2001—A CFL Odyssey: What Went Right?

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ABSTRACT

After years of steady but unremarkable sales increases, compact fluorescent lamp (CFL) sales soared in the U.S. in 2001. Relative to 2000 levels, national retail sales more than doubled, California sales increased by more than four times, and Northwest sales by roughly 10 times.

Why did this happen in such a short period of time? What lessons does it offer for future efforts to transform the markets for residential lighting and other energy efficient products? This paper examines a number of drivers for higher CFL sales and whether their impacts will persist:

- Power shortages in California and impacts on nearby regions
- Rising electricity rates
- Actions by public officials encouraging consumers to save energy
- Lower wholesale CFL prices, due to economies of scale and greater competition
- Improvements in CFL technology and testing for product quality
- Expanded Energy Star® promotions, including "Change a Light, Change the World"
- Greatly increased utility incentives, primarily for resource-acquisition
- Longstanding utility-funded efforts to build retail sales infrastructure and awareness

We explore the results of 2001 not as a single-year phenomenon, but as the culmination of a decade-long odyssey of sustained promotion and infrastructure-building. In other word, resource acquisition succeeded *after* and *because* substantial market transformation had already been done.

This paper primarily examines California and national data. However, meaningful comparisons can also be made with the Northwest and Northeast CFL experiences.

Early Efforts

It has been 23 years since the compact fluorescent lamp (CFL) was first introduced. Early designs were bulky and expensive, but found initial acceptance in commercial and industrial applications, where their longevity, lower power consumption, and cooler operating temperatures conveyed tangible financial advantages. So the products were primarily marketed to electrical contractors and building managers, who were willing to pay $15 to $25 to obtain savings two to three times greater over the life of the lamps.

Over its first two decades of sales, the CFL made only modest incursions into a retail marketplace thoroughly dominated by a century-old lamp design -- the incandescent bulb. When incandescent bulbs could be purchased for $0.25 to $0.75 apiece, few residential consumers were willing to pay far more for a product that would not fit in as many fixtures,

took awhile to start and come up to full brightness, and cast a noticeably different color of light.

The first serious marketing of CFLs as a retail product for purchase by residential users occurred in various parts of the country between 1988 and 1991. In 1990, total U.S. sales of screw base CFLs were about 4 to 6 million units (Calwell, Granda, Gordon and Ton 1999) of which perhaps a third occurred at retail stores and the remainder through commercial and industrial distribution channels like electrical wholesalers. By contrast, retail sales of standard incandescent bulbs that year were approximately 1 billion units, giving CFLs a retail market share (units basis) of about 0.1 to 0.2% (Calwell, Granda, Gordon and Ton 1999 and Borg 1997).

Utilities banded together in fledgling cooperative efforts at the state and regional level in California, the Northwest, and Northeast to find ways to expand that market share. The California Compact -- a non-profit partnership among the California utilities, NRDC, and Lawrence Berkeley National Laboratories -- hosted a number of national meetings between 1990 and 1993. Participants met with manufacturers, evaluated the latest products, shared tips on program design and marketing strategies, and collectively lamented a formidable set of market barriers -- especially stubbornly high CFL prices. Green Seal developed an environmental labeling program for CFLs during that period as well, though it did not have a high enough profile in the marketplace to greatly affect product sales.

This picture improved only incrementally over the next several years, as utilities experimented with a wide variety of program approaches to encourage greater sales. Though prices and average sizes for the products steadily dropped, CFLs continued to be a niche product in hardware, home improvement, and discount stores, and an almost non-existent product in grocery and drug stores. Some utilities would provide financial incentives for retail products in the form of coupons or direct wholesale cost reduction to manufacturers (buydowns). Others would simply give the products away for free to qualifying customers, sell them through utility bill payment centers, or offer them through mail-order catalogs in lieu of traditional retailer support.

Laying the Foundation

Finally, between 1997 and 1999, a number of things occurred that planted the seeds for dramatic future growth of efficient lighting sales. First, the U.S. Environmental Protection Agency launched an Energy Star® labeling program for residential light fixtures. This brought a clearly recognizable national brand to a fragmented marketplace. It gave utilities and regional market transformation groups a benchmark of lighting performance and quality around which to rally their marketing strategies (Calwell, Granda, Stephens and Ton 1996).

