EU Nuclear Status & Prospects

Olkiluoto – July 2005

Bertrand Barré

ENS President

INSC President

Advisor to AREVA

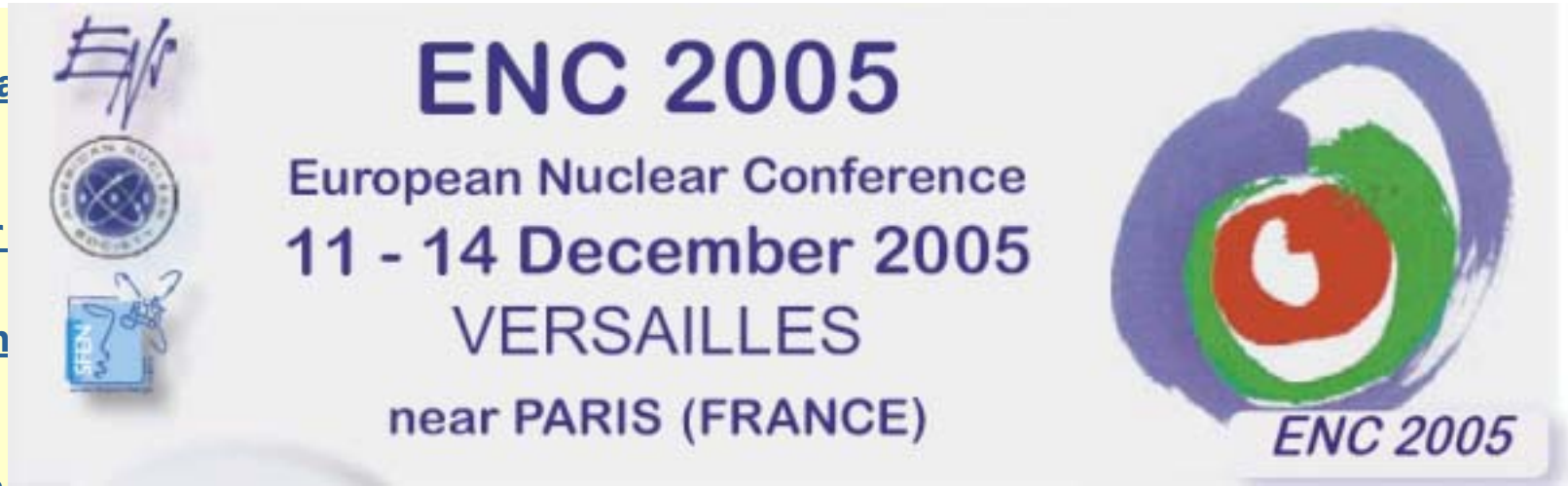
International Nuclear Societies Council

ENS

GLOBAL 05 – Tsukuba, October 2005

The European Nuclear Society
Largest nuclear society for science and industry

24 Member Societies accross Europe



Austria rgy

Bulgar ety

Danish rgy

German Nuclear Society | Hungarian Nuclear Society | Israel Nuclear Society

Italian Nuclear Association | Lithuanian Nuclear Energy Association | Netherlands Nuclear Society

Nuclear Society of Russia | Nuclear Society of Slovenia | Polish Nuclear Society

Romanian Nuclear Ener Association | Spanish Nuclear Society

www.euronuclear.org

Swedish Nuclear Society | Swiss Nuclear Society | Yugoslav Nuclear Society

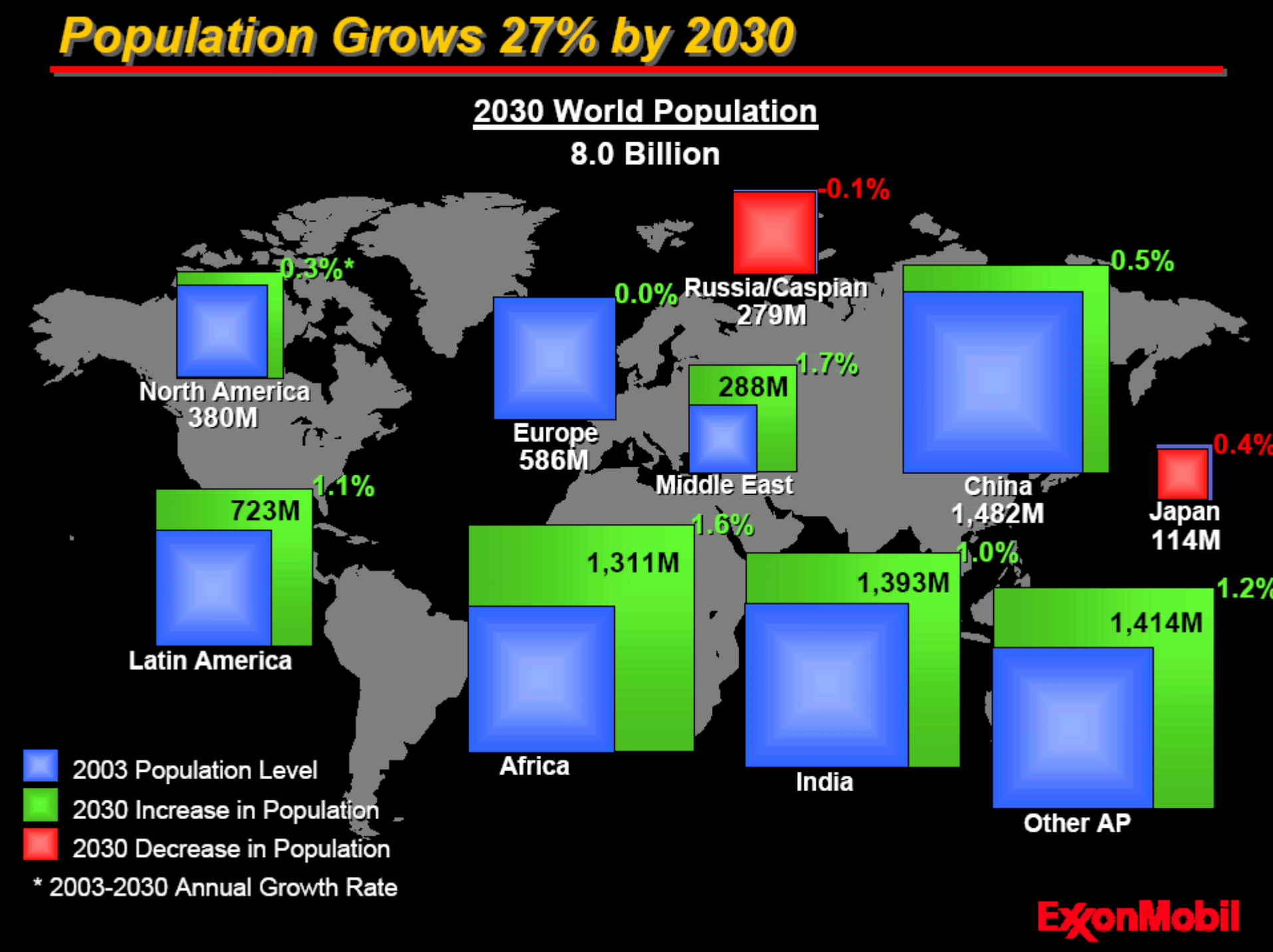
European Union EU-25

Specifics of Europe

- *Population no longer Growing*
- *High per capita GNP*
- *High energy use /Low consumption growth rate*
- *Low Fossil Fuels Resources / High dependancy*
- *Environment consciousness*
- *High technology*

