Light Without the Poison

Putting an End to Mercury Escape from CFL Bulbs

CHINTAN
ENVIRONMENTAL RESEARCH AND ACTION GROUP

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About Chintan Environmental Research and Action Group

Chintan is a registered non-profit organization with a vision of inclusive, sustainable, and equitable growth for all. Our mission is to reduce ecological footprints and increase environmental justice through systemic change brought about through partnerships, capacity building at the grassroots level advocacy and research, and sustainable scalable models on the ground.

About GIZ

The services delivered by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH draws on a wealth of regional and technical expertise and tried and tested management know-how. As a federal enterprise, we support the German government in achieving its objectives in the field of international cooperation for sustainable development. The Indo-German Environment Partnership (IGEP) is a joint programme of the Ministry of Environment and Forests (MoEF) Government of India and the German International Cooperation (GIZ) on behalf of the Federal Ministry for Economic Cooperation and Development, Germany, focusing on urban and industrial environmental management in India.

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Executive Summary

The use of Compact Fluorescent Lamps (CFLs) is increasing in India. Although this is a positive development given the energy efficiency of CFLs, these lamps contain trace amounts of mercury which, if disposed off in an environmentally unsound manner, can have an adverse impact on both health and the environment. To some extent, this nullifies the advantages accruing out of the shift from incandescent bulbs to CFLs.

Many countries have standardised processes for the safe handling and recycling of CFLs. In India, however, no such policy has yet been put in place. On the basis of a small survey done in Delhi and Kolkata, the present study aims to understand better how used CFLs are handled in India; the stages of dismantling and recycling of CFL; the stakeholders involved in CFL disposal; and the awareness level and attitude of the stakeholders towards safe handling of CFLs. The study also proposes to develop a model for the safe disposal and recycling of CFLs in Delhi. This model can be replicated across the country with minor adjustments to account for the price of CFL components in local areas.

Chapter 1
Introduction

What are CFLs and how do they differ from incandescent bulbs?

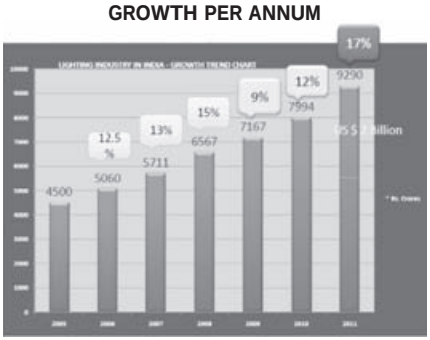
A fluorescent lamp is a gas-discharge lamp that uses electricity to excite mercury vapour. The excited mercury atoms produce short-wave ultraviolet light that then causes a phosphor to fluoresce, thereby producing visible light. A fluorescent lamp converts electrical power into useful light more efficiently than an incandescent bulb and, therefore, uses less energy. Although a fluorescent lamp costs more than an incandescent bulb because it requires a ballast to regulate the flow of current through the lamp, lower energy costs offset the initial higher cost of the lamp. While large fluorescent lamps have been used in commercial or institutional buildings, CFLs, also called compact fluorescent lights, energy-saving lights, and compact fluorescent tubes, are a type of fluorescent lamp, designed as an energy-saving alternative to incandescent bulbs used in homes.

A CFL uses 75 % less energy than an incandescent light bulb and lasts up to 10 times longer. A power plant will emit 10 milligrams (mg) of mercury to produce the electricity needed to run an incandescent bulb compared to only 2.4 mg of mercury to run a CFL for the same time. **This means that the use of a CFL will actually prevent six to eight milligrams of mercury from entering the environment.**[1]

1 http://www.epa.state.oh.us/pic/cfl_info.aspx

Trends in CFL Use[2]

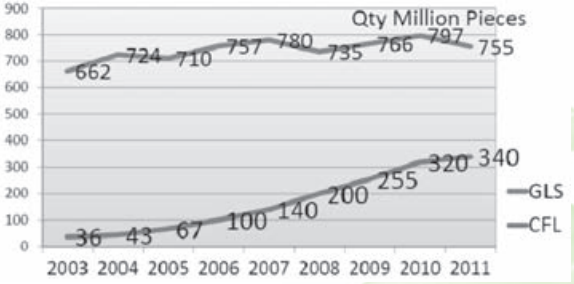
The rapid growth of the lighting industry in India is reflected by the increase in sale of bulbs across the country. According to the Electric Lamp and Compact Manufacturers Association of India (ELCOMA), the Indian lighting industry recorded approximately a 17 percent growth in the year 2011. This was the highest growth recorded since the year 2005. The value of bulbs sold in 2011 was INR 9,290 Crores (USD 2 billion). The following graph shows the growth of lighting industry in India.



Courtesy: Electric Lamp and Compact Manufacturers Association of India

Figure 1: *Growth of lighting industry in India*

A large proportion of this growth can be attributed to the increase in the number of CFLs sold. The graph below shows that the gap between the numbers of units of the two kinds of bulbs sold has reduced since year 2003.

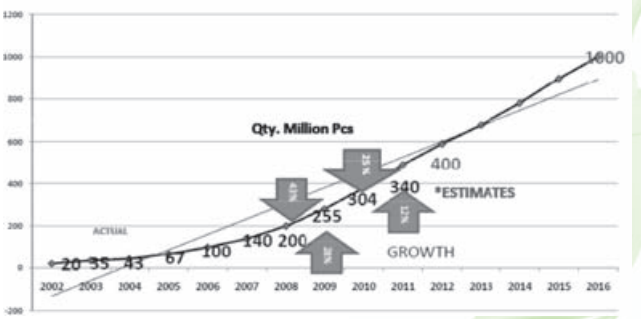


Courtesy: Electric Lamp and Compact Manufacturers Association of India

Figure 2: *Gap between incandescent lamps and CFLs sold*

The gap between the numbers of incandescent lamps (ICLs) sold and the number of CFLs sold decreased from 626 million pieces in 2003 to 415 million pieces in 2011.

The rate of growth of CFL usage is also very high. Growth registered in the year 2008 was 43% higher than the previous year, and although the rate of growth has reduced in successive years, growth rate of CFLs continues to be very high and is likely to remain so at least for the next few years.



