

Status and Trends of the World Nuclear Industry

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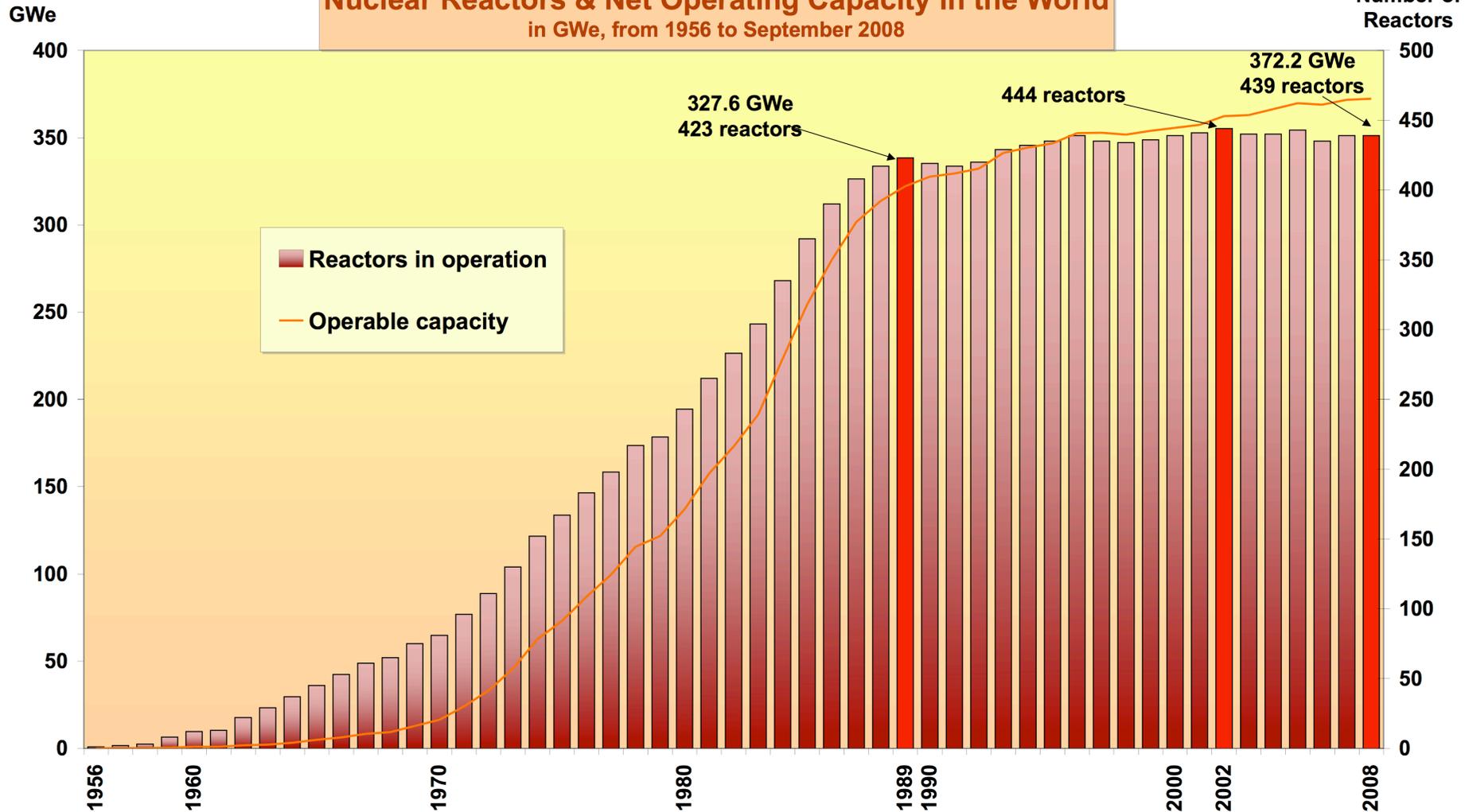
Washington DC, 17 September 2008

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1. Status and Trends of the International Nuclear Industry
 2. New build in EU, China
 3. Key Barriers
 - Financial Risks
 - Workforce Problem
 - Public Opinion

« The IAEA has revised upwards its nuclear power generation projections to 2030, while at the same time it reported that nuclear's share of global electricity generation dropped another percentage point in 2007 to 14%. »

IAEA Press Release, 11 September 2008

Nuclear Reactors & Net Operating Capacity in the World in GWe, from 1956 to September 2008

