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Analysis of the integration of Sustainable Development Goals in the Industrial Engineering Degree

Gabriela Bracho[a*], Ana M. Pedrosa[a1], Elizaveta Klyatskina[a2], Julien Maheut[a3], Soledad Bernal-Perez[a4], Juan Giner-Navarro[a5]

[a]Universitat Politècncia de València, Camino de vera s/n, 46022 Valencia, Spain
*Corresponding author: gbracho@mot.upv.es, [1]anpedsan@dimm.upv.es, [2]elkl1@upv.es, [3]juma2@upv.es, [4]sbernal@die.upv.es, [5]juanginer@upv.es

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Abstract

Universities play a key role in transforming society, which necessarily leads them to promote the Sustainable Development Goals (SDG) laid down in the UN's 2030 Agenda. The *Escuela Técnica Superior de Ingeniería Industrial (ETSII)* of the *Universitat Politècnica de València* (UPV) is working on a project to design and develop strategies and interventions to include the SDGs in their degree courses. For this, the present paper proposes a map of the industrial subjects in both the BSc in Engineering in Industrial Technologies and the MSc in Industrial Engineering to determine how far the SDGs have been incorporated into these courses. An exhaustive review of the syllabus of the related subjects was carried out, together with a diagnosis of the current status of the SDG concepts so far included. The subsequent analysis of the data identified the possibilities of each subject to develop a sense of responsibility for educating students in the SDGs.

Keywords: SDG; university; educational innovation; industrial engineering

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1. Introduction

In 2015, the United Nations approved the document "Transforming our world: the 2030 Agenda for Sustainable Development" (United Nations, 2015), which is an ambitious global agreement that establishes goals and targets of great importance for humanity. The agenda, which defines an action plan that should guide the roadmap towards economic, social and environmental sustainability, proposes seventeen Sustainable Development Goals (SDGs) covering three pillars: the people, the planet and prosperity. The success of this pact requires the organized participation of different agents, including governments, universities, industries, scientists and society in general (Ramirez-Mendoza et al., 2020).

In this Agenda, universities have an essential mission in their daily tasks of education and research to ensure knowledge and development of competences to face the current challenges the world is facing (Halili et al., 2021). The guidelines for the implementation of the 17 SDGs in education are defined in “Accelerating Education for the SDGs in Universities: A guide for universities, colleges, and tertiary and higher education institutions” (SDSN, 2020), which recommends universities to incorporate the SDGs in their teaching, research, transfer and management (Ramirez et al., 2019). The universities must also act as agents to transform society (Llopis-Albert et al., 2022).

Several Spanish universities have made relevant progress in improving and adapting their education programs to integrate the SGDs, as is the case of the Universidad Politécnica de Madrid (UPM, 2019; UPM 2020), the Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV-EHU, 2022) and the Universidad de Valencia (UV, 2019). The Universitat Politècnica de València (UPV) is also committed to improving and adapting its education plan and has stated its commitment to sustainability in its Strategic Plan of the UPV 2015-2020 (UPV, 2014), referring to its Social Responsibility Plan, which expresses the university's environmental sustainability and social commitment.

Aware of the importance of contributing to the achievement of the objectives proposed by the 2030 Agenda, the UPV’s School of Industrial Engineering (ETSII in Spanish) stated its commitment

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to the SDGs in its Strategic Plan 2021-2025 (ETSII, 2020), which identifies Sustainability, Innovation and Teaching as relevant challenges. Including the SDGs in the ETSII BSC and MSc degrees is expected to develop engineering professionals' commitment to sustainability. The first step was to determine what was being done to include SDG promotion activities.

This paper diagnoses the current situation and proposes a methodological guideline to incorporate the SDGs into the study plans.

The paper is organized as follows: Section 2 describes the method used to evaluate the current level of SDG implementation in the Industrial Engineering School's degree courses. Section 3 gives the results of the study in two parts: the first includes a map of the goals included and the second describes the potential of the subjects to incorporate the SGDs. The last section deals with the main conclusions and future work.

2. Method

The implementation of the SDGs in the curricular degree courses requires the design of new activities to make significant changes in the teaching and learning process, which needs a rigorous and clear method. According to the recommendations of the "Sustainable Development Solutions Network" guide (SDSN, 2020) the following five steps are proposed:

- Step 1: Map what you are already doing.
- Step 2: Build the capacity and ownership of the SDGs.
- Step 3: Identify priorities, opportunities and gaps.
- Step 4: Integrate, implement and embed the SDGs.
- Step 5: Monitor, evaluate and communicate.

The first two steps recommended by the SDSN were carried out in the subjects of the BSc in Industrial Technology Engineering (GITI in Spanish) and MSc in Industrial Engineering (MUII). The methodology followed is applicable to other degrees and subjects.

For the sake of practicability, a small group of observers have performed the analysis. To do this, they previously studied the SDGs, as well as their goals. The observers knew the subjects but

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did not teach all of them. In this way, it has been possible to underestimate or overestimate the potential of work of the ODSs in some cases. However, this weakness can be overcome in the implementation step, in which the teachers of each subject, based on this study, can adjust the estimation and propose the activities that best suit their subjects.

2.1. Industrial Engineering degree

The BSc and MSc train students to become professionals capable of designing, building, maintaining and managing equipment and industrial facilities in both the traditional and the expected future areas. The Bachelor's degree is completed in 4 academic years, with a total course load of 240 credits (ECTS). The subjects are distributed between 6 modules plus a Bachelor's Thesis (TFG): the Basic Training Module includes subjects common to the Industrial Branch Module, an extension of the basic training block, technology module, transversal elective block and languages. Each module may have one or more subjects. This structure can respond more effectively to achieving the training objectives and complies with the Spanish national guidelines (established in the RD 1393/2007). Figure 1 summarizes the distribution of modules and credits.

