**Southwest Energy Efficiency Project**

*Saving Money and Reducing Pollution through Energy Conservation*

# Policies and Programs for Increasing the Adoption of High-Efficiency Lighting in Homes in the Southwest

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## Preface

This report on residential lighting policy and programs is one in a series of technical briefs prepared by the Southwest Energy Efficiency Project (SWEEP) in support of the U.S. Department of Energy's Building America Program. Its intended audience is energy efficiency policy makers and program managers in the southwest region. Feedback from all readers on the form and content of this report are welcome. A companion report, "Lighting Systems in Southwestern Homes: Problems and Opportunities," is aimed at builders and design professionals. It includes information on the energy and economic performance of different types of lighting devices in the southwest region. Both reports are available for downloading at www.swenergy.org.

## Introduction

Compact fluorescent lamps (CFLs) have become one of the most common and visible (no pun intended!) energy efficiency measures in the residential sector. CFLs have improved tremendously over the past 20 years. Manufacturers have reduced their size, improved color rendering, increased lifetime, and lowered first cost (Kinney 2005). Consumers can now purchase high quality CFLs for $2-8 each.[1] Since a CFL will last on the order of six to ten times longer than an incandescent lamp, this makes CFLs comparable to if not less expensive than incandescent lamps on a first cost basis alone. Because a high quality CFL consumes one-quarter as much electricity as an incandescent lamp for a given amount of visible light, consumers will save $40-60 on their electricity bills over the lifetime of the CFL. In addition, CFLs lower internal heat gains and thus air conditioning energy use and cooling costs in the relatively warm southwest region.

CFLs offer large energy savings potential when considered in the aggregate. For example, the most recent official electric power and conservation plan produced for the Northwest finds that CFLs used in the residential sector offer more achievable energy savings potential than any other efficiency measure considered. CFLs contribute 42% of the electricity savings in residential sector and 19% of all electricity savings in this 20-year regional plan. Moreover, CFLs provide energy savings at a levelized cost of just 1.7 cents per kWh according to the Northwest Power and Conservation Council (NPCC 2005).

In spite of these positive attributes, there are significant barriers to widespread use of CFLs in homes. Surveys conducted in the Pacific Northwest in 2002 and 2003 indicate that many consumers believe CFLs are still too expensive. Also, some consumers believe CFLs will not fit in common light fixtures, that their light color is poor, or that the bulbs are not bright enough (Grover, Graven, and French 2004). These attitudes may be due in part to experience with or impressions of older, poorer quality CFLs.

Some of the barriers to CFLs can be overcome by promoting ENERGY STAR® light fixtures for applications that require more light. Rather than relying on consumers to "retrofit" their existing sockets, these fixtures contain efficient light sources. While some include lamps that are similar to CFLs, others use lamps that have higher light output. One advantage to this approach is that it eliminates the "won't fit" and "isn't bright enough" barrier for some CFLs. Another advantage is that it provides long-term energy savings since the "snapback" effect (consumers reverting to incandescents when the CFL burns out) is eliminated.

Given the advantages of today's CFLs and ENERGY STAR qualified light fixtures, energy efficiency efforts including utility demand-side management (DSM) programs routinely promote and provide incentives for the adoption of these products in homes. This report reviews the state-of-the-art in promoting CFLs and energy-efficient light fixtures in the residential sector. It covers experience nationwide as well as in the

[1] Prices for CFLs are lowest when purchased in multi-packs, and higher when purchased individually.

Southwest states including labeling efforts, utility and other ratepayer-funded efficiency programs, regional initiatives, and the promotion of efficient lighting through building codes and "beyond code" homes programs. The report complements a previous SWEEP report on lighting technology and performance (Kinney 2005).

## Rating and Labeling

The federal ENERGY STAR® program covers CFLs as well as energy-efficient light fixtures. In order to qualify as an ENERGY STAR CFL, manufacturers must certify that a CFL meets minimum efficacy (lumens of light output per watt of power consumption), color-rendering, lumen depreciation, and lifetime requirements. In addition, manufacturers must provide a guarantee of at least two years. There are now over 1,600 qualified CFLs on the ENERGY STAR CFL product list.

On August 30, 2005, the U.S. Department of Energy issued draft revised specifications for ENERGY STAR CFLs. The revisions include higher efficacy requirements as well as more extensive lumen maintenance and color rendering requirements. In addition, reflector CFLs are included as a separate category with their own requirements including lifetime testing at an elevated temperature. More details about the CFL specifications and links to the product lists are available at http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.

Ensuring product quality is critical for increasing consumer acceptance of CFLs. A number of energy efficiency organizations, utilities, and government agencies are co-sponsoring independent testing to ensure that ENERGY STAR CFLs and light fixtures meet claimed specifications. Known as the Program for the Evaluation and Assessment of Residential Lighting (PEARL), this effort has resulted in some previously certified ENERGY STAR products being delisted. Lumen maintenance at 1000 hours and 40% of rated life have been most problematic, although performance of newer CFLs tends to be better than that of CFLs manufactured some years ago (Titus et al. 2005).

PEARL will continue in the short run with at least one more round of product testing.[2] But PEARL is being replaced by a manufacturer-funded, independent third party testing program for both CFLs and ENERGY STAR light fixtures. The new CFL testing program, to be sponsored by the U.S. Department of Energy, is included in the proposed program requirements for ENERGY STAR CFLs.

The ENERGY STAR program also covers energy-efficient light fixtures which are designed to accommodate CFLs. The program includes both indoor and outdoor fixtures. Indoor fixtures include wall-mounted, ceiling-mounted, recessed, suspended, and torchiere fixtures. There are nearly 10,000 qualifying ENERGY STAR light fixtures (visit http://www.energystar.gov/index.cfm?c=fixtures.pr_light_fixtures) as of September, 2005. These fixtures normally include hard-wired ballasts that accept pin-based CFLs. However, a new specification has been published that takes effect Oct. 1,

[2] For details about the next round of PEARL testing, contact Noah Horowitz at the Natural Resources Defense Council, San Francisco, CA. nhorowitz@nrdc.org.

