EIT InnoEnergy Master's in Sustainable Energy Systems

The case in summary

The EIT InnoEnergy Master's programme in Environomical Pathways for Sustainable Energy Systems has broad and deep offers in entrepreneurship training. Its Innovation and Entrepreneurship (I&E) Journey is a structured learning experience aimed at providing students with the skills, tools, methods, and motivation to become an entrepreneur, innovator or intrapreneur. The Journey consists of six elements: Impact projects (Project of the Year and Integrated Project of the Year), Business and Innovation training, an entrepreneurship competition named "Battle of Green Talent", Data Science for Energy Engineers, career support, industry challenges & CommUnity, and internships. The Journey is the key differentiating factor as traditional engineering degrees do not offer such training. Education in this programme is highly digitised. It connects students from different cities in hybrid courses, and the "Battle of Green Talent" competition takes place online.

1. Background - Profile of EIT InnoEnergy Master's in Sustainable Energy Systems

The EIT InnoEnergy Master's programme in Environomical Pathways for Sustainable Energy Systems (SELECT) takes place in the framework of the European Institute of Innovation and Technology (EIT). EIT is an independent body of the European Union that brings together leading business, education and research organisations to form partnerships with the aim of delivering innovation across Europe. EIT organises its activities into nine Innovation Communities. One of them is EIT InnoEnergy. Its aim is to accelerate sustainable energy innovations. Running higher education programmes is a major activity of EIT and EIT InnoEnergy. Education in these programmes is highly digitised, also because they often connect students based in different European cities. The core of the EIT InnoEnergy education is to combine technical, innovation and entrepreneurial skills. EIT InnoEnergy offers seven Master's programmes. The Master's programme in Sustainable Energy Systems has one of the broadest and deepest offers in entrepreneurship training and it is focused on in this case study. The programme had been in existence even before EIT InnoEnergy was created. Before, it was a study in the framework of the European Commission's Erasmus+ programme. It joined EIT InnoEnergy on its inception in 2010.

The programme welcomes between 50 and 60 students per year. So far it has trained 354 graduates, and currently has 89 enrolled students. Students choose two universities for their studies: In year 1, Royal Institute of Technology in Stockholm (KTH, Sweden) or Universitat Politècnica de Catalunya – Barcelona Tech (UPC, Spain). In year 2 the choice is between KTH, UPC, Politecnico di Torino (Italy), Eindhoven University of Technology (the Netherlands), Instituto Superior Técnico (Portugal), Aalto University (Finland) or University of Science and Technology (Poland). Depending on their choice, the students receive a degree from year 1 and year 2 universities. In addition, they receive a certificate from ESADE Business School and the EIT Label certificate which ensures the alignment with the philosophy of EIT programmes.

2. Objectives - The Master's programme in Sustainable Energy Systems

According to the programme's description, "SELECT is an English-taught programme where you can learn how to make a real contribution to minimising the environmental impact of current and future energy solutions". In this programme, "students learn to address societal challenges with technical solutions in fields such as renewable energy, solar systems, biomass processing, offshore energy and more". Students can choose their specialties in the second year:

- Combined Energy Systems at KTH Royal Institute of Technology deals with multiple energy services from combinations of renewable energy sources.
- Energy Efficiency at PoliTo Politecnico di Torino is about new energy pathways in complex integrated systems, with a focus on efficiency in the industrial and residential contexts.
- Innovation in Energy Systems at Eindhoven University of Technology explores innovation in electrical power supply systems, including smart grids, energy storage, and built environmental design.
- Offshore Energy Systems at IST Instituto Superior Técnico focuses on innovation, economic, legal and ecological dynamics at work within the implementation of energy technologies.
- Solar Systems at UPC Universitat Politècnica de Catalunya provides expertise in solar systems as well as a broad perspective on technological development in innovation and sustainability.
- Sustainable Biomass Processing at Aalto University delivers specialised expertise in sustainable energy production, conversion systems and markets.
- Sustainable Energy Systems at AGH University of Science and Technology deals with technologies as well as economics, energy policy and energy management in the fuel and energy sector.

3. Input - Resource used for developing and running the programme

A vast number of resources are required from both EIT InnoEnergy and the partner universities. There is a **leading team** for the programme composed of a Programme Director from one of the consortia universities and a Programme Coordinator. The universities and EIT InnoEnergy appoint both. They both have teams involved in the different aspects of running the programme.

