POLITECNICO MILANO 1863

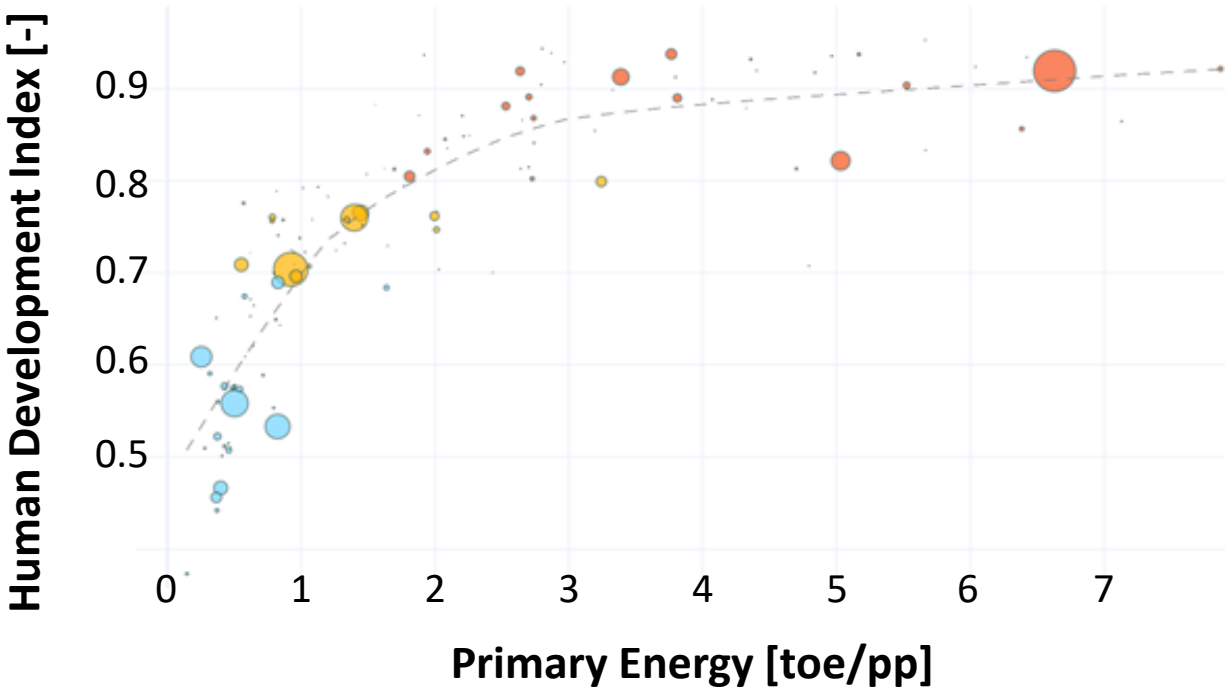
OPENDAY 2023

MASTER OF SCIENCE IN ENERGY ENGINEERING

ACADEMIC YEAR 2023-24

WHY ENERGY ENGINEERING?

Energy has a central role for the development of the countries and for the quality of life of the people



Human Development Index:
- Health
- Knowledge
- GNI per person

The future challenges of the Energy:
- Increasing world population
- Environmental sustainability
- Evolution of the global geopolitic scenario

WHAT IS ENERGY ENGINEERING?

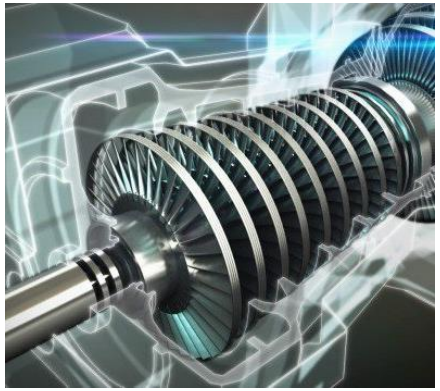
Energy Engineering is the engineering sector that deals with the **development, design and management of energy systems and their components.**

- Energy plants are all those installations for the **production, transformation and use of energy**
  - Some examples are large power plants, air conditioning systems for residences and offices, the engine of a car or of an aircraft, a solar collector and so on

- The energy engineer is called to contribute to the **development of technologies** for the production and rational use of energy and the consequent **environmental impact** in a context where energy is a fundamental element of **developed societies**, and essential for the economies of the **emerging countries**.

