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The Plan for Energy Saving and Efficiency as an Example of the University of Valladolid's Commitment to Sustainability

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Abstract. This paper presents the University of Valladolid's Plan for Energy Saving and Efficiency (February 2023) and focuses on the keys developed in relation to the sustainable design and use of university buildings and the promotion of sustainable mobility, as well as on the objectives pursued by the Plan: to reduce the environmental impact and the associated energy costs, eliminate fossil fuels and seek self-consumption. The University of Valladolid has been working for years to improve its energy and environmental performance, using biomass as the main energy resource for heating and sanitary hot water systems in most of its facilities, for the construction of sustainable and efficient buildings, for carrying out energy renovations and continuous actions to improve energy efficiency in existing buildings, and for promoting sustainable mobility models among the university community. With these actions, the University of Valladolid has managed to reduce emissions of thousands of tons of CO2 into the atmosphere each year, improving conditions in university spaces and keeping energy consumption stable. This reduction in energy consumption has made it possible to contain energy costs in global scenarios of rising prices, as well as to minimize the application of harsh measures to reduce energy consumption (closing buildings, turning off air conditioning, etc.) that most higher education institutions in our country have been forced to apply.

Keyword:

Sustainable Transport, Sustainable Mobility, Low-Emission Vehicles, Remote Working

1. Introduction

Energy is the axis that sustains productive systems, the comfort of citizens, and the

mobility of people, and the sustainability of all of them depends directly on the availability of affordable and abundant energy [1].

The University of Valladolid UVa has been working for years to improve its energy and environmental performance [2]. The commitment to biomass as an energy resource for heating and domestic hot water systems in most of its facilities, the construction of sustainable and efficient buildings, energy retrofits, and continuous energy efficiency improvements have managed to reduce emissions of thousands of tons of CO2 into the atmosphere each year, improving conditions in university spaces and maintaining energy consumption stable.

These actions have allowed us to face the current energy crisis without the urgency that other institutions have been forced to act on, who have been applying harsh energy consumption reduction measures (closing buildings, turning off air conditioning systems, etc.) for months, as well as being prepared for a possible increase in energy costs (up to four times in the most pessimistic scenarios) as shown in Figure 1.

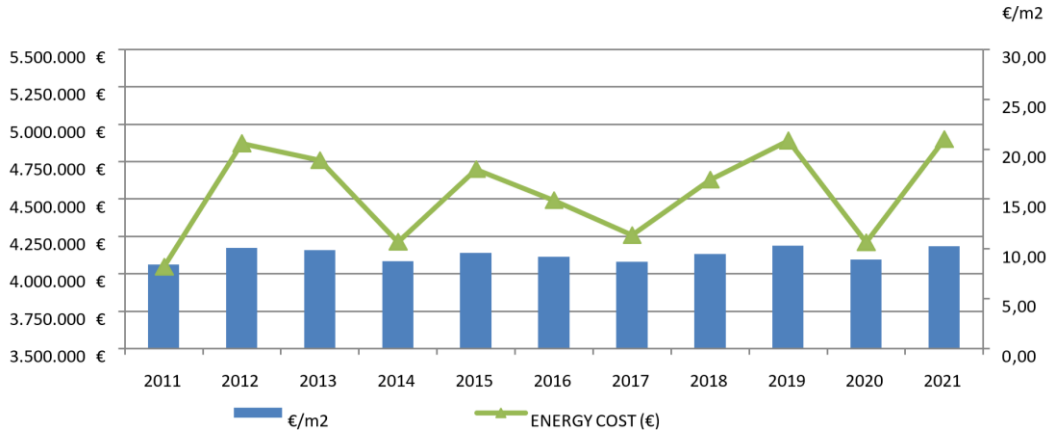

Figure 1. Evolution of energy cost and cost per square meter of the UVa during the period 2011-2022.

2. Current situation of the commitment to sustainability

During the last decade, all interventions related to buildings have been aimed at reducing energy and resource use (water management, materials, and waste) throughout their life cycle, in order to achieve the greatest possible reduction in CO2 emissions.

