	2.4	1.4	1.0	1.9	1.0	1.0	8.6
38 Instruments	3.8	3.8	1.0	0.5	-	1.9	1.0	12.0
39 Miscellaneous Manufacturing	-	0.5	-	-	-	-	-	0.5
TOTAL	33.5	30.1	12.4	8.6	3.3	4.8	7.2	100.0

Exhibit E-5
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Total Rebates (thousands of dollars) from SPC Program Participation in 1998 through 2001
Southern California Edison Service Territory

SIC-Based Industry	Thousands of Rebate Dollars by Project Size							TOTAL	Normalized Rebate to PGC Funds
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	9	-	226	391	91	179	-	896	1.01
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	87	-	-	-	-	-	87	0.49
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	297	322	-	81	-	-	-	700	8.59
25 Furniture	-	10	45	-	-	-	-	56	0.34
26 Paper	5	-	87	-	-	-	272	364	0.62
27 Printing	0	-	-	209	476	-	751	1,437	4.20
28 Chemicals	2	34	-	144	-	-	228	407	0.49
29 Petroleum	6	31	-	-	-	400	275	713	1.24
30 Rubber/Plastics	35	195	375	581	-	-	861	2,047	1.95
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	4	51	145	185	-	195	1,029	1,609	1.51
33 Primary Metals	-	-	-	-	-	400	-	400	0.46
34 Fab Metals	9	40	66	112	-	-	-	226	0.32
35 Industrial Machinery	23	108	-	117	-	-	-	248	0.49
36 Electronics	-	51	145	-	-	-	-	196	0.19
37 Transportation Equipment	-	127	163	230	731	192	586	2,029	2.50
38 Instruments	14	173	84	177	-	1,490	691	2,630	5.92
39 Miscellaneous Manufacturing	-	10	-	-	-	-	-	10	0.08
TOTAL	404	1,241	1,335	2,227	1,299	2,856	4,693	14,055	1.26

SIC-Based Industry	Percent of Rebates by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	0.1	-	1.6	2.8	0.6	1.3	-	6.4
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	0.6	-	-	-	-	-	0.6
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	2.1	2.3	-	0.6	-	-	-	5.0
25 Furniture	-	0.1	0.3	-	-	-	-	0.4
26 Paper	0.0	-	0.6	-	-	-	1.9	2.6
27 Printing	0.0	-	-	1.5	3.4	-	5.3	10.2
28 Chemicals	0.0	0.2	-	1.0	-	-	1.6	2.9
29 Petroleum	0.0	0.2	-	-	-	2.8	2.0	5.1
30 Rubber/Plastics	0.2	1.4	2.7	4.1	-	-	6.1	14.6
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.0	0.4	1.0	1.3	-	1.4	7.3	11.4
33 Primary Metals	-	-	-	-	-	2.8	-	2.8
34 Fab Metals	0.1	0.3	0.5	0.8	-	-	-	1.6
35 Industrial Machinery	0.2	0.8	-	0.8	-	-	-	1.8
36 Electronics	-	0.4	1.0	-	-	-	-	1.4
37 Transportation Equipment	-	0.9	1.2	1.6	5.2	1.4	4.2	14.4
38 Instruments	0.1	1.2	0.6	1.3	-	10.6	4.9	18.7
39 Miscellaneous Manufacturing	-	0.1	-	-	-	-	-	0.1
TOTAL	2.9	8.8	9.5	15.8	9.2	20.3	33.4	100.0

* To determine if certain customer segments are underserved, comparisons were drawn between the total amount of PGC funds that were contributed by a customer segment and the amount of program benefit (in terms of program rebates) that the customer segment received. Using CIS utility bill payments, the amount of PGC contribution for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of rebates received) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the PGC Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (program rebate) per dollar of PGC contribution than the population on average. Similarly, a PGC ratio less than one indicates that the customer segment received less benefit per dollar of PGC contribution than the population on average.
The overall ratio of 1.26 indicates that industrial customers receive incentives that are about 30 percent greater than they deserve, based on PGC charges paid.

Exhibit E-6
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
First Year MWh Saving from SPC Program Participation in 1998 through 2001
Southern California Edison Service Territory

SIC-Based Industry	Total MWh Saved by Project Size							TOTAL	Normalized Savings to Usage Ratio*
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	172	-	2,731	2,131	1,824	2,237	-	9,096	1.01
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	1,065	-	-	-	-	-	1,065	0.60
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	2,372	3,488	-	1,011	-	-	-	6,871	8.81
25 Furniture	-	103	502	-	-	-	-	605	0.38
26 Paper	77	-	1,660	-	-	-	3,022	4,760	0.79
27 Printing	2	-	-	1,394	3,458	-	5,730	10,583	3.20
28 Chemicals	19	322	-	1,305	-	-	2,847	4,492	0.53
29 Petroleum	104	348	-	-	-	2,424	3,442	6,318	0.96
30 Rubber/Plastics	389	2,433	5,156	6,969	-	-	10,110	25,059	2.35
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	67	569	2,029	2,314	-	2,432	10,989	18,401	1.68
33 Primary Metals	-	-	-	-	-	2,424	-	2,424	0.27
34 Fab Metals	89	673	1,011	1,400	-	-	-	3,172	0.46
35 Industrial Machinery	138	1,135	-	1,068	-	-	-	2,340	0.49
36 Electronics	-	451	1,708	-	-	-	-	2,159	0.20
37 Transportation Equipment	-	1,482	1,918	2,721	6,807	4,304	7,135	24,367	3.00
38 Instruments	225	1,892	1,309	1,353	-	9,404	8,640	22,823	5.11
39 Miscellaneous Manufacturing	-	112	-	-	-	-	-	112	0.09
TOTAL	3,654	14,073	18,025	21,667	12,089	23,226	51,914	144,648	1.28

SIC-Based Industry	Percent of MWh Savings by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	0.1	-	1.9	1.5	1.3	1.5	-	6.3
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	0.7	-	-	-	-	-	0.7
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	1.6	2.4	-	0.7	-	-	-	4.8
25 Furniture	-	0.1	0.3	-	-	-	-	0.4
26 Paper	0.1	-	1.1	-	-	-	2.1	3.3
27 Printing	0.0	-	-	1.0	2.4	-	4.0	7.3
28 Chemicals	0.0	0.2	-	0.9	-	-	2.0	3.1
29 Petroleum	0.1	0.2	-	-	-	1.7	2.4	4.4
30 Rubber/Plastics	0.3	1.7	3.6	4.8	-	-	7.0	17.3
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	0.0	0.4	1.4	1.6	-	1.7	7.6	12.7
33 Primary Metals	-	-	-	-	-	1.7	-	1.7
34 Fab Metals	0.1	0.5	0.7	1.0	-	-	-	2.2
35 Industrial Machinery	0.1	0.8	-	0.7	-	-	-	1.6
36 Electronics	-	0.3	1.2	-	-	-	-	1.5
37 Transportation Equipment	-	1.0	1.3	1.9	4.7	3.0	4.9	16.8
38 Instruments	0.2	1.3	0.9	0.9	-	6.5	6.0	15.8
39 Miscellaneous Manufacturing	-	0.1	-	-	-	-	-	0.1
TOTAL	2.5	9.7	12.5	15.0	8.4	16.1	35.9	100.0

* To determine if certain customer segments are underserved, comparisons were drawn between the total annual electric use for a customer segment and the amount of program benefit (in terms of annual energy savings) that the customer segment received. Using CIS data, the electric use for the entire population was estimated, as well as for a number of customer segments. Using program tracking data, the amount of program benefits (in terms of annual electric savings) was also determined for the entire participant population and for a number of customer segments. The ratio of benefit to contribution was then calculated for the population, and for each customer segment. This ratio (termed the First Year Savings to Use Ratio) was then normalized, such that it is 1.0 for the population. Therefore, for a given customer segment, a ratio greater than one indicates that they received more benefit (annual electric savings) per electric use than the population on average. Similarly, a ratio less than one indicates that the customer segment received less benefit per electric use than the population on average.
The ratio of 1.28 indicates that industrial customers, on average, obtain program savings that are about 30 percent greater than those received in the CIA population.

Exhibit E-7
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Number of Sites Participating in Gas Measures through the SPC Program in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Number of Sites by Project Size							TOTAL	Percent Penetration (%)
	< 2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,000 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	-	-	2	3	5	6	8	24	2.32
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	1	-	-	1	2	0.50
25 Furniture	-	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	1	1	0.79
27 Printing	-	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	2	1	3	0.99
29 Petroleum	-	-	-	-	-	2	1	3	4.17
30 Rubber/Plastics	-	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	1	1	0.32
33 Primary Metals	-	-	-	-	1	-	-	1	0.71
34 Fab Metals	-	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-
TOTAL	-	-	2	4	6	10	13	35	0.38

SIC-Based Industry	Percent of Sites by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	-	-	5.7	8.6	14.3	17.1	22.9	68.6
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	2.9	-	-	2.9	5.7
25 Furniture	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	2.9	2.9
27 Printing	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	5.7	2.9	8.6
29 Petroleum	-	-	-	-	-	5.7	2.9	8.6
30 Rubber/Plastics	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	2.9	2.9
33 Primary Metals	-	-	-	-	2.9	-	-	2.9
34 Fab Metals	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-
TOTAL	-	-	5.7	11.4	17.1	28.6	37.1	100.0

Exhibit E-8
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
Total Rebatesfrom SPC Program Participation (with Gas Saving Measures) in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Thousands of Rebate Dollars by Project Size							TOTAL	Normalized Rebate to PGC Funds Ratio*
	< 2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,000 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	-	-	40	123	180	619	1,722	2,684	0.27
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	36	-	-	1,941	1,977	2.07
25 Furniture	-	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	219	219	0.10
27 Printing	-	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	210	511	721	0.36
29 Petroleum	-	-	-	-	-	176	591	767	0.05
30 Rubber/Plastics	-	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	198	198	0.05
33 Primary Metals	-	-	-	-	111	-	-	111	0.18
34 Fab Metals	-	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-
TOTAL	-	-	40	160	291	1,005	5,182	6,678	0.17

SIC-Based Industry	Percent of Rebates by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	-	-	0.6	1.8	2.7	9.3	25.8	40.2
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	0.5	-	-	29.1	29.6
25 Furniture	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	3.3	3.3
27 Printing	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	3.1	7.7	10.8
29 Petroleum	-	-	-	-	-	2.6	8.9	11.5
30 Rubber/Plastics	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	3.0	3.0
33 Primary Metals	-	-	-	-	1.7	-	-	1.7
34 Fab Metals	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-
TOTAL	-	-	0.6	2.4	4.4	15.1	77.6	100.0

* Ratio of SPC Program Rebates to PGC Funds Paid, expressed as a percent of average, over all, for C/I customers in PG&E Service Territory.

Exhibit E-9
Statewide Small Industrial Wants and Needs Study
Phase 1 Customer Characterization
First Year Therm Saving from SPC Program Participation in 1998 through 2001
Pacific Gas and Electric Service Territory

SIC-Based Industry	Thousands of Therms Saved by Project Size							TOTAL	Normalized Savings to Usage Ratio*
	< 2,000 Thm	2,000-10,000 Thm	10,000-25,000 Thm	25,000-50,000 Thm	50,000-100,000 Thm	100,000-150,000 Thm	>150,000 Thm		
13 Oil/Gas	-	-	-	-	-	-	-	-	-
20 Food	-	-	40	123	322	767	2,715	3,967	3.05
21 Tobacco	-	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	36	-	-	1,764	1,800	14.46
25 Furniture	-	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	321	321	1.19
27 Printing	-	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	282	464	747	2.85
29 Petroleum	-	-	-	-	-	266	2,190	2,456	1.18
30 Rubber/Plastics	-	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	1,306	1,306	2.62
33 Primary Metals	-	-	-	-	57	-	-	57	0.69
34 Fab Metals	-	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-
TOTAL	-	-	40	160	379	1,315	8,760	10,654	2.11

SIC-Based Industry	Percent of Therm Savings by Project Size (%)							TOTAL
	< .1 GWh	.1-.5 GWh	.5-1 GWh	1-1.5 GWh	1.5-2 GWh	2-2.5 GWh	>2.5 GWh	
13 Oil/Gas	-	-	-	-	-	-	-	-
20 Food	-	-	0.4	1.2	3.0	7.2	25.5	37.2
21 Tobacco	-	-	-	-	-	-	-	-
22 Textiles	-	-	-	-	-	-	-	-
23 Apparel	-	-	-	-	-	-	-	-
24 Lumber	-	-	-	0.3	-	-	16.6	16.9
25 Furniture	-	-	-	-	-	-	-	-
26 Paper	-	-	-	-	-	-	3.0	3.0
27 Printing	-	-	-	-	-	-	-	-
28 Chemicals	-	-	-	-	-	2.6	4.4	7.0
29 Petroleum	-	-	-	-	-	2.5	20.6	23.1
30 Rubber/Plastics	-	-	-	-	-	-	-	-
31 Leather	-	-	-	-	-	-	-	-
32 Stone/Clay/Glass	-	-	-	-	-	-	12.3	12.3
33 Primary Metals	-	-	-	-	0.5	-	-	0.5
34 Fab Metals	-	-	-	-	-	-	-	-
35 Industrial Machinery	-	-	-	-	-	-	-	-
36 Electronics	-	-	-	-	-	-	-	-
37 Transportation Equipment	-	-	-	-	-	-	-	-
38 Instruments	-	-	-	-	-	-	-	-
39 Miscellaneous Manufacturing	-	-	-	-	-	-	-	-
TOTAL	-	-	0.4	1.5	3.6	12.3	82.2	100.0

* The ratio of SPC Program Therm Savings to Therm Usage, expressed as a percent of the average, over all, for C/I customers in PGE service territory.

APPENDIX F.
INDUSTRY RESULTS

APPENDIX F. INDUSTRY RESULTS

This appendix presents the results of assessments completed for each of the industrial segments targeted in this study: food processing, printing, fabricated metals, industrial machinery and the semiconductor and microelectronics industries. This section begins with a technical assessment focusing on opportunities for efficiency improvements in those industries, followed by industry assessments that were completed during the research development stages of this study.

