ENEN activities and collaboration between universities and research institutions in higher education

The EUROPEAN NUCLEAR EDUCATION NETWORK - ENEN

Gabriel-Lazaro PAVEL

Executive Director

European Nuclear Education Network (ENEN)

An international non-profit organization (aisbl) established under the French law in 2003 and relocated in 2018 in Belgium

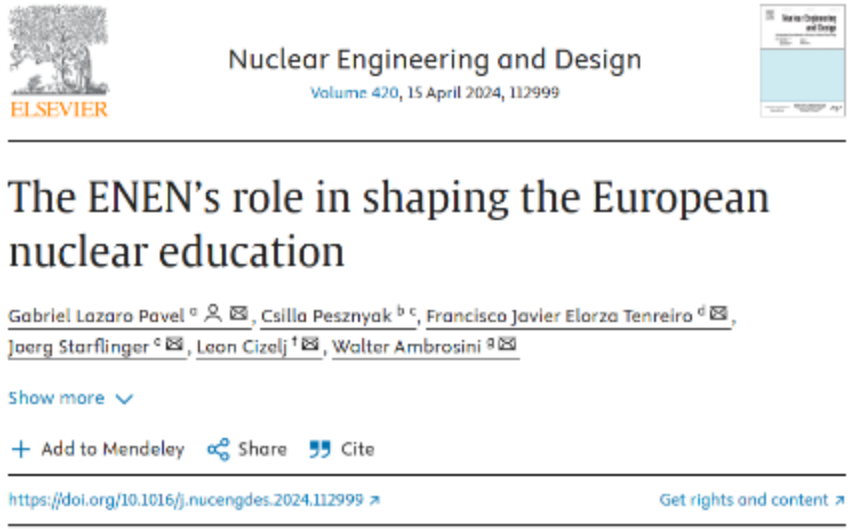
MISSION

The main objective is the **preservation** and further **development** of expertise in the nuclear fields by higher Education & Training:

- Promote and further develop the **collaboration** in nuclear E&T
- Ensure **quality** of nuclear E&T
- Increase the **attractiveness** of nuclear fields for students, researchers and professionals
- Promote **life-long learning** and career development at post-graduate or equivalent level

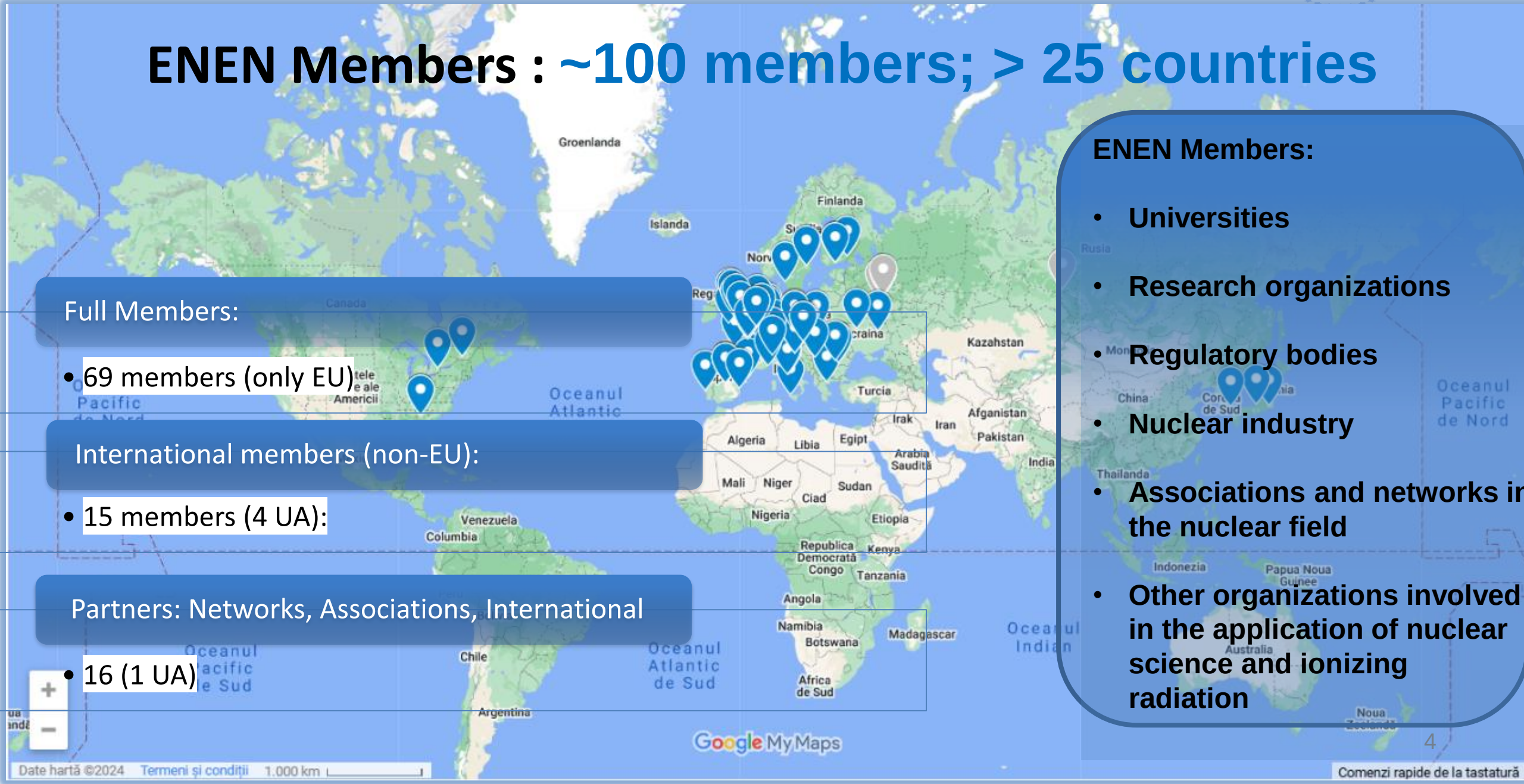
How we achieve it:

