23 December 2022

Information from Japan Lighting Manufacturers Association (JLMA) about Fluorescent Lamps (FLs)

Summary

1 . About LFLs luminaires

The IEC safety standard (IEC 62776) has been published for LED lamps, but as retrofit lamps may have safety implications even if they satisfy this standard, the IEC Technical Report "DESIGN AND APPLICATION OF LED RETROFIT LAMPS" provides designers and manufacturers with safety requirements to be considered, as well as the original lamps in use. An IEC Technical Report entitled "DESIGN AND APPLICATION OF LED RETROFIT LAMPS" will be published in the first half of 2023 to provide guidance on the responsibility for managing compliance in all applications. The safety assessment of the luminaire with LED retrofit lamps installed will also be required, which will require combination testing and is likely to result in a much lower compliance rate for the replacement of current LED retrofit lamps with conventional LFLs luminaires than previously assumed.

Integrated LED luminaires, rather than LED retrofit lamps, are now the mainstream replacement for LFLs. Integrated LED luminaires can reduce power consumption by up to 30% compared to replacing LED retrofit lamps, and the price difference between integrated LED luminaires and LED retrofit lamps is becoming almost negligible.

In Japan, 98% of luminaires sold in 2018 were already LEDs, and the replacement of installed LFLs luminaires is expected to be completed around 2030. The Japan Lighting Manufacturers Association (JLMA) is currently examining how far in advance the production of LFLs can be discontinued by increasing the supply of LED lighting fixtures and securing LFLs stock.

In addition, an estimate of the time required to replace LFLs luminaires was made for the global market as a whole, given the quantity of installed LFLs luminaires and the production capacity of the replacement product, the integrated LED luminaire. (attached as Annex 1). As the estimated time required for replacement was around 10 years, information on the results of this calculation is also provided.

2 . About CFL-ni luminaires

CFL-ni has a product range of over 80 varieties, but only some varieties of LED retrofit lamps are compatible; for CFL-ni, substitution with integrated LED luminaires rather than LED retrofit lamps is more realistic.

According to estimates by the Japan Lighting Manufacturers Association (JLMA), the time required for replacement worldwide is 8.6 years, which is about three years longer than for LFLs. Information on the results of this calculation will also be provided. (Annex 1)

Submission from Japan on mercury-added products using mercury or mercury compounds
We would like to share information on products on mercury-added products to be discussed at COP5.

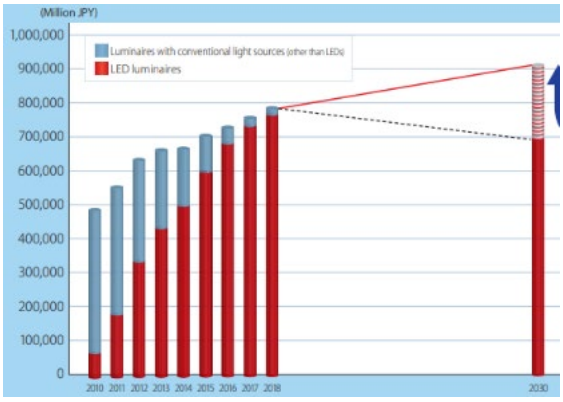
<table>
<tr><td colspan="2">Mercury-containing linear fluorescent lamps (LFLs)</td></tr>
<tr><td>Description:</td><td>Straight tube fluorescent lamps (LFLs luminaires), used for general lighting</td></tr>
<tr><td>Alternative:</td><td>Replacement of LFLs luminaires with integrated LED luminaires
Partial replacement of LFLs with LED retrofit lamps</td></tr>
<tr><td>Availability:</td><td>1. current status of LED lighting
In Japan, 98% of luminaires sold in 2018 will be LED lighting. *1 (Figure 1)
In the global market as a whole, 76.5% of luminaires sold in 2021 will already be LED fixtures. *2
LFLs are not intended for new fixtures, but mainly for maintenance applications for already installed LFLs fixtures. Regarding replacement products for LFLs, there are still technical problems common to the global market, as described below, regarding the replacement of LFLs with LED retrofit lamps. As for the replacement of LFLs with LED retrofit lamps, there are still technical problems common to the global market, as described below. Triband phosphor LFLs can be used as an alternative product to halo-phosphate phosphor LFLs, but there are still technical problems in the world market as described below.
Halo-phosphate phosphor types have a large price difference and are used differently in offices, where high colour rendering performance is required, and in parking lots, where colour rendering performance is not required, so the prior elimination of Halophosphate phosphor LFL only is problematic in terms of economic viability. In addition, although the energy efficiency of Triband phosphor type LFLs is good, replacing Halophosphate phosphor LFLs with Triband phosphor LFLs only brightens the light but does not reduce power consumption, so energy-saving effects cannot be expected.
Therefore, it is nowadays not the case that LFLs are replaced by LED retrofit lamps, but that the LFLs luminaires themselves are replaced by integrated LED luminaires of the same shape. (Figure 2)
 

