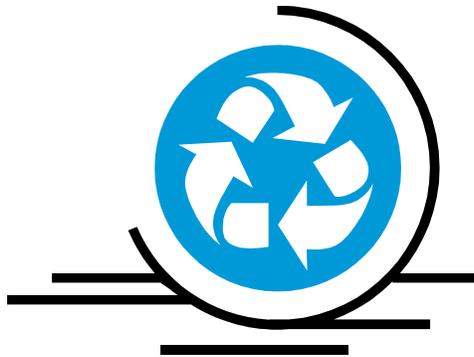


Household Compact Fluorescent Light (CFL) Recycling in Maine

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EXECUTIVE SUMMARY

Because of increased energy costs and a successful campaign by Efficiency Maine, compact fluorescent lights (CFLs) are now used in a majority of Maine homes. Although CFLs provide many benefits, they contain small amounts of mercury which, given the large number of CFLs in use, can become an environmental contaminant of concern unless recycled in an environmentally sound manner.

Despite a ban on disposing of CFLs, availability of free CFL recycling, and a statewide CFL recycling education campaign, indicators suggest that the CFL recycling rate remains very low. A study was undertaken to identify factors contributing to the low recycling rate by surveying 520 Maine residents who use CFLs.

Based on the survey, 48.3% of respondents have 10 or more CFLs currently in use and the primary impetus cited (59.6%) for purchasing CFLs was energy conservation. While 23.5% stated they recycle their CFLs, 28.9% of respondents disposed of CFLs, 16.2% did not know what they did with their CFLs, and 7.6% placed them into storage even though 76.8% of respondents knew CFLs contained mercury. The survey responses indicate that the lack of knowledge is likely the primary factor in low recycling participation; 63.2% did not know that CFLs are required to be recycled and an additional 9.7% said recycling is not required. As to locations for CFL drop-off, 64.2% said they did not know where CFLs could be brought for recycling. Finally, 72.9% of the respondents said they were unaware that CFL collection and recycling can be free. Regarding factors that would prompt CFL recycling, respondents were fairly even in selecting environmental responsibility, free or reduced recycling fees, and convenience.

Another influential factor in recycling is convenience. An analysis of the state-sponsored free CFL recycling program identified insufficient coverage of municipalities. Only 22.9% of Maine's municipalities have a participating location and the 10 municipalities with the highest population, representing 20.4% of the state's population, collectively have only 24 locations. Indicative of this situation is that the 204 participating locations have collected only 8,768 CFLs since 2007.

In light of the requirements for CFL manufacturers in the recently enacted LD 973, "An Act to Provide for the Safe Collection and Recycling of Mercury-containing Lighting," this study recommends: (1) modifying the educational focus and (2) expanding free CFL collection. Based on the results, education efforts should be reoriented from highlighting the need to recycle CFLs to focus on educating the public on the specific locations for free CFL drop-off including periodic listings of specific locations in the local media. To increase convenience, CFL collection locations should be expanded specifically to include more home improvement, warehouse, mass merchant, and chain grocery stores to coincide with primary CFL purchase locations. Efforts should be made to increase substantially the number of free drop-off locations in Maine's population centers. Finally, free CFL collection should be made available at every municipal solid waste transfer station.

INTRODUCTION

Compact fluorescent light bulbs (CFLs) are an increasingly popular lighting choice and are an important component in reducing electricity consumption for residential, commercial, and institutional lighting. CFLs have multiple benefits including longer bulb life and reduced energy consumption, which in turn reduces CO₂ emissions and electricity generation wastes. However, CFLs contain mercury and must be recycled in an environmentally sound manner to prevent the environmental release of mercury.

Compact Fluorescent Lights in Maine

Maine has one of the highest residential usage rates of CFLs in the nation.¹ Approximately 67% of Maine households, or about 347,200 (2000 census data), have at least one CFL installed; the average Maine home that uses CFLs has 7 in use.² Instrumental in the state's high usage rate is Efficiency Maine, a program that promotes the efficient use of electricity. A centerpiece of Efficiency Maine's effort is a concerted, statewide promotion and in-store coupon program directed at substantially increasing CFL purchases and use by Maine households and businesses. In 2008, Efficiency Maine announced the sale of its one millionth CFL through its CFL coupon program--more than the total sales of CFLs for 2004 through 2007--and mailed an additional 97,000 CFLs to lower income residents.³ Accurate data is not available as to how many CFLs are sold in Maine without the Efficiency Maine coupon.

Mercury and CFLs

There are many positive benefits to CFL use; however, a negative aspect is that sealed within CFLs is a very small amount of mercury. CFLs contain an average of 5 milligrams (mg), which is equivalent to the tip of a ballpoint pen.⁴ Assuming the above estimates regarding CFL usage in Maine are correct, currently there are at least 2.43 million CFLs in use in Maine households, which equates to about 26.8 pounds of mercury (this amount does not include other sources of mercury

¹ U.S. Department of Energy. *Big Results, Bigger Potential. CFL Market Profile*. March 2009. Available from http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile.pdf. Verified on August 13, 2009.

² *Efficiency Maine, 2008 Annual Report*. Available from http://www.efficiencymaine.com/pdf/EMO14758_EMAnn.Rept_v11.pdf. Verified on August 9, 2009.

³ Ibid.

⁴ This figure is reported in: Maine Department of Environmental Protection. *Maine Compact Fluorescent Lamp Study*. February 2008, p. 9. According to the Northeast Waste Management Officials' Association, 66% of all CFLs sold in 2004 had a mercury content of 0-5 mg, 30% had between 5 and 10 mg, and 4% had between 10 and 50 mg. <http://www.newmoa.org/prevention/mercury/imerc/factsheets/lighting.cfm>. In addition, as of April 2007, the National Electrical Manufacturers Association established a voluntary cap of 5 mg for each CFL.

in households including linear fluorescent lamps, thermostats, thermometers, batteries, and switches).

