

International Research Collaboration Under Scrutiny

“Return of Experiment from CEA on low carbon energies development”

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7th Conference RD20 – 30th of October 2025

Content

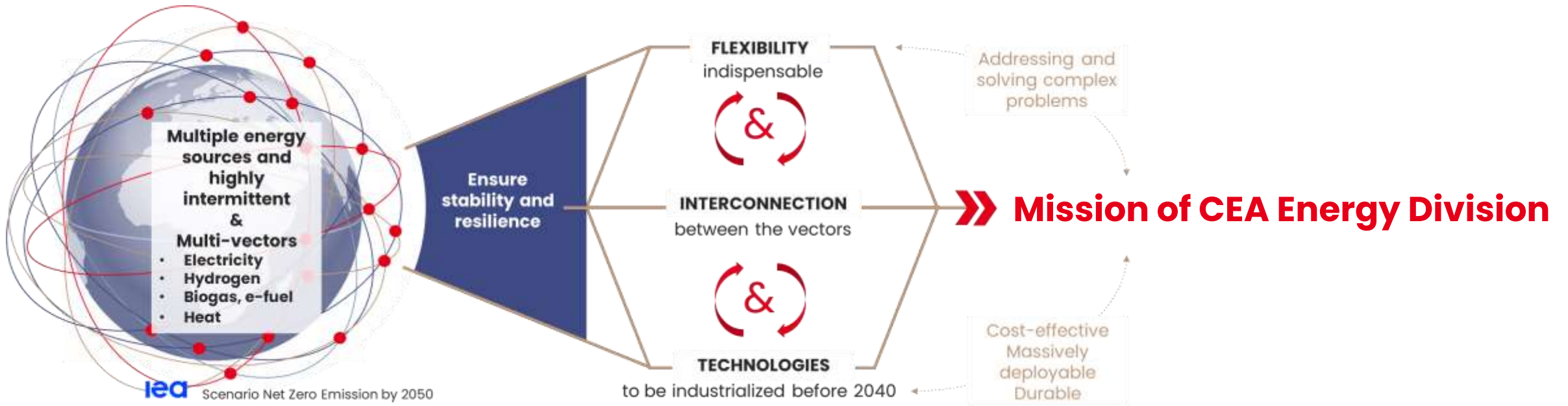
1. CEA Introduction
2. Observation on International Collaboration
3. Return of Experiment at CEA
4. Conclusion





1. CEA Introduction

NZE scenario at CEA: a comprehensive, multi-faceted approach to energy networks and systems



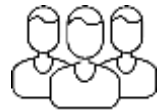
“With an **integrated vision of the energy system**, CEA is looking at all modes of **low-carbon energy** production (nuclear energy and renewable energies), their **interactions within the network** (storage, control, conversion), the issue of resources with a view to the development of an integrated energy system in a closed materials cycle, taking into account the **technical, economic, societal and political dimensions**”



- **Climate change, Technological breakthroughs** (digital)
- **Evolving role of players** (territories, consumer players)
- **Transformation of the industrial sector** (new services, business models)
- **Sovereignty issues** (relocatization, geostrategic issues for materials)

Key figures* and implantation of energy activities at CEA

*2024 datas



3750 Employees on permanent contracts,



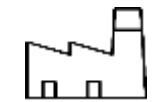
500 PhD students and post-docs



1540 M€ Budget



230 Institutional partners
(France & International)



250 Industrials partners
(France and international)



225 Patents per year



11 Start-up created from 2020 to 2023

R&D resources

- 38 nuclear basic installations (INB) and R&D platforms
- 15 nuclear service facilities

Zoom on
Solar Platform



Zoom on
Battery Platform

CEA in Europe and internationally

IN EUROPE

- **STRONG BILATERAL COOPERATIONS** with Fraunhofer, Imec, FZJülich, VTT...
- **CONTRIBUTING TO 29 STRUCTURES ASSOCIATED** with 24 European partnerships.
- **MEMBER** of the European association of RTOs.
- **FOUNDING** member of EDRIN.
- **Euratom**, 1st recipient.
- **Horizon Europe**, 3rd recipient.
- **>100 M€** European funding annually.



INTERNATIONALLY

- **REPRESENTING FRANCE** at IAEA and NEA.
- **COUNTERPART OF FOREIGN ADMINISTRATIONS** (DOE, CAEA).
- **A NETWORK** of representatives in 11 countries.
- **PARTNERSHIPS WITH MAJOR ACTORS**
 - Industry (EU, USA, UK)
 - Academics

INVOLVED IN MAJOR EUROPEAN AND INTERNATIONAL INFRASTRUCTURES AND PROJECTS

- **MEMBER** of ESRF, ILL, ESS...
- **MEMBER** of EuroHPC.
- European Chips Act pilot line (FAMES).
- Nuclear fusion (ITER).