The **universities and EIT InnoEnergy** jointly design a roadmap for the programme which determines the way forward including necessary investments in new educational formats. The partner universities then deliver and coordinate the programme. This also includes some of the activities of the Innovation & Entrepreneurship Journey such as Project of the Year in the first year and the Integrated Project of the Year in the second year, coordinated by the universities. There is also a central team at EIT InnoEnergy that organises some of the entrepreneurial activities, for example Battle of Green Talent.

Moreover, EIT InnoEnergy has a **learning and instructional design team** and an education strategy team, supporting the universities with the appropriation of new learning methodologies. It seeks challenges and case partners and deploys new technologies such as hybrid learning classrooms. EIT InnoEnergy is responsible for training the trainers involved in delivering the programme.

Finally, EIT InnoEnergy runs the **marketing and recruitment** activities for the programme. Another partner university, KIT in Germany, oversees student admissions. However, the final admission decision is taken by the partner universities of the programme consortia.

The study programme joined the EIT InnoEnergy initiative to align the goals of teaching top technical skills combined with state-of-the-art innovation and entrepreneurship. Moreover, the programme benefits from EIT InnoEnergy as it helps to attract industry partners and find case studies within its ecosystem.

4. Activities - Description of the programme and additional activities

First and second year distinctions

In the **first year**, students study at either the Royal Institute of Technology in Stockholm (KTH) or the Universitat Politècnica de Catalunya – Barcelona Tech (UPC). Courses in the first-year focus on sustainable energy conversion, renewable energy, and ways of ensuring minimal human impact on the environment. Both universities provide the content. Students join courses at the other university virtually, so the courses take place in a hybrid mode.

In **year 2**, students can select one of seven specialist tracks at different European universities – see Section 2 above. Students prepare their Master thesis in cooperation with partner organisations from industry, research, or civil society. The thesis should include both technological aspects and a solid business analysis.

Development over the years

Over the years, the programme has moved to a hybrid format, away from a conventional educational format in which each participating first year university offered its own curriculum. In this new format, KTH and UPC act as a first-year home university with a shared curriculum. Moreover, the programme has become more practice-oriented: through more industry participation in students' project work, through the addition of soft skills such as data science techniques, technical communication, and project management as well as through integrating an entrepreneurship journey by ESADE Business School. Finally, the programme has developed its contents to ensure its alignment with the energy transition and related policy acts such as the EU Green Deal. More changes are planned for the future, including, but not limited to, adding a third university as a first-year home and further differentiating the curriculum.

Drivers and barriers

A major driver to developing the programme was the need to adapt to digitisation. The programme managers put much effort into ensuring the success of hybrid education. Another driver was the need to implement a common curriculum for students at different locations that can ensure the same level of quality and best learning experience.

As regards barriers, modifying the teaching to hybrid education, where some students are present physically in the classroom and others virtually online, was a challenge for both teachers and students. First of all, there were technical challenges such as sufficient audible and visual connections between the physical teaching venue and remote students. EIT InnoEnergy invested in hybrid rooms with suitable equipment at various of its partner universities. Moreover, a need to up-skill teachers' equipment literacy became apparent. The universities responded with dedicated training to improve teachers' knowledge of equipment as well as encouraging teachers to share related best practices.

In hybrid rooms, the universities tested several systems to ensure optimal teaching. The current system in place has state-of-the-art technology with multiple cameras in the room as well as a fixed camera that tracks the educator's movements. It also includes a digital board that can be used for better engagement

with remote students. However, one issue to be solved is sounds from the hybrid rooms. The current microphones amplify voices and eliminate disturbances but still broadcast the slightest whispers. Another function that was tried and eliminated was breakout rooms. While its value was proved in a fully online educational setting, in a hybrid format it presented a significant challenge. Hence, some professors discarded it.

Finally, it is a challenge to accommodate students' need to have certain lectures face-to-face. One solution is to enhance professors' mobility to attend lectures in more than one location.

Developing the programme further

The consortium of participating universities is developing the programme further. As only two of those are sharing the curriculum for the first year, most of the content for that year is developed by them. Nevertheless, the consortium as a whole is consulted on any activity, and EIT InnoEnergy encourages all universities to participate in the whole curriculum. For example, PoliTo also provides some modules in the first-year courses.

