Information Document on Linear Fluorescent Lamps for General Lighting Purposes

This document is provided to the Parties to the Minamata Convention on Mercury as they prepare for the fifth Conference of the Parties (COP5). This information document discusses linear fluorescent lamps and their mercury-free alternatives, namely Light Emitting Diode (LED) lamps.

30 December 2022
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About the Clean Lighting Coalition

Let’s End Toxic Lighting Together. The Clean Lighting Coalition (CLiC) is a global campaign leveraging expert knowledge and clean lighting stakeholders to transition global markets to safe, cost-effective, and energy-saving LED lighting. CLiC has grown rapidly with membership comprising industry partners, public health authorities, mercury experts, and NGO partners who are working together for the global phase-out of toxic mercury lighting through the Minamata Convention on Mercury. The accelerated development of LED technology over the last five years means that phasing out fluorescent lamps is now both technologically feasible and economically justified around the world. The CLiC campaign is coordinated by CLASP.
Executive Summary

At the fourth Conference of the Parties (COP4) of the Minamata Convention on Mercury, Parties did not conclude their negotiations on the phase-out dates for linear fluorescent lamps (LFLs). It was agreed that this discussion would continue at COP5. The Clean Lighting Coalition (CLiC) prepared this information document to provide Parties with information about LFLs in order to support the negotiations at COP5.

The Clean Lighting Coalition’s (CLiC) assessment concludes that LFLs should be phased-out as early as possible, but no later than 2025. Linear fluorescent lamps are within scope of the Minamata Convention on Mercury, however they are allowed to continue to be sold even though there are cost-effective, mercury-free LED retrofit tubular lamps that can be installed and will operate in the same sockets, simplifying the upgrade to LED.

At the global level, delaying the phase-out results in costly losses. CLiC prepared an assessment of the phase-out dates for LFLs, and how delaying the phase-out will result in lost benefits in terms of mercury, electricity and greenhouse gas emissions. The cumulative benefits (2025-2050) of phasing out LFLs in different years under the Convention are presented in Table 1. This table shows the mercury savings, financial savings (i.e., lower electricity bills), carbon dioxide and energy savings according to the year of phase-out.

Table 1. Cumulative benefits of a phase-out of Linear Fluorescent Lamps (2025-50)

<table>
<thead>
<tr>
<th>Phase-Out Year -&gt;</th>
<th>2025</th>
<th>2027</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury Savings</td>
<td>198 tonnes</td>
<td>162 tonnes</td>
<td>116 tonnes</td>
</tr>
<tr>
<td>Financial Savings</td>
<td>US$1.34 trillion</td>
<td>US$1.12 trillion</td>
<td>$818 billion</td>
</tr>
<tr>
<td>CO2 Savings</td>
<td>3.3 GT</td>
<td>2.7 GT</td>
<td>1.9 GT</td>
</tr>
<tr>
<td>Energy Savings</td>
<td>9,602 TWh</td>
<td>8,022 TWh</td>
<td>5,845 TWh</td>
</tr>
</tbody>
</table>

Table 1 shows that a two-year delay from 2025 to 2027 results in a loss of 36 tonnes of avoidable mercury pollution and US$221 billion in electricity bill savings. This two-year delay will add another 600 million tonnes of CO2 to the atmosphere and forego 1,580 TWh of electricity savings. A 5-year delay from 2025 to 2030 results in a loss of 82 tonnes of avoidable mercury pollution, and over half a trillion dollars in electricity bills. It means an additional 1.4 GT of CO2 will be released to the atmosphere and 3,757 TWh of electricity savings are lost.

At the local level, not upgrading to LED tubes is costing businesses and households money. CLiC gathered product and performance data from dozens of countries across the African, Asia-Pacific and Latin American regions, and in all cases found that payback periods from switching to LED tubes had a one-year payback or less. Two thirds of the countries studied had payback periods of six months or less. Overall, across the 25 countries shown in the Figure 1, the payback period was just 5.1 months. This graph shows specifically that some countries had very short payback periods.
Short payback periods translate into lower running costs for businesses and consumers, and during a cost of living crisis when everyone is facing significantly higher energy prices and inflationary pressure, energy-efficient LED lighting can offer some relief. Switching to energy-efficient LED lighting is a simple, easy upgrade that can cut electricity bills for lighting in half. Furthermore, it should be noted that the distribution of payback periods plotted in Figure 1 will shift further to the left (i.e., even shorter payback periods) as the cost of electricity increases and the price of LED retrofit bulbs continues to fall.

Policymakers around the world are developing and adopting bans on fluorescent lighting based on both its toxicity and inefficiency. The European Union, the states of California and Vermont, the Southern and Eastern regions in Africa, Canada and elsewhere are all adopting national and regional policy measures that phase-out fluorescent lamps.

The time to say “farewell to fluorescents” is now. Linear fluorescent lamps can and should be phased out no later than 2025. This report shows the feasibility and benefits of removing fluorescent lamps from the market through the Minamata Convention. An ambitious and early phase-out of linear fluorescent lamps is a triple win for people’s wallet, public health and the environment.
1 Introduction

1.1 Overview of linear fluorescent tubes
Linear fluorescent tubes were first commercialised in the 1930s. They are low pressure gas discharge lamps that pass electricity through a mercury vapour contained within a glass tube filled with a low-pressure inert gas. The mercury vapour produces invisible UV light when it is excited by the electric discharge and the UV light is converted to visible light through the use of a phosphor coating which fluoresces when exited by the UV light. This process is illustrated in Figure 2 below.

![Figure 2. Cut-away View of a Fluorescent Lamp and Parts Necessary for Operation](image)

The manufacturing process has been refined over the years, but is essentially a glass tube internally coated with phosphor. Starting with glass tubes of typically 3 different diameters 16mm (T5), 26mm (T8) & 38mm (T12), they are coated internally with phosphor that is baked on. Each end of the tube is sealed with an electrical connection that contains a filament wire called a cathode, which is coated with a chemical emitter to help start the discharge in the lamp. The tube is filled with an inert gas (e.g., Argon) and a dose of mercury is introduced into the lamp before sealing it. The mercury can be in the form of an amalgam pill in the case of T5 or it can be liquid mercury contained in a glass phial affixed to the cathode. Fluorescent tubes require a ballast to control the electric discharge and a starter to produce a high enough voltage to start them.

Approximately one billion linear fluorescent lamps (LFL) were sold around the world in 2022. And, due to the fact that all fluorescent lamps contain mercury (5-10 mg mercury depending on the lamp), the Clean Lighting Coalition calculates that 8 metric tonnes of mercury will be installed in the lighting in offices and homes this...
year. The fact that this 120-year old technology still enjoys such widespread use is surprising because it some challenging performance aspects such as (1) contains toxic mercury, (2) takes a long time to warm-up to full brightness, (3) has a short service life (4) is fragile and (5) is difficult to dim. Fortunately, there are cost-effective mercury-free alternatives – namely retrofit tubular LED lamps – also called “TLEDs” which can be used as direct, drop-in replacements for LFLs.

### 1.2 Minamata Convention on Mercury

Annex A to the Minamata Convention on Mercury covers linear fluorescent lamps (LFLs). Figure 3 below shows some pictures of common general purpose linear fluorescent lamps that are covered, including all diameters, all shapes (including U-bend), and all lengths.

Annex A establishes limits on the mercury content based on the type of phosphor the fluorescent lamp contains - triband or halophosphate. In general, triband phosphor lamps have slightly higher efficiency and longer life (typically around 20,000 hours) than halophosphate lamps. Halophosphate lamps are based on an older, poorer quality phosphor that has a lower efficacy and shorter lifetime (typically around 12,000 hours). In contrast to these, mercury-free LED tubes are twice as efficient as fluorescent and are commonly rated for 35,000 to 50,000 hours of life and recent products are rated for 100,000 hours.

When the Minamata Convention was being drafted in 2013, the limits were set at a level that allowed these lamps to continue to be sold because at that time, mercury-free light emitting diode (LED) alternatives were an emerging technology and were not widely available. Annex A of the Convention states that triband fluorescent lamps may contain up to 5 milligrams of mercury per bulb, and halophosphate fluorescent lamps may contain up to 10 milligrams.

At the Minamata Convention on Mercury’s Fourth Conference of Parties (COP4), 137 governments adopted amendments to phase out integrally ballasted compact fluorescent lamps (CFL.i) by the end of 2025. The

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1. MASTER LEDtube T8 Ultra Efficient MAS LEDtube 1500mm UE 17.6W 840 T8 EELA [Link](#)
governments also agreed to phase out cold cathode fluorescent lamps and external electrode fluorescent lamp (CCFL/EEFL) in 2025.² The amendments are shown in the shaded rows of Table 2.

Table 2. Shaded Rows are Lighting Amendments to Minamata Annex A from COP4 in Bali, Indonesia

<table>
<thead>
<tr>
<th>ANNEX A. MERCURY-ADDED PRODUCTS</th>
<th>PHASE-OUT DATE³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤ 30 watts with a mercury content exceeding 5 mg per lamp burner</td>
<td>2020</td>
</tr>
<tr>
<td>Compact fluorescent lamps with an integrated ballast (CFLi) for general lighting purposes that are ≤ 30 watts with a mercury content not exceeding 5 mg per lamp burner</td>
<td>2025</td>
</tr>
<tr>
<td>Linear fluorescent lamps (LFLs) for general lighting purposes: (a) Triband phosphor &lt; 60 watts with a mercury content exceeding 5 mg per lamp; (b) Halophosphate phosphor ≤ 40 watts with a mercury content exceeding 10 mg per lamp</td>
<td>2020</td>
</tr>
<tr>
<td>High pressure mercury vapor lamps (HPMV) for general lighting purposes</td>
<td>2020</td>
</tr>
<tr>
<td>Mercury in cold cathode fluorescent lamps (CCFL) and external electrode fluorescent lamps (EEFL) for electronic displays: (a) short length (≤ 500 mm) with mercury content exceeding 3.5 mg per lamp; (b) medium length (&gt; 500 mm and ≤ 1500 mm) with mercury content exceeding 5 mg per lamp; (c) long length (&gt; 1500 mm) with mercury content exceeding 13 mg per lamp</td>
<td>2020</td>
</tr>
<tr>
<td>Cold cathode fluorescent lamps (CCFL) and external electrode fluorescent lamps (EEFL) of all lengths for electronic displays, not included in the listing directly above</td>
<td>2025</td>
</tr>
</tbody>
</table>

The Clean Lighting Coalition calculated the cumulative benefits (2025–2050) from the decision taken in Bali to phase out integrally ballasted compact fluorescent lamps in 2025:⁴

- **Mercury Savings**: 34.8 metric tonnes avoided
- **Financial Savings**: $105.6 billion USD saved on energy bills⁵
- **Energy Savings**: 754 TWh saved
- **CO₂ Savings**: 263 million metric tonnes avoided

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² Annex A to the Minamata Convention on Mercury, as amended by the Conference of the Parties at its fourth meeting. Minamata Convention Secretariat, 2022. Link
³ Date after which the manufacture, import or export of the product shall not be allowed
⁴ Note that the cumulative benefits of CCFLs and EEFLs being phased out in 2025 is assumed to be zero because this technology has already been eclipsed by LED alternatives
⁵ Assumes US$0.14/kWh as a global average electricity price (March 2022) Global Petrol Prices
At COP4, Parties did not conclude negotiations on the phase-out date for LFLs, thus it was agreed to discuss LFLs at Minamata COP5 (30 October–3 November 2023) in Geneva. The table showing what is under consideration at COP5 is presented below. Please note that included in this amendment being discussed at COP4 was the EU lighting proposal to expand the scope of coverage of Minamata to include halophosphate phosphor LFLs with wattages greater than 40 watts. This amendment, if adopted at COP5 would bring all halophosphate LFLs under coverage.

Table 3. Lighting Amendments to Minamata Annex A to be Discussed at COP5 in Geneva

<table>
<thead>
<tr>
<th>MERCURY-ADDED PRODUCTS</th>
<th>PHASE-OUT DATE⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear fluorescent lamps (LFLs) for general lighting purposes:</td>
<td></td>
</tr>
<tr>
<td>(a) Halophosphate phosphor ≤ 40 watts with a mercury content not exceeding 10 mg per lamp</td>
<td></td>
</tr>
<tr>
<td>(b) Halophosphate phosphor &gt; 40 watts</td>
<td></td>
</tr>
<tr>
<td>[2025] [2027] [2030]</td>
<td></td>
</tr>
<tr>
<td>Linear Fluorescent Lamps (LFLs) for general lighting purposes:</td>
<td></td>
</tr>
<tr>
<td>(a) Triband phosphor &lt; 60 watts with a mercury content not exceeding 5 mg/lamp</td>
<td></td>
</tr>
<tr>
<td>[2027] [2030]</td>
<td></td>
</tr>
</tbody>
</table>

Our analysis has shown that by phasing out LFLs early, governments will help to reduce mercury released to the environment, lower energy bills and significantly reduce CO₂ emissions. An ambitious and early phase-out of linear fluorescent lamps is a triple win for people and the environment. The Clean Lighting Coalition recommends a 2025 phase-out date for all linear fluorescent lamps.

⁶ Date after which the manufacture, import or export of the product shall not be allowed
2 Technical Information

In reviewing databases including the Design Lights Consortium Quality Products List\(^7\) in the USA and the European EPREL database\(^8\), it is clear that there are tens of thousands different models of linear LED retrofit lamps. These lamps cover the full spectrum of diameters, lengths, colour temperatures, levels of light output, and compatibility with different ballasts (or mains voltage).

LED retrofit lamps are sold and installed directly into fluorescent luminaires around the world without rewiring. These businesses, industries and households are benefitting directly from retrofitting LED lamps into existing fluorescent fixtures. The installation of LED retrofit tubes into fluorescent fixtures is common sense – it eliminates mercury, is highly cost-effective, lowers energy bills and provides better, longer-lasting lamps. Furthermore, since payback periods are less than a year (see Chapter 6) – and according to OSRAM can be as short as four months – upgrades can take place within a business’ operational fiscal year so incremental costs are off-set by the substantial energy savings, thus recouping the cost of mercury-free LED lighting.

2.1 Compatibility

The issue of compatibility of LED retrofit tubes comes down to the fluorescent lamp ballast which had been operating the fluorescent lamp. There are two types of ballast – magnetic (also called “choke”) ballasts and electronic (also called “high frequency”) ballasts. LED retrofit tubes are 100% compatible with magnetic (“choke”) ballasts. This type of ballast is particularly common in developing and emerging markets because they tolerate humidity better and can withstand voltage spikes and surges due to power fluctuations. LED retrofit tubes have 80-90% compatibility with electronic ballasts, depending on the manufacturer.

2.1.1 Developing a Compatibility Database of Ballast-LED Lamps

In this section, we present our detailed work combining the fluorescent ballast-lamp compatibility tables of several tubular LED lamp manufacturers. We started by downloading the current PDFs from the following manufacturers websites and then converting them into Excel tables:

- LEDvance; BALLAST COMPATIBILITY LIST – SubstiTUBE, Nov. 2019, Version2 Filename: Ballast
- Compatibility SubstiTUBE UNIVERSAL T8 , T5 Universal Gen 8
- Philips LEDtube compatibility list Professional Q2 2019 – MASTER LEDtube HF T5, MASTER LEDtube HF T8, CorePro LEDtube HF InstantFit; CorePro LEDtube Universal HO; May 2019
- Felio Sylvania Europe Limited, ToLEDo Superia T8 Universal Electronic ballast compatibility list, January 2018, Version 1.0

\(^7\) Design Lights Consortium Database is a US-based online searchable database that classifies LED lamps and luminaires and contains over 500,000 products. These data reflect the current North American market however because LED lamps and luminaires are globally traded, these models are indicative of what is available elsewhere in the world

\(^8\) The European Product Registry for Energy Labelling (EPREL) database which brings together thousands of lighting models that were uploaded by manufacturers to comply with the requirements of EU No. 2019/2015, covering lamps and luminaires
After merging all the databases and compatibility / non-compatibility indicators across all these catalogues and test reports, we found the following:

- For T5 linear lamps – 208 ballast-lamp combinations were given in the manufacturer’s compatibility catalogues for the European market. Of these, 166 ballast-lamp combinations had compatible LED retrofit lamps from either Philips, Osram or Sylvania. Thus, 80% of the installed stock can be retrofit with LED lamps.

- For T8 linear lamps – 262 ballast-lamp combinations were given in the catalogues for the European market. Of these, 234 ballast-lamp combinations had compatible LED retrofit lamps from either Philips, Osram or Sylvania – amounting to 89% of the T8 high-frequency (electronic) ballast stock. However, if LED lamps from Opple and LEDs Change the World are added to the database, the compatibility jumps up to 97% (253 lamp-ballast combinations are compatible). In addition, it is worth noting that T8 magnetic ballasts are 100% compatible with LED retrofit lamps.

Given the revised estimates based on our more thorough analysis of the manufacturer’s current catalogues providing their declared rates of compatibility, we have calculated new revised estimates for Europe for retrofit LED lamp compatibility in fluorescent luminaires across the EU- which is 91.4 to 93.7% across all T5 and T8 luminaires installed in Europe today.

<table>
<thead>
<tr>
<th>Lamp Size</th>
<th>Percentage of T5 &amp; T8 in EU Stock</th>
<th>Ballast Type</th>
<th>Percentage of stock by ballast type</th>
<th>Estimated EU Stock of total T5 &amp; T8</th>
<th>Compatibility, Low - High Estimate</th>
<th>Overall EU Stock Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>T5</td>
<td>30%</td>
<td>HF/ECC</td>
<td>100% of T5</td>
<td>30%</td>
<td>79% - 80%</td>
<td>23.7% - 24%</td>
</tr>
<tr>
<td>T8</td>
<td>70%</td>
<td>EM/CGG</td>
<td>70% of T8</td>
<td>49%</td>
<td>100%*</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HF/ECC</td>
<td>30% of T8</td>
<td>21%</td>
<td>89% - 97%</td>
<td>18.7% - 20.4%</td>
</tr>
<tr>
<td>Total:</td>
<td>100%</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td>91.4% - 93.4%</td>
</tr>
</tbody>
</table>

*No compatibility issues with electromagnetic T8 ballasts, LED lamps can retrofit 100% of these installations

A copy of the compatibility database that the Clean Lighting Coalition created can be found here: https://www.mercuryconvention.org/Portals/11/documents/meetings/COP4/submissions/CLASP_AnnexAB_spreadsheet.xlsx

2.1.2 Retrofit LED Lamps and Existing Luminaires
LED lamp manufacturers have taken the time to design LED retrofit lamps to have the same form, fit and function as the fluorescent lamps that they are replacing. LED lamps are compatible with existing fixtures - in
100% of cases, the fixture does not need to be changed. Using literature published by the lighting industry, the Clean Lighting Coalition has demonstrated that there can be either direct drop-in replacement LED lamps or, in the very few situations where a compatible LED tube lamp cannot be found, an electrician can “by-pass” the ballast and bring mains voltage to the fluorescent fixture sockets, and then a mains-voltage LED tube can be installed – enabling the existing fixture to remain in place.