In the last three years, the University of Valladolid has carried out interventions to improve the efficiency of lighting and illumination systems, prioritizing spaces with less efficient lighting systems and longer usage hours (libraries, study rooms, common areas, etc.). The interventions have allowed for monthly savings of more than 500 MWh with returns on investment of less than 3 years.

In relation to solar radiation, solar control glass is being installed in rooms with a south and west orientation to limit energy consumption for cooling. Synthetic high reflectivity films are also being installed on sheet metal and/or sloping roofs (4,000 m2), as well as green roofs on flat roofs (7,400 m2), which helps mitigate the urban heat island effect [3]. In addition, 1,700 m2 of photovoltaic panels with a nominal power of 236 kWp have been installed.

Regarding air conditioning, several buildings use Canadian wells with earth-to-air geothermal heat exchangers through buried pipes of great length, which conditions the outside air naturally before introducing it into the ventilation system [4]. In addition to being

a renewable energy source, it can be considered a bioclimatic device as shown in Figure 2.

Figure 2. Climate control through Canadian wells at the Soria Campus and the IndUVa building at Valladolid.

There is a biomass district heating network [5] that supplies heat to all buildings on the Miguel Delibes and Esgueva campuses as shown in Figure 3, which in the last 6 years has prevented the emission of 24,107 t CO2 into the atmosphere.

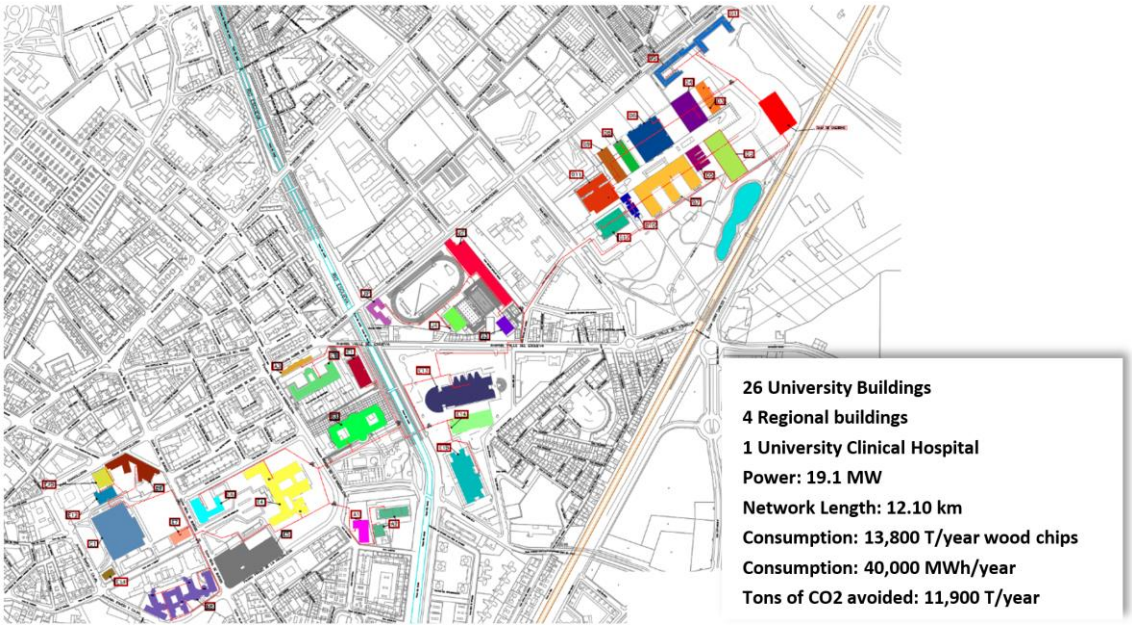

Figure 3. Biomass network at the Valladolid Campus.

The envelopes of existing buildings have been improved by increasing insulation on roofs (> 10,000 m2), replacing obsolete carpentry with thermal break carpentry and low-emissivity double glazing (> 5,000 m2), and/or energy retrofitting facades (around 7,000 m2).