65% PUBLICATIONS OF CEA
involve international co-authors

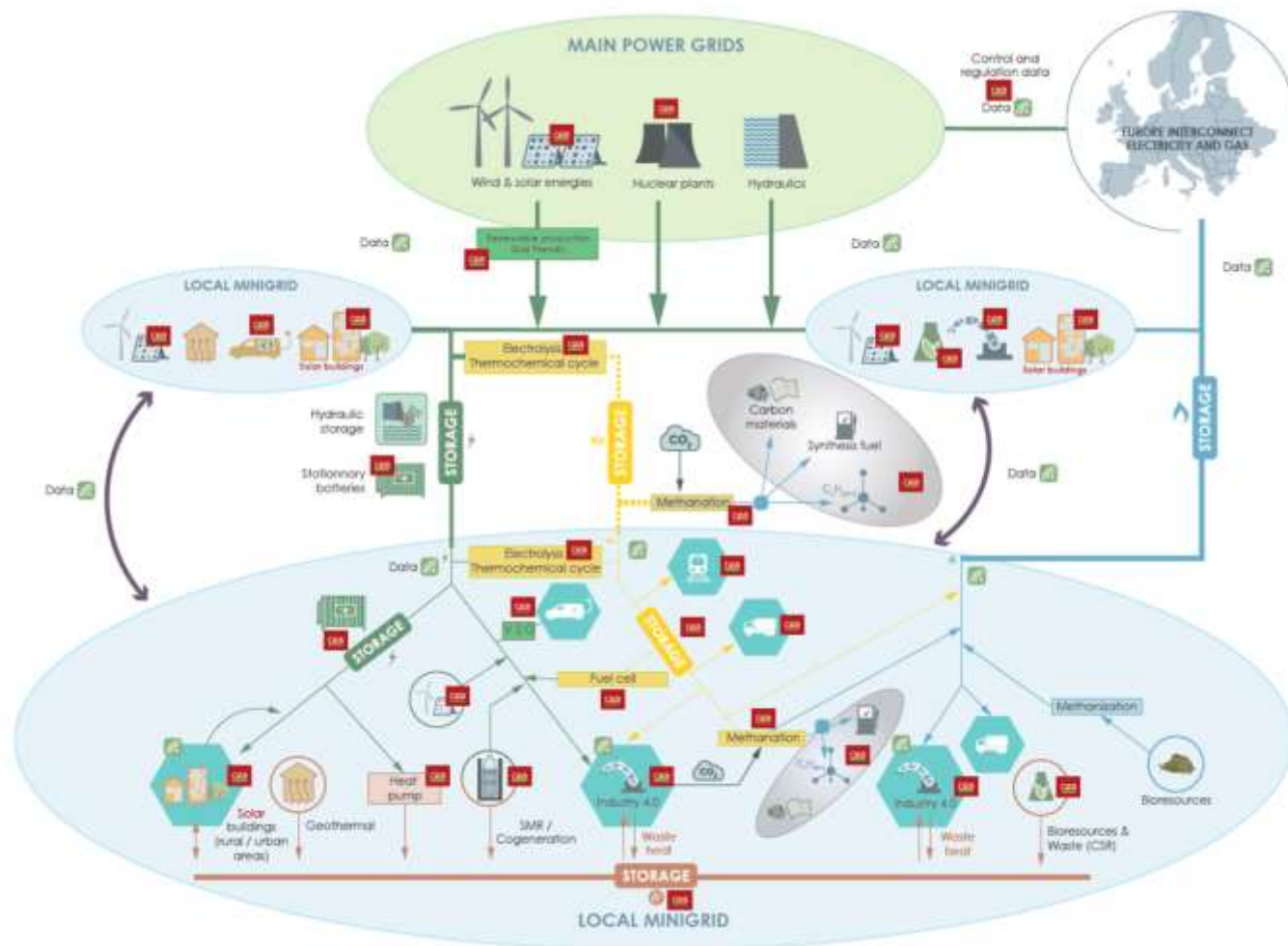


2. Observation on International Collaboration

Turning MoU into Running Task is not a long and flowing river.

Depend on Typology/Objectives/Success factor/Point of Attention

CEA's integrated vision of the energy system, to contribute in reaching 'Net Zero 2050' and French government's objectives



SYSTEM FEATURES

Multi-energy carriers
(power, heat,
gas/hydrogen)

Multi-scale
and multi-agents

Smart grids,
digitalization and
instrumentation,
energy management

Circular economy
(natural resources and
carbon, advanced
materials)

REALIZATION CONDITIONS

Renewables and
nuclear convergence

Technological
innovations

Regulation and
business models

Society
engagement

CEA's integrated vision of the energy system contributes to the national strategy and has an international reach



Our work contributes to the **definition of French energy strategy and policy**



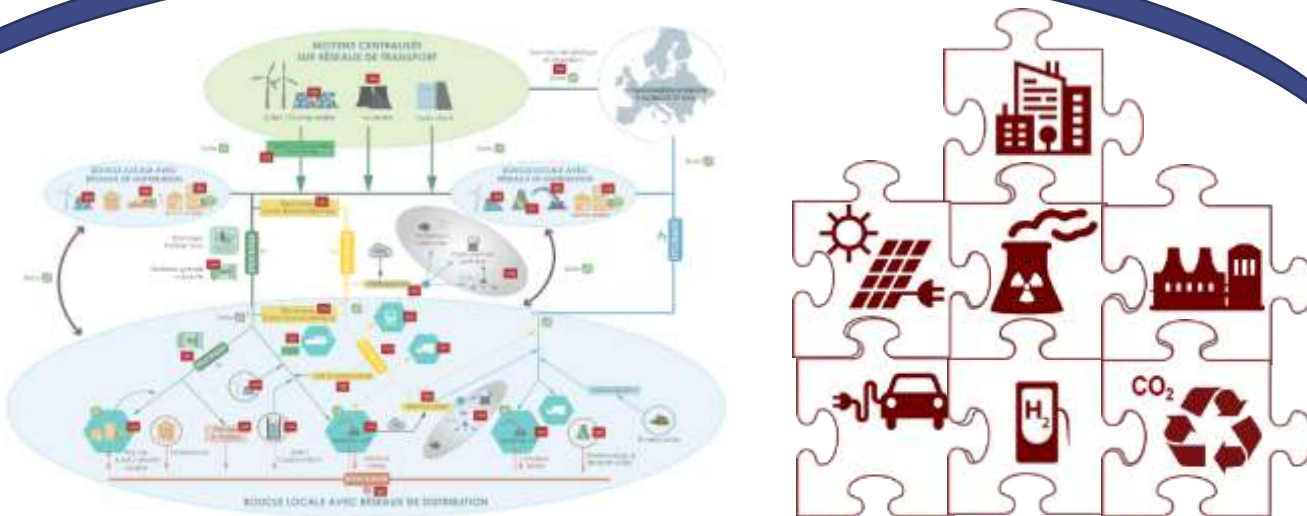
Our activities are fully in line with **national research and innovation strategies**



