Politecnico di Torino

ACADEMIC REGULATIONS

Master's degree programme

in

ENERGY AND NUCLEAR ENGINEERING

Department of Energy

Collegio di Ingegneria Elettrica ed Energetica

Academic Year **2025/2026**

The English translation of this document is provided as a support to the student community and has no legal effects. The Italian version shall constitute the sole authentic text and will be referred to for any legal matters.

SUMMARY

Art. 1 – Specific learning objectives and career prospects

1.1 Specific learning objectives

The Master's Degree Programme in Energy and Nuclear Engineering aims to help students deepen the scientific and technological knowledge that underpins applications in the fields of energy and nuclear engineering.

In addition to completing students' knowledge in fundamental engineering disciplines, such as structural mechanics, and acquiring transversal competencies in the field of energy economics, the programme aims to develop advanced skills in traditional and innovative plant engineering, focusing on the exploitation and management of renewable energy sources, the minimisation of environmental impact (including its interaction with energy networks), advanced nuclear systems and the hydrogen supply chain.

The programme provides tools for advanced analysis and processing of data obtained from the monitoring of energy and nuclear systems, with the goal of optimising their operational management.

Students are also encouraged to develop applied skills, both through experimental activities involving laboratory measurements—specific credits various aspects of energy and nuclear engineering are assigned to these activities—and through a curricular internship at a company or at public or research institutions.

1.2 Career prospects

The Master's degree programme aims to train a variety of professional profiles. The career prospects and the main functions and competencies associated to each profile are illustrated below.

Professional profile	Main functions and competencies
Energy Production and Transmission Specialist	Functions: These professionals select the most suitable technologies available on the market for the generation of electric, thermal, or combined energy. They are familiar with the main energy carriers and the issues related to their transmission and storage. They can identify the most appropriate solutions for the context. They can analyse and develop plans to adapt energy production and transmission processes in industrial settings in response to changes in the legal and economic framework. Competencies: • Knowledge of conventional and advanced energy conversion systems, both from a thermodynamic and plant engineering perspective • Understanding of energy distribution and storage systems • Familiarity with energy market mechanisms • Ability to draft energy and mass balances for civil and industrial systems • Ability to apply optimisation methods • Proficiency in analysis techniques for the proper valuation and recovery of energy resources and carriers (e.g. exergy analysis, thermoeconomic analysis) • Understanding of the challenges involved in integrating renewable energy sources into complex energy systems. • Potential Employers: • Public and private energy production companies • Energy-intensive industries • Energy Service Companies (ESCOs) • Energy market operators
Energy Systems and Components Designer	Functions: These professionals design energy systems for both civil and industrial applications. They can select and size thermal components for energy conversion, storage, and management, based on the features and constraints of energy demand. They are capable of selecting the most suitable working fluids for the energy system and can effectively collaborate with designers of mechanical and electrical systems.