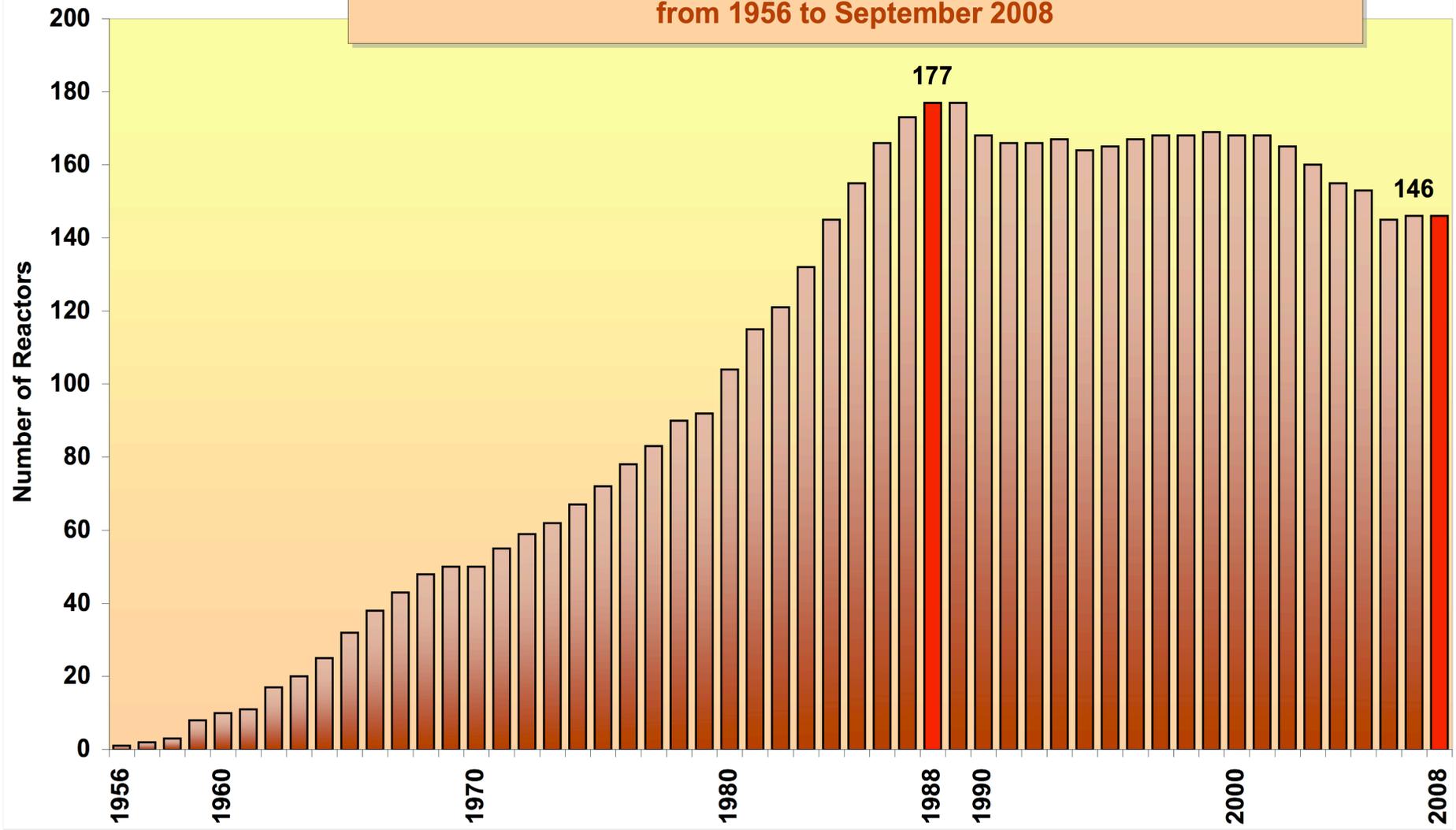


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Source: IAEA-PRIS, 2008

Nuclear Reactors in Operation in the EU 27

from 1956 to September 2008

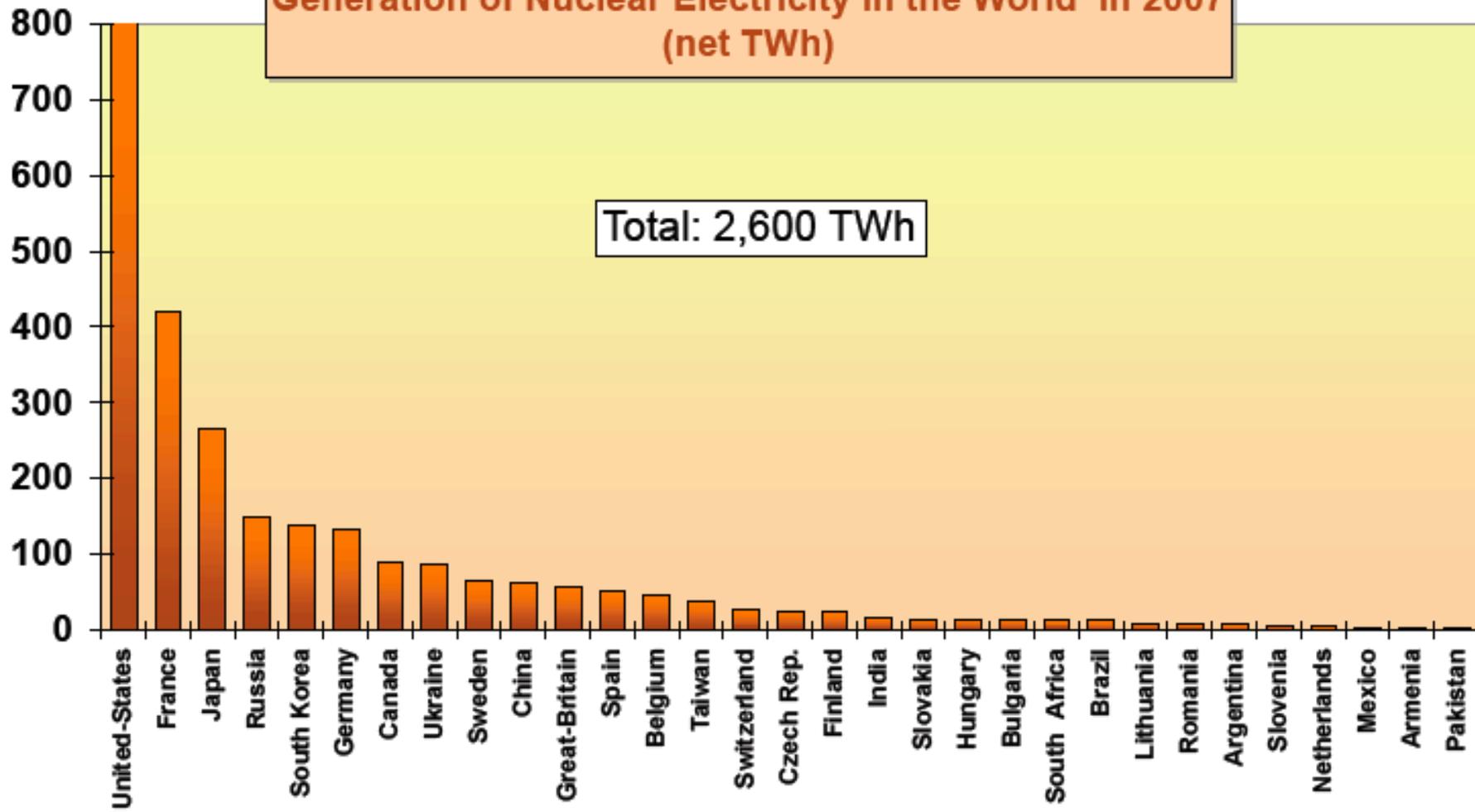


Source: IAEA PRIS

TWh

Generation of Nuclear Electricity in the World in 2007
(net TWh)

Total: 2,600 TWh



Source: IAEA/PRIS 2008

Nuclear Power in the World

By Country

(as of September 2008)