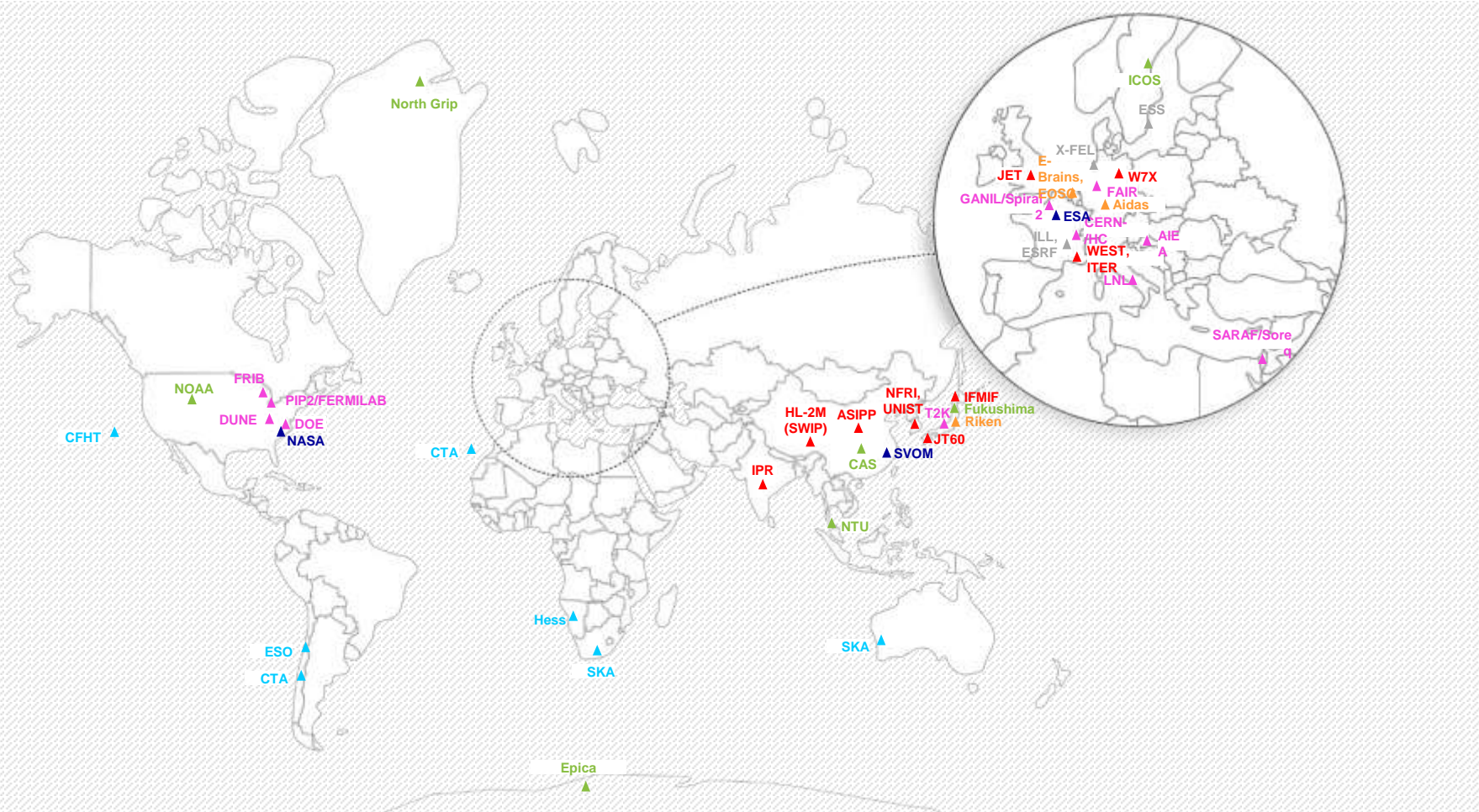
Our vision of an integrated system is **internationally Shared and challenging**



International Partnership is needed



Main collaborations with international infrastructures and research organisations



- SPACE**
- ASTROPHYSICS, ASTROPARTICLES**
- CLIMATE, ENVIRONMENT, CIRCULARECONOMY**
- FUSION**
- DIGITALTECHNOLOGY, OPENSOURCE**
- PARTICLEPHYSICS, NUCLEARPHYSICS**
- NEUTRON, SYNCHROTRON AND LASER SOURCES**

Various Typologies of International Collaboration to serve a large variety of Objectives

International Organisation
(ex CERN)

(ex CERN)

Joint Research Center
(EX for ...)

(EX for ...)

Teaming Project
(ie NOM ...)

(ie NOM ...)

EU Collaborative Project
(Horizon ...)

(Horizon ...)

Facilities Sharing
(ex ...)

(ex ...)

WG Collaboration
(ie NEA ...)

(ie NEA ...)

Researcher Exchange
(PhD, ...)

(PhD, ...)

