Explaining Consumer Choice in Purchasing, Installing and Storing Compact Fluorescent Lamps

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Abstract

The savings potential for compact fluorescent lamps (CFLs) is huge. The puzzling question is, if CFLs are so cost effective, and with utility programs devoting so much money to information and rebate campaigns, why are people not using more of them? Barriers to CFL adoption take a number of forms: technical (e.g. a CFL will not fit or function in a fixture), awareness and informational barriers (consumers don't know about them or do not understand the benefits), market barriers (price and availability), and experiential barriers (consumers have been disappointed with CFL performance or lifetime in the past).

One-hundred on-site surveys were conducted in California in households that purchased at least one CFL in 2004-2005. Each survey included a fixture inventory of both interior and exterior fixtures, and specific questions about the choice between CFLs and non-CFLs in specific fixtures in a subset of rooms (chosen on a rotating basis). Finally, CFLs in storage were inventoried, and the participant was asked why CFLs were stored rather than installed.

A large share of California's residential energy-efficiency portfolio is devoted to promoting CFLs. But right now, the CFLs subsidized by these programs fall into the black box that is consumer behavior. This study sheds light on consumers' decision processes with regard to where and when to install CFLs they have purchased. Without this understanding, program design and estimating program impacts are just a shot in the dark.

Introduction

The savings potential for compact fluorescent lamps (CFLs) is huge. The puzzling question is, if CFLs are so cost effective, and with utility programs devoting so much money to information and rebate campaigns, why aren't people using more of them?

We classify barriers to CFL adoption in five bins:

- technical
- awareness and informational barriers
- market barriers (price and availability), and
- experiential
- inventory

Many studies have attempted to characterize CFL awareness and barriers to adoption in a general way. This study, part of an evaluation of California's Single Family Rebate Program, brings a much greater degree of specificity to the current store of knowledge by focusing on CFL decision-making for specific lighting fixtures. Data was collected through on-site surveys, in which auditors sat down with participants to ask about each of the fixtures in a particular room or rooms. This approach captured the diversity in the reasons CFLs were or were not chosen for specific fixtures: hours of use for one fixture, use of a dimmer for another and appearance for yet another, for example.

The following section discusses the types of barriers that exist to CFL adoption. We then discuss the specific methodology of the study and the survey design. Results of the study are presented, followed by conclusions and recommendations.

Barriers to Adoption

Technical. We use the term "technical barrier" to describe physical or functional constraints that prevent a CFL from being installed in a fixture. In the early days of CFLs (before compact spirals became available), many fixtures simply could not accommodate a CFL. Most CFLs today take up no more space than an incandescent lamp, but size, shape or weight may still represent constraints in certain fixtures.

Controls may also constitute technical barriers, although CFL innovations have overcome some of these barriers. For example, not too long ago one could not buy a CFL that functioned with a dimmer or a 3-way switch. Some controls still pose a barrier to CFL usage; for example, certain photocell adapters that cause CFLs to flicker and fail prematurely.

CFL performance can be adversely affected by certain operating conditions or usage patterns. CFLs may be slow to start or reach full brightness in cold temperatures (since some CFLs are rated down to -10 degrees Fahrenheit, this issue overlaps with awareness and market barriers as well). CFL lifetime, and therefore cost effectiveness, can be reduced in high humidity environments (e.g. a bathroom), or with frequent on-off cycling. Of course, a consumer might be ignorant of these technical issues, choose a CFL for such an application, and have a negative experience. Such a case might be called an experiential barrier (see below) as opposed to a technical barrier.

Awareness and informational barriers. In spite of utility informational campaigns, some consumers may remain unaware of CFL technology and its benefits. An even greater number may be unaware of specialty CFLs, such as 3-way, dimmable, and small-base (candelabra) lamps. Consumers may perceive technical barriers for certain fixtures, when in fact applicable lamps are available (albeit perhaps not locally or cheaply).