TECHNICAL ASSESSMENT

The technical results presented in this section are based on a combination of information obtained from secondary literature and data sources and customer survey data collected during the course of this study. This section begins with a presentation based on customer survey results, followed by a drill-down analysis of technology targets that are examined as a function of industry and end-use.

Survey Results

Respondents of the Customer Survey were asked to provide information regarding equipment upgrades for production machinery, refrigeration and HVAC[1]. Exhibit F-1 presents the distribution of responses by study segment and end-use. The food industry respondents were by far the most active, accounting for nearly half of the actions reported. Process machinery, however, is the most active of the three end uses examined.

[1] Respondents were only asked to provide data surrounding upgrades when their self-reported top two end uses overlapped with production machinery, refrigeration or HVAC. This would preclude, for example, asking customers specifically about their lighting equipment upgrades if they had self-reported that their largest end-use is lighting. This was done to keep the study focused on less understood (by EE professionals) issues and technologies of specific interest to industrial customers.

Exhibit F-1
Recent Upgrades in the Production Equipment, Refrigeration and HVAC
Based On Small Industrial Customer Survey Responses

SIC-Based Industry	Number of Respondents Completing Recent Plant Upgrades			
	Industrial Process Machinery	Refrigeration	HVAC	Total
Food (SIC 20)	10	10	2	22
203 Fruits and Vegetables	9	6	1	16
2084 Wines Brandy and Brandy Spirits	1	4	1	6
Printing (SIC 27)	10	0	1	11
Fab Metals (SIC 34)	11	0	0	11
344 Fabricated Structural Metal Products	5	0	0	5
347 Electroplating Plating Polishing Coating Engraving	6	0	0	6
Industrial Machinery (SIC 35)	6	0	2	8
354 Metalworking Machinery	6	0	2	8
357 Computer Equipment	0	0	0	0
Small customers (less than 0.5 GWh)	21	8	2	31
Medium customers (0.5 - 1.5 GWh)	16	2	3	21
Participant*	7	5	1	13
Non-Participant**	30	5	3	38
This years production is MORE than last years production	12	3	1	16
This years production is LESS than last years production	15	1	3	19
This years production is about the SAME as last years production	10	6	1	17
Total	37	10	5	52

*Has participated in an energy efficiency program in the last two years (self reported)
**Has not participated in an energy efficiency program in the last two years (self reported)

Retrofits surrounding production machinery were found to be fairly evenly distributed among each of the industries studied, while refrigeration retrofits are clustered within the food industry segment. These customers were also asked to provide a description of the equipment they installed, which yielded the following data by end-use.

- Industrial machinery upgrades, in addition to being more numerous than for the other end uses, are spread across a wide array of technologies, with a clustering around various production machines (i.e., packaging equipment and printing presses) and high efficiency motor replacements. Other technologies include: cogeneration equipment, compressors, computer controls, copiers, fans, parts cleaners, welding equipment, etc.

- Refrigeration upgrades center around compressor replacements, with other upgrades affecting the condenser and evaporator components, and, in one case, a glycol system in a winery.

- HVAC upgrades are mostly high efficiency air-conditioning equipment, with energy management systems and insulation improvements also playing a role.

Industry-Specific Technical Results

A careful examination of the efficiency-based recommendations made during the last 20 years through the Industrial Assessment Center (IAC) Program and other sources offers a good way

to expand our understanding of industrial energy efficiency opportunities in small/medium industries. Recommendations are tracked in the IAC Program Database available online.

IAC recommendations for all seven industry segments examined in this study are analyzed in the following section, along with data surrounding technical potential from several other sources. Recommendations are categorized in both broad categories (energy, production improvement and waste reduction) and by end use (compressed air, cooling, HVAC, lighting, process heat, production for both electric and natural gas). Production is further broken down by process (changes related the production process, such as load shifting or controls) and equipment (replacing equipment, efficient motors).

While the IAC Program for small/medium industry initially targeted energy efficiency opportunities, the current program also addresses opportunities for waste reduction/optimization (through recycling, machinery upgrades, trash compacting, etc.) and productivity enhancements, through improvements to the production processes, equipment and procedures. Conclusions are difficult to draw for two industry segments, as wines (SIC 2084) and computer equipment (SIC 357) have relatively few observations.

Printing Industry

Energy efficiency recommendations made through the IAC program to the printing industry are presented in Exhibit F-2, providing both the preponderance of measure recommendations and the likelihood of customer follow-through once those recommendations are made.

Exhibit F-2
Summary of Industrial Assessment Center Recommendations
Made to the Printing Industry in California (SIC 27)

Assessment Recommendation Category	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommenations Implemented (%)
Energy	Compressed Air*	Optimize Air Intake	5	80
		Reduce Air Pressure	10	70
		Reduce Compressed Air Use	5	40
		Miscellaneous Compressed Air Measures	1	0
		SUBTOTAL	21	62
	Cooling	Miscellaneous Cooling Measures	6	50
	Heating	Miscellaneous Heating Measures	5	40
	HVAC	Miscellaneous Measures	5	60
	Hot Water	Miscellaneous Hot Water Measures	2	50
	Lighting	Install High Efficiency Lighting	19	53
		Install Occupancy Sensors	11	27
		Install Reflectors and Delamp	5	0
		Miscellaneous Lighting Measures	1	0
		SUBTOTAL	36	36
	Plug Loads	Miscellaneous Plug Load Measures	5	20
	Production Equipment	Replace Belts for Motors Drive	12	58
		Select Efficient Motors	17	76
		VSD Motor Controls	2	50
		SUBTOTAL	31	68
	Production Processes	Add Insulation	4	25
		Miscellaneous Production Measures	11	36
		SUBTOTAL	15	33
	TOTAL ENERGY		126	49
Waste Reduction		Miscellaneous Waste Reduction Measures	41	44
Production Improvements		Miscellaneous Production Improvement Measures	10	30
TOTAL			177	47

* An additional 9 recommendations were made for compressed air system leak repair, but the measure implementation fields were blank. In order to report percent of measures implemented, the system leak repair recommendations are not reported in this table.

This analysis for the printing industry sheds light on the technologies and actions that are expected to contribute to both the technical and achievable potential of a small/medium industrial program. Key findings to highlight include the following:

- Production equipment is the end-use (overall) that not only is second most likely to be recommended but also has the greatest likelihood of implementation follow-through (at a completion rate of 68%). This illustrates the fact that production (and productivity) is the number one consideration of printers, not energy efficiency.

- Compressed air, a key "energy source" for many production processes, (which is also frequently recommended) has the second greatest likelihood of implementation (at a completion rate of 62%).

- This is followed by a more traditional set of DSM measures, HVAC (and hot water), which achieve a 50% completion rate.

- One needs to look no further than lighting, to get the point. Lighting is traditionally the most common technology implemented under programs being offered, for example, to commercial sector customers. While we find that lighting is also the most common recommendation made to the printing industry, the implementation rate is much lower at just 36 percent.

- The "softer" production process (and plug load) measures (involving thermostat settings, reduced equipment operating times, insulating various production components, power factor correction and various energy billing solutions) also do not obtain much attention from this particular industry, with a clear focus, as noted above, on production equipment.

According to the Industries of the Future Roadmap for the Wisconsin Printing Industry (June 2000), the **printing** industry would benefit from programs that seek to examine and highlight the link between energy use, waste reduction and quality improvement. This can be achieved through training and education, an important avenue for emphasis in this labor-intensive industry[2], where recruitment and quality labor are highly valued. Training and education in most print shops is achieved through mentoring carried out by team leaders and foremen. In such an environment it is relatively easy to insert other trainers, including equipment vendors and manufacturers. Ultimately, it is most important to train and educate management and obtain their commitment to pursuing energy efficiency improvements.

With respect to energy efficiency, process innovation and productivity improvement, printing firms are eager for technical information on projects, including (energy) audits, benchmarking, incentives and case studies. An effective channel to consider for such an effort is the Printing Industries of America (PIA). Pitching non-energy benefits is crucial, as only about 7 percent of capital projects in the printing industry are to improve energy efficiency.

Related to this is a need for improved industry understanding of environmental quality and energy use tradeoffs. At the top of this list is ink selection, especially with regard to low volatile organic compound (VOC) products that result in a reduced need for ventilation. In many operations, ink VOC's must vented during drying (and incinerated), at considerable cost to the facility. Even in the absence of low VOC ink, a VFD on a ventilation fan is a good application, taking advantage of reduced venting when a small number of presses are in operation (vs. a more typical inlet vane solution).

The Wisconsin Roadmap offers other technologies that are appropriate for the printing industry, including: free-cooling for flexographic presses, production climate control (especially dehumidification), exhaust and makeup air balancing, low energy ventilation and air handling, process automation, reduced energy input for ink curing, low energy VOC destruction, waste heat recovery for building makeup air and process ventilation air, improved process controls, and energy monitoring and data trending for key processes.

That concludes the presentation of technical results for the printing industry. Results for the fabricated metals industry are presented next.

Fabricated Metals

Exhibit F-3 presents IAC findings for the fabricated metals industry (SIC 344).

[2] However, like many other industries, printing is (not surprisingly) undergoing a technology-based revolution, and is quickly moving from a skilled operator-driven craft to a high-technology, automated process.

Exhibit F-3
Summary of Industrial Assessment Center Recommendations
Made to the Fabricated Structural Metal Products Industry in California (SIC 344)

Assessment Recommendation Category	Target Resource	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommendations Implemented*
Energy	Electric	Compressed Air	Optimize Air Intake	2	50%
			Reduce Air Pressure	5	50%
			Reduce Compressed Air Use	2	50%
			Repair Air Leaks	13	92%
			Replace Compressor Controls	2	100%
			Use/Purchase Optimum Size Compressor	4	50%
			Reduce Operating Time	1	100%
			SUBTOTAL	29	74%
		Cooling	Reduce Operating Time	1	0%
			Use Cooling Tower Instead of Chiller	2	50%
			Use Economizers	1	0%
			SUBTOTAL	4	33%
		HVAC	Install Programmable Thermostat	1	0%
		Lighting	Clean Lamps	5	0%
			Controls	15	25%
			Install High Efficiency Lighting	14	83%
			Reflectors and Delamp	5	40%
			Skylight	1	0%
			Reduce Lighting	6	67%
			SUBTOTAL	46	46%
		Plant-Wide	Add Insulation	1	0%
			Close Doors/Windows	1	100%
			SUBTOTAL	2	50%
		Process Heating	Add Insulation	1	0%
			Recover Waste Heat	1	0%
			SUBTOTAL	2	0%
		Production Process	Install New Equipment	1	100%
			Reduce Peak Demand/Move Production to Off-Peak	1	0%
			Controls	3	33%
			Reduce Operating Time	4	50%
			VSD Motor Controls	5	25%
			SUBTOTAL	14	38%
		Production Equipment	Modify Equipment	1	0%
			Replace Equipment	1	100%
			Select Efficient Motors	12	75%
			Replace Belts for Motors Drive	2	50%
			SUBTOTAL	16	69%
	Natural Gas	Heating	Programmable Thermostat	1	0%
			Add Insulation	1	0%
			SUBTOTAL	2	0%
		Process Heating	Add Insulation	8	63%
			Boiler Tuning/Modification	1	100%
			Recover Waste Heat	5	20%
			Repair Equipment	2	50%
			SUBTOTAL	16	50%
	Switch Fuels	Production Equipment	Electric to Gas/Propane to Gas	3	33%
	TOTAL ENERGY			135	52%
Production Improvement				21	26%
Waste Reduction	Water			3	67%
	Solid Waste			25	67%
	Other Waste			11	45%
	TOTAL WASTE REDUCTION			39	61%
TOTAL				195	51%

* This calculation excludes all recommendations that have missing or ambiguous status codes. Ambiguous status codes include "P" and "K". "P" stands for Pending and is for recommendations with implementation costs of $10,000 or more. If the customer does not complete the work within a 3 year period, the "P" is changed to "N" for "not implemented". A "K" means the information has been excluded or is unavailable.

Key findings include:

- This component-producing segment (e.g., metal doors, frames, steel products for heavy construction, fabricated plate products, sheet metal work, and architectural metal work) is most likely to follow through on waste reduction (61%), then energy recommendations (52%), and finally production improvements (26%).

- With regard to energy efficiency improvements, compressed air (74%) is the end-use most likely to be implemented, followed by production equipment (69%).

- 46% of lighting projects – the most common type of recommendation – were implemented.

- Process heat, cooling and HVAC recommendations do not receive much attention from structural metal fabs.

Findings are presented in Exhibits F-4 and F-5 for metal finishers, a segment of the **fabricated metals** industry.

Exhibit F-4
Summary of Industrial Assessment Center Recommendations
Made to the Metal Finishing Industry in California (SIC 347)

Assessment Recommendation Category	Target Resource	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommendations Implemented *
Energy	Electric	Compressed Air	Optimize Air Intake	2	0%
			Reduce Air Pressure	3	67%
			Reduce Compressed Air Use	2	100%
			Repair Air Leaks	5	100%
			Purchase Optimal Sized Compressor	1	100%
			Use Synthetic Oil	1	100%
			SUBTOTAL	14	85%
		Cooling	Replace Chiller	1	0%
		HVAC	Install Programmable Thermostat	2	100%
		Lighting	Controls	1	0%
			Install High Efficiency Lighting	11	82%
			Occupancy Sensor	5	60%
			Install Reflectors and Delamp	7	71%
			SUBTOTAL	24	71%
		Plant wide	Reduce Peak Demand/Increase Off-Peak Use	1	100%
		Process Heating	Recover Waste Heat	4	0%
		Production Process	Add Insulation	3	33%
			Controls	4	100%
			VSD Motor Controls	5	60%
			SUBTOTAL	12	67%
		Production Equipment	Replace Belts for Motors Drive	3	67%
			Replace Equipment	1	0%
			Select Efficient Motors	7	71%
			SUBTOTAL	11	64%
	Natural Gas	Heating/Process heating	Boiler tuning/modification	7	71%
		Hot Water	Solar	1	0%
		Production Process	Add Insulation	6	67%
			Recover Waste Heat	1	100%
			SUBTOTAL	7	71%
	Fuel Switch	Heating	Electric to Gas/Propane to Gas	7	14%
	TOTAL ENERGY			91	63%
Production Improvement				5	20%
Waste Reduction	Solid Waste			13	58%
	Water			11	64%
	TOTAL WASTE REDUCTION			24	61%
TOTAL				120	61%

* This calculation excludes all recommendations that have missing or ambiguous status codes. Ambiguous status codes include "P" and "K". "P" stands for Pending and is for recommendations with implementation costs of $10,000 or more. If the customer does not complete the work within a 3 year period, the "P" is changed to "N" for "not implemented". A "K" means the information has been excluded or is unavailable.