The objective of the curriculum is to give a general engineering training in industrial technologies. Professionals with this profile are trained in a broad spectrum of both the traditional and new technologies. The goal is to ensure they acquire a complete training in the physical and mathematical engineering fundamentals.

This degree incorporates a general education in all the industrial technologies to facilitate the best adaptation to the MSc in Industrial Engineering, which qualifies graduates to become Industrial Engineers in Spain.

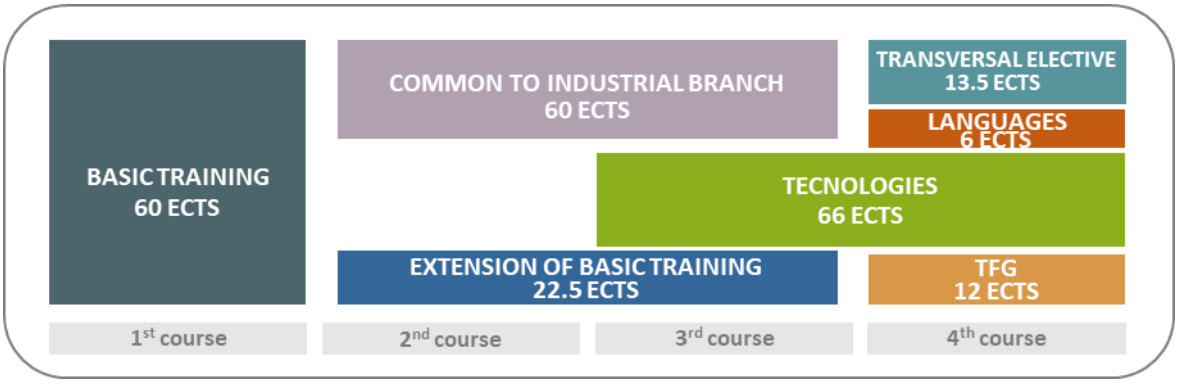

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Figure 1. Structure of the BSc degree subjects

With an MSc, graduates can become recognized Industrial Engineers in Spain. The regulations establish the minimum blocks that the degree course must cover and specify the competences and number of credits in each block, including: Industrial Technologies, Management and Installations, Plants and Complementary Constructions, plus a Master's Thesis. To comply with these guidelines, the UPV's MSC degree course is divided into two sections that depend on the student's BSc. There are two possible access routes, through the reference degree (GITI) or through other degrees in the industrial branch. Figure 2 illustrates the structure of the MSc.

The Study Plan ensures that students attain the competences established in the Ministerial Order through the 12 core subjects and the Master's Thesis (MT). Regardless of the type of access, all the students must take the same core subjects and have an MT. In the 2021-2022 academic year, more than 300 students were enrolled in core subjects (335 on average), while there was an average of 21 in the rest of the subjects.

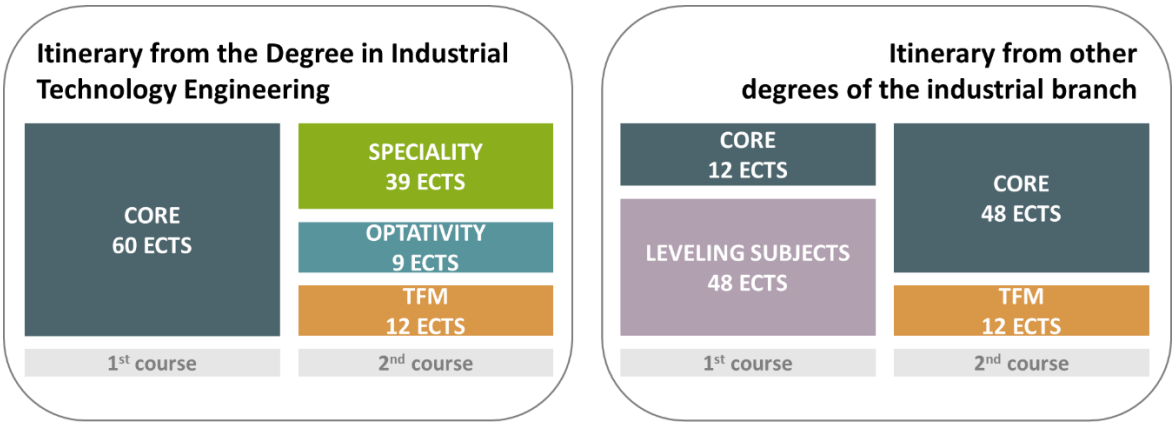

Figure 2. Structure of the Master's degree subjects

In this first phase, the analysis of the SGD implementation is based on the review of the syllabus of the core subjects, since they are the ones that affect all the students in the MSc course.

2.2. Indicators to quantify the degree of implementation of the SDGs in the Industrial Engineering subjects

The review of the syllabus was carried out from two points of view: the information related to the current situation reflected in the syllabus was first collected, after which the subject's potential

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contribution to the SDGs was identified and later used for planning activities in future courses. Tables 1 and 2 show the criteria used in each step to collect the required information.