→ Objectives :

- Increase in Skill level
- test protocol resilience
- Reducing Cost
- Complementary Knowledge
- Funding
- Safety experience
- Database
- Multiply case study and modeling
- Benchmarking EIS
- Supporting Talent Pipeline

→ Watchpoint/Success Factors :

- Intellectual Property
- Funding vs Objectives
- Complementarity (Win-Win Deal, sharing facilities and expertise, Increase in Skill level ...)
- Database
- Comparison (Test Methodologies, Results)
- Low TRL



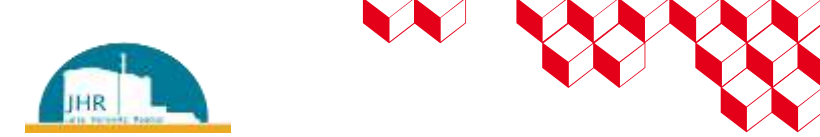
3 ■ Return of Experiment



3.1 ■ The Jules Horowitz Reactor

Example of Facilities sharing

Jules HOROWITZ Reactor (JHR) : an international user's facility



Context

- A new state of the art Material Testing Reactor (MTRs) in Europe
- **A key-tool** for the extension of the existing nuclear fleets and for the deployment of new nuclear reactors

Objectives

- Carry out R&D programs of CEA, for the needs of the French State and the nuclear industry (*performances, safety, innovation*)
- **Provide experimental irradiation capabilities for French and international partners** (*studies on the behaviour of materials and fuels under irradiation*)
- Produce radioelements for medical purposes

Organisation for technological irradiations (*nuclear fuel and materials*)

- The CEA: owner, nuclear operator and contracting authority
- **International consortium:** research centres & industrials & regulators



JHR : an ambitious Material Testing Reactor with a 100 MW th core power, designed to simultaneously accommodate a large number of core and reflector experiments, with a very large range of thermal and fast flux levels.

Under construction in CEA/Cadarache, south of France

Main achievements by 2024

more on <https://jhrreactor.com>



Concrete pouring in Safeguard building



Implementation of Equipment @ level -3



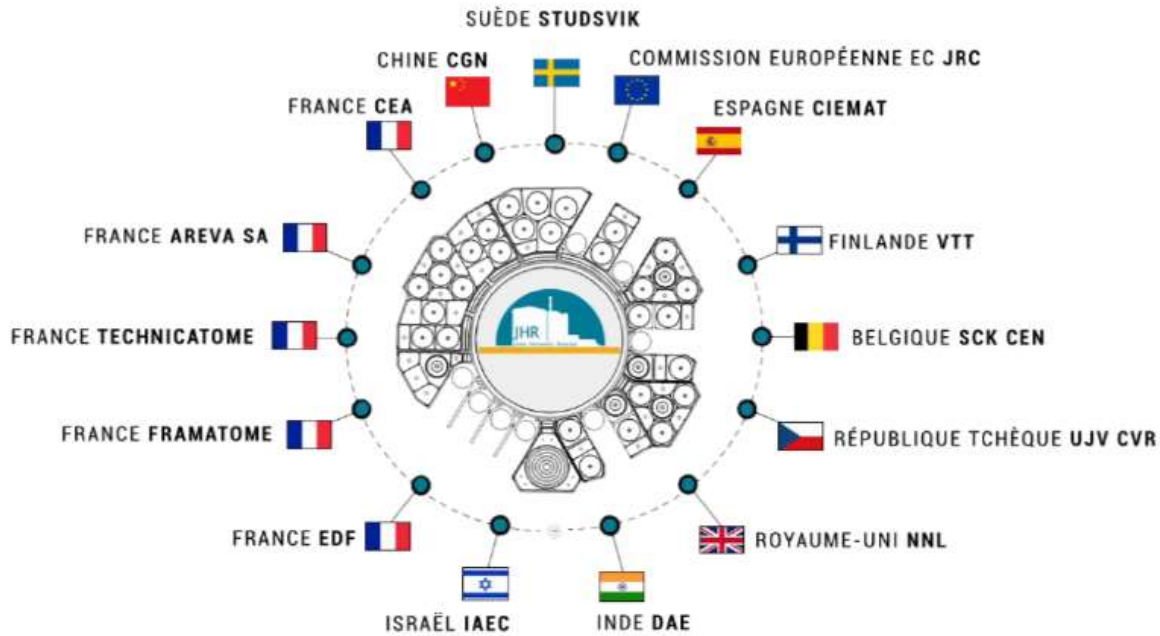
Primary pump assembly: support, volute



Installation of supports and pipes in the Cooling Circuit Building



JHR consortium today... and tomorrow



JHR project: from the beginning designed as an International Users Facility

→ The International Consortium today: 15 partners

- Consortium members can be research centers or industrial companies
- In several cases, the organization (member of the JHR consortium) is itself the representative of a national domestic consortium which gathers organizations among industry, R&D organizations, TSO, or Safety Authority
- JHR consortium gathers organizations which take part financially and get permanent access to JHR experimental capacities (1 representative / organization)

Opportunities:

- Pool and optimize facility (historically, these reactors have been numerous, almost in a 'one per interested country' logic)
- Empowerment & In-kind approach : Partners contribute to the design and manufacturing

Challenges:

- A great deal of complexity in setting up the consortium and the associated negotiations.
- A risk for the project leader to integrate all contribution for the in-kind portion and to prevent budget and calendar deviation

3.2

European « Teaming project » NOMATEN

Example of Teaming Project



An initiative designed to support the creation of a **new entity** (NOMATEN CoE) hosted by NCBJ (Poland)



With support of 2 leading European scientific institutions (CEA-France & VTT - Finland)

A European H2020 Project Dedicated to Poland



NOMATEN Teaming project main objective is to support the growth of the NOMATEN Center of Excellence dedicated to **Multifunctional Materials** for Industrial and **Medical Application**, a tool to train a new generation of researchers and set up competitive research and innovation programs in the European environment.

