MELCHOR GÓMEZ PÉREZ
(ORGANIZADOR)

CONSTRUINDO O AMANHÃ:

PERSPECTIVAS CONTEMPORÂNEAS EM ARQUITETURA E URBANISMO

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PRÓLOGO

En este libro se recogen siete contribuciones que pretender avanzar en lo que el título denomina “Construir el mañana: perspectivas contemporáneas sobre arquitectura y urbanismo”.

Los retos de emergencia climática, debida a las emisiones de gases de efecto invernadero provocadas por el consumo de combustibles fósiles, obliga a todas las áreas de las ciencias a aportar soluciones en la consecución de territorios responsables y sostenibles, libres de emisiones contaminantes. No debemos olvidar que tales emisiones provocan cuantiosos daños económicos, ambientales y de salud pública, algunos de ellos irreversibles. Además, estos daños intensifican las brechas de la desigualdad entre países y entre personas.

Arquitectura y Urbanismo son pilares fundamentales donde poder incorporar acciones de impacto positivo en los territorios donde vivimos. Para mejorar la eficiencia energética, tanto de edificios como de ciudades, son necesarias propuestas eco eficientes, que tiendan a consumos casi nulos, compensados con recursos energéticos renovables obtenidos en los propios edificios o territorios.

La utilización y el buen uso de los espacios donde habitamos, mediante una gestión integral del territorio y una necesaria escucha y cooperación con la población civil, ayudan a consolidar los necesarios cambios estructurales. Debemos cambiar la forma de consumir energía por otros más sostenibles que impliquen pasar de una sociedad que *“consume”* vorazmente a otra que solo *“utilice”* y recicle en base a una economía circular neutra en carbono.

Las propuestas que se incluyen en este libro, son variadas. Se abordandan actuaciones que van desde intervenciones pasivas en edificios, incorporación de energías renovables en entornos urbanos, a formas de intervención de la sociedad en la creación de políticas y normativas para la gestión sostenible del uso del suelo, mediante la planificación urbana potenciando la resiliencia de los territorios y adaptando las ciudades a los retos migratorios. Por último, se plantean transformaciones en ciudades con entornos marítimos recuperados y adaptados a las necesidades actuales.

Estas propuestas y otras más son las que necesita una sociedad que pretenda construir un mañana digno para nuestros hijos.

Melchor Gómez Pérez
Universidad del País Vasco

SUMÁRIO

CAPÍTULO 2

EDUCATIONAL SUSTAINABILITY PROJECT APPLIED TO THE STUDY OF SMALL WIND TURBINES IN URBAN ENVIRONMENTS[1]

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ABSTRACT: The educational sustainability project is developed within the framework of the Campus Bizia Lab (CBL) program of the University of the Basque Country UPV/EHU. The objective of the project is the installation of a small wind turbine at the Faculty of Engineering of Vitoria-Gasteiz to study the particularities of wind power applied to urban environments. Located within the framework of the "University Educators for Sustainable Development" (EU4SD) project, the CBL program aims to advance the sustainability of the educational centres of the three University Campuses that make up the UPV/EHU, using them as learning laboratories. CBL offers the entire university community the opportunity to work collaboratively on projects related to sustainable development. The projects registered in CBL focus on solving current problems, real and close to the university community; promote the development of Final Degree Projects (from now on TFG), Master's Theses (TFM) and the dissemination of the results. The purpose of our educational project is the installation of a small wind turbine to produce part of the building's energy needs *in situ*, to demonstrate the advantages of

[1] We wish to acknowledge the University of the Basque Country UPV/EHU for the funding granted to the project "Installation of a small wind turbine in the Faculty of Engineering of Vitoria-Gasteiz for the study of the integral viability of this type of renewable energy" in the sixth call of the Campus Bizia Lab (CBL) Program.

renewable energies, to develop the research and innovation capacities of the students, and to contribute to a sustainable, economic, environmental and social energy model.
KEYWORDS: Small wind turbines. Self-consumption. SDGs. TFG. TFM. Energy transition.