Market barriers. Once consumers become aware that CFLs are available for their particular application, they may face significant market barriers in purchasing them. Many stores stock only a limited range of CFLs, typically spiral lamps in the 15-watt range. In some areas, hardware and home improvement stores *may* offer lamps with diffusers, lower or higher wattage lamps, and possibly 3-way or dimmable lamps. Small-base lamps, particularly decorative ones, are difficult to find, as are CFL reflector lamps.

Those of us in the energy-efficiency field who have taken the time to look have found a full range of options available online. Unfortunately, in ordering specialty lamps for our own projects, we have found that the breakage rate is high in shipping.

The price of CFLs continues to present a barrier for many consumers, particularly for specialty lamps. While utility programs in California have brought the retail price of standard (15 watt spiral) CFLs down below $1 per lamp, prices in other regions, and for mail order, remain high.

Experiential barriers. Experiential barriers are the result of past negative experiences with CFLs, either a person's personal experience or what they have heard from others. This category captures reasons sometimes given for disliking CFLs such as "they flicker" or "the color is terrible." Some customers have had a lamp fail prematurely. A recent radio call-in on CFLs (KFOG, 2007) had a caller relating how he had a CFL that caught on fire. Rather than seeing these as unusual occurrences, or characteristics that improved technology might overcome, these things become embedded in the consumer's mind as typical and immutable characteristics of CFLs.

Inventory barriers. The last category of barriers relates to the existing inventory of incandescent lamps in fixtures and in storage. For example, one homeowner might choose to wait until an incandescent lamp burns out to replace it with a CFL, rather than retrofitting. Another might have a lamp burn out and find that she has only incandescents on hand. Others want to use up their stored supply of incandescents.

These categories are intended to provide a framework for discussion. As noted above, the lines between the categories are not always clear, as barriers can evolve from one to another as technology improves and the market matures. A consumer might start out unaware of dimmable CFLs (awareness), then learn about them but have difficulty finding them or be put off by their higher price point (market barriers). If they eventually make the purchase, they might be disappointed in the dimming performance of the lamp (experiential barrier).

Methodology

The current California Single Family Rebate Evaluation included 5,000 general population phone surveys. These surveys were used to identify households that purchased at least one CFL in the 2004-2005 program period. From these, one-hundred participants were recruited for on-site lighting surveys. Surveys were conducted by four auditors in a weighted sample of zip codes across California's three independently owned utility territories.

Each survey lasted approximately 30-45 minutes. Surveys included detailed questions about the choice between CFLs and non-CFLs for a subset of specific fixtures in each home. A primary (living/family room, dining room, or kitchen) and secondary (bathroom, bedroom, hallway, or laundry room/garage) room type was chosen for each site on a rotating basis. To keep the on-sites to a manageable length of time, the number of fixtures for the detailed questions was limited only to fixtures in one primary and one secondary room in each home. If the primary room chosen contained fewer than four fixtures, the auditor continued in another room until four fixtures were covered.

Each survey also included an inventory of all additional CFLs installed, and a full inventory of exterior fixtures. Location, fixture type, lamp type, control type, wattage and number of lamps were recorded for all inventoried fixtures, as well as CFL satisfaction level and other subjective information. Finally, all bulbs in storage were inventoried, and the participant was asked why CFLs were stored rather than installed.

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Results

Of the 100 homes surveyed, 71 had at least one CFL in the rooms selected as the primary and secondary rooms. Results were obtained for 302 fixtures with incandescent lamps, 158 with CFLs and 66 with other types of lamps (primarily tube fluorescents). Figure 1 shows the average number of fixtures and average number of CFLs by room type.