+ : 5 countries (11 units)

= : 15 countries stable

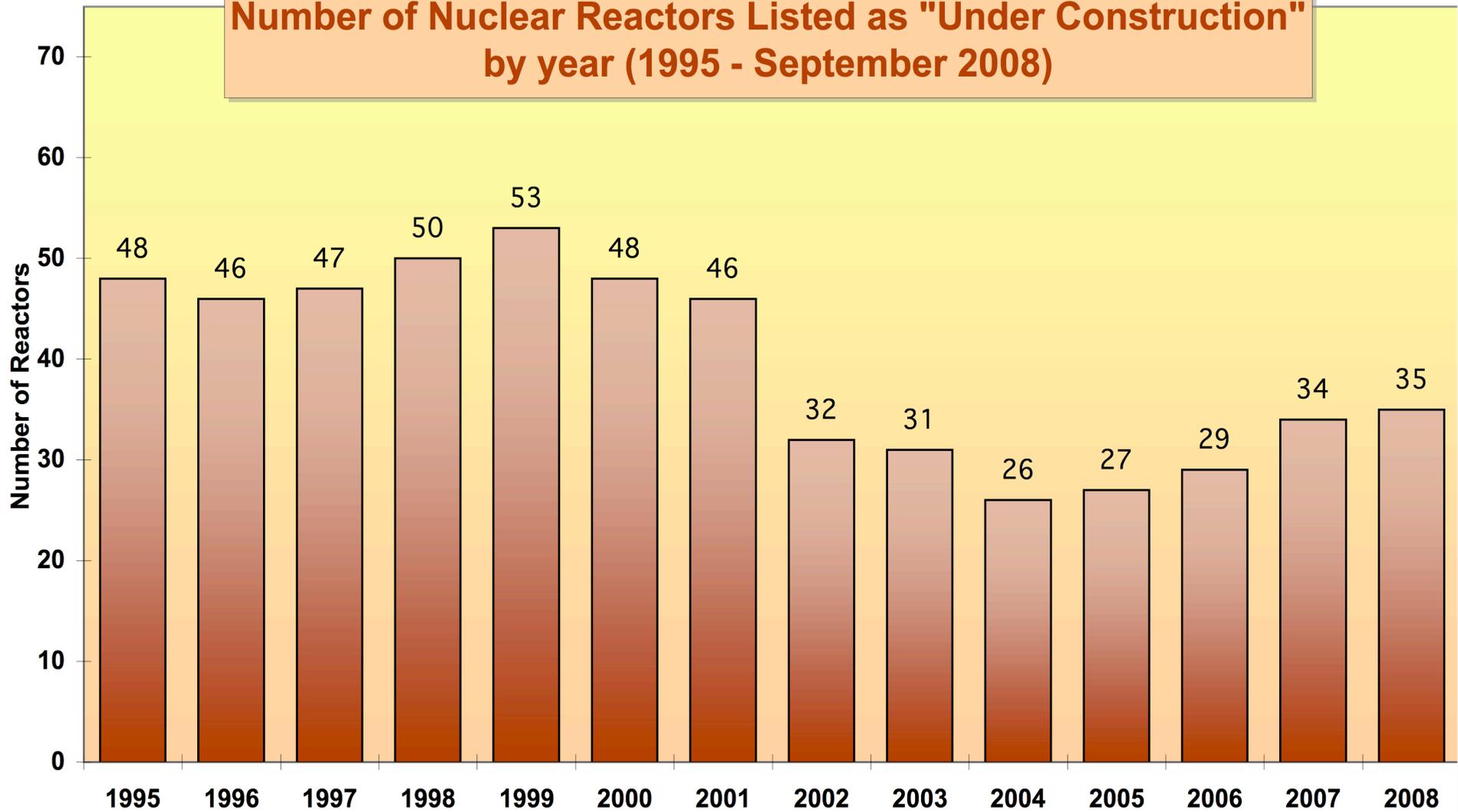
— : 11 countries

(218 units or 50%)

Sources: IAEA-PRIS 2008,
BP 2008, WNA 2008, MSC 2008

Countries	Nuclear Reactors ¹				Power ²	Energy ³
	Operate	Average Age	Under Construction ⁴	Planned ⁵	Share of Electricity ⁶	Share of Commercial Primary Energy
Argentina	2	30	1	1	7%(=)	3%
Armenia	1	28	0	0	43%(+)	?%
Belgium	7	28	0	0	54%(=)	15%
Brazil	2	17	0	1	3%(=)	1%
Bulgaria	2	19	2	0	44%(=)	16%
Canada	18	24	0	3	15%(-)	7%
China	11	7	6	24	2%(=)	<1%
Czech Republic	6	17	0	0	30%(-)	14%
Finland	4	29	1	0	29%(=)	20%
France	59	24	1	0	77%(-)	39%
Germany	17	26	0	0	26%(-) ⁷	10%
Hungary	4	23	0	0	37%(=)	14%
India	17	17	6	10	3%(=)	1%
Iran	0	0	1	2	0%(=)	0%
Japan	55	23	1	12	28%(-)	12%
Korea RO (South)	20	15	3	5	35%(-)	14%
Lithuania	1	21	0	0	64%(-)	25%
Mexico	2	17	0	0	5%(=)	2%
Netherlands	1	35	0	0	4%(=)	1%
Pakistan	2	23	1	2	2%(=)	<1%
Romania	2	7	0	2	9%(+)	4%
Russia	31	26	7	10	16%(=)	5%
Slovakia	5	20	0	2	54%(-)	20%
Slovenia	1	27	0	0	40%(+)	?%
South Africa	2	24	0	1	5%(+)	2%
Spain	8	25	0	0	17%(-)	8%
Sweden	10	29	0	0	46%(-)	30%
Switzerland	5	33	0	0	40%(+)	22%
Taiwan	6	27	2	0	19%(=)	8%
Ukraine	15	20	2	0	48%(=)	15%
United Kingdom	19	27	0	0	15%(-)	7%
USA	104	29	1	12	19%(=)	8%
EU27	146	25	4	4	28%(-)	12%
Total	439	24	35	87	14%(-)	<6%

**Number of Nuclear Reactors Listed as "Under Construction"
by year (1995 - September 2008)**



Nuclear Reactors Listed as “Under Construction” in the World

By Country

(as of September 2008)

