Module Name	Electrolysis, Fuel Cell Systems and PtX
Module Number	EuI-MT-E-EBZPX, EuI-RES-E-EBZPX
Responsible Lecturer	PD Dr.-Ing. Matthias Jahn matthias.jahn@ikts.fraunhofer.de
Qualification Objectives	After successfully completing this module, students will have a broad foundational knowledge in the field of electrolysis, fuel cell, and Power-to-X systems. Students will be able to describe the functionality of these systems, identify their potential applications, and explain the components and their functions. They will be capable of calculating the efficiency of energy conversion in these systems and evaluating their use in the context of the energy system, particularly with regard to the transformation of the energy system and greenhouse gas neutrality.
Contents	The module covers the fundamentals and motivation for the use of electrochemical energy converters, such as electrolysis cells, fuel cells, and batteries, in future energy systems based on renewable energy sources. Topics include: - Balancing material and energy flows in energy conversion plants, such as specialized fuel cell and Power-to-X systems - Definition of energy and reaction engineering terms and quantities - Design of reactors with heterogeneously catalyzed reactions - Thermodynamic analysis of systems - Basics of electrochemical energy conversion in electrolysis and fuel cells as well as batteries - Types of electrolysis and fuel cells, battery types, and their structure and function - Cell stack and stack design and function - Characterization of the electrochemical properties of cells and stacks - Overview of hydrogen production methods - Concepts and technologies for storing electrical energy from renewable sources - Classification of hydrogen and batteries for energy storage - System components and structure of fuel cell and Power-to-X systems - Efficiency of different system variants - Fuel cell systems for various application fields - Lifetime and degradation of electrolysis and fuel cells - Coupling of electrolysis with chemical syntheses, such as Power-to-Gas and Power-to-Liquids, for the utilization of CO2 - Processes to avoid CO2 emissions through the use of hydrogen, particularly in the steel industry - Overview of the long-term development of the energy system in Germany and the role of green hydrogen as an energy carrier
Teaching and Learning Forms	4 hours per week of lectures, 2 hours per week of exercises, and self-study.
Prerequisites for Participation	The competencies to be acquired in the modules Physics, Materials, and Engineering Mechanics are required.
Usability	The module is an elective module in the elective area "Competence Deepening" according to § 6 paragraph 3 SO and § 33 paragraph 3 PO in the diploma program Regenerative Energy Systems. It is also an elective module in the elective area "Methods and Applications" of the main study program according to § 6 paragraph 3 SO and § 33 paragraph 3 PO in the diploma program Mechatronics.
Prerequisites for the Award of Credit Points	Credit points are awarded when the module examination is passed. The module examination consists of a written exam lasting 120 minutes. For up to 20 participants, the written exam is replaced by a non-public oral examination as an individual exam lasting 30 minutes. If applicable, this will be announced to the registered students at the end of the registration period in the usual manner.

Credit Points and Grades	7 credit points can be earned through the module. The module grade corresponds to the grade of the written exam or oral examination.
Frequency of the Module	The module is offered every winter semester.
Workload	The total workload is 210 hours.
Duration of the Module	The module lasts one semester.