Baseline, Retention, and Persistence Studies to Track Market Transformation Goals of Residential Compact Fluorescent Lamp Programs in Mexico

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ABSTRACT

A series of studies consisting of pre-program baseline and follow-up retention and persistence studies of the Fideicomiso de Ahorro de Energía Eléctrica's (FIDE) residential compact fluorescent lamp (CFL) programs were conducted throughout Mexico. The long-term objectives of the CFL programs are to encourage residential customers' use of energy efficient lamps, stimulate their demand for the lamps and make CFLs more widely available to the residential sector.

Baseline research assessing residential consumers' awareness, attitudes, level of interest, barriers, use and purchases of CFL's was conducted in the Mexican states of Zacatecas and Sinaloa. To assist in program design, the baseline research also examined various program delivery mechanisms. Persistence and retention studies conducted in Valladolid and Ciudad Juárez in varying post-program time intervals focused on gaining a better understanding of the installation status and usage of these energy-efficient lamps, as well as customers' perceptions of them over time. The persistence and retention studies also examined trends of effective useful life and energy savings persistence for this technology in Mexico. Data were collected using door-to-door surveys with residential customers and retail store shelf surveys.

The paper examines how residential CFL programs are meeting their market transformation goals by looking at various purchase decision factors. These include customers' awareness of CFLs, their perceptions of CFLs, and their awareness of the benefits and advantages of CFLs and how these changed as a result of the programs. The paper also looks at changes in residential usage, availability, and marketing of CFLs.

Introduction

In 1996, the Mexican national utility, Comisión Federal de Electricidad (CFE), developed a residential lighting program, which is administered by the Fideicomiso para el Ahorro de Energía Electrica (FIDE). The program is focusing on developing sustainable commercialization and market conditions necessary for compact fluorescent lamps (CFLs) to replace incandescent lamps in residential homes.

The long-term goals of the program are to promote the use of CFLs in order to increase demand for them and also their availability to the public. To achieve market transformation for CFLs, FIDE initiated a program to sell CFLs directly to residential customers at manufacturer prices and allow customers to pay for them in four monthly installments on their utility bills.

The results of the evaluation studies suggest that although the program has taken several positive steps toward market transformation by increasing awareness of CFLs and

educating the public about their energy saving potential, the market for CFLs is still not sustainable. For example, in the long-term sample, 63% of program bulbs had been removed (had burned out), but only 15% of the respondents had purchased other energy-efficient bulbs (of these, 65% were 22-Watt circulars).

Efforts still need to be made to increase customers' knowledge of the benefits of CFLs. For example, near-term and long-term results about other benefits of CFLs—better light and durability–did not differ significantly from baseline results. In addition, 22-Watt circulars remain the most commonly known CFL in all the studies (baseline, near-, and long-term). Availability of these lamps also remains a problem, and the up-front costs of CFLs are still a major market barrier for residential customers.

Background

The evaluation of the CFL market transformation consisted of three stages. The first stage was to determine the initial market conditions (a "baseline"). The second stage was to evaluate the effectiveness of the program activities in the very near-term (1 year later) and to make pertinent adjustments and changes to the program. The third stage was to determine if any sustainable market changes have persisted (near-term = about 2 years; long-term = 5 years or more). This paper addresses the first (baseline) stage and the third (near- and long-term) stage.

Baseline

The purpose of the baseline research in the Mexican states of Zacatecas and Sinaloa was to determine initial market conditions. The long-range objectives were to understand the program's long-term effects, estimate the program's impact on energy consumption, and obtain preliminary information for use in the program's design.

Near-term and Long-term Studies

The primary purpose of these studies was to determine the effective useful life – and energy savings persistence – of CFLs in Mexico. The surveys also provided indicators of *market transformation* (e.g., customer perceptions of the availability of energy-efficient lighting, cost barriers, satisfaction with the products, and awareness of project marketing and delivery methods). The near-term study took place in Ciudad Juárez where the residential CFL program was introduced in 1997. The long-term study took place in Valladolid where a pilot program was introduced in 1991.

