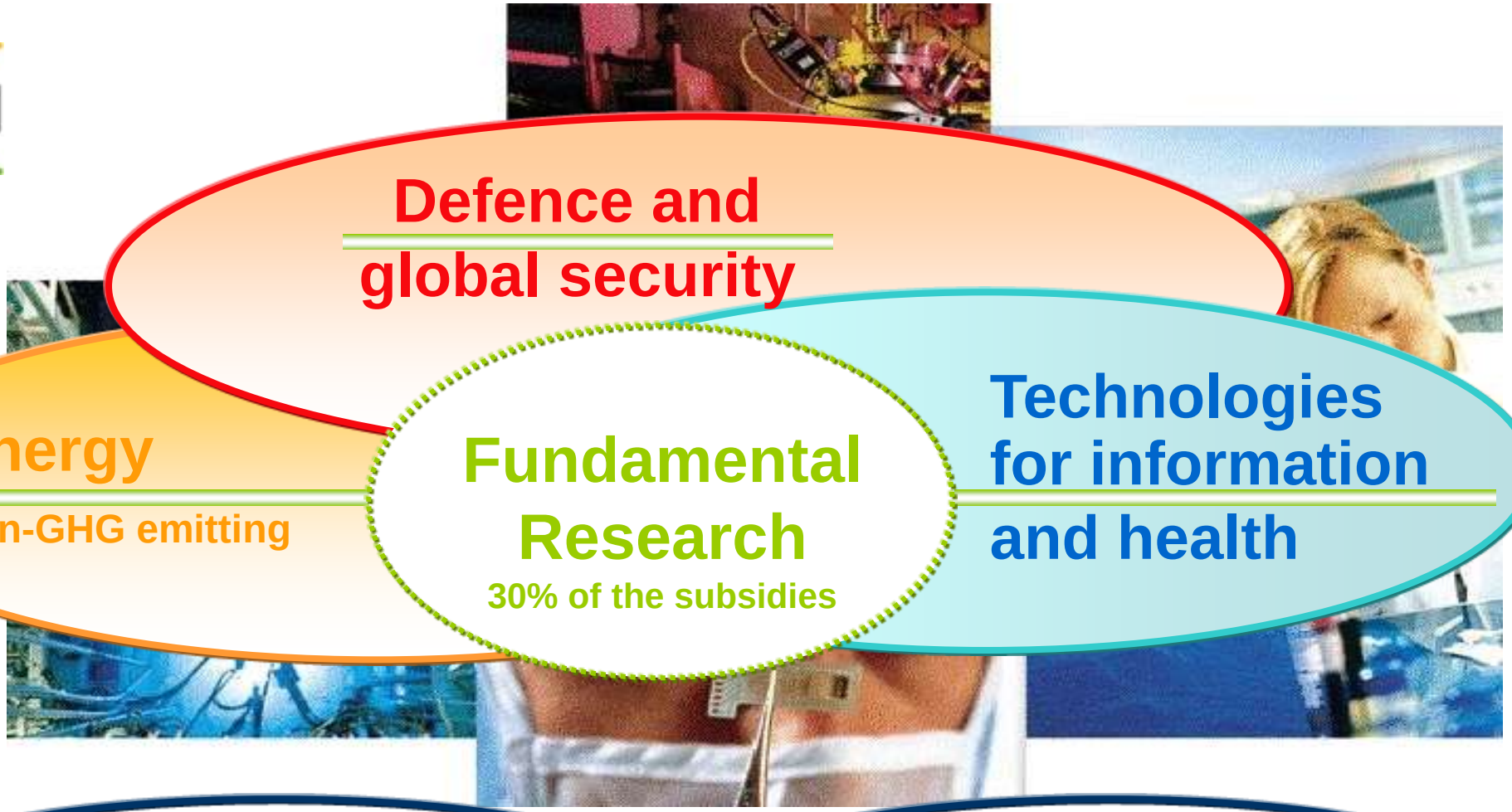
CEA :

