

# **Pacific Gas & Electric's 1998 Food Service Technology Center Market Effects Study**

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## **ABSTRACT**

The Pacific Gas & Electric Food Service Technology Center (FSTC) was established in 1986. FSTC efforts have include test development for kitchen equipment, kitchen ventilation, refrigeration, and sanitation appliances, as well whole facility energy efficiency needs (i.e., shell, lighting and HVAC). The FSTC has been disseminating information on nonresidential kitchen energy efficiency since the late 1980s. The market structure for the foodservice market is extremely complex. It involves many market actors at each market level. In addition, interactions among market actors vary by customer size. These interactions are documented in detail. This paper documents the FSTC program market effects from inception in 1986 through 1997. The evaluation used a market characterization based on in-depth interviews of selected key market actors to develop a program theory and inform the final research plan. Specific research hypotheses derived from the program theory were developed along with a detailed plan to collect data from affected market actors. Data was then collected from 11 foodservice designers, 31 equipment manufacturers, a census of end user FSTC participants over the past two years (36), and 100 California end user nonparticipants. Quantitative and qualitative analysis were conducted and the findings were integrated in order to draw the overall conclusions. Finally, the findings were reviewed by two focus groups to address key unresolved issues. The paper illustrates the strength of integrating quantitative statistical analysis with qualitative assessment guided by an overarching program theory, in addition to discussing the effectiveness of the FSTC program in market transformation.

## **Program Summary**

The Pacific Gas & Electric (PG&E) Food Service Technology Center (FSTC) was established in 1986. Shortly thereafter, the FSTC started developing test methods for acceptance by the American Society of Testing and Materials (ASTM), the national testing standardization organization. Since that time, the FSTC program has steadily developed test procedures for a progressively expanding list of foodservice equipment. As of the beginning of 1999, the ASTM had approved seventeen test procedures, five procedures were being considered for approval, and another ten were planned or under development. The FSTC has developed all of the foodservice test methods currently approved by the ASTM.

Prior to 1995, the majority of the FSTC's effort focused on commercial cooking appliances. Since that time, efforts have expanded to include kitchen ventilation,

refrigeration, and sanitation appliances, as well as the creation a program to assist customers in whole facility energy efficiency needs (i.e., shell, lighting and HVAC). As part of this expanded effort, the FSTC started working more closely with the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) on ventilation requirements in foodservice facilities.

Outreach to disseminate information on nonresidential kitchen efficiency has been a part of the FSTC effort since the late 1980s. This has been accomplished primarily via training sessions, technical report distribution, and the long-term promotion of a trade magazine addressing energy efficiency issues.

## **Study Summary**

The FSTC market effects evaluation project had three overarching research objectives: (1) characterize the market addressed by the FSTC (including baseline market condition), (2) assess the market transformation effects attributable to the FSTC efforts, and (3) lay the groundwork for future programs and evaluations.

To accomplish these goals, the evaluation approach incorporated the following key elements:

- A market characterization based on in-depth interviews of selected key market actors, chosen based on their knowledge of the industry and their market actor type.
- A research plan informed by the market characterization.
- Data collection from 11 foodservice designers, 31 equipment manufacturers of various sizes, a census of end user FSTC participants over the past two years (resulting in 36 completed data points), and 100 California end user nonparticipants.
- Qualitative analysis of the designer and manufacturer interviews and statistical analysis of the participant/nonparticipant telephone surveys.
- A review of the findings by two focus groups comprised of FSTC Advisory Board members to address key unresolved issues.
- Conclusions based on quantitative and qualitative analysis findings.