Courtesy: *Electric Lamp and Compact Manufacturers Association of India*

Figure 3: *Growth rate of CFL usage*

2 http://www.rclsa.net/wp/wp-content/uploads/2009/08/India_Case_Studies_on_Energy_Efficient_Light.pdf

Bachat Lamp Yojana Scheme

Although there is no mandatory requirement in India to use energy efficient CFLs at the household level, some government schemes like the Bachat Lamp Yojana, have played a role in increasing their use. The "Bachat Lamp Yojana", is a scheme developed by the Bureau of Energy Efficiency (BEE) that aims at the large scale replacement of incandescent bulbs in households with CFLs. Under the scheme, households are provided CFLs at a price similar to that of incandescent bulbs. However, in doing so, there is bound to be a financial gap and the plan is to recover the cost differential between the market price of the CFLs and the price at which they are sold to households by the Clean Development Mechanism (CDM) of the Kyoto Protocol. This a popular mechanism to finance carbon emission reduction. The Bachat Lamp Yojana is designed as a public-private partnership between the Government of India, private sector CFL suppliers and State level Electricity Distribution Companies (DISCOMs).Under this scheme CFL suppliers sell high quality CFLs to households at a price of Rs. 15 per CFL, in exchange for incandescent bulbs, within a designated project area in a DISCOM's region of operation.[3]

Why appropriate disposal of CFLs is important

All CFL bulbs contain mercury; a hazardous metal that can affect the brain and nervous system if absorbed by the human body. The presence of mercury in CFLs enhances the chances of mercury contamination and toxicity. Mercury is a neurotoxin known to impact vital organs such as the liver and to cause developmental and neurological problems. It is particularly dangerous to pregnant women and children as it is capable of crossing the placental barrier and causing irreparable damage to the foetus as well as to newborn babies.

Unsound disposal of spent CFL bulbs can also be very harmful to the environment. Used and discarded CFLs are either thrown into garbage, dumped at landfills or sold to waste collectors or waste pickers who, among other things, physically handle the sorting of CFLs and are therefore, directly exposed to the mercury released.

Since India does not currently have any management systems or infrastructure in place to effectively separate, segregate, and handle end-of-life and discarded CFLs, the chances of mercury entering the waste stream and the food chain is also very high.[4]

3 http://www.powermin.nic.in/acts_notification/energy_conservation_act/pdf/BLY_manual.pdf

4 http://www.toxicslink.org/?q=media/press-releases/indian-cfl-industry-puts-consumers-risk-very-high-levels-mercury

Although the Central Pollution Control Board Guideline, 2008[5] mentions ongoing efforts to reduce mercury levels in CFLs using best available technology, it has not prescribed an upper limit to the presence of mercury. There are, therefore, currently no regulations in India concerning the permissible levels of mercury each CFL bulb can contain. CFLs in India often have very high mercury content, almost four to six times more than the standards in developed countries. In some cases, the level of mercury is as much as 20 times higher[6]. According to a study, the average amount of mercury used per CFL in India is 21.21mg[6]. Due to lack of regulation, manufacturers also do not follow basic guidelines to minimize health risks, like capping the mercury in CFLs. Given the high quantities of mercury present in India's CFLs and the rapid growth in their usage, it has been estimated that the fluorescent lamp sector will consume almost 8.5 tonnes of mercury which will then need to be handled and recycled when these lamps are discarded.[6]

5 http://www.cpcb.nic.in/upload/NewItems/NewItem_134_Final%20Technical%20GUIDELINES.pdf

6 http://toxicslink.org/docs/CFL-Booklet-Toxics-in-That-Glow.pdf

Chapter 2
Methodology

Information for the present study was gathered through a series of informal discussions and surveys held in the cities of Delhi and Kolkata.

Literature and practice review

A review of processes adopted by other countries was undertaken in order to better understand the regulatory processes for both production and disposal of CFLs and to contextualise the necessity for safe handling of CFLs.

Survey

Details of the two surveys conducted in the cities of Delhi and Kolkata are as follows:

1. Survey of Collectors: CFL collectors (itinerant buyers, street waste pickers), small traders and big traders, as well as refurbishers were interviewed both informally and through formal questionnaires on the practice of handling, reusing and recycling of CFL bulbs and their parts.

2. Survey of Consumers: Households, retailers and offices as consumers of CFLs were also surveyed in these cities to understand:
   a. If/whether the demand for CFLs and its use has increased over the years
   b. If/whether disposal practices are followed by the respondents
   c. Knowledge on the use of toxic materials in the CFLs and the environmental hazards associated with its disposal in an environmentally unsound manner

The sample size for the CFL collectors' survey was 46. Of these, 31 collectors were surveyed in Delhi and 15 in Kolkata. A third of these respondents were traders who

purchased CFLs from waste pickers and sold them to refurbishers. About one-fifth of the sample comprised door-to-door waste collectors who would sell the CFLs to either itinerant buyers or to refurbishers. A large proportion of the sample consisted of segregators and refurbishers, surveying whom helped us understand the processes involved in CFL disposal and the environmental hazards associated with these methods.

The sample size for the consumers' survey was 700—1400 respondents each in Delhi and Kolkata. More than three fourths of the sample comprised households that were primary consumers of CFLs. About 8 percent of respondents were from offices and 16 percent were retailers.

Due to business sensitivities involved in the recycling sector, it took more than a month for the team members to collect the data.

Areas surveyed

In Delhi, the survey was conducted in Shastri Park, Old Seelampur, Kanti Nagar, Gautam Puri, Mustafabad, Moti Nagar, Pritam Pura, Jahangir Puri areas. The following map denotes the areas of survey in Delhi.

Figure 4: *Survey areas in Delhi*

In Kolkata, primary data collection was conducted at Baleghat (an incandescent bulb manufacturing hub), Maniktala, Chandni Chowk, Tangra, JN Sarkar Lane (Ghospara), SS Sarkar Road and Kamarhatti areas. The following map indicates the survey areas in Kolkata.

