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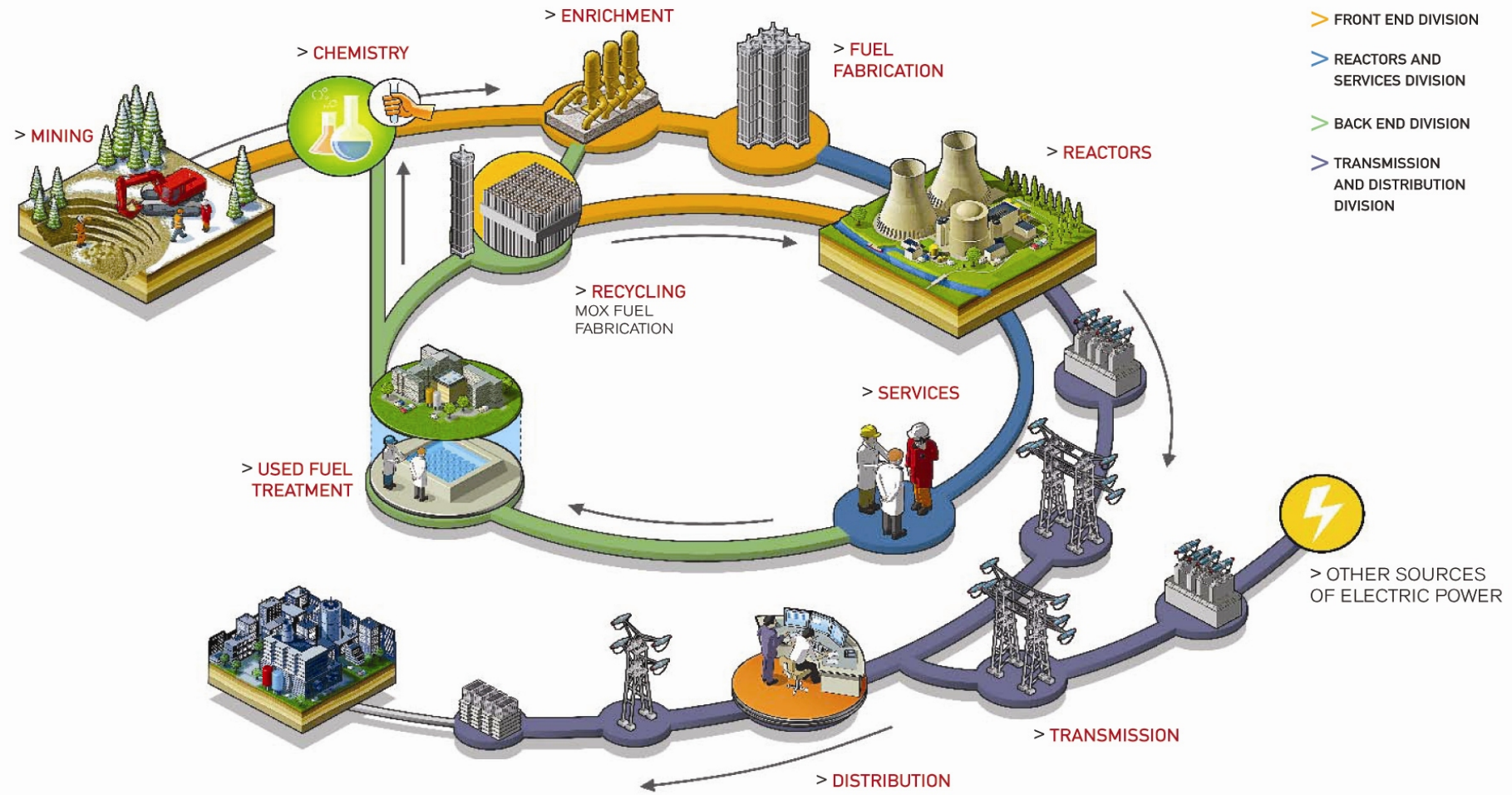
# *IPHE*

*Paris la Défense, January 28, 2005*

# AREVA Group Overview

# Energy, AREVA's core business



# AREVA Businesses

- **With manufacturing facilities in over 40 countries and a sales network in over 100, AREVA offers customers technological solutions for nuclear power generation and electricity transmission and distribution.**
- **The group also provides interconnect systems to the telecommunications, computer and automotive markets.**
- **These businesses engage AREVA's 70,000 employees in the 21st century's greatest challenges: making energy and communication resources available to all, protecting the planet, and acting responsibly towards future generations.**

