NEA activities in nuclear new built and supply chain aspects

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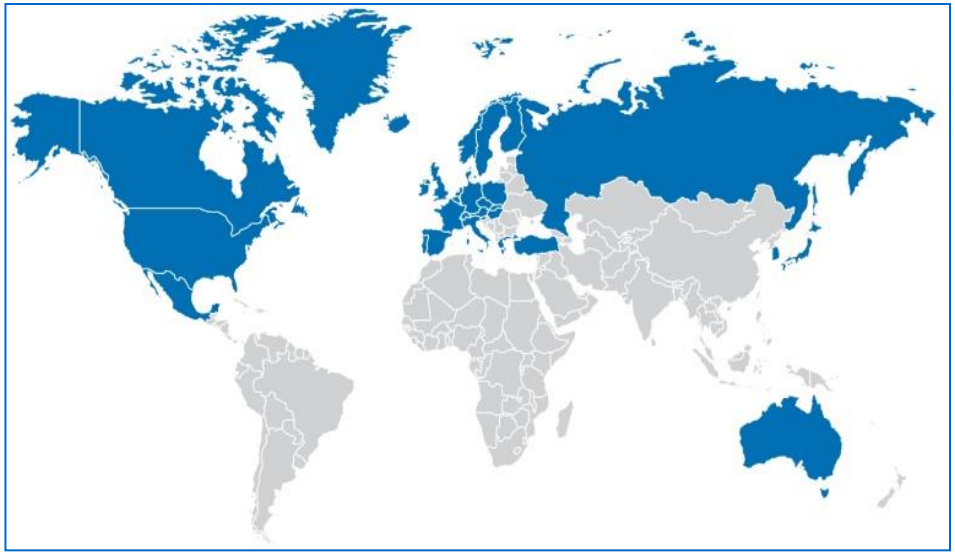
The NEA: a forum for cooperation



OECD Nuclear Energy Agency founded in 1958

33 member countries including Argentina and Romania which joined in 2017

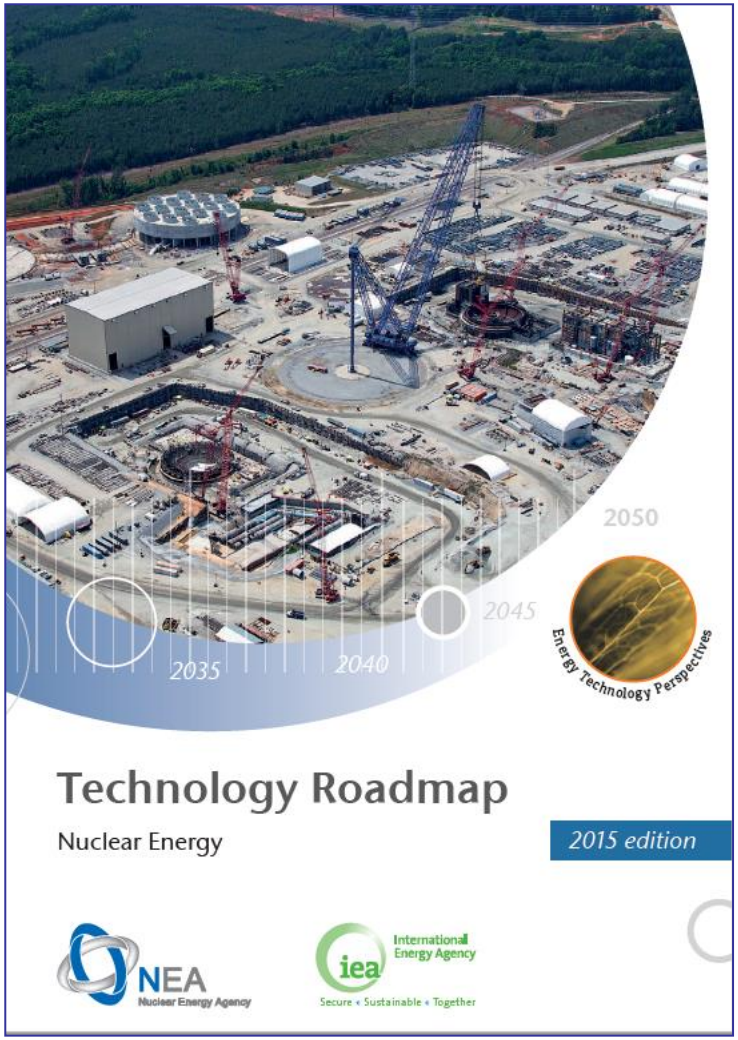
84% of global nuclear electricity capacity
[China 4.8%, Ukraine 3.5%, India 1.2%]