Career Opportunities

- Energy industries operating with renewable and/or fossil sources involved in the **production, dispatching or distribution processes**
- Industries manufacturing and selling **machines as well as components** as gas/steam turbines and compressors, hydraulic or wind turbines, engines, solar panels, boilers, air conditioners, refrigerators, heat exchangers
- **Design, testing, operation and maintenance** of energy systems such as, for example, air conditioning systems, food storage systems, small and medium-sized systems for the production, distribution and use of energy
- Design of **Zero Energy Buildings** (ZEB)
- **Energy management sector**, in private and public companies that supply the energy service (Energy Manager)
- **"Energy analyst"** in private / public companies and international organizations, responsible of collecting and analyzing energy data to provide information, trends and future scenarios to support the strategic choices.

Structure of the Study Programme

One degree

Laurea magistrale in Energy Engineering – Ingegneria Energetica

Equivalent to Master of Science (M.Sc.)

Seven tracks

- **Power Generation** (120 ECTS available in English – Milano Bovisa)
- **Energy Use and Built Environment** (120 ECTS available in English – Milano Bovisa)
- **Oil and Gas Production** (120 ECTS available in English – Milano Bovisa)
- **Green Power Systems** (120 ECTS available in English – Milano Bovisa)
- **Renewables and Sustainability** (120 ECTS available in English – Piacenza)
- **Energy for Development** (120 ECTS available in English – Milano Bovisa)
- ***Wind Energy*** *(120 ECTS available in English – BV – Joint Track with Mecc. Eng.)* NEW

Teaching Activities

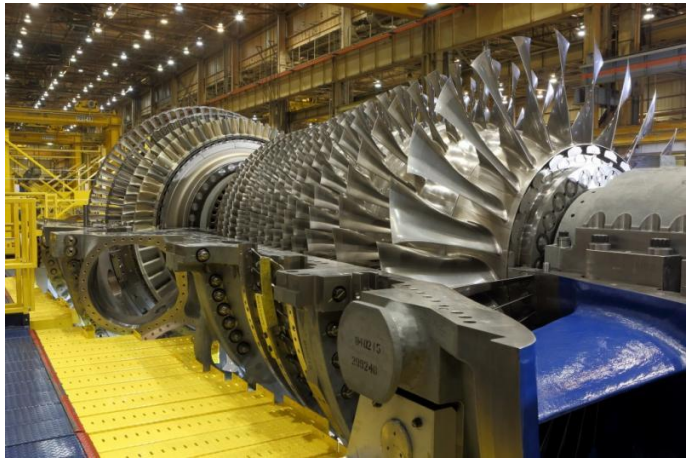
Overall ETCS: 120 = 100 Courses + 20 Thesis

- **Fundamentals (36 ECTS)**: *common to all the tracks and available on free choice in English and in Italian*
  - Heat and Mass Transfer (10 ECTS)
  - Energy Conversion or Heating and Cooling Systems (10 ECTS)
  - Fundamentals of Chemical Processes (8 ECTS)
  - Electric Power Systems (8 ECTS)
- **Specialized (32 ECTS)**: *giving the character of each track*
- **Interdisciplinary (32 ECTS)**: *linking various engineering areas*
  - Guided choice in groups (24 ECTS)
  - Free choice (8 ECTS) among all the subjects of the Study Programme or in the **Labs** and Soft Skills groups

POWER GENERATION:TOPICS

Conventional power plants

Industrial processes



Turbomachines

IC and Hybrid engines – Fuel cells

Power Generation: Specialization Courses

Advanced Energy Systems

- The course deals with the production of decarbonized energy vectors (electricity and hydrogen) from fossil fuels