The reduction of mercury as an environmental contaminant has been a priority in Maine.⁵ A major step was the adoption of a state law that bans the disposal of household generated mercury-added products, which includes CFLs, beginning in January 2005. In support of the mercury disposal ban, the state has promoted household CFL recycling. In Maine, 135 transfer facilities that serve collectively the state's 492 municipalities are equipped to collect mercury-containing lamps for recycling, generally for a fee of \$1 or less per CFL.⁶ In 2007, the infamous case of the broken CFL in Prospect, Maine caused considerable negative press on CFLs.⁷ In response Efficiency Maine established a free household CFL recycling program. Since 2007, residents can drop-off intact CFLs for free at 204 participating retail stores throughout Maine.⁸

When managed and disposed of as municipal solid waste (MSW), CFLs are subject to breakage during handling, storage, transportation, processing, and disposal thereby releasing the mercury into the environment. Intact CFLs can break in trash cans and personal vehicles, through compaction in trash receptacles and packer trucks, and breakage through further handling at a transfer station and/or disposal facility. Of the CFLs that survive intact in Maine, about 49% will be incinerated and the remaining 51% will be landfilled. Both landfilling and incineration are likely to cause a release of mercury through volatilization from breakage and further compaction. At Maine's four waste-to-energy facilities, costly mercury air-pollution capture technology is required, which captures about 90% to 95% of mercury emissions. In a landfill, there are no mercury controls; in addition to volatilization, mercury can contaminate landfill leachate.

Recycling CFLs

While it is illegal to dispose of CFLs, meaning that legitimate recycling is the only legal means of disposition, indications suggest that the majority of CFLs are not being recycled. The Efficiency

⁵ The Maine Legislature has passed numerous bills related to reducing environmental releases of mercury. Major actions include: a ban on the sale of mercury switches and measuring devices, including fever thermometers and thermostats; a ban on the sale of mercury-containing button cell batteries beginning June 30, 2011; a ban on disposal of most mercury-added items; and bounties on mercury thermostats and mercury switches from automobiles.

⁶ *Report Regarding the Recycling of Fluorescent Lamps and Consumer Education Efforts*, January 2008, p. 4.

⁷ The "Prospect incident" involved a homeowner with a broken CFL who was given an estimate of \$2,000 to clean up the mercury. For more details see <http://www.maine.gov/dep/rwm/homeowner/pdf/prospecthistory.pdf>. The situation prompted national headlines. See for example, "CFLs and Caution," 2007, March 24, *Bangor Daily News*, p. 12.

⁸ Maine Department of Environmental Protection. Available from: <http://www.maine.gov/dep/rwm/homeowner/fluorescent.htm>. Verified on August 1, 2009. Note that other stores (e.g., Home Depot) also may collect CFLs for free, but are not included in this specific program.

Maine's free CFL recycling program has had only minimal success in contrast to the sales and use of CFLs. Since its inception in May 2007, only 8,768 CFLs have been collected--a mean of 337 CFLs per month--a stark contrast to the 30,000 to 40,000 sold per month through the Efficiency Maine coupon program.

A statewide residential CFL recycling rate is unavailable for Maine and is highly problematic to obtain because sales data is incomplete and there is a substantial time gap between date of purchase and a CFL's end-of-life (average lifespan of between 8 to 15 times longer than average incandescent bulb). Also, household CFL data is not collected separately from linear fluorescent lamps at municipal transfer stations where residents also can bring CFLs for recycling. Outside of Maine, for similar reasons, accurate rates for household lamp recycling do not exist. In 2004, one organization estimated the national, household mercury-containing lamp recycling rate to be only 2%, a figure used by the U.S. Environmental Protection Agency.⁹ A 2004-2005 pilot study in Lane County, Oregon estimated the household recycling rate to be about 6.7%.¹⁰

Education Efforts

In Maine, there has been a concerted effort to educate the public about CFL recycling. Over 40,000 copies of a brochure on mercury and mercury added products were distributed to towns for public distribution. Program print ads are run that include the phrase "CFL lamps contain trace amounts of mercury and must be recycled at the end of their life;" the printing of this same phrase is on the back of Efficiency Maine in-store coupons used to buy CFLs (30,000 to 40,000 coupons are filled out by customers each month). Efficiency Maine's CFL television advertising campaign continues to include an animated talking bulb that mentions the need to recycle CFLs; it is estimated that this commercial has been viewed more than a half million times across the state.¹¹ However these messages to recycle the lamps have not focused on how or where homeowners can actually recycle the lamps.

Related to education is the coverage of the issue by the media. The Maine print media has reported extensively on mercury; from January 2000 through August 2009, nearly 1,150 articles on

⁹ Note that the sponsoring organization for the 2% figures stresses that the rate is not based on a scientific study. Association of Lighting and Mercury Recyclers, *National Mercury-Lamp Recycling Rate and Availability of Lamp Recycling Services in the U.S.*, November 2004. <http://www.lamprecycle.org>.

¹⁰ *Review of Compact Fluorescent Lamp Recycling Initiatives in the U.S. & Internationally*, Northeast Waste Management Officials' Association, July 2009. Available from <http://www.newmoa.org/prevention/mercury/lamprecycle/CFLRecyclingReport.pdf>. Verified on August 9, 2009.

¹¹ Maine Department of Environmental Protection and Maine Public Utilities Commission. *Report Regarding the Recycling of Fluorescent Lamps and Consumer Education Efforts*, January 2008.

mercury appeared.¹² Reporting on CFLs and mercury occurred far less frequently with only 50 articles. Only three articles on CFLs and mercury appeared before 2007 even though the mercury disposal ban was implemented in 2005. Beginning in 2007, articles discussing the costs and benefits of CFLs began to appear following the broken CFL clean-up incident in Prospect, Maine and the subsequent launch in 2007 of Efficiency Maine's "Replace Reduce Recycle" program. However, since 2000, only 34 articles mentioned that CFLs must, should, or need to be recycled--nearly all of these appearing after 2007. Interestingly, only 10 articles on CFLs explicitly advised that CFLs, because of their mercury content, cannot be knowingly disposed as household waste.