- *Nuclear Power well fitted to European Situation*

Population Grows 27% by 2030



ExxonMobil

Emerging Asia Drives Fuels & Emissions Growth

	North America		Europe		Emerging AP	
	2003	2030	2003	2030	2003	2030
Number Vehicles (Million)	235	325	230	270	55	420
Cars/1000	730	855	395	460	15	100
Efficiency (MPG)						
Fleet	20.5	29.0	31.5	39.0	19.0	25.0
New Sales	21.0	38.0	35.0	43.0	20.0	29.0
Advanced ICE/Diesel % Sales	1%	42%	39%	57%	13%	22%
Light Duty Fuels (MBD)	9.5	8.8	3.7	3.6	1.8	7.9
Carbon Emissions (G Tonnes/Yr)	0.35	0.33	0.14	0.14	0.07	0.30

ExxonMobil

Nuclear Electricity 2004

Country	*GWe*	TWh	Nb Reac.	%Elec
USA	*98*	789	103	20
France	*63*	427	59	78
Japan	*48*	274	55	29
Germany	*20*	158	17	32
Russia	*22*	133	31	16
South Korea	*17*	124	20	38
Canada	*12*	85	17	15
Ukraine	*13*	81	15	51
Sweden	*9*	75	10	52
U Kingdom	*12*	74	23	19
WORLD	*368*	2 619	440	16

Website WNA August 2005

Nuclear Power in EU 25

Country	Nuclear TWh (2004)	% Elec	# *reactors* (July 2005)	GWe
Belgium	44.9	55	*7*	5.7
Czech Republic	26.3	31	*6*	3.5
Finland	21.8	27	*4*	2.7
France	426.8	78	*59*	63.4
Germany	158.4	32	*17*	20.3
Hungary	11.2	34	*4*	1.8
Lithuania	13.9	72	*1*	1.2
Netherlands	3.6	4	*1*	0.4
Slovakia	15.6	55	*6*	2.5
Slovenia	5.2	38	*1*	0.7
Spain	60.9	23	*9*	7.6
Sweden	75.0	52	*10*	8.9
United Kingdom	73.5	10	*23*	11.9
TOTAL EU 25	937.3	32	*148*	130.6

Nuclear Power in Europe

Region	Nuclear TWh	# reactors	GWe
EU 25	**937.3**	**148**	**130.6**
Bulgaria	15.6	4	2.7
Romania	5.1	1	0.7
EU 28	**958.0**	**153**	**134.0**
Switzerland	25.4	5	3.2
West Europe	**983.4**	**158**	**137.2**
Russian Federation	133.0	31	21.7
Ukraine	81.1	15	13.1
Total Europe	**1197.5**	**204**	**172.0**
WORLD	**2618.6**	**440**	**367.7**

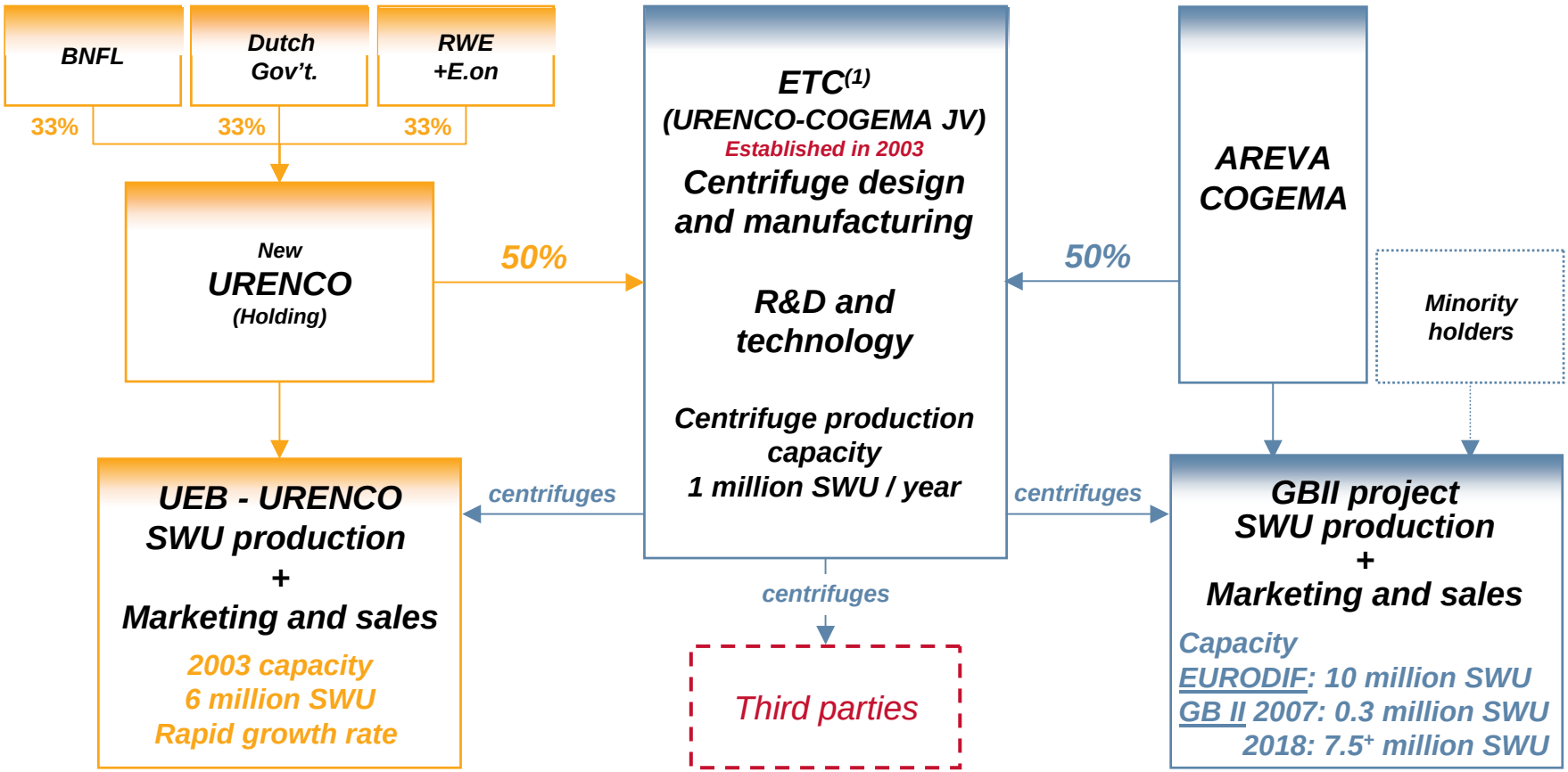
Main Players on the Nuclear Power Marketplace (2004)

		2004 Market	CAMECO*	URENCO	USEC*	AREVA	BNFL WESTINGHOUSE	MINATOM Group	General Electric*	OTHER
FRONT END	Mining / Natural Uranium	70,000 t	20%			20%		10%		50%
	Conversion/Chemistry	55,000 tU	20%			25%	5% (2006 shutdown)	20%		30%
	Enrichment	37.5 MSWUs**		20%	30% ***	25%	BNFL, URENCO shareholder	20%****		5%
	L E Uranium fuel (UO2)	6,500 t				35%	25%	10%	15%	15%
	Reactors & Services	370 GWe				25%	15%	15%	10%	35%
BACK END	Reprocessing	1,500 t				75%	15%	10%		JNFL in future
	Recycling & MOX fuel	150 t				90%	BNFL/SMP a/c 2004			10% JNFL in future

* Publicly traded company
** Separative Work Units
*** Of which half purchased from MINATOM (HEU)
*** Plus the 15% sold to USEC (HEU)

