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Proposal of a Photovoltaic System in Areas of the Technical University of Manabí

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Abstract

Solar energy has managed to establish itself as one of the most promising and sustainable alternatives when it comes to addressing the different energy challenges at a global level, especially in developing countries, which do not have a good energy system since their electricity grids can present drawbacks. Currently, in Ecuador, periodic power outages affect both residential and educational areas, making daily activities and the development of academic projects difficult. This phenomenon is very notorious in the province of Manabí, specifically in the Technical University of Manabí, which has frequent interruptions of the electricity supply, which affects its normal operation. The aim is to propose the installation of a photovoltaic system, which is responsible for transforming solar energy into electricity, thus being a sustainable solution that, in addition to helping to reduce dependence on the conventional electricity grid, would also contribute to the transition to renewable and clean energy sources. The result was that the installation of photovoltaic systems at the Technical University of Manabí is a viable solution to counteract recurrent blackouts and move towards greater energy sustainability.

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1 Introduction

In recent decades, the need to adopt sustainable energy sources has become very relevant worldwide. Photovoltaic solar energy has established itself as one of the most viable alternatives to reduce dependence on fossil fuels and mitigate the effects of climate change. According to the report of the International Renewable Energy Agency (IRENA), "solar photovoltaic energy has experienced a cost decrease of more than 80% since 2010, making it one of the most competitive technologies in the energy market" (Irena, 2020).

In this context, higher education institutions play a key role as agents of change towards sustainability. The Technical University of Manabí (UTM), committed to technological innovation and environmental preservation, has considered the implementation of photovoltaic systems for energy self-consumption as part of its institutional strategy. According to the Ministry of Energy and Non-Renewable Natural Resources of Ecuador, "energy self-consumption through renewable sources not only promotes efficiency, but also strengthens the country's energy sovereignty" (MERNNR, 2021).

This research addresses the technical, economic and environmental feasibility of the installation of photovoltaic systems in the UTM, to promote the responsible use of energy and contribute to the construction of a more sustainable university campus, taking into account some studied parameters and relevant information on solar power in the province (Rodríguez & Vázquez, 2018).

2 Materials and Methods

The research is framed within descriptive and experimental research, with a quantitative approach. It seeks to analyze the technical, economic, and environmental feasibility of the implementation of a self-consumption photovoltaic system at the Technical University of Manabí (UTM).

3 Results and Discussions

A diagnosis of the current energy consumption was carried out at the Technical University of Manabí, identifying the critical areas affected by the electrical interruptions. in addition, an assessment of the current energy consumption was carried out at the Technical University of Manabí, identifying the critical areas affected by the electrical interruptions. In Portoviejo, where the university is located, there is high potential for solar radiation. In Figure 1, a map of the province of Manabí is shown, where this potential is highlighted.

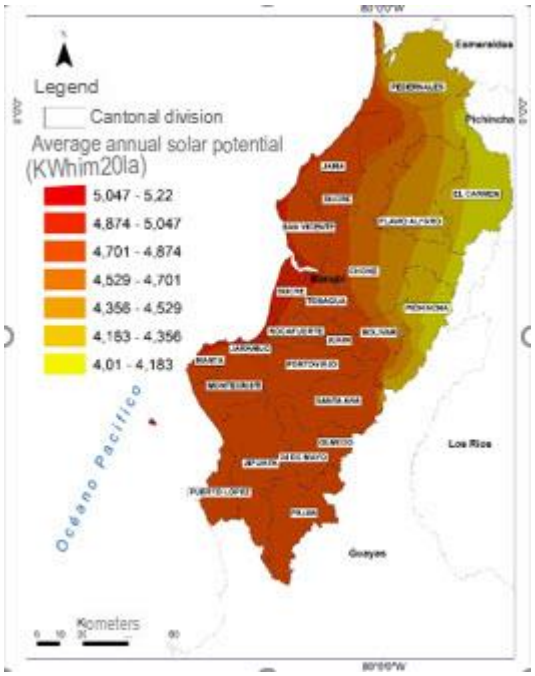

Figura 1. Mapa de potencial solar en la provincia de Manabí.
Source: (Vázquez, 2022)

In the figure you can see that the Portoviejo area has high potentials in the order of 4,674 kW/m2 per day, which shows that there are sufficient resources for the introduction of photovoltaic technology. To know the need for the system, surveys were applied to 10 people to find out their criteria about the proposal to propose the technology, in figure 2, the results are shown on whether the insertion of the technology in the UTM is positive.