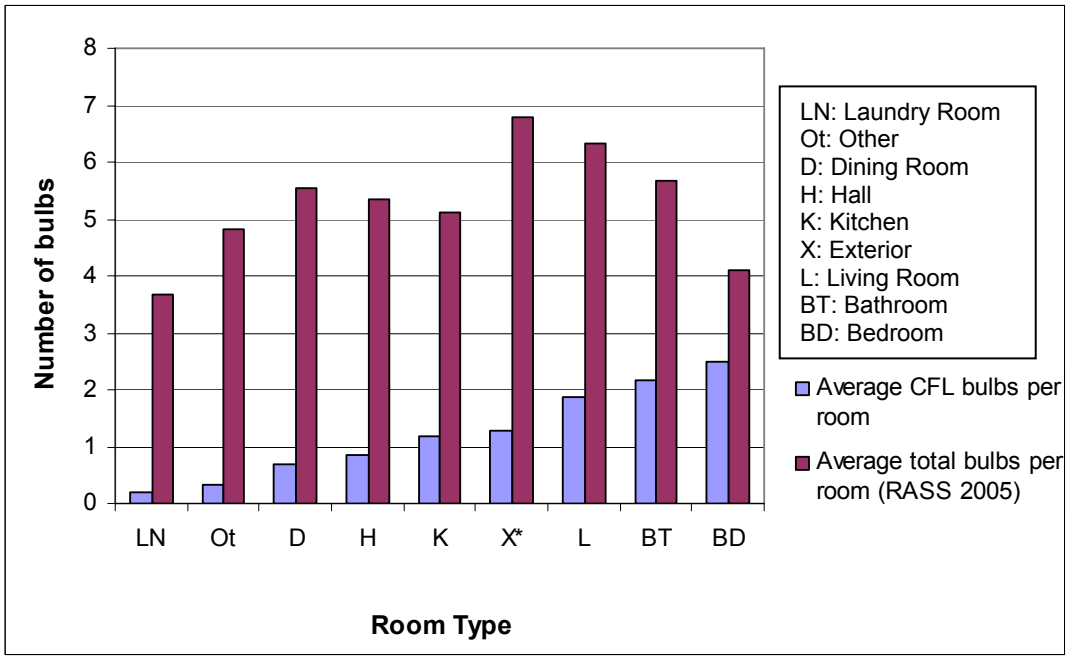

Figure 1. Average number of fixtures with CFLs by room type

Satisfaction with current CFLs. Satisfaction with current CFLs was high (See Figure 2). Only two respondents rated their satisfaction below a 6 (on a scale of 1 to 10). One of those was for a dimmable CFL that did not dim sufficiently. Most respondents with multiple CFLs rated their satisfaction the same for all fixtures. Respondents with lower satisfaction owned fewer CFLs, on average, but high satisfaction did not predict high levels of ownership (see Figure 3).