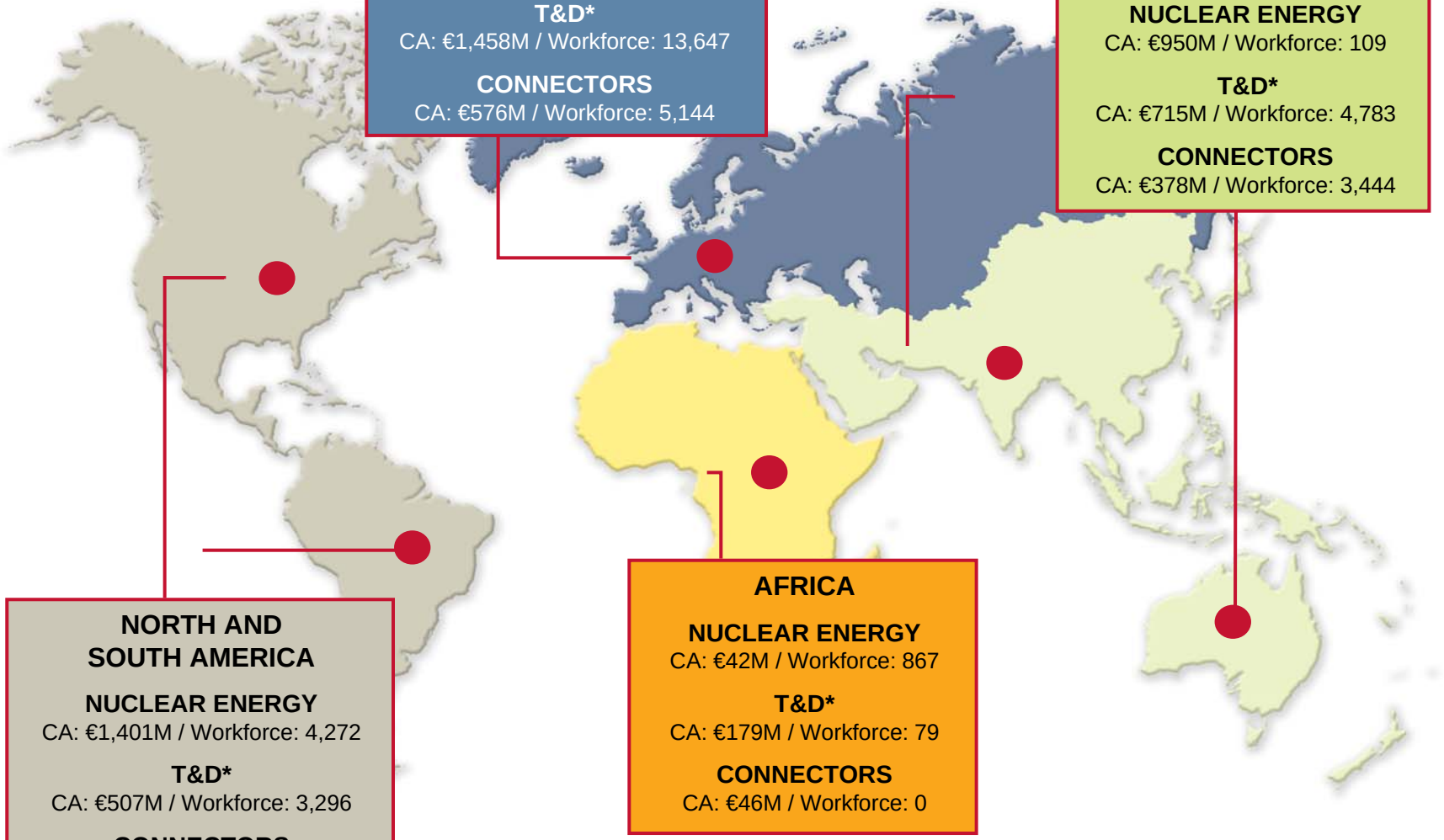
# 2003 Financial Highlights*

- **€8,255M** — **Sales**
  *(€11,114M** including the T&D division)*
- **€342M** — **Operating income**
  *(€325M** including the T&D division)*
- **€389M** — **Net income**
  *(€357M** including the T&D division)*
- **48,011** — **Employees**
  *(69,816** including the T&D division)*

* *Do not include AREVA corporate figures: €87M in sales and 2,288 employees in 2003.*

