The Joint Programme on Nuclear Materials of the European Energy Research Alliance (EERA JPNM)

Coordinating GenIV reactor materials research for a low carbon Europe

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www.eera-set.eu

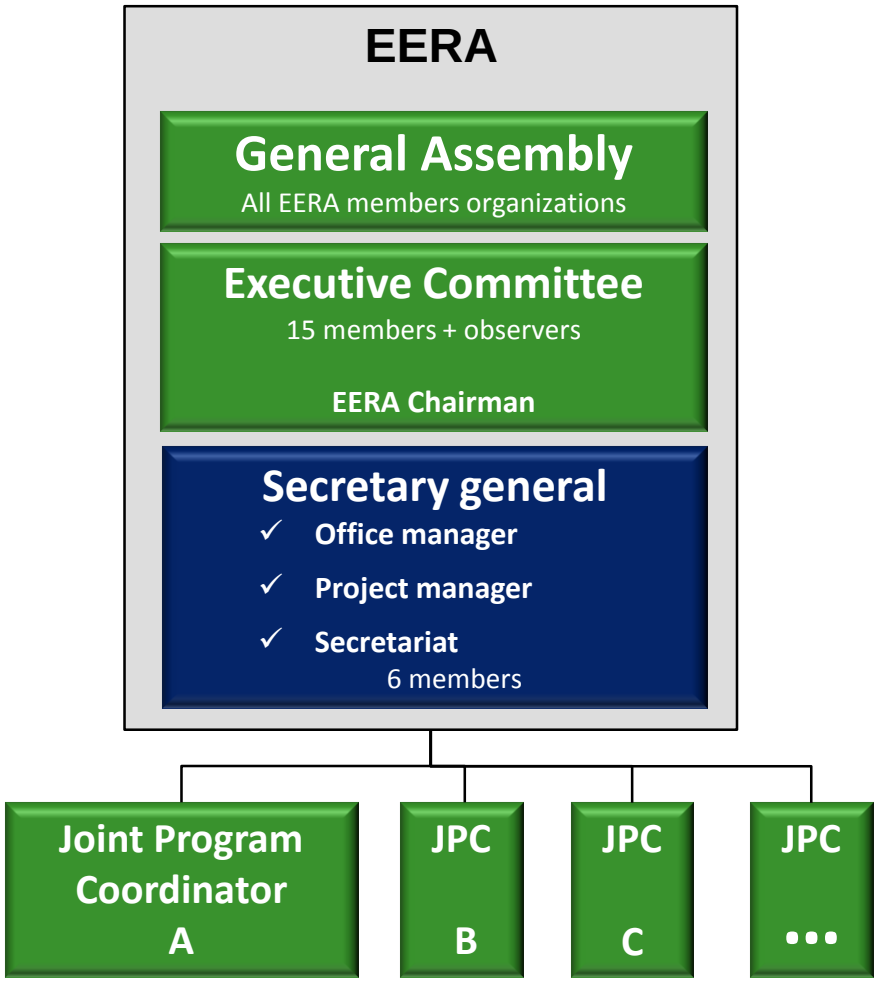
EERA is an official part of the EU SET-Plan.

http://setis.ec.europa.eu/

The European Energy Research Alliance coordinates energy research for a low carbon Europe

- **Alliance of European public research centres and universities** *(international non-profit association according to Belgian law)*
- **Cornerstone of the European Strategic Energy Technology Plan (SET-Plan)**
- **Brings together ~180 research organisations**
- **Works through 17 joint research programmes where research organisations share priorities & run research projects**

The JP on Nuclear Materials is one out of 17 JPs constituting the backbone of EERA

