Solar Energy Technology Training (SETechTra) Module for STEM Undergraduates

Erasmus+ Project №: 2020-1-UK01-KA203-079236

SETechTra project Newsletter#6 - May 2023

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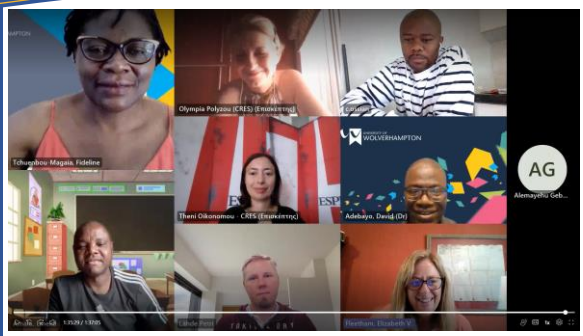
Progress and Update on SETechTra Project

The SETechTra project has continued to make significant progress and the commitment of the partners to total and complete delivery of the objectives of the project is commendable. This issue presents summary and update on the relevant IOs as the project is coming to completion at the end of August. Discussing progress made in the intellectual Outputs (IOs) by the partners, this issue highlights key deliverable and achievements to date. Preparations towards the final Transnational Project Meeting (TPM) and Multiplier Events (ME) at the University of Wolverhampton is also highlighted.

The Renewable energy workshop held at the University of Wolverhampton, Telford Innovation Campus on 4th May 2023. It features:

- **Special guest speakers**
- **Industrial speakers**
- **Project partners speakers**
- **Students' posters competition**

The workshop was supported by the INNOVATE UK PROJECT NO. 83383



SETechTra Partners' Meeting.

Science, Technology, Engineering, Arts, and Mathematics (STEAM)

There is a lot of publicity about Science, Technology, Engineering, and Mathematics (STEM), but there is little understanding about STEAM. This newsletter highlights the significant of this aspect in the education system through the SeTechTra project. The need for solar energy technology training (SETechTra) module through expansion of STEM curriculum to include STEAM, and development of resource pack for STEM and STEAM undergraduates/graduates is crucial. Based on reliable studies, more students and learners have developed long-term interest and engagement in science education, because of the integration of the arts and the expansion of STEM to STEAM.

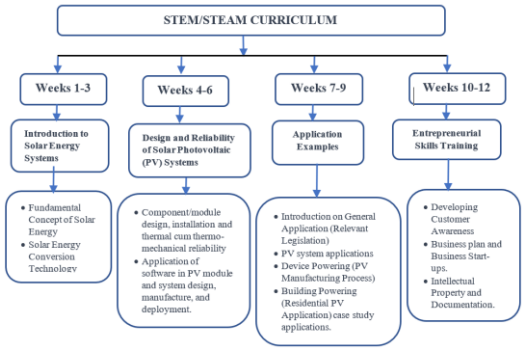
The SETechTra training module includes the expansion of the STEM curriculum to include STEAM. This is notable because STEM professionals like engineers, scientists, and educators will need to collaborate with STEAM professional such as project managers, policy makers, and marketers in the sector. The vast needs of the latter specialists make the inclusion of the arts in STEAM discipline education in the future even more necessary.

As a result of this project, it is believed that the educationist will take a holistic approach to overcome some of the challenges faced in implementation of STEAM in classrooms. Principally, the processes will involve collaboration with arts educators and teachers to integrate artistic concepts, such as design thinking, into STEM subjects, focusing on the delivery of skills needs in Solar energy sector.

A good understanding of STEAM will provide effective means to enhance both the employability and entrepreneurial potential of STEM and STEAM graduates.

Module Materials and E-delivery Platform

The module materials and e-delivery platform are led respectively, by SAMK (leader on IO3 - Module Delivery Materials) and TU (leader on IO4 - the development of the E-Delivery platform). The delivery of the module contents for the SETechTra project is designed in a structured and modular manner. The module is divided into four blocks as illustrated below to cover the academic, industrial, and entrepreneurial needs of the learners. Formative and summative assessments, which the learners will complete at the end of each section are also included in the module curriculum. PV system design and manufacturing, as well as PV system design and application software will be utilised in the module delivery.