€6.6B in 2004 sales

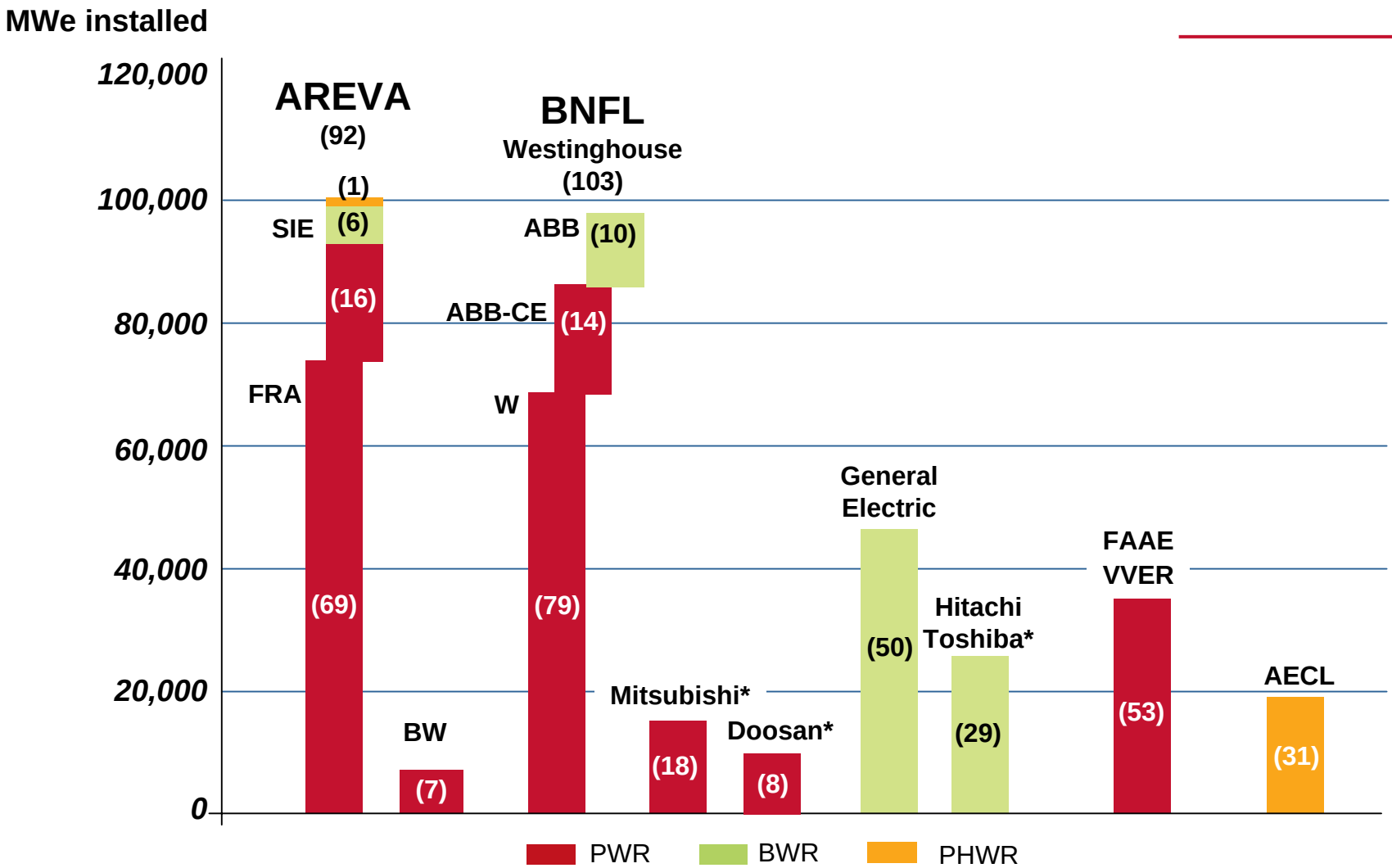
AREVA and URENCO JV* in centrifuge technology



(1) Enrichment Technology Company

*Subject to ratification of intergovernmental treaty (NL, Germany, UK, France)

Vendors'Share of LWR-HWR Capacity (MWe)



*Licensed by: Westinghouse to Mitsubishi and Doosan G.E. to Hitachi/Toshiba

** Following Framatome's purchase of the commercial reactors business from B&W at the end of the 1990s, AREVA may be considered as the preferred service partner for these reactors in the United States, although it is not liable as a constructor

