

The challenges of future nuclear power in Europe

A. Al Mazouzi
EDF R&D
SNETP-G-Secretariat



SAFE, COMPETITIVE & SUSTAINABLE NUCLEAR

SNETP is a European Technology Platform recognised by the European Commission, which supports and promotes the safe, reliable and efficient operation of Generation II, III and IV civil nuclear systems.

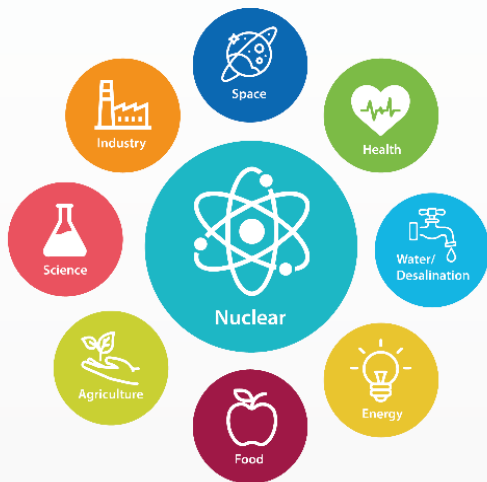
STRATEGIC VISION

1/ Nuclear Power in Europe's 2050 Energy Mix.

2/ Emphasizing Research and Innovation for Safety and Efficiency.

3/ Open to New Reactor Technologies (SMR, Gen IV).

4/ Transverse technology with strong impact on other fields (Medicine, Data, Industry, Renewables, etc.).



SNETP PILLARS

SNETP pillars support the EU's transition towards a **carbon neutral economy by 2050**.

