EKI Foundation and University of Deusto: clean energy to illuminate a fairer, more sustainable and supportive world.

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Fundación EKI y Universidad de Deusto: energía limpia para iluminar un mundo más justo, sostenible y solidario.

Fundació EKI i Universitat de Deusto: energia neta per il·luminar un món més just, sostenible i solidari

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ABSTRACT

This paper describes the collaboration between the EKI Foundation and the University of Deusto. The EKI Foundation develops photovoltaic solar energy projects in communities in sub-Saharan Africa, and the Faculty of Engineering at the University of Deusto integrates this experience into the academic training of its students under the Ignatian Pedagogical Paradigm, combining academic excellence with social responsibility and ethical training. The experience is developed through student participation in the context of their Final Degree Project and through a seminar in the Professional Ethics course, in which EKI members actively participate.

In this way, it demonstrates how institutional alliances can address global challenges from a comprehensive perspective: technology, ethics and commitment to service make possible the Jesuit ideal of educating individuals who contribute to a more just and sustainable world.

This collaboration promotes critical reflection on the role of engineers in society and opens the door to future collaborative activities.

Keywords: collaboration, ethics, justice, social impact

RESUMEN

Este artículo describe la colaboración entre la Fundación EKI y la Universidad de Deusto. La Fundación EKI desarrolla proyectos de energía solar fotovoltaica en comunidades del África subsahariana, y la Facultad de Ingeniería de la Universidad de Deusto integra esta experiencia en la formación académica de sus estudiantes bajo el Paradigma Pedagógico Ignaciano, combinando la excelencia académica con la responsabilidad social y la formación ética.

La experiencia se desarrolla a través de la participación de los estudiantes en el marco de su Trabajo de Fin de Grado y mediante un seminario en la asignatura de Ética Profesional, en el que los miembros de EKI participan activamente.

De este modo, se demuestra cómo las alianzas institucionales pueden abordar los desafíos globales desde una perspectiva integral: la tecnología, la ética y el compromiso de servicio hacen posible el ideal jesuita de educar a personas que contribuyan a un mundo más justo y sostenible.

Esta colaboración promueve la reflexión crítica sobre el papel de los ingenieros en la sociedad y abre la puerta a futuras actividades colaborativas.

Palabra clave*:* Colaboración, ética, justicia, impacto social

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RESUM

Aquest article descriu la col·laboració entre la Fundació EKI i la Universitat de Deusto. La Fundació EKI desenvolupa projectes d'energia solar fotovoltaica en comunitats de l'Àfrica subsahariana, i la Facultat d'Enginyeria de la Universitat de Deusto integra aquesta experiència en la formació acadèmica dels seus estudiants sota el Paradigma Pedagògic Ignasià, combinant l'excel·lència acadèmica amb la responsabilitat social i la formació ètica. L'experiència es desenvolupa mitjançant la participació de l'alumnat en el context del seu Treball de Fi de Grau (TFG) i a través d'un seminari en l'assignatura d'Ètica Professional, en el qual participen activament membres d'EKI.

D'aquesta manera, es demostra com les aliances institucionals poden abordar els reptes globals des d'una perspectiva integral: la tecnologia, l'ètica i el compromís de servei fan possible l'ideal jesuïta d'educar persones que contribueixin a un món més just i sostenible. Aquesta col·laboració promou la reflexió crítica sobre el paper de l'enginyeria en la societat i obre la porta a futures activitats col·laboratives.

Paraules clau*:* Col·laboració, ètica, justícia, impacte social.

INTRODUCTION

The mission of the University of Deusto (UD), inspired by the educational tradition of the Society of Jesus, is grounded in the pursuit of comprehensive knowledge at the service of society. This Jesuit perspective understands education not only as a process of acquiring knowledge, but also as a transformative experience aimed at the human, ethical and spiritual development of the individual. In this sense, university education is conceived as a response to the vocation of service, in which commitment to justice, solidarity and the common good become essential pillars of academic and professional work. Thus, the University of Deusto promotes an education that combines intellectual excellence with social responsibility, training individuals capable of actively contributing to the construction of a fairer and more humane world.

