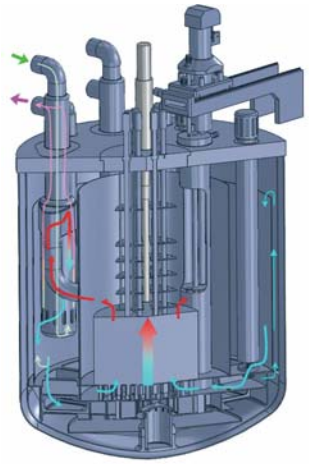
SNETP
Sustainable Nuclear Energy Technology Platform

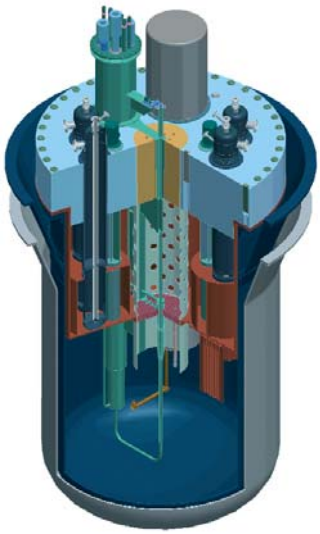
ESNII
The European Sustainable Nuclear Industrial Initiative

May 2010

A contribution to the EU Low Carbon Energy Policy:

Demonstration Programme for Fast Neutron Reactors





www.SNETP.eu

Why ESNII?

Nuclear fission energy is a proven technology that provides 30% of electricity in the EU-27, with reactors in 15 countries. The EU's Strategic Energy Technology Plan ('SET-Plan') acknowledges its role as a key technology: It is the largest source of low carbon energy, already saving nearly 900 Mt of CO_2 emissions a year. It contributes to Europe's security of supply by limiting the dependence on fossil fuel imports, and employs tens of thousands of people throughout Europe. Furthermore, nuclear fission energy has the potential to play a major role in Europe's longer term future low carbon energy mix.

The present known resources of uranium are able to supply for the next 100 years the forecasted nuclear fleet expected by 2040. However, depending on the growth rate of nuclear energy worldwide, the question of uranium resources will be raised sooner or later; therefore, it is reasonable to anticipate, as defined in the SET-Plan, the development of fast neutron reactors with closed fuel cycle. These technologies have the potential to multiply by a factor of 50 to 100 the energy output from a given amount of uranium, while improving the management of high level radioactive waste. They therefore offer the potential to provide energy for the next thousand years with the already known uranium resources.

FNRs offer potential energy for 1000 years with the known uranium resources

Target for 2040: Gen-IV Fast Neutron Reactors with closed fuel cycle ready for deployment

Fast neutron reactors have already been build and operated in Europe and in the world. However, major technological breakthroughs and investments are still necessary to develop and build modern fast neutron reactors, the so-called fourth generation. The research and development efforts are underway, but they need to be strengthened. This is the purpose of ESNII. This initiative clearly contributes to the SET-Plan vision by enabling deployment by 2040 of fast neutron reactor technologies with the highest safety standards and performance. By ensuring that uranium resources are available for centuries, this technology will increase Europe's security of energy supply, and provide economic, carbon-lean base-load electricity, thereby supporting a competitive European economy.

Definitions

- **ADRIANA**: "ADvanced Reactor Initiative And Network Arrangement": coordination action for mapping and gap analysis of research infrastructures for ESNII (http://adriana.ujv.cz)
- **ADS**: Accelerator Driven Systems
- **ALFRED**: Advanced Lead Fast Reactor European Demonstrator
- **ALLEGRO**: Experimental facility for the development and demonstration of GFR technologies
- **ASTRID**: Advance Sodium Technological Reactor for Industrial Demonstration
- **ENEF**: European Nuclear Energy Forum
- **ESFRI**: European Strategy Forum on Research Infrastructures
- **Gen IV**: 4th generation of nuclear reactors
- **GFR**: Gas-cooled Fast neutron Reactor
- **GIF**: Generation IV International Forum (www.gen-4.org)
- **LFR**: Lead-cooled Fast neutron Reactor
- **MWe**: Megawatt electrical power
- **MWth**: Megawatt thermal power
- **MYRRHA**: Multi-purpose hybrid research reactor for high-tech applications
- **SET-Plan**: The EU's Strategic Energy Technology Plan
- **SETIS**: SET-Plan Information System, managed by the EU Joint Research Centre
- **SFR**: Sodium-cooled Fast neutron Reactor
- **SNETP**: Sustainable Nuclear Energy Technology Platform (www.snetp.eu)
- **SRA**: SNETP's Strategic Research Agenda