development and **strengthening** of **cooperation** between *universities, scientific organizations, regulators, industrial companies, nuclear related associations and networks*



MEMBERS of ENEN Association:

ENEN Members : ~100 members; > 25 countries



Full Members:

- 69 members (only EU)

International members (non-EU):

- 15 members (4 UA):

Partners: Networks, Associations, International

- 16 (1 UA)

ENEN Members:

- **Universities**
- **Research organizations**
- **Regulatory bodies**
- **Nuclear industry**
- **Associations and networks in the nuclear field**
- **Other organizations involved in the application of nuclear science and ionizing radiation**

Role of ENEN in the European Nuclear E&T

MEMBERS of ENEN Association: ~100 members from more than 25 countries

INITIATIVES:

- **26 completed** (FP6, FP7, H2020).
- **11 in progress** (H2020, Horizon Europe, INTPA).
- **4 new projects** (HE)
- Funded by the EC

FIELDS OF EXPERTISE INCLUDE:

- nuclear energy, engineering, technology, safety, safeguards, management
- radiation protection,
- medical physics,
- nuclear chemistry,
- radioactive waste management…

COMPETITIONS:

- **EU nuclear competitions for secondary school pupils** 120 pupils and 60 teachers.
- **PhD EVENT & PRIZE** 18 editions, about **200 young graduates involved.**

EMSNE certification

- **EU Master of Science in Nuclear Engineering** - 18 editions, more than **110 laureates**.

Basic Principles of ENEN activities

1. Quality nuclear education and training
2. Strengthening educational programs and adopting an interdisciplinary approach
3. Support for nuclear educational projects
4. Alignment of E&T programmes with trends in nuclear area
5. Knowledge management
6. Quality communication and networking

International and regional context

COP 28 (2023): “Nuclear Energy Makes History as Final COP28 Agreement Calls for Faster Deployment” (www.iaea.org): [...] “more than 22 countries to advance the aspirational goal of tripling nuclear power capacity by 2050”[...];

France, 2022. Mr. President Macron issued an ambitious program, to reach net-zero by 2050. The MATCH program showed a huge need for human resource in the coming year. Several strong actions were started and are in place.

Mrs. President Ursula von der Leyen at the Nuclear Energy Summit: [...]” nuclear technologies can play an important role in clean energy transitions[...] Innovation in nuclear technologies […] lifetime extensions for existing nuclear plants[...] industry’s ability to deliver on time and on budget[...] Most pathways to net zero keep a place open for nuclear power. In the IEA’s 2050 scenario, e.g. nuclear capacity more than doubles by 2050[...]”

