Course: Modelling Business Ecosystems of Energy Flexibility Services credits: 10

Course code	SUVM23MBEEFS
Name	Modelling Business Ecosystems of Energy Flexibility Services
Study year	2026-2027
ECTS credits	10
Language	English
Coordinator	F. Pierie
Modes of delivery	Teaching method 1
Assessments	Fundamental Modelling - Written, organised by STAD examinations Modelling Ecosystems - Assignment

Learning outcomes

Objective of the module:

The student has achieved the following learning outcomes:

1. After successfully completing this module, the student has achieved the following:
2. Apply the fundamentals of physical modelling to energy systems.
3. Apply modelling techniques to create transparent models on energy business ecosystems and use them to evaluate energy systems on efficiency, environmental impact and basic economics
4. Apply methods for the validation and verification of created models.
5. Apply the Material and Energy Flow Analysis (MEFA) methodology and energy flow diagrams (Sankey) to analyze the environmental impact of energy systems
6. Understand the basics of the Life Cycle Assessment (LCA) methodology for analysing the environmental impact of energy systems and integrate LCA data in energy modelling.
7. Evaluate the impact of the information and flexibility services on the viability of the business ecosystem, the related business processes and design workflows delivering such services
8. Create a basic business ecosystem from a techno economic perspective using technical modeling and buisinessmodel techniques

Content

Content of the module:

In this module, students acquire the fundamentals of modelling techniques and methods, applied to a real energy system. Furthermore, the role of flexibility services in optimizing decentralized energy systems will be introduced and tested in the assignment. The aim is to develop a business ecosystem, where a viable business model for all involved stakeholders needs to be designed.

The fundamentals of modeling will be explained using three methodologies namely, Material and Energy Flow Analysis (MEFA); Life Cycle Analysis (LCA); and validation and verification of models. The students apply the learned skills in Excel based models containing the aforementioned elements. The focus is on relationships between individual elements within energy systems, e.g. production, storage, conversion. The students program these relationships in a model and use the model to gain understanding and find optimal solutions, with respect to energy efficiency, environmental impacts, and basic economics (e.g. CAPEX and OPEX). Both theory and practice (building an actual model and a real life case) are integrated to give the students a fundamental understanding of energy systems and modelling thereof. The content of the module will be given as tutorials where the students will work on an assignment (e.g. building a model in excel) where the required theory is given to help them progress (just in time). On completion of this module the student will be able to construct a well-structured and transparent model, validate the model, run scenarios in the model, and draw conclusions from the model. The knowledge gained in this module forms a foundation on which the students can expand their modelling skills by using other specialized energy models while recalling the fundamentals of modelling.

The concept of flexibility will be introduced and the role of (smart) flexibility services will be explained. Business modeling basics and the introduction of a tool for business modeling (e3value) will be introduced that can be used to design and optimize a business model for a real life neighbourhood. With the introduction of decentral renewable resources advanced flexibility services will be needed to control and manage non-controllable generation, decentral demand-supply coordination, as well as the incorporation of advanced conversion and storage technologies. Energy-related services are crucial in this, but they cannot be deployed without adequate information support. A real life case will be modelled, where flexibility (e.g. storage, conversion) is needed. In order to deliver more advanced services, several stakeholders have to be lined up in a business value network, and various business processes need to be developed. Accordingly, students will be introduced to business process management and business process modelling.

To achieve the module learning outcomes the students attend lectures on modelling theory, perform a written exam, and make a modelling assignment. All components of the module will come together in a real-life case study that needs to be modelled and worked out into a viable energy eco-system. For this students will write an essay.

Included in programme(s)

European Master in Sustainable Energy System Management

School(s)

Engineering, Life Sciences & ICT

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