Missions and Role in the European Energy Strategy

Hervé BERNARD
Deputy CEO
Atomic Energy Commission

Clear strategies



Defence and global security

Energy

Non-GHG emitting

Fundamental Research

30% of the subsidies

Technologies for information and health

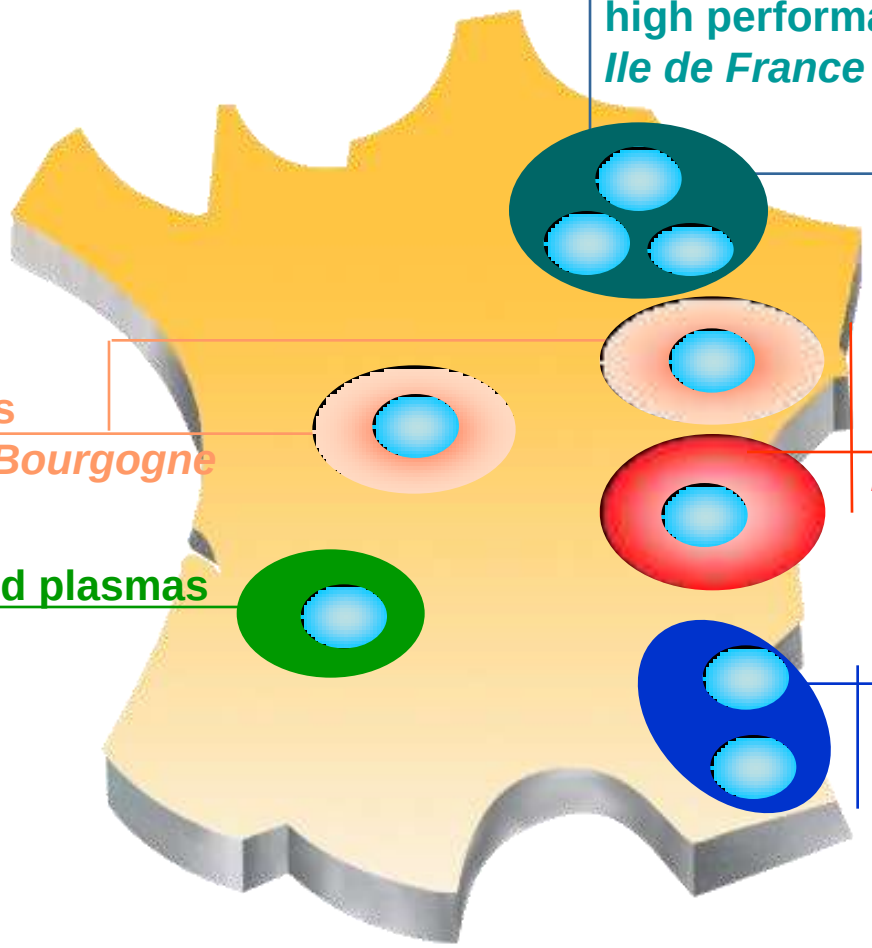
Training and Knowledge Transfer

Technology Development & Transfer

9 Research Centers in France

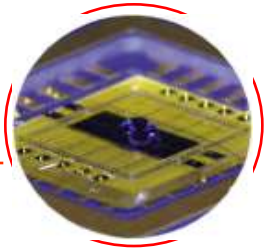
Materials
Centre, Bourgogne

Lasers and plasmas
Aquitaine



Nuclear sciences, software technologies, high performance computing, biomedecine
Ile de France

Micro/Nanotechnologies
Nanobiotechnologies
Rhône-Alpes



Nuclear :
Fusion, fission
Provence Alpes Côte d'Azur

Nuclear fuel cycle and waste management
Vallée du Rhône

CEA activities : key figures

15 618 employees

Budget: € 3,5 BN, including € 2,3 BN in subsidies

- ✓ **3 834** Scientific **publications** in 2007 (ISI base)
- ✓ **1 234** **PhD students**

- ✓ **2 852** Delivered priority **patents** in portfolio
- ✓ **530** Delivered priority patents deposited in 2008
- ✓ **196** Active partnership **agreements** with industries
- ✓ **390** Current licence agreements
- ✓ **109** Spin-off **start-ups** created from the CEA since 1984
- ✓ **51** Joint research groups

(2008 data, unless otherwise specified)