E&T Opportunities by ENEN

NUCLEAR EDUCATION

NUCLEAR RESEARCH

NUCLEAR INDUSTRY/NPPS

ENEN LinkedIn here

E&T Opportunities by ENEN

Nuclear Safety:

- Nuclear Schools and trainings on SMR related topics
- Nuclear Fuel Technologies
- Nuclear Medicine
- Radiochemistry
- Radiation Protection and Safety
- Emergency Response

ENEN HUB
on E&T and Vocational E&T

HUB here

Nuclear Safeguards:

- Specializing Master on Nuclear Safeguards
- Short term theoretical and practical trainings on safeguards

ENEN special expertise: Crisis communication, communication and stakeholder engagement

Nuclear Security:

COMING SOON

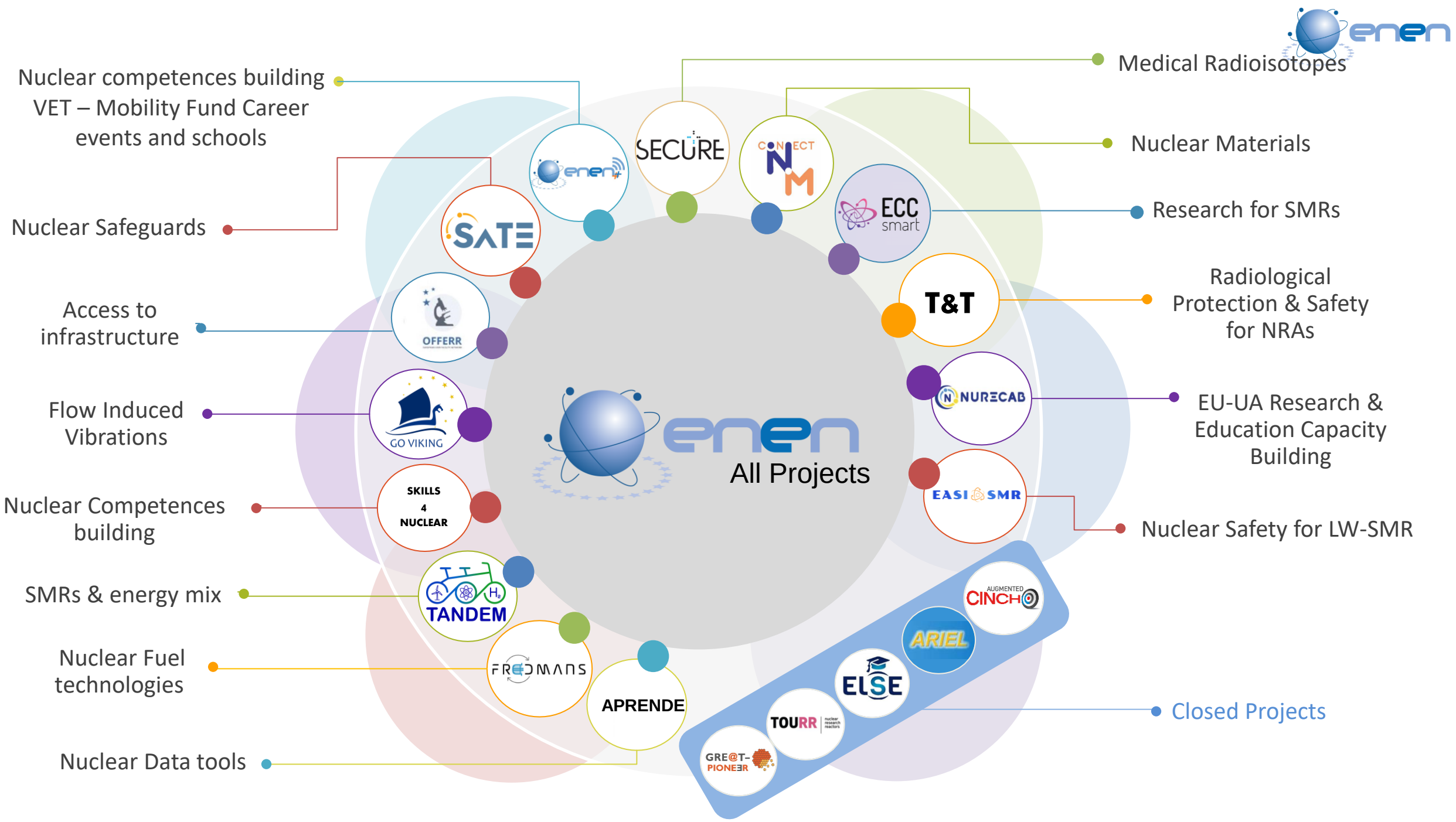
08.10.2024

ENEN Association Working Areas

ENEN Association functions in two ways:

- **Activities under implementation of the projects in ENEN portfolio**
- **Activities under the Working Areas led by voted representatives of ENEN Association**
  - Teaching and Academic Affairs Area
  - Advanced Courses and Research Area
  - Training and Industrial Project Area
  - Quality Assurance Area
  - Knowledge Management Area.

