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Sustainable Nuclear Energy Technology Platform

The challenges of future nuclear energy in Europe

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President SNETP

The Nuclear in the EU : Overall vision of SNETP between 2021 and 2050

2021

- 104 power reactors (=50% of carbon free generation)
- 100 billions €
- 1.1 M jobs
- 29 research reactors
- Many applications (medical, chip doping, space, industry, etc.)

Industry & Research vision 2050

- Significant share of Nuclear across 2050 EU scenarios
- Nuclear brings dispatchable carbon-free power to a system w/ large share of vRES
  Nuclear is v. flexible / versatile & provides massive carbon-free energy for H2, district / industrial heat, etc.
- New technologies & applications have emerged (SMRs, Gen IV)
- Long Term solutions for High Level Waste available (inc repositories)

=>To achieve this & keep EU leadership, the nuclear industry needs:

- A conducive investment framework
- A performing, continuous & modernized supply chain, R&D labs and competences
- **Investing in Innovation & R&D in order to support Industry & Research Vision 2050**

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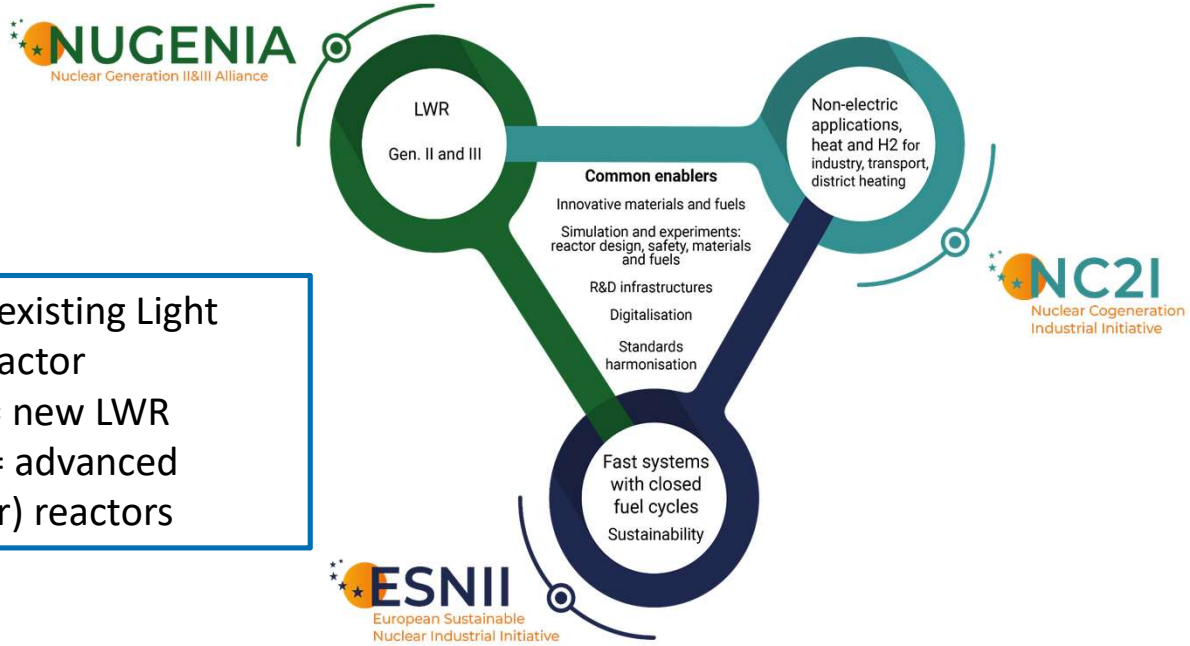
- **The association (AISBL, under Belgian law) gathers more than 110 stakeholders from industry, research centers, safety organisations, universities, non-governmental organisations, SMEs …**



Gen II = existing Light water reactor
GEN III = new LWR
GEN IV = advanced (modular) reactors

SNETP is the European Technology & Innovation platform for Nuclear Energy focused on Gen II-III and IV reactors with electric and non-electric application