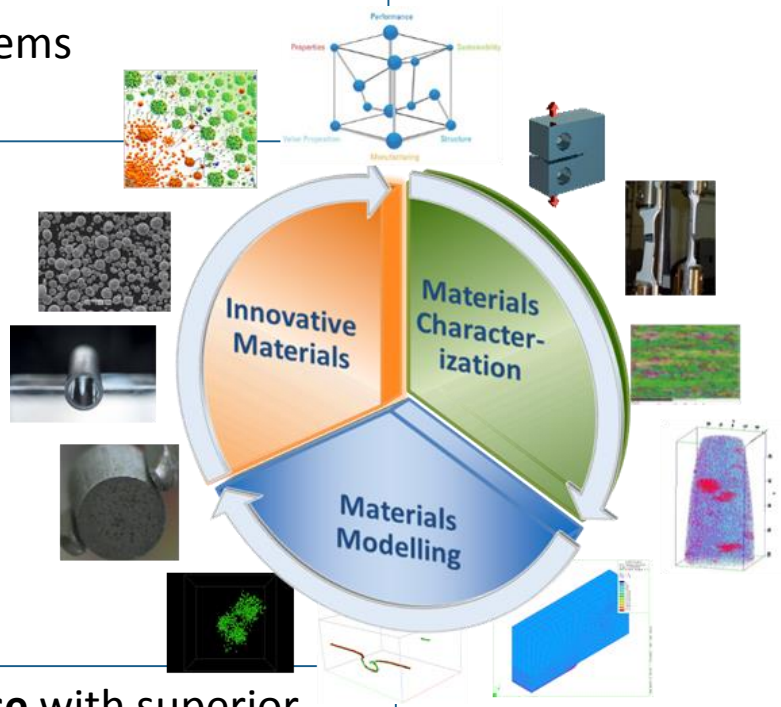


Objectives of the EERA JPNM

Pursue **better knowledge of materials behaviour** in operation:

- achieve predictive capability (radiation & temperature effects, compatibility with coolants …)
- select most suited materials for GenIV systems
- support definition of safe design rules

JPNM → improve **safety & sustainability** of Nuclear Energy, focusing on **materials aspects**



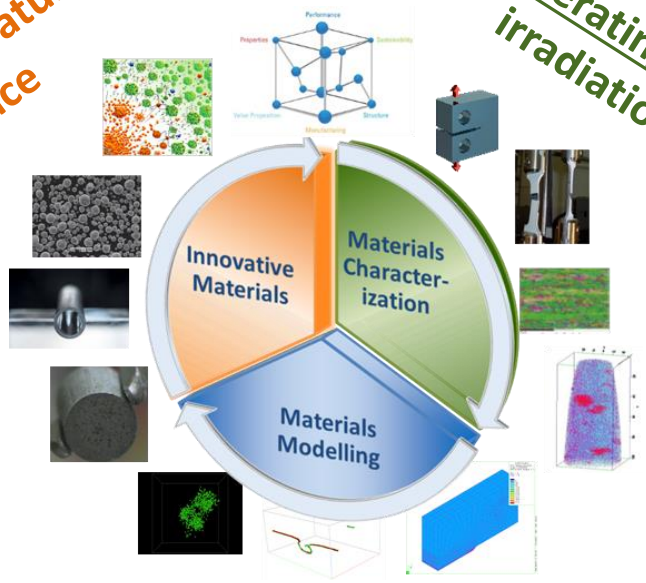
Develop **innovative materials for industrial use** with superior capabilities:

- resistant to high temperature and irradiation
- resistant to aggressive environments

Three JPNM grand challenges

Development of new materials of nuclear-relevance, with superior thermo-mechanical properties: radiation-, temperature- and corrosion-resistance

Elaboration of design rules and procedures for assessment and testing of the materials envisaged, at the expected operating conditions (high T, prolonged irradiation, aggressive environment).



Development of physical models coupled to advanced microstructural characterization to achieve high-level understanding and predictive capability

Documents detailing the research strategy and plan of the EERA-JPNM

Vision paper
www.eera-jpnm.eu About us / Downloads
Also on SETIS website

Vision paper

Strategic Research Agenda

Description of Work (general + 6 DoW of SPs)

Provide the **position of the JPNM** on the energy and nuclear energy arena, **the challenges and the pathway** to address them. VP available at JPNM website. ***Roadmap in preparation.***

Collection of **all activities of relevance** over a period of **five years** in each SP. The results will belong to the JPNM, i.e. will be **shared** : from Euratom funded projects to national programmes.

Organisation in subprogrammes & management board

Coordinator: Lorenzo Malerba, SCK•CEN, Belgium
Deputy Coord: Angelika Bohnstedt, KIT, Germany
Cross-cutting issues: Jana Kalivodová, CVR, Czech R.

	Structural materials	Fuel materials
Materials exposure & qualification Design rules	SP1 - Materials for ESNII demonstrators and prototypes Karl F. Nilsson, JRC Petten	
Development of advanced materials & manufacturing processes	SP2 – Innovative high temperatures steels Marta Serrano, CIEMAT, Spain SP3 – Refractory materials: ceramics and metals Massimo Angiolini, ENEA, Italy	SP5 – Synthesis, irradiation and qualification of advanced fuels Marco Cologna, JRC Karlsruhe
Advanced materials modelling & microstructural characterization	SP4 – Physical modelling and modelling oriented experiments for structural materials Cristelle Pareige, CNRS/U. Rouen, France	SP6 – Physical modelling and separate effect experiments for fuels Marjorie Bertolus, CEA/DEN Cadarache, France