Organisation of CEA

High-Commissioner

General Directorate

General Administrator

Deputy General Administrator

instn

Institut National des Sciences et Techniques Nucléaires

Strategy and External Relations

Human Resources and Training

Risk Control

Information Systems Management

Physical Sciences

Saclay

Technological Research

Grenoble

Life Sciences

Fontenay aux Roses

Defence

CESTA

DIF

Le Ripault

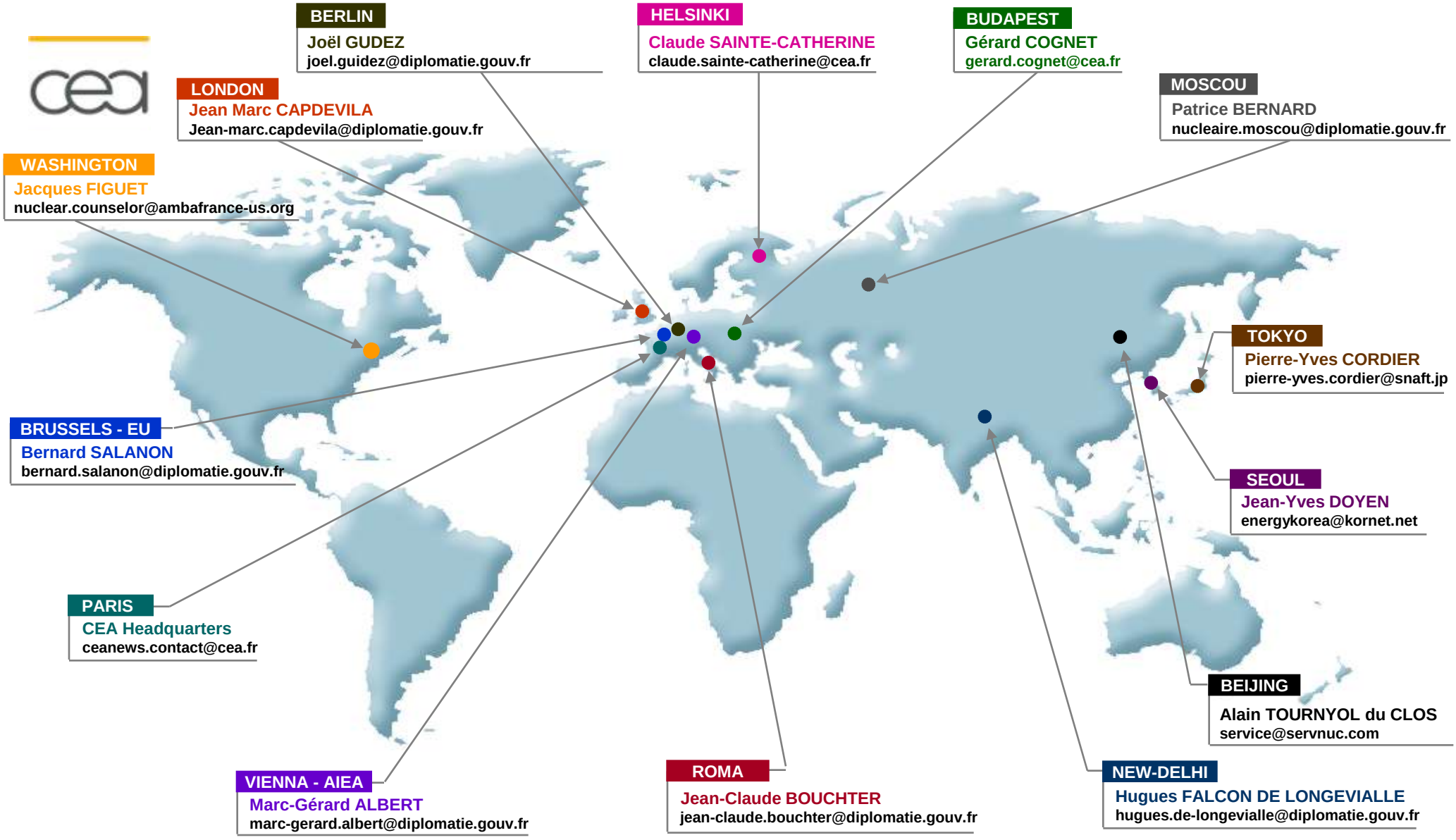
Valduc

Nuclear Energy

Cadarache

Marcoule

CEA counselors network in French Embassies



Non-greenhouse gas emitting energy

Nuclear Energy

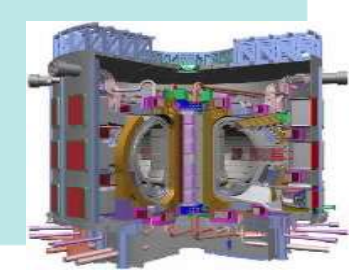
- Nuclear Systems of the future
- Optimisation of industrial nuclear use
- Research on nuclear wastes

New technologies for energy

- Hydrogen and fuel cells
- Photovoltaic cells, energy storage and energy efficiency
- Gasification of biomass

Fundamental Research in energy

- Controlled nuclear fusion
- Climate, Environment Sciences
- Sciences of matter



Radiobiology - nuclear toxicology

- Radiobiology – Radiopathology
- Nuclear toxicology

Technologies for information and health

Micro & nanotechnologies

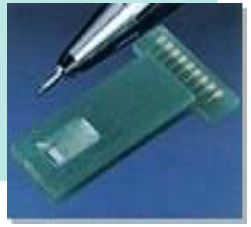
- Microelectronics
- Microsystems
- Biology and health systems
- Telecoms and communicating objects
- Valorization and Technology Transfer

Software and information system technologies

- On-board and interactive systems
- Captors and signal processing

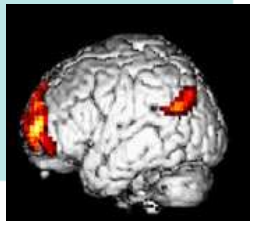
Fundamental Research for industrial innovation

- Nanoparticules Physics and Molecular engineering
- Material sciences at macro and nano scales
- Cryotechnologies



Nuclear-based technologies for health and biotechnologies

- Bio-markers, structural biology, proteins engineering
- Biomedical Imaging (in vivo)



CEA specificities : a corporate culture of project management

Expertise built upon 50 years of experience

- **400 project managers listed**
- **Specific training programs to lead projects**

