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Refurbishing Europe's Fluorescent Lamp Manufacturing Facilities

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Preface

The EU-27 are currently in the process of phasing-out domestic consumption of fluorescent lighting. There are two regulations – one final and one draft – that will eliminate fluorescent lighting by 2023:

- **Ecodesign Directive:** Commission Regulation (EU) 2019/2020 became law on 1 October 2019 and set mandatory efficiency requirements that phased out all compact fluorescent lamps (CFLs), Cold Cathode and External Electrode Fluorescent Lamps (CCFL/EEFL) and all T2 and T12 linear fluorescent lamps on 1 September 2021. A second phase on 1 September 2023 will eliminate the high-sales volume lengths of T8 linear fluorescent lamps: 2 ft, 4 ft and 5 ft.

- **Restriction of Hazardous Substances (RoHS) Directive:** not yet law, RoHS is completing its Parliamentary and Council scrutiny period in the coming few months. The European Commission adopted provisions in mid-December 2021 which will phase out all general purpose fluorescent lamps in 2023. The key categories are (1) Linear Fluorescent Lamps (double-capped, all diameters), (2) Compact Fluorescent Lamps (CFLi and CFLni), (3) Long-life CFL and (4) Cold Cathode and External Electrode Fluorescent Lamps (CCFL/EEFL).

Despite ambitious domestic policy to ban inefficient, mercury-containing lighting products, these internal market policy decisions stand in stark contrast to the position the EU-27 took in their proposal to amend lighting products in the Minamata Convention on Mercury. Through the Convention, the EU only proposed to phase-out halophosphate fluorescent lamps – a technology the EU banned in 2011. It is important to note that the Ecodesign and RoHS Directive regulations only apply to the EU's internal market and thus do not affect exports; however a ban to these same products under Minamata would eliminate exports of those fluorescent lamps.

Europe has two manufacturing facilities for fluorescent lamps which are currently operational – one in Poland and one in Germany. The fluorescent production lines at these lighting factories are limited because the product they produce is no longer fit for purpose. EU domestic market for fluorescents will be gone in 2023 and regional export markets to the European Economic Area, the United States and other countries is also being phased out by separate legislation.

To be viable, converting the facilities in Poland and Germany from T8 and T5 linear fluorescent lamps to T8 and T5 LED retrofit tubes will require EU government investment. This study demonstrates that the fluorescent export market from these countries is already in decline and projected to reach zero around 2025. However, through the EU Taxonomy Fund, there is potential to invest in these facilities and create a long-term, domestic supply of high-quality LED tubes in Europe, produced in Poland and Germany.

This report highlights this opportunity for a Taxonomy Fund investment in EU manufacturing of energy-efficient, high-value-add LED tube manufacturing, which will result in significant employment and climate benefits.

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EXECUTIVE SUMMARY

Transitioning the EU's remaining fluorescent lamp production lines in Poland and Germany to LEDs is an opportunity for new businesses to build and expand lighting markets, and to generate new jobs. These new jobs will be critical for the European market to be competitive against the largest LED producers in Asia. Factory conversions will stimulate the transition to higher efficiency, while also decreasing dependency on imports.

This report demonstrates that fluorescent lamp exports from EU-based suppliers are declining already. From 2017 to 2020, export trade value within the EU-27 countries declined by 18% per year, and exports to non-EU countries declined by 14% per year.[1] If the last four years of decline are projected forward linearly, the trade value of the export shipments reaches zero in early 2025.

Our report also demonstrates that recent EU and non-EU policies and legislation regulating fluorescent lamps will hasten this trend.

- In 2020, 61% of fluorescent exports, equivalent to €134.2 million, were traded within the EU-27 countries, where fluorescents will be phased out imminently.

- The remaining 39% of exports, corresponding to €85.4 million, were exported to non-EU countries. However, several of these non-EU countries are also adopting policy measures to phase-out fluorescent lamps. As discussed in section 4.2, policy actions are either adopted or underway in the United States, United Kingdom, Switzerland, Norway, Singapore, India and Indonesia to phase-out fluorescent lamps. Taken together these seven countries represent 48.4% of exports to non-EU countries, or approximately €47.14 million Euros of exports that will be lost in the next few years.

In total, 79.9% of the fluorescent lighting market supplied by EU-based manufacturing in 2020 will be phased-out through existing or soon-to-be-adopted policy measures by 2023/2024. The remaining 20% is not deemed to be adequate throughput to sustain these factories, and thus the production lines will be forced to close.

Transitioning these two linear fluorescent lamp factories to LED production is in line with the EU Taxonomy for Sustainable Activities and could be supported under that framework. It is also an opportunity for new businesses to build and expand lighting markets, and to generate new jobs, as discussed in Section 5. These new jobs will be critical to enabling the European market to be competitive against the largest LED producers in Asia. Factory conversions will stimulate the transition to higher efficiency, while also decreasing dependency on imports.