Figure 1: LED adoption rate in the Japanese market LFLs luminaires Integrated LED luminaires (sales basis)
 

Fig. 2 LFLs luminaires and integrated LED luminaires</td></tr>
</table>

	2.2 Advantages and disadvantages of LED retrofit lamps and integrated LED luminaires. There are two methods of replacing lighting installations using LFLs luminaires: replacing them with LED retrofit lamps or replacing the luminaires with integrated LED luminaires. The advantages and disadvantages of each method are presented. 1) Replacement of LFLs luminaires with LED retrofit lamps. ● Advantages. Replacement with LED retrofit lamps, which have the same shape as LFLs, is characterized by the fact that they can be used simply by replacing conventional lamps (not recommended in Japan for safety reasons). It also has energy-saving effects. ● Disadvantages. The IEC has issued a safety standard (IEC 62776) for LED lamps, but as retrofit LED retrofit lamps may have safety implications even if this standard is satisfied, an IEC Technical Report "DESIGN AND APPLICATION OF LED RETROFIT LAMPS" was published in the first half of 2023 to guide designers and manufacturers on the safety requirements to be considered and their responsibility to control the suitability of the original lamps for all applications in which they were used. An IEC Technical Report entitled "DESIGN AND APPLICATION OF LED RETROFIT LAMPS" will be published in the first half of 2023 to provide guidance to designers and manufacturers on the safety requirements to be considered and their responsibility to control compliance in all applications in which the original lamps were used. As it will also require a safety assessment of the luminaire when LED retrofit lamps are installed, a combination test will be required, which is likely to significantly reduce the compliance rate for the replacement of current LED retrofit lamps with LFLs, except for those sold by major European manufacturers for their own luminaires. Highly likely. (2) Replacement of LFLs luminaires with integrated LED luminaires. ● Advantages. By replacing LFLs luminaires with integrated LED luminaires, it is possible to support large-scale lighting control systems and dimming control, which are not possible with LED retrofit lamps. In addition, power consumption can be reduced by approximately 30% compared to LED retrofit lamps. If dimming control is used, power consumption can be expected to be reduced by more than 50%. Integrated LED luminaires have become mainstream in recent years and there is little cost difference between them and LFLs luminaires due to the mass production effect. There are also no safety concerns. ● Disadvantages. For replacement, installation work is necessary and requires construction costs. Therefore, planned changes are necessary in line with the life of the fixtures. 3. the period of time required to switch to LED lighting. The period required to switch to LED lighting can be estimated from the number of currently installed, LFLs luminaires and the production of LEDs for replacement. Using the number of installed fixtures currently set up worldwide and production volume data for LED lighting, the timeframe required to switch to LED lighting was estimated. (Appendix 1) 1) Conversion of all LFLs luminaires to LED retrofits: 12.5 Year 2) Replacement of all LFLs luminaires with integrated LED luminaires: 7.5 Year

Technical and economic feasibility:

1. technical feasibility

1) Alternative to LED retrofit lamps

There are reports of compliance rates of over 90% when replacing LFLs with LED retrofit lamps, but these are compliance rates when LED retrofit lamps sold by nine major European companies are used to replace their own LFLs luminaires in fixtures from nine major European companies, and not for all LFLs luminaires. These are not the compliance rates for all LFLs luminaires.

