

Report on the Generation and Potential Recycling of Fluorescent Lights

NC DENR

Division of Pollution Prevention and Environmental Assistance
Division of Waste Management

Introduction

Session Law 2007-550, Section 17 requires the Division of Waste Management and the Division of Pollution Prevention and Environmental Assistance within the Department of Environment and Natural Resources to report its findings and recommendations on the recycling of fluorescent lamps to the Environmental Review Commission. This report has been prepared in accordance with this requirement. Because fluorescent lights are substantially more energy efficient than incandescent bulbs, it is anticipated that their use will grow dramatically in the coming years, a trend encouraged by energy policies passed by the General Assembly in 2007, by the U.S. Congress, and by the actions of utilities, large retailers, and other parties. However, fluorescent lights all contain at least some amount of mercury, leading to the use of the term “Lamps Containing Mercury” or LCMs to describe these products. For shorthand, “LCMs” will be used in this report to refer to the full spectrum of fluorescent lights. An excellent overview of mercury use in lighting is available on the Website of the Northeastern Waste Management Officials Association (NEWMOA) at:

<http://www.newmoa.org/prevention/mercury/imerc/FactSheets/lighting.cfm>

Use and Generation of LCMs

Two main kinds of fluorescent lights are used in North Carolina:

- Long tubes, commonly found in commercial, institutional, and industrial applications in fixtures that include an exterior ballast (see Figure 1 below) – typically, these lamps come in 4 and 8-foot lengths.
- Compact fluorescent lights, or CFLs, that have a self-contained ballast (see Figure 2 below). Because CFLs are designed to be screwed into incandescent lamp fixtures, they are more often used in homes, and increasingly in commercial applications such as hotels.

Additional variations of LCMs are also sold and used, including circle and U-shaped lamps and high intensity discharge (HID) lamps. Although these LCMs also are subject to the same regulatory status and recycling situation as other LCMs, they represent a small portion of lamps. It is anticipated that any collection infrastructure, incentives or mandates that may affect tube lamps and CFLs will also benefit the diversion of other LCMs. Thus, the focus of this study is on tube lamps and CFLs. Figure 1 below shows a picture of typical tube LCMs and Figure 2 shows examples of CFLs.



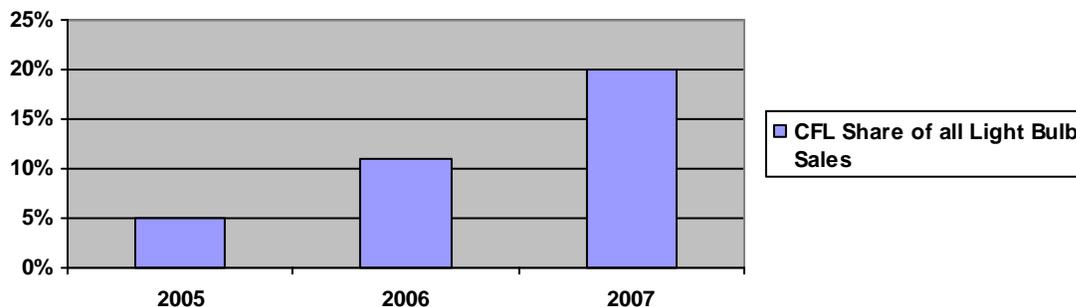
Figure 1: Tube or "Linear" Fluorescents



Figure 2: Compact Fluorescent Lights - CFLs

CFLs in particular are increasing in use due to their promise of energy savings in lighting. The three largest CFL manufacturers reported an increase in CFL sales of 65 percent in 2006. That growth accelerated in 2007. Wal-Mart's goal of selling 100 million CFLs in 2007 was met three months early.¹ Other large retailers like Home Depot and Lowes have also seen a dramatic rise in CFL sales, a trend they have encouraged with special promotion programs - Progress Energy supported such a program with Home Depot in 2007, offering \$1 discounts on CFLs until 200,000 were sold. According to a U.S. EPA estimate, total sales of CFLs increased to 290 million bulbs in 2007, rising to a record 20 percent of all U.S. light bulb sales. The graph below shows the EPA estimates of CFL market share over the past three years.

Graph 1: CFL Share of Light Bulb Sales



The transition to greater use of CFLs will be pushed further by the U.S. Energy Bill signed into law in December 2007. The bill does not outright ban the use of incandescent light but sets standards for bulbs to use 25-30 percent less energy by the years 2012-2014, and to be 70 percent more efficient by 2020. Currently, the predominant lighting technologies that can meet those standards are CFLs and LEDs, or light-emitting diodes. However, LEDs have almost no household market penetration at this point, leaving widespread use of CFLs as the most likely immediate choice to meet the Energy Bill standards. The U.S. follows Ireland, China, and Australia in passing measures that may effectively phase out the use of incandescent bulbs.

