

# Master in Nuclear Engineering

## 2024-2025

[www.upc.edu/masters-sessions](http://www.upc.edu/masters-sessions)



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH



Register  
to the information  
sessions

# Now, UPC masters degrees!



# Contents of the presentation

1. UPC/ETSEIB introduction
2. Master in Nuclear Engineering
3. How to Apply
4. Q & A





UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

30,347  
students

3,629  
teaching and  
research staff

1,989  
administrative  
and service  
staff

66  
bachelor's  
degrees

92  
master's  
degrees

45  
doctoral  
programmes

18  
schools

240  
lifelong learning  
programmes

13  
patents last  
year

371,9  
million euros  
2024 budget

80,9  
million euros  
R&D income

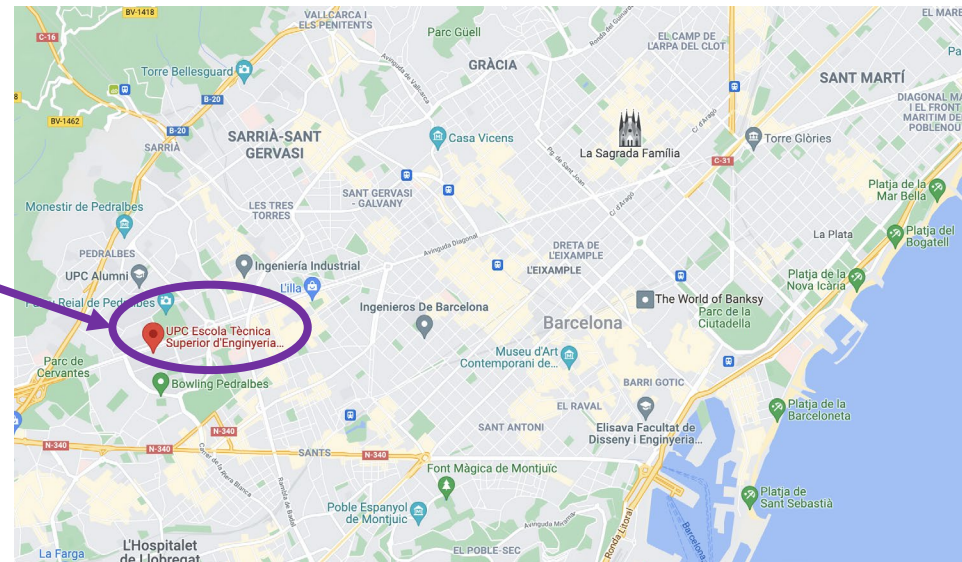
87,535  
alumni



- 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: 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**
9. **Master in Energy Engineering / MSc Programmes in Energy InnoEnergy**



# 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**

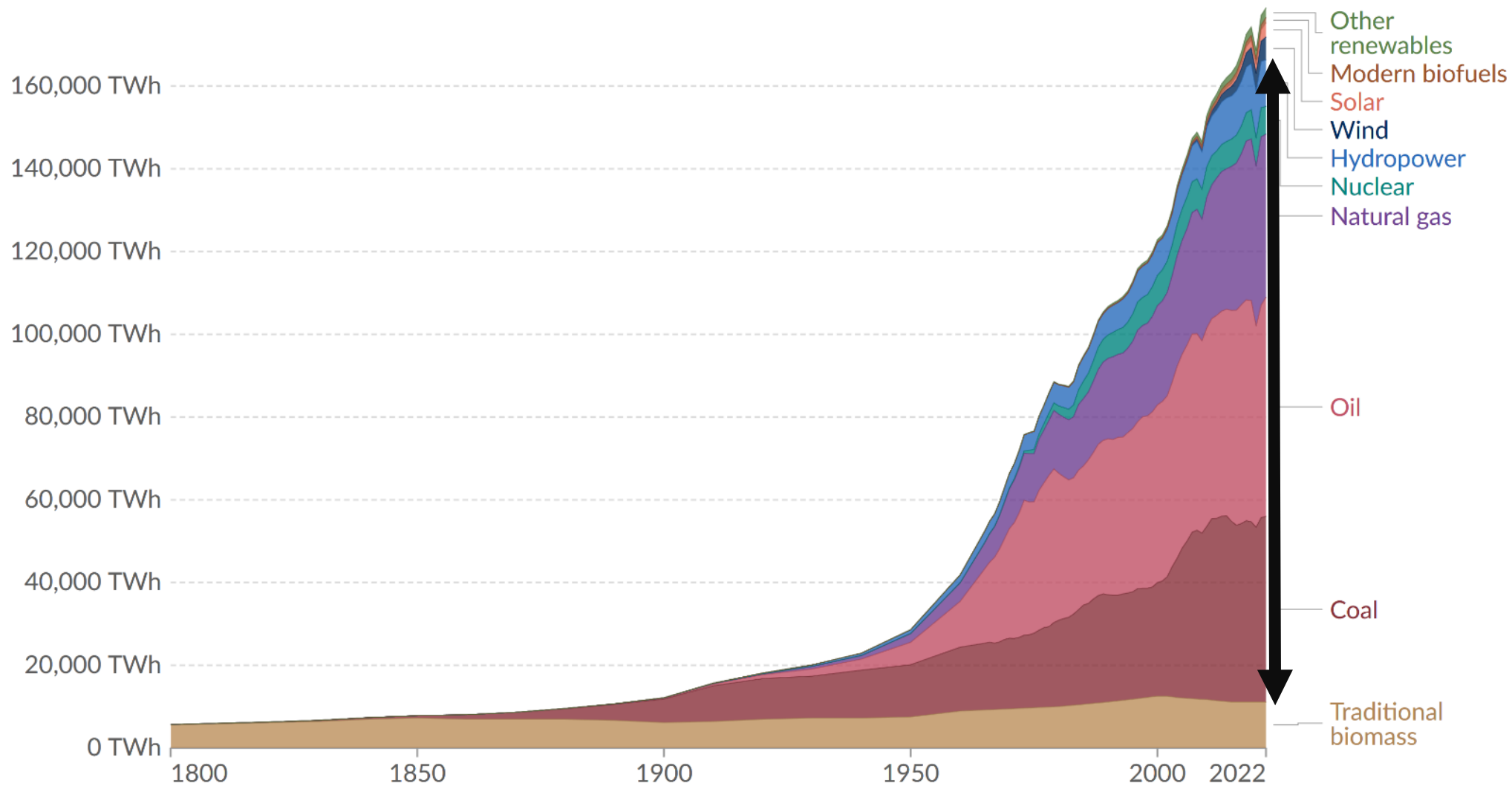




# Master in Nuclear Engineering

# Global primary energy consumption by source

Primary energy<sup>1</sup> is based on the substitution method<sup>2</sup> and measured in terawatt-hours<sup>3</sup>.



