Eliminating Mercury in Lighting: A Win-Win for Health and the Environment

Minamata Convention COP 4.2, side event
Tuesday, 08 March 2022
15h30-16h30 CET

Michael T. Bender, Mercury Policy Project and
Peter Maxson, Concorde East/West
Typical mercury content of fluorescent lamps

<table>
<thead>
<tr>
<th>TYPE OF FLUORESCENT LAMP</th>
<th>CHARACTERISTICS</th>
<th>MERCURY CONTENT PER LAMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12 (1.5 inches in diameter) Linear Fluorescent Lamp</td>
<td>Relatively low energy efficiency and high mercury content; oldest of the fluorescent tubes.</td>
<td>5 mg up to 90 mg</td>
</tr>
<tr>
<td>T8 (1 inch in diameter) Linear Fluorescent Lamp</td>
<td>The most commonly used fluorescent tube on the market, especially 4-foot lengths.</td>
<td>10 mg or less</td>
</tr>
<tr>
<td>T5 (5/8 inch in diameter) Linear Fluorescent Lamp</td>
<td>Introduced in the mid-1990's as a more efficient alternative to T8 fluorescent tubes.</td>
<td>5 mg or less</td>
</tr>
<tr>
<td>Compact Fluorescent Lamp</td>
<td>Introduced around 1980 in response to the oil-shocks of the early 1970's; promoted in the past as a more efficient alternative to incandescent lamps. Has either a screw base or pin base.</td>
<td>5 mg or less</td>
</tr>
</tbody>
</table>
Mercury releases into the environment from fluorescent lamp use

Fluorescent lamps contribute to the contamination of the atmosphere, land and water. After manufacturing, mercury releases from lamp breakage may occur during use, when discarded with general household waste, during collection and transport of discarded lamps, during recycling operations, and from landfill and other disposal practices.
Mercury exposure risks from fluorescent lamp breakage: Groups of most concern

- Sensitive populations, esp. developing fetuses, infants, children, and women who are pregnant or breast-feeding
- Vulnerable people, esp. those who have underlying health conditions, are disadvantaged, and/or are chronically exposed to a range of pollutants
- Workers involved in fluorescent lamp manufacturing, transportation, collection, processing, recycling, and disposal
Mercury exposure risks to sensitive populations

- Fetuses and infants are at higher risk of low-level mercury vapor uptake due to a number of factors
- Fetuses and infants are particularly vulnerable to developmental disabilities
- The initial release of mercury vapor from a broken lamp is the most immediate concern, since mercury levels are most likely to be more elevated
- In an unventilated space, infants at floor level are likely to have the highest mercury exposure from a broken lamp
- A broken lamp can generate mercury vapor in indoor air well above state and federal safety guidelines
Workers exposed to mercury during the entire life-cycle of a fluorescent lamp, including:

• Primary mercury mining
• Lamp manufacture
• Disposal of lamps into waste bins
• Lamp collection, transport, and recycling
• Municipal waste collection, transport and processing (e.g., at transfer stations)
• Waste disposal (e.g., at the landfill face and incinerator ash disposal sites)
Magnified health risks of mixed exposures for vulnerable populations

+ = magnified risk
### Key mercury exposure pathways and effects

<table>
<thead>
<tr>
<th>MERCURY FORM</th>
<th>KEY EXPOSURE PATHWAYS</th>
<th>TYPICAL SOURCES</th>
<th>TOXIC EFFECTS OBSERVED IN</th>
</tr>
</thead>
</table>
| Elemental (metallic)              | • Inhalation          | • Emissions from coal-fired power plants  
                                      • Broken fluorescent lamps  
                                      • Broken thermometers  
                                      • Dental amalgams        | • Central nervous system  
                                      • Immune system  
                                      • Kidneys  
                                      • Lungs             |
| Inorganic (primarily mercuric chloride) | • Ingestion  
                                      • Dermal           | • Laxatives  
                                      • Cosmetic products  
                                      • Antiseptics        | • Kidneys  
                                      • Skin (acrodyinia)  
                                      • Central nervous system  
                                      • Gastrointestinal tract |
| Organic (primarily methylmercury) | • Ingestion (oral)  
                                      • Parenteral (other ingestion)  
                                      • Placental        | • Fish (accumulated through the food chain)  
                                      • Insecticides  
                                      • Fungicides       | • Central nervous system  
                                      • Cardiovascular system |