ENEN Projects Protfolio


Nuclear competences building
VET – Mobility Fund Career events and schools
Nuclear Safeguards
Access to infrastructure
Flow Induced Vibrations
Nuclear Competences building
SMRs & energy mix
Nuclear Fuel technologies
Nuclear Data tools
Medical Radioisotopes
Nuclear Materials
Research for SMRs
Radiological Protection & Safety for NRAs
EU-UA Research & Education Capacity Building
Nuclear Safety for LW-SMR
Closed Projects
enen
All Projects
SECURE
CONNECT NM
ECC smart
T&T
NURECAB
EASI SMR
SATE
OFFERR
GO VIKING
SKILLS 4 NUCLEAR
TANDEM
FREDMANS
APRENDE
AUGMENTED CINCH
ARIEL
ELSE
TOURR
GRE@T-PIONEER

ENEN flagship project: ENEN2plus

- 51 Partners from 3 continents
- Based on the predecessing ENENplus project
- **Strengthens the nuclear education at a whole**
- Mobility fund of **2.5 Mil EUR**
- E&T HUB* https://nuclear-education.eu/
- Vocational E&T Platform

Mobility Manual

–> support for attendees to participate to developed actions/experiments;

-> increased number of researchers;

-> increased number of experiments/E&T actions;

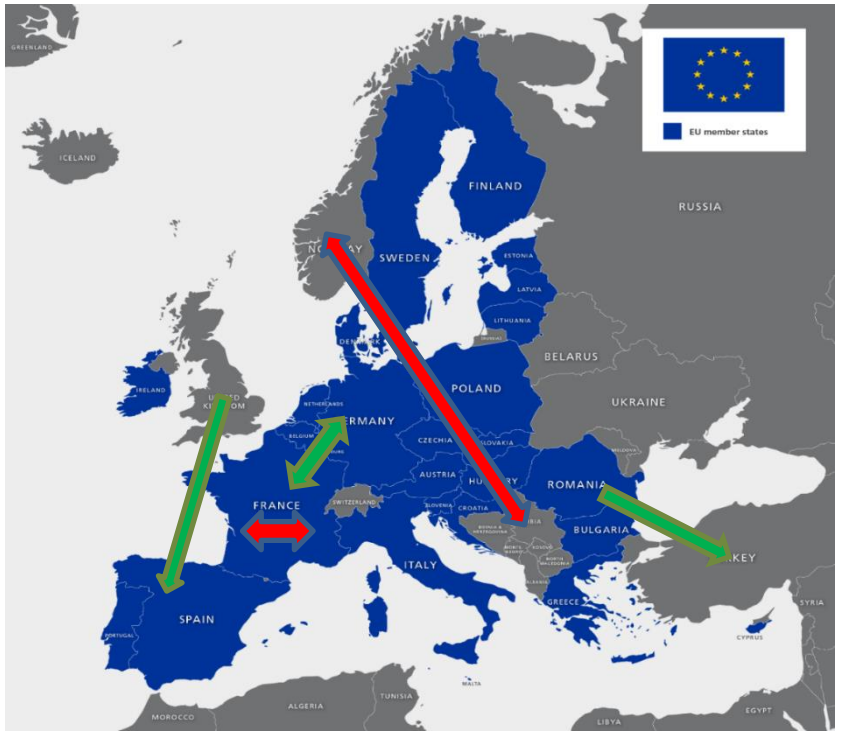
-> increased knowledge, skills and competences;

-> independent on geographical distribution of attendees;

-> EU participation is encouraged;

-> must respect Mobility Manual requirements.