Key findings include:

- California's metal finishers (electroplating, plating, polishing, coating and engraving) implemented at fairly high rates: energy (63%), waste (61%) and production improvements (61%).

- Metal finishers were most likely to improve their compressed air systems (85%). Improvements to production process, both electric and gas, is also common.

- Lighting-oriented measures were most frequently recommended, and 71% of these lighting recommendations were implemented.

Exhibit F-5 provides a breakdown of electric energy use by end-use among metal finishing companies[3]. Information like this is very useful for locating energy efficiency opportunities, as the greatest potential often lies where the greatest use occurs.

Exhibit F-5
Percent of Electric Use by End-Use
In Metal Finishing Factories

End Use	All Plants	Job Shops	Captive Shops
Exhaust fans	24.6	22.4	33.2
Electroplating and/or anodizing	23.9	29.5	1.3
Lighting	11.7	12.2	9.8
Hoists and Drives	5.0	5.9	1.4
Oven heat	4.5	-	-
Filter Pumps	3.0	3.4	2.3
Electric Tank Heating	2.9	-	14.5
Waste Treatment Equipment	2.7	2.2	4.7
Air Agitation	2.7	2.7	2.3
Chillers	2.6	-	-
All Other Pumps	2.6	2.5	-
Grinding, Polishing, Buffing	2.4	3.0	-
Electrocleaning	2.4	2.9	-
Air-conditioning	2.3	0.0	10.6
Other Uses	6.7	13.3	19.9
N	22	11	9

Source: Mazzeo, D.A. "Plating and Surface Finishing" AES Research Project 46: *Energy Conservation in Plating and Surface Finishing*. July 1979.

In the fabricated metals industry, gas is primarily used for heating metal, while the primary uses of electricity are exhaust fans, electroplating and lighting (shops must be well-lit).

- Heating ventilating and air conditioning are important end uses, offering many opportunities for efficiency improvements. For example, most facilities have exhaust ducts on their process tanks that continuously exhaust heated air to the outside that then needs to be made up. Significant energy is wasted by over-exhausting tanks, and technical solutions are infrequently used that can properly control ventilation.

- Electric motors and motor controls are also important. For example, substantial energy is used in the electroplating process, including energy used for pumps and motors. According to one industry observer we interviewed, motor and pump use in these facilities is a good target for energy efficiency improvements.

[3] Job shops refer to electroplating and metal finishing facilities which own less than 50% of the materials undergoing metal finishing, whereas captive shops own more than 50% of the materials undergoing finishing.

- Compressed air is also common, and is the highest cost utility in industrial plants. For example, metal finishing tank fluids are typically agitated with compressed air (Metal Finishers Guide to Reducing Energy Costs, Wisconsin, 2000).

- Minimizing heat loss in process tanks can also reduce energy usage (Energy Center of Wisconsin," 2000, Metal Finishers Guide to Reducing Energy Costs").

Exhibit F-6 presents a set of recommendation-based areas of concentration for the optimization of processes in metal finishing factories. Process optimization is said to be the chief means of making metal fabs more energy efficient. Optimizing steam generation and distribution systems, facility lighting, and compressed air generation, distribution and use, are other ways to make a machine shop more energy-efficient.

Exhibit F-6
Opportunities for Process Optimization
In Metal Finishing Factories

End Use	EE Opportunity
Lighting	Electronic ballasts and T-8s; switching controls; photosensor for outdoor lighting
Ventilation	Identify excessive ventilation; reduce exhaust airflows by improving vent hood and baffle design
Steam system	Optimize steam generation and distribution system
Power supply	Minimize losses in electrical power supply system by repairing poor connections and upgrading undersized conductors in AC to DC power rectifiers
Process heating	Minimize heat loss in process tanks by covering tanks, insulation, maintenance
Process heating	Use lowest cost source to heat process tanks; electricity is twice as costly to heat tanks than to use steam
Space heating	Minimize cost of winter space heating
Drying	Minimize heating cost in drying stations
Tanks	Agitate tank fluids using lowest cost method. Metal finishing tank fluids are typically agitated with compressed air, which is the highets cost utility in an industrial plant, 5x more expensive than electricity to produce the same work.
Compressed air	Cost-cutting compressed air can reduce consumption by 30%. Use a supplier or consultant to optimize compressed air generation.

Source: *Metal Finishers Guide to Reducing Energy Costs*, Energy Center of Wisconsin, 2000.

That concludes the presentation of technical results for the fabricated metals industry. Results for industrial machinery are presented next.

Industrial Machinery

In the **industrial machinery and equipment** industry, there is substantial variation in energy usage patterns between the computer manufacturing and metalworking equipment manufacturing sectors, the two sub-industries selected for detailed assessment. The cost of purchased electricity amounts to less than 0.2% of the value of shipments for computer manufacturers, but almost 1.5% of the value of shipments for cutting tool and machinery manufacturers. (1997 Economic Census, Manufacturing Industry Series, 10/4/99). Nationally, electricity and natural gas account for about equal shares of the industrial machinery and equipment sector's energy needs.

- The greater importance of energy for metalworking equipment manufacturers is accounted for by the fact that both motor-driven production equipment and process heat are integral to this sector. Industry-wide, within SIC 35, process heating accounts for 10% of electric use and 33% of gas use, while machine drive accounts for 44 percent of electric use; these are the largest end uses, driven by energy consumption in metalworking factories.

- As suggested by the end use breakdown above, the most likely prospects for improved energy efficiency in the industrial machinery sector are likely to be in more efficient motors and ASDs for production equipment, process heating (primarily for metalworking equipment manufacturing) facility lighting, and HVAC.

- Efficiency gains are also possible through the application of relatively simple controls to match equipment operation to hours of production (efficiency gains of 20% are cited for controls on production machinery).

- Other technologies currently being developed for the metalworking equipment industry focus on advances in metallurgy that would improve the efficiency of metal cutting operations. These advances are not likely to be appropriate, however, for the small job shops that characterize the small and medium sized customers in this sector – at least until they have been tested and proven in larger firms.

The results of California metalworking machinery industry IAC audits are presented in Exhibit F-7 below.

Exhibit F-7
Summary of Industrial Assessment Center Recommendations
Made to the Metalworking Machinery Industry in California (SIC 354)

Assessment Recommendation Category	Target Resource	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommendations Implemented
Energy	Electric	Compressed Air	Optimize Air Intake	1	100%
			Reduce Air Pressure	2	100%
			Repair Air Leaks	5	100%
			Purchase compressor	1	100%
			SUBTOTAL	9	100%
		Cooling	Use Economizers	1	100%
		Hot water	Temperature Set Back	1	100%
		HVAC	Controls	1	0%
		Lighting	Controls	1	100%
			Install High Efficiency Lighting	6	100%
			Occupancy Sensors	4	100%
			Delamping/Reflectors	3	67%
			Skylight	1	0%
			Install Specular Reflectors	2	100%
			SUBTOTAL	17	88%
		Production Process	Add Insulation	1	100%
			Turn Off When Not in Use/Reduce Operating Time	5	100%
			Recover Waste Heat	1	0%
			SUBTOTAL	7	83%
		Production Equipment	Select Efficient Motors	6	100%
			Modify Refrigeration System	2	0%
			VSD Motor Controls	3	33%
			SUBTOTAL	11	60%
	Natural Gas	Heating	Replace Boiler	1	0%
		Production Equipment	Reduce Operating Time	1	0%
		Production Process	Add Insulation	2	0%
			Recover Waste Heat	3	33%
			SUBTOTAL	5	20%
	Fuel Switch	Heating	Electric to Gas	1	100%
	TOTAL ENERGY			53	75%
Production Improvement				11	63%
Waste Reduction				7	71%
TOTAL				71	73%

* This calculation excludes all recommendations that have missing or ambiguous status codes. Ambiguous status codes include "P" and "K". "P" stands for Pending and is for recommendations with implementation costs of $10,000 or more. If the customer does not complete the work within a 3 year period, the "P" is changed to "N" for "not implemented". A "K" means the information has been excluded or is unavailable.

- Metalworking shops tend to undertake energy upgrades over production improvements or waste reduction
- Compressed air (100%) and production process changes (83%) were frequently implemented.
- Lighting changes were most frequently recommended and implemented. Little can be said about other DSM measures (cooling, HVAC) because so few recommendations were made.

Non-process uses account for over half the electric use of the computer and office equipment industries; electricity accounts for 70% of energy usage. Computer and electronic equipment manufacturers in particular devote over 60% of their electric use to non-process end uses, with resulting opportunities for standard HVAC and lighting efficiency measures. Sub-industries such as this drive the other major end uses across SIC 35, with HVAC accounting for 17% of electric use and 36% of natural gas use, and facility lighting accounting for 15% of electric use.

Exhibit F-8 presents IAC recommendations for the state's computer equipment industry.

Exhibit F-8
Summary of Industrial Assessment Center Recommendations
Made to the Computer Equipment Industry in California (SIC 357)

Assessment Recommendation Category	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommendations Implemented *
Energy	Compressed Air	Reduce Air Pressure	3	67%
		Repair Air Leaks	1	100%
		SUBTOTAL	4	75%
	Cooling	Purchase Optimal Equipment	1	100%
		Reduce Operating Time	2	0%
		Use Economizers	1	0%
		SUBTOTAL	4	25%
	Lighting	Install High Efficiency Lighting	4	75%
		Occupancy Sensors	2	50%
		Reflectors and Delamping	3	67%
		SUBTOTAL	9	67%
	Plant wide	Correct Power Factor	1	0%
	Process Heating	Add Insulation	1	0%
	Production Process	Reduce Operating Time	1	100%
	Production Equipment	Replace Belts for Motors Drive	1	0%
		VSD Motor Controls	2	50%
		Select Efficient Motors	3	67%
		SUBTOTAL	6	60%
	TOTAL ENERGY		26	56%
Production Improvement			1	100%
Waste Reduction			7	29%
TOTAL			34	52%

* This calculation excludes all recommendations that have missing or ambiguous status codes. Ambiguous status codes include "P" and "K". "P" stands for Pending and is for recommendations with implementation costs of $10,000 or more. If the customer does not complete the work within a 3 year period, the "P" is changed to "N" for "not implemented". A "K" means the information has been excluded or is unavailable.

- Computer equipment makers tend to implement fewer energy, production and waste reduction recommendations than the other industry segments studied.

- While it is difficult to draw robust conclusions from limited sample (N = 34), computer equipment manufacturers tend to make improvements to their compressed air systems, lighting and production equipment.

That concludes the presentation of technical results for industrial machinery facilities. Results for the food processing industry are presented next.

Food Processing

In the **food processing** industry, natural gas energy use is the most intensive, accounting for roughly 85% of all energy use, with electricity accounting for most of the remainder. An important gas end-use is process heating, while the principal electric end uses are process cooling and refrigeration, and motors to drive production equipment, like mixers, pumps and conveyors. According to industry observers we spoke with, waste water treatment, compressed air and lighting are also important targets for improved efficiency in food processing facilities. Also important are intelligent process control techniques being used to reduce processing time, eliminating over-blanching and thereby conserve energy.

- Recent sharp increases in energy costs have made the food processing industry much more aware about the importance of controlling energy costs. Opportunities for improved EE are said to exist in all aspects of food processing, from more efficient, lower emission boilers to high efficiency motors and ASDs for production equipment, to improvements in refrigeration. One of the opportunities consistently cited in the literature and by industry experts is the availability of new control technologies to optimize all aspects of the production process, thereby significantly improving energy efficiency. New technologies in boiler controls to optimize air to fuel ratios, for example, have made great leaps forward in the past five years, and the availability of relatively low cost sensors allows heating and cooling processes to be more accurately monitored and regulated so that less energy is produced and wasted.

- Emerging technologies being developed for fruit and vegetable processors to reduce energy, processing time, and waste water include efficient thermal processing, steam recycling, intelligent process control, and alternatives to conventional water and steam processing. These alternatives include microwave energy, pulsed electrical field (PEF) treatment, and food preservation by combined processes. This latter term, sometimes known as hurdle technology, involves optimizing the mix of various processing techniques to achieve the desired result at minimum cost and with minimum energy use. For blanching, a study has been conducted by the U.S. Department of Energy and the National Food Processors Association indicating that energy costs can be reduced 71% by implementing improved thermal and intelligent process control.

- In the wine industry, several EE opportunities were noted in the literature.
  - Membrane treatment technology is seen as a more energy efficient means of effluent disposal which otherwise involves pumping large quantities of water and disposing of solids by land application.
  - Alternatives to traditional "cold stabilization" methods of wine stabilization and clarification include using membranes and electrodialysis. The reported operating cost and energy consumption of these alternatives are substantially less than for cold stabilization.
  - Other methods of reducing energy use include high pressure/low volume cleaning equipment to reduce water usage, reduced energy use for cooling tanks by using

refrigeration jackets, the purchase of more efficient vacuum pumps to eliminate water used in bottling operations, and self cleaning presses used in crush operations to reduce water use.