The evaluation was able to collect data for the programs at different stages because the residential CFL programs were implemented at different times in different locales throughout the country. We believe the many significant demographic similarities make comparisons between the different localities valid. Specifically, we looked at demographic information determined through logit regression models that most influences people's awareness and purchasing behavior of CFLs. In all four locations, almost all of the respondents (at least 90 percent) lived in single family houses and owned their own home. In addition, Sinaloa, Zacatecas and Ciudad Juárez are very similar in household income and education (as determined by the head of the household).

However, Valladolid (the long-term study) had significantly lower household incomes and education levels (by head of household) than the other three locations. Half of the Valladolid respondents had annual incomes less than 1,000 pesos compared to 2,000 pesos in the other locales. In addition, half of the Valladolid respondents only had a primary school education compared to a high school education for the majority of respondents in the other three locales. Consequently, comparisons between Valladolid and the other locations are more limited and must be interpreted with caution. For example, the baseline studies found that households with higher incomes are more likely to be aware of and purchase CFLs. Therefore, it is likely that Valladolid had significantly lower initial CFL penetration and awareness than found in the baseline studies in Sinaloa and Zacatecas. An additional limitation is changes in the quality of CFLs over the time period of these programs. The quality of CFLs was improved from 1991 when the program was first introduced in Valladolid to 1997 when the program was first introduced in Ciudad Juárez.

Methodology

Baseline

On-site, in-home surveys were completed with 406 residents in Sinaloa and 486 residents in Zacatecas. The surveys with residential customers were supplemented with store visits (12 in each state; 24 total) to assess the availability of CFLs.

Near- and Long-term Studies

A survey was implemented with CFL residential program participants in Ciudad Juárez (400 respondents; near-term) and Valladolid (411 respondents; long-term) to evaluate the impact of the pilot project in both areas. In Ciudad Juárez, 62,000 CFLs had been sold to approximately 15,000 residential customers in 1997. In Valladolid, 9,000 CFLs had been sold to approximately 3,000 residential customers in 1991 to 1992.

Additional interviews were conducted in Ciudad Juárez with a non-participant sample so that the general population's awareness of CFLs, opinions about the benefits and disadvantages of CFLs and the market penetration of CFLs could be compared to the participant sample. A second supplemental data collection activity, retail store surveys, measured the availability of CFLs.

Results

Baseline

Awareness of CFLs. In an unaided question, residents of Sinaloa were twice as likely as residents of Zacatecas to have heard of CFLs (Table 1). Adding aided responses, slightly less than three-quarters of all respondents in both states had some degree of awareness of CFLs.

Table 1. Baseline Awareness of Compact Fluorescent Lamps

	Sinaloa	Zacatecas
Unaided awareness	50.5%	27.3%
Aided awareness	19.3%	45.1%
Total awareness	69.8%	72.4%

Awareness and Income. There was a significant correlation between awareness of CFLs and household income. As monthly household income increased, respondents were more likely to be aware of CFLs.

But awareness of the different energy-saving lamps varied greatly by type of lamp. The majority of respondents were aware of 22-Watt circulars, but not of any other types. This suggests a good opportunity to educate people about different types of CFLs (Figure 1).