Table 1 Score used to map the current situation of SDG studies on the subject

Score	Description
0	Not developed in the subject
1	Is developed in the subject, but is not mentioned in the syllabus
2	Developed in the subject and explicit in the syllabus

Table 2 Score used to diagnose the potential of SDG studies on the subject

Score	Description
0	Not related to the subject
1	Some contents partially related in the subject
2	Some contents totally related to the subject

3. Results

This section gives the result of the study on the compulsory subjects of the BSc degree in Industrial Engineering (GITI) and the core subjects of the MSc degree in Industrial Engineering (MUII). To analyze the information, the subjects were grouped into blocks according to their affinity with each SDG field. The GITI and MUII curriculums can be consulted on the ETSII website.

The results are given in tables that summarize the information for each subject, including: the year, semester, number of ECTS and the diagnosed potential link with each SDG. These tables map the level of SDG activity or implementation in the different activities in the subjects, based on the rankings in Tables 1 and 2. A score of 1 is shown in light gray, 2 in dark gray. Each SDG has two columns in the charts, one is for the diagnosis (D) and the other for the potential (P).

Goals 1 and 5 were excluded from the results since they had no connection to any of the subjects analyzed, while SDG 4 is an objective covered in all the subjects. As this study is within the scope of a higher degree, there is an innate motivation to offer quality teaching, an aspect further reinforced by the technological nature of the degrees analyzed.

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The main conclusions drawn from the study are given after the mapping, identifying the strengths and weaknesses of the SDG implementation in the degree course. The aim was to generate a database with organized information that could be put into practice in implementing the SGDs.

3.1. Diagnosis of current SDG implementation and potential in BSc subjects

This section describes the analysis carried out on the GITI. The bachelor's degree subjects are grouped into six blocks: Mathematics, Mechanics, Electricity, Electronics, Fluids and Environment. The following subsections show the maps for each block and details of the Diagnosis and the Potential identified in these activities for SGD promotion.

3.1.1. Mathematics Block

- **DIAGNOSIS**: Table 3 shows that this block has the poorest connection with the SDGs because it deals with the fundamental sciences. The only subject with an activity related to the SDGs is Statistics, which provides the tools for scientific research, associated with Target 9.5.

Table 3 Diagnosis (D) of the current implementation of SDG and potential (P) for their implementation in the subjects in the Mathematics Block. Score: □ 0; ■ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Mathematics	1 A	Computer Science	6											■																	
	1 A	Mathematics I	9																												
	1 B	Statistics	6											■																	
	1 B	Mathematics II	6																												
	2 A	Mathematics III	6																												
	2 B	Mathematical Methods	6									■																			
	3 B	Operations Research	4,5													■															

- **POTENTIAL**: The block itself constitutes part of the basic scientific and technological tools such as statistical analysis or the development of indicators, and thus includes examples of solving real problems related to Target 9.5 in Goal 9. In *Operations Research*, working with multi-criteria programming tools can be used in the

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development of actions or content related to the reduction of inequalities referred to in Target 10.3.

3.1.2. Mechanics Block

Table 4 gives a summary of the results of the diagnosis and potential for SDG implementation the Mechanics Block subjects.

- **DIAGNOSIS:** The subjects related to the mechanical field analyzes the characteristics of raw materials and their transformation processes, as well as the manufacture of industrial components. These processes are closely related to goals 8, 9, 12 and 17. In particular, with Target 8.2 and its contribution to the comprehensive and diverse training of the industrial branch of engineering, and with Target 8.4 and efficient resource consumption. The introduction of numerical calculation software to raise the students' technological capacity is also linked to Target 9.5. Target 12.5, related to waste reduction, is worked on in the subjects that provide the future engineer with technological knowledge in the field of mechanics that teaches them to develop effective designs. The ecological impact of the rational use of raw materials, specified in target 17.7, is also worked on in one of the years.

  On the other hand, the subjects in this block introduce the use of computer tools, which are fundamental for completing reliable studies. It provides students with the resources to develop critical reasoning to prepare technical reports from the results and conclusions obtained. This type of activities promote creativity in resolving new challenges, while at the same time they introduce students to the concept of ethical responsibility as professionals with regard to human and material resources. This approach is fully aligned with Target 9.5 in Goal 9.

  One of the subjects has activities that deal with the pollution derived from the processes for obtaining primary materials, which is linked to Target 3.4. It also involves contents related to Goal 7, since one of the units is dedicated to the search for new energy sources for the production of materials. It introduces new lines of research in cleaner industrial processes, an aspect related to Goal 13.

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Table 4 Diagnosis (D) of the current implementation of SDG and potential (P) for their implementation in the subjects in the Mechanics Block. Score: □ 0; ■ 1; ■ 2.

BLOC	Year		Subjects	ECTS	SDG2 Zero Hunger D	SDG2 P	SDG3 Good Health and Well-being D	SDG3 P	SDG6 Clean Water and Sanitation D	SDG6 P	SDG7 Affordable and Clean Energy D	SDG7 P	SDG8 Decent Work and Economic Growth D	SDG8 P	SDG9 Industry, Innovation and Infrastructure D	SDG9 P	SDG10 Reduced Inequality D	SDG10 P	SDG11 Sustainable Cities and Communities D	SDG11 P	SDG12 Responsible Consumption and Production D	SDG12 P	SDG13 Climate Action D	SDG13 P	SDG14 Life Below Water D	SDG14 P	SDG15 Life on Land D	SDG15 P	SDG16 Peace and Justice Strong Institutions D	SDG16 P	SDG17 Partnerships to achieve the Goal D	SDG17 P
Mechanics	1	A	Physics I	9																											
	1	B	Technical Drawing	6																											
	2	A	Materials Science	4,5			■				■		■	■	■						■	■		■							
	2	B	Theroy of Machines	4,5												■															■
	2	B	Elasticity and Strength of Materials	4,5												■			■		■		■								
	3	A	Structures	6												■															■
	3	A	Machine Design Technology	6									■		■	■					■	■									
	3	B	Materials Technology	4,5			■	■			■	■	■	■	■	■						■	■	■							■	
	4	A	Construction Technology	4,5																	■										
	4	A	Engineering Graphics	4,5											■	■															

- **POTENTIAL:** Writing technical reports based on mechanical fundamentals could contribute to Goal 17 by potentially disseminating knowledge of industrial technologies to both specialized and non-specialized audiences, as could be the case in developing countries, as stated in Target 17.7.