The table below extrapolates from national data the amount of LCMs sold, in use, and ready to be discarded each year in North Carolina.

¹ Conversation with Paul Abernathy, Association of Lighting and Mercury Recyclers (ALMR), 2/2/08.

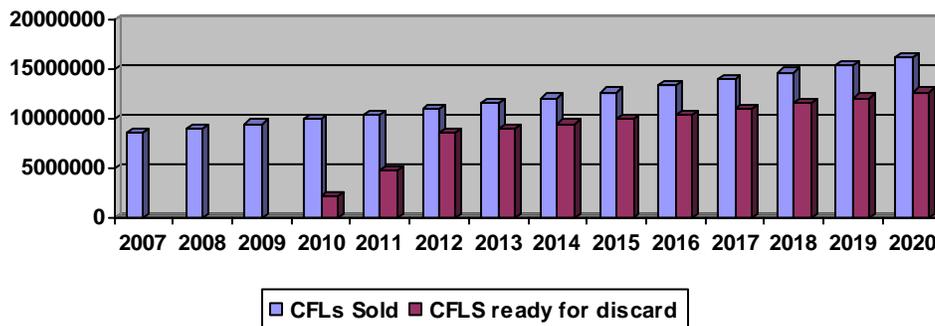
Table1: Estimated Sale and Use of LCMs, including CFLs

	National	North Carolina
Total LCMs sold	670 million ²	20 million
Total CFLs sold, 2007	290 million	8.6 million
Total Incandescent Bulbs Sold	1.45 billion*	43.5 million
Projected total of CFLs sold at 50 percent of all bulb sales	725 million*	21.5 million
Number of LCMs in use	4 billion	120 million
Number of LCMS ready for discard annually	514 million ³	15 million
Residential	142 million	4 million
Commercial	372 million	11 million

* Calculated extrapolating from EPA estimate of 2007 CFL sales reaching 20 percent of all bulb sales.

One of the beneficial features of CFLs is their relative durability, lasting 5 to 7 years in use life, much longer than a standard incandescent bulb. Because of this durability, it is difficult to accurately project actual discard rates. However, Graph 2 below shows one scenario based on the estimated sales of CFLs in North Carolina with an assumed 5-year use life per bulb. The data assumes a 5 percent growth rate per year in CFL sales, although recent sales trends exceed that growth rate. As the graph shows, by 2020, North Carolina will have approximately 12.7 million CFLs ready to be discarded on an annual basis.

Graph 2: Estimate of the Sale of CFLs and Generation of Discarded CFLs



Mercury in LCMs

All fluorescent lights require some amount of mercury to be able to function. Manufacturers of LCMs are making strides in reducing the amount of mercury in the lights but will not be able to eliminate it altogether. The disposal of LCMs thus poses a risk of release of mercury into the environment. The recycling of LCMs helps reduce these potential releases.

² E-mail from Paul Abernethy of ALMR.

³ ALMR, "National Mercury-Lamp Recycling Rate and Availability of Lamp Recycling Services in the U.S." Available at: <http://www.lamprecycle.org/>.

Members of the National Electrical Manufacturers Association (NEMA), which includes all four of the leading manufacturers of LCMs, have agreed to a 5-milligram ceiling for CFLs of 25 watts or less. According to NEMA, CFLs currently average between 3 and 4 mg per unit.⁴ For tube LCMs, NEMA reported in 2001 the average amount of mercury in a four-foot tube lamp was 8.3 milligrams.⁵ Figure 3 below shows the amount of mercury in a typical CFL relative to the size of a dime.



Figure 3: Amount of mercury in an average CFL

Manufacturers of LCMs have been successful in reducing the mercury used in their products and continue to try to decrease mercury levels. GE has said that it would like to bring the mercury content down from 5 milligrams per bulb to just 1 mg per bulb.⁶ Philips has announced that the 19 CFL products it sells through Wal-Mart contain 40 to 60 percent less mercury than the suggested NEMA level of 5 milligrams. Thus, over time, discarded CFLs will contribute less mercury per unit to potential environmental releases.

The numbers in Table 2 below multiply these average amounts of mercury by the estimates from Table 1 above for the number of lamps used, sold, and entering the waste stream. The table provides a projection of the amount of mercury in LCMs generated as discards in North Carolina, using an assumption that all of the tube lamps represented are 4-foot bulbs.