SETecTra STEM/STEAM Curriculum contents.

The selected educational platform to deliver the modules is CANVAS, which provides an opportunity to design, organize, and deliver course materials in a modular format.

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Co-funded by the Erasmus+ Programme of the European Union

Samples of Learning Materials in Multiple Languages

As part of an effort to make the SETechTra training accessible and inclusive to many learners across the Europe, the teaching and learning materials have been translated to four languages of the partnership, namely, English, Finnish, Norwegian, and Greek. Example is shown in the figure on page 2. It is expected that this approach will provide opportunity for learners across the world to participate in the SETecTra training, learn more, and acquire the necessary skills in solar energy. In addition, the approach will make the training attractive for part-time, online and blended learning, thereby, facilitating inclusion and helping in meeting the UN goals on sustainability, as well as reducing greenhouse gas emissions and transit to a low-carbon economy.

Furthermore, SeTechTra brochures have been produced on relevant topics for distribution to sensitise and create awareness among the young generations on renewable energy in partners' countries. Such brochures include (i) Innovative solar thermal system (Greece), (ii) International Solar course (Finland), (iii) Solar and renewable energy technology (England). The brochures are intended to be distributed among the young generation in schools, playground, and during outreach activities.

Example of language translation of module material from English to Greek.

CANVAS is linked to the Catalog area for the students to enrol on which in then linked to the project website. The different topics have been created for each of the blocks, resulting in a clear structure for the course. In addition, Canvas platform has been tested to be compatible with the design and application software to be used in the training to enhance the learning experience of the learners and provide instructors with the necessary tools to create, organize, and deliver the educational content effectively and appropriately. The materials for each of the blocks have been uploaded on Canvas. The resulting solar energy E-delivery platform is engaging and innovative in its content and design; facilitating roll out to HEIs, other educational institutions, and other interested users in SE for implementation. Please visit our webpage: https://setechtra.org/e-delivery/

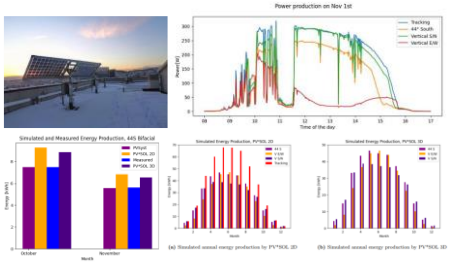
Resources Pack Development & Case Studies

In contrast to the targeted curriculum, resource pack is designed for self-study focusing on supporting any interested individual at any level to develop the solar energy sector (SES) in-demand skills. The partners have developed useful resource pack, that is a handy portfolio of information, materials, and activities relevant to acquisition of SE skills. The resource pack contains step-by-step guidelines on installation, energy generation, maintenance, safety considerations and best practices of SE systems, as well as topics on system design and planning with tools that support learners in designing SE systems for different applications. The pack contains relevant design software and other design tools, that may either be available at free access, pay-per-view and lease or bought out licenses. An example of a real-life case studies of successful SE projects that demonstrate practical applications of the tools to SE was carried out by NTU.

This offers the opportunity for learner/trainees to compare and evaluate their own designs with the real-life examples. The learners were able to assess their knowledge and understanding of the contents of the resource pack through automated self-assessments and quizzes.

The automation of the assessments makes the process not bound to time or place. For continuous learning, the resource pack provide a collection of reference materials, such as technical manuals, standards, guidelines, and publications that trainees can use to continue their learning and keep up to date with the latest developments in the sector.

It is imperative to note that some countries require a degree in a relevant field such as engineering, renewable energy, physics, energy systems engineering, energy conversion engineering or even a professional certification to adopt this approach for the trainees. It is, therefore, anticipated that each partner will develop their own resource pack on relevant specific education and training (E&T) required to work in the SE industry in their respective countries.