We estimate that the investment of between €30-60 million Euros in these two facilities in Poland and Germany would position them for long-term sustainability, competitively supplying billions of Euros of LED tubes to the EU-27 and countries abroad for years to come.

[1] *Combined Annual Growth Rate (CAGR), exports of fluorescent lamps to EU-27 countries were valued at €218.6 million in 2017 and €134.5 million in 2020. Exports to non-EU countries were €125.2 million in 2017 and €85.4 million in 2020.*

1. Introduction

1.1 INTRODUCTION

Mercury is a chemical of major public health concern, yet is still used in all fluorescent lighting. Fluorescent lamps release mercury whenever they are broken. Because fluorescent lighting is ubiquitous, lamp breakage can occur in homes, schools, child care settings, office and apartment buildings, retail stores, factories, health care and other facilities. There is no "safe" level of exposure to mercury.

Today, a typical dosing of mercury in fluorescent lamps can be anywhere from 2 to 10mg of mercury, depending on the tube and the production line. Because mercury is a hazardous neurotoxin, it requires specialist disposal at the end of lamp life because it poses high risks to human health and the environment.

In the past, fluorescent lamps were promoted as an energy-efficient alternative to incandescent and halogen lamps, and the risks associated with mercury in fluorescents were tolerated as a necessary trade-off. Today, thanks to major advances in light-emitting diode (LED) technology, mercury-free LED lamps can cost-effectively replace fluorescents in virtually all applications. In addition, LEDs last longer than fluorescent lamps, and due to their lower energy consumption, their use results in less mercury and other harmful air pollutants released from coal-burning power plants.[2]

In Europe, mercury is regulated under the Restriction of Hazardous Substances (RoHS) Directive, which was first established in 2002 (2002/95/EC) to set limits to the use of mercury, and under the Ecodesign Directive in 2009 (2009/125/EC) to define performance and quality standards[3]. Between 2019 and 2021, both policy measures were revised to address the toxicity and inefficiency of fluorescent lighting and enable the European market to phase out fluorescent lamps in 2023.

- **Ecodesign Directive:** Commission Regulation (EU) 2019/2020 became law on 1 October 2019 and set mandatory efficiency requirements that phased out all compact fluorescent lamps (CFLs), Cold Cathode and External Electrode Fluorescent Lamps (CCFL/EEFL) and all T2 and T12 linear fluorescent lamps on 1 September 2021. A second phase on 1 September 2023 will eliminate the high-sales volume lengths of T8 linear fluorescent lamps: 2 ft, 4 ft and 5 ft.

- **Restriction of Hazardous Substances (RoHS) Directive:** not yet law, but is completing its Parliamentary and Council scrutiny period in the coming few months. The European Commission adopted provisions in mid-December 2021 which will phase out all general purpose fluorescent lamps in 2023. The key categories are (1) Linear Fluorescent Lamps (double-capped, all diameters), (2) Compact Fluorescent Lamps (CFLi and CFLni), (3) Long-life CFL and (4) Cold Cathode and External Electrode Fluorescent Lamps (CCFL/EEFL).

At the international level, the EU ratified the Minamata Convention on Mercury in 2017, which was saluted as a "great success of EU green diplomacy" to protect citizens' health and the environment globally from the exposure to mercury[4]. As of February 2022, 137 countries ratified the Convention[5], progressing on phasing out and down mercury use in several products and processes. Despite this, the Convention provides an exemption to general purpose fluorescent lighting under Annex A of the Convention, citing insufficient cost-effective alternatives across global markets. However, in the decade since the exemptions were implemented in 2013, mercury-free LED retrofit lamps have become widely available and accessible.

In 2021, both the EU and the African regions submitted amendments to Annex A of the Minamata Convention which would modify the lighting exemptions. These amendments will be discussed in Bali, Indonesia at COP4.2 which will take place on 21-25 March 2022:

- The EU-27 Proposed Amendment to Annex A of the Minamata Convention will eliminate the manufacture, import, export of halophosphate phosphor linear fluorescent lamps (LFLs) used in general lighting purposes by the end of 2023. The EU proposal does not change the requirements, dates or level of mercury in Annex A for the other fluorescent lighting products, including CFL, tri-band phosphor linear lamps and CCFL/EEFL lamps.

- The African Proposed Amendment to Annex A of the Minamata Convention will eliminate the manufacture, import, export of nearly all fluorescent lighting products listed in Annex A of the Minamata Convention. Specifically, the African proposal calls for the phase-out (1) compact

[2] Maxson, P., Bender, M., Culver, A. (2021). Mercury in Fluorescent Lighting: Unnecessary Health Risks and Actionable Solutions
[3] Scholand M., Bennich P. (2020). Mercury and RoHS: The link between environmental regulations and efficiency
[4] https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1345
[5] https://www.mercuryconvention.org/en/parties

fluorescent lamps with an integrated ballast (CFL.i) for general lighting purposes that are ≤ 30 watts, and cold cathode fluorescent lamps (CCFL) and external electrode fluorescent lamps (EEFL) for electronic displays of all lengths by 2024; and (2) all linear fluorescent lamps (LFLs) for general lighting purposes by 2025. The African proposal does not change the requirements, dates or level of mercury in Annex for pin-based compact fluorescent lamps (CFL.ni).