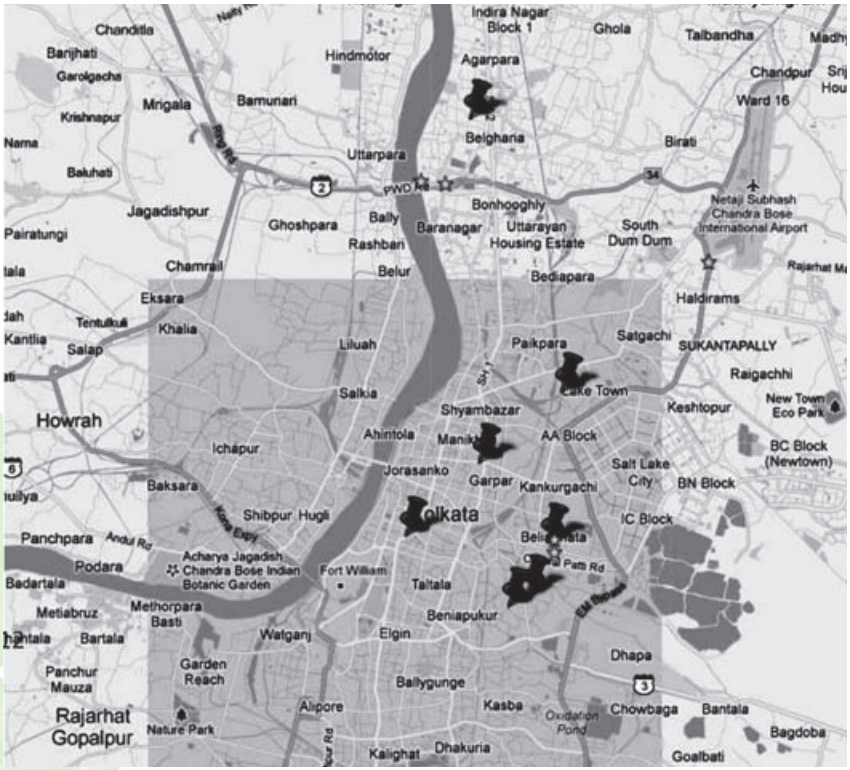


Figure 5: *Survey areas in Kolkata*

Chapter 3
Policies and practices on CFL production and disposal

Many countries in the world have adopted various methods to regulate the use and disposal of mercury containing CFLs. In this section, we review some of the policies and practices in place in Australia, the European Union and the United States of America.

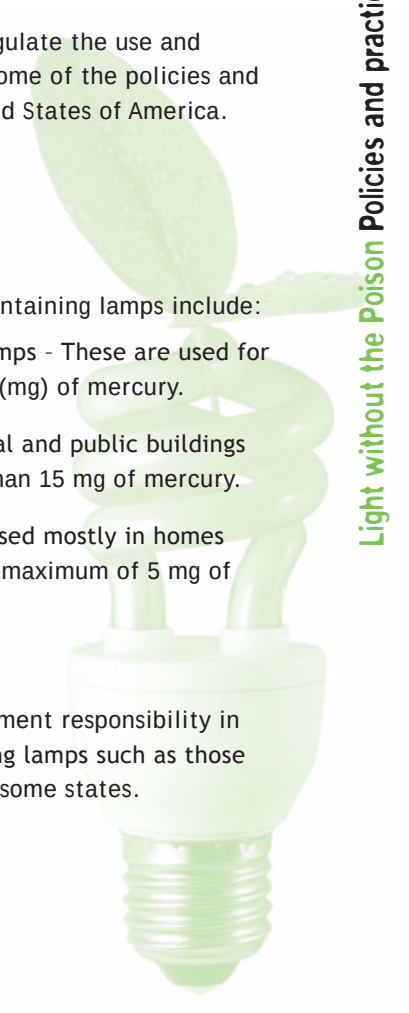
Australia[7]

Disposal of mercury-containing lamps

In Australia, a number of types of lamps use mercury. Mercury containing lamps include:

- High intensity discharge (HID) lamps e.g. mercury vapour lamps - These are used for street lighting and contain between 50 and 1000 milligrams (mg) of mercury.
- Linear fluorescent tubes - These are used in most commercial and public buildings and are required by an Australian standard to contain less than 15 mg of mercury.
- Compact fluorescent lamps (CFLs) - These, as in India, are used mostly in homes and are required under a new Australian Standard to have a maximum of 5 mg of mercury per unit, and
- Neon tubes - These are mostly used in signs.

Waste disposal and handling is primarily a state and local government responsibility in Australia. Landfill disposal of large amounts of mercury containing lamps such as those generated by businesses, institutions, or councils is forbidden in some states.



7 http://www.environment.gov.au/settlements/waste/lamp-mercury.html

Specialty recyclers

There are some speciality recyclers in Australia who, in addition to safely recovering mercury from CFLs, are also able to recover the glass, phosphor and aluminium contained in the lamps. Recovered mercury is commonly sold to the dental industry, where it is used in amalgam for fillings. Thus, taking mercury containing lamps to specialty recyclers is an alternative to landfill disposal in Australia. Most speciality lamp recyclers collect large quantities of lamps from cities and selected regional areas for transporting to a mercury-recycling facility. CFLs in Australia can also be posted to recyclers in special purpose containers, although these are mostly only available for large quantities of CFLs. A number of companies in Australia provide mercury recycling services.

FluoroCycle

FluoroCycle (www.fluorocycle.org.au) is a voluntary national scheme, set up in 2010, that aims to increase recycling of mercury-containing lamps. FluoroCycle is collaboration between industry and the government, administered by the Lighting Council Australia and sponsored by the Environment Protection and Heritage Council (EPHC).It is made up of state, territory, and Australian Government environment ministers. FluoroCycle is also supported by key industry bodies including the Australian Council of Recyclers, the Facility Management Association of Australia, the Australian Local Government Association, the Property Council of Australia and the National Electrical and Communications Association.

European Union[8]

The European Waste Electrical and Electronic Equipment (WEEE) Directive has been in place in the European Union since August 13, 2005. The directive stipulates that all discharge lamps should be collected and recycled. Only incandescent and halogen lamps are exempted from recycling because they do not contain any environmentally sensitive substances and their recycling has no significant economic justification. The WEEE Directive also requires that each manufacturer, in line with producer responsibility, finance the cost of collection and recycling for the products they have put on the market in the EU. The market for WEEE Lamps in Western Europe (including Switzerland and Norway) is estimated to be approximately 978 million pieces. In response to the WEEE directive, the European lamp industry has established a pan-EU take-back infrastructure for lamps containing mercury. Thus, according to the national WEEE legislation, in all EU member states, each spent WEEE lamp from homes can be returned to the manufacturer free of charge. In the different EU member states,

8 http://www.elcfed.org/documents/090811_elc_brochure_environmental_aspects_lamps_updated_final.pdf

ELC Collection & Recycling Services Organizations (CRSOs) or other joint systems, in accordance with the individual national WEEE legislation, ensure effective and proper lamp recycling.

Germany's WEEE directive for lamp recycling[9]

As a member of the European Union, Germany has also adopted the WEEE directive for all mercury-added lamps and has a very effective system in place for recycling. Nearly 70 to 80% of all spent mercury-containing lamps are recycled in Germany. Lightcycle Retourlogistik und Service GmbH (Lightcycle) is Germany's lamp collection and recycling service under the WEEE initiative. Lightcycle provides services to approximately 1,100 municipalities and 1,000 commercial facilities in Germany. There are also 360 non-municipal collection points. The program started in March 2006 and had collected a total of 35.5 million fluorescent lamps in 2007 (6.75 tons) and an estimated 42 million lamps in 2008 (8.0 tons). Assuming that each mercury-containing lamp contains 5 mg of mercury, approximately 391 of pounds of mercury was recovered from this program in 2007 and 463 pounds of mercury in 2008.[10]

United States of America[11]