Offering a little more detail on the two possible scenarios, which cover all situations:

- **Option A – Direct Drop-in Retrofit LED Tubes**: In 91 to 94 percent of installations⁹, a direct drop-in replacement LED tube can be sourced which can simply be installed directly into the same sockets and will operate on the fluorescent lamp ballast. For this option, the building owner does not need to rewire or change the fixture, instead they simply change the light bulb to an LED and immediately they are mercury-free and saving money. Here are two examples from some global manufacturers:
  
  - Philips/Signify: “No need to change drivers or rewire”, and a “plug and play solution that works straight out of the box”¹⁰
  
  - OSRAM/LEDvance state “SubstiTUBE” is a “Quick, simple and safe lamp replacement without rewiring”¹¹

- **Option B – Ballast By-Pass**: In 6 to 9 percent of installations, there isn’t a direct drop-in replacement LED tube – however the fixture can still be used. For these luminaires, the building owner simply has an electrician “bypass” the ballast, which means connect mains voltage (i.e., 120V or 230V) directly to fixture sockets. After taking the fluorescent ballast out of the circuit, LED tubes that operate on mains voltage can be installed into the existing fixture. maintain UL listing of the original fixture by placing a sticker inside the fixture, letting electrical inspectors know that the ballast has been bypassed, transferring mains voltage to the sockets.

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⁹ Two research studies evaluated the compatibility of LED tubes in existing fluorescent luminaires, evaluating over twenty compatibility reports published by ten different LED tube suppliers. The [Swedish Energy Agency and CLASP](https://energyefficiency.swe) (2021) and [ACEEE and ASAP](https://www.aceee.org) (2022).

¹⁰ Philips publication where the statements “No need to change drivers or rewire” and a “plug and play solution that works straight out of the box” are made. [Link](https://www.philips.com)

¹¹ Osram webpage where the SubstiTUBE produce is described as a “Quick, simple and safe lamp replacement without rewiring”. [Link](https://www.osram.com)
From our experience in the African, Asia-Pacific and GRULAC regions, we have not come across any lamps which do not fit into existing fixtures. Major lamp suppliers such as Signify/Philips and LEDvance/OSRAM have also emphasized the universality of their products on their websites:

“With OSRAM SubstiTUBE T8 Universal, you no longer need to give any thought to the driver technology being used. The innovative all-in-one LED tube can be operated with ECG, CCG and AC mains. It not only makes it much easier for users to operate, but also eliminates the need to keep a double amount of lamps on hand.” - LEDvance/OSRAM website.

This means for a particular type of fluorescent tube, a single LED tube model can be kept as replacement stock for all luminaires regardless of ballast type.

“Other lamps claim compatibility, but only InstantFit has been proven to work with over 350 ballasts and drivers delivering even light output, proven energy savings and a long average lifetime. That’s true compatibility.” – Signify/Philips brochure

2.2 Safety
IEC safety standards have been in place for 8-10 years, and LED lamps that follow these standards are considered safe. The IEC adopted safety standards for self-ballasted LED lamps in 2011, double-ended LED tubes in 2014 and semi-integrated LED lamps in 2015. Since these safety standards have been introduced and manufacturers have conformed to the requirements, safety incidents and lamp issues are virtually non-existent – certainly no greater risk than the fluorescent ballasts or fixtures themselves.

The following are the key safety standards for LED retrofit lamps to highlight:

- **IEC 62776:2014** Double-capped LED lamps designed to retrofit linear fluorescent lamps - Safety specifications
- **IEC 62560:2011** Self-ballasted LED-lamps for general lighting services by voltage >50 V - Safety specifications
- **IEC 62838:2015** LEDsi lamps for general lighting services with supply voltages not exceeding 50 V a.c. r.m.s. or 120 V ripple free d.c. - Safety specifications

Manufacturers that regularly follow IEC safety standards feel confident publishing claims of “100% safe installation”. For example, this [brochure from Philips/Signify](#) published in August 2016.
Another example is this brochure from LEDvance/OSRAM which states “quick, simple and safe replacement without rewiring”:

- General illumination within ambient temperatures from -20...+45 °C
- Corridors, stairways, parking garages
- Industry
- Warehouses
- Cooling and storage rooms
- Warehouses
- Domestic applications
- Supermarkets and department stores

- No bending to glass tube
- Energy savings of up to 68% (compared to T8 fluorescent lamp on CCG)
- Quick, simple and safe replacement without rewiring
- Instant-on light, therefore ideally suitable in combination with sensor technology
- Very high resistance to switching loads
- Also suitable for operation at low temperatures
2.3 LED Retrofit Tube Performance Equivalency

LED retrofit lamps not only meet but in many ways out-perform the old fluorescent bulbs they are designed to replace. LED lamps are far more advanced technologically and offer a much better value proposition for lighting homes, businesses, hospitals, schools and many other applications inside and out, without having toxic mercury in the living space. LEDs last 2-3 times longer than fluorescent lamps, and use half as much energy to produce the same illumination in a room - enabling end-users to cut their energy bills for lighting in half just by changing the bulb. In this section, we will discuss four aspects of the performance of LED lighting relative to fluorescent:

- **Light Output – CRI and CCT** – due to the enhanced flexibility of LED technology, this subsection will demonstrate that LED offers a broader range of color rendering indexes (CRI) and correlated color temperatures (CCT) than mercury-containing fluorescent lamps;
- **Optical equivalency** – due to the directional nature and superior optical performance of LEDs, there is less ‘wasted light’ with LED retrofit tubes, and thus in this section we will look at optical performance when replacing mercury lighting with LED and demonstrate its equivalency;
- **Lifetime and Reliability** – one of the best qualities of LED lighting is its significantly longer lifetime, which is typically 2-3 times longer than fluorescent (but can be even higher). This saves on lighting downtime and labor costs to change the lamps.

2.3.1 Light Output – CRI and CCT

Two important colour-related aspects that apply to all LED lamps are colour rendering index and correlated colour temperature (CCT). LED retrofits for fluorescent lamps already meet or exceed the CRI and CCT values of fluorescent lamps. The tables below provide links to examples of products which demonstrate the wide range of color-related performance available in LED technology.

**Colour Rendering Index** – there is a wide range of products that meet and exceed the highest CRI of fluorescent lamps. The fluorescent and LED alternatives are presented in the table below.
Table 5. Comparison of Very High CRI Values – Best Fluorescent Tubes and Best LED Tubes

<table>
<thead>
<tr>
<th>Technology</th>
<th>Manufacturer</th>
<th># Models</th>
<th>CRI Value</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent</td>
<td>Philips/Signify Master TL-D Super 80</td>
<td>59 products</td>
<td>78 to 85</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>Philips/Signify Master TL-D 90 Graphica</td>
<td>6 products</td>
<td>95 to 97</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>Osram/LEDvance LUMILUX T8</td>
<td>33 products</td>
<td>77 to 90</td>
<td>Link</td>
</tr>
<tr>
<td>LED</td>
<td>Philips/Signify Master LEDtube EM/Mains T8</td>
<td>77 products</td>
<td>80 to 83</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>General Electric – Refit Solutions High CRI with reveal TriGain Tech.</td>
<td>9 products</td>
<td>90+</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>DOMAGIC LED Tubes T8</td>
<td>4 products</td>
<td>&gt;97</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>Waveform Lighting (T5 and T8)</td>
<td>15 products</td>
<td>≥ 95</td>
<td>Link</td>
</tr>
</tbody>
</table>

From these models already available on the market, LED retrofit lamps that match all the same CRI values that are achieved by fluorescent tubes. The CRI value of the LED tubes is just a function of the LEDs that are selected by the product designer, choosing LEDs or a combination of LEDs that have a high CRI or a very high CRI. There is no technical issue from a product availability perspective for LED lamps being made with very high CRI values – it is simply a matter of market demand.

Correlated Colour Temperature – the CCT is a measure of the colour ‘shade’ of white light emitted by a lamp, relating to the colour of light emitted by an ideal blackbody radiator when heated to a particular temperature, measured in Kelvin. Spectrally, ‘warm’ shades contain more yellowish/red light content and are at lower Kelvin (2700 -3500K), while ‘cool’ shades contain more blue (greater than 5000K) to create their overall white ‘colour’ appearance.

Figure 4. Photograph illustrating Correlated Colour Temperature (1000 to 10,000K)

The CIE defines Correlated Colour Temperature as follows:

\[
\text{CIE eILV 17-258 correlated colour temperature } [\text{Tcp}] \; \text{temperature of the Planckian radiator having the chromaticity nearest the chromaticity associated with the given spectral distribution on a diagram where the (CIE 1931 standard observer based) } u', \frac{2}{3}w' \text{ coordinates of the Planckian locus and the test stimulus are depicted; Unit: K}
\]
CCT describes the colour appearance of a white light source with respect to the closest matched Planckian radiator. As with CRI, there is no technical barrier to LED lamps producing all of the same CCT values as those of fluorescent lamps – it is simply a product design decision that is made when selecting the LEDs for the lamp. On the market today, we find a full range of CCT values offered in LED retrofit linear lamps. Philips and Osram make the most popular CCT values for linear LED lamps – 2700K to 6500K; and other companies are offering 10000K and 20000K CCT. The resultant light output from the LED lamps is simply a function of the choice of LED chips used in the product, thus on a practical level, any CCT is achievable.

Table 6. Comparison of CCT Ranges for Fluorescent and LED Tubes

<table>
<thead>
<tr>
<th>Technology</th>
<th>Manufacturer</th>
<th># Models</th>
<th>CCT Value</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent</td>
<td>Philips/Signify T8 lamps</td>
<td>37 products</td>
<td>2700 to 12000K</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>Philips/Signify T5 lamps</td>
<td>20 products</td>
<td>2700 to 12000K</td>
<td>Link</td>
</tr>
<tr>
<td>LED</td>
<td>Philips/Signify T8 LED lamps</td>
<td>136 products</td>
<td>3000 to 6500K</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>MIC Light the World, T5 LED</td>
<td>User specified</td>
<td>10000K</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>Changsha Durlite Lighting Co.</td>
<td>User specified</td>
<td>20000K</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>OSRAM/LEDvance, T8</td>
<td>103 products</td>
<td>3000 to 6500K</td>
<td>Link</td>
</tr>
<tr>
<td></td>
<td>OSRAM/LEDvance, T5</td>
<td>60 products</td>
<td>3000 to 6500K</td>
<td>Link</td>
</tr>
</tbody>
</table>

In addition, there are companies in China which advertise on Alibaba who will make a customized LED lamp of any length, base type, wattage, CRI and CCT. Here are two examples of these companies, which also offer customized logo, customized packaging and give lead times for delivery which can be as short as a month or less.

**Shenzhen Wiscoon Technology Corporation**
101 – 200 Employees  
Certified by TUV SUD for LED Tube manufacturing, also ISO 9001  
Specialising in T5 and T8 linear LED tubes  
Rated lifetime of 50,000 hours  
[Click on this link](#) to view the company and their offering

**GAOPIN, Guangdong, China**
51-100 Employees  
Offers a wide range of CCT, from 2700K to 20000K  
Lengths from 300cm to 2400cm  
10 Production Lines, ISO 9001 certified; CE mark  
Rated lifetime of 50,000 hours  
[Click on this link](#) to view the company and their offering
2.3.2 Optical Equivalency
The Swedish Energy Agency conducted a lumen intensity distribution (LID) comparison of a fluorescent luminaire with a fluorescent lamp and then a retrofit LED lamp in the same fixture. The LID graphs are shown in Figure 5 with the T8 fluorescent lamp on the left and two T8 LED retrofits in the middle and on the right. The light distribution patterns are virtually identical, meaning that the illumination in the room will be perceived as the same by an occupant. This optical equivalency – coupled with the other value propositions of LED (mercury free, longer life, cost-effective energy savings) – helps to explain why the market is satisfied with the performance of LED retrofit tubes:

![Lumen Intensity Distributions (LID) of a Fluorescent Fixture with 1 LFL and 2 LED Tubes](image)

Figure 5. Lumen Intensity Distributions (LID) of a Fluorescent Fixture with 1 LFL and 2 LED Tubes

Sweden has checked with stakeholders who have replaced the fluorescent lamps and they found: “Experiences from real installations prove the existing alternatives, including retrofit LED tubes....to be clearly satisfying or superior both from a technical (lifetime, maintenance, etc.) and lighting (light distribution, glare, colour temperature, safety, comfort, esthetical, etc.) point of view. Even when it comes to the LCC, existing alternatives are many times already attractive.”

Finally, for those few installations where a full emission pattern (360 degrees) is needed, manufacturers have produced LED tubes which offer a full emission pattern. Example 1, Example 2, Example 3. Note: given that retrofitting LED tubes into fluorescent fixtures is the current market trend, it makes sense to accelerate this trend by ending the exemption for fluorescent lamps through the Minamata Convention on Mercury.

2.3.3 LED Lamp Lifetime
It is very important that when an end-user makes a decision to switch lighting technologies that the new light source is viewed as reliable and durable in the lighting application it is replacing. LED light sources – which can
be directly retrofitted into an existing luminaire – are more reliable than the fluorescent lamps that they replace. This fact is reflected in the rated lifetime and manufacturer’s guarantees that are issued with the products.

The LED replacements for linear T5 fluorescent lamps are reliable; the LED lamps have rated lifetimes are 2.1 times longer than the fluorescent lamps they are replacing. Furthermore, the product warranty offered on one of the two lamps sampled for this comparison was 5 times longer for the LED retrofit than for the fluorescent lamp it replaces.

It is very important that when an end-user makes a decision to switch lighting technologies that the new light source is viewed as reliable and durable in the lighting application it is replacing. LED light sources – which can be directly retrofitted into an existing luminaire – are more reliable than the fluorescent lamps that they replace. This fact is reflected in the rated lifetime and manufacturer’s guarantees that are issued with the products.

The table below shows some examples of fluorescent and direct retrofit (no re-wiring necessary) LED alternatives for those lamps. The rated lifetimes of LED lamps are typically about three times longer than the fluorescent lamps they are replacing. Webpage links are provided as footnotes for verification purposes.

<table>
<thead>
<tr>
<th>T5 Fluorescent Lamps</th>
<th>T5 LED Direct Retrofits</th>
</tr>
</thead>
<tbody>
<tr>
<td>**Philips TL5 HE 35W 840 (MASTER)</td>
<td>145cm - Cool White**</td>
</tr>
<tr>
<td><strong>Osram FQ HO 54W 865 G5 Lumilux - 115cm</strong></td>
<td>24,000 hours 1 year warranty</td>
</tr>
</tbody>
</table>

Both T5 fluorescent lamps are rated for 24,000 hours and the LED retrofit T5 lamps are rated for 50,000 and 60,000 hours – which is 2.1 to 2.5 times longer life. The difference between the warranty offered on the two different lamp technologies is markedly different – the fluorescent lamp only offers a 1-year warranty while the LED lamp offers a five-year warranty – five times longer. From both a rated lifetime and a warranty perspective, T5 LED direct retrofits for fluorescent T5 lamps are reliable substitutes.

12 https://www.any-lamp.co.uk/philips-tl5-he-35w-840-master-145cm-cool-white
13 https://www.any-lamp.co.uk/philips-ledtube-t5-hf-he-20w-840-145cm-master-cool-white-replaces-35w
14 https://www.any-lamp.co.uk/psram-fq-ho-54w-865-g5-lumilux-115cm
15 https://www.any-lamp.co.uk/noxion-avant-led-tube-t5-extreme-hf-high-output-26w-3900lm-865-daylight-145cm-replaces-49w-8719157042468
The LED replacements for double-capped T8 fluorescent lamps are reliable; the LED lamps have rated lifetimes are 2.5 to 3.0 times longer than the fluorescent lamps they are replacing. Furthermore, the product warranty offered on one of the two lamps sampled for this comparison was 5 times longer for the LED retrofit than for the fluorescent lamp it replaces. The table below shows some examples of fluorescent and direct retrofit (no re-wiring necessary) T8 LED alternatives for those lamps. The rated lifetimes of LED lamps are typically 2 to 3 times longer than the fluorescent lamps they are replacing.

Table 8. Lifetime Comparison for T8 Triphosphor Fluorescent and LED Retrofit Tubes

<table>
<thead>
<tr>
<th>T8 Fluorescent Lamps</th>
<th>T8 LED Direct Retrofits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philips TL-D 18W 827 Super 80 (MASTER)</td>
<td>Philips LEDtube HF 8W 830 60cm (MASTER)</td>
</tr>
<tr>
<td>warm white</td>
<td>Warm White</td>
</tr>
<tr>
<td>Osram L 36W 840 Lumilux</td>
<td>Osram SubstiTUBE LED T8 PRO (HF) Ultra Output</td>
</tr>
<tr>
<td>120cm - cool white</td>
<td>15W 840 120cm</td>
</tr>
<tr>
<td>1 year warranty</td>
<td>5 year warranty</td>
</tr>
<tr>
<td>20,000 hours</td>
<td>60,000 hours</td>
</tr>
</tbody>
</table>

Both T8 fluorescent lamps are rated for 20,000 hours and the LED retrofit T8 lamps are rated for 60,000 hours – which is 3.0 times longer life. The difference between the warranty offered on the two different lamp technologies is markedly different – the fluorescent lamp only offers a 1 year warranty while the LED lamps both offer a five year warranty – five times longer. From both a rated lifetime and a warranty perspective, T8 LED direct retrofits for fluorescent T8 lamps are reliable substitutes.

2.3.4 LED Lamp Reliability

This criterion relates to whether the reliability of the substitute LED retrofit products is ensured or not. There are tens of thousands of LED retrofit lamps that are available on the market today, some are of better quality than others, but these products do offer some information relating to the reliability of the products. There are two good proxy indicators that are available in the market to verify whether this criterion has been met:

1) Manufacturer declared lifetime (usually in hours) of the lamps
2) Warranty period offered with the LED replacement lamps

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16 https://www.any-lamp.co.uk/philips-tl-d-18w-827-super-80-master-59cm-extra-warm-white
17 https://www.any-lamp.co.uk/philips-ledtube-hf-8w-830-60cm-master-warm-white-replaces-18w
18 https://www.any-lamp.co.uk/osram-l-36w-840-lumilux-120cm-cool-white
19 https://www.any-lamp.co.uk/osram-substitube-led-t8-pro-hf-ultra-output-15w-2400lm-840-cool-white-120cm-replaces-36w-4058075545014
Manufacturers declare the lifetime of products in hours, and base this declaration on the expected service life of a product. The typical lifetime of a linear fluorescent lamp (including both T5 and T8) is around 15,000 to 24,000 hours – which corresponds to 2.3 to 2.8 years of service, if the lamp is operated 24 hours per day. The typical lifetime of an LED retrofit lamp is 30,000 to 70,000 hours – 3.4 to 8.0 years of service at 24 hours per day. Detailed examples of these lamps are given in Section 3 of this report.

Warranty periods vary across the industry. Standard fluorescent tubes have a warranty period up to 2 years, but for LED replacements, the typical warranty period for LED fluorescent tubes is more than twice as long: 5 years. This longer warranty period is due to the expected service life of the lamps, specifically the reliability of the substitutes. Thus, the reliability of LED retrofit lamps is actually better than the fluorescent lamps they are replacing. The LED lamp typically has a service life that is 2-3 times longer than the service life of the fluorescent lamp would replace.
3 Policy Progress Phasing Out Fluorescent Lamps

Due to the highly cost-effective nature of LED technology, governments around the world are taking action to remove mercury-laden fluorescent bulbs from their lighting markets. The following is a summary of policies phasing out fluorescent lighting around the world. In addition to these, there are other regulatory efforts phasing out fluorescent lamps in their early stages with various policymakers. CLiC will continue to work with these governments and will keep the Parties to the Minamata Convention informed of these important developments.