** *Unaudited pro forma 2003 figures.*

# AREVA Worldwide



**EUROPE & CIS**

**NUCLEAR ENERGY**
CA: €4,437M / Workforce: 28,264

**T&D***
CA: €1,458M / Workforce: 13,647

**CONNECTORS**
CA: €576M / Workforce: 5,144

**ASIA**

**NUCLEAR ENERGY**
CA: €950M / Workforce: 109

**T&D***
CA: €715M / Workforce: 4,783

**CONNECTORS**
CA: €378M / Workforce: 3,444

**NORTH AND SOUTH AMERICA**

**NUCLEAR ENERGY**
CA: €1,401M / Workforce: 4,272

**T&D***
CA: €507M / Workforce: 3,296

**CONNECTORS**
CA: €338M / Workforce: 3,623

**AFRICA**

**NUCLEAR ENERGY**
CA: €42M / Workforce: 867

**T&D***
CA: €179M / Workforce: 79

**CONNECTORS**
CA: €46M / Workforce: 0

** Unaudited pro forma 2003 figures.*

# AREVA interest for Hydrogen

- **Production:**
  - From nuclear primary energy
    - to electricy
    - **or hydrogen**
- **Distribution of energy**
  - Distributed networks monitoring
- **Specific usages :**
  - fuel cells: propulsion, safe supply, …

# Actual concrete implications

- **Two technological projects (R&D)**
  - HTR nuclear plan conception (ANTARES)
  - PEM Fuels cells technologies (HELION)
- **Global marketing investigations**
  - What kind of markets ? Customers ?
  - What kind of specifications ? For what kind of products ?
  - When ?

# *The HTR/VHTR Project at AREVA*

# Why HTR ?

## HTR because:

- Access to high temperature (efficiency, process heat, $H^2$ production process…)
- Substantial feed back experience
- Safety features (robust fuel, passive safety, large thermal inertia, inert and monophasic coolant)
- Takes advantage of turbines recent development (CCGT)
- Modularity (investment costs spread over time)
- Shorter construction time-schedule
- Flexibility in fuel isotope burning (incl. minor Actinides, Pu)
- But industrial viability and overall economy are still to be demonstrated

# Framatome ANP strategy for HTR development (1)

## Preliminary phase (~1996–2003)

- Assessment of the potential of HTRs
  - PBMR evaluation (BNFL, PBMR Pty in South-Africa)
  - GT-MHR conceptual design (General Atomics)
- Acquisition of competences and retrieval of past experience and expertise
- Interactions with DOE and potential partners (industry, R/D labs)

## On-going phase (2004–2006): the ANTARES program

- Basic technology and concept choices for
  - NHS (Nuclear Heat Source)
  - PCS (Power Conversion System) with MHI
  - Fuel

# The ANTARES Program

## ANTARES

**Areva New Technology with Advanced**

**gas-cooled Reactors for Energy Suppy**

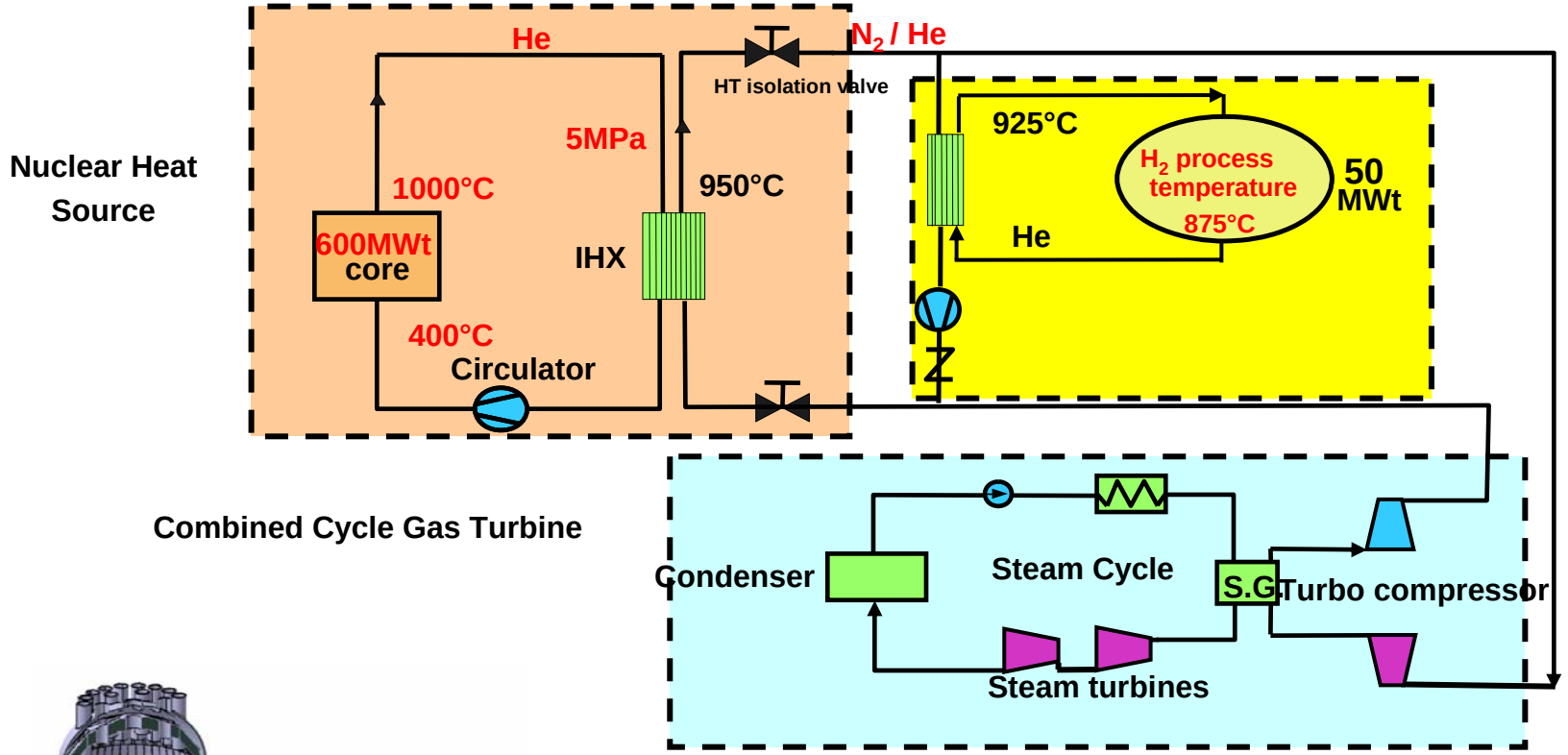
## Aiming at :