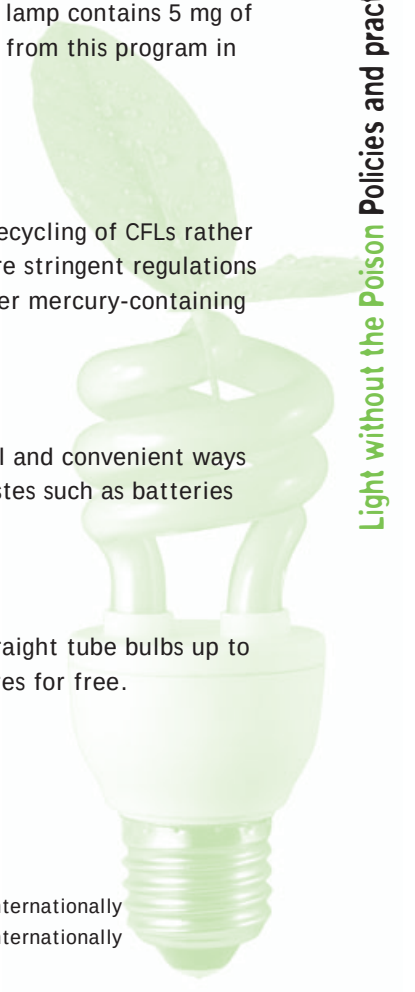
The USA Environment Protection Agency (U.S.EPA) recommends recycling of CFLs rather than disposing of them in trash. Some states in the USA have more stringent regulations than the U.S.EPA does, and require the recycling of CFLs and other mercury-containing light bulbs

California, USA

California has a Take-It-Back Partnership that provides free, local and convenient ways for California residents to recycle CFLs (and other household wastes such as batteries and electronic devices) in an environmentally sound manner.

Maine, USA

Households can recycle intact CFLs and other bulbs, including straight tube bulbs up to 2 feet in height, at any of more than 100 participating retail stores for free.



9 Review of Compact Fluorescent Lamp Recycling Initiatives in the U.S. & Internationally

10 Review of Compact Fluorescent Lamp Recycling Initiatives in the U.S. & Internationally

11 http://epa.gov/cfl/cflrecycling.html

Vermont, USA

In Vermont, any mercury-containing bulb, regardless of the amount of mercury present in it, cannot be discarded in the trash. Such bulbs are handled as hazardous waste and are stored carefully to avoid breakage. Products that are labelled mercury-containing are banned from landfills. However, disposal options differ depending on whether the bulbs are from household use, non-household use, or business use.

Chapter 4
Results of the survey: Actors and attitudes

Observations

Our survey carried out in Delhi and Kolkata reveals that most end-of-life transactions related to CFLs occur in the informal sector where there is a long chain of CFL handlers.

CFL handlers in the informal sector

Primary CFL collectors (Itinerant buyers, street waste pickers, door-to-door waste collectors) — Primary CFL collectors collect used lamps from CFL disposers who are primarily CFL users. In turn, they sell their collection daily to small traders and refurbishers. However, due to improper handling, CFL tubes often break.

Small Traders — Small Traders buy CFLs from primary collectors and, in some cases, from the disposers or users, and sell the CFLs to refurbishers and big traders. They sell collected CFLs once in a week. If they feel that a CFL tube is non-functional, they often break the tube before selling it. This in trading terms is called, the 'lattu' i.e. CFL, sans the glass tube!

Suppliers — Suppliers are small in number. They buy scrap CFL from small scrap dealers and supply them to either the big traders or the dismantlers or the recyclers depending on the price they get from them.

Big Traders — Big Traders buy CFLs from small traders and suppliers, and sell them to refurbishers and recyclers. Big Traders trade CFLs twice or thrice in a week.

Refurbishers — Refurbishers buy CFLs from different levels (depending on requirement and accessibility of the CFL trader). They repair these lamps and send them to shopkeepers for sale as refurbished CFL's.

Dismantlers — Dismantlers buy CFLs from big traders. They take out different electronic components from the Printed Circuit Boards (PCBs) and test them for their functioning. Functioning components are then sent to refurbishers or to spare part shops. Materials such as metals and plastics are recovered from non functioning parts and sent to recyclers. Trading is done almost every day.

Recyclers — Depending on their specialty, recyclers buy CFL parts such as plastics and metals, and recycle these.

The following figure describes the flow of spent or discarded CFLs in the informal sector.

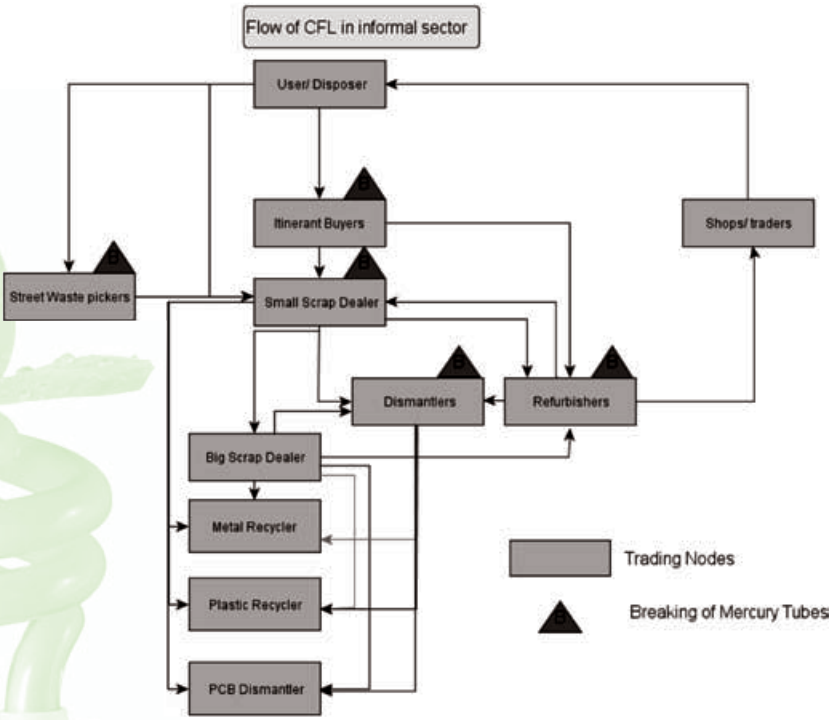


Figure 6: *Flow of CFLs in the informal sector*

The Context

Delhi

Large amounts of CFLs collected in Delhi, are sent to Moradabad and Muzaffar Nagar in Uttar Pradesh, for dismantling and refurbishing. While the refurbished CFLs are brought back to Delhi for use, the dismantlers in nearby cities recover plastics and other metals. The plastics are then sent back to Delhi for recycling while the waste metal is sent to other places.

Kolkata

Kolkata has a large number of refurbishers who repair CFLs where possible. Those that cannot be repaired are sent to dismantlers for material recovery. Plastics and metals are recycled in different areas of Kolkata.