One of the ways in which this is materialised is through the implementation in all its Bachelor's Degrees of a module of human formation and values (FHV). In some of the subjects of this module, under the methodology of Learning and Service[1], activities are developed in collaboration with third sector institutions, NGOs and institutions that have a positive impact on society and students.

In addition, a subject on Professional Ethics is also taught in all the Bachelor's Degrees, which in the case of engineering degrees allows students to study in depth the social relevance of the techno-scientific phenomenon and responsibility as a core category of the engineering profession. Likewise, in all Final Degree Projects (FDP) in the Faculty of Engineering, students must carry out an ethical assessment of their work.

Finally, some students also have the option of developing their FDP in a context of collaboration with social and service organisations.

On the other hand, the EKI Foundation[2] stands as a prime example of commitment to social justice and sustainable development. Dedicated to facilitating access to clean and renewable energy in vulnerable communities, the foundation channels its efforts primarily into solar photovoltaic projects in Africa, where the lack of energy infrastructure limits opportunities for progress and well-being.

To address this, EKI has developed a solidarity-based financing model aimed at bridging the funding gap for medium-sized solar photovoltaic installations in sub-Saharan Africa. This approach enables access to clean and affordable energy for centres that would otherwise be unable to bear the high initial capital expenditure (CAPEX). Beyond providing electricity, this initiative generates employment and fosters sustainable economic development in the region.

The University of Deusto and the EKI Foundation share a profound harmony in their ideals and commitment to sustainable human development and social justice. This convergence is materialised in a collaboration that integrates academic training with solidarity action. The activities carried out are expected to achieve the following objectives:

- Implement photovoltaic projects in educational and health centres, guaranteeing their long-term functionality through an innovative remote monitoring system. This approach makes it possible to anticipate problems, ensuring uninterrupted operation and maximising the social impact of the installations.
- Show a concrete example of how the synergy between technology and humanistic values can drive lasting positive impact.
- Demonstrate how institutional partnerships can address global challenges from a holistic perspective: technology, ethics and commitment to service make possible the Jesuit ideal of training professionals who contribute to a more just and sustainable world.

MATERIALS AND METHODS

The collaboration between EKI and UD follows the Ignatian Pedagogical Paradigm[3] (IPP) which "prioritises the constant interaction of Experience, Reflection and Action" by fulfilling the 5 key elements of the learning process:

a) **Context:** students are aware of the reality of the beneficiaries and of the contribution of EKI and UD agents.
b) **Experience:** they participate in a real way with these institutions and contribute to the improvement of the living conditions of the target communities.
c) **Reflection**: they gain a deeper understanding of the difference in conditions and opportunities between their situation and that of other com-

munities, and this promotes the development of critical thinking.

d) **Action:** they develop positive values and attitudes and make real commitments to the vulnerable.

e) **Evaluation:** they are assessed on the process of developing their tasks, and on the learning outcomes**.**

Given the large growth in the number of projects implemented and supervised, and the increase in the energy demand of the beneficiaries of these projects, the EKI Foundation, together with a group of professors from the Faculty of Engineering of the UD, detected two possible improvements that could be achieved through the development of the students' FDPs, accompanied by their tutors. In particular, the main needs detected are as follows:

- **Data management of solar installations in Africa**. There are currently more than 120 solar photovoltaic installations in operation, in 59 educational centres, 37 health centres and 15 community projects, serving more than 8,600 students, 430,000 patients and around 900 professionals. From the offices in Getxo (Spain), all these installations are monitored and supervised, and their operation is analysed based on the data recorded by the inverters. Good and efficient management of this data makes it possible not only to optimise the operation of existing facilities, but also to improve the design of future facilities.
- **The increasing size of installations**. Until recently, the way of working in the design phase of installations has used the same pattern for all solar photovoltaic installations, adding small installations progressively, until the desired size is created. In view of the growing demand and the need to develop installations with a capacity of more than 100 kW, it is necessary to modify designs strategies in order to improve not only efficiency, but also feasibility and safety.

The FDP is chosen as the framework for the activity because, in its development, students review theoretical concepts learned in different subjects from a practical and motivating perspective, and understand that knowledge has a purpose, which is a key element of Ignatian pedagogy[4].

In parallel, the EKI foundation provides a case study for the Professional Ethics subject, which is implemented through a seminar for 4th-year students on all engineering Bachelor's Degrees[5].

