How to Cite
Palacios-Intriago, V. B., Rezabala-Cedeño, D. D., & Vera-Cevallos, W. L. (2024). LED lights and their impact on energy savings in a residential environment. *International Journal of Engineering and Computer Science*, *7*(1), 8-11.
https://doi.org/10.21744/ijecs.v7n1.2306

LED Lights and their Impact on Energy Savings in a Residential Environment

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Abstract---*LED lights play an essential role in saving energy in homes, the objective of the research was to study their lifespan and efficiency compared to traditional lighting. The result was that energy efficiency and reduced consumption up to its durability, has positive economic benefits, in addition, its environmental impact is lower, and it has been proven to be a comprehensive and sustainable choice for domestic lighting.*
Keywords---*energy savings, LED lights, residential environment.*

Introduction

Since ancient times, human beings have wanted to improve their environment, seeking efficient solutions to the problems that arise in the daily life of each individual. In this way, through creativity and innovation, today's society has advanced even more in terms of lighting. From the primitive fire that our ancestors made, due to the friction between two stones, to LED technology, which today is the most innovative in terms of lighting.

Among the uses that can be given to LED technology are installing them in homes, large and small public lighting, bars, restaurants, and even large stores, such as hotels, sports clubs, soccer stadiums, basketball arenas, and hospitals. , shopping centers, where energy and economic savings can be greater, in addition to collaborating with the care of the environment. Today's society is very sensitive to the environment, which is why both the government and citizens look for ways not to deteriorate it and take care of it since this is the engine of progress for society.

Fraile & Gago (2012), mentions that "the advances are due to the fact that LEDs were introduced in the 21st century and are one of the electronic elements that are enjoying the greatest development, thanks to their multiple applications and products." (pg 2.). LED lights (light-emitting diodes) have revolutionized the way we light our homes. This essay explores the impact of LED lights on energy savings in residential environments, highlighting their environmental and economic benefits.

LED lights stand out for their efficiency by minimizing heat generation, converting more energy into light, and having a long lifespan compared to traditional bulbs. This efficiency not only translates into energy savings but also contributes to sustainability and longer-lasting, more efficient lighting. The efficiency of LED lights in converting energy into light, minimizing heat generation, is one of the most notable aspects of this technology. This

ISSN 2632-945X
Submitted: 27 June 2024 |Revised: 18 July 2024 | Accepted: 09 August 2024

phenomenon derives from the unique characteristics of the electroluminescence process on which LEDs are based and has important implications in terms of energy savings and luminous performance (Aslanoğlu et al., 2021; Dikel et al., 2018; Hu, 2021; Hanák et al., 2015; Arcentales et al., 2017).

LED lights generate light through the process of electroluminescence, where electrons move through a semiconductor and, when recombined with holes, emit photons of light. This process does not involve the emission of significant heat, unlike incandescent bulbs, which generate light by heating a filament until it becomes incandescent, releasing a large amount of heat. The absence of thermal processes in LED lights directly contributes to their energy efficiency. While incandescent bulbs convert about 90% of energy into heat and only 10% into light, LED lights can reverse this relationship, converting about 90% of energy into useful light and minimizing energy loss in the form of heat.

In residential settings, where energy efficiency is crucial to reducing costs and minimizing carbon footprint, LED lights offer significant advantages. The ability of these lights to convert more energy into light means that less energy is needed to achieve the same illumination as with traditional light bulbs, resulting in substantial savings on your electricity bill.

I can say that the mass adoption of LED lights represents an effective strategy to reduce carbon emissions by improving energy efficiency, reducing electricity consumption, and promoting more sustainable practices in the use of lighting. This change not only has benefits at the individual and residential level but also contributes to the global effort to mitigate climate change and move towards a more sustainable future (Katzin et al., 2021; Chew et al., 2016; Schleich et al., 2014; Nakano et al., 2018).

Materials and Methods

A process was carried out to measure durability and useful life, LED bulbs and traditional bulbs were used, the operating hours were recorded and the operating hours of the bulbs were monitored and recorded under normal conditions after life was compared. useful of LED lights with traditional ones to demonstrate durability.

Analysis and discussion of the results

For the analysis of the useful life, a procedure was drawn up for its evaluation where the steps to follow were taken into account, these are shown in Figure 1.