Trading in end of life CFLs

The charts below help understand the processes followed by the informal sector for CFL disposal which, in turn, serve to highlight the high probability of mercury in CFLs escaping into the environment.

More than 50% of the respondents stated that they break the CFLs to retrieve parts like plastics and metals and then sell them to traders (see Figure 7).

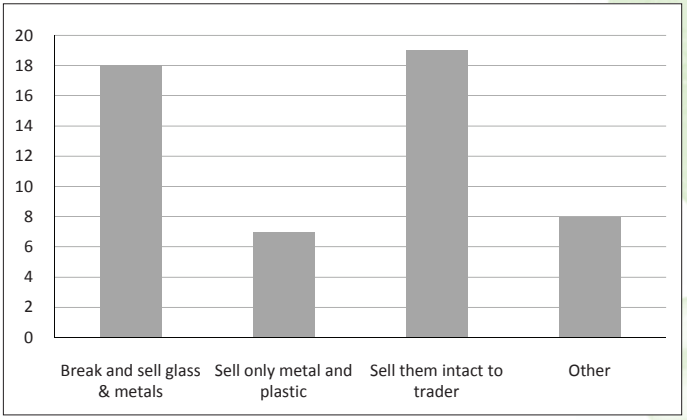


Figure 7: *What happens to a CFL?*

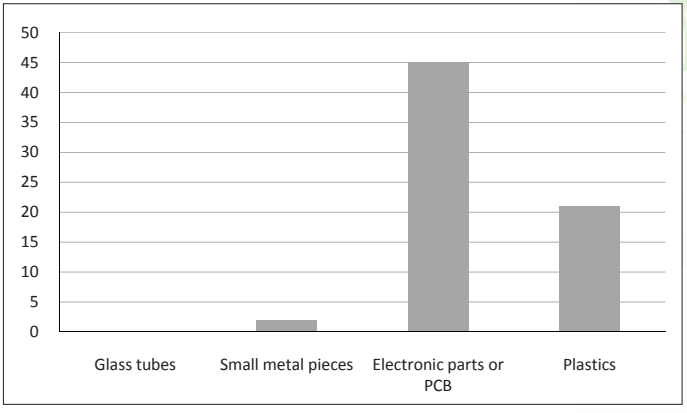


Figure 8: *Parts of a CFL*

It was found that 98% of the traders cull out the electronic parts of the CFL by breaking them and then selling the parts (see Figure 8).

One hundred percent of the traders treat glass tubes of the CFL as waste part, breaking of which releases the mercury vapour into the environment (see Figure 9).

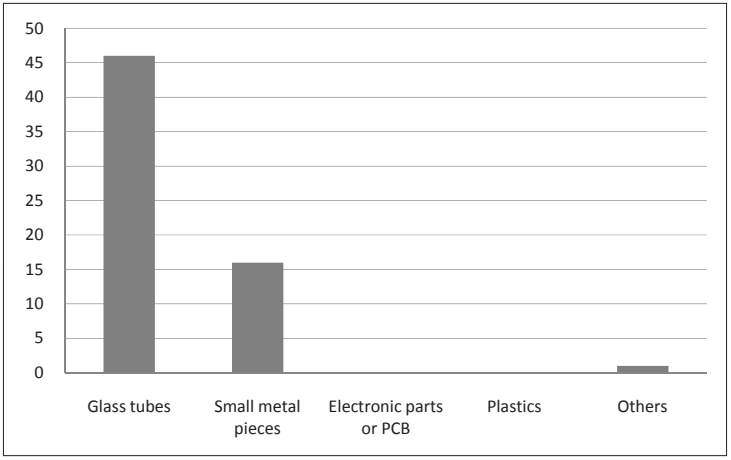


Figure 9: *Which parts of CFL are considered waste?*

Of the respondents, 63% among traders were unaware of mercury in the CFLs and its hazardous impact (see Figure 10).

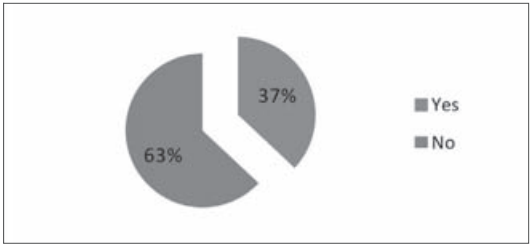


Figure 10: *Awareness of mercury and its hazardous impacts*

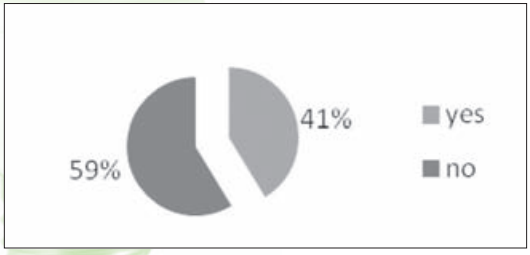


Figure 11: *Will safe recycling with kabaris work?*

On the possibility of scrap dealers (kabaris) becoming the repository for the safe disposal of CFLs, nearly 60% of the respondents felt that this would not work (see Figure 11).

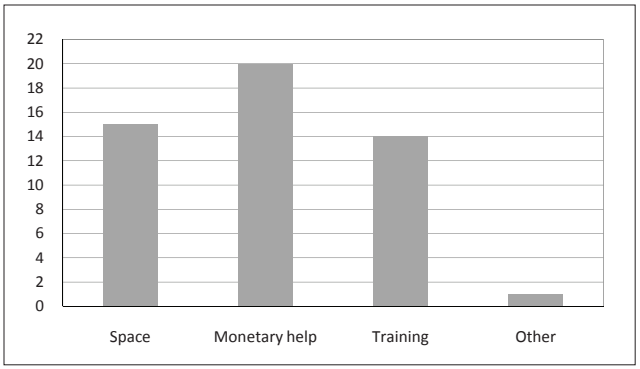


Figure 12: *What do scrap dealers/kabaris need to join a system for safe recycling?*

Nearly 40% of the handlers of used CFLs said that they would be willing to join the system for safe recycling of CFLs if they were given monetary incentives to do so (see Figure 12).

Information about and attitude towards recycling

Usage

A questionnaire based survey was conducted in Delhi and Kolkata to better understand the attitude towards and understanding of CFLs among users of CFLs.

The charts below highlight key observations and findings of the survey.

Non -Household Use

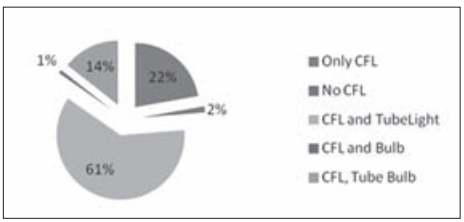


Figure 13: *What sources of light do the respondents use in their shops and offices?*

As shown in Figure 13, only 2 percent of those surveyed did not use CFLs at all in their shops or offices. Furthermore, more than 75% of the respondents stated that at least half of the lighting in their shops and offices were CFLs. More than 20% stated that they have shifted their entire lighting to CFLs in their shops and offices to save electricity.

