Master in Nuclear Engineering

2024-2025

www.upc.edu/masters-sessions

Now, UPC masters degrees!

Register to the information sessions
Contents of the presentation

1. UPC/ETSEIB introduction
2. Master in Nuclear Engineering
3. How to Apply
4. Q & A
16 Departments
2 Research Institutes
2 Bachelor degrees (GETI, GETIAE)
15 Master’s programs
3379 Students
446 Teaching and Research Staff (PDI)
126 Administrative and Support Staff (PAS)
ETSEIB School

ETSEIB: Escola Tècnica Superior d’Enginyeria Industrial de Barcelona

Over 170 years of educating professionals with a very strong scientific and technical foundation

https://etseib.upc.edu/
ETSEIB Master's degree programmes

1. Master's degree in Neuroengineering and Rehabilitation (with UAB)
2. Master's degree in Biomedical Engineering (with UB)
3. Master's degree in Automatic Control and Robotics
4. Master's degree in Automotive Engineering
5. Master's degree in Management Engineering
6. Master in Nuclear Engineering / EMINE
7. Master in Electric Power Systems and Drives
8. Master in Thermal Engineering / DENSYS
ETSEIB Double Degree programmes

Master's degree in Industrial Engineering

+ Master's degree in Automatic Control and Robotics
  Master's degree in Automotive Engineering
  Master's degree in Management Engineering
  Master in Energy Engineering
  Master in Nuclear Engineering /EMINE
Master in Nuclear Engineering
Global primary energy consumption by source

Primary energy is based on the substitution method and measured in terawatt-hours.

**Data source:** Energy Institute - Statistical Review of World Energy (2023); Smil (2017)

**Note:** In the absence of more recent data, traditional biomass is assumed constant since 2015.

OurWorldInData.org/energy | CC BY
Very strong push on electrification in EU to meet the Net Zero ambition

Electricity consumption to escalate by 3 times in less than 30 years

Gross electricity generation in the EU

Sources:
* [energy-charts.info](http://energy-charts.info) using ENTSO-E data
** Policy scenarios for delivering the European Green Deal
The EU’s needs to decarbonize are massive...across all sectors

<table>
<thead>
<tr>
<th>Electricity</th>
<th>Hydrogen</th>
<th>Industrial heat</th>
<th>District heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600 TWh/y</td>
<td>&gt;20 Mt H₂/y</td>
<td>~1250 TWhₚ/y*</td>
<td>~500 TWhₚ/y**</td>
</tr>
<tr>
<td>EU Low carbon electricity production to be deployed by 2040</td>
<td>REPowersEU Market Estimate for 2030</td>
<td>Iron – Steel, Non-metallic minerals and chemicals heat demand in EU</td>
<td>Current district heat demand in EU</td>
</tr>
<tr>
<td>80GW</td>
<td>1000 TWh/y</td>
<td>&gt; 45% market</td>
<td>&gt; 2/3 fossil-fueled</td>
</tr>
<tr>
<td>European Nuclear capacity to be replaced by 2050 (end of life)</td>
<td>Equivalent additional clean electricity demand</td>
<td>Heat &lt; 400°C</td>
<td>Assets to be retired and replaced in the coming two decades</td>
</tr>
</tbody>
</table>

*IAEA report on *Industrial Applications of Nuclear Energy* – 2017

**Calculations based on:
- Statistics | Eurostat (europa.eu)
- D2.3 (wedistrict.eu)
- Country Profiles | Euroheat & Power
Green Conflict Minerals: The fuels of conflict in the transition to a low-carbon economy

Clare Church, Alec Crawford on August 13, 2018

International Institute for Sustainable Development

IISD
The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals.

**Minerals used in selected clean energy technologies**

<table>
<thead>
<tr>
<th>Transport (kg/vehicle)</th>
<th>Minerals</th>
<th>Copper</th>
<th>Lithium</th>
<th>Nickel</th>
<th>Manganese</th>
<th>Cobalt</th>
<th>Graphite</th>
<th>Chromium</th>
<th>Molybdenum</th>
<th>Zinc</th>
<th>Rare earths</th>
<th>Silicon</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric car</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Conventional car</td>
<td>100</td>
<td></td>
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</tr>
</tbody>
</table>

**Power generation (kg/MW)**

<table>
<thead>
<tr>
<th></th>
<th>Minerals</th>
<th>Copper</th>
<th>Lithium</th>
<th>Nickel</th>
<th>Manganese</th>
<th>Cobalt</th>
<th>Graphite</th>
<th>Chromium</th>
<th>Molybdenum</th>
<th>Zinc</th>
<th>Rare earths</th>
<th>Silicon</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offshore wind</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Onshore wind</td>
<td>120</td>
<td></td>
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<td></td>
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<tr>
<td>Solar PV</td>
<td>8000</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>6000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Coal</td>
<td>4000</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>20000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Notes: kg = kilogramme; MW = megawatt. Steel and aluminium not included. See Chapter 1 and Annex for details on the assumptions and methodologies.
There has been limited progress in terms of diversification over the past three years; concentration of supply has even intensified in some cases.

