COMMERCIAL/INDUSTRIAL MARKET EFFECTS BASELINE STUDY

FINAL

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1. EXECUTIVE SUMMARY

1.1 Study Objective and Methods

This report presents the results of the Commercial/Industrial Market Effects Baseline study, focusing on the markets for packaged air conditioning and motors. The objective of this study was to characterize the current markets for packaged air conditioning and motors, including both a qualitative description of the market -- in terms of its structure, players and information flows -- and a quantitative assessment – in terms of the share of efficient technologies as well as of the status of current indicators of attitudes and perceived market barriers. As such, it provides a basis for comparison to future, post-intervention characterizations of the market.

The study focused on two markets, narrowly defined both to tailor the scope of the required data collection effort to the available budget and because each was felt to be representative of the broader HVAC and motors markets. For ***motors***, the analysis focused on motors between 10 and 100 hp used for non-OEM applications (that is, motors that were purchased by end users rather than original equipment manufacturers). For ***air conditioners***, the analysis focused on packaged air conditioning systems used by commercial customers in the school, university, hospital, and office segments.

The framework for the current study as well as anticipated future market effects studies is inspired by the initial Scoping Study by Eto, et. al. There are three basic components to this theoretical framework and to the future study: program interventions, customer perceptions of market barriers, and customer actions or intentions. Data were collected on each of these components, and results were analyzed to determine the interrelationships among them. The same data were collected for a comparison territory with no program in place or anticipated, in this case the area in Northern Illinois served by Commonwealth Edison.

Preliminary analysis for the study included a literature review, interviews with key PG&E staff, and focus groups with motor distributors and HVAC dealers. Primary data collection activities included surveys of packaged AC and motors end users within PG&E service territory and with a control group of customers outside PG&E's service territory. Interviews were also conducted with equipment vendors, architectural and engineering firms, and Energy Service Companies (ESCOs).

PG&E's customer lists and secondary data sources were used to generate appropriate sampling frames within and outside PG&E's service territory. Separate sample frames were designed for the AC and motors customer surveys; the samples were drawn based upon SIC code and rate class to identify a sample of customers who are likely to face the technology purchase decisions relevant to this study. The samples in the non-PG&E territory were then designed to mirror, as closely as possible, the characteristics of the PG&E market.

Exhibit 1-1 - Data Collection Activities

	Within PG&E Service Territory	Outside PG&E Service Territory
Staff Interviews	4	
Motor End Users	100	100
HVAC End Users	200	100
Motor Vendors	2 Focus Groups	20
HVAC Vendors	2 Focus Groups	25
Architects and Engineers	15	10
ESCOs	10	

1.2 RESULTS – PACKAGED AC MARKET

1.2.1 Baseline Market Structure and Information Flows

All of the major national **manufacturers** of packaged air conditioning units are represented in the Northern California market, and several have manufacturing/assembly facilities in the region. The dealers and distributors in several focus groups describe the manufacturers with whom they work as helpful, but not extremely active in promoting high efficiency central air conditioners (HECACs).

Manufacturers sell through a network of **distributors**, although some of those distributors are "captive" – that is, they are owned by the manufacturer and only sell a single manufacturer's products. Within PG&E's service territory there are a total of 47 firms classified as AC distributors by Dun & Bradstreet (D&B). Distributors provide the stocking function for AC units other than the most popular models, which may also be stocked by contractors. Distributors adjust their stocking levels and product mix to the current and expected demand for specific types of units from contractors; if demand for HECAC models is consistent, the distributor's inventory levels should be of sufficient breadth and depth to accommodate the need for almost any type of efficient equipment. Distributors are leery, however, of being stuck with high efficiency models that can be difficult to move when utility programs are cut back or eliminated.

Contractors provide the retail sales function in the market for packaged commercial air conditioners. These are numerous and diverse; in Northern California, there are more than 300 HVAC contractors, ranging in size from one-person operations to companies with more than 50 employees. Most of these specialize in residential installations, but even residential contractors typically do some commercial business.

Participants in two focus groups conducted with commercial HVAC contractors in PG&E's service territory complained that they are often isolated from the end user of the equipment they sell by third-party designers or predetermined specifications, yet customer surveys found that contractors play a major role in determining the type and efficiency of equipment installed. In PG&E's territory, over 37 percent of customers cited contractor advertising or sales calls as their primary source of information regarding trends in air conditioning technology. Moreover, contractors were most often cited as "having the greatest influence on the type of air conditioning unit selected" (28.2 percent of customers). In the no-program territory, 40.8 percent of respondents relied on contractor advertising and sales calls to keep up with technology, and 35.2 percent cited contractors as likely to have the greatest influence on the type of HVAC equipment selected.

Design professionals, including both consulting engineers and architectural firms, are involved in the AC market to the extent that they specify the size, type, and efficiency of equipment to be installed (On average, A&E firms reported that about 55 percent of their projects include HVAC specifications.) A&E firms often specify equipment to be installed in the new construction market; they are less influential in the replacement market. Among surveyed customers in PG&E's service territory, only 10 percent said that a consulting engineer or architect would have the greatest influence on the type of equipment selected; in the no-program territory, this figure was higher (16 percent), but still far below the level of influence attributed to contractors.

Energy Service Company (ESCO) involvement in the packaged AC market generally comes about as part of a larger, comprehensive energy project. Despite the broad capabilities that ESCOs offer, their role in the market for packaged air conditioning is still relatively limited. Among both PG&E customers and those in the comparison territory, just over 10 percent reported having used the services of an ESCO to install new packaged air conditioning equipment. Among those who had not used an ESCO, about 11 percent of both the in-territory and out-of-territory respondents reported having been contacted by an ESCO to install a new cooling system.

In discussing the market for HECAC, HVAC dealers who participated in the focus groups described the relevant market primarily in terms of the likelihood of different types of **customers** to respond favorably to recommendations or options for the purchase and installation of HECACs, as follows:

- Retailers (including banks) are poor prospects. Most do not pay for the purchase and installation of their HVAC equipment. The owners of their buildings do not see HECACs as being of value in attracting or retaining tenants.

- School districts have recently been changing from central HVAC systems to dispersed systems. In this transition, they have been installing relatively low-grade equipment, consistent with buying as cheaply as possible.

- Start-up companies are focused on keeping immediate costs under control rather than with longer-term benefits.

- Customers who wait for equipment to break down before investing in upkeep activities tend to be interested in the least-complicated, least-expensive solution to their immediate problem.

- General contractors most commonly seek equipment with the lowest first cost and also avoid any solutions that might increase labor costs or time to project completion.

- In contrast, architects and engineers are generally more willing to consider options and to initiate discussions of energy efficiency. However, architects remain prone to oversizing units to reduce the likelihood of complaints about cooling power.

- Decision-makers in larger corporations are more responsive than others to issues of energy efficiency, but they are also interested in increasing standardization of equipment (which can work against efficient solutions) and in reducing risk (which can increase the use of efficient equipment with longer warranties.)

These and other customer segments obtain information regarding energy using technologies from a wide range of sources. Approximately 11 percent of PG&E customers and 14 percent in the no-program territory consider colleagues and friends their most important information source. PG&E customers were more likely to rely on professional associations and conferences to keep up with HVAC trends than their no-program territory counterparts (16.6 percent vs. 6.2 percent) and less likely to rely on trade magazines focused on either their business or facilities management (6.2 for PG&E; 19.4 percent for the no-program area). And while less than 2 percent mentioned PG&E as their primary source of information, the utility was not mentioned at all in the no-program territory.

1.2.2 Baseline Product/Efficiency Mix

Among the customers surveyed, 22.5 percent of PG&E customers and 23.4 percent of no-program territory customers had replaced packaged air conditioning units since January 1, 1996. These numbers are consistent with replacement rates of about 10 percent per annum and an annual commercial replacement market in Northern California of some 232,000 tons (2.3 million tons of packaged AC capacity x 10 percent) or about 46,000 units averaging 5 tons.

Given the relatively small sample size and the difficulty of collecting and verifying efficiency information from customers, survey respondents were asked about the efficiency level they would purchase if they were purchasing a unit right now: standard efficiency, above average efficiency, or very high efficiency. PG&E customers were significantly less likely state they would install standard efficiency and significantly more likely to state that they would install very high efficiency units.

The proportion of high efficiency air conditioning units was also estimated from surveys of HVAC contractors and design firms.

- Among HVAC contractors, an estimated 42 percent of units (weighted by percentage of sales) were high efficient, compared to 49 percent for the Northern Illinois comparison territory. Because in-territory respondents for these questions were limited to those

firms who attended the focus group and who filled out a questionnaire, the statistical significance of these results is quite limited.

- Among A&E firms, the proportion of energy efficient units specified in 1997 was higher in PG&E territory than in the comparison territory (86 percent vs 70.5 percent, although the difference is not statistically significant). The percentage of units for which energy management systems were specified was also higher in PG&E territory (39 percent vs 26 percent). The proportion of high efficiency installations specified by California architects and engineers has been influenced by the existence of utility programs as well as by state building standards (Title 24).

1.2.3 Baseline Practices/barriers

Both focus groups and telephone surveys/interviews provided insights into current practices and the overall level and types of barriers to HECAC as perceived by vendors. Vendors reported that several changes in the market in Northern California can be seen over the past 4-5 years, and several factors have remained constant. The changes include greater availability, lower incremental cost, increased customer awareness of an interest in energy-efficient options, and longer equipment warranties. The HVAC marketers attribute these changes to General market conditions (e.g., a construction boom in the region, renovations sparked by the anticipation of El Niño); California's Title 21, manufacturer promotions, and PG&E's rebate program, which has been of considerable assistance to proactive HVAC contractors by allowing customers to overcome barriers to financing as well as increasing customer awareness.

However, according to focus group participants, the critical split incentive barrier has not changed in any way. Finally, other hypothesized barriers, such as the concern about hidden costs of premium equipment were not considered an issue.

1.2.4 Baseline Market Barriers, Program Exposure, and Purchase Intentions

The relationship between program exposure and barriers was investigated using standard bivariate analysis, factor analysis, and structural equation modeling (SEM). Data collected on three types of variables were used in the analysis.

- A total of 30 questions addressing 10 **market barriers** identified by focus groups were asked of each respondent.

- Measures of **program exposure** included whether or not the customer was served by PG&E, how often a customer had had contact with their utility by phone or in person in the last year and (within the PG&E territory) which programs they had participated in.

- The **purchase intentions** variable consisted of a question that asked the respondent what type of air conditioner their company would purchase today: 1) standard efficiency, 2) above average efficiency, and 3) very high efficiency.

The analysis of customer-perceived market barriers to the installation of energy-efficient air conditioners revealed seven barrier factors:

- Financial Focus,
- Hassle Avoidance,

- Split Incentives,
- Operations Focus,
- Technical Ignorance,
- Suspicion, and
- Analytic Orientation.

The factors, while identifiable as separate dimensions, were still substantially correlated. The means and variances of these barrier factors differed across territories, although the differences in the means were small. The means outside of PG&E territory were consistently higher for all but one barrier than those in the territory.

Using the continuous versions of PG&E program exposure variables revealed consistently negative correlations between them and market barriers. The highest correlations (statistically significant with probabilities less than .05) were Exposure with:

- Split Incentives (-.131)
- Financial Focus (-.128)

Four of the seven market barriers were correlated with Purchase Intentions (intentions concerning level of efficiency to be installed) at statistically significant levels:

- Split Incentives (-.143)
- Financial Focus (-.189)
- Hassle Avoidance (-.153)
- Technological Ignorance (-.167).

Entry of these barriers into a standard linear **regression** model resulted in explaining five percent of the variance in Purchase Intentions.

Structural Equation Modeling provided somewhat different, but consistent results compared to the bivariate and standard regression techniques. This approach required removing substantial redundancy in the measurement of the barriers. It also required increasing the consistency of the performance of latent construct indicators in terms of their correlations with the dependent variable. These increases in consistency resulted in two barrier constructs that could be tested in a model. The barriers considered were:

- Financial Risk and
- Short-Term Orientation

These two barrier constructs were tested as mediating variables between the construct of Exposure and Purchase Intentions. The model showed a good fit with the covariance matrix (chi-square probability =.55, GFI, AGFI, NFI, and NNFI were all over .94.) The results of the model showed:

- Exposure to PG&E programs over time most influences perceived Financial Risks (standardized coefficient =-.34)
- Exposure had a smaller effect on STO (standardized coefficient =-.15)
- STO had a larger effect on Intentions (-.27) than on
- Financial Risk (-.09).

An implication of this finding is that the program had the most impact on perception of financial risks, but short-term orientation had a bigger impact on Purchase Intentions. Overall, the analysis of customer-based measures of market barriers and Purchase Intentions showed:

- There are several identifiable market barriers experienced at the customer level, and the barriers are intercorrelated,

- There are small but consistent effects of PG&E programs on barriers,

- There are small but consistent effects of barriers on Purchase Intentions,

- The most consistent barriers across analyses show customers to be concerned with financial issues and with the fact that they don't have the time or expertise to give energy-efficiency much consideration. This is underlined by a demarcation between companies that operate on a short-term or a long-term orientation, with those whose orientation is short term showing less intention of purchasing more energy efficient air conditioners.

Since all relations were in the appropriate direction for every analysis conducted for this report, there is reason to have some confidence that the effects are real, if small. The size of the effects may be related to several factors.

- First, the dependent variable was not the ultimate variable of most interest: purchase behavior.

- Second, the PG&E programs under consideration were not designed to change the way commercial and industrial customers think about energy-efficiency decisions. These analyses were presented primarily for illustrative purposes, and would be expected to show stronger effects for programs with a more explicit market transformation focus.

1.3 RESULTS - CHARACTERIZATION OF MOTORS MARKET

1.3.1 Baseline Market Size and Structure

Motors are used in nearly every type of equipment application in the United States. In the US industrial sector, more than 70 percent of all electricity consumption involves motors. Most of the cost of electricity for manufacturing is associated with pumps, fan and blower systems, and air compression units. While motors are sold in hp ranges from less than 1 up to 1000, the bulk of the installed motors are between 10 and 100 hp. Most such motors are destined for the industrial market, although commercial applications such as air handling also use motors in this size range.

1.3.2 Baseline Market Structure and Information Flows

The market for motors in the 10-100 hp range in non-OEM applications is shared by several dozen national and international **manufacturers**, almost all of whom are represented in PG&E's service territory. One of the barriers to successful transformation of the motors market cited by PG&E program staff was the fragmented nature of the motors market; there do not appear to be clear market leaders who can be targeted because they will subsequently influence the rest of the market.

All the major manufacturers do offer a complete line of motors that encompasses premium efficiency models for most applications. Among the motor dealers who participated in two focus groups in Northern California, availability of high efficiency motors from manufacturers was said to be ample. Architectural and Engineering firms also rated the availability of high efficiency motors, providing a mean answer of 5.1 on a 6-point scale in response to the question, "How available were high efficiency motors from manufacturers in 1997?"

Motor manufacturers have traditionally relied on a network of distributors and dealers to supply the entire U.S. market, but this may be changing as fewer dealers seem willing (or able) to stock the wide range of motors that may be demanded by end users and as more manufacturers sell directly to multi-site customers.

Manufacturers and their advertising were cited less frequently by customers as primary sources of information on motors technology than were distributors. Only 7 percent of respondents in PG&E's territory and 4 percent of respondents in the no-program territory cited manufacturer advertising as a primary information sources, although the trade magazines where manufacturers advertise heavily were very influential. Motor dealers who participated in the focus groups did say that advertising by manufacturers has increased customer awareness and receptivity to premium, motors. Manufacturers' increases in warranty length for premium motors were also noted as an important factor in increasing customer perceptions of the value of such motors.

In Northern California, D&B identifies a total of 91 motor **distributors** or motor repair shops. According to focus group participants, distributors are far less likely to carry a complete stock of motors today than they might have been in the past, because there are too many variations in motor size, configuration, rpm, etc., to permit the creation of a strategic inventory. Moreover, many end-users for whom downtime is critical carry their own inventory.

Because typical customers more often replace motors than air conditioners, relationships between dealers and customers tend to be more important than in the HVAC market. This relationship has been undermined somewhat in recent years as more manufacturers attempt to sell directly to end users or groups of end users. Nevertheless, motor dealers remain an important source of information and influence. Distributor advertising and sales calls were cited by a total of 36 percent of PG&E survey respondents (21 percent in the no-program territory) as their primary source of information for keeping up with motors technology.

Focus group results tend to reinforce the importance of distributors in disseminating information. Many participants in these sessions believe that they can expand the market for premium motors through continued efforts at educating buyers. The willingness to devote time and effort to do so varies among market actors: some see educational efforts as a service to their customers that will differentiate them; others say that limited profit margins and price competition make such service impractical.

On average, **architectural and engineering (A&E) firms** reported that fewer than 20 percent of their projects include motors specifications; 40 percent of respondents said that none of their projects involved motors, and only 15 percent of A&E respondents indicated that motors specifications occurred in 50 percent or more of their total projects in 1997. In other words, a relatively small subset of the designer population tends to focus on motors, while other firms ignore motors entirely, subcontracting out any motor-related work that comes their way. Those

firms that do specify motors consistently said that all or almost all of their motor specifications were for high-efficiency models.

Several focus group participants noted the importance of utility and other educational efforts that appear to have reached design engineers, who all now specify top of the line, premium motors for their clients. The importance of utility contact in influencing the design community was confirmed by the results of surveys with these market actors. Among surveyed customers in PG&E's service territory, however, only 3 percent said that a consulting engineer or architect would have the greatest influence on the type of equipment selected; in the no-program territory, only a single respondent (1 percent) provided this response

Among the **Energy Service Companies** (ESCOs) interviewed, few have focused on motor applications, per se. While motors may be a part of an overall energy efficiency package, the ESCOs interviewed said they choose to rely on motors experts on a subcontractor basis for such projects. Survey results indicate that 12 percent of PG&E and 9 percent of comparison territory motor customers have used the services of an ESCO to install motors. Of the respondents who had used an ESCO, 90 percent (in both territories) planned to do so again. Overall, a higher proportion of PG&E respondents (42 percent vs. 35 percent) reported having been contacted by an ESCO. PG&E customer were also more likely to have had motors included as part of an ESCO's proposal. None of the customers in either territory, however, cited ESCOs as their primary source of information or as having the greatest influence on their motors selection.

In discussing their motors **customers**, dealers and distributors who participated in the focus groups reported that larger industrial users in the Northern California market are highly aware of the benefits of premium efficiency motors. Because these buyers typically use life cycle costing and recognize the additional value of premium motors, they tend to buy them when replacing any motors over 50 hp. Smaller customers, on the other hand, continue to purchase less efficient motors, especially for low horsepower (25 hp and below) applications. Most smaller motors are sold to relatively unsophisticated end-users for highly routinized applications, with purchase decisions made exclusively on first cost.

Customers obtain information regarding motor technologies from a wide range of sources. In addition to those cited earlier (i.e., distributors, manufacturers), word-of-mouth continues to be a powerful information source. Approximately 13 percent of PG&E customers and 10 percent in the no-program territory consider colleagues and friends their most important information source. PG&E customers were statistically significantly more likely to rely on advertising to keep up with motors trends than their no-program territory counterparts (34 percent vs. 22 percent) and less likely to rely on trade magazines focused on either their business or facilities management (25 percent for PG&E; 40 percent for the no-program area). OEMs were cited as the primary source of information by just 2 percent of respondents in PG&E's service territory and by 6 percent in the no-program territory.

1.3.3 Baseline Product/Efficiency Mix

PG&E customers surveyed had an average of 20.6 motors in the 10-100 hp range, while those in the comparison territory had an average of 15.3 – not a statistically significant difference. The comparison territory customers did, however, report a statistically significantly higher proportion of motors with ASDs: 31.6 percent vs. 16.6 percent for PG&E customers.

The average number of motors purchased or rewound since January 1, 1996 was higher among PG&E customers – in part because almost 60 percent of PG&E customers had installed motors, while only about 49 percent of no-program territory customers had done so. Among those who had installed motors, relatively few were able to provide an efficiency level (standard, high, premium). Given these small sample sizes and the difficulty of collecting and verifying this efficiency information for recently installed motors, survey respondents were asked about the action they would take if they were replacing a 10-100 hp motor right now – including the option of purchasing various kinds of new motors (cheapest available, efficiency level specified by EPACT, premium efficiency) as well as rewinding. Overall, a slightly higher proportion of no-program than PG&E territory customers said they plan to install motors in the next year (36 percent vs. 29 percent). A somewhat higher percentage of no-program territory customers also indicated that they would install premium efficiency motors.

Approximately one-third of customers reported that they would be likely to rewind the motor rather than purchase a new one. When respondents were asked at what horsepower level they consider rewinding rather than replacing motors and, above that critical level, what percentage of motors were rewound, a statistically significantly lower percentage of PG&E customers said their firm never considers rewinding (22.1 percent vs. 38.6 percent). PG&E customers were also significantly more likely to consider rewinding motors under 10 horsepower. For those customers who do rewind, the percentage of motors rewound was not statistically significantly different between territories. Based on the above results, it appears that rewinding continues to be a barrier to energy efficiency from the customer perspective.

Motor dealers in Northern California and in the comparison territory provide an added indication of the current motor efficiency mix, bearing in mind that data for PG&E's territory were collected only from the small, geographically concentrated sample of focus group participants. In both territories, fewer than 10 percent of 10-100 hp motors sold in 1997 (5 percent in PG&E territory; 7 percent in the comparison area) were standard efficiency. Northern California motor dealers did report a higher percentage of motors sold with adjustable speed drives in 1997 (27 percent, vs. 8 percent for the no-program area). Because of the small sample sizes, the differences between territories are not statistically significant.

Those design firms interviewed who specify equipment for industrial customers provide another perspective on the baseline efficiency mix. While not enough respondents were able to provide quantitative data on the percentage of premium motors specified, several noted that they routinely specify premium efficiency – a finding that is consistent with the focus group results. The proportion of high efficiency installations specified by California architects and engineers has been influenced by the existence of utility programs as well as by national standards (EPACT). The high proportion of energy efficient motors specified by these market actors does suggest that energy efficiency gains in this market may be sustainable and permanent – especially if like-for-like replacement policies ensure that efficient models are installed when new motors are needed in the future.

1.3.4 Baseline Practices/Barriers

The focus groups provided extensive insights into current practices and the overall level and types of barriers to premium efficiency motors. In discussing barriers to the sale of premium motors, vendors report that several changes in the market can be seen over the past 4-5 years, and several factors have remained constant. The changes include the following.

- Although many customers who require education regarding the improved technology and its benefits remain, considerable progress has been made—particularly among larger customers. Moreover, among customers who are aware of the technology and its benefits, life cycle costing is accepted. Customers become acclimated to the costs of premium motors (thus reducing the effect of "sticker shock"). In addition, the educated user is now motivated by the additional savings available from the use of premium motors.

- Although discussants did not cite performance reliability as a major concern in the past, they believe that both actual and perceived reliability have improved considerably.

- As the acceptance of premium motors has grown among end-users, so has the willingness of market actors to recommend those motors in bids as an option.

Barriers to premium efficiency that appear to remain in this market include a continued focus on first cost for smaller motors; the prevalence of purchasing agents rather than engineers in influencing motor selection (especially since corporate downsizing has eliminated a cadre of knowledgeable technical specialists in many firms); and continued perception of risk among decision makers at some existing facilities.

Dealers attribute observed changes in market barriers to rebate programs conducted by PG&E, which helped draw attention to the technology, provided vendors with a lever to promote the sales of premium motors, and helped bypass the first-cost orientation of the buyers once they were willing to consider the new technology. In addition, the positive experience of customers who adopted premium motors has tended to validate the technology for other potential buyers.

In addition to rewinding, discussed above, data were collected on several other aspects of customer practices that might serve as indicators of the extent of market effects. While roughly equal percentages of respondents in the two territories keep motors in stock and purchase motors from OEMs, a statistically significantly (at the 90 percent confidence level) higher percentage of PG&E customers reported having an explicit policy to purchase energy efficient equipment whenever possible. PG&E customers also were less likely to report having a corporate policy of accepting the lowest technically acceptable bid, but the difference was statistically significant at the 80 percent (rather than the 90 percent) confidence level.

1.3.5 Baseline Attitudes/Perceptions

The observations of motors focus group participants were used to develop a set of questions designed to assess current customer perceptions of barriers to premium efficiency motors in the market place. A total of 30 questions were asked of each respondent to address 10 barriers identified by the focus groups.

1.3.6 Market Barriers, Program Exposure, and Purchase Intentions

As with the packaged AC study, data were collected on program exposure, perceptions of market barriers, and the purchase intentions of customers. The relationship between program exposure and barriers was investigated using standard bivariate analysis and factor analysis; structural equation modeling (SEM) was not attempted for the motors data.

An exploratory factor analysis identified seven perceived barrier factors:

- Low Incentive
- Focus on Immediacy
- Downtime Concern
- Reluctant Investing
- Motor Sophistication
- Make-do Orientation
- Advanced System Orientation

The factor analysis helps identify which of the hypothetical barriers (that is, those hypothesized by the EPS Scoping Study) appear to be operating in this market and the ways in which they manifest themselves in customers' perceptions and might be addressed in future programs.

- As an illustration, Factor I, Low Incentives, embodies both lack of awareness of the benefits of premium efficiency motors and lack of interest in their selection and use. Moreover, these barrier items appear to reflect a low level of incentives that is probably related to relatively low use of or reliance on motors.

- Similarly, in Factor II, Focus on Immediacy, we recognize that Bounded Rationality is likely to be high for customers who feel unable to deal with issues regarding the efficiency of their equipment or production processes until a breakdown in normal operations occurs.

Both of these perceived barrier factors seem to be rooted in customer characteristics, and are consistent with the descriptions provided by market actors in the focus groups. A clear example is the dichotomy between the high-use customer sophisticated in motors and systems and the low-use customer who treats motors as off-the-shelf commodities, thinks only in terms of immediate needs and problems, and perceives a laundry list of traditional barriers, including hassle costs, doubts about payback, concerns about performance, and financing obstacles. In both cases there are clear marketing implications for future programs.

Further analysis of the identified barriers revealed that they do not vary systematically by territory or program exposure, but they do vary by amount of utility contact in both the PG&E and the comparison territories. The barriers are more strongly related to Purchase Intentions: all seven correlations with this variable were statistically significant at the .05 level (or better). The highest correlations were with:

- Make-do Orientation (-.388),
- Low Incentive (-.380), and
- Focus on Immediacy (-.335)

These barriers seem to capture something in the intention to purchase efficient motors, or the lack of intention. Looking at ANOVAs that treat the Purchase Intentions variable responses as categories also shows all relations between barriers and purchase intentions to be statistically significant. Of course, the predictive ability would probably be even stronger for a measure of actual purchase decisions.

It will be important to continue this line of studies by systematically segmenting barrier factor scores by customer type. This will facilitate targeting future programs and designing their promotional, delivery, and financial components.

2. INTRODUCTION

This report presents the results of the Commercial/Industrial Market Effects Baseline study, focusing on the markets for packaged air conditioning and motors. Following this introduction, the research objectives and targeted markets are described in the remainder of Section 2. Section 3 presents the overall approach to the project and describes the research plan, including specific data collection and analysis tasks. Results of the analysis of the air conditioning and motors markets are described in Sections 4 and 5, respectively.

2.1 Research Objectives

It should be noted at the start that there has been considerable disagreement and confusion regarding the purpose of this study; an initial set of expectations was modified several times—both before and during the project's execution. An initial goal (to focus on customer decision making) was essentially removed from the study, but remains a part of the project name in a number of documents. Moreover, project priorities changed since the project's initiation in late 1997 as more information became available on the various aspects of market effects and market transformation assessments (e.g., performance contracting, measurement of market barriers, characterization of the market in the context of a diffusion of innovation model).

The objective of this study from the perspective of the authors has been to characterize the current markets for packaged air conditioning and motors, including selecting indicators of market barriers and customer actions and intentions that can be used in future studies to assess the extent of market effects as a result of program interventions. As the transition is made to market transformation-oriented programs, it becomes more important than ever to characterize the targeted markets before significant program investments are made. Such a market characterization serves several purposes:

- to describe the market actors and distribution channels and their implications for energy efficiency
- to describe the barriers that impede the adoption of energy efficient technologies in the market
- to determine current baseline values for indicator variables that can be used to track the market's movement toward higher efficiency
- to provide guidance for future program design through the identification of critical points of intervention in the market.

The market characterization encompasses both a qualitative description of the market -- in terms of its structure, players and information flows -- and a quantitative assessment – in terms of the share of efficient technologies as well as of the status of current indicators of attitudes and perceived market barriers. As such, it provides a basis for comparison to future, post-intervention characterizations of the market.

2.2 Description of Markets

In the present study, this characterization is focused on two specific markets. These somewhat narrowly defined markets were chosen both to tailor the scope of the required data collection

effort to the available budget and because each was felt to be representative of the broader HVAC and motors markets.

For ***motors***, based upon input from the PG&E staff interviews and the literature review, the analysis focused on motors between 10 and 100 hp used for non-OEM applications (that is, motors that were purchased by end users rather than original equipment manufacturers).

The selection of this horsepower range was also based on an analysis of the most commonly installed size ranges among industrial motors customers in PG&E's service territory as well as the motors industry as a whole. Motors in the 10-100 hp range have the greatest likelihood of needing to be replaced and are used across a broader spectrum of applications than larger motors.

For ***air conditioners***, the analysis focused on packaged air conditioning systems used by commercial customers in the school, university, hospital, and office segments. These segments were selected based upon PG&E's past success in designing energy-efficiency programs aimed at these markets; their high concentration of packaged air conditioners, and their importance as the largest component of usage within PG&E's commercial market. In addition, the municipal, university, school, and hospital (MUSH) markets have traditionally been targets for ESCOs involved in performance contracting, and focusing on these segments was designed to allow us to identify more clearly the role of ESCOs and performance contracting in the HVAC market. Other commercial customers, such as restaurants, refrigerated warehouses, and supermarkets, have more specialized heating and cooling needs, which may make it more difficult to identify key market changes and industry characteristics. These segments were, however, represented in the overall sample design, as described below.

3. THEORETICAL FRAMEWORK AND RESEARCH PLAN

3.1 Proposed Future Study Methods

A key to our approach to future studies of market effects in these markets is that we hope to be able to systematically link market interventions (e.g., PG&E or CBEE programs) to changes in perceived barriers and to specific replacement actions taken. Current data on these perceptions of barriers will therefore provide a key aspect of the baseline assessment.

Theoretical framework. The framework within which we conceptualize future studies of market effects is inspired by the initial Scoping Study by Eto, et. al. In this framework, adoption of energy-efficient technologies is impeded by market barriers. In other words, given that technologies are cost-effective, there is no rational reason not to manufacture, promote, or purchase them. Yet, market actors do not always do so. The reasons for this reticence are conceptualized as barriers to the optimal functioning of the market. MT programs can be thought of as targeting one or more market barriers to eliminate, or at least lower.

Since the ultimate measure of the success of programs in lowering these barriers is the rate of technology adoption by customers (customer actions), there are three basic components to this theoretical framework and to the future study: program interventions, customer attitudes/perceptions of market barriers, and customer actions. The focus of the current research plan is on collecting data that will support a future analysis of this type, and each of these concepts will be discussed in more detail below, followed by a description of the primary

analytic tool we recommend be used in the future study to analyze the relations among them, structural equation modeling.

Market interventions. Market interventions include traditional DSM programs, other contacts with the utility, and future interventions that are expected to take place in the coming years within the CBEE public goods charge (PGC) framework. In the current baseline study information was collected on customer contact with PG&E (or the no-program territory utility) and (from the PG&E MDSS and EMS) on participation in past energy efficiency programs.

Customer actions. Customer actions with respect to energy-efficient technologies are seen as the ultimate measure of market effects. Barriers can occur at any point in the market, but the end result is the customer's decision to purchase efficient or non-efficient technologies. We expect, then, that the future study would measure customer actions by determining specifically what they have installed (within the specific technology areas that are the focus of this study), including brand, model number, and efficiency rating, where appropriate.

An important component of the analysis of customer actions is the determination of what those actions would have been if market interventions had not taken place (i.e., if the programs had not existed). While it is clearly impossible to obtain a perfect picture of how PG&E customers would have acted in the absence of PG&E programs, we take the best proxy for these actions to be the actions of customers in a similar geographic area (or utility service territory) where such programs do not exist. Selection of the appropriate comparison region or service territory was a critical part of the baseline assessment and future study.

Barriers and attitudes. While it is essential to measure market effects through changes in observed customer behavior associated with market interventions, it is equally important to determine *why* behavior has or has not changed, since this has profound implications for assessing the permanence of observed change. One of the ways of approaching this issue is to conceptualize the customer's decisions in terms of the functioning of the market and the identification of market barriers to adoption of the specified equipment. By identifying and measuring market barriers and their change over the course of a program, and by connecting the changes in market barriers to changes in customer choices, it is possible to "explain" the customer changes with the market barrier changes.

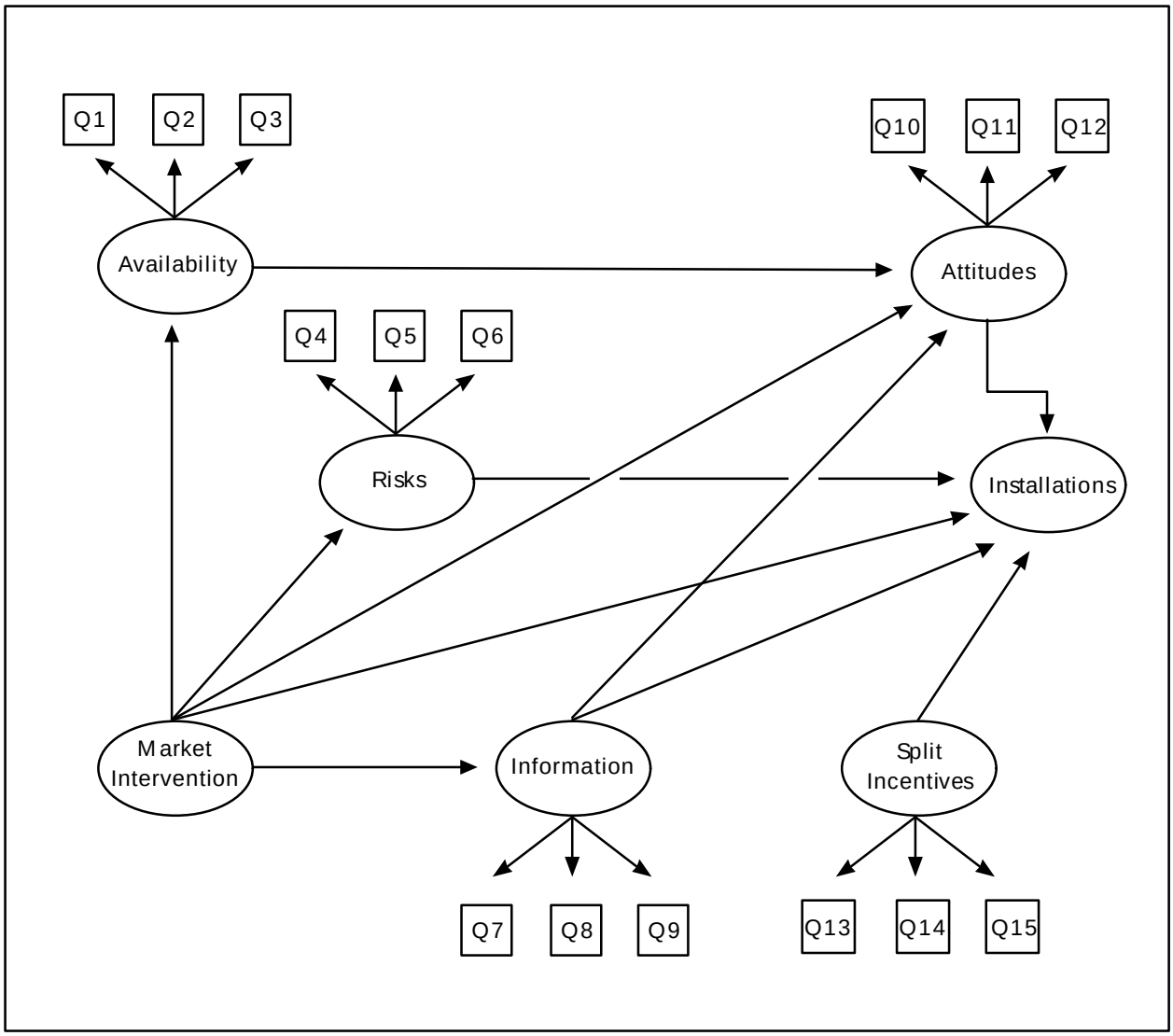
Linkages between program, barriers, and behavior. The study team recommends that a core component of the future study involve structural equation modeling (SEM), illustrated in Exhibit 3-1. SEM is an analysis method that represents a very good fit with the needs of this type of research. Specifically:

- SEM allows the analyst to estimate the impacts of multiple endogenous, exogenous, and mediating variables simultaneously. Barriers can be conceived as mediating variables between program exposure and consumer attitudes and behavior. The relative importance of the various barriers can be assessed, taking into account all of the other barriers simultaneously. Direct and indirect paths can be estimated.

