THE ASSET PROJECT AS A TRAINING TOOL FOR ENERGY TRANSITION

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Abstract

The ASSET project aims to provide a holistic and scalable solution for research, innovation and education by creating functional networks. These networks intend to be created between energy companies, universities, training actors, energy and environmental authorities, policy makers and, more generally, citizens who are sensitive to environmental issues and the quality of energy transition processes. The ASSET project delivers the framework and the tools to create and share knowledge and competences needed to tackle the energy transition by supporting training. As a highlight of this approach to education, a strong interdisciplinary component oriented to social sciences is added in an area with an exclusive technological vocation. This transition seeks to push towards a low-carbon society in order to make the energy sector sustainable. To reach this goal, ASSET intends to strengthen the skills of sector operators, to cultivate new talents with multidisciplinary skills, and to intensify research and network industry [1]. Therefore, the final target is to promote innovation and strengthen understanding of the importance of reducing carbon emissions.

Over the course of the project, 23 learning graph models and more than 40 educational programs are being developed, in addition to a portfolio of challenges and case studies on the subject. The actors involved will be able to search for the programs available - online and on-campus - on the ASSET website and, if a search is unsuccessful, a request can be sent for the creation of content necessary for their target market.

The main tools developed through the ASSET project are the Learning Graph tool, the Marketplace tool, and the EMMA platform [2]. The Learning graph tool allows for the creation and sharing of learning structures, as well as the use of existing study materials. The Marketplace tool allows the searching through the available training offer, to request courses on demand, or to offer own training programmes. Finally, the EMMA platform offers a wide range of MOOC (Massive Online Open Courses), mainly in English and with the possibility of being translated into several languages.

The Universitat Politècnica de València (UPV) participates in the project as one of the academic actors that develops courses and MOOCs in the area of Energy Storage. In this way, the UPV contributes to identify learning needs, to apply the ASSET method and tools to its teaching material, and to deliver teaching material. Specifically, the course which is being developed is called "Hydrogen as an Energy Vector". The course provides the fundamentals of hydrogen technology, using it to store energy, and to further develop the concept of its use as an energy vector. The course follows the BLENDED format, combining online elements, through a MOOC (EMMA platform) and face-to-face teaching carried out at the university facilities.

In this paper, we present the main ASSET tools, the lessons learned in the development of course materials during the lifetime project, and the analysis of the results of this experience.

Keywords: MOOC, Collaborative education, Energy transition, Hydrogen.

1 INTRODUCTION

The ASSET project falls within the context of the 2020 Horizon which uses European funds to finance this type of initiatives. The project started in May 2019 and is made up of 11 partners from 6 European countries (Spain, Italy, Belgium, Denmark, Germany and Greece) [3]. All of them agree that there is a huge challenge in creating learning programmes that address the new market gaps posed by the energy transition we are currently undergoing. The ASSET ecosystem has brought together partners from academia, innovative companies, innovation facilitators and corporations. The partners of the consortium are shown below and are summarised in Figure 1.