This program inaugurated a number of high visibility marketplace successes, including the compact fluorescent torchiere. Over the ensuing five years, Energy Star® labeled torchieres would steadily gain market share through strong promotional efforts by utilities and EPA. At the same time the previously popular halogen models fell out of favor due to safety problems (Calwell and Granda 1999).

During that same period, Pacific Northwest National Laboratories (PNNL) accelerated sales of high quality subcompact (approximately incandescent-sized) CFLs through a targeted procurement and testing effort. Most of the successful participating

manufacturers were small overseas companies that lacked significant retail distribution in the U.S. Spiral-shaped lamps received a major jumpstart through this effort, and have continued to grow in popularity. The PNNL procurement opened up an important, additional channel of competition, while helping to overcome key remaining market barriers -- product size and ability to fit in existing fixtures. It also hastened the development of an Energy Star® labeling program for CFLs, while heightening interest in systematic testing to ensure product quality and performance.

The success of the Energy Star® fixture program and the procurement caused many utilities and regional organizations to argue for the establishment of an Energy Star® labeling program for screw base CFLs as well. This program was launched by the U.S. Department of Energy (DOE) with support from EPA in May 1999, and immediately garnered participation by more than a dozen of the major CFL manufacturers and numerous utilities.

New Data Sources

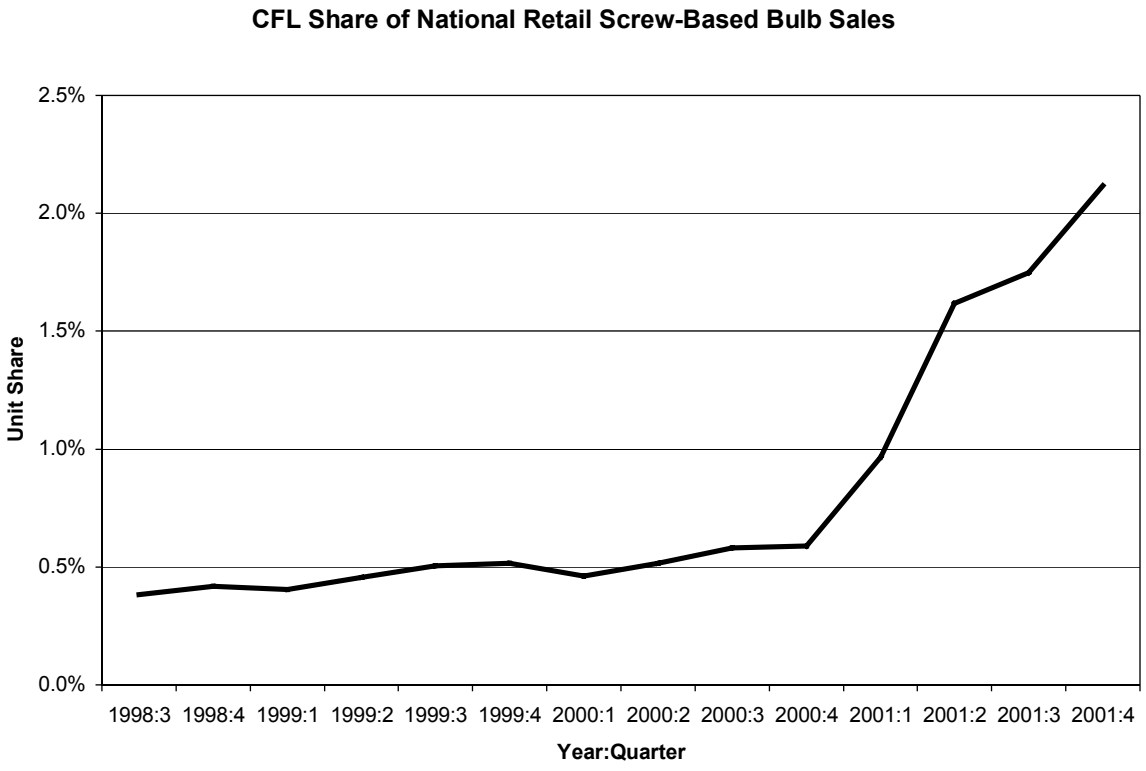
In mid-1998, Regional Economic Research (RER), under contract to California's investor-owned utilities, began comprehensively tracking national and California retail sales of incandescent, halogen, and compact fluorescent lamps. After extensive analysis and categorization of existing industry data sources from AC Nielson and Triad Vista, it was possible to establish a statistical baseline of sales and assess the effectiveness of programs to increase CFL sales (Regional Economic Research, January 2001).