Note: Inorganic compounds illegally used in skin-lightening products may include mercuric iodide, mercurous chloride, ammoniated mercury, or others.
Over the years, a variety of mercury exposure limits have been recommended:

- by different government agencies, scientific and standardization organizations
- to protect groups with varying sensitivities and/or vulnerabilities
- to consider exposures over longer (“chronic”) or shorter (“acute”) time periods
- using various safety margins, and
- generally lacking broad consensus
## Recommended limits for safe exposure to mercury vapor in air

<table>
<thead>
<tr>
<th>AGENCY AND/OR EXPLANATION OF EXPOSURE LIMITS</th>
<th>MERCURY CONCENTRATION IN AIR (ng/m³)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical U.S. ambient (outside) air</td>
<td>1 - 10</td>
</tr>
<tr>
<td>California Chronic Reference Exposure Level (REL), Office of Environmental Health Hazard Assessment</td>
<td>30</td>
</tr>
<tr>
<td>Agency for Toxic Substances and Disease Registry (ATSDR), a branch of the Centers for Disease Control, Minimal Risk Level (MRL), e.g., chronic exposure for children</td>
<td>200</td>
</tr>
<tr>
<td>California acute (short-term = 1-hour ave.) REL</td>
<td>600</td>
</tr>
<tr>
<td>American Conference of Governmental and Industrial Hygienists ACGIH (occupational exposure 8 h, 5-day week)</td>
<td>25,000</td>
</tr>
</tbody>
</table>

*All units are given in nanograms, or billionths of a gram, per cubic meter of air.
When a lamp breaks…

In research carried out by the State of Maine, following the breakage of a single CFL, the mercury concentration in the study room air often exceeded the Maine Ambient Air Guideline of 300 ng/m$^3$, with short episodes over 25,000 ng/m$^3$, and sometimes briefly exceeding 50,000 ng/m$^3$.

What NEVER to do when cleaning up a mercury spill

• Never use a vacuum cleaner or broom.

• Never pour mercury down a drain.

• Never allow people who are wearing mercury-contaminated shoes or clothing to walk around the house.

• Never use a washing machine to launder clothing or other items that may have come in contact with mercury.
How to clean up a small mercury spill

**How to Clean Up a Small Mercury Spill**
(a broken thermometer, thermostat or compact fluorescent)

**Step 1** Isolate the spill and ventilate the area right away.
- The person who will clean up the spill should have everyone else, especially children, leave the spill area, including pets. Don't let anyone touch the mercury on their way out.
- Open all windows and doors that open to the outside of the house.
- Close all doors between the room where the mercury was spilled and the house.
- Close all cold air returns so that mercury vapor is not carried through the house.
- Turn down heaters and turn up single-room air conditioners, but don't air condition.
- Use fans to blow mercury-contaminated air outside. Turn off fans that, to the outside.

**Step 2** Get the items needed to clean up a small mercury spill.
You will need the following items:
1. 4 or 5 gallon plastic bags
2. Trash bags (2 to 6 mm thick)
3. Rubber, nitrile or latex gloves
4. Paper towels
5. Cardboard or paper
6. Eye dropper
7. Duct tape, or shaving cream and small paintbrush
8. Flashlight
9. Powdered sulfur (optional)

**Step 3** Cleanup spill.
- Put on rubber, nitrile or latex gloves.
- Pick up any broken pieces of glass and place them on a paper towel, or cardboard, and put it in a zip-top bag, and seal the bag.
- Clean up the beads of mercury. Use a squeegee or cardboard to clean up the beads onto a sheet of paper. An eye dropper can also be used to collect the beads. Slowly squeeze mercury from the eye dropper onto a damp paper towel. Put the paper towel, paper, eye dropper, or anything else that has mercury on it into a zip-top bag, and seal the bag.
- After you remove larger beads, put shaving cream on top of a small piece of paper and gently blot the affected area to pick up smaller hand-sized beads. Also use duct tape or masking tape to collect smaller hand-sized beads and put them into a zip-top bag.