The proposed European Amendment allows CFLs and triband phosphor fluorescent lamps to persist in Annex A of the Convention. Therefore, the proposal from the African region is a better reflection of the EU policy measures taken domestically under Ecodesign and RoHS, to phase out all general-purpose fluorescent lamps.

In their statement on the amendments to Annex A, the African region invited all parties to join their amendment, which they defined necessary for "[…] paving the way for a global transitioning to cost effective and equivalent toxic-free, energy efficient LED lighting"[6]. The Clean Lighting Coalition has calculated[7] that if adopted, the African Lighting Amendment would bring the following benefits at the global level:

- Eliminate 232 tonnes of mercury pollution from the environment, both from the light bulbs themselves and from avoided mercury emissions from coal-fired power plants;
- Reduce global electricity use by 3%;
- Avoid 3.5 gigatonnes of CO2 emissions cumulatively between 2025-2050; equivalent to removing all passenger cars globally from the road for a whole year; and
- Save US$1 trillion on electricity bills.

Limiting the ban of all general-purpose fluorescent lighting to the EU market would therefore result in energy and CO_2 savings losses at the global level.

[6] https://www.mercuryconvention.org/sites/default/files/documents/other/African_Region_Statement_Submitted_Amendments_Sept_1_Session_EN.pdf

[7] Clean Lighting Coalition website, visited 17 February 2022. Link: https://cleanlightingcoalition.org/benefits/environment/

2. Methodology of EU Fluorescent Lamp Export Analysis

2.1 METHODOLOGY OF EU FLUORESCENT LAMP EXPORT ANALYSIS

In order to better understand the impact of the new policy measures on fluorescent lamp manufacturing in Europe, CLASP looked at the volume and value of exports of fluorescent lamps as published in the United Nation's Comtrade system.[8] CLASP examined exports of fluorescent lamps (including both CFLs and Linear Fluorescent Lamps under the same Harmonised Standard (HS) Code: 853931) for the years 2017 to 2020 from five EU-27 countries that had significant exports in fluorescent lamps: France, Germany, Hungary, Netherlands, and Poland. However, we understand that at present, there are only two fluorescent lamp production lines currently running in Europe, one in Pila, Poland belonging to Signify/Philips, and one in Erlangen, Germany, belonging to Feilo Sylvania Germany GmbH. Both facilities produce a range of lighting products, including linear fluorescent lamps. There has been a trend in recent years that European companies have sold or closed their general lighting businesses and instead imported lamps from Asia[9].

The Feilo Sylvania Germany GmbH plant in Erlangen started production in 1968. As of 2014, the main products manufactured were fluorescent tubes as well as specialty lamps[10]. In 2020 the company declared liquidation,[11] but then continued operation under the Chinese Shanghai Feilo Acoustics Co., Limited since 2021[12]. Feilo Sylvania also manufactured fluorescents in Belgium, Germany, France and the UK through main brands including Concord, Lumiance and Sylvania[13]. Those facilities are all now closed.

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[14]. Currently, the factory in Poland is producing linear fluorescent lamps and specialty tubular lamps. In 2013, the Philips factory in Pila was retrofitted with LED (LED WT460C) lighting as a demonstration project, replacing 1280 separate fittings that had fluorescent lamps (TLD Super 80 58W/840) with new LED luminaires. This investment had a return of investment of 2 years, and a 58% reduction in energy consumption for lighting[15].

As a result, while the scope of the study covers all general-purpose lamps, the findings from the analysis performed in this study are related to linear and nonlinear fluorescent lamps (LFLs), and specifically to T5 and T8 lamps, as the only lamps manufactured in the EU market.

2.2 METHODOLOGY AND DATA SOURCES

This analysis looks at exports of fluorescent lamps to determine whether there is a viable future for these two facilities in Pila and Erlangen. The primary input is data (including volume and value) collected from the UN Comtrade Database, which is analysed by country and plotted to examine trends over four years, forecasting a short period ahead with a linear regression analysis. The purpose of this analysis is to demonstrate the socio-economic impacts of an export ban of all general-purpose fluorescent lighting in terms of:

- Impacts on revenue from exports of fluorescent lamps from Europe
- Impacts on importing countries
- Employment impacts in Europe
- Feasibility of converting fluorescent factories to LEDs