RESULTS AND DISCUSSION

The implementation of the collaborative activities between UD and EKI is outlined in greater detail below.

1. Completion of Final Degree Projects

The Final Degree Project constitutes the academic activity through which undergraduate degree studies are completed. Within the framework of the FDP, each student is required to undertake an original project in the field of the specific technologies associated with their programme of study, with a professional orientation, in which the competences and skills acquired throughout their academic trajectory are synthesised and integrated.

In the case described in this article, the representatives of the EKI Foundation, in collaboration with the academic staff, identified a set of institutional needs that could be addressed through the development of various tools, applications or design solutions. These initiatives were aligned with the academic objectives of the FDP and were expected to provide practical value for the EKI Foundation.

The three initiatives arising from this experience, which resulted in the corresponding FDPs, are described below:

a) FDP of the Bachelor's Degree in Computer Engineering: "*Design and development of an application for the analysis of data from photovoltaic installations to support decision-making*" by Iker Marcelo (2024).

The main objective of this FDP was to enhance the efficiency of the EKI team in the preparation of reports aimed at analysing their solar photovoltaic installations in order to identify incidents and potential areas for improvement.

To achieve this objective, the development of a web application was proposed as the most appropriate approach. This application was designed to incorporate the following functionalities:

- Retrieval of data from the API of the manufacturer's equipment (VRM - Victron Remote Management).
- Storage of the collected data in a relational database.
- Incorporation of static data related to the installations.
- Automated generation of various types of reports to support the identification of incidents and areas for improvement.
- Figure 1 shows an example of a solar installation in Sierra Leone monitored from EKI's offices in Getxo (Spain), and the interface of the tool developed by the UD student.

b) FDP of the Bachelor's Degree in Data Science and Artificial Intelligence: "*Design and implementation of historical database and Artificial Intelligence-based models for system failure prediction in solar photovoltaic installations*" by Maren González (2025).

Building upon the work of Iker Marcelo, this project aims to enhance data analysis and failure prevention for Fundación EKI's photovoltaic installations. The core scope involves upgrading the existing web application and designing a predictive Artificial Intelligence model.

The project has the following specific objectives:

- Improve the existing application by extending its current functionalities.
- Implement a non-relational model for the storage of historical data to facilitate analysis and strategic decision-making.