Main research axes of the NOMATEN concept correspond to long term objectives of Poland and EU:

- **energy,**
- **more efficient use of resources**
- and **health** .

Objective of the NOMATEN CoE (NCBJ, POLAND): To become a recognized entity in the European research landscape, with its own resources and expertise, economic competitiveness, and service offerings in the fields of materials for energy and radiopharmaceuticals.

**Radiopharmaceuticals* are radioactive isotopes linked to biological molecules capable of targeting specific organs, tissues, or cells in the human body for diagnostic or therapeutic purposes.

What are the benefits for other teaming partners?

✓ **Short-term, scientific collaborations:**

- PhD co-supervision,
- joint R&D programs,
- Co-submission of projects in the framework of the Euratom,
- ...

✓ **Long-term vision:**

- Sharing experimental resources at the European level (cost reduction, complementary testing facilities, cross-validation of numerical models, etc.)
- **Building a coherent European scientific approach** to nuclear energy



3.3 ■ The Franco-Australian Indopacific Centre for Energy Transition - FACET

Example of Joint Reserch Center

Thanks to the support and initial funding from the French and Australian ministries , the Franco-Australian program for the energy transition will strengthen cooperation between French and Australian stakeholders in the energy transition.

It will bring together leading researchers, institutions, companies, and industry experts to pool and share knowledge across the Indo-Pacific region. *It will also support joint proposals from universities and technological and research centers from France, Australia, or the Indo-Pacific region, to collaborate on the energy transition. It will also assist SMEs and innovative small businesses in their industrial projects*

PRIORITIES AND ACTIVITIES



FUTURE OF GRIDS



STOCKAGE & HYDROGEN



NEW FUELS



PV/SOLAR



INDUSTRY DECARBONISATION



CRITICAL MINERALS



01

Thought -Leadership

- round table forums
- symposium
- website
- network membership

02

Innovation

- industry challenge program
- startup investment facilitation
- startup creation and incubation

03

Education

- skills assessment needs
- wire-integrated learning / intern
- co-curriculum development
- co-delivery in the region

04

Research

- tech certificate for market access
- PhD or postdoc matching scheme
- industrial research (incl. demonstrators)

EXAMPLES OF BILATERAL PROJECTS



The FACET Pulse Innovate programme challenge-led program to identify indopacific breakthrough innovations shaping the future of energy and make connections with key stakeholders, looking for startups developing cutting-edge technologies with prototypes and early traction, **ready to pilot**, scale and work with the support of international leaders in clean energy.



Pre-FEED study for a green H₂/CO₂ fuel demonstration plant in Australia collaboration on a **commercial-scale eFuels project** for maritime and aviation. Airbus, CMA CGM, Safran, and Technip Energies have been invited to join the steering committee. Three sites in Victoria, NSW, and Queensland are under consideration, with strong interest from local governments.



Dispatch DC grid development of a 10 MW DC microgrid case study, **repurposing retired coal infrastructure** and integrating renewables with multiple storage systems to design a new energy model for Australia. By creating a simulation tool and **digital twin** as a first deployment step, it aims to support industry and policymakers in advancing resilient, community-focused energy solutions.



OPPORTUNITIES AND CHALLENGES



2026 round of funding

concrete opportunity to get involved in the center (co-investment required; at least 1 FR & 1 AUS entity; key topics announced Nov 2025). [More: here](#)

Task forces

Join our indopacific task forces on **grids, e-fuel, hydrogen or critical minerals**

Register interest : [here](#)

Indopacific opportunities

Vibrant Indo-Pacific ecosystem (close to French Pacific territories & SW Pacific islands; Indo-Pacific advisors in FACET governance). Connect to participate : [here](#).

Cultural differences

Challenging to create a balanced bilateral expert panel for project reviews; significant effort required to align vision and methodology.

Different system

Variation in fiscal calendars, legal & regulatory frameworks.

Time difference

Frequent delays due to slow agenda coordination



 www.linkedin.com/company/gen-4
 www.gen-4.org
 https://www.youtube.com/@Gen.IV_International_Forum

3.4 ■

Generation IV International Forum

Example of International Organisation

Created in 2001, GIF is a framework for international co-operation in R&D for the next generation of nuclear energy systems.

On 1st March 2025, the new Framework Agreement entered into force and 10 Member Countries plus the EU are expected to join within the next 3 years