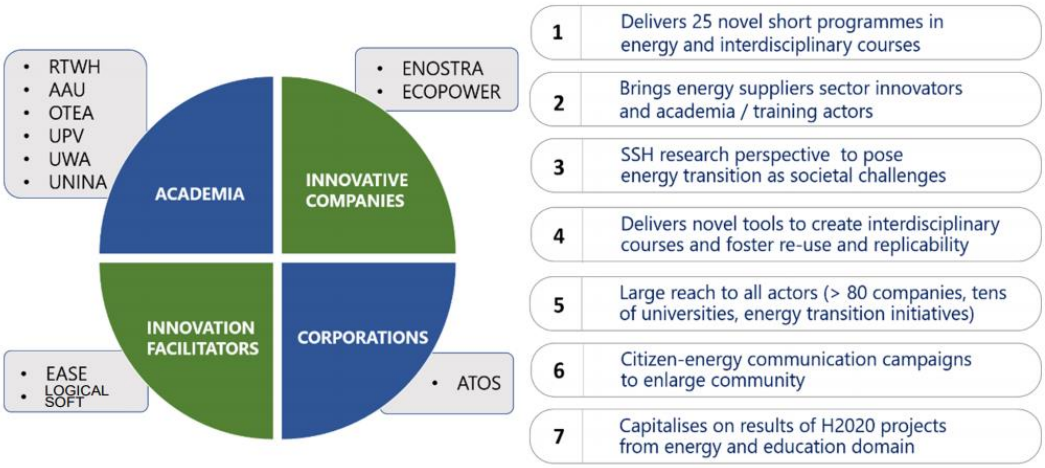

Figure 1. The ASSET ecosystem and project objectives

- RWTH Aachen University is one of the universities in Germany that has obtained the status of "University Excellence". Founded in 1870, it is a leading university in Germany and Europe with over 40.000 students and more than 500 professors.
- The energy technology department of Aalborg University (AAU) in Denmark is one of 11 departments of the faculty of engineering and science. It is a leading international department that works strongly in an interdisciplinary way.
- The Universitat Politècnica de València (UPV) is a young university which celebrated its 50th anniversary during the academic year 2018-2019, and collaborates with clear excellence in energy storage.
- The University of West Attica (UniWA) collaborates in the creation of new programs based on ASSET results for university students, and for users of post-graduate courses of the three different departments involved.
- The University of Naples Federico II (UNINA) is one of the largest universities in Italy. It is organized in 26 departments and offers courses in all academic disciplines.
- OTEAcademy is a daughter company of the OTE Group, which is a member of the Deutsche Telecom Group.
- EASE is the European association for energy storage that gives voice to the Energy Storage community with over 40 members representing operators of electricity networks, public services, research, universities and industry.
- Ecopower is an innovative company with three main objectives: investing in renewable energy, supply 100% electricity to cooperative members, and promote the rational use of energy.
- Ènostra is the leading national provider of electricity from non-profit renewable sources in Italy. The cooperative founded in 2014 aims to reduce energy waste by contributing to the transition towards a low-carbon energy system.
- Logical Soft is an Italian software house founded in 1985 that develops, markets and supports software solutions for the construction industry.
- ATOS is a leader in digital services offering consulting services and integration of managed services and BPO (Business Process Outsourcing), Cloud operations, Big Data and IT security solutions.

The overall objective of ASSET is to provide the framework and tools to create and share the knowledge and competencies needed for energy transition. Therefore, there is a need to identify skill gaps and competence deficiencies, and to create knowledge in a very efficient way.

The main feature of ASSET is for learning programmes to be free and open to everyone as far as possible. It is about making multidisciplinary programmes and creating a holistic offer, being flexible and modular and, above all, to promote a collaborative approach. This is why the involvement of multiple actors such as energy sector companies, universities, training agents, environmental

authorities, policy makers or citizens is crucial. By bringing them together, it is possible to better perceive the needs and to create the educational offer that fits them. In addition, ASSET includes actors who contribute to promoting interdisciplinary research that combines the disciplines of the social sciences and the humanities. In this way, they are capable of reaching society to create the new generation of energy-sensitive citizens to be part of the energy transition mission.

The specific objectives of the project are, first, to create the community by involving all the main actors in the energy transition. Second, to define a conceptual framework to significantly facilitate and accelerate the creation of new learning modules and to update currently available programmes. Third, to encourage interdisciplinary disciplines in research, innovation and education services, including social and humanitarian science disciplines. Four, to strength collaborations between academia and industry. Fifth, to define and develop a rich range of new innovative programmes to train students, trainers, employees and citizens. Sixth, to evaluate the value proposition and results of ASSET through experimentation in real conditions. And finally, to communicate and disseminate the vision and results of the ASSET project to the relevant target groups.

2 METHODOLOGY

In order to bring together the ASSET community, a website has been developed to join this initiative (https://energytransition.academy/). On this website it is possible to find the main tools that have been developed in the ASSET project. Figure 2 shows the appearance of the home page of the website. Specifically, in the Community section, several offers are available [4]. First of all, there is an option for tutors. In this category, thanks to the learning graph tool, they can create their own educational learning programmes, making very easy to share their learning materials. A further important section concerns learners and companies. The aim of this section is that every individual can become a student or a company can look for an educational programme for its employees. Through the Marketplace tool, it is possible to check whether the desired educational programmes are offered. In case they are not available, the tool allows to make a request. Another option is aimed at training providers, and through the Marketplace tool these actors can advertise the training programmes that they offer.