**Step 7** Properly dispose of contaminated cleanup materials.
- Place all materials used in the cleanup, including gloves, in a trash bag. Place the zip-top bags that contain mercury and other objects into the trash bag. Close and seal the trash bag and place it in a safe place outside your house. Label the bag as directed by your local health or fire department.
- Contact your local health department, municipal waste authority, or your local fire department for proper disposal in accordance with local, state and federal laws.

**Step 8** Determine if additional action needs to be taken following cleanup of spill.
- Keep the area well-ventilated to the outside (i.e., windows open and fans in exterior windows running) for at least 24 hours after the spill. Continue to keep pets and children out of the cleanup area. If anyone gets sick, call your doctor or the Poison Control Center at (888) 222-1222 immediately.
- You may want to hire a contractor who has monitoring equipment to screen for mercury vapor. Consult your local environmental health or agency to inquire about contractors in your area.
- If young children or pregnant people are in the house, seek additional advice from your local or state health or environmental agency.

**What to Do for Mercury Spills Greater Than the Amount in a Thermometer, Thermostat or Compact Fluorescent Light Bulb**

Mercury is heavy. Just two table spoons weigh nearly one pound. If more than the amount of mercury in a thermometer or thermostat or a compact fluorescent light bulb is spilled in your house, be sure to follow these steps:

- Have everyone else leave the area. Don't let anyone walk through the mercury on their way out.
- Open all windows and doors to the outside.
- Turn off the heater in winter and turn on the air conditioner in summer.
- Shut all doors to other parts of the house, and leave the area.
- Call your local or state health or environmental agency for help.

If more than two tablespoons of mercury are spilled, it is mandatory to call the
National Response Center (NRC), available 24 hours a day, 1-800-424-8802.
- If you have health-related questions about mercury, call the Agency for Toxic Substances and Disease Registry (ATSDR) at 800-232-4636 or TTY: 888-232-6348, or by email to cdcinfo@atdsr.cdc.gov.
- If you have questions about cleaning up a mercury spill of any size, call US EPA at 202-503-8840.
Recommendations

- Websites and other platforms that now encourage the use of fluorescents should be updated to support LED lighting instead.

- Parties to the Minamata Convention on Mercury should support the proposed African amendment to phase out fluorescent lamps by 2025.

- States and local governments should adopt and enforce mercury reduction policies to phase out the sale of fluorescent lamps.

- Schools, child care and healthcare facilities, public housing facilities, etc. should replace fluorescent lamps, especially where sensitive populations are present.
Recommendations (continued)

• **Lighting manufacturers and distributors** should stop selling fluorescents, remove promotional info from their websites and accept phase-out legislation.

• **Utilities** should advocate for federal, state and local policies that phase out fluorescent lamps.

• **Environmental groups** should advocate for policies at all levels that phase out the manufacture and sale of fluorescent lamps in the United States – and globally.
Questions? Comments?

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Mercury-free LED Alternatives to Fluorescent Lamps

New market data from Africa, Latin America and Asia
Are Mercury-free LED Alternatives Affordable Today?

- CLiC sought to understand whether the economics supported a phase-out globally
- Engaged partner organizations in **35 countries** across Africa, Latin America and Asia
- Gathered **1300 models** of both mercury-containing fluorescent and LED
  - General service lamps – compact fluorescent and LED
  - Linear tube lamps – linear fluorescent and LED
- Created “matched pairs” of LED equivalent to fluorescent
NGO partners

ASSOCIACAO DE SAUDE AMBIENTAL TOXISPHERA

[Logos of various NGOs and partners]
Snap-Shot of Global Market Data

**Africa Region:** Burkina Faso, Cameroon, Ivory Coast, Gabon, Zambia, Uganda, Nigeria, Kenya, Ghana, South Africa, Togo and Ethiopia

**Asia Pacific Region:** India, Bangladesh, Philippines, Pakistan, Sri Lanka, Vietnam, Indonesia, Japan and Malaysia*

**GRULAC Region:** Antigua & Barbuda, Argentina, Belize, Jamaica, Brazil, Chile, Colombia, Guyana, Mexico, Panama, Peru, St. Kitts & Nevis, Trinidad & Tobago and Uruguay
LEDs are More Efficient – Global Market Data