⁴ NEMA, "Recycling Household CFLs," September 2007. Retrieved from: http://www.nema.org/gov/env_conscious_design/upload/Recycling%20Household%20CFLs.%2009%2007.pdf.

⁵ NEMA, "Fluorescent and Other Mercury-Containing Lamps and the Environment," March 2005.

⁶ Planet Ark.org Web article, October 25, 2007. The article states that GE is "working to make incandescent bulbs more efficient. A more efficient incandescent bulb would introduce a new option for reducing energy use, as CFLs do, without the added risk of mercury contamination."

Table 2: Estimate of Mercury Content of LCMs in Use and Sold in North Carolina

	Number of LCMs in NC	Amount of Mercury in Milligrams	Amount of Mercury in Lbs.
Estimated Current Annual LCMs Ready for Discard	15 million	105,000,000	231.5
Residential Portion	4 million	28,000,000	61.7
Non-Residential (Commercial) Portion	11 million	77,000,000	169.8
Estimated Current LCMs in Use	120 million	840,000,000	1,851.9
CFLs Sold, 2007	8.6 million	34,400,000*	75.8
Projected total of CFLs sold at 50 percent of all bulb sales	21.5 million	64,500,000**	142.2

* Includes CFLs and tubes lamps together. For purpose of analysis, with tube lamps containing 8.3 mg and CFLs about 4 mg per bulb but tube lamps more prevalent, an average of 7 mg per LCM is used for mercury estimates.

** Assumes 4 mg mercury per bulb.

*** Assumes 3 mg per bulb as manufacturers reduce mercury content over time.

Predominant Non-Household Generation of LCMs

Non-residential (commercial, industrial, and institutional) sources use and discard the vast majority of LCMs in North Carolina. As seen in the table above, non-residential sources account for almost 75 percent of LCMs. In addition, because they use more tube lamps, which contain roughly twice as much mercury as CFLs, non-household sources generate by far the most LCM-related mercury. This ratio will likely change over time as more commercial and institutional sources and households buy more CFLs. But commercially generated tube lamps will continue to be the largest source of potential LCM mercury releases for at least the next decade.

Regulatory Status of LCMs

LCMs generated by households are not subject to hazardous waste rules in North Carolina, and therefore may be disposed of legally in solid waste landfills. LCMs generated by non-households, such as businesses, industries, and institutions (like schools and government entities), face a more complicated picture. According to hazardous waste and solid waste regulations, non-household generators cannot legally dispose of LCMs in a solid waste landfill unless they can provide documentation to show the waste LCMs are non-hazardous. However, it is expensive to conduct a hazardous waste test for LCMs and many, if not all of them, would likely fail. Thus, non-household generators have little practical choice except to not dispose of LCMs and recycle them instead.

To avoid subjecting non-households to costly and complex hazardous waste rules, EPA and North Carolina categorize LCMs as a “universal waste.” If generators follow some simple rules, they can manage universal wastes such as LCMs at much lower costs – in effect, this means using legitimate recycling services for LCMs and not allowing them to accumulate over time.

The Division of Waste Management and Division of Pollution Prevention and Environmental Assistance believe there is little awareness of the regulatory status or of recycling options for LCMs among many non-household generators. Therefore, many, if not most, generators across the state, particularly small businesses and institutions that have only small amounts or

occasional spent bulbs, are disposing of LCMs in their solid waste on a regular basis. While over the past five years the Division of Waste Management has cited 59 facilities for violations of LCM management standards and assessed more than \$35,000 in penalties, there remain probably thousands of businesses and institutions, such as schools and government agencies, who are in violation of state environmental regulations in how they handle their LCMs.

Disposal of LCMs in North Carolina

According to 2004 data from ALMR, national recycling rates are substantially higher for commercially generated LCMs than those generated by households. As indicated in Table 3 below, an estimated 98 percent of residential LCMs are disposed; by contrast, 71 percent of business-generated LCMs are disposed. Because non-households generate the vast majority of LCMs and the recycling rate for those materials is higher, it draws the total national recycling rate up to an estimated 24 percent.

Table 3: Estimated Recycling Rates By Source of LCM⁷

Source of LCM	Estimated Recycling Rate	Percentage Disposed
Residential	2%	98%
Commercial	29%	71%
All Generators	24%	76%

Although there is no specific data source for North Carolina, it is likely that these national estimates reflect the situation here or possibly overestimate the amount of current LCM recovery in the state. With a limited recycling infrastructure available to households in North Carolina (see “Recycling Options” below), the vast majority of spent residential CFLs and tube fluorescents are disposed. Additionally, as stated above, given the regulatory status of the materials, almost 3 out of every 4 non-household LCMs are disposed, indicating widespread technical violation of state hazardous and solid waste rules.

