CFL Market Penetration Using Point-of-Sale Data – Regional Perspectives

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ABSTRACT

Utilities, state agencies, and regional and national organizations are implementing initiatives to promote energy efficient lighting equipment, especially compact fluorescent lamps (CFLs). To assess the success of these initiatives, a comprehensive system is needed to track various indicators of market changes attributable to these efforts. Trends of market penetration, in particular, provide valuable information for program development, program evaluation and redesign, policymaking, and the cost effective allocation of public goods charges.

Efforts to develop and maintain CFL market tracking systems are underway in many states. In particular, a system to track the market penetration of CFLs in California, using detailed point-of-sale (POS) data has produced more reliable estimates. The California approach has since been adopted in Wisconsin and will soon be replicated in Massachusetts to measure the effectiveness of their lighting initiatives. Data from the market penetration tracking of CFLs in Wisconsin has been used to estimate impacts beyond market penetration, such as sales attributable to the CFL program and the effects of different rebate levels. These analyses provide program sponsors and managers with important supplementary information attributable to changes in market penetration of CFLs. In addition, replicating the POS approach in other regions allows for the comparison of different programmatic approaches, incentive structures, and demographic characteristics. The inclusion of a national comparison area provides a further context to compare and evaluate regional initiatives.

This paper describes the POS approach and its implementation in California and Wisconsin. The success of this effort and the usefulness of results in both California and Wisconsin has drawn the interest of other regional entities throughout the U.S. to develop a national efficient lighting tracking system. At the time of this writing, a working group has convened to examine the feasibility of a national tracking system through support of regional organizations, individual utilities, and the U.S. Environmental Protection Agency (EPA) and Department of Energy (DOE).

Overview

Opportunities for energy savings in the residential sector with efficient lighting technologies have gathered momentum in recent years. Throughout the U.S., utilities and regional organizations have implemented marketing and incentive programs to promote efficient lighting measures. Trends of market penetration, in particular, provide valuable information for program development, program evaluation and redesign, policymaking, and the cost effective allocation of public goods charges.

Much has been written and estimates have been made of the penetration of efficient lighting technologies in the marketplace. Historically, estimates have relied on national shipments data, Department of Commerce data, census data, self-reports, telephone and mail-in surveys, limited on-site data, and the willingness of distributors and manufacturers to supply critical data. These data lack the timeliness and level of detail needed for program planners and evaluators to gauge the effectiveness of their lighting initiatives and to modify program implementation. This is particularly true at the state or individual utility service territory level.

To evaluate the potential impacts of the energy efficiency programs in California, the Residential Efficiency Market Share Tracking system (RMST) was developed under the auspices of the four California investor owned utilities (IOUs) and the California Public Utilities Commission (CPUC). Currently in its fourth year, the RMST estimates the market penetration of various high efficiency measures in the residential sector, including lighting. The RMST examines the lamp market in California and the U.S. using point-of-sale (POS) data from five major channels through which lamps are primarily sold: food, drug, mass merchandiser, home improvement, and hardware stores. These data then are processed and classified to garner information about overall lamp sales in the residential lighting market and provide information on lamp sales trends over time, geographic regions, and sales channels. More importantly, the RMST provides details for all major lamp types used in residences, with comparisons of penetrations developed for lamps that are interchangeable in form and function.

During the development of the lighting component of the RMST, it became clear that beyond California there is a widespread need in the lighting community to understand and evaluate the penetration of CFLs and other lamp technologies in the residential marketplace. The state of Wisconsin, under oversight of the Wisconsin Energy Conservation Corporation (WECC) is also now subscribing to the market penetration tracking effort. Massachusetts has recently committed, and other New England states are likely to follow. A working group comprised of representatives from the RMST, utilities, and regional and national energy efficiency organizations has recently formed to assess and coordinate interests in developing a tracking system of national scope. The goal of this organization is to provide a forum for collaboration among interested parties and to assess the feasibility of establishing and funding a long-term national data collection and market penetration tracking system.