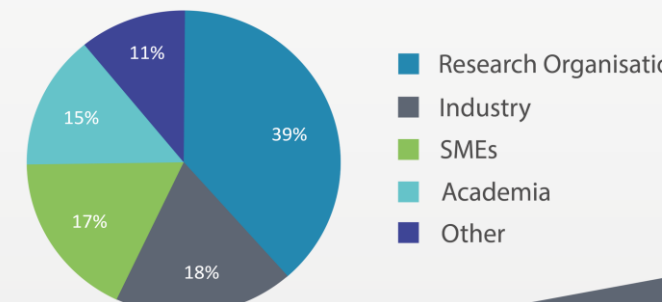


SNETP MEMBERS

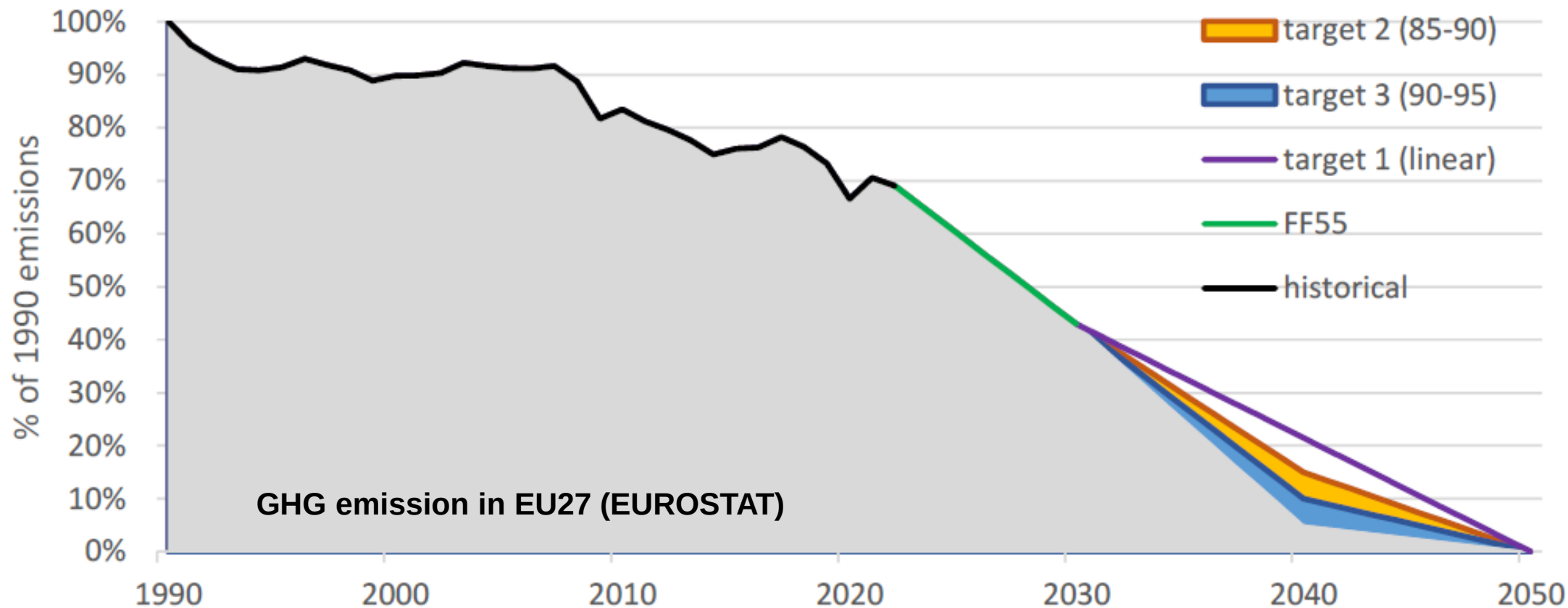


SNETP COMMUNITY

Approx. 120 members



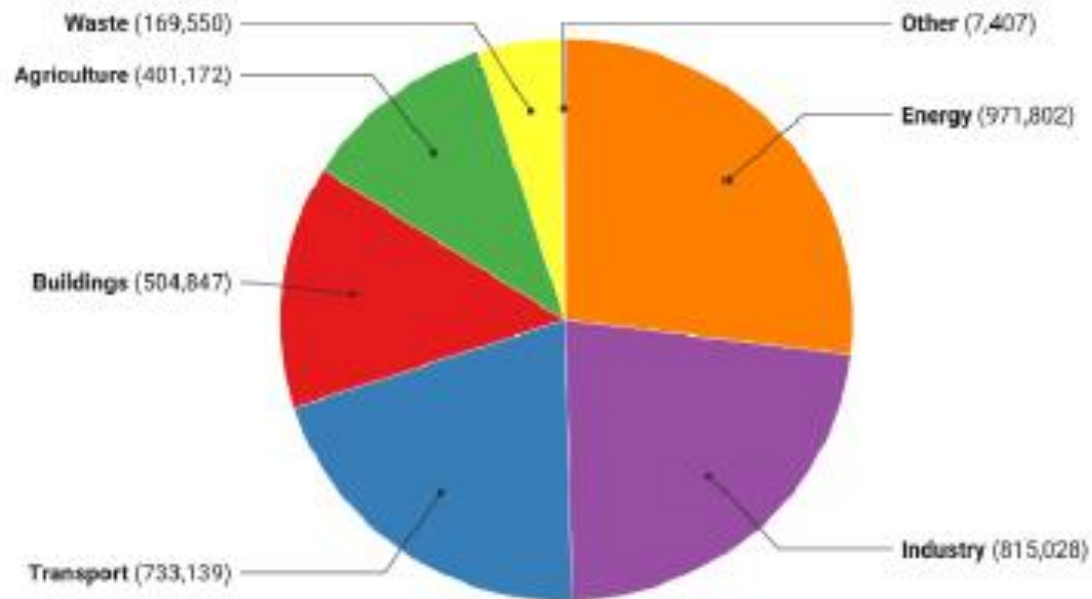
EU-27- Green Deal: NET-ZERO by 2050



EU27: GG emission as of 2021

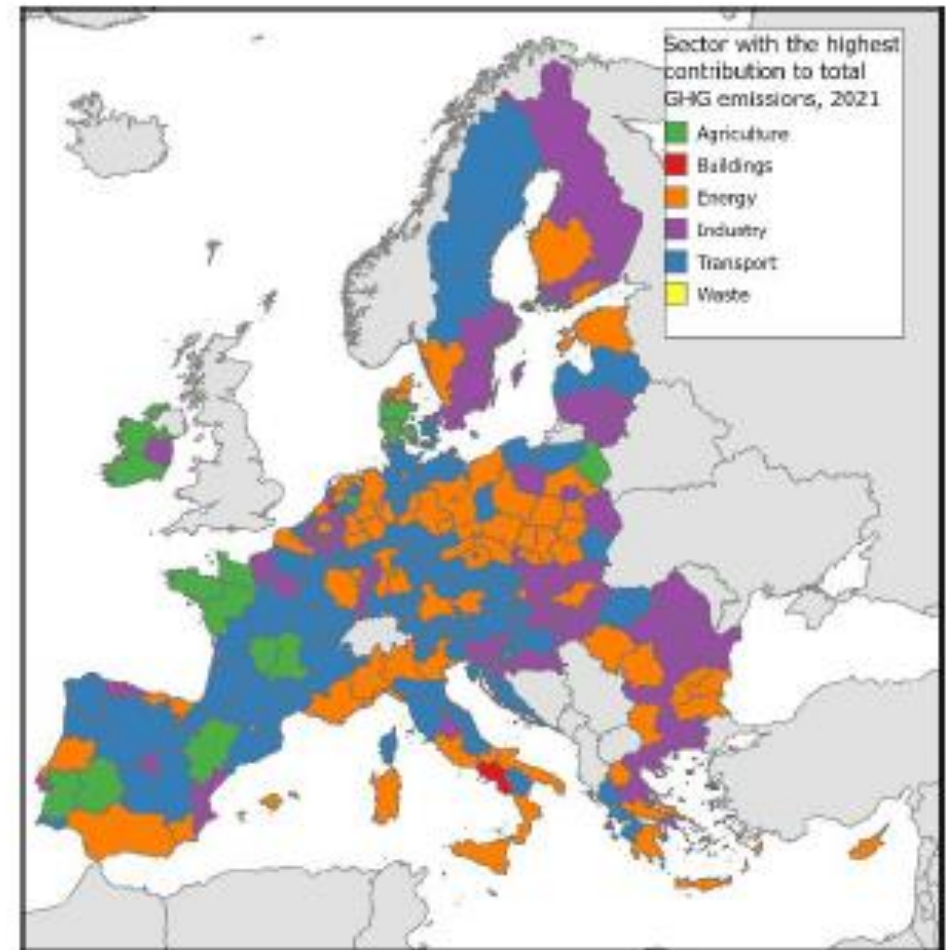
Total greenhouse gas emissions by sector in the EU27 in 2021

1000 tonne CO2 equivalent



Created with Datawrapper

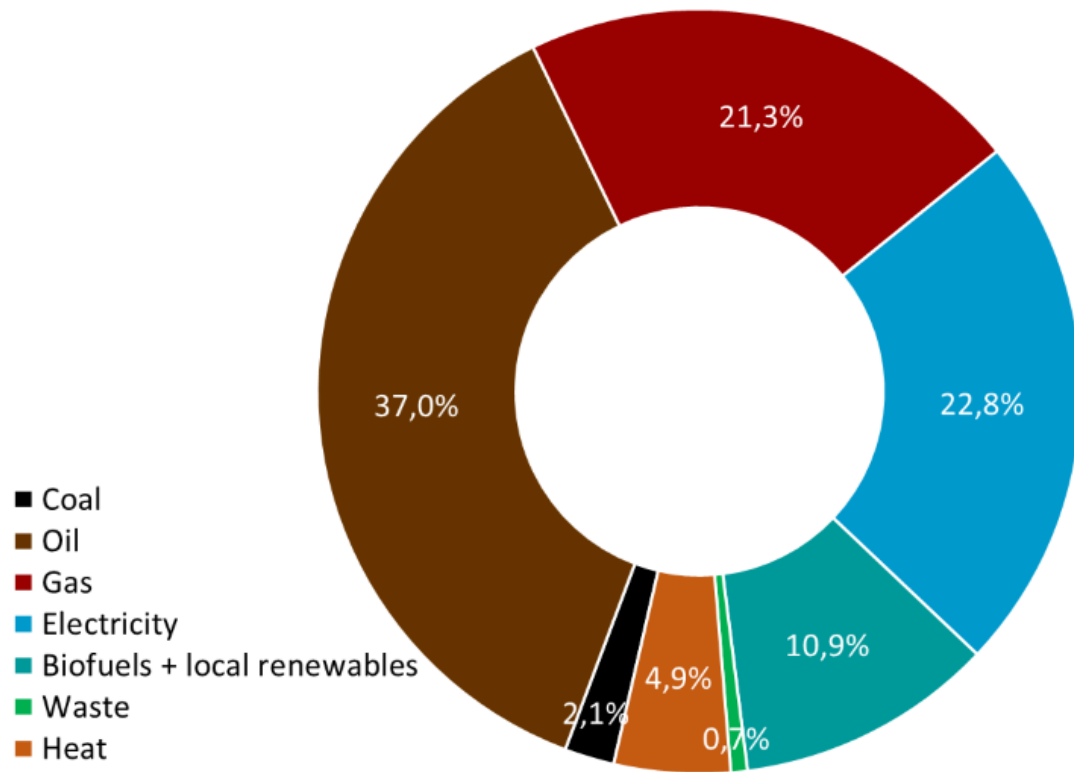
Note: leaving out aviation and shipping



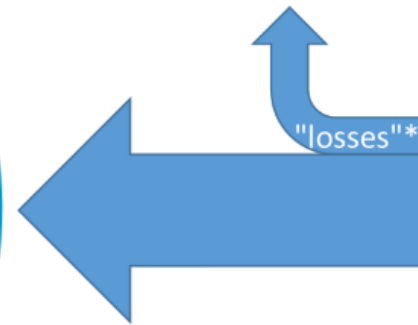
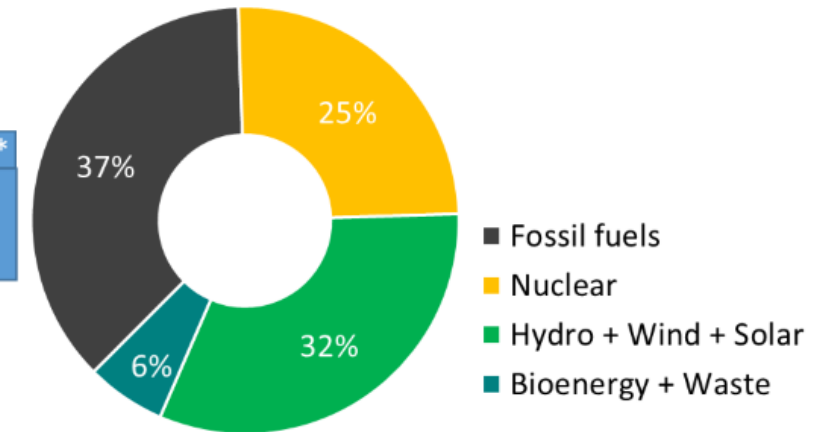
Source: EDGAR emissions database