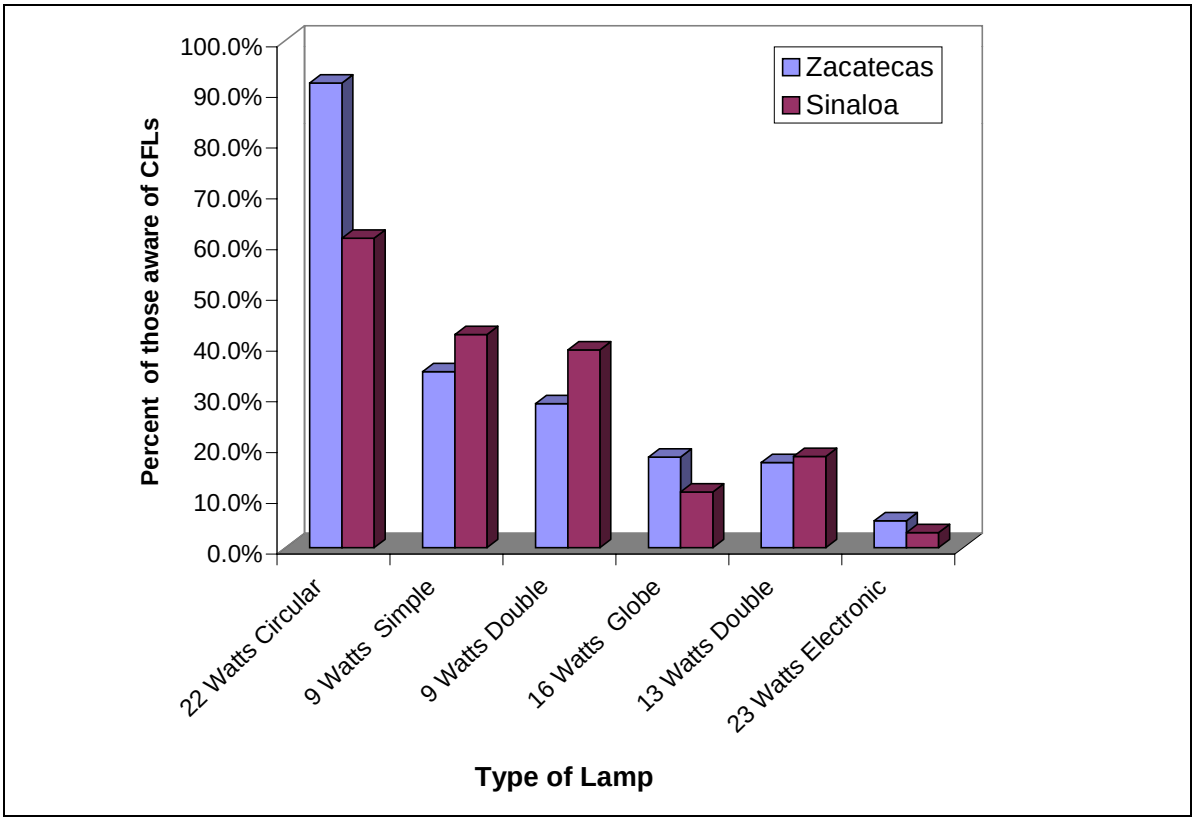

Figure 1. Baseline Awareness of Different Lamp Types

Baseline Market Penetration of CFLs. Approximately one-quarter of the Sinaloa (25.9%) and Zacatecas (19.5%) respondents had bought CFLs in the past. Similar to awareness of CFLs, there was a statistically significant relationship between those who had bought CFLs and household income. The relationship indicates that as household income increases, respondents are more likely to have bought CFLs.

Respondents who had not bought CFLs were asked why they had not done so (Figure 2). The main barrier was lack of knowledge. Although only about 15% of respondents in Sinaloa and Zacatecas cited expense as a reason for not buying CFLs, this low percentage is possibly attributable to customers' lack of knowledge about the price of CFLs. In a related question that asked if they knew how much CFLs cost, less than a third of the respondents in both states reported knowing the cost of CFLs.