Chemical processes and technologies

- The course provides the bases of chemical and physical equilibria and on chemical kinetics, which are necessary for the understanding of unit operations and chemical processes relevant to applications in the energy field

Internal combustion engines/Turbomachinery B

- The courses provide a physical and mathematical description of a four-stroke engine and the main turbomachinery

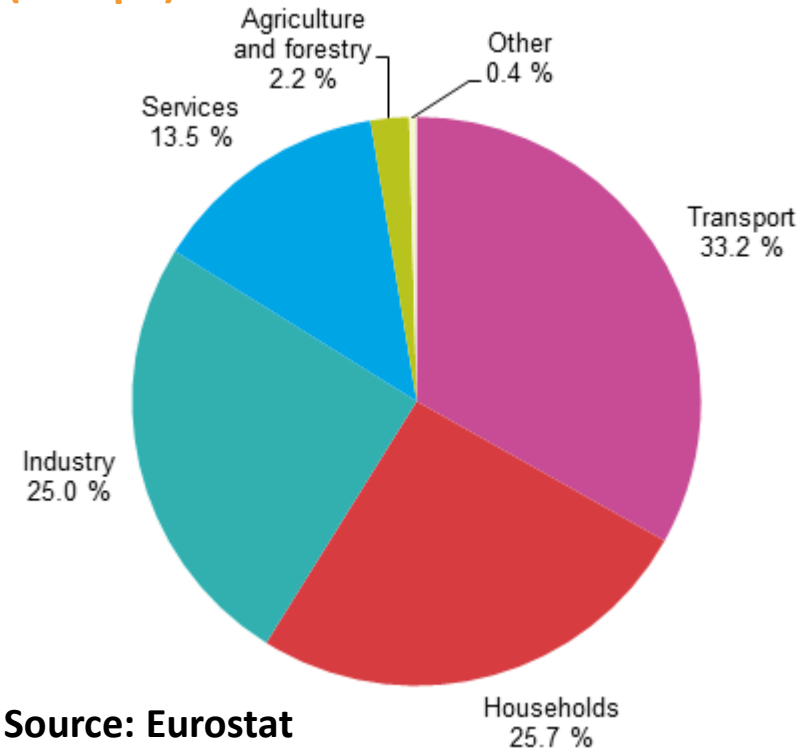
Electrochemical energy conversion and storage

- The courses enables to model and design electrochemical energy devices, including fuel cells and batteries dealing with both automotive and stationary applications

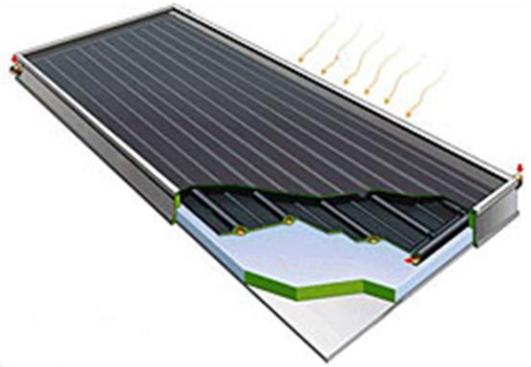
Energy Use and Built Environment: Topics

In Europe **households** (i.e. the built environment) account for about **25% of the end-use energy consumption**

Energy consumption by sector (Europe)



Source: Eurostat



Energy Use and Built Environment: Specialization Courses

Zero and positive energy districts

- The course aims to provide the base knowledge and tools for the development of buildings efficiency renovation and new plans at district and urban scale

Green building energy systems

- The course is aimed at providing the knowledge needed to design a "green" building with reduced environmental impact while maximizing occupant health

Safety ventilation and HVAC systems design

- The course is aimed at providing the knowledge and the tools needed to design an HVAC system

