

# IMPLEMENTATION OF THE SDGs AND THE 2030 AGENDA IN DEGREE OF CIVIL ENGINEERING STUDIES

L. Hojas Hojas, E. García Del Toro, I. Más-López

*Universidad Politécnica de Madrid, ETS Ingeniería Civil (SPAIN)*

## Abstract

Civil Engineering is the most important tool that society has to improve its quality of life.

Access to health, education, mobility, water, communications and in general the necessary resources to increase the quality of life are possible with the means provided by infrastructures.

Civil engineering studies have been implementing sustainability mechanisms for the last 30 years. With the enactment by the United Nations (UN), the Universities in charge of training Civil Engineers must integrate these sustainability mechanisms into their training.

The School of Civil Engineering is developing a program to adapt teaching, research and social dissemination activities aimed at the implementation of the Sustainable Development Goals (SDGs) and the 2030 Agenda for Sustainable Development.

It is proposed to do it in two steps: firstly, identify the SDGs that are more relevant to the different subjects covered by the degree, secondly, define the learning objectives that the students must achieve in order to acquire the competencies required in the field of the SDGs and to include those objectives in the Learning Guide.

It is also proposed that in each of the subjects, a dedicated activity to put into practice the SDGs covered by each specific subject is carried out. In this way, the student acquires a more tangible, practical vision of these SDGs.

For the students to be involved in their own learning process, a evaluation rubric will be included. Nevertheless, the teacher will be in charge of choosing the type of evaluation to use.

Keywords: Civil engineering, Sustainability, 2030 Agenda, SDGs, TIER, Efficiency, EMAS and GHC Protocol.

## 1 INTRODUCTION

World leaders, meeting and under the auspices of the United Nations (UN), ratify the 2030 Agenda for Sustainable Development[1]. It consists of an ambitious plan that has as final goals to eradicate poverty, protect the planet and ensure prosperity for all people. In order to achieve this, 17 goals encompassing 169 targets are defined, which collect the classic themes dealt with in all these kinds of plans of action, but include some new ones related to other current concerns of humanity focused above all on the protection of the environment.

The proposed Sustainable Development Goals (SDGs) continue the work carried out by the Millennium Development Goals (MDGs), which guided, between 2000 and 2015, global action to address the basic needs of the world's poorest countries. However, the SDGs differ from the MDGs in several important points that make them more influential and relevant[2][2].

In this framework, universities play a preponderant role in achieving compliance with the SDGs[3]. Historically, they have played an unquestionable role in the creation and dissemination of knowledge, since they have been powerful drivers of global, national and local innovation, economic development, and social well-being.

The contribution of universities to the SDGs is carried out along four main axes which are[3]: learning and teaching, research, institutional management and governance, and leadership.

To help with all of this, universities must:

- Encourage and promote the SDGs as a research topic within the university.
- Support the full spectrum of research approaches needed to address the SDGs, including interdisciplinary and transdisciplinary research.

- Support and encourage innovation for sustainable development solutions.

Advocating for national support and coordination to promote research on the SDGs at universities may be reinforced by providing university students and staff with the knowledge, skills and attitudes necessary to tackle the complex challenges of sustainable development, articulated by the 2030 Agenda. This article will focus on the opportunities for implementation of the SDGs in the field of civil engineering.

Civil engineering is the basis of social development, since infrastructures are key to contribute to the development of societies. This is well reflected by the notion about Civil Engineering published by the American Society of Civil Engineers (ASCE): “Civil engineers design, build, and maintain the foundation for our modern society - our roads and bridges, drinking water and energy systems, ports and airports, and the infrastructure for a cleaner environment, to name just a few ”[4].

At the 2006 civil engineering summit held by the ASCE[4], it was proposed that by 2025, these professionals will serve as master builders, environmental protectors, innovators and integrators of ideas and technologies, managers of risks and uncertainties caused by natural events, as well as leaders in debates and decisions that shape public policy[5].

Ratifying the ASCE proposal, the National Academy of Engineering of the United States (NAE) has published the main engineering challenges in the 21st century to achieve the success of humanity[6]: sustainability, health, the reduction of vulnerability and quality of life; principles that coincide with those promulgated in the SDGs.

Following these premises, the Universities in charge of training Civil Engineers are encouraged to integrate the SDGs into their curricula. To this aim, the first step is to identify the different subjects that are being taught as part of the university degree and how much their content addresses relevant SDGs. Subjects that can contribute to address relevant SDGs are considered below. Proposed new content to be introduced to further align with relevant SDGs is indicated. This new content could be introduced as part of the different activities performed at the University so that students can acquire the skills and knowledge to fulfil the goals addressed by the 2030 agenda.

In this work, the implementation of the SDGs in any subject of the Civil Engineering degree will be approached and tests have been carried out to integrate it into the development of the projects of the subjects and the final degree projects.

## 2 METHODOLOGY

The methodologies and guiding frameworks for teaching activities are those determined by the IAEG-SDGs classification, which is established in three levels (I, II and III) based on the methodological development and the availability of data at the different levels using the Tier Classification Sheet[7].

The development of the implementation of global indicators in the subjects studied in the teaching plan follows the guidance provided as part of the Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development[8]. In connection with this implementation, another document that has been taking into account for integration into the training plans is the document presented by the Spanish Government to the European Union entitled “Spain. Integrated national energy and climate plan (INECP) 2021-2030 ”[9].