2005. It requires all fixtures to contain electronic ballasts as well as other modifications. Many fewer light fixtures will qualify, and the performance of ENERGY STAR light fixtures will improve, once the new specification takes effect. The EPA anticipates that there will be approximately 6,000 qualified fixtures by the first quarter of 2006 (Banwell 2005). Many of these products are decorative fixtures for hallways, baths, and kitchen dining areas. Three manufacturers are also seeking ENERGY STAR qualification for fixture families (fixtures for the foyer, hall, bath, and dining areas of all the same style). Fixture families are primarily sold to new construction projects.

Ceiling fans are a third area covered by the ENERGY STAR lighting program. ENERGY STAR ceiling fans have improved motors and blade designs. In addition, all integral and attachable light kits must meet the ENERGY STAR light fixture specification, meaning CFLs must be used. As of September 2005, there were only 22 ceiling fans with light kits and 37 separate light kits listed on the ENERGY STAR web site. But more qualifying products are under development. See http://www.energystar.gov/index.cfm?c=ceiling_fans.pr_ceiling_fans.

## Utility and other Ratepayer-Funded Incentive and Promotion Programs

### *Incentive and Promotion Programs*

Many utilities and third-party program administrators offer financial incentives to encourage greater adoption of CFLs and CFL-based light fixtures. Most CFL incentive and promotion programs use the ENERGY STAR certification to determine qualifying products. The Consortium for Energy Efficiency periodically publishes a summary of residential lighting programs sponsored by its members. The most recent summary covers 18 programs implemented by utilities, third-party program administrators, and governmental entities (see http://www.cee1.org/resid/rs-lt/04rs-lt-progsum.pdf).

Many programs feature instant rebates or coupon-based in-store discounts for consumers who purchase energy-efficient lighting products. For example, the investor-owned utilities in California offer incentives of $1.00-$2.50 per ENERGY STAR CFL, depending on lamp size (i.e., light output), $5-10 per ENERGY STAR fixture, and $10 per ENERGY STAR torchiere. In addition, the California utilities urge manufacturers and retailers to offer further discounts during special promotions throughout the year. Other utilities such as the Long Island Power Authority and the Bonneville Power Administration offer higher rebates on ENERGY STAR light fixtures and torchieres, in the range of $10-30 per fixture. Experience shows that consumers prefer instant rebates (or coupon-based discounts) compared to mail-in rebates.

CFL rebates have declined in magnitude in recent years as the price of CFLs has dropped. For example, rebates provided by utilities in the Northeast, which are coordinated by the Northeast Energy Efficiency Partnership, dropped from $10 in 1998 to $3 in 2002. As of 2005, most energy efficiency program providers in the Northeast were offering incentives of $2.00 or less per CFL (Granda 2005). In addition, some Northeast utilities have transitioned from constantly available rebates to targeted, limited duration

incentives, in conjunction with expanded co-promotions with retailers and manufacturers (York and Kushler 2003).

Partnering and coordination are key attributes of the most successful lighting incentive programs. One way this occurs is by specifying that qualifying products must be ENERGY STAR-labeled. In some cases programs are coordinated with the national "Change a Light, Change the World" campaign. This campaign, organized by the U.S. EPA, occurs for two months every fall. The program includes intensive cooperative advertising as well as temporary discounts offered by some energy efficiency programs.

Successful programs actively partner with retailers and in some cases manufacturers of energy-efficient lighting products. Partnering with retailers is critical to ensure adequate product supply, sales staff training, cooperative advertising, and in-store marketing and promotion. However, providing support to both large and small retailers can be costly and time-consuming (Quantum Consulting 2004a). Consequently, some programs prefer to work with major "big box" retailers such as Costco, Home Depot, and Lowes (Fulbright, Jacobs, and Calwell 2003). On the other hand, working with smaller retailers such as neighborhood grocery and hardware stores can be useful for increasing participation by non-English-speaking and other hard-to-reach consumers. Lighting showrooms also provide an important channel for promoting ENERGY STAR fixtures and reaching new construction markets (Marshall, Simmons, and Williamson 2004).

Some programs pay incentives to manufacturers in order to reduce the wholesale price of ENERGY STAR lamps and/or light fixtures in a particular market, and subsequently the retail price. This means coupons and rebates can be avoided, making it easier for retailers as well as consumers to participate. Know as an "upstream buy-down," this approach can provide greater leveraging in situations where program resources are limited. However, program planning and evaluation can be more complicated than is the case with consumer rebates or coupons.

Effective impact and process evaluation is another attribute of the most successful residential lighting incentive programs. Most programs undertake telephone and/or on-site surveys in order to estimate level of installation, level of utilization, persistence of CFLs, and level of "free riders" and "free drivers."[3] In some cases, light usage is monitored in a sampling of households to get a more accurate estimate of average hours of use (Vine and Fielding 2005). The data collected is used to estimate average energy savings per lamp or fixture, net-to-gross energy savings for the program as a whole, and other parameters. Also, impact and process evaluations are useful for improving program design and implementation.

Table 1 compares the outcomes of "best practice" residential lighting programs implemented during 2000-02, as indicated by the energy efficiency best practices web

[3] "Free riders" are program participants who would have purchased and installed an energy efficiency measure in the absence of the program. "Free drivers," also known as spillover effect, are purchases and use of energy efficiency measures indirectly stimulated by a program; e.g., consumers who purchase additional CFLs on their own after getting acquainted with them through an energy efficiency program.

site. All of the programs had a benefit-cost ratio of at least 1.5 using the Total Resource Cost (TRC) or Societal Test. These programs employed different approaches ranging from year-round incentives and intensive marketing, to short-term discounts and marketing during the national "Change a Light" campaign, to promotion-only efforts. Because the first cost of CFLs and other energy-efficient lighting products has been decreasing over time, the cost effectiveness of residential lighting programs should be even better today than it was in 2000-02.