	Competencies: • Knowledge of the main types of thermal systems, including those for heating, ventilation, and air conditioning (HVAC) in civil and industrial environments, as well as systems for the production of hot and cold fluids for industrial processes • Understanding of the characteristics and constraints of civil and industrial energy demand • Familiarity with the thermodynamic and thermophysical properties of materials • Ability to draft energy and mass balances for civil and industrial systems • Ability to solve problems using numerical methods • Ability to plan measurement campaigns to test and validate individual components and complete energy systems • Ability to interpret and analyse data from energy monitoring or simulation activities Potential Employers: • Engineering firms working in the design and testing of energy systems • Technical departments of hospitals, universities, manufacturing companies, chemical companies, etc. • Companies producing thermal components • Companies providing digital energy management services
Energy Manager in Civil and/or Industrial Settings	Functions: These professionals critically assess energy consumption data in civil and industrial contexts and - based on these assessments - they identify alternative supply solutions. They are familiar with the pricing mechanisms of energy carriers and can propose energy demand reduction measures, evaluating their economic feasibility. Competencies: • Ability to draft energy balances for civil and industrial systems • Knowledge of the performance and costs of main energy system components • Familiarity with the main energy carriers available on the market and their economic implications depending on demand levels • Ability to plan monitoring and maintenance activities for energy systems through measurement campaigns and data acquisition Potential Employers: • Public organisations that, under current legislation, require an energy manager • Energy procurement consultant for medium- and large-scale industrial organisations • Energy Service Companies (ESCOs) • Companies providing digital energy management services
Electro-Nuclear Plant Specialist (Fission and Fusion)	Functions: These professionals mainly design and analyse components and systems currently used or intended for nuclear-based electricity generation. They address challenges in plant engineering (e.g. heat rejection systems, thermal-hydraulic design of the reactor and its components), physics (e.g. neutron core design for fission reactors and plasma-wall interactions for fusion reactors), and nuclear reactor technology (e.g. the use of innovative materials). They coordinate design teams specialising in the different areas of the project. They carry out safety analyses for both fission and fusion reactors, using deterministic and probabilistic approaches. They plan plant operations and manage the control and regulation of nuclear systems, as well as coordinate the decommissioning of fission power plants. They contribute to the development of innovative nuclear reactors, supporting the detailed design of prototypes and demonstrator plants in both fission and fusion domains. They are also able to address and solve problems related to the disposal of high thermal loads. Competencies: • In-depth knowledge of thermonuclear power plants and fusion reactors, including construction, operation, physical, engineering, and technological aspects • Strong understanding of the effects of radiation on materials • Knowledge of the biological effects of radiation and shielding techniques • Familiarity with specific research challenges in nuclear fusion physics and engineering • Ability to use and develop computational models for the design of components and systems, as well as for probabilistic and deterministic safety assessments

	• Proficiency in models and methods for managing high thermal load disposal Potential Employers: • Companies and organisations involved in the design, manufacturing, and construction of fission or fusion thermonuclear plants and components • Energy producers using nuclear sources • Research institutions in Italy and abroad • Engineering firms specialising in the design and risk analysis of complex energy systems, including those beyond the nuclear sector
Nuclear Fuel Production and Management Specialist	Functions: These professionals design the nuclear fuel cycle, covering material types and quantities, manufacturing processes, strategies for in-core use, and post-irradiation management. For each stage, they are familiar with normal operating conditions, potential incident scenarios, and radiation effects on materials. They address issues related to monitoring and storage of spent fuel and radioactive waste from nuclear power plants and research reactors, both during normal operation and following decommissioning. They contribute to the development of radioactive waste disposal sites, focusing on site selection, project coordination, and implementation. Competencies: • Knowledge of fuel types and fabrication methods for current nuclear reactors, and comprehensive understanding of the nuclear fuel cycle • Understanding of irradiation-induced material damage during in-core use • In-depth knowledge of the biological effects of radiation and shielding techniques • Ability to use and develop deterministic and probabilistic models for fuel element design, addressing both normal and accidental operating conditions Potential Employers: • Nuclear and conventional energy production companies • Companies specialising in the design and manufacture of nuclear fuel • National and international research institutions
Specialist in the Design, Manufacturing and Operation of Radiation-Based Equipment for Medical and Industrial Applications	Functions: These professionals design, develop and operate radiation-generating equipment for research (e.g. material characterisation), medical (e.g. diagnosis and therapy), and industrial (e.g. non-destructive testing and process-related applications) use. They understand structural and functional aspects, especially regarding the generation and characterisation of radiation beams and shielding techniques. In industrial applications, they develop and manage equipment for sterilisation, non-destructive testing, and radioactive tracer applications. They are also involved in the instrumentation of nuclear plants for energy, medical, industrial, or research purposes. Competencies: • Specific expertise in nuclear physics and particle/radiation transport • Knowledge of shielding techniques and technological aspects of radiation management, including monitoring, material interactions, and biological effects Potential Employers: • Companies developing and manufacturing radiation-generating equipment • Industries and hospitals employing specialists in procurement and operation of radiation-based devices • Research institutions in Italy and abroad
Energy Planning Specialist	Functions: These professionals analyse energy balances at various territorial scales (from municipal to national) and they plan the use and location of energy production plants based on local demand. They propose alternative energy supply strategies while also assessing their environmental, economic and risk-related impacts.

