



Subject card

Subject name and code	Low-carbon technologies in the energy transition , PG_00072668						
Field of study	Chemical Technology, Chemistry, Biotechnology, Engineering and Technologies of Energy Carriers, Corrosion , Green Technologies, InfoBioChem						
Date of commencement of studies	February 2026	Academic year of realisation of subject	2026/2027				
Education level	second-cycle studies	Subject group					
Mode of study	Full-time studies	Mode of delivery	at the university				
Year of study	1	Language of instruction	English				
Semester of study	2	ECTS credits	3.0				
Learning profile	general academic profile	Assessment form	assessment				
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Natalia Łukasik					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM		
	Number of study hours	45	5.0	25.0	75		
Subject objectives	The aim of the course is to familiarise students with selected low-carbon and low-emission technologies used in the energy transition, with particular emphasis on hydrogen technologies, biomass conversion, waste valorisation for electricity and heat generation, energy storage, carbon capture and utilisation, and power-to-X systems. Students will acquire knowledge of the principles, applications and limitations of these technologies, as well as practical skills related to their technological, environmental and economic assessment. The course will highlight the role of low-emission technologies in reducing greenhouse gas emissions, increasing resource efficiency and supporting the decarbonisation of energy systems and industry.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U02] carries out experiments using properly selected techniques and apparatus, taking advantage of new developments in technology and related fields	is able to conduct experiments related to selected low-emission technologies using appropriately selected research techniques, laboratory equipment, and methods for data analysis applied in modern energy and environmental technologies.	[SU4] Assessment of ability to use methods and tools
	[K7_U05] uses instrumental methods applied in technology and related fields	is able to apply instrumental methods to investigate and evaluate processes related to low-emission technologies and interprets the obtained results to assess the technological and environmental performance of the analysed solutions.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K7_K01] critically evaluates the content of cognitive and practical problems	critically evaluates technological solutions applied in the energy transition, taking into account their technical, environmental and economic aspects, and identifies their limitations and implementation potential.	[SK5] Assessment of ability to solve problems that arise in practice
	[K7_W04] recognises scientific, technological, organisational and economic opportunities and constraints in technology and related fields	knows and identifies the opportunities and limitations of low-emission technologies from scientific, technological, environmental and economic perspectives and indicates the conditions for their effective implementation in the energy transition.	[SW1] Assessment of factual knowledge
[K7_K02] understands the non-technical aspects and implications of graduate activity, including the impact on the environment	The student is ready to take into account the environmental and socio-economic impacts of implementing low-carbon technologies in their professional activities, guided by the principles of sustainable development.	[SK5] Assessment of ability to solve problems that arise in practice	
Subject contents	<p>Course content – lecture</p> <p>Lecture:</p> <ol style="list-style-type: none"> 1. Introduction to low-carbon technologies and the energy transition, 2. The role of hydrogen in the decarbonisation of industry, energy systems and transport, 3. Low-emission hydrogen production methods, 4. Carbon capture, storage and utilisation, 5. Biogas and biomethane production, 6. Biomass conversion technologies for energy production, 7. Biofuels production: liquid biofuels, advanced biofuels and e-fuel integration, 8. Circular economy and waste-to-energy technologies: RDF, SRF and energy recovery from waste, 9. Post-process gas cleaning technologies: absorption, adsorption and emission control, 10. Environmental assessment of low-carbon technologies: LCA, carbon footprint, water footprint and ESG, 11. Final assessment <p>Course content – laboratory</p> <p>Laboratory classes:</p> <ol style="list-style-type: none"> 1. Biogas production, 2. CO₂ capture methods, 3. Sodium borohydride as a chemical hydrogen storage material, 4. Photochemical water splitting for hydrogen production, 5. Post-process gas cleaning, 6. Computer laboratory: life cycle assessment of a selected low-carbon technology case study, 7. Technological study visit 8. Compensatory laboratory class 		
Prerequisites and co-requisites	Fundamental knowledge of chemical technology.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture - test	60.0%	60.0%
	Laboratory classes – tests, reports	100.0%	40.0%
Recommended reading	Basic literature	Hydrogen Technology: Fundamentals and Applications, ed. M.R. Cesario, A. J. Menezes de Araujo, F.J. Almeida Loureiro, D. Araujo de Macedo, Elsevier, Amsterdam, 2024.	
	Supplementary literature	Handbook of Fuels: Energy Sources for Transportation, ed. B. Elvers, A. Schutze, Wiley-VCH GmbH, 2022.	
	eResources addresses		

Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Discuss the role of hydrogen technologies in the decarbonisation of energy systems, industry and transport. Include examples of hydrogen production, storage and utilisation methods. 2. Compare selected low-emission hydrogen production methods, such as water electrolysis, biomass-based hydrogen production and methane pyrolysis. Discuss their advantages, limitations and environmental impacts. 3. Explain the principles of biogas and biomethane production. What types of feedstocks can be used, and how can these technologies support the circular economy and waste valorisation? 4. Describe the role of carbon capture, utilisation and storage technologies in reducing greenhouse gas emissions. Discuss selected CO capture methods and possible utilisation pathways
Practical activities within the subject	Not applicable

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