



The Sustainable Nuclear Energy Technology Platform (SNE-TP)

building the European Research Area in nuclear fission

Deployment Strategy



- Nuclear fission energy is crucial to achieve the European energy goals stated in European Commission's "Energy Policy for Europe" communication : low carbon emissions, security of supply, competitiveness and stable electricity prices
 - Nuclear energy is the main provider of low carbon electricity in Europe's energy mix : 31% of EU's electricity is produced from nuclear energy, representing a non-emission of almost 900 million tons CO₂ per year. Without nuclear, the European Union target to reduce CO₂ emissions by 20% by 2020 and 60-80% by 2050 is not achievable
 - Nuclear generation provides stable electricity prices, at a massive scale, bringing a competitive advantage to the EU industry, ensuring a strong security of electricity supply. Since uranium resource is by far less dependant to international stresses than other resources, the impact of fuel on electricity cost is low
 - The current fleet is primarily dedicated to base-load electricity generation. However, electricity demand is likely to increase in the future, as many industrial processes or the transportation sector will switch from fossil-fuelled to de-carbonised energy. Moreover, new non-electric applications of nuclear energy could be demonstrated if the market for alternative fuels (hydrogen, synthetic fuels) or heat processes develops
 - **To address these energy challenges, Europe must increase, or at least maintain, the share of nuclear energy**



Gen II

- Europe needs to keep its current Light Water Reactors fleet (Gen II LWR) operating with high level of safety and competitiveness
 - Given the proven benefits of nuclear energy in terms of competitiveness and low CO₂ emissions, the European energy policy must support the long term operation of the existing plants, while maintaining their high safety records, managing effects of ageing mechanisms, and continuing the efforts to optimize the utilisation of uranium resource
 - To support an objective of 60 years or more of existing Light Water Reactor (LWR) plants, priority actions must be undertaken, primarily :
 - **harmonization of European Long Term Operation justification methodologies**
 - **prevention and managing effects of ageing mechanisms, improvement of performance**
 - To further increase sustainability and competitiveness, actions will continue towards a more efficient usage of uranium and plutonium in LWRs
 - These actions are backed by strong R&D efforts, which will also benefit to the new type of assets that are already being deployed (Gen III) or will be deployed from 2040 onwards (Gen IV).



Gen III

- Development must be sustained to continuously improve the competitiveness and safety margins of the new technology of Light Water Reactor (Gen III LWR), as such reactors will operate during the whole of the 21st century
 - The new technology of advanced light water reactors (Gen III) already benefits from strong safety improvements. This new generation is being built across Europe, and it is very likely that the Gen III reactors will be operated most of the 21th century
 - R&D activities must continue to accompany the Gen III operations across the 21th century, to maintain the high safety level, operating performance, fuel cycle,...
 - Improving sustainability of Gen III reactors will require dedicated efforts to develop advanced fuel cycles and other reprocessing options for waste minimization and resource optimisation
 - To facilitate the construction of new reactors across Europe, efforts should be dedicated to the development of European harmonized plant design rules and justification methodology



Gen IV (1/3)

- To strengthen sustainability of nuclear energy, the Gen IV technologies must be deployed, among which Fast Neutron Reactors with closed fuel cycle can become commercially available by 2040 or even earlier if an ambitious yet realistic R&D and demonstration programme is put into place
 - Gen IV tech. can multiply by a factor 50 the energy production for a given amount of uranium fuel compared to current reactors. Another benefit is the reduction of nuclear waste, since Gen IV reactors generate less waste and are able to burn long living minor actinides
 - Gen IV tech. include a large set of reactor types, most of them being proven at the experimental level or even as prototypes, but not yet deployed in practice at commercial scale. Questions regarding the integration of components, scale-up of technology, policy and regulation, operating performance and costs are yet to be answered
 - Within the Gen IV reactors developed at the international level, Europe has set its own priorities, and fosters the development of Fast Neutron Reactors (FNR), among which the Sodium Cooled Fast Reactor (SFR) as a proven concept, the Lead Cooled Fast Reactor (LFR) and the Gas Cooled Fast Reactor (GFR) as alternative technologies