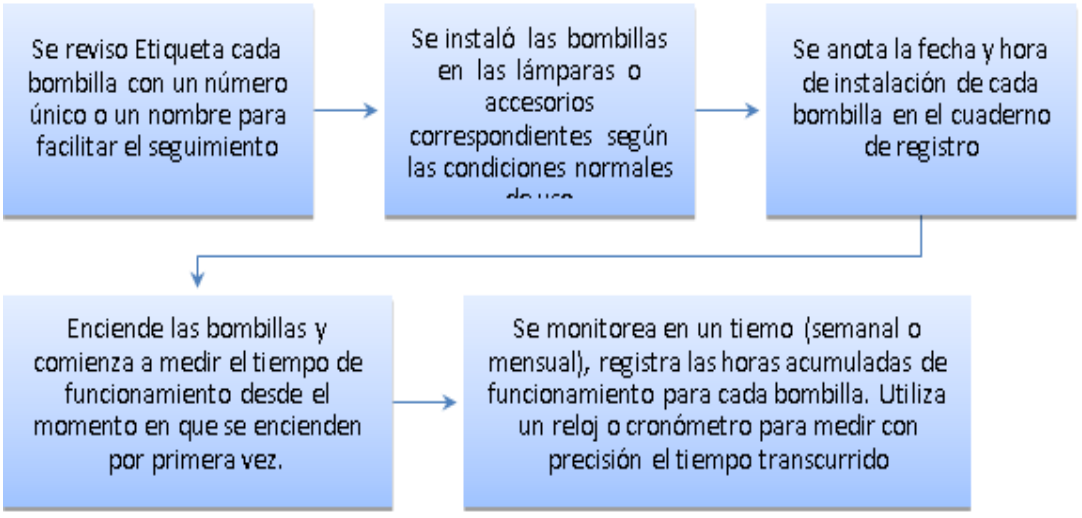

Figure 1. Monitoring process

In the study carried out, the luminaire continues to be monitored until a representative period of operation is reached, which could be several months or even a year, depending on the objectives you wish to assess. Once the monitoring period is completed, an analysis of the data recorded for each type of bulb is carried out and with this the estimated useful life in hours is calculated and any performance pattern is observed. This method provides a structured basis

for evaluating the durability and lifespan of different types of bulbs under normal use conditions, which can be valuable for decision-making in the selection of lighting technologies.

The combination of practical evaluations and data analysis provides a comprehensive understanding of the impact of LED lights on energy savings in residential environments. These methods allow energy efficiency, reduced consumption, durability, environmental impact, and economic benefits to be quantified, thus supporting the claim that LED lights are a sustainable and cost-effective choice for residential lighting.

Results and Discussions

The results obtained through practical evaluations and data analysis strongly support the idea that LED lights have a positive impact on energy savings in residential environments. From their energy efficiency to their economic and environmental benefits, LED lights are positioned as a comprehensive and sustainable option for residential lighting, providing homes with a solution that not only saves energy but also contributes to the preservation of the environment and long-term cost reduction.

The implementation of the aforementioned materials and methods provides a detailed and quantifiable understanding of the impact of the mass adoption of LED lights on the reduction of carbon emissions. Analysis of energy efficiency, residential consumption, and life cycle consistently reveals the significant contribution of LED lights to environmental sustainability. Data collected through case studies and large-scale trend analysis support the validity of these conclusions at different levels.

The energy efficiency assessment highlights the ability of LED lights to convert more energy into light and less into heat, thereby reducing emissions associated with electricity generation. Residential consumption studies provide specific insight into how the adoption of LED lights in homes leads to tangible savings in energy consumption, supporting the conclusion that this technological change has a direct impact on reducing carbon emissions. Life cycle analysis highlights the importance of considering not only the daily use of lights but also their manufacturing, transportation, and final disposal. LED lights show significant advantages in this regard, contributing to a lower carbon footprint throughout their useful life.

Residential case studies and large-scale trend analyses provide complementary perspectives. At the individual level, the adoption of LED lights is associated with positive changes in energy consumption patterns. At a broader level, trend analyses support the hypothesis that mass adoption of LED lights contributes to widespread reductions in carbon emissions across communities and regions.

Together, these methods and materials allow us to conclude that the mass adoption of LED lights not only represents a technological advance in lighting but also an effective and scalable strategy to address the global challenge of carbon emissions. The durability and long life of LED lights not only reduce the need for replacement but also contribute to sustainability by reducing waste generation. Additionally, the environmental impact study highlighted reduced carbon emissions and mitigation of light pollution as additional benefits of adopting LED lights.

In economic terms, although the initial investment in LED lights may be higher, the total cost of ownership analysis revealed that they generate substantial savings over time. The existence of government incentive programs further reinforces the financial viability of the transition to LED lights. In conclusion, LED lights not only illuminate our homes efficiently but also emerge as an essential option for energy savings. By adopting these technologies, households not only contribute to the preservation of the environment but also experience significant savings on their electricity bills. The transition to LED lights represents a crucial step towards a more sustainable future, where energy efficiency is combined with long-lasting economic and environmental benefits (Sanchis, 2022; Heather, 2017; Khan & Abas, 2011; Ahn et al., 2014; Omer, 2015).

Conclusion

Over the course of this trial, the impact of LED lights on energy savings in residential environments was thoroughly explored. From their energy efficiency and reduced consumption to their durability, economic benefits, and positive environmental impact, LED lights have proven to be a comprehensive and sustainable choice for home lighting. The energy efficiency assessment revealed that LED lights outperform traditional sources by converting more energy into light and less into heat. The energy consumption analysis conclusively demonstrated the ability of LED lights to reduce monthly electricity costs, thus supporting their contribution to household energy savings.

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