The UN Comtrade data collected and analysed had the HS Commodity Code 853931, defined as "Lamps; discharge, (excluding ultra-violet), fluorescent, hot cathode". Trade value and partners data were analysed in Excel. Trade values were converted from United States Dollars to European Euros by using the European Central Bank (ECB) yearly average reference rate as follows:

[8] https://comtrade.un.org/
[9] Commission Staff Working Document Impact Assessment of 01.10.2019 of Ecodesign Directive
[10] https://edisonreport.eu/havells-sylvania-erlangen-germany/
[11] https://www.northdata.com/?id=5812070447
[12] In German https://app.insolvenz-portal.de/Nachrichten/feilo-sylvania-germany_-restrukturierung-erfolgreich-abgeschlossen/23207
[13] https://www.sylvania-lighting.com/en-int/help-support/about-us/
[14] https://www.paih.gov.pl/nowosci/?id_news=936
[15] https://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/Global/ODLI20160224_001-UPD-en_AA-PhilipsFactory-Pila-Poland-casestudy.pdf

2017: 1.00 US$ equals EUR€0.8870
2018: 1.00 US$ equals EUR€0.8476
2019: 1.00 US$ equals EUR€0.8934
2020: 1.00 US$ equals EUR€0.8768

Desktop research provided information on the European-based fluorescent lighting manufacturing facilities, such as through companies' websites, newspaper articles, YouTube videos, Dun and Bradstreet reports and other sources and datasets.

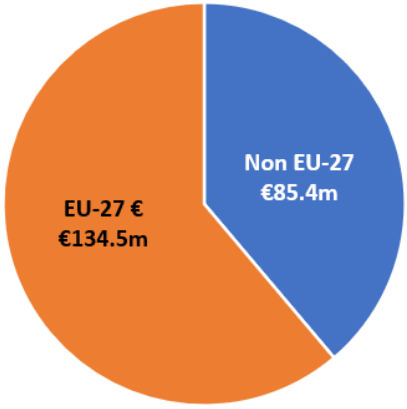
3. European Fluorescent Lamp Market Analysis

3.1 EUROPEAN FLUORESCENT LAMP MARKET ANALYSIS

3.2 TRADE IN EUROPEAN FLUORESCENT LAMPS - REVENUE INSIGHTS AND TRENDS

As shown in FIGURE 1, the total export trade value of fluorescent lamps in 2020 was €219.9 million, corresponding to fluorescent lamp export revenue from France, Germany, Hungary, Netherlands, and Poland. The figure shows that 61% of these exports, equivalent to €134.5 million, were traded within the EU-27 countries. The remaining 39% of exports, corresponding to €85.4 million, were exported to non-EU countries.

FIGURE 1. TRADE VALUE OF FLUORESCENT LAMPS (HS: 853931) EXPORTS IN 2020



Within those non-EU-27 countries, the top five countries that received exports from the five EU-27 countries analysed for exports in 2020 were the United States, the United Kingdom, Switzerland, Saudi Arabia and the Russian Federation. And of the five EU-27 countries exporting, Poland was the largest exporting country covering over half (55%) of the total exporting value to non-EU countries in 2020 (please see Table 1).

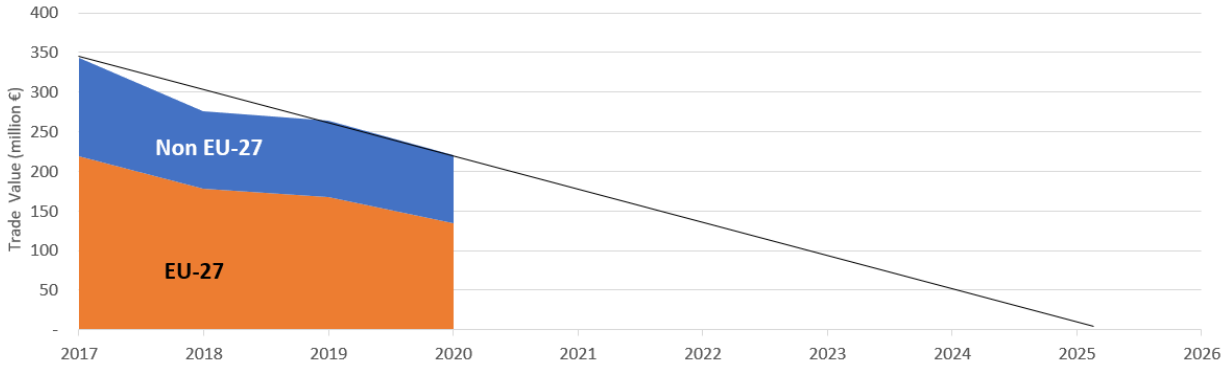
TABLE 1. FLUORESCENT LAMP EXPORT VALUE BY EXPORTING COUNTRY TO NON-EU COUNTRIES (2020)

COUNTRY	TRADE VALUE (€)	% TOTAL TRADE
Poland	46,593,722	55%
France	24,158,039	28%
Germany	7,042,687	8%
Hungary	5,152,723	6%
Netherlands	2,413,738	3%
Grand Total	**85,360,910**	**100%**

Figure 3 shows that from 2017 to 2020, fluorescent lamp exports from EU-based suppliers have been declining. Over these years, export trade value within the EU-27 countries declined by 18% per year, and exports to non-EU countries declined by 14% per year.[16] If the last four years of decline are projected forward linearly, the trade value of the export shipments reaches zero in early 2025.