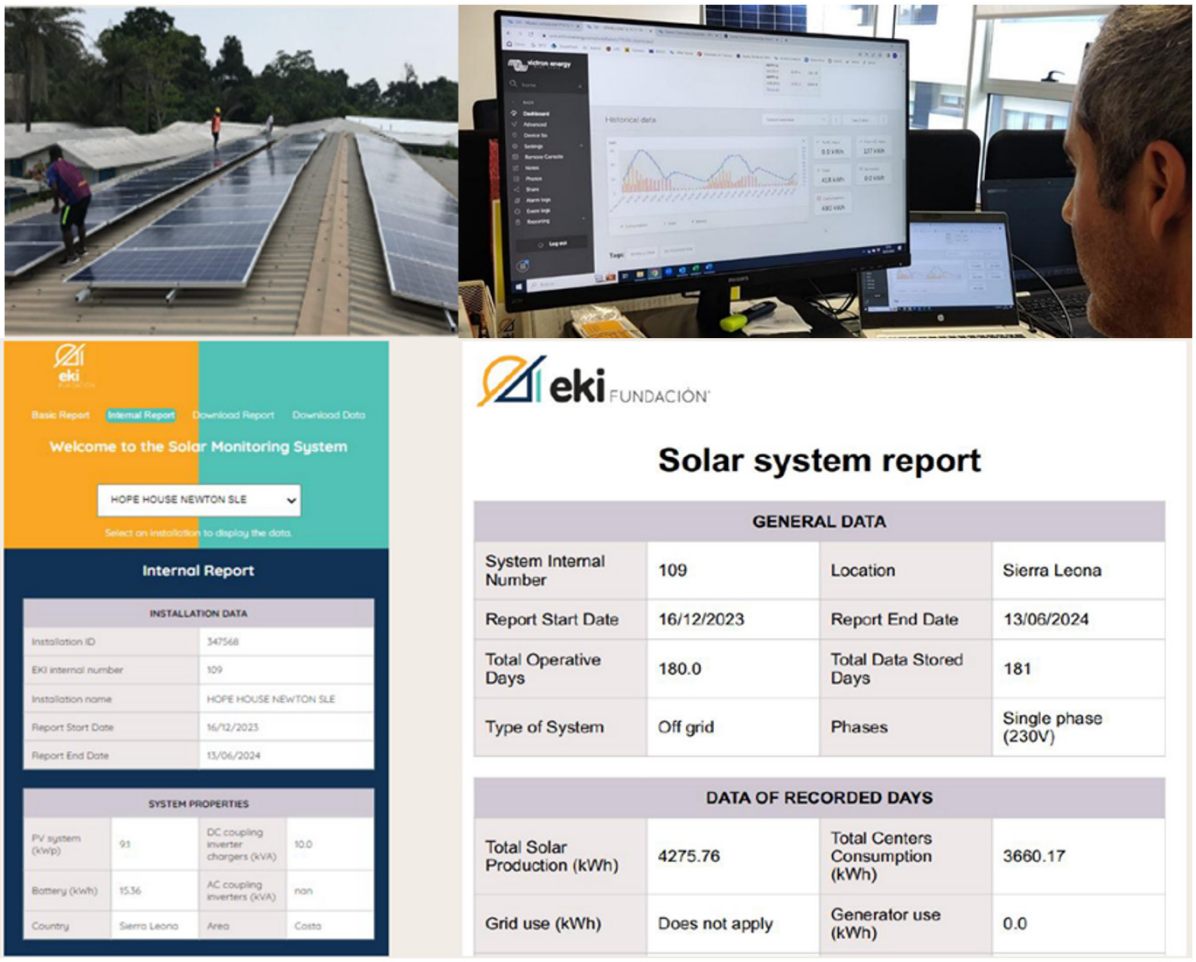

Figure 1. *Image of a data installation and monitoring[2] and developed application interface*

- Develop an AI-based algorithm for the prediction and early notification of facility failures. This will support informed decision-making and allow for preventive measures to avoid power outages.

c) FDP of the Bachelor's Degree in Industrial Technologies Engineering: "*Design of a solar photovoltaic installation at a hospital in Lunsar, Sierra Leone*" by Lucía Peláez (2024).
The primary objective of this project was to design a comprehensive solar photovoltaic (PV) installation for the Lunsar hospital in Sierra Leone, evaluating both technical feasibility and economic viability. The design process accounted for the specific geographic location—which dictates available solar irradiance—as well as the hospital's actual power and energy demand profiles.
The design includes:

- Demand analysis: Estimated power and energy demand.
- 19. PV generation: Integration of TrinaSolar Vertex TSM-DE18M (II) 500Wp modules.
- Energy storage: Selection of 3 x BYD BATTERY BOX HVM 22.1 units (100% depth of discharge, 96% round-trip efficiency and cost-effectiveness).
- Power conversion: Selection of: 3 x GW30K-ET. 30 kW hybrid inverters (98% efficiency, with 6 PV strings per inverter).
- Balance of systems: sizing of all necessary wiring and electrical protections.
- 23.Economic assessment: Total estimated investment cost of 80.000 €
- Figure 2 shows the main geographical features of the installation, a schematic of the design methodology employed and the final plan of the designed installation.

d). FDP of the Bachelor's Degree in Industrial Technologies Engineering: "Analysis *of technical solutions with central inverter and string for a photovoltaic plant in a hospital in Sierra Leone.*" by Cristina Castilla (2025).
The central aim of this project is to undertake a comparative assessment of two photovoltaic system topologies: string inverters —currently deployed by the EKI Foundation— and central inverters, proposed as an optimisation alternative. This study will focus on technical, economic, and maintenance dimensions to ascertain which configuration delivers greater efficiency, reliability, and viability for deployment in large-scale instal-

