

Possible Role of Nuclear Energy in the Energy Future of the Czech Republic

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A Changing World ...



Growing population & energy density



Cost of energy ... fuel supply & demand



Increasing environmental requirements



Escalating security concerns



Heightened investor demands

Everyone
Under
Pressure

A Changing World ...



Everyone
Under
Pressure



The Challenge

Enable the energy industry to sustainably
meet increasing challenges
... through technology



Energy and environmentally relevant

Facts

Consequences



It is about 73 years since the first mass was converted into energy by man



The experimental apparatus with which [Otto Hahn](#) and [Fritz Strassmann](#) discovered nuclear fission in 1938 © Wikipedia

In the mean time we have accumulated over

14,000 reactor/years of experience

in more than

560 power generating reactors

around the World.

Produced electricity is contributing to the well

being of our Society

But, there is no free lunch!

- Converting mass to energy is risky and not simple!



- We don't want the beneficial power production to become a nightmare!

Nuclear energy debate

- The use of nuclear energy is being extensively scrutinised once again in light of present debate on its role in sustainable development and on global security problems. The primary objective is to allow mankind to maximise the benefits and minimise the risks.
- The key words of this debate are safety, non-proliferation, security and technical co-operation in the peaceful uses of nuclear technology.
- To prepare for the future there is need for new and fully integrated approach to all infrastructure areas including also regulation.

Nuclear Power can contribute to sustainable development

- Electricity (16% today)
- Transport sector: hydrogen production
- Water desalination:
 - 2,3 B people in water-stressed areas
 - 1,7 B people in water-scarce areas
- Environmental goals:
 - 2-6 grams of C per kWh,
 - 600 Mt of C annually.
- Resource base: U and Th,
- Advanced in internalizing external costs: safety, waste disposal, decommissioning are in price of electricity.

Nuclear Power forecast

- Expands by a factor of 14
- Growth 3,5% per year through 2050 (11% in 80's)
- Most growth in non-OECD Asia, Africa, LA, ME
- **Governmental intervention** is needed
- Why?

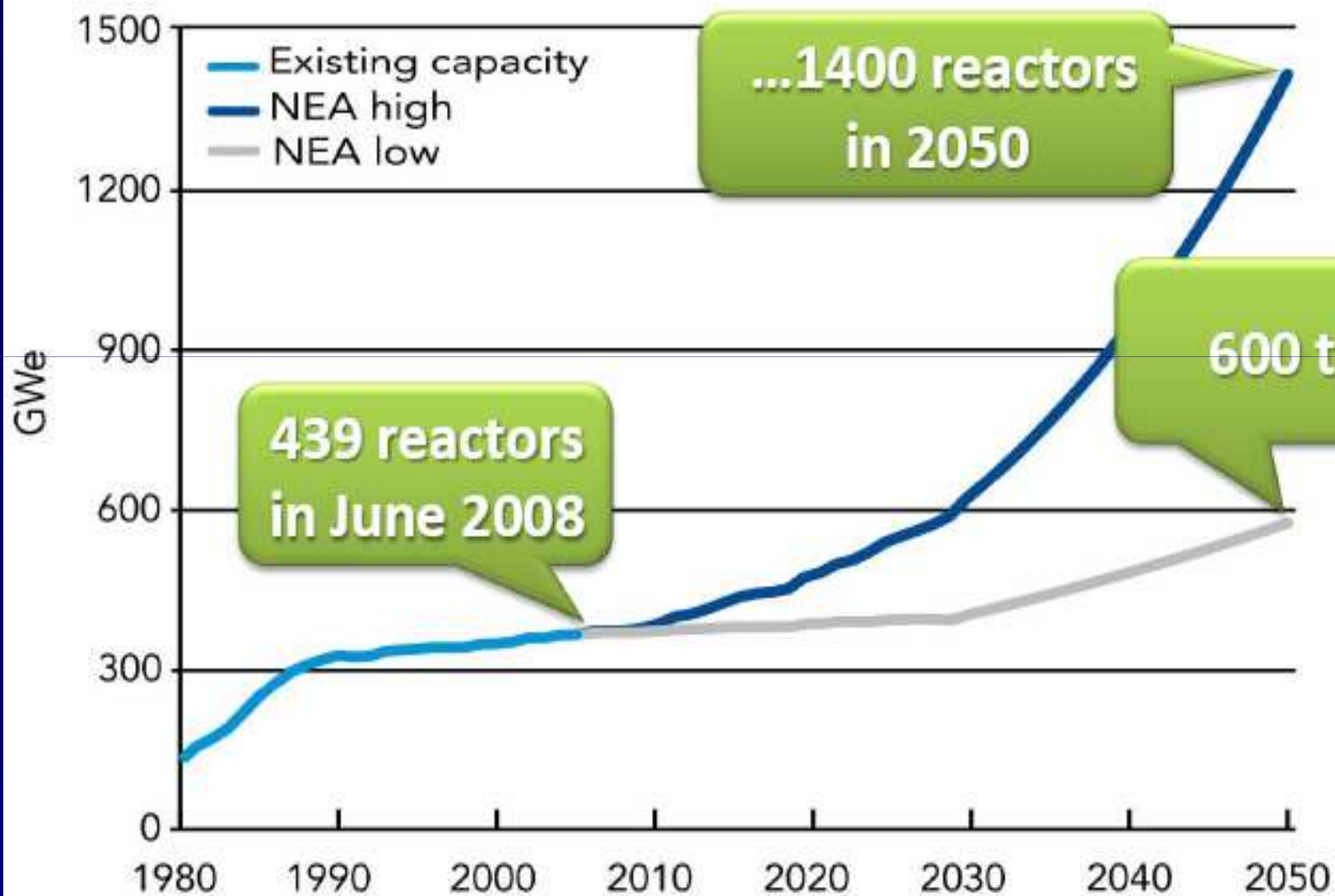
Energy Market Liberalization

- Successful history in near-term prospective
- But **failure in:**
 - forward-looking **long-term investment**,
 - **security** of energy **supply**,
 - **reduction of external cost:** climate change, environment remediation, etc.