This paper describes the approach to tracking the market penetration of lamps with POS data and presents a sampling of results from such efforts in California and Wisconsin. Additional application of the POS approach for estimating kWh impacts is also provided. Finally, we offer the reader insight into current efforts underway for developing a national tracking system through the collaboration of various state, regional, and national entities.

Point-of-Sale Data Sources

Most large retail stores today use barcode scanners and computers to maintain product inventory, pricing, and sales data for a wide range of consumer products. To support the lighting component of the RMST, such POS data were purchased for the following major market channels: food stores, drug stores, mass merchandisers, and home/hardware stores. Although the majority of lamps sold to the residential market are through these channels, it should be noted

that the data analyzed do not include sales through other smaller channels, such as the Internet, small independent stores, and direct sales from the manufacturer to the consumer.[1]

The lighting data were purchased in an unprocessed spreadsheet format and then converted into a structured electronic database categorized by various levels of product efficiency and performance. The detailed line-item data included universal product code (UPC), lamp-type indicator, location sold, retail sales channel, and monthly counts of units sold for nearly 10,000 different lamps.

Food Stores, Drug Stores, and Mass Merchandisers. ACNielsen obtains consumer sales data for food, drug, and mass merchandisers.[2] These data are collected from a sample of food stores with revenue over $2 million, drug stores with revenue over $1 million, and mass merchandisers with revenue over $1 million from major metropolitan areas across the U.S. Data from grocery stores are collected in 51 regions and data from drug stores and mass merchandisers are collected from eight regions.

ACNielsen uses a stratified sample design to measure consumer sales across different geographic regions and retailers. ACNielsen projects sample data from individual stores to represent sales data across a given region. This projection is based on a "ratio estimation" procedure, which uses a combination of total store counts and dollar sales volume to weight store level data up to a regional level. ACNielsen uses this same process to project regional data to national data. The sample selection process also accounts for socioeconomic differences such as urban versus rural, city versus suburb, ethnic versus non-ethnic, high income versus low income, etc. This sampling strategy provides a complete picture of these retail channels, taking into account variances by retailer, geography, and other factors.

Some caveats should be noted. First, the data cover only stores above a certain sales volume threshold that use computerized inventory control. Second, sales data for food stores, mass merchandisers, and drug stores cover only specific major metropolitan and regional areas. As such, U.S. Census Bureau[3] population data were used to scale these regional and metropolitan sales to the California state level and to individual IOU service territories. Specifically, sales data from California metropolitan areas were expanded to represent sales data for all of California using population as the weighting factor. Total state sales were then proportioned to each IOU service territory and areas not covered by the IOUs using a combination of utility service area maps and population data. This approach requires certain assumptions about the demographic similarities of parts of California to the whole, and is likely not as accurate as the results that could be obtained by conducting customized (and costly) sampling in all parts of the state. This scaling process is reasonably accurate for grocery stores, where original sample sizes were substantial, but less precise for mass merchandisers and drug stores, because of the relatively small sample size.[4]

Hardware and Home Improvement Center Stores. Consumer sales data for national and independent hardware and home improvement center stores were obtained from Triad Vista

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[1] Discussions with industry professionals estimate lamp sales outside of the major retail channels at 10 to 20%.

[2] ACNielsen Company, Schaumburg, Illinois.

[3] U.S. Census Bureau data obtained from www.census.gov for July 1998, July 1999, and July 2000.

[4] Using population weighted expansion factors is a reasonable approach. However, we recognize that it assumes that lamp sales per household through these channels in areas outside the regions covered by the data are the same. To the extent that promotional and product offerings differ by mass merchandisers across regions, this assumption could lead to over- or under-reporting sales of certain lamp types.

(Triad).[5] Triad collects hardware and home improvement center data from stores across four distinct regions: Northeast, Midwest, South, and West. A stratified sample design is used to develop the sample. The four main characteristics behind the sample selection process are retailer, geographic region, store type, and store size. Sample stores are chosen to be representative of all stores across these four characteristics. These sample data are scaled to the regional or national level by comparing individual store sales volumes and number of stores to overall sales for a given region.[6] RER and Triad also worked to develop a similar system to develop projections for California, each of the California utility service areas, and Wisconsin.