Notes: DRC = Democratic Republic of the Congo. Graphite extraction is for natural flake graphite. Graphite processing is for spherical graphite for battery grade. Sources: IEA analysis based on S&P Global, USGS (2023), Mineral Commodity Summaries and Wood Mackenzie.
Supply chain

Forecasted production and deployment and supply needs of key clean energy technologies and related minerals in 2030

International Energy Agency (2023), World Energy Outlook 2023, IEA, Paris

Notes: Announced pipeline includes both committed and preliminary projects. For critical minerals, the NZE Scenario deployment needs refer to the primary supply requirements (total demand less secondary supply).
Meanwhile

NG imports in Spain 2022

19 Countries that have supplied natural gas to the System

446,550 GWh Total supplies of natural gas
Who’s Still Buying Fossil Fuels From Russia in 2023?

FOSSIL FUEL IMPORTS IN 2023: JAN 1ST – JUNE 16TH 2023

China averaged $210M in daily Russian fossil fuel imports after Russia’s invasion in 2022. In 2023, this figure has declined to $170M.

Russian fossil fuel export revenues peaked in March 2022 at $1.28 in daily revenue. Since then, revenues have declined by over 80% to around $442M in daily revenue.

Revenue from exports to the EU have fallen by nearly 90% from the peak.

Although crude oil is Russia’s top fossil fuel export, Urals crude trades about $20 less per barrel than Brent crude.
Nuclear Energy Makes History as Final COP28 Agreement Calls for Faster Deployment

Parliament backs EU push for small nuclear reactors

Eleven EU countries launch alliance
Concluding remarks

Materials throughput by type of energy source

*Life cycle emissions from biomass vary significantly depending on fuel (e.g., crop residues vs. forestry) and the treatment of biogenic sources.

*The death rate for nuclear energy includes deaths from the Fukushima and Chernobyl disasters as well as the deaths from occupational accidents (largely mining and milling).

*Energy shares refer to 2019 and are shown in primary energy substitution equivalents to correct for inefficiencies of fossil fuel combustion. Traditional biomass is taken into account.


OurWorldInData.org – Research and data to make progress against the world’s largest problems. Licensed under CC-BY by the authors Hannah Ritchie and Max Roser.

“Quadrennial Technology Review: An Assessment of Key Energy Technologies and Research Opportunities,” Table 10, September 2015. United States Department of Energy. Nuclear and hydro require 10 tonnes/TWh and 1 tonne/TWh of other materials, respectively, but are unable to be labeled on the graph.
Master in Nuclear Engineering

- 90 ECTS (English)
- 30 seats
- **Main profiles:** Industrial (Mech.) Eng., Material Eng., Energy Eng., Chemical Eng.
- **Other profiles:** Other Engineering degrees and BSc. (Physics, Chemistry).
- **Objective:**
  Educate the future experts in nuclear engineering and to equip them with the competencies required to take on positions of responsibility in companies and research centers in the nuclear sector.

- **Professional opportunities:**
  The programme aims to respond to the demand of the nuclear industry and the society, and focuses not only on training professionals to be highly prepared for the industry, but also on preparing qualified personnel for research and development, or to work as technical staff for the Regulatory Authority.
MNE overview

<table>
<thead>
<tr>
<th>TYPE OF SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>46,5</td>
</tr>
<tr>
<td>Elective</td>
<td>13,5</td>
</tr>
<tr>
<td>Internship</td>
<td>15</td>
</tr>
<tr>
<td>Master’s Final Project</td>
<td>15</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>90</strong></td>
</tr>
</tbody>
</table>

- Required subjects provide students with the necessary multidisciplinary training.
- Elective courses complement students education in different topics of interest.

- The Master is strictly focused on nuclear power and will benefit of the experience of ENDESA and of the long term collaboration existing between the Nuclear Safety Council (Spanish regulatory body) and the UPC concerning nuclear safety.