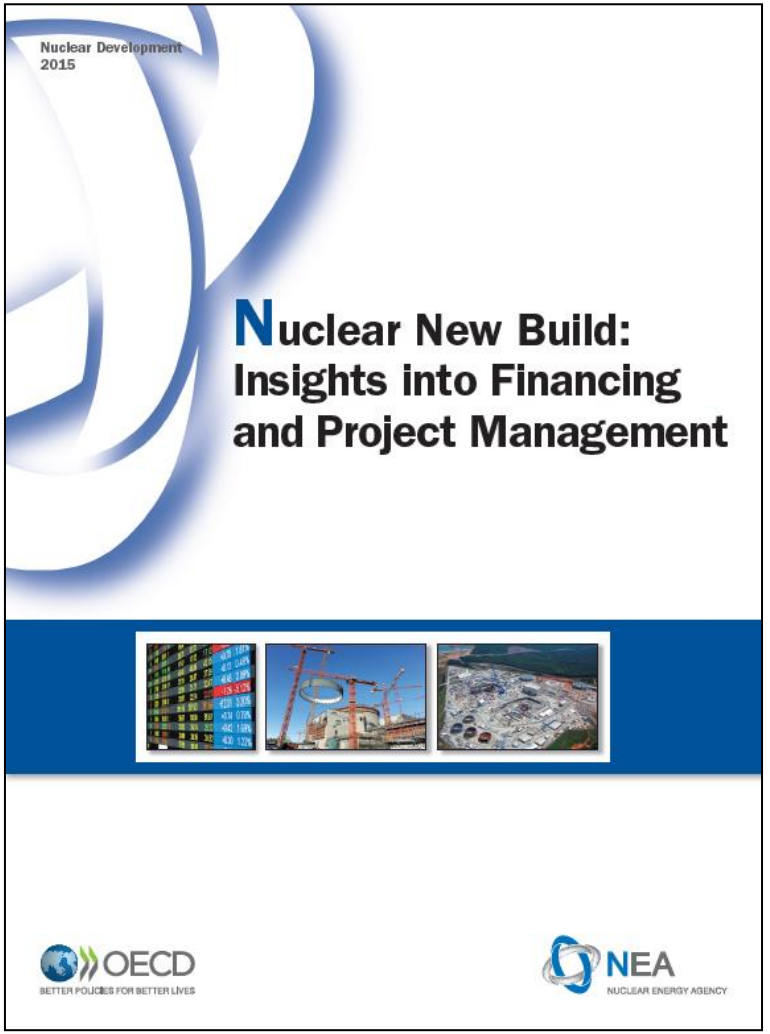
NEA Mission

- To assist its member countries in maintaining and further developing, through international co-operation, the **scientific, technological and legal bases** required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.
- To provide authoritative assessments and to forge common understandings on key issues, as **input to government decisions on nuclear energy policy**, and to broader OECD policy analyses in areas such as energy and sustainable development.

- **7 standing technical committees**
- **70+ working parties and expert groups**
- **20+ international joint projects**
- **Technical secretariat of GIF, IFNEC and MDEP**

NEA activities in the area of nuclear development



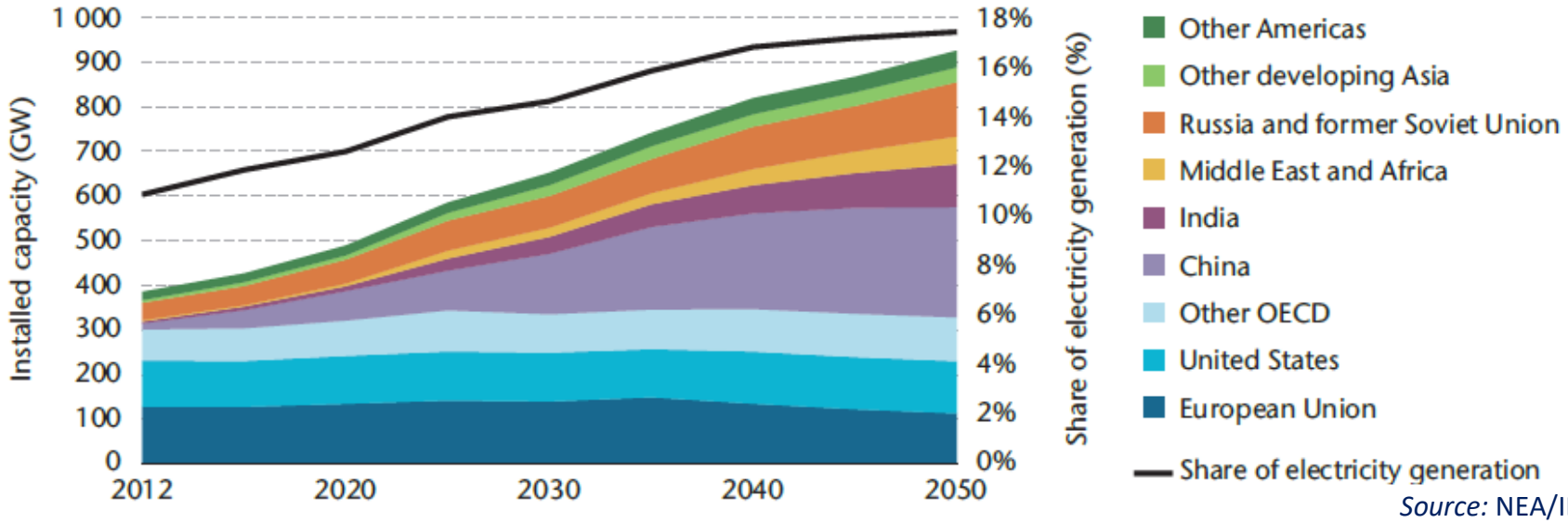


http://www.oecd-nea.org/tools/publication?query=&div=NDD

Nuclear power in a low-carbon future

- Paris Agreement requires a radical transformation of energy and power sectors: power sector must be almost completed decarbonised by the mid of this century.
- In all credible scenarios of decarbonisation nuclear power has to play a role as a reliable, dispatchable source of low-carbon electricity.
- Growth in nuclear power is led by China and other non-OECD countries.