The RER data, like other sources of market information, are imperfect. The cash register data employed are only available from a representative sample of national retailers that utilize scanning technology at the cash register. This omits consideration of smaller "mom and pop" retailers, mail order and internet sellers, and some types of potentially significant warehouse or "wholesale" retailers like Costco[1] (ECONorthwest 2002) that do not fit within the five key retailer categories tracked by AC Nielson and Triad Vista: hardware, home improvement, mass market discount, grocery, and drug stores. Finally, because of the sample size, the data tend to have greatest statistical validity on a national scale, so uncertainties grow larger as the data are scaled to the state level or especially to the utility service territory level. However, the RER data do allow consistent sales and market share comparisons to be made over time, which is not only useful, but difficult to do by other means (Calwell, Granda, Gordon and Ton 1999).

Early tracking (Figure 1) showed that national retail sales of CFLs were rising modestly, from less than 0.4% of unit sales in the third quarter of 1998 to about 0.5% two years later (the second quarter of 2000). It appeared that national market transformation for these products would continue to be a very slow, incremental process, with occasional regional successes masked by a national marketplace generally indifferent to the products.

[1] Costco played a central role in PG&E's 2001 promotions, according to PG&E's Terry Pang, and also was a major driver of high CFL sales in the Northwest, so omitting sales from Costco and other warehouse stores can undercount program results.

Figure 1. National CFL Market Share



Source: RER 2002

However, in the next quarter CFLs added another tenth of a point of a market share. After consolidating those gains in the following quarter, the market for CFLs soared, reaching nearly a 1% market share in the first quarter of 2001 and more than 1.6% market share in the second. In other words, the market share gains in the three months between April and June of 2001 were greater than all of the gains achieved in the first 260 months of the products' existence.

The California Experience

Yet even that dramatic increase pales by comparison with what occurred in California over the same period. After years of individual efforts (sometimes informally coordinated through the California Compact and the Consortium for Energy Efficiency), the California utilities embarked on a joint, multi-year effort to transform the retail landscape for Energy Star® lighting in mid-1999. Working primarily through subcontractors Ecos Consulting and ICF Consulting, the California Residential Lighting and Appliance Program (CRLAP) sought to do more than simply bring down the price of CFLs. It undertook a broad, sustained initiative to build a conscious market preference for Energy Star® labeled bulbs, torchieres, and hard-wired fixtures. This included:

- Unprecedented segmentation of the lighting marketplace and assignment of channel managers and unique marketing strategies to each key retail segment.
- A decisive shift from bill-stuffers and utility-driven advertising to in-store advertising materials and events, including point of purchase banners and shelf-mounted signage, frequent sidewalk sales, and heavily publicized torchiere turn-in events.
- A massive statewide effort to build retailer infrastructure for marketing the products, including professional training of sales representatives and regular visits by field staff to each store to display merchandise attractively, tabulate inventory levels, and maintain point-of-purchase displays.
- Cooperative advertising programs to leverage investments by manufacturers and retailers in product promotions.
- Significant investments of incentive dollars into competitively allocated manufacturer buydowns, which maximized price leverage per dollar invested. More importantly, they greatly amplified competition among manufacturers. Those who successfully "moved" their initial allocations of incentive dollars through retail channels by the program deadline could obtain additional allocations from their less successful competitors. This gave upstart manufacturers a foot in the door when competing for retail distribution space with larger, well-established competitors.

Collectively, these program elements helped accomplish something previous California utility programs had not: they built a truly competitive marketplace in efficient lighting. This occurred in two key ways. First, it meant that Lights of America, a dominant early participant in utility incentive programs for efficient residential lighting, began to face strong competition from similarly nimble manufacturers of affordable products. Second, it meant that energy efficient lighting became an important enough revenue source to Home Depot, Lowe's, Home Base, Orchard Supply, and other retailers to cause them to invest their own promotional resources (discounts, advertising, etc.) to grab market share from their competitors.