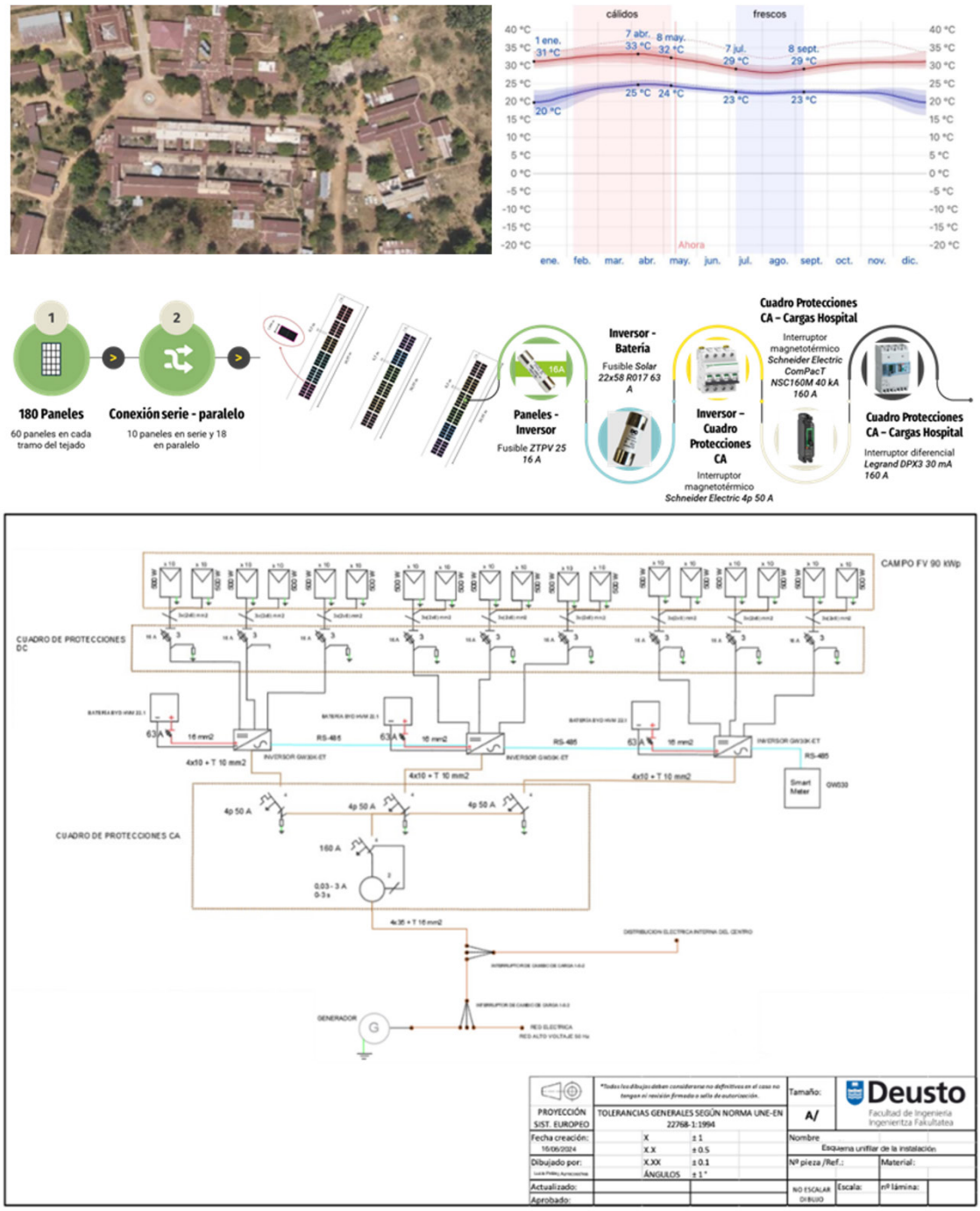

Figure 2. *Main tasks of the PFG: dimensioning and final wiring diagram*

lations, specifically exemplified by the St. John of God Hospital in Mabesseneh.

The specific objectives are:

- Analyse the existing system: Conduct a comprehensive analysis of the string inverter-based installation at St John of God Hospital in Mabesseneh, Sierra Leone.
- Performance assessment: Evaluate the system's components, configuration, and site specificities. This includes collecting historical data on energy production, consumption and overall efficiency.
- Technological comparison: Determine the technical and economic advantages and disadvantages of string inverters versus central inverters for larger capacity plants.
- Design optimization: Draw conclusions from this comparison to propose alternative improved design of a plant utilizing central inverters.