  It is also of interest to introduce the concept of materials' life cycles, which could be strengthened as it is closely related to the efficient use of raw materials. There is also a potential in the study of the recycling of waste products of mechanical components, both during the manufacturing stage and at the end of their life. All these aspects are related to Goals 3, 7, 8,9, 12 and 13.

3.1.3. Electricity Block

- **DIAGNOSIS**: Table 5 summarizes the results of SDG implementation in the Electricity Block. It can be seen that one fourth year subject has didactic units related to Goal 7, developing concepts to improve machine and power cycle efficiency, together with the study of renewable energies and sustainable fuels. Goal 9 is included

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in three subjects due to their direct link with industry, the operation, management and maintenance of machines and industrial processes.

Table 5 Diagnosis (D) of the current implementation of SDG and potential (P) for their implementation in the subjects in the Electricity Block. Score: ☐ 0; ■ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Electricity	2 A	Physics III	6								■				■				■				■								
	3 B	Electrical Machines	4,5								■				■																
	4 A	Energy Technology	4,5							■	■				■																
	4 A	Electrical Technology	6								■				■				■		■										

- **POTENTIAL:** Great potential is seen for implementing activities that include different SDGs in the subjects in this block. It would be reasonable to expand the content related to the application of different renewable technologies (ODS7, non-polluting energy) with less environmental impact. On the other hand, regarding the distribution of electrical energy addressed in the subject of *Electric Technology*, it would also be very constructive to address activities towards intelligent distribution networks or smart grids, which contribute to Goals 7, 11 and 12.

3.1.4. Electronics Block

- **DIAGNOSIS**: Table 6 shows the concentration of activities related to Goal 9 in different subjects of the higher courses due to its link with the industrial field in the Bachelor's degree, which is fully aligned with the targets of SDG 9 (Industry, Innovation and Infrastructure).

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Table 6 Diagnosis (D) of the current implementation of SDG and potential (P) for their implementation in the subjects of Electronics Block. Score: ☐ 0; ▒ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Electronics	2 B	Circuit Analysis	4,5												▒																
	3 A	Control Systems	4,5				▒		▒		▒			▒	▒				▒		▒		▒								
	3 A	Electronic Systems	4,5											▒	▒																
	3 B	Control and Automation Technology	6				▒		▒		▒			▒	▒				▒		▒		▒								
	3 B	Electronic Technology	6								▒			▒	▒				▒												
	4 B	Industrial Informatics Technology	4,5										▒		▒																▒

- **POTENTIAL:** The potential observed is very interesting, since it is possible to contribute up to eight SDGs in addition to the previous one, highlighting the possibilities in SDGs 7, 9 and 11, especially in the subjects of electronics and automation. In most of the subjects in this block, the resolution of problems and practices could be oriented towards the application of automation and computer science to design industrial control and automation systems, as well as communication networks, including examples related to Goals 3, 6 12 or 13.

  The highest potential for improvement is in the *Control Systems* and *Control and Automation Technology* subjects in relation to the application of the goals in 11 (Sustainable Cities and Communities) and 7 (Affordable and Clean Energy).

3.1.5. Fluids Block

- **DIAGNOSIS**: The subjects in this block deal with content specific to Goals 6, 7 and 11. All the subjects contain content closely related to the use of industrial resources, which Target 9.9 seeks use more efficiently.

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Table 7 Diagnosis (D) of the current implementation of SDG and potential (P) for their implementation in the subjects in Fluids Block. Score: ☐ 0; ▒ 1; ■ 2.

BLOC	Year	Subjects	ECTS	Zero Hunger SDG2 D	Zero Hunger SDG2 P	Good Health and Well-being SDG3 D	Good Health and Well-being SDG3 P	Clean Water and Sanitation SDG6 D	Clean Water and Sanitation SDG6 P	Affordable and Clean Energy SDG7 D	Affordable and Clean Energy SDG7 P	Decent Work and Economic Growth SDG8 D	Decent Work and Economic Growth SDG8 P	Industry, Innovation and Infrastructure SDG9 D	Industry, Innovation and Infrastructure SDG9 P	Reduced Inequality SDG10 D	Reduced Inequality SDG10 P	Sustainable Cities and Communities SDG11 D	Sustainable Cities and Communities SDG11 P	Responsible Consumption and Production SDG12 D	Responsible Consumption and Production SDG12 P	Climate Action SDG13 D	Climate Action SDG13 P	Life Below Water SDG14 D	Life Below Water SDG14 P	Life on Land SDG15 D	Life on Land SDG15 P	Peace and Justice Strong Institutions SDG16 D	Peace and Justice Strong Institutions SDG16 P	Partnerships to achieve the Goal SDG17 D	Partnerships to achieve the Goal SDG17 P
Fluids	1 B	Physics II	6											▒	▒																
	2 A	Thermodynamics	4,5							▒	■			▒	■																
	2 B	Heat Transfer	4,5							▒	■			▒	■																
	2 B	Fluid Mechanics	4,5					▒	■	▒	■			▒	■																
	3 B	Thermal Machines	4,5							▒	■			▒	■																
	4 A	Hydraulic machines	4,5					▒	■	▒	■			▒	■			▒	▒												

- **POTENTIAL:** Table 7 shows that the number of subjects currently working on SDGs and those with potential coincide. To improve the current situation, it is recommended to further promote and explicitly demonstrate their close relationship with the related SDGs.

