

SMR technology development in France

Energy Division – CEA

CET 2022 – septembre 21st 2022

Commissariat à l'énergie atomique et aux énergies alternatives - www.cea.fr

SMR development in the frame of energetic transition and 2050 net zero emission goals

French strategy for achieving 2050 carbon neutrality

National Low-Carbon Strategy, or NLCS (Stratégie nationale bas-carbone – SNBC), which is reviewed every five years.

■"France 2030" : Investment plan of 30 G€ during 5 years aiming at developing industrial competitiveness and technologies of the future.

Eight billion for

- Develop small, innovative nuclear reactors in France with better waste management (1 G€)
- Become the leader in green hydrogen.
- Decarbonize the French industry (objective: -35% GHG by 2030)

□Four billion for future transportation

- Production of 2M Electric or hybrid vehicles
- Develop our first low-carbon aircraft



Source : Elysée

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CEA's vision for an integrated energy to achieve 2050 net zero agenda



Multi-vectors Power, heat, gas / hydrogen

Multi-scale & multi-agents Local-territorial hubs to continental scale

Smart grids digitalisation & instrumentation, demand side management,

Circular economy Primary & secondary ressources, carbon (CO₂)

Implementation requires :

- → Technological innovation
- → Convergence of nuclear and renewables
- → Business models and regulation
- → Society appropriation

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How could nuclear energy contribute?



Converging nuclear and renewables

O Flexible nuclear

O Small nuclear (SMR or AMR) in local energy hubs

Hydrogen production

④ Nuclear raffinery for production of efuels and e- carbon molecules

- Society acceptance: new nuclear, waste management, clean up and dismantling
- Circuar economy ressources management
- Adapt to climate change
- **③** Industrial deployment







France 2030 – A call for "Innovative Nuclear Reactors"

A French government initiative with a special fund of 1 G€ to support Nuclear Projects

• Favor the emergence of a french SMR offer







- Favor breakthrough innovation on advanced nuclear reactors in order to guarantee new uses, increased safety and better waste management
 - emergence of new concepts and new players (start-up like NAAREA and Jimmy Energy, and other)
 - scientific and technical assistance from the CEA could be implemented as RTO support to R&D







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Integration of nuclear energy at local scale is an adequate answer to several challenges related to energy transition

- To power grids that may not be suitable for large nuclear capacity (65% of grids below < 10 GW by 2040 due to regional cities growth)
- To provide power to isolated sites
- To balance intermittent RES production and avoid grid strengthening with local power production
- To decarbonize energy system by replacement of coal power plants or industrial boilers

SMR are also opening "new" use cases for nuclear energy

- Process heat for energy intensive industries
- District heating or cooling networks
- Local hydrogen production for territoral uses (mobility, industry)





nuward



SMR: Euratom project on hybrid SMR



- □ Kickoff meeting: September 12 -13, 2022
- Call topic: « Safety of advanced and innovative nuclear designs and fuels »
- Duration of the project: ~42 months
- Estimate of the project cost: ~3.3M€
- Organization leading the project initiative: CEA

ENEN Germany: GRS Energia, ENEA ENGIE WP1 CIRTE CEA WP2 Modeling for the WP3 Techno-economic simulation of the hybrid system analysis and optimisation of behavior the energy mix

Belgium: ENGIE, EC-JRC, FORATOM, Czech Republic: UJV Finland: VTT. FORTUM France: EDF, IRSN, CEA Italy: CIRTEN (POLIMI, UNIPI), Ansaldo Spain: Empresarios Agrupados Ukraine: Energorisk



SNETP label

SMR for heat only



CEA and VTT signed in june 2022 an agreement to collaborate in heating reactor R&D including both technical and economic studies





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Imaging and inventing nuclear refinery for e-fuels and e-carbon molecules









Focus on building technological bricks and developing R&D programm towards nuclear refinery



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