EU energy consumption reality

European total final energy consumption by end user in 2019
acc. to data from eurostat(2021)



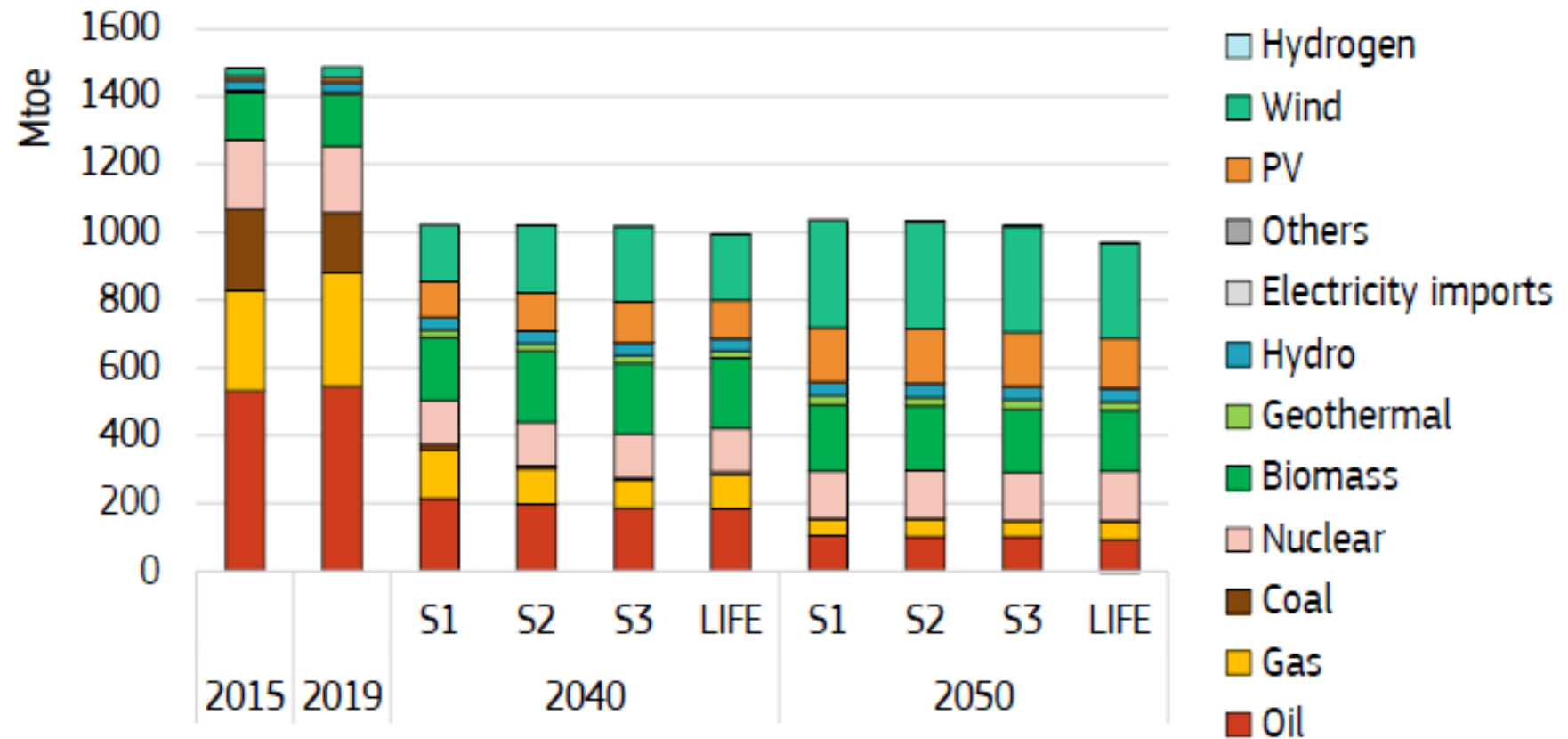
European electricity generation in 2020
acc. to data from EMBER(2021)



"losses"*

*A part (13-15 %) of the electricity produced does not arrive at the end users, as the electricity producing industry needs a fraction for their own needs and there are losses during transport and distribution

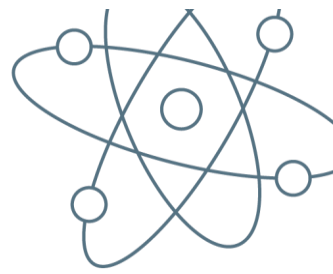
Decarbonisation of the energy sector: Scenarios



Note: Biomass and waste include non-renewable waste. Natural gas includes also manufactured gas.

Source: PRIMES.

The market need is there!



