Environmental Petition submitted to the Auditor General of Canada
June 2008

Environmental and Health Concerns Associated with Compact Fluorescent Lights

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BACKGROUND INFORMATION

With growing concern about climate change, governments around the world are looking for ways to reduce greenhouse gases and to reduce consumption of fossil fuels. One simple solution that has gained government support is phasing out energy *inefficient* light bulbs and replacing them with energy *efficient* ones. The most popular bulbs that are commercially available and affordable are compact fluorescent lights (CFL). CFL bulbs use approximately 75% less energy than incandescent light bulbs and last longer. At first glance this seems like a good way to conserve energy and to protect our environment. However, there are a number of serious problems associated with CFL bulbs that need to be considered and corrected. These include mercury content, emission of UV radiation, emission of radio frequency radiation, and generation of dirty electricity. There is the additional concern that these lights are making some people ill. This includes those who suffer from migraines, skin problems, epilepsy, and electrical sensitivity (1,2,3,4).

CFL BULBS CONTAIN MERCURY

Mercury is a known neurotoxin and can be dangerous once it is released into the environment. Light bulbs contain approximately 5 milligrams of mercury (although some manufacturers are trying to reduce that amount). The Canadian Water Quality Guideline (CWQG) to protect freshwater life is 26 nanograms of inorganic mercury per litre of water (5). What this means is that one light bulb could contaminate 190,000 liters of water to levels that exceed our water quality guidelines! With thousands of bulbs sold around the country and inadequate disposal facilities we are setting ourselves up for a mercury time bomb.

Mercury is the most volatile of all of the metals and its propensity to volatilize from landfill sites is high. Much of this mercury ends up in the Canadian arctic, where levels are known to be increasing and are of considerable concern (8). Mercury is so ubiquitous that we have advisories in Canada for eating mercury-contaminated fish in lakes (9).

Mercury can be released into the environment if the bulb is accidentally broken in the home, incinerated, or disposed at a landfill site.

Accidental Breakage: The US EPA has information on their website on how to clean up a broken CFL (6). It includes opening windows, wearing rubber gloves, and double-bagging the broken pieces (refer to Appendix A).

Disposal: CFLs need to be deposited at a toxic waste facility. Few Canadians are aware of this. Some information on proper disposal is available at Natural Resources Canada (NRCan) website on consumer questions (7). What is disturbing about information provided by NRCan is that they do not REQUIRE proper disposal of these bulbs. In response to a question about correct disposal of CFL, they state:

> *"Just like paint, batteries, thermostats and other household chemicals, compact fluorescent bulbs should be disposed of safely. Homeowners are encouraged to take advantage of local disposal programs for CFLs, where available. Governments are working with CFL manufacturers and major Canadian retailers to expand recycling options.*
>
> *Many municipalities have programs that accept household products that contain mercury. Some have implemented collection programs specifically for mercury-containing switches such as those found in your car, while others collect mercury-containing products as part of their household hazardous waste programs. Contact your municipality to find out about local disposal options.*
>
> *ENERGY STAR qualified CFLs have a warranty. If the bulb fails within the warranty period, return it to your retailer."*

This response is woefully inadequate. Proper disposal of mercury should not be a matter of chance it should be regulated. If the government is going to ban energy inefficient lights then they need also regulate the safe disposal of the toxic alternatives! If toxic waste disposal facilities are not available in a particular community then the retail story selling the product should accept the return of that produce for disposal or recycling. We do not put lead in paint any more and we should not put mercury in light bulbs. Energy efficient mercury-free bulbs are available but are not yet affordable. Until that day arrives and we can use bulbs without mercury, at the very least we should be safely disposing light bulbs that contain mercury!

The Canadian Council of Ministries of the Environment (CCME) established Canada-wide Standards (CWS) for mercury-containing lamps in 2001. The CWS is aiming for a 70% reduction by 2005 and an 80% reduction by 2010 in the average content of mercury in all mercury-containing lamps sold in Canada, from a 1990 baseline (10).

According to a 2005 Progress Report (11) of the CWS we are not doing well. Below are some examples from this document.