Environmental Impacts of Low Recycling Rates

According to a 2008 study, if Maine recycled 21% of its CFLs there would be a net, marginal decrease in atmospheric mercury from the disposal of CFLs because of the state's low reliance on coal for electricity production.¹³ Consequently, when the recycling rate is less than 21% as believed in Maine, there is a net increase in atmospheric mercury.¹⁴ In this case, CFLs cause more environmental harm, strictly from an area atmospheric mercury perspective. This, however, should not be interpreted as a condemnation of CFLs, but recognition of the negative environmental impact of mercury from too low a recycling rate. Clearly there are other environmental benefits of CFL use such as reduced greenhouse gas emissions and avoided impacts from not having to construct additional electricity generation capacity.

Study Problem

Despite a general knowledge in Maine of the negative environmental/public health impacts of mercury, the CFL disposal ban, a free recycling program, a statewide education outreach on the need to recycle CFLs, and increasing use of CFLs, available evidence suggests that the household CFL recycling rate is very low. Because of the low rate and the prevalence and increasing use of CFLs, it is estimated that there is or will be a net increase of atmospheric mercury in Maine until a recycling rate of 21% or greater is achieved. In an attempt to identify factors that explain why the Maine household recycling rate is so low, a study was conducted.

¹² The Maine Newsstand and Maine News Index Online databases were used, which include the Portland Press Herald, Bangor Daily News, Kennebec Journal, Morning Sentinel, Maine Times, Maine Sunday Telegram, Casco Bay Journal, Mainebiz, Portland Phoenix, and Down East

¹³ The effect of CFLs on an area's atmospheric emissions of mercury is a direct function of the area's reliance on coal for electricity generation, which accounts for 99% of power-generated atmospheric mercury emissions.

¹⁴ This conclusion is based on certain assumptions regarding breakage and release of mercury in addition to reliance on coal for power generation. See, Eckleman, M.J., Anastas, P.J., and Zimmerman, J.B. (2008). Spatial assessment of net mercury emissions from the use of fluorescent bulbs. *Environmental Science & Technology*, 42, 8564-8570.

STUDY METHODS

An online survey was conducted between March 28 and May 1, 2009. The population targeted was Maine residents, 18 years or older who have at least one CFL in use in their home. Because this was an online survey, the sampling frame established the additional constraints of access to a computer, Internet access, and basic computer skills. Sampling was non-randomized haphazard and snowball (referral by participants to other potential participants). Recruitment was cross-sectional through the distribution of materials all containing the same language as presented in Figure 1.¹⁵ Participation was self-selected. No incentives were offered for participation or completion.

Figure 1. Survey Recruitment Language.

Are you a Maine resident & do you use Compact Fluorescent Lights (CFLs)?

If yes, please participate in an anonymous online survey developed by the University of Southern Maine's Department of Environmental Science. This brief (7-8 minute) online survey will help us understand how the needs of your community can be served better.

Please go to: www.maine CFL survey.net

The survey instrument was created and managed through Survey Monkey. Because the URL for the survey was excessively long, a dedicated neutral website was created to serve as a portal to the survey (www.maines CFL survey.net). There were 26 multiple choice, ranking, and fill-in-the-blank questions (see Appendix I). The order of response options to each question was randomized to reduce order bias, except for questions related to scale ranking. All responses were anonymous and no personal information was requested.

Respondents who did not satisfy the population criteria (must be a Maine resident defined as a Maine zip code, 18 years or older, reside in a housing unit other than a dorm or motel room, and who had at least one CFL in use) were dropped, which yielded a sample of 520. The sample demographics as compared to Maine demographics are presented in Appendix II. As shown, while

¹⁵ Cross sectional participation recruitment was done only during the survey period through the following channels: 3x5 inch fliers distributed or posted at various commercial parking lots, rest areas, retail stores, ski areas, municipal libraries, municipal town offices, and distributed by hand in urban centers; Maine DEP website from March 20 to April 20; Face Book group and Face Book advertisement; local Public Access Television announcements, Craig's List, Press Releases; and email lists.

some of the sample demographics approximate state demographics, there are a few notable differences that highlight a response bias. First, the sampling was skewed slightly toward middle-age individuals and failed to capture a sufficient number of younger (18-25) individuals. Based on the political affiliation, the sample did not capture enough registered Republicans and correspondingly too many registered Democrats. Finally, regarding education, the sample was heavily skewed toward college and graduate education. However, the age and education demographics reflect national household Internet access trends, which was this study's sampling frame. As presented in Appendix I, according to the U.S. Census Bureau, individuals with less formal education and those over 55 years of age are less likely to have Internet access.

In general, studies have found that age, political affiliation, and education are correlated to recycling as younger, more formally educated, and registered Democrats tend to recycle at higher rates.¹⁶ Consequently, given the subject matter and demographics, the study results should be viewed as an upper-bound estimate of recycling knowledge, attitudes, and actions. Recognizing the limitations, the study still provides valuable insight regarding household CFL recycling behavior in Maine.

STUDY RESULTS

The survey results are presented in Appendix I. The following discussion contains key results and focuses on the following: Prevalence and Use of CFLs, Disposition of Spent CFLs, Knowledge of Maine's CFL Recycling Program, Challenges to CFL Recycling, Availability of Recycling Options, and Prompting Recycling.

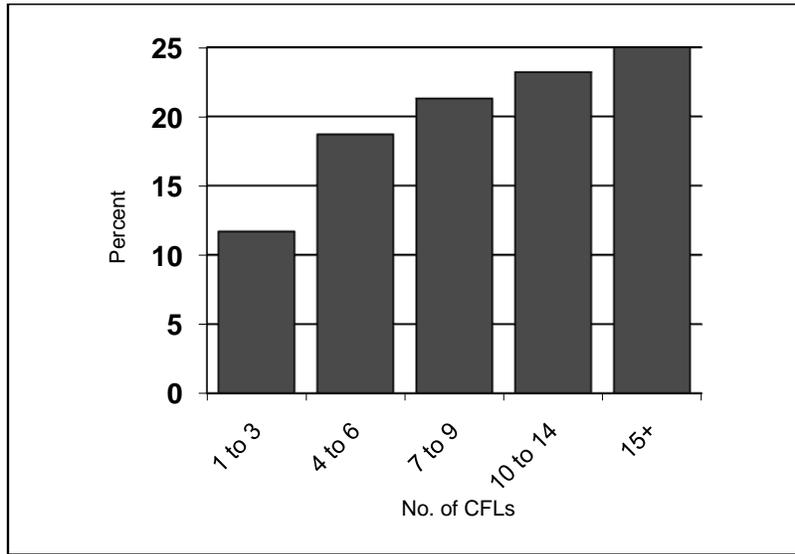
Prevalence and Use of CFLs

As presented in Figure 2, 48.3% of the respondents have 10 or more CFLs currently in use. The primary (73.4%) purchase locations for CFLs are home improvement (i.e., Home Depot, Lowes), warehouse (e.g., Sam's Club), and mass merchant stores (e.g., Wal-Mart). Only 17.1% of respondents indicated that their local hardware store is their primary source for CFLs, which is consistent with other studies.¹⁷

