

Task 50

Bypassing Barriers to Lighting Retrofit: Is Solid State Lighting Already Changing the Game?

In comparison with a lighting solution using fluorescent sources, Solid State Lighting (LED) comes with different technical, operational (maintenance) and economical parameters. Work within IEA SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings studied the impact of these fast changing parameters on lighting retrofits – intending to give sound advice to decision makers.

A large fraction of existing lighting installations is more than 10 years old, and often there is no plan to retrofit them before the end of life or for a major refurbishment of the indoor environment (ceilings, floors and wall finishes). Experts in IEA SHC Task 50 working in Subtask A: Market and Policies have investigated possible opportunities for lighting retrofits to benefit, as early as possible, from new and highly energy efficient lighting installations.

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The good news is that with the reduction in LED costs, Solid State Lighting options become more and more attractive as there is not only a possible gain in energy efficiency by improved system efficiency, but also a possibility to reduce maintenance.

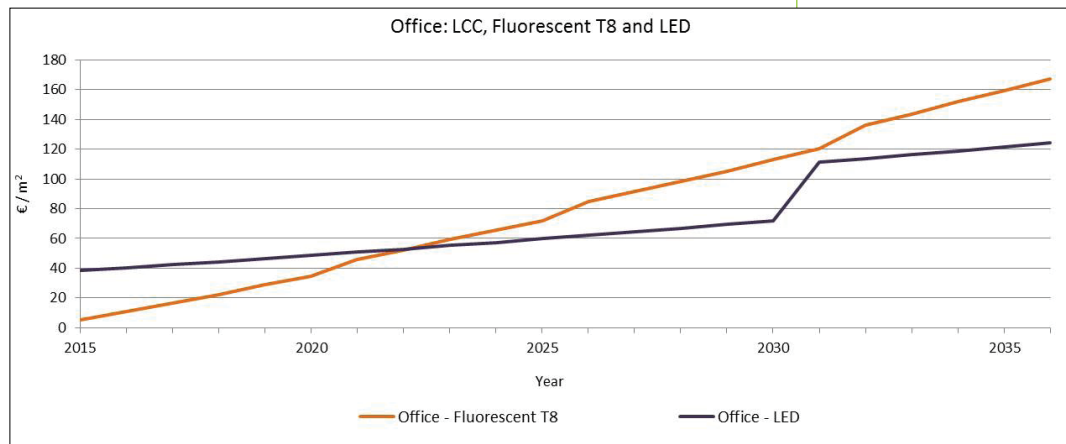
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Lighting from page 4

There are some "low hanging fruits," which are existing installations with poor efficiency and no plan for retrofit in the short term. In some cases, the return on investment is under 2 years when counting only the benefits on electricity consumption. However, in many cases, the return on investment is in the range of 3-6 years, which is usually considered too long to motivate investors. Information from stakeholders was gathered to identify on which terms and under which conditions they would be interested in accelerating retrofitting operations.

These stakeholders are: owners, tenants, facility managers, contractors (and installers), local authorities, industry sellers, design consultants, users, broker agencies, financial groups, and energy service companies (ESCOs). Some of these stakeholders are interested in:

- low investment costs,
- reduction of installation time,
- reduction of maintenance,
- extended guarantees on products,
- reduction of electricity use,
- optimization of product life, or
- opportunities for radical change of appearance of the space.



We see that a gain on energy efficiency is only one parameter among others. The good news is that with the reduction in LED costs, Solid State Lighting options become more and more attractive as there is not only a possible gain in energy efficiency by improved system efficiency, but also a possibility to reduce maintenance.

Life Cycle Cost Approach: Shifting Cost Shares

Assessing Life Cycle Costs (LCC) of lighting installations shows that the share of costs due to electricity is typically half of the total LCC value (in areas where costs of electricity are rather high, above 0.15/ KWh). Investment is more than a quarter of the total cost, and installation less than half the investment (see Figure 1). The LCC is therefore very sensitive to the evolution of electricity costs. In the next 10 years, it is anticipated that the combination of increases in energy efficiency and reduction of equipment costs will stabilize these costs, but major gains will be achieved in the reduction of maintenance.

Figure 2 shows the comparison of the evolution of cumulated costs in €/m² of a classical fluorescent installation and a LED installation. Benefits in costs due to improved energy efficiency lead to a reduction of the general slope. LED based lighting does not require changing the light sources every 15,000 hours as is the case with fluorescent sources. But the whole luminaire has to be changed after 40,000 hours. It is expected that the reinvestment in LED-based lighting at the end of life will in fact be lower due to a significant cost reduction of this technology over the next 15 years. The graph shows that the operation of LED lighting requires no maintenance over the life of the products, except cleaning. However, to obtain significant benefits, it is important that the initial costs of SSL are not much higher than that of fluorescent systems.