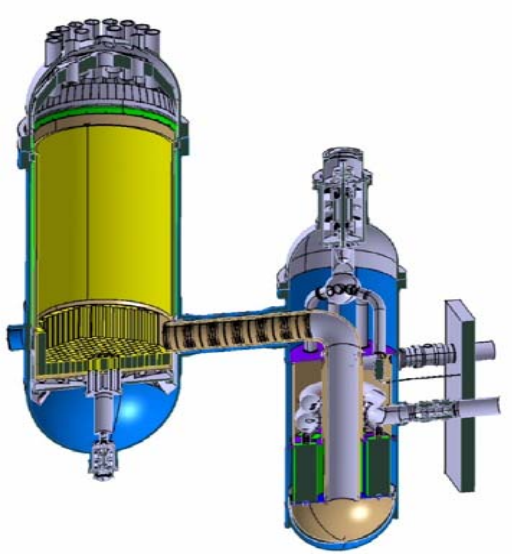
- Designing a commercial plant for electricity and / or process heat supply and $H^2$ production process
- Acquiring the needed R&D results
- Launching manufacturing, control and qualification of HTR fuel
- Paving the way towards more innovative design

## With expected support from :

- Industrial partners operating on a cost-sharing basis
- Potential customers (utilities, oil companies)

# The power conversion system



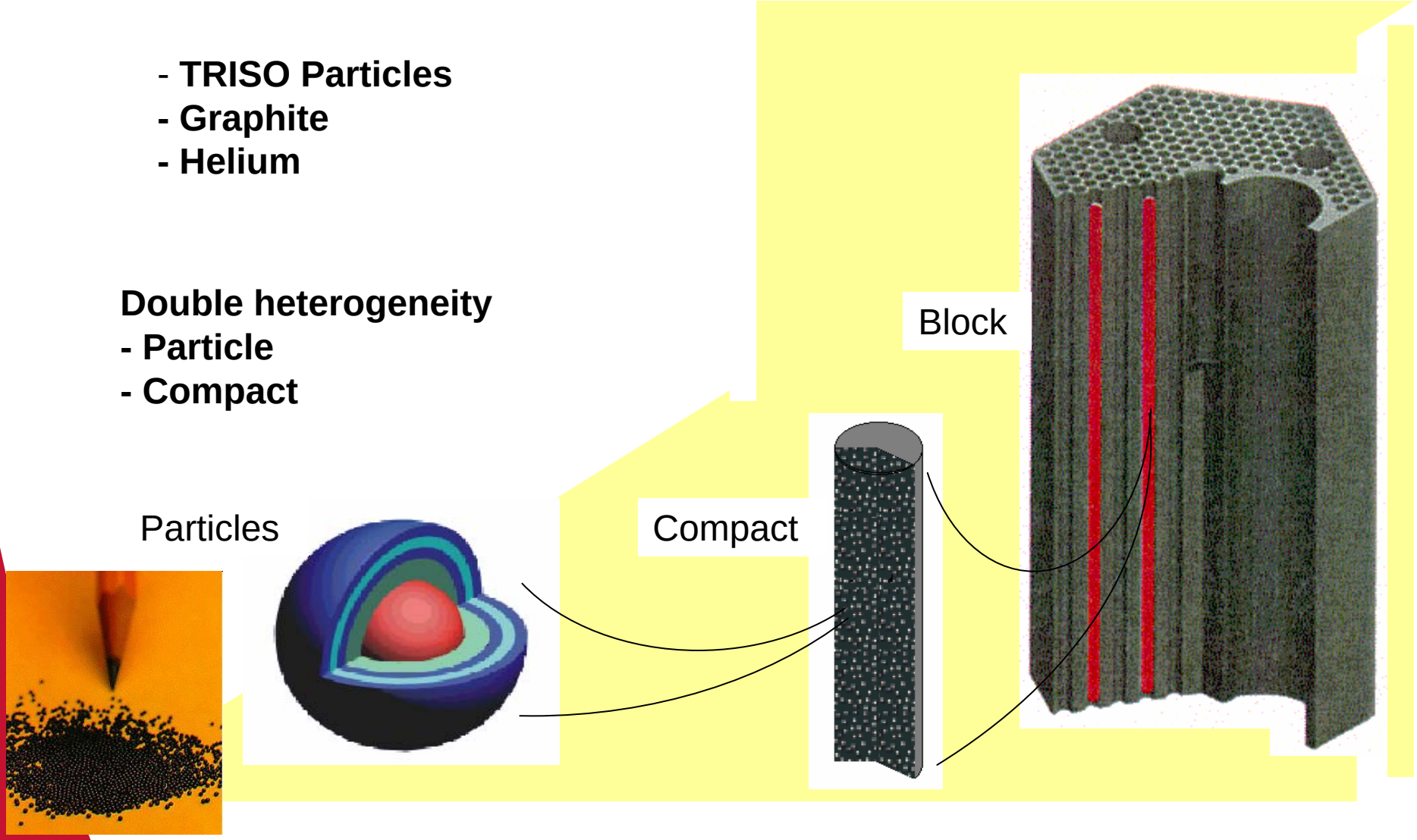



- ***Indirect combined cycle***
  - ***Same efficiency as direct cycle***
  - ***Minimizes development risks***
- ***Plate IHX (back-up tubular)***
  - ***Compactness and efficiency***