⚡ 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 H₂/y

REPowerEU Market Estimate for 2030

1000 TWh/y

Equivalent additional clean electricity demand

>125 GW

Equivalent nuclear capacity

🔥 Industrial heat

~1250 TWh_{th}/y

Iron – Steel, Non-metallic minerals and chemicals heat demand in EU26

> 45% market

Heat < 400°C

🏠 District heat

~500 TWh_{th}/y

Current district heat demand in EU26

> 2/3 fossil- fueled

Assets to be retired and replaced in the coming two decades



EN[★]S[★]REG
European Nuclear Safety Regulators Group

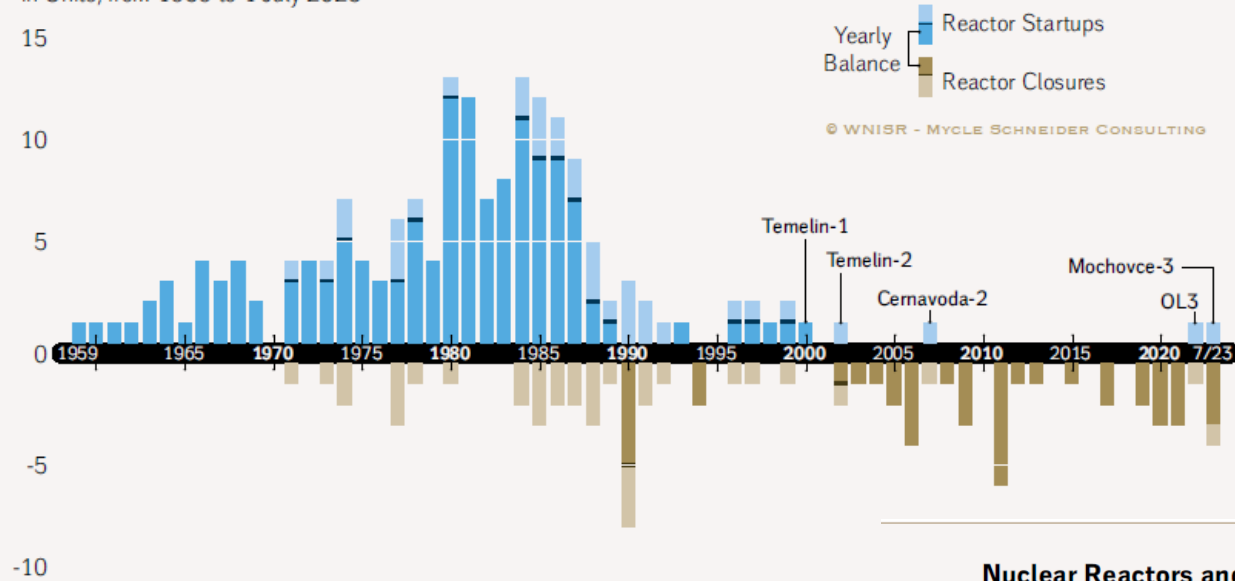
nucleareurope

SNETP
Sustainable Nuclear Energy
Technology Platform

Nuclear capacity at EU27

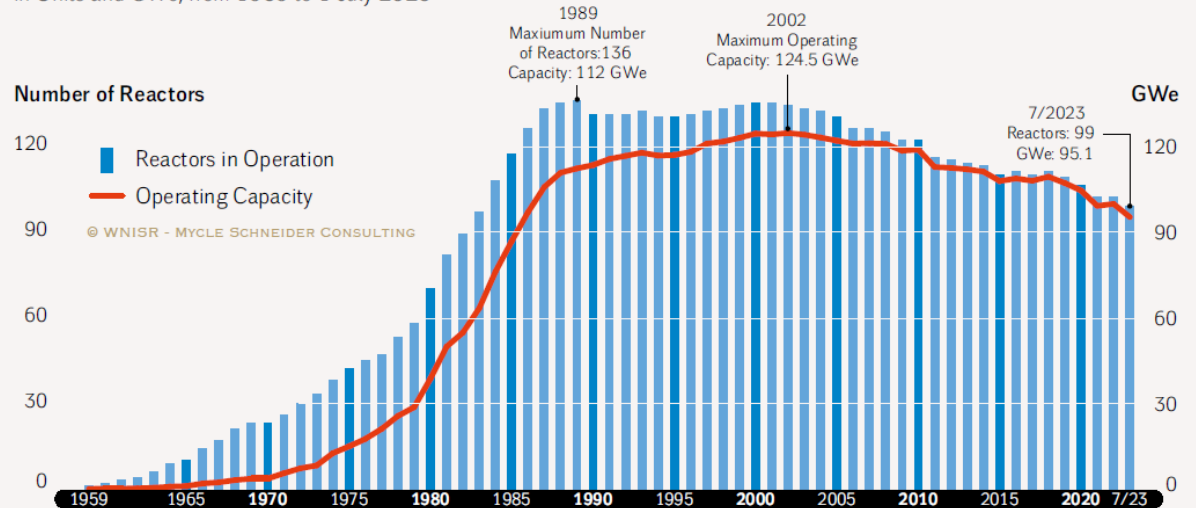
Reactor Startups and Closures in the EU27

in Units, from 1959 to 1 July 2023



Nuclear Reactors and Net Operating Capacity in the EU 27

in Units and GWe, from 1959 to 1 July 2023

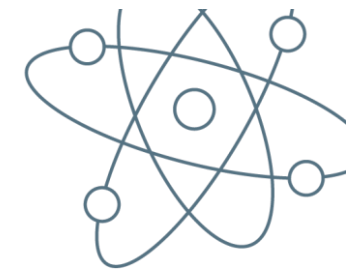


Strategy: From Long Term Operation (now) , to new Commercial Light Water Reactors (2030 and beyond) followed by Commercial Advanced Modular Reactors

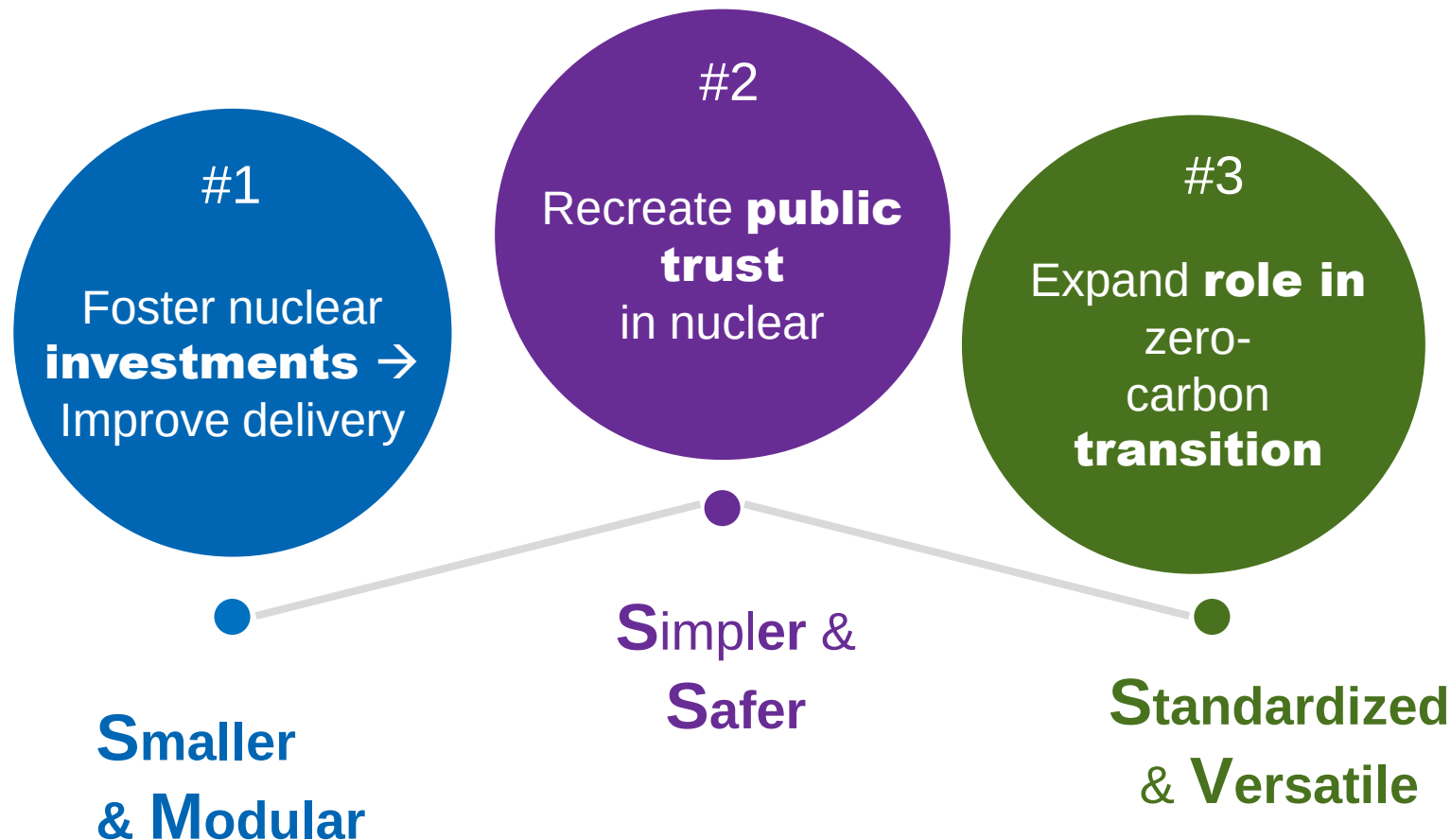
- **Together with Renewables, Nuclear reactors are a key asset to reach Net Zero by 2050**
 - Long Term Operation of existing Nuclear Power plant has to be strengthened in a safe and industrial way
 - New Gen III reactors are to be built: the technology has to be commercial no later than 2030 in order to play a significant role in the Net Zero Objective
 - ➔ Light Water Reactor (LWR), both big plants and Small Modular Reactors (SMR) is today the unique solution to reach this objective

