LECTURE COURSE FOR MASTER STUDENTS - ADVANCED ENERGY ECONOMICS POLICY AND TECHNOLOGY

RUHR UNIVERSITÄT BOCHUM RUB

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This course aims to explain the practical aspects of energy economics based on my experience from the oil industry (**ExxonMobil**), in energy consultancy (covering all forms of energy across Europe), as Chief Economist of Germany's largest power generator - **RWE AG**, and as senior advisor to the **Energy Transitions Commission**.

It focusses on how decisions driven by economics and policy and enabled by technology developments determine energy demand, the fuel mix, energy prices and greenhouse gas emissions. Important features are:

- The interaction between economics, policy, and technology
- Calculation of fixed and variable costs for energy plants and with taxes how prices are determined in wholesale and retail markets
- How and where competition takes place along the supply chain (e.g. tendering for new plants, wholesale markets, energy exchanges and at the retail level).

The course consists of thirteen lectures of which four are double-length and four pieces of coursework, each of which would require 1-2 hours work. The full length of the course, including reviews of the coursework would be: 20 units of 90 minutes. It could be delivered over a full week, or in two or three blocks.

It has been very highly rated by the students at the Ruhr University Bochum, with the top grade for overall evaluation of the course, supported by the following comments:

- *A lot of insights into processes in practice*
- *Very interesting presentation of the facts and their relevance in today's world*
- *Practical relevance, up-to-date figures/trends, extensive content on all parts of the energy industry, critical assessment of the applied policies, encourages independent research, exciting presentations with a variety of diagrams and visualizations.*
- *The professor is always able to offer the most sensible insights and critical analysis based on his vast experience. He also considers the difficulty of knowledge and simplifies complex issues. In addition, he is keen to help and care for students.*

LECTURE CONTENT

1. **The basics of energy** * (Courses with an * are double-length)
    a. Role of energy
    b. Societal requirements of energy
    c. The palette of energy sources – technical, commercial and geopolitical properties
    d. The journey to zero carbon and the drivers
    e. Key performance indicators
2. **Rudiments of energy technology**
    a. The essence of technology for energy transformation
    b. Transformation – primary to final energy
    c. Transformation – final to useful energy
    d. Environmental impact of different technologies
3. **How to move the world to zero-carbon energy**
    a. General policy principles
    b. KPIs to monitor progress and progress to date
    c. Case 1:German Energiewende
    d. Case 2: The European Green Deal
4. **Decision-taking – short-run and long-run costs to build and operate plants ***
    a. Why industry and government need to understand costs
    b. Relevant costs for producer decisions
    c. Short-run marginal costs and their role
    d. Long-run costs and their role
    e. Discount-rates, net present values, and annuities
    f. Long-run marginal costs – putting it all together
5. **Energy prices and markets along chain and role of taxation**
    a. Introduction and consumer price structures
    b. Wholesale markets
    c. Transportation
    d. Retail markets
    e. Taxation and surcharges
    f. Consequences for consumer behaviour, demand and the environment

g. Price-elasticity

6. Energy efficiency and reducing demand

a. The importance and challenges of energy efficiency and reducing demand for useful energy

b. Definition, means of improving energy efficiency and motivation, metrics and progress

c. Four ways to reduce energy demand

d. Role of economics in energy efficiency

e. Regulation and market incentives to achieve efficiency improvements

7. Carbon pricing and emissions trading

a. Carbon / Greenhouse Gas Reduction Strategy in the EU

b. Reasons for taxing carbon (and other emissions)

c. Taxation and Emissions Trading Systems Compared

d. Important Concepts of the ETS

8. Renewable technology, costs, integration and support schemes

a. Overview of renewables – economics, policy and technology

b. Factors determining the cost and value of renewables

c. Different types of support mechanisms

d. How the policies have built up renewables production

e. Cost degression through the learning curve

9. Hydrogen technology and costs

a. Properties and current uses

b. Importance for the future

c. Different types of hydrogen (by production source)

d. Economics and pricing

e. Challenges to introduce the fuel

f. Projects underway

g. The new world oil?

10. Fossil-fuel production and pricing *

a. Fossil fuels and their special characteristics

b. Coal

c. Oil

d. Gas

e. Transitioning use of fossil fuels to cleaner energy

f. Commodity trading and pricing principles for gas

11. Energy storage and costs

a. The different roles of storage

b. General technical and economic principles

c. Oil storage

d. Gas storage

e. Electricity – pumped storage

f. Electricity – batteries

12. **Power markets** *

a. Applications and special features of electricity

b. Variable and fixed costs of power plants

c. Dispatching of plants and resulting prices

d. How plants recover their costs

e. Options to balance peak demand

f. Future power supply and demand; prices

13. Completing the task: Decarbonising three end-use sectors

a. Emissions in 2021 vs. 2030 goals

b. Drivers and actors

c. Power sector

d. Industry sector

e. Transport sector

f. Building sector

g. Company actions

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