Source: AREVA

The Evolution of Nuclear Power

First Reactors

Current Reactors

Advanced Reactors

Future Systems

1950 1970 1990 2010 2030 2050 2070 2090

Generation I

UNGG

CHOOZ

Generation II

REP 900

REP 1300

N4

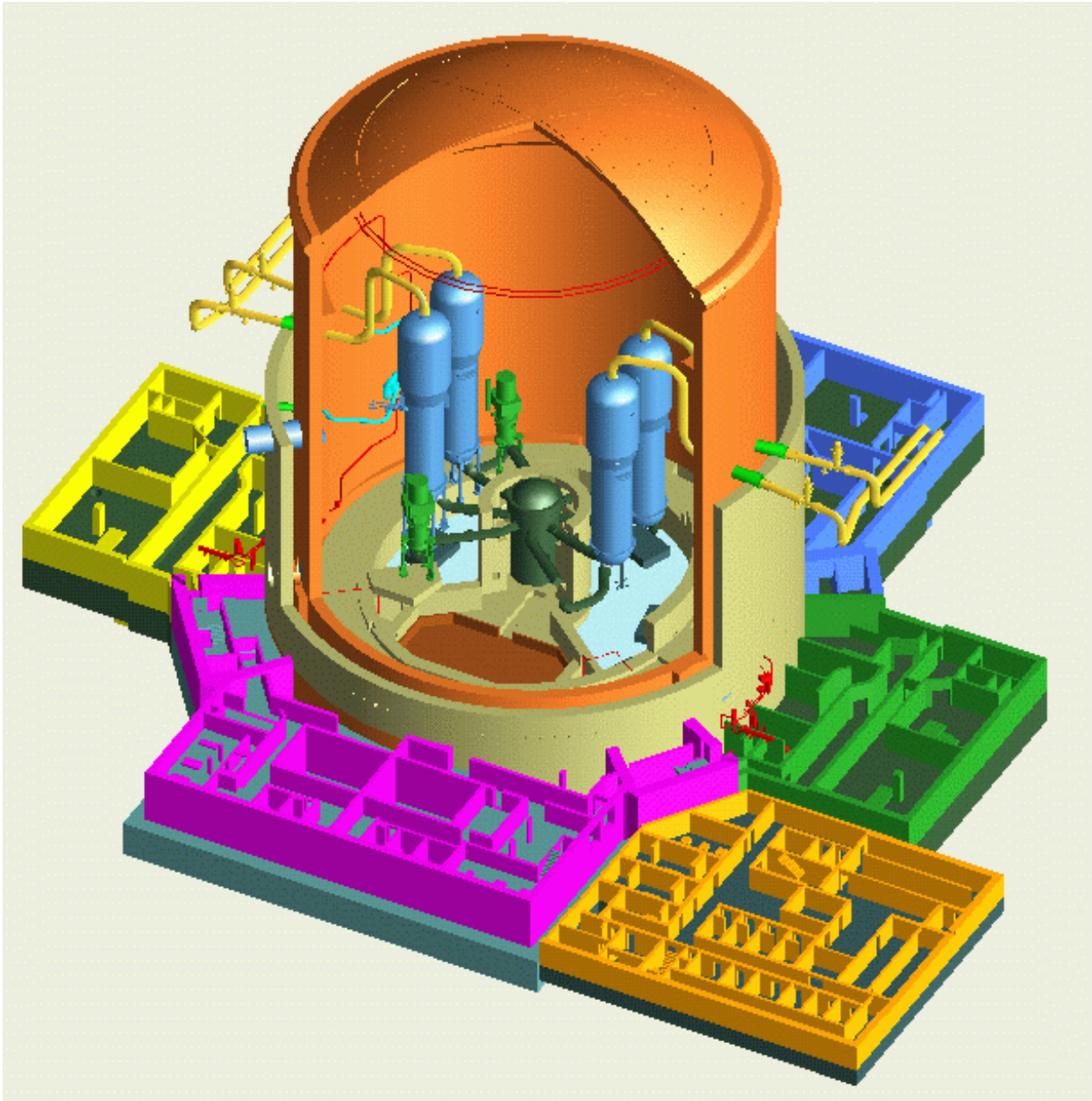
Generation III

EPR

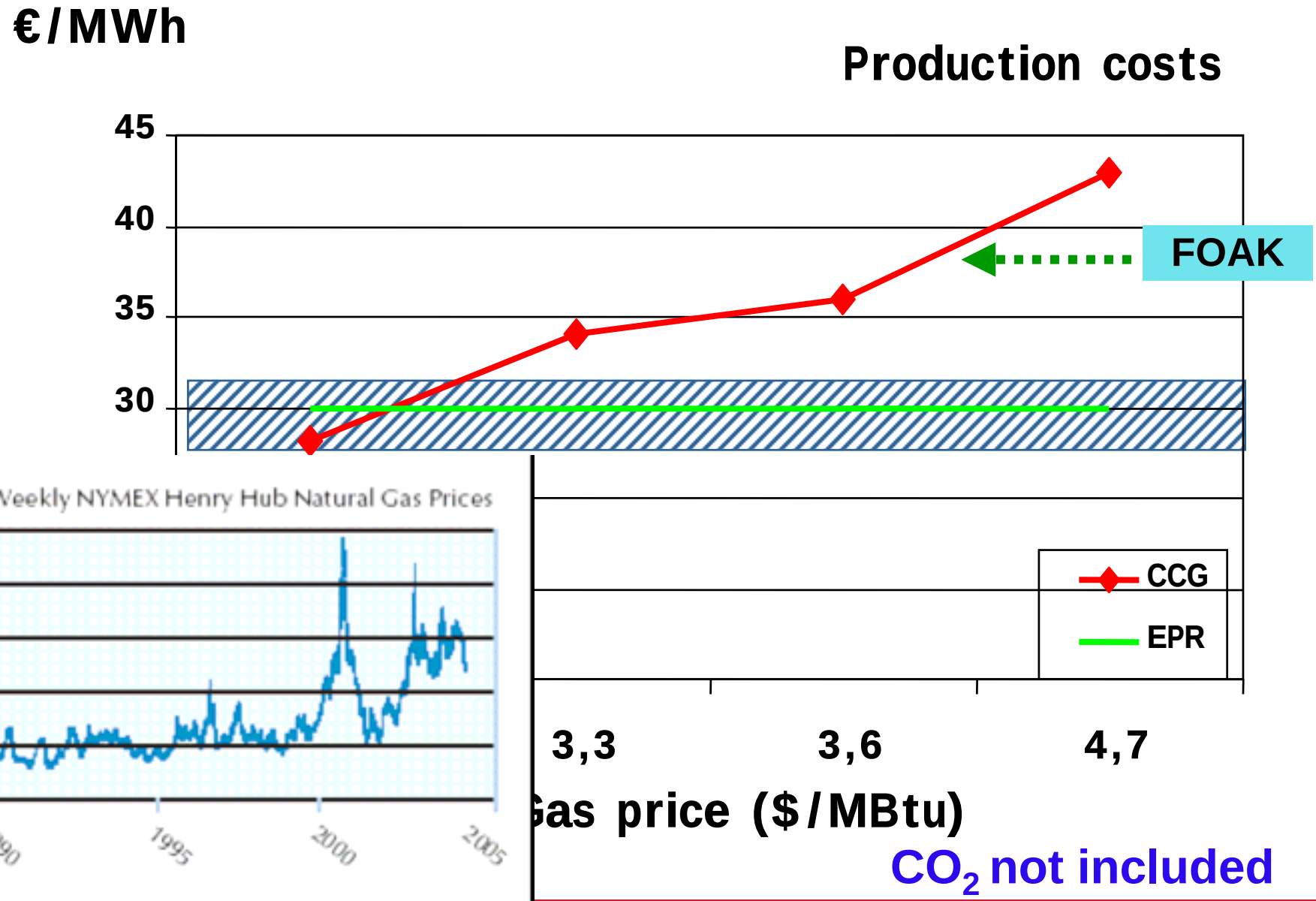
Generation IV

?