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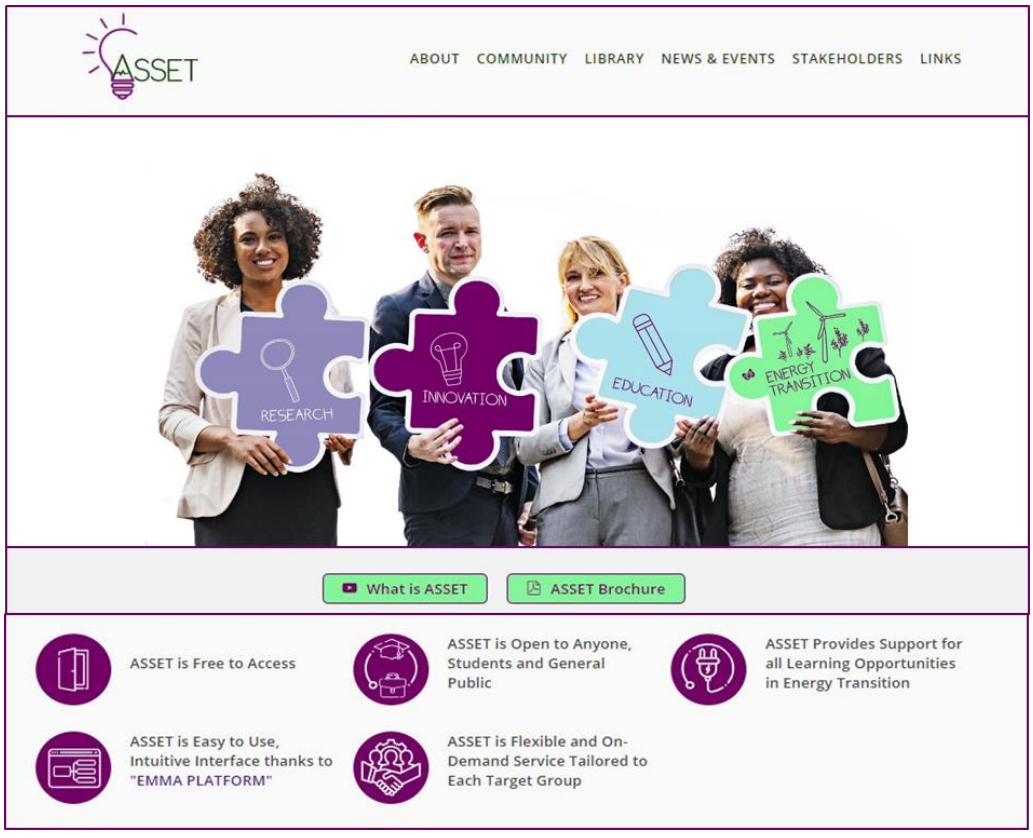


Figure 2. ASSET website

2.1 Learning graph tool

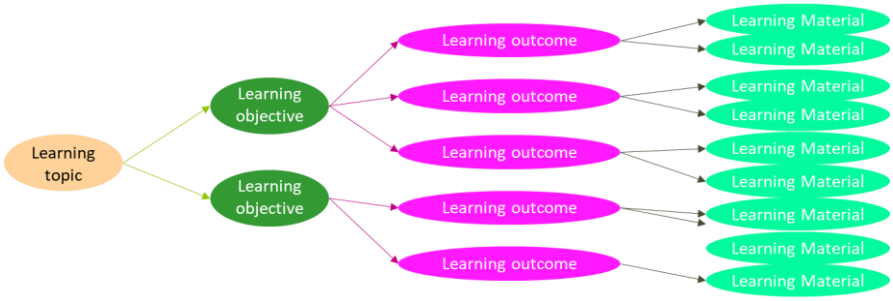


Figure 3. Learning structure of a course today

When creating training materials, the structure normally followed today is to set a learning topic, and to proceed to the breakdown shown in the Figure 3. As observed, the learning topic is first divided into learning objectives, then into learning outcomes, and finally the learning materials are built for each learning outcome.