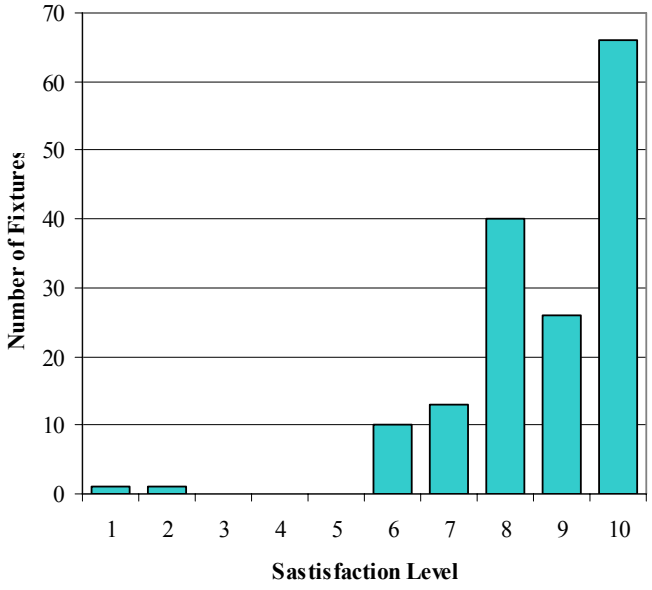

Figure 2. Number of Fixtures with CFLs by Satisfaction Level

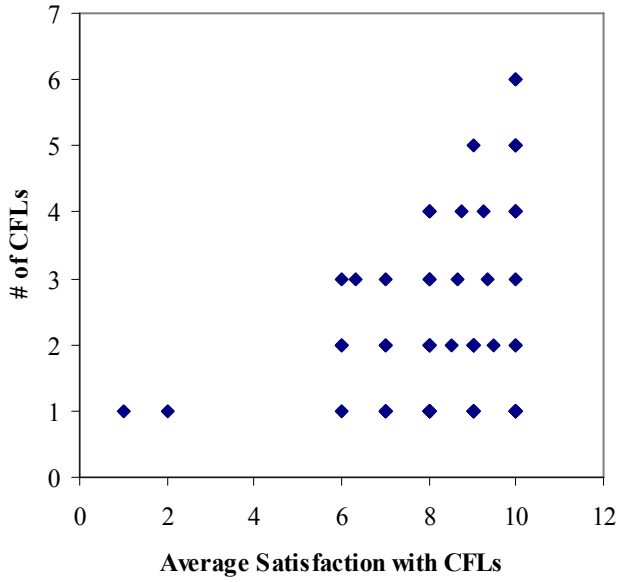

Figure 3. CFL Ownership Rates vs. Satisfaction with CFLs

When asked what would make them more satisfied with their CFL,[1] by far the most common response was "Reach full brightness faster" (60 responses). "Nothing would make me more satisfied (36, all from those giving a 10 rating) was a distant second followed by "needs to be brighter" (34) and "color of light" (31). Among those giving a satisfaction rating of 10, 46% said nothing would make them more satisfied, while 33% mentioned "reach full brightness faster" and 13% mentioned appearance (multiple answers were accepted). Of those least satisfied (7 or below), flicker came up 44% of the time, followed by "needs to be brighter (40%) and "reach full brightness faster" (36%), "eliminate delay on startup" (28%) and color (20%).

Figure 4 shows the distribution of answers to the question "What would make you more satisfied" by fixture location and overall. The values are percent of fixtures receiving that response. There were significant differences in the frequency of the different responses by room type. "Reach full brightness faster" up was an important factor for all room types, but came less often for bedrooms than other room types, and more often for dining rooms and bathrooms. Color and "not bright enough" were the most common complaints in bathrooms, where vanity activities, such as makeup application, require good lighting. "Not bright enough" was also significant for kitchens. "Too bright" came up only in living rooms and family rooms (and infrequently even for those), spaces more geared toward relaxation, conversation or television viewing. Appearance came up most often in dining rooms and living rooms/family rooms, traditionally the most public rooms in a home. The response "nothing would make me more satisfied" was given most often for bedrooms, but not at all for bathrooms.

[1] This question was asked of all CFL fixtures, including those with a 10 satisfaction rating. Multiple responses were accepted for each fixture, so the number of responses does not correspond to the number of fixtures.