- Linear fluorescent lamps: 57-84 lm/W
- LED linear retrofit lamps: 90-100 lm/W
- Compact fluorescent: 53-60 lm/W
- LED lamps: 81-97 lm/W
### LEDs pay for themselves quickly…African Region

<table>
<thead>
<tr>
<th>Country</th>
<th>LED payback vs. Inc/Hal</th>
<th>LED savings compared to CFL</th>
<th>LED payback vs. LFL</th>
<th>LED savings compared to LFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina Faso</td>
<td>Instant</td>
<td>53%</td>
<td>8 months</td>
<td>46%</td>
</tr>
<tr>
<td>Cameroun</td>
<td>8 weeks</td>
<td>55%</td>
<td>6 months</td>
<td>55%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>19 weeks</td>
<td>50%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>7 weeks</td>
<td>54%</td>
<td>11 months</td>
<td>47%</td>
</tr>
<tr>
<td>Gabon</td>
<td>18 weeks</td>
<td>54%</td>
<td>8 months</td>
<td>43%</td>
</tr>
<tr>
<td>Ghana</td>
<td>Instant</td>
<td>49%</td>
<td>1 month</td>
<td>50%</td>
</tr>
<tr>
<td>Kenya</td>
<td>3 weeks</td>
<td>50%</td>
<td>9 months</td>
<td>48%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>16 weeks</td>
<td>41%</td>
<td>9 months</td>
<td>45%</td>
</tr>
<tr>
<td>South Africa</td>
<td>Instant</td>
<td>48%</td>
<td>Instant</td>
<td>50%</td>
</tr>
<tr>
<td>Togo</td>
<td>3 weeks</td>
<td>51%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Uganda</td>
<td>Instant</td>
<td>57%</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
## LEDs pay for themselves quickly...GRULAC

<table>
<thead>
<tr>
<th>Country</th>
<th>LED payback vs. Inc/Hal</th>
<th>LED savings compared to CFL</th>
<th>LED payback vs. LFL</th>
<th>LED savings compared to LFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua y Barbuda</td>
<td>Instant</td>
<td>34%</td>
<td>11 months</td>
<td>47%</td>
</tr>
<tr>
<td>Belice</td>
<td>6 weeks</td>
<td>42%</td>
<td>11 months</td>
<td>48%</td>
</tr>
<tr>
<td>Brasil</td>
<td>4 weeks</td>
<td>43%</td>
<td>5 months</td>
<td>43%</td>
</tr>
<tr>
<td>Perú</td>
<td>2 weeks</td>
<td>50%</td>
<td>4 months</td>
<td>55%</td>
</tr>
<tr>
<td>Guyana</td>
<td>7 weeks</td>
<td>46%</td>
<td>LFL not available</td>
<td></td>
</tr>
<tr>
<td>México</td>
<td>14 weeks</td>
<td>41%</td>
<td>LFL not available</td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>Instant</td>
<td>CFL not available</td>
<td>LFL not available</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>Instant</td>
<td>38%</td>
<td>2 months</td>
<td>44%</td>
</tr>
<tr>
<td>Uruguay</td>
<td>2 weeks</td>
<td>38%</td>
<td>LFL not available</td>
<td></td>
</tr>
</tbody>
</table>
LEDs pay for themselves quickly...Asia-Pacific

<table>
<thead>
<tr>
<th>Country</th>
<th>LED payback vs. Inc/Hal</th>
<th>LED savings compared to CFL</th>
<th>LED payback vs. LFL</th>
<th>LED savings compared to LFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>7 months</td>
<td>41%</td>
<td>12 months</td>
<td>40%</td>
</tr>
<tr>
<td>India</td>
<td>7 months</td>
<td>50%</td>
<td>6 months</td>
<td>41%</td>
</tr>
<tr>
<td>Philippines</td>
<td>12 weeks</td>
<td>53%</td>
<td>2 months</td>
<td>49%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>8 weeks</td>
<td>48%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Pakistan</td>
<td>4 weeks</td>
<td>49%</td>
<td>5 months</td>
<td>47%</td>
</tr>
<tr>
<td>Vietnam</td>
<td>12 weeks</td>
<td>48%</td>
<td>4 months</td>
<td>49%</td>
</tr>
<tr>
<td>Japan</td>
<td>--</td>
<td>--</td>
<td>7 months</td>
<td>44%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6 weeks</td>
<td>47%</td>
<td>7 months</td>
<td>47%</td>
</tr>
</tbody>
</table>
Country snapshot: India

Progressive national policies have advanced the adoption of LED technology:

- Through the E-Waste (Management) Rules 2016, India is already complying with the Minamata Annex A provisions for CFLs and LFLs and it has more stringent mercury content limits for some categories. It also mandates lamp producers to collect and ensure proper recycling and recovery of mercury from end-of-life mercury-bearing lamps.