Household Use

As Figure 14 shows, at the household level, all respondents used CFLs, mostly with other forms of lighting like tube lights (i.e. fluorescent light) and incandescent bulbs. In households, about 55% of respondents stated that at least half of the lighting that they used was CFLs however, less than 10 percent of all households have shifted their entire lighting to CFLs.

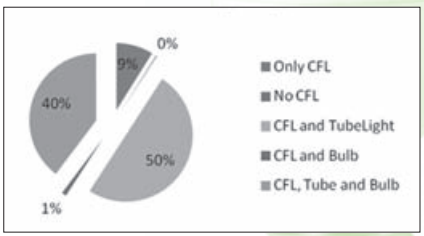


Figure 14: *What sources of light do the respondents use in their houses?*

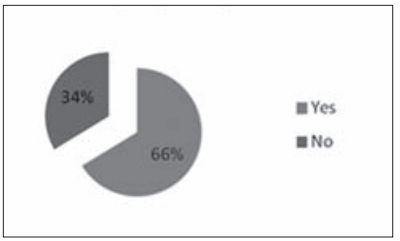


Figure 15: *Are users switching completely to CFLs?*

CFLs are thus a popular choice among consumers. About 70% of the respondents reasoned that they use CFLs because they consumed less electricity and nearly two thirds of respondents were in favour of switching completely to CFLs (see Figure 15).

It is interesting to note that CFL use in both these cities has increased at a phenomenal rate in the last 2-5 years. (see Figure 16). This has increased the risks associated with disposal practices currently followed by the informal sector.

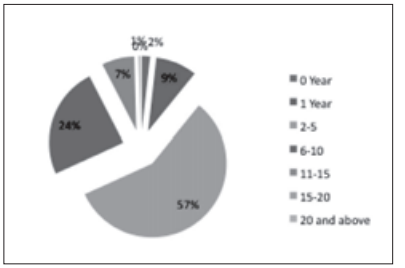


Figure 16: *How long have respondents been using CFLs?*

Disposal

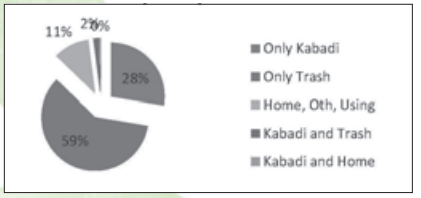


Figure 17: Current CFL disposal practices

The above finding on CFL usage indicates the likelihood that CFL use is going to only increase in the coming years. Which brings us to the worrisome aspect of appropriate disposal of used CFLs. Nearly 90 % of users throw used CFLs in trash or sell it to door-to-door itinerant waste buyers or kabaris (see Figure 17).

Even more worrying is the fact that, 95% of the respondents were unaware of the ingredients of CFLs (see Figure 18), including the fact that CFLs contain hazardous substances.

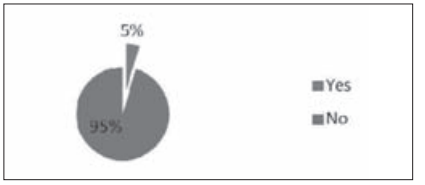


Figure 18: *Awareness of the ingredients of CFLs*

Figure 19: *Awareness of mercury escape from CFLs*

Further, 80% of respondents did not know about the possibility of mercury escape from the CFLs. (see Figure 19).

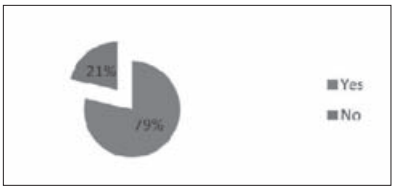


Figure 20: *Are respondents willing to change their CFL disposal practices?*

But when they were told of the dangers posed by unregulated escape of mercury into the environment, nearly 80% of the respondents (see Figure 20), said that they were ready to change their disposal practices to contain the adverse effect of mercury releasing into the environment.

Nearly 60% of the consumers (see Figure 21), were even willing to pay for the safe disposal of CFLs.

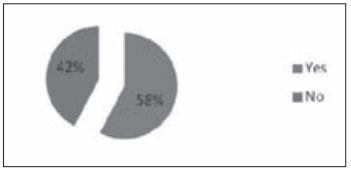


Figure 21: *Are respondents willing to pay for safe disposal?*

Among consumers willing to pay for safe recycling, more than two thirds of the respondents (see Figure 22), were willing to pay INR 5 or more for the safe disposal of CFLs.

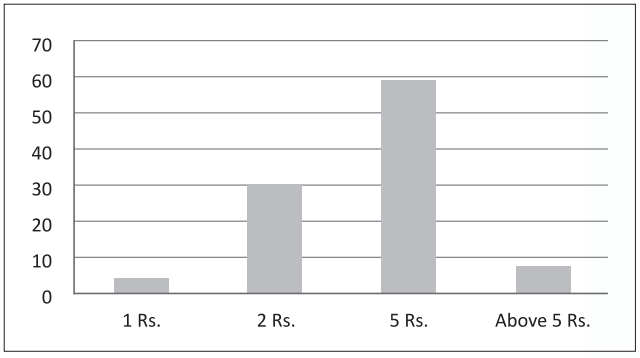


Figure 22: *How much are respondents willing to pay?*

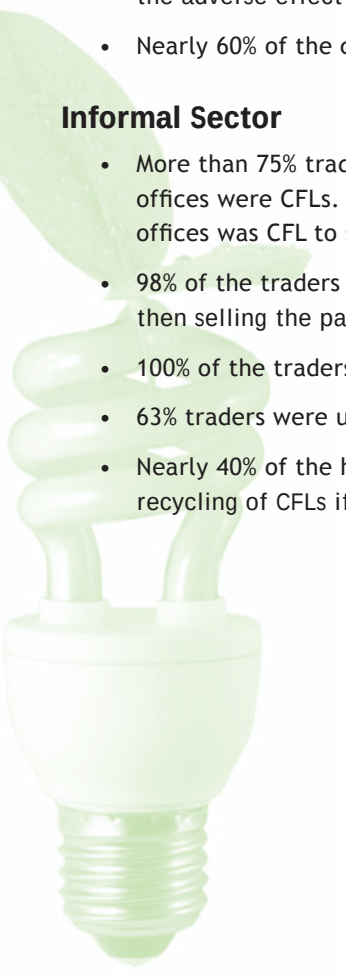
Survey reveals the following key observations