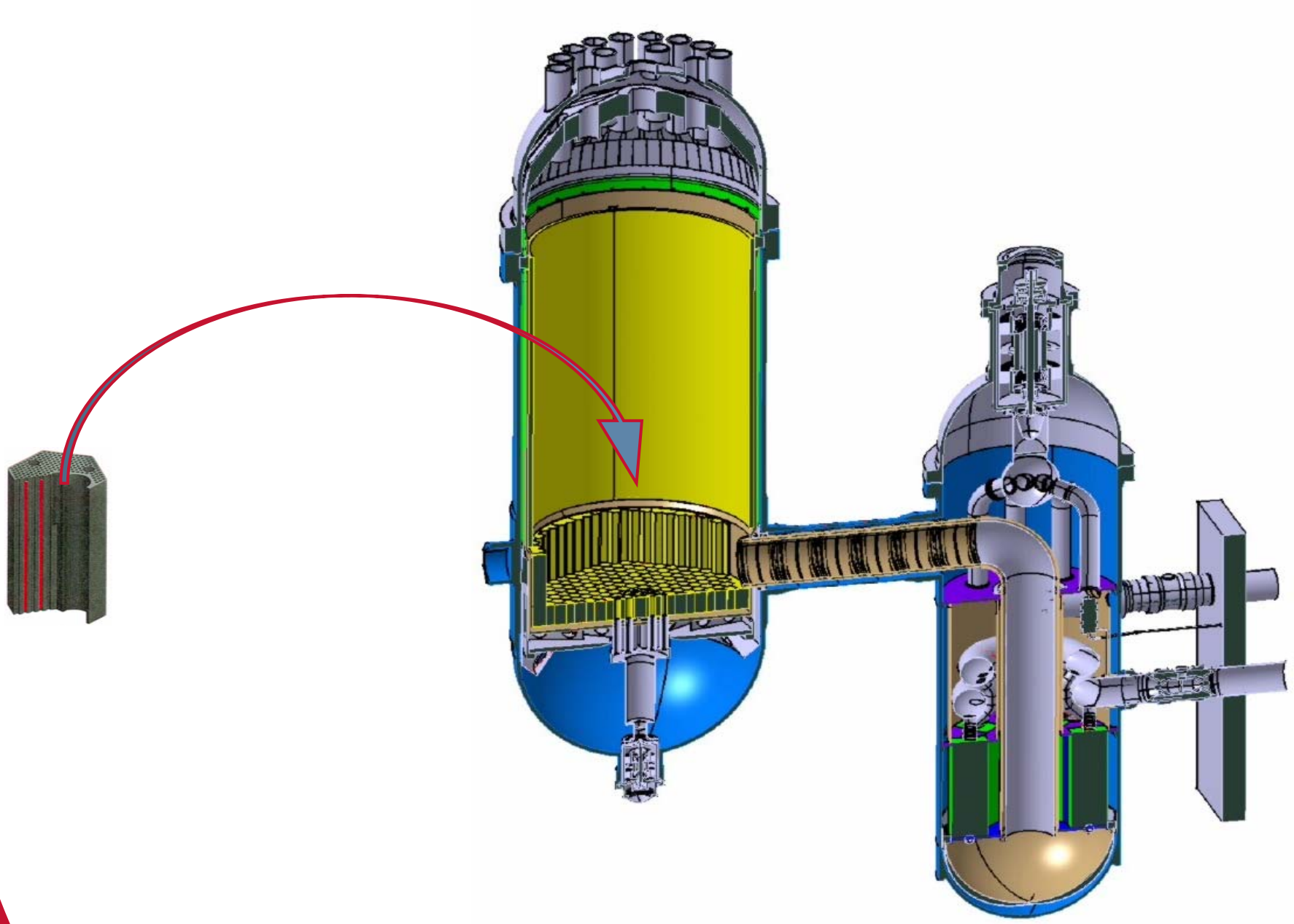
# A Specific Fuel Design

- **TRISO Particles**
- **Graphite**
- **Helium**

**Double heterogeneity**
**- Particle**
**- Compact**



# ANTARES design



# Framatome ANP strategy for HTR development (2)

## Next phase

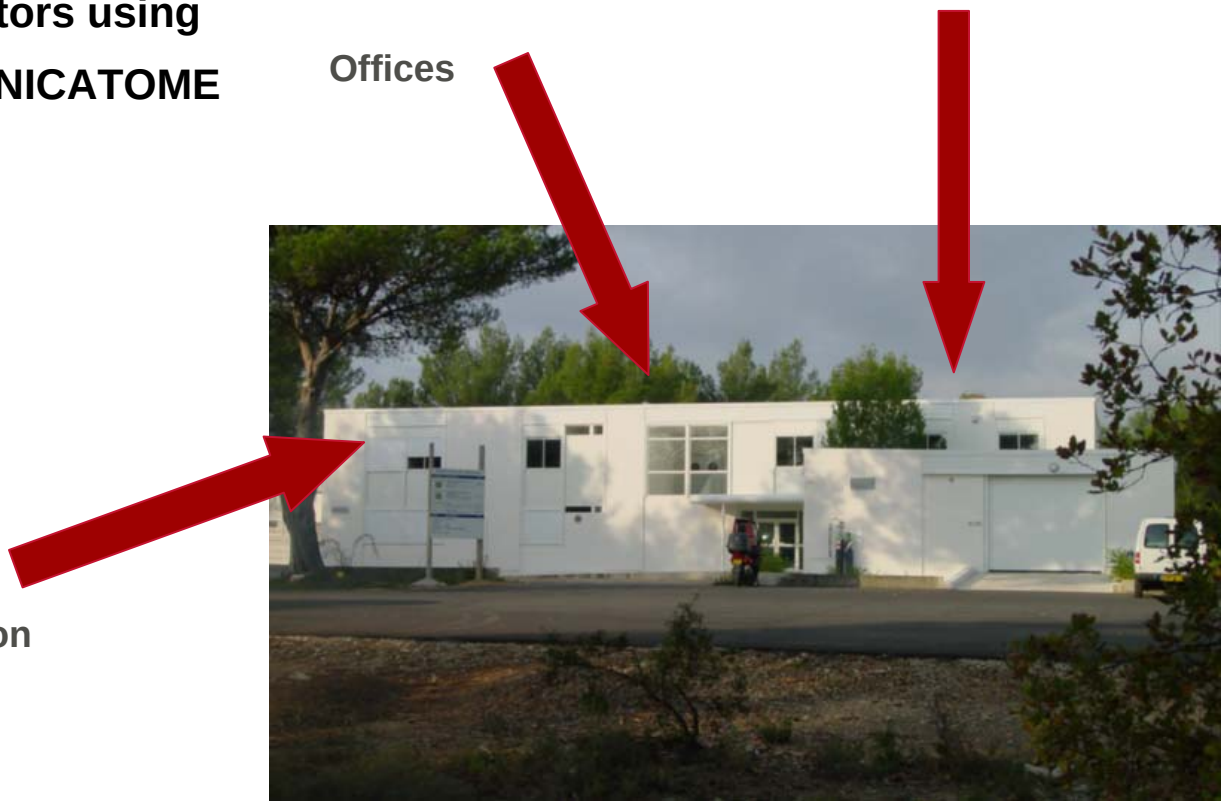
- Final objective: to freeze a design and build a leading industrial team for commercial deployment of modular HTR/VHTR systems
- Intermediate objective: to be
  - the designer and vendor of a prototype intended to be a reference for future commercial products,
  - the manufacturer of associated fuel.
- The NGNP project to be launched by the US-DOE is an opportunity for building such a reference prototype
- Framatome ANP intends to play a significant role in execution of the NGNP project