Nuclear capacity in the IEA 2DS by region

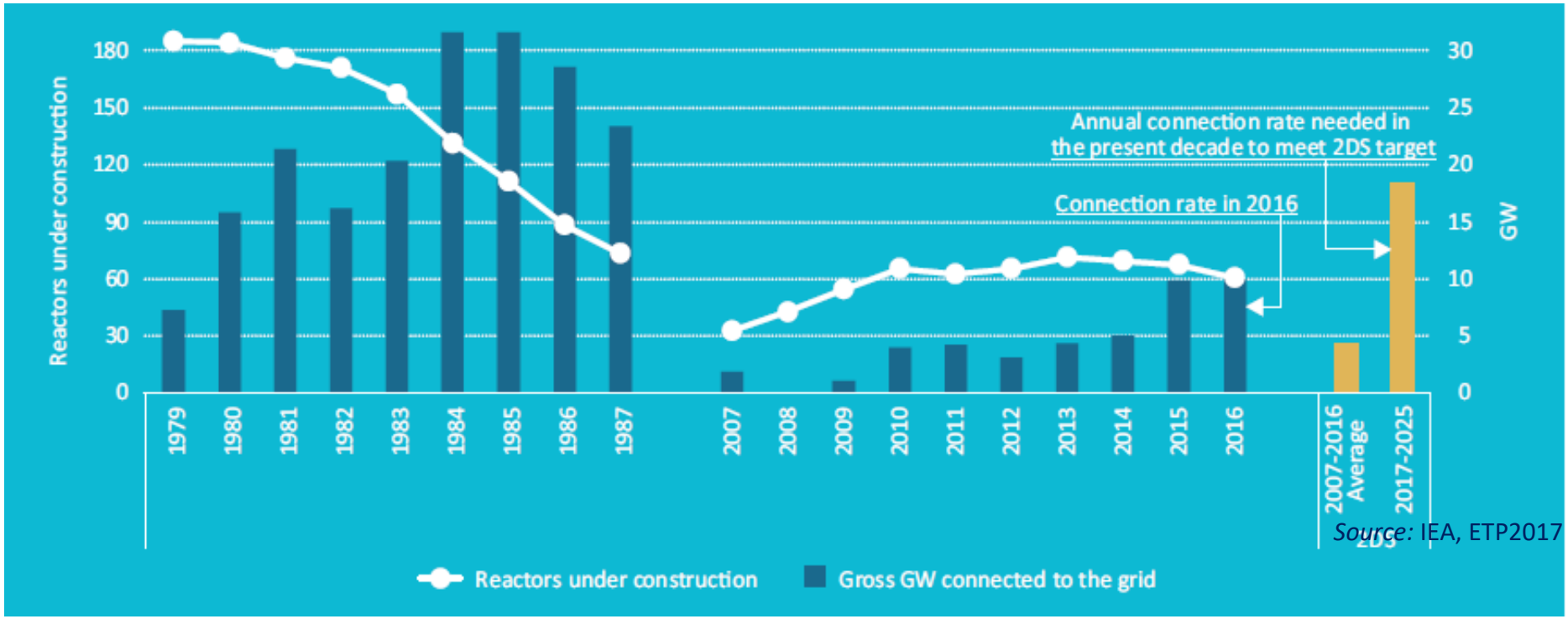


Source: NEA/IEA, 2015

Decarbonisation is a key driver for nuclear power development

Can nuclear industry cope?

Grid connection rates and reactors under construction



- Required connection rates were achieved in the 80ies.
- Current connection rates and the number of reactors under construction are not sufficient to meet long-term objectives for nuclear.

Nuclear power is under pressure

- Economic and Financial
  - Need to reduce overnight costs of new designs.
  - Ensure that new NPPs are completed on time and on budget.
  - More volatile electricity prices and higher market risk.

Nuclear power is sensitive to these aspects due to its capital intensity.

- Technical

The presence of a large share of intermittent VRE generation will require nuclear to provide additional services to the system (flexibility, ramping, etc.)

- Nuclear more flexible, able to follow the load and cope with reduced load factors
- More integrated “hybrid” system in which electricity is not the only product.
- Is there a need for a smaller, more flexible and scalable reactor (SMR)?