The first step to drive this implementation is to identify the SDGs that are relevant and within the context of the different subjects that make up the degree. In this respect, the following relevant SDGs have been identified: SDG 6 (water quality), SDG 7 (energy efficiency), SDG 9 (innovation), SDG 11 (sustainable cities and communities) and SDG 17 (participation).

The second step will consist of the inclusion of specific objectives related to these SDGs in the learning guide for the impacted subject covering each objective. These additional learning objectives will indicate the competencies that the student must achieve in order to address the targets established per each of the SDGs.

In addition, a practical case is proposed per subject in order to help the student achieve the proposed objectives. The proposed practical activity will consist of:

- Description of a case study that includes the disciplines covered and the learning outcomes achieved.

- An oral presentation, in front of the class, where the development of the proposed activities, the methodology to be used and the proposed solutions to address the issue raised in the case study will be discussed.
- The proposed solutions will be analyzed by the class, through a participatory debate that will revolve around the proposed activity and the proposed solutions.

Regarding to the rubrics used, the objectives related to the competence to be evaluated will be considered three basic levels:

- Analyze and criticize the global situation, from the point of view of sustainability, providing a multidisciplinary nature.
- Apply sustainability criteria in accordance with the professional codes of ethics in the design of the different solutions studied.
- Have the axes of sustainability: social, economic and environmental when choosing the most appropriate solution to the needs raised in the project.

To facilitate the work, a course file has been prepared where the tasks to be carried out are outlined, in said file it must appear:

- Center where the degree is taught
- Subject name
- Subject objectives
- Skills or learning outcomes specific to the subject
- Related sustainability competencies
- Related SDGs

An example is SDG 17 (participation), which is being influenced in all phases of the project, ranging from the analysis, the weighting of the social acceptance of the different proposals and the methodologies for evaluating the projects[10], [11]

### **3 RESULTS**

To measure achievements, the following tools will be established:

- Determine indicators that allow to contrast the achievement of the acquired competencies of sustainability or SDG
- Assessment instruments that allow each indicator to be evaluated (Test, exams, assignments, oral presentations ...)
- Preparation of evaluation rubrics to inform the student of the criteria used to evaluate achievement
- Responsible for carrying out the evaluation: The teacher, the students in pairs, ...
- Presentation of the evaluation to the student: numerical notes, comments, medals, badges.

It is important to note that the intent of this proposal is to achieve a full curricular integration of the SDGs so that the competencies acquired by the students in this respect are fully applied during their future work as civil engineers. For this reason, the incorporation of a practical work is proposed as an essential part of each of the subjects involved with the SDGs, where the student will be able to establish a more tangible equivalence between the subject studied and its relationship with the SDGs in the real world.

### **4 CONCLUSIONS**

After analyzing the factors that can be integrated into the subjects of the Civil Engineering Curriculum, it can be concluded that:

- For the training of civil engineers, it is essential that the SDGs are present in their curriculum because civil engineering is the engine of development of societies.

- A simple methodology has been shown by which, based on the review of the teaching guides of the different subjects that constitute the study plan, some specific subjects have been identified as optimal for the inclusion of additional learning objectives relevant to pertinent SDGs.
- It has been indicated how to validate and measure the acquisition of these SDGs related learnings for a given subject, in which as a complement and to facilitate the application of the SDGs in the real world, a case study activity is proposed to be implemented by the students and for which it has been proposed an evaluation rubric.

## REFERENCES

- [1] United Nation, "Sustainable Development Goals," *United Nations Department of Public Information*, 2015. [Online]. Available: <https://sustainabledevelopment.un.org/sdgs>. [Accessed: 21-Nov-2019].
- [2] International Centre for Engineering Education, "Ingeniería para el desarrollo sostenible. Resumen," *Ing. para el Desarro. Sosten.*, p. 21, 2021.
- [3] REDS, "Cómo evaluar los ODS en las universidades," pp. 5–6, 2020.
- [4] ASCE, "Cómo alcanzar la Visión para la Ingeniería Civil en 2025," pp. 1–100, 2010.
- [5] J. I. Peña-Reyes, "Major challenges in engineering and its role in society | Grandes retos de la ingeniería y su papel en la sociedad," *Ing. e Investig.*, vol. 31, no. 1 SUPPL., pp. 100–111, 2011.
- [6] National Academy of Engineering, "14 Grand Challenges for Engineering in the 21st Century," 2020. [Online]. Available: <http://www.engineeringchallenges.org/challenges.aspx>. [Accessed: 13-Feb-2021].
- [7] United Nations Interagency and Expert Group on and SDG Indicators (IAEG-SDGs), "Tier Classification for Global SDG Indicators," *United Nation*, no. July, pp. 1–42, 2020.
- [8] ONU, "Marco de indicadores mundiales para los objetivos de desarrollo sostenible y metas de la agenda 2030 para el desarrollo sostenible," *Labor la Com. Estadística en relación con la Agenda 2030 para el Desarro. Sosten.*, p. 23, 2020.
- [9] Gobierno de España, "Plan de Energía Nacional Integrada y Climática de España," no. December 2019, pp. 1–262, 2020.
- [10] L. I. Hojas Hojas and E. M. García Del Toro, "Final Degree Projects As a Tool for Innovation and Entrepreneurship," *EDULEARN20 Proc.*, vol. 1, no. July, pp. 8786–8793, 2020.
- [11] L. I. Hojas Hojas, "Participación Social en los Análisis de Sostenibilidad y Evaluación Ambiental," Madrid, 2019.