Syllabus

Course Title

Climate Change Economics: 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

The course "Climate Change Economics: Case Studies and Best Practices in the Energy Sector" integrates approaches of climate economics, applied modeling, and policy analysis for the formation of a systematic understanding of the impact of climate change on economic processes and the energy sector. The content of the course is built on a combination of theoretical foundations and practical tools that make it possible to assess risks, forecast the consequences of climate change, and substantiate management decisions.

The course covers basic methods of economic and mathematical modeling that are applied to the analysis of greenhouse gas emissions, the assessment of economic losses from extreme weather events, as well as the optimization of adaptation and decarbonization measures. Particular attention is paid to the use of econometric models for the analysis of climate policy and the assessment of the effectiveness of implemented decisions in various sectors of the economy, in particular in energy, transport, and agriculture.

Within the course, approaches to the adaptation of the economy to climate change are considered. The analysis includes the assessment of the impact of climatic factors on key sectors, the study of opportunities for the implementation of green technologies, the improvement of energy efficiency, and the optimization of resource use. Considerable attention is devoted to financial instruments of adaptation, in particular mechanisms for climate risk insurance, the development of green investments, and the use of climate funds.

The course also covers the development and analysis of public climate policy. International and national initiatives in the field of climate resilience, instruments for emissions regulation, as well as mechanisms for stimulating businesses to implement adaptation measures are examined. A separate module is devoted to the formulation of policy recommendations based on data analysis, scenario modeling, and the assessment of the effectiveness of management decisions. Participants

master approaches to interaction with key stakeholders, including public authorities, business, and civil society.

An important component of the course is the analysis of international experience and best practices in the energy sector, which makes it possible to adapt effective solutions to national and regional conditions. The study of case studies is aimed at understanding successful models of decarbonization, the development of renewable energy, and the integration of climate strategies into long-term economic planning.

The purpose of the course is to develop in students the ability to:

- apply modeling methods for the analysis of climate processes and their economic consequences;
- assess risks and economic losses associated with climate change;
- develop and substantiate strategies for adaptation and mitigation of the consequences of climate change;
- analyze the effectiveness of climate policy and financial mechanisms;
- integrate international experience into national and regional management practices.

The course is organized in a blended format and lasts one semester. It includes lectures, practical classes using applied models, independent work, and final assessment.

The course is aimed at developing in master's students the professional competencies necessary for work in the fields of climate policy, energy, and sustainable development, with an emphasis on the ability to make well-grounded decisions under conditions of climate risks and uncertainty.

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 course is aimed at students and professionals working at the intersection of ecology, economics, energy, and public policy. The primary audience consists of master’s and PhD students in Ecology, Economics, Public Administration, Political Science, as well as related fields connected with the study of climate change, sustainable development, and climate policy. The course is also relevant for

students planning professional activities in state strategy development, international relations, environmental management, and the energy sector.

During the course, participants develop skills in applying mathematical, economic, and econometric models to analyze climate processes, assess their impact on the economy, and develop adaptation and policy solutions. Significant attention is given to developing systems thinking, the ability to work with data, assess risks, and justify management decisions under climate-related challenges.

The secondary audience includes undergraduate and master's students from other fields (Law, Engineering, Business, Social Sciences), as well as practitioners—representatives of government authorities, local self-government, analytical centers, NGOs, and businesses working on issues of environmental and climate responsibility. For this group, the course serves as a tool for integrating climate approaches into professional activity, particularly in strategic planning, project management, and the development of regional and sectoral policies.

Minimum required preparation includes:

- understanding the principles of interaction between natural and economic systems;
- basic knowledge of economic concepts (efficiency, sustainability, market regulation mechanisms);
- understanding the causes and consequences of climate change, including the role of greenhouse gases and impacts on economic sectors;
- initial skills in working with data and using quantitative analysis methods.

Desirable: experience with software tools for modeling and data analysis (in particular MATLAB, Statistica, specialized environmental models, or open-source equivalents). However, the course provides introductory modules for participants with different levels of technical preparation.

In the design and implementation of the course, the interdisciplinary composition of the audience is taken into account, requiring adaptation of content and teaching methods. Case studies, scenario modeling, analytical tasks, and practical exercises focused on real management situations are used. Special attention is given to blended learning conditions, access to digital resources, and the need to work with international and national data.

Such an approach ensures the training of specialists capable of addressing complex climate challenges, integrating tools of analysis, modeling, and policy planning, and applying them in research, management, and practical activities.

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 that master's students should acquire during the study of the course

"Climate Change Economics: Case Studies and Best Practices in the Energy Sector":

C1. Formulate and illustrate complex interrelationships among different components of the nonlinear unified Earth system.

C2. Understand the dynamic relationship between economic activity and climate change, and explain how they influence and interact with one another.

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

LO4: Be familiar with the main techniques of climate and economic modeling, including integrated assessment models, for studying the relationship between economic activity and climate change.