- Confirmatory factor analyses can be performed to determine that we have identified the best indicators of the most important latent constructs, allowing barriers to be correlated as they surely are in reality.

- Measurement error can be assessed and removed from estimation of the structural model (i.e., the paths between latent constructs).

Exhibit 3-1
Illustrative Model for Testing Program and Market Barrier Effects on Attitudes and Incentives



- Covariance matrices can be systematically compared across specified groups, such as those associated with different geographical areas or different technologies. This allows the determination of the feasibility of combining groups to gain analytic power. These comparisons can also have independent substantive interest in that they tell us whether markets operate similarly or differently for the various technologies.

One of the implications of the SEM approach is that constructs should be measured by multiple indicators when possible. Multiple questions were therefore developed to address each of the market barriers under consideration, as described elsewhere in this report.

3.2 Baseline Plan

3.2.1 Approach

The Research Plan for this baseline study was dictated by the requirements of future market effects studies. Since our basic approach to such future studies is to develop a quantitative assessment of market effects and the mechanism by which those effects are achieved through a comparison of customer actions within and outside PG&E's service territory, we believe that establishing a market baseline entails a comprehensive assessment of practices, information sources, and actions and intentions, as well as attitudes and perceptions of barriers.. To simulate what would have happened in the absence of the current or future market intervention, the same data were collected for a comparison territory with no program in place or anticipated.

Ideally, baseline data on customer actions in both territories would be collected from a large sample of customers who had recently installed the technologies in question. Given the scope of the current project, however, data on the market penetration of efficient technologies were collected from vendors (distributors, contractors, dealers) within and outside PG&E's service territory.

In tandem with our focus on reported customer actions, we believe it would be highly desirable for the future study to explain differences in the adoption of energy efficient technologies between service territories at least in part through an analysis of market barriers. To support such an analysis, data were also collected on specific market barriers associated with the measures/technologies being investigated, recognizing that changes in barriers and attitudes will often precede changes in customer actions. A total of 500 customers were surveyed regarding their attitudes toward and perceptions of market barriers to energy efficiency in each of the two markets studied. It was felt that questions regarding customer attitudes and perceptions would be most useful when framed in the context of the individual technology being addressed.

3.2.2 Existing Data Sources and Review

In preparing the research plan for the present study, the QC team conducted a literature review and interviewed key PG&E staff. Results of the staff interviews and literature review were presented to PG&E in a previous summary memorandum, included as Appendix 1.

In addition, focus groups were conducted with two groups of motor distributors and two groups of HVAC dealers. These focus groups, too, were described in detail in previous reports, and are included with this report as Appendix 2. Key findings are cited throughout the results section of this report as appropriate, however.

3.2.3 Primary Data Collection and Sampling Plan

In addition to the focus groups and interviews with the appropriate PG&E staff described above, primary data collection activities included quantitative surveys with packaged AC and motors end users within PG&E service territory and with a control group of customers outside PG&E's service territory. Surveys were also conducted with contractors/distributors and

architectural and engineering firms in both territories. Finally, interviews were conducted with Energy Service Companies (ESCOs), which were found to have a national focus.

Sample design. Both PG&E's CI customer lists and secondary data sources were used to generate appropriate sampling frames within and outside PG&E's service territory. Separate sample frames were designed for the AC and motors surveys; the samples were drawn based upon SIC code and rate class to identify a sample of customers who are likely to face the technology purchase decisions relevant to this study. Both samples were designed to be replicable for future studies, and are presented in Appendix 3.

For packaged air conditioners, the sample for the customer survey was designed based on the allocation of packaged AC capacity across business types and climate zones, as described in PG&E's 1997 Commercial Building Survey Report. Those segments identified in the research plan as being targets for the AC baseline research effort because of their expected interest in performance contracting (i.e., colleges, schools, hospitals) were then oversampled to ensure adequate sample sizes to support analysis of these individual segments.

In an effort to maximize the number of respondents who would be likely to have packaged AC, small, medium, and large strata were developed based on annual kWh usage. The sample was then drawn 60 percent from the "medium-sized" premises and 20 percent each from the small and large groups (who are more likely to have window/wall units and built-up systems, respectively). Survey results were weighted by the segment's contribution to packaged air conditioning cooling capacity in the population.

For the motors survey, the customer sample was drawn from PG&E customers in industries that account for the largest share of motors nationwide. In addition to manufacturing customers in SICs 20-39 (with the exception of SIC 36, electronics manufacturing), the sample included firms engaged in mining and extraction (SICs 10, 12, 13, and 14), and the water supply and treatment sector (SIC 494). Survey results were weighted according to the estimated motor electricity usage, based on the annual kWh for each segment multiplied by that segment's estimated percentage of usage accounted for by motors.[1]

For both packaged AC and motors, the samples in the non-PG&E territory were then designed to mirror, as closely as possible, the characteristics of the PG&E market. Results were weighted to the PG&E population distribution.

[1] National Motor Market Baseline Study, Xenergy, 1997

Exhibit 3-2
Data Collection

	Within PG&E Service Territory	Outside PG&E Service Territory
Staff Interviews	4	
Motor End Users	100	100
HVAC End Users	200	100
Motor Vendors	2 Focus Groups	20
HVAC Vendors	2 Focus Groups	25
Architects and Engineers	15	10
ESCOs	10	

Each of the individual data collection efforts is discussed below.

Staff interviews. The interviews with PG&E's HVAC and motors program staff provided insights into current market conditions, indications of market effects from previous programs, and PG&E's future plans.

Customer surveys. Collection of customer data focused on baseline attitudes, information sources, decision influences, and perceptions of market barriers among CI customers within PG&E's service territory for comparison to those of CI customers outside PG&E's service territory. Customers were asked to respond to a series of questions relating to specific market barriers believed to be pertinent to HVAC or motor equipment replacement actions. The specific questions to be asked to elicit accurate information regarding the strength of market barriers were developed based upon the findings of the focus groups with vendors. Questions regarding specific replacement actions were also asked; given the size of the sample and the difficulty of locating customers who have recently undertaken the replacement action in question, we did not (and did not expect to) obtain enough replacement data to accurately characterize the current replacement market from the customer surveys. Instead customers were asked about their intentions regarding the equipment they would select if they were making a purchase decision now. While we believe that future studies should be designed to capture accurate customer-level equipment data, data on intentions were used for the current study to ensure enough sample points to test the feasibility of the structural equation modeling approach.[2]

Given the different market characteristics of the motors and HVAC end-use segments, QC subdivided the overall sample into those customers that are likely to install packaged air

[2] The questions regarding purchase intentions are, however, valid in their own right as baseline indicators of customer attitudes and perceptions.

conditioning equipment and those that are likely to install motors. For both customer groups, the survey instruments asked similar questions regarding firm characteristics, (i.e., square footage, number of employees, industry type, etc.). In addition, both groups were asked about their use of information sources and about influences on their selection of equipment. Separate batteries of barrier questions were, however, developed and administered for the AC and motors samples.

Since one of the goals of the customer surveys was to determine the market inroads that have been made by Energy Service Companies (ESCOs), the commercial customer sample (i.e., the sample targeting packaged HVAC users) oversampled those market segments that have been targeted by ESCOs and have been most receptive to performance contracting: that is, government, schools, universities, and hospitals. Other commercial segments with large cooling loads, such as offices and retail establishments, were also represented in sufficient numbers to support an accurate characterization of the overall market.

Vendor surveys. Questions asked of HVAC and motor vendors focused on the breakdown of sales by efficiency levels and the cost of energy efficient equipment. In the absence of a full-scale canvass survey of customers, QC believes that the vendor surveys provide the best source of data regarding the supply of energy efficient technologies, although results must be interpreted in light of the limited sample sizes and the limited willingness of vendors to provide sales-related data. Since it was agreed early in the project that the collection of vendor data should emphasize the use of focus groups to gain a better understanding of market conditions and interactions, resource constraints limited the number of other in-territory vendors from whom market data could be collected.

Interviews with architect and engineer firms emphasized the extent to which design practices now incorporate energy efficient technologies, as measured by the percentage of motors and AC specifications that were energy efficient. In addition, data were collected regarding architect and engineer firms' perceptions of customer attitudes toward energy efficiency.

ESCO interviews. As noted above, a significant component of the baseline assessment is the role that energy service companies and performance contracting play in this changing market. Therefore, QC attempted a total of 20 qualitative interviews with Energy Service Companies (ESCOs) currently operating both within and outside PG&E's service territory—although it was possible to complete only 10 interviews because of the limited number of players in this market. These interviews were open-ended and helped to further refine and assess the market practices baseline for these technologies, as well as explore other market influences that these important market actors exert. Results of these interviews are presented in Appendix 5.

4. RESULTS - CHARACTERIZATION OF HVAC/CONTROLS MARKET

4.1 Baseline Market Size and Structure

Nationally, there were approximately 5.35 million packaged HVAC units (central air conditioners and air-source heat pumps) shipped in 1997, according to the Air Conditioning and Refrigeration Institute (ARI). Most packaged AC units destined for commercial customers are in the 5-20 ton size range. Domestic shipments by the manufacturers who make up the membership of the ARI are said to account for more than 90 percent of the national market.

Shipments by efficiency level are not reported by ARI, although the average for all shipments of CAC units under 65,000 btuh in 1996 was said to be 10.68 (ARI Statistical Profile, 1996). ARI notes that current SEER/EER levels represent efficiency gains of "about 55 percent compared to units installed 20 years ago." This uptrend in nationwide efficiency levels represents both a secular increase in energy efficiency over the past two decades and the direct effects of utility incentive programs. The relative strength of the two effects would go far toward explaining the extent to which the national market has been transformed. It is worth noting that Ted Gilles, Commercial Market Specialist for Lennox, states that approximately 50 percent of his company's shipments of their L-series (8.5-30 tons) single package rooftop units nationwide in 1997 were high efficiency models (11 SEER vs. the standard 9 SEER for a 10-ton model), with large Fortune 500-type accounts representing the largest portion of this high efficiency market.[3]

California Market Size

With some 11 percent (1.5 million) of the 13.7 million businesses in the US, California, as would be expected, accounts for a proportionate share of packaged AC sales, although the total conceals a wide range of variation between the various geographic regions in the state. The 550,000 C/I customers in PG&E's service territory represent approximately 35 percent of the California market and 4 percent of the national market.

A recent PG&E appliance/equipment survey details the distribution of packaged ACs across the commercial customer base. PG&E's Commercial Energy Usage Survey (CEUS), published in 1997, provided in-depth information regarding the energy characteristics of the commercial market. Key findings include:

- Seventy-one percent of commercial square footage in PG&E's service territory was heated and 58 percent was cooled
- The penetration of cooling equipment ranged from a high of 88 percent of commercial premises in the desert/mountain climate zone to a low of 34 percent in the coastal climate zone
- Packaged electric systems accounted for 2.3 million tons of cooling capacity, or 66 percent of the territory total
    - Schools, colleges, and hospitals, restaurants, and offices all had at least 75 percent of premises with packaged electric cooling
    - Only hospitals had more built up (chiller) cooling capacity than packaged cooling capacity

[3] Presentation at ACEEE Second Annual Market Transformation Workshop, March 23-24, 1998

Exhibit 4-1
Percentage of Premises with Cooling Capacity

Business Type	Packaged Cooling Capacity ('000 tons)	Percent with Packaged Electric	Percent with any Cooling
Colleges	54.1	74%	76%
Food Stores	54.4	59%	61%
Hospitals	88.7	86%	97%
Hotels/Motels	176.6	47%	51%
Miscellaneous	243.8	46%	47%
Offices	698.4	75%	79%
Refrigerated Warehouses	8.6	79%	80%
Restaurants	251.7	79%	80%
Retail Stores	375.4	57%	62%
Schools	246.3	78%	78%
Warehouses	124.7	63%	63%

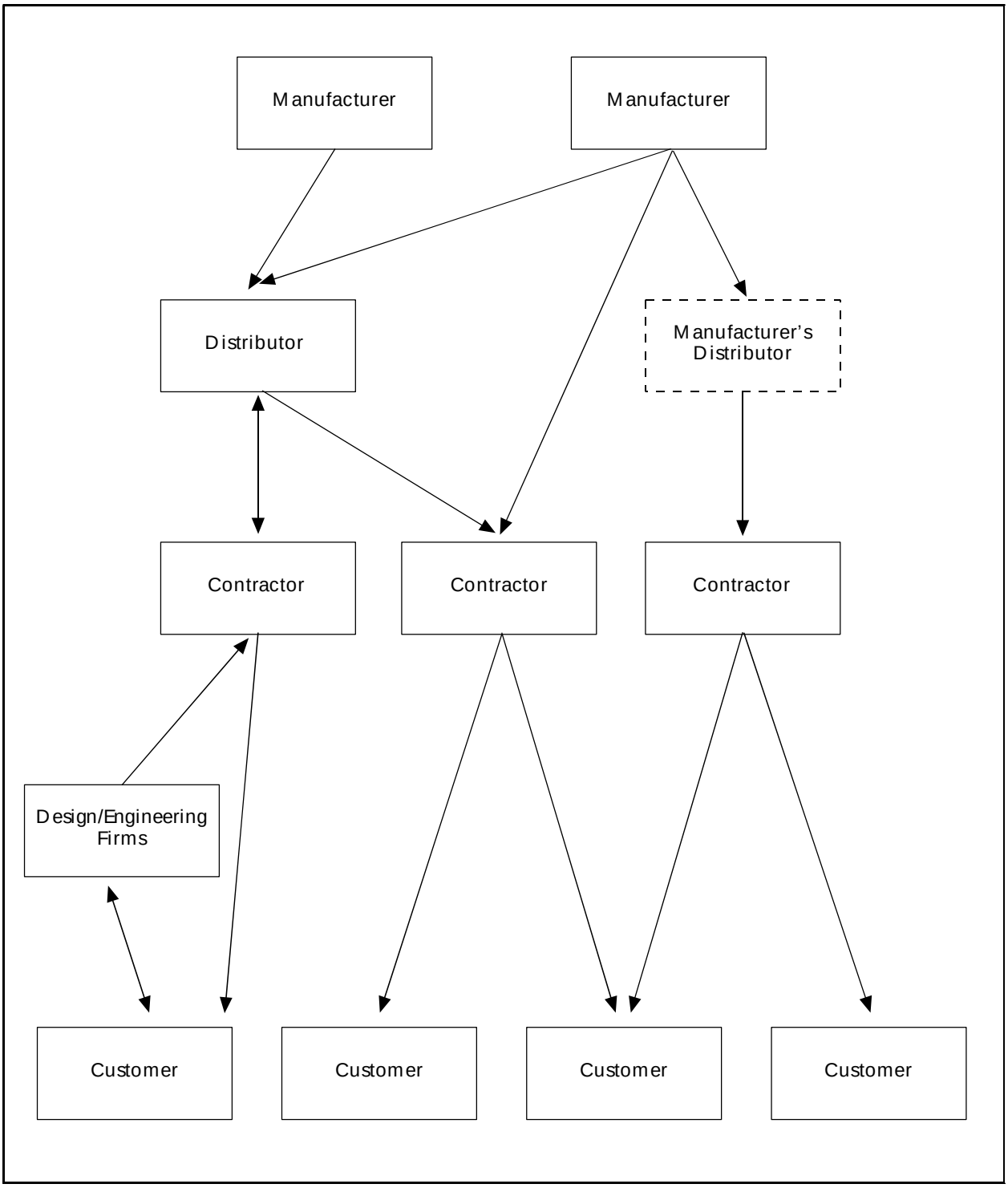
Source: PG&E 1997 Commercial Building Survey Report

As the table shows, much of PG&E's packaged AC load is generated by several large customer groups, such as offices and retail stores. As noted previously, the overall penetration of packaged cooling equipment conceals wide variations between the various climate zones.

4.2 Baseline Market Structure and Information Flows

Exhibit 4-2 presents a stylized overview of the structure of the market, indicating how various players interact. Each group of market actors and their roles are discussed below.

Exhibit 4-2
Packaged AC Market Structure



Manufacturers

All of the major national manufacturers are represented in the Northern California market, and several have manufacturing/assembly facilities in the region. Despite the presence of a relatively large number of brand names, units are actually manufactured by just a handful of firms. The primary implication for market transformation of this market structure is that it should be relatively easy for an individual manufacture to achieve economies of scale in production as demand for high efficiency units increases.

Manufacturers will develop high efficiency models – in part for advertising/promotional "bragging rights"— but will tailor the level of production of those models to the demand coming from the market through their distribution network. It should be noted that there have been no breakthrough technologies in this market. Manufacturers have been achieving efficiency gains primarily through fine tuning of their combination of compressors, condensers, and controls and the application of microelectronics.

The dealers and distributors who participated in several focus groups for this study describe the manufacturers with whom they work as helpful, but not extremely active in promoting high efficiency central air conditioners (HECACs). The manufacturers are continuing to fund research and development on this line of equipment, and participants believe strongly in the resulting quality and value of HECACs. They believe the equipment is well-designed and contains high quality materials. Moreover, they are convinced it is reliable and long-lasting. In addition, they report that manufacturers provide adequate training for vendors and good levels of product promotion. Indeed, some manufacturers are even offering lease-purchase programs to help their dealers increase sales. Nonetheless, it does not appear that any manufacturers are investing major efforts in attempting to move the market to higher levels of energy efficiency.

Distributors

Manufacturers typically sell through a network of distributors, although some of those distributors are "captive" – that is, they are owned by the manufacturer and only sell a single manufacturer's products, as depicted in Exhibit 4-2. Within PG&E's service territory there are a total of 47 firms classified as AC distributors by their primary SIC code as classified by D&B. Their size, in number of employees, is summarized along with comparable data for other market actors in Exhibit 4-3.

Distributors provide the stocking function for AC units other than the most popular models, which may also be stocked by contractors. Distributors adjust their stocking levels and product mix to the current and expected demand for specific types of units from contractors; if demand for HECAC models is consistent, the distributor's inventory levels should be of sufficient breadth and depth to accommodate the need for almost any type of efficient equipment. Distributors are leery, however, of being stuck with high efficiency models that can be difficult to move when utility programs are cut back or eliminated. A national account representative from Carrier noted that even a rumor that an HVAC rebate program might be cut typically caused a barrage of calls from distributors canceling orders for HECAC equipment (or changing the mix of efficiencies ordered.)

Exhibit 4-3

Northern California Market Actors - Packaged A/C

No. of Employees	**Distributors**	**Contractors**	**A&E Firms**
1	4	64	833
2 to 4	22	146	1912
5 to 9	8	56	414
10 to 24	10	32	252
25 to 49	2	5	85
50 to 99	1	6	33
100 +	0	0	25
Total	47	309	3554

The extent to which distributors stock high efficiency units of the type needed for a typical replacement application is a significant determinant of the availability of HECAC units to contractors and customers – which is in turn a potentially significant market barrier to HECAC.

Contractors

Contractors provide the retail sales function in the market for packaged commercial air conditioners. These are numerous and diverse; in Northern California, there are more than 300 HVAC contractors, ranging in size from one-person operations to companies with more than 50 employees. Most of these specialize in residential installations, but even residential contractors typically do some commercial business.

As noted above, two focus groups were conducted with commercial HVAC contractors in PG&E's service territory to gain insights into the decision making processes of both contractors and customers, as well as barriers to energy efficiency encountered by each. While participants in the two HVAC focus groups complained that they are often isolated from the end user of the equipment they sell by third-party designers or predetermined specifications, customer surveys found that contractors play a major role in determining the type and efficiency of equipment installed. In PG&E's territory, over 37 percent of customers cited contractor advertising or sales calls as their primary source of information regarding trends in air conditioning technology. Moreover, contractors were most often cited as "having the greatest influence on the type of air conditioning unit selected" (28.2 percent of customers – see Exhibit 4-4 and 4-5). It may be that

the influence of contractors is perceived to be greatest by small customers who simply ask for "the lowest cost unit that will do the job," leaving the vendor to suggest a specific model within those narrow constraints.

While the importance of contractors in generating customer awareness of specific energy efficiency programs has been well documented in previous evaluations, it should be noted that the role of HVAC contractors was also important in the no-program territory, where 40.8 percent of respondents relied on contractor advertising and sales calls to keep up with technology and 35.2 percent cited contractors as likely to have the greatest influence on the type of HVAC equipment selected.

A more extensive discussion of the market for HECAC from the perspective of HVAC contractors is found in the complete discussion of the focus groups in Appendix 2.

Architects/engineering firms

Design professionals, including both consulting engineers and architectural firms, are involved in the AC market to the extent that they specify the size, type, and efficiency of equipment to be installed. On average, A&E firms reported that about 55 percent of their projects include HVAC specifications.

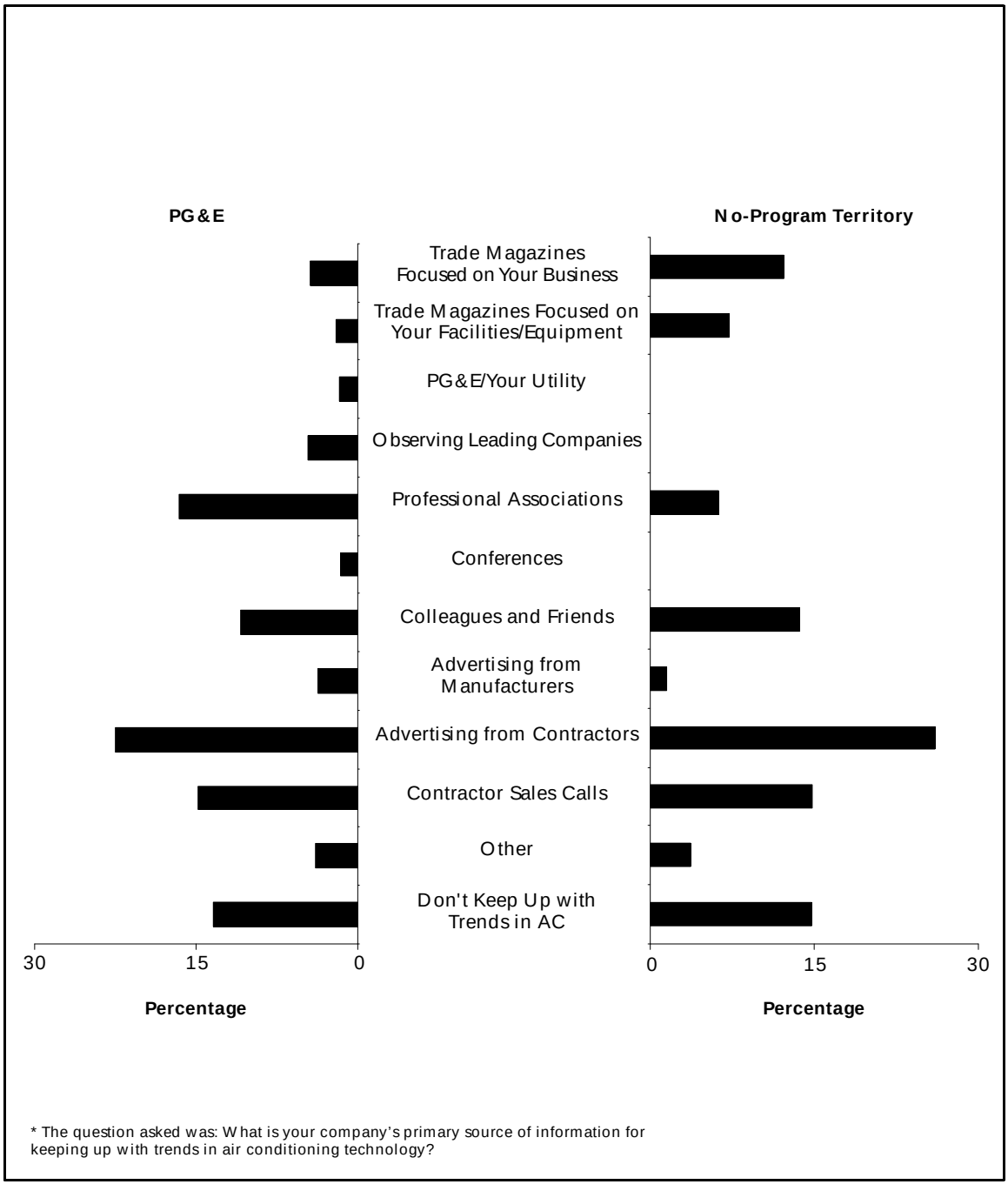
There are more than 3,500 architectural firms in PG&E's service territory. While most of the 2,700 firms with fewer than 5 employees are local, many of the larger designers (e.g., those with 50 plus employees) do business on a regional and even national scale.

The role of A&E firms in the market varies: in the new construction market, they often specify the type and efficiency of equipment to be installed; they are less influential in the replacement market. Among surveyed customers in PG&E's service territory, only 10 percent said that a consulting engineer or architect would have the greatest influence on the type of equipment selected; in the no-program territory, this figure was higher (16 percent), but still far below the level of influence attributed to contractors (see Exhibit 4-5).

Energy Service Companies (ESCOs)

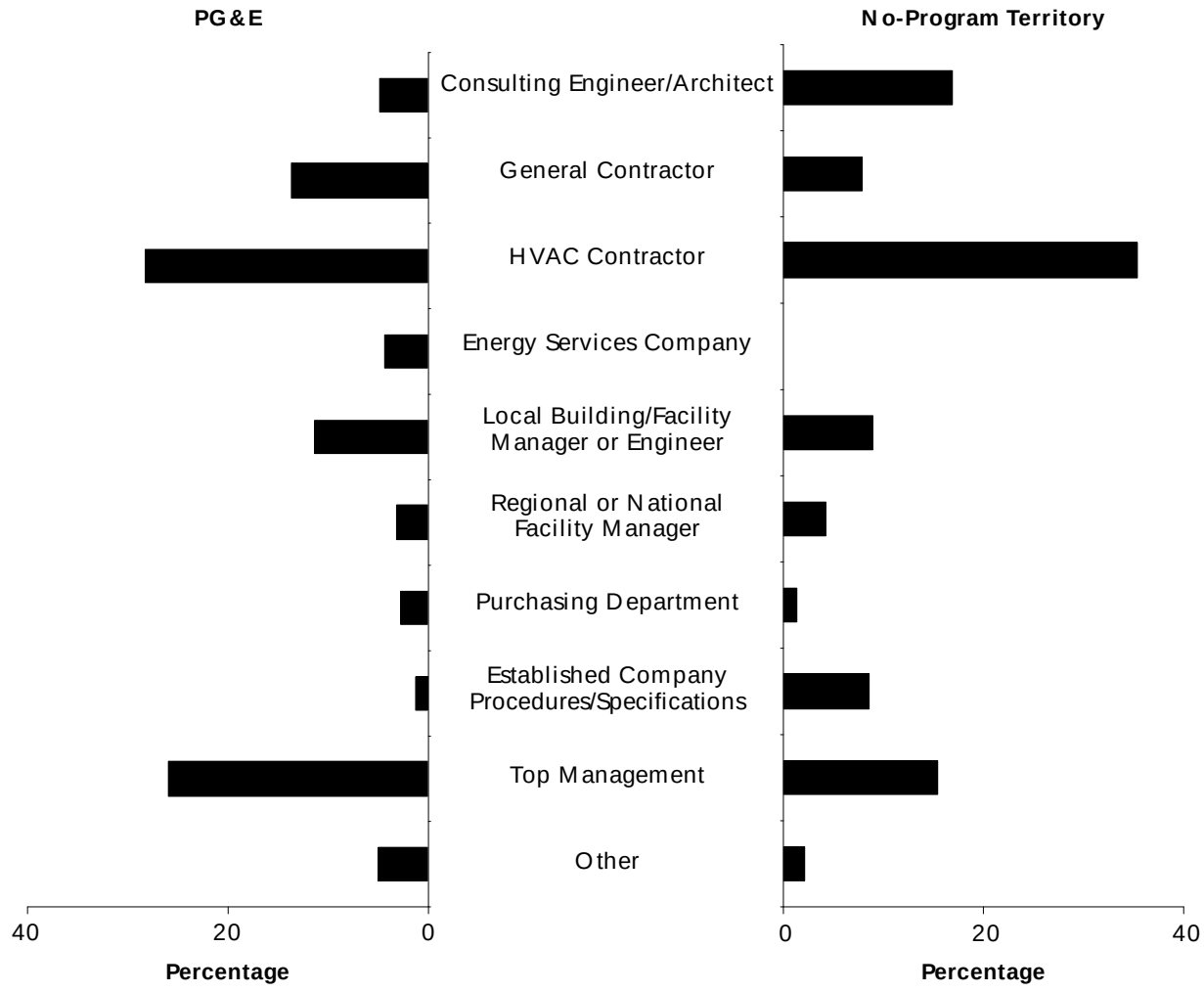
ESCO involvement in the packaged AC market generally comes about as part of a larger, comprehensive energy project. Despite the broad capabilities that ESCOs offer, their role in the market for packaged air conditioning is still relatively limited. Approximately 45 companies identified themselves as ESCOs in response to a recent California Energy Commission Survey, and these companies represent most of the major players in the market nationwide. In fact, the National Association of Energy Service Companies (NAESCO) lists only 32 members, including 15 that have gone through the organization's accreditation process. Efforts were made to contact all of these firms; 10 agreed to be interviewed. A more extensive discussion of the results of these interviews is presented in Appendix 5.

Exhibit 4-4
Customer Information Sources*



* The question asked was: What is your company's primary source of information for keeping up with trends in air conditioning technology?

Exhibit 4-5
Influences on Customer AC Equipment Selection*



* The question asked was: If your company had to replace an air conditioning unit at this facility, which of the following would be likely to have the greatest influence on the type of unit selected?

Among both PG&E customers and those in the comparison territory, just over 10 percent reported having used the services of an ESCO to install new packaged air conditioning equipment. Moreover, of the respondents who had used an ESCO, 65 percent (in PG&E's

territory) and 90 percent (in the no-program territory) planned to do so again the next time they install an air conditioner. Among those who had not used an ESCO, about 11 percent of both the in-territory and out-of-territory respondents reported having been contacted by an ESCO to install a new cooling system.

In PG&E's territory, ESCOs were cited by 5.6 percent of respondents as "likely to have the greatest influence on the type of unit selected." None of the respondents in the comparison territory provided that response.

Customers

Whatever other changes are reported in the market, the most pertinent characteristics of the market are revealed in the actions of individual customers. Customers have been the focus of most of PG&E's HECAC initiatives, and any resulting market effects should be observable at the customer level.

In discussing the market for HECAC, HVAC dealers who participated in the focus groups described the relevant market primarily in terms of the likelihood of different types of customers to respond favorably to recommendations or options for the purchase and installation of HECACs, as follows:

- Retailers (including banks) are poor prospects. Most do not pay for the purchase and installation of their HVAC equipment. The owners of their buildings do not see HECACs as being of value in attracting or retaining tenants.

- School districts have recently been changing from central HVAC systems to dispersed systems. In this transition, they have been installing relatively low-grade equipment, consistent with buying as cheaply as possible.

- Start-up companies are focused on keeping immediate costs under control rather than with longer-term benefits.

- Customers who wait for equipment to break down before investing in upkeep activities tend to be interested in the least-complicated, least-expensive solution to their immediate problem.

- General contractors most commonly seek equipment with the lowest first cost and also avoid any solutions that might increase labor costs or time to project completion.

- In contrast, architects and engineers are generally more willing to consider options and to initiate discussions of energy efficiency. However, architects remain prone to oversizing units to reduce the likelihood of end-user complaints about cooling power.

- Decision-makers in larger corporations are more responsive than others to issues of energy efficiency. They are also particularly interested in increasing standardization of equipment (which can work against efficient solutions) and in reducing risk (which can increase the use of efficient equipment, with its longer warranties.)

These and other customer segments obtain information regarding energy using technologies from a wide range of sources. In addition to those cited earlier (i.e., HVAC contractors, architects), word-of-mouth continues to be a powerful information source. Approximately 11 percent of PG&E customers and 14 percent in the no-program territory consider colleagues and friends their most important information source. PG&E customers were more likely to rely on professional associations and conferences to keep up with HVAC trends than their no-program territory counterparts (16.6 percent vs. 6.2 percent) and less likely to rely on trade magazines focused on either their business or facilities management (6.2 for PG&E; 19.4 percent for the no-program area). And while less than 2 percent mentioned PG&E as their primary source of information, the utility was not mentioned at all in the no-program territory.