JPNM: 49 Participants, 17 countries

Nr.	Name	Country	Role /Responsibility
1	**CEA**	**France**	**Full participant / SP6 coordinator**
1.1	EDF	France	Associate / Industry
1.2	UTBM	France	Associate
2	**U. Chalmers**	**Sweden**	**Full participant**
3	**CIEMAT**	**Spain**	**Full participant / SP2 coordinator**
3.1	CENIM (CSIC)	Spain	Associate
3.2	ICCRAM	Spain	Associate
3.3	IMDEA Materials	Spain	Associate
3.4	U. Alicante	Spain	Associate
3.5	UPCatalunya	Spain	Associate
4	**CNR**	**Italy**	**Full participant**
5	**CNRS**	**France**	**Full participant / SP4 coordinator**
6	**CVR**	**Czech Republic**	**Full participant / X-cutting issues**
6.1	COMTES	Czech Republic	Associate
6.2	STUBA	Slovakia	Associate
7	**ENEA**	**Italy**	**Full participant / SP3 coordinator**
7.1	CSM	Italy	Associate / Industry
7.2	IIT	Italy	Associate
7.3	POLIMI	Italy	Associate
7.4	POLITO	Italy	Associate
8	**HZDR**	**Germany**	**Full participant**
8.1	TU Dresden	Germany	Associate
8.2	ILT	Germany	Associate
9	**JRC**	**EU**	**Full participant / SP1/SP5 coordinator**
9.1	Raten	Romania	Associate
10	**KIT**	**Germany**	**Full participant / Dep. JP Coordinator**
10.1	DLR	Germany	Associate
10.2	MPA	Germany	Associate
11	**KTH**	**Sweden**	**Full participant**
12	**NCBJ**	**Poland**	**Full participant**
12.1	AGH	Poland	Associate
13	**NRG (ECN)**	**The Netherlands**	**Full participant**
13.1	TU Delft	The Netherlands	Associate

Nr.	Name	Country	Role / Responsibility
14	**PSI**	**Switzerland**	**Full participant**
14.1	ETH Zürich	Switzerland	Associate
14.2	SUPSI	Switzerland	Associate
15	**SCK·CEN**	**Belgium**	**Full participant / JP Coordinator**
15.1	Inst. Phys. Zagreb	Croatia	Associate
15.2	KULeuven	Belgium	Associate
15.3	OCAS	Belgium	Associate / Industry
15.4	ULBrussels	Belgium	Associate
16	**UKERC**	**UK**	**Full participant**
16.1	METU	Turkey	Associate
16.2	NNL	UK	Associate
16.3	CCFE (UKAEA)	UK	Associate
17	**VTT**	**Finland**	**Full participant**
17.1	Aalto U.	Finland	Associate
17.2	IFE	Norway	Associate
17.3	U. Helsinki	Finland	Associate

17 full members

32 associates

EERA JPNM connection with SNETP and its pillars

EU functioning Treaty

European Commission

Euratom Treaty

Coordination of low CO_2 energy research in EU

SNETP
Sustainable Nuclear Energy Technology Platform

TRL ≤ 5

TRL ≥ 5

Gen IV

Gen II/III

CoGen

EERA
European Energy Research Alliance

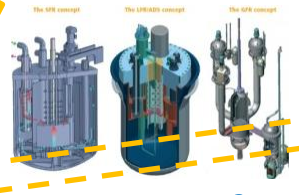
Industrial initiatives

Since 2010 - Support with research on materials

ESNII
European Sustainable Nuclear Industrial Initiative

NUGENIA
Delivering projects in nuclear generation II & III research and development

NC2I
Nuclear Cogeneration Industrial Initiative



JP energy x

JPNM (1 of 17)