Gen IV (2/3)

- To strengthen sustainability of nuclear energy, the Gen IV technologies must be deployed, among which Fast Neutron Reactors with closed fuel cycle can become commercially available by 2040 or even earlier if an ambitious yet realistic R&D and demonstration programme is put into place
 - FNRs benefit from the operating feedback of past experiences, but the present safety, operational and competitiveness standards require new designs. To achieve a commercial availability of FNRs technologies by 2040, it is vital to continue and speed-up R&D on key topics, primarily :
 - primary system design simplification
 - improved materials
 - improved safety (safety standards at least comparable to the of Gen III)
 - innovative heat exchangers and power conversion systems
 - advanced instrumentation, in-service inspection capabilities
 - partitioning and transmutation of fuel
 - innovative fuels and core performance



Gen IV (3/3)

- Speeding up the development of Fast Neutron Reactor : a European Industrial Initiative
 - To accelerate the development and the deployment of GEN IV Fast neutron Reactor, the SNE-TP plans to launch a set of demonstration projects in the frame of the SET Plan European Industrial Initiative
 - The European Industrial initiative on FNR will include the SFR prototype whose construction is planned in France in 2020, and the construction of demonstrator of alternative technology (LFR or GFR). In addition, the initiative will include supporting irradiation and fuel fabrication facilities, as well as research facilities, among which a further assessment of accelerator-driven system for transmutation
- Euro. Ind. Initiative need co-investment from private and public sources
 - The EII costs might range from 5 to 10 billions €. A large part of these costs will be justified by a return from the future revenues generated by this technology. However, the costs are subject to uncertainties (regulatory framework evolution, unrecoverable costs resulting from immature technology, learning curve effect)
 - Therefore, a better coordination and funding of R&D programmes at European level must be enforced, combining EU (> Framework Program), national and private initiatives
 - The SNE-TP will interact with the European Commission, the Steering Group and the Alliance of the SET Plan to reach this objective. The Communication from the EC on the funding of the SET Plan should provide funding proposals for all low carbon energy technologies including fission



European integration

- To preserve its technological and industrial leadership, the European nuclear sector must increase its links at European scale and reduce fragmentation of efforts
 - The first step of the European integration of the Nuclear sector started with Euratom, the Frameworks programs and other EC initiatives.
 - Another step is required, since operating at the European scale requires harmonisation and standardisation of licensing processes, coordinated R&D between all stakeholders (utilities, vendors, research and technical support organizations), education and training of the existing workforce, etc.
 - Change in nuclear technologies will coincide with change in workforce. This is both a challenge and an opportunity. There is a need to accelerate the development of a skills pipeline between university and industry to attract young talented people.
 - To reduce fragmentation of efforts, priority actions and topics are recommended, following the Strategic Research Agenda



R&D coordination

- Improving Nuclear Fission R&D coordination at the EU level
 - The Sustainable Nuclear Energy Technology platform is ready in 2009 to try to implement a smart structure to share R&D needs and leverage R&D resources
 - It is proposed to start the implementation by addressing the long-term operation of the current fleet (Gen II and Gen III), building on the existing Nulife network .
 - An “Implementation” document / Action plan will be elaborated in 2009 to describe how research will be organised. This document shall be reviewed regularly .
 - This experiment being successful, the SNE-TP could propose an initiative aimed at organizing the nuclear fission R&D between stakeholders at the EU level
- In the longer term, the Sustainable Nuclear Energy Technology Platform aims to play a leading role in coordinating and implementing research, development and demonstration initiatives, in coordination with EU institutions and Member States willing to engage in the further development of fission energy, as well as with non-EU countries on a mutual benefit approach