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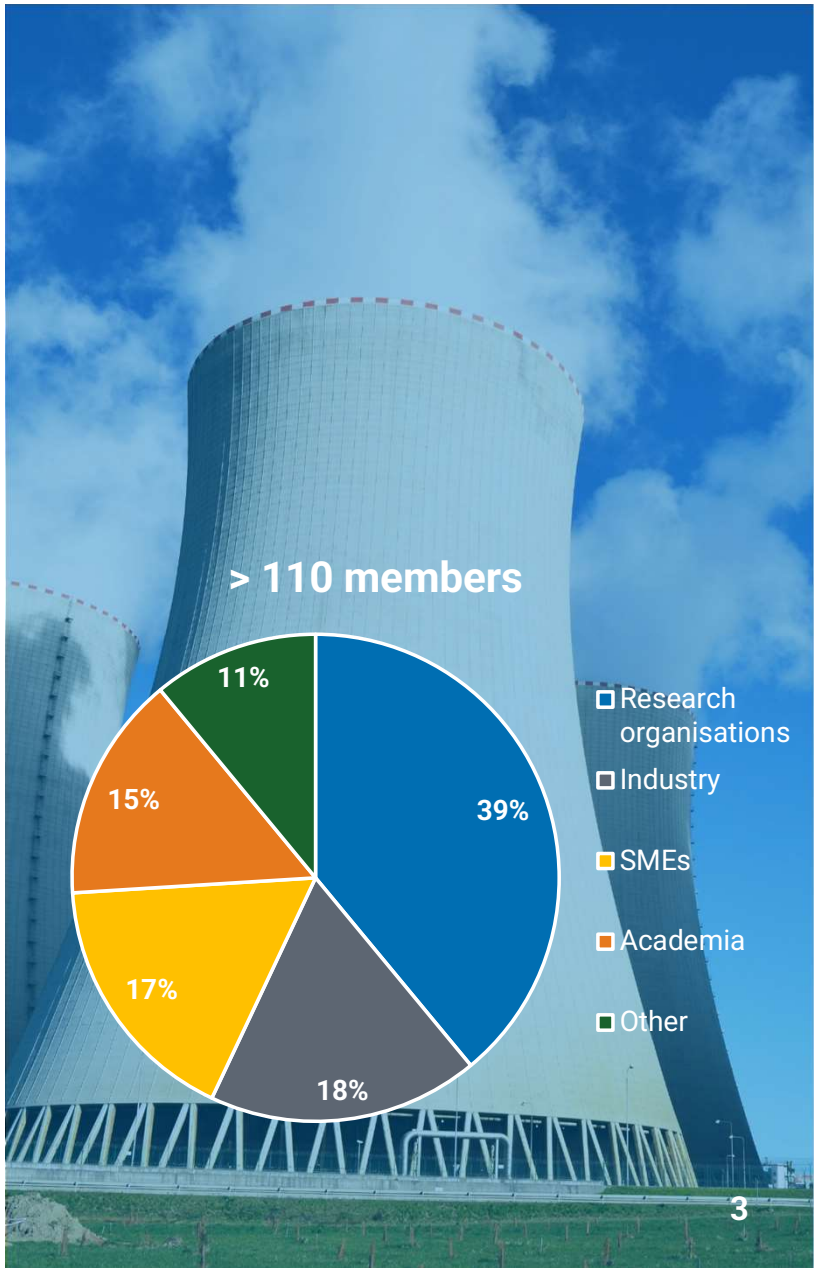

NUGENIA Vision

- **Importance of LTO for NPP economics & the grid:**
  - as nuclear has high fixed costs and low running costs
  - as it operates within a deregulated competitive electricity market
  - as nuclear remains essential to complement variable sources → Need for flexibility
  - as it supports the security of electricity supply
- **A European-wide, industrial-driven nuclear R&D programme:**
  - is key to maintaining nuclear competitiveness & safety in the EU
  - paves the way for the emergence of spin-offs in other sectors (health, energy, clean heat, hydrogen, construction, industrial manufacturing, etc.)
- **Three R&D & innovation priorities**
  - Innovation & competitiveness (inc. large NPPs, SMRs, passive safety, EATF, additive M, etc.)
  - Digital transition (digital reactor, multi-physics modelling, advanced computing)
  - Safety & environment (accidents & hazards, severe accidents, D & WM)

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ESNII vision: Advanced (Modular) Reactors Technologies

- **MYRRHA** (Multi-purpose hYbrid Research Reactor for High-tech Applications) , a **lead-bismuth Accelerator Driven System** to demonstrate transmutation of high-level waste, & to support the maturity of ESNII technologies