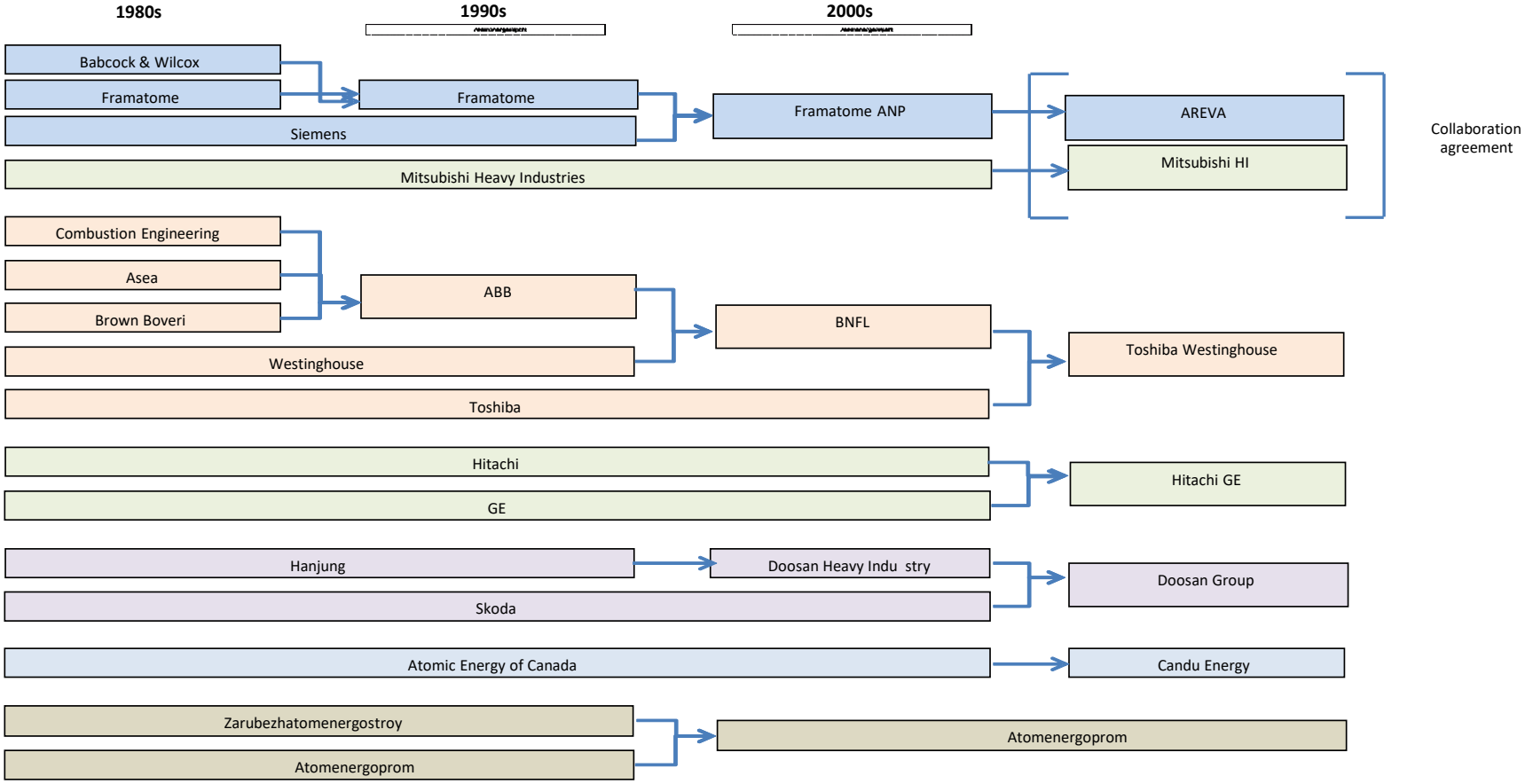
➡ Effort from the whole nuclear industry, research and policy makers.

Nuclear industry in transition

- Technological change as Generation II nuclear power plants are substituted by larger, more expensive and often more complex Generation III+ plants (FOAK risks as well as licensing and regulatory change).
- Transition from OECD to non-OECD countries.
- Loss of expertise and human capital as projects are, with the exception of China and Russia, few and far between.
- A particularly complex supply chain with quality control issues at different levels of externalisation.
- Very long time frames at all levels of the value chain. From design and licensing to construction, operations and decommissioning, changes in nuclear new build can take a decade or more until all contributing factors have adjusted and they have found their economically optimal equilibrium level.
- Shifts in political and social support after Fukushima. While only a small number of countries have actually decided to phase out nuclear, their decisions have created uncertainties beyond their national boundaries.