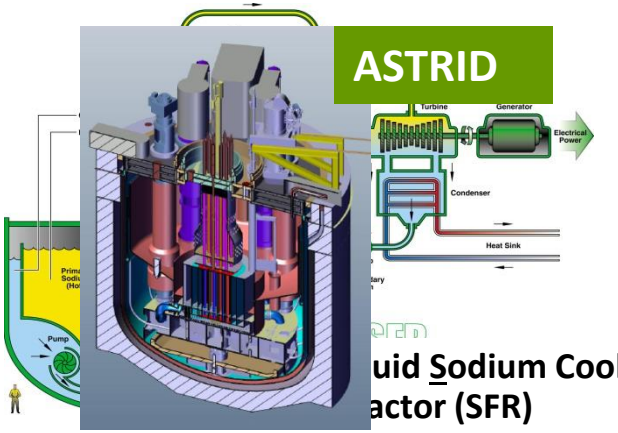
17 JPs

X-cutting issues

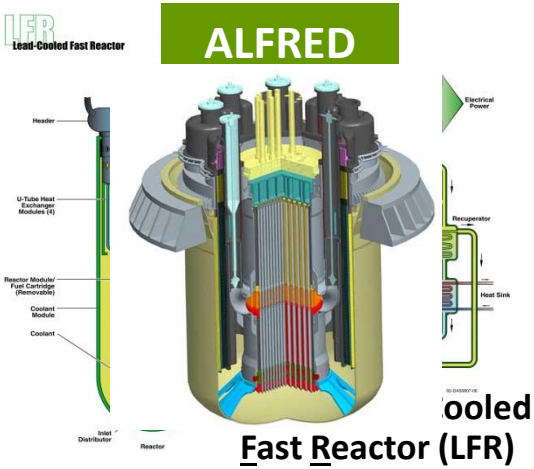
EUROfusion

Signature of MoU between EERA JPNM & SNETP created a formal link between the two sides

Links with ESNII, but also NUGENIA and NC2I, through GenIV systems

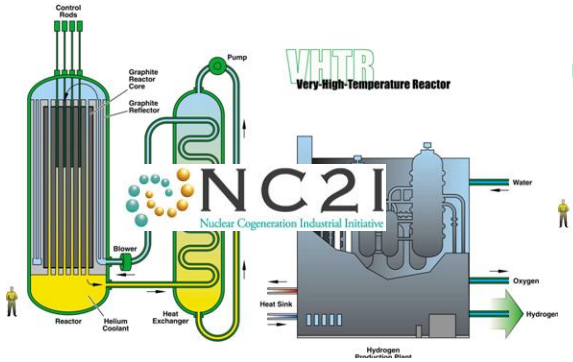


uid Sodium Cooled Fast actor (SFR)

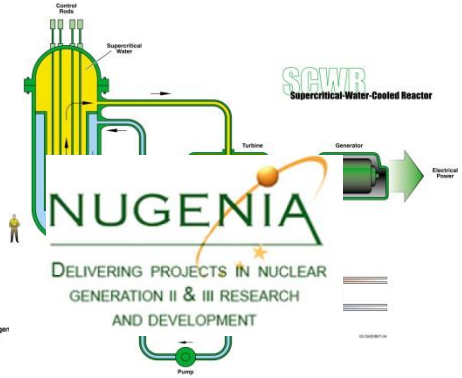


ooled Fast Reactor (LFR)

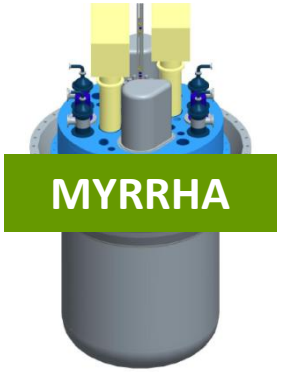
Fast GFR)



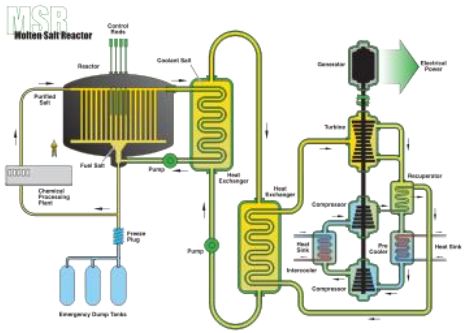
(Very) High Temperature Reactor (HTR)



SuperCritical Water Cooled Reactor (SCWR)



Accelerator Driven System (ADS)



Molten Salt Reactor (MSR)

European Sustainable Nuclear Industrial Initiative ESNII European Sustainable Nuclear Industrial Initiative **concepts**

Instruments of implementation of the EERA JPNM: the pilot projects

Task Forces (TF) → **Groups of experts** appointed to provide specific answer to a question, delivering a report. In charge for ~1 year or time required to deliver.