Mercury Releases from Disposal of LCMs

Disposed LCMs can release mercury into the environment in a number of ways. It is possible for mercury to leach from solid waste into groundwater, but landfill liners make this much less likely to occur (all municipal solid waste landfills are lined in North Carolina). Researchers with Oak Ridge National Laboratories found two main sources of mercury releases from solid waste disposal: 1) at the “working face” of the landfill as LCMs are crushed when dumped and compacted with trash, and 2) through landfill gas vents.⁸

As stated in a report by NEWMOA: “Once buried, some of the inorganic mercury in the landfill is converted by bacteria living there into a more toxic form, called organic or methylated mercury. Researchers have measured one organic mercury compound, dimethyl mercury, from gas destined for landfill venting at levels 1,000 times higher than what has been measured in open air (Lindberg, 2001).”⁹ The study notes that there can be a high degree of variability in

⁷ ALMR, “National Mercury-Lamp Recycling Rate and Availability of Lamp Recycling Services in the U.S.” Available at: <http://www.lamprecycle.org/>.

⁸ Northeast Waste Management Officials Association mercury fact sheet: www.newmoa.org/prevention/mercury/landfillfactsheet.doc.

⁹ Ibid.

how much and in what ways landfills can be sources of mercury. It should also be pointed out that LCMs are not the only mercury-containing products disposed of in solid waste – the waste stream also likely includes products such as mercury thermostats and thermometers, among other sources.

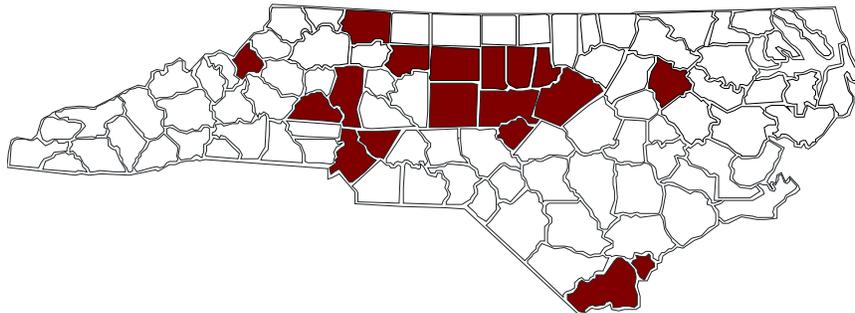
Recycling Options Available to Non-Households

The North Carolina Recycling Markets Directory lists 32 companies offering collection and recycling services for LCMs – about half of these companies are outside of North Carolina but include the state in their service area. Many of these collection companies offer on-site pick-up of materials (suitable mostly for large generators) and many also offer pre-paid mailing kits, which are especially practical for small generators. Some small quantity generators are also allowed to use a few of the local household hazardous waste (HHW) programs in North Carolina. In effect, there is no lack of commercial recycling service available to non-household LCM generators in the state and the markets are relatively competitive.

Recycling Options Available to Households in North Carolina

For some North Carolina citizens, physical recycling opportunities for LCMs are most readily available through HHW collection programs. Most HHW programs, which collect toxic and other materials such as pesticides, paint, cleaning chemicals, etc., will accept LCMs from the public. Eighteen HHW programs take fluorescent lights – see Figure 4 below showing a map of HHW programs in the state accepting LCMs. However, due primarily to the expense of HHW collection (at a statewide average of about \$1,226/ton), only a minority of counties in North Carolina have HHW programs.

Figure 4: Counties collecting LCMs in their HHW programs



For North Carolinians with no access to HHW programs, the only other identified option is the use of recycling kits supplied by LCM recyclers and other parties. For example, the U.S. Postal Service has recently announced a partnership with a leading manufacturer and a leading recycler of CFLs, Osram Sylvania and Veolia Environmental Services, to offer a kit called RECYCLEPAK for consumers to send in CFLs for recycling. The kit holds up to 12 CFLs. Consumers buy the kit on-line for a cost of \$15, pack the bulbs in the package's plastic liner, and then send it to Veolia via the USPS. At 12 bulbs per pack, the cost per bulb is \$1.25. Kits are also available for tube LCMs, with information on the service posted at:

<http://www.sylvania.com/Recycle/RecyclePak/>

One community in North Carolina, Buncombe County, has initiated a unique program using fire stations as collection points for LCMs. Fire stations were chosen because they are more conveniently located than the county's HHW center at the landfill and because they have the ability to address hazardous materials (HAZMAT) spills in case LCMs break during handling. From July 2007 through February 2008, 12 fire stations in Buncombe County have collected 3,675 LCMs, about 80 percent of them 4-foot tubes. There is no available cost data yet from the program, but Buncombe County originally budgeted \$60,000 for the program.

