Milestones for Nuclear Power Infrastructure Development

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The French General Feeling

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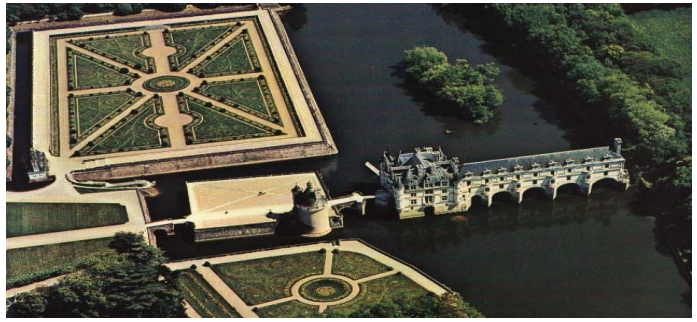
We are aware that France, as one of the most experimented country in the electronuclear production, has the duty to share is experience

France, with one of the most important fleet of nuclear reactors is also one of the leaders of the nuclear industry with the AREVA Group.

This year, in September 25, Mr Sarkozy, Président of the French Republic, said during a conference at the UNO that France is ready to help countries which want to develop electronuclear energy.



Actors involved in the nuclear programme in France

- **Definition of the French energy policy :**
  - Government : Prime Minister, Ministry in charge of environment & sustainable development, DGEMP
  - Parliament Assessment Office of Scientific and Technological Choices (OPECST) : assesses the technological decisions, the Parliament votes the laws
- **Independent Safety Authority** : ASN

- **R & D :** CEA, public research organization
- **Utilities :** EDF (only one nuclear utility)
- **Companies** : AREVA (ex Framatome-ANP, COGEMA), Alstom, but also SME, …

- **Waste management agency :** ANDRA
- **Expertise and R&D for safety :** IRSN
- **… Public opinion …:** The National Commission of Public Debate (CNDP) organizes public debates at the national and local levels about building big industrial facilities.

The long way to develop a Nuclear Power programme

Steps and arguments to prepare nuclear electricity in developing countries :

- ***A project leading to sustainable development and economical efficiency :***
  - **- Human resources**
  - **- Reactor technology choice, site choice, …**
  - **- New nuclear plant introduction in the grid**
  - **- Used fuel and waste management policy**
  - **- Public Acceptance**
- ***A long term governmental commitment :***
  - **Nuclear safety and security : a constant priority, including public acceptance aspects**
  - **Law and regulations : respect of international commitments and efficient national legal framework to implement**
- ***An opportunity to share international experience :***
  - **Including on Human resources scheduling, training and formation**

A country which looks to build a first nuclear plant and has

- no experience in building nor in operating
- no legal framework nor safety organization for nuclear electricity production

➢ **will have to rely on international cooperation for some aspects (licencing process, part of training, …)**

➢ **but will also have to prepare several institutional and organizational aspects such as :**

- Setting up national Safety Authority which remain always a national responsability

- Consolidating economical and financial aspect of the project

- Managing the introduction of a new industrial electricity production tool in the national organization (grid and distribution)

- Choosing the site(s), then building, and finaly operating the plant

- **Many complex and inter-related issues need to be look at to manage the introduction of nuclear power**

- **It is why we fully support the proposal of the Infrastrucure document of the IAEA to create as soon as possible a Nuclear Programme i*mplementation Organization* *(NEPIO)***

Let me now focus on training …..

Necessity of an action plan for training

A list of required skills and competences has to be elaborated, resulting in a « human resources development plan » :

- Training needs, at engineers and technical staff levels
- Scheduling training with nuclear project (procurement, building, operating)
- Human resources policy :
  - how to select future staff of the nuclear program ?
  - how to fix motivating salaries ?
  - how many « failures » will occur in the training process abroad?

Will need to be matched with country education system, and socio-cultural context, in order to manage successfully the know-how transfer :

- Analyse local education system
- Evaluate level of local graduations (technicians, engineers, doctors)
- Prepare adaptation of existing local training cursus to nuclear requirements

Implementing the training plan

- **as early as possible :**

  guarantee of safe and efficient operation of the plant

- **with continuous evaluation : ensure that trained people are efficiently integrated in the various institutions involved in the project**

Looking forward in 2020, early trained people will be managers in charge of high level responsibilities