3.1 United States / North America

California: The U.S. state of California adopted AB 2208, a law that bans the sale of all LFLs and all non-integrally ballasted CFLs starting 1 January 2025. This law was influenced by research that supported a fluorescent lamp phase-out due to their mercury content. AB 2208 establishes a sales ban on all CFL.i starting on 1 January 2024. The California law is actively being referenced by other states.

Vermont: The U.S. state of Vermont adopted two laws which address some of the same products covered in the California legislation. The clause 10 V.S.A. §7152(A)(6) phases out all screw-based CFLs, effective 17 February 2023. Vermont also adopted H.500 which bans all four-foot LFLs (all diameters) effective 1 January 2024.

Rhode Island: The U.S. state of Rhode Island drafted a bill modelled after the California bill to phase out all CFLs and LFLs. This draft bill was introduced into the state legislature in March 2022. It did not complete the legislative process before the end of that term, but they are considering introducing it again in early 2023.

USA National: The U.S. Department of Energy proposed a new regulation that would establish efficacy requirements for general service lamps at 120 lumens per watt. If adopted, this regulation would completely eliminate compact fluorescent lamps (CFLs) from the US market because the efficacy level is too high for fluorescent technology.

Canada: Canada recently published a draft proposal in the Canada Gazette Part 1 (Proposed Regulation Amending the Products Containing Mercury Regulations, 2022-12-24 Canada Gazette Part 1, Vol. 156, No. 52) to phase-out of all fluorescent lamps containing mercury (CFLs and LFLs). The policy measure proposes to phase-out integrally ballasted CFLs are on 31 December 2023; pin-based CFLs on 31 December 2026; all T5 linear fluorescent lamps on 31 December 2026; all 4-foot or less T8 linear fluorescent lamps on 31 December 2026; all 4-foot or less and 8-foot T12 on 31 December 2026 and all non-linear fluorescent lamps including circular and square shaped on 31 December 2026.
3.2 Europe

European Union (EU-27): In December 2019, the EU adopted EU No. 2019/2020 which covers all lamps and luminaires placed on the market. On 1 September 2021, the first requirements of that regulation took effect, phasing out CFL.i and T12 LFLs. The second phase, which will take effect on 1 September 2023, will phase out T8 Fluorescent lamps of 600 mm, 1000 mm & 1500 mm length.

In December 2021, the European Commission made a decision under the Restriction of Hazardous Substances (RoHS) Directive to ban the sales of nearly all LFLs and CFLs in 2023. Under this regulation, only T9 circular and certain U-bend fluorescent lamps received an extension.

European Economic Area (EEA): Iceland, Liechtenstein, and Norway, while not part of the European single market, are members of the European Economic Area and as such are required to conform to European regulations to maintain favourable trade status. These countries have therefore harmonised with EU No. 2019/2020 and the 2021 Amendments to the RoHS Directive (example: Norway RoHS regulation).

United Kingdom (UK): The UK recently left the European Union, but not before it adopted EU No. 2019/2020 – (UK S.I. 2021 No. 1095). Thus, CFL.i and T12 LFLs were phased out in the UK in 2021 and certain T8 LFLs will be phased out in 2023. The UK also proposed to adopt more ambitious lighting regulations (BEIS Policy Paper, November 2021), setting efficacy levels that would phase out all fluorescent lighting (120 lumens/Watt). In addition to this policy development, the UK’s Department for Environment, Food and Rural Affairs (DEFRA) is currently considering harmonising with the European Commission’s amendments to the RoHS Directive.

3.3 Africa

Southern Africa Development Community (SADC): In June 2021, the sixteen (16) countries of SADC adopted regionally harmonised quality and performance standard SADCSTAN HT-109. This standard sets a technology-neutral efficacy requirement that phases out fluorescent lamps and transitions to LEDs.

East African Community (EAC): In July 2022, the seven (7) countries of East African Community adopted a regionally harmonised quality and performance standard, EAS 1064-1:2022. The standard covers energy efficiency and functional performance requirements, sampling, and test methods for general service and tubular lamps. The requirements of the East African standard are aligned with the Southern African standard and will phase out fluorescent lamps in favour of LEDs.

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21 The seven countries of East African Community: Burundi, Democratic Republic of Congo, Kenya, South Sudan, Tanzania, Rwanda and Uganda.
3.4 Greater Middle East

**Sudan** – Sudan developed an energy efficiency strategy that includes adopting UNEP United for Efficiency (U4E) lighting regulations that phase out CFLs in 2024 and LFLs in 2025. See page 96 of [Sudan’s Energy Efficiency Strategy](February 2022).

**Tunisia** – The National Agency for Energy Management of Tunisia is drafting lighting MEPS that will phase out all fluorescent lighting technologies by setting efficacy levels that only LED technology can achieve. See the [UNEP press release](on the 2022 workshop where the government and stakeholders met to agree the way forward.

3.5 Asia-Pacific

**India** – At the Minamata Convention COP4, India supported the phase-out of compact fluorescent lamps by 2025 and linear fluorescent lamps by 2027 to protect human health and the environment from the adverse effects of mercury. In 2021, India’s lighting industry association, ELCOMA published [Vision 2024](which sets out a roadmap for India to be fully vertically integrated in LED product manufacturing by 2024 and establish itself as the second largest global exporter of LED lighting products and components.

**Pakistan** – The National Energy Efficiency & Conservation Authority developed the country’s first ever [LED MEPS and labelling](regulations with the new policy specifically “aimed to enhance the best quality LED products, for a rapid phase-out of CFL lamps and incandescent bulbs.”

3.6 Latin America and the Caribbean

**Chile** – the Ministry of Energy [published a resolution](in 2020 that will phase out CFLs by 2024 by setting mandatory efficacy requirements at a level only LED technology can achieve. In the resolution, the Ministry recognised that “a general change is required in conventional technologies from incandescent, halogen and fluorescent lighting to light-emitting diodes (LEDs).”

**Dominican Republic** – the Deputy Minister of Energy called for greater use of energy-efficient lighting and highlighted the problem of mercury toxicity from fluorescent tubes. News item is [published here](.

3.7 International Bodies

**United for Efficiency (U4E) from the United Nations Environment Programme (UNEP)** – The U4E programme published “model regulations” in early 2021 which call for the total phase-out of fluorescent lamps between the years 2023 and 2025. These regulations – also called mandatory energy performance standards – recommend that all compact fluorescent lamps are phased out in 2023\(^{22}\) and that all linear fluorescent lamps are phased out

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\(^{22}\) UNEP U4E Model Regulation on General Service Lamps (including CFLs): [Link](#)
by 2025. 23 And, it is important to note that both U4E documents contain an explicit functional performance requirements stating that the light bulb and the luminaire shall not contain any mercury, 0.0 mg.

The International Energy Agency (IEA) – The IEA is operating at a global level, looking at the energy sector and providing guidance to governments. In two recent reports that include discussion on lighting measures, the IEA recommended that the world shift to a total LED lighting market – i.e., all new installations of lighting should be LED – in 2025. These two reports can be found here:

IEA Report: Net Zero Emissions by 2050. This IEA report identifies more than 100 actions that governments should consider implementing in order to achieve a target of net zero climate emissions by 2025. In the recommendation for lighting on page 146, the IEA declares: “The share of light-emitting diode (LED) lamps in total lightbulb sales reaches 100% by 2025 in all regions.”24

IEA Report: Technology and innovation pathways for zero-carbon-ready buildings by 2030. This IEA report dedicates a whole chapter25 to the opportunity and potential for lighting to contribute to the zero-carbon emissions for buildings by 2030. The chapter is called “Targeting 100% LED lighting sales by 2025”.

23 UNEP U4E Model Regulation on Linear Fluorescent Lamps (including LFLs): Link
24 IEA Net Zero Emissions by 2050 report: Link
25 IEA Technology and Innovation Pathways report: Link
4 Fluorescent Lamp Manufacturing Globally

Global production of fluorescent lighting has been on the decline over the past five years with several manufacturing plants closing and consolidation taking place. Research by the Clean Lighting Coalition has found that only a few factories remain open. The rapid development of mercury-free, energy-efficient LED lighting has accelerated the decline of fluorescent lighting.

There are two specialized components that are used in the production of LFLs: glass tubes and phosphor, a powdery substance that converts the ultra-violet (UV) light inside the tube into visible light. The production of these components constitutes the ‘critical supply chain’ of fluorescent lamp manufacturing, and thus provide an indication of the broader trends for this product in the lighting market. We understand that all the big suppliers of fluorescent lamp phosphor have scaled back production, and phosphor prices are skyrocketing, while quality is declining at the few remaining smaller phosphor suppliers.

Production lines for the oldest fluorescent lamp technology (T12 fluorescent bulbs) tend to be labour-intensive and expensive to operate, and therefore are generally being phased out. Production of the most recent fluorescent technology (T5 fluorescent bulbs) is highly automated and employs very few people while operating continuously (i.e., 24 hours per day, 365 days per year).

The following is a regional summary of the status of linear fluorescent lamp manufacturing facilities around the world:

USA/Canada/Mexico
- General Electric at Bucyrus, Ohio (approx. 200 employees) and Logan, Ohio (approx. 50 employees) were both closed in 2022. Regarding the rationale for the closing, a company spokesman said: “the lighting industry has seen double-digit declines in demand for linear fluorescent bulbs in each of the last five years.” All other manufacturing closed. GE’s Lighting division was sold to Savant systems in May 2020.
- Osram/Sylvania spun off its general lighting business into a separate, global company called LEDVANCE in July 2016. Later that month, it was announced that a Chinese consortium would purchase LEDVANCE for approximately US$440 million. This new Chinese consortium consists of MLS Co. Limited, IDG Capital and Yiwu State-Owned Assets Operation Center. Following this move, and with more competitive manufacturing lines in China in addition to the market shift to LED, all the North American lamp manufacturing factories have been shut down.
- Philips Lighting/Signify sold its Salina, Kansas light bulb manufacturing facility in July 2021. This sale of the facility was made to Great Plains Manufacturing and the approximately 130 jobs were transferred from Philips/Signify to the new owner. This facility was re-tooled as part of a US$53 million expansion project and will now produce Kubota construction equipment.
Europe

- **Germany** | Sylvania Erlangen - The Feilo Sylvania Germany GmbH plant in Erlangen started production in 1968. As of 2014, the main products manufactured were fluorescent tubes and specialty lamps. In 2020 the company declared liquidation, but then continued operation under the Chinese Shanghai Feilo Acoustics Co., Limited since 2021. The facility employs about 200 people making T5 and T8 fluorescent tubes.

- **Poland** | Philips Pila – Signify / Philips Lighting has had lighting manufacturing in Poland since 1958 with headquarters in Pila. Its light sources manufacturing and logistics centre is focused on broadening export activities which represented 90% of the total sales in 2006. Currently, the factory in Poland is producing linear fluorescent lamps and specialty tubular lamps.

- **Hungary** | LightTech – started in 1993 in order to serve the demand for germicidal lamps in both the European and Asian markets. They produce a wide range of UV products all made to an extremely high quality and also design and manufacture custom lamps. The focus is on germicidal and photochemical as well as skin tanning applications. a specialist facility for fluorescent products only (e.g., UV tubes).

**China** – over two thirds of the global LFL manufacturing takes place in China. Factory-specific data on manufacturing is difficult to source. However it is thought that YaMing Lighting, Foshan, and Zhejiang Changhong Lighting Sources may be the last remaining large-scale producers of LFL.

**India** – there are nine manufacturers who are registered as suppliers of fluorescent lamps: Philips, Bajaj, Surya, Havells, Crompton, CEMA, Osram, HPL, and Ecolink. Seven of these nine lighting manufacturing plants also produce LEDs.

**Japan** – a ban on linear fluorescent lamps was discussed over 5 years ago, however no policies were adopted and LFL consumption continues.

**Russia** – there is an Osram/Svet factory at Smolensk which employs approximately 500 staff, although not all of them work on LFL production. This facility is not allowed to export at this time due to trade sanctions in place.
5 Highlights of the Global Market

In 2022, the Clean Lighting Coalition completed a global market assessment on the cost-effectiveness of mercury-free LED alternatives to fluorescent that included 35 countries in Africa, Asia-Pacific and Latin America. Through our network of experts and researchers, we gathered data on over 1200 models of both mercury-containing fluorescent and LED retrofits from those markets. In addition to the mercury savings potential for each country, we used this market information to conduct a cost-effectiveness calculation that included total financial savings and payback period. In this section, we provide the results for the African, Asia-Pacific and Latin American regions.

5.1 African Region

In April 2021, the African region proposed an amendment to Annex A of the Minamata Convention on Mercury to remove exemptions for mercury-containing fluorescent lamps, phasing out virtually all fluorescents by 2025. While these fluorescent exemptions may have been necessary in 2013 when the Convention was drafted, lighting technology has moved on rapidly – and today, the accessibility and affordability of mercury-free LED retrofit lamps makes the fluorescent lamp exemption unnecessary.

Adopting the proposed amendment at the fourth Conference of Parties (COP4) would lead to an accelerated global transition to LED lighting, which is non-toxic and climate friendly. Specifically, it would:

- avoid 232 metric tons of mercury pollution from leaking into the environment between 2025-2050, both from the lamps themselves and from avoided burning of coal in power plants.

- avoid 3.5 gigatons of CO₂ emissions which is equivalent to getting ALL passenger cars (globally) off the road for a whole year.

If adopted, the African Region would avoid 4,900 kilograms of mercury pollution and 220 mega tons of CO₂ emissions cumulatively 2025-2050.

Countries in green are parties to the Minamata Convention on Mercury.
The data above reflects the benefits of a global fluorescent phase-out to all countries in Africa, not just parties to the Minamata Convention on Mercury.

Based on projections from CLASP’s MEPSY model, the table below provides country-level projections of avoided CO₂ emissions and mercury releases cumulatively 2025-2050.

Table 9. Avoided CO₂ emissions and mercury releases for African Region, cumulative 2025-2050

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CO₂ (MT)</th>
<th>MERCURY (KG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALGERIA</td>
<td>21.0</td>
<td>500.3</td>
</tr>
<tr>
<td>ANGOLA</td>
<td>3.3</td>
<td>86.1</td>
</tr>
<tr>
<td>BENIN</td>
<td>0.3</td>
<td>4.5</td>
</tr>
<tr>
<td>BOTSWANA</td>
<td>3.2</td>
<td>28.8</td>
</tr>
<tr>
<td>BURKINA FASO</td>
<td>0.8</td>
<td>13.9</td>
</tr>
<tr>
<td>BURUNDI</td>
<td>0.1</td>
<td>4.0</td>
</tr>
<tr>
<td>CAPE VERDE</td>
<td>0.2</td>
<td>3.9</td>
</tr>
<tr>
<td>CAMEROON</td>
<td>1.7</td>
<td>56.7</td>
</tr>
<tr>
<td>CENTRAL AFRICAN REPUBLIC</td>
<td>0.0</td>
<td>0.9</td>
</tr>
<tr>
<td>CHAD</td>
<td>0.1</td>
<td>1.9</td>
</tr>
<tr>
<td>COMOROS</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Country</td>
<td>LFLs</td>
<td>Population</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>DEMOCRATIC REPUBLIC OF THE CONGO</td>
<td>0.2</td>
<td>39.2</td>
</tr>
<tr>
<td>REPUBLIC OF THE CONGO</td>
<td>0.8</td>
<td>17.7</td>
</tr>
<tr>
<td>CÔTE D’IVOIRE</td>
<td>3.3</td>
<td>73.7</td>
</tr>
<tr>
<td>DJIBOUTI</td>
<td>0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>EGYPT</td>
<td>66.8</td>
<td>1,796.6</td>
</tr>
<tr>
<td>EQUATORIAL GUINEA</td>
<td>0.6</td>
<td>13.3</td>
</tr>
<tr>
<td>ERITREA</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>ESWATINI</td>
<td>0.1</td>
<td>14.9</td>
</tr>
<tr>
<td>ETHIOPIA</td>
<td>0.3</td>
<td>57.5</td>
</tr>
<tr>
<td>GABON</td>
<td>1.2</td>
<td>27.5</td>
</tr>
<tr>
<td>GAMBIA</td>
<td>0.1</td>
<td>1.5</td>
</tr>
<tr>
<td>GHANA</td>
<td>3.4</td>
<td>87.4</td>
</tr>
<tr>
<td>GUINEA</td>
<td>0.4</td>
<td>9.2</td>
</tr>
<tr>
<td>GUINEA-BISSAU</td>
<td>0.0</td>
<td>0.6</td>
</tr>
<tr>
<td>KENYA</td>
<td>2.3</td>
<td>70.3</td>
</tr>
<tr>
<td>LESOTHO</td>
<td>0.0</td>
<td>3.4</td>
</tr>
<tr>
<td>MADAGASCAR</td>
<td>0.3</td>
<td>9.4</td>
</tr>
<tr>
<td>MALAWI</td>
<td>0.0</td>
<td>9.6</td>
</tr>
<tr>
<td>MALI</td>
<td>0.5</td>
<td>10.5</td>
</tr>
<tr>
<td>MAURITANIA</td>
<td>0.4</td>
<td>9.1</td>
</tr>
<tr>
<td>MAURITIUS</td>
<td>0.9</td>
<td>19.4</td>
</tr>
<tr>
<td>MOROCCO</td>
<td>13.0</td>
<td>234.1</td>
</tr>
<tr>
<td>MOZAMBIQUE</td>
<td>0.7</td>
<td>53.5</td>
</tr>
<tr>
<td>NAMIBIA</td>
<td>0.5</td>
<td>43.8</td>
</tr>
<tr>
<td>NIGER</td>
<td>0.7</td>
<td>9.1</td>
</tr>
<tr>
<td>NIGERIA</td>
<td>10.7</td>
<td>284.8</td>
</tr>
<tr>
<td>RWANDA</td>
<td>0.2</td>
<td>4.9</td>
</tr>
<tr>
<td>SENEGAL</td>
<td>1.3</td>
<td>23.4</td>
</tr>
<tr>
<td>SIERRA LEONE</td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>SOUTH AFRICA</td>
<td>66.1</td>
<td>868.7</td>
</tr>
<tr>
<td>SUDAN</td>
<td>1.8</td>
<td>44.1</td>
</tr>
<tr>
<td>TANZANIA</td>
<td>1.5</td>
<td>31.6</td>
</tr>
<tr>
<td>TOGO</td>
<td>0.1</td>
<td>4.6</td>
</tr>
<tr>
<td>TUNISIA</td>
<td>5.2</td>
<td>128.3</td>
</tr>
<tr>
<td>UGANDA</td>
<td>0.2</td>
<td>20.2</td>
</tr>
<tr>
<td>ZAMBIA</td>
<td>0.6</td>
<td>68.0</td>
</tr>
<tr>
<td>ZIMBABWE</td>
<td>6.0</td>
<td>68.5</td>
</tr>
</tbody>
</table>
5.1.1 Lighting Market Overview

The African region is a net importer of lighting products. There is no local manufacture of fluorescent lighting on the continent. However, there are several LED assembly companies, providing local jobs and stimulating national economies. The companies include:

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

As an import-based market, phasing-out fluorescents would encourage local manufacturing of LEDs, aligning with regional efforts to stimulate economic growth, generate employment opportunities, and reduce reliance on lighting product importation.