« Generation 3 » Nuclear Plants



Production costs of EPR vs CCGT



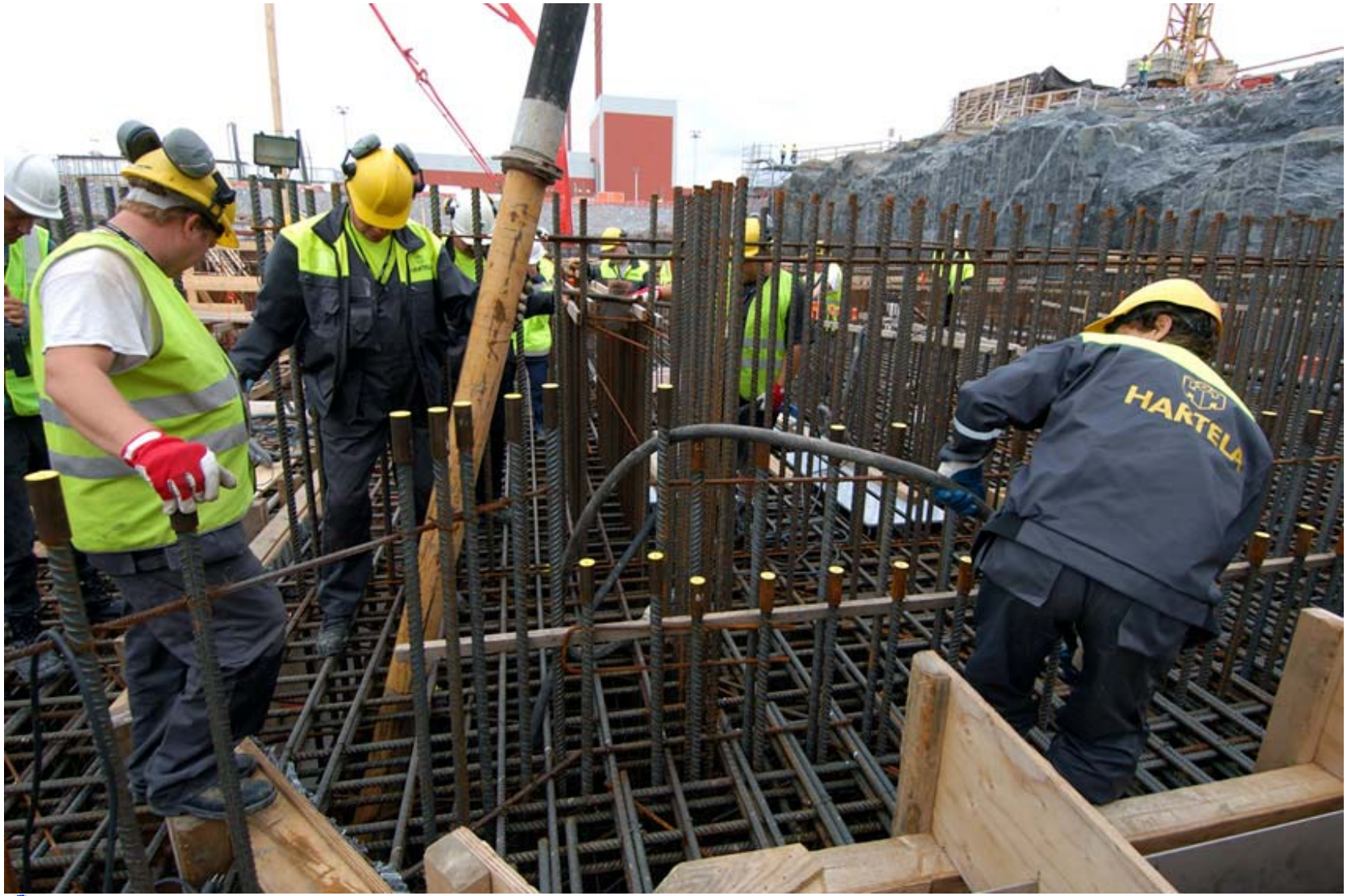
CO_2 not included

Ok 3 Supplier Consortium
Framatome ANP and Siemens PG

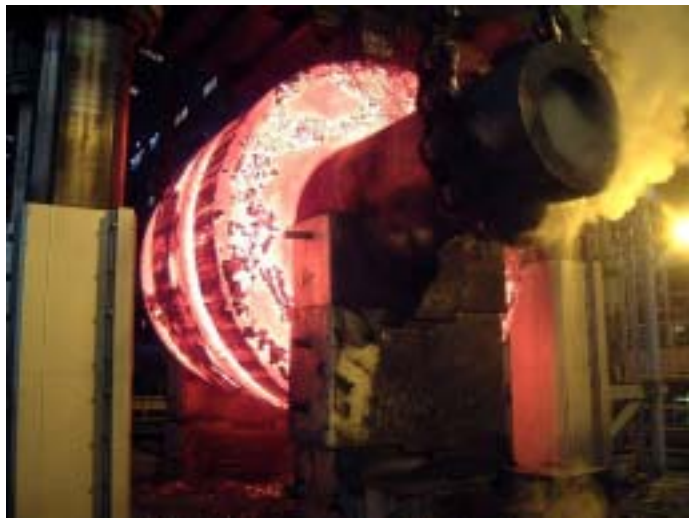
- **Framatome ANP:**
  - **overall project coordination (including functional and technical integration of the complete plant),**
  - **Nuclear Island (Nuclear Steam Supply System plus Balance of the Nuclear Island),**
  - **Instrumentation and Control plus Simulator for the whole plant,**
  - **supply of the first core of fuel assemblies.**
- **Siemens PG:**
  - **Turbine Island.**

Site Works at Olkiluoto (Finland) spring 2004

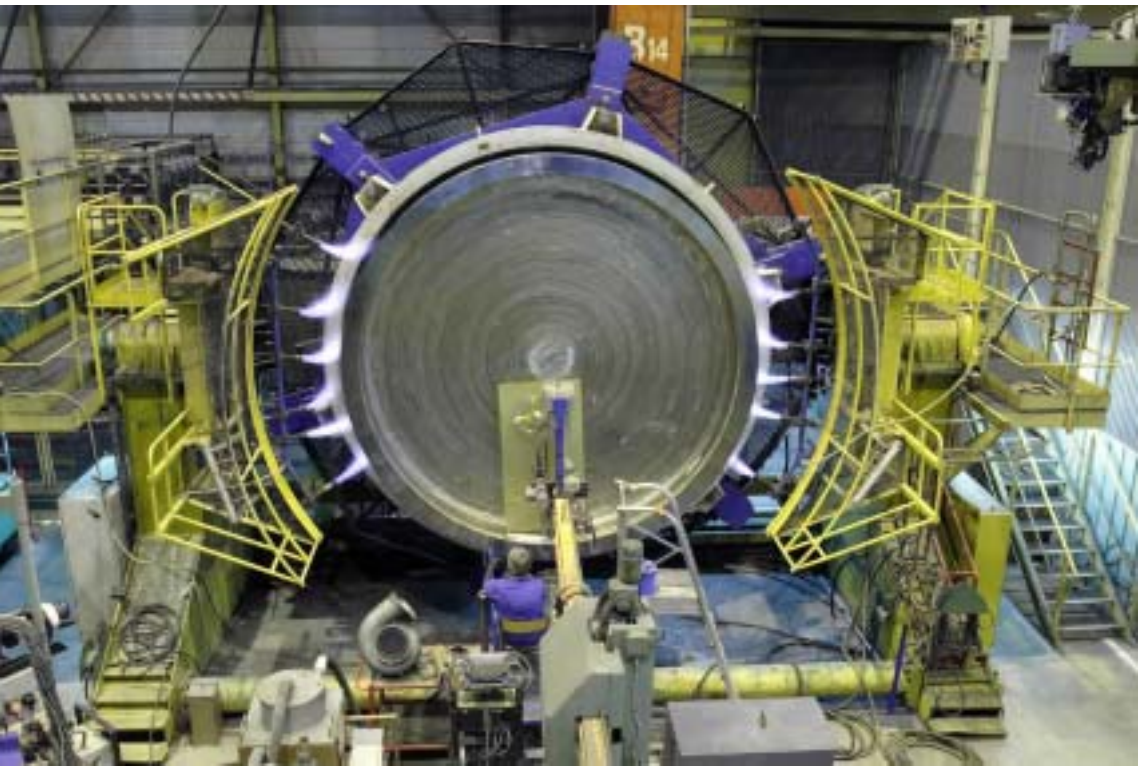
Concrete pouring August 2005



EPR Reactor Vessel



EPR Steam Generator



GEN IV : paves the way for a sustainable nuclear energy

➢ New requirements for sustainable nuclear energy

- Gradual improvements in :
  - ✓ **Competitiveness**
  - ✓ **Safety and reliability**

- ***Concepts with breakthroughs***
  - ✓ ***Minimization of wastes***
  - ✓ ***Preservation of resources***
  - ✓ ***Resistance to Proliferation***

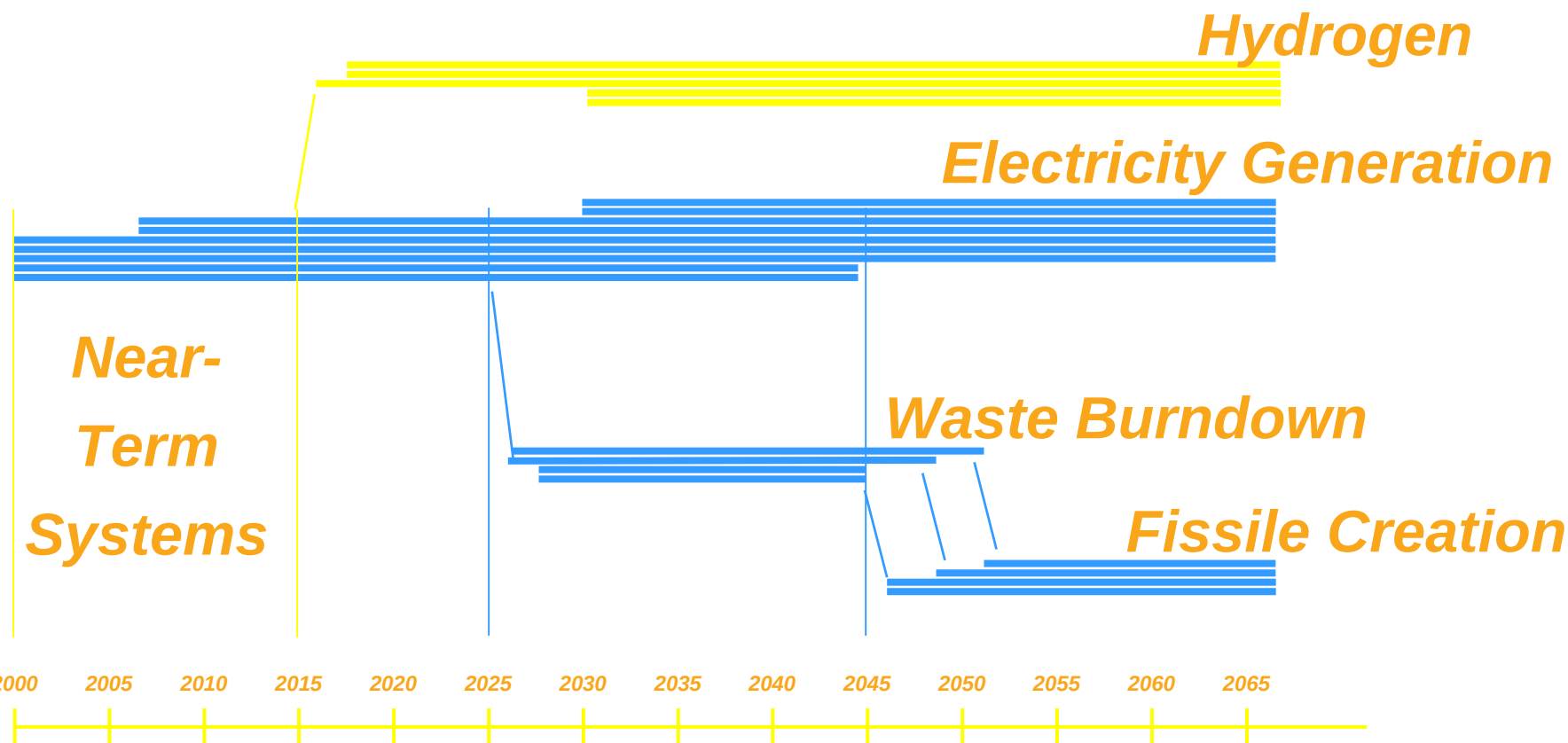
➢ New applications :