**Table 1 – Examples of Successful Residential Lighting Programs**

| | California IOUs statewide program | Efficiency Vermont | Mass. Electric Co. | Midwest Energy Efficiency Alliance | Northwest Energy Efficiency Alliance | United Illuminating Co. (CT) |
|---|---|---|---|---|---|---|
| Implementation period | 2002 | 2002 | 2002 | Fall 2002 | 2001 | 2000-2001 |
| Program expenditures (million $) | 9.4 | 1.6 (2) | 3.3 | 0.6 | 2.6 | 1.5 |
| Incentive payments (million $) | 7.3 | 0.65 | 2.2 | 0.3 | -- | 0.64 |
| Net energy savings (GWh/yr) | 163 | 11 | 18 | 10 | 271 | 8 |
| Net-to-gross energy savings | 0.80 | 1.27 | NA | NA | NA | 0.57 |
| Benefit-cost ratio (1) | 3.5 | 2.3 | 2.4 | 8.3 (3) | 1.6 | 1.8 |

(1) Measured using either the Total Resource Cost of Societal benefit-cost test.
(2) Includes some expenditures on non-lighting products.
(3) The very high benefit-cost ratio for the Midwest Energy Efficiency Alliance (MEEA) programs is due to shortcomings in the way this program estimates cost effectiveness; see discussion under Market Transformation below.

Source Quantum Consulting Inc. 2004a.

In the Southwest, the investor-owned utilities in Nevada (Nevada Power Company and Sierra Pacific Power Company) promote ENERGY STAR CFLs and light fixtures as part of their DSM programs. During 2003, the utilities educated consumers and retailers, and sponsored periodic "buy 1, get 1 free" events. Starting in 2004, the utilities employed upstream buy-downs (incentives paid directly to manufacturers). These incentives averaged about $2 per lamp in 2004 and $1.73 in 2005. The utilities estimate they saved 2.29 GWh/yr through more efficient lamps and fixtures adopted in 2003 and 4.12 GWh/yr through measures adopted in 2004 (Holmes 2005). CFLs provided 98% and ENERGY STAR fixtures 2% of the total savings over the past three years.

In Arizona, the Arizona Public Service Co. (APS) developed an upstream buy-down program which they plan to implement starting in the latter part of 2005.[4] APS will solicit discount pricing for CFLs and provide incentives to manufacturers and retailers for doing so. Consumers will be referred to participating retailers, and qualifying products will be prominently displayed and promoted. APS plans on spending $5.1 million on this program over a three-year period, and expects to save 93 GWh/yr by the end of this period. The estimated benefit-cost ratio is 2.8 using a Societal Cost test, which is the approved cost effectiveness test in Arizona.

In California, a multi-year effort was undertaken starting in 1999 to increase the adoption of CFLs and ENERGY STAR fixtures. This effort included building retailer infrastructure, training sales staff, in-store promotion, cooperative advertising, manufacturer buy-downs, and instant rebates for consumers. In addition, the 2001 electricity crisis, rising electricity prices, and a massive statewide energy conservation campaign provided "a confluence of factors at the right time and place to drive an unprecedented market outcome" (Calwell et al. 2002). Over 7 million CFLs were sold in California in 2001 through utility programs alone, a five-fold increase from the previous year (see Table 2). In addition, another 1.9 million CFLs were distributed in a door-to-door giveaway campaign in low-income neighborhoods (Rasmussen, McElroy and Rubin 2002).

**Table 2 – Annual Sales of Screw-Based Lamps per Household**

| | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| **U.S. other than CA CFL** | 0.060 | 0.172 | 0.236 | 0.302 | 0.273 |
| **U.S. other than CA Incandescent** | 13.292 | 12.743 | 12.365 | 11.919 | 11.417 |
| **California CFL** | 0.101 | 0.497 | 0.381 | 0.402 | 0.447 |
| **California Incandescent** | 10.058 | 8.031 | 8.121 | 7.803 | 7.456 |

Source: Pulliam 2004.

Nationwide, CFL sales have increased dramatically in recent years. It is estimated that sales of CFLs have increased by a factor of four between 1999 and 2001 alone (Faesy et al. 2004). This is attributed to several factors: improving products, declining CFL prices, and increased support by utility and other energy efficiency programs. CFL sales nationwide have continued to increase since 2001, although sales in California declined somewhat after that year (see Table 2). ENERGY STAR-qualifed fixtures sales have doubled since 2000, and now comprise about 4% of all fixtures sold nationally (Banwell 2005). At the same time, sales of incandescent lamps nationwide are declining.