	Competencies: • Knowledge of energy sources and transport networks • Use of energy modelling and optimisation methods on a territorial scale • Understanding of energy market operations • Ability to analyse projections of future energy scenarios • Ability to conduct life cycle assessment (LCA) of major energy technologies Potential Employers: • Local and national public institutions • International research organisations and planning centres • Engineering firms offering territorial analysis and consulting services for public administration planning
Hydrogen Supply Chain Specialist	Functions: These professionals are capable of designing and managing hydrogen supply chain systems. They can also define and implement strategies for the decarbonisation of production processes through the use of renewable energy sources. They are familiar with energy conversion technologies aimed at eliminating or reducing carbon emissions into the atmosphere. They understand key renewable energy technologies and conversion processes that enable the decarbonisation of energy resources (e.g. synthetic fuels, hydrogen). Competencies: • Knowledge of thermodynamic and plant design aspects related to the conversion of conventional and innovative energy carriers, with a particular focus on hydrogen • Understanding of energy distribution and storage systems • Knowledge of the challenges involved in integrating renewable energy sources into complex energy systems Potential Employers: • Private and/or municipal energy production companies • Energy-intensive industrial enterprises • Energy market operators • Companies operating within the hydrogen supply chain

1.3 Professional profiles (ISTAT codes)

With reference to the list of professional profiles classified by ISTAT (Italian National Institute of Statistics, https://www.istat.it/en/), graduates from this Master's degree programme can work as:

ISTAT code	Description
2.2.1.1.4	Ingegneri energetici e nucleari

Art. 2 – Admission requirements

Italian regulations on enrolment in Master's degree programmes require Italian universities to check that applicants meet the following requirements:

- have a **three-year Bachelor's degree or university diploma,** or **other educational qualification obtained outside Italy** and recognized as suitable for admission;
- meet **specific curricular requirements**;
- have an **academic performance considered suitable** for admission.
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For the specialist track in "Hydrogen Systems and Enabling Technologies" the admission requirements and procedures are available at https://www.hysetmaster.polito.it/.
For the other specialist tracks of the degree programme, the admission requirements are listed below.

CURRICULAR REQUIREMENTS

As far as curricular requirements are concerned, applicants must have a Bachelor's degree or a three-year university diploma, or an educational qualification obtained outside Italy and recognized as suitable for admission. In addition, they must have gained specific knowledge and competencies during their previous academic path (credits in specific Scientific Disciplinary Fields).

In particular, applicants must have earned:

- minimum 40 credits earned in the following Scientific Disciplinary Fields (settori scientifico-disciplinari): CHIM/07, FIS/01, FIS/03, ING-INF/05, MAT/02, MAT/03, MAT/05
- minimum 60 credits earned in the following Scientific Disciplinary Fields (settori scientifico-disciplinari): FIS/04, ICAR/01, ICAR/03, ICAR/08, ING-IND/08, ING-IND/10, ING-IND/11, ING-IND/12, ING-IND/13, ING-IND/14, ING-IND/15, ING-IND/18, ING-IND/19, ING- IND/22, ING-IND/24, ING-IND/25, ING-IND/31, ING-IND/32, ING-IND/33

The credits of the Scientific Disciplinary Fields found both in the first group and in the second group are primarily counted for the first group. The remaining credits are counted for the second group. Therefore, the credits of a course can be counted partly to reach the minimum number of credits of both groups.

Applicants who lack less than 10 credits can be admitted to the programme by the Academic Advisor of the degree programme. For applicants who lack more than 10 credits, the evaluation will be subject to the final approval of the Coordinator or the Vice coordinator of the degree programme.

