

# **REVIEW OF NUCLEAR NEW BUILD: PROJECT STRUCTURE, SUPPLY CHAIN AND FINANCING**

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Since 2000, 77 reactors started construction and 47 new reactors were connected to the grid. Vastly different forms of project management and financing in different contexts have generated a wealth of experience.

This study tries to identify **perspectives for commercially and economically sustainable new build** by focusing on two areas:

- I. The structure of financing and the allocation of financial risks among stakeholders **and** the management of long-term electricity price risk
- II. Structure of the project management and the supply chain during the construction phase

The study is characterised by a combination of **conceptual analysis, expert opinion** and **empirical case studies**.

It is overseen by the **Working Party on Nuclear Energy Economics (WPNE)** and the **Nuclear Development Committee (NDC)** and includes input from international organisations, the financial sector, vendors and utilities.

Timeframe is 18 months, final publication expected for last quarter of 2014.

## **PART I SOLUTIONS FOR ELECTRICITY PRICE STABILITY AND FINANCIAL RISK**

### **1. Value of Price Stability for Nuclear Energy**

- a) Long-term electricity price stability and the competitiveness of new nuclear projects
- b) The value of long-term pricing arrangements for risk-averse investors
- c) The impact of different market designs on the technology choices of private investors

### **2. Risk Exposure of Different Investor Groups**

- a) Present value of new nuclear projects taking into account taxation and different debt-equity splits
- b) Specific risk exposure of debt and equity holders in the case of a sub-par evolution of nuclear projects

### **3. Case Studies (Akkuyu, Barakah and Vogtle)**

## **PART II PROJECT MANAGEMENT AND THE SUPPLY CHAIN DURING CONSTRUCTION**

### **1. Overview of Number, Size and Status of Different Nuclear New Build Projects**

### **2. Vertical Integration, Design Certification and Competition**

### **3. The Evolving Structure of the Global Nuclear Supply Chain**

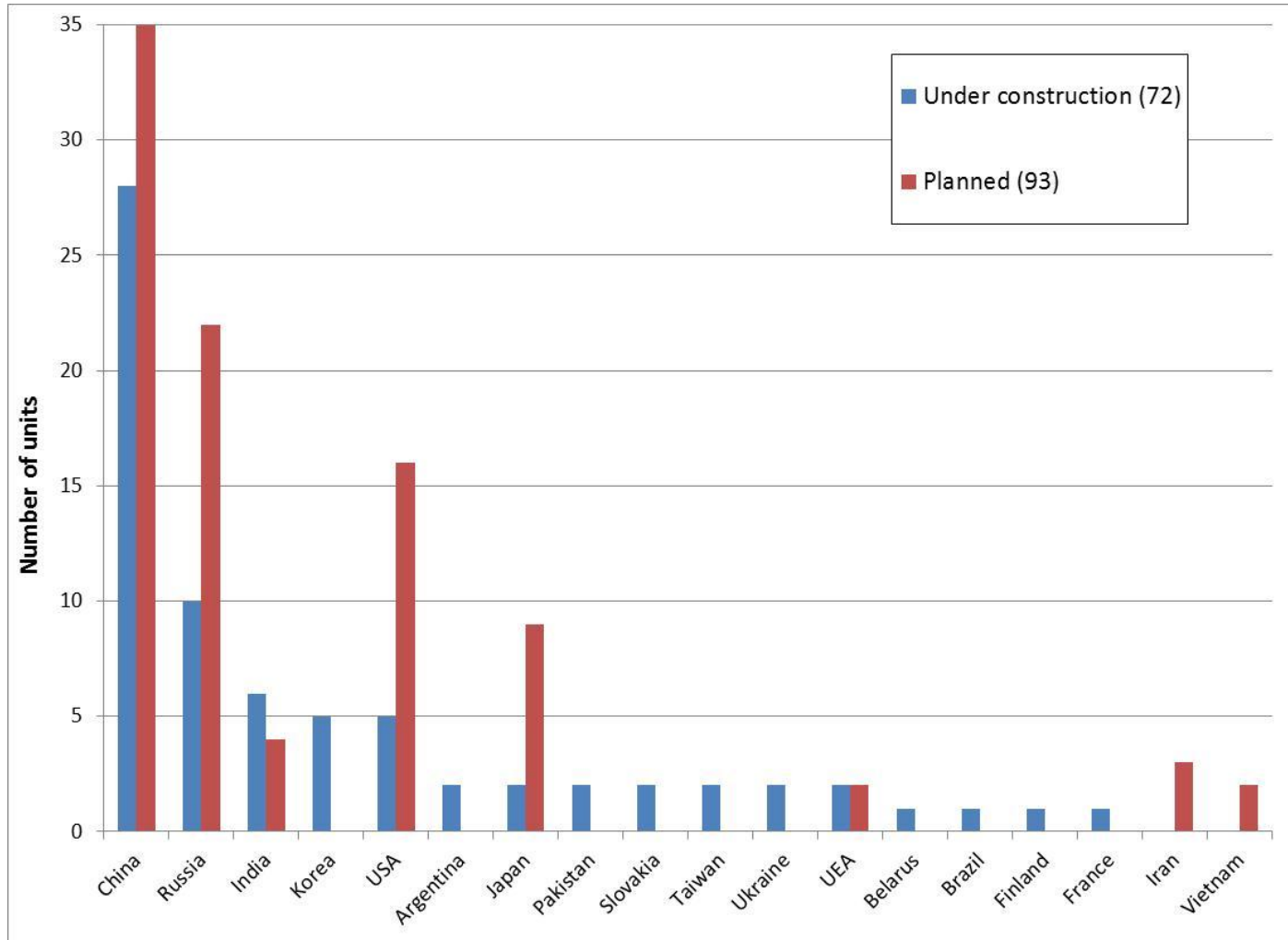
### **4. Divergence between actual and estimated costs in large industrial projects**