3.1.6. Environment Block

- **DIAGNOSIS**: Table 8 shows the results of the current situation. The subjects in this block have a direct impact on the ethical, environmental and professional responsibility of future engineers, closely related to Goals 3,6, 17. Other SDGs such as 7, 9 and 13 are also directly linked due to their scope of application. The business subjects involve knowledge on business sustainability, which Goal 8 is based on. The scope of the subject of environmental technology is very broad and is completely aligned with the spirit of the 2030 Agenda. This subject is currently linked to the largest number of SDGs.

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Table 7 Diagnosis (D) of the current SDG implementation and potential (P) for SDG implementation in subjects in the Environment Block. Score: ☐ 0; ▒ 1; ■ 2.

BLOC	Year		Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Environment	1	A	Industrial Business and Economy	6							▒	▒	▒	▒								■									▒	■
	1	B	Chemistry	6			▒	■	▒	■	▒	■		▒	▒	▒						■	▒	■	▒		▒				▒	
	2	A	Fundamentals of Business Organization	4,5		▒		▒		▒		▒	▒	▒	▒	▒				▒		▒		▒				▒	▒		▒	
	3	A	Production and Manufacturing Systems	4,5											▒	▒																
	3	A	Environmental Technology	4,5				▒	▒	▒	▒		▒		▒	▒			▒	▒	▒	▒	▒	▒			▒	▒		▒		
	4	A	Engineering Projects	6											▒						■											■

- **POTENTIAL:** Despite being the block most closely aligned with the SDGs, its potential is even greater than that currently shown in the curriculum, as in the case of the relationship between the application of environmental technologies and sustainability with Goals 7, 8 and 17. The issues of safety in the laboratory and the recycling of chemical products are also related to Goals 3, 6, 8, 14 or 15. The potential relationship with Goal 12, specifically with Target 12.6, is based on the possibility of considering the recycling of goods or industrial equipment in the preparation of budgets. In *Engineering Projects*, different types of project are analyzed, which is an opportunity for the students to identify each type with the SDGs and become familiar with them. Business organization strategies are valid for eradicating problems as serious as hunger (SDG 2), the management of public resources (SDG 11) or the design of strong institutions (SDG 16).

3.2. Diagnosis of current implementation and potential of SDGs in the subjects of the Master's degree

This section gives the results of the evaluation of the MSc subjects (MUII). After reviewing the Teaching Guide for the subjects, various SDGs were found in the courses, although none of them is explicitly mentioned in their description. SDG 9 was given the most attention in six of the subjects analyzed, in agreement with the technical and industrial nature of the degree. Continuing in

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descending subject order, SDGs 8 and 12 are included in four subjects, SDG 7 in three and, lastly, SDGs 3 and 6 have some activity linked to one subject.

To be consistent with the evaluation of the BSc degree subjects, SDG 4 was excluded from the charts, since all the subjects in the Study Plan aim to increase the students' technical and professional skills, to ensure access to a decent job, in alignment with Target 4.4.

The potential was categorized according to the relationship between the didactic units taught, the possible adaptation of academic activities indicated in the teaching guides and the targets of the different SDGs.

3.2.1. Management and Control Block

- **DIAGNOSIS**: Table 9 details the SDGs worked on in the four subjects in the block (under Column D of each goal). The contents of *Operations Management*, *Management*, and *Project Management* are related to Targets 8.4, 9.B and Goal 12, among others. *Industrial Instrumentation and Control* can be related to Goal 9. The specific objectives that could be included are linked to Target 9.4, in the instrumentation and control systems of industrial processes for structural modernization. It could also be linked to Target 9.C, focused on access to clean technology and information and communications technology.

Table 9 Diagnosis (D) of the current SDG implementation and potential (P) for implementation of the SDGs in the Management and Control Block. Score: □ 0; ▒ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 P	SDG3 Good Health and Well-being D	SDG3 P	SDG6 Clean Water and Sanitation D	SDG6 P	SDG7 Affordable and Clean Energy D	SDG7 P	SDG8 Decent Work and Economic Growth D	SDG8 P	SDG9 Industry, Innovation and Infrastructure D	SDG9 P	SDG10 Reduced Inequality D	SDG10 P	SDG11 Sustainable Cities and Communities D	SDG11 P	SDG12 Responsible Consumption and Production D	SDG12 P	SDG13 Climate Action D	SDG13 P	SDG14 Life Below Water D	SDG14 P	SDG15 Life on Land D	SDG15 P	SDG16 Peace and Justice Strong Institutions D	SDG16 P	SDG17 Partnerships to achieve the Goal D	SDG17 P
Management and control	1 A	Operations Management	4,5									▒	■	▒	▒					▒	■										
	1 A	Management	6									▒	■		▒					▒	▒										
	1 A	Industrial Instrumentation and Control	4,5								▒				▒																
	1 B	Project Management	4,5									▒	▒	▒	▒					▒	▒										

- **POTENTIAL**: *Operations Management* and *Management* are fully aligned with SDG 8. *Project Management* is a key subject since it is focused on the development of

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Industrial Engineering projects. This makes it a strategic subject for students to address goals contained in various SDGs, such as:

SDG 8: related to Target 8.2, which seeks to increase productivity through diversification, technology and innovation, and Target 8.4, which aims to improve efficient and respectful production and consumption.