Consumers

- About 55% of consumers stated that at least half of the lighting that they used was CFLs. However, less than 10 percent of all households have shifted their entire lighting to CFLs.
- About 70% used CFLs because they consumed less electricity and nearly two thirds were in favour of switching completely to CFLs
- Nearly 90 % of users throw used CFLs in trash or sell it to door-to-door itinerant waste buyers
- Nearly 80% said that they were ready to change their disposal practices to contain the adverse effect of mercury releasing into the environment
- Nearly 60% of the consumers were willing to pay for the safe disposal of CFLs

Informal Sector

- More than 75% traders stated that at least half of the lighting in their shops and offices were CFLs. More than 20% stated that the entire lighting in their shops and offices was CFL to save electricity
- 98% of the traders cull out the electronic parts of the CFL by breaking them and then selling the parts
- 100% of the traders treat glass tubes of the CFL as waste part
- 63% traders were unaware of mercury in the CFLs and its hazardous impact
- Nearly 40% of the handlers of used CFLs were willing to join the system for safe recycling of CFLs if monetary incentives were provided



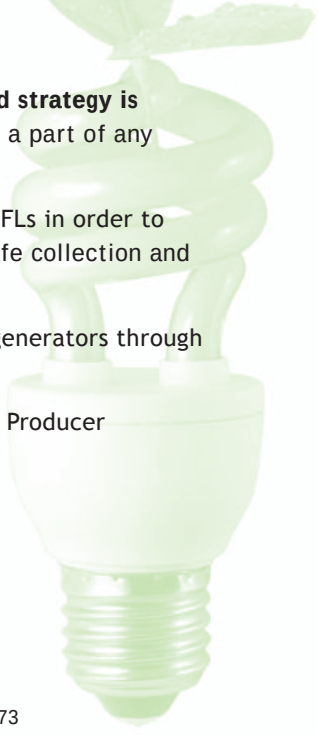
Chapter 5
How to Handle CFLs Safely?

From the above surveys, it is clear that although there is sufficient *understanding* of the benefits associated with CFLs, there is an acute *lack of awareness* about the hazards associated with them. This report also suggests that CFL usage is likely to continue to increase in the country. Given the sheer volume of CFLs that will be used, strategies to prevent mercury escape from CFLs must be put into place on an urgent basis. The Minamata Treaty, to eliminate mercury, is on the verge of coming into force.[12] India too must act in the spirit of the treaty and eliminate mercury from the environment.

Solutions

In the case of proper handling and disposal of CFLs, a three-pronged strategy is essential. The study suggests that the following key elements must be a part of any solution:

- Increase awareness of the hazards associated with mercury in CFLs in order to provide incentive to consumers to want to be involved in the safe collection and recycling of CFLs
- Involvement of the informal sector in procuring CFLs from the generators through awareness, incentives and capacity-building
- Inclusion of the manufacturers of CFLs in schemes via Extended Producer Responsibility tools.



12 http://www.unep.org/newscentre/default.aspx?DocumentID=2702&ArticleID=9373

Economics of CFL disposal

The economics of CFL dismantling is currently driven by the material values alone. If, for instance the total value of the recyclable per CFL is Rs. X, then the value added is distributed across the entire chain.

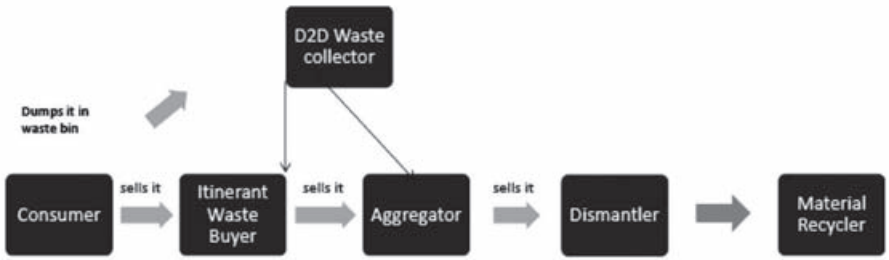


Figure 23: *Economic model of CFL disposal*

If material is diverted to a formal recycler, then the entire system will have to be subsidized. Such subsidies will be required at least until enough disposers are willing to pay for the safe disposal of intact CFLs or until extended producer responsibility is established whereby manufacturers will be responsible to finance the cost of collection and recycling of the products they have put on the market.

In the present scenario, there are many actors in the chain who distribute profits that arise out of CFL recycling.

The study has identified these actors and the roles they play. Further calculations based on the surveys resulted in numbers that indicate the economics at each level. Deeper analysis indicates that it is economically feasible to ensure proper dismantling and recycling of CFLs, provided an incentive is given to certain sections in the chain in order to prevent mercury leakage by breaking the CFL bulbs.

Presently, the primary actors in the entire chain are:

Waste generators: These are the users of CFLs. The study focuses on households, retail outlets and offices. Present behaviour towards end of life CFL indicates that the consumer sells it to a waste collector or just throws it away with other forms of dry waste that is generated.

Waste collectors: This is the 'doorstep waste collector as well as the itinerant buyer', who pays money to collect CFLs.

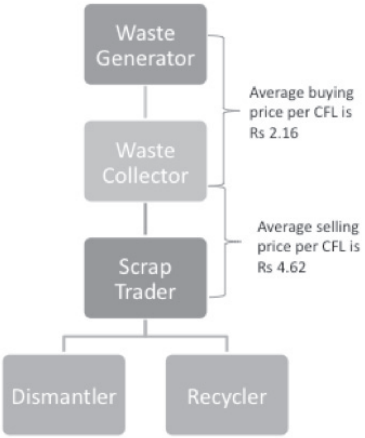
Scrap traders: The waste collectors normally sell to a scrap trader. The scrap trader collects multiple types of waste and sells it off to larger dealers, aggregators and dismantlers.

Dismantlers: The dismantler normally breaks open the dead product and retrieves as much material as possible which can give economic value. The resources employed are low cost untrained workers. Health and environment issues are seriously compromised as mercury is released from the improper handling of the dead product.

Aggregators: The aggregators collect the intact CFL glass tube from the scrap traders and use their own resources to sell them to the recyclers. These are primarily middlemen who bring no value to the process.

Recyclers: This is the point at which the aluminium from the bulb is smelted or in some cases, new CFL bulbs are also made using old, intact holders.

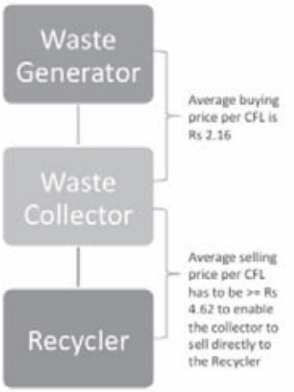
Besides identifying the primary actors in engaged in the process of CFL disposal, the survey team also collected data on economic benefits which are availed by different players. The process chain is illustrated below.