The compliance rates of LED retrofit lamps for LFLs luminaires by world region are reported by the Global lighting association, an association of lighting industry associations worldwide.[*3]

Region	Electrical compatibility status of LED plug-and-play lamps for installed fixtures and applications
Europe[4]	50%
USA	10-50 %
Brazil	< 10 %
India	nearly 0%
China	30-50 %
Japan	< 10 %
Africa	unclear
Rest of Asia	unclear

Table 1: Suitability rates for replacing LFLs with LED retrofit lamps in different regions of the world.

In Europe, the conformity rate is around 50%, but in other regions the conformity rate is still low due to the large number of LFLs fixture manufacturers.

LED retrofit lamps cannot be used in emergency lighting fixtures because the lamps that can be fitted are specified and approved in each country. Some aircraft, trains, etc., which have already been manufactured, require heat resistance, fire resistance, earthquake resistance and conformity approval tests, making it difficult to replace not only LED retrofit lamps but also integrated LED luminaires.

In order to allow countries to manufacture, import and export LFLs that cannot be replaced by these substitutes according to their circumstances, the pillar text of the Annex, (c) switches and relays, cold cathode fluorescent lamps (CCFL) and external electrode fluorescent lamps for electronic displays in cases where they cannot be replaced by a feasible mercury-free alternative product Lamps (EEFLs) and measuring instruments, with the addition of LFLs or the consideration that LFLs used in emergency lighting fixtures and used aircraft and trains are not subject to prohibition by organising that they are not general lighting.

2) Replacement with integrated LED luminaires.

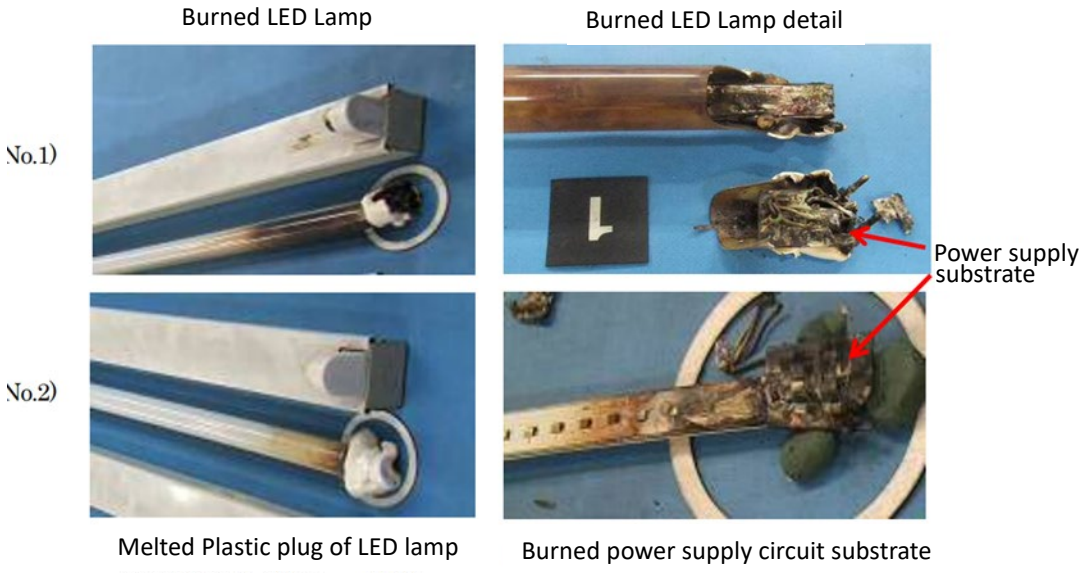
It is already widely distributed and there are no technical challenges, except for special applications such as for used aircraft.

2. economic feasibility

1) Alternative to LED retrofit lamps.

・Economic viability: payback period 2.3 years.