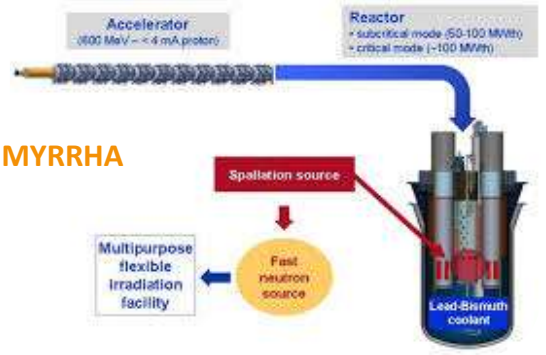
- The **Lead-cooled Fast Reactor (LFR)** and the **ALFRED** (Advanced Lead-cooled Fast Reactor European Demonstrator) project to build a European demonstrator of the LFR technology;

- The **Gas-cooled Fast Reactor (GFR)** and the **ALLEGRO** project (GFR demonstrator), an initiative with the goal to build an experimental facility to demonstrate the technological viability of the concept;

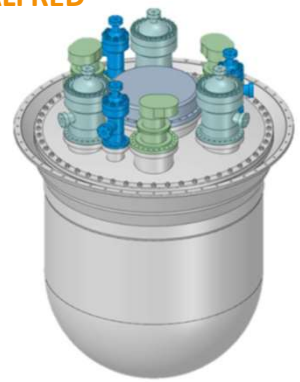
- The **Sodium-cooled Fast Reactor (SFR)** is the most internationally mature technology. Its industrial deployment in Europe necessitates still some improvements (safety, economic, …).

Demo Project at the soonest by 2035

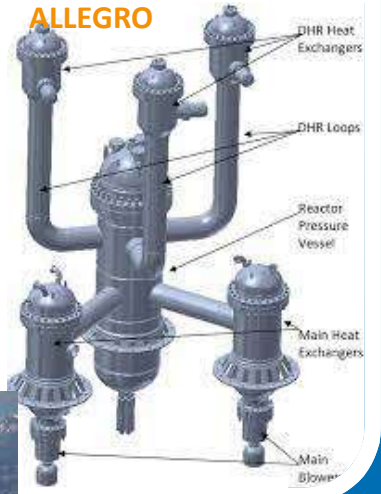
MYRRHA



ALFRED



ALLEGRO



Superphenix

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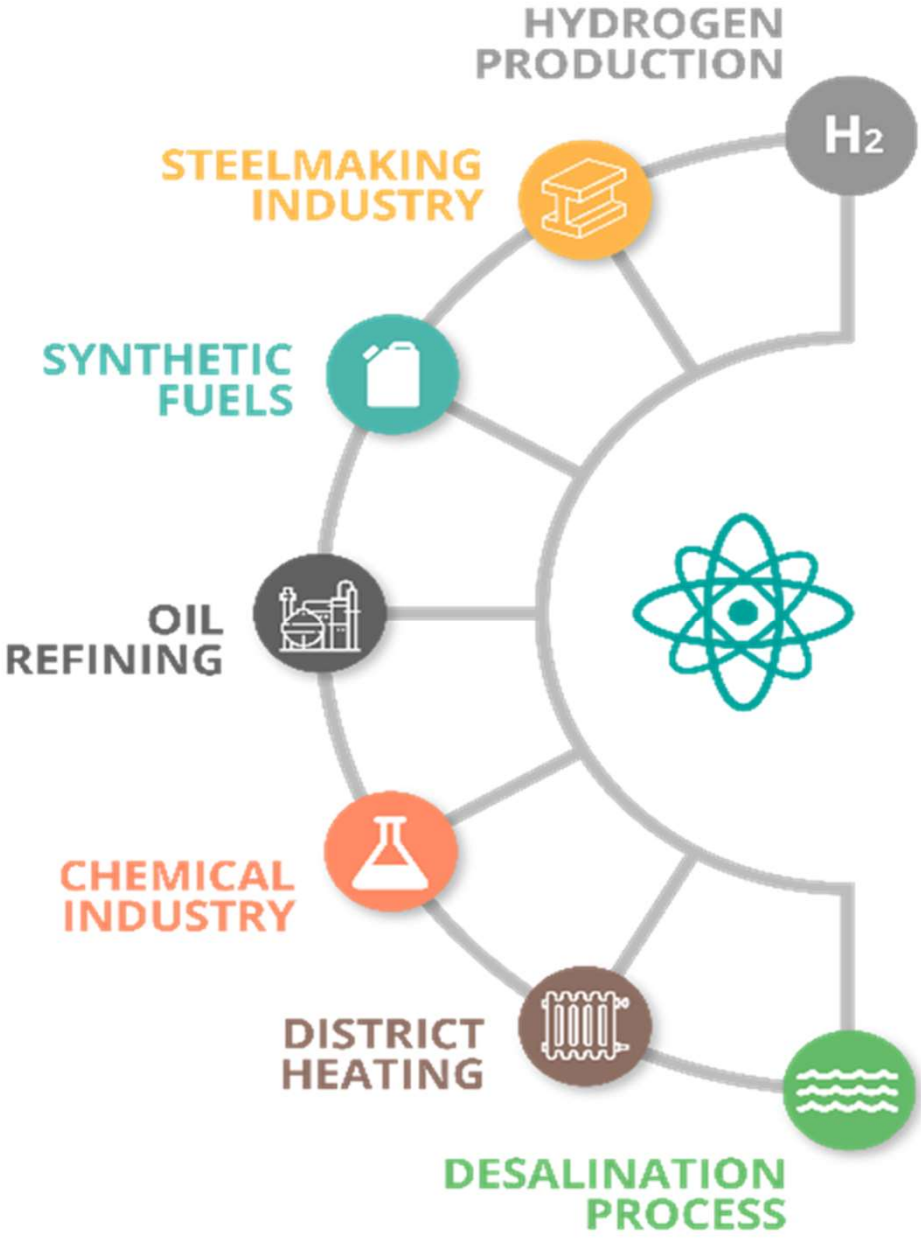
NC2I Vision