>1000 ppl moved



- ENEN2plus-Mobility rules

Eligible

Not eligible

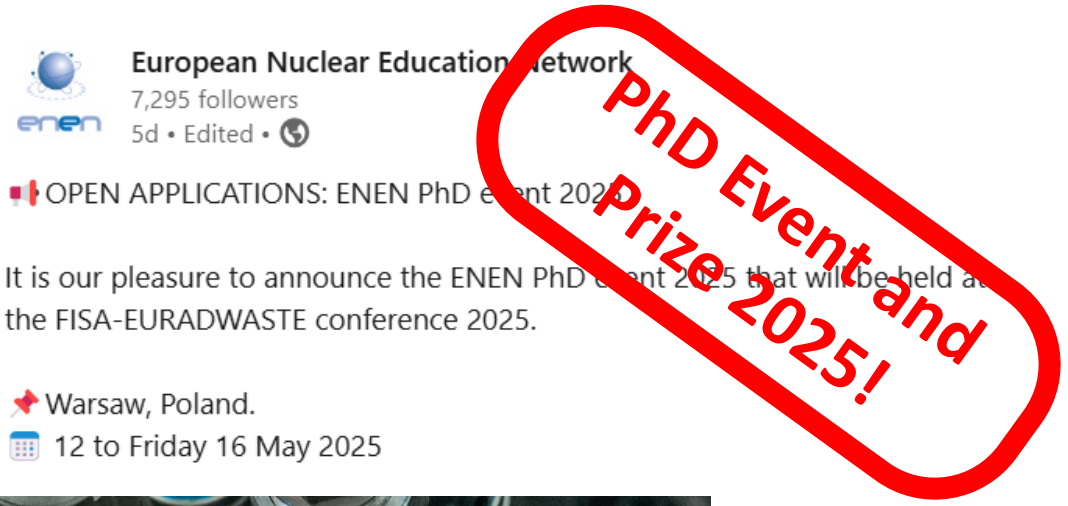
*Accessible and usable but being finalised

ENEN flagship project: ENEN2plus

ACTIONS AVAILABLE

- Training courses
- Carrier events
- YGN Workshops
- Summer Schools
- BSc, MSc, PhD Competitions
- Mobility support of other Euratom projects

OPPORTUNITY FOR ENEN MEMBERS!



Always published in ENEN socials

ENEN flagship project: ENEN2plus

About 20 upcoming events in 2025-2026

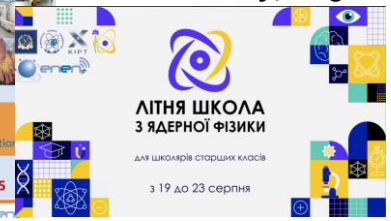
Institution	Event/Topic Description	Format	Year	Status/Participants
REL	Radon and Its Short-Lived Daughter Nuclides	In-person	2025	Planned
UNIVLEEDS	Innovations in Decommissioning	Online	2025	Planned
KIT	Innovative Nuclear Systems	In-person	2025	Planned
SCK CEN	RadProt Space	In-person	TBD	Status Not Confirmed

Special Contests for young generation

Event Description	Edition	Location	Target Audience	Date	Status
European Nuclear Competition & Summer School	3rd	BME, Hungary	Secondary Schools	July 2023	Done
European Nuclear Competition & Summer School	4th	STU, Slovakia	BSc and MSc Students	July 2024	Done
BSc and MSc Summer School	5th	BME, Hungary	BSc and MSc Students	2025	Planned
Summer School for Secondary Schools	6th	Italy	Secondary Schools	July 2025	Planned

Nuclear Schools

Name of Event	Location	Topic	Date
International Summer School of TANDEM and SMR	Politecnico di Milano, Lecco Campus, Como Lake, Italy	Nuclear & Renewable Energy Integration, SMR Technology	24-28 June 2024
Workshop on SMR Technologies	University POLITEHNICA of Bucharest, Romania	Development of SMR Technologies and Nuclear Energy	2-6 September 2024
Summer School on Nuclear Physics	Karazin Kharkiv University, Ukraine	Nuclear Physics	19-23 August 2024



Summer School on Nuclear Physics in Karazin Kharkiv University; Aug 2024

Ensuring Assessment of Safety Innovations for SMR (EASI-SMR)

NEW!

EASI-SMR will address the safety issues associated with LW-SMR innovations

- Co-generation and hybridation
- Additive manufacturing to improve compactness of Nuclear Steam Supply System
- Multi-units operation
- Soluble Boron-free cores
- Passive systems

36 participants (3 UA)

EASI SMR

NUWARD SMR (France;170 MW)

LDR-50 (Finland;50 MW)

WP8 Leadership

- WP8 management
- D&C and E&T activities
- Stakeholders Group

Duration: 2024-2028

topics based on findings of WP1-7

-scaling issues
-passive systems
-core physics
-human factors

Public awareness of SMR safety

Organisation of E&T on SMRs

Schools:
2 summer/winter
(3 days)

Workshops:
4 WSs annually
(1-2 days)