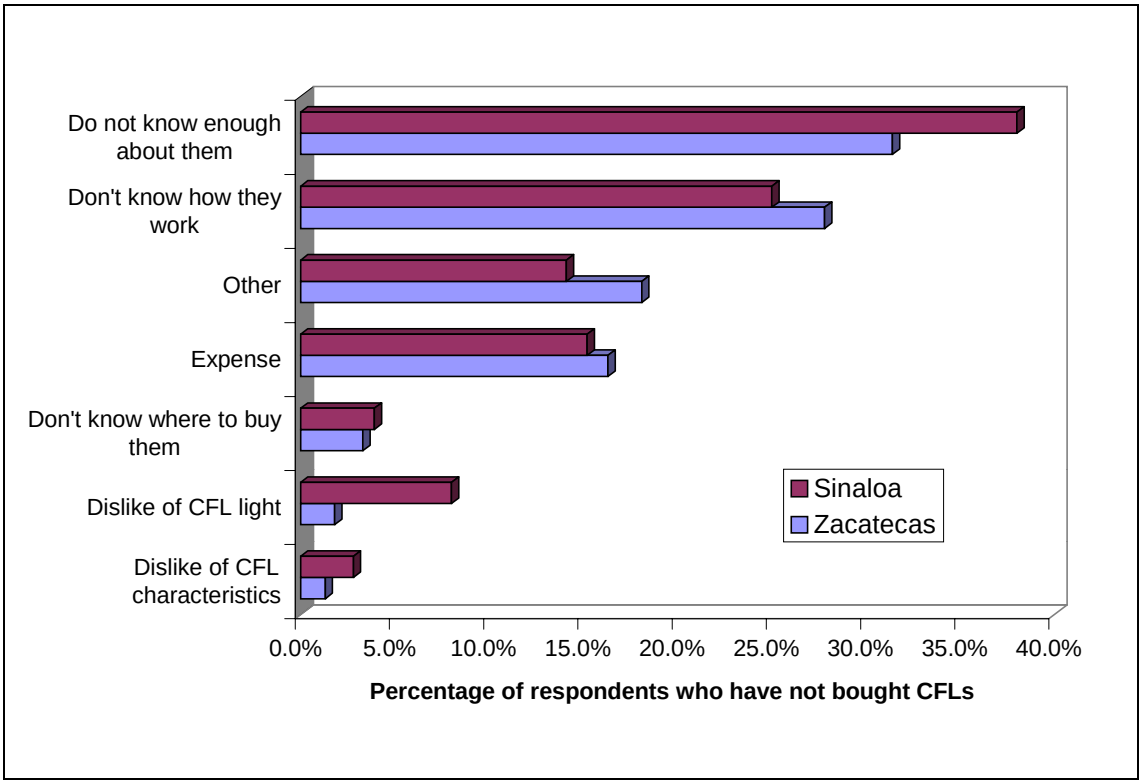

Figure 2. Reasons Baseline Respondents Had Not Bought CFLs

Respondents who had bought CFLs were asked why they decided to purchase them (Figure 3). The two main reasons were to save energy and to save money. This suggests an opportunity to inform the public about other benefits of CFLs such as their durability.

Interest in CFLs. Table 2 shows the significantly larger percentage who would buy CFLs at a reduced price if they could pay for the bulbs through monthly utility bill installments. This suggests that financing and program delivery are important factors for residential customers.

In a related question, respondents were asked if they would prefer to acquire discounted CFLs through CFE in a store with a coupon, or sold house-to-house. Approximately three-quarters of respondents in both Sinaloa and Zacatecas said they would prefer to buy CFL bulbs through CFE.

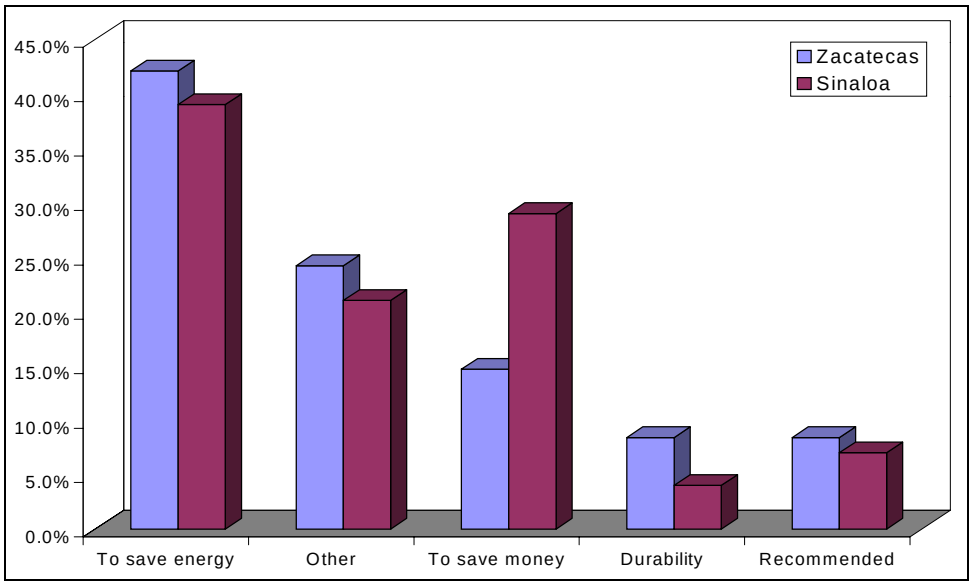

Figure 3. Why Did You Decide to Buy CFLs?