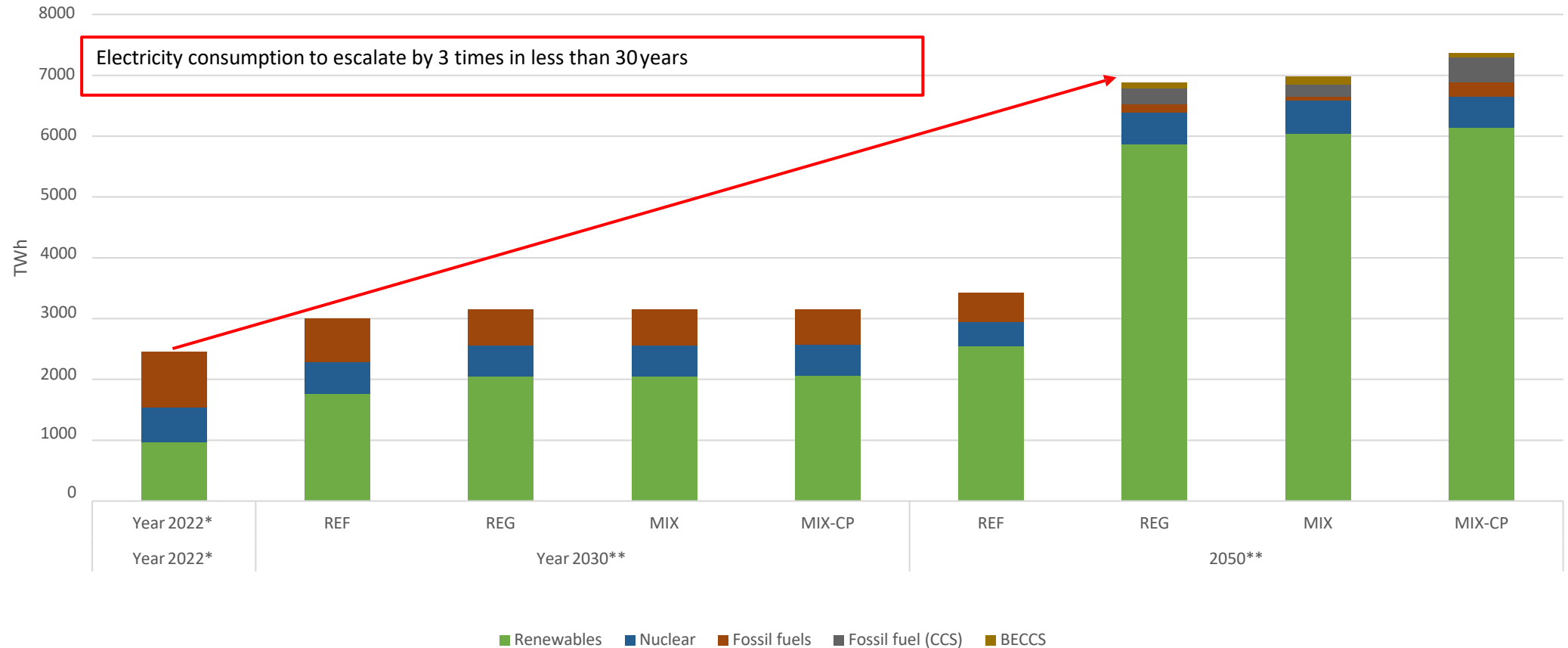
Data source: Energy Institute - Statistical Review of World Energy (2023); Smil (2017)

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

[OurWorldInData.org/energy](https://OurWorldInData.org/energy) | CC BY



# Very strong push on electrification in EU to meet the Net Zero ambition



## Gross electricity generation in the EU

Sources:

\* [energy-charts.info](https://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

## ⚡ Electricity

**1600 TWh/y**

EU Low carbon electricity production to be deployed by 2040

**80GW**

European Nuclear capacity to be replaced by 2050 (end of life)

## 🕒 Hydrogen

**>20 Mt H<sub>2</sub>/y**

REPowerEU Market Estimate for 2030

**1000 TWh/y**

Equivalent additional clean electricity demand

## 🔥 Industrial heat

**~1250 TWh<sub>th</sub>/y\***

Iron – Steel, Non-metallic minerals and chemicals heat demand in EU

**> 45% market**

Heat < 400°C

## 🏠 District heat

**~500 TWh<sub>th</sub>/y\*\***

Current district heat demand in EU

**> 2/3 fossil-fueled**

Assets to be retired and replaced in the coming two decades

\*IAEA report on [Industrial Applications of Nuclear Energy](#) – 2017

\*\* Calculations based on:

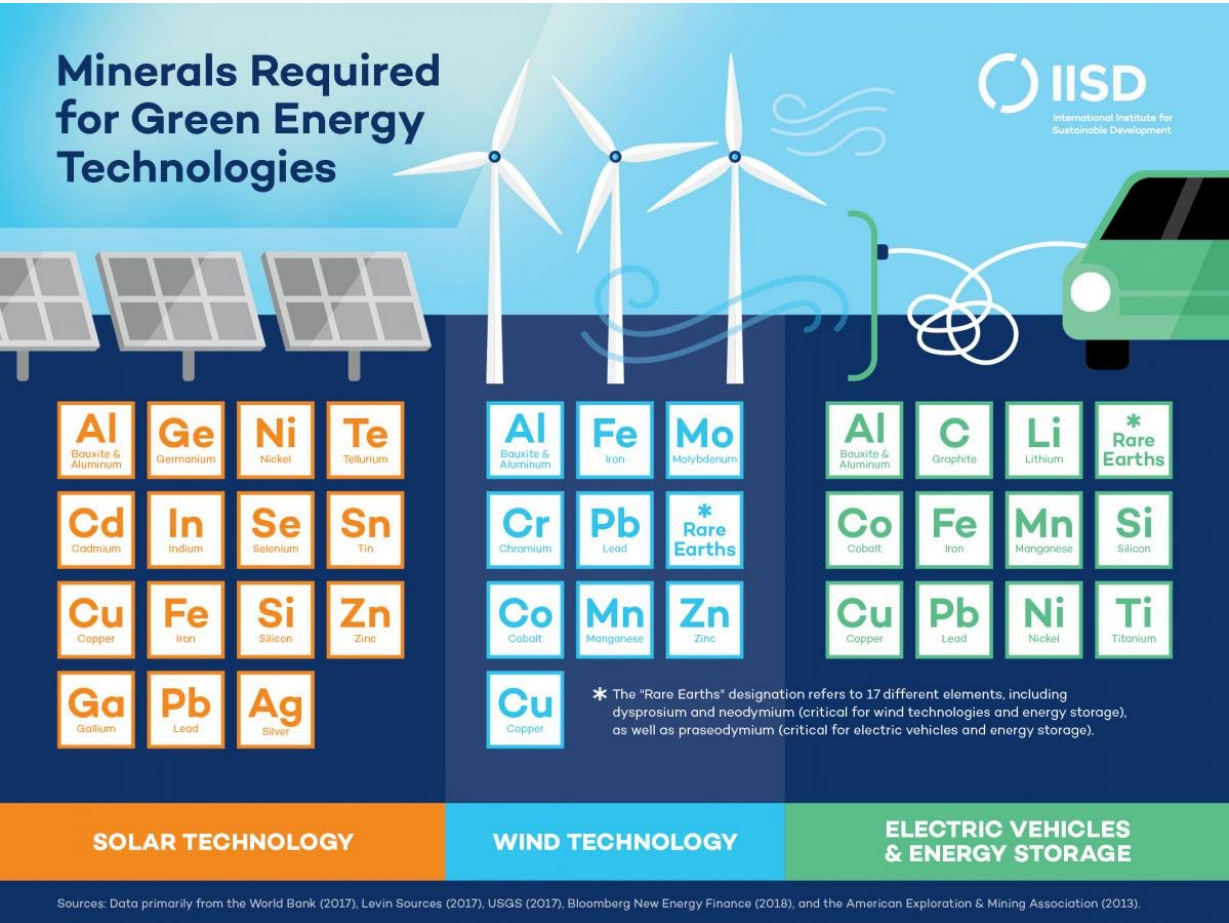
- [Statistics | Eurostat \(europa.eu\)](#)
- [D2.3 \(wedistrict.eu\)](#)
- [Country Profiles | Euroheat & Power](#)