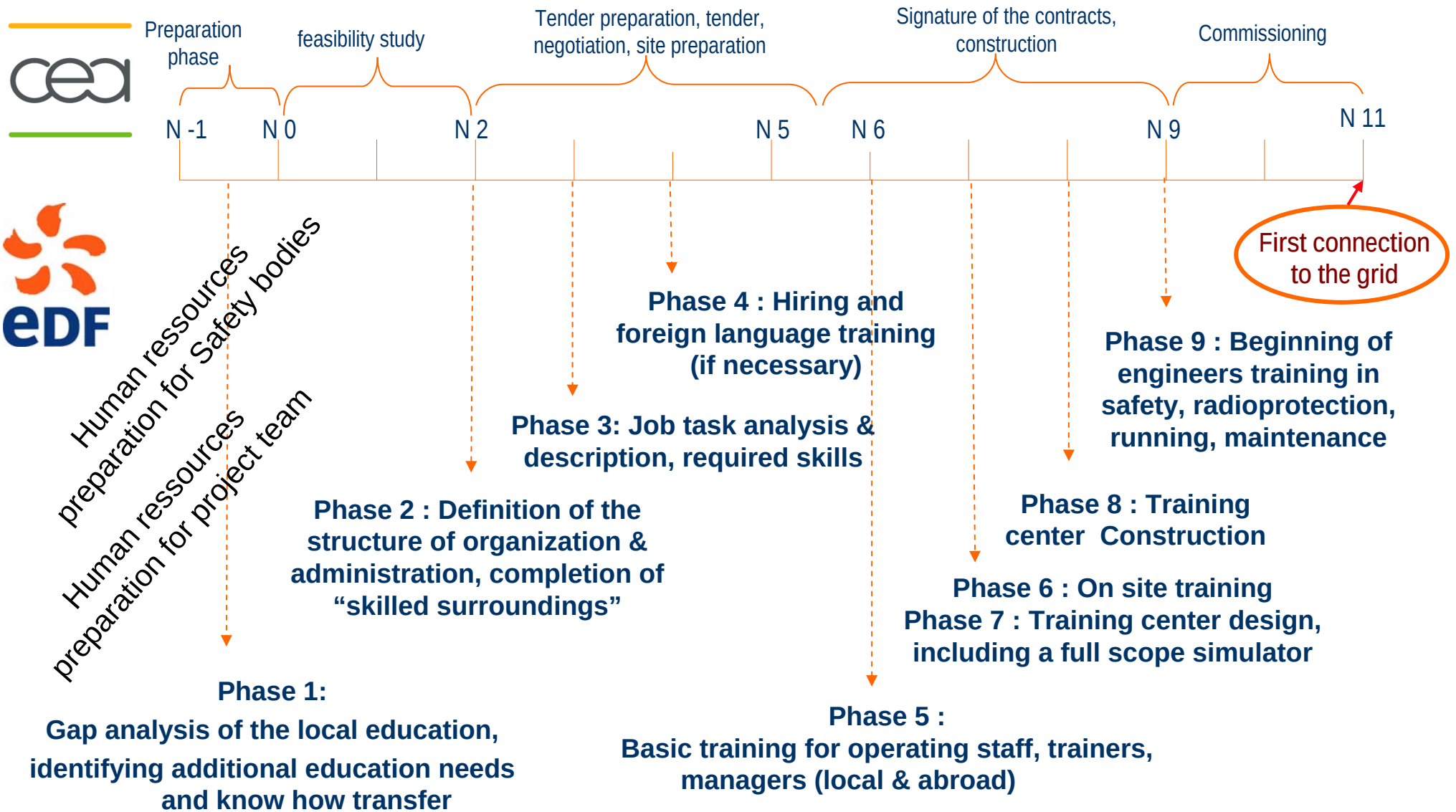
Such a training plan is a significant investment, its content depends on :

- **Number of plants to be built, number of sites**
- **Type of plants**
- **Procurement method (turn-on key, localization of some components fabrication, …)**

One set of possible hypothesis

- **2 X 1000 MWe type plants on one site, proven technology**
- **Procurement through international call for tender** for both nuclear and conventional parts
- **Coupling to the grid around 2020**
- **Consortium with local enterprises for civil works and assembling**
- **Know-how transfer through intergovernmental partnership allowing :**
  - **To the government to manage its nuclear responsibility** (safety authority, safety expertise, nuclear responsibility of the operator)
  - **To the nuclear operator to manage the site operation, including maintenance of the plant**
- **At least in a first step of the program : no technology transfer for design, no localization of fabrications**

Human Resources retro-planning (for plant operation)



Some elements regarding formation plan cost

- **Initial training including all development project, erection phase, commissioning:**

0.1 to 0.3 % investment cost

- **During the operations phase**

5 to 7 % site staff costs

conclusions

- **Even if it is really a long and difficult way to develop nuclear energy, you could benefit of the very important help of the IAEA and also of the countries which did it in the past.**

- **It should be stressed that many things could be done in a framework of international and bilateral cooperation excepted to delegate the responsibility of the Safety Authority.**

- **Bilateral cooperation can be developed only in a clear respect of international commitments.**

- **A Nuclear Programme i*mplementation Organization is needed to manage a nuclear programme.***

- **At minimum a country needs to plan during 12 years the human resources trainings needed for a new nuclear programme.**

conclusion

- **IAEA considers that in 2009, 20 countries will be engaged in a Phase 1 of a process to develop a nuclear energy programme.**

- **The number of delegations from all over the world which come in France because they are very interesting by the French experience in the field of nuclear energy increase continuously…**

- **France is ready to consider the possibility to engage bilateral cooperation with countries wishing to establish a privileged partnership with us.**