4.3 Baseline Product/Efficiency Mix

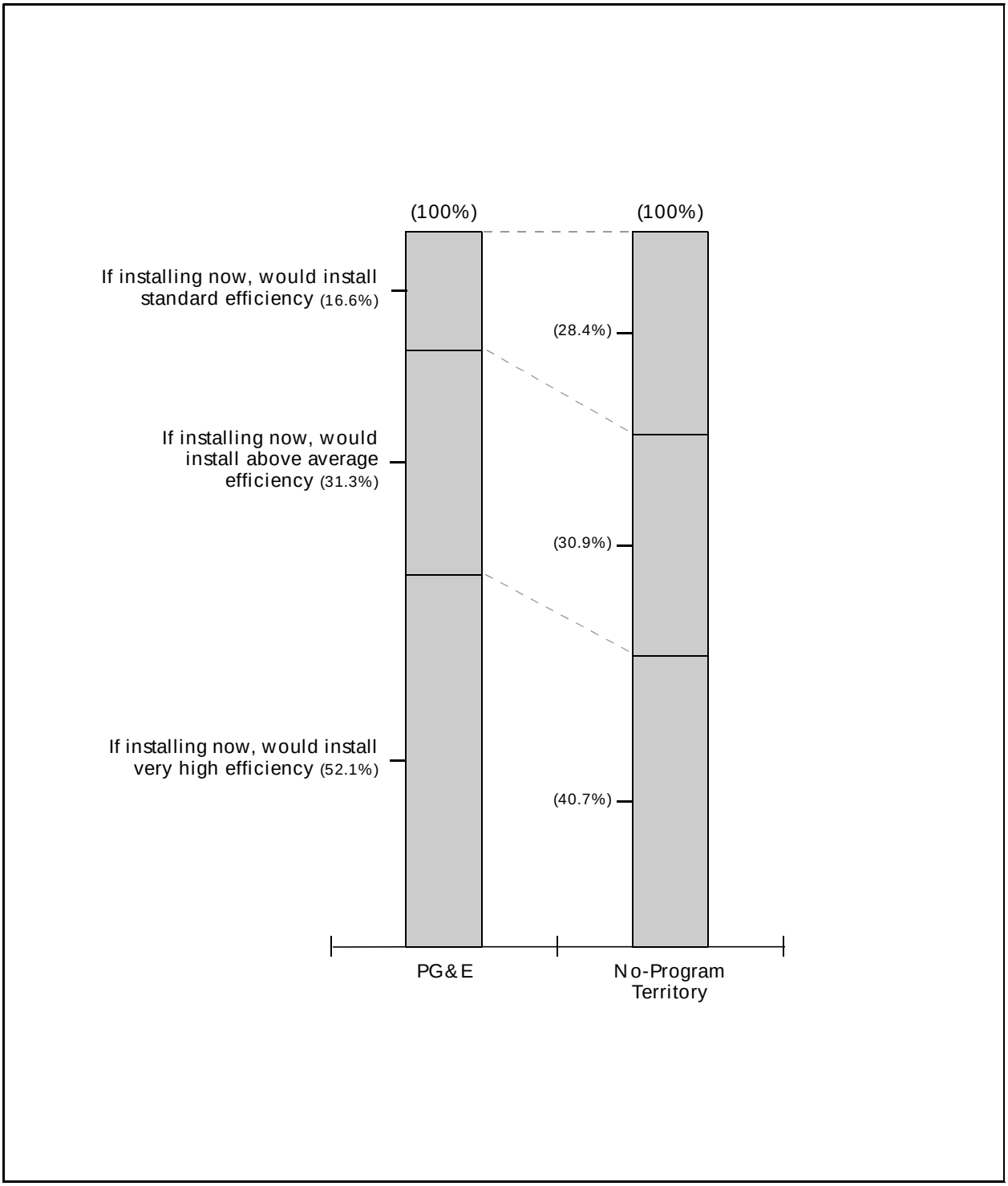
Among the customers surveyed, 22.5 of PG&E customers and 23.4 percent of the no-program territory customers had replaced packaged air conditioning units since January 1, 1996. These numbers are consistent with replacement rates of about 10 percent per annum and, based on the installed capacity reported in the Commercial Building Survey Report, an annual commercial replacement market of some 232,000 tons (2.3 million tons of packaged AC capacity x 10 percent) or about 46,000 units averaging 5 tons.

Given the relatively small sample size and the difficulty of collecting and verifying efficiency information, it was not possible to obtain any indication of the current efficiency mix of packaged air conditioning units from customers. Instead, survey respondents were asked about the efficiency level they would purchase if they were purchasing a unit right now: standard efficiency, above average efficiency, or very high efficiency. The distribution of responses, shown in Exhibit 4-6, indicates that PG&E customers were significantly less likely state they would install standard efficiency and significantly more likely to state that they would install very high efficiency units. The percentage indicating they would install above average efficiency units was about the same for both territories.

The proportion of high efficiency air conditioning units was also estimated from surveys of HVAC contractors and design firms[4]. Among HVAC contractors, those active in PG&E territory reported that the percentage of high efficiency units ranged from 36 percent for single phase units less than 65,000 btuh to a high of 58 percent for three-phase units from 65-135,000 btuh. Overall, an estimated 42 percent of units (weighted by percentage of sales) were high efficient. Note that the in-territory respondents for these questions were limited to those firms who attended the focus group and who filled out a questionnaire. Our ability to generalize from these results is, therefore, quite limited.

[4] The definition of high efficiency, provided to respondents, varied by equipment size and type, as follows: single-phase less than 65,000 BTUh: 11+ SEER; three-phase less than 65,000 BTUh: 10.4+ EER; 65-135,000BTUh: 10+ EER; over 135,000 BTUh: 9.5+ EER.

Exhibit 4-6
Efficiency of Planned Package AC Installation



In the Northern Illinois comparison territory, the percentage of high efficiency units sold, as reported by HVAC contractors ranged from 36 percent for single phase units less than 65,000

btuh to 79 percent for three-phase units from 65-135,000 btuh. Overall, an estimated 49 percent of units (weighted by percentage of sales) in the no-program territory were high efficient.

It should be noted that the differences between the territories are not statistically significantly different. They tend to support, however, the focus group findings that lasting market effects in this market are minimal.

Architects and engineering firms who specify equipment for commercial buildings provide another perspective on the baseline efficiency mix. Since these A&E firms typically have a more prominent role in new construction projects where air conditioning can be financed as part of the whole building package, they tend to specify a higher proportion of efficient units than installed by contractors: the proportion of HVAC installations specified as energy efficient is higher in both territories than the corresponding share for HVAC contractors. Moreover:

- The proportion of energy efficient units specified is higher in PG&E territory (86 percent vs. 70.5 percent, although the difference is not statistically significant)

- The percentage of units for which energy management systems is specified is higher in PG&E territory (39 percent vs. 26 percent).

The proportion of high efficiency installations specified by California architects and engineers would be expected to be higher because of the influence of utility programs as well as state building standards (Title 24).

4.4 Baseline Practices/barriers

The focus groups, described earlier and summarized in detail in Appendix 2, provided extensive insights into current practices and the overall level and types of barriers to HECAC in the Northern California market, as perceived by contractors and distributors.

In discussing barriers to the sale of HECACs, the vendors report that several changes in the market can be seen over the past 4-5 years, and several factors have remained constant. The changes include the following.

- High efficiency units are more likely to be readily available.

- The initial cost of HECACs has moderated somewhat.

- Customers are more aware of the equipment options.

- Customers interested in energy-efficient options are more likely to ask for cost and payback information regarding HECACs and to require detailed computer or written analyses, reducing information gaps between them and the vendors.

- Warranties on HECACs are longer than they were in previous years, helping to reduce any customer concerns about reliability of the equipment.

- Payback criteria have been relaxed somewhat, according to some group members. Not all agree with this assessment, with some arguing that no changes in decision criteria have occurred and there has been no increase in focus on life-cycle costing.

However, according to focus group participants, the critical split incentive barrier has not changed in any way. Finally, they say, other hypothesized barriers, such as the concern about hidden costs of premium equipment (e.g., the need for maintenance contracts) are not an issue.

When discussing observed changes in market barriers to the sale of HECACs, the HVAC marketers note several influences, including the following.

- General market conditions; e.g., a construction boom in the region, renovations sparked by the anticipation of El Niño

- California's Title 24, which tightened building codes though it did not affect equipment standards[5]

- Manufacturer's promotions

- PG&E's rebate program, which has been of considerable assistance to proactive HVAC contractors by allowing customers to overcome barriers to financing as well as increasing customer awareness of HECACs and increasing the credibility of the vendors

4.5 Baseline Attitudes/Perceptions

The observations of focus group participants were used to develop a set of questions designed to assess current customer perceptions of barriers to HECAC in the market place. A total of 30 questions were asked of each respondent to address 10 barriers identified by the focus groups. Most barriers were measured by three questions, each rated on a scale from 1 to 10. Two barriers were measured by two questions, and one barrier was measured by five questions. The complete list of questions can be found in Appendix 4.

Approximately half the respondents in the AC survey sample were asked to respond to the barrier questions using a definition of high efficiency as 11+ SEER; the other half were given a definition of 14+ SEER. As described in section 4.6 below, the differences in responses were not statistically significant.

4.6 Market Barriers, Program Exposure, and Purchase Intentions

In this section we discuss barriers, and processes related to them, that occur at the customer level. Ideally, the study would have independently measured barriers as perceived by each set of market actors. Given the limitations in resources, however, it was deemed appropriate to focus on barriers as perceived by customers.

[5] Focus group members believe that Title 24 has raised the floor for building efficiency levels. At the same time, they note, the opportunity for tradeoffs, e.g., between HVAC efficiency and glazing ratios, has limited the overall impact of the code.

One of the guiding principles of this component of the study was that the customer's perception of market barriers to purchasing energy-efficiency equipment is a factor in decisions about those purchases. The importance of that focus lies in the idea that PG&E programs may have influenced market barriers as perceived at the customer level, and may influence them more strongly in the future. Because of the potential importance of market barriers, it was felt that measures of them should be part of a baseline study. This group of measures can serve as a starting point against which to measure the impact of future programs specifically aimed at changing markets. If program effects can be assessed by a survey of customers' perceptions of barriers, this could prove to be an effective method of demonstrating program impact.

One of the appropriate approaches to assessing the interrelations among program exposure, perceived barriers, and installation behavior is structural equation modeling (SEM). It should be noted that such a model was not initially proposed as part of this study; moreover, one of the key variables that would be included in such an analysis: installation of efficient equipment (installation behavior), was beyond the data collection scope of this study. Nevertheless, the relationship between program exposure and barriers was perceived to be of sufficient importance to warrant a more detailed investigation of the utility of this method for estimating the impact of programs on barriers and on customer behavior, through the barriers.

Because one of the major variables -- customer behavior -- was not measured in this study, another variable related to behavior -- customer intentions – was used. One might also expect market barriers to be negatively related to customer intentions of installing energy-efficient equipment, where a high score reflects high efficiency, and a low score indicates standard efficiency. However, it is probably not reasonable to expect the correlations between the barriers and the intentions variable to be as strong as with actual purchase behavior. This is because the customer may not be aware of how the 'barriers' will prevent him from purchasing energy efficient equipment until he actually enters the market. For example, he may not know that his first-cost orientation will result in purchasing standard equipment. This would become known only when the customer has occasion to really make a purchase and see what the price / efficiency trade-off is. Thus, in the following analyses, we treat the intentions variable much as we would treat a purchase behavior variable, but we recognize that it is a proxy and that actual behavior would be affected by other external constraints.

The remainder of this section reports on market barriers and on their relation to PG&E's interventions as well as customer purchase intentions. Standard bivariate methods, standard regression analysis, and a SEM method are presented.

The hypotheses about the relations between program exposure, barrier perceptions, and purchase intentions were that:

1. All of the barriers would be negatively related to program exposure; i.e., the more program exposure a company has had, the lower the barriers should be.

2. All of the barriers would be negatively related to willingness to install energy-efficient air conditioners; i.e., the lower the barriers, the more willing the company would be to purchase energy-efficient air conditioners.

3. Some barriers were expected to be more affected by program exposure than others.

The specifics of these expectations will be provided later in this section, after the barriers have been described. However, the principles behind the expectations were that:

1. While there was a wide array of PG&E programs delivered over the years, two aspects were common to many of the most widely known programs: Promotion; e.g., convincing customers of the value of energy-efficient versions of equipment, and Rebates; e.g., assistance in the first-cost problems associated with purchasing energy-efficient equipment.

2. Barriers most related to these aspects of the PG&E programs would be most correlated with program exposure.

4.6.1 Measurement

Completed interviews were obtained from 226 decision-makers within PG&E territory and 105 outside the territory. For this analysis, three types of variables were involved. The first category is program exposure. The second is perceptions of market barriers, and the final variable is the purchase intentions of customers.

Program Exposure

For any given customer, the most fundamental measure of program exposure is whether or not the customer was served by PG&E. It could be argued that everyone in PG&E territory has been exposed to some level of PG&E intervention. However, more specific measures were also obtained. One question asked respondents how often they had had contact with their utility by phone or in person in the last year. Response categories were: 0, 1, 2-3, or 4 or more. This question was asked of samples in both territories. The distribution on this variable is presented in Exhibit 4-7, broken down by territory.

Exhibit 4-7
Number of Contacts with Utility in the Past Year
By Territory

# of Contacts	PG&E Territory		Out-of-Territory		Total	
0	68	36.0%	41	42.3%	109	38.1%
1	27	14.3%	13	13.4%	40	14.0%
2 or 3	37	19.6%	16	16.5%	53	18.5%
4 or more	57	30.2%	27	27.8%	84	29.4%
Total	189	100.0%	97	100.0%	286	100.0%

One central measure of PG&E exposure for this analysis consists of a combination of the territory variable and the utility contact variable. The measure was coded 0 for all respondents outside of the PG&E territory since they were not exposed to PG&E intervention; for respondents within PG&E territory, the exposure measure was coded with the value of the utility contact variable, with one modification. Because the number of respondents who occupied the two middle values of 1 or 2-3 were low, these values were combined. The whole variable was coded 0, 1 or 2, and joined with the territory variable to generate this measure of exposure. Clearly, with this method, we are defining "exposure" as contact with PG&E.

A second measure of exposure was also used. The second measure is based on the same information contained in the first measure, but with additional information from program tracking system files. The interviewed sample was matched with three years of program records so that the number of actual program participation incidents could be counted. This second exposure measure was coded 0 for out-of-territory respondents; it was coded 1 for PG&E respondents who reported no utility contact and appeared in no program records. If the respondent's business appeared in program records, this exposure measure was coded with the number of appearances in the program tracking system. Thus, this variable shares a great deal of variance with the other measure of PG&E exposure. About 10 percent of the entire sample (about 15 percent of the PG&E sample) had some entries in the program tracking system. This measure of PG&E exposure is distinguished by indications of specific program participation.

Market Barriers

A total of 30 questions were asked of each respondent to measure market barriers that were found to be relevant to the purchase of high-efficiency air conditioners. These 30 questions addressed 10 barriers identified by focus groups. Most barriers were measured by three questions, each rated on a scale from 1 to 10. Two barriers were measured by two questions, and one barrier was measured by five questions. The specific questions associated with each barrier can be found in Appendix 4. The responses to these questions were well dispersed, with no unreasonable concentrations at the end points and mid point. Mean responses to the individual barrier questions, by territory, are presented in Appendix 6.

An aspect of the measurement of market barriers at the customer level is the fact that many questions that address real barriers can also reflect realistic assessments of the impracticality of purchasing high-efficiency equipment. For example, a customer may indicate doubt about a favorable payback for efficient equipment. This could represent performance uncertainties, or it could represent a realistic assessment of the equipment in the particular application needed. It was beyond the scope and budget of this project to make these kinds of distinctions, and there is, in general, an implicit assumption in the use of each question that it represents a barrier.

Because there was no expectation that the measured barriers were independent of one another, an exploratory factor analysis was completed to understand how they did vary together, empirically. A principal components analysis was done, using an orthogonal rotation. This analysis yielded seven factors that had eigenvalues of at least 1.0, explaining 53 percent of the variance. These factors were easily interpretable. Exhibit 4-8 shows the 30 questions, grouped by the seven factors plus four questions that were not clearly part of any one factor. Also shown are the loadings of each item on its primary factor, as well as the name of the factor assigned by the study team. The names, which are self explanatory, are listed here in order of the variation they account for: Financial Focus, Hassle Avoidance, Split Incentives, Operations Focus, Technological Ignorance, Suspicion, and Analytic Orientation. These factors form the basis of most of the analyses that address barriers in this study.

The factors were subjected to a scaling analysis to determine internal consistency. These Cronbach's alphas are also shown in Exhibit 4-8. Two of the reliabilities are clearly very low at .35 for Technological Ignorance, and .03 for Analytic Orientation. The rest range between .52 and .74. The lowest alpha of .03 alerts us to the fact that the Analytic Orientation factor does not qualify as a usable scale.

To address this, another factor solution was produced which limited the number of factors to six so that what appeared as Analytic Orientation in the seven-factor solution, would be eliminated. This solution, however, was less clear than the seven-factor solution. Our decision was to continue with the seven-factor solution, but with the expectation that Analytic Orientation would not perform well, and would not be suggested as the basis for any policy suggestions. It is shown in tables throughout this section for the sake of completeness. Another reason for leaving it in is to form the foundation for further investigation of the barrier in the future. It could be that such a factor exists, but needs further indicators to achieve an acceptable alpha.

Exhibit 4-8
Items in Each Factor
with their Factor Loadings and Reliabilities

Abbreviated Items	Factor Loading	Cronbach's Alpha
Financial Focus		.74
Difficult to find financing	0.750	
Don't see enough return on extra cost given energy prices	0.591	
Investing in EE would reduce other investment opportunities	0.527	
Financing not readily available	0.521	
Hard to figure out what to buy because of SEER etc	0.515	
ROI is quite uncertain	0.501	
Most important thing is initial costs	0.452	
Hassle Avoidance		.54
Choose whatever is easiest to install	0.676	
Always use larger units than specified	0.628	
No reason to be proactive in EE in today's economy	0.613	
Most important consideration is immediate delivery	0.496	
Split Incentives		.52
Savings wouldn't go to our company	0.744	
Unwilling to take risks involved in H-E	0.588	
People who make investments won't see benefits	0.541	
Operations Focus		.61
Most important operational issue is keeping costs down	0.699	
Most important thing is reliability	0.659	
Most important concern is use of same parts	0.553	
Replace with same model	0.441	
Technical Ignorance		.35
Don't worry about equip until it breaks down	0.633	
No one in company is an expert in performance	0.590	
There are risks of unanticipated problems and costs	0.551	
Suspicion		.61
Sales people push their manufacturer's products	0.715	
Dealers / contractors use desire for H-E to charge more	0.536	
Much of what they tell us about EE is exaggerated	0.786	
Analytic Orientation		.03
Include op and maintenance costs in initial calculations	0.667	
May be cheaper to change insulation or window use	0.520	
Unused Items		
Hard to get handle on benefits without detailed analysis		
Interchangeable units & parts more important than most efficient product		
When units break down no time to think of options		
Our supplier couldn't get quickly enough to avoid downtime		

The interviews all contained the same 30 barrier questions; however, the 331 interviews were randomly assigned to two conditions of the wording used to refer to energy-efficient air conditioners. In one condition, the respondent was told that "energy efficient" meant a SEER level of at least 11, while in the second condition, respondents were told it meant SEER of at least 14. This raises the issue of whether this difference in efficiency level affected respondents' answers in a systematic way. To test for this possibility, a Hotellings T^2 test was completed to see if the seven factor means, as a group, were different for the two different efficiency stimuli.

Overall, the means were not different by efficiency level; the probability associated with the difference between the means was .13. Individually, two factors approached significance, with probabilities of .088 for Financial Focus, and .059 for Split Incentives. It seems obvious that these would be the areas most susceptible to the difference in efficiency considered in the questions, as both are directly related to the amount of extra expense that would be attached to the purchase of the air conditioner depending on its level of efficiency. In addition, individual inspection of the differences between the means for each condition revealed very small differences. All of these results justified treating the groups together for further analyses.

Purchase intentions

This variable consisted of a question that asked the respondent what type of air conditioner would be purchased by the company if it had to be done today. The response categories provided were: 1) standard efficiency, 2) above average efficiency, and 3) very high efficiency.

4.6.2 Predictions

Having described the barriers as finally constructed, it is possible to explain the more detailed expectations for the relations among program exposure, market barriers, and purchase intentions.

The barriers expected to be most affected by program exposure were Financial Focus, and Split Incentives. This is because a major emphasis of the programs was on rebates, and these barriers were attacked directly by rebates, especially the Split Incentives barrier. The programs also contained a strong promotional element, and this element would be felt more in the Financial Focus area. This factor included statements about tradeoffs between savings and extra cost and uncertainties about ROI. These aspects would be expected to be more susceptible to the information or promotional elements of the programs. Thus, the Financial Focus barrier would be expected to be attacked on both fronts and would, therefore, show the strongest relation between exposure and barrier, followed by Split Incentives. The remaining barriers were ranked according to the expected program impact on them. In descending order they are: Suspicion, Technical Ignorance, Analytic Orientation, Operations Focus, and Hassle Avoidance.

4.6.3 Bivariate Results

Exhibit 4-9 shows the mean barrier scores by territory, the most rudimentary measure of PG&E exposure. For each mean comparison, a Levene's test for homogeneity of variances was performed to determine which version of the t-test to use. In each case, the appropriate t-test is shown in Exhibit 4-9. Overall, all barriers but one are higher *out* of the PG&E territory than they are *within*. The single exception is the Technical Ignorance barrier. Another consistent

characteristic of these comparisons is that the differences between the means, though consistent, are not large.

It is interesting to note that, not only are the barrier means somewhat different by territory, but the variances are as well. In most cases, the variance is larger for the PG&E-territory than for the out-of-territory sample. This likely reflects the programs' influence on a subset of customers; i.e., the programs do not affect all customers equally, but those who are most directly affected by programs probably move to a different point on the barrier continuum, leaving others where they were. This creates a wider divergence in scores and, thus, higher variance.

Exhibit 4-9
Mean Barrier Factor Scores
By Territory

Barrier	PG&E Mean	Out-of-Terr Mean	Mean Difference	Significance (2-tailed)
Financial Focus	4.94	5.31	.371	.088
Hassle Avoidance	4.29	4.34	.050	.818
Split Incentives	3.60	4.14	.537	.032
Operations Focus	6.50	6.59	.098	.651
Technological Ignorance	5.73	5.56	-.171	.480
Suspicion	5.62	5.96	.338	.170
Analytic Orientation	5.78	5.86	.078	.748

Exhibit 4-10 displays the correlations between the barrier factors and the continuous indicators of the program exposure construct. The barrier factors are listed in order of the size of their correlations with the program exposure indicators. As one would expect, the correlations are all negative for both indicators, indicating that the more exposure to PG&E programs the respondent had, the lower the barriers they perceived.

Exhibit 4-10
Correlations of Barrier Factors
With Program Exposure and Purchase Intentions

Barrier	PG&E Exposure	PG&E Program Participation	Level of Efficiency Anticipated if Installed Today
Split Incentives	-.181**	-.131*	-.143*
Financial Focus	-.109	-.128*	-.189**
Suspicion	-.096	-.096	-.058
Hassle Avoidance	-.073	-.024	-.153*
Technological Ignorance	-.053	-.005	-.167*
Analytic Orientation	-.030	-.033	-.004
Operations Focus	-.020	-.014	-.059

*Statistically Significant (2-tailed) at .05 probability
**Statistically Significant (2-tailed) at .01 probability

The factors that are most related to program exposure, and that are statistically significant with at least one measure of exposure are Split Incentives and Financial Focus. These are the barriers that were expected to be most impacted by PG&E's programs. Clearly, rebate programs address the Split Incentive barrier by offering compensation to the party who provides the capital but does not receive the benefits of monthly savings. Similarly, the rebate programs would be expected to have an effect on those who focus their concerns on the financial aspects of equipment decisions.

One of the reasons that hypotheses are generated before analyzing results is that the predictions and their theoretical basis provide power to the results when they conform to predictions. Those same results would not have that power if interpretations were simply imposed *post hoc* on the results. We therefore take the correspondence between prediction and results observed in this study as lending credence to the hypotheses.

It should be noted, however, that predicting results based on a theoretical rationale is not a guarantee that the correct explanation of the results has been found. There might still be alternative explanations than were offered in the hypotheses. For example, for Split Incentives, an alternative explanation for the negative correlation between this barrier and PG&E exposure is that respondents who face a split incentive situation (i.e., savings would not accrue to this respondent) would be less likely to be in contact with their electric utility. If this were true, we would expect Split Incentives and utility contact also to be negatively correlated in the comparison territory; we find, however that the correlation between number of utility contacts and Split Incentives is positive in the outside territory, suggesting that the original hypothesized explanation is more powerful.

Alternative explanations for the significant correlation between Financial Focus and Exposure would hinge on the firmographics of respondents who scored high on Financial Focus (i.e., cash and information constraints) making them less likely to seek out (or be sought out by) their utility. All other correlations between barrier factors and Exposure were in a negative direction, but statistically insignificant. The fact of the consistency in the relations is a powerful argument, in itself for the program effect, although the effect seems to be small.

While differential impacts of programs on barriers were expected, there was less reason to expect very different correlations between different barriers and purchase intentions. There was some reason to think that each barrier would be somewhat negatively related to customers' willingness to install energy-efficient air conditioners.

Four barrier factors were statistically significantly correlated with purchase intentions. They are: Financial Focus, Technological Ignorance, Hassle Avoidance, and Split Incentives. Two of these barriers are related specifically to the direct financial components of the decision. The other pair of barriers to the intent to purchase energy-efficient air conditioners are Technological Ignorance and Hassle Avoidance, and these also seem to share a common dimension. They imply a sense of customers being too busy to consider decisions on air conditioning in energy-efficiency terms. Air conditioners are generally unrelated to production or to income generation, and are therefore, not likely to be a focus of time and energy from the customer.

4.6.4 Standard Regression Analysis

A series of multiple linear regressions were estimated predicting purchase intentions with the barrier factors. These models explained approximately five percent of the variance in purchase intentions. Four percent of the variance can be explained by the Financial Focus barrier, and addition of three other variables, Technological Ignorance, Hassle Avoidance, Split Incentives, brings the explained variance to five percent. These results are reflections of the fact that the central factor is the Financial Focus barrier, and this factor is quite correlated with the other barriers. It is possible to add incrementally to the explained variance beyond the Financial Focus barrier, but the bulk of the explained variance can be related to Financial Focus. However, the standardized regression coefficients, which represent the unique predictive ability of each independent variable, were all similar in size for all variables.

4.6.5 Structural Equation Model

As indicated above, QC team considered it desirable to estimate a SEM model to illustrate the usefulness of the method. Since the ultimate dependent variable for such an analysis (actual purchases) was not the focus of this study, and was not measured, the variable "Purchase intentions" was used in its place.

Measurement Issues

Two qualities of the correlations among the model indicators foreshadowed problems in the model if all indicators that represented the established factors were included.

- The first is the fact that the original factor analysis, when calculated with an oblique rotation, showed that the factors were intercorrelated; i.e., there were no clear barrier factors strongly independent of the others. There were clear themes, but interrelated ones. This reflects the fact that the list of barrier indicators shows many substantial intercorrelations. Thus, we would expect linear dependencies to appear in a model that contained all or most of the barrier indicators.

- A second situation predicting difficulties in the model is the fact that the correlations among the barrier indicators were moderate and consistent, while some of the correlations between the barrier indicators and the latent variable of intentions were very small. This produces a situation in which the analyst must choose between reproducing the correlations among the barrier indicators or reproducing the correlations between the barrier indicators and the intentions variable. An illustrative example is a situation where there are five indicators of a barrier, and their intercorrelations are all at about 0.5. If, for example, three of the indicators are moderately correlated with the intentions variable, while two of them are only very slightly correlated with it, in order to reproduce the correlations between the barrier indicators and intentions, the model would have to assign very low factor loadings to the two barrier indicators that had small correlations with intentions. This solution, however, would result in a poor fit between the original and the reproduced correlations among the barrier indicators.

The first step in addressing these problems was to limit the consideration of barriers in the model to those that showed statistically significant correlations with the dependent variable,

Purchase Intentions. Thus, those items associated with Split Incentives, Financial Focus, Hassle Avoidance, and Technological Ignorance were retained for the SEM analysis.

The second issue listed above required a similar solution, i.e., the removal of items that were not related to the dependent variable. In this case, barrier indicators that had correlations of less than .1 were removed from the pool. Using the reduced pool, a new factor analysis was completed, first using an orthogonal rotation, and then repeating it applying an oblique rotation. Both methods produced the same factor structure. Two factors emerged, involving eight items. The first factor is clearly a Short-Term Orientation (STO) factor, indicated by four items unique to it, and two items shared with the second factor (See Exhibit 4-11). The second factor is a Financial Risk variable, indicated by two items unique to it, and two items shared with the STO variable.

Four items loaded approximately equally on both factors, and were omitted from further analysis. The final two factors are correlated (at r=.29), but at a lower level than the original factors. The elements that are correlated are explicitly acknowledged in the model.

While the above steps involving removing items were certainly necessary to estimating a good model (that would fit the covariance matrix), they had another effect that is worth discussing. By eliminating factors and individual indicators that do not correlate with the dependent variable, the model that uses the stripped-down barriers represents the relations with those barrier factors that are actually relevant to Purchase Intentions and appear to be core issues for customers.

Another issue that had to be addressed concerned the missing values experienced in the survey responses. While no one question had a large proportion of missing values, if we kept only cases with all legitimate values, less than half of the sample could be used. To address this issue, missing values were imputed using NORM software, which is an estimate maximization method. This method imputes missing values based on regressions of each target variable on the rest of the variables in the data set as a first step. The regressions are estimated based on the cases in the sample where all values are present. The first round of imputations occurs based on the initial regressions, and then a number of iterations of the process are completed until the residuals cease to change significantly.

When the predictions are complete, another step is taken to address the fact that strict adherence to predicted values results in over-prediction of the missing values. This step assigns randomly selected residuals from the earlier regressions to the predicted values. The randomization assures the approximation of randomness in the 'error' assigned to each value. The use of actual residuals from the regressions assures that the level of error assigned is in keeping with that actually present in the variables in the data set.

Exhibit 4-11
Final Factors Used in SEM
with Loadings

Questionnaire Item	Short-Term Orientation Factor Loading	Financial Risk Factor Loading
Most important thing is initial costs	.659	
Most important consideration is immediate delivery	.646	
Choose whatever is easiest to install	.616	
We don't worry about equipment until it breaks down	.543	
Don't see enough return on extra cost, given today's energy prices	.274	.583
Unwilling to take risks involved in high efficiency	.335	.553
Savings wouldn't go to our company		.714
There are risks of anticipated problems and costs		.681

A final step was taken to prepare the indicators for the analysis. This was the assignment of a portion of the variance in the Intentions variable to measurement error. When there is more than one indicator for a latent variable, it is possible to estimate the measurement error associated with that variable, and the structural equation model typically does that. However, when there is only one indicator for a variable, it is impossible for the model to estimate measurement error. The estimation of measurement error allows a more realistic estimate of the structural relations of the model, since it is unrealistic to think that any one indicator measures a construct without error. Because there was only one indicator of Purchase intentions in the collected data, an estimated error was assigned to that construct. Sensitivity analyses were conducted to determine the effect of changing the assigned error, and it was found that the model results are robust over all error assignments within the range of 0 through .3 (further tests beyond .3 were not conducted). For the final model, an error of .2 was used.

Results

One model was estimated using as mediating variables those factors that showed significant correlations with the dependent variable. The indicators of the barrier constructs were used exactly as they appeared in the exploratory factor analysis. This model did not provide an acceptable fit with the covariance matrix. This model was followed by the estimation of the final model which used the new factors that emerged after eliminating the indicators that did not correlate with the dependent variable. Thus, only two models were ultimately specified and estimated.

Exhibit 4-12 shows the results of the second model and reflects what the QC team's predictions were. The model represents the expectations that the effect of Exposure on Purchase intentions would work entirely through the barriers, with little or no direct effects. It was also anticipated that, similar to the earlier bivariate analyses, the Financial barrier would be more subject to influence by Exposure, and STO would be much less influenced, if at all. Effects from both barrier factors on Purchase intentions were expected. The disturbance terms for the two barrier constructs were allowed to correlate because it was known that the latent constructs were correlated, and because there was no reason to think that the Exposure construct would explain the entire correlation between the two barrier constructs.

Overall, the model fit was good. The chi-square was not significant (p=.55), and the fit indexes were good. The GFI (Goodness-of-Fit Index) was .98. This measure compares the observed covariance matrix with the null model matrix. The GFI is the proportion of variance in the observed matrix that is explained by the reproduced matrix. The AGFI was .97. This measure is similar to the GFI but it is adjusted for model's complexity. The NFI (Normed Fit Index) was .94. This measure is based on the chi-squares of the null model compared to the observed model, normed by the null model chi-square. The NNFI (Non-Normed Fit Index) was 1.00.

These results compare to the following results for the first model estimated. In that first model, the GFI was .89, the AGFI was .86, the NFI was .75, and the NNFI was .80. These values were not extremely low, but the standard criterion for judging a good fit are for each of these measures to be at least .90. Clearly the re-specified model was an improved fit, and exceeded the standard criteria of acceptable fit.

Measurement Model

The two indicators of Exposure showed factor loadings of .95 (p=.05) for the indicator that excluded program tracking system content, and .76 (p=.03) for the indicator that included tracking system information.

Almost all of the barrier indicators had factor loadings onto the constructs of least .4, the exceptions being for those indicators that were shared by both constructs. The probabilities associated with the loadings were all close to .20.

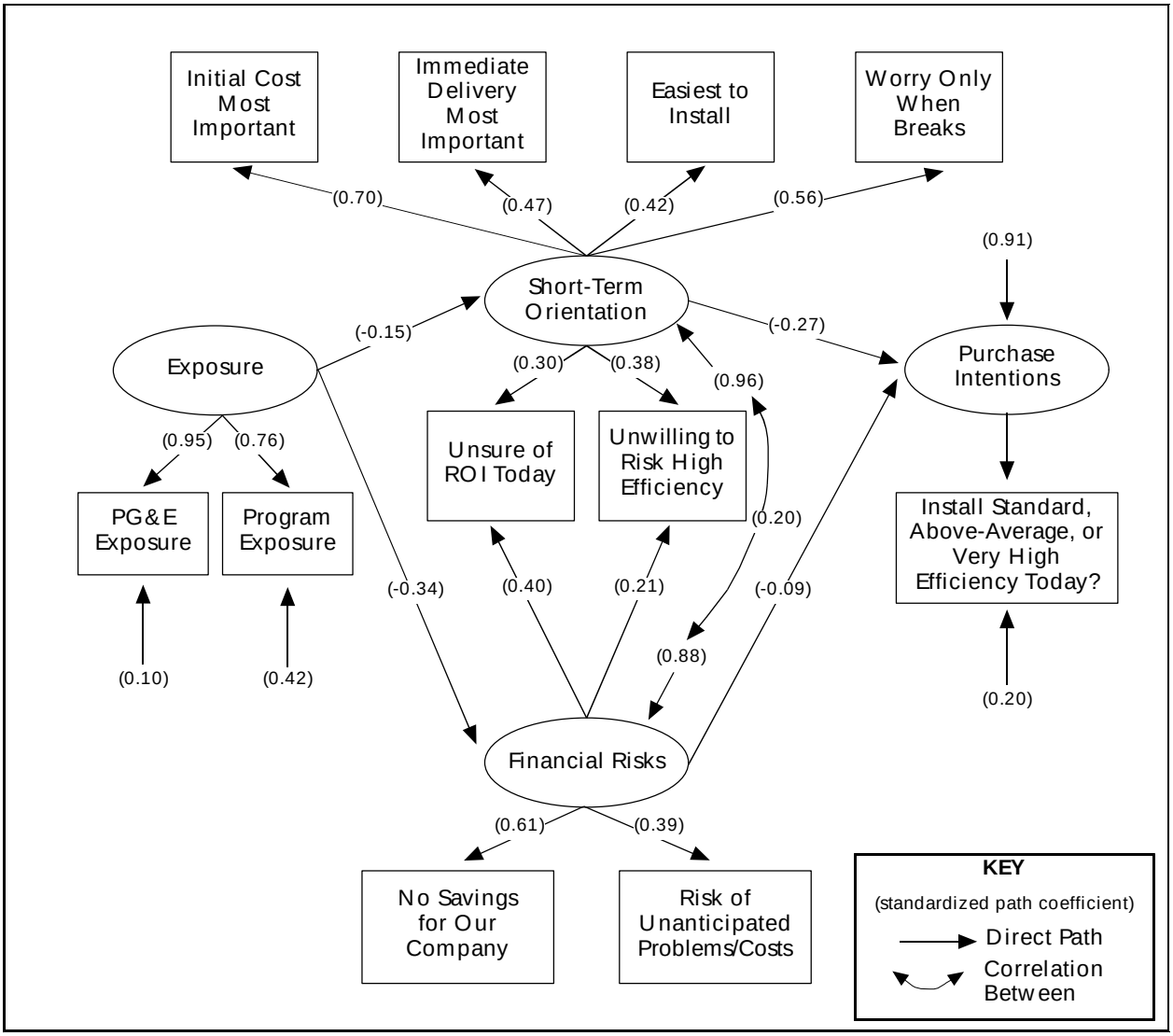
Structural Model

The standardized path coefficient from Exposure to Financial Risk was -.34 (p=.09) and from Exposure to STO was -.15 (p=.07). The relatively strong relation between Exposure and Financial Risk was expected; the relation between Exposure and STO was expected to be weak and it was. Certainly it is not impossible to explain an effect of PG&E programs on STO, since programs typically call attention to the long-term effects of energy-efficient purchases. Such messages could have had an impact on customers' exclusive reliance on short-term thinking. Still, the thrust of the programs was generally on the financial benefits of energy efficiency.