PROYECTO DE SOSTENIBILIDAD EDUCATIVA APLICADO A LA INCORPORACIÓN DE MINI AEROGENERADORES EN ENTORNOS URBANOS

RESUMEN: El proyecto de sostenibilidad educativa se desarrolla en el marco de la convocatoria del programa *Campus Bizia Lab* (CBL) de la Universidad del País Vasco/Euskal Herriko Unibertsitatea UPV/EHU. El objetivo del proyecto es la instalación de un mini-aerogenerador en la Escuela de Ingeniería de Vitoria-Gasteiz para estudiar las particularidades de la energía eólica aplicada a entornos urbanos. Situado en el marco del Proyecto *University Educators for Sustainable Development* (UE4SD), el programa CBL aspira a avanzar en la sostenibilidad de los centros educativos de los tres Campus Universitarios que conforman la UPV/EHU, utilizándolos como laboratorios de aprendizaje. CBL ofrece a toda la comunidad universitaria la posibilidad de trabajar de forma colaborativa en proyectos relacionados con el desarrollo sostenible. Los proyectos inscritos en CBL se enfocan en la resolución de problemas actuales, reales y cercanos a la comunidad universitaria; promueven el desarrollo de Trabajos Fin de Grado (TFG) y Trabajos Fin de Máster (TFM) y la divulgación de los resultados. La finalidad de nuestro proyecto educativo es la instalación de un mini-aerogenerador para producir parte de las necesidades energéticas del edificio *in situ*. Se busca resaltar las ventajas de las energías renovables y desarrollar las capacidades de investigación e innovación del estudiantado, para contribuir a un cambio de modelo energético sostenible, económico, ambiental y social.
PALABRAS CLAVE: Energía mini-eólica. Autoconsumo. ODS. TFG. TFM. Transición energética.

1 INTRODUCTION

Climate change is a reality that requires decisive action by all stakeholders to achieve a sustainable and fair energy model. The University has a crucial role to demonstrate the effectiveness of the new model, to raise awareness about its viability and to train future professionals. The 2030 Agenda focuses SDG#7 “Affordable and Clean Energy” on ensuring access to affordable, safe, sustainable and modern energy for all. Achieving this technological challenge is possible, but social policies aimed at this objective are necessary.

Our vision envisages a new “Energ-Ethic” model, environmentally friendly, devoid of fossil fuels and sustainable for the entire population. It is about moving towards socially sustainable territories (Carbonero et al. 2016). For this purpose, university education must provide technical tools that enable the change of model. As the European Economic

and Social Committee pointed out: “Energy is an essential common good, because of its indispensable role in all daily activities, which allows every citizen to have a dignified life, while lacking it causes tragedies” (Coulon y Hernández 2013). Access to affordable energy for all citizens should be a guaranteed basic service to allow for the fair development of societies and people.

Our CBL project is in line with the new energy model strategy, based on two fundamental pillars: efficient use of energy and electricity as an energy vector. Electrical energy should be extended from generation to final consumption (mechanical work, mobility, heating/cooling, lighting, communication, etc.). Energy will be obtained mainly at the place where it is consumed; distributed generation based on renewable energies will replace the conventional model of centralized generation based on burning fossil fuels. The new scenario seeks to reduce primary energy demands to a quarter of what we currently use, with a significant reduction in greenhouse gas (GHG) emissions.

The most important objective of this project is the dissemination of wind energy located near the place of consumption. This demonstrates the many advantages that the use of this renewable energy in the urban environment entails: it allows individual and shared self-consumption, eliminates polluting emissions in our environment and enhances the empowerment of the prosumer (producer and consumer of energy).

2 METHODOLOGY

The project involved a total of eight members of the Teaching and Research Staff (PDI) from different departments (Electrical Engineering, Energy Engineering, Systems and Automatic Engineering, Mechanical Engineering, Languages and Computer Systems), a member of the Technical Staff, Management and Administration and Services (PTGAS) and a student of Mechanical Engineering. We all belong to the Faculty of Engineering, Vitoria-Gasteiz, UPV/EHU.

The first phase of the project was carried out during the course 2022-23. It consisted in laying the foundations for installing a small wind turbine in the out Faculty. Course 2023-24 will delve into the social aspect of energy and its relationship with SDG#7.

The project is based on the Service-Learning methodology, which consists of linking learning actions with service to the community (Battle, 2009; Rubio, 2009; Raya-Diez, 2017; Pascual, 2023). In this case, the project is defined by the teaching innovation team and provides learning resources on a real case to involve students in the development of academic activities (subject practices and TFG’s).

3 DEVELOPMENT

The work process and the results follow.

3.1 LOCATION

First, we have carried out a preliminary analysis of wind conditions from the simulation of wind potential using Global Wind Atlas (https://globalwindatlas.info/en). The next step is the choice of the optimal location of the small wind turbine on the terrace of our Faculty, seeking a high, barrier-free area with good visibility.

Next, we have installed a wireless weather station, model PCE-FWS-20N, donated by the company PCE Instruments. The receiver of the station has been installed in a nearby laboratory for the correct reception of radio signals. The receiver is connected by USB to a Raspberry Pi (very low consumption miniature computer) that processes data through the "pywws" free software program (https://pywws.readthedocs.io/en/latest/). Currently, we are collecting wind speed and direction measurements, as well as other environmental variables such as temperature, relative humidity and rainfall, which allow us to validate simulations. In addition, real-time and historical information is accessible via two free-access web servers: Weather Underground (https://www.wunderground.com/dashboard/pws/IVITOR63) and WeatherCloud (https://app.weathercloud.net/map#7381295121).