IAC recommendations were analyzed for both winemakers and fruit and vegetable processors, but there were only twelve observations for the wine segment in California (SIC 2084). Therefore, fruit and vegetable processors only are presented in Exhibit F-9.

Exhibit F-9
Summary of Industrial Assessment Center Recommendations
Made to the Fruit and Vegetable Processing Industry in California (SIC 203)

Assessment Recommendation Category	Target Resource	End-Use Affected	Measure Group	No. of IAC Recommendations Made	Percent of Recommendations Implemented*
Energy	Electric	Compressed Air	Reduce Compressed Air Use	12	45%
			Reduce Air Pressure	4	67%
			Repair Air Leaks	11	100%
			Miscellaneous	2	0%
			SUBTOTAL	29	67%
		Cooling	Reduce Infiltration	3	67%
			Use Economizers	1	100%
			Programmable Thermostat	3	67%
			Miscellaneous	1	100%
			SUBTOTAL	8	75%
		Lighting	Delamping/Reduce Lighting	7	50%
			Controls (Occ. Sensor, Photocell Controls, Bi-level Lighting)	18	14%
			Install High Eff Lighting	25	62%
			Install Reflectors and Delamp	5	100%
			Miscellaneous	2	0%
			SUBTOTAL	57	49%
		Plant-wide	Correct Power Factor	2	0%
			Reduce Peak Demand/Increase Off-Peak Use	4	50%
			Turn Off Equipment When Not in Use	2	100%
			SUBTOTAL	8	50%
		Production Process	Controls to Use Efficient Equipment First/Only When Needed	6	50%
			Purchase/Modify Equipment	1	100%
			SUBTOTAL	7	60%
		Production Equipment	Add Insulation	2	100%
			Replace Belts for Motors Drive	6	67%
			Select Efficient Motors	19	82%
			VSD Motor Controls	8	0%
			SUBTOTAL	35	65%
	Natural Gas	Production Process	Add Insulation	5	75%
		Heating/Process Heating	Boiler Tuning Modification	10	71%
			Increase Condensate Returned	6	17%
			Repair Steam Leaks	7	57%
			Add Insulation	6	67%
			Recover Waste Heat	5	75%
			SUBTOTAL	34	57%
	Fuel Switch	Heating	Electric to Gas	2	50%
	TOTAL ENERGY			185	58%
Waste Reduction	Water			12	56%
	Solid Waste			15	71%
	TOTAL WASTE REDUCTION			27	65%
Production Improvement	Reduce Costs			29	48%
TOTAL				241	58%

* This calculation excludes all recommendations that have missing or ambiguous status codes. Ambiguous status codes include "P" and "K". "P" stands for Pending and is for recommendations with implementation costs of $10,000 or more. If the customer does not complete the work within a 3 year period, the "P" is changed to "N" for "not implemented". A "K" means the information has been excluded or is unavailable.

Key findings include:

- Fruit and vegetable processors received more recommendations than any other industry segment.

- Fruit and vegetable processors are more likely to reduce waste (65%) than reduce energy (58%) or improve production (48%). This may be because these firms face increasingly stringent environmental regulations that limit waste discharges.

- Food processors made improvements to compressed air systems and production as well as traditional DSM measures. Both cooling and lighting received serious attention from fruit and vegetable processors

With a firm understanding of technical opportunities among the industries studied, next industry assessments are presented to place those findings in perspective.

INDUSTRY ASSESSMENTS

Extensive literature review and interviews with industry experts identified a number of issues and hypotheses specific to each of the industries selected. These issues and hypotheses are discussed below, in four industry specific presentations for food processing, fabricated metals, industrial machinery and the semiconductor and microelectronics industries.

Food Processing

Industry overview. Food processing employs (in all size plants) more than 180,000 in California. Despite the overall importance of large national corporations in the food industry, there exist literally thousands of smaller operations in both the fruit and vegetable processing and wine segments – some of them owned by groups of farmers/growers, others operated as independent, often family-owned, small businesses. In addition, food processors – more than other industries – tends to be located in rural areas and small towns, which are often among the user groups under-represented in EE programs. There are more than 2500 small-to-medium customers in California, accounting for a substantial portion of small industrial customers' natural gas and electric use.

Business drivers. With few exceptions food processing is a commodity business, where producers have little control over either the price the pay for their raw materials or the price they receive for their products. (Those firms that have some pricing power through the establishment of brand identities that command a premium tend to fall into the large customer category.) Much of the food processing industry in California, including both of the segments that are the focus of our research, are characterized by dramatically seasonal production. During the short processing season, firms focus on maximizing throughput, maintaining product quality, and controlling cost.

Food processors also face major environmental and regulatory concerns related to the use of water (California fruit and vegetable processing uses 20 billion gallons per year) and emissions

associated with boiler operation. Processors located in areas with rapid population and housing growth face particular pressure to reduce their discharge of water used in processing, with some striving to become zero-discharge plants. This can create opportunities for membrane filtration technologies that contribute to reduced energy usage, as discussed below.

Role of energy and major end uses. As a percentage of total non-raw material production costs, energy represents about 2-3 percent of food processing operating cost.

Electricity meets about 15% of food processing energy needs; natural gas accounts for most of the remaining 85%. Major energy uses include:

- Process heating (29% of total energy use)
- Process cooling and refrigeration (16%)
- Motors to drive production equipment (mixers, pumps, conveyors)

In both wine production and the manufacture and storage of frozen foods, refrigeration is a major electricity end use, and helps to create peaks in demand during the warm months when crops are harvested and processed. Other energy intensive processes include waste water treatment, compressed air, and (particularly for wineries) lighting.

Opportunities for/barriers to EE. Despite the significance of energy costs, industry observers say that energy is often treated as a "sunk cost" of operation by food processors. Because of the focus on maximizing throughput during the short processing season, EE is generally not seen as a high priority. Moreover, smaller plants in particular rarely have an energy efficiency guru or champion, and they often lack even a thoroughly qualified boiler operator to help ensure that process heat is delivered efficiently.

On the other hand, recent sharp increases in energy costs have made the food processing industry much more aware about the importance of controlling energy costs. Opportunities for improved EE are said to exist in all aspects of food processing, from more efficient, lower emission boilers to high efficiency motors and ASDs for production equipment, to improvements in refrigeration. One of the opportunities consistently cited in the literature and by industry experts is the availability of new control technologies to optimize all aspects of the production process, thereby significantly improving energy efficiency. New technologies in boiler controls to optimize air to fuel ratios, for example, have made great leaps forward in the past five years, and the availability of relatively low cost sensors allows heating and cooling processes to be more accurately monitored and regulated so that less energy is wasted.

In the mature fruit and vegetable processing industry, as well as in the winemaking industry, processors look for ways to reduce product cost while still being able to meet the high demand for throughput during the relatively short processing season. While a single food blanching unit may process 30,000 pounds and consume 34 billion BTUs annually, the seasonality of food processing means that equipment is often underutilized. As a result, replacing existing equipment with alternative technology may not have sufficient return on investment, even if operating costs can be significantly reduced. The best opportunities may therefore exist for new plant construction or for plants processing high-value products year around. However, most plants can benefit from more intelligent process control techniques to reduce processing time, eliminate over-blanching, and conserve energy.

EE technologies. Emerging technologies being developed for fruit and vegetable processors to reduce energy, processing time, and waste water include efficient thermal processing, steam recycling, intelligent process control, and alternatives to conventional water and steam processing. These alternatives include microwave energy, pulsed electrical field (PEF) treatment, and food preservation by combined processes. This latter term, sometimes known as hurdle technology, involves optimizing the mix of various processing techniques to achieve the desired result at minimum cost and with minimum energy use. For blanching, a study has been conducted by the U.S. Department of Energy and the National Food Processors Association indicating that energy costs can be reduced 71% by implementing improved thermal and intelligent process control.

In the wine industry, several EE opportunities were noted in the literature.

- Membrane treatment technology is seen as a more energy efficient means of effluent disposal which otherwise involves pumping large quantities of water and disposing of solids by land application.

- Alternatives to traditional "cold stabilization" methods of wine stabilization and clarification include using membranes and electrodialysis (ED). The reported operating cost and energy consumption of these alternatives are substantially less than for cold stabilization.

- Other methods of reducing energy use include high pressure/low volume cleaning equipment to reduce water usage, reduced energy use for cooling tanks by using refrigeration jackets, the purchase of more efficient vacuum pumps to eliminate water used in bottling operations, and self cleaning presses used in crush operations to reduce water use.

Potential industry-specific program design strategies. One strategic channel for introducing new technologies to the food processing industry is the specialized engineering consulting firms that serve this market. These firms have been associated with the commercialization of advanced technologies, but could also be used as program allies in the dissemination of information and other program elements. One such firm offering design services to wineries, for example, asks on its home page "how much energy could you save using variable volume boiler and chiller system equipment with digital control?"

In Australia, the wine industry has launched a public-private sector partnership similar to the U.S. DOE's Industries of the Future Program, which seeks to achieve energy efficiency gains in the context of making the industry more competitive overall. A similar initiative might be feasible at the state level for both the wine and vegetable processing industries because of their concentration in California.

While the short processing season makes it more difficult to justify purchase of EE equipment, it does provide opportunities to conduct technology demonstrations, since individual production lines can be retrofit during the off-season with the technology to be demonstrated. This has been done effectively in the California food industry with membrane filtration technology at an olive processing plant and with a high efficiency blanching system at a prune processor.

Fabricated Metals

Industry Overview. The fabricated metal products industry comprises facilities that generally perform two functions: shaping metals and performing metal finishing. The industry is large and diverse – almost two-thirds of all finished goods manufacturers in the US use castings as a starting material. The industry is characterized by many "job shops" (small, independently owned companies) as well as large metal fabricating companies.

California has more metal products businesses than any other state. California leads the nation in sheet metal companies, metal doors, sash and trim establishments, architectural metal work, plating and polishing and metal coating (Profile of the Fabricated Metal Products Industry, EPA Office of Compliance Sector Notebook Project, 1995, pp. 7-8). The California metal fabricating industry accounts for 10% of the electricity used by small industrial customers. Its two biggest energy-using segments are structural metal products (i.e. sheet metal work, metal doors, plate work) and metal finishing. The average metal finishing company has 25 employees and $2 million in sales (Altmayer interview). There are 4105 small/medium metal fab sites in California; these are typically "Mom and Pop" job shops.

Business drivers. Small metal fabricators are fighting to survive in a commodity business in economic recession (Altmayer, Zanhiser). Compounding the drop in demand – many job shops are on the verge of bankruptcy – is foreign competition, notably in Asia. Jobs are bid out around the world through the Internet, and a metal shop in India can quote a job for little more than the cost of raw materials (Zanhiser interview). Furthermore, the cost of raw material, notably steel, is a tremendous concern to metal manufacturers. The price of steel has skyrocketed due to a supply shortage and steel tariffs (Howell interview). US metal fabs are looking to cut costs and not lose profit by running their shops more efficiently (Akers interview).

Role of energy and major end uses. Industrial processes can be grouped into three categories (Profile of the Fabricated Metal Products Industry, EPA Office of Compliance Sector Notebook Project, 1995, p. 12). In the first process – fabricating metal products – a machine shop is to take a raw material of some sort and remove material from it with a machine tool, so it can then be assembled into some kind of final product. Second, a surface is cleaned and prepared for final reparation. Third, the surface is finished by electroplating, painting, anodizing, etc.

Exhibit F-10 presents electrical end-use distribution from a sample of metal finishing companies.

Exhibit F-10
Percentage of Electrical Energy Use by End-Use

End Use	All Plants	Job Shops	Captive Shops
Exhaust fans	24.6	22.4	33.2
Electroplating and/or anodizing	23.9	29.5	1.3
Lighting	11.7	12.2	9.8
Hoists and Drives	5.0	5.9	1.4
Oven heat	4.5	-	-
Filter Pumps	3.0	3.4	2.3
Electric Tank Heating	2.9	-	14.5
Waste Treatment Equipment	2.7	2.2	4.7
Air Agitation	2.7	2.7	2.3
Chillers	2.6	-	-
All Other Pumps	2.6	2.5	-
Grinding, Polishing, Buffing	2.4	3.0	-
Electrocleaning	2.4	2.9	-
Air-conditioning	2.3	0.0	10.6
Other Uses	6.7	13.3	19.9
N	22	11	9

Source: Mazzeo, D.A. "Plating and Surface Finishing" AES Research Project 46: *Energy Conservation in Plating and Surface Finishing*. July 1979.

Exhibit F-11 presents the distribution of heat energy use from a sample of metal finishing companies. Process tank heating and boiler losses are the two biggest heating end uses.

Exhibit F-11
Percentage of Heat Energy Used in End-Use

End Use	All Plants	Job Shops	Captive Shops
Process tank heating	23.1	23.3	15.7
Boiler losses	18.2	19.7	12.2
Space heat	18.2	8.5	56.7
Cleaner tank heating	12.0	13.2	5.2
Rinse tank heating	10.0	11.2	5.8
Ovens and dryers	7.0	8.7	0.3
Vapor degreaser heater and stills	4.0	4.1	3.7
Waste recovery evaporators	3.8	4.7	-
Other Uses	3.7	6.1	0.4
N	22	11	9

Source: Mazzeo, D.A. "Plating and Surface Finishing" AES Research Project 46: *Energy Conservation in Plating and Surface Finishing*. July 1979.

Compressed air is the highest cost utility in an industrial plant. Metal finishing tank fluids are typically agitated with compressed air (Metal Finishers Guide to Reducing Energy Costs, Wisconsin, 2000). In metal fabs, gas is primarily used for heating metal. The primary use of electricity is lighting (shops must be well-lit). Electric motors and controls are also critical to their machinery. For example, energy applied to electroplating processes use rectified DC current, heat processes, and a significant amount for pumps motors and lighting. Heating, ventilating and air conditioning is another important end-use.