Table 2. Interest in Buying CFLs (Baseline Respondents)

State	Percent reporting interest in CFLs	Percent interested in CFLs who would buy CFLs at a reduced price	Percent interested in CFLs who would buy them at a reduced price if they could pay for them in monthly installments on their utility bill
Sinaloa	79.2%	80.4%	97.0%
Zacatecas	81.1%	84.0%	93.8%

Baseline Availability of CFLs. Twenty-four shelf surveys were implemented in Sinaloa and Zacatecas. The shelf surveys indicated that the availability of CFLs in the current market was limited. The store with the highest percentage had 30% as many CFLs as incandescents. Half of the surveyed stores had less than 5% as many CFLs as incandescents. Two stores (one in Sinaloa and one in Zacatecas) did not offer any CFLs and reported this was because of a lack of demand. Those stores offering CFLs had only limited brands and types available.

The Relationship between Demographic Characteristics and CFLs. Three different logit models were run to see how demographic characteristics of consumers affect the likelihood of being aware of CFLs, buying them, or being interested in buying them. Logit models were used to analyze the demographic characteristics of the Sinaloa and Zacatecas baseline respondents and Ciudad Juárez respondents who had not participated in the lighting program.

The logit model results showed that household income, level of education, number of lightbulbs in the house, number of bedrooms, and number of bathrooms with a shower all increase the likelihood of customers knowing about or buying CFLs. Interestingly, these

same factors did not affect level of interest. This suggests that programs that focus on the benefits of CFLs and offer them bulbs at a reduced price could raise the level of interest among those with lower incomes and education.

Near-term Post-program Results

Ciudad Juárez. Door-to-door sampling was carried out in Ciudad Juárez approximately two years after the program was implemented. Four hundred households were included in the sample. On average, each household had purchased 4.4 program lamps for a total of 1,741 lamps. Five types of lamps were involved: 22 Watt circulars = 53.8%; 15 Watt globes = 26.7%; 13 Watt doubles = 15.5%; 9 Watt simple = 5.1%.

Status of Program Lamps. After about 2 years, almost three-quarters (72%) of the lamps were still installed and in use. About one-quarter (23%) had been removed. According to respondents, lamps were removed because they failed to work (about half) or did not work properly. On average, lamps were installed 8 months before being removed.

About six percent of the purchased lamps had not been installed at the time of the survey. The main reason was because the program lamp had been given to another person (28%) or had been replaced with another lamp (23%).

Plans to Install in the Future. Program participants who had removed lamps planned to install energy-efficient lamps in 55% of these fixtures.

Perceptions About Energy Efficient Lamps. Sixty-four percent of the near-term participants said one advantage of the CFL's was that they saved energy (Table 3). About 17 percent thought CFLs provided a better quality of light. Forty-six percent could not name a disadvantage. Among those who could, the most common one was that CFLs were slow to turn on (56% of those naming a disadvantage). A few thought CFLs were not durable.

Bulbs Purchased Outside the Program. Most of the near-term participants (87%) said they would purchase more energy-efficient lamps. In fact, about 18 percent (71 of the surveyed participants) had purchased 81 energy-efficient lamps (Table 4). About 80 percent of these said they bought the lamps because of their experience with the pilot project (56 out of 71 participants).

Energy-efficient lamps bought outside of the pilot project were primarily purchased from a supermarket (63% of participants making additional purchases) or from a hardware store (21%) (Figure 4).

Table 3. Near-term Participants' Perceptions of Energy-efficient Lamps

	Number of Respondents	Percent
Save energy	248	64.2
Better light	64	16.6
Save money on utility bill	21	5.4
Last longer	14	3.6
Do not have to change bulbs as often	14	3.6
Do not like the bulbs	12	3.1
Miscellaneous comments	2	0.5
Have never installed them	2	0.5
Bulbs are environmentally friendly	1	0.3
They have a good design	1	0.3
Do not know	7	1.8
Total	386	100.0

Table 4. Types of Bulbs Bought After Program (Near-term Participants)

	Count	Percent of Responses	Percent of Cases
22 Watts Circular	55	67.9	78.6
15 Watts Globes	19	23.5	27.1
9 Watts Simples	3	3.7	4.3
13 Watts Doubles	4	4.9	5.7
Total	81	100.0	115.7

Percentage of cases is the percent of those who responded to this question.