The evolving structure of the nuclear supply chain

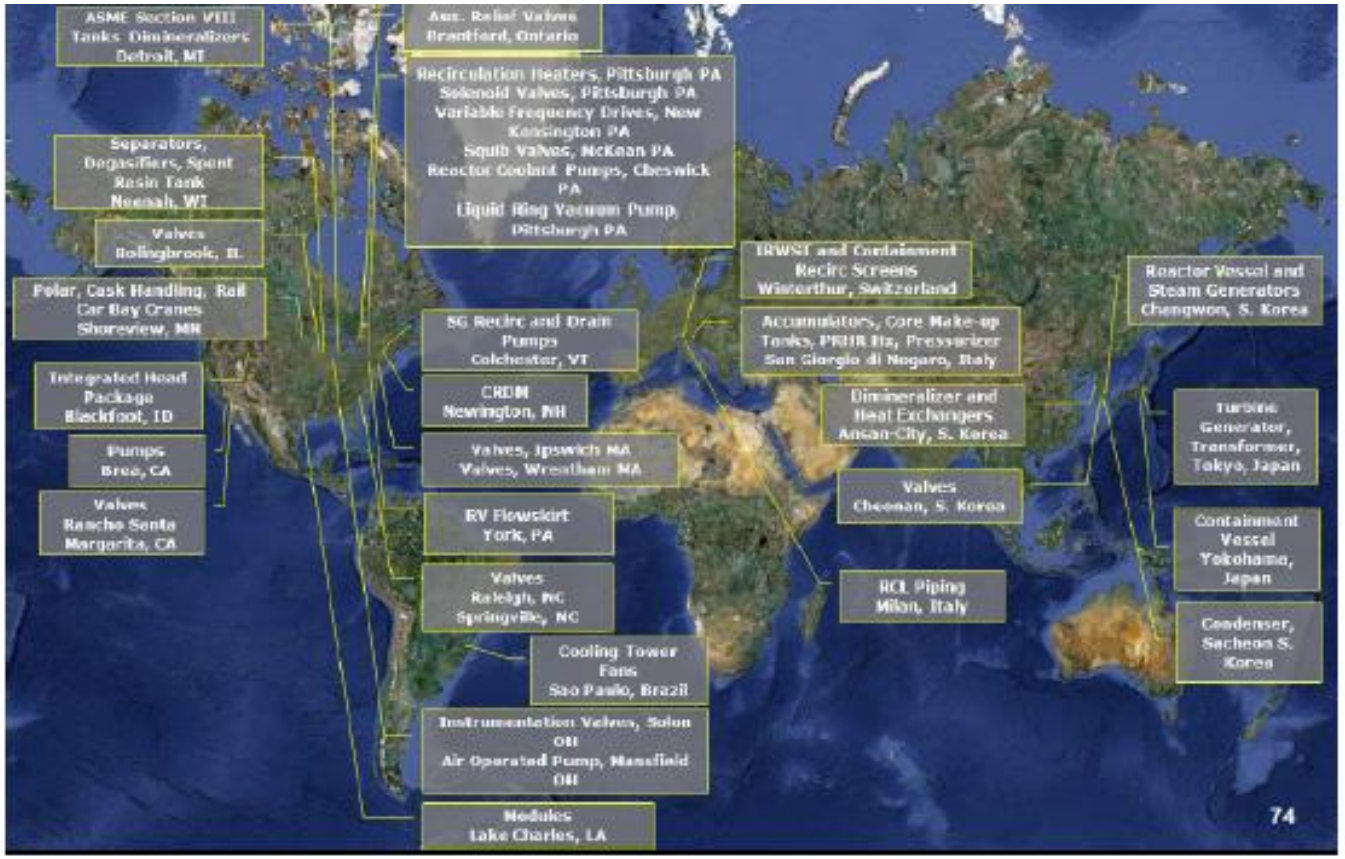
Evolution in nuclear reactor manufacture in NEA member countries



- Consolidation in the global nuclear supply chain, still further is expected.
- Similar trend is observed for fuel providers and suppliers of nuclear components.

The supply chain is global

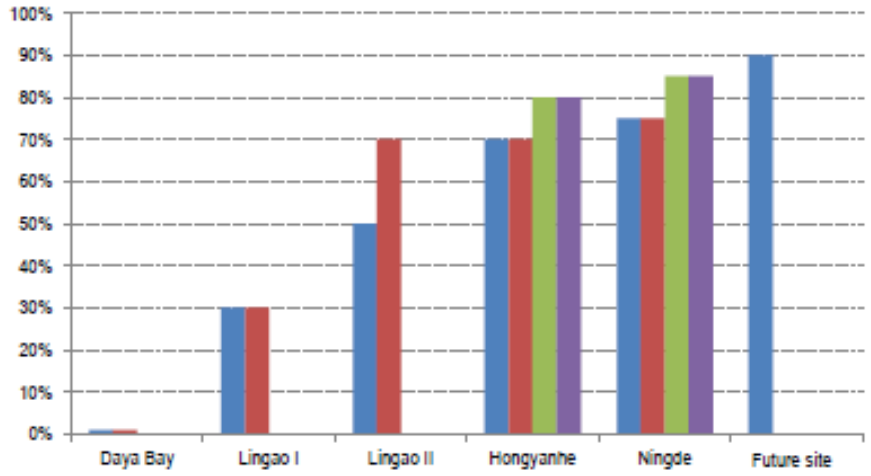
Supply chain for Summer VC components



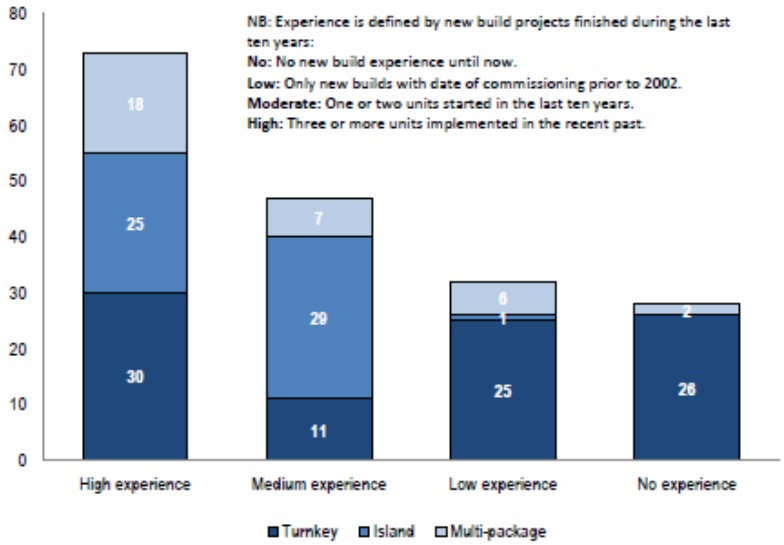
- Supply chain for new nuclear plants is global.
- The market for supply of new nuclear plant is reasonably competitive (NEA 2008)