The coefficient from STO to Purchase intentions was moderate at -.27 (p=.08), and much larger than that between Financial Risk and Purchase intentions, which was only -.09 (p=.09). This pattern may imply that customers can anticipate the effect of their short-term focus on their purchasing behavior, while they are less able to do so in the financial risk area. This dominance of STO over Financial Risks may seem to contradict the results of earlier analyses where

Financial Focus seemed to dominate all other factors. However, in this model, the residuals of the Financial Risk construct (slightly different from Financial Focus) and the STO construct were allowed to correlate. This had the effect of removing a substantial portion of the variance shared by the two constructs, so that variance was no longer available to explain the Intentions construct. Only the unique variance of STO and Financial Risk appear in the predictive paths to Intentions. When only the unique variance is available, the STO construct dominates the prediction of Intentions.

Exhibit 4-12
Structural Equation Model Results
Exposure, Barriers, and Purchase Intentions



Another way to look at the results of the model is that, while the PG&E programs had the most impact on the perceptions of financial risk, short-term orientation has the most impact on intentions. It is, of course, impossible to know how the model would look if the dependent variable were actual installation decisions.

The overall performance of the model can be partially captured by considering how much of the variance in each endogenous variable was predicted by its antecedents in the model. About 12 percent of the variance of the Financial Risk construct was explained by Exposure, only two percent of the STO construct was explained by Exposure, and nine percent of Purchase intentions was explained by the two barrier factors.

Perhaps the most important pattern in the model is the fact that all hypothesized paths are negative. This is exactly what should be anticipated, and it is reassuring about the basic appropriateness of the model.

4.6.6 Summary

The analysis of customer-perceived market barriers to the installation of energy-efficient air conditioners revealed seven barrier factors:

- Financial Focus,
- Hassle Avoidance,
- Split Incentives,
- Operations Focus,
- Technical Ignorance,
- Suspicion, and
- Analytic Orientation.

The factors, while identifiable as separate dimensions, were still substantially correlated. The means and variances of these barrier factors differed across territories, although the differences in the means were small. The means outside of PG&E territory were consistently higher for all but one barrier than those in the territory.

Using the continuous versions of PG&E program exposure variables revealed consistently negative correlations between them and market barriers. The highest correlations were Exposure with:

- Split Incentives (-.131)
- Financial Focus (-.128)

These correlations were also statistically significant with probabilities less than .05.

Four of the seven market barriers were correlated with Purchase intentions (intentions concerning level of efficiency to be installed) at statistically significant levels:

- Split Incentives (-.143)
- Financial Focus (-.189)
- Hassle Avoidance (-.153)
- Technological Ignorance (-.167).

Entry of these barriers into a standard linear regression model resulted in explaining five percent of the variance in Purchase intentions.

Structural Equation Modeling provided somewhat different, but consistent results compared to the bivariate and standard regression techniques. This approach required removing substantial redundancy in the measurement of the barriers. It also required increasing the consistency of the performance of latent construct indicators in terms of their correlations with the dependent variable. These increases in consistency resulted in two barrier constructs that could be tested in a model. The barriers considered were:

- Financial Risk and
- Short-Term Orientation

These two barrier constructs were tested as mediating variables between the construct of Exposure and Purchase intentions. The model showed a good fit with the covariance matrix (chi-square probability=.55, GFI, AGFI, NFI, and NNFI were all over .94. The results of the model showed:

- Exposure to PG&E programs over time most influences perceived Financial Risks (standardized coefficient =-.34)
- Exposure had a smaller effect on STO (standardized coefficient =-.15)
- STO had a larger effect on Intentions (-.27) than on
- Financial Risk (-.09).

An implication of this finding is that the program had the most impact on perception of financial risks, but short-term orientation had a bigger impact on purchase intentions. It is important to remember, however, that purchase intentions cannot be taken to represent actual purchase behavior. It is likely that customers do not recognize the impact of the barriers on their decisions until actually faced with the concrete consequences of those decisions.

Overall, the analysis of customer-based measures of market barriers and purchase intentions showed:

- There are several identifiable market barriers experienced at the customer level, and the barriers are intercorrelated,
- There are small but consistent effects of PG&E programs on barriers,
- There are small but consistent effects of barriers on purchase intentions,
- The most consistent barriers across analyses show customers to be concerned with financial issues and with the fact that they don't have the time or expertise to give energy-efficiency much consideration. This is underlined by a demarcation between companies that operate on a short-term or a long-term orientation, with those whose

orientation is short term showing less intention of purchasing more energy efficient air conditioners.

Since all relations were in the appropriate direction for every analysis conducted for this report, there is reason to have some confidence that the effects are real, if small. The size of the effects can be related to several factors.

- First, the dependent variable was not the actual variable of most interest: purchase behavior.

- Second, the PG&E programs under consideration were not designed to change the way commercial and industrial customers think about energy-efficiency decisions. These analyses were presented primarily for illustrative purposes, and would be expected to show stronger effects for programs with a more explicit market transformation focus.

5. RESULTS - CHARACTERIZATION OF MOTORS MARKET

5.1 Baseline Market Size and Structure

Motors are used in nearly every type of equipment application in the United States. In the US industrial sector, more than 70 percent of all electricity consumption involves motors. Motors are sold in hp ranges from less than 1 up to 1000. However, the bulk of installed motor horsepower is between 10 and 100 hp. Most such motors are used in the industrial market, although commercial applications such as air handling also use motors in this size range.

Several recent regulatory changes have significantly affected the motors market. Most industrial motors produced in the U.S. after October 24, 1977 are required to operate at efficiency levels prescribed by the Energy Policy Act of 1992 (EPAct). These efficiency levels have not been difficult for manufacturers to attain, and are in fact generally lower than the premium efficiency motors available on the market for years.[6] Their primary impact is expected to be felt in standard industrial applications and production machinery supplied by Original Equipment Manufacturers (OEMs), where standard efficiency motors have traditionally been the norm.[7]

5.2 Baseline Market Structure and Information Flows

The sales process for motors is fairly complicated, with motors often passing through a network of OEMs and various types of distributors before they are sold and installed as part of an overall production or space conditioning system. As noted previously, the current study focuses on motors in the 10-100 hp range in non-OEM applications. Major groups of market actors and their roles in this market are discussed below.

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[6] The definition of energy efficient motors provided to suppliers when they were surveyed for this study was taken from the National Electrical Manufacturer's Association (NEMA) Table 12-10. Nominal efficiency of 91 percent is required for a 20 hp, 4-pole or 6-pole open motor to qualify as "energy efficient."

[7] Energy User News, June 1998, p.28

Manufacturers

The market for the motors under consideration here is shared by several dozen national and international manufacturers, almost all of whom are represented in PG&E's service territory. None of the major brands have manufacturing/assembly facilities in Northern California, although several have plants in the Southern part of the state. One of the barriers to successful transformation of the motors market cited by PG&E program staff was the fragmented nature of the motors market; there do not appear to be clear market leaders who can be targeted because they will subsequently influence the rest of the market.

All the major manufacturers do offer a complete line of motors that encompasses premium efficiency models for most applications. Among the motor dealers who participated in two focus groups in Northern California, availability of high efficiency motors from manufacturers was said to be ample. Architectural and engineering firms also rated the availability of high efficiency motors, providing a mean answer of 5.1 on a 6-point scale in response to the question, "How available were high efficiency motors from manufacturers in 1997?"

Motor manufacturers have traditionally relied on a network of distributors and dealers to supply the entire U.S. market, but this may be changing as fewer dealers seem willing (or able) to stock the wide range of motors that may be demanded by end users. In the focus groups held with motor distributors, some complained that certain manufacturers appeared willing to sell directly to end-users, so long as the end-user had at least two facilities—even if those facilities were widely separated geographically. Other participants noted the proliferation of "alliance" programs uniting large end-users in exclusive purchasing and service arrangements with suppliers.[8]

Manufacturers and their advertising were cited less frequently by customers as primary sources of information on motors technology than were distributors. Only 7 percent of respondents in PG&E's territory and 4 percent of respondents in the no-program territory cited manufacturer advertising as a primary information source – although the trade magazines where manufacturers advertise heavily were very influential (see exhibit 5-5, below). Motor dealers who participated in the focus groups did say that advertising by manufacturers has increased customer awareness and receptivity to premium, motors. Manufacturers' increases in warranty length for premium motors were also noted as an important factor in increasing customer perceptions of the value of such motors.

Distributors

In Northern California, Dun and Bradstreet identifies a total of 91 firms classified by their SIC code as motor distributors (SIC 5063-9905) or motor repair shops (SIC 7694). Their size, in number of employees, is summarized along with comparable data for architectural and engineering firms in Exhibit 5-1.

[8] These arrangements reduce the needs of end-users for large purchasing departments and simplify their accounting requirements. At the same time, the aggregators gain market power relative to the manufacturers. In turn, the manufacturers become less responsive to their traditional distributors and representatives.

According to focus group participants, distributors are far less likely to carry a complete stock of motors today than they might have been in the past, and most participants in these focus groups do not carry extensive inventories of motors. Essentially, there are too many variations in motor size, configuration, rpm, etc., to permit the creation of a strategic inventory. Moreover, many of the end-users for whom downtime is the most critical carry their own inventory of spare motors. Accordingly, there is little competitive advantage in being able to meet a customer's needs immediately, even during night or weekend hours. In addition, most discussants reported, whatever standard motors[9] are needed are readily available—no more than two days away—from supply houses or the manufacturer. The current attitude toward stocking was epitomized by one discussant who said that inventory represents "a record of mistakes"—orders that were not consummated or bad guesses as to what would be likely to sell.

The lack of extensive inventories may help the market for premium efficiency in the long run. Since neither standard (i.e., EPACT) nor premium motors are kept in stock, buyers are less likely to be induced to buy standard models because of their immediate availability.

Exhibit 5-1
Northern California Market Actors – Motors

No. of Employees	**Dealers/ Distributors**	**A&E Firms**
1	14	833
2 to 4	30	1,912
5 to 9	22	414
10 to 24	17	252
25 to 49	6	85
50 to 99	2	33
100 +	0	25
Total	91	3,554

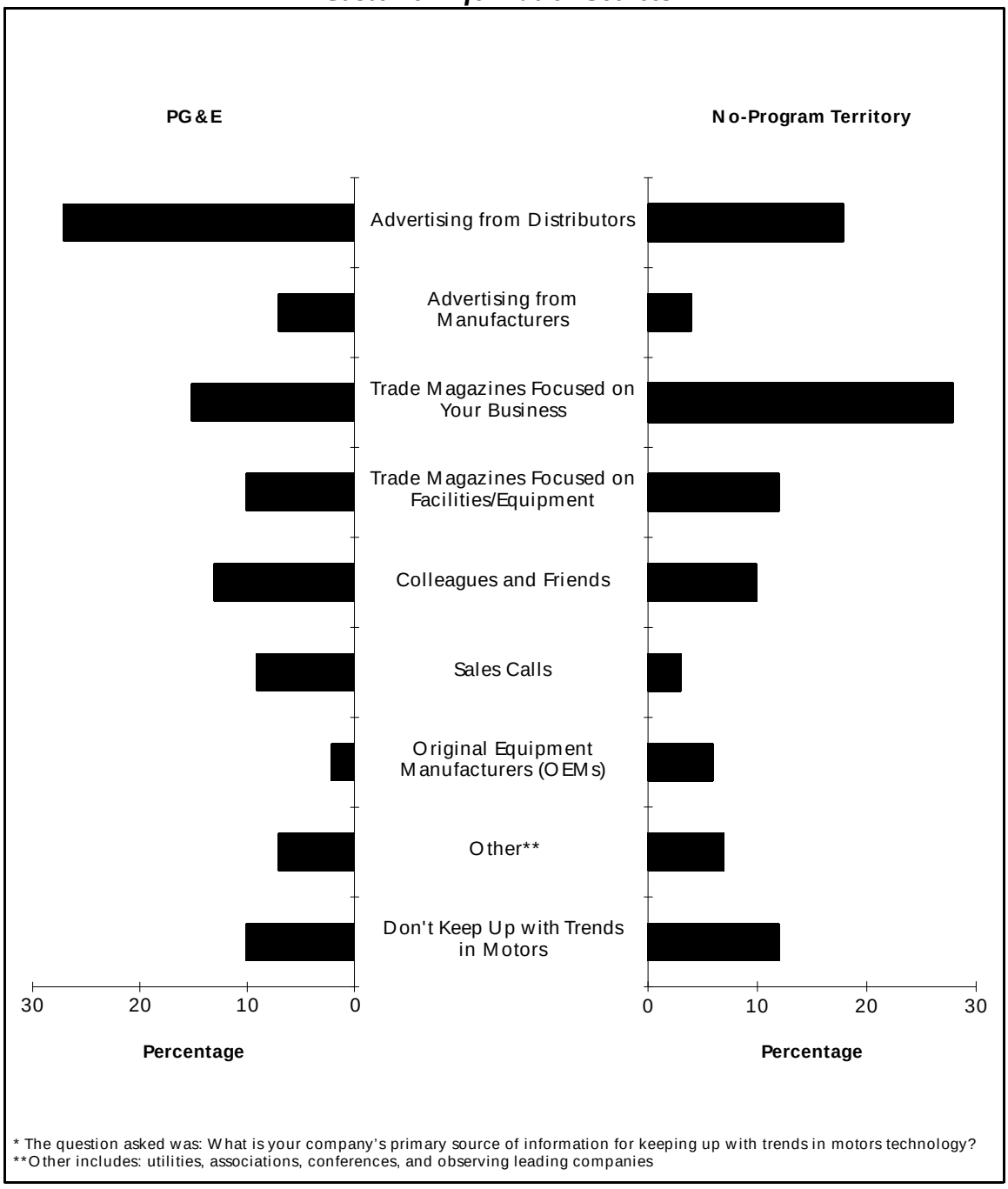
Because a typical customer more often replaces a motor than an air conditioner, relationships between dealers and customers tend to be more important than in the HVAC market. This relationship has been undermined somewhat in recent years as more manufacturers attempt to sell directly to end users or groups of end users. Nevertheless, motor dealers remain an important source of information and influence. Distributor advertising and sales calls were cited by a total of 36 percent of PG&E survey respondents (and by 21 percent of respondents in the no-program territory) as their primary source of information for keeping up with motors technology (see Exhibit 5-2).

[9] This discussion omits motors that are specially designed for unique applications. These may require several months from order to delivery. The problems arise with close-coupled motors and particular bases or frames. Within the parameters of T-frame motors in the 10 hp to 100 hp range, no difficulties exist.

Focus group results tend to reinforce the importance of distributors in disseminating information. Many of the participants in these sessions believe that they can increase the market for premium motors through continued efforts at educating buyers. The willingness to devote time and effort to do so varies among market actors. Some see educational efforts as a service to their customers and a way of showing their interest in providing service and good advice. For others, the limited profit available from sales of motors in the range highlighted and the concern that their prices will be undercut are major deterrents to spending time and effort with most customers.

A more extensive discussion of the market for premium efficiency motors from the perspective of distributors and other dealers is found in the complete discussion of the focus groups in Appendix 2.

Exhibit 5-2
Customer Information Sources*



* The question asked was: What is your company's primary source of information for keeping up with trends in motors technology?
**Other includes: utilities, associations, conferences, and observing leading companies

Architects/engineering firms

Design professionals, including both consulting engineers and architectural firms, are involved in the motors market to the extent that they specify the size, type, and efficiency of equipment to be installed. On average, A&E firms reported that fewer than 20 percent of their projects include motors specifications; 40 percent of respondents said that none of their projects involved motors. Only 15 percent of A&E respondents indicated that motors specifications occurred in 50 percent or more of their total projects in 1997. In other words, a relatively small

subset of the designer population tends to focus on motors, while other firms ignore motors entirely, subcontracting out any motor-related work that comes their way.

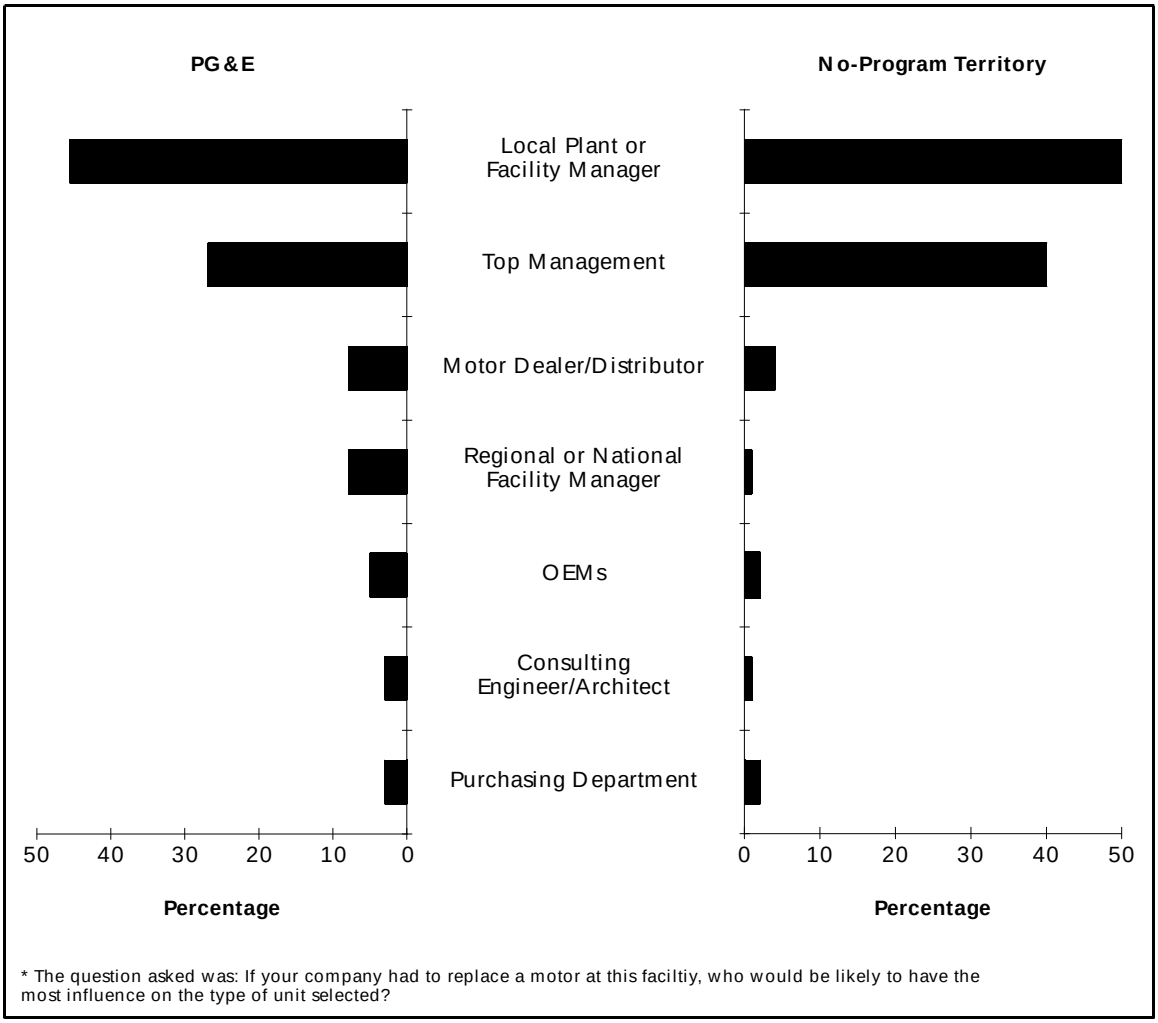
The role of A&E firms in the market varies: for plant construction or renovation projects, they often specify the type and efficiency of motors to be installed; they are less influential in the replacement market. Among surveyed customers in PG&E's service territory, only 3 percent said that a consulting engineer or architect would have the greatest influence on the type of equipment selected; in the no-program territory, only a single respondent (1 percent) provided this response (see Exhibit 5-3).

Those firms that do specify motors consistently said that all or almost all of their motor specifications were for high-efficiency models. This is not surprising; while non-EPACT motors may still be in the supply pipeline, it would be unreasonable for a specification to rely on the availability of these standard motors where EPACT efficiencies are mandated.

Several focus group participants noted the importance of utility and other educational efforts that appear to have reached design engineers. According to the focus group participants, these design professionals tend to dominate the selection of many new installations and, because of the influence of utility programs, they all now specify top of the line, premium motors for their clients.

The importance of utility contact in influencing the design community is confirmed by the results of surveys with these market actors. Among the A&E firms surveyed, 56 percent of those in PG&E's service territory and 42 percent of those in the comparison territory reported having contact with their utilities at least twice last year. While some of these contacts could be prompted by new electric service issues, it is worth noting that 63 percent of the A&E firms within PG&E's service territory were aware of some of PG&E's energy conservation programs, and 70 percent of these recalled helping customers participate in such programs.

Exhibit 5-3
Customer Decision Influences*



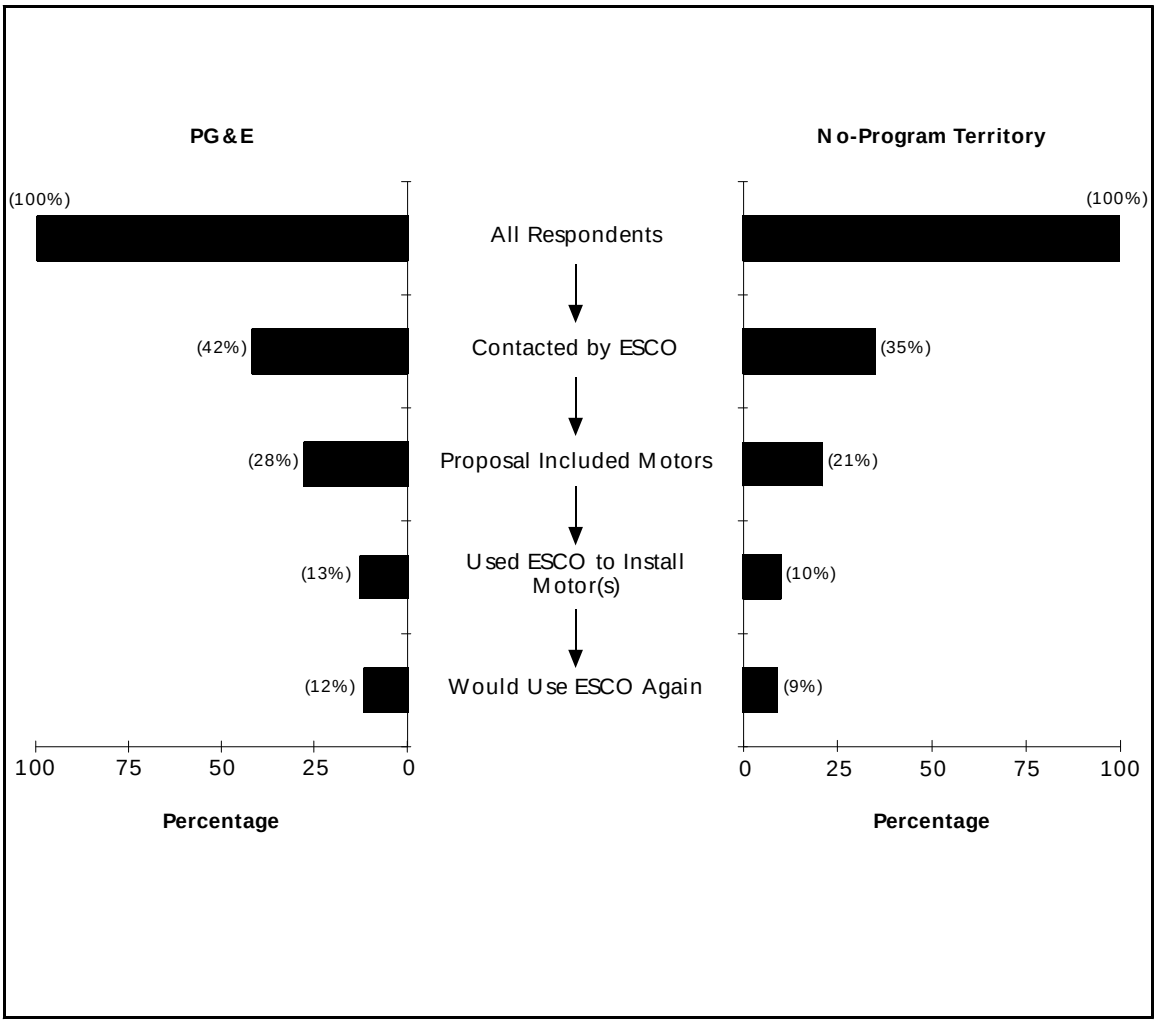
* The question asked was: If your company had to replace a motor at this faciltiy, who would be likely to have the most influence on the type of unit selected?

Energy Service Companies (ESCOs)

Among the Energy Service Companies (ESCOs) interviewed, few have focused on motor applications, per se. While motors may be a part of an overall energy efficiency package, the ESCOs interviewed said they choose to rely on motors experts on a subcontractor basis for such projects.

Survey results indicate that 12 percent of PG&E and 9 percent of comparison territory motor customers have used the services of an ESCO to install motors. Of the respondents who had used an ESCO, 90 percent (in both territories) planned to do so again (see exhibit 5-4).

Exhibit 5-4
Use of ESCOs for Motor Installations



Overall, a higher proportion of PG&E respondents (42 percent vs. 35 percent) reported having been contacted by an ESCO. PG&E customer were also more likely to have had motors included as part of an ESCO's proposal. None of the customer surveyed in either territory, however, cited ESCOs as their primary source of information or as having the greatest influence on their motors selection.

Customers

In discussing the end user market for motors, dealers and distributors who participated in the focus groups reported that larger industrial customers in the Northern California market are highly aware of the benefits of premium efficiency motors. Because these buyers typically use life cycle costing and recognize the additional value of premium motors, they tend to buy them when replacing any motors over 50 hp.

Smaller customers, on the other hand, continue to purchase less efficient motors, especially for low horsepower (25 hp and below) applications. Market actors who specialize in these smaller

motors report that the great majority of them are sold to relatively unsophisticated end-users for applications that are highly routinized. In this context, motors are treated as a pure commodity item and purchase decisions are made based on first cost.

These and other customer segments obtain information regarding motor technologies from a wide range of sources. In addition to those cited earlier (i.e., distributors, manufacturers), word-of-mouth continues to be a powerful information source. Approximately 13 percent of PG&E customers and 10 percent in the no-program territory consider colleagues and friends their most important information source. PG&E customers were statistically significantly more likely to rely on advertising to keep up with motors trends than their no-program territory counterparts (34 percent vs. 22 percent) and less likely to rely on trade magazines focused on either their business or facilities management (25 percent for PG&E; 40 percent for the no-program area). OEMs were cited as the primary source of information by just 2 percent of respondents in PG&E's service territory and by 6 percent in the no-program territory.

5.3 Baseline Product/efficiency Mix

Key characteristics of the installed base and installation of 10-100 hp motors for PG&E customers and the comparison territory are summarized in Exhibit 5-5. Note that the PG&E customers surveyed had an average of 20.6 motors in the 10-100 hp range, while those in the comparison territory had an average of 15.3 – not a statistically significant difference. The comparison territory customers did, however, report a statistically significantly higher proportion of motors with ASDs: 31.6 percent vs. 16.6 percent for PG&E customers.

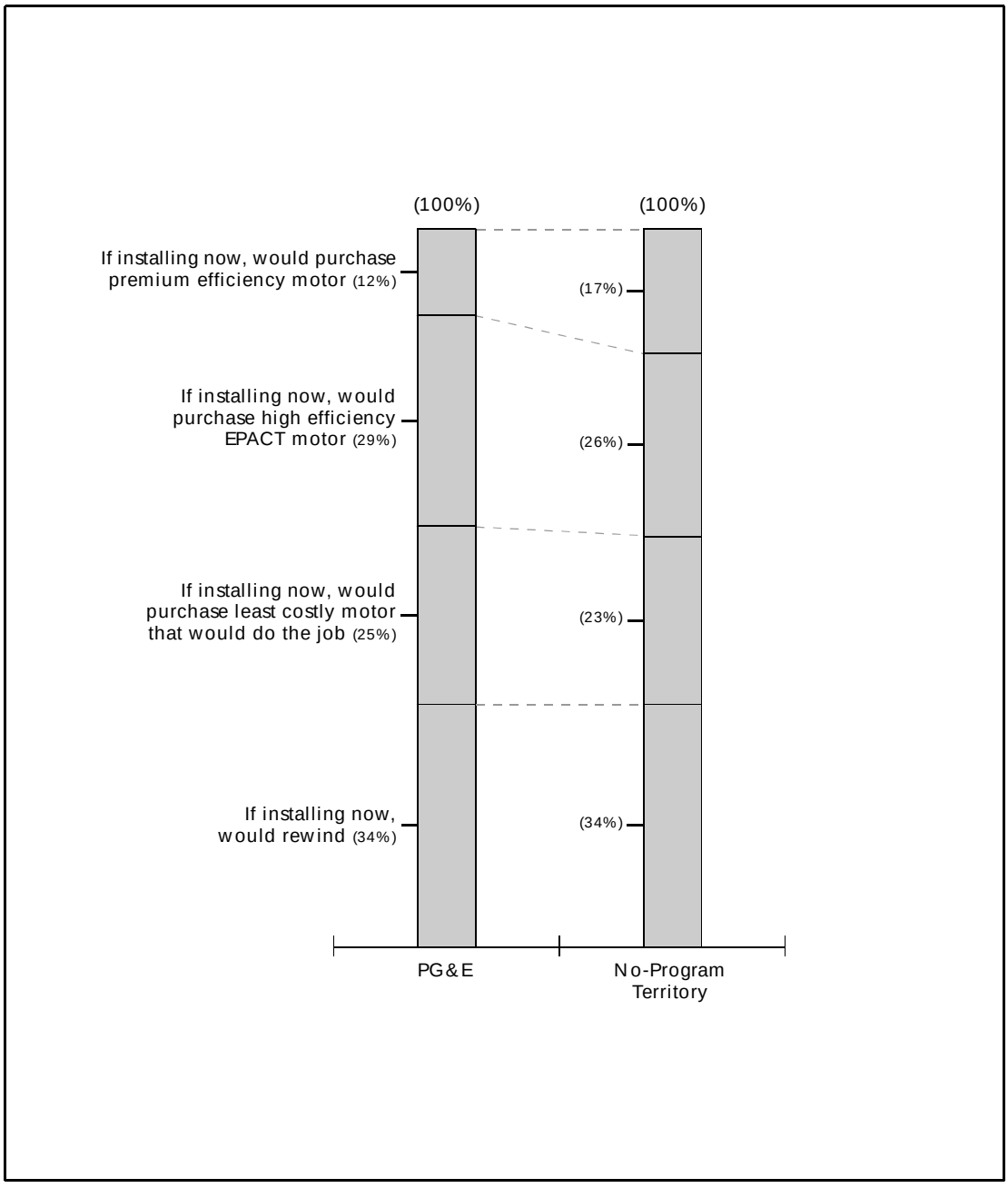
The average number of motors purchased or rewound since January 1, 1996 was higher among PG&E customers – in part because almost 60 percent of PG&E customers had installed motors, while only about 49 percent of no-program territory customers had done so. Among those who had installed motors, relatively few were able to provide an efficiency level (standard, high, premium). For the 14 PG&E territory and 21 no-program territory respondents who were able to do so, however, the distributions were very similar (the results are not presented here because of the small sample sizes).

Exhibit 5-5
Motor Installations and Replacement Actions

Installations and Actions	Territory	
	PG&E	**No-program**
Mean Number of Motors per Facility	20.6	15.3
Percent of Installed Motors with ASD	16.6	31.6
Number of Motors Purchased Since 1/1/96		
Mean	4.8	2.8
Percentage Breakdown	**%**	**%**
0	40.6	51.5
1-4	33.7	30.2
5-9	9.1	10.7
10-24	14.4	6.2
25-99	1.1	1.4
100+	1.1	0.0

Given these small sample sizes and the difficulty of collecting and verifying this efficiency information for recently installed motors, survey respondents were asked about the action they would take if they were replacing a 10-100 hp motor right now – including the option of purchasing various kinds of new motors (cheapest available, efficiency level specified by EPACT, premium efficiency) as well as rewinding. Overall, a slightly higher proportion of no-program than PG&E territory customers said they plan to install motors in the next year (36 percent vs. 29 percent). A somewhat higher percentage of no-program territory customers also indicated that they would install premium efficiency motors (see Exhibit 5-6.)

Exhibit 5-6
Efficiency of Planned Motor Installation



Note that approximately one-third of customers reported that they would be likely to rewind the motor rather than purchase a new one. To gain additional insight into the rewinding behavior of customers, respondents were asked at what horsepower level they consider rewinding rather than replacing motors and, above that critical level, what percentage of motors were rewound. The results are shown in Exhibit 5-7.

Exhibit 5-7
Rewinding Practices

Motor Size at Which Rewinding Considered	Territory	
	PG&E %	No-program %
Never Rewind	22.1	38.6
2 - 9 horsepower	22.6	8.1
10 - 24 horsepower	31.9	27.2
25 -49 horsepower	8.6	9.1
50 - 99 horsepower	10.8	12.4
100+ horsepower	3.9	4.5

A statistically significantly lower percentage of PG&E customers said their firm never considers rewinding (22.1 percent vs. 38.6 percent). PG&E customers were also significantly more likely to consider rewinding motors under 10 horsepower, with some rewinding motors as small as 2 horsepower (no respondents said they considered rewinding motors smaller than 2 hp). For those customers who do rewind, the percentage of motors rewound was not statistically significantly different (mean of 55 percent for PG&E; 50 percent for the comparison territory.)

Based on the above results, it appears that rewinding continues to be a barrier to energy efficiency from the customer perspective. The extent to which the popularity of rewinding is also a barrier on the supply side was indicated by one of the focus group participants, who said that he had translated his motors inventory into stocking wire for doing rewinds, because that affords him considerably more profit.

Motor dealers in Northern California and in the comparison territory provide an added indication of the current motor efficiency mix, bearing in mind that data for PG&E's territory were collected only from the small, geographically concentrated sample of focus group participants. In both territories, fewer than 10 percent of 10-100 hp motors sold (5 percent in PG&E territory; 7 percent in the comparison area) were standard efficiency. Northern California motor dealers did report a higher percentage of motors sold with adjustable speed drives in 1997 (27 percent, vs. 8 percent for the no-program area). It should be recalled that because of the small sample sizes, the differences between territories are not statistically significant.

Those design firms interviewed who specify equipment for industrial customers provide another perspective on the baseline efficiency mix. While not enough respondents were able to provide quantitative data on the percentage of premium motors specified, several noted that they routinely specify premium efficiency – a finding that is consistent with the focus group

results. Any efficiency gains achieved through the specification of a high proportion of energy efficient motors for new construction and major plant renovations may be sustainable and permanent – especially if like-for-like replacement policies ensure that efficient models are installed when new motors are needed in the future.

5.4 Baseline Practices/barriers

The focus groups, described earlier and summarized in detail in Appendix 2, provided extensive insights into current practices and the overall level and types of barriers to premium efficiency motors.

In discussing barriers to the sale of premium motors, vendors report that several changes in the market can be seen over the past 4-5 years, and several factors have remained constant. The changes include the following.