# HTR-generated process heat: the current problematics

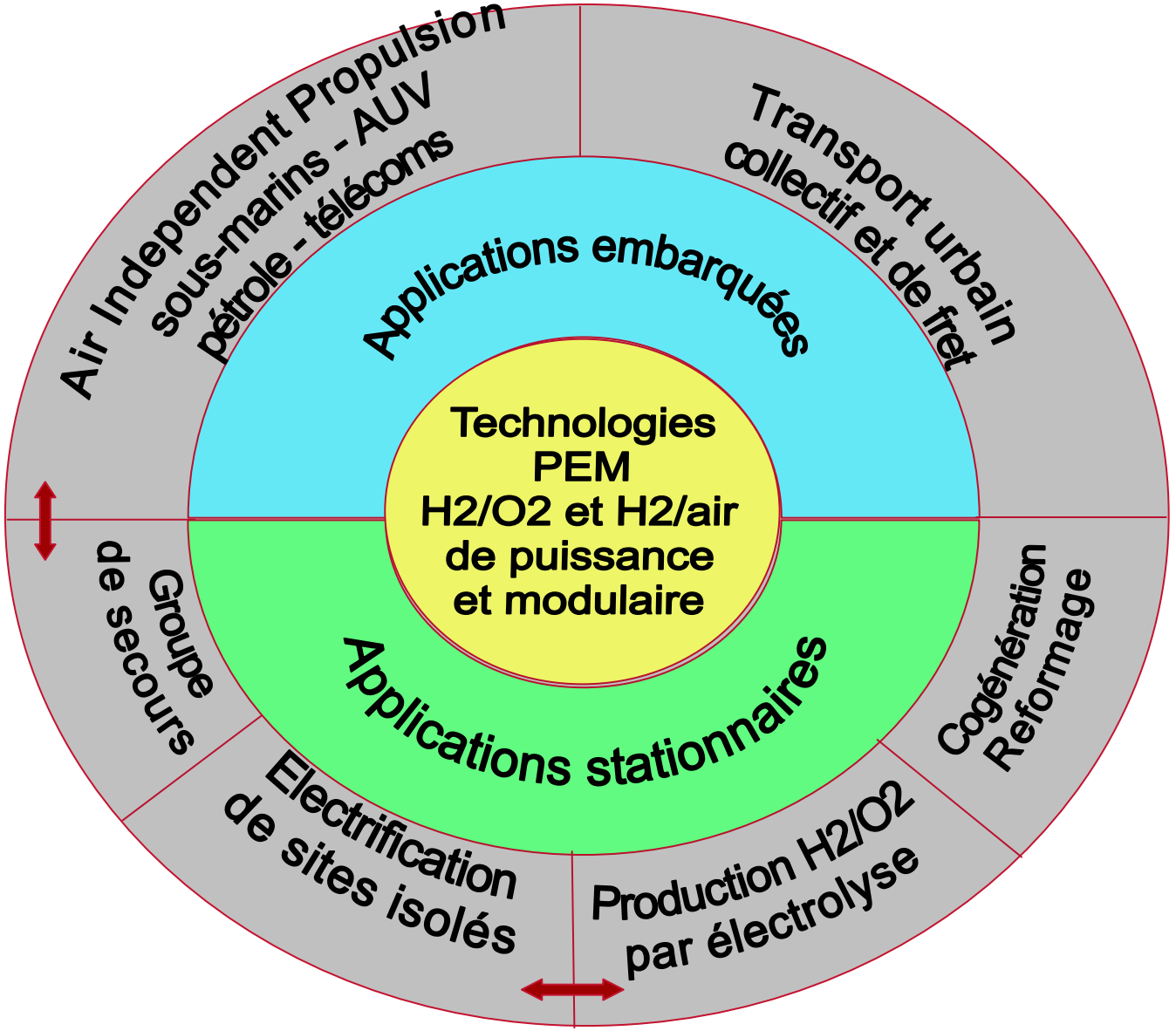
- **Potential promising applications have been identified:**
  - Replace the natural gas combustion heat source in Steam-Methane Reforming (SMR) to produce hydrogen or methanol ($CH_3OH$), fuel additives, and generally the oil product post processing…
  - Provide heat input for thermo-chemical water splitting processes to produce hydrogen
  - Provide electricity and heat for the high temperature steam electrolysis process to produce hydrogen
  - Enhance heavy oil recovery rate (presently << 30%), while limiting $CO_2$ production, by supplying the large amounts of required energy
- **Are they technically and economically viable?**