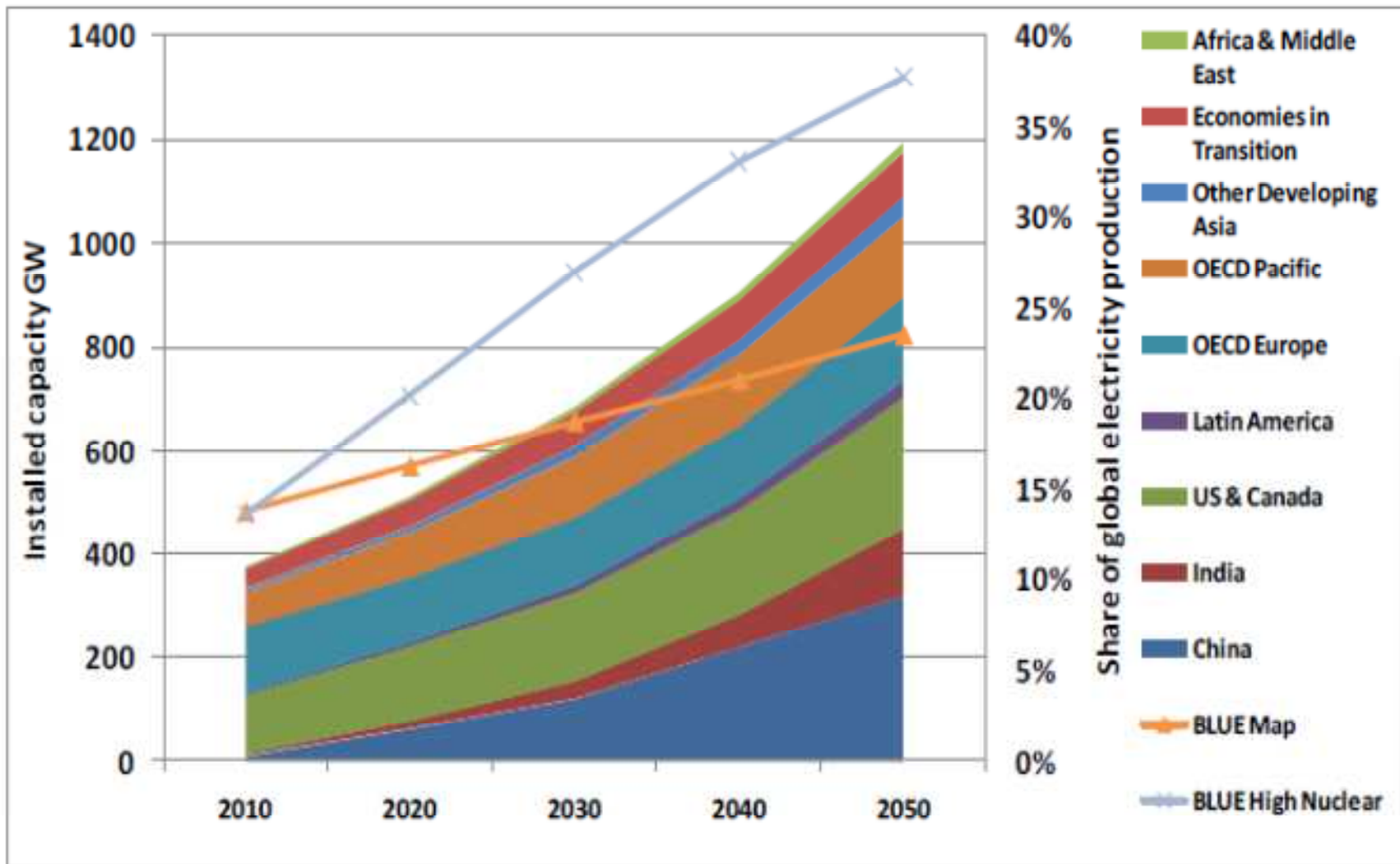
Security Challenges

- Institutional problems: non-proliferation (NPT-DRPK, Iran, Libya, Pakistan-“black market”)
- Three concepts
 - Limiting weapon-usable nuclear material in civilian programmes to facilities under multinational control
 - New systems that avoid weapon-usable materials
- Provide enhanced assurance against vulnerability to misuse and facilitate nuclear growth
 - Multinational approaches to spent fuel and radioactive waste

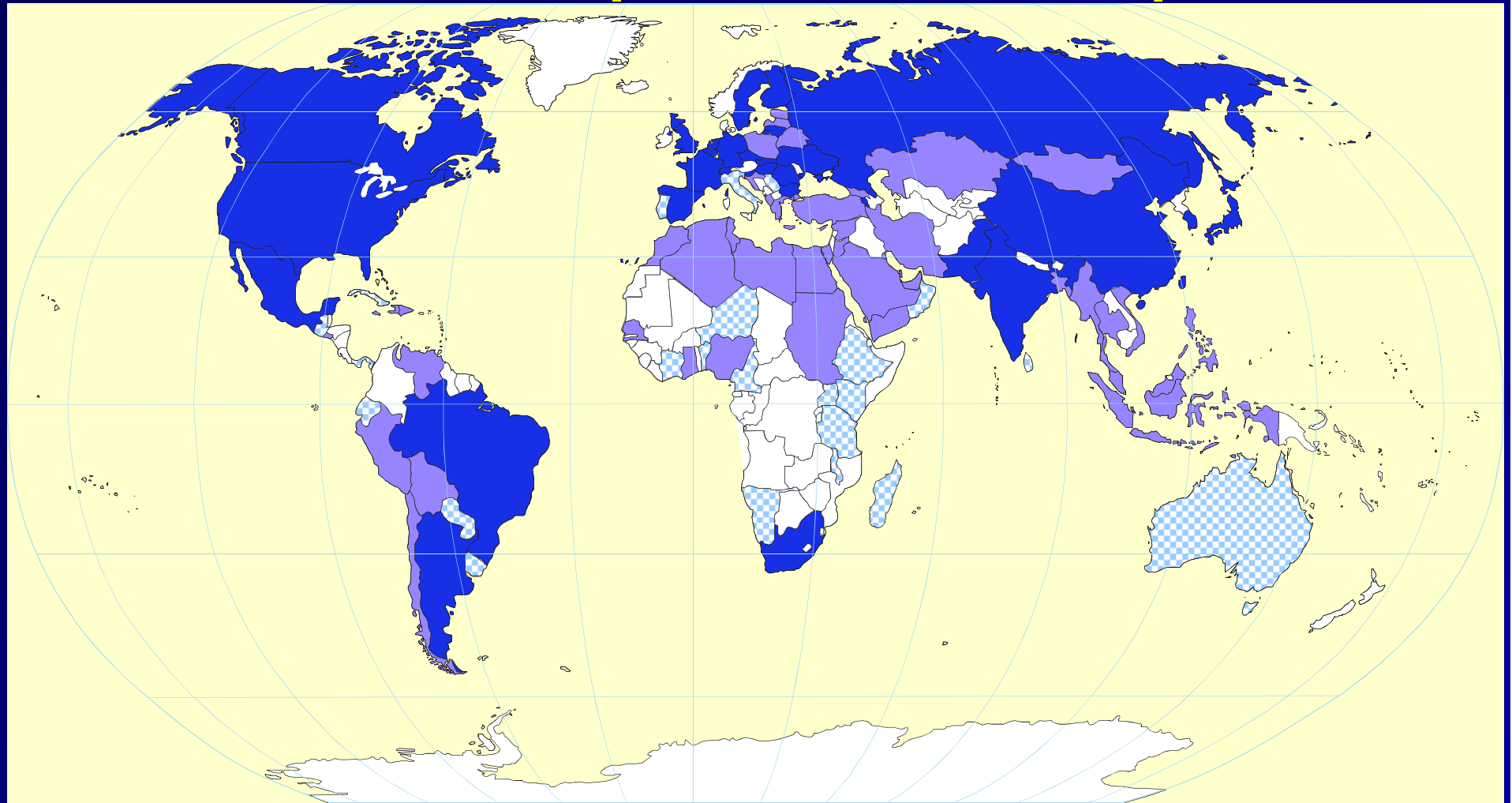
Nuclear renaissance?



Nuclear renaissance?