### **5. Case Studies (Shimane, Summer, Tianwan, Flamanville-Taishan)**

# Principal Results of Part I (Including Workshop September 2013)

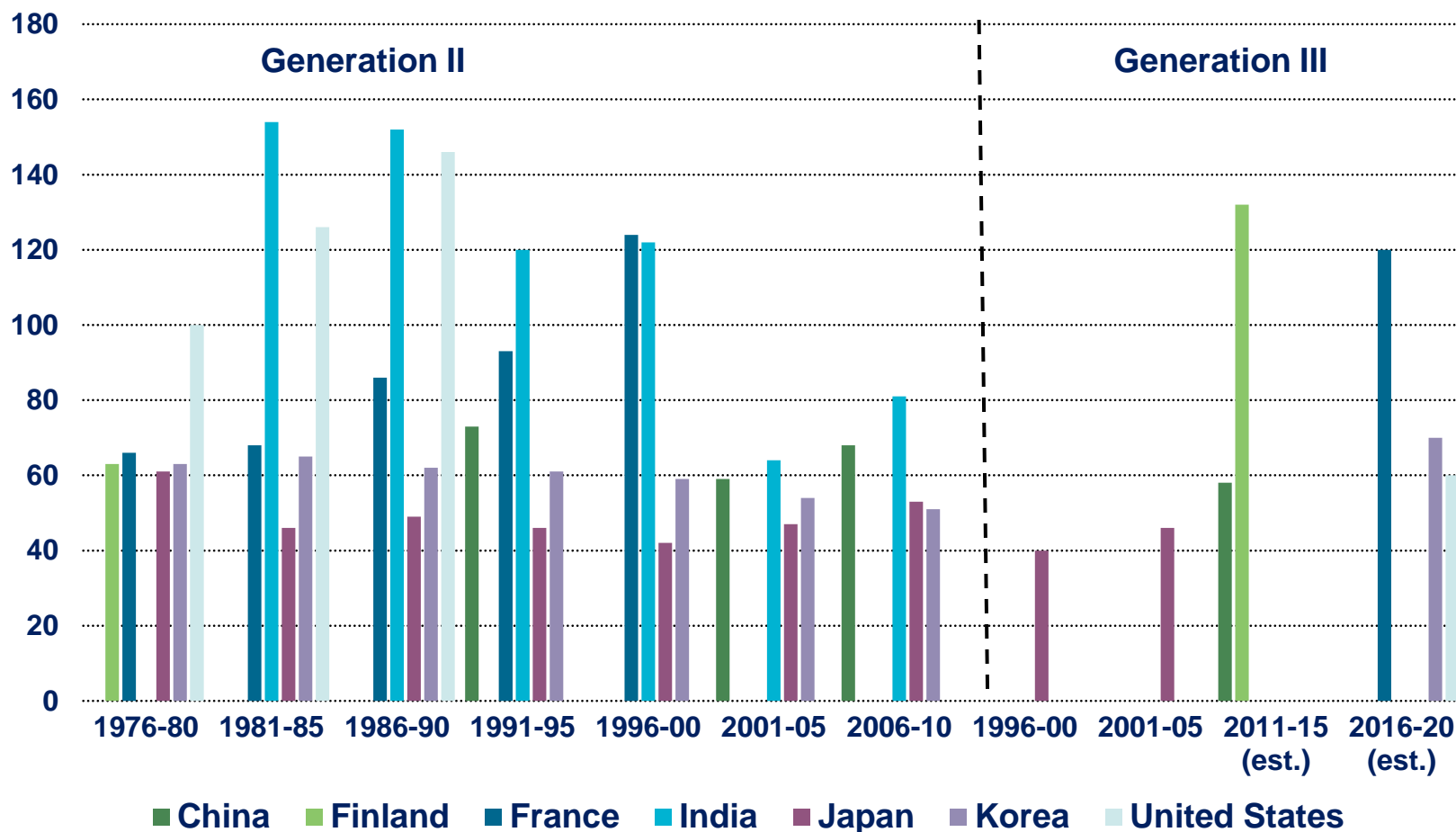
- In addition to political support and regulatory stability, optimised risk allocation over time among stakeholders and long-term electricity price stability are essential for successful nuclear new built projects. However, phase of transition still ongoing.
- Long-term electricity price risk creates bias against high capital cost technologies such as nuclear. Power purchasing agreements, contracts for differences or feed-in tariffs reduce the risk for investors and thus the opportunity cost of capital.
- Electricity sector regulation is neither technology- nor environmentally neutral. Without compensating measures (carbon taxes, long-term price guarantees), liberalised markets with high price risk discriminate against capital-intensive low-carbon technologies.
- At current levels and volatility of electricity prices in wholesale markets, no new build of nuclear (or any other generation technology) could be envisaged in continental Europe without electricity price guarantees or some other form of support.
- Nuclear new build is likely to be concentrated in regulated markets with strong population and electricity demand growth or long-term commitments to low carbon electricity production (the UK experience is therefore closely watched).
- Risk for bondholders is very limited at low debt ratios (30-50%) even under adverse electricity market conditions. At higher leverage, bondholders assume a (sizeable) part of project risk.

## New nuclear build projects in the world



Source: PRIS (IAEA)