- Although many customers who require education regarding the improved technology and its benefits remain, considerable progress has been made—particularly among larger customers. Moreover, among customers who are aware of the technology and its benefits, life cycle costing is accepted. Customers become acclimated to the costs of premium motors (thus reducing the effect of "sticker shock"). In addition, the educated user is now motivated by the additional savings available from the use of premium motors.

- Although discussants did not cite performance reliability as a major concern in the past, they believe that both actual reliability and its performance by customers have improved considerably.

- As the acceptance of premium motors has grown among end-users, so too has the willingness of market actors to recommend those motors in bids, at least as an option. And, as noted earlier, some are willing to take on the task of attempting to educate other end-users regarding the selection of premium motors.

At the same time, several barriers to premium efficiency do appear to remain in this market.

- Although the use of life cycle costing has increased, participants estimate that 75% of all customers still focus on first cost, and that this percentage rises to 90% when motors 25 hp and under are considered.

- The prevalence of purchasing agents rather than engineers has not changed—in addition, downsizing at many corporations has eliminated a cadre of knowledgeable engineers and other specialists who could understand the relevant technical issues in motor selection.

- Although the technology is now older and more mature, changes in existing facilities may still be viewed as risks to be avoided by those not confident of their expertise.

When discussing observed changes in market barriers to the sale of premium motors, dealers cite two major reasons for the changes they have observed in the premium motors market in Northern California.

- The most important of these, in their opinion, is the rebate program conducted by PG&E. The rebates helped to draw the attention of customers to the technology and provided the market actors with a lever to promote the sales of premium motors. Furthermore, the rebates helped bypass the first-cost orientation of the buyers once they were willing to consider the new technology.

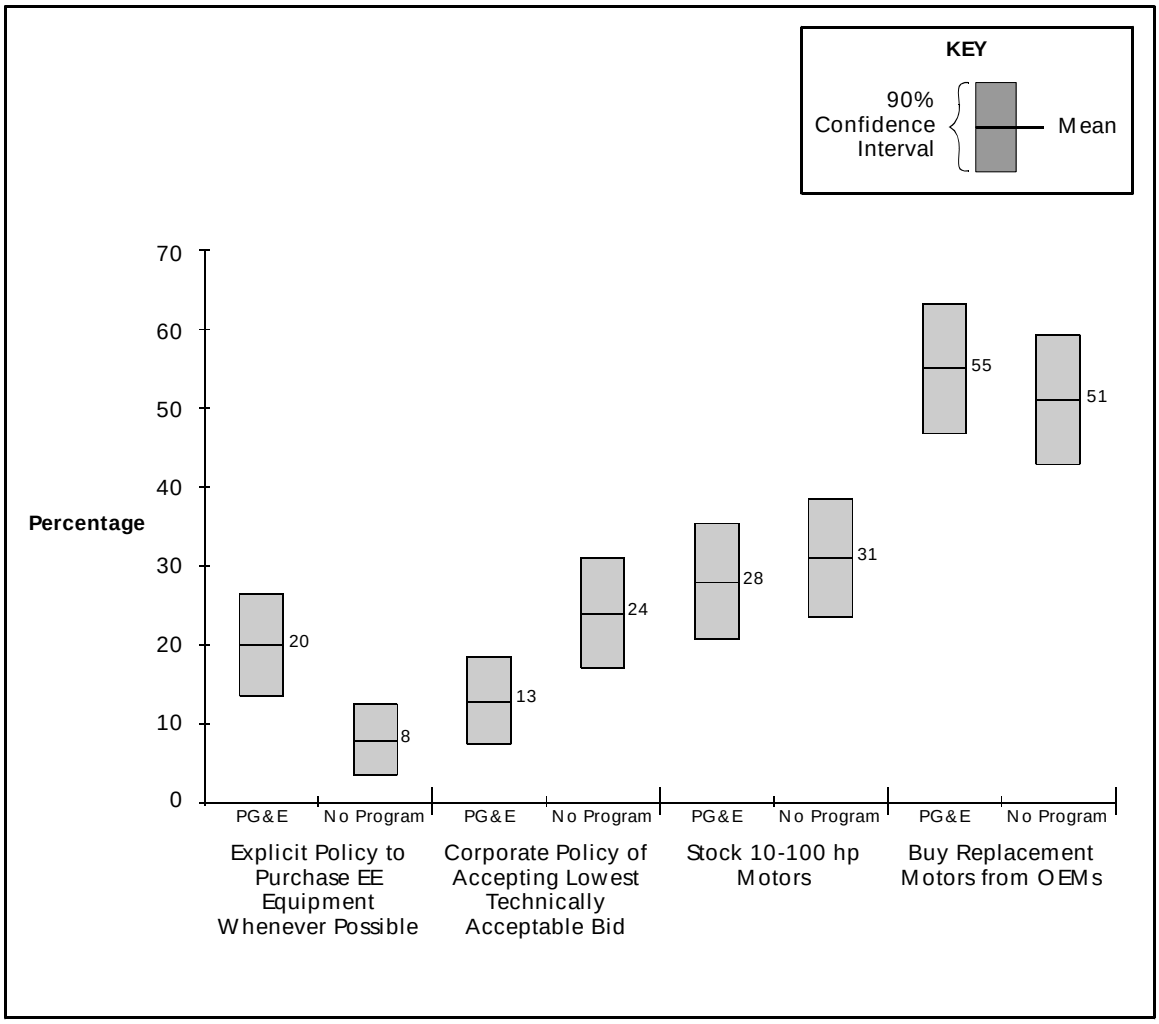
- The other major factor in creating the current market has been the experience of customers who were willing to accept the new technology. Premium motors have performed as advertised and produced the cost savings that were promised.[10] Customers who have experienced these benefits are convinced of the value achieved. This experience can also be communicated to other buyers.

In addition to rewinding, discussed above, data were collected on several other aspects of customer practices that might serve as indicators of the extent of market effects. Specifically, customers were asked about corporate policies that would tend to encourage or discourage the purchase of energy efficient motors, including corporate guidelines to select efficient equipment or choose the lowest bidder, keeping motors in stock, and purchasing motors from original equipment manufacturers (OEMs). Exhibit 5-8 compares the percentage of PG&E and no-program customers with specific practices.

While roughly equal percentages of respondents in the two territories keep motors in stock and purchase motors from OEMs, practices were different with regard to purchasing policy. A statistically significantly (at the 90 percent confidence level) higher percentage of PG&E customers reported having an explicit policy to purchase energy efficient equipment whenever possible. PG&E customers also were less likely to report having a corporate policy of accepting the lowest technically acceptable bid, but the difference was statistically significant at the 80 percent (rather than the 90 percent) confidence level.

[10] Participants are quick to note that the savings do depend on the application involved. For example, reasonable levels of cost savings will not be realized if the relevant motors are used only 1-2 hours per day.

Exhibit 5-8
Percentage of Motors Customers with Specific Practices



5.5 Baseline Attitudes/Perceptions

As with the packaged air conditioning market, the observations of focus group participants were used to develop a set of questions designed to assess current customer perceptions of barriers to premium efficiency motors in the market place. A total of 30 questions were asked of each respondent to address 10 barriers identified by the focus groups. Most barriers were measured by three questions, each rated on a scale from 1 to 10. Two barriers were measured by two questions, and one barrier was measured by five questions. The complete list of questions associated with each barrier can be found in Appendix 4.

5.6 Market Barriers, Program Exposure, and Purchase intentions

As was true of the HVAC baseline study, it was anticipated that the customer's perception of market barriers to purchasing energy-efficiency equipment is a factor in decisions about those purchases. It was thought that PG&E programs may have influenced market barriers as perceived at the customer level, and the QC team believed that knowledge of the barriers that

appear at this level and knowledge of which seem to influence purchase intentions would be valuable planning tools for future market intervention programs. The measures of barriers in this baseline study can serve as points of comparison for future measures that take place after additional programs have been launched. Mean responses to the individual barrier questions, by territory, are presented in Appendix 6.

A structural equation model was not developed for the motors data because the model presented for the HVAC market was only meant to illustrate the approach, and we believe its utility has been demonstrated. The focus of the analysis for the motors market will be limited largely to the bivariate level of analysis. This will include assessment of the relations between barriers and customer purchase intentions and between program exposure and barriers.

It is worth mentioning that actual customer behavior was not measured in this study. Instead, a measure of customer purchase intentions was used. This should not be taken to be a true substitute for a measure of purchase or installation behavior, however. While we would expect the relations between barriers and intentions to be in the same direction as those between barriers and behavior, we wouldn't expect the relations to be as strong when using intentions. The reason for this expectation is that many customers may not understand or anticipate the actual trade-offs that they may face between purchasing energy-efficiency versus availability or cost or other barriers before entering the market. It is when they actually face these trade-offs in a concrete way that the barriers are likely to be highly related to behavior. This is the context in which results concerning intentions should be interpreted.

The QC team started with several hypotheses regarding program exposure, barrier perceptions, and purchase intentions. They are the same as those brought to bear on the HVAC market analysis:

1. All of the barriers would be negatively related to program exposure; i.e., the more program exposure a company has had, the lower the perceived barriers should be.

2. All of the perceived barriers would be negatively related to willingness to install premium efficiency motors.

3. Some barriers were expected to be more affected by program exposure than others.

More specific hypotheses will be provided later in this section, after the barriers have been described. However, the principles behind the expectations were that:

1. While there was a wide array of PG&E programs delivered over the years, two aspects were common to many of the most widely know programs: Promotion; i.e., convincing customers of the value of energy-efficient versions of equipment, and Rebates; i.e., assistance in the first-cost problems associated with purchasing energy-efficient equipment

2. Barriers most related to these aspects of the PG&E programs would be most correlated with program exposure.

5.6.1 Measurement

Completed interviews were obtained from 100 decision-makers within PG&E territory and 100 outside the territory. For this analysis, three types of variables were involved. The first category is program exposure. The second is perceptions of market barriers, and the final variable is the purchase intentions of customers.

Program Exposure

For any given customer, the most fundamental measure of program exposure is whether or not the customer was served by PG&E. It could be argued that everyone in PG&E territory has been exposed to some level of PG&E intervention. However, more specific measures were also obtained. One question asked respondents how often they had had contact with their utility by phone or in person in the last year. Response categories were: 0,1,2-3, or 4 or more. This question was asked of samples in both territories. The distribution on this variable is presented in Exhibit 5-9, broken down by territory. This question is also used in subsequent analyses as a measure of exposure.

Exhibit 5-9
Number of Utility Contacts by Territory

Number of Utility Contacts	PG&E Territory	Outside Territory	Total
None	39 39.4%	42 43.3%	81 41.3%
One Contact	9 9.1%	19 19.6%	28 14.3%
Two or Three Contacts	21 21.2%	13 13.4%	34 17.3%
Four or more Contacts	30 30.3%	23 23.7%	53 27.0%
Total	99 100.0%	97 100.0%	196 100.0%

Another central measure of PG&E exposure for this analysis consists of a combination of the territory variable and the utility contact variable. The measure was coded 0 for all respondents outside of the PG&E territory; within the PG&E territory, the exposure measure was coded with the value of the utility contact variable with one modification. Because the number of respondents who occupied the two middle values of 1 or 2-3 were low, these values were combined. The whole variable was coded 0, 1, or 2, and joined with the territory variable to generate this measure of exposure. Clearly, with this method, we are defining "exposure" as level of contact with PG&E.

A third measure of exposure was also used. This measure is based on the same information contained in the second measure, but with additional information from program tracking system files. The interviewed sample was matched with three years of program records so that the number of actual program participation incidents could be counted. This exposure measure

was coded 0 for out-of-territory respondents; it was coded 1 for PG&E respondents who reported no utility contact, and appeared in no program records. If the respondent's business appeared in program records, this exposure measure was coded with the number of appearances in the program tracking system. Of the PG&E territory sample, 18 percent were recorded in program tracking system records. This measure of PG&E exposure is distinguished by indications of specific program participation.

Perceived Market Barriers

Perceived market barriers were measured by asking 30 questions of each respondent.[11] These questions were based on hypotheses regarding barriers likely to have been encountered, based on focus groups with motors distributors and manufacturers. The team's effort here was to measure these hypothesized barriers systematically on a separate, larger, sample. Most hypothesized barriers were measured by three questions. Six barriers were measured by two questions, and one was measured with five questions. The specific questions associated with each barrier can be found in Appendix 4. The responses to these questions were well dispersed, with a few exceptions. The exceptions were not severe enough to eliminate any item from further analyses.

Because the QC team expected substantial correlations among the identified barriers, the study was designed to assess these relationships. As part of this plan, an exploratory factor analysis was completed to understand how they did vary together, empirically. A principal components analysis was done, using an orthogonal rotation. Initially, the rotated component structure did not converge. The problem was judged to be the presence of certain questions that had very small correlations with all other questions. There were eight such questions, and they were removed from the pool. With the new pool of questions, convergence was achieved, and seven factors emerged, explaining 61 percent of the variance. Exhibit 5-10 shows the 22 questions, grouped by the seven rotated factors, along with the eight excluded questions. The names are listed here in order of their eigenvalues: Low Incentive, Focus on Immediacy, Downtime Concern, Reluctant Investing, Motor Sophistication, Make-do Orientation, and Advanced System Orientation. These factors form the basis for most of the analyses that address perceived barriers in this study. The factors were subjected to a scaling analysis to determine internal consistency. These Cronbach's alphas are also shown in Exhibit 5-13.

[11] As with the packaged AC analysis, an aspect of the measurement of market barriers at the customer level is the fact that many questions that address real barriers can also reflect realistic assessments of the impracticality of purchasing high-efficiency equipment. If the energy efficient option is not cost effective from the customer's perspective, no barriers would be considered to exist in the context of the EPS Scoping Study framework.

Exhibit 5-10
Factors, Cronbach's Alphas, and Factor Loadings for Items

Abbreviated Items by Factors	Factor Loading	Cronbach's Alpha
Low Incentive		.72
Simplest to replace failed motor with one exactly like it	.695	
Too risky to experiment when have experience with others	.685	
Not sure enough about savings to justify extra cost	.614	
Doubt claims about payback	.572	
Energy usage under 50 hp too small to justify investment	.544	
We don't run motors enough hours to get good payback	.418	
Focus on Immediacy		.67
When motor breaks down want what's immediately available	.803	
We don't worry about equipment unless it breaks down	.775	
When motor breaks down no time to think about diff opts	.582	
Too many other operations issues to consider energy costs	.564	
Downtime Concern		.71
Buying PE motors would require upgrading whole system	.781	
Supplier couldn't get PE quickly enough to avoid serious downtime	.746	
Reluctant Investing		.46
Lack of access to financing keeps us from upgrading	.770	
Need outside financing to make additional investment	.569	
Must see in-field demonstrations before investing	.556	
Motor Sophistication		.39
We are very confident in selecting correct size and type	.829	
Most important thing is reliability	.676	
Make-do Orientation		.36
Our practice is to rewind rather than purchase new motors	.839	
Prince of PE is well beyond what we're used to paying	.510	
Advanced System Orientation		.19
Don't have time to learn about PE motors	-.506	
More useful to invest in re-engineering processes or controls	.775	

These factors provide explanatory direction and potential marketing insights regarding both perceived barriers and target groups. First, the factors help us understand the types of barriers perceived by customers as impediments to the purchase and use of premium efficiency motors.

Second, they can be used to define important groups of customers who may or may not have been addressed effectively by earlier programs and should be targeted for future programs.

As an illustration of the first benefit of the factor analysis—the explanatory value of the factors—consider Factor I, Low Incentives. We recognize in this factor that lack of awareness of the benefits of premium efficiency motors and lack of interest in their selection and use are tied together. Moreover, these barrier items appear to reflect a low level of incentives that is probably related to relatively low use of or reliance on motors. It should be noted that this analysis also helps to highlight problems for future marketing of premium efficiency motors. For example, in this instance, the factor analysis clearly underlines the need to identify the benefits of premium efficiency motors for all customers and to convince all that the incentives are large enough to require their attention.

Similarly, in turning to Factor II, Focus on Immediacy, we recognize that Bounded Rationality is likely to be high for customers who feel unable to deal with issues regarding the efficiency of their equipment or production processes until a breakdown in normal operations occurs. Again, the marketing implications are also clear—specifically, the need to remove or reduce the perceived time and effort required to specify premium efficiency motors by customers who are enmeshed in other strategic and operational activities.

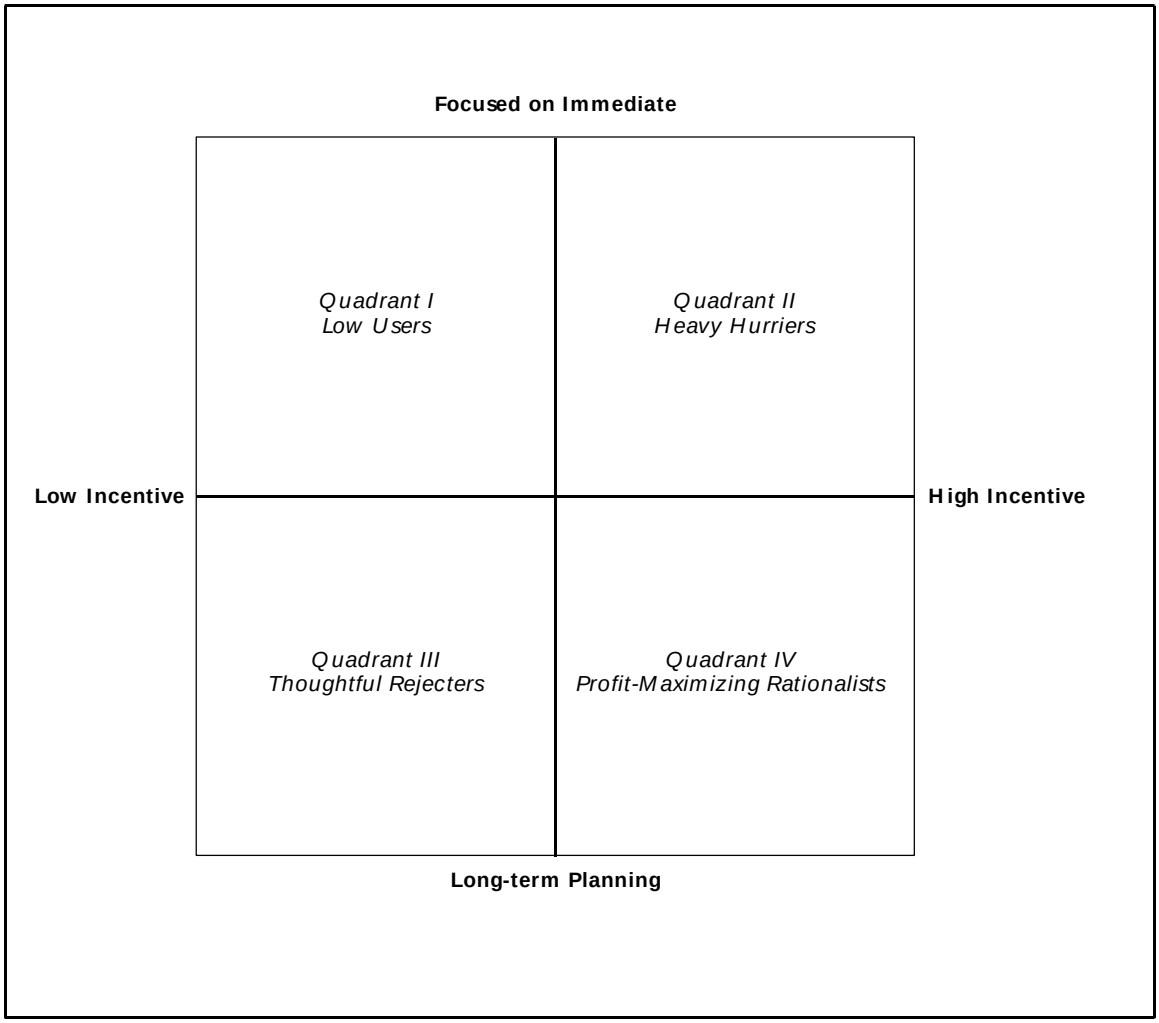
Thus, the factor analysis helps us identify which of the hypothetical barriers – that is, those hypothesized by the EPS Scoping Study -- appear to be operating in this market and the ways in which they manifest themselves in customers' perceptions and might be addressed in future programs. The remaining factors[12] could be analyzed in like manner, both to understand barriers that appear to affect the market at this time and to develop implications for future marketing efforts.

The use of the factors for targeting can also be illustrated here.[13] For simplicity, we will restrict this example to the four segments that might be defined by the first two factors, relating to the size of the implicit incentives for selecting and using premium efficiency motors and the degree of focus on issues of immediate moment. As shown in the following figure, the two independent factors define four hypothetical customer segments, one in each quadrant of the factor space. We describe each of these hypothetical segments below—but we take the liberty of providing those descriptions in a dramatic, rather than numeric, order.

[12] At least those that display a reasonable level of internal consistency on the Cronbach alpha criterion.

[13] The method of identifying customer segments is straightforward. Each survey respondent would be assigned the set of factor scores defined by his/her responses to the items comprising each factor, as weighted by the appropriate factor loadings (for those factors that are deemed reliable on the Cronbach alpha scores). A segmentation analysis would then be completed, and the resulting segments would be characterized according to the independent firmographic data, such as size, number of motors used, SIC code, etc. This analysis was not included here because of constraints relating to scope of work, timing, and budget resources.

Exhibit 5-11
Factor Dimensions and Customer Segments



Quadrant I. Low Users

These customers recognize very little value to moving to premium efficiency motors. Moreover, they are focused on their immediate operational problems.

This description seems highly consonant with the experience of account representatives, program managers, and market actors such as those in the focus groups: Many customers, especially those with few motors or motors that are not particularly important to their core business needs simply do not believe they use motors enough to gain significantly from worrying about their efficiency. Moreover, they do not even think about their motors until they fail. Programs targeted to this segment would

appear to have to overcome both the barriers of awareness/interest and that of bounded rationality. Pure rebate programs may not be effective with such customers.

Quadrant IV. Profit-Maximizing Rationalists

These customers see considerable value to the selection and use of premium efficiency motors. Moreover, they are capable of and motivated to plan for selection of appropriate technologies in advance of an immediate need.

This group is the polar opposite of those in Quadrant I. Members of the segment probably include larger corporations, with systematic planning processes and sophisticated energy managers, many of which are heavily dependent upon motors for their core product/business or who have completed detailed analyses of the payback available from premium efficiency equipment. This segment appears to be a ready target for programs that assume customer attention and interest and focus on barriers later in the decision process, such as access to financing.

Quadrant III. Thoughtful Rejecters

Members of this segment are capable of and motivated to sophisticated planning. However, they recognize little incentive for the selection and use of premium efficiency motors. .

This group may include larger customers with sophisticated planning processes and perhaps even internal energy management staff. However, these companies probably do not depend to any significant degree upon motors in their core business. Many facilities, such as schools or lodging, might fit into this group, for which the only motors applications of note would include those involved in HVAC applications or elevators—which would be installed by OEMs, and not considered as independent purchases. This group may be large and highly resistant to any programs not designed with the OEM relationship clearly incorporated and leveraged.

Quadrant II. Heavy Hurriers

This group sees considerable value to the selection and use of premium efficiency motors. However, they are highly focused on issues of immediacy and do not take the time to plan for switching to premium efficiency equipment before a breakdown occurs.

Implicit in this description is the possibility that, despite recognizing the value of moving to a more efficient set of equipment, members of this group do not do so at the moment of crisis because the need to replace the failed motors immediately overwhelms their awareness of potential gains. Programs directed toward this segment probably need to be focused on methods for avoiding the perceived hassle of selection and purchase at the time of crisis, and may include such mechanisms as predesignated replacements, rapid response suppliers, etc.

As noted earlier, these segment descriptions are intended to be illustrative. We are confident that a full, systematic segmentation analysis based on the factors identified here is likely to provide well-grounded and useful directions for future analysis and marketing.

Having explored some of the potential implications of the first two barriers in some detail, the remaining factors will be discussed more briefly. Downtime Concern reflects the EPS barriers of lack of availability as perceived by the customer. Reluctant Investing represents elements of the EPS barriers regarding access to financing (together with the need for investment) and performance uncertainty. The Make-do Orientation contains dimensions of organizational

practices as well as bounded rationality. In other words, it represents the practice of taking the least expensive path, including purchasing at a lower first cost than premium-efficiency, and rewinding.[14]

As labeled, the final two factors cannot be considered barriers in the usual sense. The positive end of both factors represent situations where the customer is quite sophisticated—in systems matters in general and in motor matters in particular. Customers with high scores on these factors would be expected either to purchase premium-efficiency motors or have legitimate reasons for not doing so. (Although it is not necessary to defend the EPS typology here, it is interesting to note that individual items on these factors do contain elements of performance uncertainty and search costs, albeit at a sophisticated level.)

Purchase intentions

This variable was measured by a question that asked the respondent what type of motor would be purchased by the company if it had to be done today. The response categories provided were: 1) Would purchase the least costly available new motor that will do the job, 2) Would rewind the motor or install a rewound motor, 3) Would purchase a high efficiency motor (that meets EPACT standards), 4) Would purchase a premium efficiency motor (that exceeds EPACT standards).

Because the second response category does not obviously belong between responses 1 and 3 in terms of this ordinal energy efficiency scale, another version of the variable was tested, which combined the first two categories, thus allowing both to represent the non-energy-efficient choice. This modification did not have a significant impact on the results of any analyses. As a result, the choice was made to use the variable in its original form for all types of analyses. However, some analyses that otherwise would have been simple correlations involving this variable are presented a second way. Specifically, some analyses use the four responses provided for Purchase Intentions as categories rather than as ordinal values. A common analysis method for assessing the relation between a categorical variable (Purchase Intentions) and a continuous one (Barrier) is an Analysis of Variance. This involves comparing the means of the continuous variable across the categories of the other variable. Thus, no assumptions are made about the order of the four categories of purchase intentions. Also, the linearity of the relation between the two variables can be assessed directly rather than assumed.

5.6.2 Predictions

Three of the barriers were judged by the QC team to be the most likely to be influenced by the PG&E motors programs, including rebate and information programs. They are: Reluctant Investing, Low Incentive, and Make-do Orientation. These are the barriers that were deemed most likely to have lower means within PG&E territory than outside of it. The Reluctant Investing barrier includes items about the need for financing and a desire to see in-field test results. Both of these desires could be met by PG&E programs. The Low Incentive category contains a number of doubts about payback and performance risk. These concerns could be

[14] Correlations among these factors with the Low Incentive and Focus on Immediacy factors hints at the possibility that these factors are all barriers of particular importance to small, low-use customers.

influenced by the programs. Finally, the Make-Do Orientation includes an item about the problem of first cost which could also be subject to the influence of rebate programs.

5.6.3 Results

Impact of PG&E Exposure on Barriers

Exhibit 5-12 portrays the mean level of each barrier by territory. t-tests were completed, but it is clear from direct inspection that the differences are too small to be considered meaningful. Even the direction is not consistent. Four barriers are lower in the PG&E territory, while three are lower out of the territory.

Inspecting the differences in means through the lens of the hypotheses for program effects does not help. Of the three barriers where program impact was expected, only one was in the expected direction; namely, the PG&E mean was lower than the non-PG&E mean. Taken by itself, this result does not provide confidence that the program had an impact.

Exhibit 5-12
Mean Barrier Scores by Territory

Barrier		PG&E Territory	Outside Territory
Low Incentive*	Mean	4.88	5.20
	S.D.	1.77	1.95
Focus on Immediacy	Mean	4.46	4.44
	S.D.	1.93	2.09
Downtime Concern	Mean	3.95	4.33
	S.D.	2.39	2.73
Reluctant Investing*	Mean	4.41	4.31
	S.D.	2.33	1.90
Motor Sophistication	Mean	7.67	7.88
	S.D.	1.82	1.82
Make-do Orientation*	Mean	4.89	4.89
	S.D.	2.55	2.15
Advanced System Orientation	Mean	5.63	5.16
	S.D.	2.12	2.12

*Barrier hypothesized to be affected by exposure

Exhibit 5-13 displays the correlations between the seven perceived barrier factors and three measures of exposure. Two of the Exposure variables distinguish between territories. The third is the utility contact variable which was asked of both sub-samples. This exhibit provides a similar set of conclusions to that reached when reviewing the barrier means by territory. First, the predictions about which barriers would be affected by programs were not supported. Second, overall, the relationship between territory and barriers is very weak.

Exhibit 5-13
Correlations of Seven Perceived Barrier Factors with Exposure Variables

Barrier	PG&E Exposure	PG&E Program Participation	Number of Utility Contacts
Advanced System Orientation	.201**	.120	.104
Low Incentive	-.091	-.062	-.183*
Focus on Immediacy	-.062	.006	-.230**
Downtime Concern	-.050	-.072	-.095
Reluctant Investing	-.018	.004	-.056
Motor Sophistication	-.005	-.064	.077
Make-do Orientation	.028	-.050	.070

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

In addition, the direction of the correlations are mixed. Partly this is to be expected given the small size of the correlations. Nonetheless, there are a few consistencies worth noting. The Low Incentive factor is consistently negatively related to each version of the Exposure variable, and the correlation between this perceived barrier and Utility Contact is statistically significant. This implies that those who have had more utility contact (in either territory, but most strongly for out-of-territory) are more likely to perceive value in premium-efficiency motors. (Presumably, also, they are less likely to be small, low-use customers, if the segmentation hypotheses are correct.. This would also be consistent with the fact that utilities are likely to target larger customers, and for a motor program, to contact customers with high motor use.) Further, it is probable that as utility representatives talk with customers, they help them understand the contribution of motors to their total energy use and, accordingly, the savings available from energy efficiency.

Another pattern worth noting is the consistently positive correlation between Exposure and the Advanced System Orientation, including a statistically significant relation with PG&E Exposure. This fits the same pattern that appeared with the Low Incentive barrier. As will be recalled, the Advanced System Orientation factor represents the tendency to believe that it may be more useful to invest in re-engineering their processes and controls than to "spend more money on premium efficiency motors." It seems possible that utility contacts may have educated some customers about the importance of a system emphasis. (Differences in customer segments should also be considered. It is possible that it is just those customers who already know about premium-efficiency motors—and are likely to use them—who are most likely to contact utility representatives.)

The significant correlation between Focus on Immediacy and Utility Contacts does not represent as strong a pattern as observed with the previous two barriers discussed, since the correlations across the three measures of exposure were not consistently negative. However, the correlation between the Focus on Immediacy and Utility Contacts is the largest one in the

exhibit, and it is highly significant. Customers who have high scores on Focus on Immediacy are less likely to work with utility representatives, as might be expected from the earlier discussions. (Again, from the segmentation orientation, they are probably also smaller, low-use customers and may well be high scorers on the Low Incentive factor..

These results are quite consistent with a picture that emerged in the focus groups with market actors. One of the conclusions of those groups was that the larger customers, who use many large motors as a central part of production, are already fully aware of premium-efficiency motors and are convinced of their value. They contrast with the customers who tend to use small motors and fewer of them. This latter group of customers generally treats motors as off-the-shelf commodities and have yet to be convinced of the value of premium-efficiency motors. The analyses using the derived factors seem to capture this distinction. However, it should be noted that the factor analysis adds considerable richness by suggesting the role of other barriers and the potential of identifying customer segments other than the two highlighted in the focus groups. Moreover, it indicates such concomitant opportunities as the Advanced Systems Orientation, which characterizes recognition of the broader opportunities for efficiency in motors systems.

Impact of Barriers on Intentions

The QC team expected all of the perceived barriers to be related to purchase intentions. While it was certainly not expected that purchasing intentions would be as strongly correlated as would actual purchasing behavior, it was thought that the relations for perceived barriers would all be in the negative direction, and would be stronger than the relations between exposure and barriers.

Two methods of analysis are presented to accommodate to the fact that the purchasing intentions variable is not, strictly speaking, an ordinal one, due to the presence of the rewinding response category. Therefore, both correlations and comparisons of means across the four intention categories are presented. The correlations are provided because 1) correlation coefficients provide comparability with other analyses in this report, and 2) the relation between most barriers and intentions is very close to monotonic, so that presenting them as correlations doesn't seem unreasonable. Exhibit 5-14 shows these correlations. In this exhibit, it is immediately clear that the correlations are stronger than any other set of correlations for motors or any of those for air conditioners (shown in an earlier section). All correlations but two are negative, and all are statistically significant. The two "barriers" that are positively correlated with intentions are consistent with predictions. Both the Motor Sophistication and the Advanced Systems Orientation are stated in positive terms, i.e., high scores mean sophistication and being advanced in thinking about systems. Given that these orientations are most likely to be associated with consideration of premium-efficiency motors, as discussed earlier, these factors cannot be described as "barriers" to these purchases. Given this, we would expect positive correlations with Purchase Intentions.

Exhibit 5-14
Correlations of Barriers with Intentions
To Purchase Premium-Efficiency Motors

Barrier	Correlation with Intentions
Make-do Orientation	-.388**
Low Incentive	-.380**
Focus on Immediacy	-.335**
Motor Sophistication	.241**
Reluctant Investing	-.177*
Advanced System Orientation	.171*
Downtime Concern	-.165*

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Exhibit 5-15 shows the mean perceived barrier scores for each Purchase Intention response category. The joint ordering of Intention categories and mean barrier scores reveals some interesting patterns.

- For three of the barriers, there is a purely monotonic relation between barriers and intentions.

- For another three, the relation is monotonic, except for the motor rewinding category. In these three instances, the highest barrier mean is seen in the rewinding category. It appears that those who make it a practice to rewind motors are those who perceive the highest barriers to purchasing premium-efficiency motors.

- Even where the rewind category does not have the highest barrier, that mean is still quite close to the mean seen in the least-costly purchase intentions category. It appears that it is not unreasonable to place the rewind category close to the category of those who expect to purchase the least costly (least efficient) motors.

As we would expect, all of the ANOVAs for this analysis show statistically significant differences in barrier means across purchase intention categories. And, given the correlations seen earlier as well as visual inspection of the arrangement of means by Purchase Intentions categories, it is clear that the bulk of the explained variance is in the linear component.

Exhibit 5-15
Mean Perceived Barrier Score by Purchase Intention Category

Perceived Barrier Factor	Purchase Intention Category	N	Mean Barrier Score	Std. Dev.	Prob
Low Incentive	1	35	5.85	1.72	.000
	2	59	5.43	1.86	
	3	48	4.55	1.58	
	4	25	3.85	1.22	
Focus on Immediacy	1	37	5.36	2.08	.000
	2	59	4.79	1.90	
	3	48	4.10	1.86	
	4	25	3.24	1.98	
Downtime Concern	1	35	4.04	2.41	.017
	2	53	4.86	2.80	
	3	46	3.77	2.45	
	4	24	2.94	2.32	
Reluctant Investing	1	36	4.37	2.32	.017
	2	59	4.85	2.29	
	3	48	4.16	2.13	
	4	25	3.22	1.36	
Motor Sophistication	1	36	7.35	1.83	.004
	2	59	7.20	1.98	
	3	48	8.23	1.56	
	4	25	8.40	1.57	
Make-do Orientation	1	35	5.41	2.06	.000
	2	58	6.13	2.25	
	3	48	3.47	1.71	
	4	25	3.60	1.99	
Advanced System Orientation	1	34	5.35	2.22	.023
	2	59	4.85	2.00	
	3	48	5.60	1.86	
	4	25	6.28	2.00	

Regression Analysis

The purpose of the regression analysis was to determine how much of the total variation in Purchase Intentions can be explained by perceived barriers. Secondarily, entering multiple barriers into the same model allows the opportunity to eliminate barriers that explain little additional variance, highlighting the most efficient statistical combination for explaining the Purchase Intentions variable, so that we can observe the barriers that are relatively independent of one another in terms of Purchase Intentions.