6 Sept 2008: First meeting of the Task Force

26 Nov 2008: Presentation of ESNII at the SNETP General Assembly

2008

11 March 2009: First meeting with the SETIS team

7 Oct 2009: EC Communication on "Investing in the Development of Low Carbon Technologies (SET-Plan)"

9 Oct 2009: ESNII Worksh in Brussels, w representatives of Member Sta EIB and EC

What is ESNII?

FNR technology has been actively developed from the 1960s to the 1990s, with several demonstration and prototype projects in Europe and elsewhere[1]. Building on past experience, a new generation of nuclear concepts is now being developed, in line with today's international standards, and coordinated under the "Generation IV International Forum" (GIF).

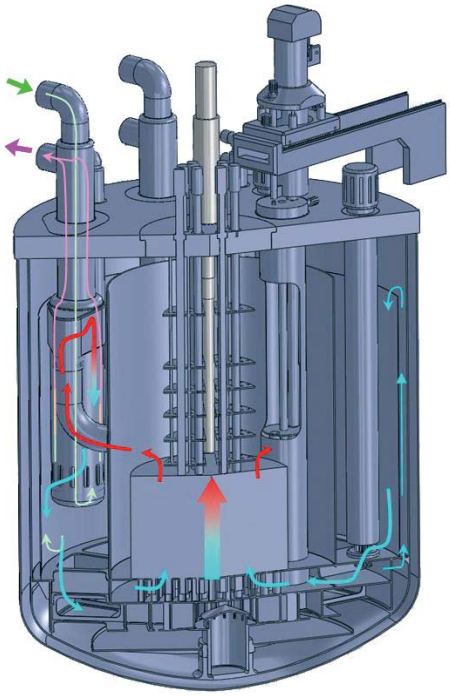
Europe, through SNETP, has defined its strategy and technological pathway for developing the fast neutron reactors:

- The Sodium Fast Reactor (SFR) as a first track aligned with Europe's prior experience, and,
- two alternative fast neutron reactor technologies to be explored on a longer timescale: the Lead cooled Fast Reactor (LFR) and the Gas cooled Fast Reactor (GFR).

ESNII is Europe's demonstration programme for Fast Neutron Reactor technologies with closed fuel cycle.

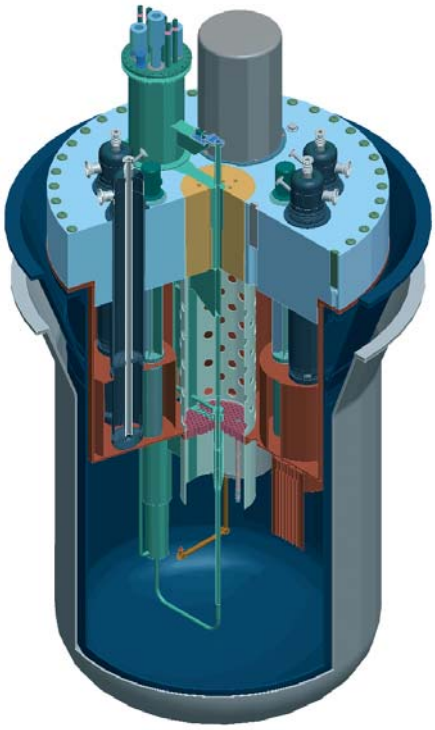
[2] US, Japan, China, India, Russia

The SFR concept



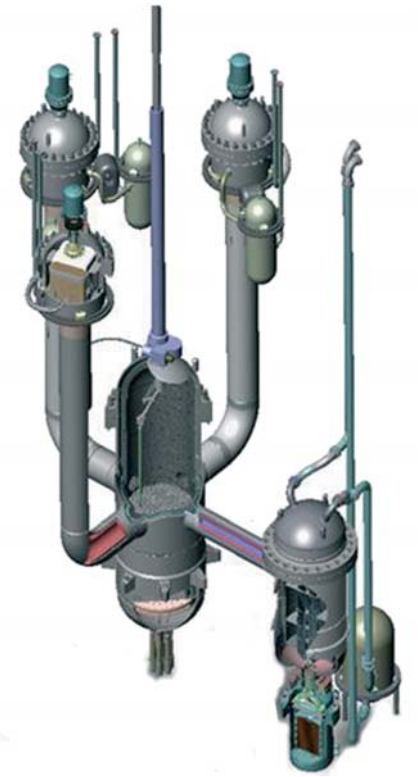
SFR prototype (ASTRID)