5. Entrepreneurial activities - The Innovation and Entrepreneurship Journey

Objectives of and rationale behind the Journey

In parallel to the Master's programme, students enter an "Innovation & Entrepreneurship Journey". It allows students to "gain hands-on experience and start building your own personal European network". The Journey consists of six elements: Impact projects (Project of the Year and Integrated Project of the Year), Business and Innovation training, "Battle of Green Talent", Data Science for Energy Engineers, Career support, industry challenges & CommUnity, and internships.

EIT InnoEnergy's Innovation and Entrepreneurship (I&E) Journey is a structured learning experience aimed at providing students with the skills, tools, methods, and motivation to become an entrepreneur, innovator or intrapreneur. While the Journey varies in content and terminology across the different Master's programmes, aims and objectives are common. Students with clear entrepreneurial ambitions obtain the chance to test their own start-up idea during their studies and receive support to make it real. Upon completion of the I&E Journey, the student shall have the following abilities:

- Use tools and methodologies that help them create new ventures as well as new products and services.
- Use a structured process for entrepreneurship and innovation to de-risk a business case and enhance product and market fit.
- Be knowledgeable about the start-up world including venture creation, funding rounds and investor typology.
- Be equipped with competencies such as creative thinking and tolerance for ambiguity.
- Understand the business basis interwoven with innovation, entrepreneurship, and intrapreneurship.
- Pitch their start-up and innovation professionally.

The I&E Journey is a cornerstone of the Master's programmes of EIT InnoEnergy. It is supposed to be a key differentiating factor as traditional engineering degrees do not offer such training. The Journey is equivalent to a minor in business due to the intensity and depth provided during the training. EIT InnoEnergy perceives that, in recent years, more and more engineering degrees started incorporating

entrepreneurship elements into their programmes. Therefore, EIT InnoEnergy considers it as key to stay "ahead of the game". Both EIT InnoEnergy and its partner universities seek setting clear intended learning outcomes for the I&E Journey, so students understand the difference with other programmes.

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Impact projects

Students in the programme work on "challenge-driven projects": the **Project of the Year** (PoY) in the first year and the **Integrated Project of the Year** (IPoY) in the second year. In teams with fellows, students apply their knowledge and skills to real-life projects, provided by an industry partner from the EIT Food network. The students learn to solve complex problems, acquire essential facts and techniques, build solid knowledge of innovation and entrepreneurship, and develop a technically sound pre-design and preliminary business plan. Exemplary projects include "REGEN: sustainable solutions for women in Nepal"[1], "Re-Cell: processing and handling end-of-life Li-ion batteries in Europe"[2], and "REMOTE: hydrogen-based storage system in Finland"[3]. In the first year, the universities and EIT InnoEnergy bring projects to the students. In the second year, students choose their projects based on their own interest.

The main challenges emerge from identifying suitable projects in industry and aligning them to educational needs. Finding that balance is a constant struggle of optimising expectations, timing, and process design. Both EIT InnoEnergy as well as personnel at the universities are tasked to develop partnerships with industry and relevant projects. EIT InnoEnergy provides specific templates, project definitions and a minimum scope to be met. Another challenge is dealing with sensitive company data and related non-disclosure agreements.

Business and Innovation training

The Fall and Spring Seminars take place in cooperation with ESADE Business School to train students in innovation and entrepreneurship. In fall, first-year students take part in courses that introduce them to project management tools and techniques. Second-year students focus on branding and fast prototyping. Courses in Spring include Design Thinking for first-year students as well as intellectual property rights and digital marketing for second-year students. Moreover, students are trained in group discussions in an international setting.

Battle of Green Talent

The Battle of Green Talent is an online entrepreneurship competition designed for all EIT InnoEnergy students. Students immerse in an online entrepreneurial ecosystem. In a six month period , they transform their ideas into business, competing with peers, interacting with virtual investors from top

1 See https://www.innoenergy.com/for-students-learners/news-events/eit-innoenergy-students-sustainable-solution-offers-new-hope-for-young-women-in-nepal/.

2 See https://www.innoenergy.com/for-students-learners/news-events/eit-innoenergy-master-school-students-aim-to-revolutionise-europe-s-li-ion-battery-value-chain/.