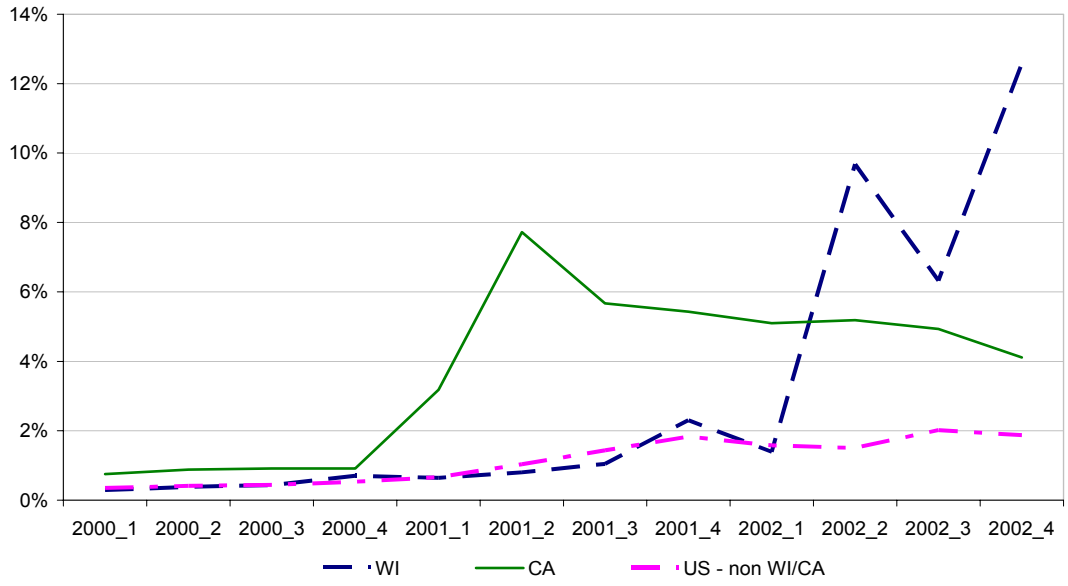
The market share of CFLs in a few states that have had especially active and successful utility or statewide programs far exceeds the market share in other states. Figure 1 shows estimates of the market shares for screw-based CFLs as a fraction of total

[4] This program was approved by the Arizona Corporation Commission in August, 2005.

residential lamp sales in California, Wisconsin, and the other 48 states during 2000-2002. Due in part to very effective incentive and promotion efforts, the market share in California in 2001-02 and in Wisconsin starting in 2002 was several times higher than the market share in other states.

With the continuation of utility incentive and promotion programs, the market share for screw-based CFLs continues to be much higher in California than for the rest of the country. In 2004, CFLs accounted for 6-7% of all medium screw-based lamps sold in Cailifornia, compared to 2.5% for the rest of the country (Pulliam 2004). It should be noted that "the rest of the country" includes regions such as the Northwest, Wisconsin, and Northeast with active incentive and promotion programs, as well as regions without such efforts.

**Figure 1 – Comparison of Screw-Based CFL Sales in California, Wisconsin, and the Rest of the United States, Market Share in 2000-2002 by Quarter (Fields et al. 2003)**




In Wisconsin, it is estimated that 1.5 million CFLs were sold between July, 2001 and December, 2002. Approximately 77% of these were attributed to the statewide program and 23% to baseline sales (Fields et al. 2003). The statewide program included consumer incentives, cooperative advertising with retailers, in-store promotions, and other retailer support.

Even though California and Wisconsin implemented very successful CFL incentive and promotion programs in recent years, the residential lighting market in these states is far from transformed. A survey of nearly 22,000 households in California in 2003 found that 51% of all dwellings had at least one CFL. One or more CFLs were used in 57% of owner-occupied homes but only 40% of rental units (CEC 2004).[5] A more recent on-site survey of 850 households in California, conducted in late 2004 and early

[5] Unfortunately, the national residential survey administered by the Energy Information Administration does not collect data on CFL usage.

2005, found that 57% of homes used at least one CFL and nearly 9% of all lamps in use were CFLs (RLW Analytics 2005).[6] In addition, while consumer acceptance and sales of ENERGY STAR-qualifed light fixtures is increasing rapidly, only about 35,000 ENERGY STAR light fixtures were sold during 1999-2004 (Banwell 2005).

***Giveaway Programs***

Some utilities have used free distribution of CFLs (giveaways) as a way to educate consumers, save significant amounts of electricity, and do so cost effectively. CFLs are purchased in bulk and distributed free of charge to targeted households.

Seattle City Light (SCL), a large municipal utility, offered "conservation kits" that included two CFLs to all of its residential customers in 2001. The goals of the program were to increase customer awareness and use of newer CFLs, increase demand and retail sales of CFLs, acquire cost-effective conservation resources, and improve public relations. Conservation kits included the CFLs, bathroom faucet aerators, and a water flow measurement device. Customers requested the kit by returning a reply postcard included in a mail solicitation. Kits were requested by 178,500 households, 57% of all residential customers at the time of the solicitation.

A follow-up survey indicated that about 94% of the CFLs were installed within six to eight months of kit delivery, with two-thirds of participants trying a CFL for the first time (Tachibana and Brattesani 2003). Self-reported "free riders" accounted for about 11% of the observed energy savings, leading to 16.3 GWh/yr of net energy savings from use of CFLs in the kit (see Table 3). But 30% of households that requested the kit purchased additional CFLs—four on average. Based on a survey asking consumers how much the kit influenced their additional CFL purchases, this spillover effect was estimated to provide 9.1 GWh/yr of electricity savings. The total savings of 25.4 GWh/yr was equivalent to about 1% of SCL's residential electricity sales.

**Table 3 – CFLs Distributed and Energy Savings from the Seattle City Light Conservation Kit Program**

| | Number | Energy savings (GWh/yr) |
|---|---|---|
| Delivered kits | 178,481 | -- |
| CFLs installed immediately | 285,570 | 19.5 |
| CFLs installed in 6-8 months | 49,758 | 2.7 |
| Gross program effect | 335,328 | 18.3 |
| Estimated free rider effect | (35,696) | 1.9 |
| Net effect from kits | 299,632 | 16.3 |
| Estimated spillover effect | 166,418 | 9.1 |
| Overall program effect | 466,050 | 25.4 |

Source: Tachibana and Brattesani 2003.

[6] This study found that the average wattage for incandescent lamps is 64 watts, while the average wattage for CFLs is 18 watts. In addition, homes had a total of 41 lamps on average.

