



## A HEI strategy to implement solutions aligned with energy and climate change challenges

Loraine Nazaré<sup>1\*</sup>, Inês Fernandes<sup>2</sup>, Joaquim Oliveira<sup>1</sup>, Ana Lillebø<sup>3</sup>, Alexandra Queirós<sup>3</sup>

<sup>1</sup>Rectory, University of Aveiro, Coordinator, Campus Universitário de Santiago 3810-193 Aveiro, Portugal

<sup>2</sup>Rectory, University of Aveiro, Senior Technician, Campus Universitário de Santiago 3810-193 Aveiro, Portugal

<sup>3</sup>Rectory, University of Aveiro, Vice-Rector, Campus Universitário de Santiago 3810-193 Aveiro, Portugal

\*corresponding author: [lnazaré@ua.pt](mailto:lnazaré@ua.pt)

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**Abstract.** The vision of the University of Aveiro (UAveiro) is “to create, share and apply knowledge, involving the whole community through teaching, research, and cooperation with the surrounding environment, in order to make a clear difference for individuals and society”. Framed in the concept of Sustainability and Intergenerational Justice, UAveiro has acted by stimulating behaviours towards sustainability and by implementing solutions aligned with energy and climate change challenges. Relevant examples are a manual of good environmental sustainability practices, dashboards to monitor our performance, University Footprint Calculator that enables “to think and anticipate realities” towards carbon neutrality without compromising future generations, UAUBike, solutions for sustainability challenges, the greenbuilding’s project. This paper showcases, from different perspectives, the role of UAveiro to contribute to tackle societal challenges arising from the climate crisis and global changes and promote transformative solutions in favour of sustainability, social responsibility and climate action.

**Keyword:**

Sustainability And Behaviour Change, Renewable Energies, Green Buildings Solutions, Higher Education Institutions

### 1. Introduction

In the UAveiro's development model, sustainability in all its dimensions is becoming increasingly important. UAveiro clearly demonstrated its concern for the environment in the 1970s, with the creation of a Department of Environment and Planning in 1978 and by offering the first course in Environmental Engineering, at a time when sensitivity to environmental issues was very different from today. In 2014, UAveiro created a Sustainability Group - the Mission Group for Sustainable Development - with the aim of promoting actions that contribute to environmental sustainability at UAveiro and disseminating research, qualifications and good practices. In 2019, UAveiro joined the

Sustainable Campus Network of Higher Education Institutions (HEIs). This commitment states that HEIs must be "particularly active elements" towards these goals, "by bringing together a unique combination of skills that allow them to play a key role in the fields of education, scientific research, social responsibility and defence of the common good" [1]. This commitment to sustainability it is a UAveiro's mark, with several actions related to teaching, research, collaboration and governance.

The Institutional Strategic Plan of the last quadrennium emphasised social, financial and environmental sustainability. One of the three strategic lines was mainly dedicated to environmental sustainability, and throughout the quadrennium the University worked to reduce the direct and indirect environmental impact of its activities. In terms of educational provision, from 1977 to the present day, the UAveiro has offered several courses dealing with environmental sustainability, climate change, energy and related issues, covering all levels from undergraduate to doctoral studies. These topics have been also very important in its research and cooperation agenda and are aligned with several of the goals of the United Nations Agenda for 2030, the SDG's, especially the SDG 13, on combating climate change, the SDG 7, on renewable and affordable energy, and the SSDGs 14 and 15, on the protection of life under water and terrestrial life, including biodiversity.

The vision for the university, as stated in its strategic plan "The University of Aveiro has tried to contribute to all these areas, stimulating and developing attitudes and actions geared towards sustainability, acting not only through words, but also by setting an example." One of the main strategies that UAveiro has developed to achieve these goals is its Indicators Portal, which is an important tool to support its management and decision-making. In this portal, the institution compiles its indicators from the data collected by the Quality Assurance System (qualitative and quantitative) on the subsystems of teaching, research, sustainability and collaboration with society. Actions to improve its energy efficiency, waste management, soft mobility, glass bottle distribution, renewable energy consumption and green buildings contribute greatly to the sustainability of UAveiro's Campi. These actions are following described in detail in number 2.