Other Potential Collection Methods

To date, there are no known alternatives for households in North Carolina other than HHW programs and self-mailed kits. A few other options may develop in the state over time, possibly encouraged by legislation, incentives, national product stewardship agreements, or other mechanisms.

One such potential option is for LCM retailers to offer collection programs to their customers. This method is being tried in a few other states, often through partnerships between a number of parties, such as state and local governments, utilities, utility commissions and certain retail stores.¹⁰

One example of such a program is in Vermont where, since August 2005, the state has conducted collection through True Value Hardware Stores and other retailers who voluntarily set up collection containers in their businesses. The program has collected 5,800 CFLs and 170,000 linear feet of LCMs at a cost of \$.35/CFL and \$.05/linear foot of bulb. It is financed through Supplemental Enforcement Program (SEP) monies. With two years of funding left, Vermont is currently looking for other long-term funding for this program. The returned bulbs do not result in additional liability for retailers as they already are selling the bulbs in their stores.

Maine's program is led by an arm of the state's Public Utilities Commission, called Efficiency Maine, in partnership with the Department of Environmental Protection (DEP). It uses retail stores as drop-off points for consumers to recycle CFLs for free – to date more than 200 retail sites are participating. Recycling costs per CFL are around \$1.00, which is financed by Efficiency Maine.

In Minnesota, a program is run through a partnership between independent hardware stores and a major lamp recycler, financed largely through fees charged to consumers using the system. Some of the utilities in Minnesota provide coupons to consumers to cover part of the costs.

At least one major chain store, IKEA, has made a corporate commitment to collect bulbs brought in by customers. To date, no retailers in North Carolina have been identified as accepting LCMs from the public for recycling. IKEA does not have a store in the state, and none of the other large retailers such as Lowe's, Wal-Mart, or Home Depot, nor any smaller chains such as ACE Hardware, have offered collection.

¹⁰ For a good overview of programs in various states, see Alexandra Behringer's article on the Energy Pulse Web site: http://www.energypulse.net/centers/article/article_display.cfm?a_id=1646.

Costs to Recycle LCMs

LCM recycling is an established industry with a number of different kinds of firms, including hazardous waste management companies that offer LCM recycling as part of a full range of services, small regional collection companies that specialize in materials like LCMs, and large national mercury recyclers that provide both collection and full processing of LCMs. The two main methods of collection for non-household or commercial generators are pick-up at the generator's facilities and use of self-mailing, pre-paid kits that generators fill and send to recyclers. In this respect, for small generators in particular, the LCM recycling service industry has provided a convenient way to avoid disposal of bulbs, albeit at a cost.

DPPEA conducted Web-based and phone research of LCM recyclers on the costs charged to manage the materials through use of kits, which depend on a number of variables, including the amount and kind of LCMs being generated. Table 4 shows a summary of this research.

Table 4: Price of Recycling LCMs Using Vendor-Provided Kits

Type of Lamp	Median Cost/Lamp	Average Cost/Lamp	Lowest Cost	Highest Cost
4 ft. tube	\$1.77	\$1.62	\$.55	\$3.27
8 ft. tube	\$3.13	\$3.03	\$1.10	\$5.93
CFLs	\$1.13	\$1.49	\$.75	\$2.80

Price can be less for larger quantities, and recycling costs for “T8” tube lamps tend to be roughly 30 percent cheaper than “T12” lamps, both for 4 and 8-foot variations (T8 lamps are smaller in diameter). As noted above, the new U.S. Postal Service program has a calculated cost of \$1.25 for CFLs. Figure 5 below shows a picture of a typical set of mail-in kits offered by LCM recyclers.



Figure 5: Example of LCM mail-in recycling kits.

Large generators of discarded LCMs can achieve a much lower cost because they can accumulate sufficient quantities for efficient handling and transport of the materials. Statewide systems that achieve economies-of-scale also can be less costly. The Maine statewide program

reportedly costs about 69 cents per lamp.¹¹ Massachusetts has established a statewide contract that can be used by state and local agencies, which helps support the state’s statutory disposal ban on LCMs. In the Massachusetts contract, the cost to recycle CFLs is \$.36 per lamp, and about \$.06 per foot for tube lamps, or about \$.24 for a 4-foot lamp and \$.48 for an 8-foot lamp.