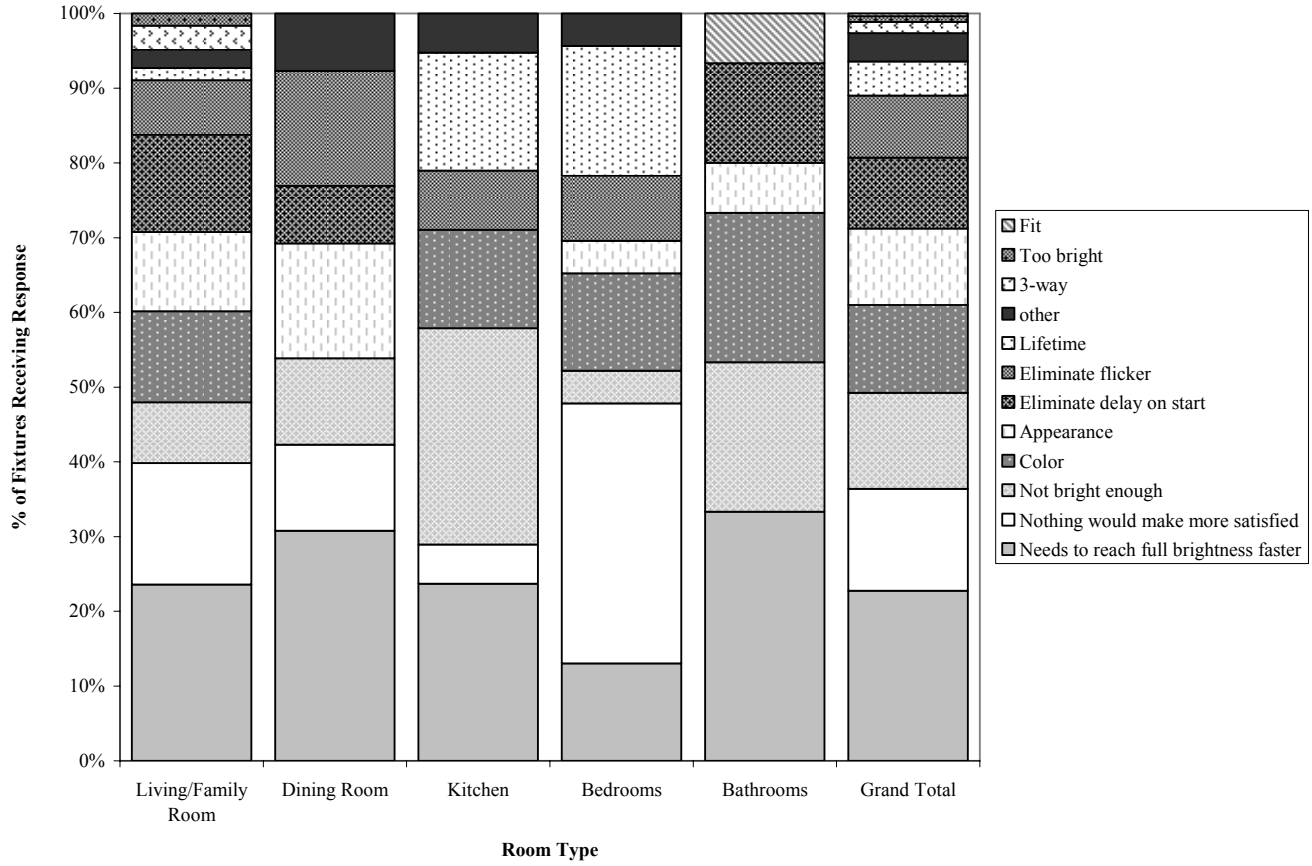

Figure 4. Breakdown of response to question, "What would make you more satisfied?" by fixture location

Barriers to further CFL Saturation. When asked why they had not chosen a CFL in their fixtures that had incandescent lamps at the time of the survey, respondents provided a diverse set of answers. In all, 17 distinct reasons were identified. Figure 5 shows the distribution of responses, with the responses categorized into inventory, experiential, information and market, technical and other types of barriers. Informational and market barriers were combined because all such responses had to do with specialty lamp types, which are arguably both.

Responses related to inventory were the most common, with the most common response being that they had installed what they had on hand (an incandescent). Our storage inventory, however, found that 71 of the 100 participants had CFLs in storage at the time of the survey (not necessarily at the time the lamp in question was installed). The most common reason given for storing CFLs was that they were waiting for a lamp to burn out (58% of those with CFLs in storage). These responses seem somewhat contradictory. Other reasons for storing CFLs had to do with lamp performance or aesthetics (25%) or the notion that CFLs were not appropriate (wouldn't fit, not cost effective, etc.) in the remaining fixtures in the house (20%).

It is certainly true that many participants have an inventory of incandescents in storage that they might want to "use up." The average number of incandescent lamps stored was 9.8; the average number of stored CFLs was 3.8. Thirty-five percent of lamps had been stored for three years or more.