LO5: Analyze and discuss economic factors that influence adaptation decisions, including consideration of costs and benefits, resource availability, market dynamics, and the economic impacts of climate risks on different sectors and communities, using insights from best practice case studies.

LO6: Synthesize knowledge in the field of climate change economics to formulate policy recommendations that enhance climate resilience in vulnerable economic sectors, focusing on strategies that promote both economic growth and environmental sustainability.

PERFORMANCE CRITERIA

- collect and store climate data and metadata in appropriate databases;
- identify and critically evaluate key economic factors (e.g., cost-benefit analysis, availability of financing, economic incentives, and resource allocation) that influence adaptation decisions;
- analyze political strategies and climate policy regulations, identifying their strengths and weaknesses;
- assess the effectiveness of the implementation of climate initiatives using quantitative and qualitative research methods;
- develop scientifically grounded policy recommendations to enhance climate resilience, taking into account international experience and best practices;
- use strategic analysis tools to forecast the consequences of climate change and evaluate potential development scenarios;
- establish effective mechanisms for cooperation among government authorities, the private sector, and the public to implement climate solutions.

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.

The course “Climate Change Economics: Case Studies and Best Practices in the Energy Sector” includes 8 lectures:

Lecture 1. Modeling the Impact of Climate Change on the Economy: Approaches and Methods

- Introduction to economic modeling of climate change
- Dynamic and static models for assessing climate risks
- Examples of applying DICE, FUND, and PAGE models

Lecture 2. Econometric Modeling of Climate Policy Effectiveness in the Energy Sector

- Regression analysis for assessing the impact of climate policies
- Case studies on the use of CGE models for forecasting changes in the energy sector
- Analysis of best practices in the energy transition

Lecture 3. Scenario Modeling of Sustainable Energy Systems under Climate Change

- The concept of scenario analysis and its application in energy
- Using modeling to develop low-carbon strategies
- Assessment of socio-economic effects of transitioning to renewable energy

Lecture 4. The Impact of Climate Change on Economic Systems: Risk and Vulnerability Analysis

- Assessment of economic losses from extreme weather events
- Determining the vulnerability levels of economic systems to climate change
- Key sectoral risks: water resources, agriculture, energy, construction
- Assessing the impact of climate change on the economy: quantitative and qualitative evaluation methods

Lecture 5. Financing Adaptation Measures: Instruments and Mechanisms

1. Green Economy and Financing "Green" Technologies:
   - Green economy and green finance
   - Example of green financing for the energy sector in Ukraine
2. International Green Financing for Sustainable Development:
   - Green bonds as a tool for project financing
   - Green banks
3. Global Trends in Green Investment:
   - Investments in low-carbon infrastructure and green technologies
   - Investment trends in the renewable energy sector
4. Current mechanisms for financing renewable energy in Ukraine

Lecture 6. International Experience in Climate Adaptation: Successful Practices

1. Global Economy and Development Indicators:
   - Current state of the global economy
   - Country economic development indicators
   - Indicators of sustainable development
2. European Green Deal:
   - Definition and essence
   - European Green Deal in the energy context: Europe and Ukraine
3. Decarbonization of the energy sector
4. International experience and best practices in energy decarbonization:
   - European countries' experience in transitioning to green energy
   - Advanced technological solutions for energy sector decarbonization

- "Blue Danube" as an opportunity for developing a hydrogen economy in Ukraine

Lecture 7. Climate Challenges and the Need for Policy Decisions

- Global and regional consequences of climate change: impact on economy, environment, and society
- Key barriers and opportunities for implementing policy measures on adaptation and climate mitigation

Lecture 8. EU Political Approaches to Enhancing Climate Resilience

- Strategies of the European Green Deal and their impact on energy policy
- Innovative technologies and transformations in building sustainable energy systems

Practical Work:

Practical Work 1. Application of Basic Modeling Methods

Master basic tools of economic-ecological modeling used to analyze the relationship between economic activity and climate change.

Students work with simple models, calculate key indicators, and interpret results in terms of emissions and economic parameters of energy systems.

Practical Work 2. Modeling Climate Change Mitigation Scenarios Using System Dynamics

Build and analyze greenhouse gas reduction scenarios using system dynamics approaches.

Explore feedback loops between economic, technological, and environmental variables, and assess the impact of different policy decisions on the long-term trajectory of the energy system.

Practical Work 3. Assessment of the Economic Consequences of Climate Change for the Energy Sector

Analyze the main economic consequences of climate change for the energy sector, including impacts on conventional and renewable energy sources.

Examine factors such as temperature changes, frequency of extreme weather events, and their effects on production, transportation, and energy consumption.

Special attention is given to economic costs and potential adaptation measures to reduce risks and enhance energy system resilience.

Practical Work 4. Analysis of International Experience in Adapting Energy Systems to Climate Change

Study international measures for enhancing energy infrastructure resilience, including renewable energy development, grid modernization, energy-efficient technologies, and risk management strategies.

Focus on the effectiveness, economic feasibility, and adaptability of these measures to other countries.