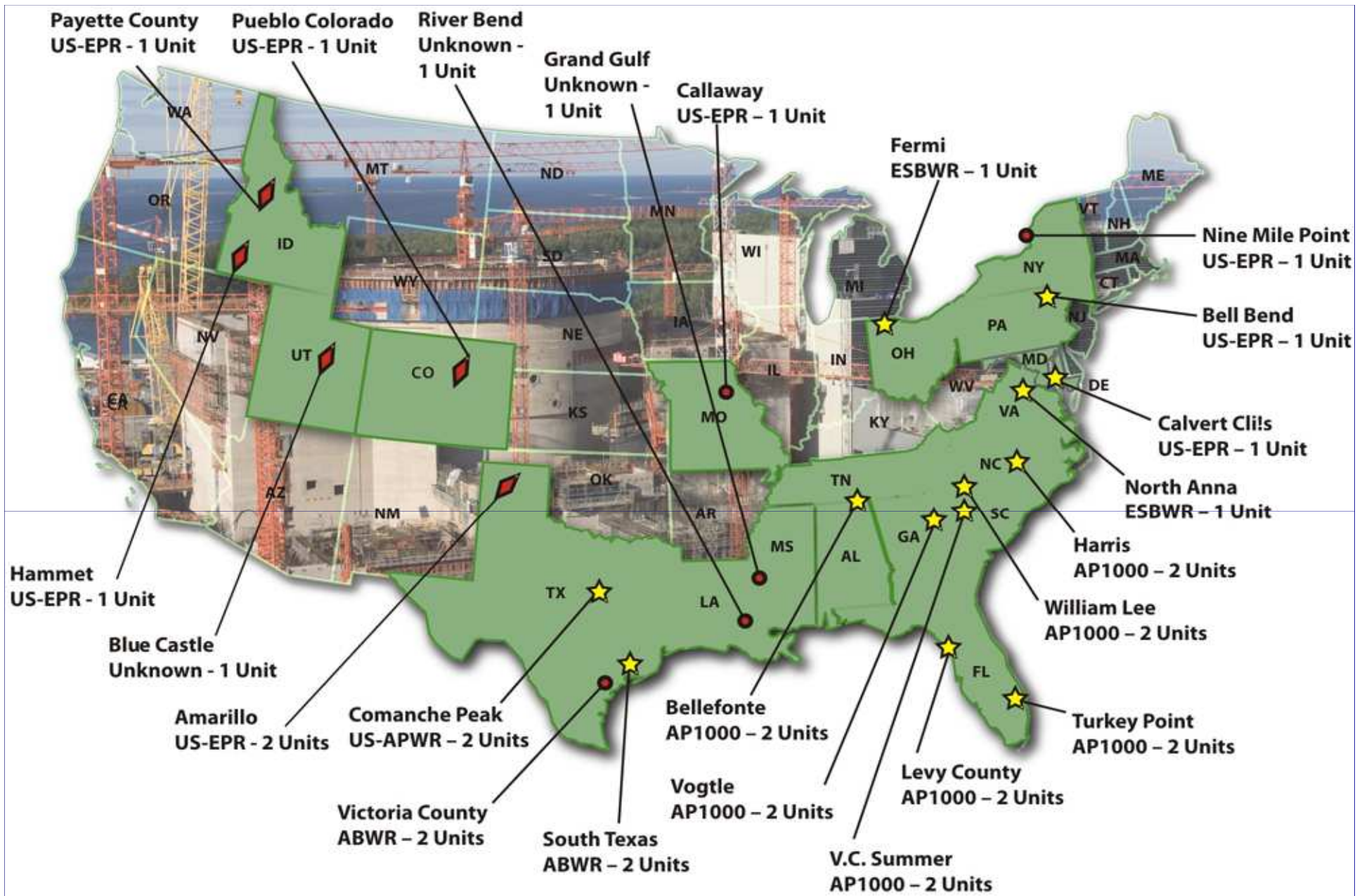
Increasing number of countries considering introduction/expansion of nuclear power



■ Operating (30) ■ Considering (43) ■ Countries having expressed interest (25)

Units under construction

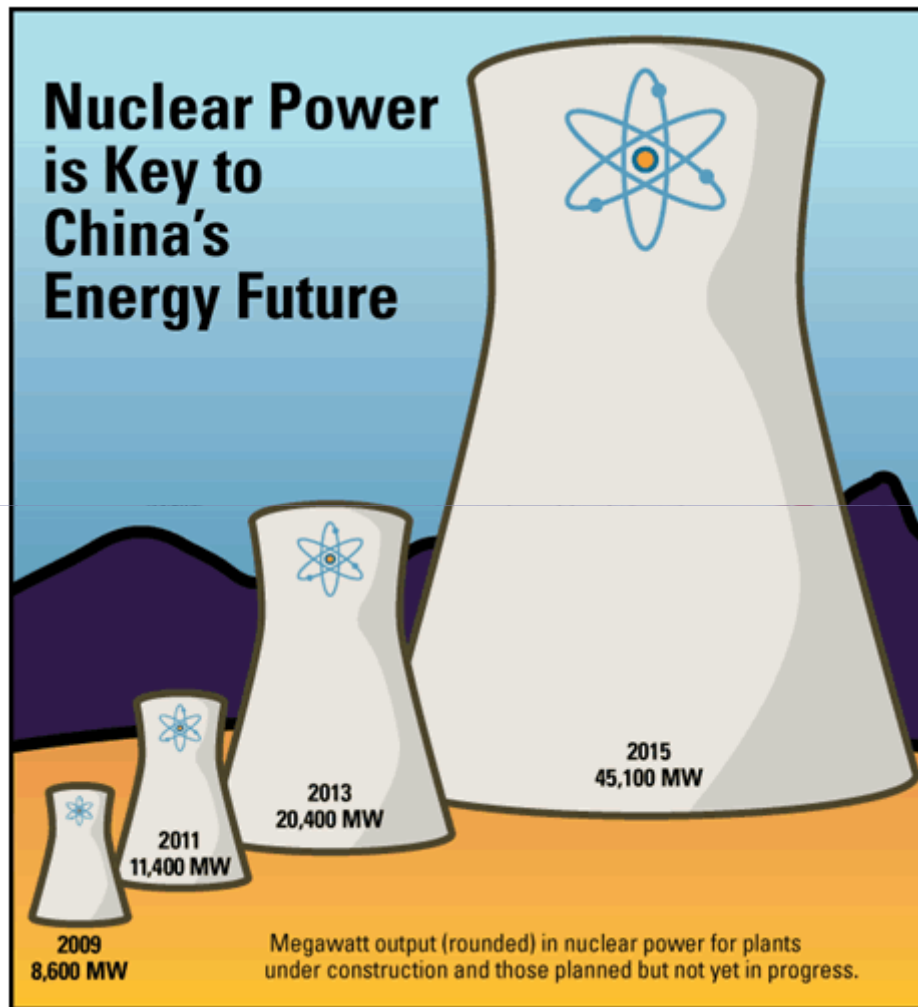




Construction and Operating License (COL) Status

- ★ Under Nuclear Regulatory Review (NRC)
- ◆ Planned Future Submittal
- NRC Review Suspended

Sites of Nuclear Power Plants in China



- Planned
- Under Construction
- In Operation

Source: Research Institute of Tepia (as of Nov. 2008)

Jingyu
Liaoning Donggang

- Rongcheng
- Rushan
- Haiyang
- Tianwan II, Jiangsu II
- Tianwan
- Jiyang
- Anhui Wuhu
- Qinshan II
- Qinshan I
- Qinshan I, II, III
- Sanmen, Sanmen II
- Pengze
- Ningde
- Nanping
- Sanming
- Fuqing I
- Putian
- Zhangzhou
- Lufeng