- annexes

Summary

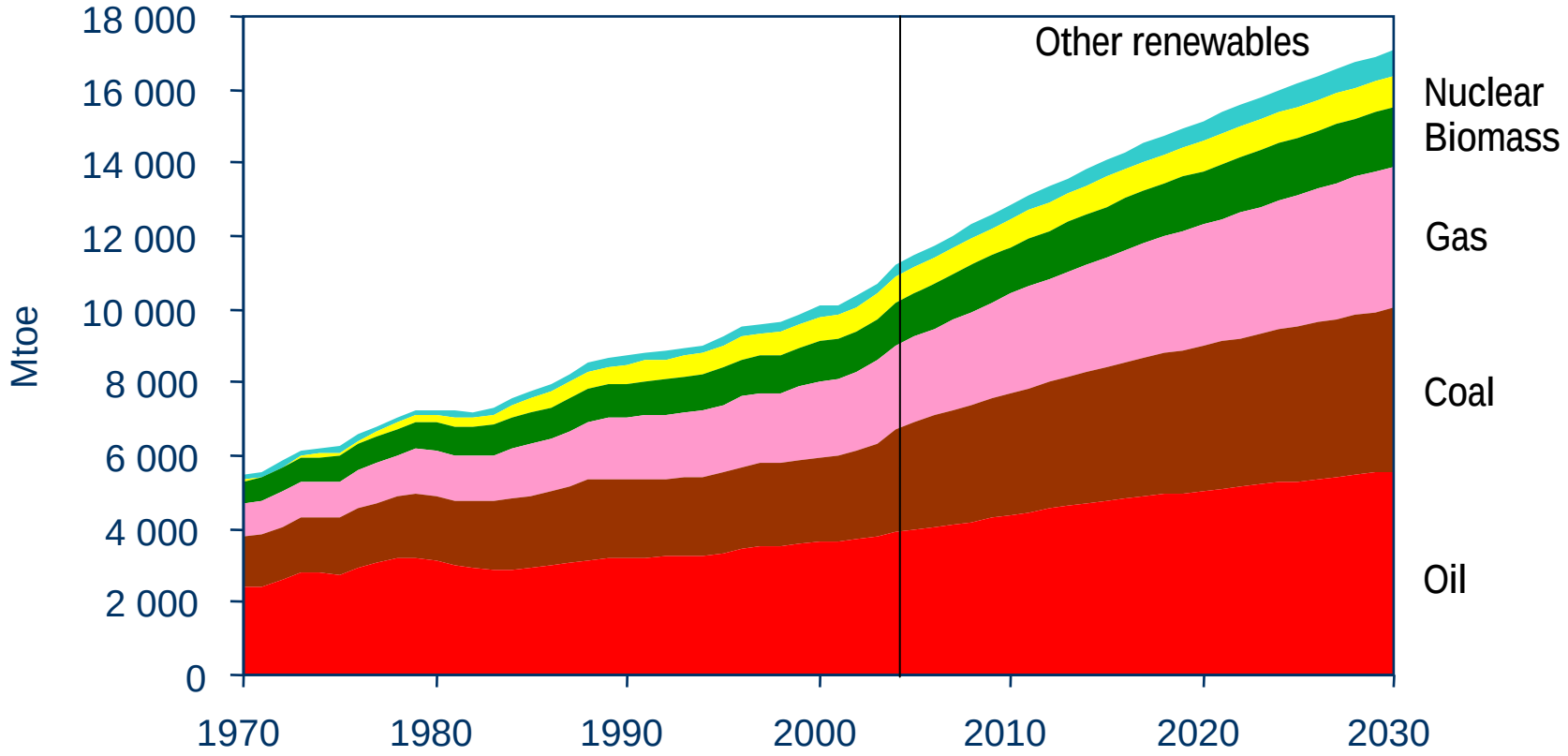
1- The revival of electronuclear power worldwide is a necessity for the planet,

2- France, as one of the most experimented country, has the duty to share is experience