ENERGY STAR® Designation of CFLs. Insofar as the majority of CFL programs, including California's residential lighting incentive program, have adopted the ENERGY STAR specification as platform for promoting energy efficient lighting, the RMST also tracks ENERGY STAR and non ENERGY STAR qualified CFLs. This was a cooperative effort that required the identification and classification of all CFL lamps tracked in the POS database.

Historical CFL Market Penetration: Total U.S., California, and Wisconsin

Results of tracking efforts to date reveal characteristics of the residential lamp market as well as historical trends of total unit sales, sales by lamp type as a percentage of all medium screw-based lamps, sales of medium screw-based lamps by equivalent wattages, among others. Here we highlight the types of results garnered from the RMST effort.

Characteristics of the Residential Lamp Market. The RMST develops key characteristics of the residential lamp market that are useful in understanding sales channels and purchasing patterns that can help program administrators develop effective programs and marketing and outreach campaigns. For example, Figures 1 and 2 present distribution of lamp sales by retail channel and by lamp type in California and the rest of the U.S. (excluding California). These results reveal a difference in purchasing preferences between consumers in California, Wisconsin, and the rest of the U.S. - shows that lamp purchases are more prevalent in home improvement centers, hardware stores and drug stores in California, while purchases in Wisconsin are more common through drug stores and mass merchandisers as well as home improvement and hardware stores. Figure 2 illustrates the distribution of medium screw-based lamp sales by type. Roughly three quarters of all lamps sold in the U.S. are incandescents; the percentage is slightly lower in California and slightly higher in Wisconsin. CFLs are included in the fluorescent category, which accounts for about 6% of all lamp sales; screw-based CFLs account for 15% of the fluorescent lamps sold in the residential sector.

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[5] Triad Vista, a division of CCITriad, Livermore, California.

[6] It should be noted that one strength of the Triad data is that it contains a census of store outlets for several of the home improvement and hardware chains. As such, no weighting is required for these elements.
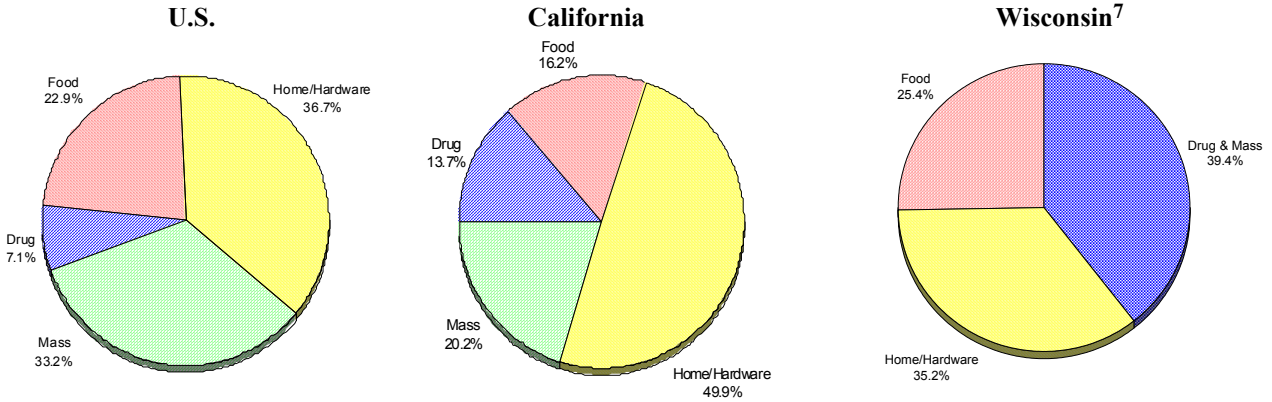
U.S.