HHW programs should also be able to achieve efficiencies that make the price of recycling LCMs more affordable. As part of this study, a number of the HHW programs around the state were contacted to get data on what they are currently being charged for LCMs captured in their collection efforts. From the information gathered, it appears that HHW programs experience recycling costs half or less than the cost of the kit recycling options in Table 4 above. Table 5 shows some examples of these costs for specific communities across the state.

Table 5: Sample prices paid by Local Government HHW programs for recycling LCMs

Community	Cost for 4-foot lamp	Cost for 8-foot lamp	Cost per CFL
City of Albemarle	\$.62	\$.90	
Avery County	\$.59	\$.98	
Brunswick County	\$.86*		\$1.08
Cabarrus County	\$.16	\$.33	\$.30
Catawba County	\$.65	\$.90	
Chatham County	\$.45	\$.65	
City of Greensboro	\$.65		
Iredell County	\$.65	\$.85	
Mecklenburg County	\$.58		
New Hanover County	\$.60	\$.70	
Wake County	\$.44	\$.62	

* Brunswick County’s cost is an average per lamp with no differentiation between lamp types.

With only two jurisdictions reporting widely divergent specific costs for CFLs, DPPEA called one of the main HHW vendors in North Carolina to check pricing. The company reported that it is seeing very few CFLs so far in HHW programs, so costs are currently being absorbed in general HHW program charges. However, if the number of CFLs starts to increase, the vendor believes the cost per bulb would be about \$.40, which is close to the price in the Massachusetts statewide contract.

A projection is made in Table 6 on the cost to recycle all of the CFLs sold in North Carolina in 2007 and projected to be sold if CFLs reached 50 percent of all bulb sales. This estimate represents the possible expense that local governments would experience if all the CFLs flowed through HHW programs that cover the whole state. In that respect, the “Total Cost” column constitutes the highest possible costs because not all counties have such programs, not all households participate in HHW programs and some households will choose other options (like the U.S. Postal Service mail back). In other words, it is highly unlikely that HHW programs will achieve 100 percent recovery, so Table 6 also shows scenarios of 50 percent and 25 percent of recovery.

¹¹ Conversation with Paul Abernathy, 1/28/08.

Table 6: Projection of Recycling Costs for CFLs recovered through HHW programs in NC

	Amount of CFLs	Price/CFL	Total Cost, 100% Recovery	Cost, 50% Recovery	Cost, 25% Recovery
CFLs Sold, 2007	8.6 million	\$.40	\$3.44 million	\$1.72 million	\$.86 million
Projected total of CFLs sold at 50% of all bulb sales	21.5 million	\$.40	\$8.6 million	\$4.3 million	\$2.15 million

It is important to note that if North Carolina succeeded in capturing a large portion of LCMs generated annually, it is quite conceivable that economies-of-scale, collection efficiencies, and the attraction of recyclers to the state would lower the cost over time. As noted above, the Massachusetts contract costs 10 percent less than the 40-cent/CFL figure used in Table 6.

Mercury Reduction Benefits from LCMs

Does the possible widespread disposal of LCMs mean that North Carolina is doing more harm than good in using these products? This question is difficult to answer, but it has long been pointed out that the energy efficient nature of LCMs means less burning of coal in electrical power plants, which is one of the chief sources of mercury emissions.

To help address this issue for North Carolina and for purposes of this report, the Division of Air Quality (DAQ) has estimated the amount of mercury generated from coal-burning power plants, taking into account the beneficial affects of the Clean Smokestacks Act. By 2010, DAQ projects that coal-related mercury emissions will be 37,549 ounces per year, or a little over 1 billion milligrams. Using these figures to calculate mercury emissions per kilowatt-hour and the estimate that 60.5 percent of all electrical generation is from coal, DAQ finds that a 15-watt CFL (equivalent to a 60-watt incandescent bulb) will reduce 3.73 milligrams of mercury emissions over its useful life. A 23-watt CFL (equivalent to a 100-watt incandescent) will reduce 6.38 milligrams of mercury emissions.

Combining and then averaging these two figures produces an estimate of 5.06 milligrams of mercury reduction per CFL. This number is slightly higher than the manufacturer ceiling of 5 milligrams of mercury per CFL and 40-60 percent higher than the NEMA estimate of between 3 and 4 mg per currently produced CFL. One conclusion based on this calculation is that if all CFLs used or sold in North Carolina were disposed and subsequently released all of their mercury in the disposal process, there would still be a net reduction in mercury emissions from using these energy efficiency products. If CFLs are then recovered in any substantial way in North Carolina, the mercury emission gap would be even more favorable toward use of the lamps. Thus, it appears that the potential disposal of mercury-bearing CFLs should not deter the state from encouraging their use.