1. For the period 1999 to 2002 less than 5% of the fluorescent lamps are being recycled in **Alberta**. And this refers to tube fluorescent lamps, not CFL.
2. **Nova Scotia** has been unable to establish a program for recycling due to "relatively small volumes of mercury-containing lamps and a disperse population base." Clearly, the "relatively small volume" no longer applies as incandescent lamps are being phased out.
3. In **Nunavut** one method of disposal is "crushing of fluorescent tubes, collecting and shipping the material to disposal facilities." As soon as the tubes are crushed the mercury is released into the environment. Clearly this is not an undesired method of disposal.
4. **Ontario** started lamp recycling in several government buildings and, as of 2005, has recycled 30,000 lamps and has captured 1 kg of mercury. Clearly this program needs to be extended beyond government buildings.
5. **Saskatchewan** does not have lamp recycling companies and all such materials must be shipped out of province for processing with their related transportation energy costs.
6. **Prince Edward Island** has made the most progress. Mercury-containing lamps cannot be placed curbside. They must be taken to one of six Waste Watch Drop-off Centers in the province where they are collected for disposal. Mercury-containing lamps must be removed from buildings prior to demolition. However, it is not clear how the Waste Watch Drop-off Centers dispose of these bulbs and how successful the drop-off program is? In order words, what percentage of the bulbs are left at curbside for dumping.

The CCME clearly recognizes the importance of keeping mercury out of the environment, but their progress in recycling mercury-containing light bulbs has been minimal. Even if the amount of mercury is reduced in light bulbs, the fact that Canadians are required to use these light bulbs means that we are losing the battle of mercury in the environment since a much larger amount of mercury-containing light bulbs are being used now than back in 1990. Unless we have appropriate recycling and proper disposal of all fluorescent lights and other lights that contain mercury (mercury discharge bulbs) we will lose the battle and will introduce more mercury into the environment with serious consequences to the health of wildlife and humans.

Arguments that emission of mercury via light bulbs is much less than the burning of coal is a red herring since in Canada we have other sources of energy including hydroelectric, natural gas, oil, nuclear, wind, and solar. We need to keep mercury levels as low as possible from ALL sources. Clearly mercury is a toxicant that should not be released into the environment.

CFL BULBS EMIT UV RADIATION

Fluorescent light bulbs contain mercury, which emits UV radiation when it is electrically excited. This UV radiation then interacts with the chemicals on the inside of the bulb to generate light. According to Philippe Laroche, Media Relations Officer for Health Canada, compact fluorescent light bulbs, unlike tube fluorescent bulbs, do not have prismatic diffusers to filter UV radiation. "*Therefore, there may be skin sensitivity issues, especially in people with certain skin diseases*."

Interestingly, the British Dermatological Association has spoken out against CFL bulbs because their patients have adverse reactions to them (3). They are asking the UK government to allow people with skin problems to continue using incandescent light bulbs once the ban for energy inefficient bulbs becomes law.

Not all CFL are the same. GE produces a low-UV bulb called Saf-T-Gard (registered Trade mark) for dark rooms. So the technology to produce safer bulbs is available and should be required for all bulbs. Why do we have bulbs on the market that emit UV when technology preventing this is readily available?

CFL BULBS EMIT RADIO FREQUENCY RADIATION

CFLs emit radio frequency radiation at levels that may interfere with various types of wireless technology. General Electric acknowledges this and puts the following notice on the back of product packaging for all GE electronically ballasted CFLs:

"*This product complies with Part 18 of the FCC Rules, but may cause interference to radios, televisions, wireless telephones, and remote controls. Avoid placing this product near these devices. If interference occurs, move the product away from the device or plug either into a different outlet. Do not install this product near maritime safety equipment or other critical navigation or communication equipment operating between 0.45-30MHz."*

Interference with wireless telecommunication technology comes under the jurisdiction of Industry Canada. The type of interference generated by CFL falls into several regulatory categories of "interference" as follows (12):

1. *Electromagnetic Compatibility* - The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.
2. *Radio Frequency Interference* - Any modification to the reception of sound or picture signals that make them unacceptable (includes Broadcast Interference - BCI, and Television Interference - TVI)
3. *Electromagnetic Disturbance* - Any electromagnetic phenomenon (or transmission) which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter.