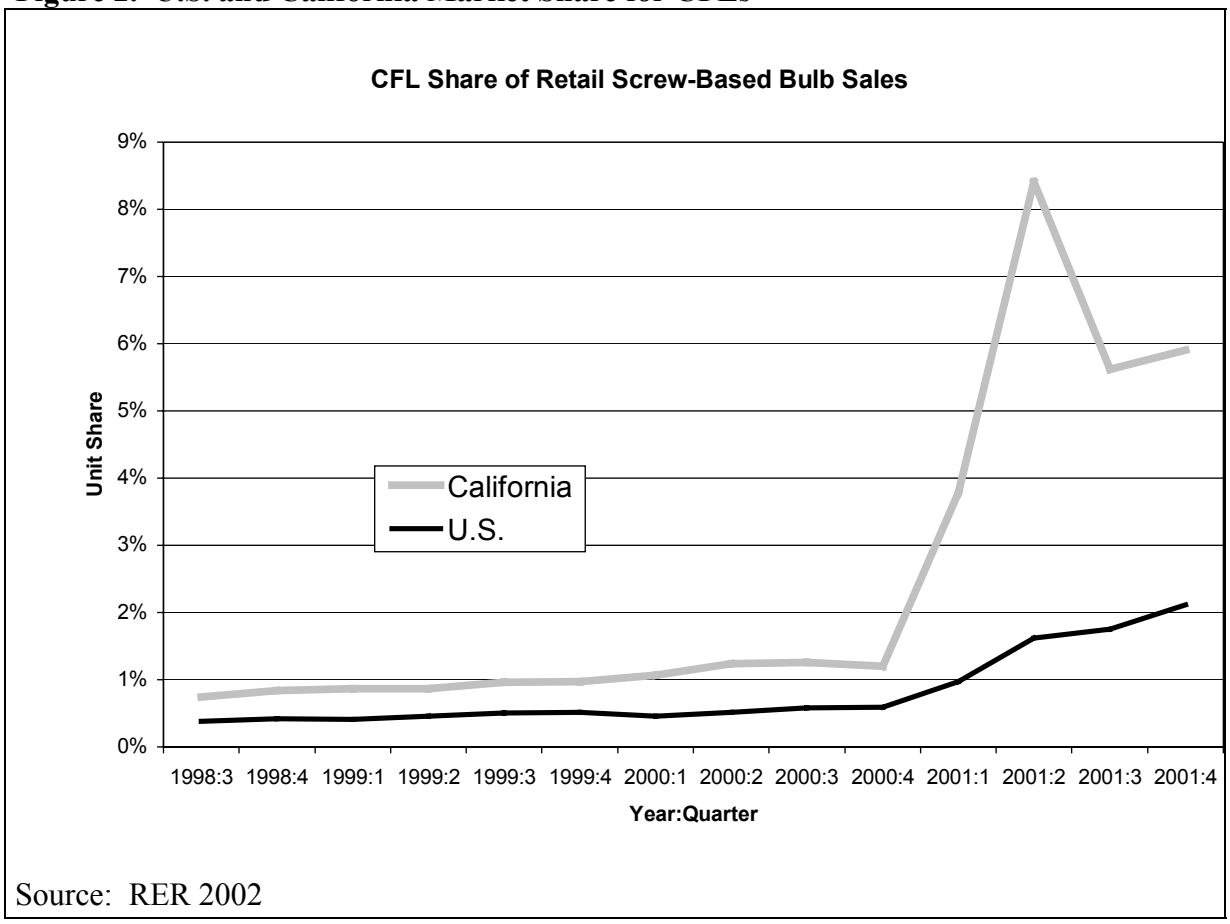
Beyond increases in product sales, the CRLAP program achieved the following successes in 2000 (Latham 2001):

- 837 sales staff in 179 participating national retail stores trained, with a 54 to 76% increase in proficiency test scores regarding Energy Star® lighting
- 1,409 self-standing displays placed in retail stores
- 13,567 pieces of point-of-purchase (POP) material placed in stores, include banners, hang tags, and shelf-mounted cars
- In-store product demonstrations conducted in 158 DIY, mass merchandiser, grocery and specialty hardware stores
- $600,000 of cooperative advertising and promotion across 10 different projects, leveraging equivalent investments by manufacturers and retailers
- In-person recruitment meetings with 18 different Energy Star® lighting product manufacturers

The results of this large-scale effort to reshape the retail landscape became quickly evident (Figure 2). In 1998, California's CFL market share was about 0.8% -- double the

0.4% share observed in the rest of the U.S. However, by 2000, the California share surged to nearly 1.2%, widening the gap with the rest of the U.S., where the share hovered between 0.4 and 0.6%.