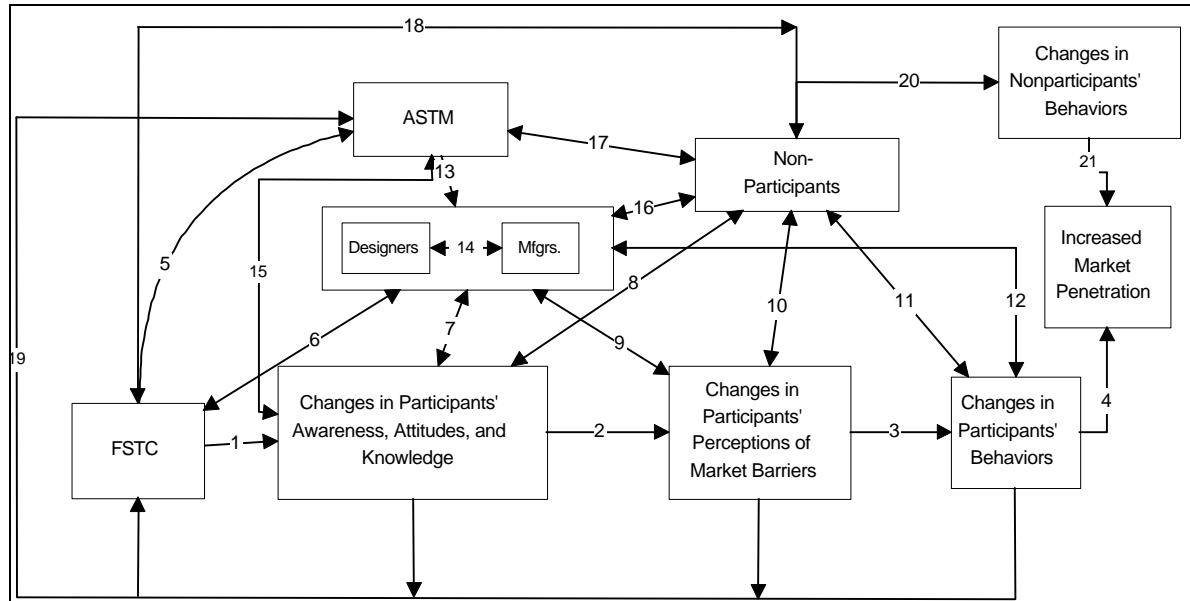
## **Program Theory**

Weiss (1998) stresses that understanding the underlying theory of a program is essential to developing the most appropriate evaluation and that a good evaluation is based on defining, testing, and analyzing the assumptions of the program theory. There are many different areas in which programs can go astray, but by focussing on theory, evaluators can keep themselves on track.

To develop an accurate and useful program theory, the evaluators interviewed FSTC staff and foodservice market leaders, and reviewed FSTC documents. In general, the theory that evolved consists of FSTC activities, the hypothesized direct and indirect communication and causal linkages of these activities to key market actors, and the expected immediate, intermediate, and long-term market effects. A critical element in any program theory is the identification of which market barriers are faced by which market actors.

## Linkages

Figure 1 contains 21 causal/communication linkages between FSTC activities and immediate, intermediate, and long-range market effects.



**Figure 1. Program Causality Theory**

Space does not allow explicit description of each of the 21 linkages shown. However, the linkages fall into three categories, the direct effects of FSTC effort (e.g., linkages 1 and 5) on industry participants, the closely related indirect effects of the program actions on the next level of market actors (e.g., linkages 7 and 13), and the results of those efforts that effect the larger market (e.g., linkages 8, 17, and 21)

## Identification of Market Barriers

A key element of program theory is an assessment of the market barriers faced by each market actor. The initial market characterization identified the key barriers. The primary source for these efforts was the interviews with key market actors. The key market actor interviews targeted a variety of market actors, including industry associations (i.e., groups promoting a specific point of view), consultants, end users, manufacturers, and trade associations (i.e., groups representing market actors such as manufacturers or restaurant owners). All of these market actors were interviewed in-depth by evaluation professionals using an interview guide. Responses were then reviewed by the evaluation team and categorized into the specific market barrier language developed by the California DSM Scoping Study (Eto, Prahl, & Schlegel 1996). Table 1 lists market barriers identified through analysis of interview responses. Seven market barriers were identified as acting in the market. Access to financing was dropped as less important due to limitations on survey length. The remaining six barriers were addressed in the market actor questionnaires.