Despite the potential interference of CFL with wireless technology, there is no mention of or reference to compact fluorescent lighting on the Industry Canada web site. Is industry Canada aware of radio frequency interference and, if they are, how do they propose to minimize it?

CFL BULBS GENERATE DIRTY ELECTRICITY

Poor power quality is commonly referred to as "dirty electricity" and is defined as deviations in the magnitude and frequency of the sinusoidal waveform. According to Hydro One (13)

> "*It [power quality disturbance] can take many forms, such as: voltage sag, phase unbalance and voltage swells, transient disturbances, momentary interruptions, and long-term steady state waveform distortions*."

CFLs produce *transients* that contribute to poor power quality on electrical wires. According to General Electric (GE) their typical electronically-ballasted CFL operate in the 24-100 kHz frequency range. This range is within the radio frequency band of the electromagnetic spectrum and is classified as Intermediate Frequency (IF) by the World Health Organization. There is concern about electromagnetic interference (EMI) associated with IF and recently studies have shown that IFs are biologically active and can have adverse health effects (14, 15).

Figure 1 provides an example of the dirty electricity generated by a compact fluorescent light bulb in comparison to an incandescent light bulb. Readings were taken through the air (0.5 m from bulb) and on the electrical wire (after passing through a ubiquitous filter that removes the 60-Hz frequency). The waveform through the air is radio frequency radiation that can contribute to electromagnetic interference (EMI), as mentioned above, and the waveform on the wire is dirty electricity.

Not all CFL are the same some generate more dirty electricity than others. In a recent study (16) the values for dirty electricity ranged from 47 to 1450 GS units compared with a background value (with lights off) between 54-58 GS units. Clearly technology exists to produce CFL that do not generate dirty electricity. What is Health Canada doing to require all bulb manufacturers to adhere to the best practices and manufacture light bulbs that do not compromise power quality on electrical wires?

In addition to the effects of poor power quality on sensitive electronic devices, dirty electricity has been shown to adversely affect human health. A recent study of cancer clusters in a school in California associated the increased risk of cancer among teachers to dirty electricity (15). Teachers who taught in classrooms where the dirty electricity was above 2000 GS units had a 5-fold increase risk of cancer (risk ratio 5.1) that was statistically significant. Teachers who never taught in those classrooms had a risk ratio of 1.8. The CFL bulbs in Figure 1 generated almost 300 GS units of dirty electricity. Clearly a house full of such bulbs could have serious health consequences.

In a Wisconsin school experiencing sick building syndrome, once the power quality was improved with power line filters plugged into electrical outlets student and teacher health improved. Of the 37 students who suffered from asthma and used inhalers on a daily basis only

3 required them and only for exercise-induced asthma once the dirty electricity was eliminated (17).

Studies with diabetics and people who have multiple sclerosis report an improvement in symptoms that coincide with improved power quality in homes (18).

If some CFLs produce dirty electricity and if dirty electricity is associated with ill health, clearly these bulbs need to be redesigned.