- MOEFCC issued a notification in September 2021 restricting imports of mercury.

- On energy efficiency – BEE has regulated LED lighting products since 2015 progressively improving efficacy requirements.
Country snapshot: India

The world’s largest zero-subsidy LED bulb program for domestic consumers was launched in 2015

- Goal to replace 770 million old wasteful lamps with modern, efficient and longer lasting LED lamps
- Reducing annual household electricity bills by about 15% saving consumers over 16 billion INR every year

“I urge you all to use LED bulbs, save money, save energy and take part in helping our nation.”
Shri Narendra Modi, Hon’ble Prime Minister
Country snapshot: India

India Lighting Industry Association Fast Tracks Transition to LEDs

• Through the vision 2024 document, ELCOMA is aiming to grow the LED lighting industry by fully localizing the manufacture and assembly of LED lamps and eliminating the dependence on imports.

• The locally assembled and manufactured LED light bulbs will be cheaper and more affordable, compared to imported lamps.

• This, coupled with consumer awareness campaigns that ELCOMA will run on the benefits of purchasing and installing LED light bulbs, will boost the indigenous LED manufacturing companies
Regional snapshot: Africa

Lighting Policy & Legislative Landscape:

• Southern Africa Development Community – 16 countries adopted a harmonised standard SADC HT 109:2021 in Q2 2021, shifts markets to LED.

• East African Community – 6 countries, draft harmonised standard DEAS 1064; finalization is expected in Q1 2022 which will shift markets to LED.

• ECOWAS’ energy efficiency plan to phase out incandescent lamps and replace them with high efficiency CFL and LED
Regional snapshot: Africa

Government Interventions for Market Transformation

• Countries such as Nigeria, Burkina Faso, Zambia amongst other have carried out lamp replacement programs to phase out old inefficient lighting sources.

• Some governments have created subsidies and financing programs for efficient lamps.

• Widespread adoption of Off Grid Solar Solutions to increased access to electricity has also hastened the adoption of LED lights.

• Ivory Coast – After signing the Minamata Convention and developing the Decree of E-waste Management (adopted in 2017), the government has been supplying LEDs lamps for public lighting in all the major cities of the country since 2019.

• Nigeria: In its highlighted strategies to achieve energy efficiency, the Nigeria Energy Policy of 2013 specifically mentions replacing all incandescent light bulbs in every home, industry and institutions with LEDs and other energy saving lamps by the year 2025.
Regional snapshot: Africa

LED assembly companies, provide local jobs and stimulate national economies:

- Ghana – Solid Home Appliance Ltd
- Zambia – Savenda Electricals
- Rwanda – Sahasra
- South Africa - LEDwise Lighting and Radiant Group (Pty)
- Nigeria – Oretronics technology
- Uganda - Lumens Manufacturing Industries (U) Ltd.
- Botswana - The Bulb World focuses entirely on LED production.
- Mozambique - Tempest LED Lighting and Tecnoelectrica
Regional snapshot: Africa

Price and Payback Period Comparisons

Across all the focus countries, some LED brands are already cheaper today or at price parity with CFLS.

Payback period on tube lighting is less than 1 year in many of the surveyed countries and instant in other countries such as South Africa and Uganda.

Payback period on general lighting is less than 18 weeks in majority of the markets and instant for some of the products in Ghana and Burkina Faso.
Example of Analysis: Nigeria, Tubular Lamp

- Two lamps: fluorescent and LED
- Same light output
- Life-Cycle Cost analysed over 15 years (LED bulb life)
- LED is 45% less expensive than fluorescent
- Payback in 9 months
- Lasts 4 years

Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 15 years, with light bulb and electricity costs discounted back to the present (2022).

