UNIVERSITY OF PIRAEUS

SCHOOL OF ECONOMICS, BUSINESS, AND INTERNATIONAL STUDIES
DEPARTMENT OF INTERNATIONAL AND EUROPEAN STUDIES

Master Program in
ENERGY: Strategy, Law and Economics

I. Instructors

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II. Course aim

The course describes the main means of financing energy investments, such as own resources, borrowing, crowd-funding, angel investors and subsidies. Students familiarize themselves with terms such as discount rate, Weighted Average of Capital Cost (WACC), Internal Rate of Return (IRR), Net Present Value (NPV), Levelized Cost of Energy (LCOE) which are important for the assessment and comparison of energy projects. Students undertake a business plan project on an energy investment, which is delivered at the end of the semester. Energy investments are subject to a number of uncertainties, the assessment and quantification of which allow the assessment of their impact on the profitability of the investments and the cash-flows. The aim of the course is to deepen knowledge that is particularly useful for managing, evaluating and assessing the various risks faced by an energy investment. It analyzes the factors that shape the risks, the prevailing measurement methodologies, and the practices to optimize the relationship between risk and performance. Investment risk management, whether in terms of economic, operational, regulatory or technical risks, is mainly addressed through the provision of financial and energy services. The economic risk management is mainly implemented through energy and stock exchanges, either through energy and financial products negotiations or through modern economic instruments such as bilateral dispute agreements and financial derivatives such as forward contracts, futures contracts or pre-emptive rights. Special focus is given on Green energy investments, Climate change risks and Hydrogen.

III. Thematic units

The following units correspond loosely to weekly lectures.

1. Environmental impacts and risk assessment [Paravantis]

Conceptual model for the environment (atmosphere, hydrosphere, lithosphere/geosphere, biosphere); Global and local environmental problems; Natural and anthropogenic environment; Environmental ethics; the Environmental Impact Assessment process; Environmental legislation in Greece; Environmental Impact Statements (EIS); Social Impact Assessment; EIS contents and methods; Environmental impact types (nature, type, likelihood, scale, duration, reversibility); Energy Technologies and Sustainable Development; Environmental risk assessment.

2. Nature of risk and methods of risk assessment [Paravantis]

Risk and uncertainty; Energy transition; Risk sources (microeconomic, mezoeconomic, macroeconomic, systematic, specific); Market, price, financial, operational, environmental, construction, technical, credit, technological, and political risk; Critical risks of the energy industry; Risk identification (checklists, Delphi method, wisdom of the crowd, nominal group, brainstorming, public debate, holistic methods).

3. Quantifying impacts and risk [Paravantis]

Methods of quantifying risk (financial, sensitivity analysis, decision making trees, networks, experts, statistical, probabilistic, and simulation); the Monte Carlo method. Net Present Value (NPV) and the Internal Rate of Return in Microsoft Excel; Life Cycle Analysis of energy and environmental investments: Case study of geothermal drilling. Using game theoretic tools.

4. Risk perceptions [Paravantis]

Psychometric methods and Likert scales; Expressing fatality risk: Case study of the fear of flying; Hazards and perceived risk and its ordering among social groups; Perceptions and behavior; Perceived risk profiles for different energy sources; Social amplification of risk: Ripple effect; Industrial (and other) accidents: Bhopal (India), Challenger (USA), Three Mile Island (USA), Chernobyl (Ukraine), Exxon Valdez, Word Trade Center (USA); Managing risk with game theory.

5. Special issues on Energy Investments in Hydrogen (A) [Makridis]

Basics on Hydrogen technology developments. Hydrogen as an Energy Carrier. Making a Hydrogen Economy a Reality (Fuel Cells: Improving fuel cell technology and materials needed for fuel cells., Production: Developing technology to efficiently and cost-effectively make hydrogen from renewable energy sources. Storage: Developing technology to efficiently and cost-effectively store and transport hydrogen.

6. Special Issues on Energy Investments in Hydrogen (B) [Makridis]

Risk management methodologies, Scenario analysis, Financing models of energy investments, Financing scenarios, Risk management tools during construction and operation of a project, Investment insurance, Recurring liquidity needs coverage, Innovative financing models, Green

business, Economic and technical monitoring of project completion, delivery and operation, Case studies and business developments on hydrogen production, storage & compression, utilisation.