Opportunities for/barriers to EE. While energy is often considered a fixed cost of metal fabricating, small shops may have greater incentive to control any cost than large companies with bigger margins. One observer thinks that the low hanging fruit, such as lighting retrofits, may already have been taken in cost-conscious small shops, but another industry expert believes energy efficiency is not on the radar screen; small shops are "fighting other fires" and are unaware of EE opportunities.

Opportunities are said to exist in HVAC. Most facilities have exhaust ducts on their process tanks that continuously exhaust heated air that needs to be made up to the outside. Significant energy is wasted by over exhausted tanks, and little if any high technology used to properly ventilate tanks. Energy efficient motors is another area of opportunity; these facilities use a lot of motors and pumps (Altmayer). Optimizing steam generation and distribution systems, facility lighting and compressed air generation, distribution and use are other ways to make a machine shop more energy-efficient. Minimizing heat loss in process tanks can also reduce energy usage (Energy Center of Wisconsin," 2000, Metal Finishers Guide to Reducing Energy Costs").

EE technologies. Process optimization is the chief means of making metal fabs more energy efficient. Exhibit F-12 below summarizes numerous ways of optimizing metal finishing processes.

Exhibit F-12
Process Optimization in Metal Finishing Facilities

End Use	EE Opportunity
Lighting	Electronic ballasts and T-8s; switching controls; photosensor for outdoor lighting
Ventilation	Identify excessive ventilation; reduce exhaust airflows by improving vent hood and baffle design
Steam system	Optimize steam generation and distribution system
Power supply	Minimize losses in electrical power supply system by repairing poor connections and upgrading undersized conductors in AC to DC power rectifiers
Process heating	Minimize heat loss in process tanks by covering tanks, insulation, maintenance
Process heating	Use lowest cost source to heat process tanks; electricity is twice as costly to heat tanks than to use steam
Space heating	Minimize cost of winter space heating
Drying	Minimize heating cost in drying stations
Tanks	Agitate tank fluids using lowest cost method. Metal finishing tank fluids are typically agitated with compressed air, which is the highets cost utility in an industrial plant, 5x more expensive than electricity to produce the same work.
Compressed air	Cost-cutting compressed air can reduce consumption by 30%. Use a supplier or consultant to optimize compressed air generation.

Source: *Metal Finishers Guide to Reducing Energy Costs*, Energy Center of Wisconsin, 2000.

Industrial Machinery and Equipment

Industry overview. Among small to medium sized firms, the industrial machinery sector is the largest electricity user and the second largest user of natural gas. The industry is broad in scope, comprising the manufacture of all types of capital equipment – from simple gears to complex computers. This sector includes many of the firms associated with the high tech California economy, since it includes computers, computer peripherals, and other office machines (SIC 357). But "old economy" segments are also important, with a variety of metalworking firms contributing some 15 percent of this 2-digit SIC's energy usage. More than most industries, this segment is dominated by small, independent machine shops. The precision machined products industry, for example, has a national output of over $5 billion, but average annual sales per firm of less than $4 million (Precision Machined Products Industry Association).

Business drivers. According to the California Small Manufacturers Association, the industrial machinery sector has been among those most hard-hit by the economic downturn. Most of the small to medium manufacturers in this industry are part of the subcontracting chain, meaning they do the actual manufacture of components for large national or global manufacturing companies. As demand for computer system components and tools has declined, the mid-sized firms who are the first-tier subcontractors to the big name companies increasingly keep for themselves work that they used to sub out to small "Mom and Pop" suppliers.

Industrial machinery manufacturers also face fierce price competition from suppliers around the world, which has been exacerbated by the proliferation of business-to-business e-commerce. In addition, the industry has faced (at least until the current slowdown) critical shortages of both skilled machinists for tool and die manufacture and highly trained computer specialists for the computer manufacturing industry. According to the Pacific Coast Manufacturers Association, a 1998 survey of 800 Southern California manufacturers found that 82 percent were affected by a shortage of skilled personnel. Several industry groups have therefore been focusing on ensuring an adequate supply of labor through training and outreach programs.

Regulatory concerns of industrial machinery manufacturers include both those associated with their labor force (Workers Compensation and OSHA issues) and waste disposal, particularly for computer and peripherals manufacturers. Computer firms are concerned about pending legislation making them responsible for disposal of electronic waste, and are devoting association resources to overturning this requirement.

Role of energy and major end uses. There is substantial variation in energy usage patterns between the computer manufacturing and metalworking equipment manufacturing sectors. The cost of purchased electricity amounts to less than 0.2 percent of the value of shipments for computer manufacturers, but almost 1.5 percent of the value of shipments for cutting tool and machinery manufacturers. (1997 Economic Census, Manufacturing Industry Series, 10/4/99).

The greater importance of energy for metalworking equipment manufacturers is accounted for by the fact that both motor-driven production equipment and process heat are integral to this sector, while non-process uses account for over half the electricity usage of computer and office

equipment manufacturers. Nationally, electricity and natural gas account for about equal shares of the industrial machinery and equipment sector's energy needs; for the computer and office equipment segment, however, electricity accounts for 70 percent of energy usage. Industry-wide, major energy uses include:

- Process heating (10 percent of electricity and 33 percent of gas use)
- Machine drive (44 percent of electricity)
- Facility HVAC (17 percent of electricity; 36 percent of natural gas)
- Facility lighting (15 percent of electricity)

Opportunities for/barriers to EE. Because of the small percentage of production costs accounted for by energy, efficiency has not been a high priority for most industrial machinery manufacturers. Small manufacturers in particular are said to see energy costs as "just a cost of doing business," and many plant managers in this industry lack the time and willingness to pursue even savings opportunities that can be achieved with minimal upfront expense (Goodreau, California Small Manufacturers Association).

In addition, prospects for EE are linked to the generally dismal business climate faced by small (especially) and mid-sized manufacturers in this segment and the experiences of the California Small Manufacturers Association in attempting to offer programs to its members in this industry. Industrial machinery manufacturers are reluctant to make investments of any kind in the current economic environment, and even spurn opportunities to save modest amounts of money with no upfront outlay at all.

As suggested by the end use breakdown above, the most likely prospects for improved energy efficiency in the industrial machinery sector are likely to be in more efficient motors and ASDs for production equipment, process heating (primarily for metalworking equipment manufacturing) facility lighting, and HVAC. Computer and electronic equipment manufacturers in particular devote over 60 percent of their electricity spending to non-process end uses, with resulting opportunities for standard C/I HVAC and lighting efficiency measures.

EE technologies. There are no major technological advances cited in the literature or by industry experts that would offer breakthroughs in energy efficiency for this sector. In addition to more efficient boilers for process heat and more efficient drives (either premium motors or ASDs) for production equipment, both these end uses could be made more efficient through the application of relatively simple controls to match equipment operation to hours of production (efficiency gains of 20 percent are cited for controls on production machinery). Other technologies currently being developed for the metalworking equipment industry focus on advances in metallurgy that would improve the efficiency of metal cutting operations. These advances are not likely to be appropriate, however, for the small job shops that characterize the small and medium sized customers in this sector – at least until they have been tested and proven in larger firms.

Potential industry-specific program design strategies. Program designs targeted to the industrial machinery industry must take into account the business climate currently faced by small

(especially) and mid-sized manufacturers in this segment. As a result, the following strategies may be appropriate:

- Interest in energy efficiency opportunities among these businesses will only be generated by programs that involve little time or hassle, minimal upfront investment, and no risk.

- In part because of the current economic and regulatory climate, small manufacturers in this industry tend to be deeply suspicious of anything that does not come from organizations with whom they have established relationships. Program should therefore be delivered through well established, channels using trusted sources of information.

- Manufacturers who are planning to move their facility within the next year may be more receptive to incorporating energy efficiency improvements into their new facilities, and such improvements may be encouraged as part of a comprehensive relocation package.

Semiconductor and Microelectronics Industry

Industry overview. Triggered by a recent recession, the semiconductor and microelectronics industries experienced a dramatic decline in sales and demand in 2001, as soaring markets from 2000 crashed. Global chip sales fell as the main industry drivers, telephone, computer and communication equipment markets slipped -- resulting in a 32 percent decline in chip sales from 2000. This has had a widespread effect on the high-tech markets in California and across the globe.

On a positive note, the downturn in 2001 production has led to an increase in R&D spending. New technologies are expected to greatly increase chip performance, and new manufacturing processes are expected to increase demand. Growth is expected, for example, in microelctromechanical systems.

Business drivers. The semiconductor and microelectronics industries are the most competitive in the world, driven by the tremendous pressure to be first to market with a new product. Those who reach the market first have the greatest opportunity to capture a large market share. Anything that enables or improves productivity is highly valued.

This competitive spirit is highlighted by companies that manufacture silicon wafers and chips. Here the next new product, a revolutionary chip, is constantly on the drawing board, and due to arrive in the market place on about a three year cycle. For example, plans are in the works now for 300 mm wafers. This change in industry production standards for the next product line is being met with abundant R&D, construction and retooling, with existing semiconductor cleanrooms undergoing major renovations, and newly designed facilities are under construction. In this high pressure setting, tried and true processes and procedures are the norm and design innovation is rare. Semiconductor firms are very reluctant to make changes to processes that already work well. Deeply ingrained design practices stand in the way of energy efficiency improvements.

More than anything, the market for silicon chips is driven by speed to market. As a result, construction jobs are fast-tracked. Surprisingly, many silicon fabrication plants are built for three years of operation to meet new product lines, and then later refurbished for some other production process. These plants must show profit within that short timeframe, and often require a capital outlay of $1 billion. To achieve this, production must run continuously. For this reason, plant site selection is important, with the main criteria for selection being cheap power, abundant access to water, access to silicon feedstock and environmental regulations that will hot hamper production. In general, the industry strives to avoid all forms of outside regulation.

While there are small firms competing in this market, the market is primarily characterized by the presence of large international companies, with many facilities and thousands of employees. It is likely that substantial industry progress, such as improvements in energy efficiency through design innovation, will first occur with larger firms, or in related government facilities, like laboratories, where planning horizons are longer.

Role of energy and major end uses. As a percentage of total production costs, energy represents a small fraction in the high-tech industries, and is treated as a fixed cost of doing business. In

chip fabrication, for example, energy represents about 1 to 3 percent of total production costs. While on first glace these costs seem reasonable, that is because the costs for design and construction are enormously large. Energy accounts for 30 to 50 percent of day-to-day operating costs, rivaling the expenses to staff a facility throughout production.

While the electronics industry accounts for just 1.8 percent of industrial natural gas use in California, this industry is very electric intensive, using 11 percent of the industrial electric supply, second only to food. Major energy uses include:

- HVAC accounts for 40 to 50 percent of electric use during production. This is typical of facilities that make extensive use of cleanrooms, like high-tech facilities, where particle-free air is an energy intensive requirement of the production process. Cleanrooms account for over 50 percent of the energy use in the applicable industries where they have them. In cleanrooms, ventilation is the key to improved energy efficiency.

- Production tools account for the next largest share of energy use; accounting for 35 percent of electric use, in fabs, for example. These tools are very energy intensive and require that temperatures be maintained within a very narrow range.

- Remaining energy use is dominated by several energy intensive processes that include de-ionizing water, water purification, processing gasses (like nitrogen) and chilling water for process uses. Similar to HVAC above, particle-free water and chemicals are a requirement of the production process, requiring substantial energy use. Ordinary end uses are also important, including lighting, as high-tech facilities are normally well lit. Pumps are used for water purification and the treatment of wastewater prior to release.

Although the cost of energy is greatly valued, as demonstrated by facility site selection in areas with relatively low energy rates, the perceived importance of energy efficiency to this industry has traditionally been negligible; energy is perceived as a "sunk cost" that falls below the corporate radar. This is highlighted by the fact that high-tech manufacturing facilities are willing to pay extra for power quality and reliability.

Opportunities for/barriers to EE. While the opportunities for energy efficiency improvements in the high-tech industry are easy to point out, and likely to revolve around improved up-front design and clean room technologies, the obstacles in this industry are numerous.

First, it is clear that high-tech manufacturing facilities require significant use of expensive, power-sensitive, and energy-intensive cleanrooms. This implies that many technical opportunities exist surrounding power quality and reliability, HVAC efficiency, and for semiconductor tools used in the production process.

- With regard to cleanrooms, semiconductor facilities make the greatest use of them, accounting for 58 percent of the cleanroom floor area. Cleanroom energy density is said to normally be 40 times that of office buildings, and up to 100 times that found in average commercial buildings. Savings of 30 to 75 percent are considered obtainable.

- Solutions focused on reliability and cogeneration are top-of-mind for microelectronics firms.

- HVAC savings of 40 to 50 percent are considered obtainable.

- Production tool specifications do not currently call for energy efficiency requirements. It is thought that a fully integrated design, including both the tool OEM and facility specifications, represents a tremendous savings opportunity for this industry, meaningfully affecting the total cost of production. Such a design could, for example, lead to a dramatic reduction in HVAC equipment sizing (which is normally designed to maintain tool tolerances), first cost and operating expenses. By designing a greater tolerance for tools HVAC systems could be downsized and costs reduced.

Second, there are many opportunities for facility design improvements. Facility design firms suggest that energy efficiency is increasingly a concern among their high-tech clients.

- In fact, the recent industry slow-down creates an opportunity to spend more time incorporating energy efficiency into the design process. For this to be successful would require close work with the design community and manufacturers and their industry associations. As mentioned below, past actions utilizing case studies have been met with interest, but a slow response and skepticism from the microelectronics industry. Frankly, there is little design time available for energy efficiency in this high pace market, where group decision-making is the norm. Energy analysis is currently a low priority for designers. Really, a champion is needed within a given firm to reach multiple layers of corporate management and facilities staff.

- Industry representatives suggest that the cyclical retooling and construction phases provide many design-based opportunities for energy efficiency improvements. For example, the development phase for the 300 mm silicon crystal growing process and chip production was just such an opportunity. There will be many others yet to come.

