Active learning of Masters in Sustainable Energy: an approach based on multiple challenges

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Background

EIT-labelled educational programmes at Master and PhD levels foster students to become more creative, innovative and entrepreneurs.

7 Cutting-edge Master's programmes

The Mission is the creation of a new generation of so-called "game changers", capable of creating new, sustainable and affordable solutions for the energy challenges of today and tomorrow and of generating a positive socio-economic impact in Europe.

These master degrees in sustainable energy address a combination of technical, operational and business learning objectives.

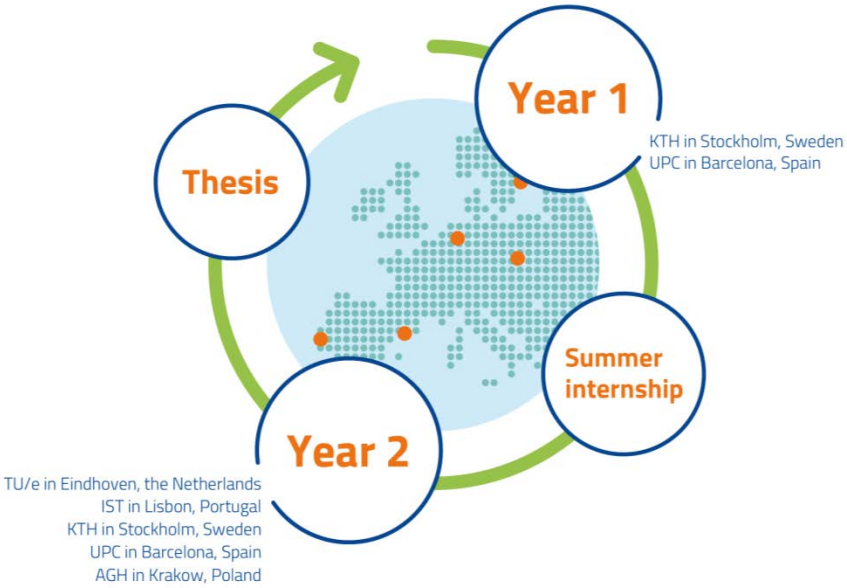
- Master's in Renewable Energy (MSc RENE)
- Master's in Pathways for Sustainable Energy Systems (MSc SELECT)
- MSc European Master's in Nuclear Energy (MSc EMINE)
- Master's in Smart Electrical Networks and Systems (MSc SENSE)
- MSc Energy for Smart Cities
- MSc Clean Fossil and Alternative Fuels
- Master's in Energy Technologies (MSc ENTECH)

Background

InnoEnergy Knowledge Innovation Community

Master's in Renewable Energy (MSc RENE)

Master's in Pathways for Sustainable Energy Systems (MSc SELECT)



Partnerships: technical universities, business schools and companies

Master's in Renewable Energy (MSc RENE)

Students competences

The competencies to acquire by following these master degrees include:

- **Problem solving (PS) -** Be a competent problem-solver, showing good ability to analyze, formulate and manage the technical problems from a system perspective.
- **Creativity (C)** - Show good ability to think beyond boundaries to create new or significantly improved products, services, processes or policies or new business models.
- **Entrepreneurship (E)** - Show good ability to think beyond boundaries to create new or significantly improved products, services, processes or policies or new business models.
- **Sustainability (St)** - An appreciation of ethical, scientific and sustainability challenges as they pertain to their field of work.
- **Social commitment (SC)** - Scrutinize and reflect on social norms and relationships and act to change them.

Teaching methodologies
Challenge-driven education

Engineering education has been transformed to focus problem solutions in 4 main different ways:

1. CDIO (Conceive – Design – Implement – Operate) engineering education.
2. Maintaining the fundamentals while strengthening the skills.
3. Engagement of key stakeholders.
4. Attracting and retaining qualified students.

The challenge-based approach is based in the concepts that follow:

1. Work organized through projects.
2. Work organized in teams.
3. Projects that primarily address unsolved problems, whether in science or society.
4. Involvement of external partners and clients in the projects.