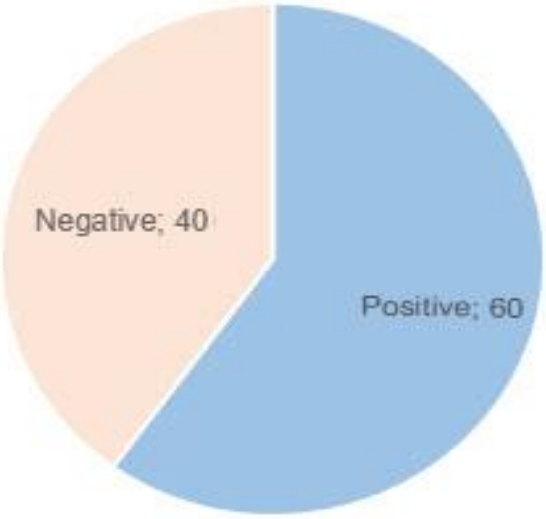

Figure 2. Criteria on whether the introduction of the technology is positive

As can be seen, most of the respondents acknowledged that it is positive to introduce technology in the UTM. The benefits expected from introducing photovoltaic systems were also considered, the results are shown in Figure 3.

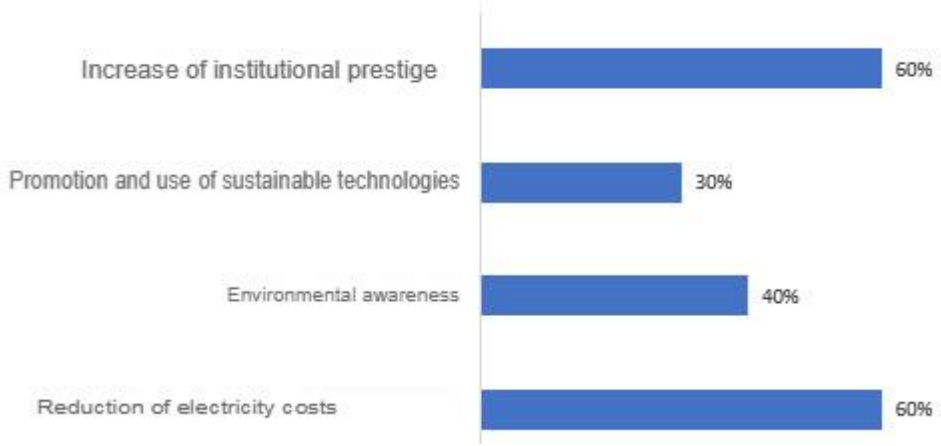

Figure 3. Benefits of introducing photovoltaic technology at UTM

Photovoltaic systems have gained prominence globally due to their multiple benefits in the economic, environmental, social, and technological fields (Luis et al., 2020), in the case of environmental awareness, users get to know the reduction of greenhouse gas emissions: By generating electricity without fossil fuels, photovoltaic systems contribute significantly to the reduction of CO_2 and other pollutants. Solar energy is inexhaustible and does not generate toxic waste during its operation low water consumption: Unlike thermal or hydroelectric power plants, photovoltaic systems require a minimum amount of water for their operation and maintenance (Kabir et al., 2018).

Savings in the electricity bill: Self-consumption allows a significant reduction in energy expenditure, which represents long-term savings for residential, commercial, and institutional users, the return on investment although initial can be high, maintenance costs are low and the system can be economically recovered in 5 to 10 years, depending on the context. There is price stability, reducing dependence on electricity tariffs that can fluctuate due to external factors (Gamez et al., 2022).

It can also report technological benefits, enhance local development, promote the training of technicians, engineers, and specialists in renewable energies, and can be integrated with other technologies: Photovoltaic systems can be combined with batteries for storage or intelligent energy management systems (Cajape-Palma et al., 2024) They have a low maintenance cost, because solar panels have a lifespan of more than 25 years and require little maintenance.

Social and Educational Benefits

The first thing that can be planted is that by promoting educational sustainability, the UTM, by adopting photovoltaic systems, promotes a responsible environmental culture among students and teachers, allows the generation of green employment, in addition to allowing the development of local jobs in installation, maintenance, design and monitoring of solar systems (Charfi et al., 2018).

The important thing in the development of these technologies in the university is that they allow the creation of a teaching model and living laboratory, where students can receive instructions directly as teaching material in careers such as engineering, architecture, or environmental sciences. The difficulties that these projects may face are shown in Figure 4, which shows these results.