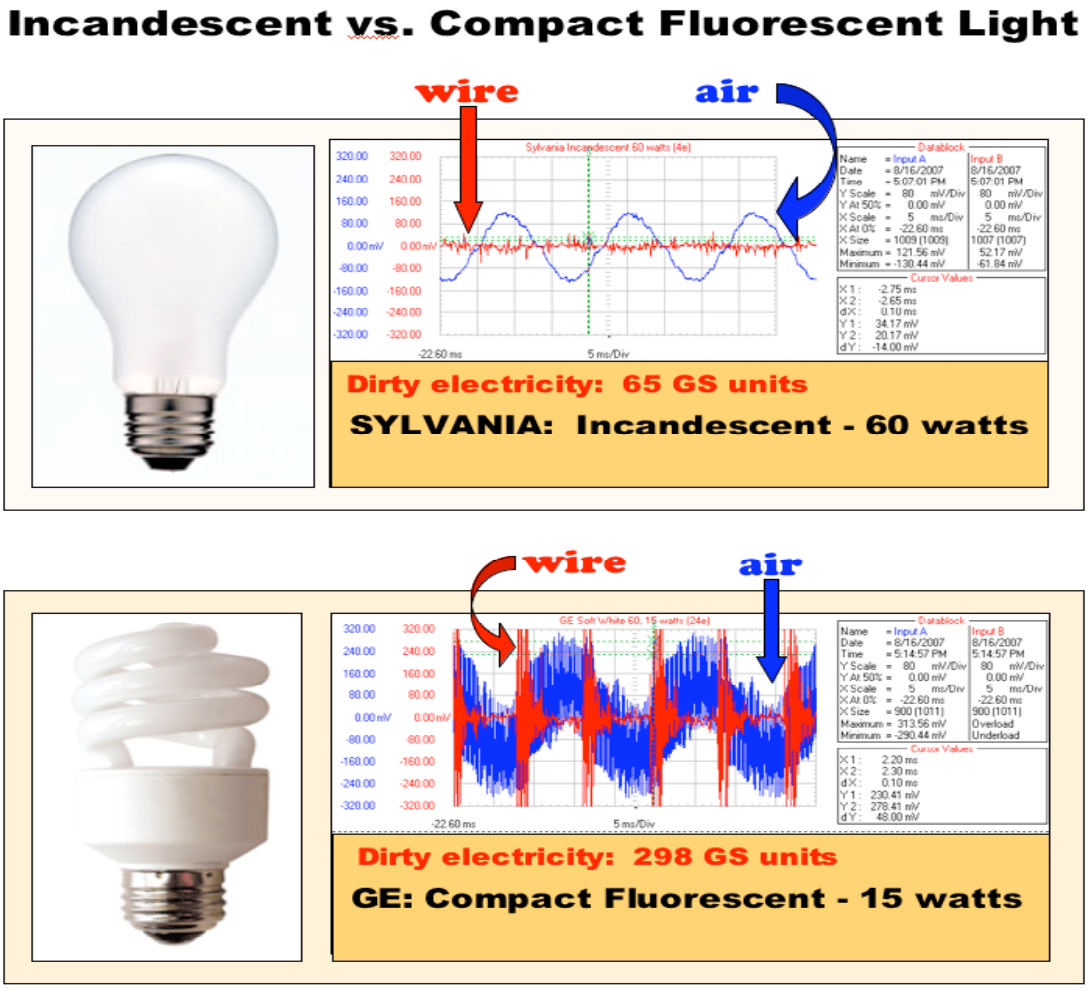


Figure 1. Waveforms generated by an incandescent light bulb and a compact fluorescent light bulb. Input A: 0.5 meters from bulb. Input B: on wire after passing through a ubiquitous filter that removes the 60-Hz cycle. Readings taken on a Fluke 196 Scope Meter.

CFL BULBS ARE MAKING PEOPLE SICK

One illness that Natural Resources Canada seems to accept that is exacerbated by CFL is Irien Syndrome. Below is a quote from the NRCan website (19):

"Research has shown that fluorescent lights can intensify the problems associated with Irien Syndrome (also known as Scotopic Sensitivity Syndrome), a perception problem that affects a person's ability to read. Incandescent lamps, on the other hand, have proven to be the most favourable source of artificial light for people with Irien Syndrome. The Government of Canada's proposed phase-out of inefficient lamps will not ban any particular technology but will regulate minimum efficiency levels for lamps. This means that incandescent lamps that meet the minimum requirements – such as a super-efficient incandescent lamp currently under development – will still be available to consumers.

The objective of the Government's regulatory proposal is not to cause hardship for Canadians but to ensure that there are practical and effective replacements for inefficient lamps. Prior to setting minimum efficiency levels, NRCan will consider many issues, including the economic, safety, environmental and health needs of Canadians. Exclusions to the standard will be identified, if necessary."

Clearly, others are also affected by these bulbs as mentioned above for power quality.

