



UNIVERSITY OF PIRAEUS
DEPARTMENT OF INTERNATIONAL
AND EUROPEAN STUDIES

UNIVERSITY OF PIRAEUS

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

Master Program in

ENERGY: Strategy, Law and Economics

Elective Course

Special Issues in Energy Finance and Risk Management

I. Instructors

John A. Paravantis

Athanasios Dagoumas

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), and Levelized Cost of Energy (LCOE) which are important for the assessment and comparison of energy projects.

Energy investments are subject to several uncertainties, the assessment and quantification of which allow the evaluation 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 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. 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.

Students undertake a business plan project on an energy investment, developed step-by-step during the second half of the course and presented at the end of the semester. A dedicated Business Hackathon session provides intensive mentoring and collaborative development time.

III. Thematic Units

The following units correspond to weekly lectures (10 weeks total).

Part A — Risk Assessment and Analysis (Weeks 1–5)

Instructor: John A. Paravantis

Week 1: Environmental Impacts and Risk Assessment

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.

Week 2: Nature of Risk and Methods of Risk Assessment

Risk and uncertainty; Energy transition; Risk sources (microeconomic, mezo-economic, 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).

Week 3: Quantifying Impacts and Risk

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.

Week 4: Risk Perceptions

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, World Trade Center (USA); Managing risk with game theory.

Week 5: Energy Investments, Green Finance, and Climate Risk

Basics in green energy financing; International and EU regulation; EU Taxonomy for sustainable activities; Climate change risks and their impact on energy investments; Key features of Renewable Energy Sources (RES); Economic evaluation of RES projects and LCOE; Special schemes for RES and CHP projects; Transition from Feed-in Tariffs (FIT) to Feed-in Premiums (FIP) and competitive processes; Energy Services Companies (ESCOs); Public-Private Partnerships (PPPs); Role of Energy Managers.

Part B — Business Plan Development (Weeks 6–10)

Instructor: Athanasios Dagoumas

Week 6: Business Plan Foundations — From Idea to Structure

This session introduces the **techno-economic and financial valuation framework** used in professional energy investment analysis. Emphasis is placed on structuring projects in a way that allows future **discounted cash flow (DCF) valuation**, risk-adjusted performance measurement, and investment decision-making.

1. From Concept to Economic Value

Students define:

- The **problem statement** and energy system context
- The **value proposition** (cost savings, revenue generation, decarbonization benefits, flexibility services, etc.)
- Target customers and market positioning

The session introduces the concept of:

- **Time Value of Money (TVM)**
- **Present Value (PV)** and **Future Value (FV)**
- Why future cash flows must be discounted to obtain their present economic value
- The difference between **accounting profit and economic value creation**

2. Market and Technical Structuring

Market Analysis Framework

- Market size (TAM, SAM, SOM)
- Competitive positioning
- Regulatory and policy drivers (FITs, FIPs, auctions, carbon pricing)

Technical Description

- Technology selection (e.g., solar PV, wind, storage, CHP)
- Installed capacity and load factors
- Site selection and permitting constraints
- Project lifetime assumptions (economic vs technical lifetime)

Students begin thinking in terms of:

- **Revenue-generating assets**
- **Cost structures**
- **Cash flow timing**
- Residual/salvage value at end of life

3. Structuring a Bankable Business Plan

The business plan is structured to allow future financial evaluation:

1. Executive Summary
2. Company & Project Overview
3. Technology & Operations

4. Market & Regulatory Context
5. Financial Plan (DCF-based)
6. Risk Assessment & Mitigation Strategy

Assignment:

Teams submit a **one-page project concept note**, including preliminary CAPEX estimate, revenue logic, project lifetime, and proposed discount rate assumptions.

Week 7: Financial Modelling and Feasibility Analysis

Students build structured financial models incorporating:

Capital Expenditure (CAPEX)

- EPC costs
- Grid connection
- Development costs
- Financing fees

Operational Expenditure (OPEX)

- Fixed O&M
 - Variable O&M
 - Insurance
 - Administrative costs
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2. Revenue Modelling

Revenue streams may include:

- Power Purchase Agreements (PPAs)
- Market-based energy prices
- Capacity payments
- Renewable subsidies (FIT/FIP)
- Guarantees of Origin (GoOs)

Scenario-based pricing is introduced:

- Base case
 - Downside case
 - Upside case
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3. Discounted Cash Flow (DCF) Valuation

Core concepts introduced in depth:

- Present Value (PV)
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Weighted Average Cost of Capital (WACC)
- Real vs Nominal Discount Rates