- **Nuclear has to be sustainable on the long run**
 - Long Life wastes have to be reduced;
 - Uranium fuel has to be recycled
 - ➔ Advanced Modular Reactor , big and small plants (AMR), is the unique solution to reach this objective
 - ➔ First demonstration projects could be available by 2035 followed by commercial projects

- **Continuity in policy is necessary between those two calendars steps:**
 - Nuclear industry is a long leading time industry (20 years from Lab to Industry)
 - Research development for LWR is beneficial to AMR
 - Huge synergies exist for Industrial supply chain and human competences between LWR and AMR



What drives the industry towards SMRs?



EU SMR-partnership started in 2021

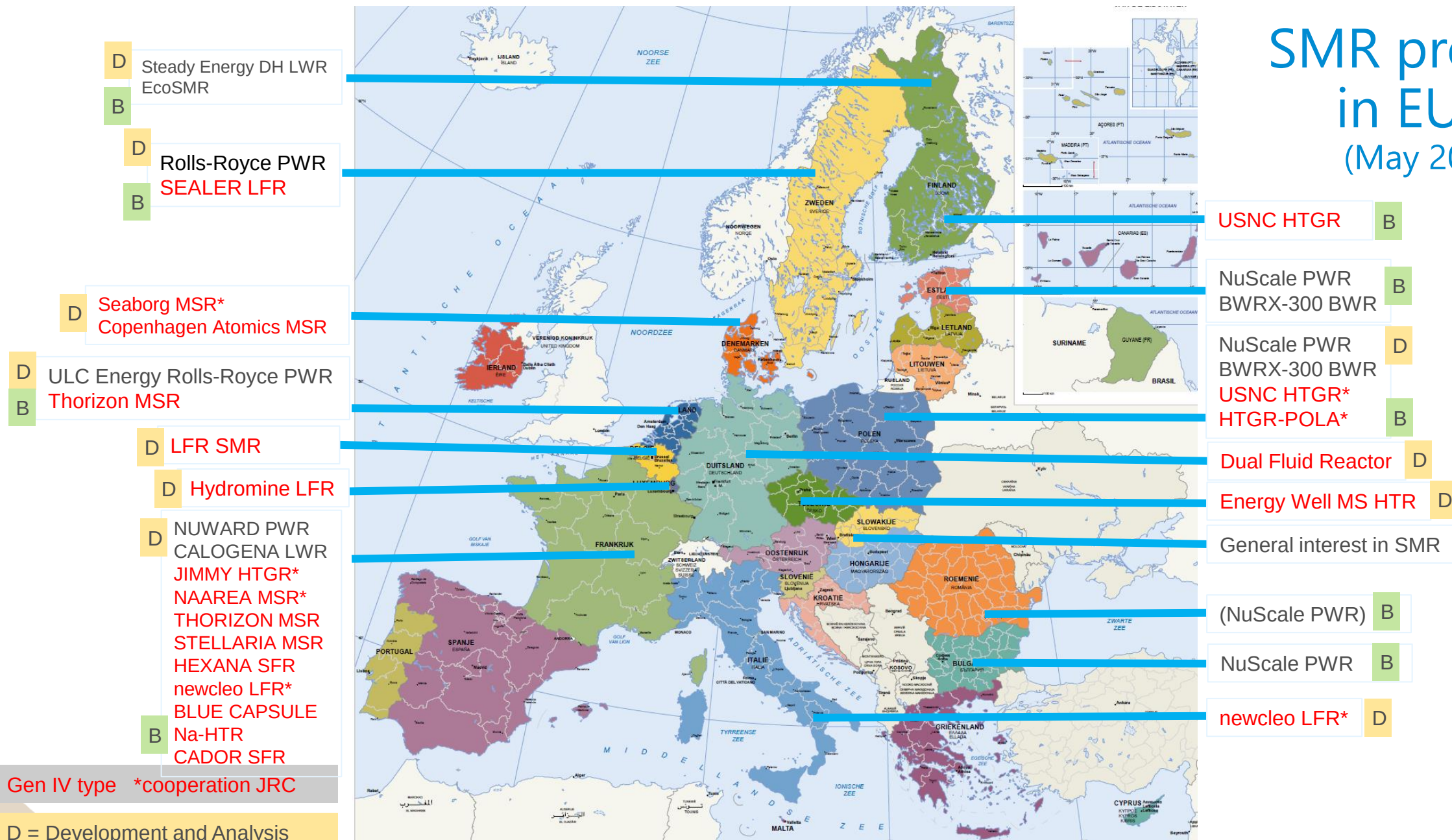
Scope:

- Establishing in the EU a domestic/European SMR programme as defined in the EC's "Vision for a decarbonised energy sector including European Small Modular Reactors",
- creating necessary enabling conditions for the first EU SMRs to start operation in 2030.
- co-ordinate MS & industry strategies towards an integrated and Robust supply chain in Europe.

Objectives

- Develop the necessary industrial supply chain in Europe
- Encourage the implementation of common (harmonized) licensing process across the EU.
- establish a strategic research agenda :
 - LWR-SMR, as a mature technology to be deployed in 2030.
 - Advanced SMR (AMR-GENIV) design has to be matured by 2035 for long term prospect (sustainability) of fission technology.
- Develop an international marketing strategy of the European SMR value chain

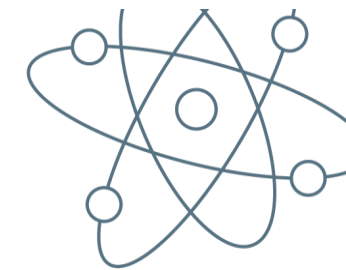
SMR projects in EU27 (May 2024)