The LFR/ADS concept



LFR pilot plant (MYRRHA)

The GFR concept



GFR demonstrator (ALLEGRO)

Three concepts developed in ESNII:
SFR as the reference technology, LFR and GFR as alternatives

21-22 Oct 2009: ESNII session at the SET-Plan Conference in Stockholm

Dec 2009: France includes 650 M€ for ASTRID in its 'Big Loan' plan

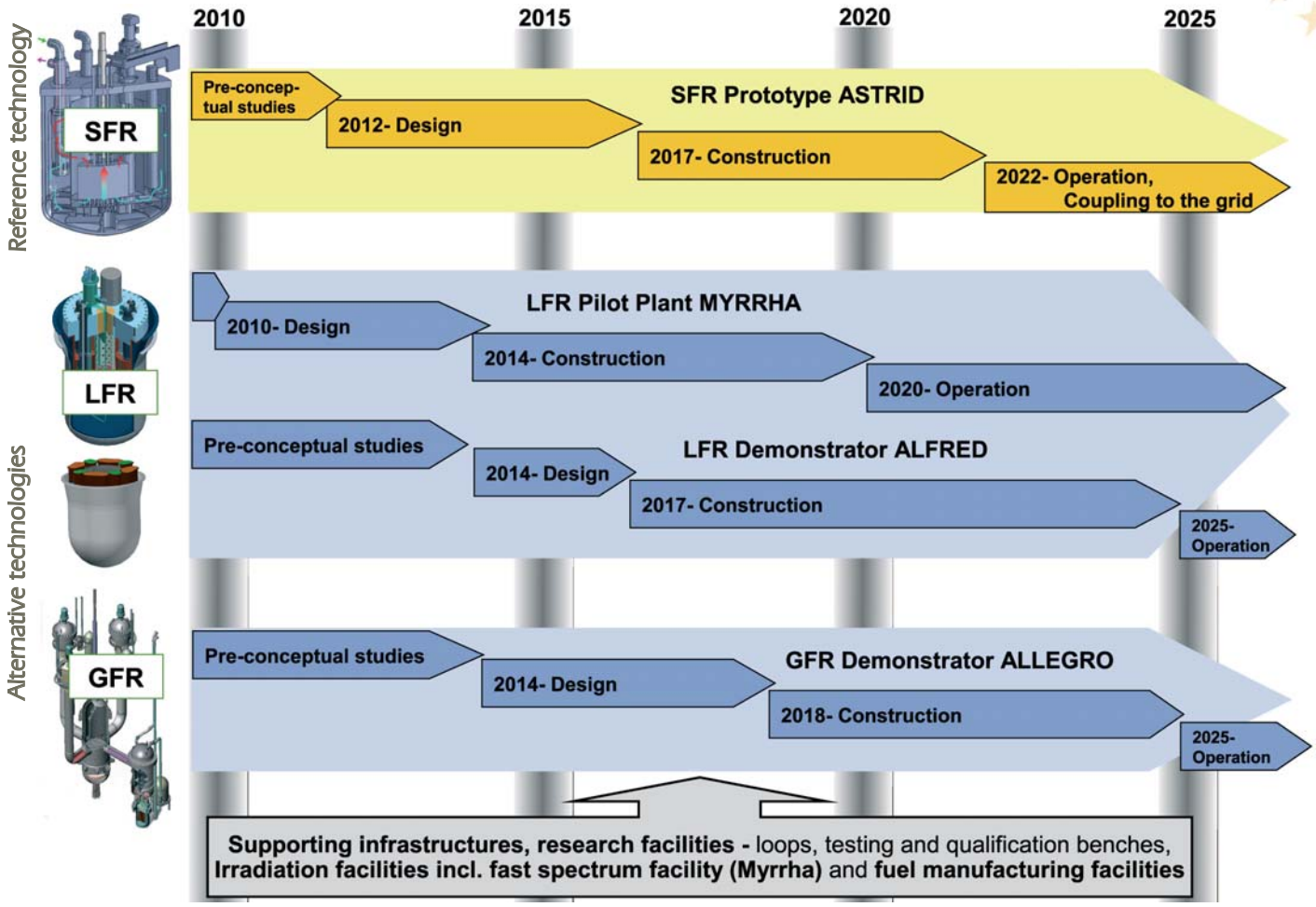
17 Dec 2009: Presentation of ESNII at ENEF/Opportunities meeting