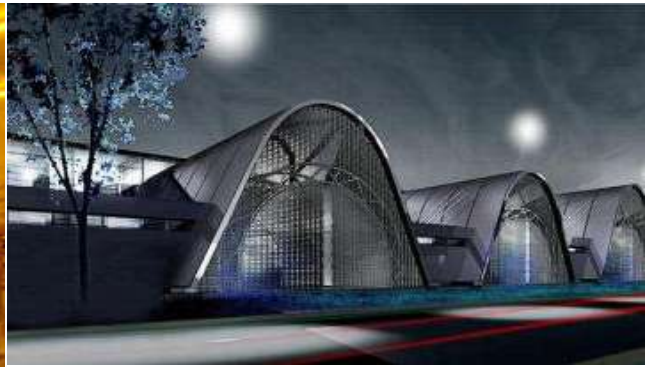
LMJ

Atalante

Iter

Minatec

Neurospin



CEA specificities : a dynamic policy of technology transfer

- **Prior Partnerships** with industries, large groups (EdF, STM, Philips, etc.), as well as with SMEs : **196 partnerships ongoing**

- **Patents** : **530 in 2008**

  incentives for patent applications :

  - ✓ **licensing** of CEA-developed know-how to industries
  - ✓ **extended incentives** including labs and developers
  - ✓ new technology **transfer modes** (co-ownership, patent-pooling, etc.)

  ex : infra-red detectors, SOI, BSE test, flat screens, etc.

- **Start-ups** in strategic technologies, **109 companies set up since 1984** :
  - **Support for Start-ups:** CEA-Investment (current investment in 12 companies)
  - **Support to Spin-offs:** specific provisions since 1999 (incubation, training, loans on trust, right of return, etc.)

CEA specificities : Education and training

CEA is strongly involved in education and training

Staff intensively involved in teaching within higher education schools and Universities : 1 500p, 23 000 h, 2/3 in nuclear and related topics

- **INSTN (Institut National des Sciences et Techniques Nucléaires) created in 1956 jointly with the French Ministry of research and higher education:**
  - «Génie atomique» (nuclear engineering degree)
  - Master degrees in cooperation with universities and «grandes écoles»
  - Training courses « on the job »
  - Seminars and Summer schools
  - Doctoral courses program
  - International cooperation
  - European projects and initiatives, Presidency of ENEN

- **CEA/INSTN is a key actor in coordination committee of French teaching programs in nuclear engineering**
  - English Master of nuclear engineering since September 2008
  - Supporting research skills and infrastructures
  - Internships, PhDs, teacher training
  - European and international involvement

Role of the CEA

in the European Energy Strategy

A new energy policy in Europe

Climate-Energy Package adopted by EU Parliament in Dec. 2008 during the French EU Presidency

Main goals : « 3x20 » by 2020

- Reduction by 20% of emissions of greenhouse gases (compared to 1990)
- With a 20% share of renewable energy in the energy mix
- Reduction by 20% of the overall consumption of primary energy

Establishment of a legislative framework for the CCS

Standards for cars emissions

Objectives for the quality of fuel oils

The unavoidable role of technologies

Key EU technology challenges for the next 10 years to meet 2020 and 2050 targets

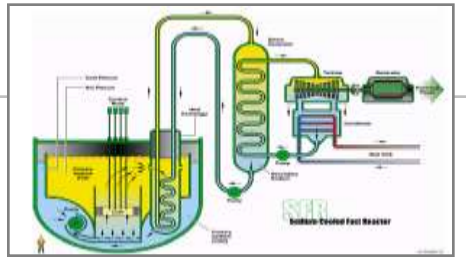
- ✓ In the immediate future, **energy efficiency** is essential
- ✓ **Technological advances** are mandatory to implement the new European Energy Policy and to meet the Environmental Challenge
- ✓ Medium and long term objectives :
  - **2020 : build research capacities and promote policy coherence between them implement European technology demonstrators**
  - **2050 : deploy breakthrough technologies after their consolidation**