Food
22.9%

Home/Hardware
36.7%

Drug
7.1%

Mass
33.2%

California

Food
16.2%

Drug
13.7%

Mass
20.2%

Home/Hardware
49.9%

Wisconsin[7]

Food
25.4%

Drug & Mass
39.4%

Home/Hardware
35.2%

Figure 1: Sales of Residential Lamps by Market Channel (2001)

U.S.

Incandescent
76.9%

Halogen
3.4%

Fluorescent
6.2%

Special
13.4%

California

Halogen
4.5%

Fluorescent
10.9%

Special
16.3%

Incandescent
68.3%

Wisconsin

Halogen
3%

Fluorescent
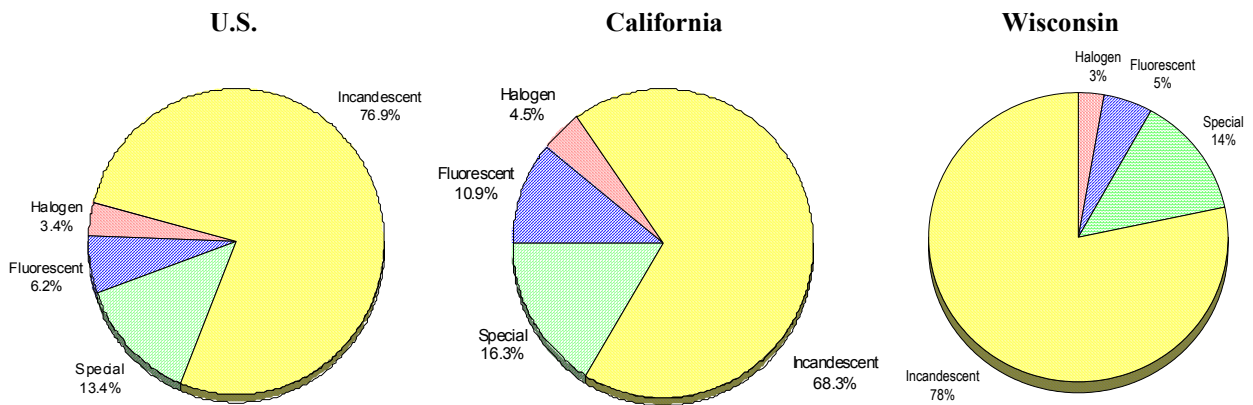5%

Special
14%

Incandescent
78%

Figure 2: Sales of Residential Lamps by Lamp Type

  Market Penetration of Medium Screw-based Lamp Sales Over Time. As shown in Figure 3, CFL market shares in California and Wisconsin have exhibited sharp increases in recent years. Before 2001, shares were below 1% in both regions (0.8% and 0.5%, respectively). Shares in California increased to 1.1% in the last quarter of 2000, and then sharply increased to a peak of 8.6% in mid-2001. Wisconsin observed a dramatic increase in CFL shares in the first half of 2002 to 7.6%, while shares in the rest of the U.S. have remained around 2% since the latter half of 2001.

  Note also that as shares of CFL sales approach the 10% range, the relative importance of stocking and selling CFLs increases for retailers. Because the relative retail cost of CFLs and incandescents is about ten to one, the dollar sales volume of CFLs and incandescents converges. This could send a significant (profit) signal to retailers to stock and promote CFLs more on their own.

