



MINERAL RESOURCE ECONOMICS AND MANAGEMENT

Raw Materials Exploration and Sustainability

CONTACT INFORMATION

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COURSE CONTENT AND INTENDED LEARNING OUTCOMES (ILOs):

The course aims at providing students with the tools to understand the economics and management of raw materials and its relationship with economic and environmental sustainability with particular reference to Climate Change threats and challenges. To achieve this goal the course is organized into two interrelated modules. In the first module the students will acquire the basic concepts and tools used in evaluating economic initiatives with specific reference to sustainability and impact investment. In this context business ethics issues will also be discussed. In the second module the students will acquire a methodological toolkit to autonomously understand, design, and evaluate the economic and environmental costs of any venture or governmental initiative related to the sustainable use of raw materials. The course argues that raw material economic efficiency must take into account the environmental imperative posed by the climate change.

At the end of the course, students will be able to:

- Correctly build and quantitatively estimate the sustainable strategic positioning of a business or governmental initiative related to material and energy use.
- Critically evaluate and comment on Companies or Government sustainable claims.
- Design and evaluate with creativity and innovation business models of new ventures related to efficient use of raw materials.

Aligning with the EIT OLOs:

EIT OLO 1 - Making value judgments and sustainability competencies

2= highly relevant to the course content: the course discusses the challenges posed by climate change to business and society at large, introducing the students to tools be able to identify and measure the impact of sustainable business based on scientific facts and experience from the field (possibly avoiding the fads).

EIT OLO 2 - Entrepreneurship skills and competencies

1 = marginally relevant to the course content: The course illustrates to the students how to convert business ideas into investible proposals.

EIT OLO 3 - Creativity skills and competencies

2= highly relevant to the course content: the course will appeal to creatively apply scientific and technological knowledge and competencies to sustainable economic value creation.

EIT OLO 4 - Innovation skills and competencies



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1 = marginally relevant to the course content: The students will be exposed to a variety of case examples of ‘digital transformation’ enabling innovation and hence, improving technology management and sustainability.

- EIT OLO 5 - Research skills and competencies
- EIT OLO 6 - Intellectual transforming skills and competencies
- EIT OLO 7 - Leadership skills and competencies

2= highly relevant to the course content: The students will be exposed through practical cases and class discussions to how important is individual responsibility in the foundation and development of any sustainable economic value creation. Team work and class presentations will be also instrumental to develop the necessary soft skills necessary to be effective in presenting new business ideas to potential future stakeholders.

ASSESSMENT METHODS AND GRADING SYSTEM

The course attempts to reach its learning objectives by offering a balanced menu of theory and business cases, internal discussions and guest speakers. The course will encompass the following elements: lectures by the instructor; group and individual case studies and assignments; interactive guest lectures; plenary discussions on selected sets of readings and in-class presentations by students.

The individual performance is evaluated through individual assignments, the final written test and class participation. In particular, the written final test will be instrumental to evaluate the EIT OLO 1 learning outcome.

The group’s performance is evaluated through a group assignment that will consist in the analysis of the mining company financial reports in the light of the 17 Global Goals for Sustainable Development. In particular, this group assignment will be instrumental to evaluate the EIT OLO 1 learning outcome. The students of the course are expected to bring business ideas related to efficient raw materials use, Global change mitigation that will be at the core of the business idea pitch that will be presented to a qualified panel during the course “Entrepreneurship and business models.” The group’s performance will be instrumental to the student evaluation regarding the EIT OLO 3 and EIT OLO 7 learning outcomes.

The grades in the Italian university system are expressed out of thirty. The passing grade is 18/30. In case of full grade (30/30) the Professor(s) may also decide to award honours (lode).

You can find below the breakdown of the final grade:

ASSESSMENT METHOD	WEIGHT ON FINAL GRADE
Class participation	15%
Group assignments	20%
Individual written outputs: essays, position papers, case studies	40%
Written final test	25%



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COURSE SESSIONS

Suggested pre-course reading materials:

Allwood, JM, and Cullen, J, *Sustainable Materials - with both Eyes Open*, Cambridge, 2012, Cambridge. Part I, II and III. Available also at <http://www.withbotheyeyesopen.com/>

McKay, D J., *Sustainable Energy - without the Hot Air*, UIT, Cambridge, 2008. Available also at <http://www.withouthotair.com/>. Part I, III and IV.

Tirole, J., *Economics for the Common Good*, translated by Steven Rendall, Princeton University Press, Princeton, 2018. Chapters 2, 4 and 8.

Session 1	INTRODUCTION TO THE COURSE, MANAGEMENT AND BUSINESS MODELS
Content	<ul style="list-style-type: none"> • Objectives and structure of the course; • Outline of the contents and the assessment methods; • Introduction to management and business models • Introduction to Sustainability • Climate change threats and challenges
Readings	Class material and slides
Assignment	Recent press article or public speech excerpt analysis arguing against or seed doubts about climate change driven by human activities

Session 2	INTRODUCTION TO COMPANY FINANCIAL REPORTING
Content	<ul style="list-style-type: none"> • Basic concepts, (the balanced sheet and the income statement.) • Investments and working capital. • Cash flow statement. • Company Sustainability report.
Readings	Libby, R., Libby, P., Short, D., <i>Financial Accounting. A global perspective</i> , McGraw-Hill International, Chapters 1, 2, 3, 4, 6. Class material and slides.
Assignment	Mining companies financial reports analysis.