[16] Combined Annual Growth Rate (CAGR), exports of fluorescent lamps to EU-27 countries were valued at €218.6 million in 2017 and €134.5 million in 2020. Exports to non-EU countries were €125.2 million in 2017 and €85.4 million in 2020.

FIGURE 2. TRADE VALUE LINEAR PROJECTION OF FLUORESCENT LAMP (HS: 853931) EXPORTS



However, the business-as-usual linear projection in FIGURE 2 is not considering the impact of the 2019 Ecodesign Directive and of the 2021 RoHS Directive which will accelerate the phaseout of fluorescent lamps within the EU market. In this scenario, the orange part of the figure drops to zero in 2023 and therefore removes 60% of the trade value. The remaining 40% represents exports to non-EU countries (see discussion below about impacts on these exports).

The declining trend in fluorescent trade value is also evidenced by Signify Annual Report of 2020 which states that at the global level, Signify operated 11 manufacturing plants for conventional lamps (including fluorescent, tungsten and high-intensity discharge lamps) at the end of 2020 compared with 45 at the end of 2008. Between 2017 and 2020, sales for these lamps declined by 48%, but according to the Report, this production line serves to optimize free cash flow within a market that is shifting rapidly to LEDs[17,18].

3.3 IMPACT ON IMPORTING COUNTRIES

Table 2 provides the top-30 countries importing fluorescent lamps from France, Germany, Hungary, Netherlands, and Poland (representing 84.1% of the total export value to non-EU countries).

The United Kingdom, Switzerland, and Norway (ranked 2, 3 and 8 respectively) are already aligned with Ecodesign Regulation EU No 2019/2020 and will likely adopt the updated RoHS provisions once they are finalized and published in the Official Journal of the European Union in Q2 of 2022. These countries alone represent 23.2% of the 2020 export value to non-EU countries.

The United States has been rapidly transitioning to LED lighting, even in the absence of regulatory pressure. Resources such as the Design Light Consortium's database, the EPA's Energy Star programme, the Federal Energy Management Program (FEMP) and numerous green procurement initiatives at the state and federal level have all been transitioning the market. In addition to these, the states of Vermont and California are both actively introducing legislation that will phase-out general purpose compact fluorescent and linear fluorescent lamps over the next few years. These legislative initiatives are expected to be replicated in other states, and eventually adopted at the Federal level, with a phase-out of fluorescent lighting across the United States expected by 2025.

In addition to this, policy and other initiatives in India, Indonesia[19], and Singapore (accounting for nearly 3% of the export value) have all respectively put forward policies to transition to LEDs. For example, India's Electric Lamp and Component Manufacturers (ELCOMA) published a Vision 2024 Roadmap to transition market to LED by 2024. Indonesia developed a Roadmap for High Efficiency Lamps which aims to phase out lamps that contain mercury in government agencies and state-owned enterprise buildings by 2022. Also, the Singapore National Environment Agency (NEA) is aiming for all light bulbs sold in Singapore to be minimally as energy efficient as LED bulbs from 2023 onwards[20].

TABLE 2 presents the top 30 countries importing fluorescent lamps (classified in UN Comtrade as HS Code: 853931) in 2020 from the five European countries analysed: France, Germany, Hungary, Netherlands and Poland.

[17] Signify Annual Report 2020 https://www.signify.com/static/2020/signify-annual-report-2020.pdf page 2020
[18] Signify Annual Report 2017 https://www.signify.com/static/2017/philips-lighting-annual-report-2017.pdf
[19] Indonesia is the 31st top importing country with a trade value of €257.9 thousand and accounting for 0.3% of the 2020 total trade value.
[20] https://www.nea.gov.sg/media/news/news/index/all-light-bulbs-sold-in-s-pore-to-be-minimally-of-led-efficiency-level-from-2023