31 Dec 2009: ALLEGRO and MYRRHA apply to ESFRI roadmap on "Energy Research Infrastructure"

18 Jan 2010: results of study on potential funding mechanisms and legal structures for ESNII projects

2 Feb 2010: kick-off of 'ADRIANA': gap analysis of research infrastructures for ESNII

2009



The ESNII roadmap

Why 3 technologies?

All three types of fast reactor have a comparable potential for making efficient use of uranium and minimising the production of high level radioactive waste. So what are the differences?

- The previous work in Europe on sodium technology gives this option a strong starting position. However, significant R&D is still required because of today's more stringent constraints on capital cost, environmental impact, safety, safeguards, proliferation resistance, and operational performance.
- As an alternative to sodium, lead does not react with water or air, has a very low vapour pressure, good heat transfer characteristics and is cheap. It has a very high boiling point and high gamma shielding capability. Finally its density is close to that of MOX fuel, which reduces the risks of re-criticality in case of core melt. Significant progress is still necessary to confirm the industrial potential of this technology, in particular because of the corrosive character of lead, and of its high melting point requiring the temperature to be maintained above 350°C. Furthermore, lead like sodium is opaque, so that in-service inspection remains to be properly addressed.
- As another alternative, the gas fast reactor offers enhanced safety using a totally inert coolant, with low risk of core disruptive accidents, simplified inspection and repair (non activated and transparent coolant), and potentially high temperature heat delivery for industrial processes. Significant progress is necessary to confirm the industrial potential of this technology, because of small thermal inertia of the core which requires a specific safety approach; innovative fuels with refractory cladding need to be developed to address the issues relating to the high power density and high temperature in the core.

5 March 2010: release of the ESNII concept paper and implementation plan for the SET-Plan Steering Group meeting

9 March 2010: Belgium gives its go-ahead for MYRRHA

25 March 2010: launch of an action on European codes and standards for ESNII

May 2010: 14 organisations sign the Memorandum of Understanding

3-4 June 2010: presentation of ESNII at the Set-Plan Conference in Madrid

14 Sept 2010: presentation at the SNETP General Assembly

15-16 Nov 2010: expected launch of ESNII at the SET-Plan Conference in Brussels

2010

The ESNII Task Force

A group of representatives of European industry and research organisations have constituted a Task Force under the umbrella of SNETP, in order to:

- Consolidate technical content and roadmaps,
- Interface with the SET Plan Governance Structure, and with SETIS,
- Propose guidelines for intellectual/industrial property issues,
- Foster the establishment of consortia and PPPs for executing the projects, propose the most appropriate funding and legal structures.

A memorandum of understanding formally defines the frame and principles for the Task Force. It was initially signed by 13 organisations from 7 member states[2] - a group likely to expand, as other organisations are expressing their interest to actively contribute to ESNII.

Since the first meeting in September 2008, the preparation of ESNII has made considerable progress with the delivery of the following strategic documents:

- A first consolidation of the ESNII roadmap and costing served as an input to the European Commission's Communication on "Investing in the Development of Low Carbon Technologies (SET-Plan)" in October 2009,
- A study on potential funding mechanisms and legal structures for the ESNII projects was delivered by Deloitte in January 2010,
- The ESNII concept paper, presenting the demonstration programme, its main milestones, costs, and key performance indicators was released in February 2010 – available for download at www.snetp.eu/esnii,
- The first implementation plan, defining the research priorities for the period 2010-2012, as required by the SET-Plan.