5.1.2 Comparing Costs: LEDs vs CFL/LFL

Based on projections from CLASP’s MEPSY model, transitioning to efficient LED lighting would avoid the sale of 183.7 million compact fluorescent lamps and 525.9 million linear fluorescent lamps. Taken together, this will avoid 4,900 kilogrammes of mercury in the lamps and save approximately 425 TWh of the African Region’s total electricity consumption between 2025 and 2050. Over the 25 year analysis period, Africa would save $31.4 billion USD and 221 million metric tonnes of CO2.

The following tables provide comparative information about the cost of light across countries. The tables show the prices that were recorded in retail stores and on-line shops in each country, and then three columns illustrate the benefits associated with switching to mercury-free LED technology. The Payback Period column tells the amount of time needed for the energy savings from the LED lamp to pay for its higher cost. If the LED lamp is less expensive than the fluorescent lamp, then the payback is “instantaneous”. Next, the column labelled “energy savings with LED” shows what the savings will be on the energy bills over the lifetime of the LED lamp.

The following tables detail comparative cost across countries. Please note that the value in brackets is the equivalent cost in USD.
Table 10. The True Cost of Light – Linear Lamps – Payback and Savings from LED upgrade

<table>
<thead>
<tr>
<th>Country</th>
<th>LFL Price (US$)</th>
<th>TLED Price (US$)</th>
<th>PAYBACK PERIOD</th>
<th>ENERGY SAVINGS WITH LED (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina Faso</td>
<td>XOF 2,200 (3.96)</td>
<td>XOF 4,000 (7.20)</td>
<td>7 months</td>
<td>XOF 67,489 (115.19)</td>
</tr>
<tr>
<td>Cameroon</td>
<td>XAF 2,500 (4.42)</td>
<td>XAF 3,500 (6.19)</td>
<td>5 months</td>
<td>XAF 53,447 (91.19)</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>EBT 95 (2.00)</td>
<td>EBT 170 (3.57)</td>
<td>11 months</td>
<td>EBT 2,314 (45.56)</td>
</tr>
<tr>
<td>Gabon</td>
<td>XAF 650 (1.17)</td>
<td>XAF 2,500 (4.50)</td>
<td>7 months</td>
<td>XAF 42,753 (72.95)</td>
</tr>
<tr>
<td>Ghana</td>
<td>GHS 7 (1.12)</td>
<td>GHS 10 (1.60)</td>
<td>1 month</td>
<td>GHS 1,468 (220.28)</td>
</tr>
<tr>
<td>Kenya</td>
<td>KES 125 (1.13)</td>
<td>KES 400 (3.60)</td>
<td>8 months</td>
<td>KES 10,800 (94.89)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>NGN 500 (1.20)</td>
<td>NGN 1,500 (3.60)</td>
<td>10 months</td>
<td>NGN 56,301 (135.29)</td>
</tr>
<tr>
<td>South Africa</td>
<td>ZAR 39.99 (2.60)</td>
<td>ZAR 39 (2.54)</td>
<td>Instantaneous</td>
<td>ZAR 1,246 (81.12)</td>
</tr>
<tr>
<td>Uganda</td>
<td>UGX 14,500 (4.06)</td>
<td>UGX 8,600 (2.41)</td>
<td>Instantaneous</td>
<td>UGX 205,726 (58.26)</td>
</tr>
</tbody>
</table>

5.1.3 Energy Efficiency Comparison
The energy efficiency of a light bulb is measured in lumens/watt. Based on data collected in Q4 2021, the graphic below depicts the ranges of energy efficiency of different types of bulbs available across African markets. It represents efficiency quartiles (0%, 25%, 50%, 75%, 100%) of the data we collected when sorted from lowest to highest efficiency. The box with numbers represents the 25th-75th quartile while the thin lines with the dots represent the lowest and highest efficiency per technology on either end.
The graph below shows the energy efficiency of individual samples collected across the region. LEDs are up to 2-3 times more efficient than the other lighting technologies, therefore use less overall electricity to provide the same or better lighting service.

### 5.1.4 Lighting Policy & Legislative Landscape
Many countries in the region are shifting towards LED only markets through energy efficiency policy and/or mercury regulation. Some of the notable regulations include:

- **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.

- **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. The government is further promoting LEDs lamps by reducing taxes on these lamps.

- **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.

- **Burkina Faso**’s National Energy Act has an entire chapter dedicated to Energy Efficiency. In support of this objective, one of the notable government interventions includes the installation of 3,000LED streetlamps.
5.1.5 Compatibility/Retrofits for LED tubes
In all African markets where data was collected, LED retrofits were easily available for both general service lamps and tube lamps. This availability confirms that in nearly all cases, rewiring of old lighting fixtures will not be necessary. In the few cases (6 to 9%) where the LED tubes available in the market are not compatible with the fixtures, the ballast can be ‘by-passed’ with mains voltage at the sockets, so that the fixture can remain in place. Additionally, the economic co-operation between regions such as EAC and SADC is an indicator that can be used to extrapolate the availability of retrofits in the other African countries, given regions typically have harmonized standards for lighting products and source through the same import channels.

5.1.6 End of Life Management for Lighting
Collecting fluorescent lamps at the end of life is a global problem that has existed since the introduction of fluorescents. Mercury released during the lifecycle of fluorescent Lamps contaminate the atmosphere, land and water. This contamination may occur from lamp breakage when old lamps are comingled with general household waste, and during installation, collection or transport of discarded lamps, processing or recycling of spent lamps, or when lamps are landfilled, incinerated or otherwise disposed of.

In Africa, collected and properly recycled e-waste (not just lighting products) was at 4% in Southern Africa, 1.3% in Eastern Africa and close to 0% in other regions. The small size and weight of bulbs makes them easy for consumers to mistakenly dispose of in general waste, and consumers may not be aware that they require special disposal. Collection and safe recycling/disposal of fluorescent lamps is difficult – especially in regions with low levels of general e-waste collection and processing. Currently, sub-Saharan Africa has no mercury treatment or disposal facility.

However, major e-waste recyclers across the continent are already safely disposing LED lighting products, including Enviroserve in Rwanda, WEEE Centre in Kenya, Hinckley Recycling in Nigeria and more. While LED lamps are also considered e-waste, they are not toxic or considered hazardous waste. The proposed African Lighting Amendment would remove toxic e-waste from the market more quickly.
5.2 Asia Pacific Region
In 2021 the Clean Lighting Coalition engaged partner organisations in 35 countries across Africa, Latin America and Asia-Pacific and gathered over 1200 models of both mercury-containing fluorescent and LED retrofits from those markets.

In April 2021, the African region proposed an amendment to Annex A of the Minamata Convention on Mercury to remove exemptions for mercury-containing fluorescent lamps, phasing out virtually all fluorescents by 2025. While these fluorescent exemptions may have been necessary in 2013 when the Convention was drafted, lighting technology has moved on rapidly – and today, the accessibility and affordability of mercury-free LED retrofit lamps makes the fluorescent lamp exemption unnecessary.

Adopting the proposed amendment at the fourth Conference of Parties (COP4) would lead to an accelerated global transition to LED lighting, which is non-toxic and climate friendly. Specifically, it would:
• avoid 232 metric tons of mercury pollution from leaking into the environment between 2025-2050, both from the lamps themselves and from avoided burning of coal in power plants.
• avoid 3.5 gigatons of CO₂ emissions which is equivalent to getting ALL passenger cars (globally) off the road for a whole year.

If adopted, the Asia Pacific Region would avoid 75,900 kilograms of mercury pollution and 3.28 gigatons of CO₂ emissions cumulatively 2025-2050.

Countries in green are parties to the Minamata Convention on Mercury.

The data above reflects the benefits of a global fluorescent phase-out to all countries in Asia Pacific, not just parties to the Minamata Convention on Mercury.

Based on projections from CLASP’s MEPSY model, the table below provides country-level projections of avoided CO₂ emissions and mercury releases cumulatively 2025-2050.
Table 11. Avoided CO₂ emissions and mercury releases for Asia-Pacific, cumulative 2025-2050

<table>
<thead>
<tr>
<th>Country</th>
<th>CO₂ (MT)</th>
<th>MERCURY (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>4.0</td>
<td>96.9</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>26.2</td>
<td>558.7</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.1</td>
<td>27.3</td>
</tr>
<tr>
<td>Brunei Darussalam</td>
<td>1.3</td>
<td>35.2</td>
</tr>
<tr>
<td>Cambodia</td>
<td>4.8</td>
<td>84.3</td>
</tr>
<tr>
<td>China</td>
<td>2,129.0</td>
<td>48,977.0</td>
</tr>
<tr>
<td>Fiji</td>
<td>1.4</td>
<td>8.8</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>0.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Hong Kong, China (SAR)</td>
<td>12.3</td>
<td>345.2</td>
</tr>
<tr>
<td>India</td>
<td>123.7</td>
<td>3,002.4</td>
</tr>
<tr>
<td>Indonesia</td>
<td>123.7</td>
<td>2,096.9</td>
</tr>
<tr>
<td>Iran (Islamic Republic of)</td>
<td>61.1</td>
<td>1,358.0</td>
</tr>
<tr>
<td>Japan</td>
<td>156.3</td>
<td>4,509.8</td>
</tr>
<tr>
<td>Jordan</td>
<td>5.8</td>
<td>122.0</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>46.2</td>
<td>775.6</td>
</tr>
<tr>
<td>Kuwait</td>
<td>12.3</td>
<td>318.3</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>1.2</td>
<td>68.8</td>
</tr>
<tr>
<td>Lao People’s Democratic Republic</td>
<td>1.2</td>
<td>25.7</td>
</tr>
<tr>
<td>Lebanon</td>
<td>5.6</td>
<td>107.2</td>
</tr>
<tr>
<td>Macau</td>
<td>1.0</td>
<td>46.9</td>
</tr>
<tr>
<td>Malaysia</td>
<td>35.1</td>
<td>814.4</td>
</tr>
<tr>
<td>Maldives</td>
<td>0.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Mongolia</td>
<td>5.8</td>
<td>57.8</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.2</td>
<td>41.3</td>
</tr>
<tr>
<td>Oman</td>
<td>6.5</td>
<td>185.7</td>
</tr>
<tr>
<td>Pakistan</td>
<td>33.3</td>
<td>720.1</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>1.8</td>
<td>43.6</td>
</tr>
<tr>
<td>Philippines</td>
<td>35.6</td>
<td>779.9</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>92.1</td>
<td>3,620.7</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>91.2</td>
<td>2,130.1</td>
</tr>
<tr>
<td>Singapore</td>
<td>5.5</td>
<td>250.6</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>5.4</td>
<td>140.4</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>5.9</td>
<td>115.9</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>0.7</td>
<td>94.9</td>
</tr>
<tr>
<td>Thailand</td>
<td>52.8</td>
<td>1,546.1</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>8.4</td>
<td>120.9</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>23.1</td>
<td>709.8</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>28.4</td>
<td>548.9</td>
</tr>
</tbody>
</table>
5.2.1 Lighting Market Overview

The Asia Pacific region is a hub for manufacturing and exporting fluorescent and LED lighting products. In terms of fluorescent lamps manufacturing, China accounts for 73% of the global production. YaMing Lighting\textsuperscript{26}, Foshan, and Zhejiang Changhong Lighting Sources\textsuperscript{27} might be the only remaining large scale producers. The second largest manufacturer is India, with nine manufacturers registered as suppliers of fluorescent lamps, including Philips, Bajaj, Surya, Havells, Crompton, CEMA, Osram, HPL, and Ecolink. Out of these, nine plants also produce LEDs.

The LED market is also dominated by Asia. In particular, five Asia-Pacific countries export 91% of the total trade value of US$3.1 billion LED die chips and packaging globally\textsuperscript{28}. Malaysia represents the main exporting country for this market segment (25% of the global exports in Table 12).

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>TRADE VALUE IN US $ BILLION</th>
<th>% GLOBAL EXPORTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>0.77</td>
<td>25%</td>
</tr>
<tr>
<td>Japan</td>
<td>0.66</td>
<td>21%</td>
</tr>
<tr>
<td>China</td>
<td>0.55</td>
<td>18%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.42</td>
<td>14%</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.34</td>
<td>11%</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.06</td>
<td>2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.8</td>
<td>91%</td>
</tr>
</tbody>
</table>

China is the main global exporter of LED lamps and luminaires, representing respectively 89% and 56% of the total exporting value (US$ 5.35 billion and US$ 15.52 billion).

As a key producer and exporter of LED and fluorescent lighting products, phasing-out fluorescents would not only provide a safer and cost-accessible lighting technology in Asia, but also drive the transition to clean lighting globally.

5.2.2 Comparing Costs: LEDs vs LFL

Based on projections from CLASP’s MEPSY model, transitioning to efficient LED lighting would avoid the sale 8.4 billion linear fluorescent lamps. Taken together with the phase-out of compact fluorescent lamps, this will avoid 75,900 kilogrammes of mercury in the lamps and save approximately 6,800 TWh of the Asia Region’s total

\textsuperscript{26} YaMing Lighting in Foshan, China. \textbf{Link}
\textsuperscript{27} Zhejiang Changhong Lighting Sources, China. \textbf{Link}
\textsuperscript{28} Guidehouse (2021). 2020 LED Manufacturing Supply Chain 2020
electricity consumption between 2025 and 2050. Over the 25 year analysis period, Asia would save $691.8 billion USD and 3,279 million metric tonnes of CO₂.

Table 13 provides a comparison about the cost of light for an LFL vs LED lamps across seven countries in the Asia-Pacific region. They show the prices that were recorded in retail stores and on-line shops in each country. The next two columns illustrate the benefits associated with switching to mercury-free LED technology. The Payback Period column shows the amount of time needed for the energy savings from the LED lamp to pay for its higher cost. If the LED lamp is less expensive than the fluorescent lamp, then the payback is ‘instantaneous’. The column labelled ‘energy savings with LED’ indicates the savings on energy bills over the lifetime of the LED lamp.

The tables also detail comparative cost across countries. Please note that the value in brackets is the equivalent cost in US$.

<table>
<thead>
<tr>
<th>Country</th>
<th>LFL Price (BDT)</th>
<th>TLED Price (BDT)</th>
<th>PAYBACK PERIOD</th>
<th>ENERGY SAVINGS WITH LED (BDT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>320 (US$ 3.84)</td>
<td>580 (US$ 6.96)</td>
<td>11.9 months</td>
<td>2340 (US$ 28.08)</td>
</tr>
<tr>
<td>India</td>
<td>58 (US$ 0.75)</td>
<td>346 (US$ 4.50)</td>
<td>5.7 months</td>
<td>2680 (US$ 34.84)</td>
</tr>
<tr>
<td>Philippines</td>
<td>84 (US$ 1.68)</td>
<td>170 (US$ 3.40)</td>
<td>1.9 months</td>
<td>3175 (US$ 63.51)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>210 (US$ 1.20)</td>
<td>650 (US$ 3.71)</td>
<td>5.1 months</td>
<td>6975 (US$ 39.76)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>20,000 (US$ 0.88)</td>
<td>40,000 (US$ 1.76)</td>
<td>4.5 months</td>
<td>818,377 (US$ 36.01)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>36,000 (US$ 2.52)</td>
<td>75,100 (US$ 5.26)</td>
<td>5.6 months</td>
<td>495,148 (US$ 34.66)</td>
</tr>
<tr>
<td>Japan</td>
<td>583 (US$ 5.07)</td>
<td>980 (US$ 8.53)</td>
<td>6.9 months</td>
<td>8905 (US$ 77.47)</td>
</tr>
</tbody>
</table>

5.2.3 Energy Efficiency Comparison
The energy efficiency of a light bulb is measured in lumens/watt. Based on data collected in Q4 2021, the graphic below depicts the ranges of energy efficiency of different
types of bulbs available across Asia-Pacific markets. It represents efficiency quartiles (0%, 25%, 50%, 75%, 100%) of the data we collected when sorted from lowest to highest efficiency. The box with numbers represents the 25th-75th quartile while the thin lines with the dots represent the lowest and highest efficiency per technology on either end.

![Illustration of higher efficiency of LED linear retrofit tubes](image)

**Figure 7. Illustration of the higher efficiency of LED linear retrofit tubes**

### 5.2.4 Lighting Policy & Legislative Landscape

Many countries in the region are shifting towards LED-only markets through energy efficiency policy and/or mercury regulation. Some of the notable initiatives and regulations include:

- **India**: India’s Electric Lamp and Component Manufacturers Association (ELCOMA) published Vision 2024 Roadmap to transition lighting market to LED by 2024.

- **Indonesia**: In 2021 Indonesia approved a Roadmap for High Efficiency Lamps for Indonesia, which includes phasing out lamps that contain mercury in government agencies and state-owned enterprises’ buildings by 2022.

- **Pakistan**: Pakistan developed MEPS for LEDs in 2020 and a national efficient lighting strategy to accelerate the transition to LEDs, already at 70% penetration in Pakistan’s domestic market.

- **Philippines**: Philippines’ House Bill No. 262 (pending approval) aims to require all government offices to use LEDs instead of incandescent and CFL bulbs and fluorescent tubes.

- **Singapore**: Singapore’s National Environment Agency is aiming for all bulbs sold to be minimally as efficient as LEDs from 2023 onwards.

- **Sri Lanka**: Sri Lanka is implementing a project (2021-2023) under the Minamata Specific International Program to strengthen the national capacity for phasing out mercury-added products, including through alternatives to CFLs and LFLs. MEPS for LEDs were first adopted in 2016 and revised in 2019.
• **Thailand**: Thailand’s 2021 Long-term Low Greenhouse Gas (GHG) Development Strategy includes LEDs as part of the technologies for a successful transition to low GHG development. Voluntary MEPS for LEDs are in place since 2013.

• **Vietnam**: In 2020 GEF approved a UNDP project that supports Vietnam’s transition to non-mercury lighting (among others). In 2019 MOIT issued Circular No. 08/2019/TT-BKHCN that mandates certification requirements for domestically produced and imported LED products.

### 5.2.5 Compatibility/Retrofits for LED tubes
In all Asia-Pacific markets where data was collected, LED retrofits were easily available for both general service lamps and tube lamps. This availability confirms that in nearly all cases, rewiring of old lighting fixtures will not be necessary. In the few cases (6 to 9%) where the LED tubes available in the market are not compatible with the fixtures, the ballast can be ‘by-passed’ with mains voltage at the sockets, so that the fixture can remain in place.

### 5.2.6 End of Life Management for Lighting
Collecting fluorescent lamps at the end of life is a global problem that has existed since the introduction of fluorescent lamps. Mercury released during the lifecycle of fluorescent lamps contaminate the atmosphere, land and water. This contamination may occur from lamp breakage when: a) old lamps are comingled with general household waste; b) during installation, collection or transport of discarded lamps, processing or recycling of spent lamps; or c) when lamps are landfilled, incinerated or otherwise disposed of.

Collection and safe recycling/disposal of fluorescent lamps is difficult – especially in regions with low levels of general e-waste collection and processing. For example, countries in the Association of Southeast Asian Nations (ASEAN) do not recycle mercury-containing lamps. The countries that have recycling facilities, such as Indonesia, Malaysia, Philippines, Thailand only dismantle or crush fluorescent lamps locally and export them to other countries, including Germany and Japan.29,30 In addition, statistics indicate that collection of lamps is inefficient. In Sri Lanka for example, only 39% of fluorescent lamps are collected.