Public webinar for stakeholders

links with ENEN2plus, OFFERR and other national/international projects

enen+

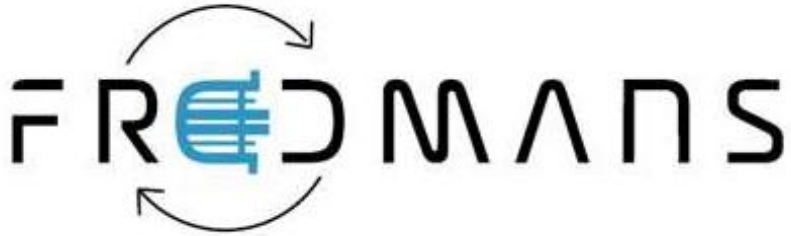
Mobility Fund!

https://cordis.europa.eu/

OFFERR

- 15 Partners from 10 Countries
- Access to research infrastructures for scientists
- Support for research activities
- Design of research programs
- Mobility scheme in conjunction with ENENplusplus

FREDMANS

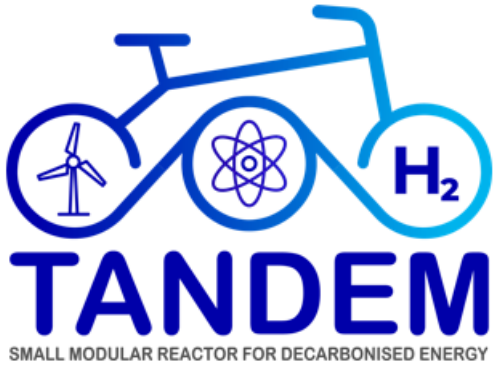


- 17 Partners from 11 countries
- Research and Innovation
- **Fuel recycle** and experimentally demonstrated **manufacturing of advanced nuclear solutions** for safety
- FREDMANS aims to increase safety and efficiency in both nuclear power production as well as the recycling of spent fuel.
- Mobility fund available

Go Viking

- Research and Innovation
- 18 Partners from 9 countries
- The GO-VIKING project aims at improving the current state-of-the-art of **flow induced vibrations** knowledge and analysis concerning the following global targets: improve overall NPP safety, enhance plant reliability in long-term operation and power uprate programs, reduce staff exposure, design components that are less susceptible to FIV, and increase the regulatory acceptance.
- The GO-VIKING consortium gathers expertise from research, industry and technical safety organisations

Tandem



- Research and Innovation
- 17 Partners from 8 countries
- Assess the safety compliance of SMRs to be integrated in the future European energy mix
- Provide guidance in a deployment perspective for future **integration of SMRs and AMRs into well-balanced hybrid energy systems**
- Foster enabling environment for development of hybrid energy systems based on SMRs and AMRs

SECURE

- Research and Innovation

Overview

The SECURE project aims to make a major contribution to the **sustainability of medical isotope production** and its safe application in Europe;

- To remove critical barriers along the production of its selected alpha and beta emitting isotopes that restrict a sustainable production;
- Develop a framework of guidance and recommendations that enables exploring the full clinical potential of alpha and beta particle therapy and its safe application

- 17 Partners from 10 countries
- DURATION: October 2022 – September 2025

ENEN Contribution: Communication, dissemination, exploitation and stakeholder involvement (Lead Beneficiary WP5)

Safeguards Training and Education

Objective:

Strengthen the capabilities of the beneficiary Nuclear Regulation Authorities and their support organizations in charge of **safeguards**. Provide training and education for the staff or potential future staff of these organizations involved in conducting inspections, facilitates fulfilling the countries' **international safeguards** obligations. The project targets extra-EU participants.

ENEN Contribution - Development and implementation of:

- A 2-week Blended course on Nuclear Safeguards
- A one-year Master Program

Facilitating the exchange of experience through cooperation between EU and partner countries' nuclear safeguards organizations.

The SaTE project is a EC DG INTPA (former DG DEVCO) funded project under contract no. INSC/2018/401-261 and implemented by ENEN

GRADUATE EDUCATION ALLIANCE FOR TEACHING THE PHYSICS AND SAFETY OF NUCLEAR REACTORS

The GRE@T-PIONEeR project aims at developing a specialized education in reactor physics and nuclear reactor safety for PhD and Post-Doc students, for nuclear engineers, and taken as advanced courses for MSc students.

The education will encompass both **theory and hands-on training exercises**, the latter heavily relying on the use of research/training reactors and of computer-based modelling environments.