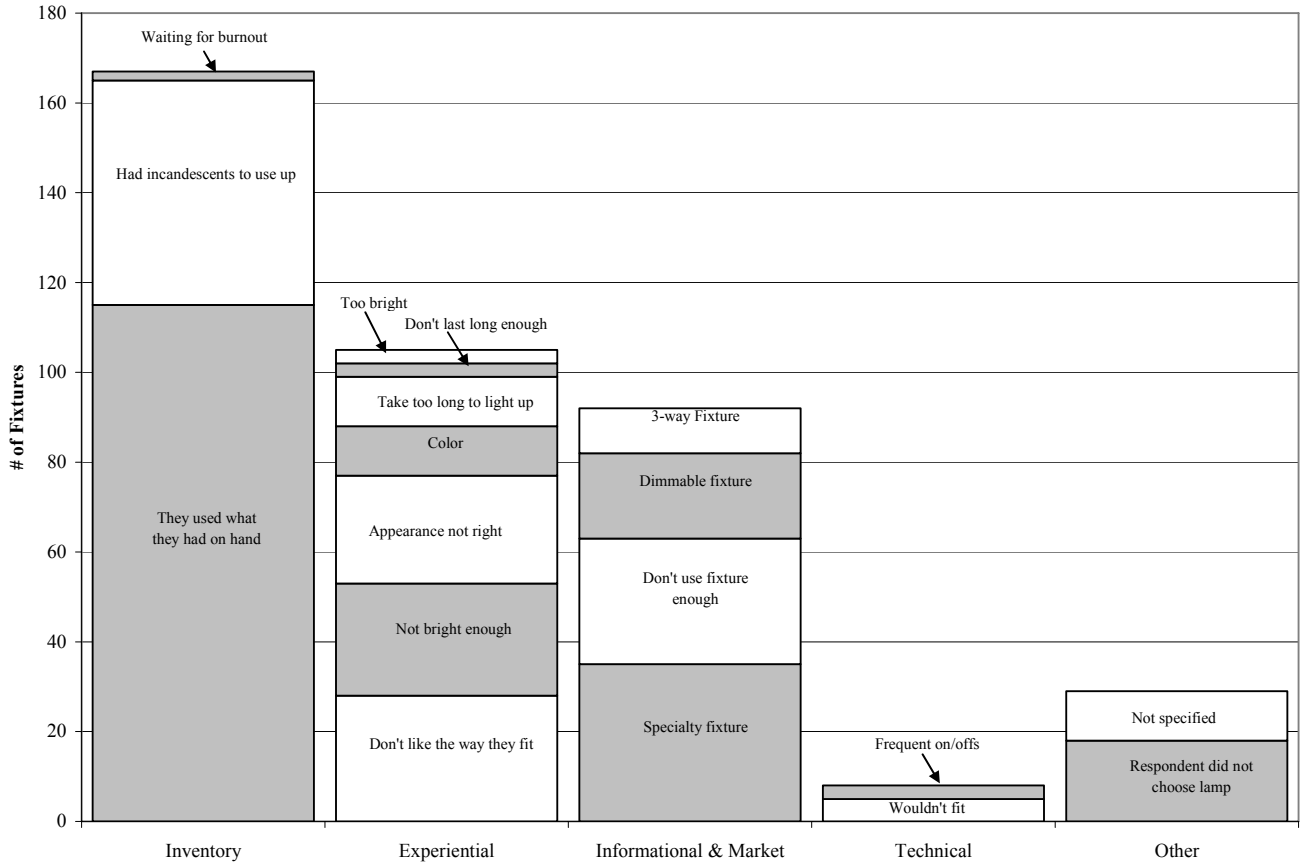

Figure 5. Reasons CFL not chosen for specific fixtures

Experiential barriers comprised the next most common set of responses. Appearance was a frequent complaint, ranging from the general to specific complains about color and the way they stick out of open fixtures. Brightness (both not bright enough and too bright) and the time for the lamp to warm up to full brightness were also mentioned. Two respondents expressed disappointment that the lamps did not last longer.