- Inflation adjustments
 - Cost of equity vs cost of debt
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4. Levelized Cost of Energy (LCOE)

Students compute Levelized Cost of Energy (LCOE):

$$LCOE = \frac{\sum_{t=0}^T \frac{Costs_t}{(1+r)^t}}{\sum_{t=0}^T \frac{Energy_t}{(1+r)^t}}$$

Interpretation:

- Comparison across technologies
 - Relationship between LCOE and market price
 - Limitations of LCOE in systems with high renewables
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5. Risk and Sensitivity Analysis

Students conduct:

- Sensitivity analysis ($\pm 10\%$ CAPEX, price, WACC)
- Break-even analysis
- Scenario planning
- Basic introduction to **risk-adjusted discount rates**

Assignment:

Teams submit a **working DCF-based financial model**, including:

- Cash flow table
- NPV & IRR
- Sensitivity results
- LCOE calculation

Week 8: Risk Management, Financing Strategy, and Plan Integration

This session integrates **risk management, capital structure, and financing mechanisms** into the business plan.

1. Risk-Adjusted Valuation

Students revisit:

- Regulatory risk
- Market price risk
- Volume risk
- Construction risk
- Operational risk

- Technology risk
- Climate and transition risk

Financial treatment of risk:

- Adjusting cash flows (certainty equivalents)
- Adjusting discount rates (risk premium)
- Monte Carlo simulation (conceptual introduction)
- Probability-weighted expected NPV

Students discuss:

- Systematic vs specific risk
 - Beta and cost of equity (conceptual introduction via CAPM)
 - Impact of risk on WACC
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2. Financing Structures in Energy Projects

Comparison of:

Corporate Finance

- On-balance-sheet financing
- Parent guarantees

Project Finance

- Special Purpose Vehicle (SPV)
- Non-recourse or limited recourse debt
- Debt Service Coverage Ratio (DSCR)

Blended Finance

- Public grants + private capital

Green Bonds & Sustainable Finance

- ESG-linked financing
- EU Taxonomy alignment

Students analyze:

- Optimal capital structure
 - Debt-to-equity ratio impact on WACC
 - Leverage effects on equity IRR
 - Liquidity buffers and working capital needs
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3. Advanced Financing Instruments

- Energy Performance Contracts (EPCs)
 - Crowdfunding platforms
 - EU structural funds
 - JESSICA programs
 - Investment insurance mechanisms
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4. Integrating the Full Investment Narrative

Students ensure alignment between:

- Technical design
- Market assumptions
- Financial valuation (NPV/IRR)
- Risk mitigation strategy
- Financing structure

The objective is to produce a **bankable investment case** suitable for:

- Commercial banks
 - Infrastructure funds
 - Institutional investors
 - Public funding agencies
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Peer Review & Submission

Peer-to-peer structured review focusing on:

- Internal consistency of assumptions
- Realism of discount rate
- Sensitivity robustness
- Risk disclosure transparency

Assignment:

Teams submit a **complete first draft** including:

- Executive Summary
- Technical Section
- Market Analysis
- DCF Financial Model (with present value calculations)
- Risk-adjusted valuation
- Financing strategy

Week 9: Business Hackathon

An intensive, full-session hackathon dedicated to refining and finalizing the business plans. This collaborative workshop simulates the pressure and dynamism of real-world investment preparation. The session includes:

- Rapid iteration: teams refine their financial models, risk assessments, and strategic narrative
- Expert mentoring: instructor provides focused, team-by-team guidance on strengthening weak areas
- Competitive element: teams pitch their progress in a 3-minute lightning round for peer and instructor feedback
- Cross-team collaboration: opportunities to share insights, data sources, and problem-solving approaches

- Final polishing: teams prepare presentation-ready materials and finalize their written business plans
- Deliverable: Completed business plan document submitted by end of session

Week 10: Presentation of Business Plans

Teams present their completed business plans before the class and a review panel. This final session simulates an investor pitch environment. The format includes:

- Formal presentations (15–20 minutes per team): covering the full business plan from concept to financials
- Q&A and challenge session: panel and peers ask critical questions on assumptions, risks, and viability
- Evaluation criteria: technical soundness, financial rigour, risk awareness, presentation quality, and innovation
- Constructive feedback and lessons learned: discussion of common strengths and areas for improvement across all projects
- Final grading of business plan projects

IV. Exams

Business plan project (team-based, developed during Weeks 6–10), and written exam (per instructor).

V. Indicative Literature

Risk Assessment and Environmental Analysis

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