A growing population is developing symptoms of electrohypersensitivity (EHS), which the WHO defines as (20):

". . . a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs). . . . Whatever its cause, EHS is a real and sometimes a debilitating problem for the affected persons . . . Their exposures are generally several orders of magnitude under the limits in internationally accepted standards."

As many as 3% of the population in Sweden has severe symptoms of EHS (21) and another 35% has moderate symptoms of EHS (18) which includes the symptoms in Table. 1.

A survey was conducted on line to determine how self-proclaimed electrically sensitive people respond to different types of lighting. Participants were asked to identify their degree of electrohypersensitivity and to identify their symptoms when they were exposed to various types of lighting. Figure 3 shows their results for headaches. The highest percentage of headaches was reported for exposure to both tube and compact fluorescent light bulbs among those who classify themselves as either moderate sensitive to extremely sensitive. Results for other symptoms were similar.

Individuals who suffer from extreme sensitivity when exposed to electromagnetic frequencies also complain they develop headaches, eye problems, become irritated, confused, anxious, depressed and experience poor memory, dizziness, nausea, skin problems, heart problems, and poor sleep when they are exposed to either tube fluorescent lighting or CF bulbs (16).

Table 1. Symptoms of Electrohypersensitivity or Radio Wave Sickness (7).

Neurological: headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint paint, leg/foot pain, flu-like symptoms, fever. More severe reactions can include seizures, paralysis, psychosis and stroke.
Cardiac: palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath
Respiratory: sinusitis, bronchitis, pneumonia, and asthma
Dermatological: skin rash, itching, burning, and facial flushing
Ophthalmologic: pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, and cataracts
Others: digestive problems; abdominal pain; enlarged thyroid, testicular/ovarian pain; dryness of lips, tongue, mouth, eyes; great thirst; dehydration; nosebleeds; internal bleeding; altered sugar metabolism; immune abnormalities; redistribution of metals within the body; hair loss; pain in the teeth; deteriorating fillings; impaired sense of smell; ringing in the ears.

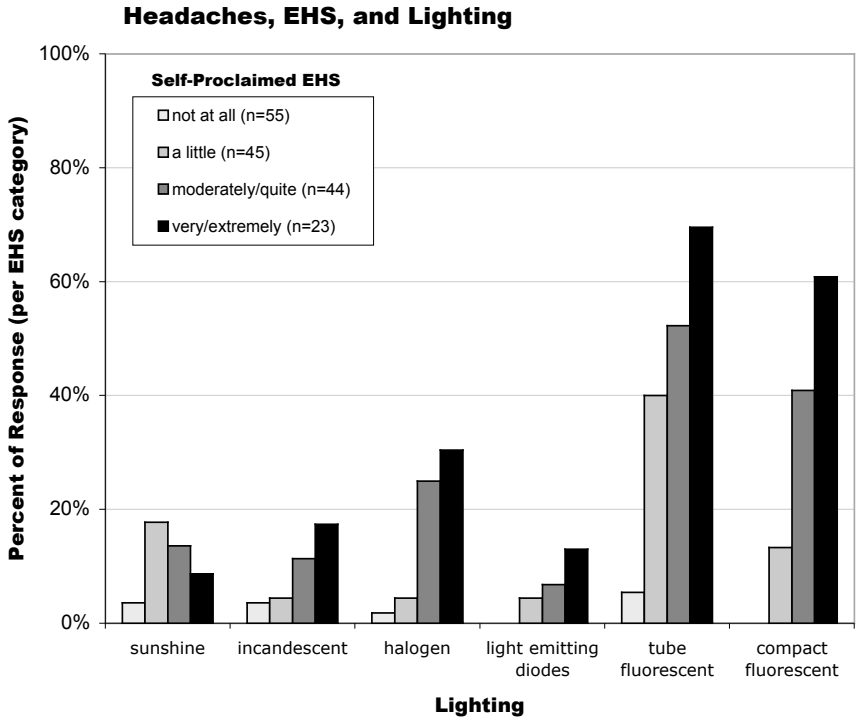


Figure 2. Responses to an electronic survey on self-proclaimed electrohypersensitivity and to various types of lighting n=168.