Xiaomoshan
Taohuajiang
Guangxi Fangchenggang
Hainan Changjiang
Yangjiang
Taishan
Ling'ao II
Daya Bay, Ling'ao

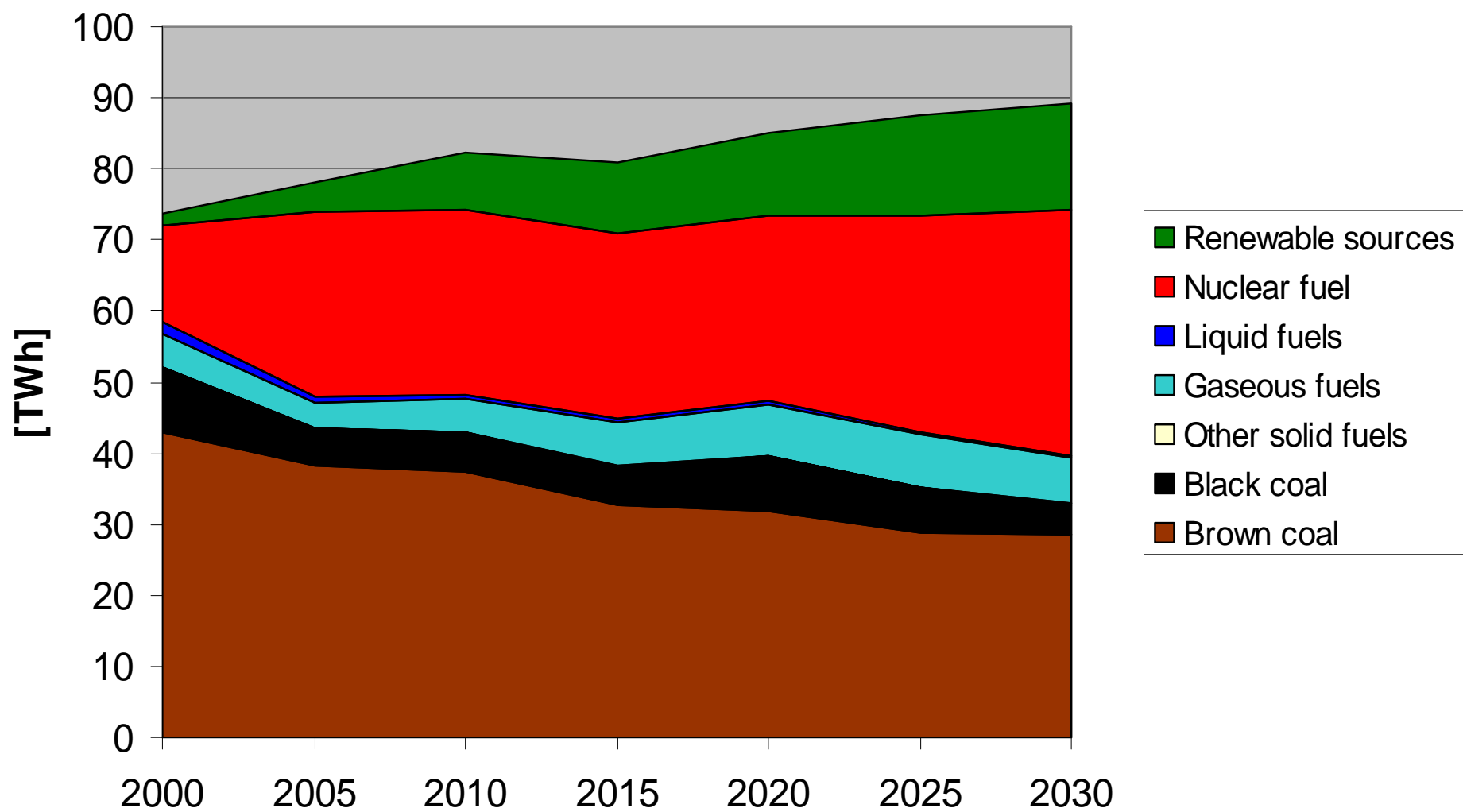
CZECH REPUBLIC

Country Profile

- The Czech Republic is a medium size European country, both in population (about ten million people) and in size (about 80,000 square kilometers).
- The Czech Republic is quite limited in hydro resources, and has no oil or gas.
- Poor quality light coal is the dominant energy source.
- The uranium is supplied domestically; conversion, enrichment, and fabrication are carried out in a variety of other countries.



Structure of electricity production in the CR



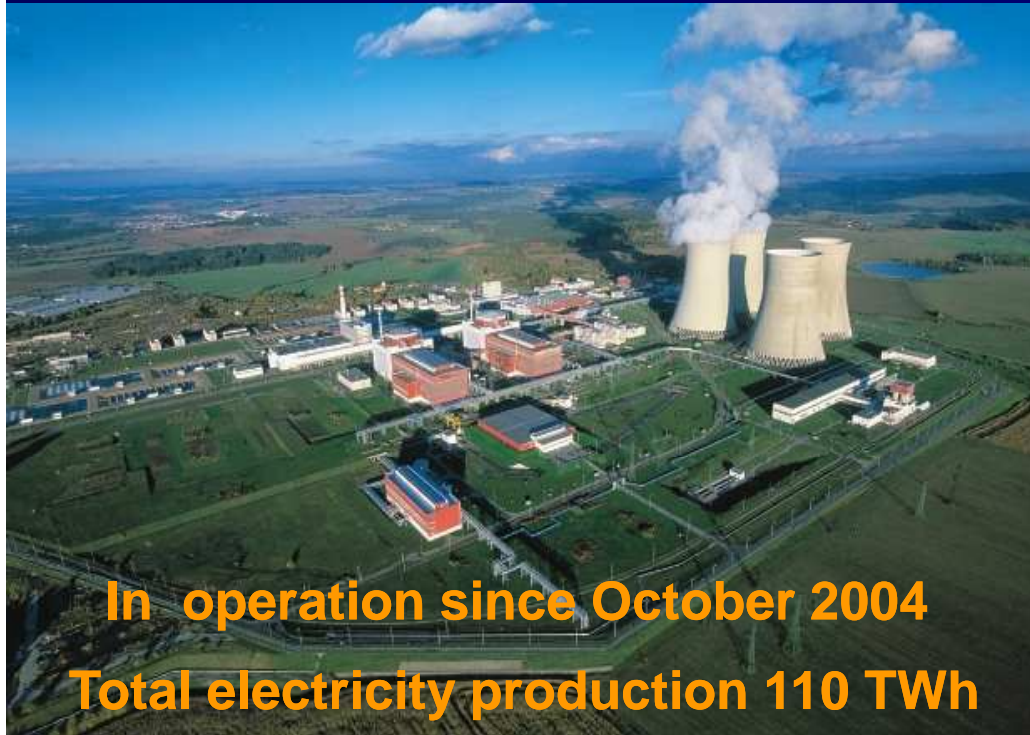
History of peaceful nuclear program

- Connection of NPP Temelín to grid in 2002 finalized this effort. The share of nuclear energy on electricity production is ~ 32%,
- The share of the Czech nuclear industry on construction of own NPPs reached 80%; it took part also in construction of NPPs abroad (e.g. 21 reactors VVER 440, 3 VVER 1000, 76 steam generators, 20 pressurizers were produced in CR),
- The results were achieved thanks to goal oriented research effort: R&D of a HWGCR reactor in sixties, participation in R&D of a fast sodium-cooled reactor and of the fuel reprocessing in 70-ties, modernization of VVERs in 80-ties and 90-ties, which is necessary condition for a long- time orientation on the nuclear power.