Gen IV type *cooperation JRC

D = Development and Analysis

B = EoI to build



The first wave of SMRs will be Light Water Reactors



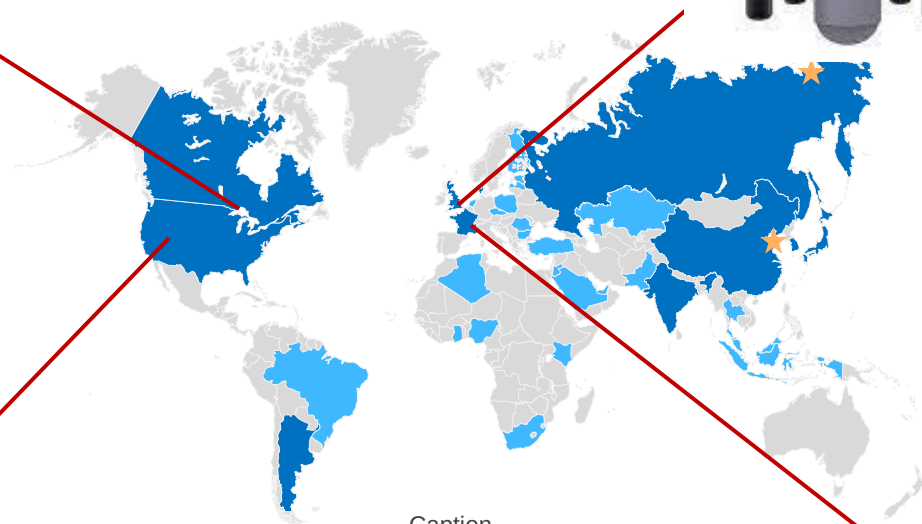
BWRX-300 (GE-Hitachi)
Single-Module BWR
300MW
Expected COD:
- 2028, Darlington, CANADA
- ca. 2029, Clinch River, USA



RR SMR (Rolls-Royce)
Single-Module PWR
470MW
Expected COD: ca. 2030, UK



NuScale VOYGR (Fluor)
Multi-module PWR
6x 77MW
Expected COD: 2029, Idaho Falls, USA



Caption
■ Developer
■ Expression of interest
★ Demonstrator built



Key characteristics of LW-SMR

- **+70 years** industry and operating experience
- **Existing** supply chain
- **Mature** regulatory landscape
- **1** design **approval** granted by US NRC
- **10+** companies actively developing a LW-SMR design
- **10+ deployments** announced in Europe and North America < 2035

Nuward (EDF)
Multi-module PWR
2x 170MW
Expected COD: ca. 2034, FRANCE



TOWARDS and European Industrial alliance

- Publication of [the reports](#) by the end of July 2023;
- [consultation of stakeholder's](#) has been launched through the EU Survey Tool, until 15 September 2023;
- Organisation of the [Stakeholders' forum](#) with EC, MS and MEPs on October 26th at Brussels
- K. Simson (commissioner) [announcement](#) at ENEF 2023/Bratislava Nov. 2023
- 10 MS support the initiative, Nov' 2023
- T. Breton confirmed the launch at WNE, Dec 2023
- The EP has approved the [Bogovic report](#) on SMRs; Dec 2023
- Nuclear Safety is the 6th priority of the [SETplan](#) (Dec'2023)
- the Nuclear (SMRs) is one of the strategic technologies in NZIA (confirmed by the European parlement), Dec'2023
- The [Alliance on SMRs](#) is part of the Climate Target 2040

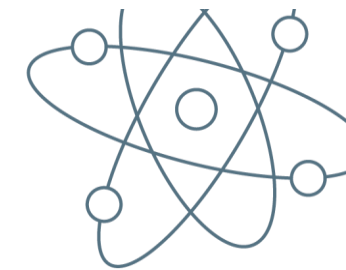
Officiel Launch: 9 February 2024



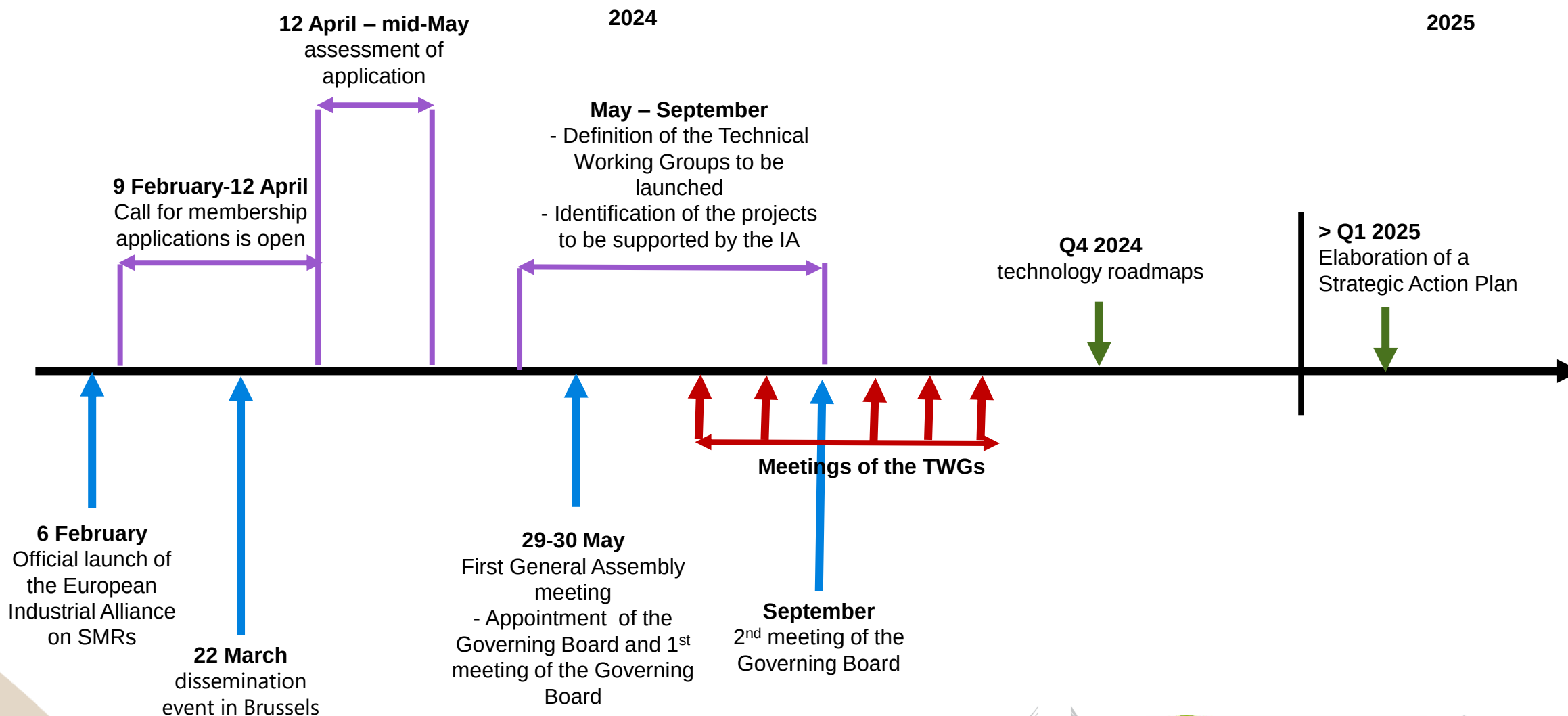
Main objectives:

- to facilitate and accelerate the development, demonstration, and deployment of the first SMRs projects in Europe in the early 2030s,
- Assist emerging SMRs projects to reach the demonstration and deployment phase.