Oil and Gas Production: Topics

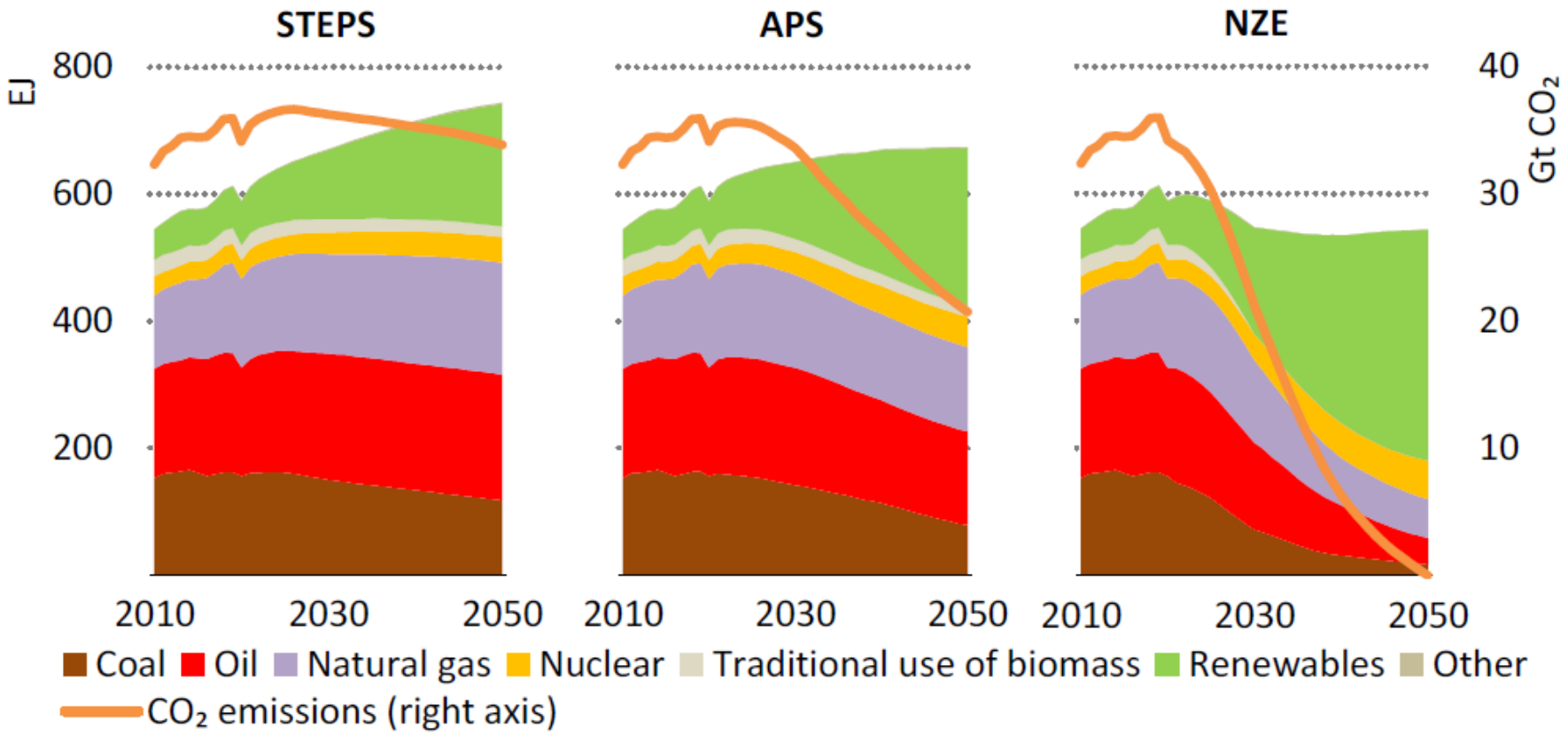
Exploration

Production

Tranportation

Refining

Oil and Gas Production: Topics



Scenarios:

- **STEPS** = Stated Policies Scenario
- **APS** = Announced Pledges Scenario
- **NZE** = Net Zero Emissions

Source: World Energy Outlook 2021

Oil and Gas Production: Specialization Courses

Fundamentals of Oil and Gas engineering

- This subject deals with geology, hydraulics and physics matters mainly, including the most advanced concepts of physics and chemistry of 2 and 3 phase reservoir systems

Sustainable Use of Underground Energy Resources

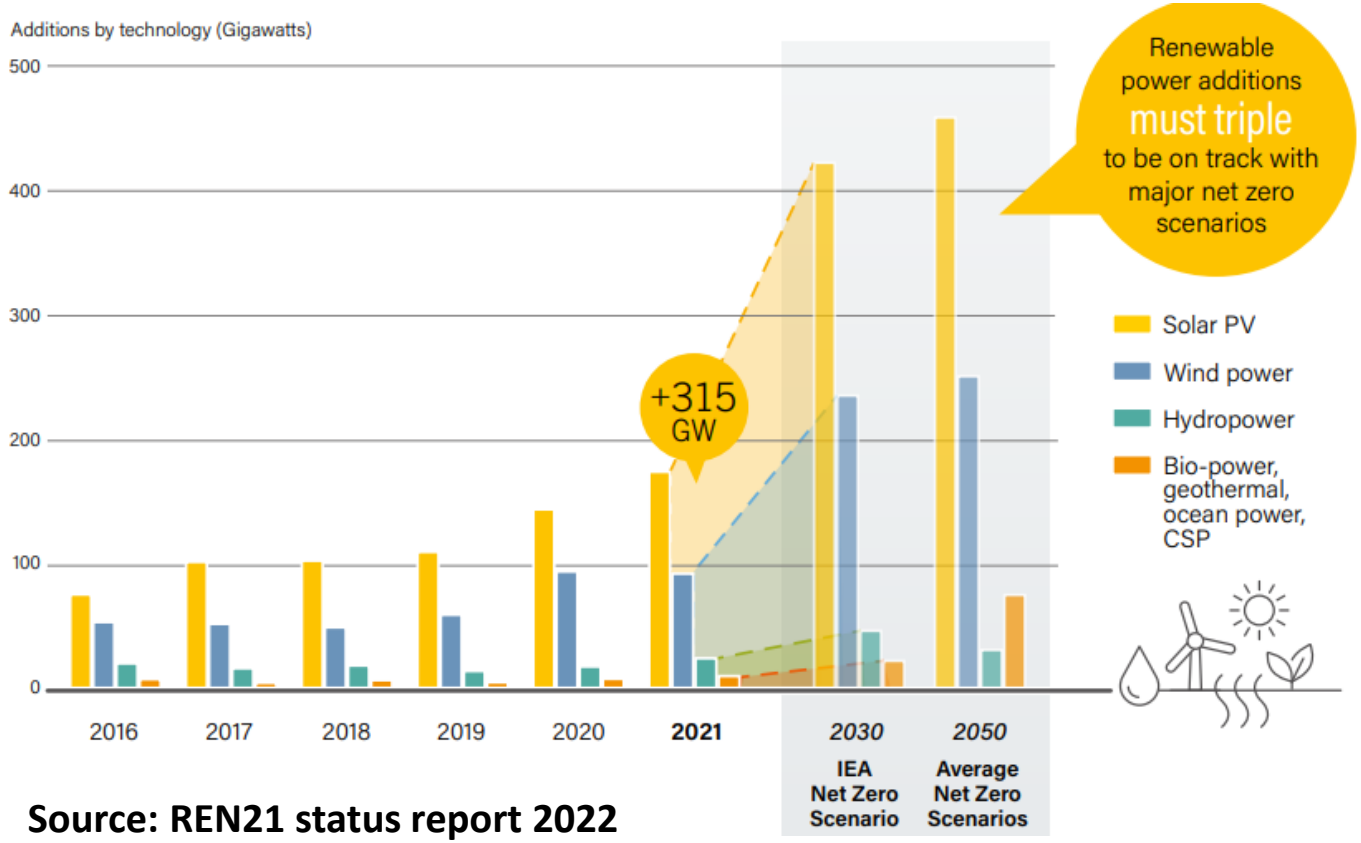
- The course will cover the basic processes associated with fluid flow in porous and fractured media, geological storage technologies and its extensions to multiphase flows