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[7] The Wisconsin data could not be segmented by drug and mass stores separately due to confidentiality agreements between the stores and the vendor.
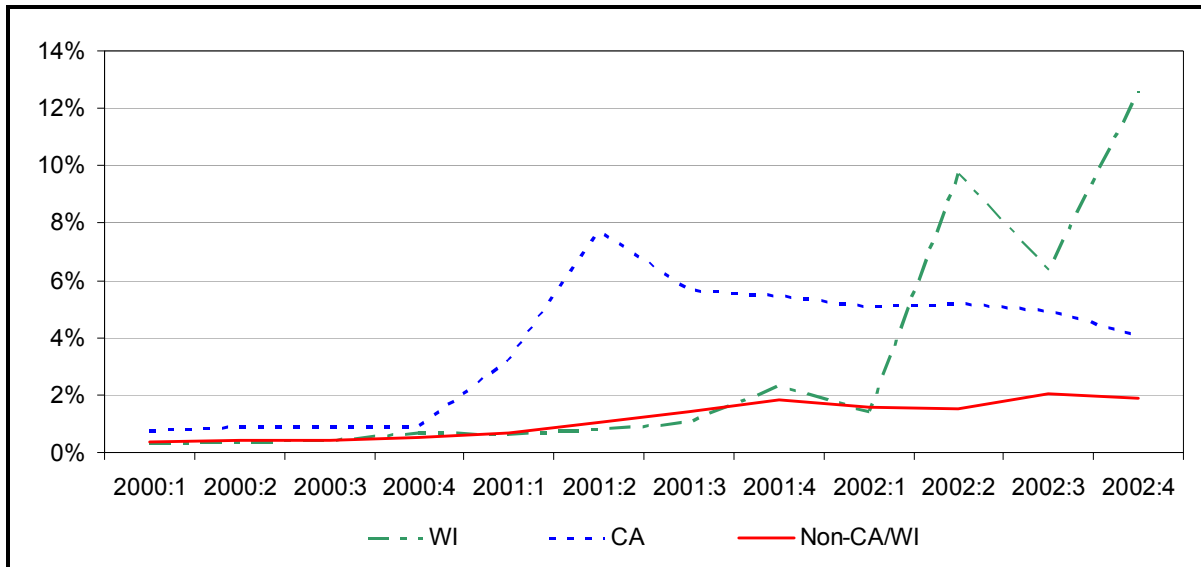
Figure 3: CFL Shares of Medium Screw-based Lamps

In addition to tracking the market penetration of CFLs, the RMST database also identifies sales of ENERGY STAR qualified products. As shown in Figure 4, the share of ENERGY STAR qualified CFLs sold in California and Wisconsin parallels the market share trends of CFLs presented above. The market penetration of ENERGY STAR qualified CFLs in Wisconsin approached 13% by the end of 2002, while shares in California settled at around 4%. The average difference between the penetration of CFLs and that of ENERGY STAR qualified CFLs reveals that about 70% of the CFLs sold are ENERGY STAR qualified.

Figure 4: Sales of ENERGY STAR Qualified Lamps
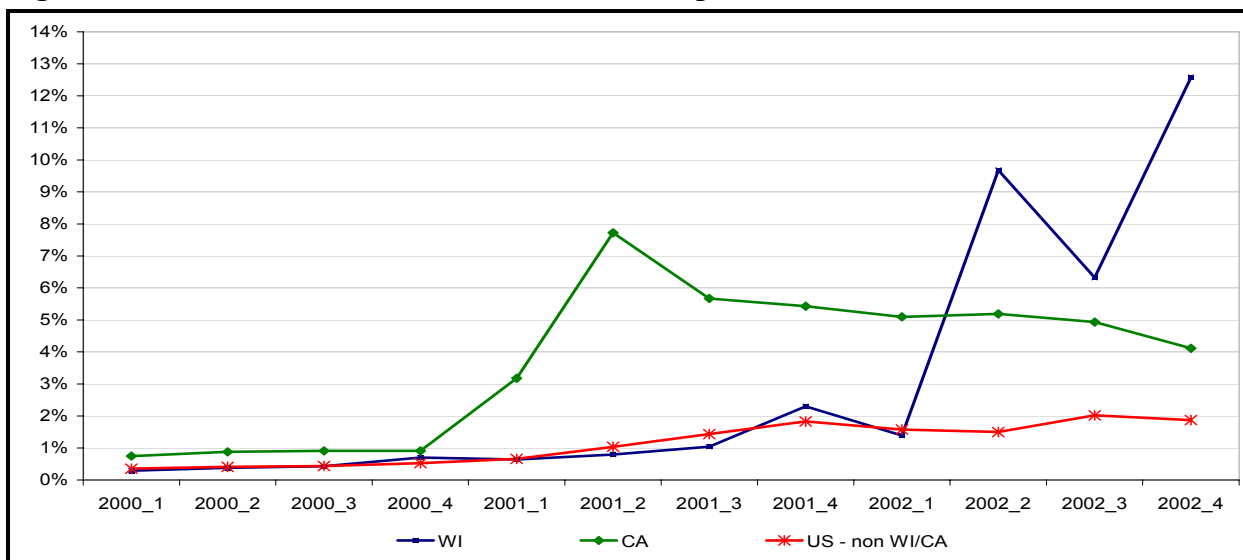
Evidence of Impact of Energy Crisis on CFL Sales. The market penetration of CFLs in each of the four IOU service areas is particularly interesting with respect to California's "energy crisis" in 2001. The sharp increase of CFL market shares for all IOUs coincided with