# Minerals Required for Green Energy Technologies



Sources: Data primarily from the World Bank (2017), Levin Sources (2017), USGS (2017), Bloomberg New Energy Finance (2018), and the American Exploration & Mining Association (2013).

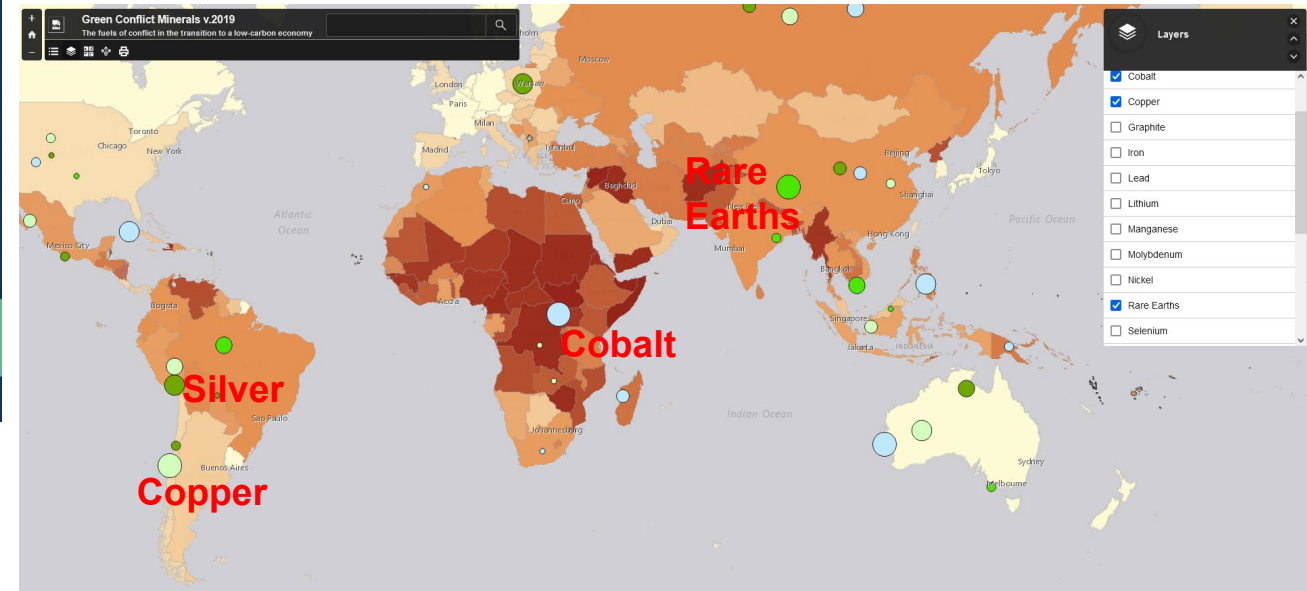
## Green Conflict Mineral Hotspots 2019

# 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

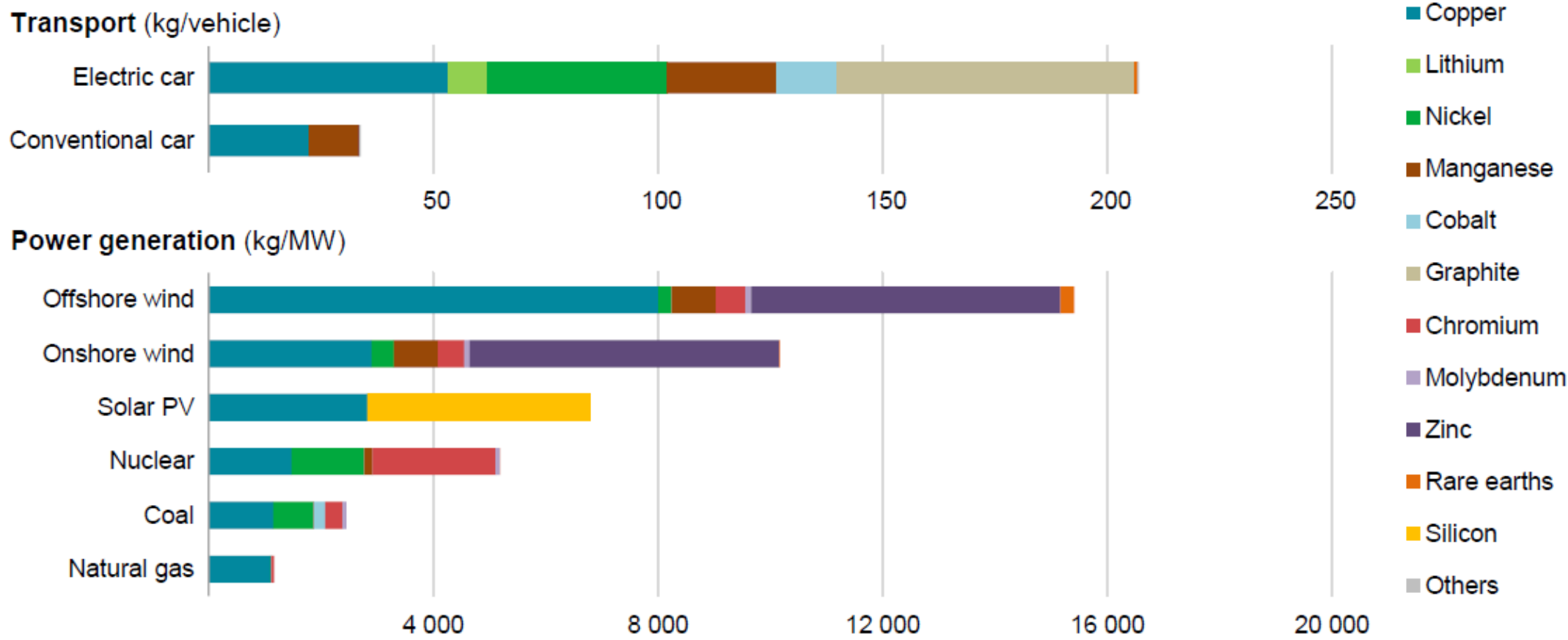
IISD



# 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

IEA 2021 The Role of Critical Minerals in Clean Energy Transitions



IEA. All rights reserved.