Localisation trends

Local content of different Chinese CPR-1000 reactors



Choice of contract types



- Strong pressure toward localisation to maximise economic opportunities and technology transfer for the host country.
- The qualification of a new supply chain remains a challenge.
- Experience in France, Japan, Korea and more recently China.
- Similar trend are observed also in the type of contract chosen.

➡ Need to have good balance between supply chain localisation and globalisation.

Key aspects

- Need for a stable and sustained demand of nuclear power plant to reach an equilibrium in the a nuclear supply chain.
- The global standardisation of reactor designs and harmonisation of Codes and Standards is a step toward a more competitive and better integrated supply chain.
- Align regulatory requirements and foster exchange of information and lesson learned during licensing and safety reviews would also facilitate the development of a global nuclear market while also enhancing safety and security levels.
- Modularisation and off-site manufacturing holds potential for cost reductions and quality assurance, but requires up-front investment and scale.
- Supply chain and nuclear liability regimes.

  Not adhering to international conventions creates uncertainty for suppliers and may affect the willingness of reactor vendors and suppliers to enter in these markets.

  Conventions allow operators to have recourse against a vendor/supplier if such recourse is explicitly provided in the contract.

Thank you
For your attention

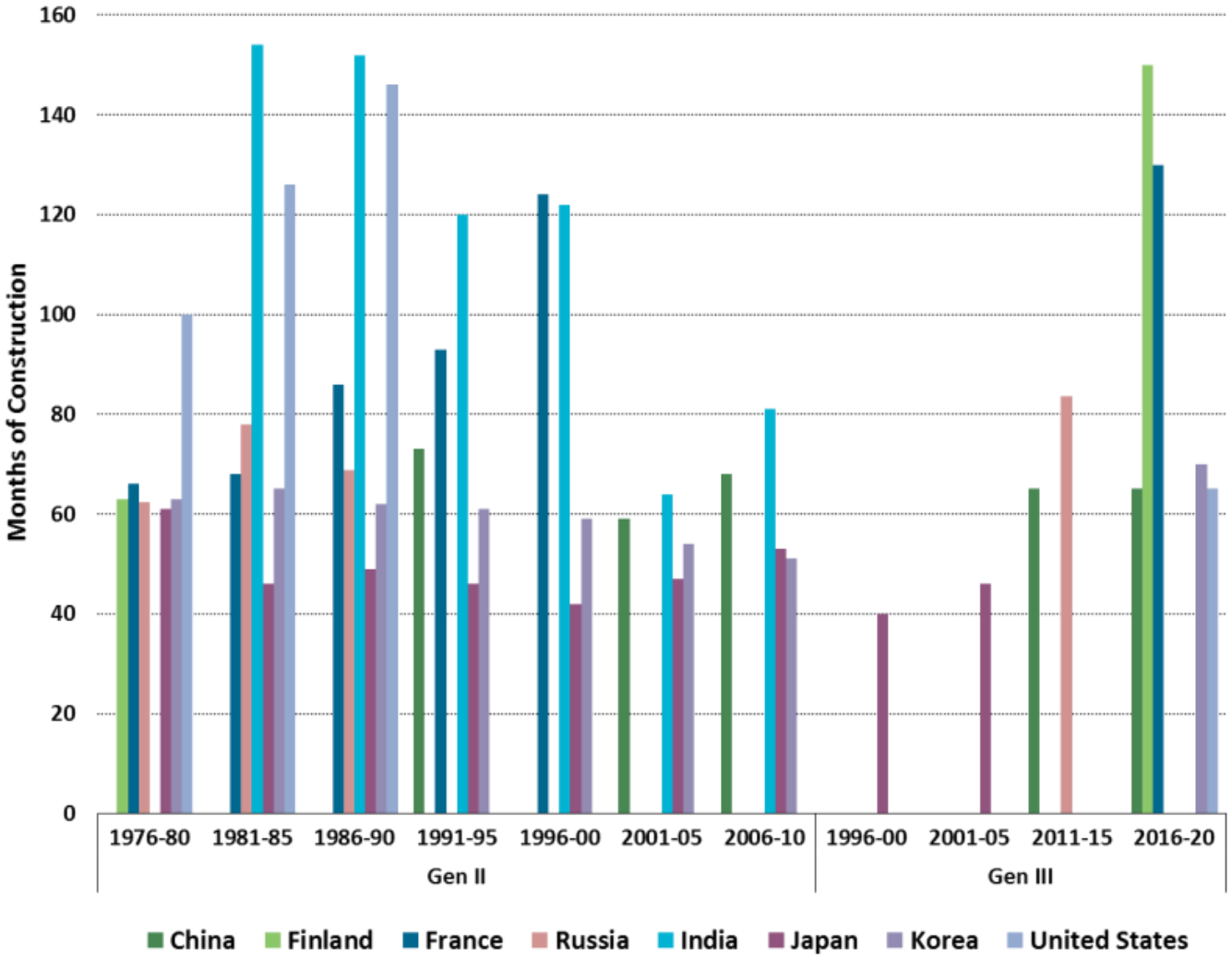
Nuclear New Build Today

Reactors Currently under Construction or Planned

Region	Under Construction	Planned
Europe	4	19
Russia and FSU	11	30
China	27	56
Rest of East Asia	10	10
West Asia	2	8
South Asia	7	24
South East Asia	--	4
Africa	--	1
North America	5	7
South America	2	--
SUM	68	227

