Syllabus

Course Title

Climate Change Mitigation and Adaptation: Case Studies and Best Practices in the Energy Sector

General Information

General description of the required education/training, outlining the main objectives and explaining the necessity of the education/training at the organizational/country/regional level

Climate change is one of the most pressing global challenges of the present day, significantly affecting environmental, economic, and social systems. The increasing concentration of greenhouse gases leads to a rise in average global temperatures, an increase in the frequency of extreme weather events (floods, droughts, hurricanes), ecosystem degradation, and threats to energy and food security. This creates the need for a comprehensive approach to climate change mitigation and adaptation at the global, national, and regional levels.

The energy sector is one of the key sources of greenhouse gas emissions; therefore, its transformation plays a crucial role in achieving climate goals. The main directions include the decarbonization of the energy system, improvement of energy efficiency, implementation of renewable energy sources, development of innovative technologies, and establishment of effective climate policy. At the same time, adaptation measures aimed at increasing the resilience of energy systems to climate risks are becoming increasingly important.

The course “Climate Change Mitigation and Adaptation: Case Studies and Best Practices in the Energy Sector (CCM&A EN)” is designed to develop students’ systematic understanding of mitigation and adaptation processes in the energy sector. It combines interdisciplinary approaches, including environmental, economic, technological, and policy dimensions, enabling the development of comprehensive solutions for sustainable development.

Within the course, modern decarbonization strategies, international and national experience (including in the context of climate commitments and nationally determined contributions), and approaches to developing climate action plans tailored to regional and sectoral specifics are examined. Special attention is given to

Co-funded by the Erasmus+ Programme of the European Union

integrating knowledge from different disciplines, analyzing best practices in the energy sector, and applying them in real-world conditions.

The course is aimed at increasing students' awareness of current climate change challenges, developing skills in assessing mitigation and adaptation strategies, and designing effective solutions to reduce emissions and enhance the resilience of energy systems.

The learning process is delivered in a blended learning format (a combination of online and offline components) and lasts one semester. The course is designed to develop professional competencies of master's students in accordance with the educational program.

Audience

The main target audience of the course and any secondary audience, if it may influence decisions regarding the structure or content of the course

Expected level of knowledge and skills of the main audience (current or minimally required), as well as other factors (for example, cultural characteristics, level of technical training, access to the Internet) that should be considered when planning the course, as they may affect the choice of teaching methods, materials, and approaches to interaction with the audience

The main audience is master's students of universities who are obtaining education in the field of E2 "Ecology." The course will be useful for those who are interested in deepening their knowledge regarding climate change mitigation and adaptation to it, especially in the context of the energy sector.

The secondary audience is master's and bachelor's students of different specialties who seek to obtain practical skills in analyzing climate strategies, developing solutions in the field of decarbonization, and increasing the resilience of energy systems to climate risks.

Current or Minimum Required Level of Preparation of the Audience
Master's students must have basic knowledge of global problems of humanity, possible ways of adaptation and mitigation of climate change impacts, and basics of sustainable development. They must also have basic skills in information search and modern digital technologies.

Competencies

Training needs at the individual or organization/country/regional level, as well as a description of how these needs were identified and recognized as relevant.

Competencies targeted by the training.

Competencies to be Acquired

During the study of the course “Climate Change Mitigation and Adaptation: Case Studies and Best Practices in the Energy Sector (CCM&A EN)”, master’s students are expected to develop the following competence:

C5: Based on economic assessments, provide action-oriented recommendations for the development and improvement of adaptation and mitigation strategies that enhance resilience and reduce negative impacts.

Learning outcomes and performance criteria

Learning outcomes and performance criteria formulated with regard to the knowledge and skills to be acquired during the training process.

Learning Outcomes:

LO1: Critically evaluate mitigation strategies relevant to specific sectors such as energy, transport, or agriculture, analyzing their potential to reduce greenhouse gas emissions and the challenges of implementation.

LO4: Integrate knowledge from different disciplines, including economics, politics, science, and technology, in order to develop comprehensive and effective solutions to climate change.

LO6: Integrate knowledge of sectoral mitigation strategies, adaptation measures, and best practices to create comprehensive climate action plans tailored to specific geographic regions, economic sectors, or communities.

Performance criteria:

Identify and describe key concepts and contributions from different disciplines (including economics, environmental science, public policy, and technology) relevant to addressing climate change; assess the economic, social, and political challenges associated with the implementation of sectoral mitigation strategies; and develop comprehensive climate action plans that integrate both mitigation and adaptation measures.