LED light sources cost of ownership is about half as much as fluorescent sources, yet produce the same amount of light from the fixture.

<table>
<thead>
<tr>
<th>Price for one lamp (NGN):</th>
<th>500</th>
<th>950</th>
<th>NGN/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.20</td>
<td>2.28</td>
<td>USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
<td>Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>13,000</td>
<td>50,000</td>
<td>Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
<td>kWh/year</td>
</tr>
<tr>
<td>LCC of operating lamp for 15 years, discounted to 2022:</td>
<td>38,182</td>
<td>19,428</td>
<td>NGN (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>4.4</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions, electricity for one lamp operating for 15 years:</td>
<td>355</td>
<td>177</td>
<td>kg CO2/15 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Nigeria for this comparison Photos taken: Q4 2021
# Global & Regional Benefits (cumulative, 2025-50)

<table>
<thead>
<tr>
<th>Country / Region</th>
<th>Mercury avoided in lamps only (metric tonnes)</th>
<th>CO2 avoided (million metric tonnes)</th>
<th>Electricity bill savings (billion USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>127.2</td>
<td>4,639</td>
<td>$ 1277.8</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>75.9</td>
<td>3,279</td>
<td>$ 691.8</td>
</tr>
<tr>
<td>Latin America</td>
<td>11.3</td>
<td>239</td>
<td>$ 90.9</td>
</tr>
<tr>
<td>Africa</td>
<td>4.9</td>
<td>221</td>
<td>$ 31.4</td>
</tr>
</tbody>
</table>
For more information, download the Global Report here:

https://cleanlightingcoalition.org/resources/global-report/
Thank you!

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EU Policy Pathway to Phasing out Fluorescent Lighting in General Lighting Applications in 2023

Pre-COP4.2 Side Event: Eliminating mercury in lighting - A win-win for health and the environment

2022 March 08

Peter Bennich, The Swedish Energy Agency
Michael Scholand, CLASP Europe
Focus on: Fluorescent Lighting

• A dominant light source for over 50 years; producing roughly 70% of the lumens in 2015

• Fluorescent lighting contains mercury, a known neurotoxin – extremely hazardous to people and the environment

• Sales of these lamps are covered under:
  – Restriction of Hazardous Substances (RoHS) Directive
Restriction of Hazardous Substances Directive

- RoHS was passed in 2003 (Directive 2002/95/EC) and took effect in 2006
- It was revised in 2011 (Directive 2011/65/EU), establishing new more stringent limits
- RoHS limits or bans ten substances, one of which is mercury
- For fluorescent lighting, RoHS sets a maximum amount (milligrams) of mercury per bulb
- RoHS is a CE-marking directive, meaning that all suppliers must ensure they comply before placing them on the market
Ecodesign Directive

- Ecodesign was passed in 2005 (Directive 2005/32/EC) and was recast in 2009 (Directive 2009/125/EC)
- Established a public-participative process for developing quality and performance regulations on products
- Lighting products – including fluorescent lamps – were regulated under several regulations, starting in 2009
- Regulations primarily focused on energy-efficiency requirements, but also have quality requirements like minimum colour rendering (CRI) and lifetime
- Ecodesign is also a CE-marking directive, meaning suppliers must comply before placing them on the market
# Differences between RoHS and Ecodesign

<table>
<thead>
<tr>
<th><strong>RoHS Directive</strong></th>
<th><strong>Ecodesign Directive</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Delegated Act, the Commission (DG ENV) has authority to carry out the regulation</td>
<td>• Follows Comitology, the Commission (DG ENER, DG GROW or DG ENV) manages the process</td>
</tr>
<tr>
<td>• Expert consultants and Member State advisors (but no Member State vote)</td>
<td>• Decisions are made by the Member States in the Regulatory Committee</td>
</tr>
<tr>
<td>• No public participation</td>
<td>• Expert consultants</td>
</tr>
<tr>
<td>• Letters and information treated as confidential; freedom of information request</td>
<td>• Highly transparent and participative, including Member States, industry, NGOs, civil society</td>
</tr>
<tr>
<td>• No mandatory deadlines on DG ENV to update, although guidance was 5 years (expired 2016)</td>
<td>• Decisions are driven by several factors, including least life-cycle cost</td>
</tr>
</tbody>
</table>
| • Decisions are driven by toxicity, and calls for exemptions to be phased-out if alternatives exist | }
A Technology Revolution in the Lighting Market

• Previously one of the largest end users of electricity – about 3000 TWh/yr in 2005, projected to 5000 TWh/yr in 2030 with no new policies

• Enter LED => a disruptive and transformative technology

• Plus, new knowledge of the relationship between light and health

• And, legacy lighting companies exposed to competition by new actors => changed the whole lighting industry.