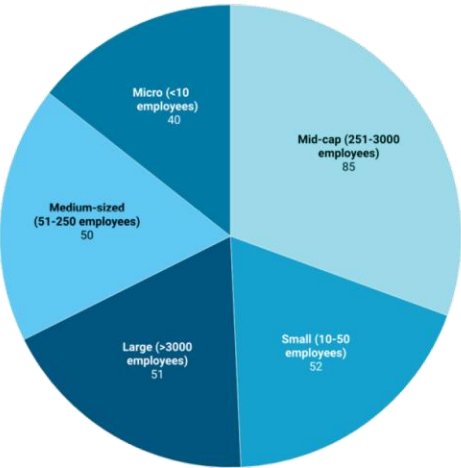
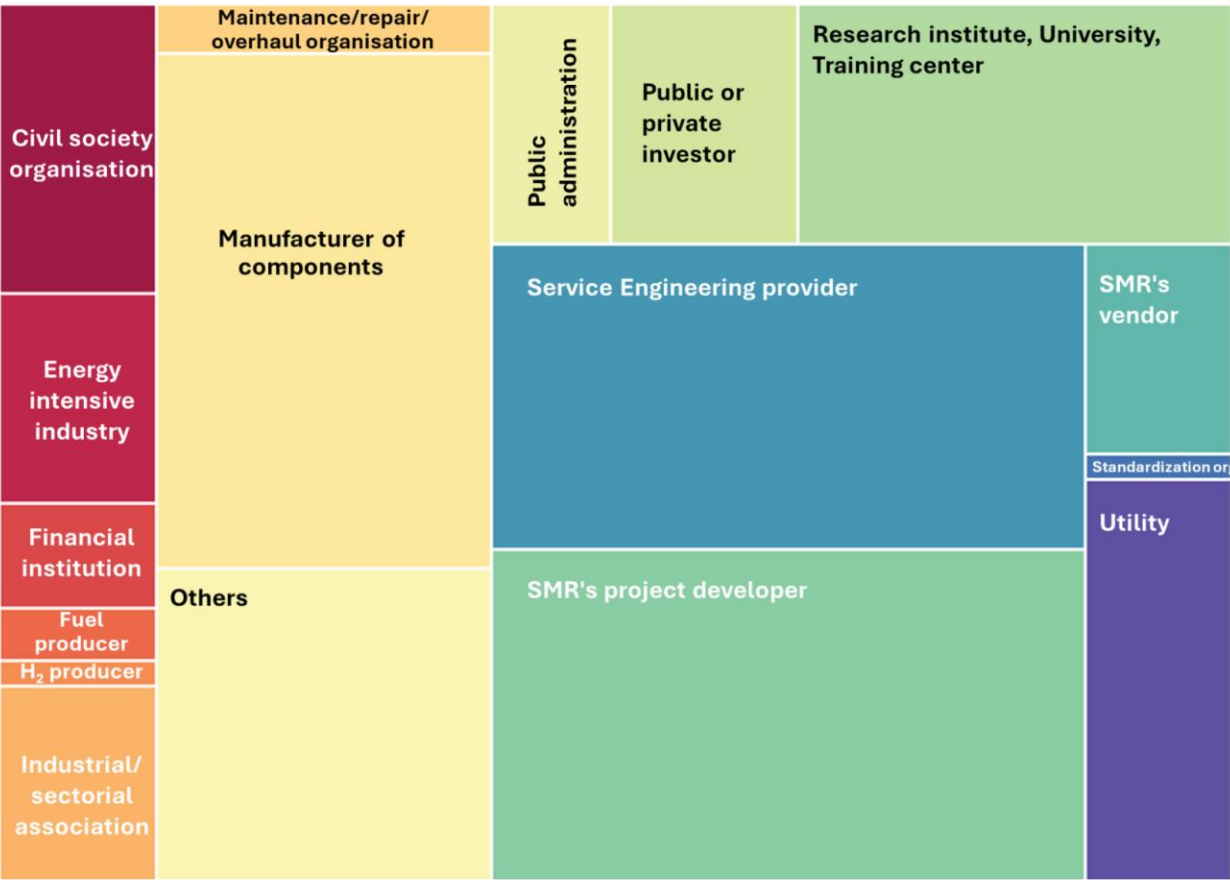
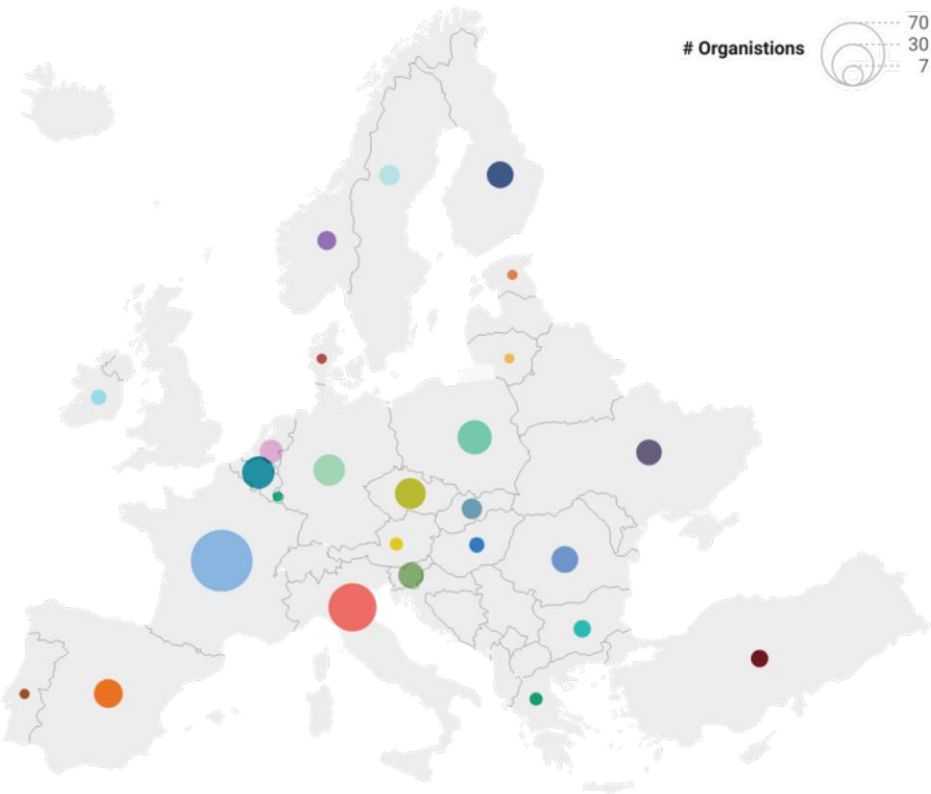




Indicative timeline



[Country distribution, Members]



5 Technologies



LW-SMR, AMR



General Assembly

- More than 350 participants, from 190 members and 20 countries.
- EC-commissioners
- Ministries
- Industries
-