SDG 9: achieving increased scientific research and technological capacity.

SDG 12: addressing the efficient use of natural resources and supporting sustainability based on science and technology.

Operations Management can be included in this line of work, since, among the skills to be developed, students must acquire knowledge and strategy and planning skills applied to different organizational structures. They also acquire skills in work organization and human resources and learn how to apply occupational risk prevention. All these competencies are connected to the targets previously discussed for SDGs 8 and 12.

Management works with four different SDGs. The different units, competencies and activities enable work on Targets 8.4 and 12.6, through sustainable production and consumption patterns. The didactic units of both business management planning and strategic plans can be oriented towards this goal, while Target 8.4 is included in one didactic unit that describes management by processes. SDG 9 can also be included in the topics of I+D innovation and management throughout the entire course. *Manufacturing Technologies* could also be included in Target 8.4.

3.2.2. Construction and Industrial Technology Block:

- **DIAGNOSIS**: The SDGs in this block are summarized in Table10. Targets 9.1 and 9.4 are included in *Manufacturing Technology*, *Construction, Architecture and Industrial Urban Planning* and *Design and application of industrial equipment*. in the contents of *Manufacturing Technology* allow working on Target 8.4. The *Industrial Chemical Technology* course has also contents that refer to Targets 3.9, 12.2 and 12.4.

  Design and application of industrial equipment is a subject in which two SDGs are linked to the *Final Degree Project*, in which students must carry out a practical study on a real company with an analysis of optimization processes or improvements in handling systems and/or goods transport inside industrial facilities and demonstrate

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familiarity with contemporary problems. They must apply the SDG principles and choose the most appropriate to improve current conditions as well as the principles of industry 4.0. All these aspects are aligned with SDGs 8 and 9.

Table 10 Diagnosis (D) of current SDG implementations and their potential (P) in the subjects in the Construction and Industrial Technology Block. Score: □ 0; ▒ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Construction & Industrial technology	1 A	Manufacturing Technology	4,5									▒	▒																		
	1 B	Construction, Architecture and Industrial Urban Planning	5,25									▒	▒	▒	■					▒											
	1 B	Design and application of industrial equipment	7,5									▒	▒	▒	■																
	1 B	Industrial Chemical Technology	4,5			▒	▒							▒	▒					▒	▒		▒								

- **POTENTIAL**: Although *Industrial Chemical Technology* does not explicitly mention it in its course description, this could be related to various goals. It has potential to work on Target 3.9, focused on handling of hazardous chemical products. It also has didactic units aligned with Targets 12.2, 12.4 and 12.5 focused on reducing waste through recycling, which also has a medium-term impact on SDG 13.

  Construction, Architecture and Industrial Urban Planning is a subject that, although it does not mention the SDGs, like most of the subjects, its content is strongly linked to SDG 9, which focuses on industry, innovation and infrastructure, since its didactic units focus on the fundamentals of developing construction projects, infrastructures and urban planning.

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3.2.3. Process and Industrial Systems Block

- **DIAGNOSIS**: Table 11 shows a diagnosis and the potential for working on the SDGs in the Process and Industrial Systems Block. In *Heating, Cooling and Air Conditioning*, activities are carried out related to Targets 7.3 and 7.B. This is complemented by the units in *Fluid Systems Engineering*, which develops content aligned with Goals 6.5 and 9.5. *Advanced Energy and Thermal Machines* works on Targets 7.3 and 7.A, linked to the field of energy efficiency, research and investment in clean energy, respectively. Goal 7 is adequately covered in *Generation, Transmission and Distribution of Electric Power*. Although in the 2020-21 academic year the course description did not mention the SDGs, the course outline included an analysis of the advantages of generating part of the energy consumed through cogeneration or renewable energy and the associated costs. It also includes information about the processes involved in generation, transport and distribution of electrical energy.

As Fluid Systems Engineering is based on fluid mechanics and hydraulic engineering, it therefore has a relevant relationship with numerous SDGs. Hydraulic engineering is directly or indirectly related to thirteen SDGs and 69 targets, and the subject works on Goals 6 and 7. It analyzes distribution systems of liquids and gases in both external and internal networks. Through the project they must carry out within the subject, students work on the design, selection and regulation of different facilities.

Table 11 Diagnosis (D) of SDG current implementation and potential (P) for their implementation in the Process and Industrial Systems Block. Score: □ 0; ■ 1; ■ 2.

BLOC	Year	Subjects	ECTS	SDG2 Zero Hunger D	SDG2 Zero Hunger P	SDG3 Good Health and Well-being D	SDG3 Good Health and Well-being P	SDG6 Clean Water and Sanitation D	SDG6 Clean Water and Sanitation P	SDG7 Affordable and Clean Energy D	SDG7 Affordable and Clean Energy P	SDG8 Decent Work and Economic Growth D	SDG8 Decent Work and Economic Growth P	SDG9 Industry, Innovation and Infrastructure D	SDG9 Industry, Innovation and Infrastructure P	SDG10 Reduced Inequality D	SDG10 Reduced Inequality P	SDG11 Sustainable Cities and Communities D	SDG11 Sustainable Cities and Communities P	SDG12 Responsible Consumption and Production D	SDG12 Responsible Consumption and Production P	SDG13 Climate Action D	SDG13 Climate Action P	SDG14 Life Below Water D	SDG14 Life Below Water P	SDG15 Life on Land D	SDG15 Life on Land P	SDG16 Peace and Justice Strong Institutions D	SDG16 Peace and Justice Strong Institutions P	SDG17 Partnerships to achieve the Goal D	SDG17 Partnerships to achieve the Goal P
Process and Industrial Systems	1 A	Heating, Cooling and Air Conditioning	5,25							■	■			■	■				■												
	1 A	Fluid Systems Engineering	4,5					■	■					■					■		■										
	1 B	Power	4,5							■																					
	1 B	Advanced Energy and Thermal Machines	4,5					■	■	■	■				■								■								