The British Dermatological Association, Migraine Action and Epilepsy Action, have all reported adverse health effects associated with their members who have used CFLs (1,2,3). They are lobbying the UK government to allow their members to continue using incandescent light bulbs after the ban takes effect in 2012.

CONCLUSION

The energy efficient compact fluorescent lights that are commercial available generate radio frequency radiation, ultraviolet radiation, and dirty electricity; they contain mercury-a known neurotoxin; and they are making some people ill including those who suffer from migraines, epilepsy, skin problems and electrical sensitivity. Instead of promoting compact fluorescent light bulbs governments around the world should be insisting that manufactures produces light bulbs that are electromagnetically clean and contain no toxic chemicals. Some of these are available (CLED) but are not yet affordable. With a growing number of people developing electrohypersensitivity we have a serious emerging and newly identified health risk that is likely to get worse until regulations restricting our exposure to electromagnetic pollutants are enforced. Also, with improper disposal of these bulbs we are creating a mercury-time bomb. Since everyone uses light bulbs and since the energy inefficient incandescent light bulbs are being phased out in many countries by 2010-2014, this is an area that requires immediate attention.

PETITIONS REQUESTS/QUESTIONS:

1. Has Health Canada evaluated the safety of CFL bulbs, including conducting their own research and obtaining directly relevant information form the industries involved in the manufacture of these light bulbs?

2. How does Health Canada respond to several reputable organizations (British Dermatological Association, Epilepsy Action, and Migraine Action) that have asked these products to be banned?

3. In light of all these major health concerns, has Health Canada adequately warned the public? Do they have plans to do so that go beyond information on their website? Has Health Canada considered having manufacturers place health warnings on packaging (similar to warnings on cigarette packages)?

4. What steps are being taken to inform the public about the potential health and environmental hazards associated with these light bulbs and their safe disposal?

5. Has Health Canada or Natural Resources Canada worked with industry to set up a scheme of recycling and safe disposal and possibly environmental reuse? How far have they progressed in their discussions?

6. Will Health Canada now compel manufactures to design bulbs that filter **UV radiation**? Will they work with manufacturers to ensure that the bulbs sold to the public are ones

that have minimum emissions and will they set standards for these environmental emissions so that manufacturers know what they need to produce?

7. Will Health Canada now compel manufactures to design bulbs that do not contribute to **poor power quality**? Will they work with manufacturers to ensure that the bulbs sold to the public are ones that have minimum emissions of these high frequency transients and will they set standards for these environmental emissions so that manufacturers know what they need to produce?

8. Health Canada should ascertain whether the present mercury levels in the light bulbs can be reduced.

9. Are any incentives being offered for industry to come up with safe and efficient methods of recycling of mercury from spent bulbs?

10. What is the government doing to regulate the safe disposal or recycling of compact fluorescent light bulbs?

11. Could they provide updates on their progress with either the manufacturers or such bulbs or the distributors of such bulbs?

12. Is industry Canada aware of radio frequency interference and, if they are, how do they propose to minimize it?

13. Why do we have bulbs on the market that emit UV when technology preventing this is readily available?

14. What is Health Canada doing to ensure that light bulbs do not contribute to poor power quality?

15. What is Health Canada doing to ensure that compact fluorescent light bulbs do not emit UV radiation?

16. What is the Canadian government doing to promote the use of alternative technologies, such as CLEDs (clean light emitting diodoes). These bulbs do not contain mercury, do not generate UV, RF, or dirty power and are approximately 5 times more energy efficient than CFL and 20 times more efficient than incandescent light bulbs.

What is needed is that the substantial benefits of energy savings be coupled with reduction and elimination the numerous environmental and health problems. The technology already exists for dealing with most of these.

But serious consideration should also be given to alternative technologies such as light emitting dioxides (LEDs) which are considerably more energy efficient than the CFLs and do not have any of the adverse health and environmental effects of the present generation of CFL bulbs.

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APPENDIX A: WHAT TO DO IF A CFL BREAKS. EPA

http://www.epa.gov/mercury/spills/index.htm#flourescent, last update June 11th, 2008.