Applicants who do not meet the curricular requirements must make up for their unfulfilled curricular requirements (missing credits) before enrolment, by means of:

- **enrolment in single courses in order to make up for unfulfilled curricular requirements**: this is possible for students who need to earn up to a maximum of 60 credits. Students who enrol in single courses for this reason are allowed to include in their Personal Study Plan exclusively the courses assigned by the evaluator.
  or else,
- **credit transfer at Bachelor's level**: this is possible for students who need to earn more than 60 credits. In this case, students need to enrol in the Bachelor's degree programme that offers the credits in the specific Scientific Disciplinary Fields (core subjects and commentary subjects) required for admission to this Master's degree programme.

SUITABLE ACADEMIC PERFORMANCE

Applicants must have a suitable academic performance and an English language certificate (B2 level or above, as defined by the Common European Framework of Reference for Languages: Learning, Teaching, Assessment - CEFR).

The academic performance will be assessed as follows

1) **Applicants from Politecnico di Torino**

Applicants can be admitted to the programme if they earned their Bachelor's degree in:

- 4 years or less (1) - no exam average grade required

- between 4 and 5 years (1) –exam weighted average grade required (2): ≥ 21/30
- more than 5 years– exam weighted average grade required (2): ≥ 24/30

The weighted average grade is calculated on all accrued course credits (graded on a scale of 30) counting towards the achievement of the Bachelor's degree, after having subtracted the worst 28 credits.

The duration of the Bachelor's path is calculated on the basis of the number of academic years in which the applicant has been enrolled at the university, starting from the first enrolment in the Italian university system:

- for full-time students: the duration of the Bachelor's path is equivalent to the number of academic years of enrolment.
- for part-time students: each year of enrolment is counted as half-year.
- for full-time students taking part in the "Dual Career" programme: each year of enrolment is counted as half-year, as for part-time students.

In the event of credit transfer, the duration of the Bachelor's path must be increased proportionally to the number of credits that have been recognized by Politecnico (10-60 CFU =1 year, etc.). The worst 28 credits must be subtracted proportionally to the number of validated credits.

(1) Applicants must have graduated by the end of the December Graduation Period
*(2) The weighted average is calculated as follows: ∑(grade*credits) / ∑credits*

2) Applicants from other Italian universities

Applicants who have a Bachelor's degree awarded by another Italian university must have a weighted average grade of all the exams ≥ **24/30**, regardless of the number of years it took them to graduate. The weighted average grade (∑(grade*credits) / ∑credits) is calculated on all accrued course credits (graded on a scale of 30) counting towards the achievement of the Bachelor's degree, after having subtracted the worst 28 credits.

3) Applicants with a non-Italian educational qualification

To be admitted to Politecnico Master's degree programmes, applicants must have an academic qualification awarded by an accredited/recognized foreign university, earned after completing at least 15 years of total education (including primary school, secondary school and university).
Applicants who have attended a university programme lasting five or six academic years (different from the 3+2 system) without completing it must still meet the minimum requirement of 15 years of total education (of which at least 3 years at university level) and they must have earned at least 180 ECTS credits or equivalent. Pre-university courses or foundation years cannot be counted towards the minimum number of credits or the minimum numbers of years of total education mentioned above.
In addition to having an adequate academic background and certified knowledge of the English language (minimum B2 level), students applying to degree programmes delivered in Italian or partially taught in Italian must also have an Italian language certificate (minimum B2 level), as defined by the Common European Framework of Reference for Languages (CEFR), as an admission requirement.
The applicant's academic performance and the consistency between the degree programmes offered by Politecnico and the applicant's previous academic background are assessed by the professors designated by Coordinator of the Collegio. The evaluation is carried out on the Apply@polito platform under the section called "Applicants with a non-Italian qualification."

A positive evaluation (offer of admission) allows applicants to enrol in the programme only in the academic year in which the application has been submitted. Admitted applicants who do not complete the enrolment process within the deadlines are required to apply again to the programme in the next academic years.