While LED lamps are also considered e-waste, they are not toxic nor considered hazardous waste. Also, transitioning to LEDs would eliminate fluorescent e-waste lamp trade from developing countries to countries equipped with dismantling facilities, therefore posing additional environmental pollution and health safety concerns from exposure to mercury globally. The proposed African Lighting Amendment would remove toxic e-waste from the market more quickly.

---

5.3 Latin America and Caribbean Region

In 2021 the Clean Lighting Coalition engaged partner organisations in 35 countries across Africa, Latin America and Asia and gathered over 1200 models of both mercury-containing fluorescent and LED retrofits from those markets.

In April 2021, the African region proposed an amendment to Annex A of the Minamata Convention on Mercury to remove exemptions for mercury-containing fluorescent lamps, phasing out virtually all fluorescents by 2025. While these fluorescent exemptions may have been necessary in 2013 when the Convention was drafted, lighting technology has moved on rapidly – and today, the accessibility and affordability of mercury-free LED retrofit lamps makes the fluorescent lamp exemption unnecessary.

Adopting the proposed amendment at the fourth Conference of Parties (COP4) would lead to an accelerated global transition to LED lighting, which is non-toxic and climate friendly. Specifically, it would:

- avoid 232 metric tons of mercury pollution from leaking into the environment between 2025-2050, both from the lamps themselves and from avoided burning of coal in power plants.

- avoid 3.5 gigatons of CO\textsubscript{2} emissions which is equivalent to getting ALL passenger cars (globally) off the road for a whole year.

If adopted, the Latin American Region would avoid: 11,300 kilograms of mercury pollution and 239 mega tons of CO\textsubscript{2} emissions cumulatively 2025-2050. The data above reflects the benefits of a global fluorescent phase-out to all countries in Latin America and the Caribbean, not just parties to the Minamata Convention on Mercury.

Countries in green are parties to the Minamata Convention on Mercury.
Based on projections from CLASP’s MEPSY model, the table below provides country-level projections of avoided CO₂ emissions and mercury releases cumulatively 2025-2050.

Table 14. Avoided CO₂ emissions and mercury releases for GRULAC, cumulative 2025-2050

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CO₂ (MT)</th>
<th>MERCURY (KG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>20.4</td>
<td>737.9</td>
</tr>
<tr>
<td>Bahamas</td>
<td>0.5</td>
<td>13.8</td>
</tr>
<tr>
<td>Barbados</td>
<td>0.3</td>
<td>9.6</td>
</tr>
<tr>
<td>Belize</td>
<td>0.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Bolivia</td>
<td>2.2</td>
<td>67.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>79.4</td>
<td>5042.8</td>
</tr>
<tr>
<td>Chile</td>
<td>14.2</td>
<td>575.5</td>
</tr>
<tr>
<td>Colombia</td>
<td>10.5</td>
<td>652.4</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>0.9</td>
<td>78.8</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>4.0</td>
<td>109.3</td>
</tr>
<tr>
<td>Ecuador</td>
<td>6.8</td>
<td>229.5</td>
</tr>
<tr>
<td>El Salvador</td>
<td>1.4</td>
<td>54.4</td>
</tr>
<tr>
<td>Guatemala</td>
<td>3.2</td>
<td>102.6</td>
</tr>
<tr>
<td>Guyana</td>
<td>0.6</td>
<td>12.8</td>
</tr>
<tr>
<td>Haiti</td>
<td>0.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Honduras</td>
<td>2.3</td>
<td>57.9</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1.2</td>
<td>23.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>56.7</td>
<td>2,207.8</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>0.8</td>
<td>20.9</td>
</tr>
<tr>
<td>Panama</td>
<td>2.1</td>
<td>74.7</td>
</tr>
<tr>
<td>Paraguay</td>
<td>0.4</td>
<td>93.6</td>
</tr>
<tr>
<td>Peru</td>
<td>8.2</td>
<td>373.1</td>
</tr>
<tr>
<td>Surinam</td>
<td>0.7</td>
<td>19.7</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>1.7</td>
<td>57.9</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1.3</td>
<td>104.5</td>
</tr>
<tr>
<td>Venezuela</td>
<td>19.3</td>
<td>582.0</td>
</tr>
</tbody>
</table>

There were not sufficient data to accurately project mercury and CO₂ figures for the following countries: Antigua and Barbuda, Cuba, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines.

5.3.1 Lighting Market Overview
The LAC region is a net importer of fluorescent lamps, with nearly no manufacturing of fluorescent lighting. Most CFL manufacturers have already transitioned to producing LEDs. Furthermore, there are many LED manufacturing and assembly companies in several countries in the region, accounting for an important share of the LAC LED market (19 of the top 50 LED companies in LAC are local, and together, these account for 12.7% of the LAC market share, or 395.72 million USD).
Key LED players in the region are:

- **Mexico** - 4.6% of global exports of LED luminaires and 0.6% of LED packages/dies. LED companies identified include: Construlita, Argos, Iluminación LED Hércules, and LEDsMex

- **Brazil** - 13 of the top 50 LED companies in the region are in Brazil, including Taschibra - 2nd in the region (after Signify) with a market share of 4.4% (131.6 million USD).

As an import-based market, a complete phase-out of fluorescents in this region would further encourage the growth of the local LED industry, stimulating economic growth, generating employment opportunities, and reducing reliance on lighting product importation.

### 5.3.2 Comparing Costs: LEDs vs CFL/LFL

Based on projections from CLASP’s MEPSY model, transitioning to efficient LED lighting would avoid the sale of 893 million compact fluorescent lamps and 913 million linear fluorescent lamps in the GRULAC region. Taken together, this will avoid 11,300 kilogrammes of mercury in the lamps and save approximately 806 TWh of the GRULAC Region’s total electricity consumption between 2025 and 2050. Over the 25-year analysis period, Latin America and the Caribbean would save $90.9 billion USD and 239 million metric tonnes of CO₂. The following tables detail the comparative cost across countries. Please note that the value in parentheses is the equivalent cost in USD.

#### Table 15. The True Cost of Light – Linear Lamps – Payback and Savings from LED upgrade

<table>
<thead>
<tr>
<th>Country</th>
<th>LFL Price (US$)</th>
<th>TLED Price (US$)</th>
<th>PAYBACK PERIOD</th>
<th>ENERGY SAVINGS WITH LED (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antigua &amp; Barbuda</strong></td>
<td>XCD 16.48</td>
<td>XD 55</td>
<td>6 months</td>
<td>XCD 1063.78 (US$ 393.62)</td>
</tr>
<tr>
<td></td>
<td>(US$ 6.10)</td>
<td>(US$ 20.35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Belize</strong></td>
<td>BZD 4.50</td>
<td>BZD 18</td>
<td>10 months</td>
<td>BZD 101.27 (US$ 50.03)</td>
</tr>
<tr>
<td></td>
<td>(US$ 2.25)</td>
<td>(US$ 9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brazil</strong></td>
<td>BRL 14.90</td>
<td>BRL 29.99</td>
<td>5 months</td>
<td>BRL 271.85 (US$ 53.70)</td>
</tr>
<tr>
<td></td>
<td>(US$ 2.94)</td>
<td>(US$ 5.92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peru</strong></td>
<td>PEN 6.90</td>
<td>PEN 14.90</td>
<td>4 months</td>
<td>PEN 93.31 (US$ 24.90)</td>
</tr>
<tr>
<td></td>
<td>(US$ 1.64)</td>
<td>(US$ 3.98)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Guyana</strong></td>
<td>LFL not available</td>
<td>GYD 1,000</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>(US$ 4.80)</td>
<td>(US$ 4.80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Type of Bulb</td>
<td>Local Price</td>
<td>US Price</td>
<td>Time Period</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Mexico</td>
<td>LFL not available</td>
<td>MXN 174</td>
<td>US$ 8.31</td>
<td>---</td>
</tr>
<tr>
<td>Argentina</td>
<td>LFL not available</td>
<td>ARS 399</td>
<td>US$ 3.68</td>
<td>---</td>
</tr>
<tr>
<td>Chile</td>
<td>CLP 1,790</td>
<td>CLP 2,390</td>
<td>2 months</td>
<td>CLP 25,519</td>
</tr>
<tr>
<td>Uruguay</td>
<td>LFL not available</td>
<td>UYU 199</td>
<td>US$ 4.60</td>
<td>---</td>
</tr>
<tr>
<td>Colombia</td>
<td>COP 2,200</td>
<td>COP 7,900</td>
<td>4 months</td>
<td>COP 161,105.84</td>
</tr>
<tr>
<td>Jamaica</td>
<td>JMD 488</td>
<td>JMD 718.75</td>
<td>7 weeks</td>
<td>JMD 7,217</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>TTD 70</td>
<td>TTD 45</td>
<td>Instantaneous</td>
<td>TTD 312.72</td>
</tr>
<tr>
<td>Panama</td>
<td>PAB 1.59</td>
<td>PAB 3.99</td>
<td>4 months</td>
<td>PAB 29.45</td>
</tr>
</tbody>
</table>

5.3.3 Energy Efficiency Comparison

The energy efficiency of a light bulb is measured in lumens/watt. Based on data collected in Q4 2021, the scales below depict the ranges of energy efficiency of different types of bulbs available across LAC markets.
5.3.4 Lighting Policy & Legislative Landscape

Many countries in the region are shifting towards LED only markets through energy efficiency policy and/or mercury regulation. Some of the notable regulations include:

- **Chile** – [Updated MEPS for general lighting](#), to phase out inefficient lamps: 40 lm/W by 2021, 70 lm/W by 2023, 85 lm/W by 2025. Shifts market to LED by 2023.

- **Uruguay** - [Decree No. 15/019](#). Since 2020, it prohibits fluorescent lamps unless the manufacturer/importer presents and implements a comprehensive end-of-life management plan. Practically shifted market to LED since 2020.

- **Mexico** - [NOM-030-ENER-2016](#) establishes minimum energy efficiency and safety standards for LED lamps. Having these standards is an important step to ensure the quality of the LEDs available in the local market.

- **Argentina** - [Efficient Lighting Plan (PLAE)](#) will replace existing luminaires in public lighting by LED technology.

5.3.5 Compatibility/Retrofits for LED tubes

In all LAC markets where data was collected, LED retrofits were easily available for both general service lamps and tube lamps. This availability confirms that in nearly all cases, rewiring of old lighting fixtures will not be necessary. In the few cases (6 to 9%) where the LED tubes available in the market are not compatible with the fixtures, the ballast can be ‘by-passed’ with mains voltage at the sockets, so that the fixture can remain in place.

5.3.6 End of Life Management for Lighting

Collecting fluorescent lamps at the end of life has been a global challenge since the introduction of fluorescents. In addition, mercury released during the lifecycle of fluorescent lamps contaminate the atmosphere, land, and water. This contamination may occur from lamp breakage when old lamps are comingled with general household waste, and during installation, collection, or transport of discarded lamps, processing, or recycling of spent lamps, or when lamps are landfilled, incinerated, or otherwise disposed of.

Collection and safe recycling/disposal of fluorescent lamps is difficult – especially in regions with low levels of general e-waste collection and processing. Several e-waste or mercury waste regulations are in force in countries in the region, such as Uruguay, Mexico, and Colombia. Mercury treatment facilities have been identified in the region, however, there are still important awareness, logistics and infrastructure issues that limit the region’s capabilities to manage mercury-containing lamps soundly at end-of-life. There are few fluorescent lamps recycling programs, and they are usually focused on commercial rather than residential users. Some companies and non-governmental organizations, such as Alianza Contaminación Cero in Panama, are working on awareness-raising campaigns and encouraging governments to enforce fluorescent lamp recycling programs. Some local businesses have lamp collection programs in place, and the United Nations Environment
Programme has supported several governments in the region in the development mercury inventories and sound end-of-life policy proposals. Despite these efforts, the regional share of sound end-of-life management of electronic waste (including fluorescent lamps) is estimated at 2.7%, according to a UNIDO-GEF report published in 2022. While LED lamps are also considered e-waste, they are not toxic or considered hazardous waste.
6 The Cost of Delaying LFL Phase-Out

The Clean Lighting Coalition prepared an assessment of the phase-out dates and the impact that selection will have on the global environment and consumers. The cumulative benefits (2025-2050) of phasing out linear fluorescent lamps varies according to the phase-out years being discussed by the Parties to the Convention (see Table 3). Table 16 presents the global benefit of phasing out linear fluorescent lamps early in terms of mercury savings, financial savings (i.e., lower electricity bills), carbon dioxide and energy savings. Direct, drop-in LED retrofit lamps are cost-effective alternatives that bring many co-benefits.

Table 16. Cumulative benefits of a global phase-out of linear fluorescent lamps (2025-2050)

<table>
<thead>
<tr>
<th>Phase-Out Year</th>
<th>2025</th>
<th>2027</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury Savings</td>
<td>198 tonnes</td>
<td>162 tonnes</td>
<td>116 tonnes</td>
</tr>
<tr>
<td>Financial Savings</td>
<td>US$1.34 trillion</td>
<td>US$1.12 trillion</td>
<td>US$818 billion</td>
</tr>
<tr>
<td>CO₂ Savings</td>
<td>3.3 GT</td>
<td>2.7 GT</td>
<td>1.9 GT</td>
</tr>
<tr>
<td>Energy Savings</td>
<td>9,602 TWh</td>
<td>8,022 TWh</td>
<td>5,845 TWh</td>
</tr>
</tbody>
</table>

As shown in Table 16, a two-year delay from 2025 to 2027 results in a loss of 36 tonnes of avoidable mercury pollution and US$221 billion in electricity bill savings. This two-year delay will add another 600 million tonnes of CO₂ to the atmosphere and forego 1,580 TWh of electricity savings. A 5-year delay from 2025 to 2030 results in a loss of 82 tonnes of avoidable mercury pollution, and over half a trillion dollars in electricity bills. It means an additional 1.4 GT of CO₂ will be released to the atmosphere and 3,757 TWh of electricity savings are lost. For the reasons presented in this chapter, the Clean Lighting Coalition recommends 2025 phase-out date for all linear fluorescent lamps.

6.1 Background and Methodology

The Minamata Convention is considering phase-out dates for LFL in 2025 and 2027. These dates are already four and six years later than the global lamp study has shown was feasible and justified in 2021. To better understand the impact of delaying the phase-out of fluorescent lamps, the Clean Lighting Coalition developed a global fluorescent lamp market model that projects shipments of fluorescent lamps to 2050. Using this model, the Coalition prepared an assessment of the phase-out dates to demonstrate the impact selection will have on the global benefits. This information can assist the Parties to the Minamata Convention make decisions that protect public health and the global environment.

Six runs of the global lighting market model were conducted, considering six phase-out dates for linear fluorescent lamps, starting in 2025.
6.2 Mercury Saved phasing out fluorescent lamps

All fluorescent lamps contain mercury, but this product category was given an exemption in Annex A of the Minamata Convention because there were not enough cost-effective mercury-free alternatives in 2013 when the Convention text was drafted. Over the past decade, innovations in mercury-free light emitting diodes (LEDs) have rapidly changed global lighting markets. The alternative to LFLs is linear LED tubes, which contain no mercury and use half the power to produce the same light when installed into the same fluorescent fixtures. Retrofit tubular LED lamps not only offer an opportunity to eliminate mercury in the bulb, but also save energy, which reduces mercury emissions from power stations.

Figure 9 presents the results for mercury savings – both in the lamps themselves as well as the emissions from coal-fired power stations. The model shows that the later the COP phases out fluorescent lighting, the more mercury pollution is released into the environment from lighting. The model estimates that 198 metric tonnes of mercury can be avoided if the Parties choose 2025 as the phase-out date. However, if the phase-out year selected is 2026, an additional 18 metric tonnes of mercury will be emitted into homes, buildings and the environment both through the lamps and lost energy savings. This is a loss of 9% of the 2025 savings potential. If the phase-out year is delayed until 2027, 36 metric tonnes of mercury - 18% of the 2025 potential – will be lost.

---

31 LED retrofit tubes are designed to be installed directly into existing fluorescent fixtures where fluorescent tubes are being used today. The LED tube is designed to operate with the fluorescent ballast still in the circuit.

32 Cumulative mercury savings for lamps and power stations, summed from 2025 to 2050.
6.3 Electricity bill savings from phasing out fluorescent lamps

As the cost of living rises, governments are promoting and encouraging energy-efficiency measures – lighting presents a significant opportunity for energy savings. LED lighting uses half the power to produce the same light as fluorescents – therefore lighting energy bills are cut in half. Power savings translate into financial savings.

Figure 10 illustrates the value of the total electricity savings\(^{33}\) from phasing out linear fluorescent lamps through Minamata in eight different years. The greatest savings on electricity bills – US$1.3 trillion\(^ {34}\) – occurs if 2025 is selected as the phase-out year. If there is a one-year delay and 2026 is selected for the phase-out year, US$112 billion of savings will not be realised by businesses and consumers. If there are two years of delay to 2027, US$221 billion in savings will be lost – meaning households and businesses will have to spend an unnecessary US$221 billion globally on their electricity bills.

\(^{33}\) Savings are calculated on the basis of an average global electricity price of US$0.14/kWh. (March 2022) Global Petrol Prices

\(^{34}\) An estimate of the total value of cumulative electricity savings, from 2025 to 2050
While the world faces an ongoing climate crisis, governments are hesitant to place restrictions on emissions that might jeopardise the global economic recovery. Energy-efficiency provides the same service (i.e., light) using less power (i.e., watts). Mercury-free LED lighting uses half the power of fluorescent lamps, offering a highly cost-effective pathway to carbon dioxide savings (CO$_2$).