The spillover effect from the giveaway program, along with a subsequent retail coupon discount program, contributed to a big increase in retail sales of CFLs in the Seattle area. Retail sales increased more than ten-fold from approximately 21,000 in 2000 to 227,000 in 2001. This increase in sales was also influenced by the western energy crisis and regionwide ENERGY STAR product promotions (Tachibana and Brattesani 2003).

This energy efficiency program was very cost effective for SCL and its customers. Kits were delivered for a total cost of about $16 each, including measures, promotion, and fulfillment. SCL's levelized cost was estimated to be about 1.8 cents per kWh saved, significantly below the projected cost when the program was designed and about one-quarter as much as SCL's cost for supplying electricity at the time (Tachibana and Brattesani 2003). Spillover purchases were also very cost effective. Moreover, participants indicated a high level of satisfaction with the bulbs.

In the Southwest, Utah Power implemented a CFL giveaway program in 2001-2002. Customers were offered two free 20-watt ENERGY STAR CFLs and could request them by returning a reply card, calling a toll-free number, or enrolling via a Web site. Nearly half of the 580,000 eligible households requested bulbs.

A follow-up phone survey conducted in early 2003 indicated that 74% of CFLs were installed at the time of the survey, with most participants indicating they still intended to install the remaining bulbs. The reported average use was 6.3 hours per day, significantly greater than the original estimate. Based on this level of usage, energy savings was estimated to equal about 116 kWh/yr per bulb. Approximately 30% of surveyed participants purchased at least one additional CFL, and half indicated the purchase was influenced by the giveaway program. Also, the number of free riders was assumed to be neglible. Based on this information, it was estimated that the program saved 48.5 GWh/yr directly and 61.1 GWh/yr including the spillover effect (Khawaja, Dimetrosky and Williams 2003).

This program cost Utah Power $7.15 per CFL distributed. Including the participant costs associated with additional bulbs purchased, the program had a total cost of $5.3 million and provided utility system benefits of $6.5 million, meaning a benefit-cost ratio of 1.22 using the Total Resource Cost test (Khawaja, Dimetrosky and Williams 2003). However, this analysis assumed relatively low utility avoided costs based on market conditions in 2002. With the higher natural gas prices that prevail today (and that are expected to continue in the future), the program would be even more cost effective.

CFL giveaways are included in a growing number of weatherization programs for low-income households. These programs frequently install two or three CFLs in heavily used light sockets. But some programs have found it worthwhile to install a larger number of CFLs. For example, a program in Ohio installed 15 CFLs on average in high electricity use households and 12 CFLs on average in moderate use households. Regression analysis estimated savings of 43 kWh per year per bulb on average in spite of the large number of lights that were retrofitted (Blasnik, Berger, and Lenahan 2005).

## Regional Market Transformation

In 1997, the Northwest Energy Efficiency Alliance (NEEA) launched a multi-year effort to transform the residential lighting market in Oregon, Washington, Idaho, and Montana. NEEA is increasing ENERGY STAR CFL and fixture availability throughout the region, training sales staff, providing in-store promotional materials, co-funding cooperative advertising, and educating consumers in other ways (CEE 2005). Activities are tailored to different types of vendors including do-it-yourself stores, hardware stores, mass merchandisers, and lighting specialty stores.

It is estimated that only about 380,000 CFLs were sold in the northwest region in 2000. During the western energy crisis in 2001, utilities in the Northwest provided coupons worth $5 to $6 per lamp in combination with NEEA's market transformation efforts. CFL sales jumped to about six million units in 2001, with about 40% of those purchased using discount coupons (Grover, Graven and French 2004). Coupons were discontinued after the first quarter of 2002 but NEEA's market transformation and consumer education efforts helped to maintain relatively strong ENERGY STAR CFL sales. It is estimated that 3.8 million units were sold in 2003 and over 5 million units in 2004 (CEE 2005). NEEA's goal is to increase region-wide sales of ENERGY STAR CFLs to 9 million per year by 2010.

NEEA spent about $1 million promoting ENERGY STAR lighting in 2004 (Sanders 2005). The additional 1.2 million CFLs sold in the region in 2004 compared to the previous year yielded about 47 GWh/yr of electricity savings.[7] The estimated benefit-cost ratio for this program was 2.3 in 2004 based on the Total Resource Cost (TRC) test, which includes participant and program costs (NEEA 2005). Furthermore, the estimated benefit-cost ratio for NEEA's residential lighting program increased year-to-year during 2001-04 due to CFLs declining in price and the program becoming more effective.

Surveys conducted in the Northwest show relatively high satisfaction with CFLs although considerable work is still needed to "transform the market." About 80% of CFL purchasers in 2001-2003 were very satisfied or somewhat satisfied with their bulbs. Likewise, about 82% of bulbs were still in use one year after purchase. However, surveys also indicate that 70% of CFLs are being replaced with incandescent lamps when the CFL burns out (Grover, Graven and French 2004). In addition, a survey carried out in 2004 indicated that 32% of households in the Northwest states were still unaware of CFLs (Rasmussen, Goepfrich, and Horkitz 2005).

The Midwest Energy Efficiency Alliance (MEEA) operates an ENERGY STAR CFL incentive and promotion effort in conjunction with EPA's "Change a Light, Change the World" campaign. This coordinated effort involves CFL manufacturers, retail sponsors, state agencies, and utilities. The 2004 program stimulated the purchase of 305,441 CFLs in five states during the fall campaign period (MEEA 2005).

[7] This estimate assumes about 39 kWh/yr of electricity savings per CFL based on a retrospective third-party savings evaluation

MEEA implemented the program in 2004 by first hiring a contractor (the Wisconsin Energy Conservation Corporation—WECC). MEEA and WECC issued an RFP to manufacturers and retailers. The Ace Hardware Corporation and General Electric (GE) were selected as the primary retailer and manufacturer partners. The program combined discounts provided by GE and retailers on three different CFLs (15, 20 and 36 watt models). The state or utility efficiency program contributed $1.50 and GE contributed $0.55 per CFL (see Table 4). This reduced the reduced the final price to the purchaser to $0.99-1.70 per bulb, with the retailer receiving $2.99-3.79. MEEA and its lead contractor assisted with promotional materials, cooperative advertising, retailer training, press events, and fulfillment of the instant rebate.