the energy crisis, which included rolling blackout in early 2001. Note however, that SDG&E customers experienced exorbitant energy prices before the rest of the state - during the summer of 2000. Figure 5 depicts an increase of CFL shares in SDG&E's territory before sales increased in the other services areas. As a result of the rolling blackouts and the threat of continued crisis through the fall of 2001, the state of California launched an aggressive marketing campaign to reduce peak load that included promoting the purchase and installation of CFLs. PG&E in particular promoted CFLs heavily and observed the highest average market share over the last year.
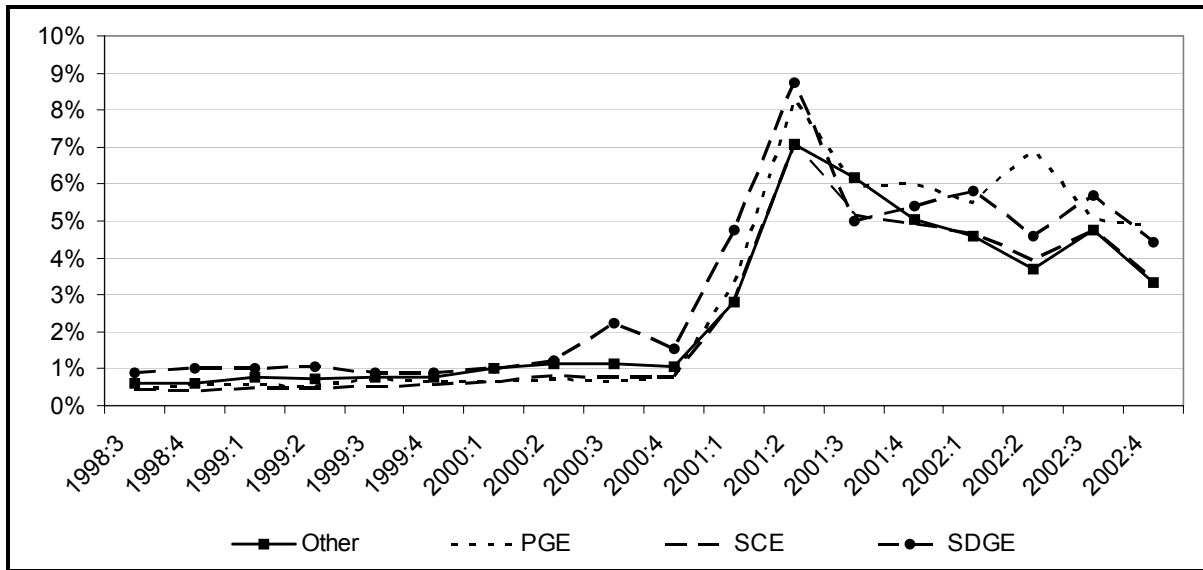

Figure 5: CFL Shares of Medium Screw-based Lamps, by California IOU

kWh Impact Analysis in Wisconsin: Further Uses of the Data

While the market penetration of efficient lighting is useful in itself, efforts in Wisconsin exemplify how the data are used to estimate energy impacts attributable to changes in CFL shares. In particular, the RMST data allowed the sponsors and managers of Wisconsin's Focus on Energy (Focus) program to determine that their CFL program has been achieving considerable success in increasing market penetration since it was implemented statewide in July 2002. (This success is evident in Figure 4 above.)