Nuclear Installations in the Czech Republic



Nuclear Power Plants in the CR

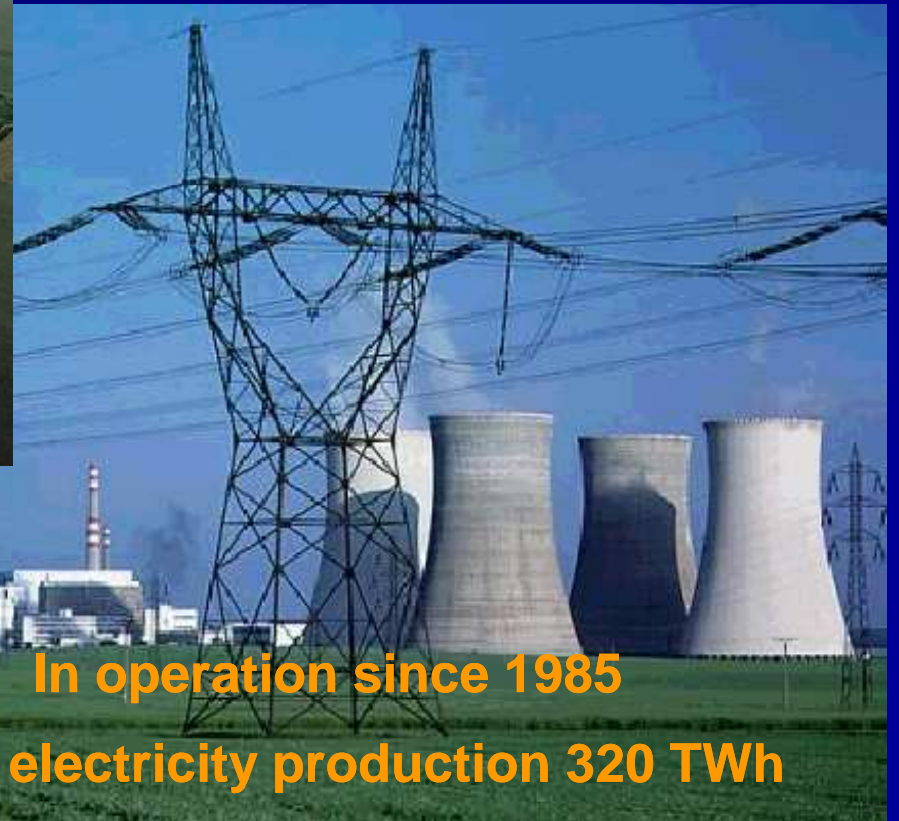


Dukovany NPP 4x440 MWe

Celebrated 25 years of safe operation in 2010

In operation since October 2004

Total electricity production 110 TWh



Temelin NPP

2x1000 MWe

In operation since 1985

Total electricity production 320 TWh

Drivers for rising expectations for nuclear power growth

- Growing energy needs;
- Security of energy supply;
- Environmental concerns and constraints;
- Rising and volatile prices of fossil fuels;
- Improved relative economic competitiveness of nuclear power;
- Nuclear power's increasing experience and good performance;
- Interest in advanced applications of nuclear energy

EU 2020 Objectives (SNETP):

- Assure safe, secure and economic operation of existing and future Light Water Reactors (LWRs)
 - Enhance knowledge to understand, prevent and mitigate the effects of ageing
 - Harmonise long-term operation justification methodologies at European level
 - European harmonised plant design and justification methodology
- Develop advanced fuel cycles for waste minimisation and resource optimisation

Policy Implications for Nuclear Renaissance

- Continued diligence in achieving safety and reliability of nuclear plants;
- Improving economic competitiveness;
- Financing nuclear is a major challenge
- Achieving and retaining public confidence in nuclear power;
- Retaining and developing the necessary workforce competences;
- Continuing successful management of spent fuel and radioactive waste;
- Demonstrating the successful ultimate disposal of spent fuel and high level waste;

Policy Implications for Nuclear Renaissance

- Management and acceptance of the transport of nuclear fuel;
- Maintaining confidence in nuclear non-proliferation and nuclear security;
- Establishing acceptable infrastructure in countries introducing nuclear power;
- Achieving proven reactor designs that are appropriate to specific countries;
- Achieving, for the long term, effective and sustainable use of resources.
- Enhance public dialogue to inform stakeholders about the role of nuclear in energy strategy
- Stable government policies on nuclear is key

Obstacles to New Nuclear Build

Spent Fuel ...



Proliferation ...



Economics ...

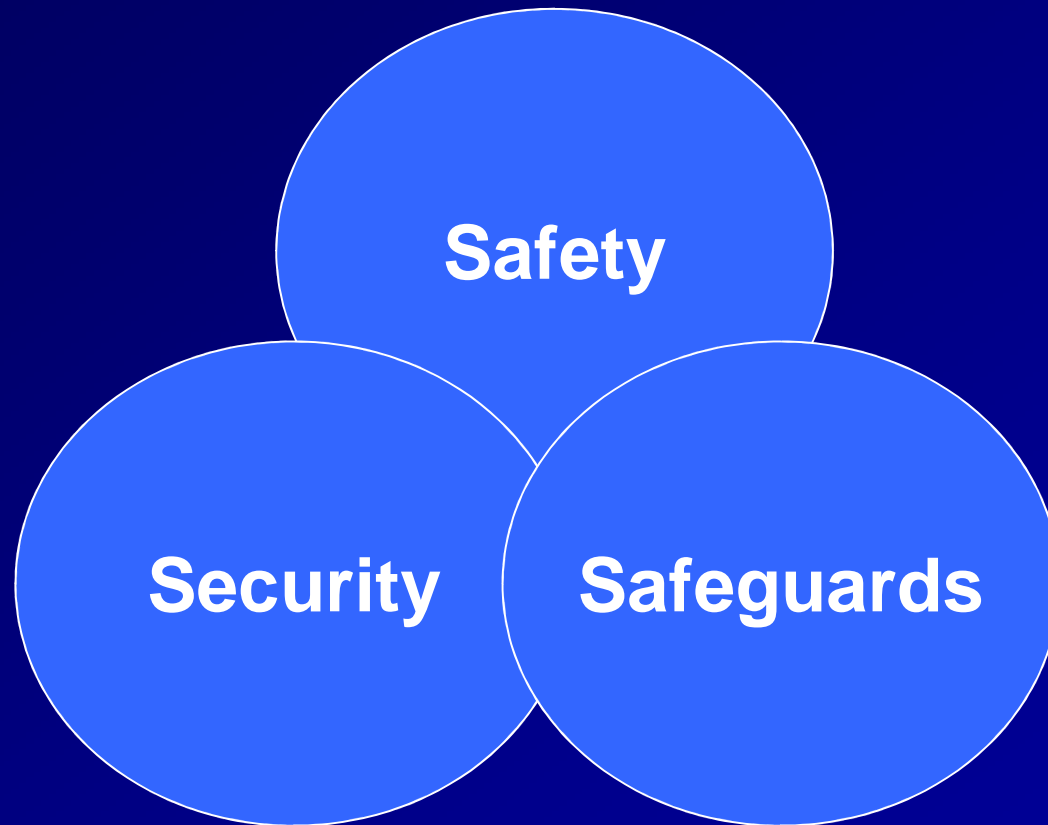


Public Perception ...