¹⁶ See for example, Nixon, H. & Saphores, J.D., 2007. Financing electronic waste recycling: Californian households' willingness to pay advanced recycling fees. *Journal of Environmental Management*, 84, 547–559; Kipperberg, G., 2007. A comparison of household recycling behaviors in Norway and the United States. *Environmental & Resource Economics*, 36, 215–235; and Tucker, P. & Speirs, D., 2003. Attitudes and behavioural change in household waste management behaviours. *Journal of Environmental Planning and Management*, 46, 289-307.

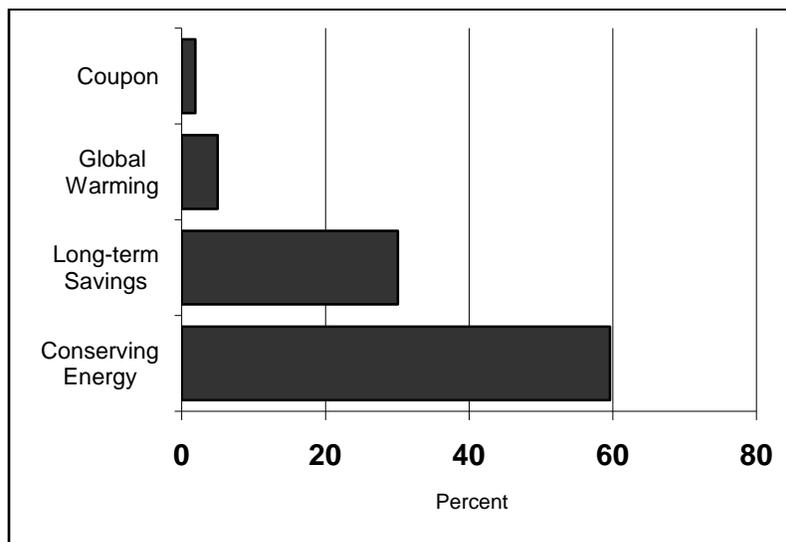
¹⁷ *Big Results, Bigger Potential. CFL Market Profile*. March 2009.

Figure 2. Number of CFLs in Use, N=520.



As presented in Figure 3, respondents indicated that conserving energy (59.6%) was the primary factor influencing their decision to purchase CFLs, which was followed by long-term cost savings (30.1%) and global warming (5.0%). Only 1.9% selected the Efficiency Maine coupon as the primary reason for CFL purchase.

Figure 3. Most Important Factor Influencing Purchase of CFLs, N=501.

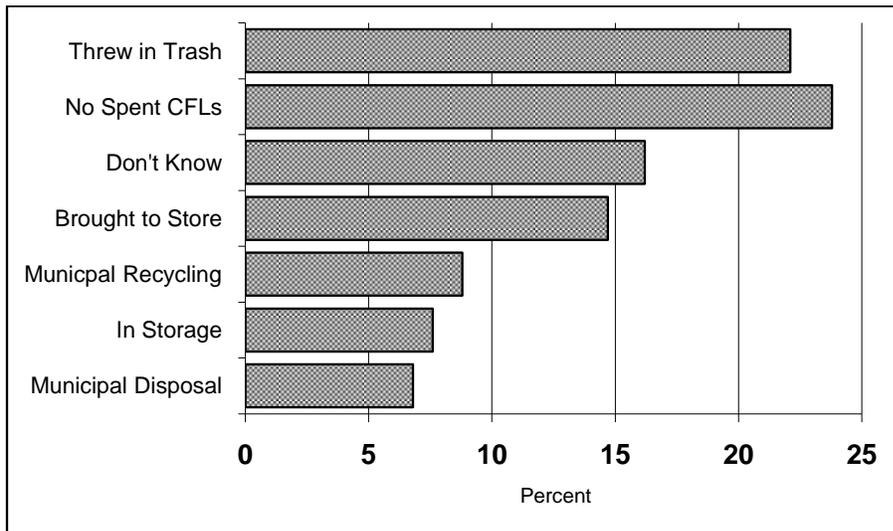


Regarding the installation or purchase of additional CFLs, 44.7% stated that they were not discouraged, price was selected as a discouragement by 21.8%, difficulty of disposal by 19.6%, toxic ingredients by 17.1%, poor light quality or performance by 11.5%, and the disposal cost was a discouragement by 5.8% (multiple options could be selected for this question). Of those respondents who selected one or more factors as a discouragement, 63.5% did not know the specific CFL recycling location and 46.9% did not know about Maine’s requirement to recycle CFLs.

Disposition of Spent CFLs

As shown in Figure 4, pertaining to the disposition of intact, spent (non-working) CFLs, 28.9% admitted that they disposed of CFLs; of these respondents 22.1% threw them into the trash and 6.8% brought them to a municipal facility for disposal. Regarding recycling, 23.5% said they either brought them to a store or to a municipal facility for recycling. Of the remaining 47.6%, they either did not yet have a spent CFL (23.8%), the CFLs currently are in storage (7.6%), or they did not know what they did (16.2%). Because CFL recycling requires a special trip to a select location and would be more memorable, it is likely that most of the 16.2% who did not know what they did either placed them in storage or disposed of them.

Figure 4. Disposition of Intact, Non-working CFLs, N=499.