Sensitive to social concerns on sustainability issues and contributing to intergenerational justice, UAveiro, aware of the need for behavioral changes both on its campus and beyond through the actions of its students and collaborators in society, has implemented the University Footprint Calculator that enables "to think and anticipate realities" towards carbon neutrality without compromising future generations.

Only by reflecting and recognizing the importance of our role in society as HEI, can we institutionally define which relevant actions and measures will contribute positively, in the short term, but mainly in the long term for future generations.

## **2. Points of Results and Discussions**

The University was a pioneer in the integrated pedagogical approach to environmental problems, with the creation of the first Environmental Engineering course in our country, in the 70 years. Concerning research and cooperation with society, UAveiro has five Associated Laboratories, the CESAM - Centre for Environmental and Marine Studies - which develops research in the field of environmental and marine sciences; CICECO – Aveiro Institute of Materials - which dedicates one of its three thematic lines to sustainability and circular economy; Instituto de Telecomunicações (IT) - wich develops research in Wireless Communications, Optical Communications, Networks and Multimedia and Basic Sciences

and Enabling Technologies; Institute for Nanostructures, Nanomodelling and Nanofabrication - Physics of Semiconductors, Optoelectronics and Disordered Systems (I3N-FSCOSD) - which develops research in Modelling of materials behaviour, Nanofabrication and micro-technologies, Nano and microstructured polymer-based systems and Physical characterization of self-assembled nanostructures and LAQV-REQUIMTE - Associated Laboratory for Green Chemistry - which develops research in Energy – Clean & Renewable; Environment – Monitoring & Analysis; Food & Nutrition; Functional Materials, Health & Wellbeing.

In what concerns sustainability, UAveiro defines its priorities in: i) developing social, financial and environmental dimensions; ii) contributing to intergenerational justice; iii) having a more conscious and responsible use of natural resources; iv) creating and rehabilitating spaces with sustainability principles; v) contributing to energy efficiency and waste management.

### **2.1. Manual of Good Environmental Sustainability Practices**

The Manual of Good Environmental Practices is intended to be a communication tool to support institutional commitments to quality and the environment within the academic community. UAveiro has developed several good practices in the field of sustainability, which are disseminated throughout the community to change daily behaviours that could affect future generations. The manual includes practical advice for informed and responsible action that, if applied, will greatly contribute to minimising the environmental impact of their tasks and how changing their behaviour is linked to each SDG. It's also a guide to sustainable practices in areas such as energy, water, paper, plastics, waste, mobility, events and food. Currently, UAveiro has three manuals on this subject, namely: I) Manual of Good Environmental Sustainability Practices; Manual for Good Practices for Sustainable Energy Consumption; Manual for Good Practices for sustainable events [2].

### **2.2. Dashboards to Monitor Our Performance**

In April 2021, the UAveiro launched its new indicators portal, replacing the one that had been in place since 2006, completely changing the way data could be handled, accessed, displayed and used to support decision-making at different levels of the institution. The portal is the official repository of institutional indicators produced in the different areas of activity of the University. It is an important tool to support the management and decision-making of the University's bodies, as the information it contains allows for institutional self-knowledge. The Indicators Portal provides a wide range of indicators related to the different areas of the UAveiro mission (Figure 1). It supports course directors, unit directors, scientific coordinators, service directors, in addition to the Rectorate, but it is gradually being made available to a much larger group of academic actors, thus providing greater transparency of institutional data to support decision-making.



Figure 1. UI Greenmetric dashbord within UAveiro Indicators Portal  
 [Source: <https://indicadores.ua.pt/>]

### 2.3. University Footprint Calculator

"The University Footprint Calculator" provides HEI with a tool that enables the academic community to better understand natural resource management. Through simple metrics, actionable insights and analytical reports, it presents sustainability from a different perspective to help make informed decisions. In this context, UAveiro adopts this calculator, which was developed as part of the European project EUSTEPS, in which UAveiro was a partner. This project, in addition to the educational component, aimed at students and the academic community in general, developed a methodology to assess and support the reduction of the environmental impact of HEI.