Sustainable nuclear energy

Availability, Affordability, Acceptability



To prepare for the future there is a need for new and fully integrated approach to all infrastructure areas, including also regulation.

Nuclear regulator and the public

Recent experience of SUJB shows some controversial aspects of offering information on licensee safety performance to the public. We must have in mind that:

- The expectations of the public are very high
- The public wants to be protected by a perfect regulator
- The public will not forgive any weakness of the regulator

Nuclear regulator and the public

On the other hand, to build up “sustainable” trust of the public we must try to explain that:

- The persons of the regulator staff are good and motivated but not perfect
- The regulator surveillance and inspection programme cannot cover 100%
- Incidents and accidents cannot be totally avoided, but occurrence probability can be reduced
- Scientific knowledge is limited by several uncertainties

Nuclear regulator and the public

Do not try to be loved by the public





























Do not look for easy success by playing attractive roles like:

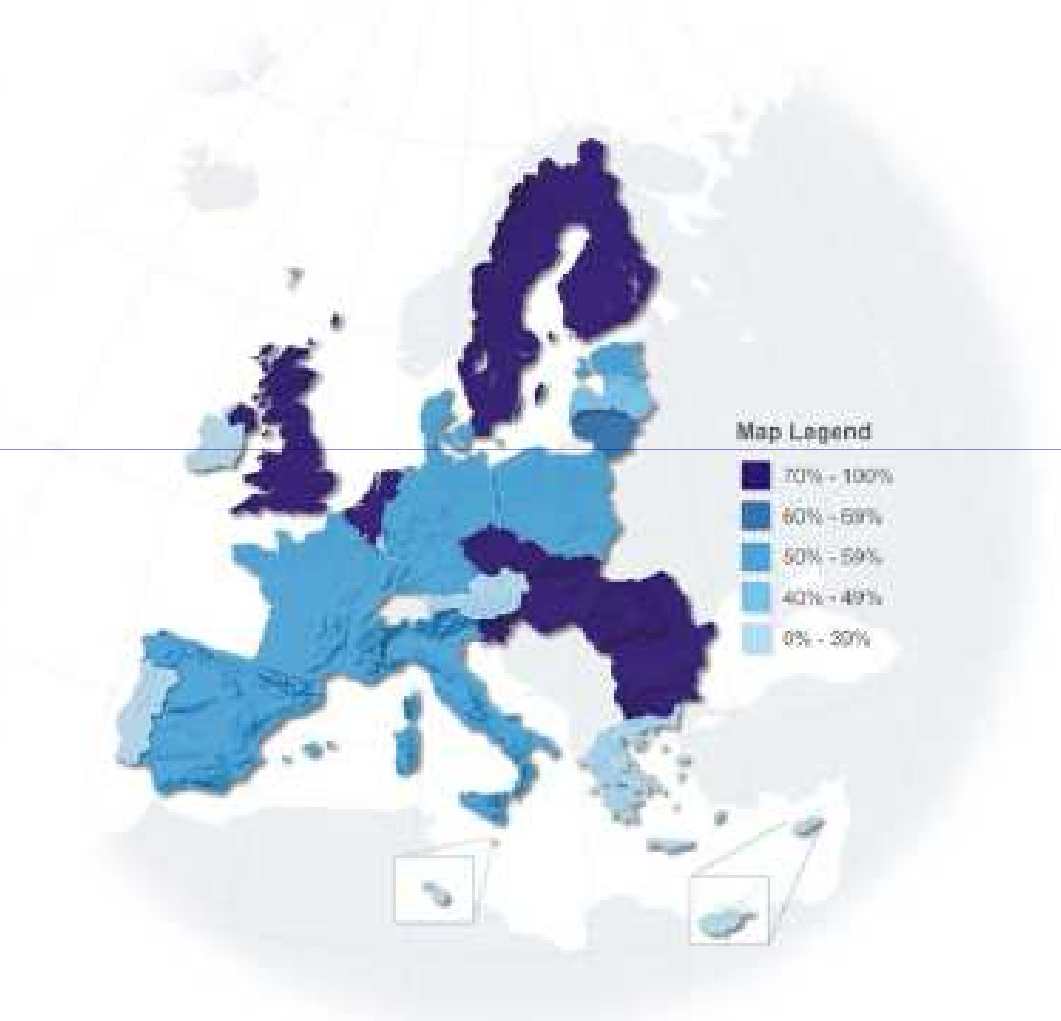
- Little David winning against Goliath
- The severest among all regulators

Question: QA10.1. To what extent do you agree or disagree with each of the following statements?

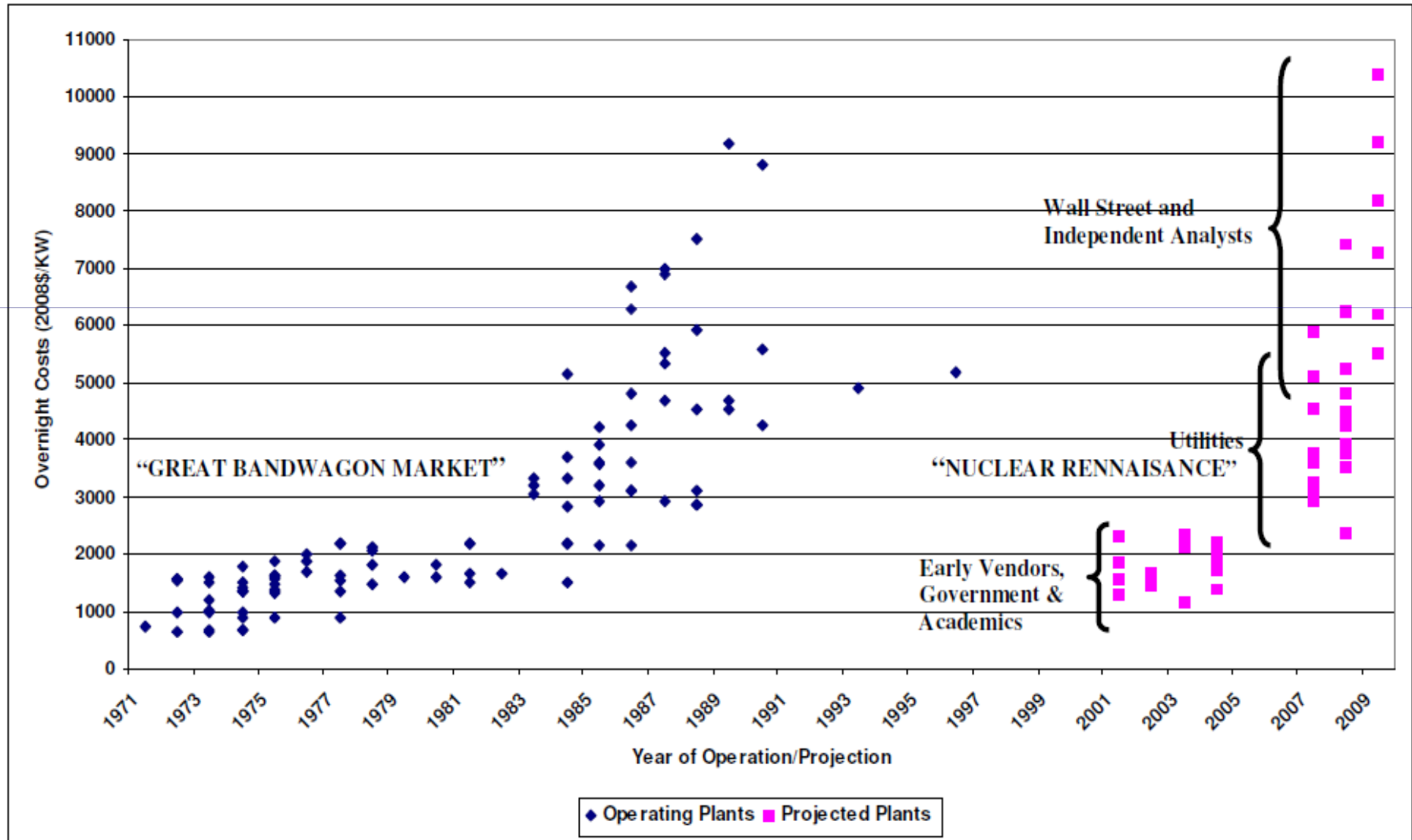
Option: It is possible to operate a nuclear power plant in a safe manner