In this scheme, there are certain concepts that are not well formalised, such as the learning objective. However, this is not the case for the concept of learning outcome. There are very clear definitions which state that, in this context, a learning outcome should be a competence that the student or learner acquire once following the learning programme. Due to this precise definition, the concept of learning outcome is acquired as a tool in the ASSET project to share more easily the structures created. As can be seen in the figure, each learning outcome is associated with several learning materials. The number of learning materials is quite random and varied, as it could be worth a presentation, a lecture, a social game, or a test, among others.

Since the concept of objective is not formalised today, as mentioned above, and there is a one-to-one correspondence between the learning outcome, the learning objective and the learning topic, it is proposed to eliminate this level. The learning structure is therefore defined, as shown in Figure 4, keeping only three levels: the learning topic, the learning outcomes and the learning materials. This is the assumption that has been made in the project, and accepted by all partners to develop the learning content.

The learning graph tool created in this project, and available on the ASSET website, aims to create and share learning structures (based on the proposed learning structure), and to take advantage of existing study materials. Through this tool, tutors can benefit from ASSET ready-made components when preparing educational programmes [5]. In other words, it is possible to share learning programmes aiming at the same learning objective but with different levels or modes of EQF (European Qualifications Framework). In addition, it is possible to share learning materials for use in different teaching models and/or different topics. For example, learning programmes targeting different teaching models (face-to-face, Massive Online Open Courses, blended or other) may have common components such as online test or CBL (Challenge Based Learning). And finally, multidisciplinary programmes can be created very easily. For example, all programmes can include learning outcomes targeting SSH (Social Science and Humanities) issues, learning outcomes targeting entrepreneurship competencies and/or learning outcomes targeting soft skills.