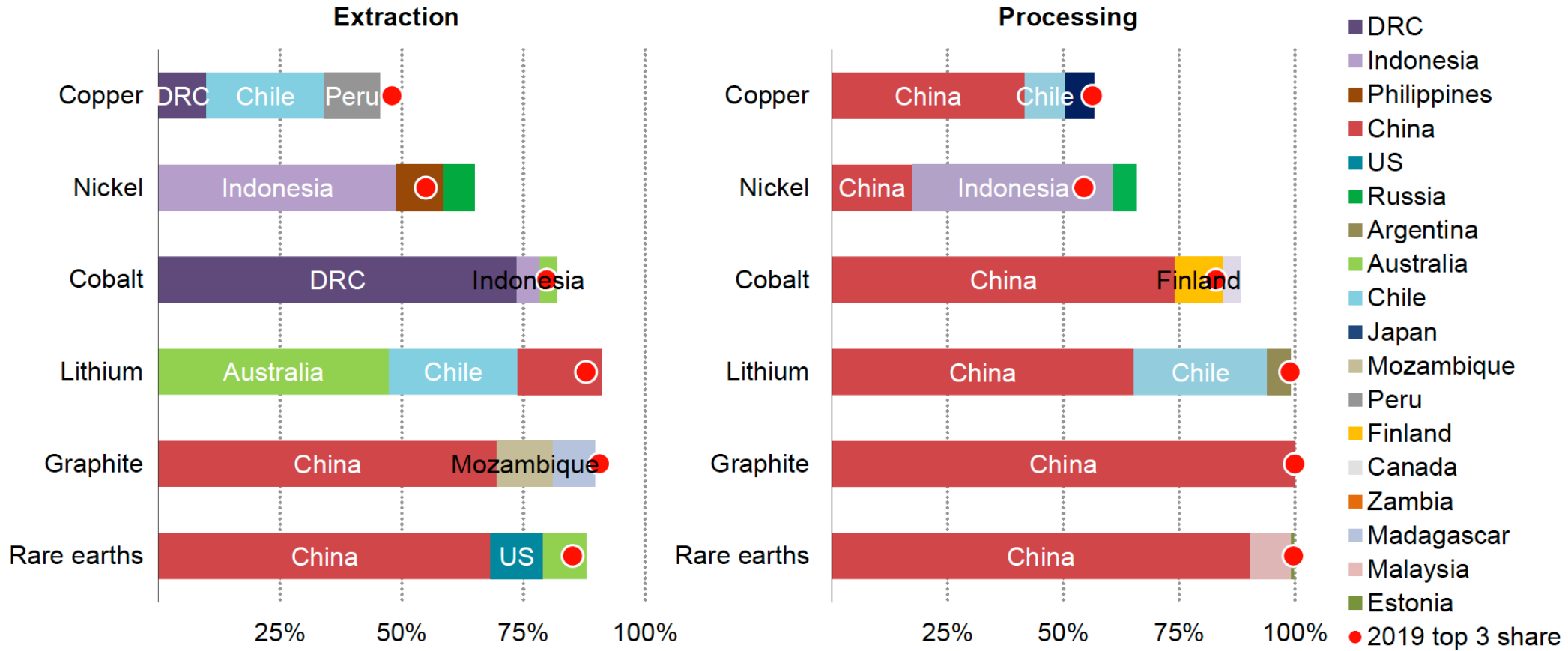
Notes: kg = kilogramme; MW = megawatt. Steel and aluminium not included. See Chapter 1 and Annex for details on the assumptions and methodologies.



## There has been limited progress in terms of diversification over the past three years; concentration of supply has even intensified in some cases

IEA 2023 Critical Minerals Market Review 2023

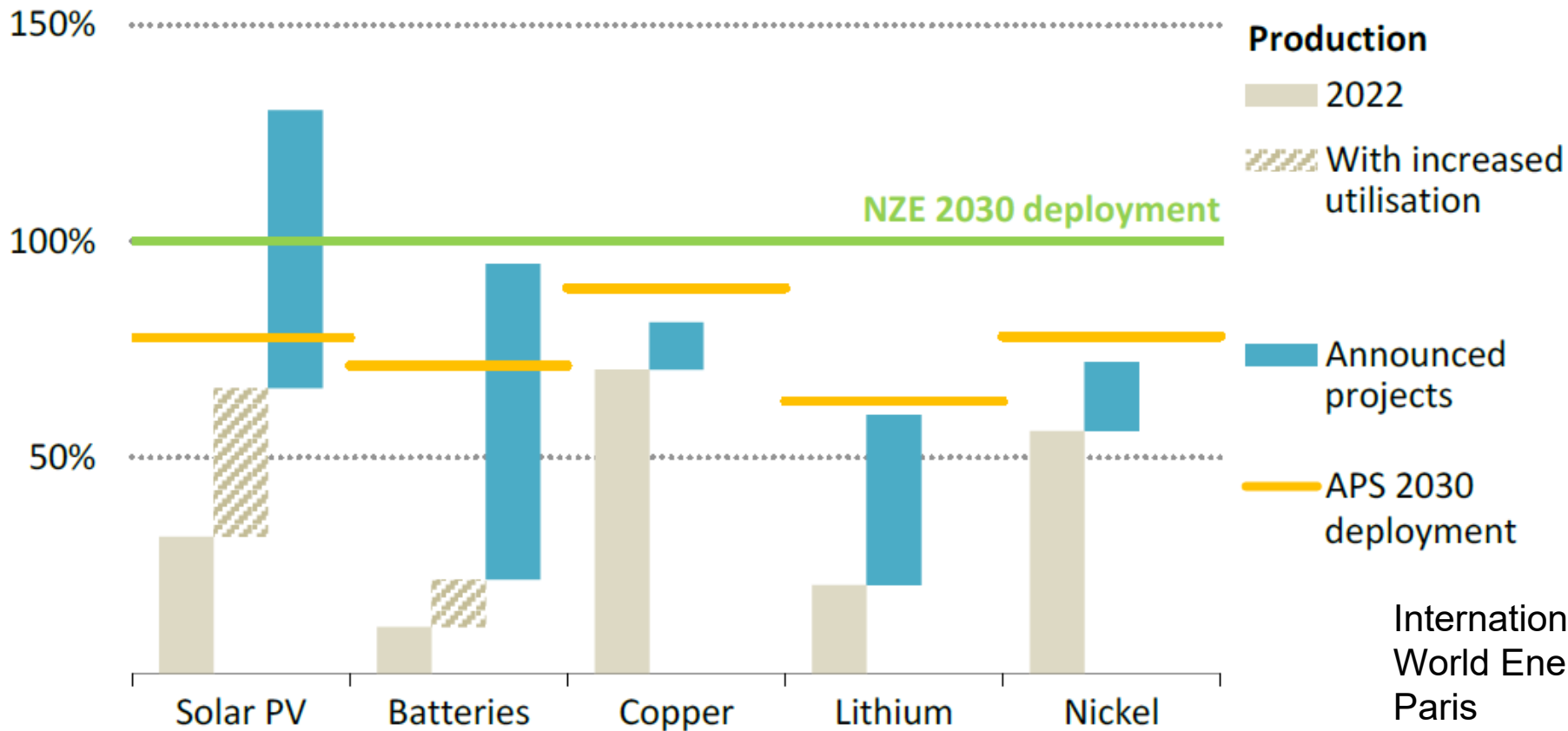
Share of top three producing countries in total production for selected resources and minerals, 2022



IEA. CC BY 4.0.