Sets of educational materials will be created.

The covered topics will allow the students to fully comprehend all the methods and corresponding approximations used for modelling the behavior of nuclear reactor cores, from the generation of nuclear cross-sections to the response of a reactor during a transient.

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 890675.

Joint European Canadian Chinese development of Small Modular Reactor Technology

The ECC-SMART is oriented towards assessing the feasibility and identification of safety features of an intrinsically and passively safe small modular reactor cooled by supercritical water (SCW-SMR), considering specific knowledge gaps related to the future licensing process and implementation of this technology.

The main objectives of the project are to define the design requirements for the future SCW-SMR technology, to develop the pre-licensing study and guidelines for the demonstration of the safety in the further development stages of the SCW-SMR concept including the methodologies and tools to be used and to identify the key obstacles for the future SMR licensing and propose strategy for this process .

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945234.

CONNECT-NM

Overview

CONNECT-NM is a co-funded European Partnership on nuclear materials for all reactor generations that applies modern digital technologies to materials science practices for the acceleration of innovation.

Strategic Goals

1. **Nuclear Materials (NM) Acceleration Platforms**
2. **Test-beds for Accelerated Qualification**
3. **Intelligent Materials Health Monitoring**
4. **Advanced Prediction of Materials Behavior**
5. **Knowledge Organization Systems**

- ### Research Lines

1. Advanced materials development & manufacturing
2. Materials & component qualification (testing, standards, design rules)
3. Non-destructive examination & health monitoring
4. Advanced materials modelling & characterization
5. Knowledge & data management

Kick-off meeting
DATE: October 2-4, 2024
📍 Madrid, Spain – CIEMAT

ENEN Contribution: Communication, dissemination, and evaluation activities. Its involvement ensures broad engagement from its network and provides support for capacity-building actions related to mobility (ENEN2Plus) and training within the Partnership.
WP1 - Task 1.1 – Creation and operation of the Management Support Office (MSO).
Task 1.5 – Organization of the calls for projects and launch of the selected ones.
WP2 - Task 2.1 Education and Training.
Subtask 2.1.1: Mobility scheme
Subtask 2.1.2: Summer schools
Subtask 2.1.3: Young researcher networking and workshops
Subtask 2.1.4: Online training
WP3 - Task 3.1 – Dissemination, outreach and engagement strategy and plan.
Subtask 3.1.2: Communication and Dissemination Master Plan
Task 3.3 – Dissemination and outreach actions alignment among funded projects.
Subtask 3.3.1: Dissemination and outreach guidelines and monitoring

NURECAB

Objectives

- Support and Enhance Nuclear Education and Training in Ukraine
  - Improve the quality of nuclear education and training programs in Ukraine.
  - Bridge the gap between academic programs and the needs of the nuclear sector.
  - Attract young talent to careers in nuclear research and engineering.
- Strengthen Ukraine's Integration into the Euratom Research and Training Program
  - Foster collaboration between Ukrainian and EU research entities and academic institutions.
  - Enhance the competences and communication tools of Ukrainian Euratom National Contact Points (NCPs).
  - Increase awareness of the Euratom program among Ukrainian stakeholders.
- DURATION: 1 September 2024 – 31 August 2026

ENEN Contribution:

- ✓ Organizes training courses/workshops, transferring EU expertise to non-EU specialists.
- ✓ Conducts gap analysis and competence mapping, coordinates standardized training, and engages with international organizations.
- ✓ Manages mobility actions, ensuring practical experience in various nuclear facilities and organizations.
- ✓ Facilitates international collaboration, supports workshops, and shares research findings.
- ✓ Represents the nuclear education community, engaging with policymakers and industry leaders.
- ✓ Establishes specialized training programs, ensuring up-to-date education for nuclear professionals.
- ✓ Organization of events to support communication and information exchange between members and partners.

APRENDE

Scope

Enhancing nuclear data for modeling and simulation tools essential for nuclear energy (fission and fusion) and non-energy applications, addressing priority areas identified by European stakeholders.

Key Priority Areas:

1. Spent Nuclear Fuel (SNF): Addressing all aspects of SNF management.
2. Reactor Operations: Improving data for reactivity, burnup, transients, and safety margins.
3. Advanced Systems: Supporting SMRs, GenIV reactors (lead/sodium cooled, molten salt, and MYRRHA accelerators).
4. Safety Assessments: Enhancing criticality safety and shielding methodologies.
5. Non-Energy Applications: Radiation protection, radionuclide production, health, geosciences, space research, and industrial uses.