In terms of people's mobility, the campus bike lane network has been improved (15,800 m2 added) and connected to the municipal network, the number of bike parking spaces has been increased, totalling 906 spaces, and self-repair stations (4 stations) have been added. The bike rental system has also been expanded to promote sustainable mobility (315 units, of which 5% are electric). Free electric car chargers have also been installed in all university buildings to encourage their use [6].

Regarding water and flora management, permeable pavements are being installed (over 12,000 m2) that favour natural drainage to maintain aquifers and avoid sending rainwater to the treatment plant [7]. Trees are also being planted on the different campuses as carbon sinks [8] (currently there are more than 3,000 specimens).

Newly constructed buildings are certified for sustainability, receiving high ratings through the LEED international certification [9][10] and the Spanish VERDEGBC tool [11] [12], with savings of non-renewable primary energy exceeding 60%, as shown in Figure 4 for the IndUVa building.

Figure 4. IndUVa Lecture Hall - School of Industrial Engineering

3. A More Sustainable University: The Plan for Energy Saving and Efficiency Measures

The Plan for Energy Saving and Efficiency Measures of the University of Valladolid (PESEM) [13], outlines the general application of energy-saving measures across all university buildings of the institution, with a target of reducing energy demand in our facilities by between 20% and 25%.

The objectives of PESEM are to reduce energy consumption and its environmental impact, reduce energy costs, decarbonize energy consumption, increase the production of renewable energy on-site, and promote self-consumption, to achieve the SDG 7 [14].

The implementation of the measures described in PESEM would allow us to achieve the national targets for 2050 by 2030, through the improvement of management and energy efficiency of our facilities as shown in Figure 5, as well as the use of renewable energy technologies in new buildings, consolidating the energy policy change initiated in 2014 with the implementation of a biomass district heating network.

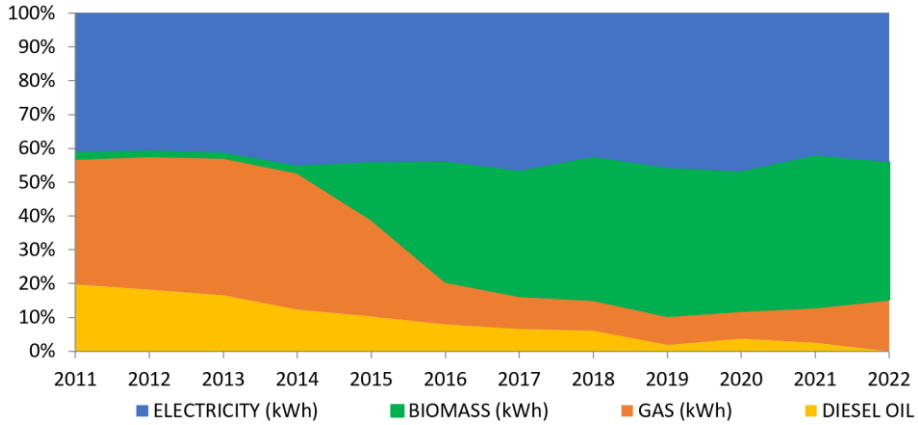

Figure 5. Evolution of UVa's energy sources usage during the period 2011-2022

PESEM addresses five macro areas of importance in sustainable institutional management as shown in Figure 6: people, energy, buildings, mobility, and waste.

The proposed actions are structured in four lines: Optimal management of buildings, Reduction of consumption in air conditioning, lighting, and IT, Awareness-raising among the university community, and Decarbonization and promotion of renewable energy.