Figure 2. U.S. and California Market Share for CFLs



Source: RER 2002

More importantly, however, the ongoing investment by California throughout the 1990s and 2000 was quietly building an efficiency infrastructure that would pay enormous dividends in 2001, when unprecedented changes in the energy landscape would drive consumers to stores in record numbers to purchase energy efficient products.

The 2001 Experience

At the same time that national sales of CFLs grew from 0.5% share in mid-2000 to 1.6% share in mid-2001, California sales absolutely soared (Figure 2), reaching 4% share in the first quarter of 2001 and a peak of 8.5% in the second quarter. California market share stabilized between 5 and 6% in the third and fourth quarters of 2001. National market share continued to grow as a glut of new, low cost CFLs entered the market, reaching 2.1% by the fourth quarter of 2001.

Even accounting for sharp declines in average selling price (ASP) of compact fluorescents, it is still interesting to note how much more dramatic the CFL market share

became on a dollars basis. Remarkably enough, for the full year of 2001, CFLs outsold incandescent bulbs on a dollars basis in California.[2] While dollar market share is not a direct measure of the products' contribution to energy savings, it does indicate their newfound importance to retailers as a source of revenues and profits. Remembering that each CFL sold is the equivalent of 8 to 14 incandescents purchased all at once by a consumer (due to longer lifetime), also illustrates the products' importance to retailers. It also suggests the reason for correspondingly steady declines in sales of incandescents. Even though typical CFL prices may have fallen from about $25 in their early years of introduction to, in many cases, $5 or less, the parallel growth in sales volumes has been enormous, increasing greatly the products' contribution to overall retailer revenues.

So how did events of 2001 build on the foundations laid in 2000 and prior years? First, as reserve margins of electricity supply became tight in California, utilities and regulators switched from a market transformation mode to a resource acquisition mode. Much of the previous focus on building a message of value in consumers' minds was temporarily suspended.

Instead of steadily decreasing incentives and relying primarily on marketing and education to drive sales, the utilities offered rebates equal to the majority of a CFL's purchase price. The rebate *amounts* were not particularly high by historical standards. PG&E, for example, employed rebates of $3 per bulb compared to rebates of $4 to $7 per bulb in the early 1990s, yet achieved CFL sales of approximately 7 million units in 2001 -- a massive increase compared to year 2000 volumes (PG&E 2002).

However, the rebates were high enough in the competitive environment of 2001 to allow purchasers to buy the products for a few dollars or less – cheaper than the cost of a comparable number of incandescent bulbs. This phenomenon was not confined to the West Coast, but played out in a variety of successful Northeast programs as well.[3]

Relatively high rebates were not by themselves able to drive a stampede of purchases until the key barriers to growth had been removed. Retail sales staffs were already very familiar with the products' benefits, branding and consumer education messages were firmly in place, and retailers had longstanding relationships already in place with numerous competitors, making possible the large orders that would follow.

But on top of all of that, a number of extraordinary factors came into play in 2001. Any one or two of them alone might have led to a banner year of sales, but together they created something of a "perfect storm" -- a confluence of factors at the right and time and place to drive an unprecedented market outcome. These factors included:

- *Episodic power shortages, rolling blackouts, and the fear (both in California and the Northwest) that they would expand in scope and duration*. California experienced 70 days of Stage 1 emergencies (voluntary conservation requested), 65 days of Stage 2 emergencies (interruptible customers curtailed), and 38 days of Stage 3 emergencies

[2] RER reports about 88 million incandescent and 5 million CFL units sold in 2001 in California. Assuming average prices of $0.35 and $7 per unit respectively yields $30.8 million of incandescent sales compared to at least $35 million of CFL sales. Actual CFL sales (including Costco) were substantially higher.

[3] Rebate levels in the Northeast also fell over time, according to NEEP's Subid Wagley, dropping from $10 to $5 per bulb between 1998 and 2001. Yet $5 rebates were sufficient to cover all or nearly all of the purchase price of some CFL models by 2001.