**Table 4 – 2004 Change A Light, Change the World Campaign Implemented by the Midwest Energy Efficiency Alliance**

| CFL Wattage | Suggested Retail Price | Instant Rebate Amount | State/Utility Contribution | Manufacturer Contribution | Price to Consumer |
|---|---|---|---|---|---|
| 15 W | $2.99 | $2 | $1.50 | $0.55 | $0.99 |
| 20 W | $3.49 | $2 | $1.50 | $0.55 | $1.49 |
| 26 W | $3.79 | $2 | $1.50 | $0.55 | $1.79 |

Source: MEEA 2005.

MEEA indicates that the 2004 program will provide $9.6 million in economic benefits for consumers (net present value of electricity savings) while the sponsors contributed only $772,000, resulting in a benefit-cost ratio of 12.5 (MEEA 2005). However, this economic analysis ignores the financial contributions of the manufacturer, retailers, and consumers. Also, it does not take into account bulbs that are not used or used temporarily, free riders, and any spillover effect. While a more sophisticated program evaluation is warranted, it is still likely that the MEEA approach is a cost-effective means of stimulating greater CFL adoption and electricity savings. But it is not clear if the program is truly transforming the market for CFLs in the Midwest given its focus on a limited number of retailers and products.

Torcheire turn-in events are also an attractive, relatively simple way to not only drive the sale of new high-efficiency portable fixtures, but also assure the removal of energy-intensive halogen portable fixtures from the grid. These events, sponsored by efficiency groups across the country, have demonstrated the ability to drive sales of hundreds of ENERGY STAR qualified torchiere fixtures over the course of a single weekend (Banwell 2005).

## Building Codes and Other New Construction Programs

Building energy codes traditionally do not place any restrictions on the number or energy performance of lighting devices that a builder installs in a new single family home. However, this situation is changing. New residential energy codes adopted in California in 2004 include important lighting energy standards. These new building

codes, known as the Title 24 standards, take effect statewide on October 1, 2005.[8]

The new standards require that at least 50 percent of lighting wattage in kitchens be "high efficacy." Lighting in bathrooms, garages, laundry rooms, and utility rooms must be high efficacy or be controlled by a dimmer switch. Also, permanent outdoor lighting must be high efficacy or controlled by a motion sensor or photosensor. High efficacy in the new standard is defined as a minimum of 40 lumens per watt for lamps/fixtures 15 watts or less, a minimum of 50 lumens per watt for lamps/fixtures 15 to 40 watts, and a minimum of 60 lumens per watt for lamps/fixtures over 40 watts. Virtually all pin-based CFLs (and no incandescents) will qualify. In addition, the new standard requires that recessed luminaries be air-tight.

These standards should result in a significant reduction in electricity use for lighting in new homes. Assuming that builders comply and that homeowners accept the more energy-efficient fluorescent lighting, California's lighting standards could be emulated by other jurisdictions and eventually be incorporated into the national model energy code.

The national ENERGY STAR new homes program encourages use of energy-efficient lighting but has not required efficient lighting in order for a home to qualify. However, this is starting to change as well. The U.S. EPA has issued new qualification requirements that take effect in 2006. The new requirements allow builders to qualify a home by meeting either prescriptive or performance-based specifications. The prescriptive requirements, called the Builder Option Package, require five or more ENERGY STAR light fixtures, ceiling fans equipped with light fixtures, and/or appliances. ENERGY STAR light fixtures installed in storage rooms or garages would not count towards compliance. This provision should stimulate greater adoption of ENERGY STAR light fixtures and ceiling fans in new homes.

The specification also states that the EPA will propose adding the ENERGY STAR Advanced Lighting Package (ALP) as a requirement in the prescriptive path starting in 2009. The ALP is now recommended to builders and consumers, but is not required in ENERGY STAR new homes. It calls for ENERGY STAR fixtures comprising at least 50% of fixtures in high-use rooms (kitchen, dining room, living room, family room, bathrooms, halls, and stairways) as well as outdoor lighting except landscape or solar lighting. In addition, it calls for ENERGY STAR fixtures comprising at least 25% of fixtures in medium and low-use rooms.

More details about the ALP and case studies of housing developments that have incorporated it are provided on the EPA ENERGY STAR new homes web site, http://www.energystar.gov/index.cfm?c=fixtures.alp_consumers. For example, D.R. Horton is distinguishing itself from the competition by including all ENERGY STAR fixtures in its Sierra Valley Oaks development in Sacramento, CA. According to Rich Coyle from D.R. Horton, "We haven't had to 'sell' the ENERGY STAR lighting to customers, the lights sell themselves! The fixtures are very attractive and the lighting

[8] See www.energy.ca.gov/Title24/2005standards/index.html

quality is very good." D.R. Horton includes ENERGY STAR fixtures and energy efficiency as part of its marketing message, and it has had a positive effect on sales.

EPA reports that during 2004-2005, 25 builders, including some large national builders, have committed or installed the ALP in over 730 homes. Most of these builders are located in California, Colorado, New England, and the Pacific Northwest. Several of these builders have regional operations in the Southwest (Banwell 2005).

While there are examples of builders utilizing ENERGY STAR fixtures to a high degree, the reality is that this has been a tough sell. Utility and other energy efficiency programs have had limited success with incentives and promotion of ENERGY STAR fixtures, both to builders and in the replacement market. For example, the California statewide residential lighting program provided incentives for over 3.5 million CFLs in 2002 but only about 30,000 ENERGY STAR fixtures and torchiere lamps (Quantum Consulting 2004b).