Source: WNA

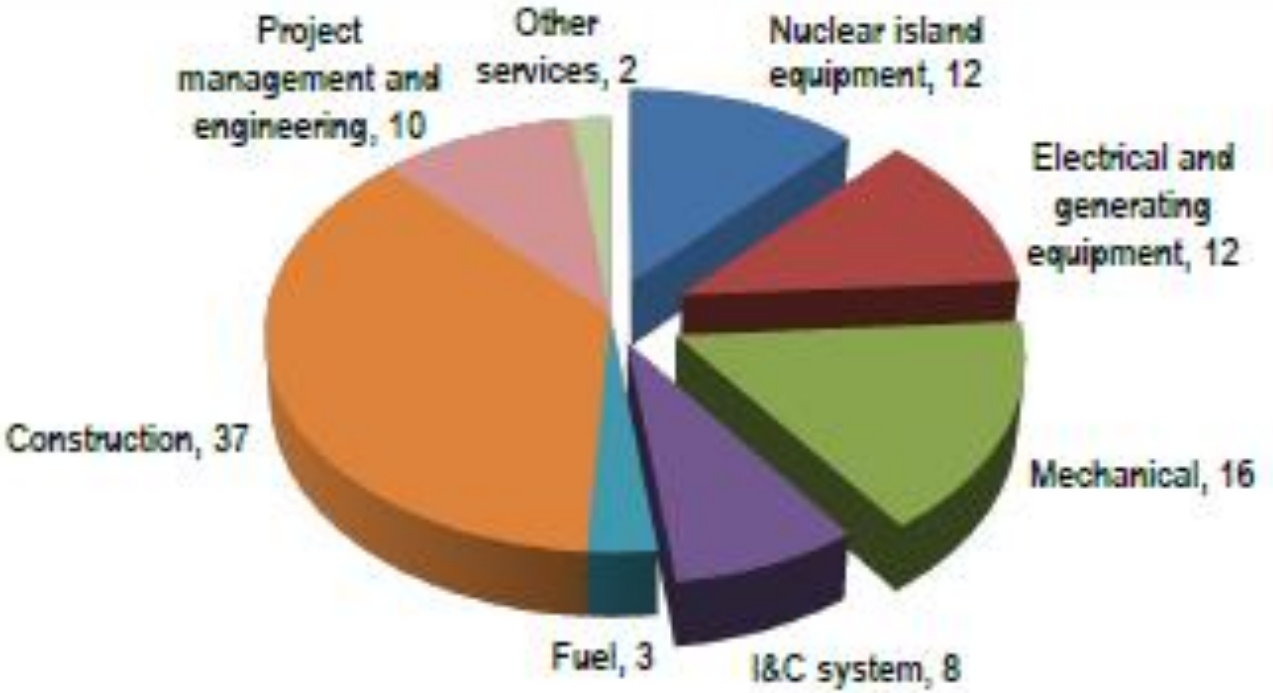
Construction Times of New Reactors



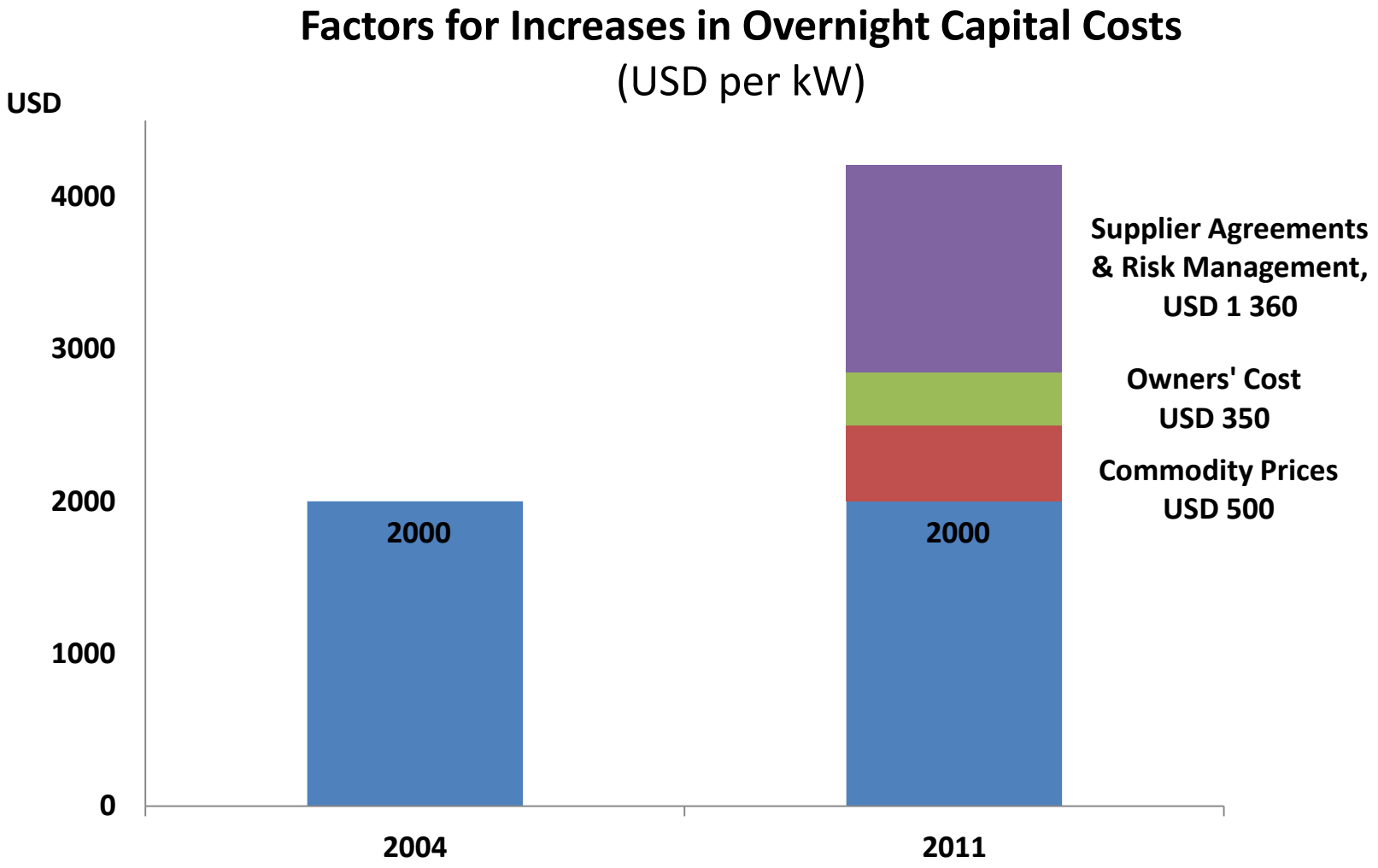
***Source*: IAEA PRIS and press reports.**

Cost breakdown for a NPP new built

NPP Percentage cost breakdown



Is De-verticalisation Driving Costs?



Component	Location	Continent	Component	Location	Continent
Condenser	Sacheon, Korea	Asia	Instrumentation valves	Solon, OH, US	North America
Containment vessel	Yokohoma, Korea	Asia	Integrated head package	Blackfoot, ID, US	North America
Demineraliser	Ansan City, Korea	Asia	Liquid ring vacuum pump	Pittsburgh, PA, US	North America
Heat exchangers	Ansan City, Korea	Asia	Pumps	Brea, CA, US	North America
Reactor vessel	Changwon, Korea	Asia	Reactor coolant pumps	Cheswick, PA, US	North America
Steam generators	Changwon, Korea	Asia	Reactor vessel flowskirt	York, PA, US	North America
Transformers	Tokyo, Japan	Asia	Recirculation heaters	Pittsburgh, PA, US	North America
Turbine generator	Tokyo, Japan	Asia	Selonoid valves	Pittsburgh, PA, US	North America
Valves	Cheonan, Korea	Asia	Separators	Neenah, WI, US	North America