United States Environmental Protection Agency

What to Do if a Fluorescent Light Bulb Breaks?

Compact fluorescent lights (CFLs) are lighting more homes than ever before, and EPA is encouraging Americans to use and recycle them safely. Carefully recycling CFLs prevents the release of mercury into the environment and allows for the reuse of glass, metals and other materials that make up fluorescent lights.

EPA is continually reviewing its clean-up and disposal recommendations for CFLs to ensure that the Agency presents the most up-to-date information for consumers and businesses. Maine's Department of Environmental Protection released a CFL breakage study report Exit EPA Disclaimer on February 25, 2008. EPA has conducted an initial review of this study and, as a result of this review, we have updated the CFL cleanup instructions below.

Pending the completion of a full review of the Maine study, EPA will determine whether additional changes to the cleanup recommendations are warranted. The agency plans to conduct its own study on CFLs after thorough review of the Maine study.

Frequently Asked Questions about Compact Fluorescent Light Bulbs and Mercury (PDF) (2 pp., 71K, About PDF)

Learn more about recycling and disposal options for fluorescents

Find fluorescent light bulb recycling programs in your area

Learn more about compact fluorescent light bulbs from the ENERGY STAR program

Fluorescent light bulbs contain a very small amount of mercury sealed within the glass tubing. EPA recommends the following clean-up and disposal below. Please also read the information on this page about what never to do with a mercury spill.

Before Clean-up: Air Out the Room

- Have people and pets leave the room, and don't let anyone walk through the breakage area on their way out.
- Open a window and leave the room for 15 minutes or more.
- Shut off the central forced-air heating/air conditioning system, if you have one.

Clean-Up Steps for Hard Surfaces

- Carefully scoop up glass pieces and powder using stiff paper or cardboard and place them in a glass jar with metal lid (such as a canning jar) or in a sealed plastic bag.
- Use sticky tape, such as duct tape, to pick up any remaining small glass fragments and powder.
- Wipe the area clean with damp paper towels or disposable wet wipes. Place towels in the glass jar or plastic bag.
- Do not use a vacuum or broom to clean up the broken bulb on hard surfaces.

Clean-up Steps for Carpeting or Rug

- Carefully pick up glass fragments and place them in a glass jar with metal lid (such as a canning jar) or in a sealed plastic bag.

- Use sticky tape, such as duct tape, to pick up any remaining small glass fragments and powder.
- If vacuuming is needed after all visible materials are removed, vacuum the area where the bulb was broken.
- Remove the vacuum bag (or empty and wipe the canister), and put the bag or vacuum debris in a sealed plastic bag.

Clean-up Steps for Clothing, Bedding and Other Soft Materials

- If clothing or bedding materials come in direct contact with broken glass or mercury-containing powder from inside the bulb that may stick to the fabric, the clothing or bedding should be thrown away. Do not wash such clothing or bedding because mercury fragments in the clothing may contaminate the machine and/or pollute sewage.
- You can, however, wash clothing or other materials that have been exposed to the mercury vapor from a broken CFL, such as the clothing you are wearing when you cleaned up the broken CFL, as long as that clothing has not come into direct contact with the materials from the broken bulb.
- If shoes come into direct contact with broken glass or mercury-containing powder from the bulb, wipe them off with damp paper towels or disposable wet wipes. Place the towels or wipes in a glass jar or plastic bag for disposal.

Disposal of Clean-up Materials

- Immediately place all clean-up materials outdoors in a trash container or protected area for the next normal trash pickup.
- Wash your hands after disposing of the jars or plastic bags containing clean-up materials.
- Check with your local or state government about disposal requirements in your specific area. Some states do not allow such trash disposal. Instead, they require that broken and unbroken mercury-containing bulbs be taken to a local recycling center.

Future Cleaning of Carpeting or Rug: Air Out the Room During and After Vacuuming

- The next several times you vacuum, shut off the central forced-air heating/air conditioning system and open a window before vacuuming.
- Keep the central heating/air conditioning system shut off and the window open for at least 15 minutes after vacuuming is completed.