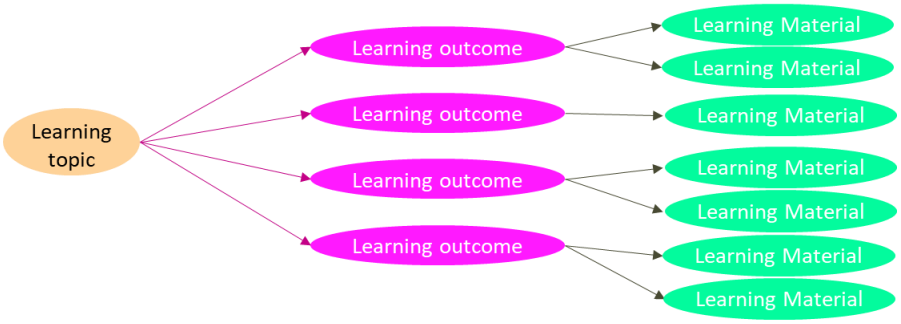


Figure 4. ASSET proposed learning graph structure

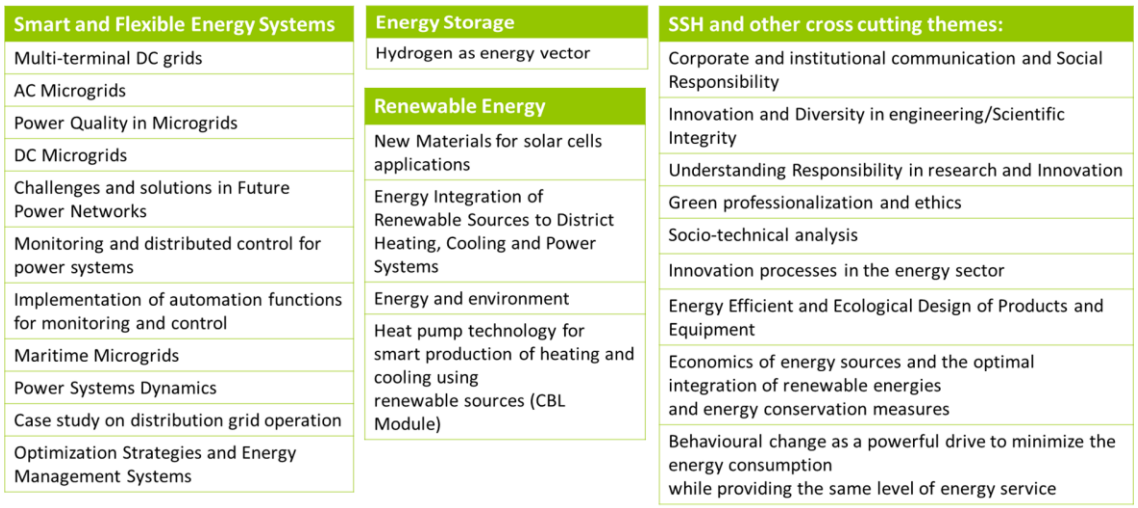


Figure 5. ASSET educational programmes offer

Figure 5 shows the set of programmes currently offered by the ASSET consortium through its website [6]. All of them are based on the learning graph methodology. As can be seen, technological courses are included, as well as others based on SSH and other transversal topics.

2.2 Marketplace tool

The marketplace tool is included in the ASSET website and is aimed at anyone looking for a specific educational program. In a simple way, it is possible through key words or search filters to look into the existing educational offer (Figure 5) till finding the desired educational program. In addition, this tool also allows to request on-demand courses in the event that the training offer does not meet the needs of the searcher. Finally, it is also possible to offer own training programmes so that other people can benefit from it.

2.3 EMMA platform

Another tool created through the ASSET project is the EMMA (European Multiple MOOC Aggregator) platform. On this website (https://platform.europeanmoocs.eu/) there is a wide availability of MOOC (Massive Online Open Courses) courses published by the members of the consortium following the learning structure based on the learning graphs methodology. This educational platform has been developed to include very varied and useful training tools. The main features of the platform are an automatic translation and transcription system into 8 languages, interactive features, assessment tools, and learning data. Users have a personal learning environment where they can benefit from a number of tools, such as annotation system, coursebook, personal blog, conversation tool and virtual classroom. Moreover, the assessment tools available for the evaluation of acquired knowledge are quizzes, a blog to solve questions, homework and peer assessment tools. For example, the MOOC course can include questionnaires to evaluate the concepts learned and numerous materials can be uploaded in addition to the videos, such as additional readings, images or graphics. The platform also has interactive tools to make communication between users easier, for example, via internal forums.

The last feature of the platform to be mentioned is the possibility of collecting learning data. From this data, the tutors can extract information about the enrolments, the visualization of the lessons or the activity stream from the platform itself. Furthermore, through its monitoring tools, EMMA is able to collect information from different surveys about the student profiling and their expectations. Finally, on the user's side, they are able to see their progress, the lessons overview and the completion rate of the course.

2.4 BLENDED Course Hydrogen as an Energy Vector

The Universitat Politècnica de València (UPV), as one of the academic partners of the consortium, has developed the blended course called "Hydrogen as an Energy Vector" [7]. Since the ASSET project focuses on the development of courses related to energy transition to increase social awareness and

to promote training, this course has been developed with the aim of aligning itself with the objectives of the ASSET project.

The course develops the concept of hydrogen as an energy vector, meaning that it can be used as a primary energy carrier to potential points of consumption. According to this, first some kind of energy has to be used to obtain hydrogen, then it is stored, and finally it is transformed into electrical energy at the point of consumption. For example, hydrogen can store energy from renewable sources when there is an imbalance between supply and demand. This excess of energy is used to produce green hydrogen through electrolysis. When the stored energy is required, hydrogen can be transported to a location where this energy is needed and then transform it to produce electricity using a fuel cell. Therefore, the course provides the fundamentals of hydrogen technology, using it as a form of energy storage. Hydrogen production methods are presented, with an emphasis on electrolysis as a means of producing hydrogen from renewable energy, since it is the most sustainable production technology. In addition, hydrogen storage methods are described, and the process of generating electricity from hydrogen using fuel cell technology is explained.