While these results suggest that the CFL recycling rate may be as high as 23.5%, this rate is certainly higher than the statewide recycling rate. As described earlier, the respondent demographics are skewed toward the population more likely to recycle and such, most likely

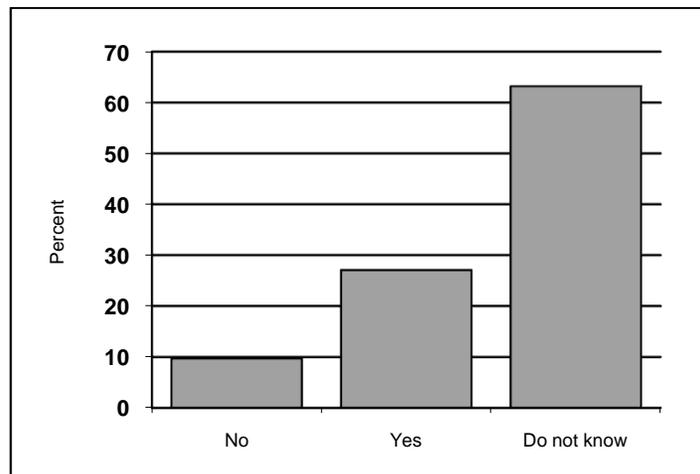
represents an upper-bound estimate of recycling rather than the mean. If the sample were truly representative of the state population, the recycling rate would be lower.¹⁸

Interestingly, despite the low recycling rate, respondents expressed a high degree of recognition that CFLs contain mercury. In response to the question, “Which of the following toxic components are commonly found in CFLs,” 76.8% of the 469 respondents correctly identified mercury.

Knowledge of Maine’s CFL Recycling Program

As shown in Figure 5, in spite of the state CFL disposal ban, 72.9% stated they did not know if CFLs are required to be recycled or responded incorrectly that there is no such requirement. Of the respondents who stated that they knew about the recycling requirement, 17.2% of them said they disposed of CFLs as trash. Similarly, 17.2% of those who disposed of CFLs stated that they had seen Efficiency Maine’s television advertisements related to CFL recycling. Therefore some respondents chose not to recycle in spite of contrary knowledge, indicating that other factors are influential (e.g., convenience). When asked whether the respondent knew the specific location where CFLs can be recycled, 64.2% said no and 35.8% said yes. Respondents who answered yes were requested to specify the location. Of the respondents who said yes, 66% provided locations.

Figure 5. Knowledge of Maine’s CFL Recycling Requirement, N=506.

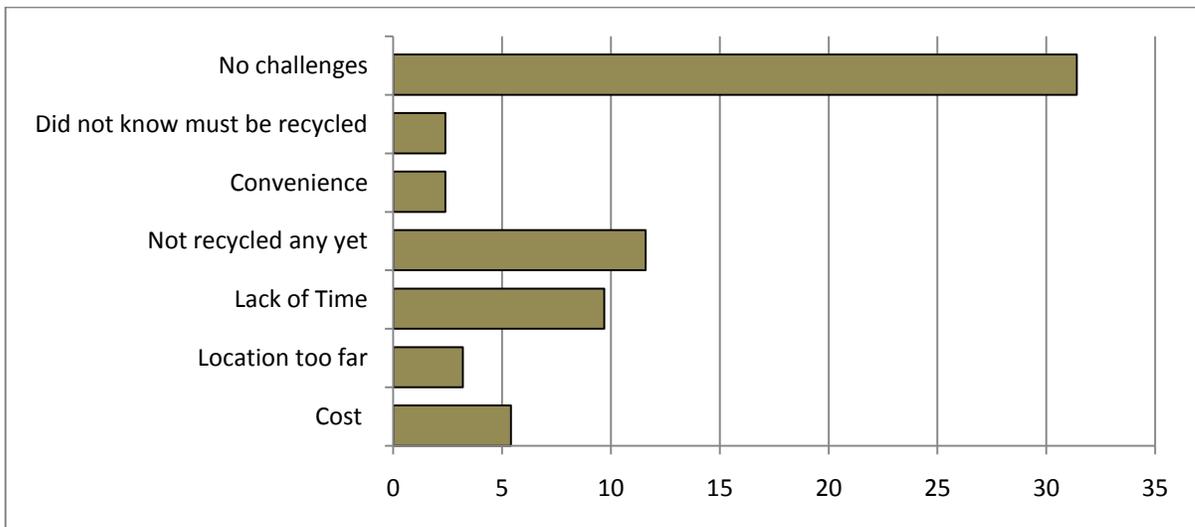


¹⁸ This is a result of non-response bias, where survey respondents provide different responses than would have been provided by sample members who did not respond.

Challenges to CFL Recycling

As presented in Figure 6, respondents were asked to select all the challenges experienced in recycling CFLs. The most prevalent response was no challenges followed by not recycled any CFLs yet, and then lack of time. While respondents who recycled may not have faced any challenges, it is unclear as to whether respondents selected this response because they did not face challenges, had not recycled, or had not yet had a spent CFL. Otherwise, the responses were within the expected range for recycling programs, such as inconvenience (i.e., includes convenience, lack of time, and location), lack of knowledge, or cost.

Figure 6. Challenges Faced in Recycling CFLs (multiple responses allowed), N=462.



Availability of Recycling Locations

As shown in Table 1, of the 204 stores participating in the Efficiency Maine free CFL recycling program, local hardware stores are the most predominant (44%) and less than 1% of the stores are large home improvement stores. In addition to the 204 stores partnering with Efficiency Maine, other stores voluntarily have initiated free CFL drop-off opportunities (e.g., Home Depot) or sponsor periodic drop-off events (e.g., Whole Foods).¹⁹ Regarding the location of the Efficiency Maine partner stores, there is significant disparity between the number and location of

¹⁹ In June 2008, Home Depot announced its National CFL Bulb Recycling Initiative (see http://www6.homedepot.com/ecooptions/stage/pdf/cfl_recycle.pdf). Home Depot has 11 stores in Maine. Data on the number of CFLs collected at Home Depot’s Maine stores was not available. Of the 179 respondents who stated they knew where CFLs could be recycled, 8 (4.5%) listed Home Depot.

participating stores and the state’s population centers. Only 113 of the 492 state’s municipalities (22.9%) are served by a participating store. The 10 cites with the highest populations, representing 20.4% of the state’s population, collectively have only 24 or 11.7% of the participating stores. As presented in Table 2, there is a lack of correlation between the population rank of a county, the number of participating stores, and the population served per store. These data suggest that an additional challenge to recycling is the availability of free drop-off locations within a convenient driving distance.