TABLE 2. TOP 30 COUNTRIES IMPORTING FLUORESCENT LAMPS FROM EUROPE IN 2020

RANK #	IMPORTING COUNTRY	TRADE VALUE (€)	% OF 2020 TOTAL TRADE VALUE
1	USA	22,400,783	23.0%
2	United Kingdom	11,189,265	11.5%
3	Switzerland	7,613,378	7.8%
4	Saudi Arabia	4,554,526	4.7%
5	Russian Federation	4,261,980	4.4%
6	Turkey	4,166,867	4.3%
7	Rep. of Korea	3,862,976	4.0%
8	Norway	3,755,837	3.9%
9	China	2,564,008	2.6%
10	Egypt	2,440,511	2.5%
11	United Arab Emirates	2,356,250	2.4%
12	Canada	1,282,859	1.3%
13	South Africa	1,137,288	1.2%
14	China, Hong Kong SAR	1,113,571	1.1%
15	Singapore	1,046,850	1.1%
16	Australia	896,706	0.9%
17	Israel	884,351	0.9%
18	Malaysia	815,563	0.8%
19	India	809,730	0.8%
20	Ukraine	594,936	0.6%
21	Panama	548,894	0.6%
22	Other Asia	544,579	0.6%
23	Qatar	544,510	0.6%
24	Iraq	470,698	0.5%
25	Serbia	413,360	0.4%
26	Mexico	387,504	0.4%
27	Oman	361,010	0.4%
28	Tunisia	331,757	0.3%
29	New Zealand	274,068	0.3%
30	Iceland	263,333	0.3%
Total (€)		81,887,948	84.1%

Considering the sum of the exports to these countries with active / on-going policy measures to phase out fluorescent, including: United States (23%), United Kingdom (11.5%), Switzerland (7.8%), Norway (3.9%), Singapore (1.1%), India (0.8%) and Indonesia (0.3%), taken together they represent 48.4% of exports to non-EU countries, or approximately €47.14 million Euros of exports that will be lost.

Thus, the exports to EU-27 countries which represent 61% of exports from these five countries, including Poland and Germany, will be zeroed out in 2023. Of the remaining 39% of exports to non-EU countries, 48.4% - roughly half of those exports – will be phased-out by 2024/25 through policy initiatives already in place or underway. This leaves the two fluorescent lamp manufacturing facilities with a modest 20% of their previous exports remaining. Thus, the facilities are more than likely to be closed as this revenue is inadequate to maintain the high-volume production lines at the facilities.

Fluorescent lamp manufacturing is no longer 'fit for purpose' in the EU, nor globally, with the rapid transition to LED retrofit lamps and new LED luminaires. Another solution is needed in Poland and Germany, one where a government-led economic investment will facilitate the refurbishment of production lines to produce LED tubes to keep up with market developments.

4. Employment Impacts In Europe

4.1 EMPLOYMENT IMPACTS IN EUROPE

The evidence shows that while the two fluorescent lamp factories in Europe – Pila (Poland and Erlangen (Germany) – are still operating today, 80% of their export sales will be wiped out in the next two years. Thus, these production lines are already likely slated for closure, and the EU banning the export of fluorescent lamps will not change the employment situation for those facilities. In fact, job losses have already occurred in the past due to the shift from incandescent lighting to fluorescents and to the relocation of manufacturing and sourcing of tubular lamps in/from China. The Pila factory employs 3,000 people[21] and cut 264 jobs in 2013 due to the phase out of incandescent lamps[22]. Also, according to Signify Annual Reports data, Signify reported that their number of employees dedicated to the conventional market (including fluorescent, high-intensity discharge and incandescent lamps) decreased by 30% globally from 2017 to 2020.

Thus, transitioning the fluorescent lamp production lines in Poland and Germany to LEDs represents the only viable solution to maintain the European lighting manufacturing industry. This intervention represents an opportunity for new businesses to build and expand lighting markets, and to generate new jobs. These new jobs will be critical to allow the European market to be competitive against the largest LED producers in Asia. Factory conversions will stimulate the transition to higher efficiency, while also decreasing dependency on imports.

Within the lighting sector, wholesalers and distributors who supply the businesses and installers would not be negatively impacted by any export ban, as they would smoothly transition to handling LED tubes along with fluorescent tubes. Finally, transitioning to 100% LEDs at the manufacturing facilities in Poland and Germany would represent a safe alternative to fluorescent lighting that would not put any workers at risk of being exposed to mercury from broken lamps.

[21] https://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/Global/ODLI20160224_001-UPD-en_AA-PhilipsFactory-Pila-Poland-casestudy.pdf
[22] https://ekonomia24.pl/artykul/706160,974944.html

5. Converting European Fluorescent Factories to LED Retrofit Lamps

5.1 CONVERTING EUROPEAN FLUORESCENT FACTORIES TO LED RETROFIT LAMPS

5.2 OVERVIEW OF LINEAR FLUORESCENT TUBES

Linear fluorescent tubes were first commercialised in the 1930s. They are low pressure gas discharge lamps: passing electricity through mercury vapour contained within a glass tube filled with a low pressure inert gas. The mercury vapour produces invisible UV light when 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 1 below.