**Table 1. Market Actor Interview Responses**

Market Barrier	Market Actor Affected		
	End User	Mfgr.	Designer
Organizational Practices	√	❖	❖
Performance Uncertainty	√	√	
Asymmetric Information	√		
Information & Search Costs	√		❖
Access to Financing	❖		
Split/Misplaced Incentives	√		
Product Unavailability	❖		❖

√ = Most Important Barrier for End Users ❖ = Lesser Market Barriers for End Users

## Market Effects Hypotheses

Any reduction of the market barriers listed in Table 1 is in turn hypothesized to cause certain market effects. For the market-effects portion of the analysis, eleven research hypotheses were established. The hypothesized market effects organized by market actor were:

### Participants

1. FSTC activities will increase participant awareness of and improve their attitude toward energy efficient cooking, refrigeration, and ventilation equipment.
2. The FSTC will reduce selected market barriers for FSTC participants.
3. FSTC activities will cause participants to increase the extent to which they share information about energy efficient technologies.
4. FSTC activities will cause participants to increase the extent to which they require performance data when assessing products for installation.
5. FSTC activities will cause participants to increase the extent to which they purchase energy efficient equipment.

### Nonparticipants

6. FSTC activities, by affecting the market, will cause nonparticipants to increase their requirement for performance data when assessing products for installation.
7. FSTC activities, by affecting the market, will cause nonparticipants to increase the extent to which they purchase energy efficient equipment.

### Manufacturers

8. The FSTC activities will increase manufacturers' use of FSTC test data.
9. The FSTC activities will increase the extent to which manufacturers use standardized test methods to develop new equipment.

### Designers

10. The FSTC activities will increase designers' requests for performance data.

11. The FSTC activities will increase the extent to which designers recommend energy efficient equipment.

Hypotheses 1 through 5 address the immediate impacts of the FSTC on participants. These hypotheses were analyzed statistically to determine the level of impacts. Hypotheses 6 through 11 represent intermediate and long-range impacts on the nonparticipants, manufacturers, and designers. These six hypotheses were examined qualitatively using self-reported data collected during structured interviews with a limited number of market actors from each group. Thus, the conclusions that can be drawn based on these six hypotheses are limited. The more rigorous tests for effects on these groups can only be done when data have been collected over time so that trends can be observed.

## **Analysis Approach**

The analysis techniques used during the evaluation can be summarized as follows:

### **Self Reports**

In some cases, the only available data were the responses of a market actor with no other points of comparison. For example, designers were asked the extent to which they ask manufacturers about energy efficient cooking equipment. Because their responses cannot be compared to those of any comparison group, there are no firm conclusions regarding the role of the FSTC in causing designers to make such requests. However, in other cases, self-report data are somewhat more compelling. For example, manufacturers were asked whether they had ever taken any of their equipment to the FSTC for testing. Fifty-five percent of the cooking equipment manufacturers indicated they had. While it is impossible to tell what these manufacturers would have done in the absence of the FSTC, no other centers currently provide comparable testing. In this case, there appears to be prima facie evidence that the FSTC has had a substantive impact on cooking equipment manufacturers.

### **Statistical Analysis**

When participant and nonparticipant end user comparisons were possible, either chi square or t tests were calculated to determine statistical significance, depending on whether the data were interval, ordinal, or nominal. In order to control more effectively for group differences, multiple regression was used. Some of these group differences are number of full-time employees, size of business, number of other sites in California, and whether respondents think the greatest opportunity to reduce costs is in equipment purchases. These differences may affect their attitudes, knowledge, awareness, and behaviors, in addition to whether or not they participated in FSTC activities. To control statistically for these observed differences, a regression model was estimated with the company's attitude toward energy conservation (assessed using a battery of attitudinal questions) as the dependent variable, whether one was a participant or nonparticipant as the key independent variable, and number of employees, size of company, and number of other California sites as the additional independent variables or covariates.

However, there were unobserved differences that may still have affected attitudes, knowledge, awareness, and behaviors. To control for any unobserved differences, an inverse Mills ratio was inserted into the regression model.

### **Assessing the Longevity of Observed Market Effects**

Eto et al. (1998) noted three examples of evidence that could help to support a claim that any observed market effects are sustainable. The first is whether the observed market effects, such as the retooling of manufacturing production lines, are inherently difficult to reverse. The second is the successful prediction of near-term market indicators that are expected to lead to long-term market effects. The last is whether the sequence of observed market effects to date are as predicted by the initial justification of the program.

One of the near-term predicted effects is that key market barriers, as perceived by FSTC participants, will be lower as a result of participation. It is also expected that participants may decide to change their behavior with respect to seeking out more information regarding energy efficient equipment and deciding to purchase more efficient equipment. For manufacturers, one indication could be their decision to test their own equipment using standard testing methods and to provide the results of these tests to designers and end users.