Table 1. Free CFL Drop-off Location by Store Type (N=204).

Store Type	Examples	No.	Pct.
Hardware Stores	Small local hardware stores, independent and franchise (e.g., Ace)	90	44.0%
Grocery Stores	Local chains and independent stores, including IGA. No regional or national chain grocery stores	34	16.6%
Building Supply	Independent and local chains including building supply stores and lumber yards	31	15.0%
Miscellaneous	Lighting, green, and farm supply stores	18	8.8%
Department Stores	Predominately independent and one local chain (Reny’s). Only national chain represented is K-Mart.	17	8.3%
Mass Merchant	Wal-Mart	11	5.4%
Home Improvement	Lowes	3	<1.0%

Table 2. Comparison of Population and Number of Stores by County.

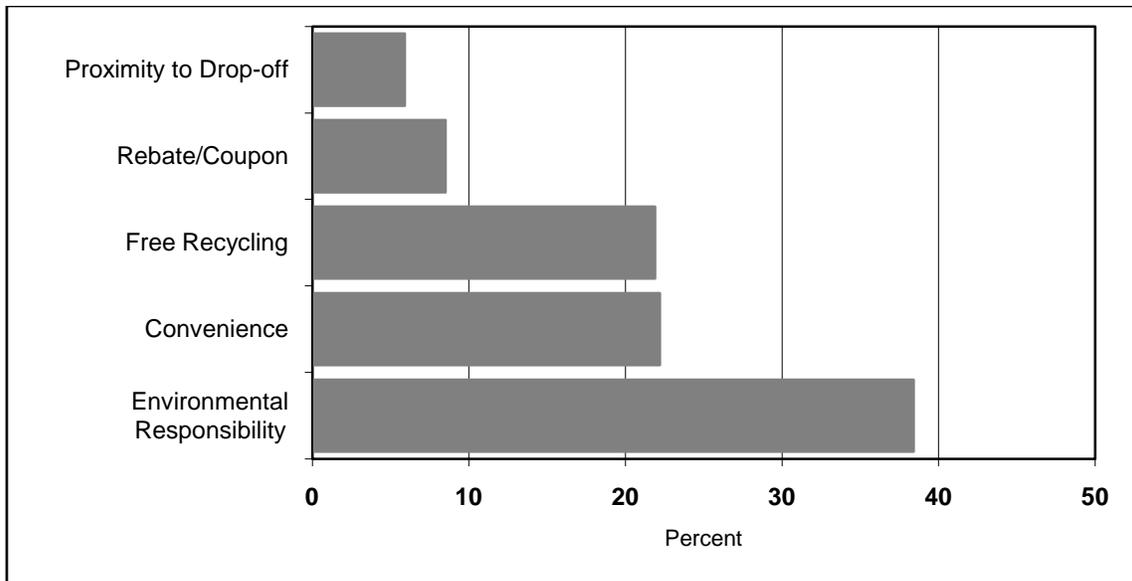
Pop Rank	County	Population	No. of Stores	Pop per store
1	Cumberland	276,047	26	10,617
2	York	201,686	18	11,205
3	Penobscot	148,651	28	5,309
4	Kennebec	120,959	9	13,440
5	Androscoggin	106,877	8	13,360
6	Aroostook	71,676	30	2,389
7	Oxford	56,741	4	14,185
8	Hancock	53,137	15	3,542
9	Somerset	51,377	11	4,671
10	Knox	40,686	5	8,137
11	Waldo	38,342	7	5,477
12	Sagadahoc	36,332	5	7,266
13	Lincoln	34,628	6	5,771
14	Washington	32,499	19	1,710
15	Franklin	29,857	5	5,971

16	Piscataquis	16,961	9	1,885
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Prompting Recycling

When asked which factors would most prompt the respondent to recycle CFLs, environmental responsibility was the most prominent (38.4%) as shown in Figure 7. The other factors can be grouped into economic incentives and convenience. Economic incentives were cited by 30.4% of the respondents (Free Recycling = 21.9% and Recycling Rebates/Coupons = 4.5%) and 28.1% selected convenience (Convenience = 22.2% and Proximity to Drop-off = 5.9%).

Figure 7. Factors That Would Prompt CFL Recycling (N=487).



CONCLUSION

CFLs are in wide use and sales are increasing primarily due to savings through reduced energy use. It is reasonable to assume that as energy prices increase, and the retail price of CFLs continues to remain stable or drop, CFL usage will increase. This means that the collective amount of mercury in household CFLs will be increasing. Assuming that the recycling rate in Maine remains below 21%, which is likely the current situation, there will be a net increase in atmospheric mercury from the disposal of CFLs. As a result, the CFL recycling rate must increase to reduce atmospheric mercury emissions in Maine.

Although it was not the intent of this study to determine a quantifiable recycling rate, the results from this particular sample suggest that the rate is near 24%. This, however, likely overestimates the statewide recycling rate, but nevertheless the rate is encouraging compared to other studies. Instead, this study sought to identify factors that are likely causes of a low recycling rate in spite of state law, education efforts, and free recycling locations. Based on this study, the following two conclusions are the most relevant:

- The survey results suggest that lack of knowledge is the most influential factor in the low recycling rate. While the state's multi-media education and outreach efforts have focused on CFLs and mercury and the need to recycle, most of the survey respondents (in spite of comparatively high level of education) were unaware of the state CFL recycling requirement. Similarly, there was a high degree of unawareness as to where CFLs can be recycled and most respondents also were unaware of the free, state-sponsored recycling option. Yet, the majority of respondents knew that CFLs contain mercury. A contributing factor regarding knowledge is the extent of state print media coverage. Since 2000, 50 articles have appeared that discuss CFLs and mercury, but only 34 articles specifically discussed CFLs and recycling, and only 10 of these articles specifically stated that CFLs cannot be disposed of waste.
- Similar to many studies assessing recycling participation, the survey findings also indicate that convenience is an important factor in reducing recycling participation. While Maine's program has attempted to promote recycling through statewide education and by offering a free recycling drop-off program, household recycling of CFLs remains inconvenient for the general public. For example, the free CFL drop-off system relies heavily on local hardware stores, but the majority of respondents do not purchase CFLs at local hardware stores nor do they likely shop at such stores on a routine basis. And, as discussed previously, the size of the current free CFL collection system is inadequate. Most of the state's population is not located within a convenient distance of a free collection location. Only 23% of Maine's municipalities have a participating store and the state's most populous cities are under-served. Moreover, because many of the state's population centers also have curbside collection of recyclables, individuals not served by or near a participating store would have to make a special trip to the transfer facility to drop-off a CFL (which may charge a fee). For many residents served by curbside collection this would be inconvenient.