The calculation of the Ecological Footprint of HEI is based on their consumption of natural resources and use of ecosystem services, allowing them to better identify areas for intervention to reduce the environmental impact of their activities. Additional benefits are: i) assessment and monitoring of ecological performance (natural resources and services); ii) identification the greatest impact and definition of intervention areas to reduce the environmental impact in institutional management; iii) development of an interactive tool to support analysis and raise awareness of the academic community.

### 2.4. UAUBike

UAveiro has promoted many innovative programmes for new approaches and solutions, as part of a series of investments aimed at making its campi more sustainable and bicyclefriendly. The UAUBike project, coordinated by UAveiro and funded by the national project U-Bike Portugal (2016-2022), aimed at promoting smooth mobility with a focus on bicycles. As an important measure, UAveiro purchased bicycles with long-term loans to encourage the shift from individual motorised transport to cycling, reducing primary energy consumption and emissions of greenhouse gases and air pollutants. The foreseen sustainable mobility was: i) promotion of the use of electric and conventional bicycles in academic communities; ii) change travel habits; iii) compromise to the reduction of primary

energy consumption; iv) compromise to the reduction of emissions of greenhouse gases and air pollutants. UAveiro has acted by encouraging sustainable behaviour and implementing solutions that address the challenges of energy and climate change and has even managed to exceed the proposed target for increasing the number of bicycle users. As part of this, Aveiro has recently opened a closed cycle park for its community.

## 2.5. Solutions for Sustainability Challenges

In line with the national strategy and the European Green Deal, UAveiro is committed to contributing to carbon neutrality and, in collaboration with its Technical Management Services, has carried out a survey and diagnosis of the main energy sources in UAveiro, to continue implementing measures to incorporate renewable energy and energy efficiency (Table 1). The following are examples of efficient energy management on campus.

Table 1. efficient energy management on campus - UAveiro energy capacity

Appliance	Total number energy Efficient appliances	Total Number	Percentage
Outdoor lighting (number of campi)	4	4	100%
Indoor efficient lighting (LED, Fluorescent) - (number of buildings)	3229	17309	19%
Indoor lighting (fluorescent lighting T5 with electronic ballasts) - (number of buildings)	9113	17309	53%
Indoor lighting (sensors) - (number of buildings)	17	107	15,9%
HVAC (number of units)	32	107	29,9%
Multifunction printer	150	150	100,0%
Routers, switches, servers, pcs, desktop, laptops, access points [%]	60%	100%	60,0%
<b>Average Percentage</b>			<b>53%</b>

As a result of the diagnosis, actions, and measures to incorporate renewable energies, UAveiro has its own production of photovoltaic solar energy:

- Maximum energy output (peak) (kWhp) - 250;
- Panel area (m<sup>2</sup>) - 1,325;
- Annual installed capacity - 200 MW/year.

By the end of 2021, UAveiro had replaced around 52% of all lighting with more efficient equipment, with 100% of outdoor lighting replaced with efficient equipment.

Table 2 shows the UAveiro estimated own production of renewable energy in 2022.

Table 2. UAveiro estimated own production of renewable energy in 2022

Installed capacity of the energy [kWh]	Energy Production [kWh]	Renewable Energy/ Total Electricity Consumption [%]	Total Electricity acquisition [kWh]	Renewable Energy/ Total Electricity acquisition [%]	Renewable Energy/ Total Electricity acquisition [%]	Photovoltaic Energy/ Total Electricity Consumption [%]
271 057,00	1 419 295	100%	<b>13 133</b>	<b>11%</b>	<b>10%</b>	<b>0,55%</b>
240 600,00		100%	<b>213,00</b>			
200 000,00	67 013,7	100%				
not determined	not available	not aplicable				
<b>12 083</b>	<b>1 486</b>	<b>11%</b>				
<b>782,78</b>	<b>308,64</b>					

## 2.6. Uaveiro Greenbulding's Project

The building waste has a major impact in what concerns to energy consumption and emissions [3] [4]:

- 40% of energy consumption
- 36% of CO2 emissions
- 30-50% of material use

Construction is responsible for 34% of European waste if looked at by source. The materials are for example Concrete, Bricks, Gypsum, Wood, Glass, Metals, Plastic and Solvents. [5]

The UaveiroGreenBuilding objective was to develop a solution that can contribute for a more sustainability building process. The aim of this project was to implement a methodology that introduces a measurable sustainability factor into the decision-making process of building designers at an early stage, in a practical way that facilitates the design process and allows an implementation of the circular economy principles in building process. It will also enable designers to measure and compare the environmental and economic impacts of different scenarios defined by the solutions under consideration. Simplifying the procedures to achieve this goal is important because it is in the interest of all stakeholders and technicians involved in design projects to incorporate the "circular way of thinking". The aim is to incorporate the principles of the circular economy as a friendly approach to the use of this tool, which does not lead to more work than usual, but to something that designers can easily refer to, regardless of their specific design processes. The project team, aware of the environmental impact of construction and rehabilitation and the need to repair, reuse, recycle and use materials with recycled content, is seeking to define future practices through pilot test cases at the University of Aveiro campus. As a result, this project will mainly lead to the development of a methodology for architecture and engineering that incorporates various tools into the decision processes, namely the construction and demolition waste management plan, the use of materials with recycled content, the definition of a control flow of the materials removed, the use of circularity passports and environmental product claims in deciding which components and solutions to use (Figure 2).

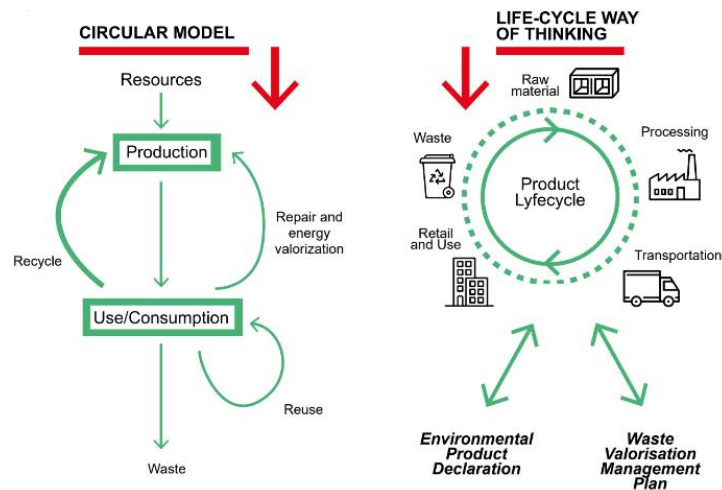


Figure 2. Sustainable decision-making assistance for construction or renovation project  
 Image source: Greenbuilding's project link <https://www.ua.pt/en/greenbuilding/resultados>)

## 2.7. Highlights for Research, Societal Engagement, Teaching, Cooperation and Governance

UAveiro has strengthened innovative actions to promote sustainability in key areas (e.g., research, engagement, teaching, collaboration and governance). Some relevant examples are [2]:

### Research

- **ERASMUS+ Think Twice:** foster ecological sustainability in european project management; ·
- **EMERGE:** evaluate, control, and mitigate the environmental impacts of shipping emissions and develop effective strategies and measures to reduce the environmental impacts of shipping;
- **BioChangeR:** evaluate the ability of microalgae from Ria de Aveiro to capture as much carbon as produced by 10,000 people; ·
- **MarRisk:** ensure smart and sustainable growth in costal adaptation to climate change: knowing the risks and increasing resilience;
- **InPaCTus:** presente innovative products and technologies from eucalyptus; ·
- **SUSPHOTOSOLUTIONS:** development of sustainable Photovoltaic Solutions, namely for PV energy conversion, including new solar cells based on non-critical materials with low toxicity;
- **CHARCLEAN:** aims to improve current knowledge about charcoal production in Portugal, including its economic and environmental relevance by technological upgrading of charcoal kilns to make them clean and resource efficient targeting a fire resilient economy in Portuguese rural areas.