Country	Units	MWe (net)	Construction Start	Planned Grid Connection
ARGENTINA	1	692	1981/07/14	2010/10/01 ¹
BULGARIA	2	1906		
<i>Belene-1</i>		953	1987/01/01	?
<i>Belene-2</i>		953	1987/03/31	?
CHINA	6	4220		
<i>Hongyanhe</i>		1000?	2007/08/18	?
<i>Lingao-3</i>		1000	2005/12/15	2010/08/31
<i>Lingao-4</i>		1000	2006/06/15	?
... <i>Ningde-1</i>		1000	2008/02/18	?
<i>Qinshan-II-3</i>		610	2006/03/28	2010/12/28
<i>Qinshan-II-4</i>		610	2007/01/28	2011/09/28
FINLAND	1	1600	2005/08/12	Summer 2011 ²
FRANCE	1	1600	2007/12/03	2012/05/01 ³
INDIA	6	2910		
... <i>Kaiga-4</i>		202	2002/05/10	2008/07/31 ⁴
... <i>Kudankulam-1</i>		917	2002/03/31	2009/01/31 ⁵
... <i>Kudankulam-2</i>		917	2002/07/04	2009/07/31 ⁶
... <i>PFBR</i>		417	2004/10/23	?
... <i>Rajasthan-5</i>		202	2002/09/18	2008/06/30 ⁷
... <i>Rajasthan-6</i>		202	2003/01/20	2008/12/01 ⁸
IRAN	1	915	1975/05/01	2009/08/01 ⁹
JAPAN	1	866	2004/11/18	? ¹⁰
PAKISTAN	1	300	2005/12/28	2011/05/31
RUSSIA ¹¹	7	4720		
... <i>Novovoronezh-2-1</i>		1085	2008/06/24	?
... <i>BN-800</i>		750	1985 ¹²	?
... <i>Kalinin-4</i>		950	1986/08/01	? ¹³
... <i>Kursk-5</i>		925	1985/12/01	? ¹⁴
... <i>Severodvinsk-1</i>		30	2007/04/15	?
... <i>Severodvinsk-2</i>		30	2007/04/15	?
... <i>Volgodonsk</i>		950	1983/05/01	? ¹⁵
SOUTH KOREA	3	2880		
... <i>Shin-Kori-1</i>		960	2006/06/16	2010/08/01
... <i>Shin-Kori-2</i>		960	2007/06/05	2011/08/01
... <i>Shin-Wolsong-1</i>		960	2007/11/20	2011/05/28
TAIWAN ¹⁶	2	2600		
... <i>Lungmen-1</i>		1300	1999	2010 ¹⁷
... <i>Lungmen-2</i>		1300	1999	2010 ¹⁸
UKRAINE	2	1900		
... <i>Khmelnytski-3</i>		950	1986/03/01	2015/01/01
... <i>Khmelnytski-4</i>		950	1987/02/01	2016/01/01
USA	1	1165	1972/12/01	?
Total:	35	28274		

Sources: various, MSC 2008

Notes pertaining to Table 2

¹ Date published after January 2008

² This date refers to the new planned start-up of the plant. However, the plant owner TVO has so far reported dates for the “commercial operation” of the plant, that usually takes place several months after the initial start-up. It is possible that the new delays reported in December 2007 will postpone commercial operation to the end of 2011. (TVO, Press Release, 28 décembre 2007, see <http://www.tvo.fi/1016.htm>). Also, the plant experienced a significant fire at the construction site in August 2008, which is believed to delay the construction by an additional several months.

³ Unofficially delayed by 9 months.

⁴ Delayed again from planned start-up at 2007/07/31 as of the end of 2007 (sic)

⁵ Delayed again from previous planned start-up in December 2007

⁶ Delayed again from previous planned start-up in December 2008

⁷ Delayed again from planned start-up at 2007/06/30 as of the end of 2007 (sic).

⁸ Delayed again from planned start-up at 2007/12/31 as of the same date.

⁹ Delayed again from planned start-up at 2007/11/01 as of January 2008

¹⁰ Delayed from planned start-up at 2009/12/01 as of January 2008 without new planned start-up date.

¹¹ Balakovo-5 has been withdrawn from the list since the beginning of 2008.

¹² The IAEA Power Reactor Information System (PRIS) curiously provides a new construction start date as 2006/07/18. Until 2003, the French Atomic Energy Commission (CEA) listed the BN-800 as « under construction » with a construction start-up date « 1985 ». In subsequent editions of the CEA’s annual publication *ELECNUC, Nuclear Power Plants in the World*, the BN-800 had disappeared.

¹³ Delayed from planned start-up at 2010/12/31 as of end of 2007, no new date.

¹⁴ Delayed from planned start-up at 2010/12/31 as of end of 2007, no new date.