# HELION

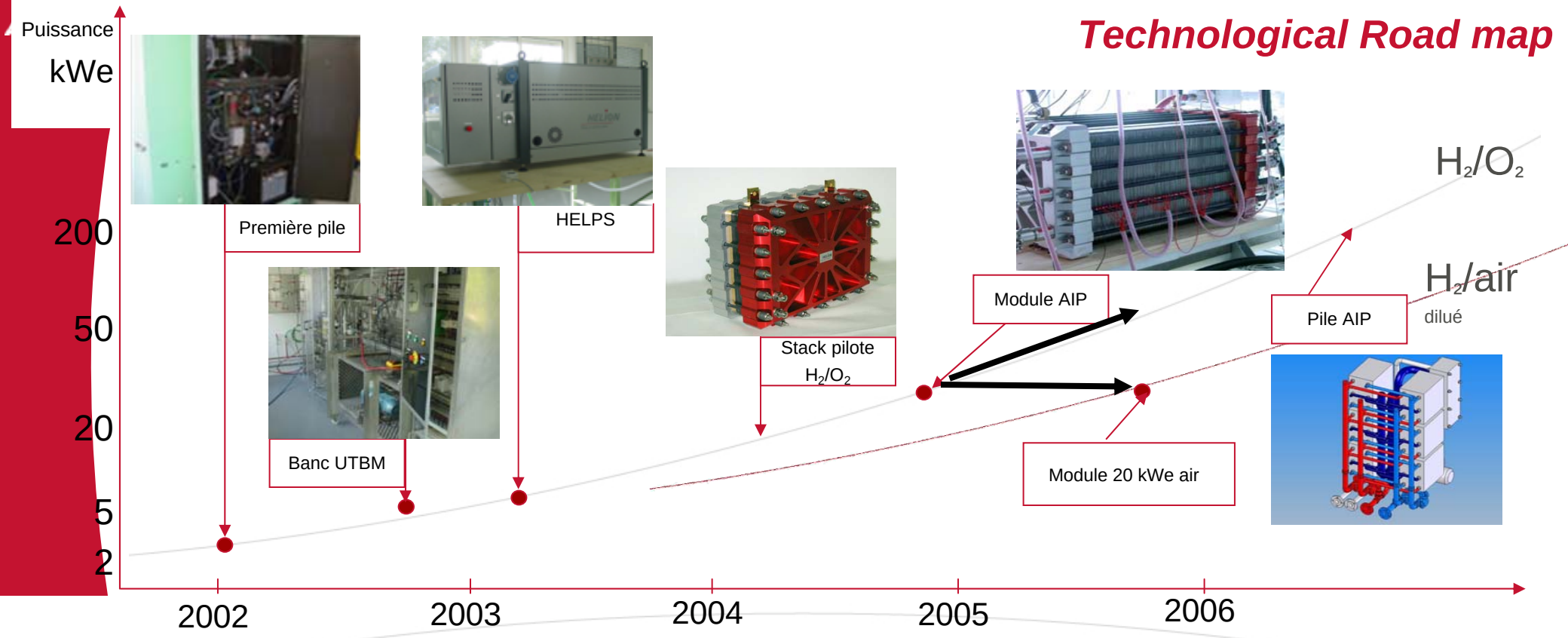
- Capital**: 1 534 000 €**
- Start in March **2001**
- Staff : **more than 25 collaborators using technical support from TECHNICATOME and AREVA**
- Localisation**: Aix-en-provence**



# Applications and technologies



# Technological Road map




| Génération 1<br>plaque graphite | Génération 2<br>plaque composite $O_2$ | Génération 2<br>Composants avancés, air et couplages |
|---|---|---|

- Augmentation surface 800 $cm^2$
- Qualification composite
- Premières EME HELION
- Étanchéité et mécanique
- Couplage entre stacks et reformeur

# Integration of HELPS safety supply

# 20 kWe HELION Fuel cell in test

Retour Sommaire