(involuntary rolling blackouts) in 2001. Only one Stage 3 emergency had occurred in California in the previous three years (www.caiso.com/docs/09003a6080/08/8a/09003a6080088aa7.pdf)

- *Public awareness messages broadcasted by state and city government officials and utilities urging customers to conserve, specifically by purchasing and using CFLs*. The state's Flex Your Power campaign, with initial funding of $20 million and later budget additions, was able to promote simple energy efficiency messages very widely in the state. It also successfully urged nearly a third of California's households to participate in the state's "20/20" program. This granted 20% electric bill rebates to households that reduced their overall summer electric use by 20% compared to the previous year.
- *Massive direct purchases by state and local governments.* The California legislature mobilized $20 million of emergency funding for the California Conservation Corps (CCC) to purchase and distribute free CFLs to nearly half a million low-income households. CCC members conducted "power walks" throughout every county in the state over a four month period, distributing a total of 1.9 million CFLs and 1.4 million "Flex Your Power" brochures. These activities frequently involved local elected officials as well, attracting substantial publicity that undoubtedly drove additional retail sales. While some of the early CFLs for the program were purchased at local retailers (thereby influencing the totals tabulated by RER), the vast majority were purchased in direct competitive procurement arrangements with manufacturers, adding to the totals already reported (California Conservation Corps 2001).
- *Rising electricity rates, especially for usage above baseline amounts, giving consumers a powerful new motivation to cut demand*. While baseline electric have held steady, Californians saw very steep increases in their incremental rates for consumption above baseline. Southern California customers with high electric usage now pay as much as $0.26 per incremental kwh -- some of the highest rates in the nation (www.sce.com/NR/sc3/tm2/pdf/ce12-12.pdf).
- *Unprecedented competition among manufacturers and retailers to gain or at least maintain market share*. This appeared to result in substantial internal discounting (manufacturers and retailers accepting lower gross margins than they typically would for CFLs). It created a "virtuous cycle" in which price cuts drove greater sales, increasing economies of scale in manufacturing and making possible even lower prices on subsequent orders. These competitive forces may well have done more to reduce average bulb prices than utility incentives, especially outside of California and the Pacific Northwest.
- *The coincidental imposition on Asian manufacturers of steep tariffs (up to 75%) by the European Union in response to charges of dumping (below-cost selling).* This caused numerous low cost suppliers from Asia to shift the focus of their marketing efforts to North America, greatly increasing the available supply of products and driving additional price competition. This increase in manufacturers is perhaps most evident in the Energy Star® CFL program registrant data. At the beginning of 2001, the program included 17 manufacturers offering 161 qualifying products. By the end of the year, that list had grown to include 94 manufacturers and 455 qualifying products.

Federal Efforts

If anything, that growth reemphasized the need for stringent random testing to ensure that products met the requirements of Energy Star® (particularly longevity). *Consumer Reports* set off the initial round of interest in this subject, noting in a critical product evaluation that many CFLs failed to live up to claims of product performance and longevity. Thereafter, Home Depot and other retailers imposed a number of testing requirements and ultimately made changes in their list of approved vendors, heightening aspects of competition well beyond price.

EPA, NRDC, and a number of utilities worked to establish PEARL (Program for the Evaluation and Analysis of Residential Lighting) shortly thereafter to formalize that testing function, obtaining samples from a number of retail locations around the country and sending them to the Lighting Research Center for testing. This became especially critical because many of the new Energy Star® program participants had no track record of sales in the U.S. or existing relationships with retailers. As with many other types of consumer electronics, CFL manufacturing shifted heavily to China in the interest of achieving the lowest possible manufacturing costs, and outsourcing by brand name manufacturers became common practice.

Two rounds of testing identified a number of products with performance problems, or products labeled as Energy Star® compliant that did not meet program requirements. DOE acted on these findings to suspend one manufacturer from the program and place greater scrutiny on many other products submitted for labeling. In fact, the most recent specification change for the first time requires that products meet particular testing requirements at independent laboratories prior to labeling, which may narrow the field of qualifying products appreciably.

In the fall of 2001, EPA launched an unprecedented national media campaign — Change a Light, Change the World -- to drive even greater sales of Energy Star® lighting products. This program resulted in a number of landmark actions by manufacturers and retailers. More than 100 utilities, hundreds of retailers, and 25 manufacturers participated in the promotion. For many of these allies, it was their first such opportunity to participate in an Energy Star® promotion. Over 5 million radio listeners heard radio stories about Change a Light, while radio, TV, and print advertising reached tens of millions more. Even after the events of September 11 and the resulting intense competition for news coverage, the national campaign successfully drove a great deal of additional purchasing activity by consumers. GE's advertising alone ran in 16 major papers throughout the country and achieved 26 million impressions. Its sales during the Change a Light timeframe were up by approximately 300% from the previous year.