・Calculation conditions

	Overall power consumption of LFLs 2-lamp type luminaires (including power consumption of lighting circuits) 95 W LED retrofit lamps Power consumption 36 W, lamp cost 80 $ (for 2 lamps) Electricity cost 1 kWh = 0.2 $, 3000 hours of lighting per year. 2) Replacement with LED-integrated luminaires. ・Economic viability: payback period: 3.1 years (including replacement works) 2.4 years (not including replacement works) ・Calculation conditions Overall power consumption of LFLs 2-lamp type luminaires (including power consumption of lighting circuits) 95 W Integrated LED luminaire, power consumption 25W, fixture cost 100$, replacement cost 30$. Payback period: 3.1 years (including replacement works) 2.4 years (not including replacement works) Electricity cost 1 kWh = 0.2 $, 3000 hours of lighting per year.
Risks and benefits:	1.LED retrofit lamps 1) Risks. LED retrofit lamps have a specific lighting circuit that can be used for each model, and there is a risk of fire if they are installed incorrectly. As there are dozens of different lighting circuits and they can be physically installed in incompatible fixtures, there have been many cases of misuse, for example, more than 160 fires have occurred in Japan in the five years since 2011. In addition, even when LED retrofit lamps are installed in the circuits recommended by the LED retrofit lamp manufacturers, radio noise and other factors may exceed the standards depending on the combination, and there have been cases where medical devices have been affected. The following are examples of LED retrofit lamps that have caught fire. (Figure 3)  Figure 3: Example of LED retrofit lamp fire incident There have also been cases where the lighting circuits of luminaires have caught fire due to LED retrofit lamp installation. (Fig. 4) If the lighting circuit of an LFLs luminaire fails, multiple layers of

safety designs are employed, such as a thermal fuse that blows or does not turn on. (Fig. 4) However, when LED retrofit lamps are used that were not envisaged at the time of design, these safety designs do not work and cases of luminaires catching fire have occurred.
In Japan, when LED retrofit lamps are used through ageing ballasts for LFLs, the ballasts are to be removed in principle, as this encourages accidents of ballast instability at the end of their life (e.g. fire accidents due to current leakage and short circuits caused by insulation degradation).
Production is limited due to a shortage of semiconductors, etc., and replacement may take longer than expected.

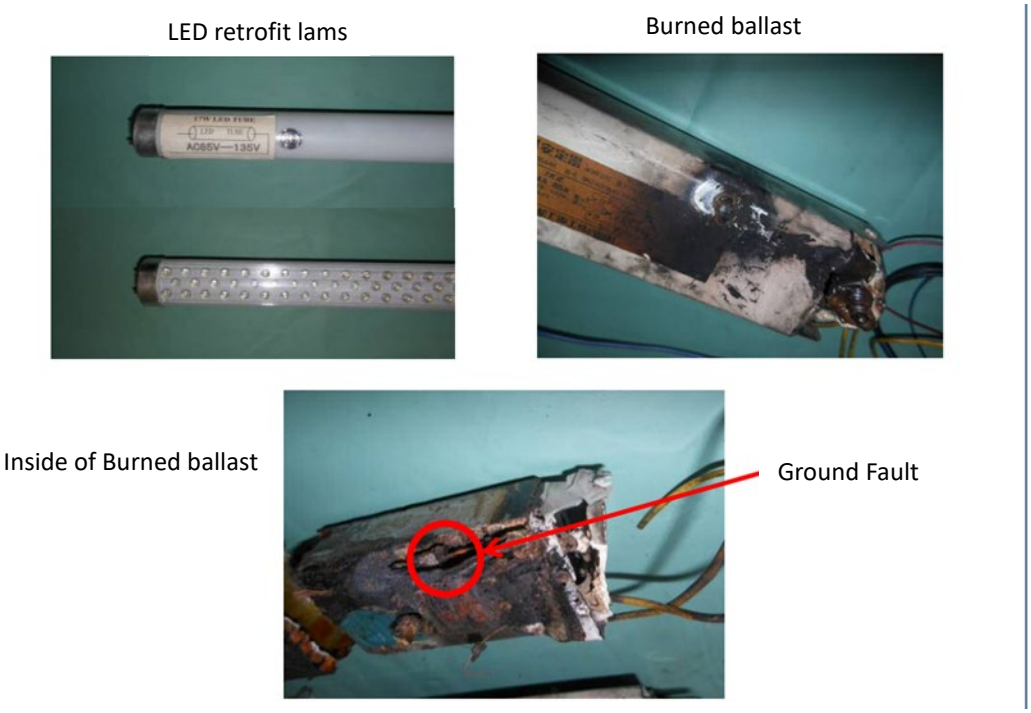


Figure 4: Example of a fire on the luminaire side

2) BENEFITS:
Ease of replacement; superior energy-saving performance compared to LFLs luminaires.