Answers: Agree

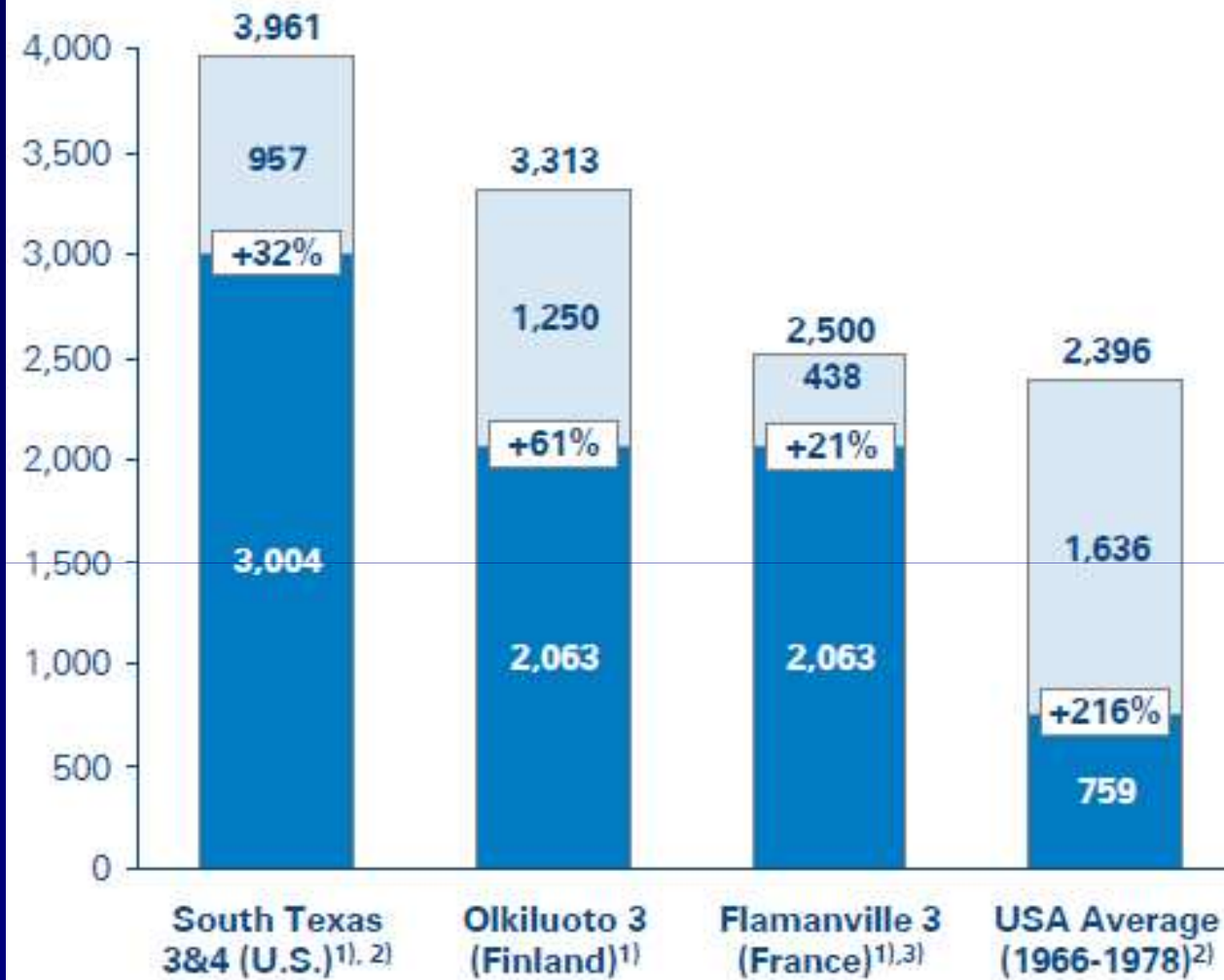
 SK	75%
 SE	74%
 HU	74%
 FI	72%
 CZ	71%
 NL	71%
 SI	71%
 BE	71%
 UK	71%
 LT	69%
 EU27	59%
 DE	58%
 FR	58%
 DK	55%
 ES	55%
 EE	55%
 PL	55%
 IT	50%
 LV	47%
 LU	38%
 IE	37%
 PT	37%
 EL	36%
 CY	33%
 AT	28%
 MT	27%
 BG	20%
 RO	22%



Capital costs



Costs in EUR/KW



1) Estimates, project in progress (South Texas construction not started, yet)

2) In EUR (conversion date 2010, May 20th)