3- The long way to develop a Nuclear Power programme

1. The revival of electronuclear power worldwide is a necessity for the planet

Reference Scenario:
World Energy Outlook 2006 : World Primary Energy Demand



1. The revival of electronuclear power worldwide is a necessity for the planet

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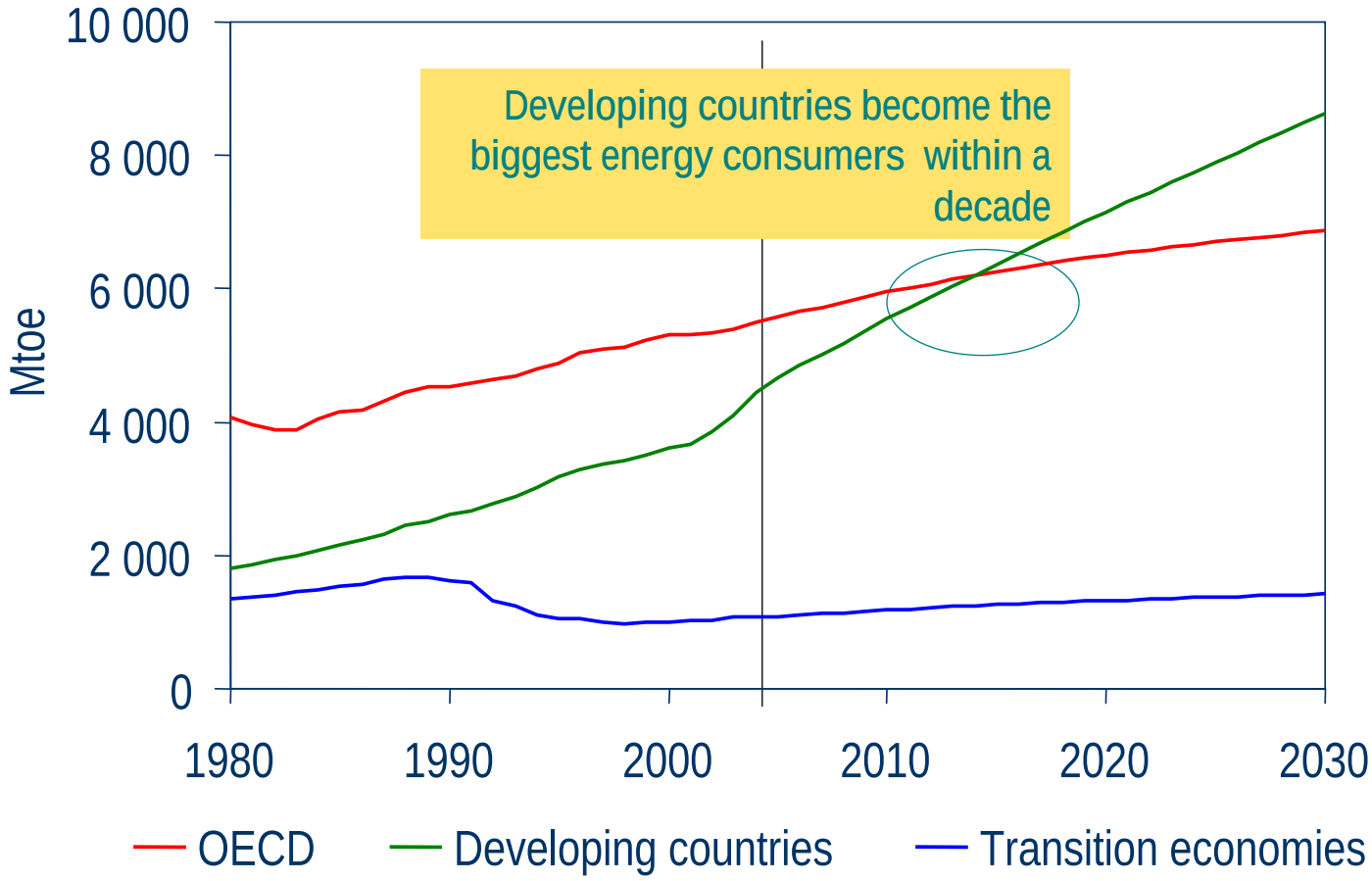
World Energy Outlook 2006 : **Primary Energy Demand by Region**