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

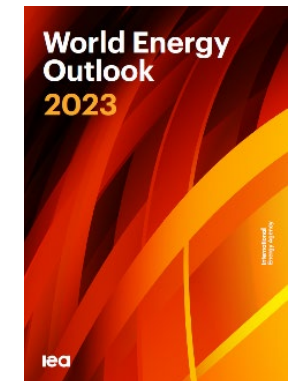


International Energy Agency (2023),  
World Energy Outlook 2023, IEA,  
Paris

IEA. CC BY 4.0.

*Progress on the development of clean energy supply chains has been uneven*

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

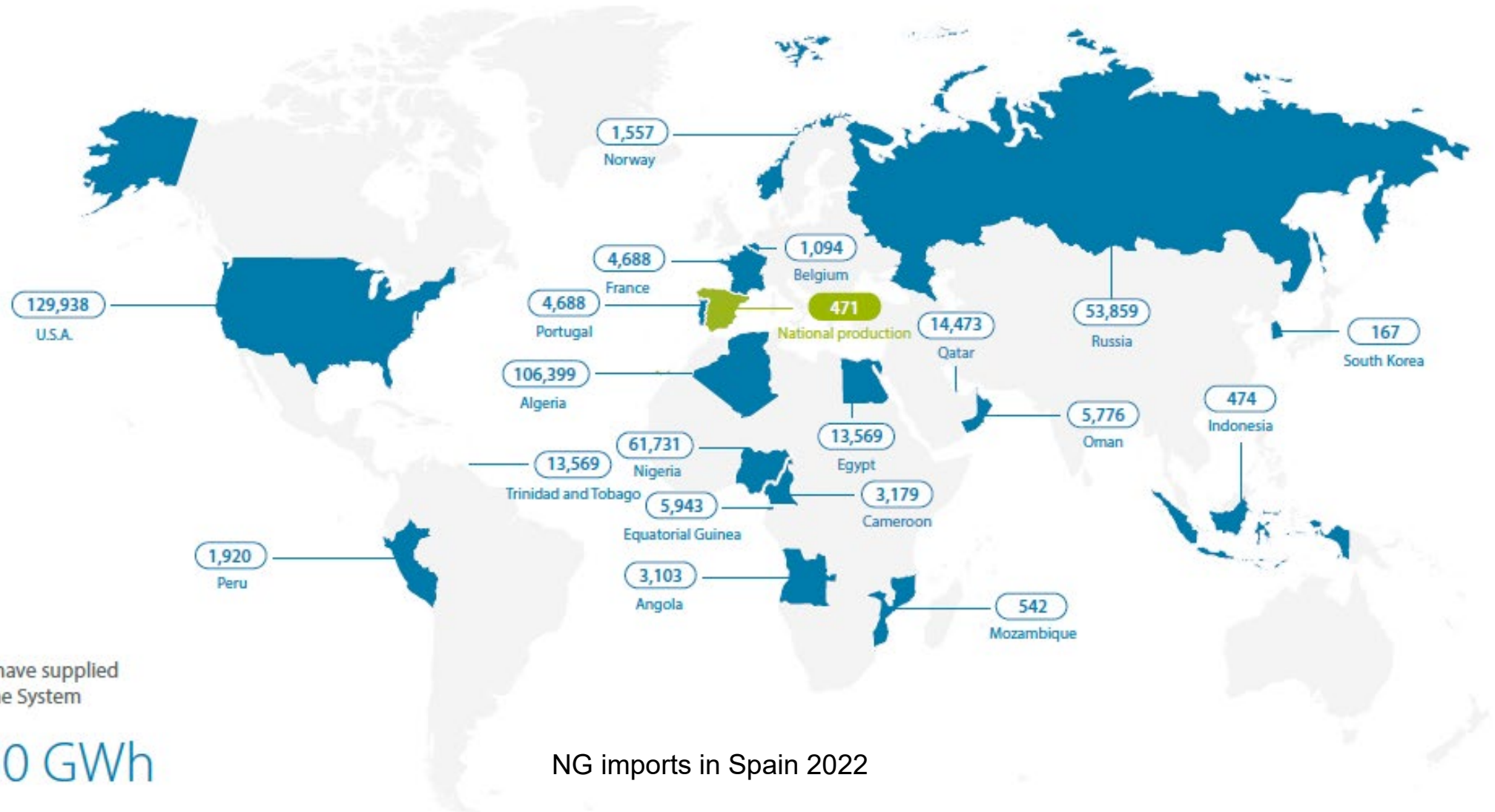


Notes: Announced pipeline includes both committed and preliminary projects. For critical minerals, the NZE Scenario deployment needs refer to the primary supply requirements (total demand less secondary supply).