GIF's Objectives

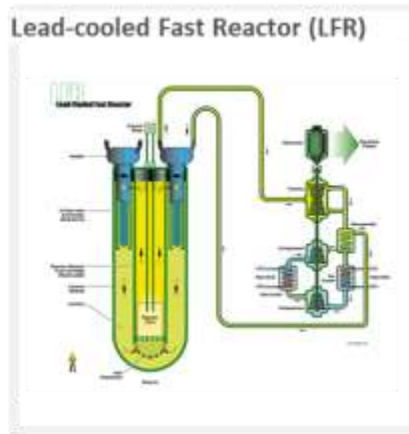
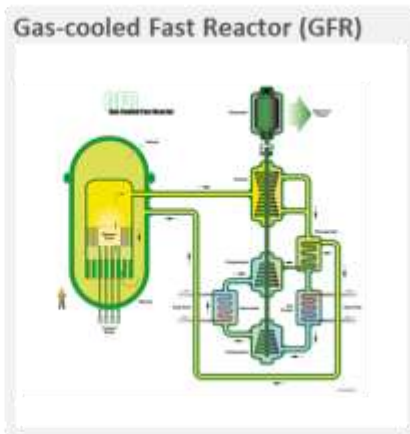
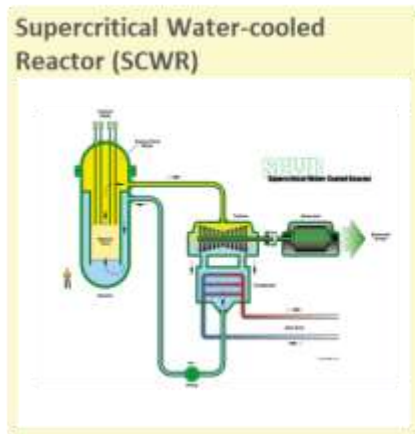
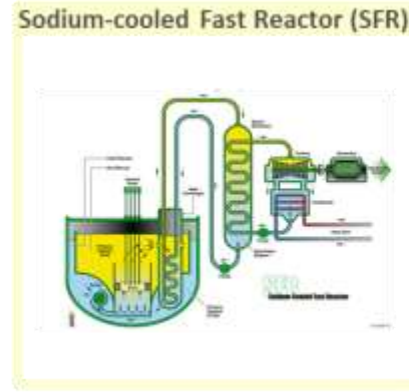
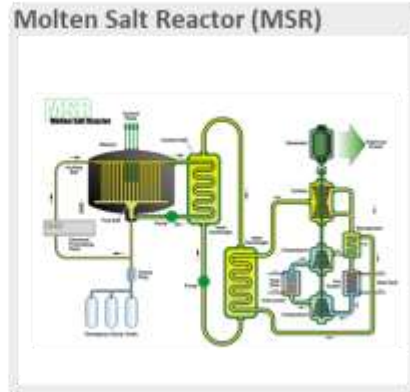
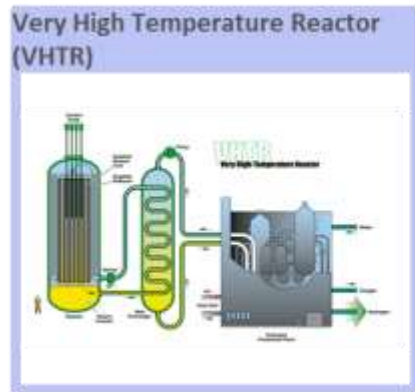
Accelerating the Readiness of Gen IV Systems to Meet Net Zero Goals

- **Strengthening Gen IV system features to address climate change**
 - Enabling Flexible operations applications beyond electricity generation
- **Supporting transition from R&D to demonstration and deployment**
 - Technical readiness,
 - Regulatory readiness
 - Optimising performance
- **Strengthening the relevance of GIF to the industry**
 - Promoting Industry engagement
 - Senior Industry Advisory Panel (SIAP)
- **Supporting the development of the Gen IV talent pipeline**

Nuclear Domino Effect 2024



Supporting transition from R&D to demonstration and deployment on 6 systems features



Cross-cutting Collaborations

- ❖ Economics & Modelling
- ❖ Education & Training
- ❖ Proliferation Resistance & Physical Protection
- ❖ Risk & Safety
- ❖ Safety Design Criteria
- ❖ Non-Electric Applications of Nuclear Heat
- ❖ Advanced Manufacturing & Materials Engineering

To achieve goals in four areas:

1. Sustainable energy with minimum waste
2. Life cycle cost advantages
3. Safety and reliability
4. Proliferation resistance & physical protection

- ➔ Strengthening the relevance of GIF to the industry
- ➔ Supporting the development of the Gen IV talent pipeline

How GIF's members contributes

With concrete projects: contribution to a Project Plan

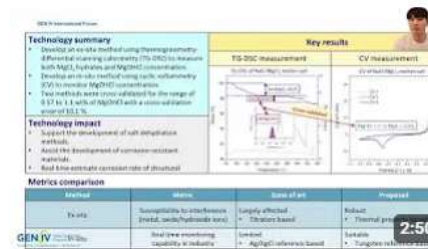
- 11 projects are running,
- 1 new will start with Industry

With in-kind contributions:

- Contribution to GIF's report and White Papers
- Active participation to webinars:
 - On cross-cutting collaborations,
 - On Education and training session,
 - With potential GIF's partners: GIF talks with industry
 - On dedicated technology

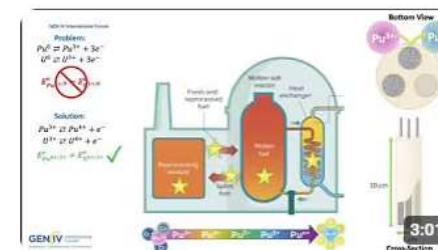
With a Voluntary Contribution to GIF's budget:

A dedicated budget has been strategically allocated to ensure the successful support of the GIF initiative.



PYG4R-2025: Method to Measuring Moisture Concentration in MgCl2 Containing Molten...

518 vues • il y a 4 mois



PYG4R-2025: Novel Diamond Sensor to Investigate High-Valence Actinides in Molt...