### Societal Engagement

- Contribution via the participation of a researcher at the **Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change**. IPCC – 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis;
- Meeting on Energy and Environmental Economics (ME3) – **Sustainable Energy Communities**.

### Teaching

- **PhD Programme in Biology and Ecology of Global Changes;** · Curricular Unit Education

for Sustainability;

- **Doctorate** in Energy Systems and Climate Change;
- **Master** in Sustainable Energy Systems.

#### Cooperation

- **EUSTEPs:** the EUSTEPs sustainability teaching module for students from the different partner Universities;
- **Smart Green Homes project:** reinforce research, technological development, and innovation for homes, being developed in co-promotion between Bosch Termotecnologia S.A and the UAveiro;
- **INSTABAT:** Innovative sensor platform to monitor electric vehicle batteries.

#### Governance

- **Carbon neutrality** (strategic plan 2019-2022).

### 3. Future

HEI have a paramount role as enablers for social transformation towards the achievement of the UN Sustainable Development Goals for 2030. These represent an urgent call for measures, involving social responsibility and climate action, to promote environmental, social and economic commitment from local to global sustainable development.

Sustainability therefore tests our capacity for innovation and resilience - scientific, technological, social and cultural, in the context of global change. All future development of UAveiro should consider this structuring purpose, as an institutional opportunity and in this sense some commitments and initiatives assumed in the UAveiro Action Plan 2022-2026 are presented, namely

- **Zero carbon on campuses:** through a phased process, diversified interventions will be carried out that will focus on heating, glazing, lighting, electricity production, replacement of air treatment units and water efficiency. **Improve energy autonomy:** The energy consumption of the UAveiro is based on several energy sources. Electric energy has still a dominant weight, therefore requires special attention, which is why UAveiro will reduce the use of the public electricity grid. To this end, the photovoltaic capacity will grow in a phased manner, so that in the medium term the energy generated will be sufficient to supply most of the needs. **Reduce the impact of travel and mobility:** Reinforcement of awareness-raising actions for the use of more sustainable ways of traveling, favoring the use of non-polluting modes of transport, creating better conditions for their use, such as the recent closed car park for bicycles. It should be noted that UAveiro services already use bicycles for internal mobility and a new modality will be introduced (**Bike Sharing**).
- **Train and raise awareness of sustainability:** UAveiro provides training and information on sustainability, accessible to any member of the academic community, to stimulate community awareness and promote individual initiative, namely in the workplace and in the performance of functions.
- **Improving UAveiro's spaces:** new phase with the rehabilitation project of the Central Technical Area, which will become a collaborative workspace as well as a space for socializing and leisure with green spaces.



#### 4. Conclusion Or Concluding Remarks

All HEI should play a fundamental role in the journey towards sustainability, in terms of teaching, by including in the curricula ways of developing greater environmental awareness and new ways of looking at human existence; in terms of research, it is imperative to invest in clean technologies; in terms of governance, it is necessary to change strategies that transform each campus into more ecological, efficient spaces for discussing these issues. UAveiro has shown its commitment to sustainability throughout its history, as analysed here, and assuming it as one of the central pillars of its activity.

There has been a focus on R&D for more efficient products and processes that improve the use of increasingly scarce resources.

#### References

- [1] SDG Report 2021, University of Aveiro URL: <https://www.ua.pt/file/72346>, accessed: 04-28-2023
- [2] <https://www.ua.pt/pt/campusmaissustentavel/documentos>
- [3] Artola I. et al. (2016) "Boosting building renovation: potential value for Europe" [https://www.europarl.europa.eu/RegData/etudes/STUD/2016/587326/IPOL\\_STU\(2016\)587326\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2016/587326/IPOL_STU(2016)587326_EN.pdf)
- [4] Herczeg et. Al (2014) Resource efficiency in the Building Sector. URL: <https://ec.europa.eu/environment/eusds/pdf/Resource%20efficiency%20in%20the%20building%20sector.pdf>
- [5] European Commission URL: buildings-database, accessed: 04-28-2023



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