In this case, several models were tested to determine the most efficient combination of barriers in explaining Purchase Intentions. The total amount of variance explained by barriers in this dataset was about 18 percent. The figure stays at almost exactly the same level for a number of other combinations of barrier variables. However, the most efficient method of attaining that level of explained variance was through using the two barriers of Motor Sophistication and Make-Do Orientation. Adding any of the other variables does not improve on this model. This implies that the others are statistically redundant with these two, so that these can be interpreted to represent the essence of the barriers that affect Purchase Intentions. Together these factors seem to represent the distinction that was noted in the focus groups: 1) customers who are high users of large motors and that have been convinced of the value of premium efficiency motors, and 2) low-end users who tend to take the least expensive, least risky (as they perceive it) alternative, which includes the practice of rewinding motors. At one level, identification of these groups helps considerably in understanding who does and does not purchase premium efficiency motors.

It should be noted, however, that another model is equally effective and parsimonious in identifying at least two polar opposite groups. This model also explains 18 percent of the variance in Purchase Intentions with Focus on Immediacy and Low Incentive. The Low Incentive factor represents barriers including the simplifying practice of replacing like for like, the fear of risky experiments with unknown motors, and uncertainty about payback. The Focus on Immediacy represents practices of replacing broken motors with what is immediately available, not worrying about equipment until it breaks, and perceiving oneself as being too busy to think about motor options It is clear that this model explains the same variance explained by the first model, since addition of the factors from the first model to the second does not increase the explained variance.

At another level, the findings clearly demand the systematic segmentation of the factor scores. As indicated in the earlier hypothetical discussion, further segmentation analysis could develop more refined group definitions that would lead to a higher level of explanation that would be the basis for more targeted program planning. It is unlikely that all large customers who use motors will be equally enthusiastic about premium-efficiency motors. Similarly, it is unreasonable to think that all low-use customers are uninterested in them. It could be quite beneficial to program planners to identify more detailed perceptions and characteristics of the customers—and possible marketing tactics—where progress is needed in the perception of barriers to purchasing efficient motors.

5.6.4 Summary

Issues that appeared to be impediments to the purchase of premium-efficiency motors, based on the focus groups, were converted into 30 interview questions, and were categorized by hypothesized market barriers. The 30 items, minus the items that had very small correlations with all other items, were subjected to an exploratory factor analysis. This process identified seven perceived barrier factors. The barriers identified were:

- Low Incentive
- Focus on Immediacy
- Downtime Concern

- Reluctant Investing
- Motor Sophistication
- Make-do Orientation
- Advanced System Orientation

These barrier factors provide a valuable guide to the perceptions and concerns about premium-efficiency motors among customers themselves. Accordingly, they can help clarify reactions to earlier motors programs as well as issues that must be addressed in future efforts. In addition, they offer the possibility of identifying important customer groups (on the basis of the patterns of factor scores) that may or may not have been addressed effectively in the past and that should be targeted for future programs.

The identified barriers do not vary systematically by territory or program exposure, but they do vary by amount of utility contact. The correlation between utility contact and barriers is equally true in both the PG&E and the comparison territories.

The barriers are much more strongly related to Purchase Intentions. All seven correlations with this variable were statistically significant at the .05 level (or better). The highest correlations were with:

- Make-do Orientation (-.388),
- Low Incentive (-.380), and
- Focus on Immediacy (-.335)

These barriers seem to capture something in the intention to purchase efficient motors, or the lack of intention. Looking at ANOVAs that treat the Purchase Intentions variable responses as categories also shows all relations between barriers and purchase intentions to be statistically significant. Of course, the predictive ability would probably be even stronger for a measure of actual purchase decisions.

It will be important to continue this line of studies by systematically segmenting barrier factor scores by customer type. This will facilitate targeting future programs and designing their promotional, delivery, and financial components. In particular, several of the perceived barrier factors seem to be rooted in customer characteristics, and are consistent with the descriptions provided by market actors in the focus groups. A clear example is the dichotomy, discussed earlier, between the high-use customer sophisticated in motors and systems and the low-use customer who treats motors as off-the-shelf commodities, thinks only in terms of immediate needs and problems, and perceives a laundry list of traditional barriers, including hassle costs, doubts about payback, concerns about performance, and financing obstacles.

APPENDIX 1. LITERATURE REVIEW MEMO

November 8, 1997

To: Ceyda Can

From: C&I Market Effects Baseline Study

Re: Summary of Literature Review Findings

Quantum Consulting (QC) has completed the literature review of the information currently available in the following markets:

- Motors Market, including Variable Speed Drives (VSDs) and
- Heating, Ventilation, and Air Conditioning Systems (HVAC), including controls

This memo summarizes the data gathered from PG&E staff and program materials and from secondary research materials, such as reports and market studies. This memo is organized as follows:

- Overview of the C&I Markets
- Summary Findings for the Motors Market
- Summary Findings for the HVAC Market

The purpose of this review was to identify the types of equipment, markets, and customer groups that should be targeted for this baseline study. This review also provided the project team with more in-depth information regarding PG&E's role and experience in these markets.

This memorandum summarizes the information QC staff gathered from:

- PG&E staff interviews
- PG&E impact evaluation reports
- PG&E program materials
- Market transformation studies

- Research reports and industry publications

SUMMARY OF PG&E INFORMATION

To gain a better understanding of the inter-relationship among PG&E's various commercial and industrial programs, QC staff reviewed current PG&E programs. PG&E programs that target HVAC and Motors applications include:

Exhibit 1
Summary of PG&E C&I Programs

Program	Targeted Applications	Targeted Markets
Retrofit Express	A/C, Motors, Refrigeration, Food Service	C&I customers
Retrofit Efficiency Options (REO)	Cooling Towers, Irrigation Pumps/ Oil field pumping	C&I, Ag customers
Advanced Performance Options (APO)	"Custom" equipment upgrades	C&I and Ag-larger/high value projects
Customer Efficiency Options (CEO)	Total improvements	Large Industrial customers
Customized Incentives	Closed	Closed
Prescriptive Program	Title 24 upgrades	Title 24 occupancies
Performance Program	Envelope, lighting, and HVAC measures	Large commercial buildings including prisons, wineries, hospitals and high-rise residential units
Performance by Design-Hospitals	Lighting, controls, glazing, motors and HVAC	Hospitals and health care facilities

Source: PG&E's Annual Summary Report on DSM Programs in 1996 and 1997

QC staff talked with members of PG&E's program staff to learn more about the ways that PG&E may be influencing customers in the Motors and HVAC markets. The staff interviews notes are attached separately.

The major findings include:

- PG&E has changed its traditional piece-meal approach that encourages the installation of one specific type of energy-efficient technology (e.g., lighting), by developing programs that target entire facilities or systems.

- PG&E's staff are also currently re-evaluating its rebate programs and the role that rebates play in influencing the market.

- PG&E has already developed one pay-for-performance program, called PowerSavings Partners (PSP), and may develop additional performance contracting programs to replace rebates.

- PG&E staff have designed programs that achieve two goals:

  - Target systems level changes, and

  - Target distributors rather than customers

Customer Decision-Making Process

The staff interviews provided insight into the customer decision-making process, as it affects both the motors and HVAC markets. PG&E's staff indicated that the decision-making process for acquiring these technologies is often disjointed and confused. Furthermore, many HVAC technologies rely on motor applications, however, the decision process is based upon total HVAC equipment performance rather than the performance of its motor components. Therefore, it is essential to analyze these purchase decisions separately.

Other findings noted by PG&E staff included specific details about the purchase process for both motors and HVAC technologies. Most energy decisions, especially those regarding equipment replacement, are made based upon the price and availability of the equipment. Unless energy-efficient equipment is specifically required or requested, it is usually not the customer's first-choice.

The decision-making process also varies depending upon customer characteristics. PG&E staff described the three "types" of customers:

- Long-standing PG&E customers who rely on PG&E's advice and input when making energy decisions. Examples include grocery stores and

large-case refrigerator manufacturers in which energy accounts for a substantial portion of their overall operating costs.

- Customers who are concerned with energy-efficiency options, when it suits them. Examples include building owners, property managers and speculative builders.

- Customers who simply don't have time to weigh or consider other options. Examples include customers in highly competitive markets such as the semi-conductor industry, where energy costs and their impacts have little direct relevance to customers' long-term success.

Commercial Market Characteristics

PG&E's 1997 Commercial Building Survey provided in-depth information regarding the commercial market. PG&E's commercial market includes the business types summarized in the following exhibit.

Exhibit 2
PG&E Commercial Market

Business Type	SIC Codes
Colleges	822, 824-829 except 8241
Hospitals	805-807
Food Stores	540-549
Hotels/Motels	700-709
Miscellaneous	000-099, 680-6599, 710-719, 740-759, 770-800, 840-859, 870-889, 970-999
Offices	600-679, 730-739, 801-804, 808-819, 823, 8241, 830-839, 860-869, 890-969
Refrigerated Warehouses	4222, 5142-5144, 5146-5148
Restaurants	580-589
Retail Stores	520-539, 550-579, 590-599, 720-729, 760-769
Schools	820-821
Warehouses	4220-4221, 4223-4229, 5000-5141, 5145, 5149-5199

The commercial market information provided insights into the HVAC market in particular, which are described more fully later in this memo.

Industrial Market Characteristics

Information regarding PG&E's industrial customer base was more difficult to obtain. The 1994 Impact Evaluation of Miscellaneous Measures among Industrial Customers provided insights regarding the installation trends of energy-efficient motors.

PG&E's Industrial customers represent a broad range of types:

- Wineries
- Glass Companies
- Sand and Gravel
- Timber
- Semiconductor Mfg.
- Food Processing

SUMMARY FINDINGS- MOTORS MARKET

PG&E Information-Motors Market

The PG&E staff interviews, reports, and materials also provided specific information regarding the motors market. PG&E is currently offering several DSM programs that target C&I customers to replace or upgrade their motors applications. These programs can be described as either performance-based or prescriptive-based.

Prescriptive programs, especially those designed for motors applications, target a broad range of customers and trade allies. In contrast, the performance-based programs are targeted at the larger industrial markets and feature more complex projects with longer timeframes.

Other PG&E programs are aimed at the larger industrial markets, which feature more complex projects and longer timeframes. These programs, which also target motors applications, rely on more direct relationships between PG&E's technical staff and the customer's key decision-makers.

PG&E's new construction program is focusing on high-efficiency pumps, VSDs and ventilation motors applications. PG&E staff indicated that the greatest opportunities appeared to be in those applications. In fact, one ESCo is involved in a competitive bidding program for large industrial program specializing in VSDs.

Other motors applications appear less promising. PG&E staff cite, in particular, concern about the structure of the compressed air system market. One serious problem appears to be a complete lack of overall metrics or a common approach to determining performance.

An analysis of industrial customers surveyed for PG&E's 1994 Impact Evaluation revealed that 20 customers installed 129 energy-efficient motors. Of these motors, 57 percent were between 10 and 25 hp, suggesting that this is the most prevalent grouping of motors among industrial customers. No customers reported motor installations of hp less than 1.

The PG&E staff indicated the following areas of concern in developing effective programs to target the motors market. These concerns included:

- Lack of Name Recognition: The sheer diversity of the motors market and the number of vendors make it difficult to target motor vendors. The majority of motor vendors in PG&E's service territory are not aware of the motors' programs.

- Sizing Criteria: PG&E does not yet have the information required to determine how customers size motors. Some purchases may be based upon by buying replacement motors of the same size without attention or regard to determining the appropriate motors size. This leads to many motors being vastly over-sized for a particular application.

- Shelf Stock: Most motors are sold as future replacements. That is, these motors are purchased and kept in reserve to replace existing motors when they fail. A motor purchased today may not be needed for months or years.

- Rewind Practices: There is a lack of uniform standards and practices regarding motor rewinds. Improper rewinds impede motor performance and energy efficiency.

- Motor Life: The useful life on a motor is quite long. Some motors are rewound and resold to other customers. There is a flourishing market in older, inefficient motors, that further delays the adoption of more energy-efficient motors.

- EPAct: The Energy Policy Act in 1992 was the first set of national standards for motors market. This is just the beginning, however, and PG&E staff are concerned that its effects are limited since it did not address motor rewind.

- Lack of Stocking Information: No current information exists on the installed baseline efficiency of motors in the industrial segment.

- This market has been ignored: Motors represents the largest energy end-use in the U.S., but information regarding efficiency levels, installation rate, and stocking data are not available. This market has been overlooked by both utilities and government agencies.

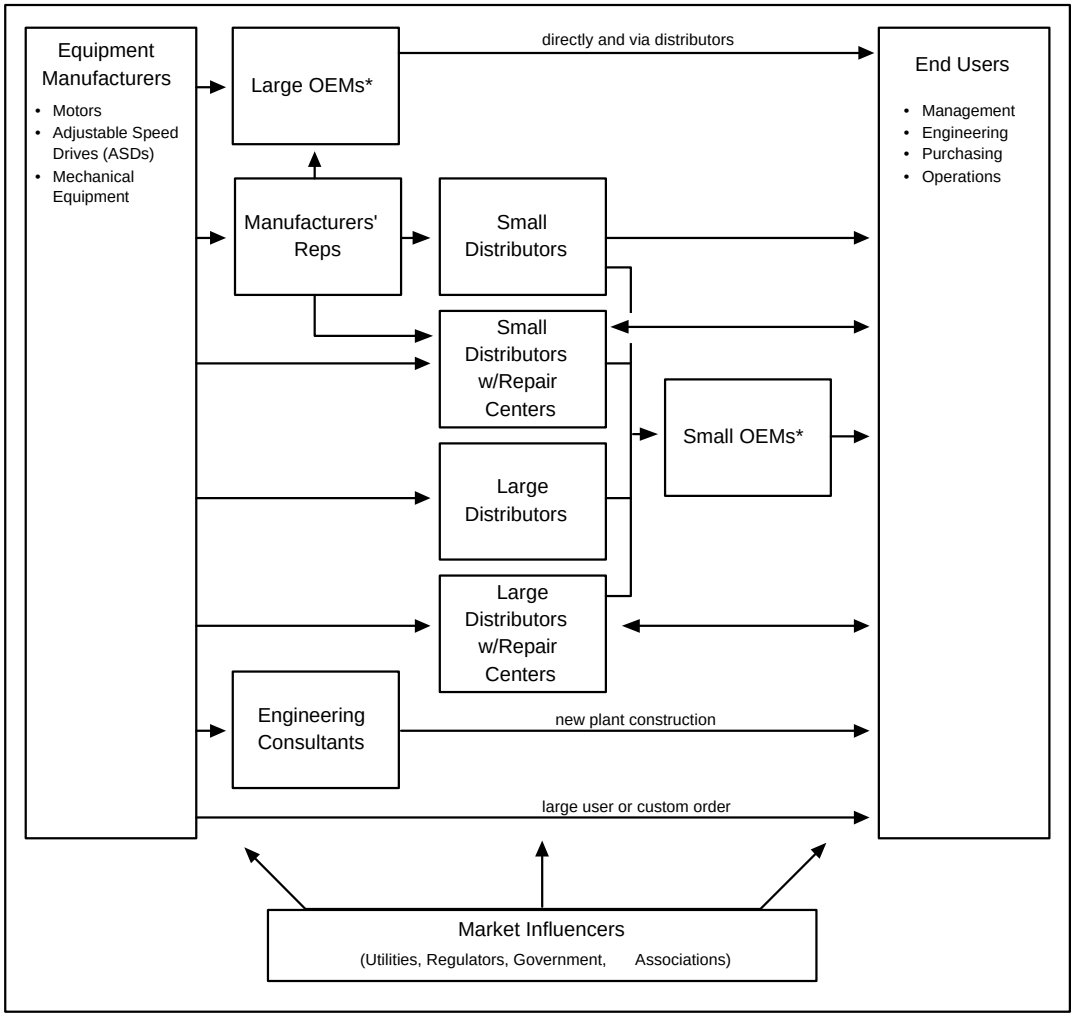
Secondary Literature Review Findings: Motors Market

The literature review led to the following findings:

- The energy efficient motors market has been studied extensively for the past seven years.
- Several market transformation studies have been conducted regarding the energy-efficient motors market, with particular emphasis on utilities in the Northeastern United States.

As shown in Exhibit 3, the motors market is complex, with a number of direct and indirect market influencers.

Exhibit 3
The Electric Motor System Market



Motors are used in nearly every type of equipment application in the United States. In the US industrial sector, more than 70 percent of all electricity consumption involves motors. Most of the cost of electricity for manufacturing is associated with pumps, fan and blower systems, and air compression units, which together are said to offer 60 to 70 percent of the total market potential for energy savings.

Motors are sold in hp ranges from less than 1 up to 1000. However, the bulk of the installed motors are between 1 and 100 hp. The largest percentage of energy-efficient motors are between 1 and 50 hp. Other findings regarding hp trends include:

- Many users now routinely replace general purpose motors between 40 and 75 hp upon failure. Above 70 hp, the decision to repair or replace is based upon the motor's age and condition. Motor repair shops indicate that they are beginning to see significant levels of energy-efficient motors in for repair.

- Savings potential from further penetration of energy-efficient motors is greatest in the smaller horsepower classes.

- Energy-efficient motor penetration has increased to about 25 percent overall. High distributor channel penetration has been driven heavily by utility programs promoting retrofits / replacements, with the greatest penetration occurring in the larger / higher use motors.

Regarding the adjustable speed drive (ASD) market, the literature review found that ASD purchases are small relative to purchases of integral horsepower polyphase AC motor sales. However, this is a growing market for several reasons:

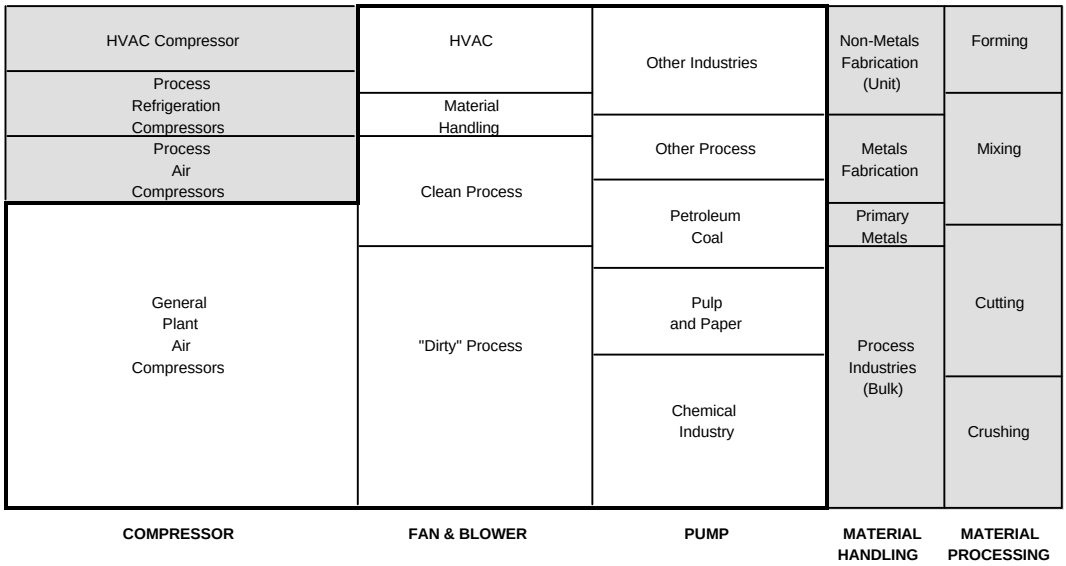
- Improved technology allows ASDs to replace DC drives in applications requiring precise speed control

- Unit costs have been declining.

- Motors and ASDs are sold as a packaged unit, thus becoming less expensive.

Exhibit 4 highlights the opportunities within the motors market that offer the largest potential for energy savings.

Exhibit 4
Strategic Map of Energy-Efficient Motor Market Opportunities



Source: Easton Consultants Inc.
Note: Area bound in bold represents greatest opportunities.

Process Pump Systems

This is a concentrated market that relies heavily on motor applications. The Original Equipment Manufacturers' (OEM's) role is limited to: determining pump efficiency, selecting pumps suitable for applications, and providing performance data and selection software tools. Other characteristics of this market segment include:

- Engineering/specifying firms play an important role in process pump system design.

- A small number of companies account for a large share of the total installed pump systems. Process industry associations are key market influencers.

- The pumps market is extremely competitive. Manufacturers sell pumps through representatives or distributors or directly to major end users.

- Pump manufacturers' representatives and distributors are the primary link to customers and offer a diverse set of services. Their level of sophistication varies significantly.

  - Manufacturers' representatives help determine which pump is chosen for a specific job, but they have little stake in the pump's efficiency.

  - Mechanical contractors install most process pumps. Consulting engineers design nearly all pump systems in new facilities and may play a significant role in major renovations or equipment retrofits.

  - End users often design smaller system renovations.

- The most important influence points for promoting market transformation in the process pump systems are pump manufacturers and their agents.

Industrial Fan/Blower Systems

This is another motor-intensive market, with the following characteristics:

- There are thousands of manufacturers. Fans are commodity components and fan manufactures are not involved with system design.

- Application-specific OEMs who supply the "submarkets" for fans and blowers offer some leverage within smaller markets.

Industrial Air Compressor Systems

This is a highly specialized market, 98 percent of which is comprised of motors using less than 5 horsepower. The market is dominated by a few large manufacturing firms. Distributors dominate the market, but have little stake in energy efficiency. Other features include:

- Air compressor OEMs are key leverage points because they are responsible for air-end component design and packaging.

- Compressed air specialists offer the most leverage, because they offer design assistance for existing systems.

- Currently, there are no strong trade associations that integrate the engineering and design specifications process within this segment.

Motors Sales Process

The sales process for motors is fairly complicated. Most motors pass through a network of Original Equipment Manufacturers (OEMs), distributors, resellers, manufacturers representatives, and other intermediaries before the equipment is sold and installed.

Exhibits 5 and 6 show the types of distributors that are currently operating within the motors market. The first exhibit explains the distributor characteristics, while the second exhibit summarizes their overall role in this market.

Exhibit 5
Distributor Segment Characteristics

Repair Oriented	Small, owner-operated. Heavily oriented toward motor rewind/repair.
Volume Oriented	Larger operations with multiple branches. Most revenue from new sales/service.
Technically Oriented	Large, multi-branch operations with a varied inventory. Selling more specialized equipment including VSDs/ASDs.
Warehouse Distributors	Chains with hundreds of branches nationwide. Motors sold with other industrial supplies. No repair and little technical support. Sophisticated management.

Source: Easton Consultants Inc.

Exhibit 6
Distributor Segment Market Roles

	Importance of Motor Revenue*/ Total Revenue	Average Number of New Motors Sold/Year/ Distributor	Importance of Repair Revenue/ Motor Revenue	Approximate Average New Motor Size
Repair Oriented	87%	140	54%	5 HP
Volume Oriented	70%	950	41%	10 HP
Technically Oriented	19%	500	32%	20 HP
Warehouse Distributor	25%	1,000 †	0%	7.5 HP

Distributor-level information regarding stocking trends and equipment replacement rates for new motor installations is still sketchy. This is one area of focus for the DOE's Motors Challenge Program.

Barriers Within The Motor Systems Market

The barriers uncovered in this review include the following:

- Information: Lack of consistent, easy-to-use and timely product information on system performance

- Knowledge and Experience: Lack of knowledge at the end-user level regarding the potential energy savings available through optimum motor systems. Lack of technical expertise and tools required to accurately quantify savings potential and verify results.

- Practices: End users may not perform life-cycle cost analysis when considering equipment or system investments. Most current efforts focus on energy-efficient components, not system-level savings.

- Responsibility and Motivation: Lack of incentive or motivation for certain market stakeholders to demand high performance or promote efficient system design or equipment purchases. Lack of system responsibility where there is no single decision-making point.

- Availability: This barrier was cited in the PG&E staff interviews. Many customers do not purchase or install energy-efficient motors due to stocking constraints of the distributors. Distributors want to limit the number of stocking units they have, and thus energy-efficient units are not commonly stocked for the replacement market.

- Unwillingness or Reluctance to Pay for energy-efficiency: This barrier was cited by PG&E staff as one of the critical problems facing the motors market in particular.

- Federal Standards: The lack of consistent standards is an especially high barrier in the air compression market, one that is not currently being addressed in the DOE's Motor Challenge work.

Preliminary Recommendations For Study Focus

Based upon input from the both the PG&E staff interviews and the literature review, QC recommends focusing our analysis on motor customers:

- Who purchase motors between 10 hp and 100 hp.

- Who use motors and drives for process pumps and industrial fan / blower systems.

The selection of these horsepower ranges and industry applications were based upon both an analysis of the most commonly installed hps among industrial motors customers, derived from PG&E's 1994 Impact Evaluation, as well as an analysis of the motors industry as a whole. To make inroads in this market, QC recommends concentrating on those motors that have the greatest likelihood of needing to be replaced. In general, most customers replace smaller hp motors more frequently than larger motors, and smaller hp motors are used across a broader spectrum of industry applications.

QC does not believe that the industrial air compression motors market would make a good target for the baseline study at this time. The concentration on motors with less than 10 hp, the lack of strong industry standards, and the limited role played by engineers and specifiers all suggest that this segment does not offer enough leverage points in its overall structure to warrant inclusion in a baseline study at this time.

SUMMARY FINDINGS -HVAC MARKET

A second target of the staff interviews and literature search was to gather information regarding trends in the heating, ventilation, and air conditioning (HVAC) market. QC staff relied on information collected from the following sources to complete this section of the literature review:

- Staff Interviews
- PG&E Program Information
- Research Reports and Information Collected from Secondary Sources

Review of PG&E Program Information

Building upon the information that PG&E staff provided regarding motors applications, the staff provided some insights into HVAC market characteristics. Key findings from the staff interviews regarding this market include:

The HVAC market has already been transformed, so future changes may be more difficult to achieve. PG&E staff pointed out that the HVAC market has already undergone one significant transformation with the establishment of minimum ARI efficiency levels among both utilities and manufacturers. Now that these minimum standards are being adopted, PG&E staff are concerned that there may be some reluctance to raise the bar even higher.

QC staff talked in-depth with PG&E staff members who were directly involved in influencing the adoption of minimum energy efficiency standards in the packaged air conditioner market. The market was effectively transformed based upon developing market standards that were uniformly set by utilities throughout California, and indeed the nation.

This market transformation took approximately three years to achieve, since it relied heavily on gaining the acceptance and support of manufacturers. HVAC manufacturers need a minimum of one year to implement production design changes.

The two factors contributing to the success of adopting minimum standards were the appeal of the utility rebates and the assurance that these programs would remain in place for a minimum of two years.

So far, the market has seen a fairly high penetration of package purchases meeting the initial efficiency requirements. In the last two years, ASHRAE has adopted these new standards, and the federal government will soon join in as well.

- The mechanisms used to achieve market transformation in the past are no longer in place. PG&E staff also pointed out that reaching agreement on even the minimum standards required attracting interest among manufacturers. Utility rebate programs offered that built-in incentive for achieving this market change. With the reduction in rebate programs, achieving future gains may be more difficult.

- The decision-making process for HVAC changes are often left to "experts" who may not be that concerned or interested in energy-efficiency. According to the PG&E staff, most of the decision-makers in the HVAC market are not the "true end users," but are rather the defacto decision-makers, such as consultants and specifiers. These engineers, equipment vendors, and specifiers have no reasons to recommend energy efficient equipment, per se, nor do they have any incentive to talk to each other about equipment recommendations.

PG&E's Commercial Energy Usage Survey (CEUS), published in 1997, provided in-depth information regarding the energy characteristics of the commercial market. Key findings include:

- Seventy-one percent of commercial square footage was heated and 58 percent was cooled.

- Cooling accounted for 17 percent of PG&E's total electric sales; heating accounted for 43 percent of the company's commercial gas sales.

This study also provided specific findings regarding space conditioning:

- Schools, colleges, and hospitals had the largest percentage of conditioned square footage among all commercial customers.

- Packaged heating and cooling systems represented 59 percent of the installed heating capacity. The following tables display these findings.

Exhibit 7
Packaged Heating Capacity
(million Btu/h)
By Equipment Type and Fuel Type

Equipment Type	Electric	Gas
Electric Heater	1989	
Gas Furnace		22077
Heat Pump	5383	182
Unit Heater	195	3293
Total	7,567	22,551

Source: PG&E 1997 Commercial Building Survey Report

Exhibit 8
Percentage of Premises with Cooling Capacity

Business Type	Percentage Owning Packaged Electric	Total Capacity
Colleges	74%	76%
Food Stores	59%	61%
Hospitals	86%	97%
Hotels/Motels	47%	51%
Miscellaneous	46%	47%
Offices	75%	79%
Refrigerated Warehouses	79%	80%
Restaurants	79%	80%
Retail Stores	57%	62%
Schools	78%	78%
Warehouses	63%	63%

Source: PG&E 1997 Commercial Building Survey Report

As the two tables show, most of PG&E's cooling load is generated by several large customer groups, such as schools and hospitals. Furthermore, the most commonly installed equipment type is packaged electric cooling systems. Based upon the findings from the PG&E information, it would appear that the HVAC market will present more of a challenge in measuring future gains. It will be important for the baseline study to accurately capture the extent of market transformation that has already occurred, especially among the larger and more sophisticated customer groups.

Secondary Literature Review Findings: Hvac Market

QC staff also reviewed reports of the heating and cooling market. One study was a comprehensive assessment performed by Strategic Marketing Research, Inc., published in January, 1996. The report collected valuable information regarding the decision-making process for HVAC equipment among commercial customers.

The following exhibit illustrates the various scenarios that exist for commercial customers to purchase new HVAC equipment. As this exhibit shows, few commercial customers voluntarily replace their HVAC equipment (29%), while most customers "inherit" their HVAC systems in the buildings they either purchase (32%) or lease (12%).

Exhibit 9
HVAC Equipment Purchase Scenario

Scenario	Description	Percentage Reporting
Involuntary Replacement	System broken/customer must choose new one	12%
Voluntary Replacement	Customer opts to install a new system	29%
New Construction	Customers selects new system when as part of a new building construction	15%
Inherited System/ Existing Building	Purchased/leased building with heating system in it	32%
Inherited System/ New Building	Purchased/leased new building with heating system already selected	12%

Source: Customer Space Conditioning Choice Research, SMRI, Jan. 1996

This finding helps explain why most HVAC decisions are left to others, simply because commercial customers may not have the opportunity to directly influence this purchase.

This report went on to identify the criteria by which commercial customers make HVAC purchase decisions:

- Cost Factor, which includes the initial expense of purchasing, maintaining, and operating an HVAC system, including reliability.

- Performance Factor, which includes operating specifics, safety, comfort, and cleanliness.

- Influence Factor, which includes the sources of information used in the decision-making process.

These criteria are summarized in the following exhibit across commercial segments.

Exhibit 9
Summary of Decision-Making Criteria
Across Customer Segments

Commercial Segment	Cost Factor	Performance Factor	Influence Factor	Timing of Decision
Small Retail/ Services	Highest Concern	Comfort, Cleanliness	HVAC Dealers, brand name	Quick Decision-often based on previous equipment
Large Retail	Lesser Concern-Reliability Critical	Not an issue	Brand name/ internal recommendations	Formalized decision-making process
Institutional	Cost Factor-System Life/Payback	Safety/ Indoor Air Quality Important	Recommendations/ seek out information sources	Complicated/detailed process involving engineers, committees and outside sources
Landlord/ Manager	Not a concern	Not a concern	Internal recommendations/ brand name/ expert advice	Longer decision-making process uses committees and mechanical engineers

Source: Customer Space Conditioning Choice Research, SMRI, Jan. 1996

As this exhibit illustrates, decision-making criteria vary among commercial customers. This exhibit also shows that large institutional markets, such as

hospitals and schools, do in fact rely on input from others in their decision-making process. The same trend also appears among landlords/managers of office buildings.

This report also explored more fully the role that outside "experts" such as engineers and architects play in the HVAC selection process. The findings are summarized in the following exhibit.

Exhibit 10
Role of Architects & Engineers in the Decision Process

Role	Percentage Reporting
Makes final decision	48%
Serve as information source	35.0%
Refer to heating/cooling dealers	33%

Source: Customer Space Conditioning Choice Research, SMRI, Jan. 1996

Nearly half the time, it is these experts that make the final decision for HVAC equipment (48%). Another third of these decisions are made by heating and cooling "experts," namely dealers (33%). These findings serve to reinforce the critical role that architects, engineers, and dealers play in the HVAC market.

Lastly, this report also highlighted the differences in equipment attributes that often emerge among commercial customers, HVAC dealers, and architects and engineers. The following exhibit shows that while customers may rate "reliability" as a critically important attribute, this attribute is not as highly valued among architects and engineers. These ratings illustrate that there is often a "disconnect" between meeting the customers' needs and meeting the experts' needs. In the end, it appears that the "experts'" preferences tend to win out in a majority of cases.

Exhibit 11
Attribute Importance
(Mean Ratings on a Five-Point Scale)
Among Key Market Decision Makers

Attribute	Commercial	HVAC	A&E
Reliability	***4.82***	4.65	4.37
Safety	***4.77***	4.18	4.14
Comfort	***4.73***	4.60	4.57
Energy Cost	***4.32***	4.32	4.40
Expected Life of System	***4.67***	4.22	4.07
Monthly Operating Cost	***4.58***	3.78	4.23
Air Quality	***4.56***	3.78	4.23
Cleanliness	***4.52***	4.18	3.87
Maintenance Cost	***4.61***	3.93	4.18
Payback	***4.47***	3.88	3.80
Ease of Installation	***4.14***	-	3.08
Brand name	***3.69***	3.81	3.38
ARI Ratings	-	3.41	3.08

Source: Customer Space Conditioning Choice Research, SMRI, Jan. 1996

The bold italics in the exhibit above further highlight the differences in importance that the customers and architects/engineers place on selected equipment attributes.

Barriers in the HVAC Market

The information provided from both PG&E staff and the literature review pointed out some of the more obvious barriers to achieving further market transformation. These barriers include:

- Information: Customers are not aware of the various types of energy-efficient applications currently available.

- Knowledge and Experience: Commercial customers tend to select equipment they are familiar with, or rely on advice from experts.

- Design Practices: They are poorly understood, and the trade allies have no incentive to select the "best energy choice."

- Lack of Understanding about proper equipment sizing: Trade allies want to install the largest unit they can sell, rather than designing for optimum efficiency.

- Lack of Future Incentives: This is of particular concern to manufacturers who may not be willing to continually develop improved products if sales in the current line lag.

- Industry Standards: This was the largest barrier to the packaged HVAC market three years ago. Now, the standards have been developed so this barrier has been effectively eliminated. However, future standards must continue to drive the manufacturers to develop more efficient products or else the market changes will not have lasting value.

- Nonreversability: Once energy-efficient equipment is available, it is impossible to return to the previous standards. Nonreversability may be the largest barrier to achieving the next level of market transformation.

Preliminary Recommendations for Study Focus

QC recommends focusing our analysis on **commercial** customers in the following markets:

- Schools

- Universities

- Hospitals

Another area for consideration may be the office segment, which accounts for a large number of installations of packaged air units. However, drawing a representative sample within the office market may be beyond the scope

of this study, given its finite resources. The office market contains a broad range of decision-makers, and this could make determining the market effects more difficult.

QC selected these segments based upon PG&E's past success in designing energy-efficient programs aimed at these markets. These segments are also high users of HVAC systems, and they represent the largest component of usage within PG&E's commercial market. In addition, these segments are also the targets for ESCOs involved in performance contracting, and narrowing the focus to these segments will allow us to identify more clearly the role that performance contracting plays in the HVAC market. Other commercial customers, such as restaurants, refrigerated warehouses, and supermarkets, have more specialized heating and cooling needs, which may make it more difficult to identify key market changes and industry characteristics.