The data were analyzed to provide additional information to the program sponsors (the Division of Energy in the state Department of Administration - DOA). To provide the legislature with a defensible estimate of the savings achieved, the DOA wished to identify the number of CFLs sold that could be attributed to the program, which could then be multiplied by the deemed savings for each lamp.

The Wisconsin Energy Conservation Corporation (WECC), which served as the administrator for all residential programs in the state including the CFL component, tracked customer rebate redemptions. However, it was universally understood that the rebate redemptions do not provide a complete picture of sales. Moreover, it was recognized that a sales tracking system independent of rebate applications was needed, lest programs be forced to continue offering rebates even when other promotional strategies might be appropriate.

Estimates of total CFL sales in Wisconsin validated the assumption that many more CFLs were sold than the number rebated. Additional analysis was required, however, to estimate the sales attributable to the program. The analysis involved disaggregating the total estimated CFL sales for the state, into three constituents:

- The number of CFLs that would have been sold in Wisconsin in the absence of the Focus program (estimated baseline sales),
- The number of CFLs that were sold through the program, based on rebate redemptions, and
- The number of additional CFLs sold as a result of the program (but not tracked— whether because of customers' failure to claim rebates, or a result of various market effects, such as increased promotion and availability as well as lower prices)

To estimate the sales that can be associated with the program, it was assumed that the market share for CFLs in Wisconsin would mirror that for CFLs in the U.S., were it not for the intervention.[8] Thus, any sales beyond that level were deemed as resulting from the program. The following steps were involved.

1. Adjust the national sales reports for each period to reflect only those states or regions where no strong program is supporting CFL sales, insofar as possible.[9]
2. Compute the expected CFL market share (adjusted national CFL sales, relative to adjusted national MSBL sales for the relevant period) in the absence of an energy-efficient residential lighting program.
3. Project the sales of CFLs in Wisconsin in the absence of the program by applying the expected market share to the sales of MSBLs in Wisconsin during the relevant period. This is the estimated baseline level of sales.
4. Determine the sales attributable to the program by subtracting the estimated baseline sales of CFLs from the total of all CFL sales in the state (provided by Itron) for the period.
5. Disaggregate the program-attributable CFL sales into those that are tracked by the program (through rebate redemptions) and those that are not tracked.

The results for the period spanning July 2001 through December 2002 are presented in Table 1. A review of these data underlines several aspects of the Focus effort to stimulate CFL sales in Wisconsin. First, approximately 1.5 million CFLs were sold in the state during the first six quarters of the program, with the majority going in the first six months of the current contract year. This reflects the ramping up of the program and intense activity during autumn 2002 Change-A-Light promotion (CAL). Second, over one million of those CFLs can be attributed to the program. Third, because the autumn CAL campaign relied heavily on instant rebates (rather

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[8] To remove the upward-biasing effects of other major programs on overall national market penetration, the U.S. results provided by RER were adjusted by removing the Wisconsin sales, as well as those in California (also provided by Itron) and from the Pacific Northwest (provided by the Northwest Energy Efficiency Alliance).

[9] At the time of this writing, the data for Massachusetts and Vermont were not available. The failure to remove the impact of these programs on the national market penetration is effectively to make the Wisconsin projections somewhat more conservative than they might otherwise be, in that the estimate of U.S. sales of CFLs without program support is somewhat exaggerated.

than mail-in rebates), many more sales were part of the tracked program effects, possibly reducing the sales that might otherwise be attributed to the longer-term market effects of the program. In contrast, during the first program year when mail-in rebates were stressed, the program rebated 149,199 CFLs, but also can be credited with the sale of another 226,740 CFLs—almost double the number rebated.