Because of the limited acceptance of ENERGY STAR fixtures, some programs such as the Massachusetts and NEEA ENERGY STAR homes programs now promote use of either screw-based CFLs or ENERGY STAR fixtures in new homes. This has led to greater energy savings compared to promoting ENERGY STAR fixtures alone, although persistence of energy savings is much more uncertain with CFLs (Faesy et al. 2004). In general, there are appropriate applications for CFLs, ENERGY STAR fixtures, and linear fluorescent lamps in new homes. This potential is exemplified in a new home being built by energy efficiency expert Chris Granda and his wife in Vermont. Fluorescents account for 43 out of 44 lights installed in this energy-efficient dwelling (see Table 5).

**Table 5 – Lights Used in the Granda Home in Vermont**

| Light Type | Locations | Number |
|---|---|---|
| Linear fluorescents | Basement, storage rooms, kitchen pantry, kitchen undercabinet, bathrooms, sun room | 19 |
| Compact fluorecents | Halls, stairs, exterior fixtures, kitchen, entrance area | 18 |
| ENERGY STAR fixtures | Bedrooms, bathrooms, utility room | 6 |
| Halogen | Dining room | 1 |

Source: Granda 2005.

## Conclusion and Recommendations

Experience in California, Wisconsin, and elsewhere has demonstrated that well-designed utility incentive and promotion programs can greatly increase the purchase and use of CFLs in the residential sector. In addition to providing incentives directly to consumers or indirectly through upstream buydowns, successful programs actively partner with retailers in order to ensure adequate product supply, train sales staff and provide in-store promotional materials, and share advertising costs.

CFL giveaway programs can be an effective way to rapidly expand CFL awareness and use, and achieve large amounts of electricity savings. Experience in both Seattle and Utah has demonstrated that one-time CFL giveaway programs can be cost effective from a total resource cost perspective; i.e., the avoided utility system costs exceed the costs for the CFLs and programs administration. In addition, a carefully designed CFL giveaway program can lead to increased retail sales.

Experience in California and the Northwest has shown that multi-year efforts can be very effective. NEEA in particular has succeeded in stimulating a relatively robust and growing demand for CFLs in the Northwest without financial incentives. This has been accomplished through years of retailer support and consumer education. Nonetheless, more work needs to be done increase the penetration of CFLs everywhere, and to ensure that consumers continue to use them especially once an existing CFL burns out.

In contrast to CFLs, utilities and other energy efficiency program administrators have had more limited success promoting and providing incentives for ENERGY STAR light fixtures. The national ENERGY STAR homes program is attempting to increase use of ENERGY STAR fixtures as is the new building energy code in California. These efforts should be supported and followed closely. However, from the point of view of maximizing energy efficiency and energy savings, it may be advantageous to promote both screw-based CFLs and ENERGY STAR fixtures in new homes. The new ENERGY STAR homes program specification permits either CFLs or ENERGY STAR fixtures for its performance compliance path, but only ENERGY STAR fixtures for the prescriptive compliance path.

CFLs and fixtures designed to use them can provide substantial electricity savings and do so very cost effectively. Large-scale residential CFL programs in various regions have achieved a benefit-cost ratio of at least 2-to-1. Given that the price of CFLs has fallen while the price of electricity is rising, new programs are likely to be even more cost effective than those implemented a few years ago.

This experience leads to the following recommendations for residential lighting programs in the southwest region:

1) **Actively promote and provide incentives to increase the purchase and use of CFLs and ENERGY STAR light fixtures.** Promotion should include in-store display materials, sales staff training, and cooperative advertising. Incentives can take the form of either instant rebates for consumers or upstream buy-downs. Make a multi-year commitment to develop both the supply of and demand for CFLs and ENERGY STAR fixtures, with incentives for CFLs in particular ramping down over time.

2) **Recognize that CFLs and light fixtures are sold through different market channels and require different program approaches.** CFLs can be promoted directly to consumers through retailers of various types. Fixtures efforts should focus

on unique opportunities such as new construction, renovation, and fixture replacement, i.e., targeting lighting distributors and showrooms, builders, and contractors. If feasible, implement separate programs for CFLs and light fixtures.

3) **Consider sponsoring a one-time CFL giveaway program.** This can be especially valuable at the time a new energy efficiency effort is launched. But complement a giveaway with sales promotion and store-based incentives to maximize retail sales and market development.

4) **Contribute to quality assurance efforts.** Energy efficiency programs in the southwest region should consider co-sponsoring the PEARL effort as long as it continues. It is expected that PEARL will be replaced by a manufacturer-funded but independent third party testing program in the near future.

5) **Educate builders and encourage the use of ENERGY STAR fixtures and high quality CFLs in new housing.** Promote the ENERGY STAR Advance Lighting Package, provide incentives for ENERGY STAR homes that meet this specification, and encourage use of efficient lighting in all new homes; i.e., non-ENERGY STAR as well as ENERGY STAR homes. Emphasize ENERGY STAR light fixtures since they will provide longer term energy savings than CFLs alone.

6) **Consider adding lighting efficiency requirements to residential building energy codes.** Observe how the implementation of this requirement in California plays out and replicate California's pioneering lighting standard if it proves to be successful.

7) **Maximize lighting efficiency in low-income households.** Lower income households base their buying decisions heavily on first cost. Weatherization programs often replace several incandescent lamps in low-income households with CFLs. However, it may be feasible to replace 15 or more incandescents with CFLs during the retrofit process.

8) **Carefully evaluate residential lighting programs.** It is important to conduct surveys and field measurements to check the level of CFL utilization, persistence of CFL use, and general consumer satisfaction. In addition, evaluations of major energy-efficient lighting programs should take into account estimates of both free riders and free drivers (spillover effect).