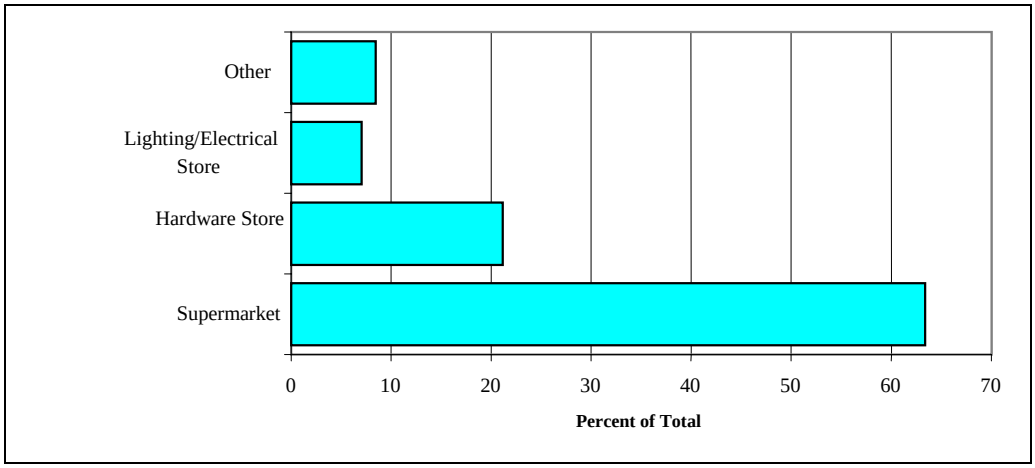

Figure 4. Where Additional Lamps Were Purchased (Near-term Participants)

Non-participants in Ciudad Juárez. Non-participants were demographically different from participants. They were:

- more likely to rent
- live in smaller houses
- have a smaller income
- be younger
- be less well educated
- have fewer lightbulbs

In a question aided by a picture of a CFL bulb, 84.2% of non-participants said they had heard of CFLs. Of those who were aware, 26.2% had bought a CFL at some time in the past (21.6% of all non-participants). Non-participants who had purchased CFLs bought an average of 2.86 bulbs; the maximum was 14. The 43 non-participant purchasers bought a total of 123 bulbs.

Almost three-quarters (71.6%) of the non-participants who were familiar with CFLs could name a reason for liking them. Whereas participants cited energy savings as the main advantage of CFLs, the most common aspect of CFLs that non-participants liked was the quality of the light. This was followed closely by energy savings.

Almost one-quarter of all non-participants did not know where they could buy CFLs. Of the remainder, most thought they could be bought at a supermarket (agreeing with participants). Next most common location was a hardware store for both types of customers.

Among non-participants who had never bought a CFL, the most common reason for not buying them was that they were too expensive. Also frequently mentioned was that the respondent did not know how these bulbs worked, did not know where to buy them, or was not interested. When asked how much CFLs cost, the average answer was 66.1 pesos (the minimum was 20 pesos, maximum was 200 pesos, and the standard deviation was 36.62, illustrating the wide range of cited costs). Over three-quarters (80.8%; N=120) of the non-participants said they would buy CFLs if the bulbs were cheaper.

Long-term Post-program Results

Valladolid and Agua Calientes. Door-to-door sampling was carried out in Valladolid and Agua Calientes approximately 4 to 6 years after the CFL residential program had been implemented in those areas. The purpose of this research was to assess the long-term status of program-sponsored compact fluorescents. In Valladolid, the average number of program-sponsored lamps purchased was three. Thus, the sample of 411 households included 1,224 lamps. Almost all (about 95%) of these lamps were the 22-watt circulars.

Status of the Program Lamps. One-third of the long-term lamps were still installed and in use. Respondents said that 63% of originally installed lamps had been removed, and the remaining small percentage (3.4%) had never been installed.

The most common reason for removal was that the lamp no longer worked (44%). As in Ciudad Juárez, Valladolid customers' reasons for removing lamps were similar to results obtained in comparable project evaluations in the U.S. For removed lamps, length of time installed prior to removal was on average 2.4 years.