2. integrated LED luminaires:.
1) Risks:.
The fixtures have been adequately tested on their own and pose no safety risk. Production is limited due to a shortage of semiconductors and other factors, and it may take longer than expected to replace installed fixtures.
2) BENEFITS:.
Power consumption is 26% of that of a 40 W LFLs luminaire, which has a significant effect on global warming prevention; can be operated with 70% less power consumption than LED retrofit lamps; can be operated with less than 50% of LED retrofit lamps in the case of a lighting control system combined with a motion sensor or brightness sensor. In the case of a lighting control system combined with a motion sensor or brightness sensor, it can be operated with less than 50% of the power consumption of LED retrofit lamps.

	1.Japan Lighting Manufactures Association LIGHTING VISION 2030: https://www.jlma.or.jp/about/vision/pdf/LV2030_webEM.pdf 2. LEDS AND THE WORLDWIDE MARKET FOR CONNECTED LIGHTING CSIL/Nov 2022 3.Position Statement on the Phasing-out of Fluorescent Lamps: https://www.globallightingassociation.org/library

Mercury-containing CFL-ni	
Description:	Used for general lighting, CFL-ni
Alternative:	Integrated LED luminaires with the same shape as the CFL-ni luminaires
Availability:	1. current status of LED lighting In Japan, 98% of luminaires sold in 2018 will be LED luminaires. [*1] Also in the global market as a whole, 76.5% of luminaires sold in 2021 will already be LED fixtures. [*2] CFL-ni is not intended for new fixtures, but mainly for maintenance applications for already installed CFL-ni fixtures.  Fig. 6 Integrated LED luminaires with similar geometry to CFL-ni luminaires 2. advantages and disadvantages of LED retrofit lamps and integrated LED luminaires 1) Replacement of CFL-ni with CFL-ni LED retrofit lamps. ● Advantages: replacement for LED retrofit lamps with the same shape as CFL-ni. Characterised by the fact that they can be used simply by replacing conventional CFL-ni. Also has an energy-saving effect. ● Disadvantages: survey of sales of LED retrofit lamps for CFL-ni shows that few are available, so it is practically impossible to replace them with LED retrofit lamps. 2) Replacement of CFL-ni luminaires with integrated LED luminaires. Advantages: when integrated LED luminaires are used as a replacement for CFL-ni lamps, power consumption can be further reduced by approximately 30% compared to LED retrofit

	lamps. Furthermore, by using a lighting control system combined with dimming control, etc., a reduction in power consumption of more than 50% can be expected. ● Disadvantages: installation work is required for replacement, which adds to construction costs. Therefore, planned changes are necessary in line with the life of the equipment. 3. the period of time required to switch to LED lighting (Annex 1). 1) Replacement of CFL-ni with LED retrofit lamps. Only a small number of LED retrofit lamps can be supplied and supply capacity is almost non-existent. 2) Replacement of CFL-ni luminaires with integrated LED luminaires: 8.6 years.
Technical and economic feasibility:	1. technical feasibility 1) Alternative to LED retrofit lamps. Compliance rate for CFL-ni luminaires is less than 10% Compliance rate is low because there are more than 80 varieties of CFL-ni in Japan alone. 2) Replacement with integrated LED luminaires. It is already widely distributed and there are no technical challenges. 2. economic feasibility 1) Alternative to LED retrofit lamps. Many varieties are not marketed except for the main varieties due to the high number of varieties and the cost of development. 2) Replacement with integrated LED luminaires. Most of the fixtures on the market today are integrated LED luminaires, which have already been replaced The following are some of the reasons why the fixture should be replaced. If replacement is required at the end of the life of the fixture, the cost of purchasing and installing the fixture and reducing the electricity bill The reduction effect needs to be taken into account. The lifetime of the fixtures is around 10 years.
Risks and benefits:	1. LED retrofit lamps for CFL-ni:. 1) Risks:. LED retrofit lamps other than the main varieties are likely not to be developed from an economic point of view. Production is limited due to a shortage of semiconductors and other factors, and replacement may take longer than expected. Ex. 2) BENEFITS: Ease of replacement. Also has energy-saving effects. 2. integrated LED luminaires:. 1) Risks:. Currently, production is already limited due to a shortage of semiconductors and other factors, making it difficult to further increase production capacity. It may take longer than expected to replace installed equipment. 2) BENEFITS:.