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More information is available at https://www.polito.it/en/education/applying-studying-graduating/admissions-and-enrolment/master-s-degree-programmes

Art. 3 – Programme curriculum

3.1 Programme overview

The degree programme is structured into three main alternative specialist tracks:

- Renewable Energy Systems
- Design and Management of Power Plants
- Sustainable Nuclear Energy

In addition, the programme offers a further track within the Erasmus Mundus JointMaster project coordinated by Politecnico di Torino:

- Hydrogen Systems and Enabling Technologies

The "Renewable energy systems" track is English-taught. It is designed to provide the knowledge and skills required for the analysis, design and management of components, plants and systems enabling the exploitation of renewable energy sources, also in combination with fossil fuels. The programme includes courses on the availability of renewable energy resources and the technologies used to convert them into electrical and/or thermal energy. These are complemented by courses on energy networks and component- and system-level optimisation methodologies.

The "Design and management of power plants" track is Italian-taught. It provides the knowledge and skills needed to analyse, design and manage components, plants, and systems for the heating, cooling and air conditioning of civil buildings and for energy recovery in industrial plants. It also develops the ability to assess energy demand and identify the most appropriate measures for the rational use of energy in civil and industrial contexts. The training includes courses in thermal energy applications in civil and industrial sectors, system design and management and machine learning techniques for processing monitored data.

The "Sustainable nuclear energy" is English-taught. It provides the knowledge and skills required for the design of components and systems for nuclear fission and fusion reactors. Topics covered include radiation protection, safety, risk and reliability analysis, and the nuclear fuel cycle. The programme also addresses innovative materials suitable for applications in the nuclear sector. Students study models and methods for the physical description of fission and fusion systems, nuclear plant engineering, and fusion reactor technologies.

Students can also personalise their educational path by selecting elective courses from the other tracks. They can do an internship in their area of interest, or they can choose from a wide range of optional credits. These include: refrigeration and cryogenics, thermal measurements and control, lighting and noise control, models for energy planning, biomedical applications of radiation, advanced materials for energy, energy auditing of buildings, geothermal energy, sustainable use of biomass, thermal therapies, computational thermofluid dynamics, energy system management, radiation protection, hydroelectric plants, environmental impact assessment and LCA, and machine learning techniques applied to energy systems.

The "Hydrogen Systems and Enabling Technologies" track focuses on the hydrogen supply chain and is taught in English as part of the Erasmus Mundus Joint Master Degree. In year 1 students take courses at Politecnico di Torino where they learn about the tools needed for the analysis, design and management of components, plants and systems enabling the exploitation of renewable energy sources, also in combination with fossil fuels. Courses address the availability of renewable energy resources and the technologies used to convert them into electrical and/or thermal energy, alongside courses on energy networks and optimisation methodologies at both the component and system levels.

In year 2 students attend classes at one of the following partner universities: Norges Teknisk-Naturvitenskapelige Universitet (NTNU), Universitat Politècnica de Catalunya (UPC), or Technische Universiteit Eindhoven (TU/e). Upon completion of this track, students are awarded a Master's degree both from Politecnico di Torino and from the partner university where they completed the second year of study.

The degree programme is part of the initiatives promoted by Politecnico to support awarding of double degrees in some Master's degree programmes offered at Politecnico di Torino. The University allows credit transfer through elective credits that provide foundational knowledge for students who, upon completing their Master's degree in Energy and Nuclear Engineering, wish to enrol in another Master's degree programme.

3.2 Organization of educational activities

The list of courses (compulsory and optional), curricula, possible organization of courses into modules, any pre-requisites and exclusions and the list of the faculty members responsible for the courses are available at: https://didattica.polito.it/pls/portal30/sviluppo.offerta_formativa_2019.vis?p_a_acc=2026&p_sdu=32&p_cds=554

The list of the Scientific Disciplinary Fields (Settori Scientifico Disciplinari) for each activity (specific subjects and complementary subjects) is available at: https://didattica.polito.it/pls/portal30/sviluppo.vis_aig_2023.visualizza?sducds=32554&tab=0&p_a_acc=2026

Art. 4 - Student career

The Student Guide is published on the Teaching Portal every year before the beginning of the academic year. There is a specific Student Guide for each Master's degree programme. The Student Guide is available on the web site of the degree programme.