Because this survey targeted households with at least one CFL, information and awareness barriers were only a factor with respect to the availability of specialty CFLs, such as 3-way, dimmable, small-base (e.g. for chandeliers), or decorative CFLs. Of the 59 households who had incandescent lamps installed in their specialty fixtures, 24 were unaware that specialty CFLs existed. When asked whether they would consider CFLs in these specialty fixtures in the future, 14 of these participants now planned to install CFLs in at least one specialty fixture. This is a very encouraging result; however, these decisions will depend largely on the price and availability of these specialty CFLs. Because the issue of specialty CFLs is also a market issue — while such CFLs exist, they are not readily available and often cost more than standard bulbs—we chose to treat market and informational barriers together.

Low fixture usage was also included here as a market barrier, since low usage rates make the lamp less cost-effective. Low usage lengthens the payback period, and consumers typically steeply discount future savings. In the presence of experiential barriers, low usage may tip a homeowner away from using a CFL if the electricity savings benefits do not outweigh the combined monetary cost of the lamp plus intangible issues such as lamp aesthetics, color rendering, flicker, and the hassle of choosing and installing a CFL.

Technical barriers were present for only a small number of fixtures. Either a CFL would not fit in the fixture, or the participant felt that a CFL was inappropriate due to frequent on/off cycling.

Among the other reasons for using incandescents was that the lamp was not chosen by the respondent (for example, a lamp that was already installed in a fixture when she moved into her home or apartment). In some cases, the choice of incandescent could be attributed to split incentives; that is, the lamp purchaser knew someone else would be paying the electric bills (as might be the case with a landlord-tenant situation). It could also be that the original purchaser faced barriers of one or more of the types already discussed, and the current occupant simply inherited their decision.

Conclusions

People have many diverse reasons for not being satisfied with CFLs in some applications and not installing them in all their fixtures. Many of these reasons are based on personal experience with CFLs and reflect the technological differences between incandescents and CFLs. CFLs take longer to warm up to full brightness than incandescents, particularly in cool temperatures. Compared to incandescents, CFLs have a much greater range of light color. Most customers are unaware that CFLs come in a range of light temperatures (warm to cool color), and even if they were, the rating scale for color temperatures is unfamiliar to most. Incandescents almost never flicker (and if they do, the problem is typically with the electricity supply). While most modern CFLs do not flicker at a rate that most people can perceive, flicker has been a problem in the past. Some purchasers have had CFLs fail prematurely; this can be frustrating when long life is one of their key selling points. Brightness issues, of course, can also occur with incandescents (e.g. installing a 60 W where a 100 W would be more appropriate). But unlike incandescents, the brightness of CFLs can vary significantly for the same wattage; purchasers must look for the "incandescent equivalent" information on the packaging. Even with this guidance, some respondents complained that in covered fixtures the "equivalents" on the packaging did not equate to equivalent performance.

Based on all these factors, when consumers buy or install a CFL, their odds of getting exactly what they expect is lower than for an incandescent. While some consumers readily adapt to the differences, others prefer the consistency and familiarity of incandescents. Choosing CFLs may be seen as risky, or as unnecessarily complex.

Inventory factors were also significant reasons why participants chose incandescents over CFLs. To those in the efficiency business, this looks like a case of penny wise, pound foolish. Respondents wanted to use up their store of incandescents, presumably because throwing them away seems wasteful, but that assessment of wastefulness ignores the higher life cycle costs of incandescents.

Some of the results regarding inventory issues seemed contradictory: many of the participants said that they installed an incandescent because it was what they had on hand, yet had CFLs in storage at the time of the survey.

Specialty CFLs face a number of barriers: Double market barriers in the form of spotty availability and high prices; information barriers, since many consumers do not know that CFLs exist for their chandeliers, dimmable, and 3-way fixtures; and experiential barriers, since consumers have not always been satisfied with the dimming performance of dimmable CFLs or the appearance of small-base CFLs in their chandeliers.

CFL technology has improved significantly since they were first introduced. But they represent a different technology, with different advantages and disadvantages compared to inandescents. All of the participants owned CFLs, and most expressed high levels of satisfaction, but almost all identified areas that they thought needed improvement. For these participants, at least, their relatively minor complaints seem to be outweighed by the benefits of CFLs (energy or environmental), at least for some of their lighting fixtures.

References

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