9) **Last but not least, strive for market transformation over the long run.** This means a situation whereby CFLs and energy-efficient light fixtures are widely available and marketed, most consumers are aware of their characteristics and benefits, and consumers routinely buy CFLs without financial incentives.

## References


Banwell, P. D. 2005. Personal communication with Peter Banwell, U.S. EPA, Washington, DC, September 16.

Blasnik, M., J. Berger, and T. Lenahan. 2005. "Low-Income Electric Usage Reduction." In *Proceedings of the 2005 International Energy Program Evaluation Conference.* pp. 375-386. Brooklyn, NY, August.

Calwell, C., J. Zugel, P. Branwell, and W. Reed. 2002. "2001-A CFL Odyssey: What Went Right?" In *Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings*. pp. 6.15-27. Washington, DC: American Council for an Energy-Efficient Economy.

CEC. 2004. *California Statewide Residential Appliance Saturation Study.* Report 400-04-009. Sacramento, CA: California Energy Commission.

Faesy, R, C. Granda, J. Pratt, and M. McNally. 2004. "Screw-Based CFLs or Pin-Based Fluorescent Fixtures: Which Path to Greatest Lighting Energy Savings in Homes?" In *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*. pp. 2.69-78. Washington, DC: American Council for an Energy-Efficient Economy.

Fields, A., R. Harcharik, J. Holmes, S. Feldman, R. Winch, and R. Pulliam. 2003. "CFL Market Penetration Using Point-of-Sales Data—Regional Perspectives." In *Proceedings of the 2003 International Energy Program Evaluation Conference.* pp. 571-580. Seattle, WA, August.

Granda, C. 2005. Personal communication with Chris Granda, Vermont Energy Investment Corporation, Burlington, VT, October 2005.

Grover, S., P. Graven, and E. French. 2004. "Consumer Preferences for CFLs over Time: Where Are We Going." *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*. pp. 2.128-139. Washington, DC: American Council for an Energy-Efficient Economy.

Holmes, L. 2005. Personal communication with Larry Holmes, Nevada Power Company, Las Vegas, NV, April 22.

Kinney, L. 2005. *Lighting Systems in Southwestern Homes: Problems and Opportunities*." Boulder, CO: Southwest Energy Efficiency Project. June.

Khawaja, M.S., S. Dimetrosky, and H. Williams. 2003. *Utah Compact Fluorescent Light Bulb Program*. Report prepared by Quantec, LLC for Utah Power. Salt Lake City: Utah Power.

Marshall, B., B. Simmons, and P. Williamson. 2004. "Shining the Spotlight on Fixtures: Showcasing Showrooms to Increase Market Penetration of ENERGY STAR Light Fixtures." In *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*. pp. 6.240-251. Washington, DC: American Council for an Energy-Efficient Economy.

MEEA. 2005. *Midwest Energy Efficiency Alliance 2004 Change A Light, Change the World Campaign Summary Report, Results and Lessons Learned*. Chicago, IL: Midwest Energy Efficiency Alliance. www.mwalliance.org/programs/changealight/CAL04FinalReport.pdf

Pulliam, R. 2005. *California Lamp Report 2004*. Report prepared by Itron, Inc. for Southern California Edison. San Diego, CA: Itron, Inc. June 15.

Quantum Consulting. 2004a. *National Energy Efficiency Best Practices Study. Volume R1-Residential Lighting Best Practices Report* . Berkeley, CA: Quantum Consulting Inc. http://www.eebestpractices.com/pdf/BP_R1.PDF

Quantum Consulting. 2004b. National Energy Efficiency Best Practices Study. Summary Profile Report – California Statewide Residential Lighting Program. Berkeley, CA: Quantum Consulting Inc. http://www.eebestpractices.com/pdf/SummaryProfileReport_R14.PDF

Rasmussen, T., K. McElroy, and R. Rubin. 2002. "Mass Deliveries of Compact Fluorescent Lamps (CFLs) as a Response to the Energy Crisis: Evaluation of California's 2001 CFL Programs." In *Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings*. pp. 10.247-258. Washington, DC: American Council for an Energy-Efficient Economy.

Rasmussen, T., V. Goepfrich, and K. Horkitz. 2005. "Drivers of CFL Purchase Behavior and Satisfaction: What Makes a Consumer Buy and Keep Buying?" In *Proceedings of the 2005 International Energy Program Evaluation Conference.* pp. 897-908. Brooklyn, NY, August.

RLW Analytics 2005. *2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study*. Sonoma, CA: RLW Analytics. August 23.

Sanders, M. 2005. Personal communication with Marci Sanders, Northwest Energy Efficiency Alliance, Portland, OR, August 23.

Tachibana, D.L.O. and K.A. Brattesani. 2003. "Seattle's Conservation Kit Program—Transforming the Residential Use of Compact Fluorescent Lighting." In *Proceedings of the 2003 International Energy Program Evaluation Conference.* pp. 949-964. Seattle, WA, August.

Titus, E., G. Reed, N. Horowitz, and C. Granda. 2005. “Pearls of Wisdom: Assuring Efficient Lighting Product Quality and Program Integrity.” In *Proceedings of the 2005 International Energy Program Evaluation Conference.* pp. 859-869. Brooklyn, NY, August.

Vine, E. and D. Fielding. 2005. “An Evaluation of Residential CFL Hours-of-Use Methodologies and Estimates: Recommendations for Evaluators and Program Managers.” In *Proceedings of the 2005 International Energy Program Evaluation Conference.* pp. 835-846. Brooklyn, NY, August.

York, D. and M. Kushler. 2003. *America’s Best: Profiles of America’s Leading Energy Efficiency Programs*. Washington, DC: American Council for an Energy-Efficient Economy.