Figure 11 shows the calculated CO$_2$ savings that would accrue globally from phasing out fluorescent lamps in the years shown. The greatest savings occurs by phasing out in 2025 – there would be 3.3 gigatonnes of CO$_2$ emissions avoided between 2025-2050. If 2026 is the selected phase-out year, 300 million tonnes of potential CO$_2$ savings are lost. Delaying the linear fluorescent phase-out to 2027 will result in a total of 600 million tonnes of CO$_2$ savings lost.
By phasing out fluorescent linear fluorescent lamps early, governments will help to reduce mercury released to the environment, lower energy bills and significantly reduce CO$_2$ emissions. An ambitious and early phase-out of linear fluorescent lamps is a triple win for people and the environment.
Annex A. Country Profiles

In this Annex, we present the detailed economic findings for list of countries had their lighting markets studied and the cost-effectiveness of LED lighting demonstrated. In the coming months, CLiC will be updating this analysis for COP5.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>ANNEX A PAGE #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua &amp; Barbuda</td>
<td>A-1</td>
</tr>
<tr>
<td>Argentina</td>
<td>A-3</td>
</tr>
<tr>
<td>Bangladesh</td>
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<td>Belize</td>
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<td>Brazil</td>
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<td>Burkina Faso</td>
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<td>Cameroon</td>
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<td>Chile</td>
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<td>Gabon</td>
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<td>Guyana</td>
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<td>India</td>
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<td>Indonesia</td>
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<td>Jamaica</td>
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<td>Peru</td>
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<td>Philippines</td>
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<td>Sri Lanka</td>
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<td>South Africa</td>
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<td>Togo</td>
<td>A-53</td>
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<tr>
<td>Trinidad &amp; Tobago</td>
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<td>Uganda</td>
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<td>Uruguay</td>
<td>A-58</td>
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<tr>
<td>Vietnam</td>
<td>A-60</td>
</tr>
<tr>
<td>Zambia</td>
<td>A-62</td>
</tr>
</tbody>
</table>
Antigua & Barbuda

Important information about mercury and lighting in Antigua & Barbuda:

- There are mandatory energy efficiency labels and testing methods for LED lamps (IEC ABNS 62612:2013) and for CFLs (IEC ABNS 60969:2016).
- The Ministry of Energy, the Antigua Public Utility Authority, the Department of Environment and the Environmental Awareness Group are all public sector actors with interests in the health of society and the ecosystem. They have supported initiatives to phase out mercury projects.
- The National Solid Waste Management Authority Act, 2005 was created to maintain the distribution and pollution by solid waste in the country of Antigua and Barbuda. This kind of waste includes biomedical, hazardous and any litter.
- Zero Waste Antigua and Barbuda is working to reduce the use and importation of mercury and mercury products, and to implement use of proper disposal methods and containers. The organisation carried out its first project, Phase Down/Phase Out Mercury with the aim of decreasing the amount of mercury on the islands by 10% to 20%. The project was executed from 2019 to 2021.
- The Mercury Phase Out Programme, implemented by The Marine Protected Areas Trust, the Medical Association of Antigua and Barbuda, the Christian Union Church, and Zero Waste Antigua and Barbuda, supported by GEF/UNDP, raised awareness about mercury in fluorescent lamps and placed lamp collection bins throughout the country. With this program, an amount equivalent to 5% of the fluorescent lamps sold in the country each year were collected, destroyed and contained.
- Findings of the market study carried out by our NGO partners show that LED lamps for general use are already more affordable than CFLs in Antigua and Barbuda.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Antigua & Barbuda. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately XCD 1000 over the lifetime of the LED lamp, yet the LED only costs XCD 60 more at the time of purchase.
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 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 (XCD):</th>
<th>16</th>
<th>75</th>
<th>XCD/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>6.10</td>
<td>27.77</td>
<td>USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>40</td>
<td>20</td>
<td>Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>24,000</td>
<td>50,000</td>
<td>Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>131.4</td>
<td>65.7</td>
<td>kWh/year</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 15 years, discounted to 2022:</td>
<td>2,006</td>
<td>1,061</td>
<td>XCD (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>--</td>
<td>10.7</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 15 years:</td>
<td>2,208</td>
<td>1,104</td>
<td>kg CO2/15 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Antigua and Barbuda for this comparison.

Figure 1. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Antigua
Argentina

Table 1. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Argentina

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>58,464,107 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>59,407,335 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>738 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>52.5 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 5.8 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Argentina:

- Resolution 71/2019 established the need for a Prior Informed Consent for import and export of products with added mercury.
- Resolution 75/2019 prohibited the production, import and export of products with mercury as of January 1, 2020, as specified in the Minamata Convention Annex A, including compact fluorescent lamps ≤ 30 W with more than 5 mg of mercury, triband phosphor linear fluorescent lamps < 60 W with more than 5 mg of mercury, halophosphate phosphor lamps ≤ 40 W with more than 10 mg of mercury, high pressure mercury vapor lamps, and cold cathode fluorescent as specified in Annex A.
- The Efficient Lighting Plan (Plan de Alumbrado Eficiente – PLAE) promotes the replacement of public lighting by LED technology. The incorporation of this higher efficiency technology can represent up to 50% of energy savings over current consumption. (IRAM AADLJ 2022-2.) PLAE beneficiaries are offered non-refundable contributions to make LED technology replacements in public lighting systems throughout Provinces and / or Municipalities of the country that meet the requirements and criteria established in the General Regulations, including:
  o Potential for energy savings and/or efficiency.
  o Adequate infrastructure or adequacy capacity.
  o Ability to execute the work in a timely manner.
  o Speed of execution of work.

The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Argentina. Switching to LED in Argentina can offer an instantaneous payback, because the LED lamp is less expensive than the CFL. Additionally, the LED lamp consumes half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save approximately ARS 1000 over the lifetime of the LED retrofit lamp.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 10 years, with light bulb and electricity costs discounted back to the present (2022).

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

![Cost of Lighting Comparison - Linear Fluorescent Lamp and LED replacement for Argentina](image)

<table>
<thead>
<tr>
<th></th>
<th>Price for one lamp (ARS):</th>
<th>Price for one lamp (USD):</th>
<th>Lamp wattage:</th>
<th>Annual electricity consumption for each lamp type:</th>
<th>Life-Cycle cost using lamp for 10 years, discounted to 2022:</th>
<th>Simple Payback period in months, compared with CFL:</th>
<th>CO2 emissions due to electricity used for 10 years:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFL</td>
<td>249</td>
<td>2.47</td>
<td>15</td>
<td>16.4</td>
<td>2,236</td>
<td>--</td>
<td>57</td>
</tr>
<tr>
<td>LED1</td>
<td>369</td>
<td>3.65</td>
<td>7</td>
<td>7.7</td>
<td>1,221</td>
<td>14.8</td>
<td>27</td>
</tr>
<tr>
<td>LED2</td>
<td>249</td>
<td>2.47</td>
<td>9</td>
<td>9.9</td>
<td>1,344</td>
<td>(instant)</td>
<td>34</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Argentina for this comparison. Photos taken: Q4 2021

Figure 2. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Argentina
Table 2. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Bangladesh

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>18,618,377 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>62,085,984 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>600 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>50.19 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 3 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Bangladesh:

- Bangladesh’s MIA (2019) marks the phasing out of fluorescent lamps as a “high” priority plan (Source: [MIA 2019](#)).
- Mercury emissions from the use and disposal of mercury-containing lamps is estimated to be 359 kg/yr (Source: [MIA 2019](#)).
- [Bangladesh’s 8th Five Year Plan](#) (2020-2025) mentions mercury’s harm to human and environmental health and sets a goal of energy efficient and low maintenance street and community lighting systems, in addition to overall energy efficiency objectives.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Bangladesh. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately BDT 2,400 over the lifetime of the LED lamp, yet the LED only costs BDT 200 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 9 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (BDT):</td>
<td>320</td>
<td>580</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>3.84</td>
<td>6.96</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>15,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>118.3 kWh/yr</td>
<td>65.7 kWh/yr</td>
</tr>
<tr>
<td>LCC of operating lamp for 9 years, discounted to 2022:</td>
<td>5,877 BDT (NPV, 2022)</td>
<td>3,537 BDT (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>-- months</td>
<td>11.9 months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 9 years:</td>
<td>532 kg CO2/9 yrs</td>
<td>296 kg CO2/9 yrs</td>
</tr>
</tbody>
</table>

Figure 3. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Bangladesh
Belize

Table 3. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Belize

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>601,034 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>544,158 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>7 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>0.5 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 87.1 million</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Belize:

- In 2013, Belize was one of the co-signatories of the Central American Regional Efficient Lighting Strategy, a document developed in the framework of Proyecto Mesoamérica with the support of the UNEP/GEF en.lighten initiative (United for Efficiency).

- Energy efficiency is the first priority of Belize’s five pillars that constitute its Sustainable Energy Roadmap 2030. In this framework, Belize is working to develop energy standards and labels for lighting and other appliances, with the support of the OAS-SECBI.

- The Energy Unit within the Ministry of the Public Service, Energy and Public Utilities in collaboration with the electrical students of ITVET Stann Creek, carried out energy conservation measures by installing LED lights in public buildings. A total of 185 LED tubes were installed. Five years of operations of fluorescents tubes would cost a total of $55,302.91. The LED replacements will cost $27,651.46 for the same use within the same 5-year period. This reflects a combined savings of $27,651.46, accumulated over the next 5 years, for replacing the fluorescent with LEDs.

- Findings of the market study carried out by our NGO partners show that LED lamps for general use are already more affordable than CFLs in Belize.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Belize. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately BZD 100 over the lifetime of the LED lamp, yet the LED only costs BZD 13 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>BZD/lamp</th>
<th>USD/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (BZD):</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>2.25</td>
<td>9.00</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>13,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>65.7</td>
<td>29.6</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 7 years, discounted to 2022:</td>
<td>210</td>
<td>109</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>--</td>
<td>10.2</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 7 years:</td>
<td>138</td>
<td>62</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Belize for this comparison. Photos taken: Q4 2021

Figure 4. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Belize
Brazil

Table 4. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Brazil

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>398,190,706 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>406,911,926 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>5,043 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>357.3 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 46.4 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Brazil:

- The 2050 National Energy Plan (PNE 2050, in the Portuguese acronym) was launched by the Ministry of Mines and Energy (MME) and the Brazilian Energy Research Company (EPE). Energy policy making for the next 30 years will be supported by its analysis and projections of economic growth, demand for energy and output potential.

- Thirteen of the top 50 LED companies in the Latin American and Caribbean region are in Brazil, including Taschibra - 2nd in the region (after Signify) with a market share of 4.4% (131.6 million USD).

- The Brazilian Development Bank (BNDES) and the Ministry of Mines and Energy (MME) are offering financial instruments to transition public lighting to LED. Public-private partnership bids have already been selected for projects in Macapá, Petrolina, Teresina, Porto Alegre and Vila Velha, with upcoming projects in Curitiba, Canoas, Caruaru and Jaboatão dos Guararapes. These projects have already updated over 570 thousand fixtures to LED, benefitting over 7 million people. BNDES has also funded energy efficiency projects in small and medium enterprises which include transitioning to LED lighting.

- On March 13, 2015, INMETRO granted Ordinance no. 144, which approves the Conformity Assessment Requirements for LED lamps intended to enter the Brazilian market. Then, on February 15, 2017, INMETRO approved the administrative Rule No. 20, 2017, establishing the technical and conformity criteria for street lighting using discharge lamps and LED technology.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Brazil. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately BRL 270 over the lifetime of the LED lamp, yet the LED only costs BRL 15 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs. 

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

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

### Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Brazil

<table>
<thead>
<tr>
<th></th>
<th>LFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (BRL):</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>2.68</td>
<td>5.40</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>10,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>118.3</td>
<td>65.7</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 7 years, discounted to 2022:</td>
<td>634</td>
<td>362</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>--</td>
<td>4.8</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 7 years:</td>
<td>166</td>
<td>92</td>
</tr>
</tbody>
</table>

**Figure 5. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Brazil**
Burkina Faso

Table 5. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Burkina Faso

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>522,929 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>1,503,849 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>14 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>1.22 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 220 million</td>
</tr>
</tbody>
</table>

Important facts about Burkina Faso:

- According to their MIA, mercury light sources contribute 26 Kg Hg/Year resulting in air and soil pollution. It is estimated that about 573,000 (very rough estimate) lamps are imported into the country annually. Their low cost, improved efficiency and porous borders mean that a lot more mercury containing lights make their way into Burkina’s market.

- The Burkinabe government has rolled out several initiatives in recent years including the replacement of 1,926 inefficient streetlamps in Burkina Faso’s major cities and has installed 3,000 LED streetlamps.

- As members of ECOWAS, Burkina Faso subscribe to the ECOWAS’ energy efficiency plan to phase out incandescent lamps and replace them with high efficiency alternatives.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Burkina Faso. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately XOF 20,000 over the lifetime of the LED lamp, yet the LED only costs XOF 1800 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

LED light sources cost about half as much in running costs as fluorescent sources, yet produce the same amount of light from the fixture.

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (XOF):</td>
<td>2,200</td>
<td>4,000</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>3.96</td>
<td>7.20</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>18,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td>LCC of operating lamp for 7 years, discounted to 2022:</td>
<td>45,399</td>
<td>24,696</td>
</tr>
<tr>
<td>Simple Payback period in months, compared fluorescent:</td>
<td>=&gt;</td>
<td>7.3</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 7 years:</td>
<td>265</td>
<td>132</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Burkina Faso for this comparison. Photos taken: Q4 2021

Figure 6. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Burkina Faso
Table 6. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Cameroon

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>2,211,769 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>6,082,023 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>5.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 710 million</td>
</tr>
</tbody>
</table>

Cameroon has a 10 year (2015 –2025) National Policy, Strategy and Action Plan to promote Energy Efficiency in the Electricity Sector of Cameroon, with specific strategy and action plan that includes:

- Facilitating the Emergence of Bankable Energy Efficiency Projects,
- Development of a regulatory and normative framework promoting energy efficiency,
- Development of a program to optimize lighting efficiency
- Development of an energy efficiency code for the construction of new buildings and national regulations for the energy performance of existing buildings,
- Promotion of Compact Fluorescent Lamps (CFLs) or LEDs,
- Campaigns to raise awareness of energy efficiency among the general public Awareness campaigns for professionals on energy efficiency

In addition to this, Cameroon has an emerging green technology business Cameroon Energies which is looking to produce LED technologies. Mercury-free LED retrofit bulbs are highly cost-effective in Cameroon.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Cameroon. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately XAF 18,000 over the lifetime of the LED lamp, yet the LED only costs XAF 1000 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

LED light sources cost about half as much as in running costs fluorescent sources, yet produce the same amount of light from the fixture.

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>LED1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (XAF):</td>
<td>2,500</td>
<td>3,500</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>4.42</td>
<td>6.19</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>15,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td>LCC of operating lamp for 7 years, discounted to 2022:</td>
<td>37,497</td>
<td>19,888</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>—</td>
<td>5.1</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 7 years:</td>
<td>116</td>
<td>58</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Cameroon for this comparison.
Photos taken: Q4 2021

Figure 7. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Cameroon
Table 7. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Chile

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>41,440,676 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>49,100,400 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>575 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>42.4 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 6.8 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Chile:

- In 2013, the Ministry of Energy of Chile and Fundación Chile, with the support of the UNEP/GEF en.lighten initiative (United for Efficiency), developed its National Efficient Lighting Strategy. This strategy established general minimum energy performance standards (MEPS) that phased out inefficient (incandescent) lamps, and proposed mercury labels and a sound end-of-life management system for mercury-containing lamps.

- Through Ministerial Resolution N. 10/2020, the Ministry of Energy updated MEPS for general lighting, to phase out inefficient lamps: 40 lm/W by 2021, 70 lm/W by 2023, 85 lm/W by 2025. This update effectively phases out fluorescent lamps as they do not currently reach those minimum energy performance standards, and makes the shift to LED lighting.

- In 2021, Chile published its first Energy Efficiency Law (No. 21,305) to promote the rational and efficient use of energy resources. According to the terms of this new law, the Ministry of Energy is required to prepare a National Energy Efficiency Plan and it must include, at least, the following matters:
  - residential energy efficiency
  - minimum standards and artifact labelling
  - energy efficiency in construction and transportation
  - energy efficiency and smart cities
  - energy efficiency in the productive sectors, and
  - education and training in energy efficiency

- In addition, the plan must establish short-, medium- and long-term goals, as well as the programs and actions necessary to achieve those goals. The 10% reduction in energy intensity targeted for 2030 should lead to cumulative savings of US$15.2 billion and a reduction of 28.6Mt of CO2.

- Following Law 21,305, new homes will be required to have an energy efficiency label, like those found on electric appliances indicating their energy running costs. Large energy consumers will be required to implement an energy management system and to report annually on their consumption and other indicators. ...

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Chile. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube.
– so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately CLP 93,000 over the lifetime of the LED lamp, yet the LED only costs CLP 900 more at the time of purchase.

![Figure 8. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Chile](image)

<table>
<thead>
<tr>
<th>Price for one lamp (CLP):</th>
<th>2,590</th>
<th>3,490</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>3.11</td>
<td>4.19</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>2,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>65.7</td>
<td>16.4</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 13 years, discounted to 2022:</td>
<td>130,547</td>
<td>37,186</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>--</td>
<td>1.6</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 13 years:</td>
<td>290</td>
<td>73</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Chile for this comparison.
Photos taken: Q4 2021

Figure 8. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Chile
Colombia

Table 8. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Colombia

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>53,836,977 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>51,095,607 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>652 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>45.3 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 6.34 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Colombia:

- On April 23rd, 2021, the president of Colombia, Iván Duque, signed a decree that prohibits the manufacture, import and export of products containing added mercury.

- In 2010 the Ministry of Energy of Colombia issued the Technical Guidelines for General and Public Lighting (RETILAP). This document provides thorough minimum energy performance standards, testing parameters, and labelling requirements for all lighting appliances in Colombia. The document has been updated several times since its release.

- Findings of the market study carried out by our NGO partners show that LED lamps for general use are already more affordable than CFLs in Colombia.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Colombia. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately COP160,000 over the lifetime of the LED lamp, yet the LED only costs COP 5,700 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 9 years, with light bulb and electricity costs discounted back to the present (2022).

LED light sources cost 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 (COP): 2,200</th>
<th>7,900</th>
<th>COP/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD): 0.55</td>
<td>1.98</td>
<td>USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage: 18</td>
<td>8</td>
<td>Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime: 20,000</td>
<td>30,000</td>
<td>Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type: 59.1 kWh/year</td>
<td>26.3 kWh/year</td>
<td></td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 9 years, discounted to 2022: 301,457 COP (NPV, 2022)</td>
<td>140,351 COP (NPV, 2022)</td>
<td></td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL: --</td>
<td>3.7 months</td>
<td></td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 9 years: 123 kg CO2/9 yrs</td>
<td>55 kg CO2/9 yrs</td>
<td></td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Colombia for this comparison. Photos taken: Q4 2021

Figure 9. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Colombia
Ethiopia

Table 9. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Ethiopia

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>2,196,952 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>6,199,896 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>5.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 300 million</td>
</tr>
</tbody>
</table>

Important facts about Ethiopia:

- There are several local manufacturers who either manufacture, import or assemble different lighting technologies and accessories including LED. They include ABC Electrical Manufacturing, Maensu, Fosera, Edison and others.
- Five or six years ago, the government purchased 10 million CFLs and distributed them to the people as part of an energy-efficient lighting initiative, the lamps contained 5 mg of mercury each.
- The use of mercury in consumer products, including lighting products, is approximately 14 percent of the total mercury released to the environment in Ethiopia.
- Ethiopia is revising its National Energy Policy and Strategy at the moment, and the plan is expected to ensure least life-cycle cost options are implement.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Ethiopia. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately ETB 800 over the lifetime of the LED lamp, yet the LED only costs ETB 75 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 9 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></th>
<th>T8 Fluorescent</th>
<th>LED1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (ETB):</td>
<td>95</td>
<td>170</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>2.00</td>
<td>3.57</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>13,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td>LCC of operating lamp for 9 years, discounted to 2022:</td>
<td>1,752</td>
<td>930</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>10.7</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 9 years:</td>
<td>21</td>
<td>11</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Ethiopia for this comparison. Photos taken: Q4 2021

Figure 10. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Ethiopia
Gabon

Table 10. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Gabon

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>1,090,411 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>2,935,461 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>27 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>2.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 450 million</td>
</tr>
</tbody>
</table>

Important facts about Gabon:

- Importers and traders include Foberd Gabon and Gabon Meca who import majorly LED lighting products, both lamps and luminaires.
- Gabon’s oil product is in decline, thus the government is investing in the wider economy to diversify and develop new technologies and businesses.
- Gabon’s strategy encourages private investment, both domestic and foreign, through the creation of Special Economic Zones (SEZ).
- Lighting regulations can be traced back 2011 by Decree n°0658/PR/MERH of the National Council for Water and Electricity (CNEE). This Decree gives this body the power to implement a national public lighting policy. Certainly, efforts are being made to popularize public lighting with LED lamps to the detriment of halogens.
- Mercury-free LED retrofit bulbs are highly cost-effective in Gabon.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Gabon. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately XAF 12,000 over the lifetime of the LED lamp, yet the LED only costs XAF 1800 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 4 years, with light bulb and electricity costs discounted back to the present (2022).