Proposed European Industrial Initiatives

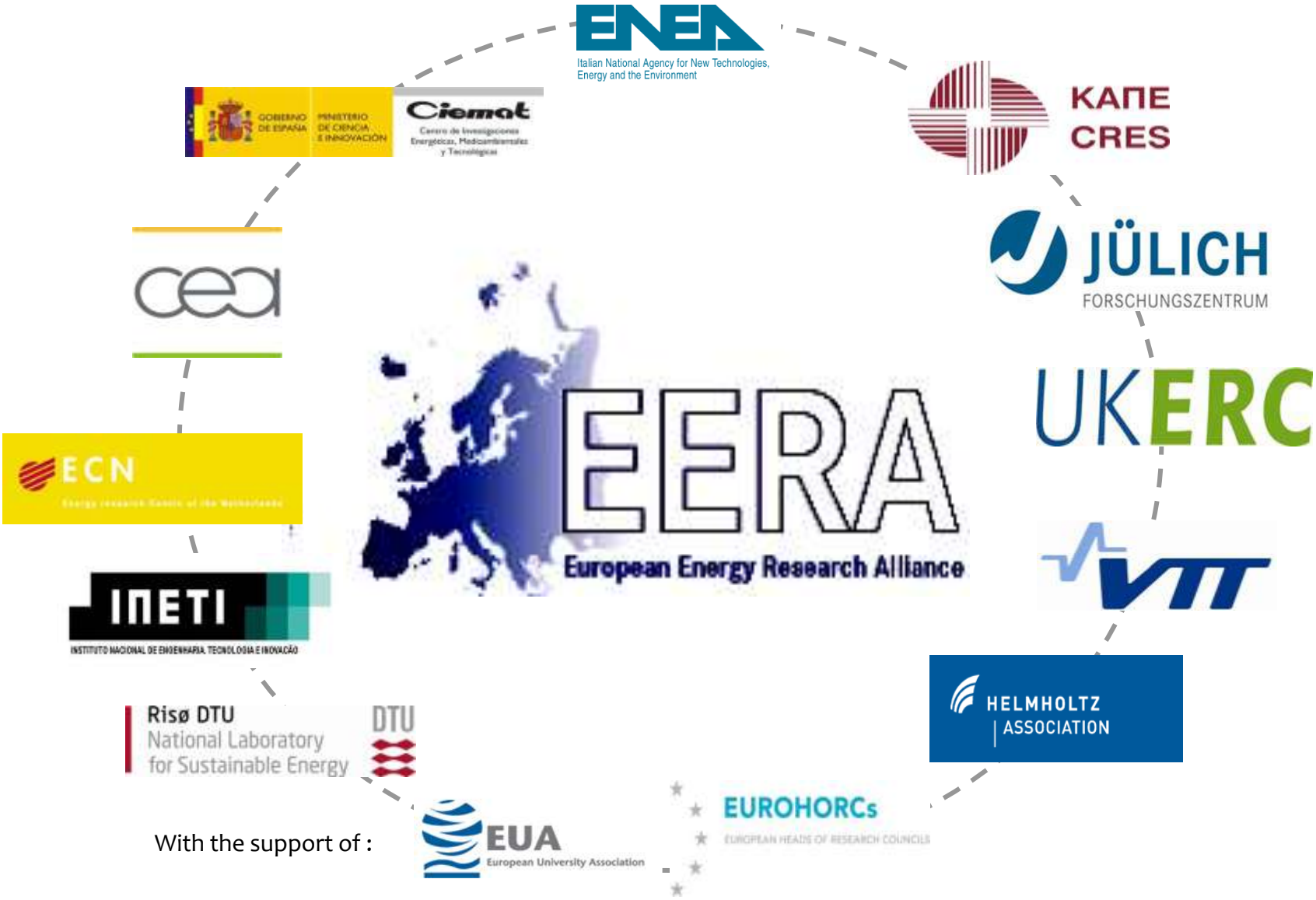
New European Industrial Initiatives for SET-Plan :

- **to strengthen R&D effort and to focus them**
- **to a timely achieved major breakthrough**

- European **Wind** Initiative
- **Solar** Europe Initiative
- **Bio-energy** Europe Initiative
- European Electricity **Grid** Initiative
- European **CO_2 capture**, transport and storage initiative
- Sustainable **fission** initiative (Gen IV)



The European Energy Research Alliance (EERA)



French energy policy (1)

« Je souhaite que la priorité soit donnée au développement des biocarburants de deuxième génération plus pertinents face au défi environnemental et au défi alimentaire. »

To address the key challenges of energy supply and climate change

- On January 24th, 2009 President Sarkozy announced that a **second EPR** is going to be built in Penly (to be connected in 2017).
  The first is under construction in Flamanville (connected in 2013)

- On June 9th, 2009 at Chambery, President Sarkozy stated that France had the political ambition to be a world leader in nuclear energy **and** in renewable energy sources

- On July 17th, 2009 **ANCRE** alliance for Energy signed between CEA, IFP, CNRS to coordinate the French public research centres (coordination committee presidency chaired by IFP for 2 years). Close links with EERA.

French energy policy (2)

" Contribute to European objective of 3x20 by 2020 "

- **Enter France into the " factor 4 "** (a quartering of CO_2 emissions)
- **" +20 Mtoe in 2020 " :** increase from 20 Mtoe our production of renewable energy in 2020 and exceed a proportion of 20% of renewable energy in the final consumption of energy
- **Energy savings and decrease of greenhouse gas emissions :** sectorial working groups at work and setting up of operational measures immediately