The final objective - specialized knowledge is complemented by and built through open-ended, challenge based, interdisciplinary team work.

Teaching methodologies
Multiple-challenge approach

A learning strategy based on they addressing a number of challenges, which focus in different kind of requirements and needs.

- We analyse d how a total 32 challenges addressed by the students take into account a list of 9 competences and characteristics of the projects and the diversity of the own characteristics and the solutions adopted.
- The final objective is to test the effectiveness of the development by the students of a diversity of projects.

Types of projects and challenges

1. ***MSc SELECT Project of the Year*** - students form teams of 6-10 students to work one year on a proposed "Product or Service" for a significant impact on sustainability. The project is supervised by academic supervisors and external industry representatives

2. ***MSc RENE – RENE Project*** - integrated into a complete learning activity, the so-called "Engineering and Business Case", which combines a set of training activities with industry experts and in business schools with projects at the technical universities of the Program Consortium. **The overall objective is a pre-design and in-depth business feasibility discussion for the innovative energy conversion schemes needed in the respective sub-projects**.

3. ***EDPR University Challenge*** - This challenge is an initiative of EDP Renewables together with PremiValor Consulting. The aim is to promote interconnection framework between universities and the business world. **Students are challenged to show their knowledge and developing a project in the areas of engineering, strategy and / or marketing in the field of renewable energy**.

4. ***Iberdrola Challenge*** - Energy Challenge aiming to engage our master students in innovation and in **creating social impact for the today's energy sector**. Topics include: (1) Global affordable energy; (2) New digital models in energy; and (3) 3- Social economy for affordable energy. Students must create a group of 2 or 3 students.

Projects Analysis

Factor		Scale
Technologies		IPC Classifications for Renewable Energy Generation Technologies
Level of development		Technology readiness level (TRL) scale
Competences	Problem solving	Problem solving can be taken into account or not.
	Innovation	Improved products (P), services (S), solutions (SO), processes (PR) or policies (PO) or new business models (BM).
	Entrepreneurship	The result can be ranked as intrapreneurship (I), eager to create a start-up (SU) or eager to create a spin-off (SO).
	Sustainability	Sustainability can be taken into account or not.
	Social commitment	Social commitment can be taken into account or not.
Market and industry	Market approach	Market approach can be taken into account or not.
	Connection with industry	The connection with may be done for large companies (L), SMEs (SME), Start-ups/spin-offs (SU), Non-Governmental Organisations (NGO).

Analysis of competencies

Problem solving	a total 31 out of 32 projects developed this competence
Innovation	The more common innovation was a product innovation, with a total of 11 out of 32 cases. Business models (BM), services (S), solutions (SO) were also addressed by a good number of projects. Diversity on this respect was considerable.
Entrepreneurship	A total of 18 out of 32 projects involve a intrapreneurship initiative. Diversity in this area was limited.
Sustainability	All the projects took into account this competence

Innovation

Type	#
BM	5
BM/SO	1
P	11
PR	1
S	6
SO	8
Total	32

Entrepreneurship

Type	#
I	18
I/SO	4
I/SU	1
SO	2
SU	6
Total	32

Conclusions

- All or almost all the projects analysed consider **problem solving**, **sustainability** and **market approach**
- Only a limited number of projects involve **social commitment**.
- In other cases, we are testing not only that a competence or a characteristic of the project is taken into account but that a diversity of characteristics and solutions are addressed.
- In relation to the level of development, and contrarily to what could be expected, the **students do not prioritize often recent technological developmen**ts.
- Finally, connection with the industry is limited and scarcely diversified.

Proposals for improvement

- In relation of some competences and characteristics of the projects it would be necessary a more intense focus and a higher diversity of the solutions adopted.

- Because of the open character of these activities the control and management of the competences developed is not immediate.

- As a future suggestion we propose to extend the use of the multiple-challenge approach in sustainable energy programs and, at the same time, the development of a systematic monitoring of the kind of challenges addressed and the competences developed by each student.

Questions?

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