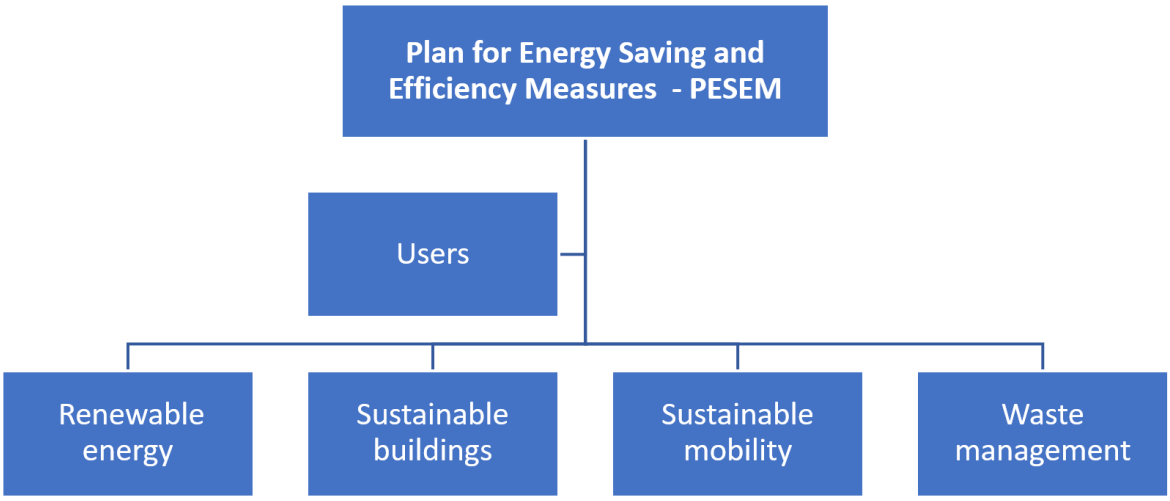

Figure 6. Areas of work for sustainable management

To maintain continuous communication and coordination, PESEM proposes the creation of energy optimization and saving working groups in each faculty, consisting of an environmental quality and sustainability technician, a maintenance service technician, an energy coordinator (from faculty's management team), and an energy administrator.

The entire university community is the protagonist and co-responsible for this continuous improvement, including institutional managers and administrators, faculty, researchers, staff, students, and external company personnel.

To engage the entire university community, a communication and participation plan has been designed to inform about the university's energy situation, raise awareness about environmental and energy issues and responsibility in finding solutions, inform about the energy saving and efficiency plan and its actions, publish the improvements achieved, and involve the community.

This omni-channel plan will use signage and dissemination in faculties, social media campaigns, dissemination through faculty screens and web pages, design of incentive models for savings by faculties, creation of a virtual suggestion box, creation of an email address to send questions and suggestions, and the collection of suggestions and contributions through surveys.

4. Application of new measures for energy saving and efficiency

4.1. Line 1: Optimal management of buildings

The optimization of the management of university spaces is the most effective tool for reducing energy consumption in buildings in the short term. There is no cleaner or more economical energy than the one that is not consumed. Generally, the opening of administrative buildings will be concentrated between 8:00 am and 4:00 pm, extending in teaching buildings until 7:00 pm and minimizing afternoon activities.

The work calendar will establish closing periods during Christmas, Easter, and at least 15 days during the month of August. During weekends and holidays, each campus will enable a low consumption building where activities can be concentrated. For external activities, the energy cost will be considered for the applicant.

Windows should generally be kept closed. In classrooms, there will be a 10-minute cross-ventilation between each hour occupied, in common spaces ventilation will be carried out every 7 hours, and in offices and other areas, two ventilations will be carried out per day. Mechanical ventilation systems will be used in high occupancy areas, and informative posters on how to ventilate will be hung.

4.2. Line 2: Reduction of consumption in air conditioning, lighting, and ICTs

Consumption in air conditioning will be reduced by establishing a heating system operation from November 1 to March 31, with a generalized reduction in hours and a target comfort temperature of 19°C [15]. An occupancy protocol for spaces by zones will be enabled, and each campus will enable a common library or study room.

As for cooling, it will be turned off except in spaces where temperatures consistently exceed 27°C, as well as in spaces with specific needs. A review of passive solar protection systems (blinds, curtains) will also be carried out.

To reduce lighting, luminaires will be turned off in circulation spaces and lobbies if there is sufficient natural light, furniture and work elements will be relocated with respect to windows, inefficient lamps will be replaced, presence detectors will be installed, and illuminated areas will be defined. The lighting in parking lots will also be turned off outside building operating hours, ensuring minimum safety conditions, optimizing interior lights, and exterior lighting.