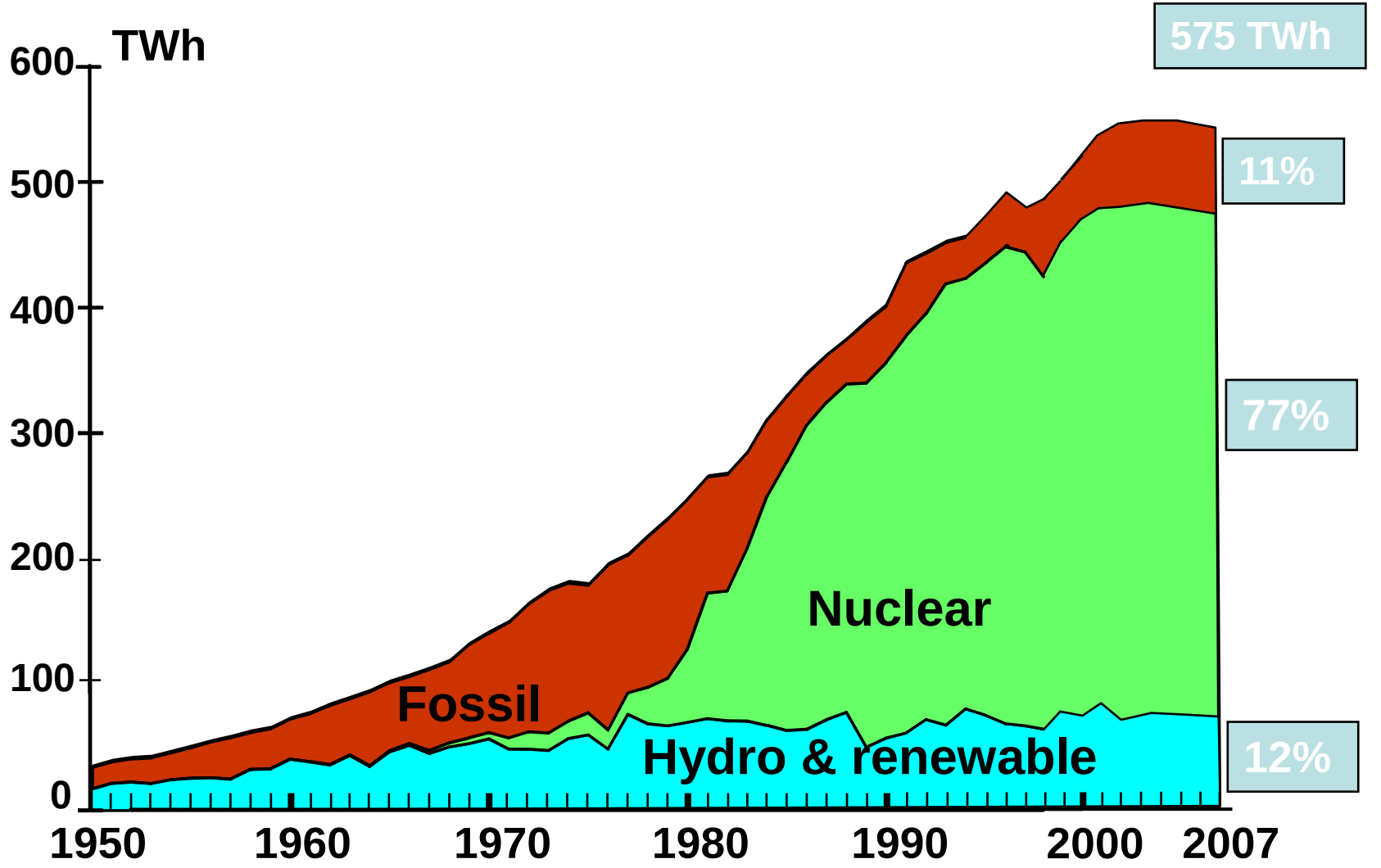
  - **Building :**
    reduction of 20% of energy consumption in service sector building
    decrease of 12 % in residential buildings in 5 years, this reduction should reach more than one third in 2020

  - **Transport /mobility :**
    diminish by 20 % the greenhouse gas emissions in 12 years