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APPENDIX 2. FOCUS GROUP RESULTS

The Market for High Efficiency Commercial Air Conditioning in Northern California:

Current Status, Recent Trends, and Future Prospects

A Memo Report of Two Focus Groups
Conducted for PG&E

By
Quantum Consulting

December 1997

Table of Contents

The Market for High Efficiency Commercial Air Conditioning in Northern California:

Current Status, Recent Trends, and Future Prospects

Executive Summary

This memo summarizes selected findings from two focus groups conducted with HVAC dealers and distributors to assess the current market for high efficiency commercial air conditioners (HECACs) in Northern California, recent changes in that market, and expectations about the future of that market. The research is part of a larger study of the effects of prior rebate programs, designed to help determine their effects and to help set baselines and directions for future programs, including market transformation efforts.

The sessions were designed for "mini-groups," composed of 4-8 highly knowledgeable and interested market actors. The participants ranged from a performance contractor with a major controls company to a sheet metal contractor, as well as standard equipment dealers. Their responsibilities included sales as well as all aspects of project management. In these sessions, they focused on their commercial sales of packaged air conditioning units, although most handled other equipment and residential sales as well.

When considering the key findings from the focus groups, the following background characteristics of the commercial HVAC market should be kept in mind.

- HVAC contractors are often not in direct contact with the end-users who make decisions regarding the efficiency level of equipment purchases because much of the vendors' business involves supplying and installing equipment already specified in a bid request.

- The standard installation for packaged units is reported to have an efficiency rating of 10 SEER.[15] PG&E and other utilities have provided rebates for more efficient equipment, such as 12 SEER units (which some have designated as Tier 1

[15] SEER refers to Seasonal Energy Efficiency Rating, an index of cooling capacity relative to power requirements for the cooling season, and is used for units of less than 5.5 tons or 65,000 Btu/hr. Larger units are measured in EER, which is based only on the ratio of peak cooling capacity to peak connected load. The groups focused on the smaller units.

improvements). However, their longer-term intent is to move the market toward *premium* efficiency units, of 14 SEER or more (Tier 2 improvements).

- According to focus group participants, current power rates do not permit customers to achieve short paybacks for installing HECACs rather than standard efficiency equipment unless they are replacing highly inefficient units. This problem is mitigated to some extent by the rebates that have been offered for Tier 1 improvements; however, it is only minimally addressed by the rebates available for Tier 2 improvements.

Focus group members describe the relevant market primarily in terms of the likelihood of different types of customers to respond favorably to recommendations or options for the purchase and installation of HECACs. A preliminary typology includes the following.

- Retailers (including banks) are poor prospects. Most do not pay for the purchase and installation of their HVAC equipment. The owners of their buildings do not see HECACs as being of value in attracting or retaining tenants.

- School districts have recently been changing from central HVAC systems to dispersed systems. In this transition, they have been installing relatively low-grade equipment, consistent with buying as cheaply as possible.

- Start-up companies are focused on keeping immediate costs under control rather than with longer-term benefits.

- Customers who wait for equipment to break down before investing in upkeep activities tend to be interested in the least-complicated, least-expensive solution to their immediate problem.

- General contractors most commonly seek equipment with the lowest first cost and also avoid any solutions that might increase labor costs or time to project completion.

- In contrast, architects and engineers are generally more willing to consider options and to initiate discussions of energy efficiency. However, architects remain prone to oversizing units to reduce the likelihood of end-user complaints about cooling power.

- Decision-makers in larger corporations are more responsive than others to issues of energy efficiency. They are also particularly interested in increasing standardization of equipment (which can work against efficient solutions) and in reducing risk (which can increase the use of efficient equipment, with its longer warranties.)

One indicator of the customer segmentation practiced by the HVAC marketers is that they tend to price HECACs as a specialty item directed to a relatively narrow niche. The sellers are less likely to offer any type of discount or price reduction for HECACs than for standard efficiency units. Most dealers and distributors recognize their job as selling and installing units, not

changing the mix of units in the market. Concerned that attempting to increase margin slightly through sales of the higher-priced, more efficient units is just as likely or more to result in a lost customer, they have little incentive to push for HECACs.

At the same time, these market actors differ among themselves in their assessment of the difficulty of converting customers to HECACs and their consequent willingness to make such efforts. A few believe that premium units "sell themselves," particularly with the PG&E rebates that have been available. Such vendors describe spending as much as 7-8 hours developing a bid, reviewing specifications, and dealing with customers' questions, and they report roughly 40% success in selling HECACs. Most, however, do not see such opportunities and rewards available, possibly because they serve a different market segment or possibly as a direct outcome of their view of their market functions. The latter group reports the need to provide as many as ten bids per day and indicates no time being available to educate customers about the benefits of HECACs.

The dealers and distributors describe the manufacturers with whom they work as helpful, but not extremely active in promoting HECACs. The manufacturers are continuing to fund research and development on this line of equipment, and participants are very strong in their beliefs about the resulting quality and value of HECACs. They believe the equipment is well-designed and contains high quality materials. Moreover, they are convinced it is reliable and long-lasting. In addition, they report that manufacturers provide adequate training for vendors and good levels of product promotion. Indeed, some manufacturers are even offering lease-purchase programs to help their dealers increase sales. Nonetheless, it does not appear that any manufacturers are investing major efforts in attempting to move the market to higher levels of energy efficiency.

In discussing barriers to the sale of HECACs, the vendors report that several changes in the market can be seen over the past 4-5 years, and several factors have remained constant. The changes include the following.

- High efficiency units are more likely to be readily available.
- The initial cost of HECACs has moderated somewhat.
- Customers are more aware of the equipment options.
- Customers interested in energy-efficient options are more likely to ask for cost and payback information regarding HECACs and to require detailed computer or written analyses, reducing information gaps between them and the vendors.
- Warranties on HECACs are longer than they were in previous years, helping to reduce any customer concerns about reliability of the equipment.
- Payback criteria have been relaxed somewhat, according to some group members. Not all agree with this assessment, with some arguing that no changes in decision criteria have occurred and there has been no increase in focus on life-cycle costing.

However, according to participants, the critical split incentive barrier has not changed in any way. Finally, they say, other hypothesized barriers, such as the concern about hidden costs of premium equipment (e.g., the need for maintenance contracts) are not an issue.

When discussing observed changes in market barriers to the sale of HECACs, the HVAC marketers note several influences, including the following.

- General market conditions; e.g., a construction boom in the region, renovations sparked by the anticipation of El Niño
- California's Title 24, which tightened building codes though it did not affect equipment standards[16]
- Manufacturer's promotions
- PG&E's rebate program, which was of considerable assistance to proactive HVAC contractors by allowing customers to overcome barriers to financing as well as increasing customer awareness of HECACs and increasing the credibility of the vendors[17]

Few members of these groups are optimistic about the market for HECACs being transformed in the foreseeable future—particularly if rebate programs are completely eliminated. They do not believe that the interest of most customers in energy-efficient equipment has increased and they anticipate manufacturers cutting back on their promotional efforts in the absence of the demand that had been enhanced by rebate programs. Moreover, some argued, it was difficult to see benefits to utilities from reducing supply needs in the restructured industry.

Although one discussant believes that retail competition will motivate customers to increase their energy efficiency as part of the effort to strike better deals for power, this view was rejected as unlikely by most. They noted that expected decreases in power costs would instead be likely to erode interest in more efficient equipment. Furthermore, some argued, it might be cheaper to achieve any additional efficiency desired through changes in fenestration or insulation, rather than HECACs. Additional legislation or regulation might force some improvement, they said, but codes cannot move the market too far, given concern for the viability of smaller manufacturers.

Considerable discussion was devoted to emerging trends in the mix of competitors for HVAC projects, particularly the rise of large consolidated service and equipment companies. A number of important issues regarding market power relative to manufacturers, the likelihood

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[16] Focus group members believe that Title 24 has raised the floor for building efficiency levels. At the same time, they note, the opportunity for tradeoffs, e.g., between HVAC efficiency and glazing ratios, has limited the overall impact of the code.

[17] The participants also offered a number of specific comments on the strengths and weaknesses of the rebate program which are covered in the text.

of improved industry standards, and other topics were raised. Most directly relevant to the issue of future energy efficiency, the group members did not believe that most of these companies would be likely to compete on the basis of the energy efficiency they could achieve for customers. However, they do believe that energy efficiency might be part of a broader push toward standard, consistent procedures that would appeal specifically to the larger customers likely to be targeted by consolidators. And they suggest that it might be advantageous for utility spinoffs to trade on their franchise as energy experts, through a focus on energy efficiency or alliances with selected manufacturers or consolidators.[18]

Preliminary conclusions from these focus group discussions include the following.

- PG&E's rebate programs have helped to increase the penetration and saturation of HECACs (primarily Tier 1) in the commercial HVAC market, over and above that which would have occurred naturally.

- However, there seems to be no evidence that the rebate programs or any other marketing efforts have transformed the overall market for HECACs.

It is necessary and appropriate to supplement the focus group discussions with more systematic data collection, both to test the generality of these findings and to quantify some of the results suggested.

However, should these findings be confirmed, certain strategic directions are worth considering.

- It may not be useful to focus efforts to transform the HECAC market on contractors.

- It may be useful to review the benefits and costs of the two-tier strategy for improving packaged HVAC efficiencies.

- It may be useful to explore further the relative value of focusing programs on building systems rather than specific pieces of equipment.

Background

PG&E has conducted major programs throughout the decade to help its commercial and industrial customers improve their energy efficiency. These programs were designed and implemented prior to the emergence of the "market transformation" orientation that characterizes many current discussions of efficiency programs. In contrast, they tended to rely on the rebate mechanisms that some program managers would like to leave behind as the industry becomes more competitive. Nonetheless, it is reasonable to ask whether those programs appear to have affected the underlying markets—and if so, whether those effects are likely to be sustainable. The answers to these questions are important for several reasons. They

[18] One other issue of concern was the difficulty of securing trained, motivated personnel capable of working with sophisticated equipment, both now and in the future.

can help determine whether PG&E should be credited with having helped develop the relevant markets, provide a current baseline for the design and evaluation of future activity, and contribute to the assessment of the value of rebate programs.

The larger study of which this is a part includes individual interviews of important market actors (e.g., architects, engineers, and ESCOs) and the collection of relevant statistical information regarding sales and other indicators of market effects. To supplement those data and to gain qualitative information and insight regarding the motors and HVAC markets in Northern California, we conducted a series of four focus groups with other market actors. Specifically, we conducted two groups with HVAC distributors and dealers, as well as two groups with motors distributors, dealers, rewinders, OEMs, and manufacturers' representatives. This memo summarizes important findings from the HVAC group.

Method

The sessions were designed for "mini-groups"—focus groups of 4-8 members. Such groups are quite useful when the members are likely to have both considerable knowledge about the topic of interest and a willingness to discuss the relevant issues. The smaller number of participants permits the group to go into greater depth regarding the experience and beliefs of each member and can provide a richer understanding of the topic than the usual model of larger (10-12 member) focus groups.

Participants were drawn from the entire San Francisco Bay region, including such areas as Oakland, Hayward, Concord, Walnut Creek, and Pleasanton. They were recruited by Quantum Consulting's professional focus group staff from lists provided by PG&E and a Dun & Bradstreet database (eMARKET). Each was offered an incentive of $100 for attendance and completion of a brief quantitative survey. (The survey form and results are provided in a separate memo.) The great majority of participants had many years of experience in the HVAC market. They represented a variety of types of firms, ranging from a performance contractor with a major controls company to a sheet metal contractor, as well as standard equipment dealers. The particular responsibilities of most group members tended to include sales as well as the entire range of project management, from design and estimation to management of installation activities.

A draft discussion guide was prepared and provided to PG&E's Project Manager. Copies of the discussion guide and the screener are presented in the Appendix to this report.

Throughout the discussions, participants were asked to focus on packaged air conditioning units, rather than chillers or larger, custom-built installations. Moreover, they were asked to address only their commercial market and to ignore their residential customers. The group members discussed all occasions for packaged unit sales: new construction, retrofits, and replacements.

Findings

To some extent, we present the findings from the two focus groups with HVAC market actors in the same format as that used for describing those from the motors focus groups. We divide this discussion chronologically. First, we summarize past and current baselines for the high efficiency commercial air conditioning (HECAC) market, as reported by focus group

participants. We include in the review of reported changes in that market over the past five years discussion of the factors said to be responsible for those changes. We then describe the participants' expectations regarding future changes in the market.

However, we preface these results with our understanding of the overall approach to the market evidenced by the focus group participants in their discussion. Moreover, we contrast this approach to that demonstrated by the participants in the motors focus groups. We do so in the belief that many of the subsequent findings can be better understood in the context of the apparent characteristic of the HVAC market as more oriented to single transactions and less relationship-oriented than the motors market.

Market characteristics

Participants in the HVAC focus groups describe their interactions with customers and their market behavior quite differently from those in the motors focus groups. HVAC contractors are often not in contact with the end-users or agents who make the decisions regarding the efficiency level of equipment purchases. A large proportion of their business (which varies by the contractor and the niche his company occupies) is supplying and installing equipment already specified in the bid request.

Although the motors vendors are often required to bid their wares, most appear to maintain some sort of continuing relationship with their customers—undoubtedly because they sell more units to their customers and do so more frequently than do HVAC vendors. Accordingly, motors vendors appear more likely to be in a position to become de facto consultants or specifiers with regard to models and product characteristics of the equipment required. (A few HVAC vendors do attempt to create continuing relationships with customers through maintenance contracts. However, the resulting contacts are generally between lower level employees and the vendors must work hard to obtain the relevant benefits of recognition and new sales opportunities.) An additional factor of interest is that most motors vendors appear to carry several brands, adding to their credibility as objective experts. In contrast, most HVAC marketers are constrained from carrying more than one brand, because of the sales agreements required by their suppliers.[19]

One symptom of this more distant relationship with customers is that HVAC vendors seem to be required more often than motors vendors to bid competitively for projects, with relatively little opportunity to help design the specifications. Indeed, HVAC dealers and distributors are often not in direct contact with their final customers. In many large projects, particularly in new construction, the HVAC marketers are interacting, not with the building owner or end-user, but with an architect, engineer, or general contractor who serves as the owner's agent. In these

[19] Manufacturers differ from one another in the degree to which they demand vendor "loyalty" in return for the ability to carry their equipment. They also differ with respect to enforcing rules as to the type of company that can purchase units directly, and whether or not special rules are in effect for equipment that is eligible for PG&E rebates. In general, however, it appears that price breaks are only available to those vendors willing to be part of the manufacturer's dealer network. This conveys certain advantages, such as having the manufacturer's name on the truck and co-op advertising support; it also restricts some opportunities. Dealers appear to believe such arrangements are considerably more useful in the residential market than in the commercial market.

situations, the HVAC expert is even less likely to be in a position to promote any option other than what has already been specified by others.

The resulting competitive pressures, coupled with the considerably greater cost of HVAC units and the relatively long payback for investments in high efficiency, appear to discourage most of these vendors from strong efforts to market more efficient equipment to their customers. In contrast to the motors vendors who participated in the focus groups, few HVAC vendors report strong proactive efforts in this area.

Past and current baselines

Given the importance of project bidding to HVAC dealers, it is not surprising that much of the discussion of the market centered on the types of customers who are willing to consider energy efficiency and those who are not. Other topics considered here include differences among the HVAC vendors themselves, the role of manufacturers, changes in the market, and intervention by external forces.

In reviewing these issues, the reader should keep in mind certain baseline information about the equipment available and its cost structure. First, air conditioning is virtually a requirement for commercial space, all year around, even though the Northern California climate does not necessarily require such units for comfort in residential settings. Second, the standard installation for packaged units is reported to have an efficiency rating of 10 SEER.[20] PG&E and other utilities have provided rebates for more efficient equipment, such as 12 SEER units (which some have designated as Tier 1 improvements). However, achieving major gains in energy efficiency, customers must move to units with a SEER rating of 14-16 SEER, which entails approximately a doubling in price (but even so, less than a 50% increase in efficiency). Hence, the longer-term intent of PG&E and other utilities is to move the market toward *premium* efficiency units, of 14 SEER or more (Tier 2 improvements).

According to focus group participants, with current power prices customers are unlikely to achieve short payback periods for the additional investment (absent rebates) unless they are replacing highly inefficient units. This is particularly true with respect to relatively small units such as 5 tons. (However, some customers are willing to move incrementally—to the Tier 1, 12 SEER units—because the price differential is relatively small, perhaps $1,600-$1,800, much of which may be covered by rebates. But the corresponding efficiency gains are also limited, as are the operational savings at current electric rates.

Customer Segmentation

According to most focus group members, their market for selling high efficiency air conditioning units is highly segmented. Several types of customers are unlikely to be willing to even consider such units, largely because of first-cost issues and the low probability of recapturing the additional investment required—even if those customers were to focus on life cycle costs. The list of those that are poor prospects for HECACs include short-term lessees, building owners who anticipate selling their property in the near future, and start-up companies.

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[20] See footnote 1.

In contrast, large customers who are sophisticated about energy use and own their buildings do demand energy-efficient equipment. Moreover, these decision-makers are aware of and interested in the rebates programs in effect, while smaller companies seem to consider only the immediate price quotes. One other market segment that does offer good prospects includes lessees who are on a triple-net lease.[21] Since they sometimes also invest capital in the facility, this group also seems responsive to the expected lower life cycle costs of HECACs as compared to standard equipment.

Group members believe that retail space (in which category they include banks) is particularly susceptible to the use of low levels of HVAC efficiency. Building owners must contend with high levels of turnover and lessees who are considered notoriously poor maintainers of property. Given the costs of changes in occupancy (including lost revenues, advertising or move-in inducements, and renovation to suit the new tenant), they imply, investments in HECACs are luxuries they cannot afford. Moreover, that equipment is neither readily financed nor obviously of particular value in attracting or retaining tenants.

It might be thought that school districts are good prospects for HECACs, because their nonprofit status and corporate stability should allow them to forego short paybacks. However, according to participants, school districts are currently changing from central HVAC systems to dispersed systems and, in the process, are installing relatively low-grade equipment, consistent with buying as cheaply as possible and ignoring opportunities for investment in energy efficiency.[22]

Start-up companies tend to recognize the overall mortality rate for new entrants. Many do not last long; all are focused on keeping immediate costs under control in order to make it through the first couple of years.

Another poor market[23] for HECACs is the customer who operates on “a breakdown maintenance schedule”—that is, waiting for equipment to break down before investing in any upkeep activities. In those situations, the customer may often be suddenly faced with the need for replacement of a major component or the complete system. And, at such a time, the decision-maker tends to be interested in hearing the least-complicated, least-expensive solution to his immediate problem.[24]

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[21] A lease that excludes taxes, insurance, and utility costs.

[22] Contractors cannot speak definitively to the reasons for this, since they enter the market well after the pertinent decisions have been made. However, it may be hypothesized that attempts to minimize the need for and costs of bond issues for equipment are driving these decisions, despite the impact on future operating costs. In some states, this problem is addressed through special state funding for school efficiency projects.

[23] We do not mean to imply that the following description is independent of the factors already discussed. It seems highly likely that customers in start-up businesses and those concerned with immediate payback are particularly likely to fit this group.

[24] Focus group members contrast these customers with those who buy premium equipment and then protect it with a service contract. They liken the two groups to owners of Yugos and owners of Mercedes in their appreciation of their investments.

As noted earlier, general contractors are often the immediate customers for the HVAC marketer. This is particularly the case for new construction projects or when a broad range of improvements is involved. Such projects almost always result in bid situations. Not only do these decision-makers seek equipment with the lowest first cost (given the pressures on them for cost containment), but they also strongly avoid any decisions or installation requirements that might complicate labor needs or time of completion. They tend to favor standard quality unless the final customer specifically demands premium equipment.

In contrast, architects and engineers as well as larger corporations tend to be favorable markets for HECACs. The HVAC marketers are pleased when they can work with such decision-makers. The architects and engineers often want to review various options and may initiate discussions of energy efficiency. In general, they are willing to consider nonstandard equipment, provided that it is engineered well, is likely to last, and will serve their ultimate customer's needs. Moreover, architects and engineers are far more likely than general contractors to provide straightforward blueprints, reducing the hassle and risk involved in many projects with general contractors. Several group members said they would love to be able to stay away entirely from the smaller jobs with general contractors, if only their level of business would permit. However, some also report that architects continue to specify HVAC units that are considerably larger than required, using older rules of thumb, to protect themselves from any possibility that the end-user may complain about lack of cooling.

As indicated previously, decision-makers in larger corporations are more responsive than others to issues of energy efficiency. However, another important consideration for many corporations is overall reduction of decision requirements and simplified stocking requirements for replacement parts (to be warehoused by the suppliers). On the positive side, this can result in the purchase of HECACs on a national scale; e.g., through an overall agreement with a vendor such as Trane. On the negative side, the company's effort to set an internal equipment standard can result in ignoring more efficient equipment, depending on the timing and terms of such agreements.

One other important factor reported to influence the decisions of larger corporations is the reduction of risk. Those making the purchase decisions are often financial managers who are motivated, for both corporate and personal reasons, to value redundancy and other means of guarding against downtime. The longer warranties against equipment failure that are offered with HECACs are often more important to them than the energy savings promised. As one group member put it, when the customer is interested in guaranties, he is likely to select the energy-efficient product.

HVAC vendor orientation

Another indication of the customer segmentation practiced by the HVAC marketers may be seen in their HECAC pricing strategy. They see HECACs as high quality products directed to a relatively narrow customer niche. Generally, it is the interested customers who take the initiative in the sale or at least indicate their willingness to accept something other than the low bid. Accordingly, the sellers are less likely to offer any type of discount or price reduction for HECACs than for standard efficiency units.

From this perspective, the PG&E rebate program is of considerable value to the sales opportunities of the dealers and distributors. Its promotion increases awareness of the high quality product and its availability increases the number of customers who are willing to pay a premium price for a premium product (on the expectation that they will receive a rebate for the difference in price).

It is important to recognize that the occasions for proactive selling are in fact somewhat limited. Investment requirements and paybacks dictate that relatively few end-users retrofit a well-functioning system.[25] New construction and replacement opportunities are generally not known in advance by HVAC marketers, and "selling up" in unit size is not an option (especially if energy efficiency is an objective). Thus, most potential gains in profits from proactive efforts lie in installation efficiencies and increased sales margin. If going for that extra income through pushing an option the customer is unwilling to consider is just as likely or even more likely to result in a lost sale, there is no reason to push for HECACs.

The overall attitude of participants is epitomized by the comment that there will always be a market for the low-priced option and a market for the high-priced option, with most customers falling between the two. What this perspective appears to reflect is a lack of any strong initiative to move the majority of customers toward one option or another. Rather, it appears to accept the status quo along with a willingness to profit on the margins as opportunities for selling either the low-priced option or the high-priced option present themselves. It reflects no interest in helping create a market where HECACs are the routine commodity product.

As with the motors vendors, however, the HVAC participants differ among somewhat themselves regarding the benefits and costs of promoting energy efficiency, depending upon the niche they occupy. One participant said that he may spend 7-8 hours in developing his bid for submission to a general contractor, reviewing the specifications and sending and receiving faxes with relevant information. He believes he can tell when the contractor is a "hard nose" and there is no room to move toward more efficient equipment. Overall, he estimates that he can get the contractor to "roll over" approximately 40% of the time. In contrast, another member of the same group said he needs to get out ten bids in a day. Consequently, he cannot spend hours with a single general contractor. For him, many deals are made in "two minutes." Another contractor noted that he simply cannot afford to spend three hours and the cost of a lunch to make an additional $200 (by convincing a potential buyer); the margin is insufficient to support that effort.

One participant disagreed strongly with others regarding the ease of selling HECACs. He maintained that he had not sold any 10 SEER units all year. Indeed, he reported concentrating on 15-16 SEER units, which he found to "sell themselves," especially with the PG&E rebates available. Several characteristics may differentiate vendors of this type from others. These

[25] It is here, of course, that some maintenance contractors and some ESCOs have an opportunity. Monitoring system performance can help alert contractors to customer needs. Being able to offer performance contracts or shared savings can help overcome customer's concerns over financing issues. These opportunities are likely to be greater, however, for chillers and other large systems.

factors may include the particular customer segments targeted and the vendor's perceptions of his market functions.

A related contrast in vendor orientation appears in the way in which they describe their bidding strategy. Some provide a base quote and then offer options for more energy-efficient equipment. Others argue that, while it is important to always offer options to the customer, starting from the low end will seldom allow upward movement. Instead, they counsel, it is important to pique the customer's interest in savings, demonstrate what the contractor believes is best, and then indicate other options.

This vendor described earlier does not disagree with others regarding the types and motivations of customers. He agrees that building owners will often select poor equipment, so long as it can satisfy the tenant's immediate needs. But he appears to make an effort to sell to the end-user, who is likely to care about achieving energy savings and to be willing to select more efficient equipment so long as the rebate offsets much of the incremental costs.

In addition, some vendors see themselves as having psychological ownership of their projects. For them, the job includes educating the customer and offering options, rather than simply quoting prices. These market actors appear willing to tell a customer that if all he wants is the cheapest equipment, that customer should select another vendor.[26] They stand in contrast to the majority—those who maintain that their business is to sell and install HVAC equipment, not to press recommendations on customers who are unwilling to seek advice or pay for efficiency.

The Role of Manufacturers

The members of the discussion groups were quite positive regarding the quality of the HECACs they sell and the support they receive from the manufacturers. Participants recognize the quality and other benefits of HECACs, and would strongly recommend them to customers when asked their professional opinion.[27] High SEER equipment is at least as reliable and long lasting as standard models. Indeed, the warranties are longer because the technology has proven itself to have low failure rates. More research and development has been involved. Moreover, the use of Variable Frequency Drives in two-staged models stresses the equipment less, and this leads to considerable savings in equipment failure.

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[26] The suggestion here is that some vendors are at the extreme on this dimension. Virtually all would agree that they must provide some level of quality to maintain their reputation. Installation of lowest-cost equipment, which falls apart after a few years, is recognized as a poor advertisement. Most contractors appear willing to settle for middle-of-the-road materials, however.

[27] One respondent argues, however, that the higher ratings are largely "smoke and mirrors." He believes that they are achieved through various technical tricks (which he described), and do not translate into actual cooling. (This may reflect confusion between SEER and EER ratings.) More generally, several other participants voiced concern that the ratings are (ideally) achieved under laboratory conditions and may not be valid indicators of actual performance.

The participants also believe that most manufacturers provide good levels of product promotion and adequate training for vendors.[28] Depending upon the dealer's sales volume, the manufacturer will offer technical classes at their own facility or will do so at the vendor's site. They will also provide some sales training and most provide software programs that assist the dealers in project estimation and in education of customers.

Some manufacturers (particularly Trane) are also offering equipment-leasing programs to help their dealers increase sales. The manufacturer will arrange the financing through a financial institution and allow the customer to pay the cost of the lease through savings on the utility bill, with a buy-out scheduled at the end of five years. These programs have been particularly attractive to smaller companies that are interested in the premium equipment or the energy savings, but need to preserve capital for other investment or operational opportunities.

Market Changes

Discussants indicate that the market has matured from that of several years ago, in that certain barriers that had been present earlier have been reduced. For example, most high efficiency units are now readily available from most manufacturers where they had not been previously.[29] (It is uneconomical for dealers or distributors to stock packaged units because there are too many parameters—sizes and phases—involved. At this time, manufacturer's representatives can promise to have a unit on a truck for delivery within an hour of receiving an order.)[30] The initial cost of HECACs has also come down somewhat.

Customer awareness of the equipment has also increased somewhat. PG&E's rebate program and its promotion have helped create this awareness of the equipment (along with awareness of the rebates themselves). In addition, Trane and Lenox have placed many advertisements in trade magazines and other venues, reaching both customers and dealers. And of course, vendors themselves have also been helping to make customers more aware of the high-efficiency options.

Part of the vendors' educational efforts are to address the asymmetric information problem. To a considerable degree, the need for this appears to result from PG&E's promotional efforts. The advertising raises interest in the issue, but does not provide the information required for full understanding. Many customers do not understand SEER ratings or the efficiency concept—

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[28] This is not to say that any manufacturers invest significantly in attempting to move the market toward higher levels of energy efficiency through their own rebates or other strong promotional efforts. Nonetheless, they do continue to conduct research and development to push the efficiency envelope and do provide the dealer support described in the text. (As for research and development, group members report that 18 SEER units are available now—but largely for technological "bragging rights." Furthermore, they say, that to maintain the technological lead the company involved has 21 SEER units are ready for production once other companies reach the 18 SEER level.)

[29] This does not appear to be universally true, however. One discussant recalled nearly losing a sale of 16 SEER units because of availability issues. Another reported that Trane continued to have problems in this area.

[30] To some degree, of course, the lack of stocking also reflects the relatively low turnover of units over the course of a year. HVAC dealers and distributors do keep a large inventory of furnaces, given the size of the housing market they service.

confusing it with the “amount of cooling” received, for example. They also recognize that they will find it difficult to determine their exact savings after the fact, since so many factors affect actual usage.

The interest and lack of understanding create the opportunity for vendor educational efforts. Over and above the conceptual explanations, HVAC marketers report, many customers require extensive software or written analyses and documentation before agreeing to the purchase of HECACs. As one discussant put it, “Trust is not an issue, so long as the customer can see the numbers in black and white.”

All in all, the risk of equipment failure was considered minimal. The equipment itself has been improved considerably; it is built to a higher standard than earlier. Moreover, as noted above, manufacturers now provide longer warranties on efficient units, including compressors (which now carry warranties for five years, rather than one).

However, participants noted that customers were very concerned with the risk of not achieving the payback projected. As noted earlier, this concern prompts major educational efforts by the vendors. In addition, it provides the opportunity for performance contractors to develop projects in which they offer to absorb that risk and profit not only from the initial project but also from associated maintenance contracts and service support activities.[31]

One of the focus group members, employed by an ESCO, reported that corporate practices may have changed somewhat in this area. He reported that there was some tendency for payback criteria to be more relaxed today than they were four to five years ago. Some of his customers appeared willing to accept payback over ten years today, as compared to less than two years in the past. This allows him to provide considerably better quality equipment than he could have done earlier. Nonetheless, he noted, it remains critical that the project can be funded from the energy savings; it will die if the savings will not cover the incremental costs involved. One of the critical strategies in developing effective projects, therefore, is the bundling of various improvements rather than focusing on HVAC alone.

Other participants disagree on the extent of such a change. Some do believe that there is greater concern with operating costs. Most, however, report no change in decision criteria and no conscious focus on life-cycle costing.

At the same time, several barriers have not changed at all. Foremost among these is the split incentive between the building owner who is usually responsible for the investment in HVAC equipment and the tenant who must pay for—and would reap the benefits of—the operational costs.

Finally, some potential barriers are considered irrelevant by the group members. For example, when asked whether customers might be concerned about any hidden costs of premium

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[31] Providers of these services are also capitalizing on the current trend toward outsourcing of labor costs. In some cases, the group members maintain, the new competitors are virtually giving away the equipment in order to gain the maintenance and service contracts.

equipment (e.g., the need for maintenance contracts), they indicated that such issues were discussed up-front with customers and did not constitute a barrier.

Intervention by External Forces

As would be expected, overall market conditions are an important determinant of the activity of HVAC dealers and distributors. Currently, there is a new construction boom, for example. Nonetheless, group members report that the replacement market is more lucrative for them at this time than is the market for design and construction. In part, this may be an artifact of efforts to "prepare" for el Niño by ensuring that roofs and roof-top units are as secure as possible. However, the availability of new construction in the current space market is leading to cheap leasing opportunities. With the costs per square foot relatively low, neither developers nor renovators—nor customers—appear to be considering longer-term issues such as embedded energy efficiency.

When asked about the role of standards and of various professional organizations, such as ASHRAE or ARI, participants reported that California's Title 24 has been a major factor in changing the market for HECACs. Building codes have been tightened, particularly in that envelope and ventilation requirements have been strengthened. However, they noted, nothing has changed with respect to equipment standards themselves—it is almost as if those requirements have become more lenient.

Focus group members also pointed out the perverse effects of Title 24: The standards do lead to the achievement of minimum energy-efficiency levels that are distinct improvements over earlier building practices. However, the tradeoffs allowed in the calculations of efficiency levels do not encourage above-standard results. In many cases, discussants say, HECACs are used to offset increased application of glass walls and windows. In other cases, the costs of HECACs are avoided by reducing glass areas and increasing the use of shading. In other words, the code accomplishes the elimination of extremely inefficient buildings; however, it does not appear to motivate the routine use of HECACs or the creation of highly efficient commercial space.

Federal legislation banning the use of CFCs has affected chillers and some split systems. It does not directly affect packaged systems or the mix of units sold or installed, in part at least because these units are sealed.

PG&E's rebate program was of considerable assistance to the more proactive contractors in addressing some parts of the HECAC market. Not only does it allow customers to bypass the barrier of access to financing, but it also permits them "to try things, with less risk." Since PG&E is picking up the incremental costs, the customers can test what they see as an innovation. Moreover, these contractors believe that the rebate strategy works as a way of increasing awareness of the practical value of energy-efficient equipment among some customers. Once these customers install HECACs, "They can see it. It works; it saves them money; it does what it's supposed to do." As a result, "When they come to put in another one, they [will] probably do it even without the rebate."

Group members also cited several other aspects of PG&E's program as being of particular value to them in their market functions. In particular, they were able to gain credibility with their customers for savings estimates because PG&E helped "run the numbers" and sent reports that

included the PG&E logo. In addition, PG&E representatives visited job sites with them and cooperated effectively with both individual HVAC companies and EGIA.

However, participants reiterate, the rebates and the program do not affect the decisions of all customer segments. As a case in point, one group member described in detail a major replacement project where the customer was aware of a very attractive rebate package and of the fact that those funds would not be available in the future. Nonetheless, the customer elected to make do with the existing units so long as he can—"piecemealing" the project—in order to minimize the use of his current funds. Moreover, the vendors report that PG&E failed to provide them with promotional literature to give their customers. Thus, to the question, "Did rebates help move the market?" HVAC dealers reply, "It depends." Still, when asked what interventions were the most important in removing market barriers, more cite the rebates than any other factor.

The ease of participating in the program is also an important issue for HVAC marketers. One pointed out that the normal program required him to do considerable work to prepare the application. Then, he experienced delays in gaining approval for a major project and ultimately his customer received payments far lower than anticipated. Accordingly, this contractor would no longer participate in anything but the Retrofit Express. Another said that he would only work with the utility if his customer explicitly asked him to do so.

Discussants also cited other areas in which they believed PG&E might have been more proactive. For example, they noted that PG&E does not provide regular information about HVAC maintenance to mid-sized customers, as they do to larger corporations. Yet, they argue, it is just those customers who are likely to own their HVAC systems but lack the internal expertise to deal properly with them. In addition, some report that PG&E has not shown sufficient interest in setting up alliances and partnering with HVAC contractors, teaching them how to save energy, educating and training them in promotional skills. A specific concern was the lack of cooperation experienced in efforts to arrange for use of the utility company's training facilities. In their view, the effects of eliminating the rebate programs could be minimized through PG&E continuing or enhancing its involvement with HVAC vendors and helping them to educate customers about service issues.[32] Finally, some group members suggest that PG&E might work with customers who are about to move their facilities. Under this proposed proposal, similar to a commissioning program, PG&E would encourage companies to hire contractors or service companies to inspect premises to which they are intending to move. They would then assist customers in requiring certain levels of energy efficiency prior to the move, so that they do not experience disruptions later. The participants also suggest that such an inspection (commissioning) program might be tied to commercial energy-efficiency mortgages, which they believe would be more successful than those attempted in the residential sector.

[32] In one group, a specific point was made regarding the need to educate BOMA members—those whom one might hypothesize would be most likely to be knowledgeable in this area.