In this scenario, the waste collector makes a profit of Rs 2.47 in the present system whereby he can sell the intact CFL glass tubes to the scrap trader, dismantler or the recycler. As against the above identified economics of waste disposal the present study proposes an alternate scenario.

Data collected across all actors who are part of the system helped to map the economic benefits available to each. The Waste Collectors, who, by far are the most important actors because they collect the glass tube intact CFL (thereby saving our environment from the ill effects of Mercury) incur an average cost of INR 2.16 on each CFL that they purchase. These costs arise out of the collection, transportation and other costs associated with this activity.

The average rate at which they sell the glass tube intact CFLs to the scrap trader is INR 4.62. The profit that is being made by deducting average purchase price from the average selling price is being considered the basic sustenance level of the Waste collector. This amount is INR 2.47 as is indicated in the illustration below.



To enable the collector to sell the glass tube intact CFL directly to the recycler, an amount of at least Rs 2.47 be passed on as subsidy to him. Logistics costs however need to be paid over and above this amount.

Other than proposing an alternate economic logic to motivate the collector, the study also concludes that in order to prevent mercury pollution from CFLs, certain key interventions are essential. These include the following recommendations:

- Ensure that the CFL is being properly collected
- Ensure the Waste collector's sustainability
- Ensure that the process is formalised

Model for CFL handling

The model we thus propose for handling CFLs in a medium to large city is based on capturing collected CFLs for safe recycling. This requires all CFLs to be channelized through a collection chain and that incentives be provided. Existing actors, such as waste collectors, kabaris etc will also have to be trained and key aggregators in the chain targeted for both awareness and economic incentives.

The basic features of the proposed model which emerge from the study undertaken can be outlined as follows:

- Collect waste directly from the Waste collector by providing incentives to sell to the recycler

- Ensure a bare minimum profit margin of INR 2.47 such that the Waste collector can sell to the recycler and sustain herself or himself.
- The logistic costs need to be paid separately in this model or else an aggregator needs to be formally appointed who can take care of transportation and handling large quantities of dead CFLs.
- A credit facility needs to be set in place for the collector.
- These Waste collectors can be institutionalised as well and an awareness campaign needs to be conducted so that the generators are well versed about the risks involved in poor waste disposal practices. This would lend credence to the program and ensure better livelihood for the waste collector as well.

Along with the above, we also propose awareness through schools, RWAs, shops and the media to enable users of CFLs to use the channels set up for recycling, and encourage their waste collectors to do the same. Some strategies for these will include setting up mobile collection units for CFLs that mimic the informal sector system in that they call the kabaris to determine volumes and make rounds to purchase the items at pre-determined rates. Some kabaris and material recovery facilities, as well as colonies will also have drop boxes, where these items can be dropped off.

The model above has described the societal and economic aspects of collection of CFLs. It shows that not only an amount must be invested per CFL for return to a collection channel but an entire structure of incentives and motivations needs to be created.

Recent notifications, such as the Plastic Waste (Management and Handling) Rules, 2011[13] and the E-Waste (Management and Handling) Rules, 2012[14] have already shown the way with their innovative approach to Extended Producer Responsibility (EPR). Both these rules require manufacturers to actively participate in taking back and safely disposing the specific wastes. Financial investment is also part of this model. The CFL take-back system should learn from both these rules as well as from the gaps in their implementation. The gaps include the need for much more communication about these rules amongst the general public to create communities of practice. In practice, there is little public reporting about what the producers are able to do, and what other stakeholders have done.

To initiate a pilot test, government agencies can invest and run a pilot for a fixed amount of time, but invite the producers to participate to improve and make the model more efficient. Before the end of the time period, the model should be upgraded, and handed over to the producers to lead as key investors. However, government agencies

13 http://moef.nic.in/downloads/public-information/DOC070211-005.pdf

14 http://envfor.nic.in/downloads/rules-and-regulations/1035e_eng.pdf

must take on the role of enabling or taking on communications, monitoring the systems and helping facilitate the collection.

We know that every CFL produces mercury pollution. This report concludes that a collection system, which is the key to the prevention of mercury escape from CFLs into the environment, will therefore comprise these aspects:

The diagram below shows a schematic represenation of a possible collection system:

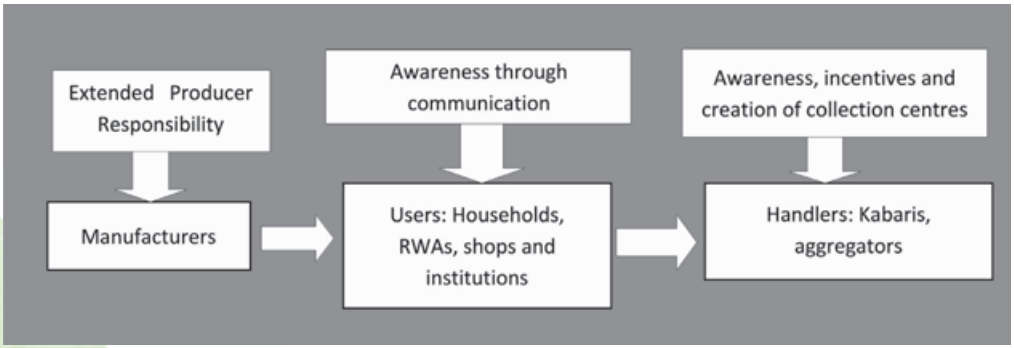


Figure 24: Model for CFL recycling

- A high degree of awareness using multiple media is required for any strategy to be implemented.
- As consumers and the informal sector have shown a general willingness to join the system for safe recycling of CFLs if monetary incentives were provided, the tool of EPR (Extended Producer Responsibility) can play a pivotal role.
- The work of the informal sector in collection of CFL bulbs from generators before they are broken is vital and must be part of any system.

About this study

The use of Compact Fluorescent Lamps (CFLs) is increasing in India. Although this is a positive development given the energy efficiency of CFLs, these lamps contain trace amounts of mercury which, if disposed off in an environmentally unsound manner, can have an adverse impact on both health and the environment. To some extent, this nullifies the advantages accruing out of the shift from incandescent bulbs to CFLs.

Many countries have standardised processes for the safe handling and recycling of CFLs. In India, however, no such policy has yet been put in place. On the basis of a small survey done in Delhi and Kolkata, the present study aims to understand better how used CFLs are handled in India; the stages of dismantling and recycling of CFL; the stakeholders involved in CFL disposal; and the awareness level and attitude of the stakeholders towards safe handling of CFLs. The study also proposes to develop a model for the safe disposal and recycling of CFLs in Delhi. This model can be replicated across the country with minor adjustments to account for the price of CFL components in local areas.

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