About three percent of the purchased lamps had not yet been installed. The most frequently reported reasons for not installing were (1) the lamp had been given to another person (about 60% of responses) or (2) the respondent had forgotten to install the lamp (about 29% of responses).

Plans to Install in the Future. Long-term respondents who had removed lamps said they planned to install an energy-efficient lamp in 75 percent of the fixtures where they had previously removed a project lamp.

Perceived Advantages of Energy-efficient Lamps. A majority of the surveyed participants in Valladolid (65%) reported that energy savings was the major advantage of the energy-efficient CFL's. In addition, almost one-fourth (24%) said that these lamps produced better lighting.

Perceived Disadvantages of Energy-efficient Lamps. Sixty-five percent of these long-term respondents could not name a disadvantage of CFL's. Of the remaining customers, the most common objection was that bulbs were slow to turn on.

Less than 5% of the respondents had purchased energy-efficient lamps before their experience with the program (19 of 411). However, over 80 percent said they would buy other energy-efficient lamps.

Bulb Purchased Outside the Program. Fifteen percent of Valladolid participants had actually purchased other energy efficient lamps outside the program (62 out of 411). Over 65 percent of the lamps they purchased were 22-watt circular bulbs (Table 5).

Table 5. Types of Bulbs Bought After Program (Long-term Participants)

	Count	Percent of Responses	Percent of Cases
22 Watts Circular	43	65.2	69.4
15 Watts Globes	9	13.6	14.5
9 Watts Simple	8	12.1	12.9
9 Watts Double	4	6.1	6.5
13 Watts Double	2	3.0	3.2
Total	66	100.0	106.5

Percentage of cases is the percent of those who responded to this question.

Did the Additional Purchases Result from the Customer's Experience with FIDE? Almost all of these long-term customers who made additional purchases of energy-efficient lamps (97%) said they bought the bulbs because of their experience with the FIDE program.

Where Were Other Lamps Purchased? The additional lamp purchases in Valladolid were primarily from an electrical supplies store (Figure 5). Many were also from a local hardware store.