Course Content

Provide a content outline that corresponds to the learning objectives and outcomes. This may be a course outline as it will be presented to students, but not necessarily a complete curriculum.

Include a general list of all topics that you consider necessary to cover. If you believe it would help clarify the scope, indicate what will NOT be covered.

Module 1: Assessment of Climate Change Mitigation Strategies in the Economic Sector (Energy)

- Lecture 1: Climate change mitigation strategies in the energy sector.
- Lecture 2: The European Green Deal and decarbonization of the energy sector.
- Lecture 3: Application of renewable energy sources using the example of bioenergy and wind energy.

Module 4: Integration of Interdisciplinary Knowledge

- Lecture 1: The environmental aspect within the structure of interdisciplinary knowledge.
- Lecture 2: The economic aspect within the structure of interdisciplinary knowledge.
- Lecture 3: Integration of interdisciplinary knowledge in the field of renewable energy sources.

Module 6: Development of Climate Action Plans under Specific Conditions

- Lecture 1: Ukraine's national climate targets in the energy sector: strategy to 2030.
- Lecture 2: Nationally Determined Contributions (NDCs) as a tool of climate policy.
- Lecture 3: International experience in developing national adaptation strategies in the energy sector.

Learning Solutions and Methods of Implementation

List the learning solutions (teaching methods) that will be used and explain why they were chosen. For example: classroom learning, online learning, blended learning, workplace learning, online resources for self-study, coaching or mentoring, etc.

For master's-level training, a variety of teaching methods are applied to ensure a combination of theoretical knowledge acquisition and practical skills in the field of climate change mitigation and adaptation. The main methods include:

- **Classroom-based learning** – used for active discussion of complex concepts, analysis of case studies, review of best practices in the energy sector, conducting discussions, and developing critical thinking. This format supports the development of professional communication skills, argumentation abilities, and informed decision-making in climate policy.
- **Distance learning** – used to provide access to learning materials, online lectures, scientific sources and databases, as well as for consultations and completion of selected assignments. A full transition to a distance format is possible in cases of critical circumstances, while a blended learning format is prioritized to ensure the quality of the educational process.
- **Independent out-of-class work** – includes the study of scientific publications, analytical reports, climate strategies, video materials, and educational resources. This form of learning is aimed at developing critical analysis skills, assessing the effectiveness of climate measures, and forming independent conclusions on mitigation and adaptation.
- **Interactive learning methods and mentoring su**pport – include case study work, group projects, climate solution modelling, as well as consultations, mentoring, and feedback from the instructor. This promotes interdisciplinary thinking and the ability to apply knowledge in practice.

This combination of methods ensures comprehensive training of master's students aimed at developing analytical, research, and communication competencies necessary for effective professional activity in the field of climate change and energy.

Learning Strategies

Consider which learning strategies you will use. Provide justification for why you intend to apply them, including reasons why they will help participants achieve the planned learning outcomes.

Combine different learning strategies to create a diverse learning environment that accommodates different learning styles of participants. This will increase the effectiveness of learning and help achieve the planned learning outcomes. This section does not require a detailed description of specific activities.

For master's-level training, various teaching strategies are used, aimed at bringing the educational process closer to real professional conditions in the field of climate policy and energy, as well as developing complex competencies: critical and analytical thinking, interdisciplinary knowledge integration, innovation, effective communication, and teamwork.

The main strategies include:

- **Lectures** – provide a basic and systematic body of knowledge about the causes and consequences of climate change, approaches to mitigation and adaptation, as well as modern strategies for energy decarbonization (LO1).
- **Case studies (situational analysis)** – allow the study of specific examples of climate policy implementation and energy solutions, analysis of successful and problematic practices, formulation of analytical conclusions, and avoidance of typical mistakes (LO4, LO6).
- **Discussions and brainstorming** – stimulate the development of critical thinking, argumentation skills, evaluation of alternative solutions, and informed decision-making in the field of climate change and energy (LO4).
- **Inquiry-based learning** – ensures deep engagement with the problem of climate change mitigation and adaptation, is oriented toward students' research interests, and develops the ability to independently formulate and solve complex problems (LO4, LO6).
- **Independent reading and literature analysis** – includes the study of scientific articles, analytical reports, climate strategies, and policies with critical evaluation of sources, contributing to the development of research skills and the ability to synthesize knowledge (LO4).

The combination of these strategies forms a diverse learning environment that takes into account different learning styles of master's students, ensures integration of theoretical knowledge and practical skills, and supports the effective achievement of learning outcomes and the formation of professional competencies.

Learning Activities

Describe the main learning activities that will be included, such as lectures, readings, case studies, discussions, exercises, practical assignments, simulations, role-playing games, etc.