Source : MEEDDM

French electricity production since 1950

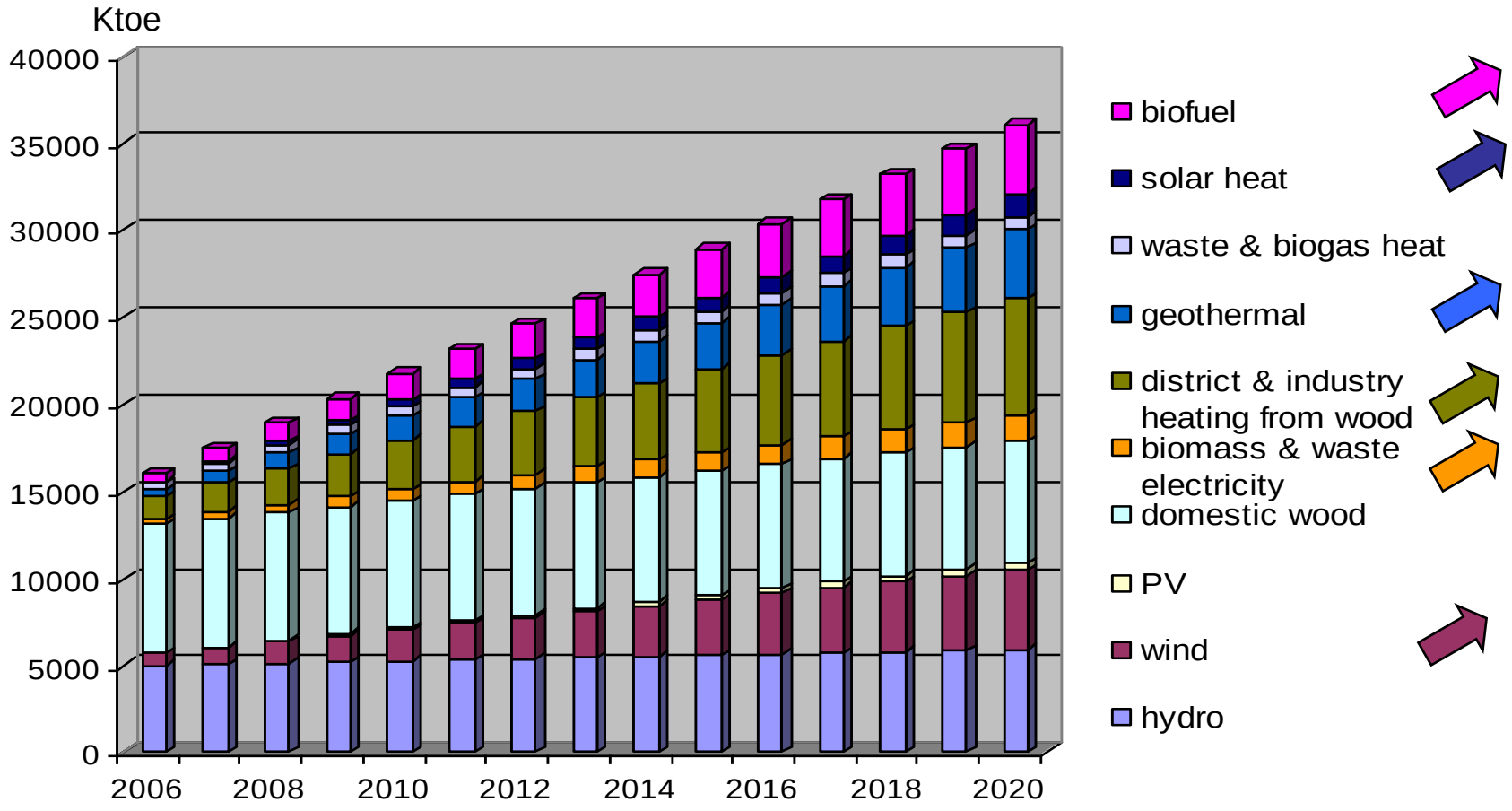
Energy mix



Source IEA

A challenging road towards 2020

The following figures are an example of allocation of the target (+ 20 Mtoe) between technologies



Source : MEEDDM

French national priorities for Research and Development

Development on renewable technologies for Energy

Generation IV nuclear reactors and fusion **(Iter)**

Capture and storage of CO_2
(absolutely necessary at the world scale)

Conception of energetic self sufficient building
at an acceptable cost

New Technologies for Energy Programme : CEA R&D

BATTERIES FUEL CELLS and HYDROGEN

- Clean vehicles
- Electricity storage
- Storage capacity : hydrogen
- Cost

BIOFUELS FROM BIOMASS

- Large biomass resources utilization & bio-carbon efficiency
- Cost
- Energy Efficiency