311 vues • il y a 4 mois



WEBINARS

GIF talks with industry series #3 - LFR Developers: Ansaldo Nucleare

WEBINARS

GIF talks with industry series #2 - LFR Developers: Blykalla

WEBINARS

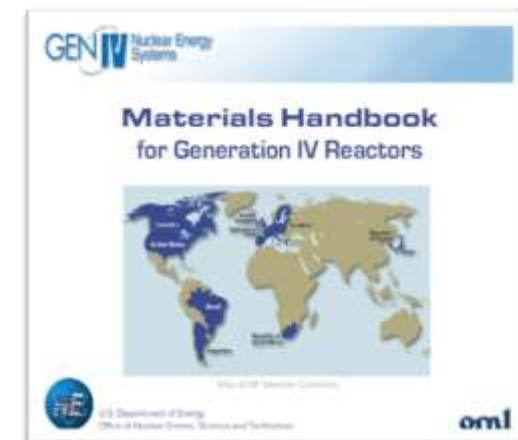
GIF talks with industry series #1 - LFR Developers: newcleo

Example of GIF R&D products – Gen IV Materials Handbook

R&D Results from the VHTR Materials Project are used to Qualify High Temperature Advanced Reactor Materials

The Gen IV Materials Handbook is a digital database system used to collect and manage well over High Bankable GIF VHTR materials data:

- Includes graphite, metals, ceramics & composites data.
- Includes technical reports, test data, materials pedigrees, microstructures, data analysis & comparison tools, etc.
- Constitutes an authoritative single source of Gen IV VHTR materials data with controlled accesses: information is available to Project Arrangement Signatories and their authorized representatives.
- Provides technical basis for improved codes & standards.



GIF's main challenges

✓ Knowledge Management

- That's the bottom line: **turning knowledge into strategic value**

Over the past 20 years, the organisation has built a strong knowledge that must now be capitalised and transformed into lasting value.

- **Challenge:** It requires manpower and budget

✓ Appeal to Industry

- To ensure lasting relevance, **GIF must connect with industry** needs, and industry must in turn acknowledge and leverage what GIF can bring to the table.

- **Challenge:** It requires clear rules, IP acceptable for both GIF & Industry

✓ Diplomatic considerations

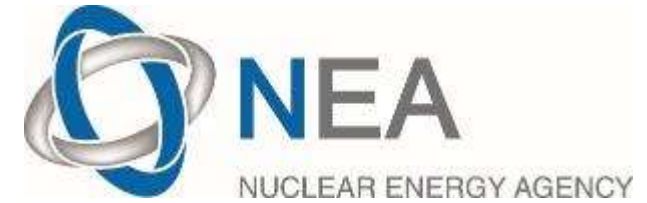
- GIF is based on a **Framework Agreement** for international collaboration, signed by Governments

- **Challenge:** GIF's work from the governance level to the project level is subject to diplomatic dynamics

✓ Limited budget

- GIF's budget lean on **Voluntary Contribution**, yearly established and approved

- **Challenge:** GIF needs to elaborate a 2 to 3 years budget plan. Must find financial ways to support GIF activities (communication, inventory assets...)



3.5 ■ NEA Working Group on Hydrogen Value Chains

Example of WG Collaboration

Mandate

- **Duration: 2023–2026**
- **Objectives: Economic assessment for real-world nuclear-based end-to-end hydrogen value chains**
 - a **forum for discussion** of all stages of hydrogen value chains, i.e. production, transport, distribution, transformation, and storage
 - **assess the feasibility, market potential and competitiveness of different nuclear-hydrogen systems** for the **production of low-carbon fuels** such as ammonia, syngas (carbon monoxide and hydrogen) and **synthetic fuels**
- **Co-Chairs:**
 - **Julie MOUGIN, CEA, France**
 - **Todd Knighton, INL, USA**
- **12 Countries involved:**
 - **Canada, Czechia, Finland, France, Japan, Korea, Poland, Slovakia, Spain, Turkey, UK, USA**
- **+ IAEA**

Actions

- **Database to gather input data**
- **Selection of case studies**
- **Modelling approach:**
 - **Economic assessment** for different end-to-end nuclear based **hydrogen value chains**.
 - Demand is hydrogen for **synthetic fuel production**.
 - Location specific modeling.
- **Deliverable at the WG end**
 - **First Outcomes:**
 - **The role for nuclear-based hydrogen in a hydrogen economy:**

Distinct opportunity to co-locate SMRs with integrated industrial applications.

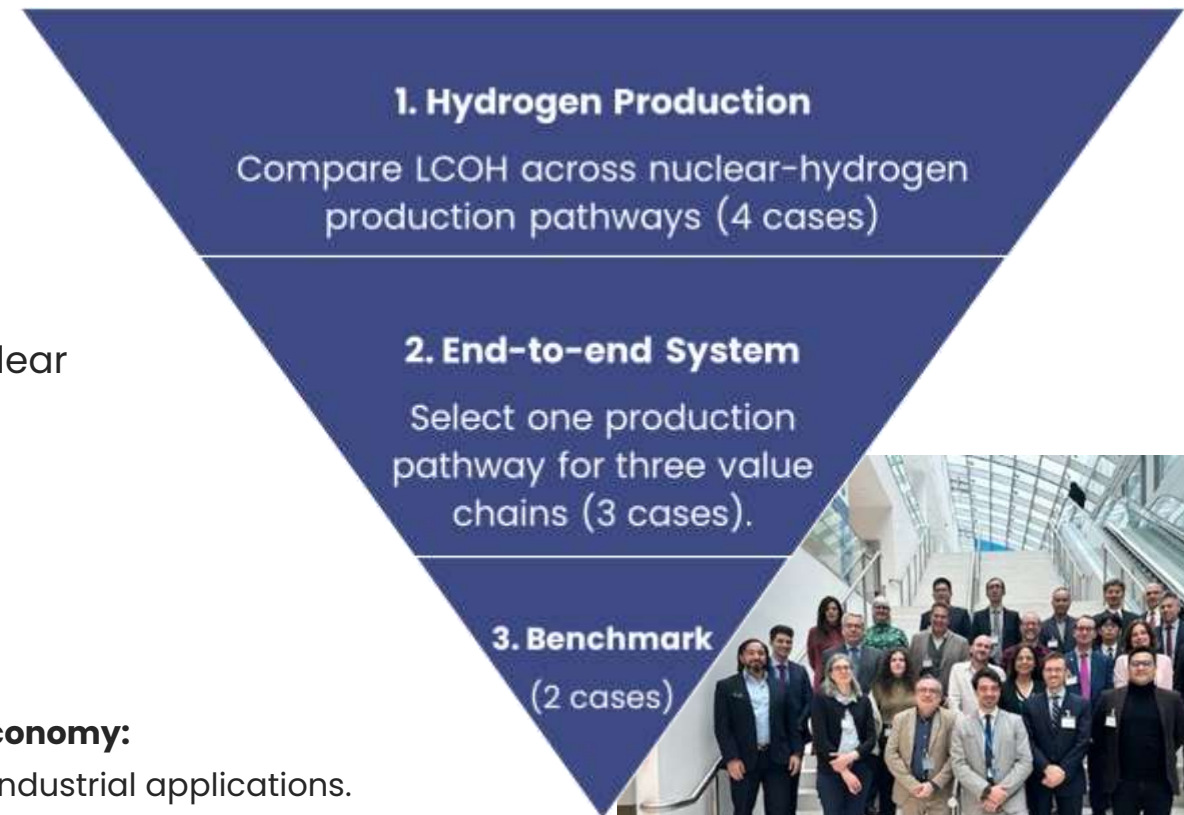
There is no silver bullet: Renewables, nuclear, grid electricity, steam methane reforming with CCUS, all solutions will play a role to the hydrogen economy.