3.2 DATA ANALYSIS

Data analysis for conclusive results will be performed when we have a longer collection period. This will result in a TFG to be carried out by a student of the Bachelor Degree of Computer Management and Information Systems Engineering in the next course. This TFG will analyse meteorological station data and develop charts to facilitate decision-making.

3.3 TYPE OF WIND TURBINE

The choice of the type of wind turbine best suited to the environmental conditions will be validated by means of measurements that are being carried out. The choice of the wind turbine is complicated, as it is necessary to weigh many technical and economic variables. Collaborators working in this section also value the technical needs for the location of the control equipment, considering a dual mission: on the one hand, they must be accessible for use in research laboratories; on the other hand, they must be conditioned for connection to the electricity grid to enable self-consumption.

3.4 ENERGY POTENTIAL

The calculation of the energy potential should serve to make sense of the installation from an energy point of view and to validate this type of energy as necessary and useful to replace the use of fossil fuels still used in the building. In the next phases of the project, it will be possible to quantify the energy generated and validate whether it is economically viable and, applicable to other locations in an urban environment comparable to ours. This would meet one of the challenges posed by the CBL program, namely Challenge 1: actions aimed at minimising energy consumption and promoting the use of clean and renewable energies, as well as the identification and implementation of measures for the mitigation and adaptation of climate change with a tool that allows the reduction of greenhouse gas emissions.

3.5 TFG AND TFM INCUBATOR

Aligned with one of the objectives of the CBL, which is to promote the development of a practice of high impact on students with curricular recognition materialized through TFG, it has been possible for a student of the Degree of Mechanical Engineering to finish his TFG with a theme related to our project. Specifically, it has been focused on the design and structural analysis of a tower for the installation of the small wind turbine. The study has served us to select the most appropriate type of tower to support it. A basic model has been used to perform the study, while the determination of the definitive model is still pending. From the point of view of learning process, this work highlights the effectiveness of these types of facilities that use renewable and sustainable energy.

3.6 APPLICATION WITH ACTIVE METHODOLOGIES

In the subject of Energy Management and Ecoefficiency of the 4th Degree in Environmental Sciences in the Faculty of Pharmacy UPV/EHU, several activities have been worked with active methodologies based on Service-Learning applied to the subject of the new energy model, linked to the SDG#7. Through the project of installing a small wind turbine in an urban environment, an attempt to activate in students' participatory culture has been promoted, essential for changes in their local environment to endure and be sustainable in time (Gómez, 2017). In addition, we have included the additional objective of the dissemination of the proposals for energy management intervention, requiring that the work considers the design of communication strategies necessary to raise public awareness to achieve the proposed objectives.

3.7 INSTALLATION PROJECT

The cost of the installation must be supervised by the Architecture and Works service and supported by the Vice-Management of Planning and Infrastructure of the UPV/EHU. The work is also complemented by the search for support offered by the institution “Ente Vasco de la Energía” (EVE) prior to the implementation of a feasibility study for the installation of small wind turbines in UPV/EHU buildings using the support of the “Incentive programme linked to self-consumption and storage, with renewable energy sources, as well as the implementation of renewable thermal systems in the residential sector”, funded by the European Union – NextGeneration EU.

The methodology used can be replicated in other buildings of the three UPV/EHU Campuses.

4 CONCLUSIONS

In conclusion, we highlight the involvement of the university community in the development of activities and in the dissemination of the proposal and its objectives. Not all the objectives have been achieved, as these were genuinely ambitious for the limited allocation. However, it has been possible to establish a sound basis for the continuation and completion of the project for the installation of a small wind turbine. In the extension of the project of the next course we will be able to further develop the objectives initially envisaged.

This project offers the possibility of interacting with several areas of knowledge, and of growing with the participation of students from different disciplines that, under the supervision of the collaborators PDI, lead to different TFG or TFM.

The project is aligned with the roadmap that aims to develop the three main mandates of the University: training, research and transfer. Through the project, students are aware of sustainability as an essential value for human development, and valid and reliable information about the efficiency of the installation, and its feasibility as an alternative to self-consumption is obtained. We hope that, soon, results will be extended to other types of buildings.

Future challenges include involving students from other knowledge areas, mainly in the field of social sciences and education, to raise awareness of the right to energy and the technical possibility of ensuring affordable and sustainable energy systems.

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