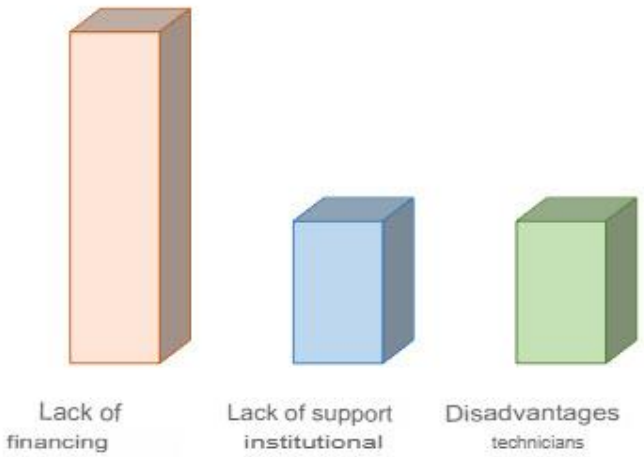

Figure 4. Drawbacks in the process of facing the project

Despite these drawbacks, others can be found, such as in the case of technical projects, especially those that involve the implementation of sustainable technologies such as photovoltaic systems, which face a series of challenges in their initial stages. In the case of this project at the Technical University of Manabí, the main drawbacks detected during the introduction and approach were both technical and administrative, and logistical.

Uno de los primeros obstáculos fue la limitada disponibilidad de datos precisos sobre el consumo eléctrico histórico de las distintas edificaciones de la universidad. Esta información era necesaria para dimensionar adecuadamente el sistema fotovoltaico. La recopilación y verificación de estos datos requirió más tiempo del previsto, lo cual retrasó el inicio del diseño técnico, otro de los parámetros es las dificultades en la obtención de datos climáticos locales (Rayes García et al., 2022).

Although general information on solar radiation in the region was available, there was no up-to-date climatological database specific to the exact installation site, which forced the use of satellite models and estimates, increasing uncertainty in the simulations (Venkateswari & Sreejith, 2019).

Also during the planning phase, financial constraints arise that make it difficult to select highly efficient equipment. Administrative processes can be slow, requiring compliance with internal procedures and regulations that lengthen approval times, and material procurement can pose a challenge to schedule planning.

4 Conclusion

Photovoltaic technology represents a sustainable and accessible solution that not only allows institutions such as the Technical University of Manabí to reduce their carbon footprint and energy costs but also promotes the formation of a new generation committed to sustainable development and technological innovation.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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References

Cajape-Palma, J. J., Juleidy-Cedeño, N., Cedeño-Cuzme, C. L., Molina-Menendez, E. E., & Zambrano-Intriago, R. A. (2024). Monitoring System for A Self-consumption Photovoltaic System. *International Research Journal of Engineering, IT and Scientific Research*, *10*(2), 20-27.

Charfi, W., Chaabane, M., Mhiri, H., & Bournot, P. (2018). Performance evaluation of a solar photovoltaic system. *Energy Reports*, *4*, 400-406. https://doi.org/10.1016/j.egyr.2018.06.004

Gamez, M., Castillo, G., Guerrero, J., & Alvarez, J. (2022). Energy Repowering Using Photovoltaic Microgrids-A Case Study in the Province of Manabi ni Ecuador. *International Journal on Engineering Applications*, 167-176.

Irena, A. (2020). Renewable capacity highlights. *Proc. Int. Renew. Energy Agency (IRENA)*, 1-8.

Kabir, E., Kumar, P., Kumar, S., Adelodun, A. A., & Kim, K. H. (2018). Solar energy: Potential and future prospects. *Renewable and Sustainable Energy Reviews*, *82*, 894-900. https://doi.org/10.1016/j.rser.2017.09.094

Luis, C. A., Luis, A. R., & María Beatriz, P. (2020). Proyectos fotovoltaicos en generación distribuida¿ Rentabilidad privada o sustentabilidad ambiental?. *Revista Politécnica*, *45*(2), 31-40.

MERNNR. (2021). ACUERDO Nro. MERNNR-MERNNR-2021-0016-AM. Obtenido de https://www.recursosyenergia.gob.ec/wp-content/uploads/2021/09/MERNNR-MERNNR-2021-0016-AM-Di%CC%81a-del-Trabajador-Minero-Ecuatoriano-2.pdf

Reyes-García, V., da Cunha Ávila, J. V., & Caviedes, J. (2022). Evidencias locales del cambio climático y sus impactos: ejemplos desde Sudamérica. *Antropologías del sur*, *9*(17), 103-120.

Rodriguez, M., & Vázquez, P. A. (2018). La energía fotovoltaica en la provincia de Manabí. *Portoviejo: Ediciones UTM. Obtenido de https://www. utm. edu. ec/ediciones_utm/index. php/component/content/article*.

Vázquez Pérez, A. (2022). El manejo de fuentes renovables de energía para el desarrollo local endógeno y sostenible en la provincia de Manabí.

Venkateswari, R., & Sreejith, S. (2019). Factors influencing the efficiency of photovoltaic system. *Renewable and Sustainable Energy Reviews*, *101*, 376-394. https://doi.org/10.1016/j.rser.2018.11.012