NC2I aims to make a significant contribution to Europe by providing clean and competitive energy beyond electricity by facilitating the deployment of nuclear cogeneration plants.

Based on a first HTGR demonstration by the end of the 2020s, it is possible to have 25% of process heat needs of industry delivered by nuclear high temperature cogeneration in 2050.

https://snetp.eu/wp-content/uploads/2020/10/NC2I-roadmap-October.pdf



SNETP strategy based on:

- **Nuclear Energy is one key element of electricity generation by 2050 according to EU long term scenarios (15% of the mix)**
- **Nuclear research and innovation is key to keep on strengthening safety, performance, dismantling, waste management**
- **The door shall be kept widely open for research and innovation on new reactors (such as SMR, Gen IV) which could provide enhanced safety, performance and waste management**
- **Nuclear is a transverse technology with strong impact on other fields such as medicine, but also data management, industrial software development, balanced energy mix with variable RES**

Digitalisation	Advanced manufacturing	Hydrogen

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The approach: *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 in time and in budget 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 more 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 at the soonest by 2035 ; commercial projects beyond 2050**

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

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EU SMR-partnership to start 2023

- **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**

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Take-away

- EU-citizens and industry need access to energy 24/7 in a **safe , resilient and affordable way**;
- Electricity demand is set to **increase from 3000TWh to 4808TWh by 2050** due to increased electrification;
- Nuclear provides **both flexible and dispatchable electricity**, **generating large quantities** of low-carbon energy **24/7** without the need for other backup sources of energy nor large-scale storage;
- SNETP as **the unique technological platform** for fission R&D&I to dialogue with the EC services and member states;
- **Big reactors and SMR development and deployment** in Europe is an opportunity for a **better mitigation of climate change, affordable energy prices, security of supply and Net-Zero emission by 2050**;
- **Together with big LWRs existing design, LWR- SMR are mature** to be deployed starting 2030 as a key asset to succeed with Net Zero by 2050;
- **AMR design to be matured by 2035 to ensure the sustainability** of fission technology;
- The multiple challenges require:
  - **high and continuous involvement of EU-Member states** together with EC services and industry (such as SMR partnership)
  - State of the art **experimental facilities** and demonstration
  - **Highly skilled competences** and **affordable supply chain in a continuous process**

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Invitation:

SNETP-FORUM-2022, June 2d, 2022 at Hotel de la région/Lyon

- Aim: discuss and analyse recent technological innovations in different selected Scientific and technical topics to the stakeholders of SNETP
- 6 technical topics:
  - **SMRs :** ***Ferry Roelofs (NRG), Jozef Sobolewski (NCBJ)***
  - **Nuclear codes and standards and supply chain:** ***Oliver Martin (JRC)***
  - **Digital and robotics:** ***Eero Vesaoja (FORTUM), Christophe Schneidesch (Tractebel), Elisabeth Guillaut (ORANO)***
  - **R&D&I facilities:** ***Pavel Kral (UJV), Petri Kinnunen (VTT)***
  - **Waste minimization and fuel cycle:** ***Erika Holt (VTT), Anthony Banford (NNL)***
  - **The role of nuclear energy in mitigating climate change including non-electrical applications (hydrogen, heat, etc):** ***Ronald Schram (NRG), Michael Fütterer (JRC)***

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