- ✓ **hydrogen production**
- ✓ **water desalination**
- ✓ **direct use of heat**

➢ Penetration of new markets :

- ✓ **emerging countries**
- ✓ **small countries**

Different systems for different applications



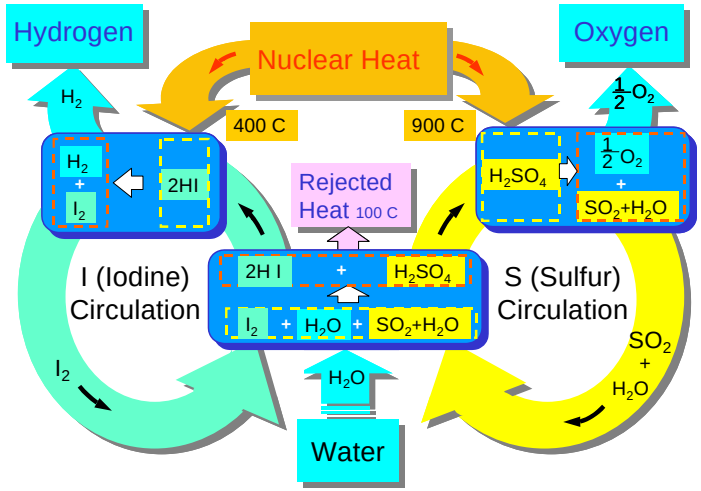
Capability to target new applications

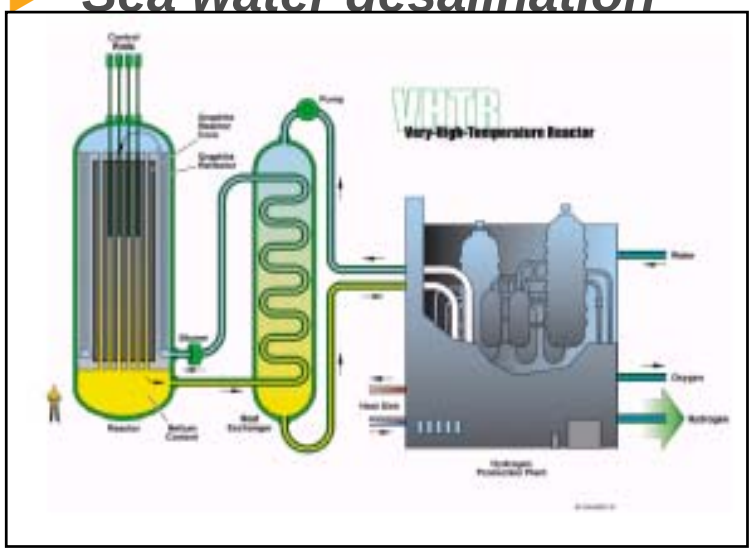
Nuclear energy will be essential for :

- ***Electrical power generation***

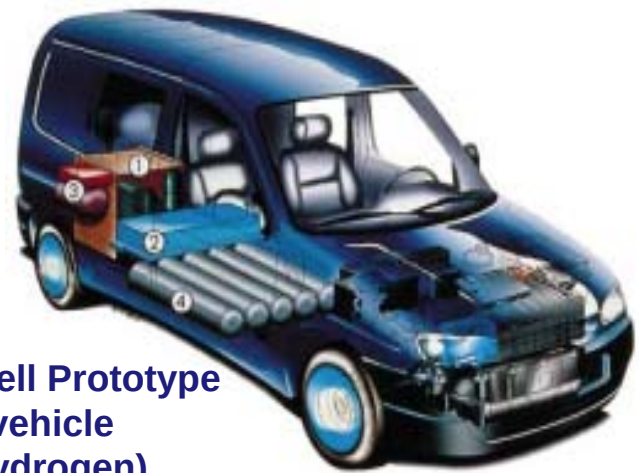
… but also for new applications :

- ***Hydrogen production***
- ***Direct use of Heat***
- ***Sea water desalination***





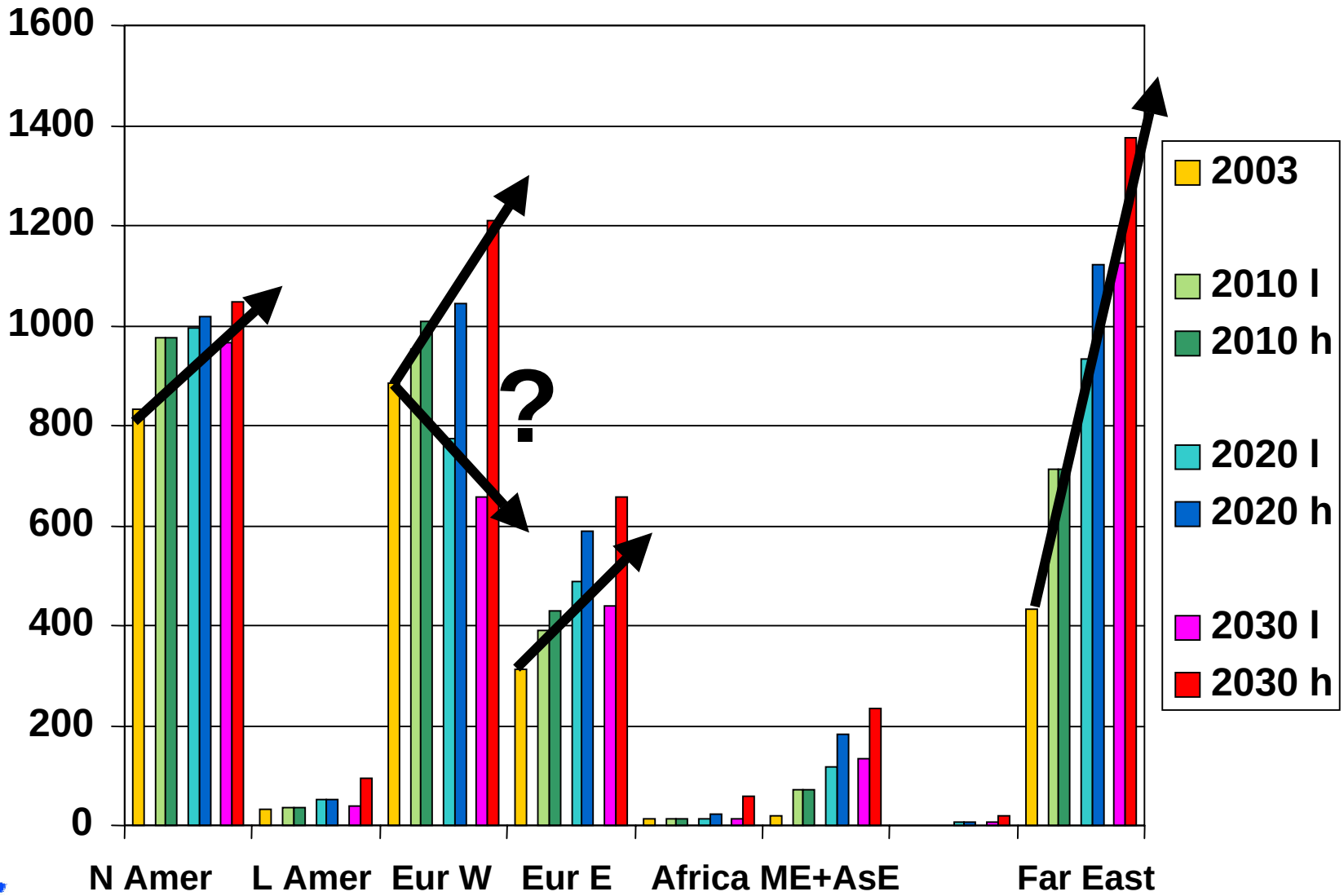
Very High Temperature Reactor



Fuel Cell Prototype vehicle (hydrogen)