• Conclusion: it's important to distinguish between legacy companies with an old and new product portfolio and new companies only focussing on LED-based lighting
A Challenge to Policy-Makers

• How to assess market development when the market moves so fast - both technology (performance) and sales distributions?
• How to guarantee the quality of lighting when using a new technology (LED) - especially considering new knowledge on light and health?
• How to explain to normal consumers why the incandescent light bulbs were phased out?
• How to ensure legacy companies are able to make the switch?
• How to guide new companies to innovate and provide products with good lighting qualities?
• And so on…
A Strong Track Record of Policy Measures

• EU-27 and the European Economic Area have adopted policy-measures over a decade to keep transforming the European lighting market

• ECODESIGN Regulation
  • Incandescent: 2009-12; halogen spot lamps: 2015 and halogen non-directional: 2018 [EC No 244/2009]
  • Halophosphate fluorescent: 2010-12; [EC No 245/2009]
  • CFLi, T2 and T12 Linear Fluorescent: 1 September 2021; [EU No 2019/2020]
  • T8 Linear fluorescent in 60cm, 120cm and 150cm: 1 September 2023; [EU No 2019/2020]

• RoHS Regulation
  • Removes fluorescent lighting from virtually all general purpose lighting applications on either 24 February 2023 or 24 August 2023.
  • CFLni – all base-types (single capped): 2023; [EU No 2022/276] (RoHS)
  • T8, T5 – all lengths and diameters: 2023; [EU No 2022/284] (RoHS)
Are there Mercury-Free Alternatives to Fluorescent?

- Yes, literally tens of thousands of mercury-free LED retrofit lamps
- Different diameters, lengths, ballast types (magnetic and electronic), colour temperatures, and light output
- Products sold today do not need to rewire the old fluorescent fixture:
  - Philips/Signify: “No need to change drivers or rewire”, and a “plug and play solution that works straight out of the box”
  - OSRAM/LEDvance state “SubstiTUBE” is a “Quick, simple and safe lamp replacement without rewiring”
  - Tungsram says in addition to “the 2.5-3x longer life (compared to T8 fluorescent)….LED T8 tubes provide lower system loss while existing fixtures remain intact.”
- Sweden-CLASP database (pictured) shows 91-93% of existing fluorescent fixtures can accept drop-in retrofit LED lamps
Are LED Tubes safe to use?

Yes. IEC has safety standards for LED Lamps and Tubes

Suppliers use these to ensure safety

Millions and millions in use today

“100% safe installation”

IEC 62560:2011 - IEC safety standard for self-ballasted LED lamps for general lighting services

IEC 62776:2014 – IEC safety standard for linear LED retrofit tubes
## Are LED Retrofit Lamps Cost-Effective?

<table>
<thead>
<tr>
<th>Economic indicator description</th>
<th>T8 LFL</th>
<th>T8 LED-1</th>
<th>T8 LED-2</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp:</td>
<td>€3.68</td>
<td>€6.77</td>
<td>€12.74</td>
<td>Euros/lamp</td>
</tr>
<tr>
<td>Rated lamp wattage:</td>
<td>36</td>
<td>18</td>
<td>12.5</td>
<td>Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>20,000</td>
<td>30,000</td>
<td>50,000</td>
<td>Hours</td>
</tr>
<tr>
<td>Annual electricity consumption (10 hr/day):</td>
<td>131</td>
<td>66</td>
<td>46</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Annual cost of electricity:</td>
<td>€16.48</td>
<td>€8.24</td>
<td>€5.72</td>
<td>Euros/year</td>
</tr>
<tr>
<td>Payback period in years:</td>
<td>0.38</td>
<td>0.84</td>
<td></td>
<td>years</td>
</tr>
<tr>
<td><strong>Payback period in months:</strong></td>
<td><strong>4.5</strong></td>
<td><strong>10.1</strong></td>
<td></td>
<td><strong>months</strong></td>
</tr>
<tr>
<td>Life-Cycle Cost, 13 years, net present value:</td>
<td>€223.40</td>
<td>€118.82</td>
<td>€87.12</td>
<td>Euros (NPV, 2021)</td>
</tr>
<tr>
<td>Life-Cycle Cost savings (net present value):</td>
<td>€104.58</td>
<td>€136.28</td>
<td></td>
<td>Euros (NPV, 2021)</td>
</tr>
</tbody>
</table>