- Procurement strategy: Analyse suppliers to optimise component sourcing. Specifically, evaluate the feasibility of replacing individual equipment purchases with integrated containerised solutions. This involves identifying manufacturers that offer the best balance of quality, cost and ease deployment.
- Strategic framework: Define a reference framework for future EKI Foundation implementations to ensure the technical and economic viability of PV projects in regions with limited energy access.

2. Conduct a classroom seminar on Professional Ethics: ethical analysis of the use of technology and its impact. (2025)[5].

Figure 3 shows some pictures of the seminar held between the executive director and two of the project managers of the EKI Foundation and the 160 students of the Professional ethics course of the engineering degrees of the Faculty of Engineering of the UD. The speakers made a presentation on the purpose of the EKI Foundation and explained the operation of the projects from their inception to their implementation and maintenance. All tasks are performed in close collaboration with end-users at the project site. This partnership presents certain logistical challenges, particularly when equipment cannot be sourced locally. Furthermore, since maintenance depends on local technicians, they have implemented specialized training programs. This not only fosters local entrepreneurship but also empowers individuals to apply their expertise to other facilities. Following the presentation, the following ethical dilemmas were raised:

- Local sourcing: Supporting local industry at a higher price point versus importing equipment to maximize cost-effectiveness for the end-users.
- Financial Model: The strategic choice of an investment-led framework over a purely philanthropic donation model.

The speakers also explored the core motivations for working at EKI compared to conventional companies, focusing on:

- Social impact: The rewarding nature of improving beneficiaries' quality of life.
- Values alignment: Prioritizing personal meaning and life satisfaction over purely economic professional success.

The following principles stand out in the EKI Foundation's impact analysis:

- Beneficence: Ensuring high-quality engineering and design to provide effective solutions for end-users.
- Empowerment: Fostering independence among users and local partners to avoid dependency and paternalism.
- Justice: Addressing the energy gap and advancing gender equality, ensuring that both women and men in Africa have an equal stake in and benefit from technological progress.

Based on the evaluations provided by both students and faculty in the Professional Ethics course, several key highlights emerged:

- Student feedback:
  - Real and authentic experience: the high impact of the session.
  - Accessibility of speakers: the value of personal testimonials.
  - Presence and participation of other faculty members.
  - Curricular alignment: A clear and direct link to Professional Ethics syllabus.
  - Professional growth: Strong focus on FDP and future career development.
- Faculty perspectives:
  - The initiative effectively facilitates practical exercises and classroom activities.
  - Strong integration between the activity and the core subject matter.
  - The depth of the ethical questions raised.
  - Ethical project analysis: The development of concrete arguments regarding complex ethical dilemmas derived from the seminar.

Figure 3. *Attendees and speakers at the seminar*

CONCLUSION AND FUTURE WORK

- The main conclusions of the activities carried out at the Faculty of Engineering of the University of Deusto in collaboration with the EKI Foundation are as follows:
- The collaboration between the Faculty of Engineering of the University of Deusto and the EKI Foundation demonstrates how academic institutions and social organisations can jointly address global challenges through an integrated technological, ethical and educational approach.
- From a technical perspective, the Final Degree Projects developed within this framework have provided EKI with concrete tools to improve the design, monitoring and management of photovoltaic installations, enabling higher-capacity systems, more efficient operation and informed decision-making based on data analysis. These contributions strengthen the long-term viability and social impact of the foundation's projects.
- From an educational perspective, the collaboration enriches engineering training by embedding real social challenges into the curriculum. Student participation in FDPs and in the Professional Ethics seminar fosters critical reflection on the social responsibility of engineers, reinforces the vocational dimension of the profession and promotes the development of values aligned with sustainability, justice and the common good, in accordance with the Ignatian Pedagogical Paradigm.
- The experience also highlights the value of institutional alliances in linking technological innovation with ethical reflection, preparing future professionals to address global inequalities such as access to energy from a holistic perspective.
- Finally, this collaboration establishes a solid foundation for future work, which may include new Bachelor's and Master's Degree Final Projects, further improvements in data management and system design, and continued ethical analysis of the social impact of technology in vulnerable contexts.

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