## **Study Findings**

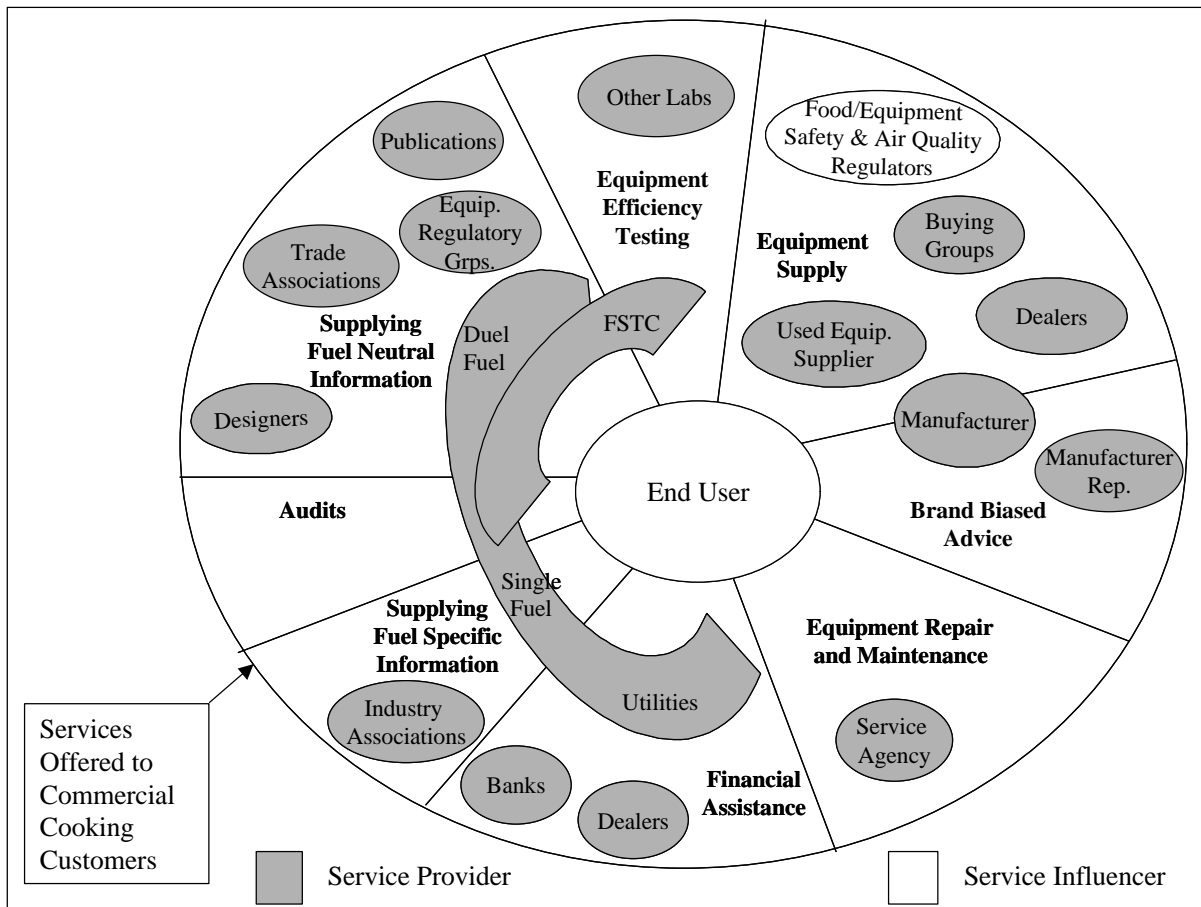
### **Market Characterization**

The market segment being studied is the California commercial kitchen efficiency market. Geographically, it is defined by the borders of the State of California. This market segment has two elements: the foodservice facility element (i.e., building, lighting, insulation, window, and HVAC), and the kitchen equipment element (i.e., the cooking hood ventilation system, cooking equipment, refrigeration, and sanitation equipment).

**Market actors.** The foodservice market has many different market actors. For the purposes of this market characterization, the services provided within the commercial kitchen equipment efficiency market were divided into eight primary services. These services are illustrated in Figure 2, along with the market actor(s) offering the various services. As illustrated, there are many service providers in the commercial kitchen market, with many of the service providers supplying services in several service sectors. Not all end users have a need for, or access to, all of the services or service providers available in the industry.