Nuclear Generation Forecasts 2003-2030

(IAEA July 2004)



24 708 EU25 citizens…

EUROBAROMETER

Special Eurobarometer

European Commission

Radioactive waste

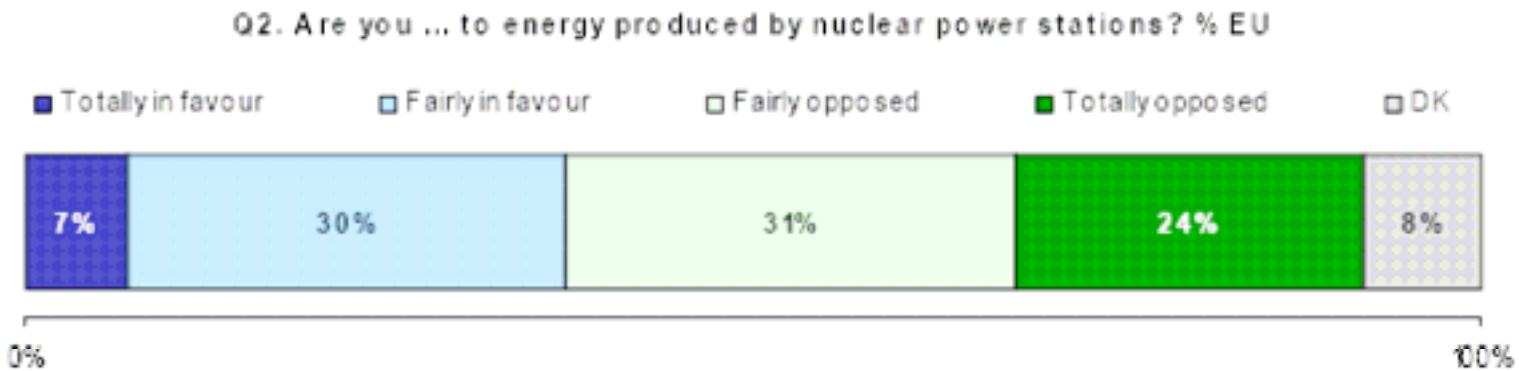
Fieldwork : February- March 2005

Publication : June 2005

Some Results of EUROBAROMETER 277

- A minority of interviewees in favour of nuclear energy -

Across the European Union, 37% of interviewees say that they are in favour of energy produced by nuclear power stations, while 55% are against it and 8% express no opinion.

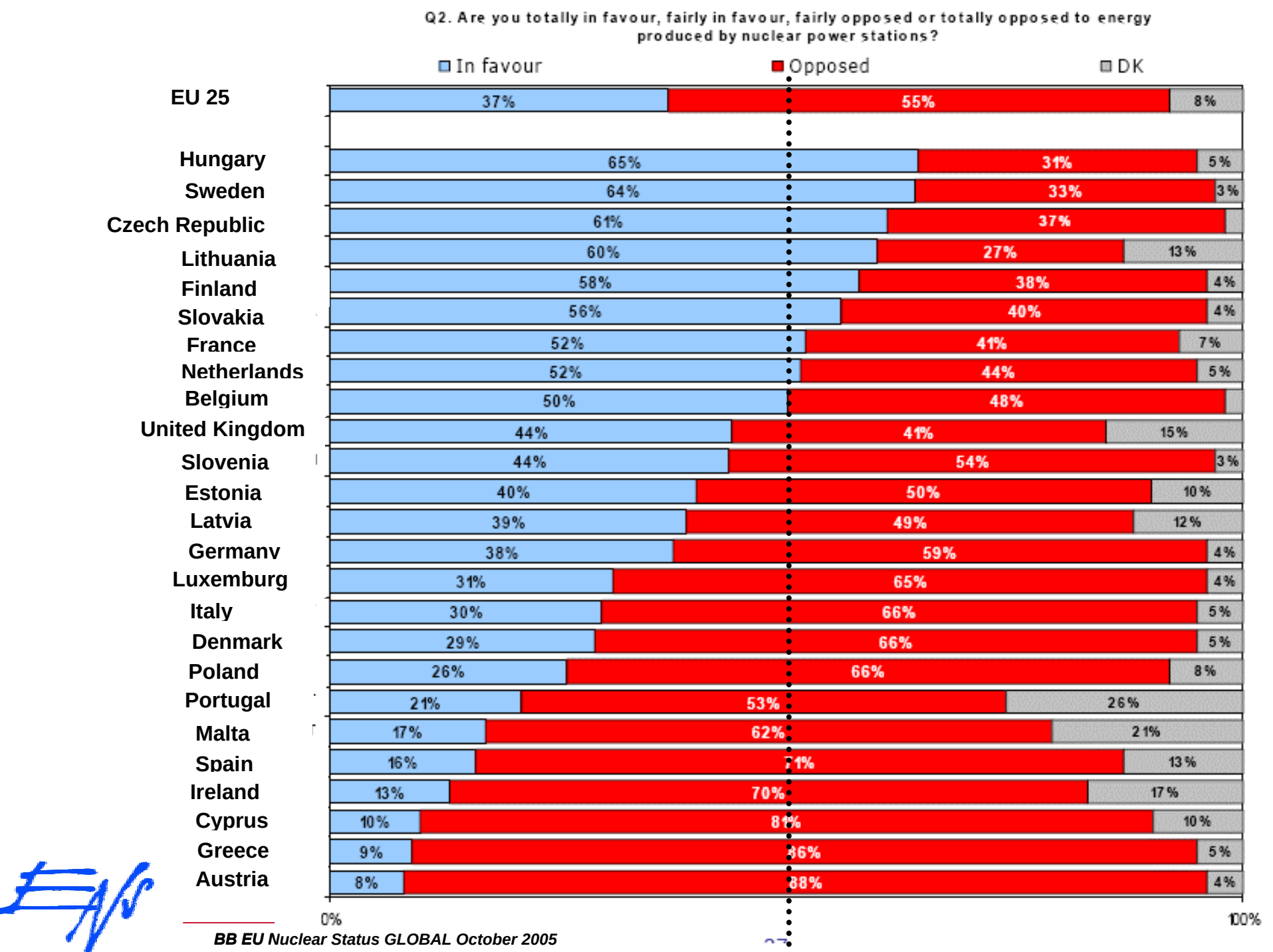


Considerable differences of opinion emerged in different Member States regarding the energy produced by nuclear power stations.