7. Special issues on Energy Investments in Hydrogen (C) [Makridis]

Presents the international investment environment in the hydrogen. Current situation and short-term trends. Basic consumption scenarios and medium to long-term investment trends. Characteristics of investors and sources of funding. Real Industrial approaches combined nuclear to hydrogen achievements. Green Deal in reality.

8. The Green Dimension in Energy Financing [Ibrahim]

Basics in green energy financing. International and EU regulation. Taxonomy, etc.

9. Investments in RES and energy savings [Ibrahim]

Key features of Renewable Energy Sources (RES), Economic evaluation of RES projects, LCOE, Special schemes for RES and CHP projects, Transition from FIT to FIP and ultimately to competitive processes, Rational Management of Organic Waste, Financing of RES projects, Factors influencing the viability of investments, The structure and experience of Home Savings project, Flexible Financing Funds, Exploitation of European funds and JESSICA programs, Energy Services Companies (ESCOs), Public and Private Sector Co-Financing (PPPs), Role of Energy Managers, Project Bond Financing, Energy Performance Contracts, Shared Benefits, Case Studies

10. Energy investments in industry and environment [Ibrahim]

Energy and environmental costs in Industry, Modern tools for energy cost reduction, demand response and Interruptibility schemes, Indirect emission cost compensation, State Aid Guidelines for Energy and Environmental Subsidies, Bilateral Contracts on Differences and Financial Derivatives, Futures, Future Contracts performance or energy efficiency, white certificates, Environmental Protection Facilities, Anti-pollution, Environmental Rehabilitation, Recycling Units, Modern Environmental Investment Funding and Risk Management Tools, Optimal energy management strategies for smart grids and smart grids images cities

11. Drafting of economic and technical studies [Dagoumas]

Methodology and the sequence of the steps of the techno-economic studies of energy investment projects. In particular, the technical part of the analysis is described and detailed instructions are provided for the preparation of relevant studies. Subsequently, the feasibility studies and business plans are analyzed in detail, and various project case studies on energy investments are discussed

IV. Exams

Quizzes, term projects/papers, written exam (per instructor).

V. Indicative literature

Behrens, W., & Hawranek, P.M. (1992). *Manual for the preparation of industrial feasibility studies.* UNIDO.

Darbra, R. M., Eljarrat, E., & Barceló, D. (2008). How to measure uncertainties in environmental risk assessment. Trends in Analytical Chemistry, 27(4), 377-385. https://doi.org/10.1016/j.trac.2008.02.005

Day, A. (2010). *Investing in Resources: How to Profit from the Outsized Potential and Avoid the Risks*. Wiley, 2010

Inkpen, A., & Moffett, M. H. (2011). *The Global Oil & Gas Industry: Management, Strategy and Finance.* PennWell Corp.

Kaliński, J., Paska, J., Pawlak, K., Terlikowski, P., & Urbanek D. (2018). Investment risk in the energy sector on the example of a biogas power plant. *Polityka Energetyczna – Energy Policy Journal*, 21(4), 125-140. https://doi.org/10.24425/124504

Lacirignola, M., Meany, B. H., Padey, P., & Blanc, I. (2014). A simplified model for the estimation of life-cycle greenhouse gas emissions of enhanced geothermal systems. *Geothermal Energy*, 2(8). https://doi.org/10.1186/s40517-014-0008-y

Lazarou, S et al. https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.194

Lazarou, S.; Makridis, S. Hydrogen Storage Technologies for Smart Grid Applications. *Challenges* **2017**, *8*, 13. https://doi.org/10.3390/challe8010013

Mack, I. M. (2014). *Energy Trading and Risk Management: A Practical Approach to Hedging, Trading and Portfolio Diversification.* Wiley.

Makridis, S. (2016) https://digital-library.theiet.org/content/books/10.1049/pbpo101e_ch1

Mian, M. A. (2011). *Project Economics and Decision Analysis, Volume 1: Determinisitic Models*. PennWell Corp.

Mian, M. A. (2011). *Project Economics and Decision Analysis, Volume 2: Probabilistic Models*. PennWell Corp.

Simkins, B. & Simkins. R. (2013). *Energy Finance: Analysis and Valuation, Risk Management, and the Future of Energy.* Wiley.

Slovic, P. (2002). Perception of risk posed by extreme events. *Risk management strategies in an uncertain world* conference, Palisades, New York, April 12-13, 2002.