The strategic documents being delivered, projects on the three technologies can move towards a more operational phase with (1) the release of ADRIANA on the identification of the main research and testing facilities in support to the three technologies and with (2) the Belgium Government support for MYRRHA, (3) the French Government support to ASTRID and (4) the preparation of a memorandum of understanding on ALLEGRO technology between Czech, Hungarian and Slovak R&D organisations.

Now ESNII is ready for the official launch during the 2nd semester of 2010.

[2] Belgium, Czech Republic, France, Italy, Slovakia, Spain, and the UK

Members of the ESNII Task Force (May 2010)

Industry

AREVA, AnsaldoNucleare Una Società Finmeccanica, EDF, amec, CEZ GROUP, ŠKODA, GDF SUEZ

Research

cea, National Nuclear Laboratory, SCK•CEN Studiecentrum voor Kernenergie Centre d'Etude de l'Energie Nucleaire, ENEA, Gobierno de España Ministerio de Ciencia e Innovación, Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, ÚJV

ESNII and SNETP

About SNETP

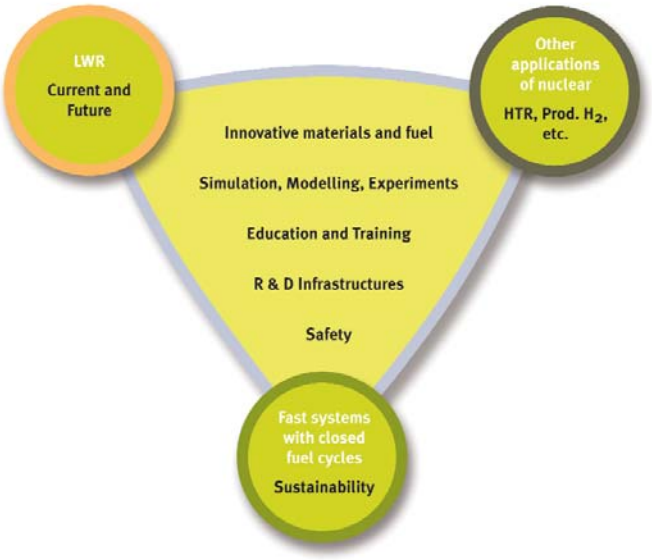
The Sustainable Nuclear Energy Technology Platform (SNETP), launched in September 2007, gathers European stakeholders involved in nuclear fission: industry and services, research, academia, safety organisations, NGOs, and associations.

SNETP prepared a vision resting on three technology pillars, as means to achieving the SET-Plan goals:

- Safety and competitiveness of today's fission technology,
- Fast neutron reactors with closed fuel cycles for increased sustainability,
- Cogeneration of process heat and power for industrial applications.

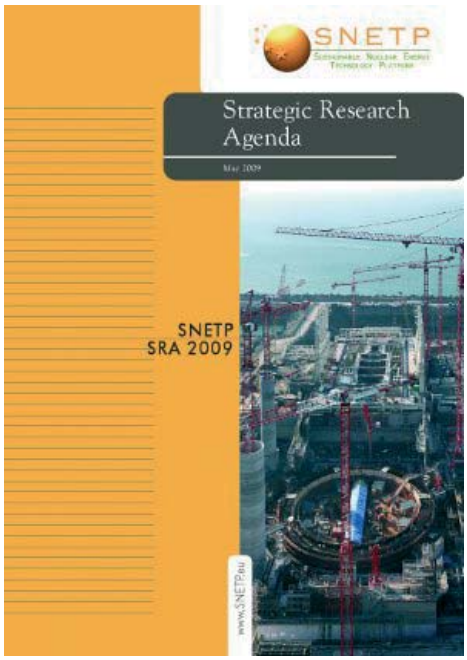
Having published its Vision Report (2007), Strategic Research Agenda (2009) and Deployment Strategy (2010), the Platform coordinates the implementation of the work programme by prioritising, organising and monitoring the RD&D.

In 2010 SNETP comprises 80 members, a number continuously increasing.



The SNETP vision

ESNII has been prepared under the umbrella of SNETP: the Task Force reports to the Platform's Executive Committee, and the ESNII programme is fully in line with SNETP's strategic research agenda.



The SNETP Strategic Research Agenda

Keep posted for events and developments at
www.snetp.eu/esnii

SNETP
Sustainable Nuclear Energy Technology Platform

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