## Origin of supplies

GWh

# Meanwhile



19

Countries that have supplied natural gas to the System

446,550 GWh

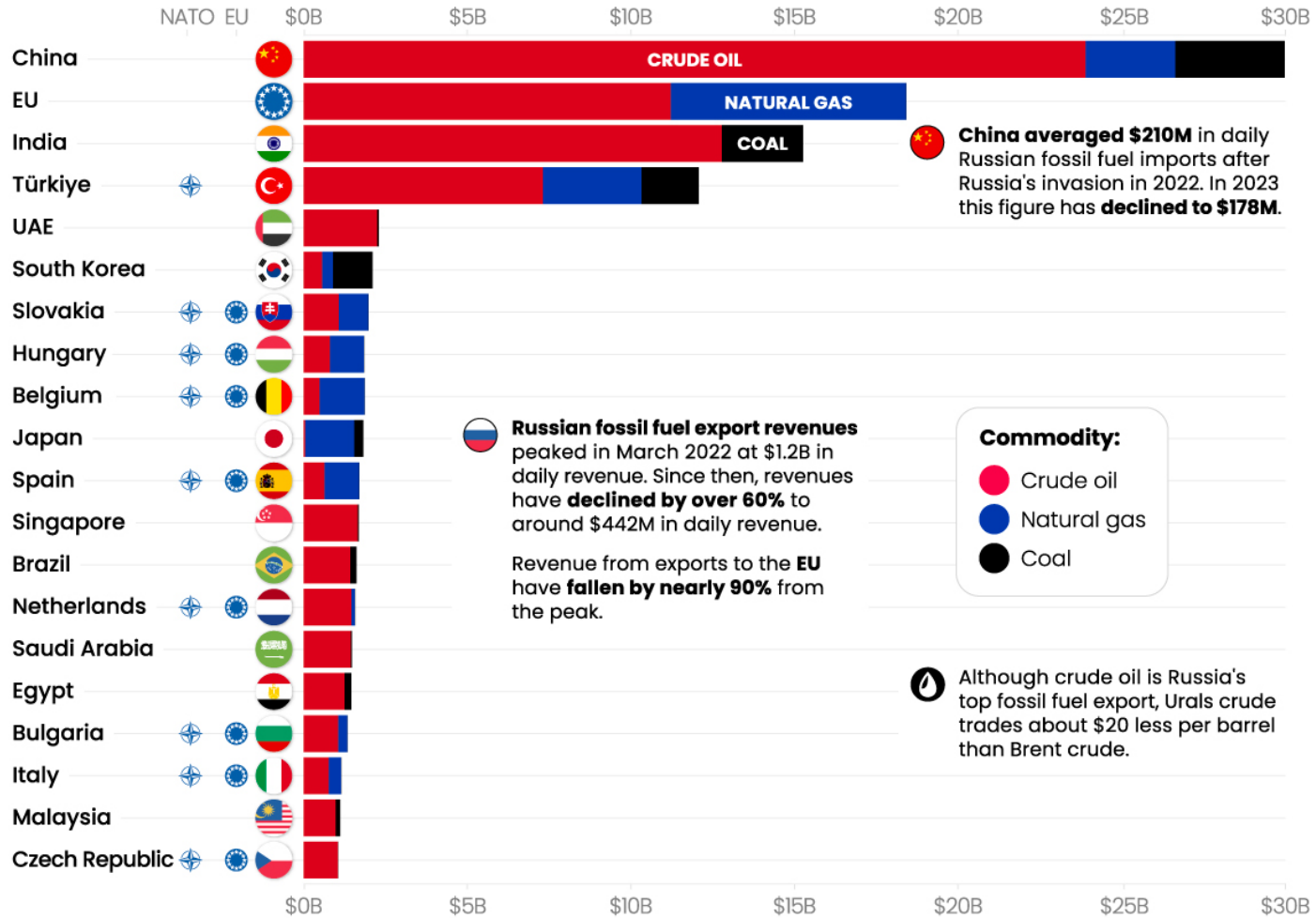
Total supplies of natural gas

NG imports in Spain 2022



# Who's Still Buying Fossil Fuels From Russia in 2023?

FOSSIL FUEL IMPORTS IN 2023: JAN 1<sup>ST</sup> - JUNE 16<sup>TH</sup> 2023



China averaged \$210M in daily Russian fossil fuel imports after Russia's invasion in 2022. In 2023 this figure has declined to \$178M.

Russian fossil fuel export revenues peaked in March 2022 at \$1.2B in daily revenue. Since then, revenues have declined by over 60% to around \$442M in daily revenue. Revenue from exports to the EU have fallen by nearly 90% from the peak.

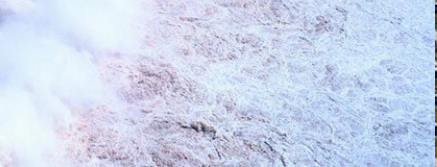
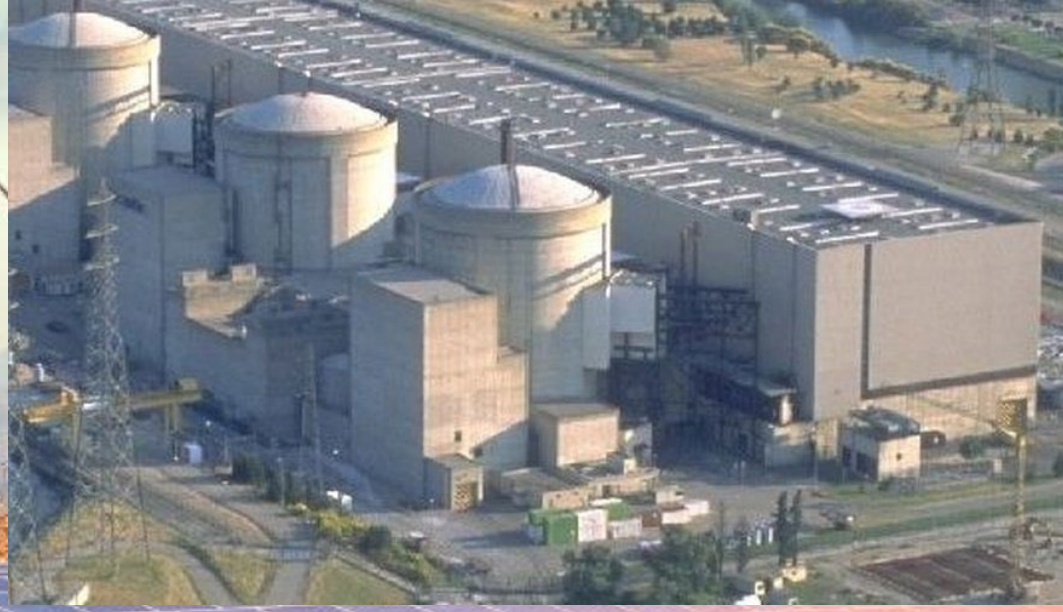
**Commodity:**

- Crude oil
- Natural gas
- Coal

Although crude oil is Russia's top fossil fuel export, Urals crude trades about \$20 less per barrel than Brent crude.

Source: Centre for Research on Energy and Clean Air







# Nuclear Energy Makes History as Final COP28 Agreement Calls for Faster Deployment

# Eleven EU countries launch alliance

By Frédéric Simon | Euractiv.com ⌚ Est. 4min

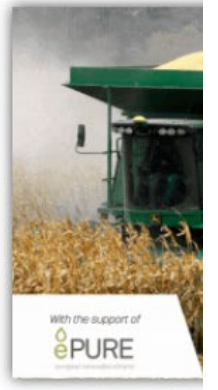


Home / News / Energy & Environment / Nuclear / Parliament backs EU push for small nuclear reactors

# Parliament backs EU push for small nuclear reactors

By Paul Messad | Euractiv France | translated by Daniel Eck ⌚ Est. 5min 14 de des. de 2023