Energy yield analysis and evaluation of PV software for simulation of bifacial PV modules in Trondheim, Norway (collaboration with research Institute SINTEF).

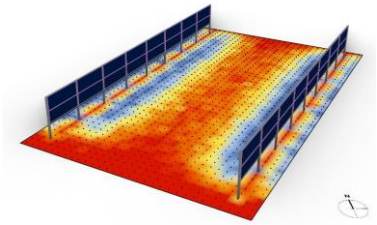
Table 1: UoW undergraduate students' career and their prospect in solar energy

Students	Project Title	Students Current Status
A	Hazard study of novel mobile power station with sodium ion battery: heat sink	Master of Science and Technology in environmental engineering and Sustainability (France)
B	Hazard study of DC-DC converter	Master's in international business (UK)
C	Hazard study of DC – AC solar inverter for mobile power stations with sodium – ion batteries	Master's in Energy System and data analytics at University, UK
D	Hazard study of console panel component of the mobile power station with sodium-ion batteries	Master of Science and Technology in environmental engineering and Sustainability (France)
E	Hazard studies on battery pack	Master's in Materials for Energy Storage and Conversion (MESC), an Erasmus + Joint programme by Slovenia, France, Poland and Spain Master Degree, 2023-2025

Coming soon:

Transnational Project Meetings (TPM) and Multiplier Events (ME), 30th and 31st August 2023, respectively at the University of Wolverhampton, UK. ME is designed to showcase the solar energy technology, demonstrate the teaching materials platform and to disseminate the project results and the impacts. Key events include special guest speakers.

Solar Energy Technology Demonstrator



Solar Photovoltaic Design and Modelling in Agrivoltaic System.

Students experience in solar energy based mini projects: Building students' interest in energy.

Research seems to suggest that students career decidedness is informed by many factors including, coursework and work experience. Based on this literature, we were interested to see know what the five undergraduate chemical engineering students who selected solar energy-based projects as their undergraduate mini research project were doing after their graduation. These 5 students, cohort 2021/2022 worked for 2 months on the development of a mobile solar power energy storage, which is part of an Innovate UK funded project with 3 industrial partners intitle "development of innovative off-grid energy storage for sub-Saharan Africa using portable & affordable Na-ion battery system". They performed hazard study on different main components of an energy storage system as presented in Table 1. Among the 5 students, 4 went to pursue Technology in environmental engineering or energy related master's degree. Although the number of students is low, this observation reinforces the idea that undergraduate work experience plays a role in making decision about the field they would pursue a master's degree and thus, the field to consider for career.

This activity is not limited to the UK only, as a group of students (16) from NTNU who have developed interest in Solar energy were fully involved in SETecTra activities through different project as shown in Table 2.

Table 2: NTNU students in SETechTra project - 2020 2023

Group	Year	Thesis Topic
A (Three students)	2020	• Oxygen related defects in CZ Si ingots. • Role of impurities in mc Si ingots. • Bubbles distribution in fused quarzt crucibles.
B (Three students)	2021	• Investigation of different PV systems at NTNU. • Modelling of impurities distribution in HPMC Si ingots. • Comparison of PV systems in Norway, Denmark and Ukraine.
C (Seven students)	2022	• Comparison of sofwares prediction of different PV systems at NTNU. • Effect of albedo on a bifacial PV system at IFE. • An agrivoltaics system at Skjetlein school Irradiation. • Modelling and decomposition. • An agrivoltaics system at Skjetlein school. • Characterization of laser treated mc Si wafers. • The role of sand quality in bubbles distribution in quartz crucibles
D (Three students)	2023	• An agrivoltaics system at Skjetlein school. • Effect of temperature on lifetime measurements. • Energy communities in Norway'.

Performance Modeling of Bifacial PVPower Plants in a Nordic Climate (Collaboration with Research Institute Ife - Institute for Energy Technology, Norway).