It contains information and deadlines on:

- academic calendar;
- Personal Study Plan and Annual Personal Study Plan;
- free choice credits;
- internships;
- tuition fees;
- dual career;
- classes and exams;
- class delivery;
- foreign language learning;
- studying abroad/mobility programmes;
- exam rules;
- transfers in/out and internal transfers;
- interruption, suspension, withdrawal, forfeiture;
- credit transfer.

Art. 5 - Final Examination

The final examination is an educational milestone of the Master's degree programme and consists of a thesis that must be developed independently and originally by the student under the guidance of a Supervisor.

Students are expected to independently carry out an in-depth study of a scientific, technical, or design-related problem, critically review the relevant literature or documentation, and analyse the problem by proposing appropriate engineering solutions.

Students can work on their thesis project at the University's departments and laboratories, at other Italian or international universities, at external research centres, or in collaboration with companies and professional firms with which formal partnerships have been established.

Graduands must demonstrate the ability to work independently, a thorough understanding of the topics and the ability to summarize and clearly communicate the content of the thesis while engaging in a public discussion.

The thesis may be written and presented in English.

The workload required for the thesis corresponds to 16 ECTS credits (400 hours).

Students are allowed to write and present their thesis in both English or Italian.

Students are required to publicly present their thesis in front of a Graduation Examining Committee, which includes the Supervisor(s) and a Co-Examiner. The Co-Examiner is a member of the committee who is responsible for providing a critical review of the thesis.

Students must submit their thesis application and request the thesis topic online through a dedicated procedure available in their personal page on the Teaching Portal, under the section entitled "Thesis," in compliance with the Graduation Periods deadlines published in the Student Guide – Thematic Calendar Section.

The final grade is given by the Graduation Examining Committee. Its members evaluate the overall average grade of all the exams on a scale of 110. The committee may add up to a maximum of 8 points, considering the following:

- the number of credits earned in courses passed with honours (grade: 30 cum laude);
- experiences at universities and research centres abroad;
- any extracurricular activities or participation in Student Team activities;
- the duration of studies (if shorter than the average time to graduation).

A degree with honours (cum laude) may be awarded at the Committee's discretion if the total score is at least 113 by qualified majority, i.e. at lasts 2/3 of the Committee members.
If the thesis meets the required standards, the Committee may grant the dignità di stampa (printing honour) only if the final grade is 110 cum laude and the Committee's decision is unanimous.

More Information and Deadlines:

- Student Regulations
- Student Guide

Diploma Supplement:
In compliance with article 11, paragraph 8, of Ministerial Decrees No. 509/1999 and 270/2004. Politecnico di Torino issues the Diploma Supplement, a document that can be attached to a higher education qualification. It is designed to improve the transparency of international qualifications, as it provides the description of the curriculum successfully completed by the student. This certificate follows the European model developed by the European Commission, the Council of Europe and UNESCO – CEPES: it is issued in two languages (Italian-English) and it is composed of approximately 10 pages.

More information at: https://www.polito.it/en/education/applying-studying-graduating/academic-experience/certificates-and-other-documents

Art. 6 - References

6.1 Student Regulations

The Student Regulations define the rights and responsibilities of students and set out the administrative and disciplinary rules that all students enrolled in a degree programme or in a single learning activity at Politecnico must abide by.

6.2 Other Regulations

Particular aspects of students' academic progress are governed by specific Regulations or Calls for Applications published on its website.
In particular:

- The Tuition Fee Regulations specify the annual tuition fees that students must pay. The procedure for requesting a tuition fee reduction is explained in a dedicated guide.
- The University Regulations on Funds for Student Mobility Abroad outline the principles and rules for awarding and disbursing mobility grants. Standard procedures apply to all types of mobility programmes with unified Calls for Applications published twice a year at https://www.polito.it/en/education/applying-studying-graduating/studying-abroad
- The Code of Ethical Conduct also applies to students.