Content-Type: News



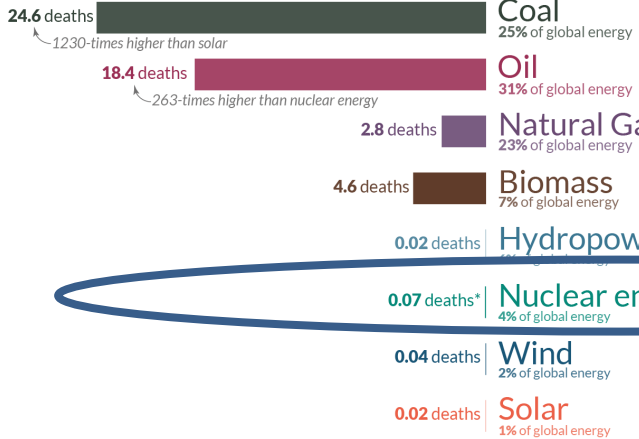
# Concluding remarks

Our World in Data

## What are the safest and cleanest sources of energy?

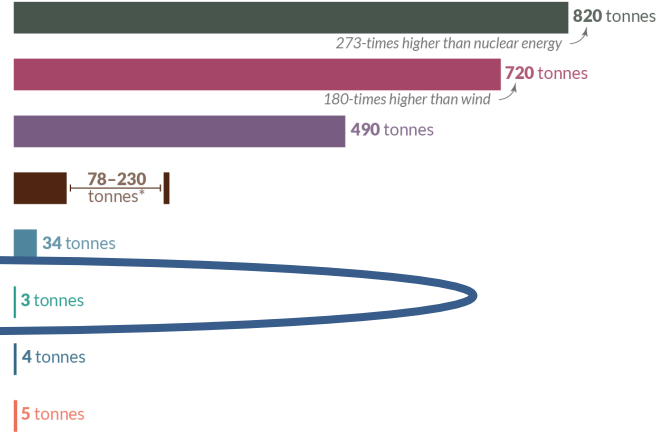
### Death rate from accidents and air pollution

Measured as deaths per terawatt-hour of energy production.  
1 terawatt-hour is the annual energy consumption of 27,000 people in the EU.

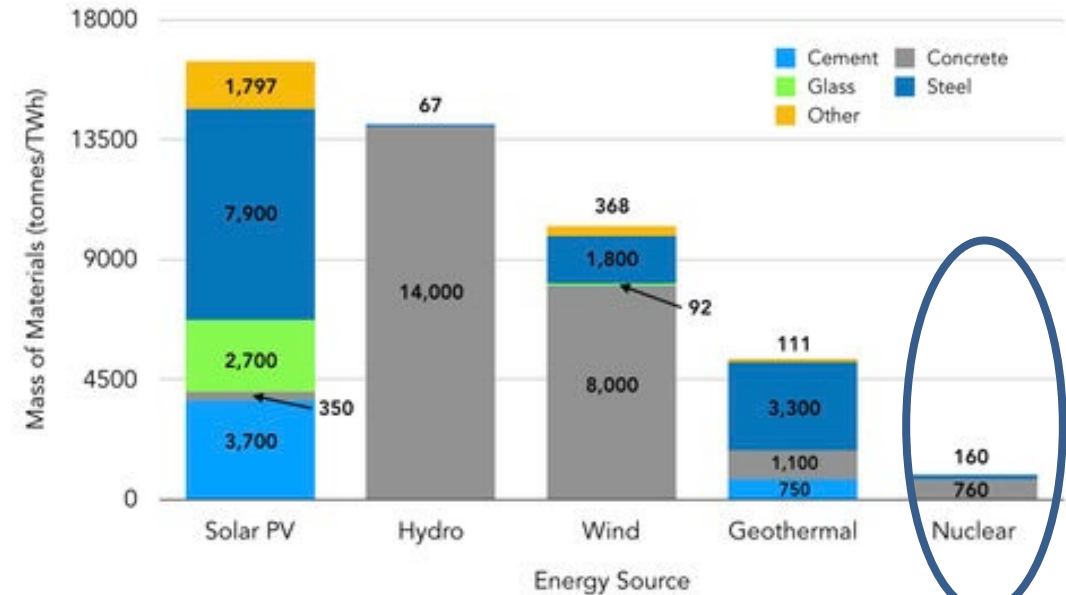


### Greenhouse gas emissions

Measured in emissions of CO<sub>2</sub>-equivalents per gigawatt-hour of electricity over the lifecycle of the power plant.  
1 gigawatt-hour is the annual electricity consumption of 160 people in the EU.



## 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.

Data sources: Death rates from Markandya & Wilkinson (2007) in *The Lancet*, and Sovacool et al. (2016) in *Journal of Cleaner Production*; Greenhouse gas emission factors from IPCC AR5 (2014) and Pehl et al. (2017) in *Nature*; Energy shares from BP (2019) and Smil (2017).

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 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

TYPE OF SUBJECT	CREDITS
Required	46,5
Elective	13,5
Internship	15
Master's Final Project	15
TOTAL	90

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

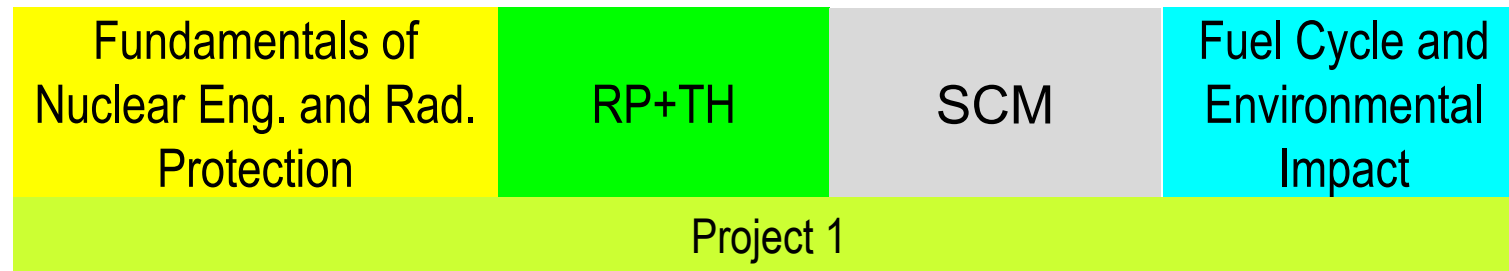
Internship

Final Project



# MNE overview

## SEMESTER 1



## SEMESTER 2



Transversal PBL courses

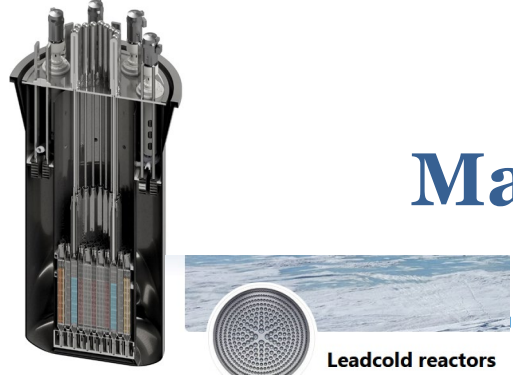
# Methodology

- 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

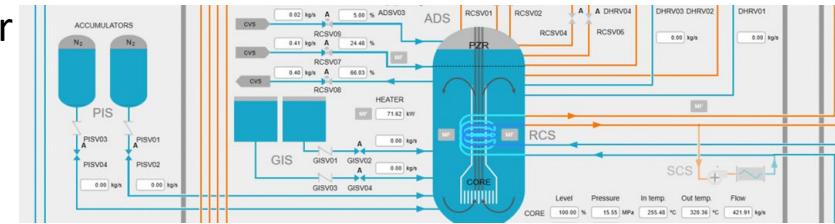
COURSES	CREDITS
<b>First semester</b>	
Fundamentals of Nuclear Engineering and Radiological Protection	8
Reactor Physics and Thermal-Hydraulics	7.5
Systems, components and materials	6
Fuel Cycle and Environmental Impact	5.5
Project 1	3
<b>Second semester</b>	
Regulations and Safety	5
Management of Nuclear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

# 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.



## COURSE OF LEADERSHIP FOR SAFE OPERATION OF NUCLEAR POWER PLANTS

To be included in the Topic Area 240NU022 - Management of Nuclear Power Plants, of the Master in Nuclear Engineering, Universitat Politècnica de Catalunya



5a EDICIÓN CONCURSO

**Atracción de talento 2020**

La SNE tiene el placer de presentar la quinta edición de este concurso, lanzadera de talento para el sector.