The course is designed for students of Masters, PhD or Industry with an EQF 7 level, and it is a blended course. It means that the content course has a form of online learning through the MOOC offered via the EMMA platform, combined with face-to-face learning delivered on university campus. The learning objectives of the course are, first of all, to obtain the knowledge to understand the processes of electrolysis technology on an industrial scale, and to be able to size an electrolyser. It should also be possible to size the corresponding hydrogen storage system. And finally, to understand the process of electricity generation through the use of fuel cells, being able to select and size a fuel cell. The learning graph of the course has the structure shown in Figure 6.

Figure 6. Learning graph Hydrogen as an Energy Vector

This scheme follows the identification marked by the ASSET project, which breaks down the course into the learning topic, learning outcomes and learning materials. As can be seen, the type of learning materials can be through slides, through a video, through a laboratory practice or through a case study. The learning outcomes are those that appear at the intermediate level and are as follows:

- To identify hydrogen properties and applications.
- To recognize industrial hydrogen production processes.
- To explain electrolysis technology working.
- To describe hydrogen storage technology.
- To explain electricity generation through the use of fuel cells.
- To calculate a hydrogen energy storage system.

The course was first launched in May 2020 with a duration of 8 weeks. Due to the situation generated by COVID-19, the face-to-face part had to be cancelled. However, the online part could be done through the EMMA platform. The second edition of the course took place between November and December 2020, and it could be done in a blended form. In combination with the more theoretical teaching provided by the online course, 6 face-to-face sessions were organised at the university. The character of these sessions was very practical and focused on learning based on real industry experiences (conferences of experts in the sector), laboratory practices to better understand the real workings of the technology, and case studies to address sizing of real installations.

3 RESULTS

The results to date of the development of the project have been very successful, reaching good figures of engagement in the available training offer. In addition, several events and workshops have been organised to extend the ASSET methodology, allowing the project to become more visible and to attract ambassadors [8]. For example, UPV organized an online workshop on October 2020 where the ASSET learning programme model and tools were presented, used, and tested. The workshop was attended by industries (11 people), universities (11 people) and public administrations (2 people), including people from the Americas. After conducting the workshop, a great feedback was obtained on the ASSET tools and possible improvements. The following results on the marketplace tool and the learning graph tool were obtained from the questionnaires given to the participants.

- 86% consider the learning graph concept valid (the rest 14% say “absolutely valid”).
- 57% believes that the use of the learning graph tool will save more than 30% of the time needed for preparing a new educational programme.
- 100% believe ASSET concept is valid and replicable in other sectors
- 71% are very satisfied with ASSET value proposition.
- 71% consider that the ASSET marketplace tool is easy to use (the rest 29% say “very easy”)
- 86% consider the marketplace tool a valuable instrument for their work.

As mentioned above, the EMMA platform provides a collection of learning data from which useful information can be extracted about the development of MOOC. Below are some figures from the first edition of the launch of the EMMA platform's educational courses. Figure 7 shows the enrolment rate for different courses, among which the Hydrogen as an Energy Vector course stands out with a high enrolment rate.