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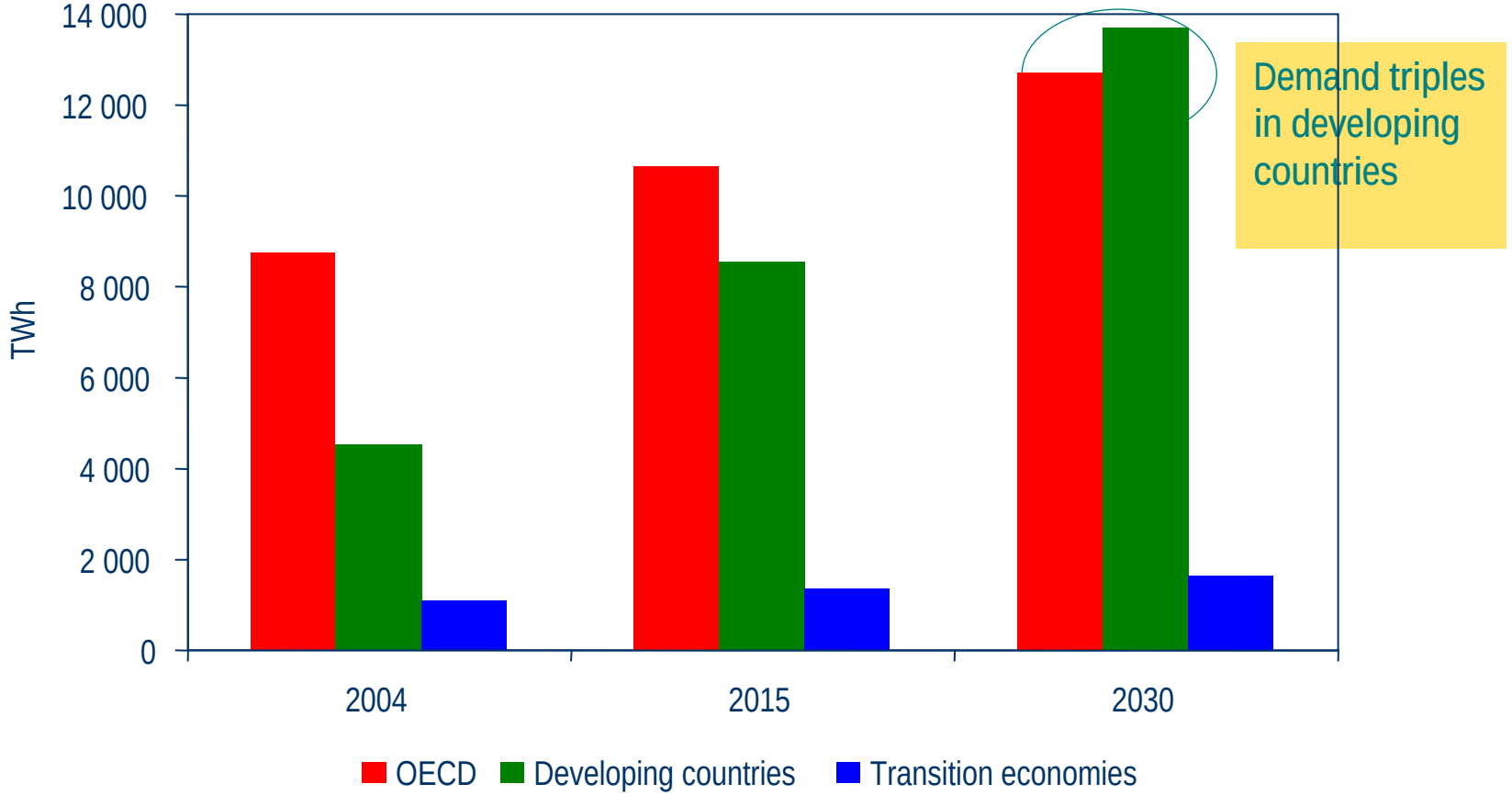
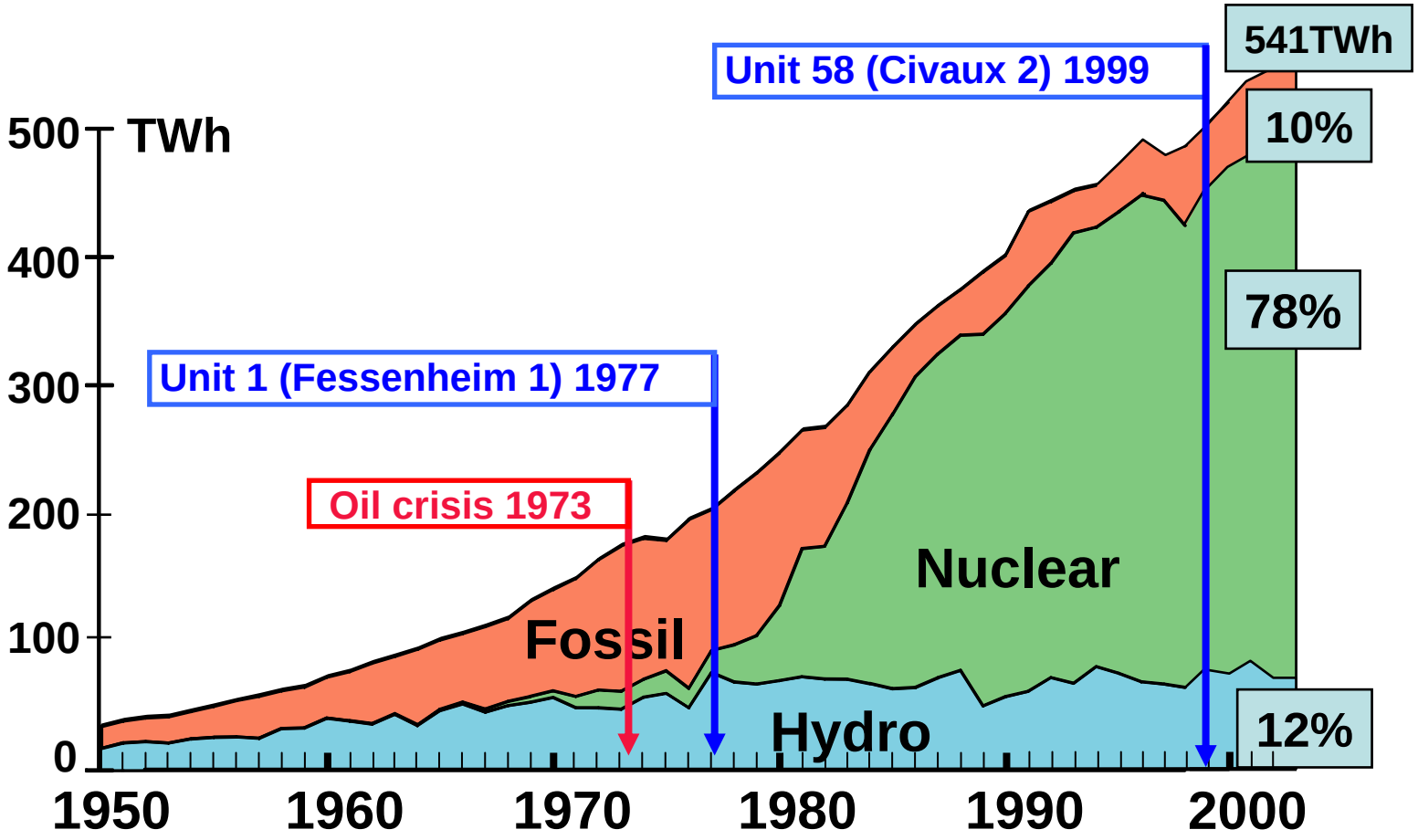


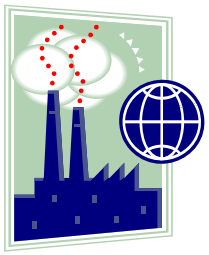
Building the energy mix in France



2005 : Nuclear : 78 % of total energy production
Thermal : 12 %
Hydraulic, wind and photovoltaic : 10 %