Used eg for the problem of 60 years of design lifetime

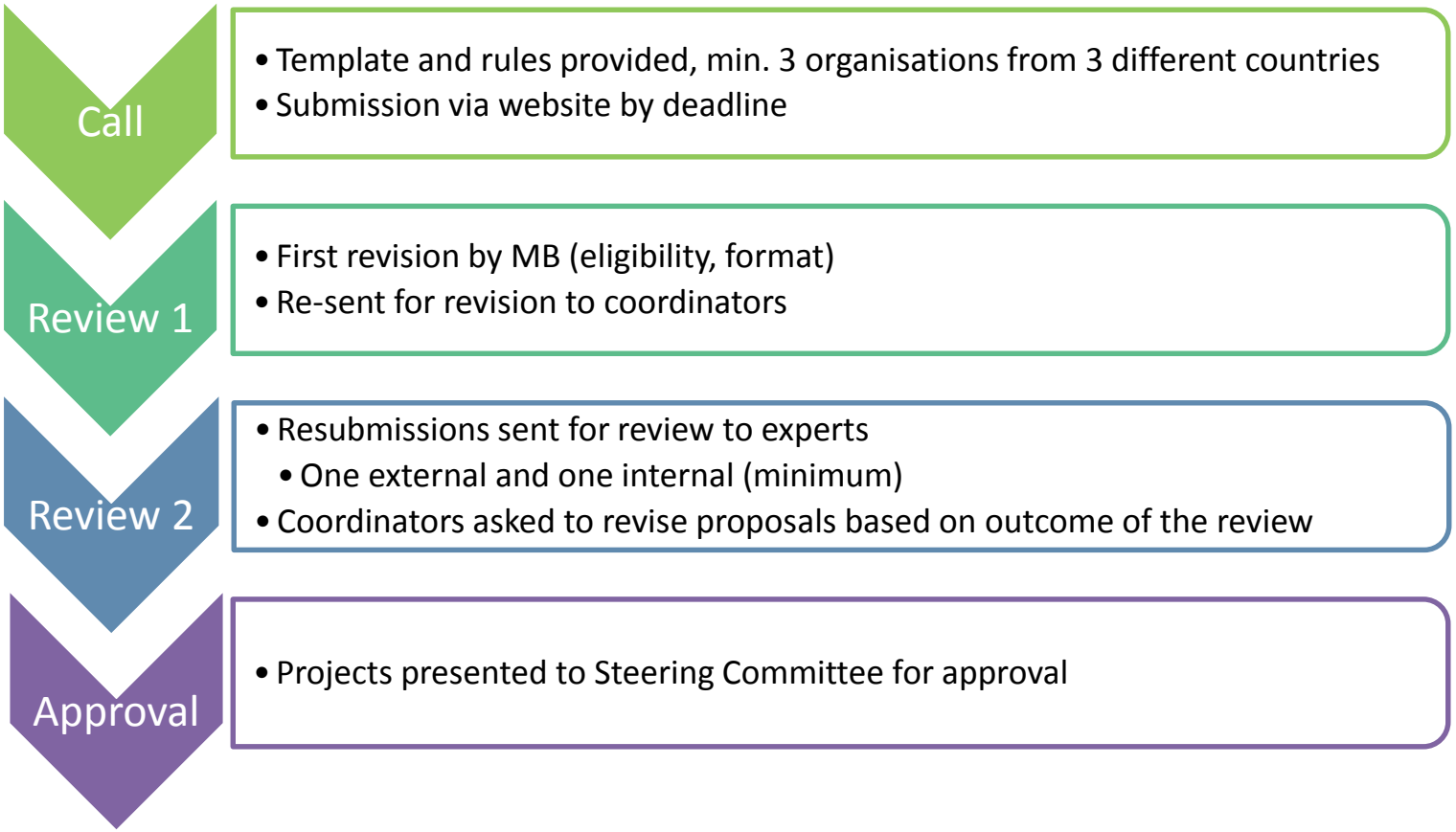
Joint Technical Teams (JTT) → **Scientific community** involved in each SP that meets regularly in targeted workshops or other meetings to monitor and **share results and discuss collaboration**.

Essential for the direct involvement of researchers

Pilot Projects (PP) → Small **projects** (~2-3 M€) **focused on precise topics** included in DoW that result from **convergence** of plans of a few labs from different MS. Typical duration: 3-4 years.

Main instrument for the alignment of national programmes

Pilot project proposal selection procedure



The set of approved pilot projects, together with previous ones and a few monographic activities, constitute the current EERA JPNM research portfolio:

Activities on which different organisations/countries agree to work together → alignment