Also describe the roles of instructors and students during these activities.

The learning process combines lectures, practical classes, projects, and independent work with various forms of active learning: situational analysis, discussions, case studies, problem-solving tasks, project work, and reading of scientific sources.

Distribution of Learning Time

- Lectures – 20%
  Instructor: records 15–20 minute video lectures, delivers material in a clear and logical way, provides presentations, and answers students' questions.
  Students: watch video lectures, prepare questions, and participate in discussions.
- Practical classes – 20%
  Instructor: presents examples, facilitates discussions, summarizes results, and provides consultations.
  Students: perform situational analysis, discuss case studies, and propose solutions.
  Main topics of practical assignments:
  - Carbon Capture and Storage (CCS) technologies.
  - Comparison of alternative and traditional energy sources.
  - Economic mechanisms for emission reduction.
  - Assessment of low-carbon energy development in different regions of Ukraine.
  - Impact of military actions on the development of renewable energy sources.
- Projects and presentations – 20%
  Instructor: assigns tasks, explains the problem context, supervises the process, and monitors results.
  Students: conduct critical analysis of literature sources and develop comprehensive solutions and presentations.
  Main project topics:
  - Development of a sectoral emission reduction plan in the energy sector (NDC).
  - Adaptation strategy for the energy sector of a region in Ukraine based on international experience.
  - Assessment of hydrogen energy potential for decarbonization of industrial regions.
- Independent work – 40%

Students study scientific sources, online resources, and prepared materials, complete individual analytical tasks, and develop skills in critical thinking and research work.

The combination of these activities ensures the integration of theoretical knowledge with practical skills, active student participation, and the formation of competencies necessary for academic and professional activity in the field of climate change and energy.

Assessment of Learning

Describe the assessment plan for participants before, during, and/or after the course, including tests, exercises, activities, and projects that will be assessed. Indicate whether self-assessment or peer assessment will be used.

Explain how the assessment is linked to the learning outcomes.

Master's students are assessed before, during, and after the course in order to ensure a comprehensive evaluation of knowledge, analytical, critical, and research competencies. The following methods are used:

1. **Quizzes** – short tests or exercises for reinforcing theoretical material. Students may use them to better understand basic concepts and terminology, and the obtained scores are taken into account in the final course grade.
2. **Critical review** – preparation of presentations, participation in discussions and debates. Students evaluate peer presentations based on criteria such as: how fully the topic is covered, whether all possible solutions were considered in the analysis of the situation, whether logical conclusions are drawn, and how well they reflect the essence of the presentation.
3. **Case study analysis** – the instructor assesses students' presentations and projects, providing feedback on the logic, content, and justification of proposed solutions.
4. **Final test** – a written or online assessment of knowledge and skills that allows evaluation of the level of material mastery and the ability to apply knowledge in practical and analytical tasks.

In addition, self-assessment and peer assessment are applied, which contribute to the development of critical thinking, the ability to analyze peers' work, and to objectively evaluate one's own results.

These methods ensure a comprehensive evaluation of theoretical knowledge, practical skills, and analytical abilities of master's students in the field of climate change and energy.

Storyboard of Learning (Learning Storyboard)

Use this to create a visual scenario of your blended learning activity

Learning resources and tools

List the available resources that will be used for different types of learning activities and recommended to students.

Describe the technologies that will be used to implement learning solutions, including educational technologies and operational equipment (hardware, software, collaboration tools).

To implement the learning activities, a variety of resources and technologies will be used to ensure effective knowledge acquisition and the development of practical skills of postgraduate students:

1. Learning Resources:

- thematic literature, peer-reviewed scientific articles, monographs, textbook chapters, and methodological materials;
- video lectures and instructional materials for class preparation available on the Moodle platform;
- access to scientific databases (Scopus, Web of Science, ResearchGate) and electronic books from the university library;
- PowerPoint presentations for lectures and practical sessions;
- reports from international organizations (UN, IPCC, Greenpeace), textbooks on sustainable development economics, innovation management, and environmental marketing;
- additional video materials available on educational platforms (YouTube).

2. Educational Technologies and Tools:

- platforms for distance and blended learning (Moodle, Zoom, MS Teams);
- internet access to information resources;
- collaboration and discussion tools (Google Workspace, Miro, Padlet);
- technical equipment for practical and laboratory work, including computers, multimedia projectors, and interactive whiteboards.
- These resources and tools ensure the integration of theoretical knowledge with practical skills, support active student participation in the learning process, and promote the development of critical thinking, research competencies, and interdisciplinary collaboration.