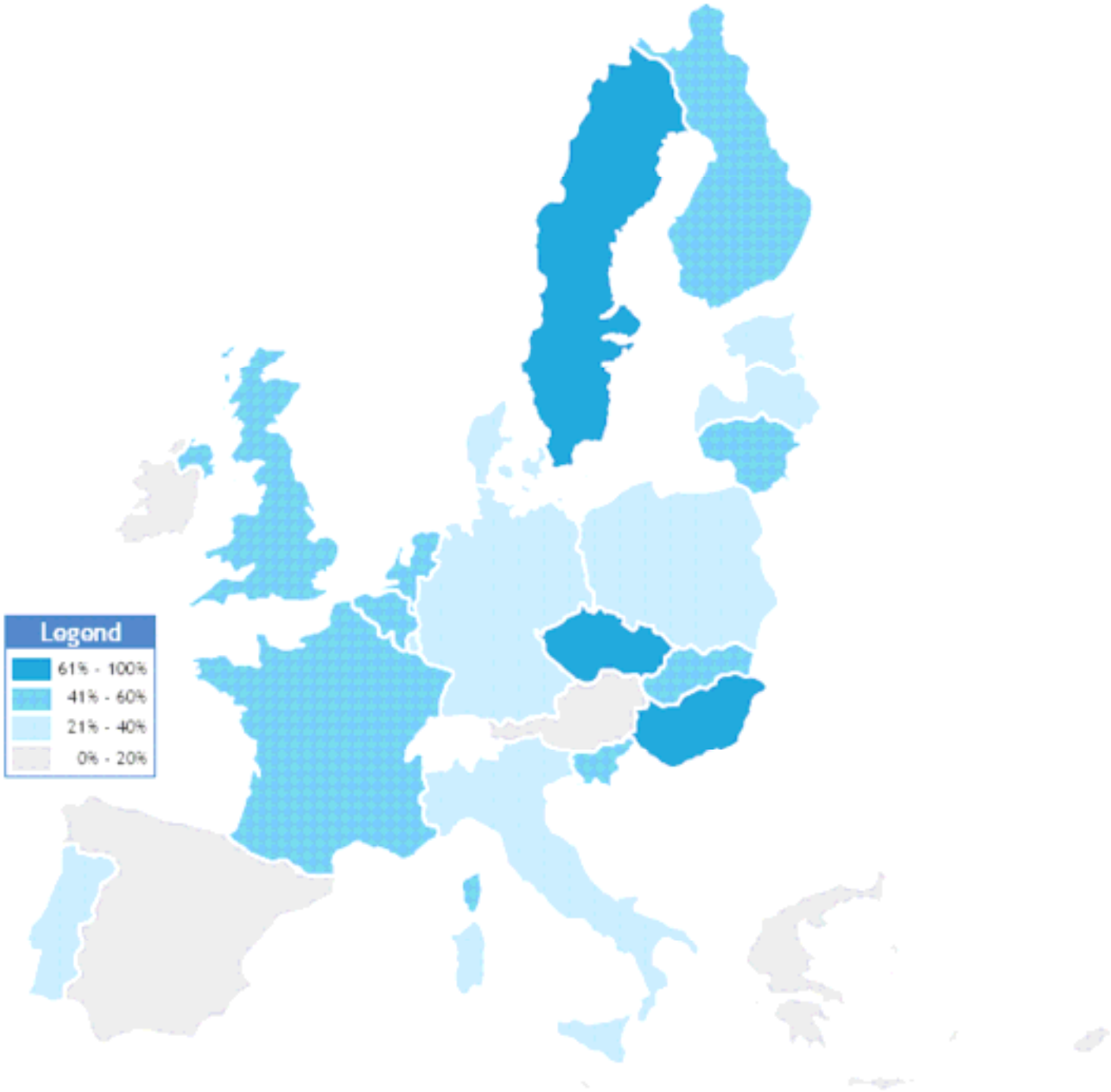
More than six out of ten citizens support this type of energy in **Hungary** (65%), **Sweden** (64%), the **Czech Republic** (61%) and **Lithuania** (60%). It should be noted that these countries follow a different nuclear policy. While Sweden proposes to abandon the nuclear route over the next forty years, the Czech Republic is undertaking the construction of two new reactors.
Furthermore, a majority of respondents also said they were in favour of nuclear energy in **Finland** (58%), **Slovakia** (56%), **France** (52%), **the Netherlands** (52%) and **Belgium** (50%).

However, opponents of nuclear energy represent a very large majority of the population, primarily in **Austria** where 88% of interviewees state that they are opposed to this type of energy, but also in **Greece** (86%), **Cyprus** (81%), **Spain** (71%), **Ireland** (70%), **Poland** (66%), **Denmark** (66%), **Italy** (66%) and **Luxembourg** (65%). It should be noted that Austria has adopted a law prohibiting the operation of nuclear power stations for the production of electricity, thus renouncing the use of nuclear energy. This country has also set itself the task of creating a nuclear energy free zone in central Europe. It is against this background that Austria is in favour of closing down the Russian-designed Czech power station at Temelin, situated only 60 km from its border, and where the opening of two new reactors is planned for 2015.

Finally, in **Portugal** around a quarter of interviewees were unable to give their opinion on this question (26% of 'don't know' responses).


Q2. Are you totally in favour, fairly in favour, fairly opposed or totally opposed to energy produced by nuclear power stations?
In favour
Opposed
DK
EU 25 37% 55% 8%
Hungary 65% 31% 5%
Sweden 64% 33% 3%
Czech Republic 61% 37%
Lithuania 60% 27% 13%
Finland 58% 38% 4%
Slovakia 56% 40% 4%
France 52% 41% 7%
Netherlands 52% 44% 5%
Belgium 50% 48%
United Kingdom 44% 41% 15%
Slovenia 44% 54% 3%
Estonia 40% 50% 10%
Latvia 39% 49% 12%
Germany 38% 59% 4%
Luxemburg 31% 65% 4%
Italy 30% 66% 5%
Denmark 29% 66% 5%
Poland 26% 66% 8%
Portugal 21% 53% 26%
Malta 17% 62% 21%
Spain 16% 71% 13%
Ireland 13% 70% 17%
Cyprus 10% 80% 10%
Greece 9% 86% 5%
Austria 8% 88% 4%
0%
100%

Member States Results	
Hungary	65%
Sweden	64%
Czech Republic	61%
Lithuania	60%
Finland	58%
Slovakia	56%
France	52%
The Netherlands	52%
Belgium	50%
United Kingdom	44%
Slovenia	44%
Estonia	40%
Latvia	39%
Germany	38%
EU25	37%
Luxembourg	31%
Italy	30%
Denmark	29%
Poland	26%
Portugal	21%
Malta	17%
Spain	16%
Ireland	13%
Cyprus	10%
Greece	9%
Austria	8%



Nuclear supporter : male, educated, right-wing

Q2.	In favour	Opposed	DK
EU25	37%	55%	8%
Sex			
Male	46%	49%	5%
Female	29%	60%	11%
Education (End of)			
15	28%	60%	12%
16-19	40%	53%	8%
20+	43%	53%	4%
Still Studying	37%	56%	7%
Left-Right scale			
(1-4) Left	34%	61%	5%
(5-6) Centre	40%	53%	7%
(7-10) Right	49%	46%	5%

Q4. *% Agree*	The use of nuclear energy enables European countries to diversify their energy sources	We could reduce our dependence on oil if we use more nuclear energy	An advantage of nuclear power is that it produces less greenhouse gas emissions than other energy sources such as oil or coal
EU25	62%	61%	62%
Sex			
Male	68%	66%	69%
Female	57%	56%	56%
Age			
15-24	63%	60%	59%
25-39	65%	62%	63%
40-54	64%	62%	64%
55 +	59%	60%	61%
Education (End of)			
15	52%	52%	51%
16-19	65%	62%	64%
20+	69%	68%	71%
Still Studying	65%	63%	65%
Left-Right scale			
(1-4) Left	62%	59%	63%
(5-6) Centre	65%	64%	65%
(7-10) Right	71%	70%	69%

Even in Europe : a Change of Mood ?

- ***Finland and France order new plants***
- ***German phaseout not supported by CDU-CSU***
- ***After Baerseback, no new Swedish shutdown in the planning***
- ***New EU Members much more supportive – Likely to influence the EP***
- ***Swiss antinuke referendum widely beaten***
- ***UK White Paper still « in » ?***
- ***Even in Italy, nuclear non longer « taboo »***