Expectations about the future of the market

Few members of these groups are optimistic about the market for HECACs—particularly Tier 2 equipment—being transformed in the foreseeable future. In part, this traces to their view of the most customers having little interest in energy efficiency. One participant noted that only one of his recent customers—a hospital—was energy conscious (so much so that they did not even look at the rebates available in making their equipment decision). In the absence of rebates, the HVAC marketers anticipate that they will simply stop selling 16 SEER equipment; that the market will evaporate just as did that for the solar industry when rebates were eliminated.

One participant believes that retail competition will motivate customers to increase their efficiency as part of obtaining the best available deals for power. In the view of most discussants, however, the expected reductions in energy costs will also reduce the demand for HECACs. It is difficult enough to sell the high efficiency units with the paybacks currently available. As energy costs are reduced, the savings opportunities will shrink even more. Moreover, another group member argued, utilities are unlikely to promote energy efficiency as strongly as before, since they will not stand to gain from reduced supply needs. Still another discussant argued that the general societal push toward energy efficiency is questionable in an era where customers are increasingly making less economical transportation choices.

Under these circumstances, they believe, manufacturers may reduce their current efforts to promote HECACs. They will still be able to sell some 16 SEER units, but market saturation will be slow. The likelihood of obtaining return on the investment in developing 18 SEER units will be considerably lower. Thus, as rebates are eliminated, the manufacturers will see their profits for high-efficiency equipment drop and will consequently shift their efforts to other lines of equipment.

Participants also returned to the issue of tradeoffs among efficiency solutions noted in the discussion of Title 24 above. It is cheaper to achieve efficiency through changes in fenestration or insulation than through retrofitting packaged HVAC units. Moreover, those solutions do not require sophisticated controls or scheduled maintenance to ensure continued effectiveness. Additional legislation or regulation might force some improvement, but codes cannot move the market too far or smaller manufacturers—who do not have the technological expertise—will be forced out of business.

Finally, the groups discussed at some length the developing and potential changes in the mix of competitors for HVAC projects. Several participants noted that some larger companies are consolidating individual contractors, thus moving the structure of the market toward an oligopoly. Among the arguments the consolidators are using is that smaller companies will be at severe risk as more and more utilities spin off unregulated subsidiaries that are able to use their market power to capture customers.[33] But as those larger companies develop, the key markets for manufacturers will be limited to a relatively small number of large companies: .It is

[33] On this and related issues, discussants did not seem particularly knowledgeable about the timing of retail competition in California, specific utility or holding company activities, or proposed legislative and regulatory protections against utility market power.

they who will have the (national) power to drive bargains and dictate equipment specifications and price levels.[34] Moreover, it is they who will be likely to develop the lobbying strength that is likely to determine state regulations and codes.

Some participants see other value and other dangers in the trend toward consolidators. On the positive side, they anticipate that the consolidators will alleviate the fragmentation of effort and the inconsistencies that are now prevalent. In addition, the larger companies will have the resources and need to advertise. In turn, they believe the proper public exposure will bring to the HVAC contracting industry a credibility it does not now have. They are concerned, however, with the lack of trained, motivated personnel and the difficulties of recruiting the needed staff (whether for smaller companies, consolidators, or utility spinoffs).

The discussants were asked whether the consolidators compete on the levels of efficiency they can provide customers. Their consensus was that the consolidators would be likely to position themselves as service experts, for whom energy efficiency was one of several defining characteristics. Indeed, one group believes, energy efficiency might be part of the general push toward standard, consistent procedures that would appeal specifically to the larger customers targeted by consolidators. However, the groups do not believe consolidators would be likely to compete on that platform alone, given the anticipated price of electricity.

In the opinion of participants, however, it might be advantageous for utility-related service companies to focus on energy efficiency. Those companies could credibly trade on their franchise as energy experts and they might be able to create effective alliances with manufacturers to take advantage of that market position. Another option that was raised was the possibility that utilities might partner with certain consolidators, leaving the mechanical engineering functions to the contractors and thus eliminating the need to increase their staffing in those areas. No estimate of the likelihood of either approach was offered.[35]

Other new business models were also discussed. None of these models appeared to offer a significant role for a focus on energy efficiency or the transformation of the HECAC market.

Conclusions and Recommendations

The results of the HVAC vendor groups suggest some preliminary conclusions about changes in the HECAC market. They also indicate some areas for further investigation as well as some strategic considerations, should these findings be consistent with more systematic survey results. We discuss each of these areas briefly in the remainder of this report.

Preliminary conclusions

The findings described above suggest that PG&E's rebate programs have helped to increase the penetration and saturation of HECACs in the commercial HVAC market, over and above that

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[34] Partnering is another strategy that might be followed. One group discussed the report that Service Experts may be entering into an alliance with Goodman (a manufacturer of low-end equipment).

[35] It was noted, however, that the overall model is already in use. For example, Johnson Controls sells projects which they then subcontract to local implementers.

which would have occurred naturally. This seems especially true for Tier 1 equipment, but also true to some extent for Tier 2 units. The rebate programs appear to have accomplished this by providing HVAC dealers with tools for overcoming customer concerns about asymmetric information and access to financing. In addition, the promotional efforts of PG&E, coupled with those of manufacturers stimulated customer awareness of the high-efficiency options and helped to support the educational efforts of the dealers and distributors themselves.

However, there seems to be no evidence that the rebate programs, the efforts of manufacturers, or the behavior of HVAC marketers have transformed the overall market for HECACs. As presently designed, the program helps to sell HECACs as a more expensive product whose cost is reduced through rebates. It does not generally focus the customer on the continuing stream of operational benefits. Although some customers are likely to purchase HECACs or to repurchase them when their current equipment fails, most are reported to remain uninterested in energy efficiency or the other benefits of premium packaged HVAC equipment. Manufacturers seem unlikely to push high-end equipment more than they have in the past; most dealers and distributors do not see this as their job. The rebate programs prompted them to increase the availability of HECACs, according to discussants, but not to change the production or sales mix with regard to SEER levels or unit sizes in any radical way. Some architects and engineers are reportedly advocates of HECACs, but they do not account for the majority of installations. Insofar as HECACs remain a niche product, the prospects for continuing gains in efficiency in this sector seem limited unless significant changes in market players or their motivations occur.

Additional research

As the reader is undoubtedly aware, focus groups do not necessarily provide data that are representative of the entire population of interest. It is important to test the generality of the findings reported here and the conclusions they suggest. This will be done in the remainder of this project, using a broader sample of HVAC dealers and distributors that has not been selected for availability and willingness to participate in focus groups in a particular place, at a particular time. Moreover, individual interviews will provide an opportunity to confirm that the findings reported here are not artifacts of the dynamics of particular group discussions.

It will also be particularly important to test independently the hypotheses that draw together much of the previous discussion—that HVAC marketers often have no contact with final customers; are generally pushed toward the low bid, using standard equipment; and are seldom proactive in offering high efficiency options. It will be valuable to survey a representative sample of these professionals as to (among other things) the percentage of the time (and types of jobs) for which they must bid competitively, the frequency with which they provide options, including high efficiency options, and the contacts with whom they work.[36] It is possible that the self-selection bias for participation in the groups actually increased the

[36] It may be expected that the market actor population is itself segmented with respect to these issues. If so, the survey should be designed to help distinguish among those who are more likely to be proactive in support of HECACs and those who are not.

percentage of participants with an interest in high efficiency equipment, but that remains to be tested.

Strategic considerations

If the findings from these focus groups are borne out by further study, they suggest that it may not be useful to focus efforts to transform the HECAC market on contractors. These market actors appear to have little contact with decision-makers. Moreover, most appear to receive little benefit from efforts to increase the energy efficiency of their customers and, accordingly, are seldom proactive on that front.[37]

Some additional consideration might also be given to the merits of programs focused on Tier 1 improvements in HECACs, relative to those focused on Tier 2. The timing and size of investments at each level might be reassessed in the light of their demonstrated effectiveness in moving the market, as well as issues of political and technical feasibility.

Finally, it may also be useful to explore further the relative value of focusing programs on building systems rather than specific pieces of equipment. If it is true that comparable levels of energy-efficient building operation can be achieved via changes in fenestration, insulation, or diversity of zoning, rather than investments in equipment, it may be advantageous to reorient programs away from changing the HECAC market and toward building design, solar orientation, and general contracting practices. Further attention might also be devoted to EMS, particularly with respect to peak load issues,[38] and to ductwork in commercial spaces.

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[37] This is not to say that some effort should not be expended in keeping these professionals informed about high efficiency equipment and its benefits. It is only to suggest that market transformation programs should probably not be designed around them as key market actors. However, it may be useful to consider a two-track approach here if the expanded research indicates that there is an identifiable segment comprising those vendors who are proactive.

[38] One group member suggests that billing analyses may be a useful tool in this area.

The Market for Premium Efficiency Motors in Northern California:

Current Status, Recent Trends, and Future Prospects

A Memo Report of Two Focus Groups
Conducted for PG&E

By
Quantum Consulting

November 1997

The Market for Premium Efficiency Motors in Northern California:
Current Status, Recent Trends, and Future Prospects

Background

PG&E has conducted major programs throughout the decade to help its commercial and industrial customers improve their energy efficiency. These programs were designed and implemented prior to the emergence of the "market transformation" orientation that characterizes many current discussions of efficiency programs and tended to rely on the rebate mechanisms that some program managers would like to leave behind. Nonetheless, it is reasonable to ask whether those programs appear to have affected the underlying markets—and if so, whether those effects are likely to be sustainable. The answers to these questions are important for several reasons. They can help determine whether PG&E should be credited with having helped develop the relevant markets, provide a current baseline for designing and evaluating future activity, and contribute to the assessment of the value of rebate programs.

The larger study of which this is a part includes interviews of important market actors (e.g., architects, engineers, and ESCOs) and the collection of relevant statistical information regarding sales and other indicators of market effects. To supplement those data and to gain qualitative information and insight regarding the motors and HVAC markets in Northern California, we conducted a series of four focus groups with other market actors. Specifically, we conducted two groups with HVAC distributors and dealers as well as two groups with motors distributors, dealers, rewinders, OEMs, and manufacturers' representatives. This memo summarizes important findings from the motors group.

Method

The sessions were designed for "mini-groups"—focus groups of 4-8 members. Such groups are quite useful when the members are likely to have both considerable knowledge about the topic of interest and a willingness to discuss the relevant issues. The smaller number of participants permits the group to go into greater depth regarding the experience and beliefs of each member and can provide a richer understanding of the topic than the usual model.

Participants were drawn from the entire San Francisco Bay region, including such areas as Oakland, Hayward, Concord, Walnut Creek, and Pleasanton. They were recruited by Quantum Consulting's professional focus group staff from lists provided by PG&E. Each was offered an incentive of $100 for attendance and completion of a brief quantitative survey. (The survey form and results are provided in a separate memo.) The great majority of participants had many years of experience in the motors and electrical equipment markets and represented a wide range of specialties, from OEMs and manufacturers' representatives through service managers, sales managers, and owners of firms.

A draft discussion guide was prepared and provided to PG&E's Project Manager. Copies of the discussion guide and the screener are presented in the Appendix to this report.

Throughout the discussions, participants were asked to focus on standard, mid-sized motors sold on a stand-alone basis. In other words, the discussion addressed integral, T-frame motors of less than 100 horsepower (hp). Although sales to original equipment manufacturers (OEMs) were discussed to some extent, the sales of the pumps, fans, blowers, and other products of the OEMs were not.

It should also be noted that the discussion centered on "premium efficiency" motors, rather than "efficient" motors. Although some confusion of terms has plagued the motors market regarding proper terms (and may still do so in various parts of the country), participants in these groups appear to recognize three levels of efficiency that are now easily distinguished. Specifically, "high efficiency" motors describe those that meet the newly effective standards of the Energy Policy Act (EPAct), and can be related to the pertinent ASHRAE (and NEMA) standards. "Standard efficiency" motors do not meet EPAct (and can no longer be manufactured in the U.S.). "Premium efficiency" motors exceed EPAct requirements.

Findings

We divide the discussion of our findings chronologically. First, we will summarize the current baseline for the premium efficiency motors market, as reported by focus group participants. Next, we will discuss reported changes in that market over the past five years and the factors said to be responsible for those changes. Finally, we will describe the participants' expectations of future changes in the market.

Current Baseline

Group members report that larger industrial customers in the Northern California market are highly aware of the benefits of premium efficiency motors and tend to buy them when replacing any motors over 50 hp. This tendency results from the buyers' recognition of the additional value of the premium motors and their use of life cycle costing. However, smaller customers continue to purchase less efficient motors, in large part because they focus on first costs.

Many of the motors distributors and dealers who participated in these sessions believe that they can increase the market for premium motors through continued efforts at educating buyers. The interest in and willingness to devote time and effort to do so varies among market actors. Some see educational efforts as a service to their customers and a way of showing their interest in providing service and good advice. For others, the limited profit available from sales of motors in the range highlighted and the concern that their prices will be undercut are major deterrents to spending time and effort with most customers.

As suggested by the foregoing comments, the responses of different market actors derive to a large extent from the niche they occupy and their view of their competitive position. OEMs face the split incentive problem in its most acute form. The final purchasers realize any benefits from the use of premium motors while the OEMs incur the considerable risk that their competitors will be able to produce much cheaper products and undercut their prices by using less efficient motors. Although OEMs indicate their willingness to use premium motors *if specified by their customers*, they have no incentive to take the initiative in this area.

Market actors who specialize in smaller motors (25 hp and below) also report little incentive to increase their promotion and sales of premium motors. It appears that the great majority of these small motors are sold to relatively unsophisticated end-users for applications that are highly routinized. In this context, motors are treated as a pure commodity item. The profit on these motors is relatively small and does not appear to justify the time and effort required to educate customers regarding the benefits of premium efficiency.

For the most part, the participants in these focus groups do not carry extensive inventories of motors. One group member said that he had translated his motors inventory into stocking wire for doing rewinds, because that afforded him considerably more profit. Essentially, there are too many variations in motor size, configuration, rpm, etc., to permit the creation of a strategic inventory. Moreover, many of the end-users for whom downtime is the most critical carry their own inventory of spare motors. Accordingly, there is little competitive advantage in being able to meet a customer's needs immediately, even during night or weekend hours. Moreover, most

discussants reported, whatever standard motors[39] are needed are readily available—no more than two days away—from supply houses or, at worst, the manufacturer. The current attitude toward stocking was epitomized by one discussant who said that inventory represents "a record of mistakes"—orders that were not consummated or bad guesses as to what would be likely to sell.

Market Changes

When asked, focus group members identified several reasons why customers did not purchase premium motors in the early 1990s and described several changes in this market. Under additional questioning, they also offered several explanations for those changes.

Historical barriers to the penetration of premium motors

Participants agreed that the single largest barrier to the purchase of premium motors five years ago was a lack of awareness of both the technology and the savings that could be achieved. They also cited as a major problem the first-cost orientation of most end-users, along with the end-users' lack of knowledge about and interest in their operating costs. One group characterized the reaction of customers to the prices of premium motors as "sticker shock," which engendered a strong demand among buyers for proof of value and certifiable long-term savings.

Other corporate practices were also mentioned as important contributors to the marketing problem. Specifically, participants noted that motors are often bought by purchasing agents, with a near-term accounting orientation, rather than engineers, with an operational orientation. Moreover, many buyers reduced their perceived risk by purchasing "like-for-like," thus failing to consider the value of technological improvements.

Additional factors mentioned as affecting some customers include the hidden costs of purchasing premium motors (e.g., the need to upgrade other parts of the system once such a motor has been installed), avoidance of novelty, and access to financing. Most participants did not believe that the availability of premium motors was a major concern, nor that customers lacked trust in the distributors or dealers themselves. Although most group members believe that premium motors entail few performance risks, a few suggested that certain new models (particularly at the small end) may not be as reliable or as easily rewound as older models.

In addition to these barriers to market pull on the part of the customers, the groups discussed several factors that inhibited their own push of the market. First, failing to receive significant discounts from manufacturers, the dealers and distributors were reticent to accept the lower margins that appeared necessary to move premium motors. Second, they were unwilling to risk losing sales because their prices were undercut by competitors in low-bid situations. Finally, in those situations when they did stock motors (which appears to have been more prevalent

[39] This discussion omits motors that are specially designed for unique applications. These may require several months from order to delivery. The problems arise with close-coupled motors and particular bases or frames. Within the parameters of T-frame motors in the 10 hp to 100 hp range, no difficulties exist.

earlier in the decade), they were unwilling to accept the risks of tying up cash in a large stock of premium motors.

Reported changes in the premium motors market

According to participants, the premium motors market has improved significantly in recent years. Although many customers who require education regarding the improved technology and its benefits remain, considerable progress has been made—particularly among larger customers. Moreover, among customers who are aware of the technology and its benefits, life cycle costing is accepted. Customers become acclimated to the costs of premium motors (thus reducing the effect of "sticker shock"). In addition, the educated user is now motivated by the additional savings available from the use of premium motors.

Although discussants did not cite performance reliability as a major concern in the past, they do believe it has improved considerably. Several group members reported that the current generation of premium motors is far superior to earlier models with respect to materials, cooling fans, bearings, and wire. In addition, they note that manufacturers are willing to offer three-year warranties—not to make up for perceived risk, but to help enhance the perceived value of the product.

As the acceptance of premium motors has grown among end-users, so too has the willingness of market actors to recommend those motors in bids, at least as an option. And, as noted earlier, some are willing to take on the task of attempting to educate other end-users regarding the selection of premium motors.

At the same time, several barriers described earlier do appear to remain in this market. Although the use of life cycle costing has increased, participants estimate that 75% of all customers still focus on first cost, and that this percentage rises to 90% when motors 25 hp and under are considered. The prevalence of purchasing agents rather than engineers has not changed—in addition, downsizing at many corporations has eliminated a cadre of knowledgeable engineers and other specialists who could understand the relevant technical issues in motor selection. Although the technology is now older and more mature, changes in existing facilities may still be viewed as risks to be avoided by those not confident of their expertise.

Factors promoting change in the premium motors market

Focus group members cite two major reasons for the changes they have observed in the premium motors market in Northern California. The most important of these, in their opinion, is the rebate program conducted by PG&E. The rebates helped to draw the attention of customers to the technology and provided the market actors with a lever to promote the sales of premium motors. Furthermore, the rebates helped bypass the first-cost orientation of the buyers once they were willing to consider the new technology.

The other major factor in creating the current market has been the experience of customers who were willing to accept the new technology. Premium motors have performed as advertised and

produced the cost savings that were promised.[40] Customers who have experienced these benefits are convinced of the value achieved. This experience can also be communicated to other buyers.

Additional reasons for changes in the premium motors market cited by participants include advertising by manufacturers and publicity about EPAct, both of which helped increase customer awareness. Manufacturers' increases in warranty length, mentioned earlier, were also noted as an important factor in increasing customer perceptions of the value of premium motors, as was the longevity of the product itself. Furthermore, the development of industry standards for motors and systems[41] were mentioned by several discussants, as were increased attention to systems issues and overall process efficiencies.

Finally, some group members note the importance of whatever educational efforts reached the design engineers. These professionals tend to dominate the selection of many new installations and they all now specify top of the line, premium motors for their clients.

Expectations about the Future of the Market

Most participants in these focus groups anticipate continued movement of end-users toward the purchase and use of premium motors. Among the reasons they offer are the increased willingness of many purchasers to focus on life cycle costing. Some group members are optimistic enough about this trend to believe that the elimination of rebate programs may not have major adverse effects on the market. Moreover, since the price differential between premium motors and high efficiency motors is considerably less than that between premium motors and standard motors, they expect that the first cost issue may be less salient in the future. Others, less optimistic, note that the gap in efficiency is also smaller, so that the increase in value relative to cost will remain a concern.

Group members also noted awareness of the benefits of premium motors among larger users, the development of more efficiency-oriented standards in certain industries such as petrochemicals and pulp and paper; the increased quality of premium motors and the willingness of manufacturers to provide extended warranties. Some pointed out that the inertia of many decision-makers—the tendency to replace "like for like"—would begin to benefit the premium motors market in the future, as newer motors begin to fail. A few suggested that environmental consciousness may be a driver of future decisions. More concretely, most cited the advent of EPAct. Moreover, many expect that EPAct will be extended to cover varieties of motors that are not now affected; that awareness of the benefits of premium motors will spill over to smaller users as those motors become the "normal" choice; and that manufacturers will simplify their production lines by eliminating low end models.

Some notes of caution were sounded, however. Most focus group members see no solution to the difficulty of increasing efficiency among OEMs except the outright banning of low-end

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[40] Participants are quick to note that the savings do depend on the application involved. For example, reasonable levels of cost savings will not be realized if the relevant motors are used only 1-2 hours per day.

[41] Particularly for petrochemicals and the paper and pulp industry.

motors. Moreover, several pointed out that EPAct may have certain perverse effects: whereas the gain in efficiency between a standard motor and a premium motor is large, the gain in moving from a high efficiency motor to a premium efficiency motor is considerably less. Accordingly, it may be more difficult to convince customers that the marginal efficiency gain is worth the marginal cost increase. (Nonetheless, these discussants argue, the likelihood is not a reversal of the trend towards increased sales and use of premium motors, but a slower increase in their penetration of the market.)

In further discussions of EPAct, focus group members were also somewhat critical of its design. They recognized that it represented political compromises, but they noted that—unlike Canadian legislation—it fails to cover all but the most standard motors and that, even for those, it is easy to create exceptions that allow standard motors to be sold with little difficulty.[42] Moreover, they noted, the pipeline is filled with standard efficiency motors, so that it will be years before the full effects of EPAct will be felt. Finally, they questioned whether enforcement mechanisms are in place and exercised. Still, the discussants believe that the legislation is an important step and that it has had useful effects in raising awareness of motor efficiency and changing the manufacturing mix.

The participants also noted several other trends of interest. Of most importance technologically, many noted the increasing sophistication of control devices and variable frequency drives (VFDs). As are other electronic devices, these are rapidly becoming both more powerful and less expensive. As a result of the opportunities thus created, at least some of the market actors are working with design engineers, focusing more on the creation of efficient *systems* and less on specific components. Moreover, as VFDs are installed, they help drive the market for the premium motors required to capture their full benefits (e.g., soft starts).

A few focus group members anticipate that VFDs will alter the market for air handling and water pumps (and even conveyer belts) beyond recognition within a very few years. However, others suggest that VFDs are still a difficult sell given their current prices. These participants say that customers are still demanding case studies and demonstrated successes before investing in this technology for their facilities.

Other discussions of interest dealt with the organization of the market. One group was somewhat concerned about the rise of large, multi-state organizations that are attempting to consolidate the supply side of the market. Some participants were concerned that they would be unable to compete with the market power of such organizations and their ability to achieve name recognition among end-users.

Additional threats to the traditional distribution chain were also cited. Some market actors complained that certain manufacturers appeared willing to sell directly to end-users, so long as the end-user had at least two facilities—even if those facilities were widely separated

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[42] Discussants believe the legislation was neither comprehensive nor well thought out in the areas covered. They reported, for example, that footed motors, those that are multi-speed or have extended shafts are not covered.

geographically. Other participants noted the proliferation of “alliance” programs uniting large end-users in exclusive purchasing and service arrangements with suppliers.[43]

In response, one group member argued that all of these threats had their basis in the treatment of motors as a commodity item. He suggested that the proper strategic response o the part of distributors and dealers was to emphasize the advice and special services that they provide to the end-user—that so long as they treated motor selection and applications as unique, their market would remain.

Another trend that evoked concern is the development of ESCOs and the expectation that the role of these organizations would grow as deregulation occurs. ESCOs can provide the end-user with many benefits, such as signature analysis, monitoring, performance guarantees, and shared savings, as a comprehensive service. Whether the ESCOs are utility spin-offs, subsidiaries of motor manufacturers, or aggregations of smaller companies, their backing may make them formidable adversaries. Some participants were particularly fearful of the possibility that PG&E might itself become a direct competitor, although most appeared to feel that such a threat was by no means immediate and would require considerable staff development by any new utility subsidiary.

[43] These arrangements reduce the needs of end-users for large purchasing departments and simplify their accounting requirements. At the same time, the aggregators gain market power relative to the manufacturers. In turn, the manufacturers become less responsive to their traditional distributors and representatives.

APPENDIX 3. HVAC AND MOTORS BASELINE SAMPLING PLANS

Packaged AC Baseline Sampling Plan

Business Type	Percent Owning Packaged	Percent Cooled	Packaged Capacity ('000 tons)	Percent of Packaged Capacity	Number of Points	Allocation with Targets Oversampled (Quotas)	Sample Needed (based on % with packaged)	Proposed Allocation and Available Sample by Climate Zone							
								Desert/ Mountain		Valley		Coastal		Hill	
								22.0%	Available	27.8%	Available	12.9%	Available	37.3%	Available
Colleges	74%	76%	54	2.3%	5	**20**	270	59	75	75	124	35	233	101	109
Food Stores	59%	61%	54	2.3%	5	**5**	85	19	1,169	24	1,718	11	3,654	32	1,425
Hospitals	86%	97%	89	3.8%	8	**30**	349	77	1,296	97	2,557	45	3,456	130	2,351
Hotels/Motels	47%	51%	177	7.6%	15	**15**	319	70	177	89	449	41	1,010	119	421
Miscellaneous	46%	47%	244	10.5%	21	**10**	217	48	7,650	60	14,744	28	18,697	81	10,114
Offices	75%	79%	698	30.1%	60	**55**	733	161	3,813	204	7,348	95	10,180	274	5,108
Refrigerated Warehouses	79%	80%	6	0.2%	0	**0**	0	0	0	0	0	0	0	0	0
Restaurants	79%	80%	252	10.8%	22	**10**	127	28	1,359	35	2,722	16	6,237	47	2,476
Retail Stores	57%	62%	375	16.2%	32	**15**	263	58	3,499	73	6,856	34	11,462	98	5,736
Schools	78%	78%	246	10.6%	21	**30**	385	85	379	107	671	50	556	143	512
Warehouses	63%	63%	125	5.4%	11	**10**	159	35	1,531	44	2,445	20	3,641	59	1,488
TOTALS			2320	100.0%	200	200	2907	639	20,948	808	39,634	375	59,126	1,084	29,740

Motors Baseline Sampling Plan

Business Type	SIC Codes	Targeted Completes	Annual GWh usage	Estimated percent of usage acctd. for by motors	Est. Motors GWh Usage	Percent of Motors Usage
Mining and Extraction	10, 12, 13, 14	20	1,520	90.0%	1,368	14.5%
Process Industries	20 -29	30	5,940	67.0%	3,980	42.2%
Assembly and Miscellaneous	30-39, exc. 36	30	6,740	50.0%	3,370	35.7%
Water Supply and Treatment	494	20	752	95.0%	714	7.6%
TOTALS		100	14,952		9,432	100.0%

APPENDIX 4. DATA COLLECTION INSTRUMENTS

Hello, this is _____. I'm calling on behalf of Pacific Gas and Electric.

May I please speak with your facilities manager or manager?

IF ASKED WHY

PG&E is working with the California Public Utilities Commission to evaluate its existing energy-efficiency programs to help design more attractive programs for Californians in the future. To support this effort we'd like to ask a few questions about recent or potential changes in your firm's air conditioning equipment.

Hello, this is ___. I'm calling from Quantum Consulting on behalf of Pacific Gas and Electric. I was told that you were the best person to talk to about your firm's cooling equipment at _____.
Is this correct?

We're helping PG&E evaluate its energy-efficiency programs so that more attractive programs can be offered to businesses and organizations like yours in the future.

We'd like to ask a few questions about your perceptions regarding the availability and other characteristics of high efficiency air conditioning equipment.

The survey only takes 15 minutes or so; is now a good time?

001. What kind of air conditioning systems do you have at this facility?

Packaged unitary
Packaged split system
Rooftop system
Window or wall unit(s)
Built-up system or chiller
Other
(UNLESS PACKAGED UNITARY OR SPLIT OR ROOFTOP, THANK AND TERMINATE)

002. Does your company own or lease the facility?

002a. (If leased) Who is responsible for paying the electric bill: your company or the building owner?

(IF BUILDING OWNER PAYS BILL, THANK AND TERMINATE)
IF BOTH PAY BILL:
Is your company involved in the selection or air conditioning equipment at the facility?
IF NO, THANK AND TERMINATE; IF YES, CONTINUE

003. What is the main business ACTIVITY at the facility?

Office
Retail (nonfood)
Manufacturing/Assembly
Warehouse
Restaurant
Grocery Store
School (K12)
Hotel or Motel
Hospital
College/University
Health Care

Construction
Other (please specify
rf (refused)
dk (don't know)

004. How many employees work at this facility?

005. How long has your organization been at this location?

005a. (If less than three years)How long has your company been in business?

006. Does your organization expect to move from this location within the next two years?

007. What is the square footage of the area at the facility that is air conditioned?

008. Approximately how many years old is this facility?

009. Since January 1, 1996, have you replaced one or more of the air conditioning units at this facility?
IF YES
009a. Can you tell me the size of the units installed (in tons or BTUh)
First unit capacity _____ (BTUh or Tons?)
Second unit capacity _____ (BTUh or Tons?)
Third unit capacity _____ (BTUh or Tons?)

009b. Do you know the energy efficiency rating (EER or SEER) of the units?
First unit efficiency _____ (EER or SEER?)
Second unit efficiency _____ (EER or SEER?)
Third unit efficiency _____ (EER or SEER?)
IF NO
009c. Are you planning to replace one or more of the air conditioning units at the facility in the next year?

009d. If your company had to replace an air conditioning unit right new, which of the following best describes the efficiency level of the unit that you would purchase:
Standard efficiency
Above average efficiency
Very high efficiency

Now I'd like to ask you some questions about your perceptions regarding the purchase and use of air conditioning units by your company. I am going to read a list of statements with which you may or may not agree. Please indicate, on a scale of 1 to 10, whether you agree or disagree, with each of the statements, where 1 means you strongly disagree and 10 means you strongly agree. If you are unable to answer because you don't know, please let me know. Bear in mind that there are no right or wrong responses; what we are interested in are your perceptions regarding each of these statements.

One final point: when I mention "high efficiency air conditioning" in these questions, I'm referring to units that have a SEER or EER efficiency rating of 11 or higher, compared to a 10 SEER rating that's standard for new units.

OR :
One final point: when I mention "high efficiency air conditioning" in these questions, I'm referring to units that have a SEER or EER efficiency rating of 14 or higher, compared to a 10 SEER rating that's standard for new units.

1. Air conditioning sales persons usually just try to push the products of whatever manufacturer they're closest to. (A1)
2. Air conditioning dealers and contractors use the desire for high-efficiency equipment by customers like us to charge more than it's really worth. (A2)
3. I think much of what salesmen for air conditioning units tell us about the performance of high-efficiency air conditioning units is exaggerated.(A3)
4. The operational cost savings from installing energy-efficient air conditioning would not flow to our company.(B1)
5. The people who have to make the investments in energy-efficient air conditioning units for our company are not the same ones who would see the benefits in lower operating costs.(B2)
6. When we select air conditioning equipment, the most important thing we look for is reliability of operation.(C1)
7. To be sure we get enough cooling capacity for our business, I would always require air conditioning units that are larger than those specified by engineering tables.(C2)
8. Our company is unwilling to take the risks involved in the use of high-efficiency air conditioning units.(C3)
9. I don't see enough return on the extra cost of energy-efficient air conditioning units given today's energy prices.(D1)
10. It may be cheaper to save energy by changing our overall system or our use of windows or insulation rather than by investing in high-efficiency air conditioning units.(D2)
11. The return on investment from an energy-efficient air conditioning unit is quite uncertain.(D3)
12. There's no one inside our company who is an expert on something like the performance of our air conditioning units.(E1)
13. It's hard to figure out which air conditioning units to buy because of all the stuff about SEER ratings, EER ratings, Btus, kilowatts, etc.(E2)
14. It's hard to get a handle on the benefits of energy-efficient air conditioning units without a detailed written analysis. (E3)
15. When we select air conditioning units, the most important concern is to make sure they can use the same parts as the others we have bought. (F1)

We'll do just a few more of these statements in a moment, but first I'd like to ask you about how you get information about air conditioning for your business.

012. What is your company's primary source of information for keeping up with trends in air conditioning technology. (do not read; if more than one cited, put 1, 2, or 3 next to each in the order they're mentioned; read list only if they ask for examples)

Trade magazines focused on your business
Trade magazines focused on equipment/facilities management (e.g., Energy User News)
PG&E/your utility
Observing leading companies in your business
Professional associations
Conferences
Colleagues and friends
Advertising from manufacturers
Advertising from contractors
Contractor sales calls
WE DON'T KEEP UP WITH TRENDS IN AIR CONDITIONING
Other (specify) _____

In the past year, how often did you have contact with a PG&E (utility, in out-of-area) representative, either by phone or in person.

0
1
2 or 3
4 or more

010. If your company had to replace an air conditioning unit at this facility, which of the following would be likely to have the greatest influence on the type of unit selected?

consulting engineer or architect
general contractor
HVAC (heating, ventilation, and air conditioning) contractor
Energy Service Company
Local building/facility manager or engineer
a regional or national facility manager
purchasing department
established company procedures/specifications
the company's top management
other (specify)

014. Has your company used the services of an Energy Service Company (ESCo) to install new packaged air conditioning equipment? (DEFINE: An Energy Service Company helps organizations identify opportunities for energy savings and then structures a transaction that enables the organization to pay for new equipment or other energy efficiency measures through the savings they generate.)

If YES: Do you think you will use an energy service company the next time you install new packaged air conditioning equipment?

If NO: Have you been contacted by an ESCo to install a new cooling system?

Great. Now we have just a few more of the statements that I asked you to agree or disagree with. We're over halfway through the list. Remember, 1 means you strongly disagree and 10 means you strongly agree.

16. When selecting air conditioning units, I want my staff or general contractor to choose whatever is most easily installed. (F2)
17. When purchasing energy-efficient air conditioning units there are risks of unanticipated problems and costs.(F3)
18. So far as I know, financing is not readily available to cover the extra cost of energy-efficient air conditioning units.(G1)
19. It's difficult to get the financing necessary for the extra investment required to put in energy-efficient air conditioning units.(G2)
20. Our practice is to replace air conditioning units with the same model as much as possible.(H1)
21. Keeping our stock of air conditioning units and parts standard and interchangeable is more important than getting the most efficient model.(H2)
22. When air conditioning equipment breaks down, we don't have time to start thinking about all the different options that are out there.(H3)
23. Our practice is not to worry about equipment unless it breaks down.(I1)
24. If we needed to replace our current equipment, I doubt that our supplier would be able to get an energy-efficient air conditioning unit quickly enough to avoid serious downtime. (I2)
25. When we select air conditioning units, the most important consideration is immediate delivery.(I3)
26. Our company includes the long run operating and maintenance costs of equipment like air conditioning units in its initial calculations.(I4)
27. When we select an air conditioning unit, the most important issue is its initial cost.(I5)
28. The most important operational issue for our company is keeping our costs under control.(J1)
29. Investing extra money in energy-efficient air conditioning units would reduce our ability to take advantage of opportunities to invest in production or sales efforts.(J2)
30. I don't see any reason to be proactive with regard to energy efficiency in today's economy.(J3)

Those are all the questions I have for you. Thank you very much for your time. Before you go, I would like

to get your job title.

President/Owner /CEO/Partner
Senior Manager (Vice President, Chief Operating Officer, General Manager)
Financial Manager (Comptroller, Chief Financial Officer, Accountant)
Energy Manager
Operations Manager (Plant Manager, Maintenance Director/Manager)
Building Manager (Engineer)
Other SPECIFY
rf
dk

Do you have any additional comments at this time?

Yes
no
ref
dk

What would you like to say?
Record verbatim

rf
dk

On behalf of PG&E, thank you very much for your time and cooperation.