Nuevos reactores nucleares en España

**GANADOR**

UNIVERSIDAD POLITÉCNICA DE CATALUÑA





## Involvement of Industry

- Contribution to the design of the programme
- Study visits
- Lectures by external experts
- Internships

**Ciemat**

 **Westinghouse**

 **enusa**

**CSN**  **CONSEJO DE  
SEGURIDAD NUCLEAR**

merience

**IDOM**



**orano**

 **nucleonor**

 **ensa**  
 **endesa**  
 **tecnatom**

 **enresa**

 **anav**  
Asociación Nuclear Ascó-Vandellós II, A.I.E.

**AMPHOS**<sup>21</sup>  
an **RSK** company



# Our recent “champions”



# Proud of our alumni

UPC at ENYGF





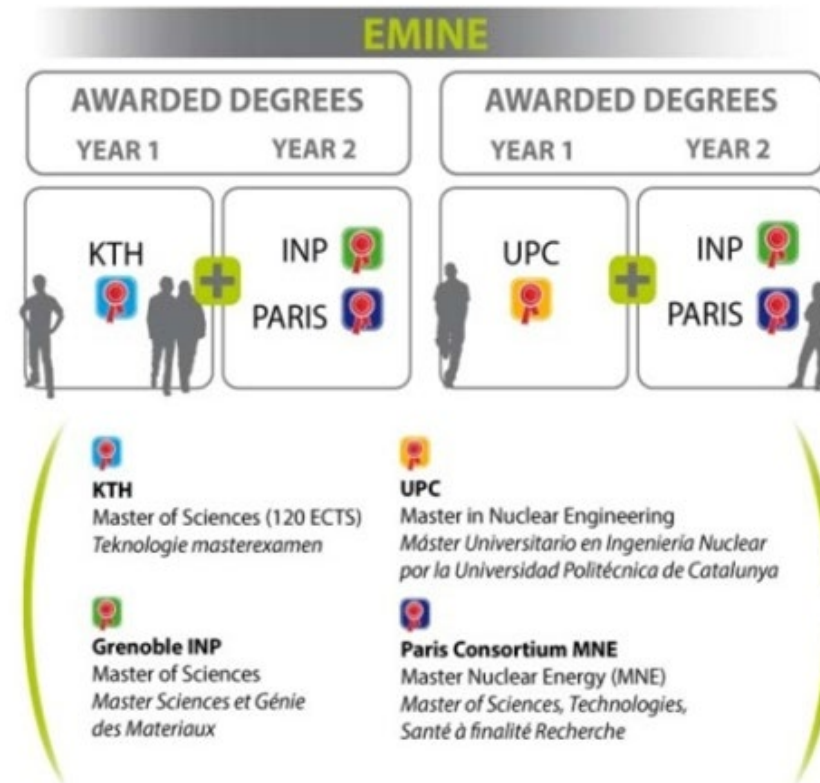
# European Master in Nuclear Energy (EMINE)



European Master in Nuclear Energy

## 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](http://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:

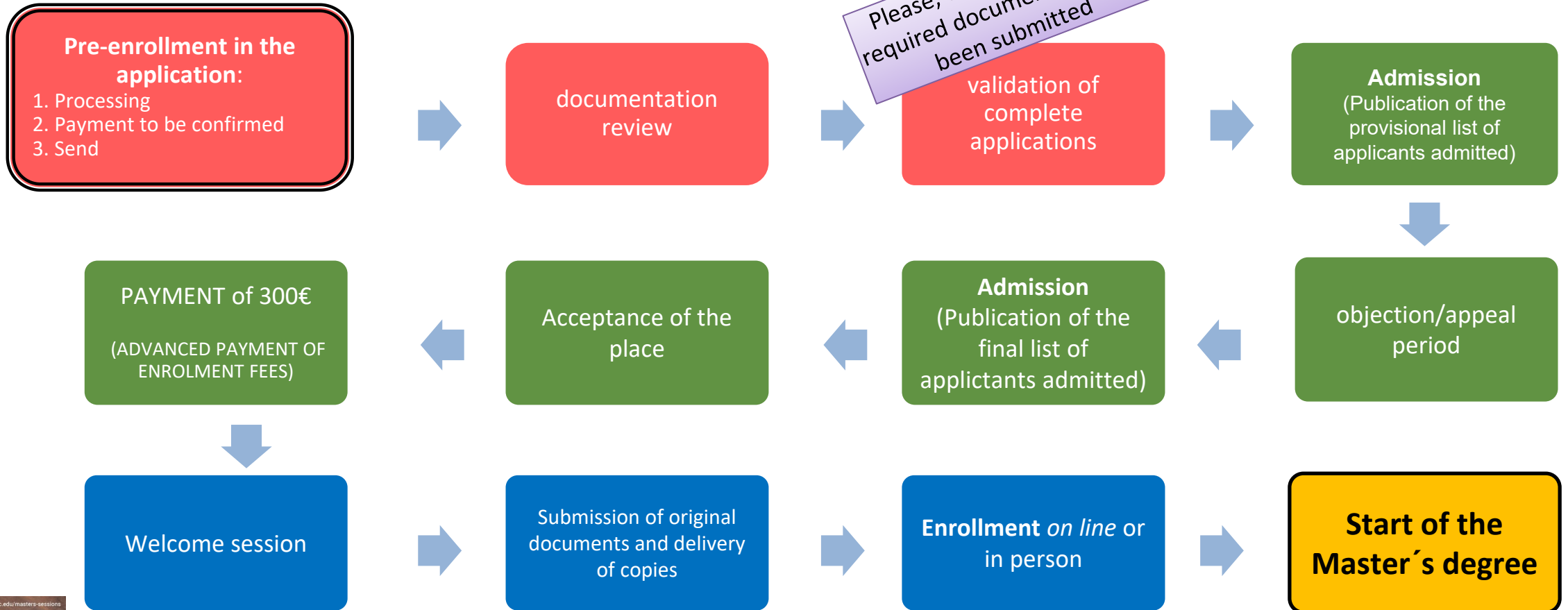
[Application](#)

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

- Personal data
- Academic details
- Required documentation [Required documents](#)
- 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



# ... 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





# ETSEIB

Escola Tècnica Superior  
d'Enginyeria Industrial de Barcelona

**Escola de referència:  
Formació i recerca  
de màxim nivell  
científic i tecnològic.**



## Thank you for your attention

[admissions.etsuib@upc.edu](mailto:admissions.etsuib@upc.edu)

