Module name: Sustainable Buildings

Module number: B 5		**ECTS credit points: 5**
Academic level	Master	
Intended curriculum phase	2nd sem.	
Compulsory module or compulsory elective module	Compulsory module	
Ratio of in-person/online teaching	1.5 in-person teaching	3.5 online teaching
Assigned courses*/ stages / ECTS credit points *... Course types and associated workloads are explained in detail under planned didactics and methodology	1. Fundamentals of Sustainable Building (Grundlagen des Nachhaltigen Bauens); e-learning course – **online stage**, 1.5 ECTS credit points 2. Advanced Topics in Sustainable Building with Focus on Office and Company Buildings (Ausgewählte Kapitel des Nachhaltigen Bauens, Schwerpunkt Büro- und Firmengebäude); lecture / case studies – **in-person stage**, 1.5 ECTS credit points, VU (lecture with integrated exercises) 3. Transfer Project; e-learning project – **transfer stage**, 2 ECTS credit points, PT (project)	
Scope	5 ECTS credit points	
Required skills/modules; skills/modules to be acquired in parallel	none	
Prerequisite for	none	
Course language	English	
Central idea and skills to be imparted	At the start of this module, the students learn about the fundamentals and application of lifecycle assessments and life cycle costing in the construction sector along with the importance of lifecycle assessments for the design of climate-friendly company buildings. The basic principles of lifecycle assessment and life cycle costing are explained, and the influence of the applicable system framework is discussed. Students become familiar with state-of-the-art tools and databases. Using application examples, different evaluation methods are discussed and methods for communicating results are presented.	

	In the latter half of the module, students learn about lifecycle-based sustainability assessments and optimisation of buildings, allowing them to become familiar with the topic on an implementation level. Using real-life examples, trends in relation to sustainable company buildings are discussed along with optimised implementations for use in individual companies.

Teaching content	**Learning outcomes / goals**
	Upon successful completion of the module, students are able to:
Fundamentals and application of lifecycle assessments and life cycle costing in construction ▪ Basic principles of lifecycle assessment and life cycle costing ▪ System framework ▪ Evaluation methods ▪ Databases and tools ▪ Application examples, influencing factors and strategies ▪ Result communication	• explain the fundamentals and principles of lifecycle assessments in construction • present an overview of current national and international standards and labels in sustainable planning and building • summarise common methods for economically sensible and climate-neutral construction of company buildings (LCA and LCCA) along with their heating, ventilation and air conditioning requirements present the basics of lifecycle assessment and describe the structure and implementation of lifecycle assessments and lifecycle cost calculation
Lifecycle-based sustainability assessment and optimisation of buildings ▪ Fundamentals and trends for assessing sustainability in construction ▪ Assessment, optimisation and certification of building sustainability	• outline the basics and trends for evaluating sustainability in construction and identify the common building certificates along with their possible uses as lifecycle control instruments for the holistic optimisation of real estate and real estate portfolios • demonstrate the role of sustainability certificates in the lifecycle of buildings • identify strategies to decarbonise heating and air conditioning in industrial buildings and apply them to the design and construction of new company buildings
Energy and buildings ▪ Energy flows in buildings in consideration of building physics and building technology aspects	• explain how the shape, shell and orientation of a building influences heating and cooling requirements as well as the indoor climate and elaborate the central role of electricity demand, generation and storage in construction

Teaching and learning activities and methods*	**Planned didactics and methodology:**

*... teaching and learning activities and methods along with their structuring are explained under planned didactics and methodology

The in-person stage is conducted as a mixture of front-of-class, question-based and discussion-based teaching and with much time devoted to joint discussion (whole-class, in groups).

Theoretical input from the teacher is illustrated and consolidated with the aid of examples. Participants work on other tasks during in-person time, either on their own or in groups, preparing and following up by means of self-study.

Independent work is offered on the basic literature and acquisition of principles in preparation and follow-up for the in-person stages as an asynchronous distance learning element.

Each in-person unit begins with a voluntary short oral quiz on what was previously learned during the online stage.

An application-oriented transfer project rounds off the didactic concept of this module and is devoted to actual corporate tasks performed by the students.

Distribution of ECTS credit points:

	Estimated time commitment in units of 60 minutes
E-learning (preparation for the in-person stage)	37.5
In-person teaching units	20
Course assessment	17.5
Transfer project (follow-up to in-person stage)	50
Total	**125**

Assessment

Assessment methods and criteria:

The online stage is assessed online (multiple-choice exam). The in-person stage is assessed by means of a written examination along with developing and presenting a group project (case study discussions), while the transfer stage is assessed on the basis of a transfer project in the form of a project report or presentation of the project results.

Weighting of the individual assessments in the overall assessment of the module:

	Weighting	Minimum required positive assessment for a completion of the course on the first try
Online assessment	30%	**> 50%**
Written exam – in-person stage	30%	**> 50%**
Project report, presentation	40%	**> 50%**
Total	**100%**	**> 50%**

	Any deviations from this description of the overall assessment are announced at the beginning of the module.

Specialist literature and other learning materials	Core literature: Books, publications, journal articles, each in the current edition: • Abergel, T.; Dulac, J.; Hamilton, I.; Jordan, M.; Pradeep, A. (2019): *Towards a zero-emissions, efficient and resilient buildings and construction sector,* Global Alliance for Buildings and Construction (GABC). • Bauer, Michael; Mösle, Peter; Schwarz, Michael (2013): *Green Building: Leitfaden für nachhaltiges Bauen*, Springer Verlag. • Passer, A.; Lützkendorf, T.; Habert, G.; Kromp-Kolb, H.; Monsberger, M.; Eder, M.; Truger, B. (2020): "Sustainable built environment: transition towards a net zero carbon built environment". In: *The International Journal of Life Cycle Assessment*, 25 (6), pp. 1160–1167. • Frischknecht, R.; Balouktsi, M.; Lützkendorf, T.; Aumann, A.; Birgisdottir, H.; Ruse, E. G.; Hollberg, A.; Kuittinen, M.; Lavagna, M.; Lupisek, A.; Passer, A.; Peuportier, B.; Ramseier, L.; Röck, M.; Trigaux, D.; Vancso, D. (2019): "Environmental benchmarks for buildings: needs, challenges and solutions", previously electronically published. In: *The International Journal of Life Cycle Assessment*., 9 p. • Kreiner, H.; Scherz, M.; Passer, A. (2019): "How to make decision-makers aware of sustainable construction?". In: Frangopol, D. M.; Caspeele, R.; Taerwe, L. (ed.): *Life-Cycle Analysis and Assessment in Civil Engineering: Towards an Integrated Vision,* proceedings of the 6th International Symposium on Life-Cycle Civil Engineering, IALCCE 2018, London: CRC Press/Balkema, pp. 479–485.
	Other learning materials: • PPT slides • TU Graz learning videos (20-30 min.) • screencasts and slidecasts • other free learning and teaching materials