Goal: Deliver accurate, reliable nuclear data to meet the highest priority needs of the EU and its Member States.

ENEN Contribution: Organization of two summer schools (M1-M48) - Cooperation with ENEN will allow to reach out to a wider research community (Task 6.5). ENEN will act as a link with external E&T projects like ENEN2Plus.

3S Synergy E&T

ENEN LinkedIn here

E&T Opportunities by ENEN

Nuclear Safety:

- Nuclear Schools and trainings on SMR related topics
- Nuclear Fuel Technologies
- Nuclear Medicine
- Radiochemistry
- Radiation Protection and Safety
- Emergency Response

ENEN HUB
on E&T and Vocational E&T

HUB here

Nuclear Safeguards:

- Specializing Master on Nuclear Safeguards
- Short term theoretical and practical trainings on safeguards

ENEN special expertise: Crisis communication, communication and stakeholder engagement

Nuclear Security:

COMING SOON

ENEN follows nuclear technology trends

- **Systematic** consideration of interfaces between **safety, security, and safeguards** are important in the **design** stage of SMRs; the 3S should be considered in a **holistic** manner, e.g., via risk assessment and risk-informed decision-making process.
- **Security by design** must address both **physical and computer security** through systematic risk assessment, with particular emphasis on **vital area identification** and **insider threat mitigation**.

NUCLEAR SECURITY E&T

Educational Gap in the EU

- **Engineering Graduates**: In 2022, 15.5% of EU tertiary students were in engineering fields, 72.7% male. (ec.europa.eu)
- **Nuclear Jobs**: The EU nuclear sector supports 1.1 million jobs and contributes €500 billion to GDP. (world-nuclear-news.org)
- **Aging Workforce**: Many nuclear experts are nearing retirement, with most aged 45-55. (publications.jrc.ec.europa.eu)
- **Workforce Needs**: 150 GW nuclear capacity by 2050 requires major workforce growth. (nucleareurope, 2023 Annual Report)

Several European institutions currently offer programs covering nuclear security E&T in various extends

- **International Nuclear Security Education Network (INSEN):** A collaborative network of educational and research institutions, as well as international organizations, focused on enhancing nuclear security education.
- **European Nuclear Education Network (ENEN):** Delivers a Master Programme on Nuclear Safeguards, including security aspects.
- **National Programmes in EU**: Countries like France, Germany and the UK have established nuclear security nuclear engineering programs, often in collaboration with national nuclear agencies. Germany has a postponed Master Programme.

Rising Demand for Nuclear Security Education

- Nuclear energy, particularly SMRs, is key to decarbonization. NEA reports nuclear capacity must reach 1,160 GW by 2050 (up from 394 GW in 2020) to meet climate goals, highlighting the need for a skilled workforce in nuclear security.
- The need for nuclear security workforce has grown due to political turbulence in the global environment.

E&T initiatives to be considered for implementation

Initiative	Description
Curriculum Development	Design courses on SMR technology and associated security
Professional Training Programmes	Offer workshops and certifications for professionals to up-to-date their skills
Collaborative Research Opportunities	Facilitate partnerships between academic institutions and industry to promote research in nuclear security.
Student Exchange and Mobility Programs	Encourage cross-border educational experiences to share best practices and standardize training

Networking Opportunities by ENEN: 2025

ENEN Special Event 2025
March 2025

GO VIKING

and many more here
https://enen.eu

References

1. **Eurostat**. *Tertiary Education Statistics - Enrolment in Engineering and Related Fields in the EU (2022)*. https://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics
2. **World Nuclear News**. *Study Highlights Nuclear's Value to EU Employment and Economy* (2021). https://www.world-nuclear-news.org/Articles/Study-highlights-nuclears-value-to-EU-employment
3. **European Commission Joint Research Centre**. *Nuclear Workforce Report* (2020). https://publications.jrc.ec.europa.eu/repository/bitstream/JRC117806/kjna30014enn.pdf

- **nucleareurope**.*Annual Report 2023. https://www.nucleareurope.eu/publications/#annual_reports*

1. **European Nuclear Education Network (ENEN)**. www.enen.eu
2. **International Atomic Energy Agency (IAEA)**. *Nuclear Security Education Network (INSEN)*. www.iaea.org

Questions?

European Nuclear Education Network AISBL
Rue d'Egmont 11, 1000 Brussels, Belgium
www.enen.eu

Email: secretariat@enen.eu