LED light sources cost of ownership 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 (XAF):</th>
<th>650</th>
<th>2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.17</td>
<td>4.50</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>10,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td>LCC of operating lamp for 4 years, discounted to 2022:</td>
<td>26,211</td>
<td>14,983</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>7.1</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 4 years:</td>
<td>104</td>
<td>52</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Gabon for this comparison.
Photos taken: Q4 2021

**Figure 11. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Gabon**
Ghana

Table 11. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Ghana

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>3,668,340 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>9,205,838 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>8.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 2.24 billion</td>
</tr>
</tbody>
</table>

Important facts about Ghana:

- Ghana is operating a Mandatory Appliance Standards and Labelling regime. Lighting technologies, sold in the country must meet minimum efficiency and performance standards approved by the Ghana Standards Authority (GSA). Appliance manufacturers who export to Ghana and retailers who sell in Ghana are obliged to display a label which indicates the energy efficiency rating of the product. It is therefore an offence under LI 1815 and LI 2353 to import, display for sale or sell lighting technologies in Ghana unless they meet the minimum performance standards and are properly labelled. The market is going through a transition with increased adoption of LED lighting technologies.

- In 2007 the country implemented a programme to replace 6 million incandescent lamps with CFLs. Import duty and VAT were waived on the importation of CFLs in 2002 and on light emitting diode (LED) lamps in 2010.

- Ghana is ahead of the curve with a local assembler of LED lighting technologies: Solid Home Appliances.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Ghana. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately GHS 500 over the lifetime of the LED lamp, yet the LED only costs GHS 3 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 9 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.

---

**Figure 12. Cost of Lighting Comparison – Linear Fluorescent Lamp and LED replacement for Ghana**

<table>
<thead>
<tr>
<th>Price for one lamp (GHS):</th>
<th>7</th>
<th>10</th>
<th>GHS/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.12</td>
<td>1.60</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>8,000</td>
<td>30,000</td>
<td>Hours</td>
</tr>
<tr>
<td>LCC of operating lamp for each lamp type:</td>
<td>984</td>
<td>492</td>
<td>GHS (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>0.7</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 9 years:</td>
<td>192</td>
<td>96</td>
<td>kg CO2/9 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Ghana for this comparison.
Photos taken: Q4 2021
Guyana

Table 12. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Guyana

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>1,092,383 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>978,623 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>13 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>1.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 238 million</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Guyana:

- Under the Hinterland LED Lighting Project the Guyana Energy Agency initiated an energy conservation initiative that will replace energy inefficient lights with energy efficient lights. Beneficiaries are customers of the 6 hinterland utilities.
- Findings of the market study carried out by our NGO partners show that LED lamps for general use are already more affordable than CFLs in Guyana. Moreover, Linear fluorescent lamps were not available for purchase in local stores, with TLEDs being the only available option.

The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Guyana. Switching to LED in Guyana offers a 9.7 month payback, meaning the LED lamp pays back the incrementally higher cost of the LED lamp through electricity savings. Additionally, the LED lamp consumes half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save approximately GYD 3,600 over the lifetime of the LED retrofit lamp.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 10 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>CFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cost of light over 10 years (GYD, 2022)</td>
<td>8,665</td>
<td>5,012</td>
</tr>
<tr>
<td>Price for one lamp (GYD):</td>
<td>400</td>
<td>700</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.92</td>
<td>3.36</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>10,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>14.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 10 years, discounted to 2022:</td>
<td>8,665</td>
<td>5,012</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with CFL:</td>
<td>--</td>
<td>9.7</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 10 years:</td>
<td>87</td>
<td>47</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Guyana for this comparison. Photos taken: Q4 2021

Annex A–26
India

Table 13. Cumulative Benefits of Phasing-Out Fluorescent Lighting in India

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>111,773,729 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>325,799,769 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>3,000 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>269.26 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 27 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in India:

- India’s Electric Lamp and Component Manufacturers Association (ELCOMA) published Vision 2024 Roadmap to transition lighting market to LED by 2024.
- As per ELCOMA, India manufactured about 1.4 billion lamps (ICL, CFL and LED) and tubular fluorescent lights and linear LED in 2018-19. The lighting market is dominated by conventional lighting – incandescent lamp, linear fluorescent and CFL with (54%) followed by LED -lamps and tube lights (46%), where the combined share of CFL and fluorescent tubes accounts for 11%.
- In the absence of an environmentally sound mercury management for collection and disposal of discarded fluorescent lamps, using ELCOMA’s production data for 2010-2018, approximately 22 tons of mercury were used in the CFLs and fluorescent tubes and that mercury is likely to have been released into the environment from the discarded lamps.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in India. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately INR 3,000 over the lifetime of the LED lamp, yet the LED only costs INR 190 more at the time of purchase.
### Cost of Lighting Comparison of Purchasing and Running (Consuming Electricity) Different Light Bulbs

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cost of light over 7 years (INR, 2022)</td>
<td>6,467</td>
<td>3,787</td>
</tr>
<tr>
<td>LCC of operating lamp for 7 years, discounted to 2022 (INR, NPV, 2022)</td>
<td>6,467</td>
<td>3,787</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL</td>
<td>--</td>
<td>5.7</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 7 years (kg CO2/7 yrs)</td>
<td>555</td>
<td>308</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in India for this comparison.
Photos taken: October 2021
Indonesia

Table 14. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Indonesia

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>75,779,834 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>229,062,513 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>2,100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>188.01 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 18.8 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Indonesia:

- Indonesia is hosting COP4 in Bali. Due to the COVID-19 pandemic, the Conference of the Parties had to be held in two parts, one online in November 2021 and one in-person in March 2022. Indonesia proposed the Bali Declaration on Combating Illegal Trade in Mercury. The proposed non-binding declaration invites all countries to join in the fight and form strong international cooperation in combating cross-border illegal mercury trade.

- The LED lighting industry shows a strong growth in the country. In 2021 Indonesia approved a Roadmap for High Efficiency Lamps for Indonesia, which includes, among others, phasing out lamps that contain mercury in government agencies and state-owned enterprises buildings by 2022.

- LEDs are primarily imported from China. Virtually no general service lighting local manufacturing exists in Indonesia.

- The National Action Plan to Eliminate and Reduce Use of Mercury from 2018 to 2030 (RAN PPM, Perpres 21/2019) aims to reduce mercury use in manufacturing (among others) by 50% in 2030 against 2018 levels. According to the Plan, the use of Mercury for lamp production was 163 kg / year in 2018.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Indonesia. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately IDR 500,000 over the lifetime of the LED lamp.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 6 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (IDR):</td>
<td>36,000</td>
<td>75,100</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>2.52</td>
<td>5.26</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>36</td>
<td>18</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>13,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>118.3</td>
<td>59.1</td>
</tr>
<tr>
<td>LCC of operating lamp for 6 years, discounted to 2022:</td>
<td>1,077,077</td>
<td>581,929</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>--</td>
<td>5.6</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 6 years:</td>
<td>452</td>
<td>226</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Indonesia for this comparison.
Photos taken: February 2022
Jamaica

Table 15. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Jamaica

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>1,905,188 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>1,838,319 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>23 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>1.7 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 750 million</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Jamaica:

- The Jamaica Public Service Company Limited, with the support of USTDA, is implementing a project to transition 110,000 streetlights to LED, as well as installing intelligent controls and metering capabilities for revenue generation.
- As of 2020, two-thirds of the public lighting in Jamaica was LED.
- In 2017, Finance and the Public Service Minister, Hon. Audley Shaw, inaugurated the Energy Management and Efficiency Programme (EMEP), with the support from the Japan International Cooperation Agency and the Inter-American Development Bank. At the event, the Minister promoted and encouraged the population to transition to LED lights to reduce bills and electricity consumption.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Jamaica. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately JMD 7,000 over the lifetime of the LED lamp, yet the LED only costs JMD 250 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 4 years, with light bulb and electricity costs discounted back to the present (2022).

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

Photographs of the light bulbs selected in the retail store in Jamaica for this comparison.
Photos taken: Q4 2021
Table 16. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Japan

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>117,822,782 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>522,753,035 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>4,500 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>419.13 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 96.4 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Japan:

- LED die and chips exports from Japan account for 21% of total global exports (US DOE & Guidehouse 2021).
- In 2019 energy conservation lighting policies were introduced to regulate incandescent lightbulbs alongside LEDs and fluorescent lighting and lighting equipment regulations were introduced to regulated LEDs alongside fluorescent lamps starting in 2020 (Source: METI 2019).
- In 2017 the use of mercury in lighting was 25% out of a total 5.6 ton of material flow of mercury (Source: Ministry of Environment 2017).

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Nigeria. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately JPY 9,000 over the lifetime of the LED lamp, yet the LED only costs JPY 400 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 12 years, with light bulb and electricity costs discounted back to the present (2022).

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

### Table: Comparison of T8 Fluorescent and T8 LED

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (JPY)</td>
<td>583</td>
<td>980</td>
</tr>
<tr>
<td>Price for one lamp (USD)</td>
<td>5.07</td>
<td>8.53</td>
</tr>
<tr>
<td>Lamp wattage</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Rated lamp lifetime</td>
<td>15,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Annual electricity</td>
<td>59.1</td>
<td>32.9</td>
</tr>
<tr>
<td>LCC of operating lamp</td>
<td>20,306</td>
<td>11,401</td>
</tr>
<tr>
<td>Simple Payback period</td>
<td>--</td>
<td>6.9</td>
</tr>
<tr>
<td>CO2 emissions</td>
<td>270</td>
<td>150</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Japan for this comparison.
Photos taken: February 2022
Kenya

Table 17. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Kenya

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>2,713,707 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>7,558,884 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>6.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 740 million</td>
</tr>
</tbody>
</table>

Important facts about Kenya:

- Standards have already set limits for the mercury content in lighting products (the maximum allowable mercury of 2mg for single capped fluorescent lamps <50W while for lights >50-150W its set at 4.5mg). These regulations also identify the disposal requirements.

- Kenya has MEPS for general service lighting (GSL), directional & non directional lamps and LED that phases out fluorescent lighting (KS 2914:2002) and is in the process of being made mandatory.

- The lighting products (both DC and AC) led to increased uptake of Light Emitting Diode technology, which has quickly been adopted outside the solar segment, leading to increased awareness on efficiency of LED luminary products. The LED product also come in different shapes, and designs, that has further appealed to the consumers as they offer greater flexibility for internal and external lighting fixtures compared to CFLs. The narrowing price differentials between CFLs and LEDs, have translated to many households adopting LED bulbs as opposed to traditional halogens or incandescent bulbs, and currently slowly replacing CFLs

- Kenya is currently the largest market for LED products in the East Africa region; of the different applications; commercial, industrial, residential and other application sectors, the commercial sector accounts for the largest share.

- Kenya is ahead of the curve with a local assembler of LED lighting technologies: LEDMatix

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Kenya. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately KES 5000 over the lifetime of the LED lamp, yet the LED only costs KES 275 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 13 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 (KES):</th>
<th>125</th>
<th>400</th>
<th>KES/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.13</td>
<td>3.60</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>30,000</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 13 years, discounted to 2022:</td>
<td>10,613</td>
<td>5,742</td>
<td>KES (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>8.4</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 13 years:</td>
<td>246</td>
<td>123</td>
<td>kg CO2/13 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Kenya for this comparison.
Photos taken: Q4 2021
Mexico

Table 18. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Mexico

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>167,831,511 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>182,491,073 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>2,208 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>161.3 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 9.7 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Mexico:

- The National Institute of Ecology and Climate Change (INECC) published a report on the Development of the initial assessment of the Minamata Convention in Mexico, to identify the readiness of the current legal framework of the country and propose modifications for the adoption of the Minamata Convention in the country.
- In Mexico, regulations for lighting products are based on 9 Official Mexican Standards (currently in force). The report mentioned above identified that the following norms must be revised and adapted to satisfy the Minamata Convention obligations:
- Notably, Mexico also has NOM-030-ENER-2016 and NOM-031-ENER-2019, which define the minimum energy efficiency and safety standards for LED lamps for general use and for public lighting, respectively. These standards are an important step in protecting the national markets from low-quality lighting products.
- Mexico is an important actor in the global LED market, accounting for 4.6% of global exports of LED luminaires and 0.6% of LED packages/dies. A growing number of LED lamp manufacturers/assemblers are based in Mexico.
- There are several supporting policies, institutions and mechanisms in place that support the transition to more efficient and cleaner technologies, such as:
  - The Energy Efficiency Program promoted through the Trusts Instituted in Relation to Agriculture (FIRA).
  - The Energy Efficiency Program in the Federal Public Administration 2020-2024, which is promoted through the Ministry of Energy (SENER) and the National Commission for the Efficient Use of Energy (CONUEE). The Program establishes specific annual energy savings goals for participating buildings, vehicle fleets and industrial facilities.[2]
  - The FIDE Substantive Programs, which are promoted through the Trust for the Saving of Electric Energy. FIDE is a private, non-profit fund, created at the initiative of the Federal Electricity Commission (CFE) to contribute to the actions of saving and efficient use of electrical energy. These programs include the FIDE voluntary certification of energy-efficient products.
The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Mexico. When switching from CFL to LED in Mexico, the payback in the domestic sector is 18-22 months. The LED lamp consumes approximately half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save approximately MXN 100-110 over the lifetime of the LED retrofit lamp.

<table>
<thead>
<tr>
<th>Price for one lamp (MXN):</th>
<th>29</th>
<th>49</th>
<th>42</th>
<th>MXN/lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.35</td>
<td>2.30</td>
<td>1.97</td>
<td>USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>15</td>
<td>7</td>
<td>9</td>
<td>Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>8,000</td>
<td>11,000</td>
<td>11,000</td>
<td>Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>16.4</td>
<td>7.7</td>
<td>9.3</td>
<td>kWh/year</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 10 years, discounted to 2022:</td>
<td>259</td>
<td>147</td>
<td>161</td>
<td>MXN (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with CFL:</td>
<td>--</td>
<td>21.7</td>
<td>17.5</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 10 years:</td>
<td>53</td>
<td>25</td>
<td>30</td>
<td>kg CO2/10 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Mexico for this comparison. Photos taken: Q4 2021
Nigeria

Table 19. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Nigeria

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>10,306,161 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>31,106,907 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>300 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>25.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 2.47 billion</td>
</tr>
</tbody>
</table>

Important facts about Nigeria:

- Nigeria adopted MEPs for lighting products including self-ballasted and tungsten filament GSL and is carrying out awareness raising on the phase put CFL through their energy efficiency policies.
- The Nigeria Energy Policy prioritized the replacement of all incandescent light bulbs in every home, industry, institution and establishments in Nigeria with LEDs and other energy saving lamps by the year 2025. Nigerian National Energy Efficiency Action Plan (NEEAP) also prioritize the use of EE lighting and target that 40% of households will use EE lighting by 2020 and 100% by 2030.
- The Nigerian Clean Energy Access Program (NCEAP) plans to distribute 150 million efficient bulbs over the next five years under the Clean Development Mechanism (CDM).
- Nigeria has an LED assembly company: Oretronics Technology and key association include Power9ja and Consumer Protection Council who carried out an awareness on LEDs for importers and dealers.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Nigeria. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately NGN 19,000 over the lifetime of the LED lamp, yet the LED only costs NGN 450 more at the time of purchase.
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 due to 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
Pakistan

Table 20. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Pakistan

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>26,930,338 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>78,065,917 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>700 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>64.68 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 6.5 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Pakistan:

- Pakistan’s 2021 Nationally Determined Contribution states mitigation objective of increasing energy efficiency 1.5% per year, with specific mention of LEDs (Source: NDC 2021).

- Pakistan started regulating LED bulbs, downlights, tubes and outdoor lighting through minimum energy performance standards in 2020 with the objective to enhance the best quality LED products, for a rapid phase-out of CFL lamps and incandescent bulbs (Source: U4E 2020).

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Pakistan. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately PKR 7,000 over the lifetime of the LED lamp, yet the LED only costs PKR 400 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 7 years, with light bulb and electricity costs discounted back to the present (2022).

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

Price for one lamp (PKR): 210 650
Price for one lamp (USD): 1.20 3.71
Lamp wattage: 36 18
Rated lamp lifetime: 13,000 25,000
Annual electricity consumption for each lamp type: 118.3 59.1
LCC of operating lamp for 7 years, discounted to 2022: 14,887 7,912
Simple Payback period in months, compared with LFL: -- 5.1
CO2 emissions due to electricity used for 7 years: 373 186

Photographs of the light bulbs selected in the retail store in Pakistan for this comparison.
Photos taken: January 2022
Panama

Table 21. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Panama

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>6,176,854 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>5,846,221 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>75 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>5.3 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 1.1 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Panama:

- In 2013, Panama was one of the co-signatories of the Central American Regional Efficient Lighting Strategy, a document developed in the framework of Proyecto Mesoamerica with the support of the UNEP/GEF en.lighten initiative (United for Efficiency).
- In 2018, the Government of Panama prohibited entry into the country of appliances (i.e., air conditioners, lamps, and refrigerators) that do not meet certain minimum energy efficiency requirements. The promotion of efficient equipment is one of the aspects included in ‘Law 69’, of October 12, 2012, which establishes a policy for the rational use and efficiency of energy (UREE).
- ‘Law 69’ was regulated by the Ministry of the Presidency of Panama through ‘Executive Decree No. 398’, of June 19, 2013. This regulation seeks to raise awareness among consumers to achieve a rational and efficient behavior of energy and promote the development of new energy technologies in the Central American country.
- At the end of 2020, the Panamanian government approved a 10-year energy transition policy roadmap in which it considers universal access to electricity as “priority one”. Although Panama has been working to expand rural electrification in recent years, it is estimated that approximately US$350 million of new investment will be needed to achieve universal access by 2030.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Panama. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately PAB 38 over the lifetime of the LED lamp, yet the LED only costs PAB 2 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 4 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th>Metric</th>
<th>LFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (PAB):</td>
<td>2 PAB/lamp</td>
<td>4 PAB/lamp</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.59 USD/lamp</td>
<td>3.99 USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>20 Watts</td>
<td>9 Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>13,000 Hours</td>
<td>15,000 Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>65.7 kWh/year</td>
<td>29.6 kWh/year</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 4 years, discounted to 2022:</td>
<td>58 PAB (NPV, 2022)</td>
<td>29 PAB (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>-- months</td>
<td>3.8 months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 4 years:</td>
<td>95 kg CO2/4 yrs</td>
<td>43 kg CO2/4 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Panama for this comparison. Photos taken: Q4 2021
Peru

Table 22. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Peru

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>32,993,184 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>27,743,925 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>373 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>25.6 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 4.6 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Peru:

- Peru approved in 2019 its National Plan for the Implementation of the Minamata Convention on Mercury, through Supreme Decree No. 004-2019
- According to a lighting market study developed by MINEM in 2015, it was projected that from the year 2021 the purchases of spotlights in the country would migrate massively towards the purchase of LED bulbs and that from the year 2024 the incandescent bulbs would disappear from the national market.
- Peru has a program of climate change mitigation measures, which includes the transformation of the lighting market in the residential sector with more efficient technology.
- Peru has a Technical Regulation on energy efficiency labeling for energy equipment, approved in 2017 by MINEM, through Supreme Decree No. 009-2017-EM. This Technical Regulation (RT) aims to establish the obligation of energy efficiency labelling, as well as the technical requirements and energy efficiency ranges for the classification of the same, in order to protect the environment and safeguard the right to information of consumers and users.
- In 2016, a Supreme Decree approving measures for the efficient use of energy (Supreme Decree No. 004-2016-EM) was promulgated. This regulation requires that entities and / or public companies that need to acquire or replace energy equipment, must do so with the most efficient technology that exists in the market, at the time of purchase.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Peru. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately PEN 93 over the lifetime of the LED lamp, yet the LED only costs PEN 8 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 4 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (PEN):</td>
<td>7 PEN/lamp</td>
<td>15 PEN/lamp</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.73 USD/lamp</td>
<td>3.73 USD/lamp</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18 Watts</td>
<td>8 Watts</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>10,000 Hours</td>
<td>15,000 Hours</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1 kWh/yr</td>
<td>26.3 kWh/yr</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 4 years, discounted to 2022:</td>
<td>184 PEN (NPV, 2022)</td>
<td>91 PEN (NPV, 2022)</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL:</td>
<td>-- months</td>
<td>4.1 months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 4 years:</td>
<td>71 kg CO2/4 yrs</td>
<td>32 kg CO2/4 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Peru for this comparison. Photos taken: Q4 2021
Philippines

Table 23. Cumulative Benefits of Phasing-Out Fluorescent Lighting in the Philippines

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>27,796,067 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>85,456,923 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>800 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>70.16 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 12.6 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Philippines:

- Double-end fluorescent tubes and compact fluorescent lamps are among the major sources of mercury and mercury-containing waste in the Philippines. It is estimated they emit or release 23.5 and 2.20 tons of mercury per year, respectively (Source: IPEN 2018 and Mercury Assessment Environmental Management Bureau 2008).
- Philippines lamp waste is of about 50 million pieces per year. Out of these, 42 million pieces (84%) are disposed of as garbage (Source: IPEN 2018).
- House Bill No.262 is pending approval and requires all government offices to use LEDs instead of incandescent and CFL bulbs and fluorescent tubes.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in the Philippines. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately PHP 3,000 over the lifetime of the LED lamp, yet the LED only costs PHP 90 more at the time of purchase.
Clean Lighting Coalition (CLiC) - Information Document on LFLs for General Lighting Purposes

Annex A–48

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

Analysis period is 6 years, with light bulb and electricity costs discounted back to the present (2022).