Oil and Gas field development and production

- The course will provide the basis for understanding how an oil or gas field is designed, developed and managed during the production life

GREEN POWER SYSTEMS: TOPICS

Annual Additions of Renewable Power Capacity [GW]



Source: REN21 status report 2022

Green Power Systems: Specialization Courses

Wind, Hydro and geothermal power generation & Solar and biomass power generation

- These courses provide the knowledge and the tools to correctly design renewable power systems

Electric conversion from green sources of energy

- The goal of the course is to provide the fundamental elements of the energy conversion produced by renewable sources and their connection to the electric grid

Design of fluid machines for clean power generation

- The course provides the necessary basic skills for the aerodynamic design and performance analysis of fluid machines in the frame of power production from renewable energy (i.e. wind and hydraulic turbines)

Renewables and Environmental Sustainability: The Piacenza Campus

- Very **well-connected** to whole Italy → Milano-Piacenza takes about 45’
- Limited number of **Students per Teacher** → teaching on a human scale
- Strong **internationalisation** → about 50% of RES students is foreign
- Strong collaboration with **local companies** → possibilities for stage-based MSc Thesis

Renewables and Environmental Sustainability: Specialization Courses

A MULTIDISCIPLINARY APPROACH combining energy, electric and environmental engineerings:

- **Energy engineering courses** as “Bioenergy and Waste-to-Energy Technologies” and “Renewable Energy and Low Carbon Technologies”
- **Electric engineering courses as “**Smart Grids and Regulation for Renewable Energy Sources”
- **Environmental engineering courses** as “Air Pollution and Control Engineering” and “Industrial Ecology”

ENERGY FOR DEVELOPMENT: TOPICS

Energy is essential to

- Socio-economic **development**
- **Quality of life** for the people
- Global **security**
- **Environmental** protection

SE4ALL | COP21 & COP22 …. | GOAL 7

2012
INTERNATIONAL YEAR OF
SUSTAINABLE
ENERGY FOR ALL

LABEL
PARIS2015
COP21·CMP11

MARRAKECH
COP22|2016|CMP1
UN CLIMATE CHANGE CONFERENC

7 AFFORDABLE AND CLEAN ENERGY

Energy → **Services** → **Development**

Energy for development: Specialization Courses

Thermoeconomics and Energy modeling

- Current energy scenarios, challenges and policies at a global level in the frame of Thermoecomics theory.
- Governing principles of energy modeling are illustrated with a focus on linear programming models

Energy Accounting and Impact Assessment Methods

- Fundamental of energy accountings at local and national level
- Principles and practice in quantitative impact assessment methods, including LCA and Industrial Ecology

Development economics

- Principles of development economics are key to understand the global challenges of development

Engineering and cooperation for development

- Widening the vision of the students to design ad hoc energy solution that meet local needs and exploit local resources

Wind Energy: Topics and Specialization Courses




- **Design of fluid machines for clean power generation**
- **Wind turbines and wind farm modelling and control**
- **Wind farm O&M**
- **Lab Wind Energy**

Joint Track with Mechanical Engineering

PASSION IN ACTION (PIA)

Passion in Action is a catalogue of open participation teaching activities that Politecnico offers to students to support the development of transversal, soft, and social skills and to encourage/facilitate students in enriching their personal, cultural, and professional experience.

- A range of subjects can be chosen, depending on personal interests and aptitudes.
- A range of activities can be picked: short courses on transversal tools and methodologies; design activities on multidisciplinary areas; group work projects in cooperation with companies; hackathons and students' competitions.