However, the EERA JPNM does not dispose of own funds for research

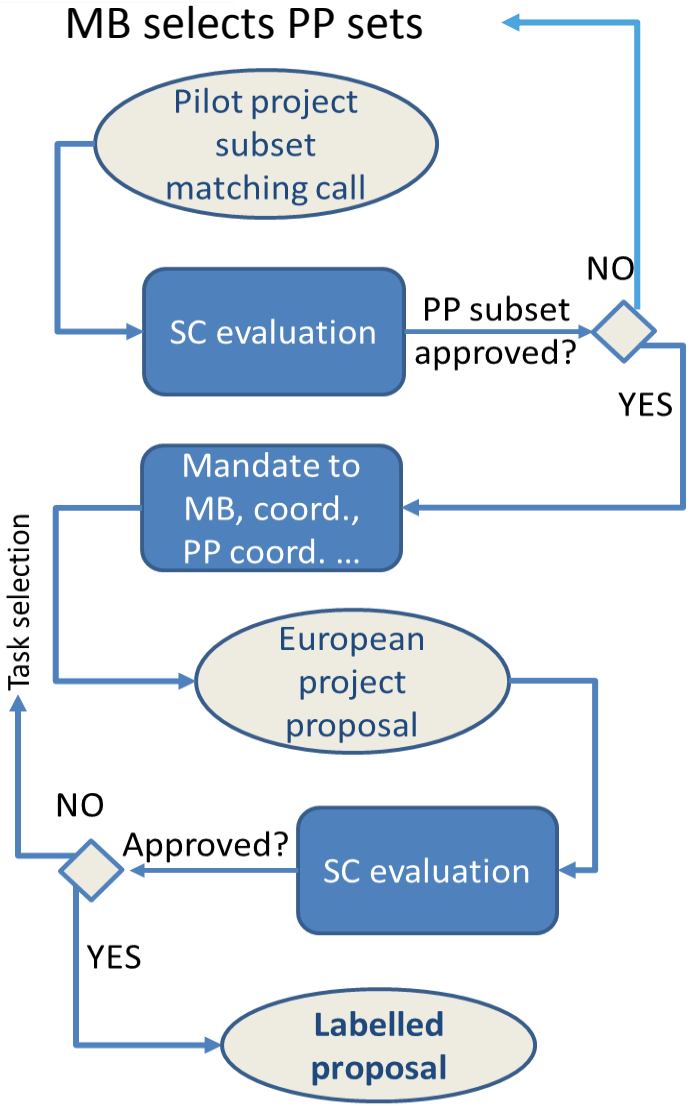
What does the launch of pilot projects provide?

- Definition of concrete short/medium term European research agenda
  - Foster coordinated use of institutional funding
- Quantification of resources required
  - Who, where, how, using which infrastructures
  - How much it costs
- Identification of research gaps , clear perception of what is covered by current funding and what not
  - Advisory role of EERA JPNM to EC and MS

Research activities that are part of pilot projects are the target of funding opportunities at all levels:

institutional, national, European, international

Labelling procedure: project proposals must provide support to pilot projects



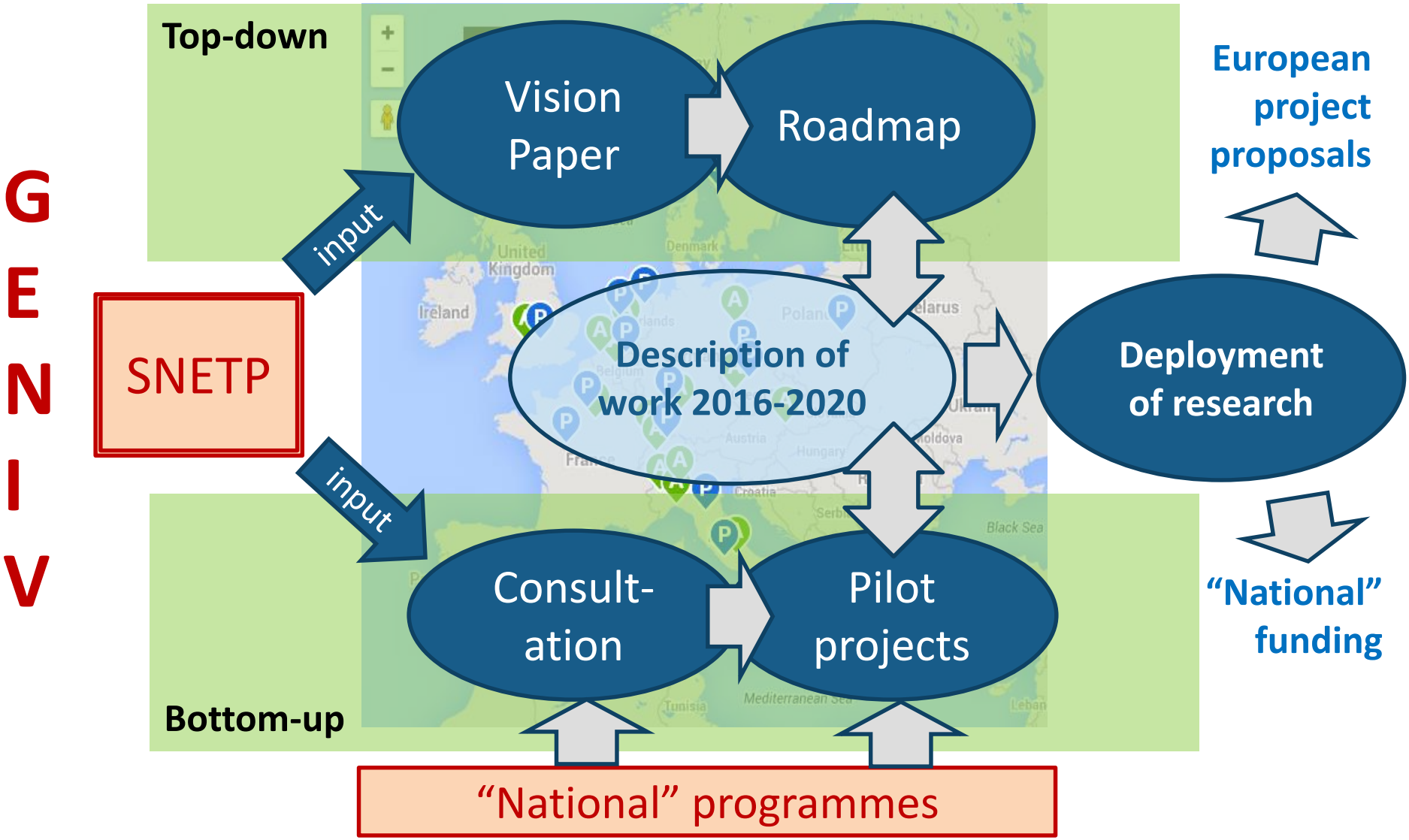
The EERA JPNM labelling procedure is based on the principle that EC project proposals must provide direct support to the research portfolio of the JPNM, embodied by the approved pilot projects