Table 1: Wisconsin CFL Sales, by Contract Period

WI CFL Sales	Contract Year 1 July 2001-June 2002	Contract Year 2 (YTD) July 2002-Dec. 2002	Program-to-Date July 2001-Dec. 2002
Total	582,988	895,247	1,478,235
Baseline Sales	207,049	133,890	340,939
Program Attributable	375,939	761,357	1,137,296
Tracked	149,199	726,478	875,677
Non-tracked	226,740	34,879	261,619

Additional analyses conducted in Wisconsin beyond market penetration provided sponsors and the program managers with important supplementary information. This includes the volume of sales attributable to the program; the volume that is attributable to the program, over and above the rebated sales; and the effects of different rebate offers. Using a deemed savings for each CFL installed of 66 kWh per year, WECC and DOA estimate the savings attributable to the CFL program for the first eighteen months at more than 75,000 MWh.[10]

Moving Forward Toward a National-based Tracking System

The data collection and analysis efforts to date represent a comprehensive analysis and reliable estimates for tracking energy efficient lighting product sales. However, the analyses are based upon historical trends; in order to sustain and improve the system to support ongoing long-term tracking, the support and momentum of the project needs to continue. Recent developments this year have brought the RMST to a crossroads: we are on the brink of replicating the system in other regions, but because the system relies heavily on the POS data vendors and key retailers themselves, the reliability of market penetration estimates of specific retail channels could be comprised due to the withdrawal of major retailer participation. This has a large impact with respect to moving forward in 2003 and beyond, but has not diminished the strength of the POS data available for sales throughout the U.S. for periods prior to 2003 (when many efficiency programs were in full swing).

The Efficient Lighting Tracking Working Group. Growing interest in tracking the market penetration of lighting measures in other regions has spurred discussions among various parties on the feasibility of expanding the POS approach in other regions. Currently, a lighting tracking working group is convening to assess the feasibility, level of interest, and commitment of doing so. A key task of the group is to coordinate the common interests of various organizations, utilities, and state and federal agencies that have different needs for market penetration tracking. The specific objectives of the working group are to 1) assess data needs of program administrators, regional and federal organizations, and individual utilities, 2) determine if current data collection efforts can be replicated in other regions, 3) identify and assess existing relationships with retailers and POS vendors, 4) identify potential funding sources, 5) examine

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[10] Realized MWh savings are contingent upon installation.

the potential market coverage and develop feasible options, and 6) estimate the costs of expanding the approach, if deemed feasible. While the working group is still in its nascent stage, we expect to have recommendations and results of a feasibility assessment for a national system by the fall of 2003.

Long-Term Viability Requires Regional and National Support. Concurrent to the formation of the lighting tracking working group was the withdrawal of major retailers from POS data collection conducted by ACNeilson and Triad. The absence of sales data by prominent retailers in the database will significantly impact the robustness of the estimates. This is particularly true at the regional level where lamp sales are more prominent in one market channel more than the others. For example, the withdrawal of Home Depot from Triad's POS database will affect the estimation of market penetration in California, since nearly half of all lamp sales in California are through the home improvement and hardware market channel.

The efforts of the lighting tracking working group currently underway will identify means for overcoming such obstacles and strengthening the long-term viability of the tracking system. In this respect, the working group will be assessing the extent of support from the EPA/DOE during the upcoming months. Through ENERGY STAR labeling program for efficient lighting, the EPA/DOE has developed relationships with key national retailers, and also could benefit greatly from national estimates of market penetration of ENERGY STAR qualified lighting products.

The value of the market penetration tracking increases as the number of regional and state entities subscribing to the system grows. Replicating the market penetration tracking in other regions allows for the comparison of different programmatic approaches, incentive structures, and demographic characteristics. Monitoring the trends of market penetration for efficient lighting measures – including ENERGY STAR qualified products - provides data for determining the cost effectiveness of public investments and provides information critical to projecting energy use and energy needs for forecasters and policy makers. The inclusion of a national comparison area provides a further context to compare and evaluate regional initiatives. Without reliable and consistent national data, progress with lighting programs cannot be properly measured. Moreover, without state specific data, the utility and state organizations cannot readily assure their regulatory agencies and sponsors that ratepayer or taxpayer funds are being used effectively.