**Technologies.** The foodservice efficiency market can be divided into three categories: building efficiency measures, food preparation equipment efficiency measures, and sanitation equipment measures.

**Building Measures.** This category for the foodservice industry closely mimics the building efficiency measures that are applied in most other sectors. It includes shell thermal and infiltration performance, lighting use efficiency, and HVAC efficiency. With respect to building efficiency measures, the foodservice industry is unique in three primary ways: (1) the tremendous internal heat load represented by the cooking equipment, (2) the large amount of moisture generated in food processing, cooking, and sanitation tasks, and (3) the high air-change rates required for the kitchen hood exhausts. All of these create higher HVAC loads.



**Figure 2. Services Offered to Commercial Kitchen Customers**

This having been said, most of the energy efficiency measures applied in other sectors (anti-infiltration measures, high-efficiency windows, thermal insulation, high efficiency HVAC, high efficiency lighting), are still applicable to the foodservice market sector. Indeed, the long hours of operation and high energy loads make them even more effective in this sector than in other sectors.

**Foodservice Equipment.** Foodservice equipment category is the first thing most people think of when the foodservice market sector is discussed. The foodservice equipment category covers a wide range of products, including: cooking equipment (ranges, griddles, fryers, steamers ovens, hot food tables ), kitchen ventilation equipment, and refrigeration equipment (standing and walk-in refrigerators, cold tables, ice makers).

**Sanitation Equipment.** The separate category of sanitation equipment primarily covers dishwashing equipment, hot water use in the kitchen, and hot water booster heaters.

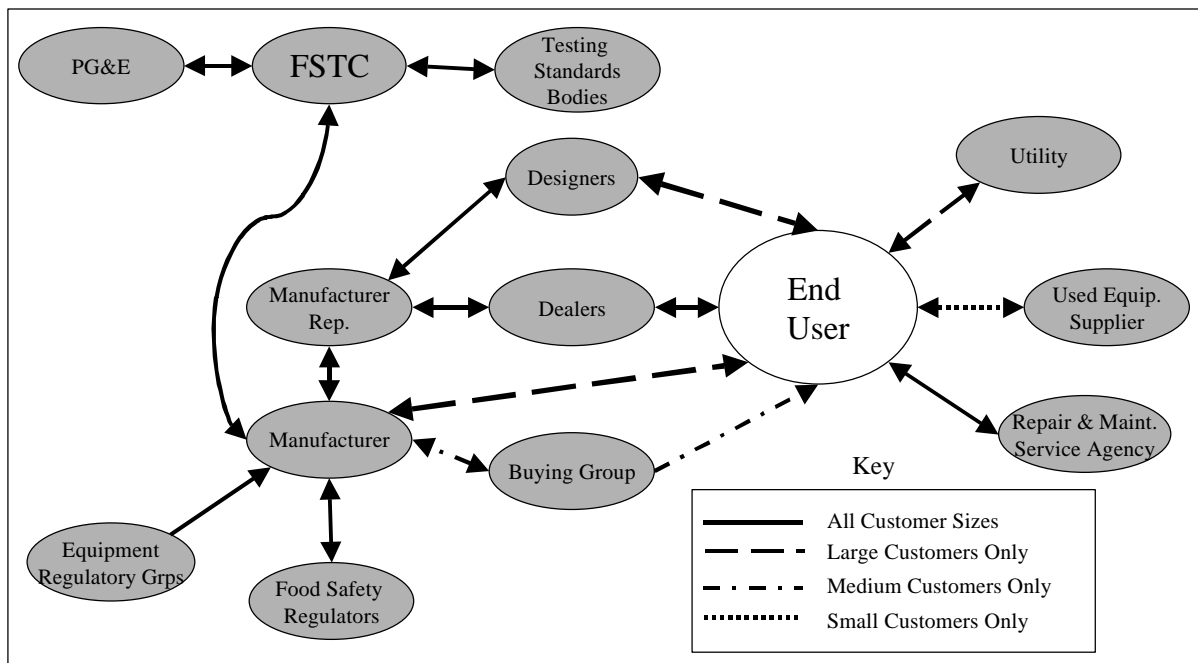
Many of these technologies have a wide have a wide variation in configuration. For example, griddles can be single-sided or double-sided and can have conveyors. Ovens can have steam, rotisserie, and convection options, not to mention configurations large enough to walk into. Most can be obtained either in gas or electric versions.