Since PP entering proposals must be selected and tasks from them chosen, this process implicitly implies prioritization

LABEL:

"This project proposal aligns major research performing organisations in the framework of EERA and the SET-PLAN"

Underlying strategy: combination of bottom-up and top-down approaches



GEMMA: GenIV materials maturity

SP1

CERBERUS, 2.4 M€
Corrosion ERosion BEhaviour of nucleaR materials in heavy liqUid metal coolantS

RESTRESS, 0.8 M€
Assessment of residual stresses for nuclear components and its impact on weld integrity

WELLMET, 3.1 M€
Welds' manufacturing and characterisation in heavy liquid metals

SP4

MARACAS, 2.4 M€
Simulation of Model Alloys Representative of AustenitiC stAinless Steels.

MOLECOS, 1.3 M€
MOlten LEad and lead bismuth COrrosion of Steels.

STAR-TREC, 1.0 M€
STructural features, mechAnical pRoperties, and environmental Testing of REfractory Coatings for next generation nuclear systems

SP3

ALCORE, 1.4 M€
Alumina forming steels and modified surface layers for lead-cooled fast reactors

SP2

12.4 M€

⊂

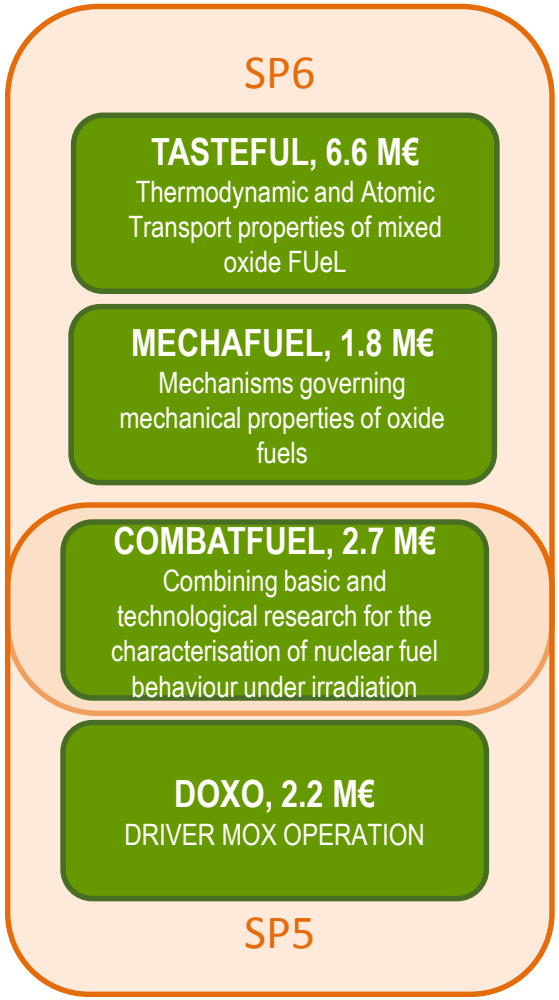
Prioritization : Materials for ESNII Prototypes