In conclusion of this first point, the relaunch of electronuclear power worldwide is a necessity

- **Sustainable development**
  - **Awareness of the effects of global warming**



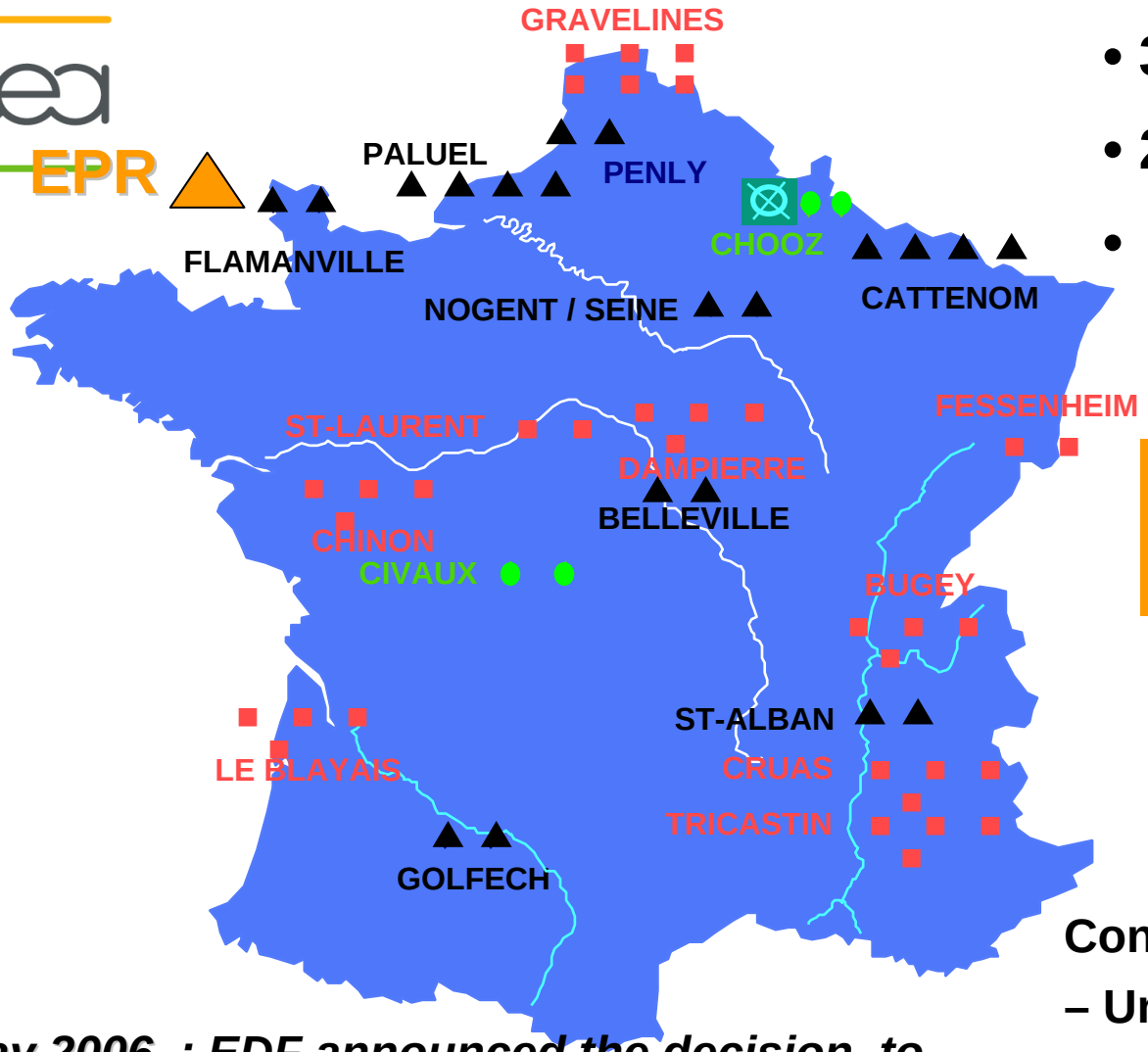
- **Safety of supplies**
  - **Rise in the price of oil and gas**

- **But you must also to take in account the Public perception of nuclear power risk**

A second wind for civil nuclear power after the initial enthusiasm of the 1960-70's

From 360 GWe today to 1500 GWe by 2050 ?

The current nuclear power fleet in France



- 34 900 MWe units
- 20 1300 MWe units
- 4 1500 MWe units

58 PWR units
63184 MWe installed

451.5 TWh produced in 2005

May 2006 : EDF announced the decision to built a first EPR in France (Flamanville)

Connection to the grid :

– Unit 1 (Fessenheim 1) : April 1977

– Unit 58 (Civaux 2) : December 1999

French atomic energy commission : the atom, from research to industry

1945 : CEA foundation

- **Atom and its applications for France : defence, energy, research, industry**

Today and tomorrow

- **Reference institution at worldwide level for nuclear energy**
- **Leading European body for technological research (Information and health)**
- **Defence and security**

Civil activities

- 15,000 employees
- Budget : 1.7 G€, including 0.9 G€ from governmental funding
- More than 2,800 scientific papers/year, more than 1000 ongoing PhD theses
- 62 UMR (common research units) 64 LRC (associated research units)
- 2203 active priority patents in portfolio (+ 322 in 2005)
- 1491 active agreements with industry (+ 254 in 2005)
- 97 high-tech spin-offs from CEA since 1984 (4 in 2005)
- Main shareholder of AREVA group

What role for nuclear power in the world energy mix ?