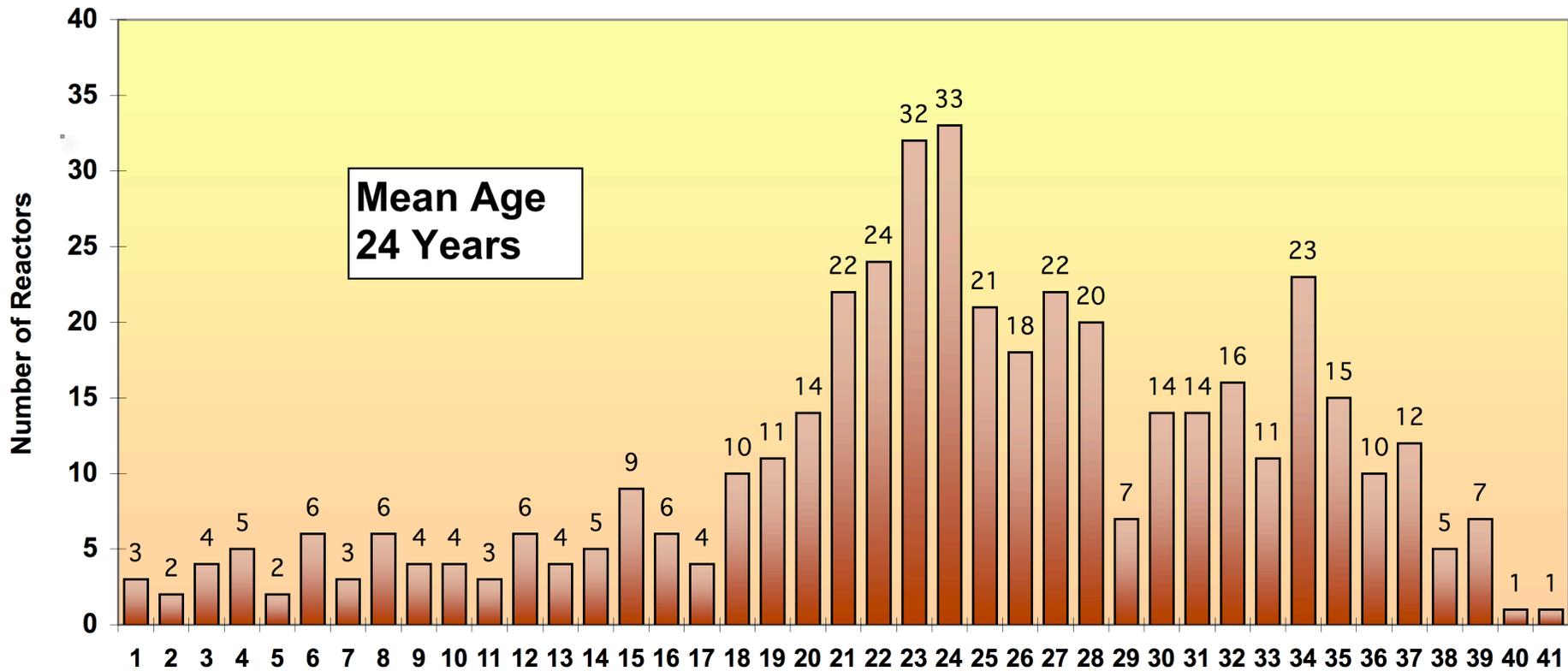
¹⁵ Delayed from planned start-up at 2008/12/31 as of end of 2007, no new date.

¹⁶ Data on Taiwan from http://www.world-nuclear.org/info/inf115_taiwan.html

¹⁷ Delayed from original start-up date of mid-2006

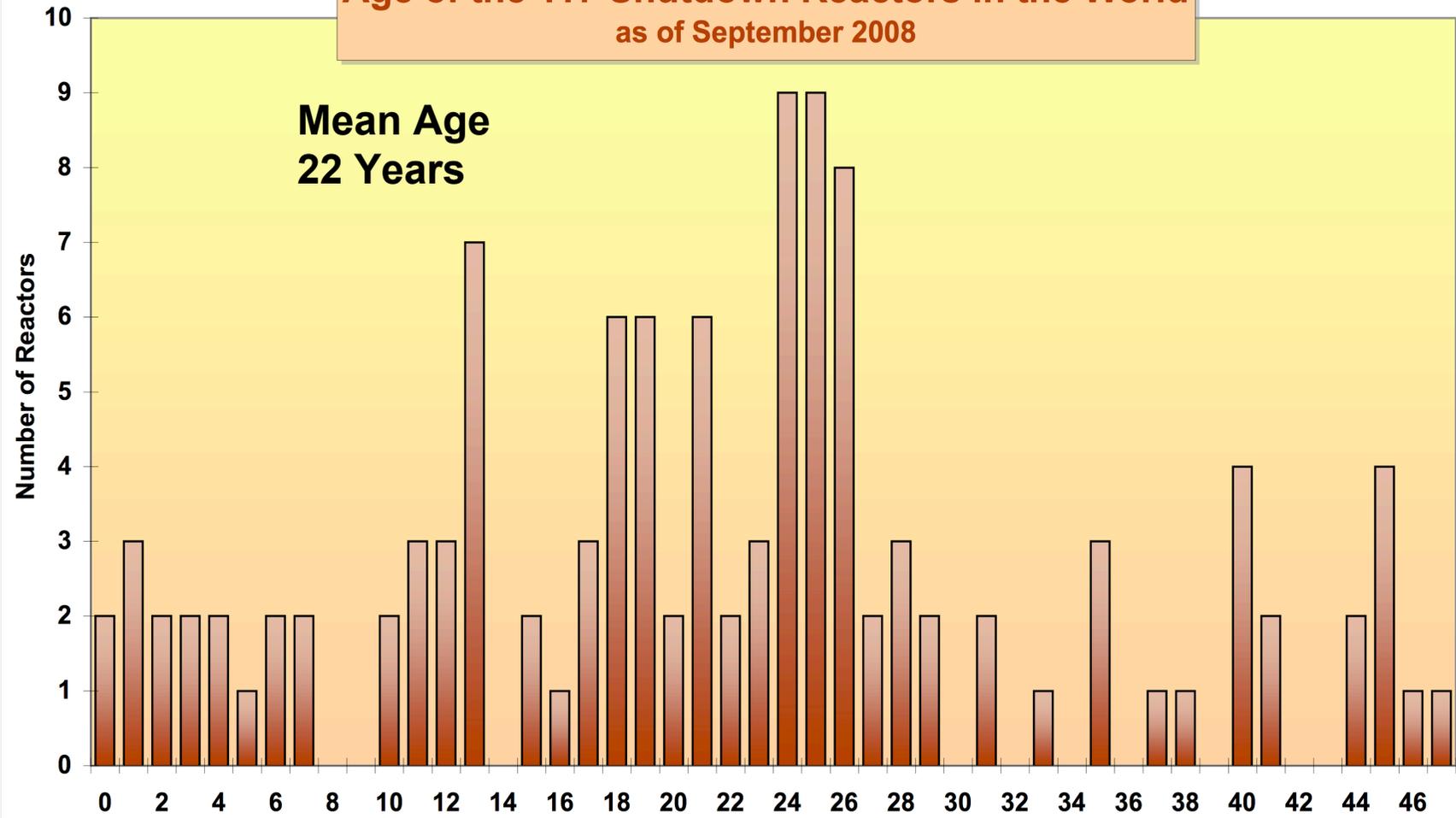
¹⁸ Delayed from original start-up date of mid-2007