Some uncertainty on the role for nuclear energy in the short term.
 - **Evolving LCOH costs:**

The “chicken-and-egg issue”: The high price of the low-carbon hydrogen limits off-takes which in turn limits cost reduction potential.

Insufficient supply of “clean electrons” may limit LCOH reduction potential for electrolytic hydrogen in the short term (i.e. competition with data centres).

Cost reduction strategies and analysis on hydrogen end-use applications is a priority area of study.



Opportunities and challenges:

- **Opportunities:**
 - good countries coverage
 - several case studies representative of different locations considered
- **Challenges:**
 - activities on a voluntary basis (no funding)
 - Limitation of the resources in particular for the modelling activities



U.S. DEPARTMENT
of ENERGY

3.6 ■ Advanced Water Splitting Technology Benchmarking

Example of WG Collaboration

Actions

- **Advanced Water Splitting Pathways Benchmarking meeting**
 - Held every year in the USA
 - Last edition was on May 6-7, 2025 at the Arizona State University in Scottsdale, AZ
 - 117 participants
 - **Sessions focus:** developing plans to validate protocols written to date, defining future protocols to be written and aligning with international efforts
 - **Plenary session:** provided perspectives on international activities in each technology area



International perspective – FCH JU supported High temperature Electrolysis in the EU

Julie MOUGIN, Head of Hydrogen Technology
Commissariat à l'énergie atomique et aux énergies alternatives

3rd Annual Advanced Water Splitting Technology Pathways Virtual, March 1st, 2021

Editorial: Advanced water splitting technologies development: Best practices and protocols

Brendan Bullen¹, Marcelo Carmo², Roel Van de Krol³, Julie Mougin⁴, Kathy Ayers^{5*}, Karl J. Gross⁶, Olga A. Marina^{7*}, George M. Roberts⁸, Ellen B. Stechel^{9*} and Chengxiang Xiang^{10*}

HTE technology status and standardization effort in Europe

Julie MOUGIN,
Deputy Director For Hydrogen Technologies at CEALITEN, France
Hydrogen Europe Research Board Member for Hydrogen Production

6 - 7 May, 2025 –
Advanced Water Splitting Technology Pathways
Annual Meeting

- CEA participates regularly:
 - To share testing protocols, compare practices between EU and USA, and to contribute to the protocols harmonization
 - To present the status of development of electrolysis technologies in Europe
 - As a co-guest editor for Frontiers in Energy Research publications on advanced water splitting development: best practices and protocols

Opportunities and challenges:

- **Opportunities:**
 - international forum on a topic of interest (testing protocols) without IP issues
- **Challenges:**
 - round robin testing campaigns might be necessary to benchmark protocols
 - But may be difficult to perform without funding (no funding framework for collab between US and EU)



6 ■ Conclusion

Perspective for RD20, Factors of Success, Sensitive point

Recommendations / Perspectives



Turning MoU into Running Task is never a long and flowing river

Main factors of success and watchpoint

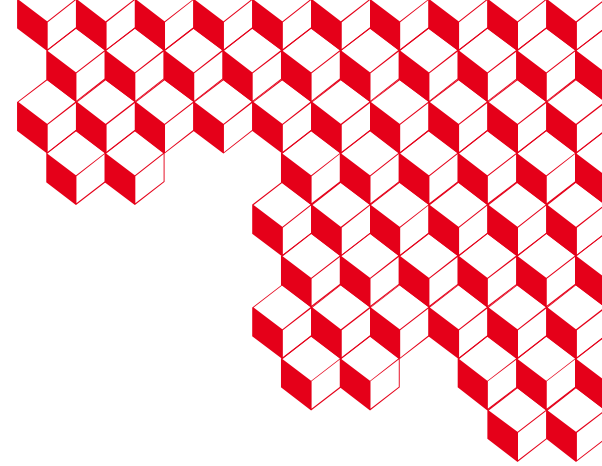
- Intellectual Property
- Funding vs Objectives
- Complementarity

A very large variety of Typologies of International Collaboration : « From Researcher Exchange through WG Collaboration toward Join Research Centre »

RD20 set up 2 typologies of collaboration

- Task forces can be taken in WG collaboration
- Summer School is a try to convert into Reserch Exchange

Type of project to prioritize → see survey and discussion at the Workshop



Thank you for your attention!

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