Nuclear power : a proven technology

21% of electricity produced by the nuclearised countries
16% of the electricity produced in the world
7% of all primary energy in the world

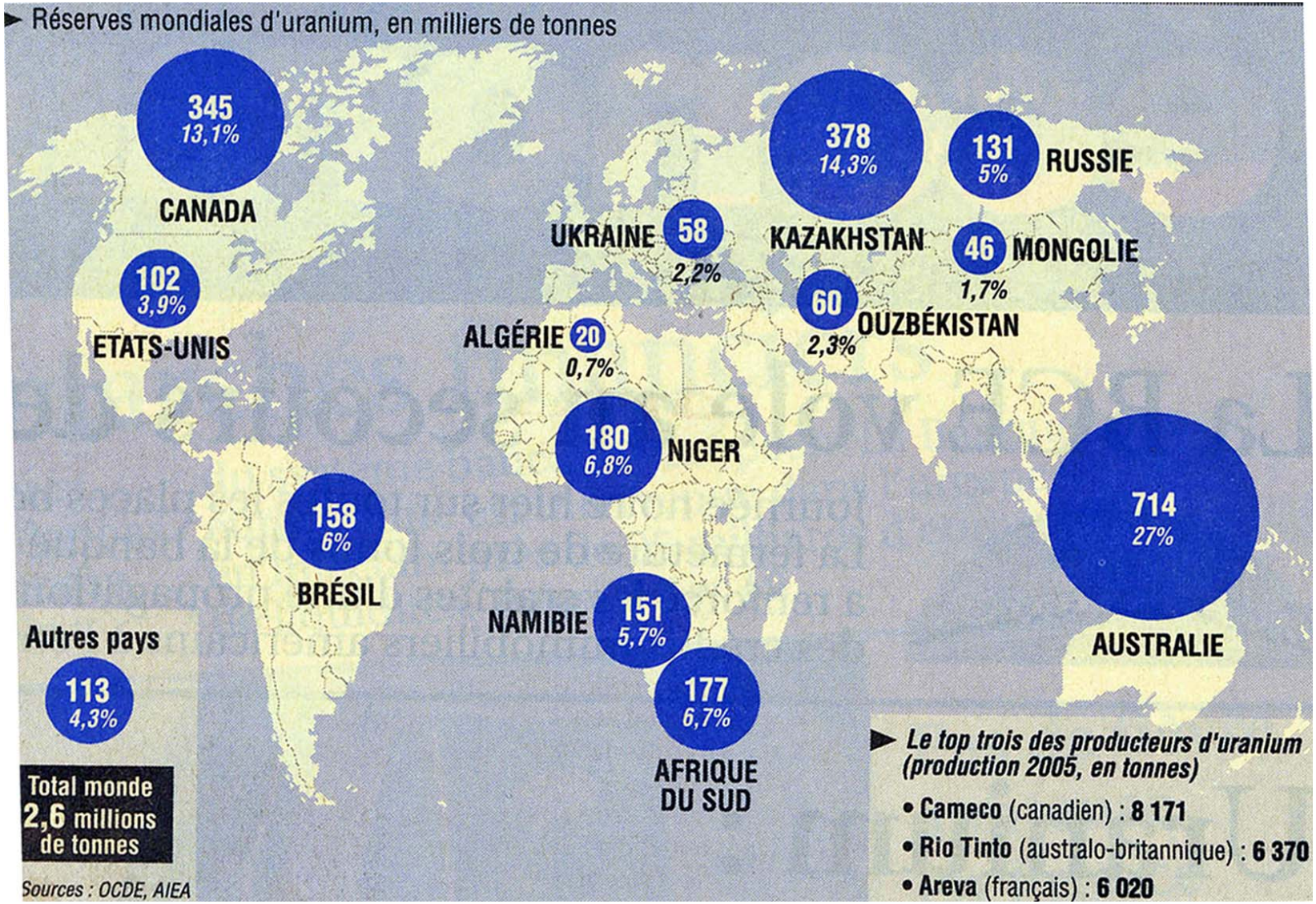
- More **than 30 countries** produce nuclear electricity for the benefit of nearly **4 billion inhabitants**

- **More than 440 reactors** (147 in 13 amongst EU 25 MS, 104 in US, 105 in Asia)
  Highly standardized world fleet (90% in 3 types) : 263 PWR, 92 BWR, 38 HWR
  Average age of the world fleet is 22
  12,000 years of cumulative industrial and commercial operation experience
- 284 research reactors in 56 countries for scientific purposes and production of medical and industrial isotopes

- 30 nuclear power reactors are under construction, another 35 firmly planned

- **Distribution of Uranium resources around the world** : a substantial **geopolitical diversification** with respect to suppliers of oil and gas

Distribution of Uranium resources around the world



2- French energy policy and nuclear power

- **Energy bill : 38.3 billion € in 2005, or 2.26% of GDP (5 % in 1981)**
- **Rate of energy independance : 49,8 % in 2005 (26 % in 1973)**