Age of the Reactors in Operation in the World as of January 2008

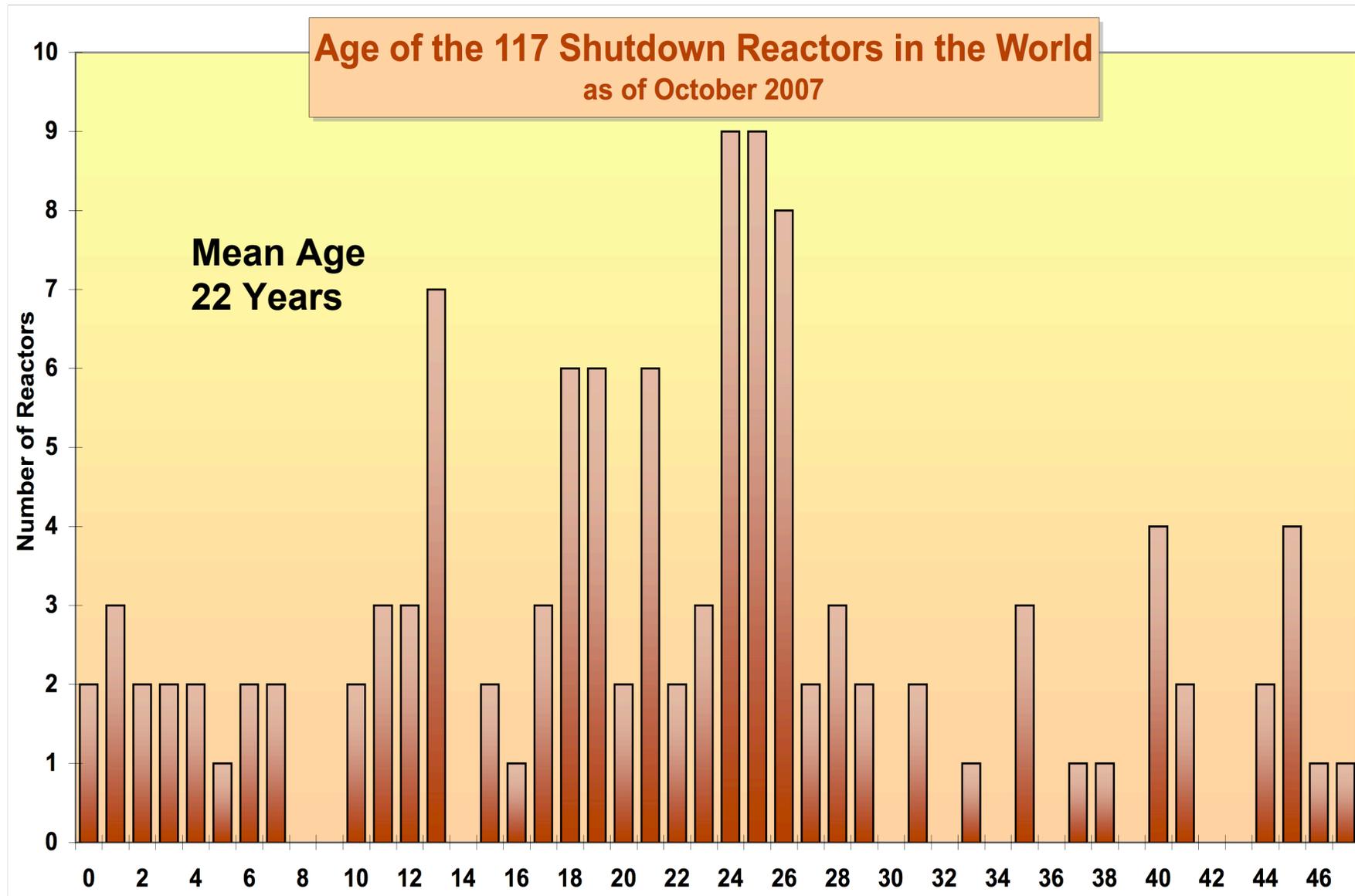


Sources: IAEA-PRIS 2008

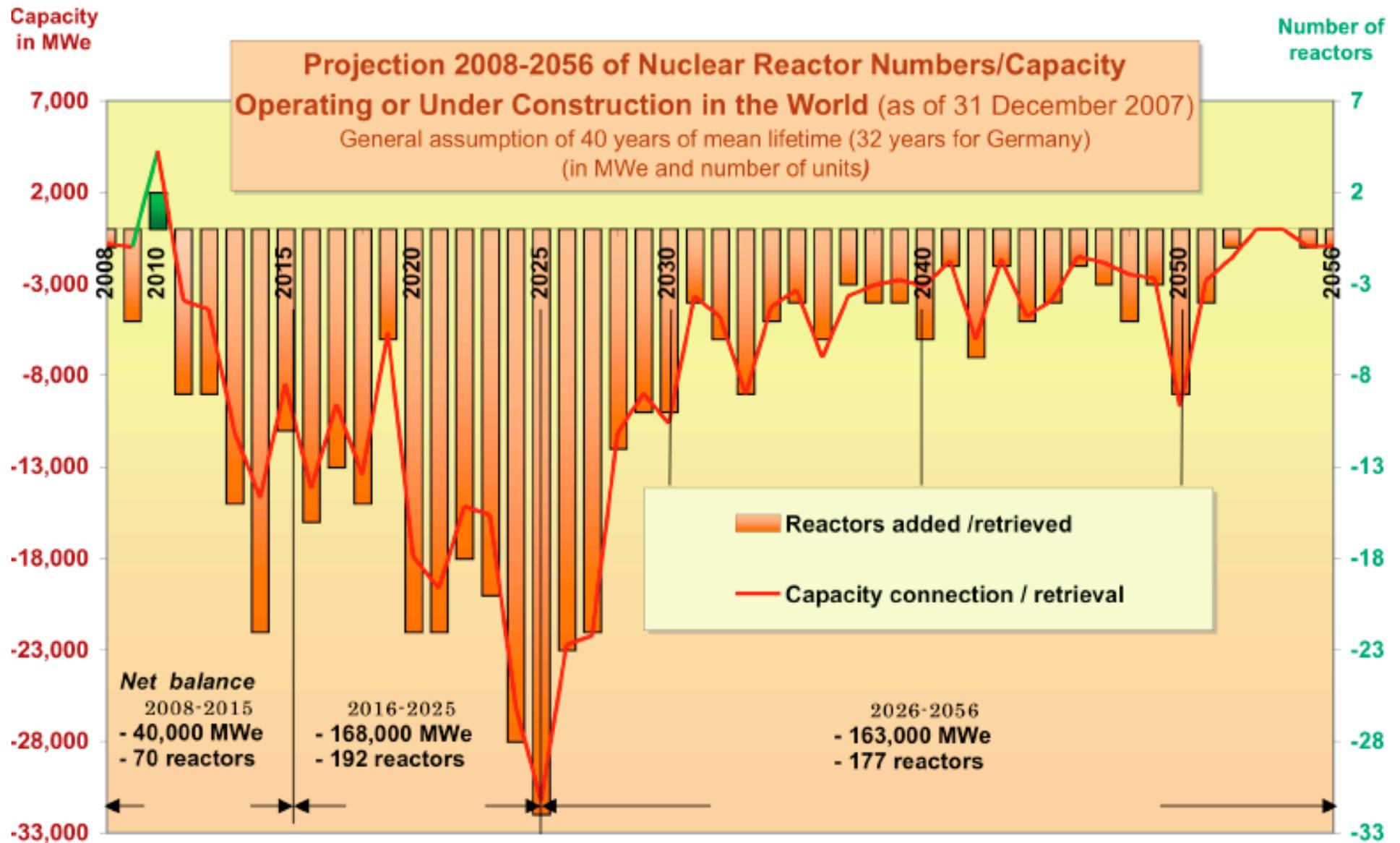
**Age of the 117 Shutdown Reactors in the World
as of September 2008**