Even with this potential for energy efficiency improvement looming before us, one can expect receptivity to design innovation to move slowly. Opportunities to improve this should be forged through alliances with industry representatives and groups. These include the Semiconductor Equipment & Materials International (SEMI), SEMATECH, the Semiconductor Industry Association (SIA), and the Semiconductor Industry Suppliers Association (SISA). Also important is the International Semiconductor Environmental Safety and Health Conference (ISESH). Several of these institutions are working on or have worked on relevant projects:

- SIA produced the International Technology Roadmap for Semiconductors, which took a careful look at the potential for energy and other environmental improvements in the semiconductor industry. These recommendations are covered below in the Technology sub-section.

- SEMI is developing guidelines for a highly automated factory of the future, including e-diagnostics for manufacturing processes.

- SEMATECH is running a pilot energy audit study of semiconductor fabs. SEMATECH is a consortium of manufacturers working to develop advanced manufacturing technologies needed to build the most powerful semiconductors.

A recommended approach might be to partner with toolmakers that serve the semiconductor industry and facility design engineers, using these associations as a common platform. Furthermore, there are a number of other energy efficiency partnering opportunities, with those involved in the high-tech industry, including the Northwest Power Planning Council, NEEA, CIEE, EPA, ASHRAE, LBNL and Supersymetry.

EE technologies. Based on a review of available literature, many potential energy saving technologies were identified. The technologies are listed, along with the source from which they were obtained.

- EPA Labs for the 21st Century: daylighting, high efficiency lighting, VAV fume hoods, variable frequency drives for air supply and exhaust and water systems, heat pipe energy recovery system with evaporative cooling, chilled water thermal energy storage system, premium efficiency motors, premium efficiency multiple-boiler system, energy management control system, sunshades and reflective glass, and metering and commissioning.

- California Energy Commission Clean Rooms publication: reduce exhaust air, recirculation of air, use heat recovery, control systems to account for part-time occupancy, required cleanliness levels, process load and humidity levels, and the use of mini-environments. All told, a 50 percent reduction in energy intensity can be achieved in cleanrooms through improved design, Cx and operations.

- SIA International Technology Roadmap for Semiconductors: reduce equipment heat discharge, recycle equipment exhaust, reduce process area size by equipment integration, develop water-cooled equipment (vs. air-cooled), reduce energy consumption of plasma and sputtering systems, reduce RF plasma energy consumption, use alternate low energy plasma systems, develop/use new energy efficient thermal processes, new water and chemical heating technologies, reduce exhaust requirements for tools, EE environmental design, EE tool design, and factory integration for improved EE design (which includes facility optimization, cogeneration, use of mini-environments to reduce AC loads, mini-pod systems and clean dry air tunnels).

- NEEA Silicon Crystal Growing assessment: recharge silicon growing apparatus to pull longer crystals, modifications to the hot zone and argon gas usage, and use or granular polysilicon feedstock.

Relevant programs/initiatives. Based on a review of available literature, several energy efficiency program and initiatives were identified. These are briefly listed below.

- Using PIER funds, the California Energy Commission has been working with LBNL to develop the following EE infrastructure to serve the high-tech community: laboratory design guide, EE case studies, clean room design charrette, and a special project to design a low flow fume hood.

- NEEA has been involved in pilot interventions in the Pacific Northwest, including silicon crystal growing demonstrations involving production process enhancements, and two other market transformation initiatives.

- The EPA Labs for the 21st Century focuses on improving laboratory energy and water efficiency and encourages the use of renewable energy; intervention consists of partnering arrangements/demonstrations, training and the development of an EE tool kit.

Potential industry-specific program design strategies

- Using established relationships with high-tech customers, the utilities should serve as the courier of information from established research completed by NEEA, EPA, LBNL, etc. Also consider funding the E-Source multi-client study of market and technical opportunities for EE in the high-tech production industry.

- New construction and design initiatives are thought to have the greatest likelihood of success.

- Incentives are thought to be important because the maintenance and improvement budgets are very modest in the semiconductor industry. Also, public good research and development is needed for the smaller companies that can't afford access to ongoing research involving best industry practice.

- Consider an alliance with SEMATECH, in their pursuit of advanced manufacturing technologies, as a best practices showcase for energy efficiency.

- Ongoing NEEA demonstrations are needed to either prove or disprove whether or not crystal growth using granular polysilicon will produce semiconductor grade crystals. Also, demonstration of the many non-energy benefits and energy benefits is needed.

- Intervention is needed at the tool OEM, where design specifications rarely, if ever, call for the energy efficiency of the tool. Possibly work with SEMI, a trade association for tool manufacturers who supply the equipment and materials needed to produce semiconductors.

- It is widely believed that demonstrations, case studies and benchmarking are needed to drive change in the high-tech industry.

APPENDIX G.
LIST OF INDUSTRY EXPERTS

Appendix G.
List of Industry Experts Interviewed in Phase I

Name	Position	Industry
Fred Hart	Steam Expert, DOE Best Practices Program	food processing
Chuck Yuska	President, Packaging Machinery Manufacturers Institute	food processing
Tom Gillespie	Technical Director, International Association of Food Industry Suppliers	food processing
Chris Howell	Regulatory Manager, Precision Metalforming Association	fab metals
Frank Altmayer	Technical Director, American Electroplaters and Surface Finishers Society	fab metals
Rob Akers	Industrial Technology Director, National Tooling and Machining Association (NTMA)	fab metals
Ron Leiker	President, Metal Finishing Association of Southern California	fab metals
Richard Zahniser	Technical Director, Precision Machined Products Association (PMPA)	fab metals
David Goodreau	Executive Director, California Small Manufacturers Association	production machinery
Michaela Platzer	VP, Research/Policy Analysis, American Electronic Association	production machinery
Joe Lyons	Energy Policy Director, California Manufacturing and Technology Association	production machinery
Chris Cockrill	Compressed Air Expert, DOE Best Practices Program	General
Jerry Lawson	Director, Energy Star Small Business Program, US EPA	General
Lynn Price	Deputy Group Leader, International Energy Studies, Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory	General
Ernst Worrell	Staff Scientist, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory	General
Neal Elliott	Industrial Program Director, American Council for an Energy-Efficient Economy	General
Phil Degens	Evaluation Coordinator, Northwest Energy Efficiency Alliance	General

APPENDIX H.
LIST OF PROGRAM MANAGERS

Appendix H.
List of Program Managers Interviewed in Phase I

First Name	Last Name	Type	Implementer	Program Area
Genrick	Gofman	utility	PG&E	audits
Mike	Baker	TPI	SBW	compressed air
John	Skelton	TPI	Xenergy	compressed air
Carol	Harty	utility	PG&E	Express Efficiency
Jacqueline	Jones	utility	SCE	Express Efficiency
Jeff	Alexander	utility	SDG&E	Express Efficiency
Lilia	Villareal	utility	SCG	Express Efficiency
David	Wightman	TPI	XDX Innovative Refrigeration	refrigeration
Gary	Suzuki	utility	SCE	Savings by Design
Angie	Ong-Carrillo	utility	PG&E	SPC
Don	Amuzie	utility	PG&E	SPC
Hjelsand	Grant	utility	SCE	SPC

APPENDIX I.
LITERATURE SOURCES

Appendix I.
List of Literature Sources Reviewed in Phase I

Alliance to Save Energy. Business Value of Steam Efficiency
Aspen, Nonresidential Market Share Tracking System Project, in progress
California Energy Commission. Industrial Energy Efficiency: Clean Rooms and Laboratories for High-Technology Industries. 1999.
California League of Food Processors, Manual of Good Practice, Land Application of Food Process Rinse Water
Carbon Products Consortium. Carbon Products Industry Vision for the Future
Delivering Energy Services to Semiconductor and Related High-Tech Industries: http://www.esource.com/public/products/mcs_hitech.asp
DOE OIT, Best Practices: Motor Efficiency Case Studies
DOE OIT, Best Practices: Steam Case Studies
DOE OIT. Agriculture Industry Profile - Industries of the Future project
DOE OIT. Aluminum Industry Profile - Industries of the Future project
DOE OIT. Chemicals Industry Profile - Industries of the Future project
DOE OIT. Forest Products Industry Profile - Industries of the Future project
DOE OIT. Glass Industry Profile - Industries of the Future project
DOE OIT. Metalcasting Industry Profile - Industries of the Future project
DOE OIT. Mining Industry Profile - Industries of the Future project
DOE OIT. Motor Challenge Information and Case Studies (www.oit.doe.gov/bestpractices/motors)
DOE OIT. Motors Market Assessment Executive Summary
DOE OIT. Petroleum Industry Profile - Industries of the Future project
DOE OIT. Roadmap for Process Heating Technology: Priority Research and Development Goals and Near-Term Non-Research Goals to Improve Industrial Process Heating. 2001
DOE OIT. Steel Industry Profile - Industries of the Future project
DOE, Office of Energy Efficiency and Renewable Energy. Impacts: OIT Summary of Program Results
DOE OIT. Energy Efficient Food Blanching System, NICE3 Success Story
Einstein, D. et al, LBNL. Steam Systems in Industry: Energy Use and Energy Efficiency Improvement Potentials.
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Megdal, Lori, Darren Schauf, and Ingo Bensch, 2002. "Decision-Making Among Small and Medium Manufacturers, and Indications of What is Needed to Reach These Customers." *Proceedings from the 2002 ACEEE Summer Study,*
Membrane Filtration System Cuts Water Use and Eliminates Wastewater Discharge, California Energy Commission and DOE OIT
National Association of Manufacturers, 2001 NAM Small Manufacturers Operating Survey Results
N. Martin, E. Worrell, et al. Emerging Energy-Efficient Industrial Technologies, executive summary
N. Martin, N. Anglani, D. Einstein, M. Khrushch, E. Worrell and L. K. Price. Opportunities to Improve Energy Efficiency and Reduce Greenhouse Gas Emissions in the US Pulp and Paper Industry. 2000.
NEEA. Assessment of Industrial Motor Systems Market Opportunities in the Pacific Northwest (www.nwalliance.com/resources/reports/industrial.html)
OIT, Oak Ridge, DOE. United States Industrial Motor-Driven Systems Market Assessment: Charting a Roadmap to Energy Savings for Industry. 1998
Quantum Consulting, Assessment of 1999 Nonresidential Process Overhaul Program
Quantum Consulting, Statewide Small/Medium Nonresidential Customer Wants and Needs Study. 2001
Research Into Action and Shel Feldman Management Consultants and NEEA. Market Progress Evaluation Report for Silicon Crystal Growing Facilities.
Research Into Action and Shel Feldman Management Consultants and NEEA. First Market Progress Report of the Microelectronics Initiative.
Roadmap for Process Heating Technology: Priority Research and Development Goals and Near-Term Non· Research Goals to Improve Industrial Process Heating. 2001
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Semiconductor Equipment and Materials International (SEMI) Report 2001 - 2002, State of the Industry (http://www.semi.org/report/p4.html)
Shipley, Anna Monis, Elliott, R. Neal, and Hinge, Adam, "Energy Efficiency Programs for Small and Medium-Sized Industry", American Council for an Energy-Efficient Economy, Report Number IE002, February 2002.
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Wineries of the Future, Energy Efficiency Best Practice Program, Department of Industry, Tourism and Resources, Canberra, Australia
Wisconsin Energy Center. Wisconsin Metalcasting Roadmap. 2000.
Xenergy and OIT. United States Industrial Motor Systems Market Opportunities Assessment. 1998.
Xenergy, California Industrial Energy Efficiency Market Characterization Study. 2001
Xenergy, Industrial Market Potential Study and Program Gap Analysis. 2001
Xenergy, Oak Ridge and DOE OIT. Assessment of the Market for Compressed Air Efficiency Services

APPENDIX J.
CUSTOMER SURVEY INSTRUMENT

APPENDIX J
DRAFT 11-6-02
CALIFORNIA SMALL/MEDIUM INDUSTRIAL NEEDS AND WANTS STUDY
TELEPHONE SURVEY

Q1. Hello, this is <INTERVIEWER NAME> calling from Quantum Consulting on behalf of the California Public Utilities Commission. May I please speak with the person at this location who is most knowledgeable about decisions affecting your energy using equipment such as lighting, HVAC, and production equipment?

[IF NEEDED:] This is a fact-finding survey only – we are NOT interested in selling anything, and responses will not be connected with your firm in any way. The four investor-owned utilities in California are cooperating on this important study, authorized by the California Public Utilities Commission, to better understand how businesses like yours think about and manage their energy consumption. Your input is very important to the utilities and to the Commission as they look for ways to help you minimize your energy costs. [DO NOT RECORD INFORMATION FOR INDIVIDUAL AT SOME OTHER BUILDING OR LOCATION. WE WANT THE INDIVIDUAL MOST KNOWLEDGEABLE ABOUT THIS LOCATION, EVEN IF BUILDING IS OWNED BY OFF-SITE MANAGER.]

1	Current individual is best contact	Q45
2	Transferred to best contact	Q45
3	Given best contact's name and number	Record for future contact
99	Don't know/refused	Thank & terminate

[WHEN CORRECT RESPONDENT IS ON-LINE (REPEAT **AS NEEDED** WHEN CURRENT INDIVIDUAL IS BEST CONTACT):]
Q2. Hello, this is <INTERVIEWER NAME> calling from Quantum Consulting on behalf of the California Public Utilities Commission. I understand you are the person at this location who is most knowledgeable about decisions affecting energy using equipment, such as lighting, HVAC, motors, and production machinery at this location.

Today we're conducting a very important study on the needs and perceptions of firms like yours, how businesses like yours think about and manage their energy consumption. This survey should take no more than about 15 or 20 minutes, and it's an important opportunity to make sure your views are represented. If you like, we can send you a copy of the final report once it's completed.

Our records show that the address for this business is [ADDRESS.] Is this correct?

IF NOT CORRECT: Could you please tell me the correct address for this business? THEN THANK AND TERMINATE

[IF NEEDED:] Can I confirm that you're responsible for making energy-related decisions for your firm at [ADDRESS]?

[IF NEEDED:] This is a fact-finding survey only – we are NOT interested in selling anything, and responses will not be connected with your firm in any way. [UTILITY] wants to better understand how businesses think about and manage their energy consumption.