However, it is also important to note that because tube fluorescents contain 2 to 3 times the amount of mercury as CFLs, the disposal/emissions balance may not be as favorable. This further reinforces the priority of maximizing recovery of non-household tube LCMs.

Role of Utilities in the LCM issue

Both Duke Energy and Progress Energy were contacted for this report to explore their perspectives on LCMs and to identify any plans or recommendations they have in regard to the recycling and disposal issue.

Because of the energy efficiency aspects of fluorescent lights, both utilities are involved in promoting the use of CFLs. Duke has extensive experience with programs in Indiana and Ohio, including partnerships with Wal-Mart and Sam's Club to boost the sale of CFLs. The company includes CFLs in its Energy Efficiency Starter kits. Progress Energy also wants to see wider use of CFLs and, as noted above, recently partnered with Home Depot to provide coupons for purchase of the lamps.

In regard to the management of end-of-life LCMs, the utilities have slightly differing perspectives. Duke Energy sees its primary role as encouraging its customers to use existing local government HHW programs. For Duke, the issue of financing a collection infrastructure is one that is national in scope and that may require solutions on that level. Progress Energy posts information on the benefits of CFLs on its Web site, which in turn refers to EPA information on recycling options. The company also refers customers to the national recycling information network, Earth 911. For its Wake County customers, Progress provides basic information on the County's HHW collection program. Like Duke Energy, Progress has not been actively involved in addressing recycling issues, but supports the development of a network of recycling options that in turn helps facilitate the greater use of CFLs.

Both Duke and Progress are also exploring the possible expanded use of LEDs. Duke is testing use of LEDs in parking lot lights, but sees limited availability and current expense as a barrier to their use in the mass market. Progress Energy is having preliminary discussions with LED manufacturers to explore how to increase use of LED lighting and sees a role for the state in encouraging wider adoption of LED products.

Examples of Utility Involvement in LCM Recycling in the U.S.

The approach of Duke Energy and Progress Energy are similar to most utilities in the U.S. However, some utilities have taken proactive steps in regard to LCM recycling. A number of small utilities in Wisconsin and Illinois have helped sponsor public collection programs with hardware stores. ComEd, a large Midwest utility, conducted a collection program in late 2007 in partnership with Illinois EPA and Ace Hardware Stores. In Minnesota, XCel Energy partners partnered with retailers to help subsidize LCM collection through county collection centers. In Oregon, a 2005 pilot collection program involving counties, utilities, and retailers was successful enough to be continued into a permanent program in which (because of the volume being collected) overall bulb recycling costs have dropped over time. In a variation of direct utility involvement and as noted above, Efficiency Maine, the energy division of the state Public Utilities Commission, runs a statewide program in cooperation with retailers.

Clean Up of Broken LCMs

When an LCM is broken, mercury may be released as a vapor and be potentially harmful to anyone who is exposed. A number of agencies and other organizations have specified different

variations of clean-up protocols, and the work on this issue is continuing - for example by many of the states in EPA Region 1 in the northeastern U.S. It will be important for North Carolina to monitor developments on this issue and provide information to its citizens on how to properly clean up broken LCMs. For now, North Carolinians can be referred to the EPA Web site for recommendations on what to do if a fluorescent lamp breaks:

<http://www.epa.gov/mercury/spills/index.htm#fluorescent>.

Other Mercury Problems with LCMs

The problem of mercury in discarded LCMs is only one element of the mercury dilemma with fluorescent lights. China is by far the largest manufacturer of fluorescent lights, using 64 tons of mercury each year to make 30 billion lamps, including 14 metric tons of mercury to make 1.7 billion CFLs. However, according to one expert, because of the manufacturing methods that China employs, a great deal of mercury does not actually make it into the bulbs themselves and is instead released as emissions or pollution.¹²

Other Common Consumer Product Sources of Mercury

LCMs are not the only commonly-used consumer products that contain mercury. For example, mercury thermostats are still used in North Carolina and contain 500 times the amount of mercury as a typical CFL.¹³ Similarly, typical mercury thermometers use at least .5 grams of mercury, 100 times more than a CFL.¹⁴ For many consumer products like thermostats and thermometers, non-mercury alternatives are widely available and affordable. A number of states have taken steps to ban the sale of the mercury-bearing types of these products, and North Carolina could consider similar measures – for a list of state laws on mercury products, see the EPA Web site at: <http://www.epa.gov/epaoswer/hazwaste/mercury/laws.htm>.

The major manufacturers of thermostats have set up a third-party organization – the Thermostat Recycling Corporation – to collect mercury thermostats back through HVAC installers and wholesalers. The Product Stewardship Institute, of which North Carolina is a member state, has conducted a number of projects on this issue, including assisting with successful public collection programs in Indiana and Oregon.