Lessons Learned

One of the clear lessons from 2001 is that disruptions in electricity supply (and the resulting inconvenience, higher rates, and saturated media coverage) can drive the same kinds of short-term improvements in product efficiency that the oil crises of 1973 and 1979 did with vehicles. However, such responses are, by themselves, inherently transitory, and

consumer behavior can be expected revert back to previous levels if not sustained by other factors.

Figure 3. Four-Pack of CFLs Currently Available Nationally for Less than $10

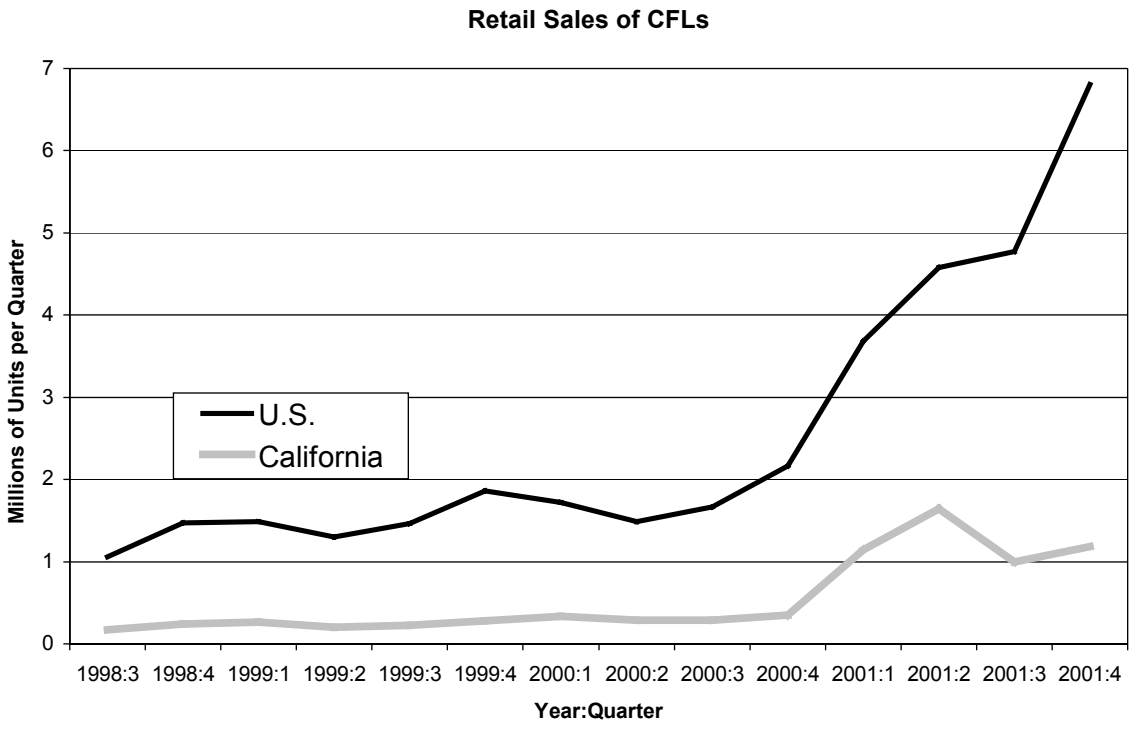
There is already mounting evidence of a glut of unsold CFLs, primarily because so many manufacturers ramped up capacity by so much to meet the spike in demand. It seems highly unlikely that sales will revert back to their earlier levels, however. National retailer Kmart is currently offering packages of four "twister" style CFLs for less than $10 (total) in regions of the country with no utility promotions or incentives (Figure 3).

Likewise, sales in the Northwest have continued to be strong even after a high visibility, $6/unit coupon campaign wound down. Most respondents surveyed indicated that they would continue to purchase additional products in the future, with or without coupons. More than 6.8 million CFLs were sold in the region in 2001 -- about ten times the estimated sales in 2000. (ECONorthwest 2002). This led to a peak CFL market share of about 11% in the Northwest in 2001 -- perhaps the highest regional share achieved in the U.S. so far (Grover, Cohan and Ton 2002).[4]

Another key lesson from the 2001 California and Northwest programs is that data tracking processes need to be modified to better capture highly concentrated sales in particular regions and store types. Sales through warehouse stores like Costco and Sam's Club, for example, are not captured through the current RER data tracking process. As a result, total sales numbers captured by RER are difficult to reconcile with the roughly 14 million CFL units represented by PG&E and the Northwest alone for 2001 (Figure 4). RER is taking steps to broaden the scope of its retailer data gathering in future years (Fields 2002).