European Industrial Alliance structure



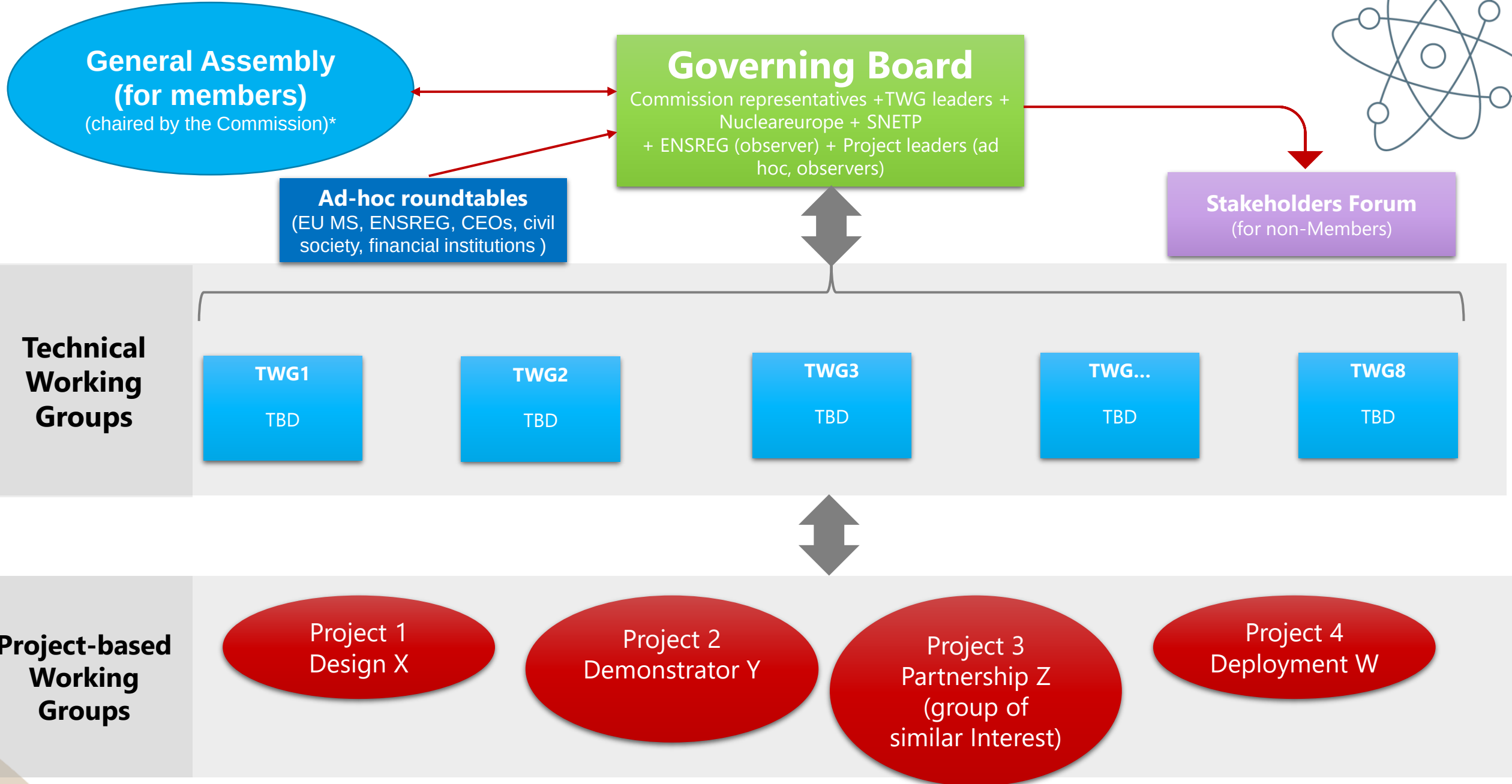
Technical Working Groups

- Groups for policy reflection and action in important aspects for which further work is needed (project development, project finance, supply chain, financing, safety research, public engagement, waste management, etc.) or not yet touched upon.
- Will be nourished by projects' feedback experience and will disseminate best practices across projects
- Will directly interact with EU & National decision-makers.

Project-based Working Groups

- Will be assisted under the SMR Alliance
- Will gather interested stakeholders through specific agreements.
- Depending on project nature & objectives, they could fall under different categories (IPCEIs, PPP, SRIA, etc,)
- Will run under strict commercial protection / non-disclosure agreements
- Possibility of forming project partnerships that will bring together technologically similar projects





*: The three Commissioners for Energy, for Internal Market, and for Innovation, Research, Culture, Education and Youth will co-chair the General Assembly meetings.





Working Methods – Technical Working Groups



- Technical Working Groups assigned tasks by the Governing Board.
- Stakeholder collaboration: developers, vendors, utilities, research institutes, financial institutions, supply chain representatives, training centres, and civil society.
- European Commission could provide technical support, including research on safety and safeguards.
- Working Groups may meet multiple times a year.
- Administrative support provided by an entity designated by the industry in agreement with the European Commission.



The first key deliverable of the Alliance: the elaboration of a Strategic Action Plan for Q1 2025

What task	Which TWG	Timeline									
		Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25
T1. Exploring investments possibilities & cost sharing models	TWG 1										
	TWG 8										
T2. Technology roadmaps	TWG 2										
T3. Promote connection with end-users	TWG 1										
T4. SMR supply chain mapping & completeness	TWG 3										
T5. Financing support mapping (incl. investors attractiveness & dialogue)	TWG 8										
	TWG 1										
T6. Future needs & priorities in Euratom / national research programs, demonstrators & skills	TWG 2										
T7. Education & Training needs in SMR value chain	TWG 4										
T8. Interactions strenghtening w/ ENSREG & NRAs	TWG 6										
T9. Standardization of practices & processes / good practice dissemination	TWG 3										
T10. Establishing dialogue with stakeholders & civil society	TWG 5										

Strategic Action Plan finalized

Technology roadmaps completed

Industrial Alliance –Project Working Groups

Way forward



Potential SMR project partners

Different categories:

- utilities or energy intensive users which are willing to use SMRs for their own benefit,
- SMR designers willing to operate as a utility providing electricity and/or heat to customers,
- group of different SMRs designers willing to collaborate to develop the supply chain in the EU,
- fuel chain manufacturers willing to develop a specific type of fuel necessary for different SMRs, etc
-

Requirements

Qualitative and Quantitative inputs :

- Objectives,
- Implementation Status (R&D, feasibility, study, design, licensing, ...)
- Challenges & Key milestones
- Political and business support
- Potential industrial applications
- Potential contribution to the EU economy
- Alignment with regional developments strategies
- Adherence to EU safety and environmental legislation
- Compliance with the Net-Zero objectives

Decision

By the Governing Board based on a comprehensive assessment of the project (s) eligibility

Timeline

- Project description: Deadline June 28, 2024
- 1st Governing Board first week of July
- Assessment: September 2024





Questions ???



Governance – Governing board



Composition (up to 15 members)

Permanent

- European Commission
- nucleareurope
- SNETP

Elected/Nominated

TWG Chairs
(vice-chairs are
substitutes for the
meetings)

Observer

ENSREG
PWGs (upon invitation)

administrative support by the **Alliance Secretariat**

TASKS

- oversee the Alliance's operational work
- monitor and report on TWGs
- endorse the deliverables of the TWGs
- report annually to the General Assembly
- organise roundtables

Meetings

at least 3 times a year

Ad-hoc roundtable discussions with:

- Industry
- Users
- Civil Society
- Finance (EIB, BRD, ..)
- EU-MSs
- International bodies



Alliance Secretariat



DG ENER Directorate D

- Ghislain Pascal
- Ivelina Ivanova

DG GROW Directorate I

- Nikos Pantalos

DG RTD Directorate C

- Angelgiorgio Iorizzo

JRC

- Laura Aldave de las Heras

Nucleareurope

- Andrei Goicea

SNETP

- Abdou Al Mazouzi: abderrahim.al-mazouzi@edf.fr