3 See https://www.innoenergy.com/for-students-learners/news-events/msc-students-create-a-hydrogen-based-storage-system-on-koekar-island-for-their-poy/.

business schools around the world and receiving advice from business creation professionals. The best team wins a cash prize and a voucher to benefit from start-up incubation services.

Data Science for Energy Engineers

In special training courses, students can learn about data science skills to analyse, forecast and optimise energy demand. InnoEnergy introduced this element because data science is a particularly important field in the energy industry.

CommUnity, career support and industry challenges

CommUnity is a platform of EIT InnoEnergy students and alumni where participants can "connect, interact, join events and (..) take advantage of an exclusive job board". The programme also offers career support services and opportunities to work on real-life challenges in cooperation with industry.

Internships

Students are encouraged to do an internship at one of the programme's industrial or research partners in the summer between the first and second year. EIT InnoEnergy supports students in finding a suitable internship or job placement through a dedicated job board including vacancies from its partner companies.

Adding activities to an already congested first year curriculum is a major challenge. Whilst both teachers and students consider the entrepreneurship journey as very valuable for students' skills, EIT InnoEnergy is, together with students, reflecting on how to integrate it even more appropriately into the curriculum. Timing is critical, and a redesign of activities will avoid overlaps that draw too much on students' capacity.

6. Stakeholders - How stakeholders are involved and contribute to the outcome

At the heart of the programme is the EIT **InnoEnergy ecosystem**. It comprises more than 300 start-ups that emerged from the Master's programmes and more than 500 partners across Europe. Students interact with and learn from this ecosystem in many ways from the first day, for example through events, in-company projects, and the student-alumni community. EIT InnoEnergy considers the ecosystem as the main characteristic that distinguishes the EIT InnoEnergy programmes from other offerings. As marketing manager Javier Arias puts it: "Our ecosystem is an active learning space where our students take up responsibilities and work side-by-side with experts and practitioners. Students experience hands-on what it means to lead, take responsibility and solve problems with multidisciplinary dimensions and no predefined outcome."

Developing the ecosystem is at the core of the work of EIT InnoEnergy since it came into being. EIT InnoEnergy has more than 200 employees most of whom are dedicated to expanding and maintaining this ecosystem. EIT InnoEnergy invests in companies, supports their development, helps train their staff, de-risks the investment of future investors, supports the commercialisation of products and services from the ecosystem. There is an annual event that brings all players from the ecosystem together to nurture it further, "The Business Booster".[4] Moreover, EIT InnoEnergy has a dedicated team of Career Centre experts and industry liaisons within its Education department that is responsible for connection with the ecosystem. In this way, EIT InnoEnergy tries to overcome any potential challenge that arises.

[4] See https://tbb.innoenergy.com/.

For example, the broadness of activities may dilute the focus on recruiting students or engaging with them through case studies. This team also organises challenges with companies so that they remain engaged with the students.

7. Outputs and outcomes

In 2022, the SELECT programme has a network of over 350 alumni and 89 current students, some of who are in senior positions such as CEO, Department Heads, managers, and directors. Moreover, graduates from the programme have created 19 start-ups. While energy tends to be a domain that attracts predominantly men, around 30% of participants are female. Women's participation has increased to 20 out of 53 in 2021. The plan is to keep their share increasing.

Implementing and running a programme like EIT InnoEnergy, including substantial entrepreneurship education, requires the deep cooperation of several higher education institutions. Moreover, it requires being part of a large ecosystem with industry players. EIT InnoEnergy considers itself the largest ecosystem in sustainable energy in Europe and even one of the largest in the world. This way, EIT InnoEnergy in particular can provide good practice examples for higher education institutions that seek to be part of such larger European networks. However, single higher education institutions or alliances of only a few institutions may try to develop their own 'entrepreneurial journeys' for their students on a smaller scale.

Sources

This case study was prepared by Dr. Stefan Lilischkis from empirica Gesellschaft für Kommunikations- und Technologieforschung mbH, Bonn, Germany, through collection and analysis of broad documentation about InnoEnergy and interviews with key representatives from the University.

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Contact

Javier Arias, Senior Marketing Manager – Master & PhD Schools, EIT InnoEnergy,
javier.arias@innoenergy.com

Links

EIT Inno Energy Master's Programme in Sustainable Energy Systems:
https://www.innoenergy.com/for-students-learners/master-school/master-s-in-sustainable-energy-systems/

European Institute of Innovation and Technology: https://eit.europa.eu/