Other energy-saving measures include optimizing contracted power in supplies, bioclimatic rehabilitation and high energy efficiency of building thermal envelopes, individual counting of large consumers and external services, individualization of air conditioning and lighting production installations in study and examination rooms, sectorization of facilities and integration of control systems in buildings, optimization of the operation of general facilities, implementation of remote on/off and connection protocols, use of efficient data processing centres, installation of new AC equipment.

4.3. Line 3: Sensitization of the university community

Regarding the members of the university community, instructions have been provided regarding their workplace computers, the use of natural light, the end of the workday, the control of common spaces (classrooms, offices, laboratories, bathrooms, etc.), the elimination of personal appliances, and the promotion of teleworking.

Measures have also been included for people working in external services such as cleaning, security, or additional services (vending machines, photocopiers, etc.).

4.4. Line 4: Decarbonization and promotion of renewable energies.

The University of Valladolid maintains and strengthens its commitment to renewable energies, by contracting 100% renewable electricity supply, implementing self-consumption photovoltaic installations, and conducting feasibility studies on cogeneration and mini-wind power.

In terms of thermal energy, the University of Valladolid stands out for the massive use of biomass in thermal facilities, complemented by solar thermal panels for heating

and domestic hot water installations, the use of geothermal energy for building thermal conditioning, and the planned connection to existing heating and/or cooling networks for buildings that are not yet connected.

5. Conclusions and future actions

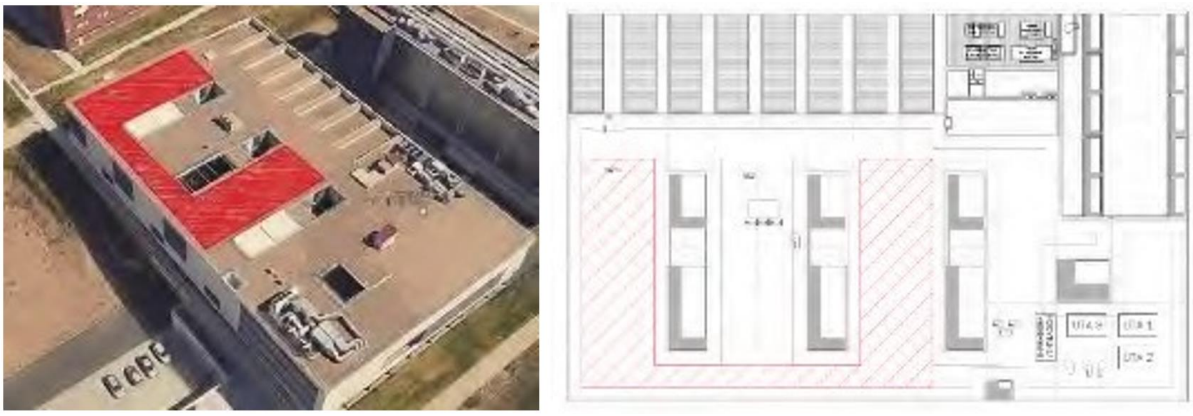

Figure 7. Feasibility study for photovoltaic installation on roofs

The University of Valladolid has been concentrating efforts for several years to increase its commitment to sustainability, as described above. The recent approval of the PESEM by the Governing Council enables this trajectory to continue with the realization of important milestones, including the complete elimination of the use of diesel oil once the biomass heat network of the Palencia Campus is fully activated, with the ultimate goal of eliminating the use of fossil fuels in all university buildings.

The installation of almost 20,000 m2 of photovoltaic panels is currently in the first phase of the project as shown in Figure7, which could allow for the installation of about 4,440 kWp of solar power, with a reasonable goal of achieving on-site electricity production close to 25% of the institution's needs.

The rehabilitation of buildings that are in worse energy performance conditions should be a task to continue reducing the energy demand of facilities, which, together with the implementation of renewable energy sources, will allow achieving the ambitious decarbonization goal of the University of Valladolid by 2030, according to SDG [16].

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