[IF NEEDED:] The four investor-owned utilities in California are cooperating on this important study, authorized by the California Public Utilities Commission, to better understand how

businesses like yours think about and manage their energy consumption. Your input is very important to the utilities and to the Commission.

1	Current individual is best contact	Q10
2	Transferred to best contact	Repeat Q2 w/best contact
3	Given best contact's name and number	Record for future contact
99	Don't know/refused	Thank & terminate

Firmographics

I'd like to start with some general questions about your business.

Q10. What is the main activity at your business? [DO NOT READ]

1	Office	T&T
2	Warehouse	T&T
3	Industrial Process/Manufacturing/Assembly	Q22
14	Other (SPECIFY)	T&T
99	DK/Refused	T&T

(IF NOT 3, T&T: We are currently focusing on industrial facilities, and therefore do not wish to continue with the interview at this time. On behalf of [UTILITY], thank you for your time.)

Q22. What is the specific type of manufacturing activity at your facility? [ENTER VERBATIM AND THEN CODE BELOW_____

1	Fruit and vegetable processing	Q83
2	Wine production	Q83
3	Printing and publishing	Q83
4	Metalworking	Q83
5	Computer and peripheral assembly	Q83
6	Computer and peripheral component manufacture	Q83
7	Machine shop/tool and die making	Q83
8	Machinery manufacture	Q83
9	Other _____	T&T
99	Don't know	T&T

(IF Q22 = 9 OR 99, T&T. We are not focusing on your type of facility, and therefore do not wish to continue with the interview at this time. On behalf of [UTILITY], thank you for your time)

Q83. How many of employees does your firm have at this location? [DO NOT READ]

1	1 to 5	Q91
2	6 to 10	Q91
3	11 to 20	Q91
4	21 to 50	Q91
5	51 to 100	Q91
6	Or, over 100	Q91

9	[DO NOT READ:] DK/NA/refused	Q91

Q91. How many locations or separate facilities does your firm have? [DO NOT READ]

1	1	Q10
2	2 to 4	Q90
3	5 to 10	Q90
4	11 to 25	Q90
5	Over 25	Q90
9	[DO NOT READ:] DK/NA/refused	Q90

Q90. And which of the following statements best describes the location of your firm's facilities?

1	Our facilities are concentrated in one part of California	Q97
2	Our facilities are located in various parts of California, but not Outside the state	Q97
3	Our facilities are located both within and outside California	Q97
4	Other (specify) _____	Q97
99	[DO NOT READ:] None of the above	Q97

Q97a. What is the estimated square footage of your facility at this location? _____

IF NECESSARY
Q97b. Would you estimate the total square footage of your facility at this location to be …? [READ]

1	Less than 2,500 square feet	Q98
2	2,500 but less than 5,000 square feet	Q98
3	5,000 but less than 10,000 square feet	Q98
4	10,000 but less than 20,000 square feet	Q98
5	20,000 but less than 50,000 square feet	Q98
6	50,000 but less than 100,000 square feet	Q98
7	Greater than 100,000 square feet	Q98
8	Ag/Non-facility – Outdoors	Q98
99	Don't know	Q98

Q98. Thinking about your facility's production this year compared to last year, would you say that this year's production is:

1	More than last year	WN1
2	Less than last year	WN1
3	About the same	WN1
99	Don't know	WN1

Wants and Needs

WN1. On a 1 to 10 scale, where 1 means you NOT AT ALL IMPORTANT and 10 means VERY IMPORTANT, how important are each of the following to your business. [RANDOMIZE, READ AND OBTAIN A RATING FOR 5 OF THE 9 STATEMENTS.]

1	Maintaining product quality and consistency	WN5
2	Meeting your production schedule	WN5
3	Meeting regulatory requirements	WN5
4	Keeping up technologically with competitors	WN5
5	Keeping up with new or shifting market demands	WN5
6	Having a reliable, high quality supply of electricity	WN5
7	Maintaining your market niche	WN5
8	Maintaining a happy and productive staff	WN5
9	Identifying and implementing cost saving measures	WN5

WN5. What other factors do you consider to be very important to your business?
_____

WN15. What are the primary factors that may prevent your firm from implementing cost-saving measures? _____

WN20. On the same 1 to 10 scale, where 1 means you NOT AT ALL IMPORTANT and 10 means VERY IMPORTANT, please rank the likelihood of your firm implementing each of the following cost saving measures [RANDOMIZE, READ AND OBTAIN A RATING FOR EACH.]

1	Extend or shorten production schedule	Q23
2	Shift production schedule	Q23
3	Make use of best industry practices/training to improve productivity	Q23
4	Purchase equipment to improve productivity	Q23
5	Implement energy conservation	Q23
6	Layoffs and other staffing-based considerations	Q23
7	Downsize our production facility	Q23

Energy Firmographics

Q23a. What percentage of your operating costs does energy (excluding vehicle fuels) account for?
_____

IF NECESSARY
Q97b. Would you estimate the percentage of your operating costs accounted for by energy to be …? [READ]

1	Less than 1 percent	Q24
2	1 but less than 2 percent	Q24
3	2 but less than 3 percent	Q24
4	3 but less than 4 percent	Q24
5	4 but less than 5 percent	Q24
6	5 but less than 6 percent	Q24
7	6 but less than 10 percent	Q24
8	10 to 15 percent	Q24
9	16 to 25 percent	Q24
10	26 to 50 percent	Q24

11	Over 51 percent	Q24
88	Refused	Q24
99	Don't know	Q24

Q24. Of your annual energy bill, what percentage would you say is attributable to:

1	Electricity	Q25
2	Natural Gas	Q25
3	LP Gas	Q25
4	Fuel Oil/Other	Q25

Q25. What are your two biggest uses of electricity? (READ)

1	Lighting	Q25a
2	Space Cooling/heating	Q25a
3	Ventilation	Q25a
4	Production machinery	Q25a
5	Motors	Q25a
6	Compressors	Q25a
7	Pumps	Q25a
8	Process heat (including cooking/food processing)	Q25a
9	Fans/blowers	Q25a
10	Refrigeration	Q25a
11	Production tools	Q25a
12	Process or hydro cooling	Q25a
13	Other (Specify) [COLLECT MULTIPLE RESPONSES]	Q25a
88	Refused	Q25a
99	Don't know	Q25a

Q26. (IF NATURAL GAS IN Q24>0: What are your two biggest uses of gas(READ)

1	Space Heating	aQ27
2	Space Cooling	Q27
3	Direct Process heat	Q27
4	Indirect Process heat (steam)	Q27
5	Cogeneration	Q27
6	Other (Specify)	Q27
88	Refused	Q27
99	Don't know	Q27

Next I would like to talk about your facility's production schedule.

Q27. Approximately how many months a year does your facility produce its output?

1	1 or less	Q28
2	2	Q28
3	3	Q28
4	4	Q28
5	5	Q28

6	6	Q28
7	7	Q28
8	8	Q28
9	9	Q28
10	10	Q28
11	11	Q28
12	12	Q28
88	Refused	Q28
99	Don't know	Q28

Q28. What are the months of peak production? CHECK ALL THAT APPLY; 13 IF SAME ALL YEAR

1	January	Q29
2	February	Q29
3	March	Q29
4	April	Q29
5	May	Q29
6	June	Q29
7	July	Q29
8	August	Q29
9	September	Q29
10	October	Q29
11	November	Q29
12	December	Q29
13	Same all year	Q29
88	Refused	Q29
99	Don't know	Q29

Q29. During those months, how many hours do you typically operate:

On weekdays _____ hours IF Q28 =13, THEN CON10
On Saturdays _____ hours IF Q28 =13, THEN CON10
On Sundays _____ hours IF Q28 =13, THEN CON10

Q30. During the rest of the year, how many hours do you typically operate:

On weekdays _____ hours CON10
On Saturdays _____ hours CON10
On Sundays _____ hours CON10

Conservation

Next, I'm going to ask you about actions that your business may have taken to reduce or manage your energy use.

CON10. Other than installing new equipment, have you taken any energy conservation actions over the past year to reduce your overall energy use, such as routinely turning off lights or production equipment or setting the thermostat higher when using the air conditioning?

1	Yes	CON20
2	No	HE10
88	Refused	HE10
99	Don't know	HE10

CON20. What energy conservation actions have you taken **in the part of your facility where production takes place**? [RANDOMIZE, READ. SELECT ALL THAT APPLY]

1	Turn off production equipment when not in not in use at night and during the weekend	CON25
2	Turn off production equipment when not in use during the day	CON25
3	Schedule high electrical energy-use processes during off-peak periods where feasible.	CON25
4	Turn off any lights that are not being used	CON25
5	Modified our production process to use less energy	
6	Set thermostats lower when heating and higher when using the air conditioning	CON25
17	Other (SPECIFY)	CON25

CON25. By about how much have these conservation actions reduced your overall energy usage? [DO NOT READ]

1	0 to 5 percent	CON30
2	6 to 10 percent	CON30
3	11 to 15 percent	CON30
4	16 to 20 percent	CON30
5	21 to 30 percent	CON30
6	More than 30 percent	CON30
88	Refused	CON30
99	Don't know	CON30

CON30. What were the most important reasons that you took energy conservation actions to reduce your energy use? [ACCEPT MULTIPLES; DO NOT READ]

1	Lower energy (operating) cost	HE10
2	Shift load to off-peak ours	HE10
3	Help avoid blackouts	HE10
4	None	HE10
66	Energy crisis (general, including "civic duty" type responses)	HE10
5	Other (Specify) ___	HE10
99	Don't Know	HE10

HE Equipment

Next we're going to talk about another way that businesses can reduce their energy use -- by installing more energy efficient equipment.

HE5. Have you installed any high efficiency equipment at your facility in the past 24 months?

1	Yes	HE10
2	No	HE20
88	Refused	HE20
99	Don't know	HE20

HE10. For each of the following types of high efficiency equipment, please tell me a) whether you installed it, and b) if not, whether you are likely to install it within the next 24 months.

		HE 10. Installed	HE20. Likely to Install

IF Q25 = 1

1	High Efficiency Lighting		

IF Q25 = 10

2	High Efficiency Refrigeration:		

IF Q25 = 10 AND HE10 or 20/2 = YES What measures did you install/are you planning to install? (ENTER ALL THAT APPLY)

3	(SPECIFY)		
4	(SPECIFY)		
5	(SPECIFY)		
6	Other		

IF Q25 = 4 or 11

7	High Efficiency Industrial Machinery or Equipment		

IF Q25 = 4 or 11 AND HE10/7 = YES What measures did you install/are you planning to install? (ENTER ALL THAT APPLY)

8	(SPECIFY)		
9	(SPECIFY)		
10	(SPECIFY)		
11	(SPECIFY)		
12	(SPECIFY)		
13	(SPECIFY)		
14	(SPECIFY)		

IF Q25 = 2

15	High Efficiency HVAC		

IF Q25 = 2 AND HE10/15 = YES What measures did you install/are you planning to install? (ENTER ALL THAT APPLY)

16	High efficiency AC		
17	Energy Management System		

18	HE Gas Furnace		
19	HE Boiler		

HE20. Next I would like to ask you about new production technologies for your industry. Are you aware of any specific new technologies for the [INDUSTRY] industry?

1	Yes	HE21
2	No	Q50
88	Refused	Q50
99	Don't know	Q50

HE 21. Technology 1: _____

HE21a. How did you learn about this new technology? [ENTER VERBATIM]

HE21b. Have you installed this new technology?

1	Yes	HE22
2	No	HE21c

HE21c. Are you considering doing so?

1	Yes	HE22
2	No	HE22

HE22. Are you aware of any other new technologies for your industry?

Technology 2: : _____

HE22a. How did you learn about this new technology? [ENTER VERBATIM]

HE22b. Have you installed this new technology?

1	Yes	Q50
2	No	HE22c

HE22c. Are you considering doing so?

1	Yes	Q50
2	No	Q50

IF HE5 =NO AND HE21b=NO AND HE22b=NO, GO TO DM2.

Q50. What were the most important reasons that you installed high efficiency equipment or new technologies? [DO NOT READ. ACCEPT MULTIPLES]

Q50		
1	Lower energy (operating) cost	BR40
2	Enhance productivity	BR40
3	Improve quality of worker environment	BR40
4	Improve product quality or consistency	BR40
5	Reduce organization's environmental impact	BR40

6	Reduce downtime	BR40
7	Company policy	BR40
8	Recommended by contractor	BR40
9	NONE	BR40
77	Other (Specify) ___	BR40
88	Don't Know	BR40
99	Refused	BR40

BR40. Who were the most important sources of information and influence in helping you make the decision to install this equipment? [DO NOT READ. ACCEPT MULTIPLES]

1	Contractors (e.g., lighting, HVAC, motors)	DM2
2	Energy Service Companies, often referred to as ESCOs	DM2
3	Your electric utility (e.g., PG&E, SCE, SDG&E)	DM2
4	Equipment manufacturers	DM2
5	Corporate decision	DM2
6	Made decision on my own	DM2
7	In-house staff	DM2
8	Design engineers	DM2
9	Equipment vendors	DM2
77	Other_____	DM2
99	Don't Know/ Refused	DM2

DM2. Does your organization have a policy to buy high efficiency rather than standard-efficiency versions of energy using equipment? (INTERVIEWER NOTE: For example, a policy requiring all new fluorescent lighting systems to be T8 lamps with electronic ballasts, or that all new motors be premium efficiency).

1	Yes	Q60
2	No	Q60
99	DK/NA/Refused	Q60

Q60. Is there someone on staff (including yourself) whose job specifically covers energy management and controlling energy costs?

1	No one	Q65
2	Me	Q65
3	Someone else	Q65

Q65. Is there someone on staff (including yourself) who you would describe as an energy guru or expert?