Source: IAEA PRIS



Source: IAEA PRIS



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Source: IAEA, PRIS, 2007, MSC



New Build Issues

- **European Union**
- **China**

Excessive Lead Times/Cost Overruns: Example Olkiluoto-3, Finland

- 1998-1999 TVO submits environmental impact assessment report.
- 2000 TVO submits application for decision-in-principle.
- 2001 Preliminary safety assessment. Public hearings.
- 2002 Government and Parliament approve decision.
- 2003 TVO selects its Olkiluoto site to build a third reactor.
- 2004 TVO applies for construction licence.
- 2005 MTI grants licence. First concrete in August.
- 2006 Project running 18 months late.
- 2007 Project running 24 months late.
- 2011 Expected start-up.



Lead Time: 12-13 years since EIA

Official Price: ca. €3 Billion (Guaranteed Fix Price)

Cost Overrun 2 Years after Construction Start: €1.5 Billion

Sources: OECD-IEA, WEO 2006; AREVA 2006, French Ministry of Finances 2006

Chinese Fantasies

Chinese Forecasting	Capacity Planned	Capacity Installed	Share Realised
in 1985 for 2000	20,000 MW	2,168 (in 15 Years)	11%
in 1996 for 2010	20,000 MW	max.10,282 (in 25 Years)	51%
in 2006 for 2020	40,000 MW to 60,000 MW	+30,000 to + 50,000? (in 10 Years?)	?

Source: Mycle Schneider Consulting

OECD Nuclear Energy Agency on Nuclear Competence Crisis in Finland, Germany, South Korea, UK, USA...

These national surveys show that employers require more engineers and scientists having a nuclear component to their education than those graduating.