Find out more on the Politecnico Website:

https://www.polimi.it/en/programmes/innovative-teaching/

Extra-curricular activities will be tracked in the students' career in the diploma supplement and by an electronic badge.

POLIMI AMBASSADORS

Politecnico di Milano has activated high-level training courses aimed at creating new professional figures, the Polimi Ambassador in **Green Technologies**, **Smart Infrastructures**, and **Inclusivity Design** which:

- have skills in specific areas consistently with the training project
- acquire digital enabling technologies in line with the profile
- master interdisciplinary tools, methods, and aptitude for a systemic vision
- develop talent to operate in interdisciplinary and multisectoral contexts, acquired through exposure, even in teams, to case studies and challenges

POLIMI AMBASSADOR GREEN TECHNOLOGIES

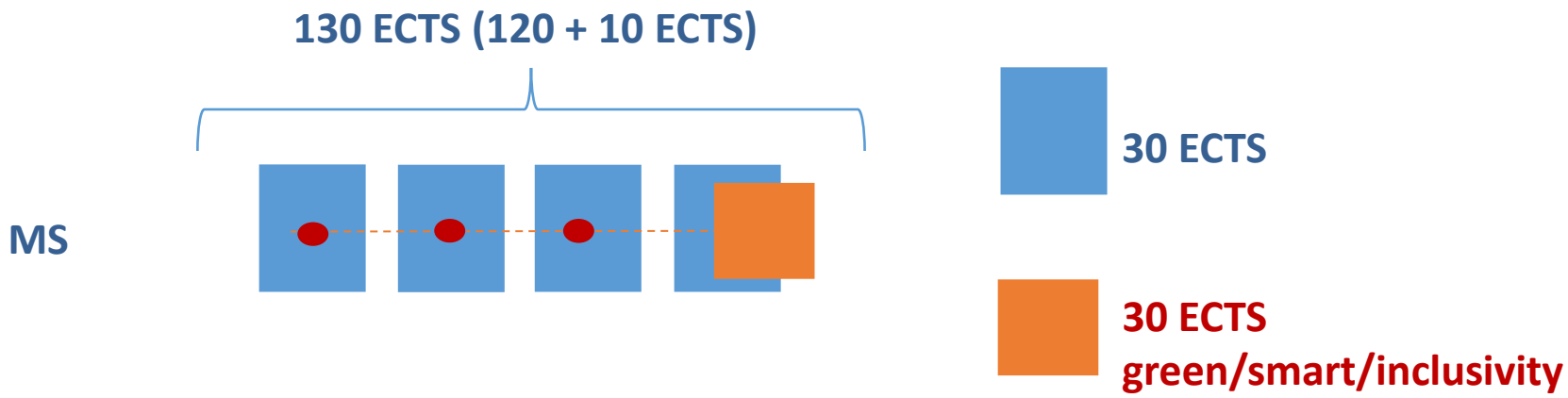
POLIMI AMBASSADOR SMART INFRASTRUCTURES

POLIMI AMBASSADOR INCLUSIVITY DESIGN

To find out more, visit the Politecnico Website:

https://www.polimi.it/en/programmes/high-level-training-courses/green-technologies-smart-infrastructures-e-inclusivity-design

PoliMI Ambassadors



30 ECTS green/smart/inclusivity =

≈10 ECTS	+	≈ 20 ECTS
Vertical Courses (topics characterizing the DP of context)		Transversal Courses (topics different from the ones characterizing the DP of context)

Honours Programme *"Scientific Research in Industrial Engineering – Energy"*

- This programme falls within the strategy for ***high level training*** of Politecnico di Milano.
- It is intended for students with ***high predisposition to studies and research*** and aims at improving the students' skills in order to train engineers devoted to science and technological research.
- The programme is structured through the ordinary Course in Energy Engineering and gives the opportunity of ***deepening some subjects*** from the point of view of both methodology and contents, under the ***supervision of a reference professor***.
- For this purpose the programme foresees ***additional training activities*** in several disciplines and within the MSc Thesis for a total of ***20 additional credits***.
- The title of the programme will be ***officially reported in the transcript of records*** together with the description of the conducted activities.