RECOMMENDATIONS

On June 8, 2009, Governor Baldacci signed into law LD 973, “An Act to Provide for the Safe Collection and Recycling of Mercury-containing Lighting.”²⁰ In addition to requiring the Maine DEP to establish maximum limits of mercury in lamps sold in Maine and to the improvement of the state’s procurement policy to purchase low-mercury fluorescent lighting, the bill also mandates a producer-financed collection and recycling program, which must include an education component. This is the nation’s first law that requires CFL bulb manufacturers to share the costs and responsibility for recycling mercury-containing CFLs through extended producer responsibility.

Education

Maine’s new law requires producer-financed recycling programs to include, “Effective education and outreach, including, but not limited to, point-of-purchase signs and other materials provided to retail establishments without cost.” Education should continue to be a component, but should be modified to address the study findings. Education efforts should reorient the message from the need to recycle to focus on educating the public specifically on the locations for free CFL recycling. By focusing on free CFL recycling as the primary message, the secondary message conveyed is that CFLs need to be recycled. While additional research should be conducted on effective messaging and social marketing techniques to deliver the primary message, the following important steps should be taken:

1. Create a dedicated, simplified website specifically for CFL recycling information to include a user-friendly map and list of drop-off locations rather than the current Excel spreadsheet format. (There currently are two websites related to CFL issues: Maine DEP and Efficiency Maine, which are not user-friendly.) The drop-off locations should be kept current and should include contact information and hours of operations.
2. Select a simple, short, and memorable URL, such as www.recyclecfls.xxx or www.maine.cfl.xxx.
3. Label each CFL package with a vibrant sticker that includes the phrases “Must be Recycled” and “Maine CFL Recycling Information – www.xxx.xxx” and include the CFL recycling URL.
4. Post and continuously distribute the CFL URL at all municipal transfer stations, though utility bills, Efficiency Maine ads, and on a tear-off section (which could be retained by the purchaser) of Efficiency Maine CFL in-store coupons and/or on the front of the coupons.

²⁰ The act’s effective date is September 12, 2009. A copy of the act can be found at: <http://www.productstewardship.us/associations/6596/files/Maine%20Fluorescents%20PUBLIC272.pdf>

5. Using the print media, periodically list specific locations of participating stores that will accept CFLs free.

Collection and Recycling

Maine's new CFL law requires manufacturers of household mercury-containing lamps to establish a producer-financed, shared-responsibility collection and recycling system to include free collection systems at municipal and retail locations by January 2011.

A focus must be on reducing real or perceived inconvenience to dropping off CFLs by increasing significantly the number of free collection points at locations generally deemed convenient by households. For example, because most (73%) respondents purchase CFLs from home improvement, warehouse, or mass merchant stores, these point-of-sale locations should also be required or encouraged to have free CFL collection facilities (in addition to local hardware and large chain grocery stores). Also, free collection containers should be made available at municipal solid waste transfer stations or town offices (if a municipality is served by a regional transfer station). Because CFL recycling mail-in kits are already available, CFL point-of sale locations could offer these kits directly for free, through a mail-in coupon, or through an online request. Periodic (e.g., quarterly) curbside recycling of special CFL collection containers would also significantly reduce inconvenience and is worthy of consideration.

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Appendix I
CFL Survey Questions

The following are the questions as presented in the online survey. Note that the order of most response choices was randomized. The response rate may not equal 100% due to rounding errors. In addition, for some questions, multiple responses could be selected and are so noted.

Question	N	%
1. What is your zip code?	520	100%
2. How many compact fluorescent lights (CFLs) are installed in your home? a. 0 b. 1-3 c. 4-6 d. 7-9 e. 10-14 f. 15+	520	0% 11.7% 18.7% 21.3% 23.3% 25.5%
3. Do you currently reside in a...? a. House b. Apartment c. Condo d. Dorm Room e. Mobile Home	518	82.0% 12.2% 2.1% 0% 3.7%
4. Where have you purchased most CFLs? a. Home Depot/Lowes b. Local Hardware Store c. Grocery Store d. Wal-Mart e. Department Store f. Other (please specify)	518	44.7% 17.1% 8.3% 20.0% 4.0% 6.3%
5. What was the most important factor influencing your purchase of CFLs? a. Conserving Energy b. Long-term Cost Savings c. Global Warming d. Coupon e. Other (please specify)	518	59.6% 30.1% 5.0% 1.9% 3.3%
6. Has any of the following discouraged purchasing/installing more CFLs (select <u>all</u> that apply)? a. Not discouraged b. Price c. Toxic Ingredients d. Disposal Cost e. Difficulty of Disposal f. Other (please specify)	514	44.7% 21.8% 17.1% 5.8% 19.6% 20.3%