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- **POTENTIAL**: The content of *Heating, Cooling and Air Conditioning* is totally aligned with SDG 7 and there is also the possibility of students working with SDG 9 and SDG 11. One of the subject's units is focused on refrigeration, considering refrigerant fluids and cycle efficiencies. This unit can be related to Targets 7.3 and 7.B while working with industrial technologies makes it possible to relate it to Targets 9.1 and/or 9.4. The design of domestic air conditioning systems can be related to some targets in SDG 11.

3.3. Analysis of the Potential to work on the SDGs in the subjects

3.3.1. Degree in Industrial Technology Engineering

As in the previous section, the analysis was carried out by classifying the subjects into blocks.

Mathematics Block: The subjects in this block are part of the basic of technological tools such as statistical analysis or the development of indicators, so that it could include examples of solving real problems related to SDGs 9, 12 or 13.

Mechanics Block: Writing technical reports based on mechanical knowledge could contribute to SDG 17 by disseminating industrial technologies to both specialized and non-specialized audiences, as in the case in developing countries, as included in Target 17.7. It is also of interest to introduce the concept of the life cycle of materials, which could be enhanced by being closely related to the efficient use of raw materials, energy resources and the potential recycling of waste products, both during the manufacturing stage and at the end of their useful life. All these aspects are related to SDGs 3, 7, 8, 9, 12 or 13.

Electricity Block: There is here a considerable potential for working on different SDGs. With respect to energy production, it would be reasonable to expand content related to the application of renewable technologies (SDG7, clean energy) with lower environmental impacts. Regarding the distribution of electrical energy addressed in *Electrical Technology*, it would also be constructive to address activities involving smart grids, which would contribute to SDGs 11, 12 and 7.

Electronics Block: The potential here is interesting, as it can contribute to eight SDGs in addition to the two previous ones, highlighting the possibilities of SDGs 7, 9 and 11, especially in the subjects of Automation.

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Fluids Block: The number of subjects in which work is currently being done in this block have further potential. It also shows an improvement in the sense that it is possible to further promote and explicitly demonstrate this close relationship with the related SDGs.

Environment Block: This block has greater potential than is currently evident in the SDGs. This is the case of the relationship between the application of environmental technologies and sustainability with SDGs 7, 8 and 17. The issues of safety in the laboratory and the recycling of chemical products are also related to SDGs 3, 6, 8, 14 or 15. The potential relationship with SDG 12, specifically with target 12.6, is based on the possibility of increasing the recycling of industrial goods or equipment. In the subject of projects, different types of projects are presented, which is an opportunity for students to be acquainted with each type.

3.3.2. MSc degree in industrial technology engineering

Although it can be seen that each subject can potentially work on a minimum of two SDGs, according to the teachers' assessment, not all subjects have the potential to cover a homogeneous number of SDGs. Subjects such as *Industrial Chemical Technology* or *Energy and Thermal Machines II* lend themselves to covering more SDGs than others, such as *Manufacturing Technologies* or *Generation, Transport and Distribution of Electrical Energy*. It can also be seen that the intrinsic characteristics of the subjects do not allow work on all the existing SDGs. We consider that eight of the SDGs (1,2,5,10,14,15,16 and 17) could not be covered in the current situation without adjusting the didactic units or substantially modifying the proposed training activities. However, we do consider that SDG 4 is covered, due to the nature of the technical subjects taught and we consider that SDG 9 could be worked on in up to 10 of the 12 subjects. It should also be noted that some subjects have a content naturally aligned with the SDGs. For example, *Fluid Installations* has content aligned with SDG 6 (Clean Water and Sanitation) and *Energy and Thermal Machines II* is naturally aligned with SDG 7 (Affordable and Clean Energy). On the other hand, SDG 8 has 2 fully linked subjects: *Operations Management* and *Business Management*, while SD 9 is naturally covered by *Industrial Construction, Architecture and Urban Planning and Design and Application of Industrial Equipment*.

It should also be noted that some SDGs could potentially be addressed by a small number of subjects. While SDG 3 (Health and Wellbeing) can only be addressed through *Industrial Chemical*

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Technology, SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) could be partially covered by two different subjects.

4. Conclusions

The present work has addressed a wide-ranging review of the teaching guides of industrial subjects in two of the UPV's degree courses to determine the weights they carry in the current configuration of their contents. The analysis of the data obtained indicates that there is a potential to significantly extend the number of subjects in which the SDGs are currently included. Future actions to be implemented consist of, firstly, making the specific SDGs being worked on directly or indirectly in each subject explicit in the teaching guides and, secondly, applying the remaining SDGs with which it is partially or totally linked in the academic content of each subject. The specific training of teachers in SDGs for this curricular adaptation is seen as necessary to be able to trace these potentialities in the industrial area, hence reducing any imbalance between the actions implemented and the potential observed.