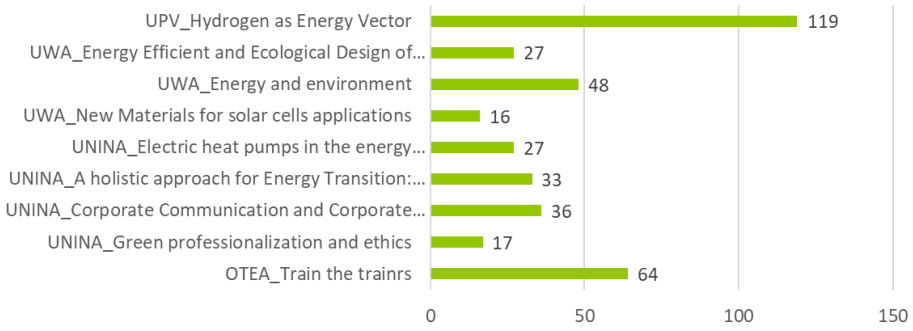
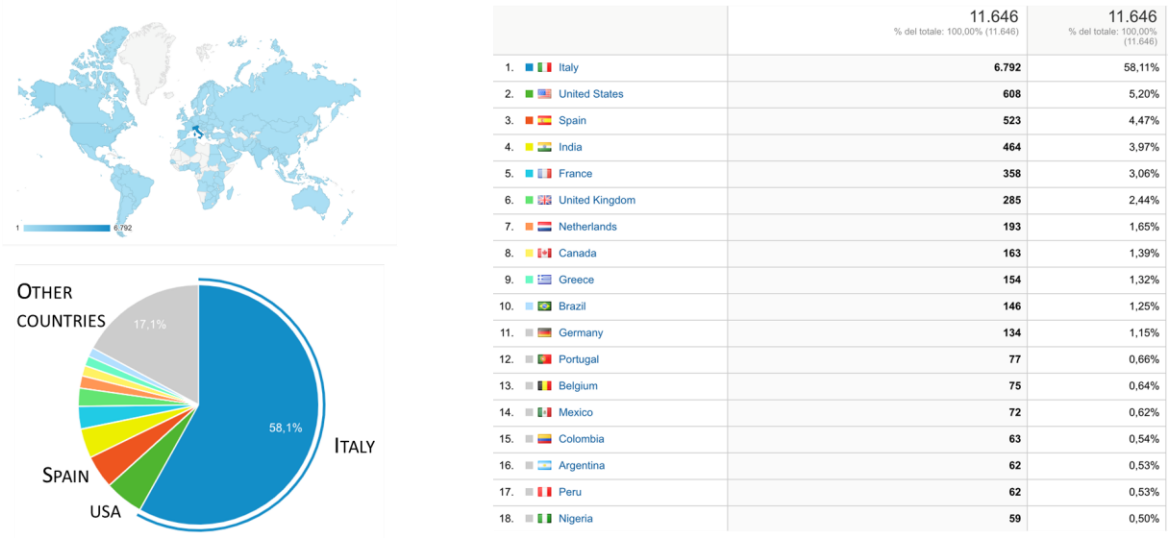


Figure 7. First EMMA MOOC edition enrollment



		11.646 % del totale: 100,00% (11.646)	11.646 % del totale: 100,00% (11.646)
1.	Italy	6.792	58,11%
2.	United States	608	5,20%
3.	Spain	523	4,47%
4.	India	464	3,97%
5.	France	358	3,06%
6.	United Kingdom	285	2,44%
7.	Netherlands	193	1,65%
8.	Canada	163	1,39%
9.	Greece	154	1,32%
10.	Brazil	146	1,25%
11.	Germany	134	1,15%
12.	Portugal	77	0,66%
13.	Belgium	75	0,64%
14.	Mexico	72	0,62%
15.	Colombia	63	0,54%
16.	Argentina	62	0,53%
17.	Peru	62	0,53%
18.	Nigeria	59	0,50%

Figure 8. ASSET Courses students by region. Google Analytics (May-June)

Figure 8 shows numbers for the origin of the different users. As observed, a high number of users come from Italy (58.11%), but users come from also United States, Spain, India, etc. This means that the ASSET project is not only attracting attention on a European level but also on a global level.

3.1 Hydrogen as an Energy Vector Statistics

As mentioned above, the Hydrogen as an Energy Vector course has been launched in two editions through the EMMA platform, the first in spring 2020 and the second in fall 2020. Figure 9 shows a comparison between the two editions (data provided by EMMA platform). This figure gives the number of interactions and average time spent on lessons for both course editions. As can be seen, the average time decided upon for each lesson has a non-linear trajectory with some peaks, depending on the type of stimuli the students receive from the teachers, and the time spent on the study material. It can be appreciated how the measured time dedicated to each unit follows the same pattern from one edition to another. Likewise, the number of interactions increases considerably from the first to the second edition, being almost double.

It is also interesting to show the result of the enrolment history from the time the course was first launched. Figure 10 shows the rate of enrolment and unenrolment over time. As can be seen, the enrolment is higher at the time of the lockdown caused by the COVID-19, since in the first edition the course was totally online. However, despite the fact that in the context of the second edition there was no lockdown, the enrolment has been sustained over time.