For this calculation, it is assumed the lamps operate on average 10 hours per day (3650 hours/year), non-domestic electricity costs are €0.1254/kWh (EuroStat, 2021a), that there is an annual increase in electricity price of 4.0% and a discount rate of 4.0% (VHK, 2019).
**Compact Fluorescent Lamps**
- Integrally ballasted CFL (CFLi)
- Pin-based non-integrally ballasted CFL (CFLni)

**Linear Fluorescent Lamps**
- Triband phosphor Linear Fluorescent Lamps
- Halophosphate Linear Fluorescent Lamps

**CCFL / EEFL**
- Cold Cathode / External Electrode Fluorescent Lamps

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<tbody>
<tr>
<td></td>
<td>for general lighting purposes that are ≤ 30 watts with a mercury content exceeding 5 mg per lamp burner: <strong>2020</strong></td>
<td>for general lighting purposes: (a) Triband phosphor &lt; 60 watts with a mercury content exceeding 5 mg per lamp: <strong>2020</strong></td>
<td>(CCFL and EEFL) for electronic displays: a) short length (≤ 500 mm) with mercury content exceeding 3.5 mg per lamp b) medium length (&gt; 500 mm &amp; ≤ 1 500 mm) with mercury exceeding 5 mg per lamp c) long length (&gt; 1 500 mm) with mercury content exceeding 13 mg per lamp: <strong>2020</strong></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Ecodesign Directive EU 2019/2020</th>
<th>Compact Fluorescent Lamps</th>
<th>Linear Fluorescent Lamps</th>
<th>CCFL / EEFL</th>
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<tr>
<td>Phase-out 2023 Cat 1(a) to (e) – Feb. Cat 1(g) – Aug.</td>
<td>Phase-out 2023 Cat 1(a) to (e) – Feb. Cat 1(g) – Aug.</td>
<td>Phase-out 2023 T12 2(a)(3) – Feb. T8 Cat 2(a)(4) – Aug. T5 Cat 2(a)(2)– Aug.</td>
<td>Bans products from containing CCFL/EEFL on day of publication in OJEU (Feb 2022)</td>
</tr>
</tbody>
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For general lighting purposes that are ≤ 30 watts with a mercury content exceeding 5 mg per lamp burner: **2020**, for general lighting purposes: (a) Triband phosphor < 60 watts with a mercury content exceeding 5 mg per lamp: **2020**, for general lighting purposes: (b) Halophosphate phosphor ≤ 40 watts with a mercury content exceeding 10 mg per lamp: **2020**, (CCFL and EEFL) for electronic displays: a) short length (≤ 500 mm) with mercury content exceeding 3.5 mg per lamp, b) medium length (> 500 mm & ≤ 1 500 mm) with mercury exceeding 5 mg per lamp, c) long length (> 1 500 mm) with mercury content exceeding 13 mg per lamp: **2020**.
European Policy Process Conclusions

- Ecodesign removed many fluorescent lamps in Europe on the basis of Lifecycle Cost.
- RoHS removed the remaining general purpose fluorescent lamps on the basis of toxicity.
- Feasibility was demonstrated: LED retrofit are available, and in 91-93% of stock can be installed directly without any rewiring (just change the bulb).
- Consultants calculated EU benefits from 2021 through 2035 from the RoHS phase out:
  - €29.9 billion in net savings (bulbs, energy, luminaires);
  - 2.9 tonnes of mercury (plus 2.5 tonnes from avoided coal powerplant emissions).

Minamata is an opportunity to scale up the EU fluorescent phase-out globally through the proposed African Amendment on Lighting to COP4.
Thank you – Any Questions?

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