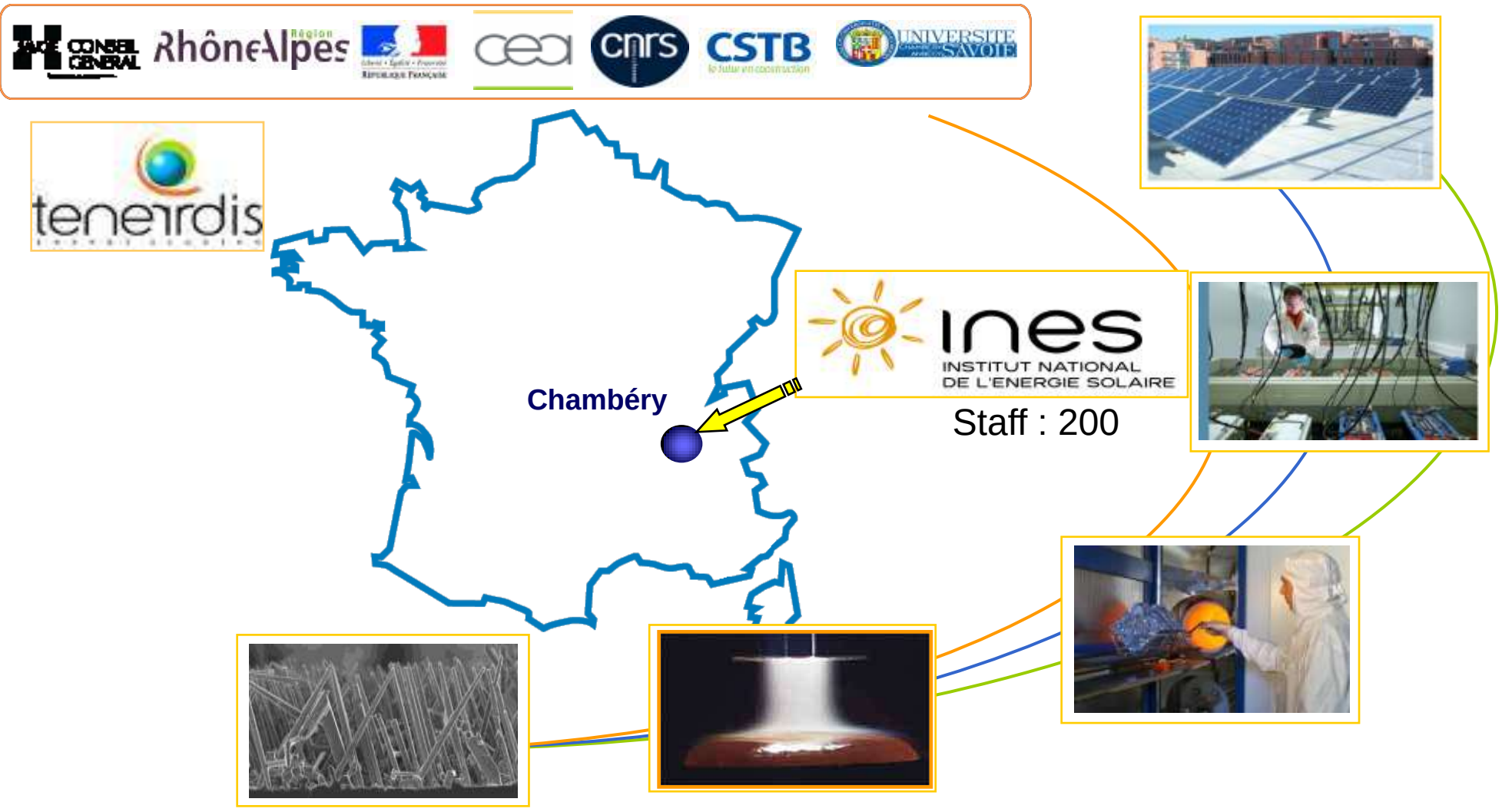
PHOTOVOLTAIC POWER and ENERGY STORAGE

- Cost
- Energy Efficiency
- Storage
- System efficiency
- Integration in Building

Two major fields of application : building & transport

INES: the newly created National Solar Energy Institute

An integrated structure gathering research, training and industrial development



Innovation for future nuclear systems

CEA is mainly involved in the development of Fast Reactors for a sustainable nuclear with a closed fuel cycle :

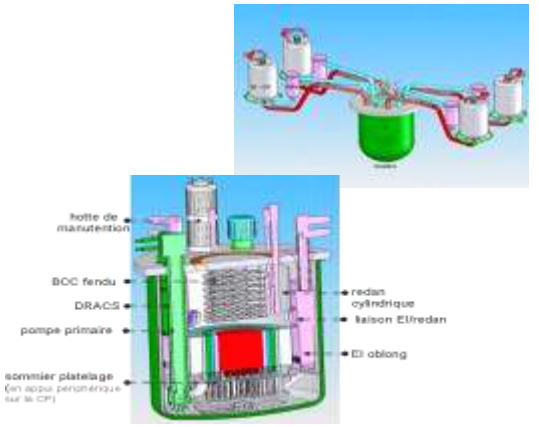
- **Sodium Fast Reactor (SFR)**
- **Gas Fast Reactor (GFR)**
- New processes for spent fuel treatment and recycling/ Waste management

Aim of the GIF:

Contribute to answering the world's future energy needs by developing next generation nuclear energy systems that meet sustainability criteria :

* Waste minimisation
* Natural resources conservation
* Proliferation resistance
* Competitiveness
* Safety and reliability

→ New applications: H_2, syn-fuels, desalinated water, process heat



Sustainable Nuclear Energy-Technology Platform (SNE-TP)

Strategic Research Agenda (SRA)

Research Infrastructures & Competences

Current and future Light Water Reactor

- Plant life Management, material ageing issues
- Advanced modelling tools & intelligent plant monitoring systems

Generation IV Fast Neutron Reactors

- Innovative fuels (incl. MA-bearing for transmutation) and core performance
- Improved materials
- Advanced instrumentation, in-service inspection systems

Other applications of nuclear energy

Optimization of reactor design (LWR/HTR/FNR) and heat process applications for

- Production of H_2
- Production of synthetic fuel, 2nd Gen. biofuels, Coal to Liquid

SNE-T Platform launched on 2007, Sept. 21st

Chairman CEA ***Vice-Chairmen UJV & E.ON***

Maintain competitiveness in fission technologies

Demonstration of a new generation (Gen-IV) of fission reactors for increased sustainability

Nuclear as a low carbon energy supply to other industries

Base load electricity

New applications

Conclusions

Energy supply is a major challenge for future

- European cooperation is vital to reach the objectives.
  Need of a common vision. Importance of EERA

- Ambitious objectives are one of the key for mankind

- R&D, the key to overcome technological blockages, must be strongly supported

- Demonstrators or prototypes must be developed in close cooperation with industry