GEMMA
6.6 M€ declared cost
4.0 M€ requested
23 participants (incl. Korea)
Coord. ENEA (P. Agostini)

Kick-off: 21-22 June 2017 in Rome

~32% funded

INSPYRE: Investigations Supporting MOX Fuel Licensing in ESNII Prototype Reactors



13.3 M€

⊂

Prioritization

MOX for ESNII prototypes

INSPYRE

9.4 M€ total cost

4.0 M€ requested

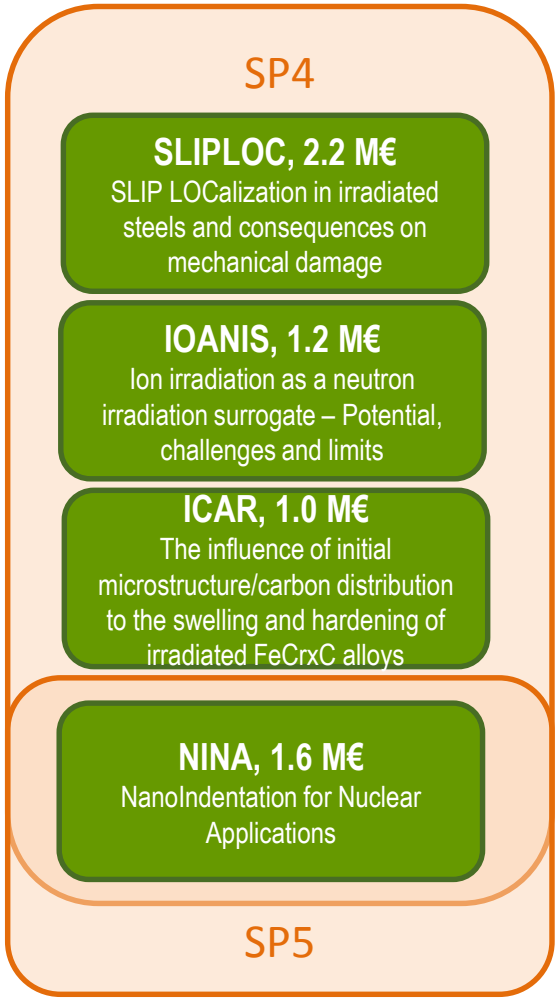
14 participants

Coord. CEA (M. Bertolus)

Kick-off: 5-6 Sept. 2017 in Lecco (Italy)

~30% funded

M4F: Multiscale Modelling for Fusion and Fission Materials



6.0 M€

⊂

prioritization

M4F

6.5 M€ total cost (fission & fusion)

4.0 M€ requested

2.0 fusion + 2.0 fission

21 participants

Coord. CIEMAT (M. Serrano)

Kick-off: 5-6 Sept. 2017 in Madrid

~33% funded

JPNM added value in 10 points

1. Framework for researchers to promote ideas and initiatives through trans-border collaboration
2. Centralised collection and dissemination of data, results, information on events, etc
3. Promotion of needs of the relevant scientific community in the outside world
4. Coordination of national and European project proposals based on joint prioritization and short/medium-term planning
5. Optimisation of use of resources towards targeted priorities, focusing institutional, national and European funds towards common goals
6. Access to previous project results on which to build future ones, maintaining stable research lines
7. Recognition of credibility and excellence by MS and EC, leading in the medium-to-long term to dedicated support
8. Single interlocutor and entry point for exchange and collaboration with all stake-holders
   - EC & MS, industry, and other platforms, including international organisations (GIF, IAEA, NEA-OECD, …);
9. Promotion of cross-fertilisation with other energy technologies and recognition of nuclear energy as low-carbon technology;
10. (Potentially) coordinate of irradiation campaigns, making best and most affordable use possible of existing facilities

Interest for Ukrainian organisations

- Identify concrete Ukrainian contributions that suitably complement ongoing research on GenIV nuclear materials in the EU
  - Ensure role of Ukrainian actors in a European framework
  - Prepare participation in (partially) funded H2020 projects

- However
  - Some level of in-kind contribution is required
  - Being members of EERA costs a fee

Ukraine may have an interest to create a single umbrella organisation as entry point to EERA (not only JPNM)

For more info: www.eera-jpnm.eu – Contacts:

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- SP6 Coordinator: Marjorie Bertolus, CEA (FR), marjorie.bertolus@cea.fr
- Cross-cutting issues: J. Kalivodová, CVR (CZ), Jana.Kalivodova@cvrez.cz

Thank you for listening