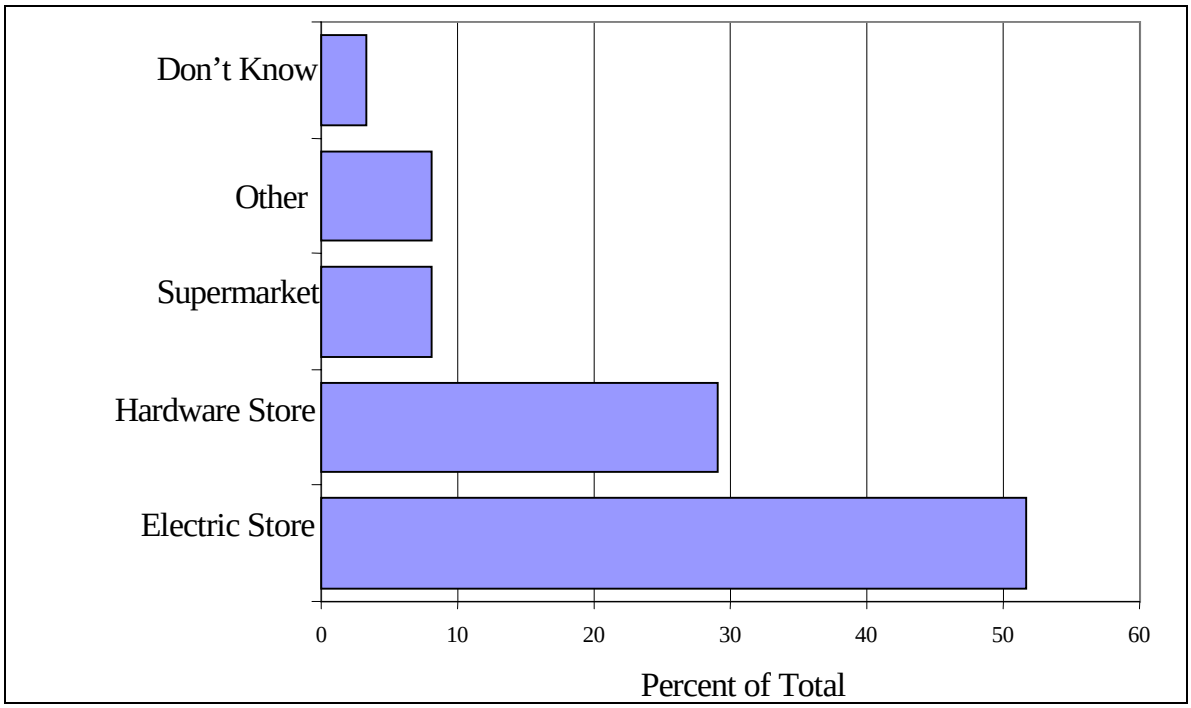

Figure 5. Where Additional Lamps Were Purchased (Long-term Participants)

Conclusion: Overall Effect of Program

One of the main indicators of market transformation is the percent of program participants who buy additional CFLs as a result of the program. The surveys in Sinaloa and Zacatecas established a baseline market penetration rate of approximately 25 percent. Over three-quarters of participants (87% of near-term; 80% of long-term) in the Ciudad Juárez and Valladolid programs report planning to buy additional CFLs.

Despite the majority of respondents reporting plans to purchase CFLs in the future, only a small percentage had actually bought more energy-efficient lamps (18.5% of near-term, 15.1% of long-term) However, as noted earlier, there are significant differences between the baseline respondents and the long-term study participants. Specifically, only five percent of long-term program participants said they had bought CFLs prior to participating in the program. Although this is significantly less initial CFL penetration than found in the baseline study, we find this believable because of Valladolid's substantially lower household income and education level. Consequently, the long-term study shows approximately a ten percent increase in CFL penetration among program participants. Almost all of these long-term customers who made additional purchases of energy-efficient lamps

(97%) said they bought the bulbs because of their experience with the FIDE program. In addition, of the 18.5% of short-term participants who purchased additional CFLs, 80% said they bought the CFLs as a result of the program.

One *attitudinal* indicator of market transformation is customers' perceptions of the benefits of CFLs. The premise behind attitudinal indicators of market transformation is that they will lead to behavioral changes. In other words, as people perceive more benefits to CFLs, they are more likely to purchase them in the future. Between the baseline studies and the near-term and long-term studies, there was about a 25% increase in the percentage of respondents who perceived CFLs as "energy-saving." Approximately 40% of baseline

respondents reported that CFLs save energy compared to approximately 65% in both the near-term and long-term studies. The program appears to have successfully gotten the message out that CFLs "save energy." However, there were no significant increases in the percentage of respondents who cited other benefits of CFLs such as their durability.

The results clearly indicate that awareness of CFLs is a major barrier among customers who are not currently buying them. Thus, awareness of CFLs is another attitudinal indicator of market transformation in that increased awareness appears to result in increased purchases of CFLs. The Ciudad Juárez non-participant survey suggests that the residential program is having some spill-over effects, i.e., that it is increasing the awareness of the general population. The baseline studies show initial awareness of CFLs are around 70%. The non-participant survey in Ciudad Juárez showed an awareness of CFLs at around 84%. This difference is statistically significant difference at the 95% confidence interval. Again, because of demographic similarities between Ciudad Juárez, Zacatecas and Sinaloa, we believe the comparisons between the baseline study and non-participant study are valid in showing program spill-over effects.

Although the program has taken several positive steps toward market transformation by increasing awareness of CFLs and educating the public about how CFLs save energy, the results suggest the market for CFLs is still not sustainable. For example, in the long-term sample, 63% of program bulbs had been removed (had burned out), but only 15% of the respondents had purchased other energy-efficient bulbs (of these, 65% were 22-Watt circulars).

Further efforts are needed to increase customers' knowledge of the benefits of CFLs (near-term and long-term results regarding "other" benefits of CFLs such as better light and durability did not differ significantly from baseline results). In addition, as in the baseline survey, 22-Watt circulars were still the most commonly known CFL among both near-term and long-term participants. Availability also remains a problem, as does the up-front cost of these bulbs, which is still a major market barrier for residential customers.