[4] This market share calculation is estimated by a different method than RER uses, so direct comparisons to the other market share estimates are difficult.

Figure 4. Comparing National and California Unit Sales



Source: RER 2002

California's increased sales in 2001 were heavily concentrated within a few types of retailers, and indeed, a few retail chains, including Home Depot, Costco, and Lowe's. This same pattern was evident in the Northwest, but was definitely amplified in California, as utilities concentrated their greatest incentive allotments and marketing efforts in the hands of the few retailers with the capacity and the customer base to drive the greatest sell-through.

This approach definitely led to some occasional problems, as retailers sought to sell as many products as possible. In some cases, retailers were redeeming coupons for non-qualifying products or struggling to enforce utility-requested limits on the number of discounted bulbs that could be purchased per customer. In such cases, it seems likely that many sales were not to first-time buyers, or even to residential users of any kind, but to commercial customers, electrical contractors, building managers, etc. who could obtain them in large quantities more cheaply through warehouse stores than through traditional wholesale distribution. This offers some potential lessons regarding ways to more tightly target programs and limit free ridership.

A number of market changes have occurred that are likely to persist even after utility rebate levels and promotional efforts drop off:

Unprecedented competition has fueled a wave of product innovation and aggressive pricing that will make CFLs affordable and potentially attractive to most purchasers from now on. Stores like Home Depot, Ikea, Costco, and Kmart have made inexpensive CFLs a

standard promotional item, in many cases bypassing major manufacturers to offer a private label brand at a lower price.

Not all of these private label CFLs meet Energy Star® requirements, however, which raises legitimate questions about the products' performance and longevity. Energy Star® has gained enough support in the marketplace to be willing to limit participation to products verified to have high quality. Thus, the program has moved from a *recruitment* phase to a *discernment* phase, requiring manufacturers to meet more stringent specification and testing requirements beginning in July 2002. It no longer needs simply to encourage consumers to buy any CFL instead of an incandescent bulb, but can instead direct consumers toward high quality CFLs with superior efficiency and performance.

Retailers now clearly understand the benefits of CFL technology, both to consumers (energy savings and convenience) and to the retailers themselves (higher sales revenues per unit of shelf space than incandescent bulbs). As a result, some level of in-store CFL promotion will now be self-sustaining, allowing the utilities to retarget or reduce their funding and still achieve a given level of market success.

Utilities, regional groups, and state governments have come to understand that a largely transformed CFL market represents a very fruitful place to prospect for resource acquisition, both on a short term and long term basis. The CCC program generated a payback of approximately one year on a $20 million investment of public funds, though long-term evaluations will be needed to verify the persistence of savings and continued usage rates. Most importantly, the program put approximately six times more dollars in the hands of low income residents through long term energy savings than if it had simply given the $20 million to the residents directly (California Conservation Corps 2001). This "multiplier effect" is likely to feature prominently in future low-income programs or others that need to achieve demand reductions quickly to meet local or regional power shortages.

National outreach and education campaigns like Change a Light are likely to continue to be successful if they can capitalize on existing market trends and waves of interest in particular products. It is much easier to interest retailers and manufacturers in co-sponsoring promotions of products that are already highly popular than to rely on the national campaign alone to generate that interest. Monitoring sales trends and partner interests closely before launching such campaigns will obviously help point them toward promising technologies at the right time.

One overarching lesson from the events of 2001 is that market transformation takes time. CFLs ground their way to begrudging market acceptance for more than two decades before finally gaining traction with consumers. That period reflects multiple generations of revision to the technology itself, the trying and refining of numerous utility program approaches, and a great deal of hard work by a whole array of allies. Large incentives by themselves do not guarantee large energy savings, but they can stimulate a dramatic short-term response in an already substantially transformed, competitive market.

Each success stands on the shoulders of its forebears. The lessons learned from each previous generation of programs inform our continued progress toward a marketplace in which CFLs truly become the default lighting choice of consumers nationwide.

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