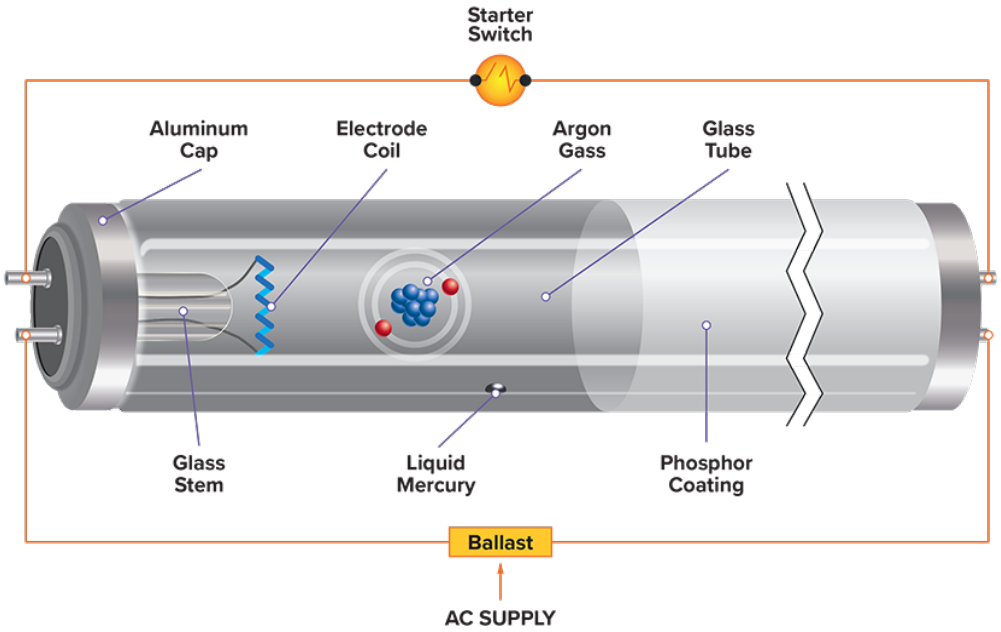


FIGURE 3. CUT-AWAY VIEW OF A FLUORESCENT LAMP AND PARTS NECESSARY FOR OPERATION

The manufacturing process has been refined over the years, but is essentially a glass tube internally coated with phosphor. Each end of the tube is sealed, with an electrical connection sealed into to it, carrying a filament wire called a cathode which is coated with a chemical emitter to help start the discharge in the lamp. Finally, a cap is fitted to provide the electrical connection. Fluorescent tubes require a ballast to control the electric discharge and a starter to produce a high enough voltage to start them.

The manufacturing process uses glass tubes of typically 3 different diameters 16mm (T5), 26mm (T8) & 38mm (T12). They are first coated internally with phosphor that is baked on, the ends are then sealed with the stem mounts which have an exhaust tube through which the tube is filled with inert gas (for example, Argon) before finally sealing the lamp. Finally, 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.

5.3 LED LINEAR TUBE REPLACEMENTS.

LED retrofits designed to replace the traditional fluorescent tubes are now commonly available and use the same glass tube construction as fluorescent lamps. However, the LED retrofit lamps are constructed with a strip of LED chips on a printed circuit board inserted in the tube. The LED retrofit tubes do not have to be filled with an inert gas but it is still possible with a glass tube construction and is the way forward for a new generation of LED tubes for thermal management and protection from the atmosphere to achieve a higher efficacy reliable product with a long service life. LED tubes require an electronic driver; this is usually contained within the tube though it can also be remotely installed.

LED tubes do not contain hazardous materials, they save energy (and thus CO_2 emissions) and their service life is typically 2-3 times longer than Fluorescent. They are twice as efficient partly due to the much better efficacy and partly due to the more directional output.

Linear Fluorescent tubes are being phased out in Europe in favour of these more efficient and less hazardous LED options. The rest of the world is following Europe's lead, linear fluorescent will no longer be viable and will be replaced with more efficient LED tubes.

5.4 CAN LINEAR FLUORESCENT PRODUCTION BE CONVERTED TO LED?

Some aspects of the production process can be converted, but with the readily availability of LED tubes from low-cost countries in Asia it is not economically viable to convert the complex lines in the EU without financial support from governments on a strategic level. Linear Fluorescent production lines are highly automated and high speed, they involve rotating high vacuum valve plate technology along with automated glass sealing. These well-developed high technology lines need skills and expertise to run them.