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

---

### Price for one lamp

<table>
<thead>
<tr>
<th>Type</th>
<th>Price for one lamp (PHP)</th>
<th>Price for one lamp (USD)</th>
<th>Lamp wattage</th>
<th>Rated lamp lifetime</th>
<th>Annual electricity consumption for each lamp type</th>
<th>LCC of operating lamp for 6 years, discounted to 2022</th>
<th>Simple Payback period in months, compared with LFL</th>
<th>CO2 emissions due to electricity used for 6 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>T8 Fluorescent</td>
<td>84 PHP/lamp</td>
<td>1.68 USD/lamp</td>
<td>36 Watts</td>
<td>13,000 Hours</td>
<td>118.3 kWh/year</td>
<td>6,539 PHP (NPV, 2022)</td>
<td>-- months</td>
<td>348 kg CO2/6 yrs</td>
</tr>
<tr>
<td>T8 LED</td>
<td>170 PHP/lamp</td>
<td>3.40 USD/lamp</td>
<td>18 Watts</td>
<td>20,000 Hours</td>
<td>59.1 kWh/year</td>
<td>3,363 PHP (NPV, 2022)</td>
<td>1.9 months</td>
<td>174 kg CO2/6 yrs</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in the Philippines for this cost comparison.

Photos taken: January 2022
Sri Lanka

Table 24. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Sri Lanka

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>5,018,524 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>15,379,438 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>100 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>12.14 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 1.4 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Sri Lanka:

- Between 2013-2016, 99% of the mercury-containing lamps imported to Sri Lanka were fluorescent lamps, from which over 87% were comprised of CFL (MIA 2019).
- Orange Electric has a market share of 48% of CFLs. Orange Electric also owns the only CFL recycling company in the country, which exports the extracted mercury to Germany. CFL collection is however not very effective, also according to the Sri Lanka Sustainable Energy Authority (Source: Sri Lanka Sustainable Energy Authority).
- The country is implementing a project (2021-2023) under the Minamata Specific International Program to strengthen the national capacity for phasing out mercury-added products, including through alternatives to fluorescent lighting. (Source: Minamata Convention on Mercury 2021).

The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Sri Lanka. The LED lamp is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save over LKR 2,000 over the lifetime of the LED retrofit lamp.
Clean Lighting Coalition (CLiC) - Information
Document on LFLs for General Lighting Purposes

Annex A–50

Price for one lamp (LKR): 375
Price for one lamp (USD): 1.84
Lamp wattage: 15
Rated lamp lifetime: 8,000
Annual electricity consumption for each lamp type: 16.4
Life-Cycle cost using lamp for 10 years, discounted to 2022: 4,578
Simple Payback period in months, compared with CFL: --
CO2 emissions due to electricity used for 10 years: 130

Photographs of the light bulbs selected in the retail store in Sri Lanka for this comparison. Photos taken: January 2022
South Africa

Table 25. Cumulative Benefits of Phasing-Out Fluorescent Lighting in South Africa

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>38,288,466 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>90,306,453 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>900 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>76.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 11.39 billion</td>
</tr>
</tbody>
</table>

Important facts about South Africa:

- South Africa has already a compulsory specification policy for General Service Lamps (GSLs) at an advanced stage. South Africa’s National Regulator for Compulsory Specification (NRCS) set out compulsory specifications for safety performance and energy efficiency and functional performance requirements of General Services Lamps: VC 9110 and VC9109 respectively. The proposed VCs will phase out lighting products which do not meet the specifications would be removed from the market in two phases, the first taking effect twelve (12) months from publication in the Gazette and the second phase taking effect in 2024. These new regulations for general-purpose light bulbs in South Africa will make it unlawful to continue selling the compact fluorescent lamps that are currently on the market.

- These specifications are in line with UNIDO program that is actively working to try and shift the general service lamp market to LED (phasing out all CFLs and halogens) by 2023: The UNIDO program which is focusing on adoption of regional MEPS for lighting has been adopted by SADCSTAN (SADC HT 109:2021). However, South Africa has not “domesticated” the SADCSTAN regionally harmonized standard.

- South Africa led the region in phasing out the use of incandescent lighting and is on track to abolish CFL lights

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in South Africa. The LED tube is less expensive than the fluorescent lamp on a first-cost basis, so the payback period is instantaneous. Furthermore, the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately ZAR 450 over the lifetime of the LED lamp.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 6 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>LED1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price for one lamp (ZAR):</strong></td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td><strong>Price for one lamp (USD):</strong></td>
<td>2.60</td>
<td>2.54</td>
</tr>
<tr>
<td><strong>Lamp wattage:</strong></td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td><strong>Rated lamp lifetime:</strong></td>
<td>13,000</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Annual electricity consumption for each lamp type:</strong></td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td><strong>LCC of operating lamp for 6 years, discounted to 2022:</strong></td>
<td>894</td>
<td>448</td>
</tr>
<tr>
<td><strong>Simple Payback period in months, compared with fluorescent:</strong></td>
<td>--</td>
<td>(instant)</td>
</tr>
<tr>
<td><strong>CO2 emissions due to electricity for one lamp operating for 6 years:</strong></td>
<td>294</td>
<td>147</td>
</tr>
</tbody>
</table>

---

Photographs of the light bulbs selected in the retail store in South Africa for this comparison.
Photos taken: Q4 2021
Togo

Table 26. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Togo

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>174,237 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>495,033 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>5 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>0.40 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 70 million</td>
</tr>
</tbody>
</table>

Togo’s lighting market is transitioning to LED, driven by the strong economic benefits of switching away from mercury-containing fluorescent lamps.

The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Togo. Switching to LED in Togo offers an instantaneous payback, because the LED lamp is less expensive than the CFL. Additionally, the LED lamp consumes half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save approximately XOF 11,000 over the lifetime of the LED retrofit lamp.

Photographs of the light bulbs selected in the retail store in Togo for this comparison. Photos taken: Q4 2021
Trinidad & Tobago

Table 27. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Trinidad & Tobago

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>4,596,098 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>4,662,529 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>58 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>4.1 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 82 million</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Trinidad & Tobago:

- The Government of Trinidad and Tobago launched a 2020-2024 Energy Conservation and Energy Efficiency Policy and Action Plan, which includes policies and initiatives to transition the country to LED lighting.
- As part of this Action Plan, in 2020, The Trinidad and Tobago Electricity Commission started its LED Light Bulb Distribution Program, giving away LED bulbs in efforts to reduce electricity consumption in the country, targeting over 400,000 households.
- Findings of the market study carried out by our NGO partners show that LED lamps for general use and tube LEDs are already more affordable than CFLs and LFLs in Trinidad and Tobago.

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Trinidad & Tobago. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately TTD 320 over the lifetime of the LED lamp, yet the LED only costs TTD 25 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 12 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>LFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (TTD)</td>
<td>70</td>
<td>45</td>
</tr>
<tr>
<td>Price for one lamp (USD)</td>
<td>10.50</td>
<td>6.75</td>
</tr>
<tr>
<td>Lamp wattage</td>
<td>32</td>
<td>18</td>
</tr>
<tr>
<td>Rated lamp lifetime</td>
<td>10,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type</td>
<td>105.1</td>
<td>59.1</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 12 years, discounted to 2022</td>
<td>556</td>
<td>234</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with LFL</td>
<td>--</td>
<td>(instant)</td>
</tr>
<tr>
<td>CO₂ emissions due to electricity used for 12 years</td>
<td>530</td>
<td>298</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Trinidad and Tobago for this comparison.
Photos taken: Q4 2021
**Uganda**

**Table 28. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Uganda**

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>765,806 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>2,176,310 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>20 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>2.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 250 million</td>
</tr>
</tbody>
</table>

In Uganda, according to draft regulation 43 (of 17th June, 2021) of The National Environment (Management of Hazardous Chemicals and Products Containing Hazardous Chemicals), a person shall not import, manufacture, use or recycle any of the following:

- Compact fluorescent lamps for general lighting purposes that are less or equal to 30 watts with a mercury content exceeding 5 mg per lamp burner
- Triband phosphor linear fluorescent lamps for general lighting purposes of less than 60 watts with a mercury content exceeding 5 mg per lamp
- Halophosphate phosphor linear fluorescent lamps for general lighting purposes of less than 40 watts with a mercury content exceeding 10 mg per lamp
- High pressure mercury vapour lamps for general lighting purposes
- Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps for electronic displays of short length (≤ 500 mm) with mercury content exceeding 3.5 mg per lamp
- Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps for electronic displays of medium length (> 500 mm and ≤ 1 500 mm) with mercury content exceeding 5 mg per lamp
- Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps for electronic displays of long length (> 1 500 mm) with mercury content exceeding 13 mg per lamp

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Uganda. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately UGX 65,000 over the lifetime of the LED lamp, yet the LED only costs UGX 1,600 more at the time of purchase.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 4 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></th>
<th>148,268</th>
<th>83,686</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cost of light over 4 years: (UGX, 2022)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T8 Fluorescent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table:

<table>
<thead>
<tr>
<th>Price for one lamp (UGX):</th>
<th>7,000</th>
<th>8,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.96</td>
<td>2.41</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>8,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>32.9</td>
</tr>
<tr>
<td>LCC of operating lamp for 4 years, discounted to 2022:</td>
<td>148,268</td>
<td>83,686</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with fluorescent:</td>
<td>--</td>
<td>1.3</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 4 years:</td>
<td>33</td>
<td>18</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Uganda for this comparison.
Photos taken: Q4 2021
Uruguay

Table 29. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Uruguay

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>8,120,819 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>8,522,153 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>105 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>7.5 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 1.6 billion</td>
</tr>
</tbody>
</table>

Important information about mercury and lighting in Uruguay:

- Decree 15/2019 of the Ministry of Environment of Uruguay (MVOTMA) regulates and promotes the adequate management of mercury-containing products. Items reached by the decree include products covered in Annex A of the Minamata Convention (compact and linear fluorescent lamps, high pressure mercury vapor lamps, cold cathode fluorescent lamps, external electrode fluorescent lamps, high discharge lamps, thermometers and pressure measuring devices). Such products may not exceed the maximum mercury content established in the Minamata Convention.

- Decree 15/2019 also establishes the obligation of importers of mercury-containing products to design and implement a sound end-of-life management system including the reception, collection, storage, treatment, and destination of the mercury-containing waste.

- In 2013, the Ministry of Environment of Uruguay, with the support of the UNEP/GEF en.lighten initiative (United for Efficiency), developed its National Efficient Lighting Strategy. This strategy set the goals of phasing out inefficient lamps and certain mercury-containing lamps such as high-pressure mercury lamps used for public lighting. It also presented plans for the sound management of mercury in fluorescent lamps.

The box below offers an economic analysis of a CFL and LED retrofit bulbs. Both of these lamps were selected and photographed in a retail store in Uruguay. The LED lamp is slightly more expensive than the CFL on a first-cost basis, but the LED consumes half as much power as the CFL, so electricity bills are halved over the lamp lifetime. Switching from CFL to LED in Uruguay will save approximately UYU 600 over a ten year analysis period, yet the LED only costs UYU 7 more at the time of purchase. Thus, switching to LED in Uruguay offers a payback period of just 1.3 months and then goes on to save the user hundreds of UYU over its lifetime.

Annex A–58
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 10 years, with light bulb and electricity costs discounted back to the present (2022).

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

<table>
<thead>
<tr>
<th></th>
<th>CFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (UYU):</td>
<td>70</td>
<td>77</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>1.61</td>
<td>1.76</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>8,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>13.1</td>
<td>6.6</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 10 years, discounted to 2022:</td>
<td>1,303</td>
<td>676</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with CFL:</td>
<td>--</td>
<td>1.3</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 10 years:</td>
<td>21</td>
<td>10</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Uruguay for this comparison. Photos taken: Q4 2021
## Vietnam

### Table 30. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Vietnam

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>49,696,592 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>145,373,302 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>1,300 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>118.53 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 9.5 billion</td>
</tr>
</tbody>
</table>

### Important information about mercury and lighting in Vietnam:

- In 2019 a Hanoi light bulb warehouse fire leaked 15-27 kilos of mercury as 480,000 fluorescent lightbulbs were burnt (Source: VNExpress international).
- In 2020 GEF approved a project to support Vietnam’s transition to non-mercury lighting, among others. According to GEF, Vietnam is preparing the shift from CFL to LED which will be further driven by the Minamata Convention on Mercury (Source: GEF 2020).
- In 2019 MOIT issued Circular No. 08/2019/TT-BKHCN that mandates certification requirements for domestically produced and imported LED products.
- Vietnam accounts for 2% of the total global LED die and chips exports (US DOE & Guidehouse 2021).

The box below offers an economic analysis of a linear fluorescent lamp and an LED retrofit tube, both of which were selected and photographed in a retail store in Vietnam. The LED tube is more expensive than the fluorescent lamp on a first-cost basis, but the LED lamp consumes half as much power as the fluorescent tube – so electricity bills are halved over the lamp lifetime. Switching from fluorescent to an LED retrofit tube will save approximately VND 800,000 over the lifetime of the LED lamp, yet the LED only costs VND 20,000 more at the time of purchase.
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 about half as much as fluorescent sources, yet produce the same amount of light from the fixture.

<table>
<thead>
<tr>
<th></th>
<th>T8 Fluorescent</th>
<th>T8 LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cost of light over 15 years (VND, 2022)</td>
<td>1,664,696</td>
<td>846,318</td>
</tr>
<tr>
<td>Price for one lamp (VND):</td>
<td>20,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>0.88</td>
<td>1.76</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>15,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>59.1</td>
<td>29.6</td>
</tr>
<tr>
<td>LCC of operating lamp for 15 years, discounted to 2022:</td>
<td>1,664,696</td>
<td>846,318</td>
</tr>
<tr>
<td>CO2 emissions due to electricity used for 15 yr:</td>
<td>319</td>
<td>160</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Vietnam for this comparison.
Photos taken: January 2022
Zambia

Table 31. Cumulative Benefits of Phasing-Out Fluorescent Lighting in Zambia

<table>
<thead>
<tr>
<th>Lighting Source / Metric for Quantifying Benefits</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided compact fluorescent lamp sales if phased-out in 2024 (cumulative, 2024-50)</td>
<td>2,388,867 lamps</td>
</tr>
<tr>
<td>Avoided linear fluorescent lamp sales if phased-out in 2025 (cumulative, 2025-50)</td>
<td>7,473,796 lamps</td>
</tr>
<tr>
<td>Total mercury in fluorescent lamps avoided (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>68 kilograms</td>
</tr>
<tr>
<td>Total energy savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>6.0 TWh</td>
</tr>
<tr>
<td>Total energy bill savings, CFL and LFL phase-out (CFL 2024, LFL 2025, cumulative to 2050)</td>
<td>US$ 230 million</td>
</tr>
</tbody>
</table>

Important facts about Zambia:

- The Zambia Electricity Supply Company (Zesco) has a programme to phase out energy consuming bulbs and replacing them with energy saving bulbs.
- Zesco is giving out Energy saving bulbs to communities so as to introduce the energy saving bulbs to the communities and the communities must compare and differentiate the energy saving bulbs from the energy consuming bulbs.
- In achieving the goal of transitioning households to LEDs, the Zambia Electricity Supply Company (Zesco) has made one brand of lighting bulbs called Woo Jong lighting, Model led A65 13 watts going at a price of k50. And it’s a Mercury free product.

The box below offers an economic analysis of a CFL and LED retrofit bulbs. All of these lamps were selected and photographed in a retail store in Zambia. Switching to LED in Zambia offers an instantaneous payback, because the LED lamp is less expensive than the CFL. Additionally, the LED lamp consumes half as much power as the CFL – so electricity bills are halved over the lamp lifetime – yet the LED lamp produces the same amount of light. Switching from CFL to LED will save approximately ZMW 100 over the lifetime of the LED retrofit lamp.
Cost of lighting comparison of purchasing and running (consuming electricity) different light bulbs.

Analysis period is 10 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></th>
<th>CFL</th>
<th>LED1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price for one lamp (ZMW):</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>Price for one lamp (USD):</td>
<td>2.03</td>
<td>1.74</td>
</tr>
<tr>
<td>Lamp wattage:</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Rated lamp lifetime:</td>
<td>6,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Annual electricity consumption for each lamp type:</td>
<td>19.7</td>
<td>9.9</td>
</tr>
<tr>
<td>Life-Cycle cost using lamp for 10 years, discounted to 2022:</td>
<td>194</td>
<td>98</td>
</tr>
<tr>
<td>Simple Payback period in months, compared with CFL:</td>
<td>(instant)</td>
<td>months</td>
</tr>
<tr>
<td>CO2 emissions due to electricity for one lamp operating for 10 years:</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

Photographs of the light bulbs selected in the retail store in Zambia for this comparison.
Photos taken: Q4 2021
ENDING TOXIC LIGHTING TOGETHER