For ventilation systems and walk-in refrigerators, the equipment is often custom made for each application.

**Market Events.** The primary market event of interest in the foodservice equipment arena is the sale/purchase of a unit of equipment. Updated Arthur D. Little (ADL 1995) estimates indicate that in excess of 150,000 units of high value equipment were sold in the U.S. in 1998. Prorated based on foodservice establishments, this represents about 12,000 units in California. These events are precipitated by new restaurants construction, replacement of closed restaurants, worn out equipment stock, and menu changes. The ADL study indicates that approximately two-thirds of these market events result from the replacement of closed restaurants (and presumably replacement of worn out stock), while one-third represents actual increase in restaurant capacity.

**Market Structure.** The structure of the foodservice market is extremely complex. It involves many market actors at each market level (upstream, midstream and downstream). In addition, interactions between market actors vary by customer size.

The major market interactions identified in the market characterization are illustrated in Figure 3. This exhibit illustrates the size of the end user effected and where they interact. The cooking manufacturer interviews illustrated that the FSTC is exerting major influence on testing standards groups and cooking equipment manufacturers. While there are indicators of effects on other actors, the interviewees clearly indicated that currently these cannot be considered strong interactions.



**Figure 3. Primary Foodservice Market Interactions**

**Market Character.** One of the most important facts that emerged from the market characterization is that energy efficiency appears to be a very low priority for foodservice providers. Market forces seem to dictate a low priority for energy efficiency. Some of the market forces that create this situation are:

- Energy costs represent 3% to 5% of operating costs for most foodservice providers while labor and material costs are on the order of 30% each.



- The primary objective for most entrepreneurs is growth. Keeping their capital costs down maximizes their return on investment, which attracts capital. As such, commercial kitchen equipment costs are kept as low as possible as part of the overall pressure to minimize capital spending.
- Performance, reliability, durability, and cost almost always come before energy efficiency in end users' selection criteria. As the size of the end user decreases, price rapidly becomes the most important purchase criterion.

**Market Size.** In 1998, the total U.S. foodservice market was estimated to be about \$336 billion with California representing about 8%. There are about 800,000 foodservice locations nationwide, with about 72,000 in the California market and about 63,500 of these being fast-food or sit-down restaurants. One of the defining characteristics of the market is the large number of foodservice equipment manufacturers, with estimates of about 200 to 250 manufacturers of energy-consuming equipment. It is estimated that only two or three of these manufacturers have annual revenues in excess of \$20 to \$30 million. The typical equipment manufacturer is estimated to have annual revenues of less than \$5 million.