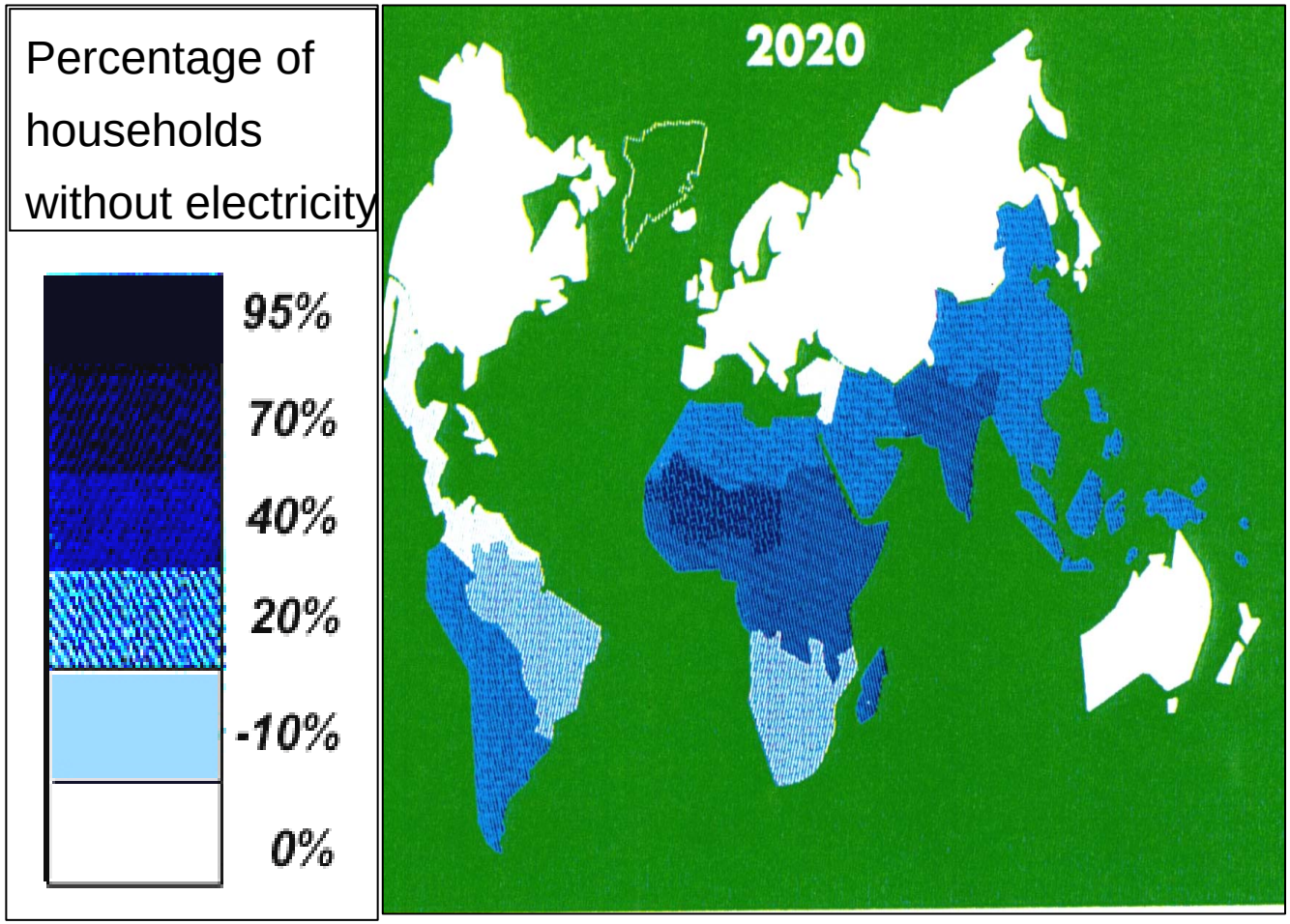
- 4th biggest energy consumer in the OECD (276.5 MTOE in 2005), France is only in the 27th place for CO2 emissions in relation to the GDP (2003, IEA)
- Competitive electricity for industry and for domestic consumers, characterised by stable prices

- Electricity production covering all national requirements and enabling France to be the leading electricity exporter in the world
- A network of nuclear power stations that makes France the second producer of nuclear-generated electricity in the OECD after the United States

Safety of supplies

« The right to energy » : development factor, global challenge

20 % of the population consumes 60% of the energy produced



1.6 billion people are without electricity

Project phases definitions

- ***Feasability study : roughly 30 people team full time during 2 years***
  First training actions should be engaged at this stage

- ***Program planning and procurement procedure : at this stage***
  - ***Future plant operator must be in capacity of negotiating with possible makers***
  - ***It's necessary to have organized :***
    - ***Safety authority and its expertise support, with necessary technical competences***
    - ***Operator, owner of the future plant, which will obtain licencing from safety authority***
    - ***Consortium gathering local and foreign companies for civil works and assembling***

- ***Industrial phase industrial after formal provider choice :***
  - *Design from T0 – 84 months to T0 – 20 months*
  - *Fabrication from T0 – 78 months to T0 -25 months*
  - *Construction assembling on site from T0 - 60 months to T0- 10 months*
  - *Tests and connection to the grid from T0- 14 months to T0*

- ***Project Management, Operations and maintenance***