- Another of the assets of the Master is the collaboration of other Spanish research institutions (e.g. CIEMAT) and companies (e.g. ENUSA, TECNATOM, ENRESA, ENSA, Westinghouse, IDOM, etc.) both in lecturing and in hosting internship students.
MNE overview

SEMESTER 1
- Fundamentals of Nuclear Eng. and Rad. Protection
- Nuclear Power Plants
- Fuel Cycle and Environmental Impact

SEMESTER 2
- Regulations and Safety
- Management of Nuclear Power Plants
- Elective Block

SEMESTER 3
- Internship
- Final Project
MNE overview

SEMESTER 1
- Fundamentals of Nuclear Eng. and Rad. Protection
- RP+TH
- SCM
- Fuel Cycle and Environmental Impact

Project 1

SEMESTER 2
- Regulations and Safety
- Management of Nuclear Power Plants
- Elective Block

Project 2

Transversal PBL courses
Methodology

- Learning by Doing
- Completely adapted to ESHE.
- 1 ECTS = 25 h of student dedication
- Combination of lectures, practical sessions, self-guided study, use of computational codes, and laboratory practice with guided visits to different nuclear installations
- An important part of the learning process will take place via Project Based Learning (PBL), i.e. solving a complex combined problem, working mostly in small cooperative groups.
## Syllabus

<table>
<thead>
<tr>
<th>COURSES</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First semester</strong></td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Nuclear Engineering and Radiological Protection</td>
<td>8</td>
</tr>
<tr>
<td>Reactor Physics and Thermal-Hydraulics</td>
<td>7.5</td>
</tr>
<tr>
<td>Systems, components and materials</td>
<td>6</td>
</tr>
<tr>
<td>Fuel Cycle and Environmental Impact</td>
<td>5.5</td>
</tr>
<tr>
<td>Project 1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Second semester</strong></td>
<td></td>
</tr>
<tr>
<td>Regulations and Safety</td>
<td>5</td>
</tr>
<tr>
<td>Management of Nuclear Power Plants</td>
<td>8.5</td>
</tr>
<tr>
<td>Elective block (3 subjects)</td>
<td>3 x 4.5</td>
</tr>
<tr>
<td>Project 2</td>
<td>3</td>
</tr>
</tbody>
</table>
Master in Nuclear Engineering

Key elements:
- Sponsored and supported by ENDESA
- Relevant involvement of professionals from the nuclear industry and regulatory authority
- Field visits to nuclear sites and facilities
- Embedded in the educational project of InnoEnergy.
Involvement of Industry

- Contribution to the design of the programme
- Study visits
- Lectures by external experts
- Internships
Our recent “champions”
Proud of our alumni

UPC at ENYGF
European Master in Nuclear Energy (EMINE)

- **MsC EMINE:**
  - Two year programme (120 ECTS)
  - Double master degree: UPC+Paris Consortium; UPC+INP Grenoble
  - Students from around the world

2 week summer course in a business school between Y1 and Y2 (ESADE)
Master in Nuclear Engineering

- 2013 MNE Distinctive Mention International Master's Programme (AGAUR)
- 2013 EMINE gets the EIT label for 4 years
- 2015 the Program is accredited by ANECA
- 2016 MNE Accredited in progress towards Excellence by AQU Cat.
- 2017 EMINE gets the EIT label for 5 years
- 2020 MNE Accredited in progress towards Excellence by AQU Cat.
- 2022 EMINE gets EIT label for 5 years
Double master MUEI-MUEN

Q1
36.5 ECTS

Q2
36 ECTS

Q3
37 ECTS

Q4
31.5 ECTS

Q5 (TFM+int.)
42 ECTS

Total: 183 ECTS
How to apply

(https://etseib.upc.edu/en/Academic%20programmes/academic-procedures/acces/application-msc-programmes)

- Application
  Deadline: 13th of May 2024
- Acceptance (Academic Comission)
  June 2024
- Provisional listing of accepted students
  Before the end of June 2024
- Students' acceptance
  Up to 7 days from the publication of the listing
- Definitive listing of accepted students
  Mid-July 2024
- Enrolment
  Check information at website etseib.upc.edu
How to apply

(https://etseib.upc.edu/en/Academic%20programmes/academic-procedures/acces/application-msc-programmes)

How to apply:

Apply UPC Admissions: Application

To validate the request, it is necessary to complete the information for every field:

- Personal data
- Academic details
- Required documentation

- Application (*) (choose 3 specialty options for the master required)
- Data protection
- Pre-enrolment fees (General information about UPC” on this page)
Admission and enrollment process

Pre-enrollment in the application:
1. Processing
2. Payment to be confirmed
3. Send

PAYMENT of 300€
(ADVANCED PAYMENT OF ENROLMENT FEES)

Welcome session

Acceptance of the place

Submission of original documents and delivery of copies

Enrollment on line or in person

Please, check that all the required documentation has been submitted

validation of complete applications

Admission
/Publication of the provisional list of applicants admitted

objection/appeal period

Start of the Master’s degree

Admission
/Publication of the final list of applicants admitted

PAYMENT of 300€
(ADVANCED PAYMENT OF ENROLMENT FEES)
... further information

FAQ’s

Check the most frequently asked questions in this document.

International Relations and Admissions Office

Face-to-face opening office hours:

from Monday to Friday 11 am to 1:30 pm
and Tuesday 3.00 pm to 17.30 pm

Information request: https://demana.upc.edu/etseib/

+34 93 401 59 27
Thank you for your attention

admissions.etseib@upc.edu