1	No one	Q70
2	Me	Q70
3	Someone else	Q70

Q70. Which aspects of facility maintenance, if any, are you contracting out or outsourcing, such

as HVAC or production equipment maintenance? (DO NOT READ; SELECT ALL THAT APPLY)

1	Refrigeration equipment maintenance	Q75
2	Production equipment maintenance	Q75
3	Motor/compressor/pump maintenance	Q75
4	HVAC maintenance	Q75
5	Lighting maintenance	Q75
6	Overall facility maintenance	Q75
7	Other (specify)	Q75

Q75. I would like to ask how decisions regarding the purchase of production equipment are made. I'm going to read a list of decision descriptions and I would like to know which statement best describes how each decision is made at your firm.

1	I make the decision on my own	T1
2	I make the decision with input from other members of a group or committee	T1
3	The decision is completely a group or committee action	T1
4	Someone else makes recommendations but I make the final decision	T1
5	I make recommendations but someone else makes the final decision	Q77
6	None of the above (Please describe the process)	T1

Q77. (IF Q75 = 5) How often are your recommendations regarding the purchase of production equipment followed?

1	Always	T1
2	Most of the time	T1
3	Some of the time	T1
4	Rarely or never	T1
99	DK/REFUSED	T1

Barriers

T1. Now I'd like to read a brief series of statements and I'd like you to tell me how well each statement describes your beliefs about energy efficient investments. We'll again use a 1-to-10 scale, where 1 means you DON'T AGREE AT ALL with the statement, and 10 means you AGREE COMPLETELY with the statement. The first/next one is … [RANDOMIZE, READ AND OBTAIN A RATING FOR 6 of the 12. WHEN SEQUENCE COMPLETE, GO TO T5.]

1	When considering a new energy efficiency investment, I am concerned that the actual bill savings will be less than what was estimated.	T5
2	In the current business climate, I don't see much point in making investments in energy efficiency.	T5
3	I don't have the information I need to make an informed decision about energy efficient investments.	T5
4	I'd rather improve energy efficiency by properly adjusting existing systems instead of buying new equipment	T5

5	I feel uncertain about the reliability of information provided by non-utility firms proposing energy-efficient investments for my business.	T5
6	I am satisfied with the energy conservation decisions I have made in my business.	T5
7	There is too much time and hassle involved in selecting a qualified energy efficiency contractor.	T5
8	Lack of financing is a barrier to our organization making energy efficiency investments that we want to make.	T5
9	People who try to sell me energy efficiency investments are just out to advance their own self- interest.	T5
10	The added cost of energy efficient equipment is more than we can afford.	T5
12	Trying to install energy efficient equipment would lead to excessive downtime for my production line.	T5

EFFICIENCY OFFERS

T5. Which of the following kinds of companies do you typically use to implement changes to your production process or facility that would affect your energy usage? (READ)

1	Consultants	T10
2	Architect/engineering companies	T10
3	Equipment vendors	T10
4	Installation contractors	T10
5	Energy service companies (ESCOs)/ESPs	T10
6	Utilities	T10
7	Manufacturers representative	T10
8	Others (specify)	T10

Information Sources & Program/Web Awareness

T10. If you needed help or information related to energy efficiency or energy conservation, what types of companies or organizations would you be most likely to call on for assistance:

[[DO NOT READ. ACCEPT MULTIPLES , Enter Verbatim, Upcode afterwards]

1	Engineering / Architectural Design Firms	T7
2	Energy Equipment Contractors and Installers (e.g., lighting, HVAC)	T7
3	Energy Service Companies, often referred to as ESCOs or ESPs	T7
4	Your electric distribution company (e.g., PG&E, SCE, SDG&E)	T7
5	Companies, **besides your electric distribution company**, that provide electricity supply, referred to also as ESPs (Energy Service Providers)	T7
6	Building operations and maintenance companies	T7
7	Equipment manufacturers	T7
8	State agencies like the California Public Utilities Commission	T7

9	Internal – Facilities Manager/Custodial	T7
77	Other_____	T7
99	[DON'T READ] Don't Know/ Refused	T7

T7. Using a 1 to 10 scale, where 1 is NOT AT ALL HELPFUL and 10 is EXTREMELY helpful, how helpful would you say that your utility is in providing support for your energy efficiency decisions and actions?

1		CB2

CB2. Is your business a member of a trade or industry organization?

1	Yes	CB3
2	No	CB3
88	Refused	CB3
99	Don't know	CB3

CB3. How effective do you think these trade groups are as a source of information on conservation, energy efficiency, and coping with the energy crisis? Would you say they are…..

1	Very effective	CB4
2	Somewhat effective	CB4
3	Not at all effective	Q93a
88	Refused	Q93a
99	Don't know	Q93a

IF CB3 =1 or 2

CB4. What organization or organizations that you belong to are you be most likely to trust as a source of information on energy-related matters? (Enter verbatim)

_____1_____		Q93a

Q93a. If you were looking for information on how to reduce energy usage at your business, in what form would you prefer to receive energy-related information? (Do not read, accept multiple)

1	Internet	Q95
2	Printed materials (i.e. brochures and guidebooks)	Q95
3	Phone conversation	Q95
4	In person conversation	Q95
5	Group setting (i.e. seminar)	Q95
6	Email	Q95
77	Other (specify) _____	Q95
88	Refused	Q95
99	Don't know	Q95

Q95. Are you aware of any programs or resources provided by [UTILITY] in 2001 or 2002 that were designed to promote energy efficiency for businesses like yours?

1	Yes	Q95YES
2	No, not aware of any programs	Q95a
99	Refused/Don't know	Q95a

IF YES to Q95

Q95YES. What types of programs can you recall? [RECORD ALL MENTIONS.]

1	SPC / Standard Performance Contracting	Q95a
2	Business energy audits	Q95a
3	Distributor incentives	Q95a
4	Express Efficiency	Q95a
5	Rebates/incentives (non-specific)	Q95a
77	Other programs [SPECIFY:]_____	Q95a
88	Don't know	Q95a
98	No, not aware of any programs	Q95a
99	DK/refused	Q95a

Q93. Has your firm ever used the internet or the Web to obtain information about or purchase energy-related products and services?

1	Yes	Q94a
2	No	Q98
9	DK/NA	Q98

IF Q93 = 1

Q94. Have you used your utility's website?

Q98. What information or services would you like to see on online that would help you make decisions related to your organization's use of energy?

1	None	Q96
2	Don't use computer/go online	Q96
3	Enter information here	Q96
4	Refused/DK	Q96

Q96. During the last two years, did this facility participate in any energy efficiency programs offered by [UTILITY]? [RECORD ALL MENTIONS]

1	Yes, Express Efficiency	Q96a
2	Yes, SPC/Standard Performance Contracting	Q96a
3	Yes, energy audits	Q96a
4	Yes, other [SPECIFY:] _____	Q96a

5	No, did NOT participate in other programs	Q83
99	DK/refused/no more	Q83

IF Q96 = 1-4

Q96a. How did you hear about these programs?
[DO NOT READ CATEGORIES, INDICATE UP TO 3 RESPONSES]

1	Utility Bill inserts	Q83
2	Utility Mailing	Q83
3	Utility rep	Q83
4	Utility Walk thru representative	Q83
5	Radio advertising	Q83
6	Television advertising	Q83
7	Newspaper or magazine advertising	Q83
8	Newspaper articles	Q83
9	Word of mouth from friends/family/coworkers	Q83
10	Previous participant	Q83
11	Information from state agencies	Q83
12	Contractor/AC Person	Q83
13	Another utility's DLC program	Q83
77	Other: _____	Q83
88	Refused	Q83
99	Don't Know	Q83

Q83. And finally, based on what we've discussed today, what other comments or suggestions do you have regarding energy-efficient products and practices, or utility programs that support energy efficiency? [RECORD VERBATIM]

May I please record your name, simply for verification purposes – a supervisor will confirm a small percentage of the interviews I've done.

Thank you very much for your participation in this very important survey, you've been extremely helpful. I hope you found the process interesting and enjoyable. Thanks again, and have a great day.

APPENDIX K.
SUPPLIER INTERVIEW GUIDE

APPENDIX K
PG&E Small Industrial Customer Wants and Needs Study
Supplier Interview Guide – Draft 12-2

I. INTRO AND SCREENER

Hello, this is <INTERVIEWER NAME> calling from Quantum Consulting on behalf of the California Public Utilities Commission. May I please speak with the person at this location who is most knowledgeable about your company's sales to small and medium sized industrial customers?

(IF NEEDED) This is a fact-finding survey only – we are NOT interested in selling anything, and responses will not be connected with your firm in any way. The CPUC and the California utilities want to better understand how businesses like yours market their equipment and services to small and medium sized industrial customers, and the overall business concerns of both suppliers and buyers. Your input will help the utilities as they look for ways to design programs that can help small industrial companies minimize their energy costs.

Since we know your time is very valuable, we will provide you a $50 check as a token of our appreciation. The survey should take no more than 20-25 minutes.

Is now a good time, or would you like to schedule a time when we can talk?

S1. Will you be able to participate in this survey? Y/N _____

[IF NECESSARY] I want to emphasize that the information you provide is strictly confidential.

If now is a good time, I'd like to run through the survey with you

1a. What types of industries (businesses) do you offer services to?

1b. Thinking about the industrial customers that you serve, what types of equipment do you service and maintain?

II. GENERAL INFORMATION ABOUT YOU AND YOUR COMPANY

I'd like to start with some general information about you and your company.

1. About how many full-time employees does your company employ?
   - Overall?
   - At this location?
   - In other California locations?
2. How do you define your company's business? (probe for product line, target market, geographic coverage)

What percentage of your sales would you say are made to small and medium-sized industrial facilities, if we define those as having fewer than 50 employees?

III. STRUCTURE OF THE MARKET

We are particularly interested in the way that small and medium sized industrial customers make purchase decisions.

1. Thinking about the business you do with those customer, about what percentage of that business is:
    - Plant expansion or new construction
    - Retrofit/replacement of existing equipment
    - Repair or servicing of existing equipment
2. Compared to large customers in the same industry, are these small customers more likely to depend on you for assistance in selecting equipment or designing a production line? IF NO: Who provides those services, or what in-house resources do small customers use?
3. In the past year, what percentage of your sales to small and mid size industrial customers for retrofit/replacement were made through each of the following?

    Retrofit/replacement

    Competitive bid (%)
    Established relationships(%)
    Other(%)

3a. Are there any differences for expansion or new construction projects?

4. Who are the most important players in the equipment selection process in retrofit projects for small customers? Why is that? [Probes: owner, engineer, plant manager, contractor (ie your company), engineer]

IV. BUSINESS PRACTICES AND MARKET TRENDS

Next I would like to ask you about the factors that influence how your firm does business and markets its products and services, including the extent to which you promote energy efficient equipment such as adjustable speed drives for motors, high efficiency pumps and compressors, and HVAC equipment with high EERs.

1. What things do your small industrial customers ask for when they're buying XXX equipment? (Probe for price, availability, brand, warranty, financing, operating cost, energy efficiency) If more than one, which is the most important?
2. To what extent do practices and trends in large companies in the industry influence the practices and equipment selection of smaller firms? Do large firms have the same criteria? Is your sales approach different for small vs large industrial customers?
3. What percentage of your sales to small industrial customers are of high efficiency models of the equipment you sell? How does this differ from the percentage of high efficiency sales to large industrial customers? If they differ, why?

4. Among small customers, what distinguishes those who do select high efficiency from those who do not? (Probe for financial resources, owner involvement, use of consulting engineers, presence of energy guru.)
5. What are some of the leading edge technologies being incorporated into XXX equipment that you sell to industrial customers in California? To what extent are

those technologies being adopted by large customers? By small customers? What's driving those adoption decisions?

6. What payback do your customers require on equipment they purchase?

V. ROLE OF ENERGY EFFICIENCY

1. If you needed help or information related to energy efficiency or energy conservation, what types of companies or organizations would you be most likely to call on for assistance?
2. In the course of selling, bidding, or making recommendations to small industrial customers, how frequently do you take steps to promote energy efficient equipment?

   Almost never
   Less than half the time
   About half the time
   More than half the time
   Almost always

3. How does this compare with your promotion of EE equipment to large customers in the same industry? Why are they/are they not different?
4. [IF PROMOTE AT LEAST HALF THE TIME] What aspects of energy efficient XXX equipment do you stress in your promotion efforts. ? (Probe for overall quality, bill savings, EE label or rating, warranty, performance, rebates/pricing, environmental benefits) If more than one, which is the most important?
5. [IF PROMOTE NEVER OR < HALF THE TIME] What are the main reasons that you rarely or never promote energy efficient XXX equipment to small customers? Would the availability of utility rebates make you more likely to promote such equipment?

VI. BARRIERS, INTERVENTIONS, AND INFORMATION SOURCES

1. We are also interested in some of the obstacles to energy efficiency and how you view programs that utilities and others may have used to promote energy efficient equipment. What do you see as the most significant obstacles to the purchase of energy efficient processes and equipment by small industrial users of XXX equipment? How do these obstacles differ from those for purchases by larger users in the same industry?
2. What, in your opinion, are the most effective ways of overcoming these obstacles for small customers? Why are those the most effective?
3. What specific program features do you think would be most effective in helping your company promote energy efficient equipment to small industrial customers? [Probe for other features in addition to rebates: training, design assistance, information, case studies.] Why do you say that?

VII. MAINTENANCE AGREEMENTS

IF APPROPRIATE: Finally, we are interested in the role of maintenance contracts for small industrial customers.

1. Approximately what percentage of your small industrial customers have a service contract or maintenance agreement with you? (%)

2. [IF Q1 > 0] What are the main reasons those customers entered into a service contract ? (e.g., reliability, desire for stable maintenance expenses)
3. [IF Q1 <100%] What are the main reasons other customers don't have service contracts?
4. Is there anything you'd like to add regarding small industrial customer energy efficiency from your perspective?

Interviewee Information

Please provide the name to whom the $50 check should be made payable below.

Company
Name
Title
Address
City
Zip
Phone
Date of Interview

You should receive the $50 check within 2-3 weeks.