Source: OECD NEA, *Nuclear Competence Building*, 2004



Nuclear Education Crisis in Germany

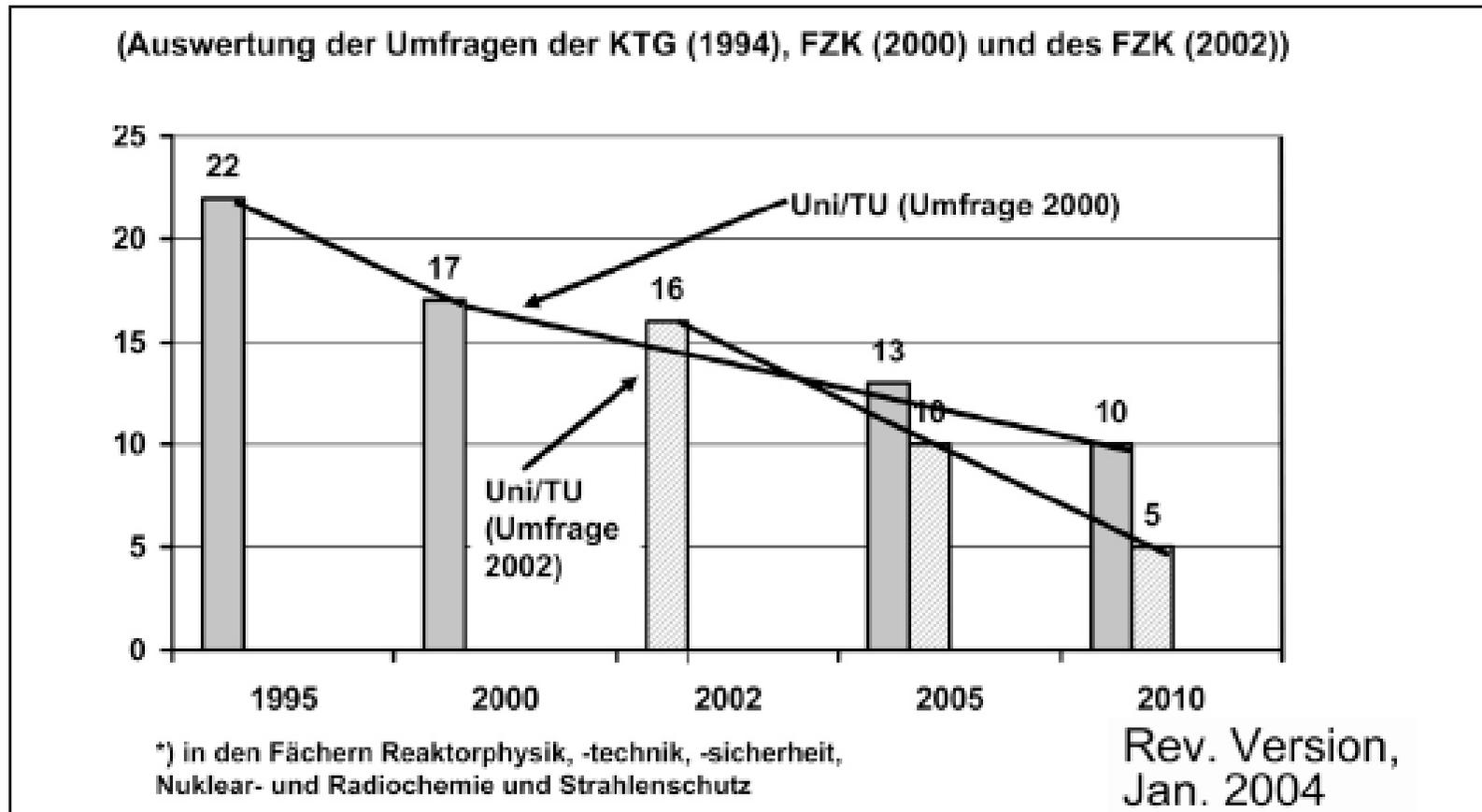


Abb. 6: Umfrageergebnisse zum Trend bei den kerntechnischen Lehrangeboten in den Fächern Reaktorphysik, -technik, -sicherheit, Nuklear- und Radiochemie und Strahlenschutz an deutschen Hochschulen (Uni, TU)

Source: Atomwirtschaft, 6/2004

No Change in Sight

« The “aging workforce” issue is keeping countless CEOs awake at night. (...)

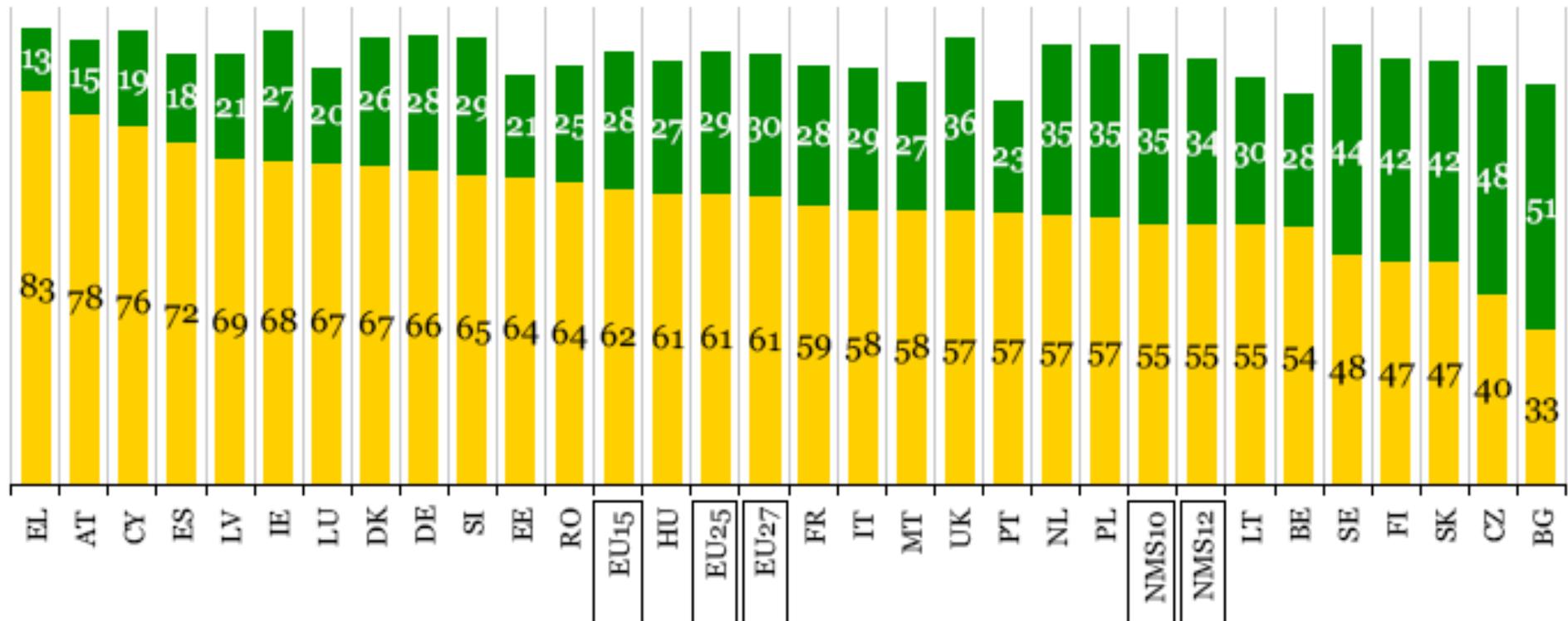
The U.S. Department of Labor indicates that a third of the workers in the nuclear industry are eligible to retire in the next five years. (...)

The U.S. nuclear power industry will need to attract about 26,000 new employees over the next 10 years for existing facilities. These estimates do not include additional resources necessary to support new plants. »

Source: Capgemini, « Preparing for the Nuclear Renaissance », March 2008

Public Opinion on Nuclear Power in the EU

- The share of nuclear energy should be increased, as it does not contribute to climate change and global warming
- The share of nuclear energy should be decreased, as it poses safety problems like nuclear waste, or the danger of accidents



Q9. One third of EU electricity comes from nuclear energy. Regarding nuclear energy there are two fundamental approaches, which one do you tend to agree more?
%, Base: all respondents, by country

Gallup, *Attitudes on issues related to EU Energy Policy*, European Commission, DG TREN, April 2007

“The European public is still strongly opposed to the use of nuclear power; those who are worried about climate change are even more fiercely opposed.”

Gallup, *Attitudes on issues related to EU Energy Policy*, European Commission, DG TREN, April 2007

Conclusions

- Nuclear power plays a limited role. It is highly likely that it will further decline.
- The industry has a a long term workforce problem and will struggle to maintain competence levels for existing facilities.
- Public opinion in the EU remains critical towards nuclear power and has a strong preference for other energy forms.
- The nuclear industry has failed to deliver in the past. Large budget overruns, construction delays and excessive overall lead times. Much of this had to be covered by the tax-payer.
- Problems with recent new build projects indicate that there is no change to be expected.
- Hypothesis: Nuclear energy will rather hinder than favour reliable, sustainable energy policies.