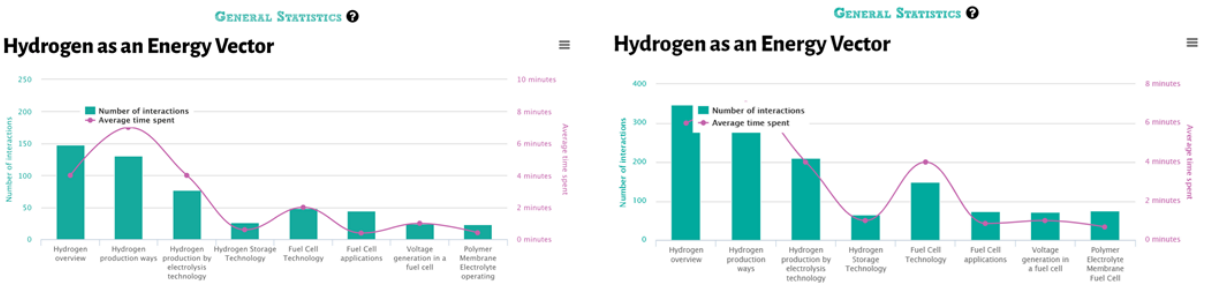


Figure 9. 1st edition (left) versus 2nd edition (right) statistics. Hydrogen as an Energy Vector

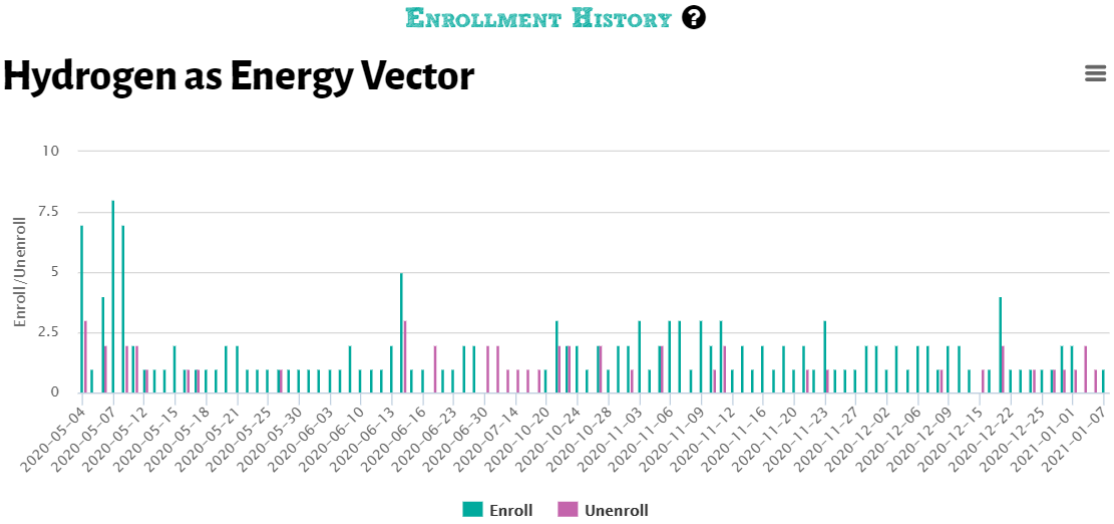


Figure 10. Enrollment history. Hydrogen as an Energy Vector

4 CONCLUSIONS

As developed, the ASSET project has a large number of tools to encourage the creation of educational materials related to energy transition. Moreover, its multidisciplinary approach gives it an added value by combining purely technical areas with other more transversal areas and SSH. In this way, the training offered is much broader, combining the learning of technology with the challenges at a social and economic level posed by the change of paradigm to which the energy transition is leading us.

The success of both the first and second editions of the Hydrogen as an Energy Vector course is a clear example that the tools created by the ASSET project are very useful. Moreover, the monitoring tools offered by the EMMA platform, and the feedback received when organising events or workshops, allow for continuous improvement of the objectives set by the project. Up to now, all the KPIs (Key Performance Indicators) defined at the beginning of the project have been achieved within the established deadlines. It can therefore be concluded that the ASSET project is having a great impact on the community and reaching the audience that was expected when it started.

ACKNOWLEDGEMENTS

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