Degree in Engineering in Industrial Technologies (GITI)

- Despite having grouped the subjects into blocks, an increasing connection of the subjects with the SDGs was detected as the courses progress and the contents are more specialized.
- SDG 4 is the most implemented in the industrial subjects, especially in the first years due to its being more generic.
- The greatest potential detected appeared in matters related to the environment, such as the exploitation of natural resources (especially water and those with an environmental effect), in which a considerable number of SDGs are being worked on and we even detected a possibility of exploiting this link more explicitly.
- The teaching guides in the Electricity and Electronics blocks do not mention or establish developing SDGs in fields as related as those of sustainable energy and the intelligent distribution of energy resources.

MSc Degree in Industrial Engineering (MUII)

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- At least one SDG is worked on in all the subjects in the core block, 25% have 3 SDGs in their teaching guides and 25% reach 4 SDGs, indicating the increasing joint effort and coordination to update the focus of the subjects throughout the degree course.
- SDG 4 (Goal 4.4) stands out in the teaching guides, since it is included in all the core subjects, indicating the commitment to quality of the ETSII in planning studies and their relationship with the SDGs.
- The fact that 50% of the core subjects work on SDG 9 (Goals 9.1 and 9.4) and a third develop other skills related to SDG 8 (Goals 8.2 and 8.4) show the relationship between the SDGs and the activities carried out in the industrial and technological field.

The participants of this study are satisfied with the results of SDGs implementation in Industrial Engineering subjects. It is also expected to be able to quantify more precisely the level of satisfaction of the different actors of the teaching-learning process in the next stages of the project.

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References

ETSII. (2020). *Plan Estratégico ETSII 2021-2025.* Escuela Técnica Superior de Ingenieros Industriales (ETSII). Universitat Politècnica de València. Valencia. Spain. https://www.etsii.upv.es/presentacion/documentos/Plan_estrategico_21-25.pdf

ETSII. (2022). *Titulaciones*. Escuela Técnica Superior de Ingenieros Industriales (ETSII). Universitat Politècnica de València. Valencia. Spain. https://www.etsii.upv.es/docencia/titulaciones-es.php.

Halili, S.H., Sulaiman, S. (2021). Students' perception to integrate education 4.0 in Science program. *Multidisciplinary Journal for Education, Social and Technological Sciences*, 8(1), 45-57. https://doi.org/10.4995/muse.2021.14768

https://doi.org/10.4995/muse.2023.18898
e-ISSN: 2341-2593

Llopis-Albert, C., Rubio, F., Zeng, S., Grima-Olmedo, J, Grima-Olmedo, C. (2022). The Sustainable Development Goals (SDGs) applied to Mechanical Engineering. *Multidisciplinary Journal for Education, Social and Technological Sciences*, 9(1), 59-70. https://doi.org/10.4995/muse.2022.17269

Ramirez, M., Romero, O., Schot, J., Arroyave, F. (2019). Mobilizing the Transformative Power of the Research System for Achieving the Sustainable Development Goals. *SWPS* 2019-25. http://dx.doi.org/10.2139/ssrn.3497623

Ramirez-Mendoza, R.A., Morales-Menendez, R., Melchor-Martinez, E.M., Iqbal, H., Parra-Arroyo, L., Vargas-Martínez, A., Parra-Saldivar, R. (2020). Incorporating the sustainable development goals in engineering education. *International Journal on Interactive Design and manufacturing,* 14, 739–745. https://doi.org/10.1007/s12008-020-00661-0

SDSN. (2020). Accelerating Education for the SDGs in Universities: A guide for universities, colleges, and tertiary and higher education institutions. *Sustainable Development Solutions Network* (SDSN). New York. USA. https://resources.unsdsn.org/accelerating-education-for-the-sdgs-in-universities-a-guide-for-universities-colleges-and-tertiary-and-higher-education-institutions.

United Nations (2015), *Transforming our world: the 2030 Agenda for Sustainable Development*. (Retrieved on March 1st 2022 from www.refworld.org/docid/57b6e3e44.html).

UPM. (2019). *Sostenibilidad en los Estudios Oficiales de la UPM 2019*. Vicerrectorado de Calidad y Eficiencia, Universidad Politécnica de Madrid (UPM). Madrid. Spain. https://sostenibilidad.upm.es/wp-content/uploads/sites/759/2020/06/V3-Informe-Docencia-ODS-UPM-2019.pdf

UPM. (2020). *Sostenibilidad en los Estudios Oficiales de la UPM 2020*. Vicerrectorado de Calidad y Eficiencia, Universidad Politécnica de Madrid (UPM). Madrid. Spain. https://sostenibilidad.upm.es/wp-content/uploads/sites/759/2021/03/Sostenibilidad-estudios-oficiales-UPM-2020.pdf

UPV. (2014). *Plan Estratégico UPV (2015-2020)*. Universitat Politècnica de València (UPV). https://www.upv.es/noticias-upv/documentos/plan_estrategico_upv2020.pdf

UPV-EHU. (2022). *EHU agenda 2030 for sustainable development.* Universidad del País Vasco (UPV-EHU). País Vasco. Spain. https://www.ehu.eus/es/web/iraunkortasuna/ehuagenda-2030

UV. (2019). *La Universidad de Valencia como motor de transformación social a través de los ODS*. Vicerrectorat d'Igualtat, Diversitat i Sostenibilitat. Universitat de València (UV). Valencia. Spain. https://www.uv.es/uvsostenible/PROYECTOODS.pdf

Nomenclature and Abbreviations

ETSII	School of Industrial Engineering (Escuela Técnica Superior de Ingeniería Industrial)
GITI	Bachelor's degree in engineering in Industrial Technologies
MT	Master Thesis
MUII	Master's degree in Industrial Engineering
SDGs	Sustainable Development Goals
SDSN	SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
TG	Teaching Guides
UPV	Universitat Politècnica de València