To find out more, visit the Politecnico Website:

https://www.ccs-energetica.polimi.it/it/honours-programme/

Enhance Program - *European Universities of Technology Alliance*

Association of seven renowned Universities of Technology

Chalmers University of Technology (Sweden)
Norwegian University of Science and Technology (Norway)
Politecnico di Milano (Italy)
RWTH Aachen (Germany)
Technische Universität Berlin (Germany)
Universitat Politècnica de València (Spain)
Warsaw University of Technology (Poland)

To find out more, visit the Politecnico Website:

https://www.polimi.it/il-politecnico/network-internazionali/enhance

OCCUPATIONAL SURVEY

After 1 year (data 2022)

EMPLOYMENT RATE*

100%

* 1 year after graduation, except students

WITHIN 6 MONTHS*

89%

* percentage calculated on those employed 1 year after graduation

NET MONTHLY SALARY

€1,610

EMPLOYMENT STATUS

Employee	96%
Self-employed	4%

CONTRACT TYPE*

Permanent	58%
Fixed-term	10%
Apprenticeship	29%
Internship	2%
Other*	1%

* Project-based; occasional collaboration

COMPANY SIZE*

1-250	55%
251-1.000	13%
+1.000	32%

* number of employees

WHERE THEY WORK

Italian graduates working abroad	8%

TOP 5 SECTORS

Energy	47%
Mechanics and Installation	12%
Oil&gas	7%
Business Consultancy	4%
Building and Construction	3%

TOP 5 AREAS OF EXPERTISE

Design	58%
Planning	25%
Research and Development	25%
Commercial, Sales and Purchases	19%
Planning and Control	15%

SATISFIED WITH SPECIFIC DEGREE: 87% **JOB THAT FITS WITH THEIR STUDIES: 95%**

After 5 years (data 2021)

WHAT IS THE EMPLOYMENT SITUATION OF ENERGY ENGINEERING GRADUATES 5 YEARS AFTER GRADUATION?

The following data has been extracted from the 2021 Employment Survey on 2015 Graduates, interviewed 5 years from graduation. Full details on the website http://cm.careerservice.polimi.it/en/employment-statistics/
In 2015, 223 Italian students obtained a Master's degree in Energy Engineering at Politecnico di Milano. Total respondents to the survey were 152 (coverage rate 68%).

EMPLOYMENT RATE

99%

HAS INCREASED BY 3%*

NET MONTHLY SALARY

€2,215**

HAS INCREASED BY €621*

PERMANENT CONTRACT

93%

HAS INCREASED BY 40%*

WORK IN ITALY

88%

SATISFIED WITH SPECIFIC DEGREE: 90%
Education and training acquired at the university is adequate for the current job

DEGREE FITS WORK: 90%
In order to carry out their job, they need their qualification or an equivalent one

ADMISSION CRITERIA

Students with a BSc from an Italian University

CFU-weighted average score ≥ SC

- **Admission Threshold**
  - ***S***: basic threshold
  - ***N***: number of years from the first enrollment

$$SC = S + \frac{N-3}{2}$$

- **AES, ENG, IPI, MEC Engineering POLIMI** — S = 21
  - *Supplementary subjects for BSc professional tracks*
- **Energy Engineering from other Universities** — S = 24
  - *Supplementary subjects according to the Minimum Requisites Tables*
- **Any Engineering POLIMI or other Universities** — S = 25
  - *Supplementary subjects according to the Minimum Requisites Tables*
- **BSc other than Engineering** — S = 27
  - *Supplementary subjects according to the Minimum Requisites Tables*

CONTACTS

Website: www.ccs-energetica.polimi.it

Teaching rules: https://www.polimi.it/corsi/corsi-di-laurea-magistrale/

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