Practical Work 5. Economic Feasibility of Transitioning to Renewable Energy and Analysis of the Impact of International Climate Initiatives on the Energy Sector

Examine the economic rationale for transitioning from traditional to renewable energy.

Analyze the influence of international climate conferences and initiatives on energy sector development.

Study key economic benefits and challenges of renewable energy adoption, including cost reduction, energy security, and environmental impacts.

Evaluate international climate agreements that have guided energy policy reform and shaped global energy development directions.

Practical Work 6. Analysis of Climate Change Impacts on Ecosystems and Society

Assess the effects of climate change on natural ecosystems and socio-economic systems.

Consider changes in biodiversity, water resources, agriculture, and public health, along with approaches for quantitative and qualitative climate risk assessment.

Practical Work 7. International Cooperation in Combating Climate Change

Analyze international climate policy mechanisms, including global agreements and multilateral initiatives.

Review tools for coordination among states, emission reduction obligations, and the role of international organizations in achieving climate goals.

Practical Work 8. Analysis of Political Initiatives of the European Green Deal

Focus on key areas of the European Green Deal as an EU climate transformation strategy.

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Analyze political tools for decarbonization, energy efficiency, and sustainable development, and their impact on economic sectors and markets.

Practical Work 9. EU Hydrogen Strategy and Energy System Integration

Examine the role of hydrogen energy in decarbonization and the integration of EU energy systems.

Consider technological and economic aspects of hydrogen infrastructure development and its significance for increasing energy system flexibility and resilience.

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 students, blended learning is provided:

1. Practical classes: conducted in the classroom, providing students with the opportunity, under the guidance of the instructor, to receive necessary practical instructions, examples, and assistance in completing practical assignments.
2. Lectures: the online format ensures free access for students to learning platforms, the possibility of freely searching for information, and obtaining the necessary basic learning materials. It also ensures accessible learning for inclusive groups.
3. Independent learning: implemented through the processing of acquired information for solving practical tasks, preparing presentations, and critically reflecting on the materials found.

A personalized approach enables students to effectively apply their knowledge under the guidance of the instructor to complete practical tasks and fully master the learning materials.

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.

The following learning strategies will be used during the course:

Classroom learning: provides close interaction between students, the instructor, and other participants, allowing for more comprehensive acquisition of necessary information and a deeper understanding of the material through discussion, explanation, and scenario modeling of methods for mitigating the negative effects of climate change.

Online learning: ensures students have free access to information databases, the ability to search for information independently, and obtain the necessary basic learning materials. It also provides accessible learning for inclusive groups. A flexible learning schedule promotes openness and efficient use of time.

Blended learning: combines classroom and online learning. This method improves material retention through practical guidance and explanation of theoretical content by the instructor.

Combining different learning methods ensures broad access to the course for a diverse audience, creates a dynamic educational environment that accommodates varied participant needs, and supports the achievement of learning objectives.

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.

Master's Students:

Course activities will consist of lectures, which will account for approximately 20% of the total course time. Practical sessions will be implemented in the form of various assignments (20% of the time) and presentations (60%). Practical work will also include discussions, which will take place either after the assignment is completed or during its execution.

Lectures:

- *Instructor's role:* record a high-quality 20-minute video, present the lecture content clearly, logically, and concisely, provide materials for visualization (presentations), explain the material, and answer students' questions that arise during the lecture.
- *Student's role*: review the video lecture, prepare for the lecture, formulate questions about the lecture, and ask them during the session.

Practical sessions (seminars):

- *Instructor's role*: demonstrate examples related to the practical topics, lead discussions with students on the assigned topics, summarize and consolidate discussion outcomes.
- *Student's role:* actively participate in discussions, ask questions about completing practical tasks, and preparing presentations.

Practical assignments will cover research on topics such as:

1. Assessment of the state of low-carbon energy in different regions of Ukraine.
2. Comparison of the use of renewable energy sources in the energy sector in Ukraine and globally.
3. Impact of military actions on the development of renewable energy sources in Ukraine.

- *Instructor's role:* assign tasks, explain the objectives of the tasks, provide guidance and monitor the preparation of presentations.
- *Student's role:* conduct a critical analysis of literature, identify key solutions for addressing the assigned problem, and propose optimal options.

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.

During the course, the following assessment methods will be applied:

1. Consolidation of theoretical material: mastery of theoretical material will be checked using self-assessment tests, which can be used by students to better assimilate the theoretical part of the course. The results of these tests will be considered when calculating the final course grade.
2. Seminars: students will gain experience in peer assessment (how fully the presenter revealed the topic, whether all aspects of methods for mitigating the negative effects of climate change were used in the analysis of the situation, whether conclusions were made, and how these conclusions reflect the essence of the report).
3. Instructor assessment: the instructor evaluates the presentations and reports prepared by the students.
4. Final test

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).

1. Video lectures and necessary working materials will be freely available on the Moodle platform for review before the lectures.
2. Internet access to informational resources
3. Lectures on the MS Teams platform
4. Presentations in PowerPoint

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