Household CFL Recycling in Maine

7. How have you gotten rid of non-working CFLs that are still intact? a. Threw in the trash b. Brought to solid waste facility for disposal c. Brought to solid waste facility for recycling d. Brought to local store for recycling e. Don't know f. Other (please specify)	511	22.1% 6.8% 8.8% 14.7% 16.2% 31.3%
8. Do you know the specific location of where you can recycle CFLs? a. Yes b. No c. If yes, please specify	499	35.8% 64.2%
9. Have you brought any used CFLs to your local solid waste facility? If yes, please rate your experience? a. Very convenient b. Convenient c. Neutral d. Inconvenient e. Very Inconvenient f. N/A	406	4.9% 6.9% 8.4% 4.9% 3.2% 68.5%
10. What challenges have you experienced in recycling your old CFLs (select <u>all</u> that apply)? a. Cost b. Did not know where to recycle c. Location too far d. Lack of time e. No Challenges f. Other (please specify)	461	5.2% 42.9% 3.2% 9.8% 31.4% 20.2%
11. Which of the following factors would most prompt you to recycle CFLs? a. Rebate/Cost Incentive b. Environmental Responsibility c. Proximity to Recycling Center d. Free Recycling e. Convenience f. Other (please specify)	503	8.5% 38.4% 5.9% 21.9% 22.2% 3.2%
12. Have you brought any used CFLs for recycling to your local retail store where you purchased them? a. Yes b. No c. If no, why?	501	12.9% 87.1%
13. Which of the following toxic components are commonly found in CFLs (select <u>all</u> that apply)? a. Mercury b. Lead c. Cadmium d. Arsenic e. 1,4-Butadiene f. Other (please specify)	466	76.8% 9.6% 9.2% 4.1% 5.1% 20.9%

Household CFL Recycling in Maine

14. In Maine, how much does it cost a homeowner to recycle a CFL at a participating retail store? a. \$0 b. \$1 c. \$2-5 d. \$6+ e. Do not know	505	27.3% 0.9% 1.6% 0% 70.3%
15. Should Maine adopt a deposit/refund system for CFLs? (Pay deposit at time of purchase, get refund when recycled.) a. Strongly agree b. Agree c. Somewhat agree d. No Opinion e. Somewhat disagree f. Disagree g. Strongly Disagree	474	19.8% 23.4% 17.1% 10.7% 4.4% 9.7% 13.7%
16. Does Maine law require CFLs to be recycled? a. Yes b. No c. Do not know	505	27.1% 9.7% 63.2%
17. How satisfied are you with Maine's household CFL recycling program? a. Extremely Satisfied b. Satisfied c. Somewhat Satisfied d. Do not recycle CFLs e. Somewhat Dissatisfied f. Dissatisfied g. Extremely Dissatisfied h. No Knowledge of Maine's Program	498	3.0% 12.4% 9.8% 5.4% 6.6% 3.0% 2.2% 58.2%
18. Have you seen any Efficiency Maine television ads about CFL recycling? a. Yes b. No	505	29.7% 70.3%
19. If you have had a question about recycling whom have you contacted in the past (select <u>all</u> that apply)? a. Town Office/City Hall b. Solid Waste Facility/Transfer Station c. Maine DEP d. Friends/Family e. Efficiency Maine f. Do not Know g. Retail Store where CFL was purchased h. Other (please specify)	456	17.3% 30.0% 11.2% 16.7% 6.1% 28.0% 14.0% 10.7%

Household CFL Recycling in Maine

20. How much do you rely on each of the following for Maine information/news?		
a. Television:	483	
i. Very close Attention		15.5%
ii. Close Attention		29.8%
iii. Moderate Attention		24.4%
iv. Some Attention		14.7%
v. No Attention		15.5%
b. Radio:	468	
i. Very close Attention		15.8%
ii. Close Attention		23.0%
iii. Moderate Attention		25.0%
iv. Some Attention		21.6%
v. No Attention		14.5%
c. Newspaper:	476	
i. Very close Attention		12.6%
ii. Close Attention		24.4%
iii. Moderate Attention		23.8%
iv. Some Attention		22.7%
v. No Attention		16.6%
d. Magazine:	428	
i. Very close Attention		1.6%
ii. Close Attention		4.9%
iii. Moderate Attention		14.7%
iv. Some Attention		25.1%
v. No Attention		50.7%
e. Internet:	464	
i. Very close Attention		14.2%
ii. Close Attention		26.7%
iii. Moderate Attention		26.5%
iv. Some Attention		22.7%
v. No Attention		9.9%
f. Other (please specify)		
21. How did you find out about this survey?	507	
a. Maine DEP Website		2.7%
b. Email		23.9%
c. Flier		3.9%
d. Family/Friend		40.8%
e. Store		0.9%
f. Other (please specify)		27.6%

Appendix II

Table IIa. CFL Study Sample and Maine Statewide Demographics.

	CFL Study Sample (2009)	Maine (2007)
22. Gender (N=496)	Male = 41.9% Female = 58.1%	Male = 48.8% Female = 51.2%
23. Age ²¹ (N=491)	18-25 = 4.9% 26-34 = 15.7% 35-44 = 10% 45-54 = 27.3% 55-64 = 28.3% 65+ = 13.8%	18-25 = 12.3% 26-34 = 12.9% 35-44 = 18.2% 45-54 = 21.1% 55-64 = 16.7% 65+ = 18.8%
24. Highest Level of Education Attained ²² (N=502)	High School or less = 13.1% Some College = 22.5% College grad = 36.5% Graduate School grad = 27.9%	High School or less = 35.8% Some College = 19.4% College grad = 18.3% Graduate School grad = 8.6%
25. Political Affiliation (N=483)	Democrat = 45.8% Republican = 14.9% Green = 3.9% Independent/unaffiliated = 35.4%	Democrat = 31.4% Republican = 28.1.9% Green = 2.9% Independent/unaffiliated = 37.8%
26. Race (N=498)	White = 92.4% Non-White = 7.6%	White = 96.5% Non-White = 3.5%

Table IIb. National Household Internet Access Data.²³

Percent households with <u>no</u> Internet use at home based on householder characteristics	
Education Attained	Age
Less than high school graduate = 76.0%	Under 25 = 42.3%
High school graduate. = 50.5%	25-34 = 34.4%
Some college or associate's degree = 31.1%	35-44 = 28.2%
Bachelor's degree or higher degree = 16.0%	45-55 = 29.3%
	55 and older = 49.8%

²¹ The Maine 2007 census data is adjusted, the categories reflect the percent population excluding persons <18 years old to match the survey population.

²² The Maine census data for highest education attained is from 2005.

²³ U.S. Census Bureau, Computer and Internet Use in the United States: October 2007, Table 1. Available from <http://www.census.gov/population/www/socdemo/computer/2007.html>, verified on August 1, 2009.