- Aspects of existing automated production that could be converted are as follows, allowing for a sealed in glass tube construction if wanted in future:*
    - Tube coating, to create a light diffusing layer inside the tube.
    - Tube glass sealing* with two stem mounts one carrying the electrical connections
    - Inert glass filling*, that is evacuation of the tube and filling with an inert gas.
    - End cap/base mounting with G13 or G5 caps
- Additional automated processes will be needed: -
    - Mounting of the LED on a linear PCB
    - Production & mounting of the electronic driver (note: surface mounting technology for fluorescent ballasts could be adapted to make the LED drivers)
    - Insertion of the assembly into the tube

The two linear fluorescent plants based in Europe could be opportunities for the manufacture of LED tubes through some conversion of the lines. Strategically, the EU should maintain production capability to avoid losing the engineering expertise and to maintain local employment. Also, local production avoids long supply chains, mitigating the associated lead-times and carbon cost in shipping goods across the world. European production will have to be more highly automated to be competitive with Asia. This means the additional processes will all need to be automated. Effectively new production lines will be needed using some aspects of the old ones, and assuming the LED chips are sourced the cost of conversion is likely to be in the region of €15 to €30 million per plant. European engineering expertise will be crucial and will be enhanced in the development process. As well as maintaining jobs and because there is more complexity in the LED supply chain this will also result in more indirect employment.

Assuming sealed-in glass construction does become more common in future, then existing plant and expertise in the old fluorescent lines will have a further competitive edge over current more basic construction techniques.

However, without the support of government finance, conversion will not happen; skills and employment will be lost to Asia and there will be long supply chains with high carbon costs. Once Europe loses capability, there are also other risks in terms of price and delivery times, with susceptibility to exchange rate fluctuations and reliance on third party supply. Political factors could also play a part and limit supply options.

The demand for LED tubes is expected to increase significantly over the next 3 years given the regulatory changes in the EU and its major export markets to ban fluorescent tubes on energy and hazardous mercury grounds. Maintaining local production will help protect supplies and control pricing. While there is enough global capacity to supply growing LED markets, the EU should ensure participation in this new era of market competition.

6. Conclusions and Recommendations

6.1 CONCLUSIONS AND RECOMMENDATIONS

Transitioning to LED lighting is imperative to achieve global net zero targets. According to IEA Net Zero by 2050's Roadmap for the Global Energy Sector[23], the share of LED lamps in total lightbulb sales needs to reach 100% by 2025 in all regions to meet the zero net goal by 2050. In addition, by phasing out fluorescent technology in favour of LED, the EU will be demonstrating leadership on eliminating toxic mercury from the environment. To help meet these two critical targets, the EU could invest to support the rapid conversion of this remaining fluorescent tube manufacturing to LED.

According to a Signify (formerly Philips Lighting) Executive, "LED lighting is one of the quickest renovations that dramatically cuts carbon - it does not require large capital investments and has a short payback time[24]." The transition to LED lighting is well underway and has been for over a decade globally, and regrettably, two manufacturing facilities in the EU have not yet been upgraded to transition their output from the old 1930's fluorescent technology to LED.

This conversion from fluorescent lamps to LED at the Pila, Poland facility and the Erlangen, Germany facility represents an investment that is fully in line with the EU Taxonomy for Sustainable Activities. The economic activities for climate change mitigation include manufacture of energy efficiency equipment for buildings, and Activity 3.5, Manufacturing, of the Taxonomy Compass[25] covers, among others, "light sources rated in the highest two populated classes of energy efficiency in accordance with Regulation (EU) 2017/1369 and delegated acts adopted under that Regulation."

Large lighting manufacturing companies (both Sylvania and Signify[26]) fall under the scope of the Non-Financial Reporting Directive (NFRD) Directive 2014/95/EU and of the proposed Corporate Sustainability Reporting (CSRD)[27]. They are therefore required to report and disclose their non-financial and diversity information, including Taxonomy-aligned activities to guide informed investment decisions. If companies producing fluorescents planned to transition to 100% LEDs by 2025, they would therefore benefit from aligning with taxonomy activities by attracting investors who are increasingly interested in making a positive environmental impact.

Transitioning these two linear fluorescent lamp factories to LED production is in line with the EU Taxonomy for Sustainable Activities and could be supported under that framework. It is also an opportunity for new businesses to build and expand lighting markets, and to generate new jobs, as discussed in Section 5. These new jobs will be critical to enabling the European market to be competitive against the largest LED producers in Asia. Factory conversions will stimulate the transition to higher efficiency, while also decreasing dependency on imports.

We estimate that the investment of between €30-60 million Euros in these two facilities in Poland and Germany would position them for long-term sustainability, competitively supplying billions of Euros of LED tubes to the EU-27 and countries abroad for years to come.

[23] Net Zero by 2050 Report; the International Energy Agency, Paris, France. October 2021.
Link: https://www.iea.org/reports/net-zero-by-2050
[24] https://www.signify.com/en-gb/our-company/news/press-releases/2021/20211104-signify-calls-on-world-leaders-to-accelerate-transition-to-energy-efficient-connected-led-lighting
[25] For more information https://ec.europa.eu/sustainable-finance-taxonomy/ and spreadsheet downloadable here: https://ec.europa.eu/sustainable-finance-taxonomy/documents/taxonomy.xlsx last consulted on Feb 10th 2022.
[26] For criteria, please see: https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_1806
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