▲ **Figure 1. Evolution of cumulated costs over time, for classical fluorescent installation and new LED product.**

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Low hanging fruits

It was found that the return on investment is easier and faster on installations with high annual operating times, for example in factories where lights are on a large fraction of the time (more than 5,000 hrs/yr). Here, fluorescent tubes must be changed every two years, and SSL every 5 years.

Furthermore, in factories with dirty environments it is suggested to replace equipment every 10-15 years, which is in line with the life span of SSL products.

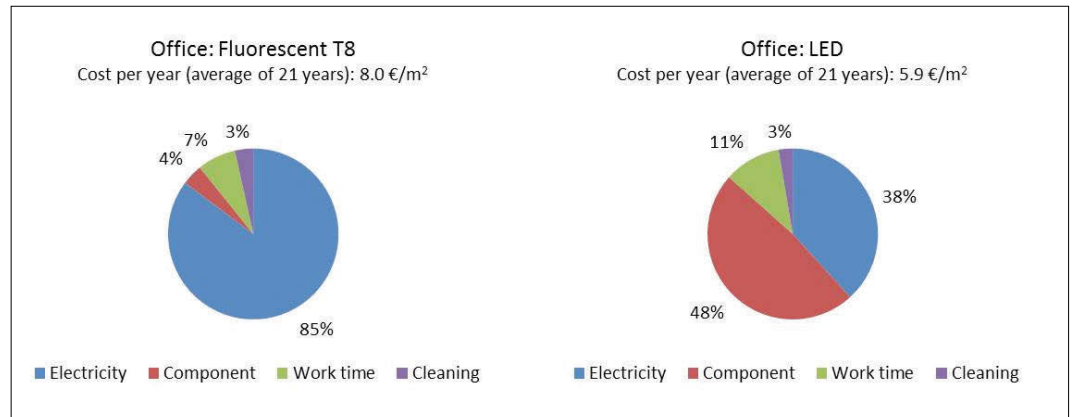
To the contrary, in buildings such as schools, light is used more often for shorter periods, typically summing up to around 1,000 hrs/yr, suggesting that fluorescent tubes should be changed every 15 years, and SSL every 40 years. Here, the retrofit should clearly focus on possible savings in simplification of maintenance and improvement of lighting quality.

To account for differences as those explained above, typical approaches for four main building categories were investigated: industrial buildings, office buildings, school buildings and department stores. In Figure 3 typical old and new lighting systems are compared.

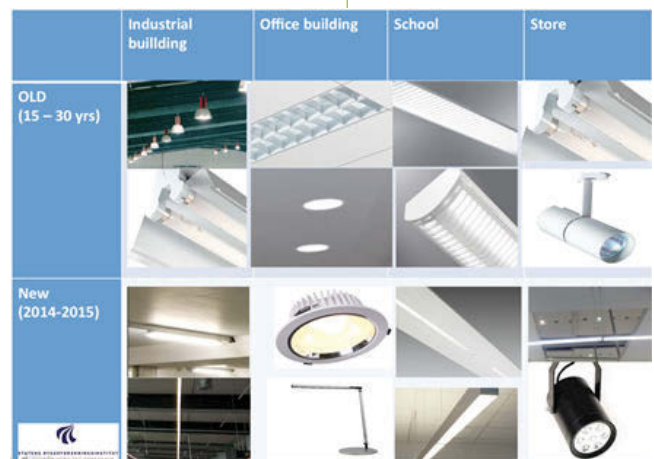
Lighting retrofit and replacement of other building equipment

Development of cost models demonstrates that accelerating retrofit operations makes sense mainly for low hanging fruits; “accelerating” meaning to conduct retrofit earlier than at the end of product’s life. However, often it is wise to wait for a major general retrofit (ceiling replacement, painting) since it could benefit from a possible upgrade in the electrical architecture. Hence the importance during field assessment is to identify possible times for a general retrofit of indoor spaces. Lighting, as any other technical equipment (heating, ventilation, plumbing, etc.) has its own life. But, the evolution of products and reduction of prices should lead to higher replacement rates.

This article was contributed by Marc Fontoyront of Aalborg University in Denmark and leader of IEA SHC Task 50 Subtask A: Market and Policies.



▲ **Figure 2. Life Cycle Costs of an office lighting installation using fluorescent tubes [€/m²].**



▲ **Figure 3. Typical existing ‘old’ electric lighting products found in existing buildings and highly efficient ‘new’ lighting products, mostly using LED technology.**