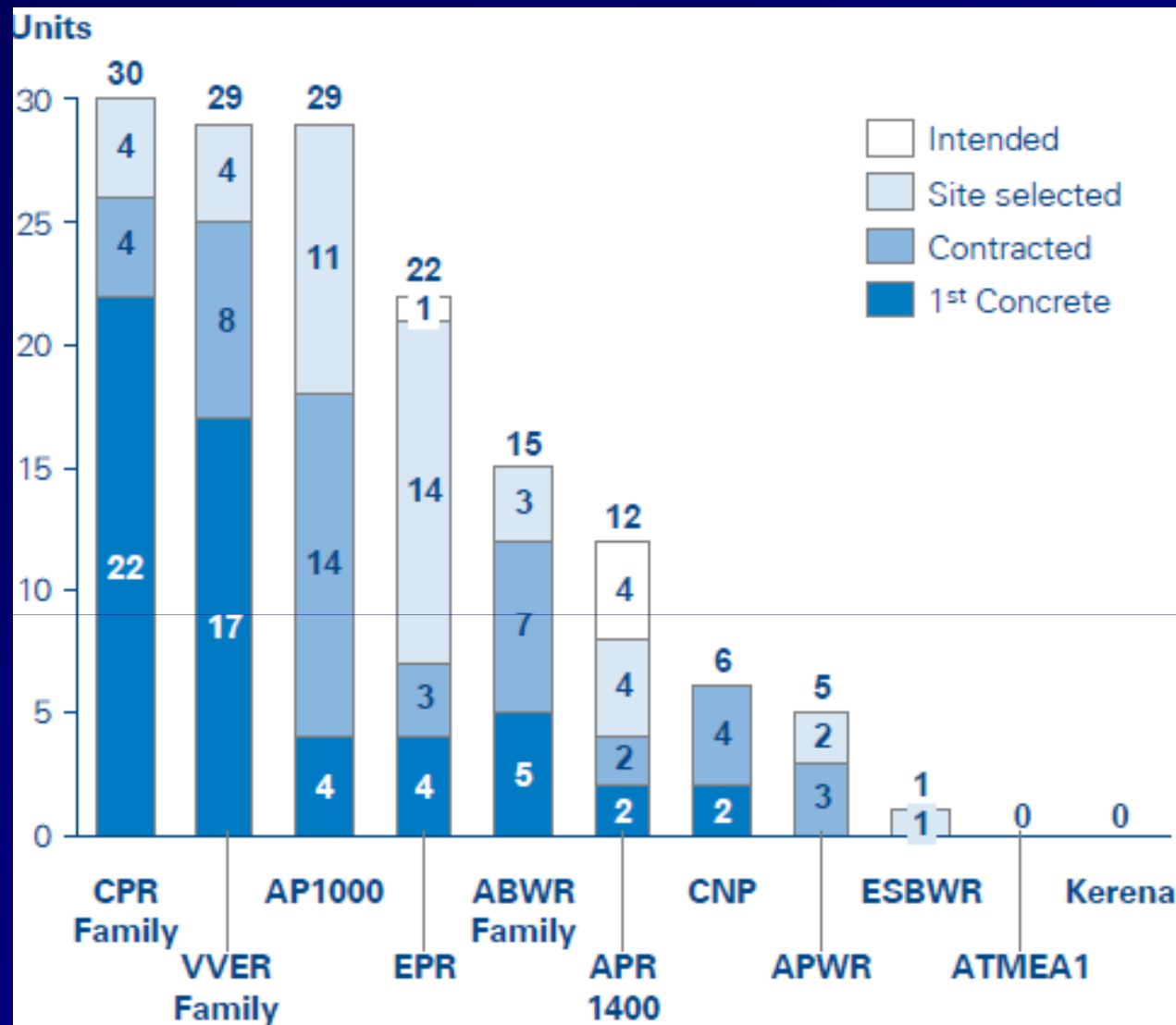
3) Initial overnight estimate 2005, cost update in 2008

Source: Arthur D. Little Analysis



1) COD = Commercial Operation Date

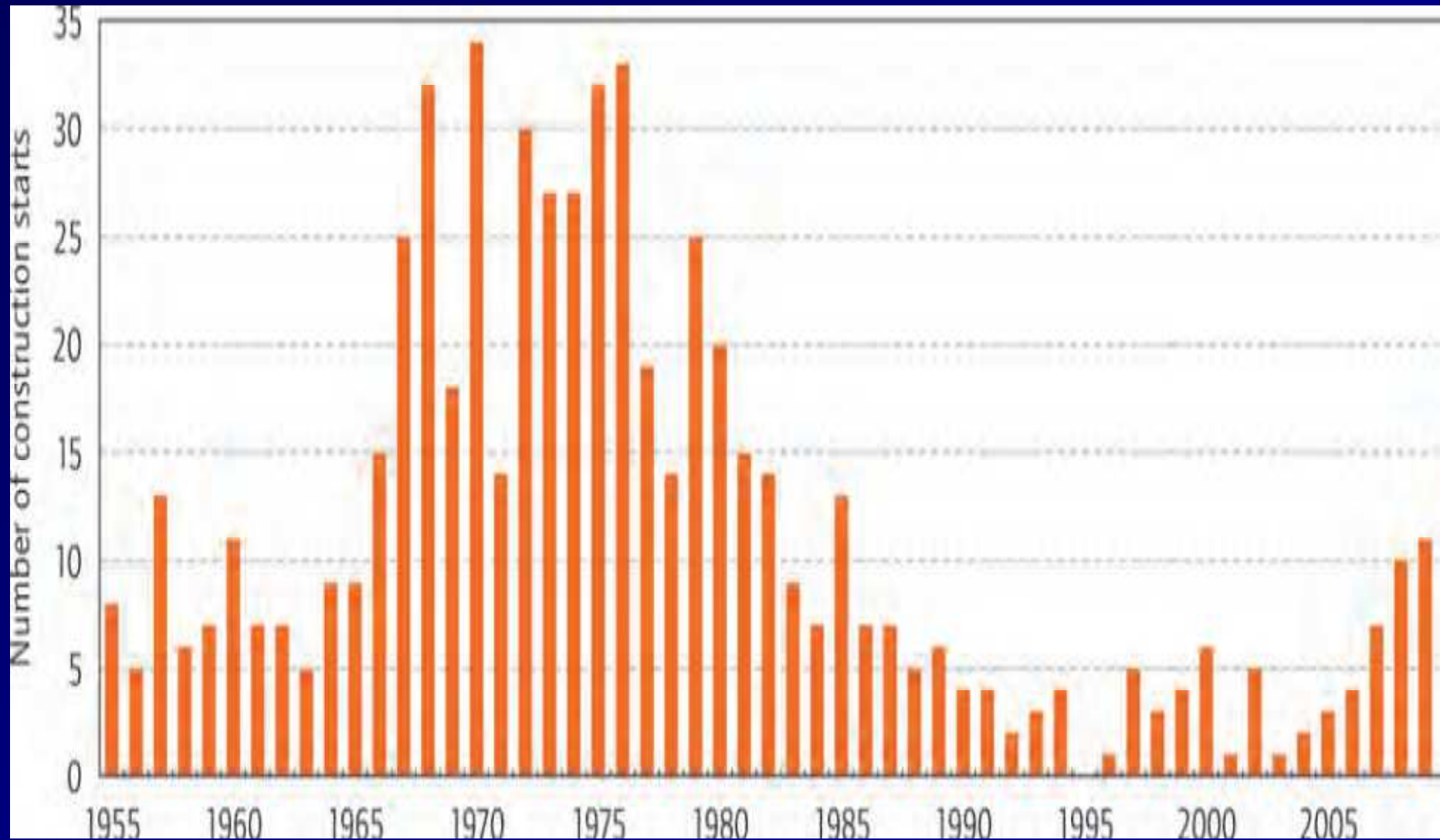
Source: World Nuclear Association, Arthur D. Little Analysis



Note: The ATMEA1 and Kerena reactors (both Areva) are being considered by certain owners, but have not yet been finally selected. Toshiba's AB-1600 is not included due to unclear design status.

Source: Arthur D. Little Analysis

Number of Commissioned Units



The Train is Leaving the Station

- Am I on it?
- Do I know where it is going?
- Do I know what to do once I am on the train?
- Do I know if everybody on the train knows what they should do?
- Do I have the plan, the tools, the resources I will need to get it to its destination?
- Do I and everyone else know what to expect during the trip?
- Do I know what to do when it gets to its final destination?