Accumulators	San Giorgo, Italy	Europe	Steam generators recirculation and drain pumps	Colchester, VT, US	North America
Containment recirculation screens	Winterthur, Switzerland	Europe	Spent resin tank	Neenah, WI, US	North America
Core make-up tanks	San Giorgo, Italy	Europe	Squib valves	McKean, PA, US	North America
IR water storage tank IRWST	Winterthur, Switzerland	Europe	Tank demineralisers	Detroit, MI, US	North America
Pressuriser	San Giorgo, Italy	Europe	Valves	Bolingbrook, IL, US	North America
PRHR Hx heat exchanger	San Giorgo, Italy	Europe	Valves	Rancho, St. Marg., CA, US	North America
Reactor coolant loop piping	Milan, Italy	Europe	Valves	Ipswich, MA, US	North America
AP1000 modules	Lake Charles, LA, US	North America	Valves	Winchester, MA, US	North America
Air operated pump	Mansfield, OH, US	North America	Valves	Raleigh, NC, US	North America
Auxiliary relief valves	Brantford, ON, Canada	North America	Valves	Springville, NC, US	North America
Control rod drive mechanism	Newington, NH, US	North America	Variable frequency drives	New Kensington, OA, US	North America
Cranes	Shoreview, MN, US	North America	Cooling tower fans	Sao Paulo, Brazil	South America
Degasifiers	Neenah, WI, US	North America			