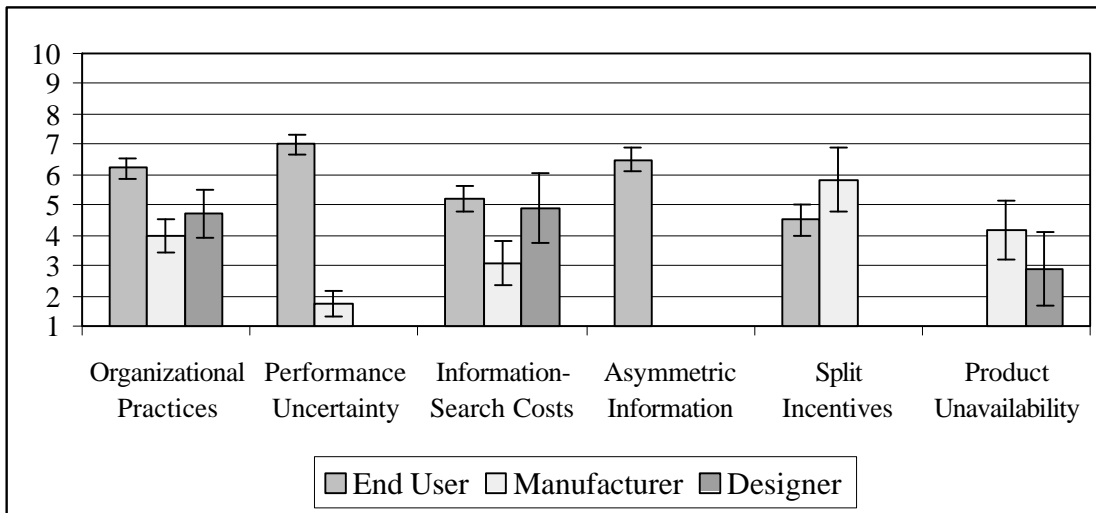
### **Baseline**

The market characterization completed at the beginning of the study hypothesized the important barriers in the market. This understanding of the market was combined with program design and implementation information to identify the subset of barriers that could possibly be affected by the program. These key market barriers were organizational practices, performance uncertainty, asymmetric information, information and search costs, split incentives, and product unavailability.

While the overall results address many issues, this baseline summary presents only the results of the market barrier analyses (Figure 4). In Figure 4, and Figure 5 that follows, a value of 1 means no barrier and a value of 10 means maximum barrier. The range bar in these exhibits represents the 95% confidence interval. The following trends can be drawn about existing barriers by market actor type.

- **End Users.** The largest barrier for end users is performance uncertainty. That asymmetric information is the next highest barrier seems logical, since sales staff may exaggerate the performance claims of the equipment. It is a little surprising that the information-search costs barrier is so much lower than performance uncertainty, since information should reduce performance uncertainty. One explanation is that, while information may be readily available, performance information is not often provided or, when it is provided, the customer does not find it credible.
- **Manufacturers.** The largest barrier, as seen by the manufacturers, is that of split incentives. The customer who makes the decision on a piece of equipment (e.g., the purchasing manager) is not the person who would see any benefits in operating or maintenance costs (e.g., the facility operator).
- **Designers.** Designers do not seem to feel that there are barriers to energy efficiency. Designers were not asked questions on split incentives or performance uncertainty because the initial market characterization indicated that these were not barriers for them.

## Participant/Nonparticipant Market Barriers Comparison



**Figure 4. Barriers for End Users, Manufacturers, and Designers**

A review of Figure 4 illustrates the following points about market barriers across market actors,

- End users perceive organizational practices as more of a barrier than either designers or manufacturers. This indicates that end users see more organizational obstacles to implementing energy efficiency within their organizations than manufacturers see in the development of efficient equipment or designers see in developing efficiency recommendations.
- There is a big difference in how the manufacturer and end user perceive the performance uncertainty of energy efficient equipment, with end users considering it much more of a barrier. This is logical because the manufacturers are the creators of the information and are more likely to be motivated to make certain that it is correct. Also, manufacturers are less likely to admit they are uncertain of energy efficiency performance. On the contrary, end users are currently reliant on manufacturers for performance information, since standardized information is not widely available.
- Split or misplaced incentives are perceived to be more of a barrier by the manufacturers than the end users. This may be a result of the samples for each group. End users represented a wide range of company size. The manufacturers, however, tend to have direct interactions with large chains, where split incentives are more likely to be present. They most likely based their responses on those direct interactions.

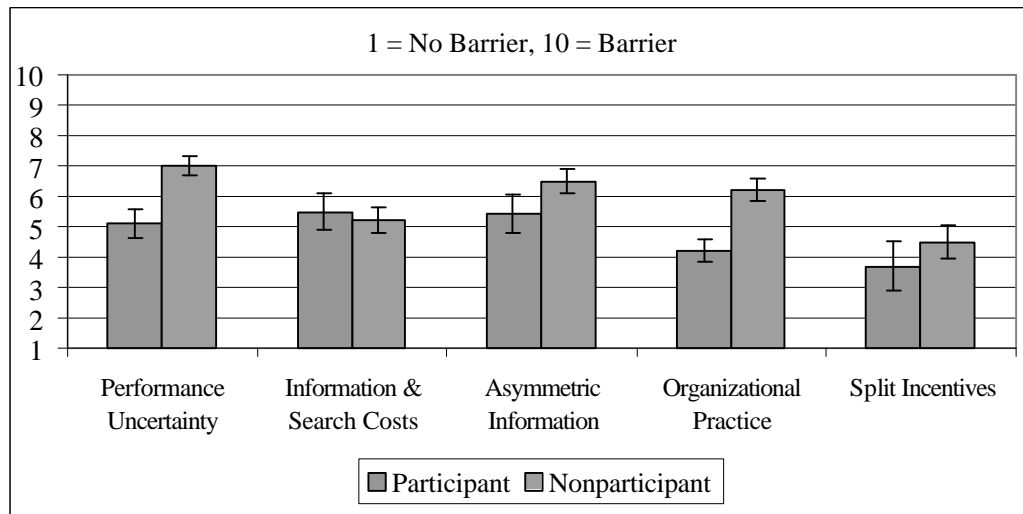
## FSTC Market Effects

The market effects that are, to varying degrees, attributable to the FSTC are:

- FSTC has produced some near-term quantifiable effects for participants (i.e., awareness, knowledge, projected purchase decisions, etc.). Statistically

significant market barrier effects (participant to nonparticipant) were identified for performance uncertainty, asymmetric information, and organizational practices (Figure 5).

- It was not possible to assess market effects for nonparticipants because no prior benchmarks exist.
- FSTC has had weak manufacturer and designer market effects. It should be noted, however, that, while not a specific hypothesis, the FSTC has very high market recognition in the manufacturer/designer community. This is an important market effect in itself.
- FSTC is having a major, most likely sustainable, effect on ASTM test procedure development.
- Overall, the FSTC program is addressing many of the crucial communication links and market barriers.

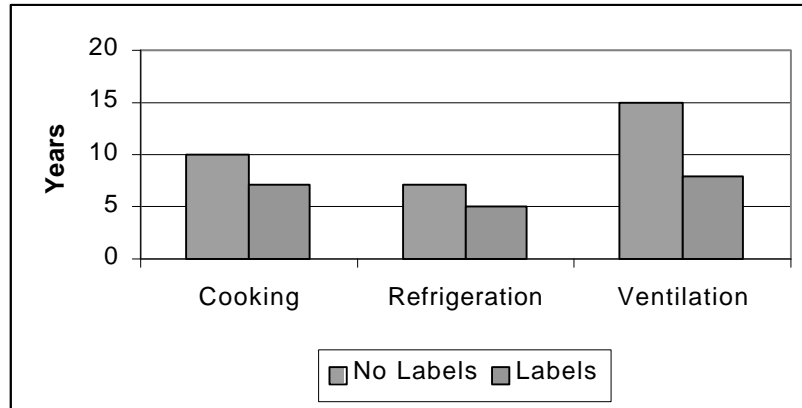


**Figure 5. Participant/Nonparticipant Market Barriers Comparison**

**Forecasting Market Effects.** Various diffusion models were used to project the path towards market potential over time for cooking, refrigeration, and ventilation equipment under two scenarios, one with no-labeling system present and one with a labeling system present. The results, as illustrated in Figure 6, suggest:

- Establishing a labeling program can have a significant impact on market penetration for all three technologies.
- The labeling system shows the largest effect on ventilation because it starts at the lowest assumed penetration due to a lack of previous marketing of energy efficient systems.

It is crucial for readers to realize that the primary value of diffusion analysis is as a framework for thinking about and understanding the complex web of assumptions that underlie market forecasts. Such heuristic devices can be very useful for strategic program planning, *but are highly dependent upon the input assumptions*. They can be particularly useful in identifying information and data needed to better understand the market.



**Figure 6. Years to 100% Saturation by End Use and Scenario**

## Conclusions

From its inception in 1986, the FSTC program was designed to change the market, or in current parlance, as a market transformation program. It has implemented a nationally orchestrated approach to develop test procedures, supply information, influence market actors, and, generally, to change the structure of the market to favor energy efficiency.

Clearly, the foodservice industry is one of the more complex markets to try to change, because of 1) the number and diversity of the market actors, 2) the fact that energy efficiency is a low priority because energy costs are a very small fraction of operating costs, and 3) an emphasis on growth requires that equipment costs be kept low to minimize capital spending. In the face of these challenges, the FSTC Program has produced near-term quantifiable market effects, caused a very likely sustainable impact on ASTM testing methods, and is addressing many of the crucial communication links and market barriers. While the FSTC Program represents a viable model for transforming a market, it also underscores how long it actually takes to change a very diverse market with no initial energy efficiency infrastructure in place. Additionally, the restricted market effects may reflect the limited effect that a single player can have both in terms of the barriers affected and the size of the market changes.

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