Session 3	INTRODUCTION TO CORPORATE FINANCE
Content	<ul style="list-style-type: none"> • Investment decision criteria and role of sustainability.

	<ul style="list-style-type: none"> • From Income to Cash Flow. • The Adjusted Present Value (APV). • Introduction to Sustainable finance.
Readings	<p>High-Level Expert Group on Sustainable Finance, “Sustainable financing A European Economy”, Interim Report, July 2017, available at https://ec.europa.eu/info/sites/info/files/170713-sustainable-finance-report_en.pdf</p> <p>Smith, C.W., “Managing Corporate Risk”, in B. Espen Eckbo, <i>Managing corporate risk. Handbook of Corporate Finance: Empirical Corporate Finance</i>, Vol 2, Elsevier/North-Holland, 2008, pp 540-557.</p> <p>Welch, I., <i>Corporate Finance</i>, 4th edition, 2017, available at http://book.ivo-welch.info/read/. Chapters 2, 4, 13 and 14.</p> <p>Class material and slides.</p>
Assignment	Exercises related to the contents presented.

Session 4	ENGINEERING FUNDAMENTALS OF ENERGY EFFICIENCY AND MATERIAL EFFICIENCY
Content	<ul style="list-style-type: none"> • Technical and economic modeling concepts and tools that will allow designing the “business map” of green initiatives avoiding greenwashing. • The Science Laws (first and second principle of thermodynamics, the Exergy concept) and the business concepts (e.g. Levelized Cost of Energy - LCOE) that matter in Sustainability. • The case of the electrification of automotive industry
Readings	<p>McKay, D J., <i>Sustainable Energy - without the Hot Air</i>, UIT, Cambridge, 2008. Chapters: 3 Cars, 6 Solar, 20 Better Transport, 26 Fluctuations and Storage, Part IV chapter I “Quick Reference”. Optional Chapters: A Cars II, D Solar II . Available also at http://www.withouthotair.com/.</p> <p>Lazard's levelized cost of energy analysis — version 13 – Nov 2019, available at https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf</p> <p>Lazard's levelized cost of storage analysis — version 5.0 – Nov 2019, available at https://www.lazard.com/media/451087/lazards-levelized-cost-of-storage-version-50-vf.pdf</p> <p>Class material and slides.</p>
Assignment	Exercises related to the contents presented.

Session 5	MAP OF NATURAL RESOURCE SUPPLY, TRANSFORMATION, AND USE IN FINAL SERVICES
Content	<ul style="list-style-type: none"> • Processes and use of steel and aluminum. • Re-using metal components.



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	<ul style="list-style-type: none"> Options for change. Introduction to Life Cycle Assessment principles.
Readings	<p>Allwood, JM, and Cullen, J, <i>Sustainable Materials - with both Eyes Open</i>, Cambridge, 2012, Cambridge. Part I, II and III. Available also at http://www.withbotheyesopen.com/</p> <p>Geng, Y., Sarkis, J. and Bleischwitz, R., “Globalize the Circular Economy,” in <i>Nature</i>, 565 (2019), pp. 153-155.</p> <p>Class material and slides.</p>
Assignment	Group assignments on Raw materials for renewable energy (the rare-earths case) and on Raw materials for Giga factory (li-ion battery case.)

Session 6	INTRODUCTION TO BUSINESS ETHICS
Content	<ul style="list-style-type: none"> Business Ethics – myth or reality: What can be taught? Ethical Decision Making. Corporate culture and individual responsibility. Introduction to game theory: the prisoner’s dilemma and Climate Change.
Readings	<p>Ryan, T. G., & Bisson, J., “Can Ethics Be Taught?” in <i>International Journal of Business and Social Science</i>, 2/12 (2011), pp. 44–52.</p> <p>Tirole, J., <i>Economics for the Common Good</i>, translated by S. Rendall, Princeton University Press, Princeton, 2018, Chapter 8.</p> <p>Trevino, L. K., Brown, M. E. “Managing to Be Ethical: Debunking five business Ethics Myths” in <i>The Academy of Management Executive</i>, 18/2 (2004), pp. 69-81.</p> <p>Class material and slides.</p>
Assignment	<p>Norsk Hydro Cyber Attack case – to be discussed during the class.</p> <p>Ajxan Alumina Plant in Hungary case – to be discussed during the class.</p>

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Session X	GUEST SPEAKERS
Content	<ul style="list-style-type: none"> During the course guest speakers from industry and academia will be invited with the aim to present and discuss new business opportunities related to sustainability.
Readings	Material distributed before the presentation
Assignment	Introduction speech of the guest speaker made by a group of students

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Session J	FINAL EXAM
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Date - hours	(To be defined) Month, Day.
Content	<ul style="list-style-type: none">• Written test: discussion of a case using a given template in order to verify the correct use of the tools and concepts presented during the course. The exam will be open book and open notes. Duration: 3 hours;• Oral examination: on request, a brief oral examination might integrate the written test. The candidate will be requested to discuss in 10-15 minutes one of the cases discussed during the course.



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