One area of concern for both fluorescent lights and thermostats is the generation of these materials in building demolition and remodeling. Most construction and demolition (C&D) debris in North Carolina goes to unlined C&D landfills with fewer environmental controls than lined municipal solid waste (MSW) landfills. North Carolina may want to consider steps to ensure mercury-containing thermostats and fluorescent lights generated in building demolition and remodeling are properly removed and handled to avoid disposal.

¹² Dave Lennett, Fluorescent Light conference call convened by the Mercury Policy Project, December 10, 2007.

¹³ Calculated using thermostat fact sheet from NEWMOA:

<http://www.newmoa.org/prevention/mercury/imerc/FactSheets/thermostats.doc>.

¹⁴ <http://www.epa.gov/epaoswer/hazwaste/mercury/con-prod.htm>.

Recommendations

If North Carolina's main goal is to reduce the amount of mercury released from LCM disposal, the state should first concentrate on ensuring widespread recovery from non-household sources. This approach is best pursued through two complementary strategies:

- 1) Increased outreach and educational efforts to make non-households fully aware of their regulatory obligations and recycling options for LCMs.
- 2) Increased enforcement of hazardous and solid waste regulations on non-household generators of LCMs and on the landfills that accept non-household LCMs for disposal.

If North Carolina can increase the recovery of LCMs from non-households from the current recycling rate of about 29 percent to 80 percent, the state will prevent approximately 37 million milligrams or 85 pounds of mercury from disposal each year. However, positions dedicated to this purpose do not currently exist in the Department of Environment and Natural Resources and to accomplish these tasks, the General Assembly would need to consider establishing positions within DENR focused on the non-household LCM issue.

To boost the recovery of household-generated LCMs, North Carolina should encourage the expansion of HHW programs. Permanent HHW programs provide a baseline option for households to properly manage their discarded fluorescent lights.

However, because HHW programs tend to have low public participation rates, North Carolina should also identify methods to increase the convenience of fluorescent light recycling by spreading services to other venues, e.g., household use of kits and possibly retailer take-back programs. In particular, due to the success of such efforts in other states, North Carolina should provide incentives to encourage partnerships between utilities and retailers to provide fluorescent light recycling opportunities to citizens.

To help foster these partnerships, the General Assembly should also consider convening a workgroup involving the Utilities Commission, the utilities, and representatives of the retail, local government and environmental communities to identify and recommend measures and funding sources to expand fluorescent light recycling in North Carolina.

The General Assembly should also require all state agencies, including universities, community colleges, and schools to begin recycling of all their spent LCMs and to submit a one-time report on their efforts by March 1, 2009.

In addition, because many of the solutions may best be on a national scale, North Carolina should support the efforts of the Product Stewardship Institute and others to conduct a dialogue with manufacturers, retailers, state and local governments and other stakeholder on a national system for recovery of LCMs.

To address other consumer products with larger amounts of mercury, the General Assembly should consider a ban on the sale of mercury-containing thermostats and thermometers in North Carolina. All mercury containing products, including fluorescent lights should also be banned from disposal in *unlined* landfills – i.e., C&D landfills. Alternatively or in conjunction, the

General Assembly should consider legislation that requires the removal of all fluorescent lights and thermostats before a building is demolished.

Encouraging the Use of LEDs

The long-term challenge of managing the mercury in LCMs may be at least partially met through an accelerated use of even more efficient, mercury-free lighting in the form of LEDs. The measures North Carolina could consider include:

- Requiring use of LEDs in state-owned facilities where applications are feasible.
- Eliminating or temporarily suspending sales taxes on LEDs.
- Providing tax credits for businesses and industries that switch to LEDs - for example, for up to half the cost of installation.
- Providing economic incentives to manufacturers of LEDs to develop LED products for the mass home market.

Appendix A: Requirement for Development of Program Proposal on Fluorescent Lights by NC DENR

SECTION 17. The Division of Waste Management and the Division of Pollution Prevention and Environmental Assistance of the Department of Environment and Natural Resources shall jointly develop a proposal for a recycling program for fluorescent lamps. The program will be developed so as to ensure that substantially all of the mercury contained in fluorescent lamps will be recovered so as to facilitate a phase-out of incandescent lamps without damage to public health and the environment from the increased use of mercury lamps as replacements for fluorescent lamps. The Department of Environment and Natural Resources shall report its findings and recommendations, including legislative proposals and cost estimates, to the Environmental Review Commission on or before 1 March 2008.