	Compared to CFL-ni luminaires, they consume 40% less power and contribute to the prevention of global warming. The power consumption can be further reduced in the case of lighting control systems combined with motion sensors and brightness sensors. In order to prevent global warming, it is desirable to promote the use of LEDs and to promote energy saving through more advanced lighting control systems.
	1.Japan Lighting Manufactures Association LIGHTING VISION 2030: https://www.jlma.or.jp/about/vision/pdf/LV2030_webEM.pdf 2. LEDS AND THE WORLDWIDE MARKET FOR CONNECTED LIGHTING CSIL/Nov 2022

Annex 1.

Estimation of the duration required to convert existing fluorescent lighting fixtures to LED lighting using 2020 global total market data

1. Objective.

The Minamata Convention on the Prohibition of the Manufacture of Lamps, etc., is being discussed. The time required to convert all existing fluorescent lighting fixtures to LED lighting was estimated.
The percentage numerical values used for the estimation were based on statistical numerical value for the Japanese market, which is the most LED-intensive market.

2.Estimation of the duration required

Global market data for existing luminaires and LED production in 2020*1)

Stock of existing lighting fixtures	16 billion (A)
Sales of LED luminaires	1.8 billion (B)
Sales volume of LED lamps	2.8 billion (C)

*Sales volumes of LED luminaires and LED lamps may be subject to capacity expansion in the future, but it is difficult to predict changes in production volumes.
The calculations use actual data for 2020, as it is difficult to forecast changes in production volumes.

2-1 Duration required for LFL replacement

All existing luminaires installed	16 billion (A)
LFL fluorescent lamp fixtures	5.1 billion

(Assuming 32% of installed fixtures are LFLs luminaires)

(i) Duration required to replace LFLs with LED retrofit lams

Quantity of LED lamps sold	2.8 billion (C)
Quantity of LED retrofit lamps	0.62 billion

(Assuming 22% of LED lamps manufactured are LFL types, all of which are LFL replacements)

*Number of LFLs used per luminaire (assuming 1.5)
Quantity of LED retrofit lamps required for replacement is 7.7 billion
(5.1 billion x 1.5 = 7.7 billion)

Duration required to replace LED lighting is 7.7 billion ÷ 0.62 billion/year = 12.4 years

(ii) Duration required to replace LFL luminaires with integrated LED luminaires

All existing luminaires installed	16 billion (A)
LFL luminaires	5.1 billion

(Assuming 32% of installed fixtures are LFLs luminaires)

LED luminaires	1.8 billion (B)
LFL-type integrated LED luminaires	0.68 billion

(38% of integrated LED luminaires manufactured are LFL luminaires, all of which are assumed to be replacements)

Duration required to replace LED lighting is 5.1 billion ÷ 0.68 billion/Year = 7.5 years

2-2 Duration required of CFL-ni replacement.

(i) Estimate for replacing CFL-ni with LED retrofit lamps
There are many types of CFL-ni, about 80 varieties, of which CFL-ni are sold.
Only about 10% of the varieties are available, so there are no substitutes, making calculations impossible.

(ii) Estimate for replacing CFL-ni luminaires with integrated LED luminaires

All existing luminaires installed 16 billion (A)
CFL-ni luminaires 4.3 billion
(Assuming 27% of installed luminaires are CFL-ni luminaires)

LED luminaires sold 1.8 billion (B)
CFL-ni type LED luminaires 0.50 billion
(Assuming 28% of all integrated LED luminaires manufactured are CFL-ni luminaires, all of which are replacements)

Duration required to replace LED lighting is 4.3 billion ÷ 0.50 billion/year = 8.6 years

*1) LEDs and the worldwide market for connected lighting 2021 CSIL
https://www.csilmilano.com/