## Average Construction Times (Months) of Nuclear Power Plants During the Past Four Decades in Different Regions



Source: PRIS and Henri Paillère, NEA/NDD

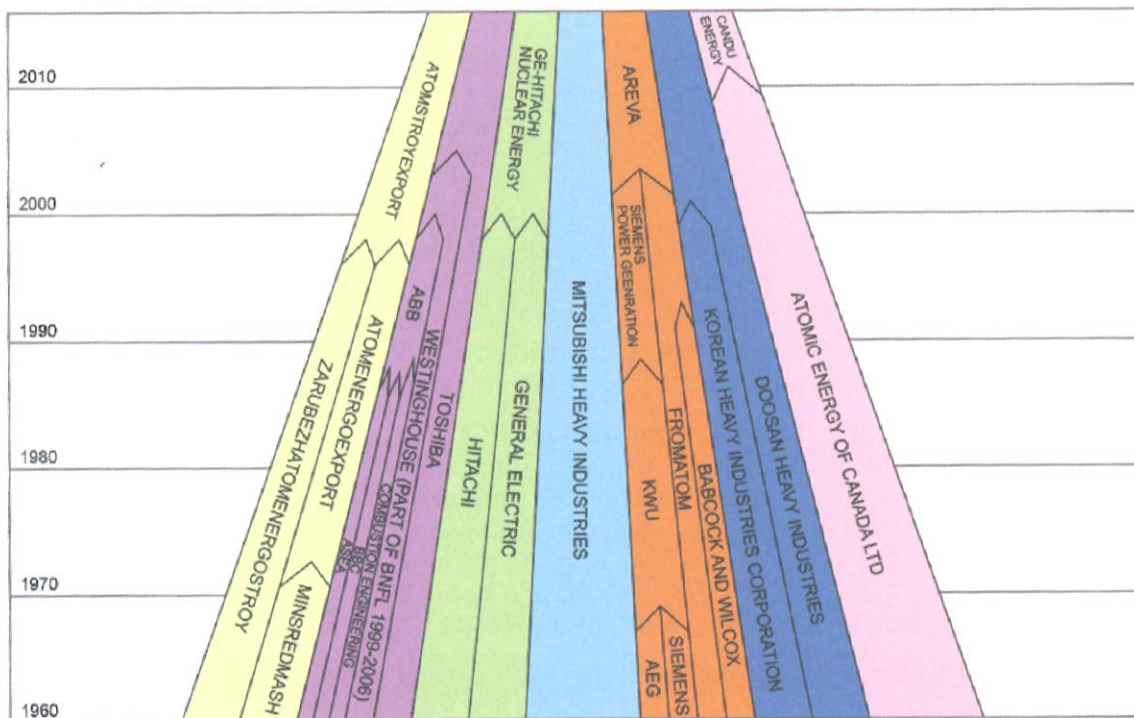
- Nuclear new build characterised by large scales, long time frames, complexity and is impacted by externalities (“an accident anywhere is an accident everywhere”).
- Three basic models of project management prevail in nuclear:
  1. Turnkey project provided by integrated reactor vendor
  2. Operator-assembler works with small number of key sub-contractors
  3. EPC contractor manages project with competitive procurement at different steps
- The theory of transaction costs (Coase, Williamson) holds that vertical integration should substitute for contractual relationships if the following prevail:
  - a) High frequency of transactions (not necessarily the case in nuclear industry),
  - b) Industrial assets are “specific”, i.e. not commoditised (very much the case), and
  - c) Opportunities for contractual “hold-up” due to asymmetries of information and incomplete contracts (somewhat the case).
- Models 1 and 2 can reduce uncertainties and provide clear interlocutor for customers and governments. Model 3 may have advantages in reducing costs.
- Increasing external contractual relations as well as externalities call for international standard-setting through regulation or auto-regulation.

# The Evolving Structure of the Global Nuclear Supply Chain

Reconfiguration of global nuclear supply chain with consolidation of reactor vendors and emergence of new specialised suppliers.

- What are the recent trends and the tendency for the future?
- Will there be sufficient capacity in the future?

## Reactor manufacture consolidation



Source: WNA, "The World Nuclear Supply Chain"



Recent experience in many OECD countries has shown difficulties in forecasting construction time and cost for new nuclear build projects.

Cost over-runs and construction delays are a major element of the overall financial risk of a nuclear new project.

- What are the key drivers of cost escalation and construction delays in recent nuclear projects?
- Are there elements on reactor design and project management that could deliver more effectively new nuclear projects ?
- Were things different in the past?
- Asia vs. Europe/US : are there lessons to be learnt from other OECD regions?
- Are there elements specific to nuclear or are they intrinsic to large industrial projects?

# Conditions for Cost Reductions in Overnight Costs

In March 2014, *Nuclear Energy Insider* published results of global survey of 200 decision makers in the nuclear industry of which 73% experienced budget cuts :

- Cost efficiency strategies (62%) by far most important trend in supply chain management.
- More than 80% of nuclear procurement engineers are reconsidering their relationships with suppliers and shifting towards an internationalized supply chain at a much faster rate than initially thought.
- Share of international procurement for 50-75% of supply chain is expected to rise from 17 to 42% during next ten years.

What are the conditions to sustain this trend?

- More standardised approaches in reactor design and regulation (CORDEL, MDEP);
- Harmonisation of international codes (RCC-M/E, ASME) in the nuclear industry as well as ISO qualifications;
- Could airline industry be an example? High complexity, externalities and cost pressures make for similarities although differences remain.

# Three Guiding Questions

1. Is there single model for project management emerging?
2. Are cost overruns and construction delays inevitable features of the nuclear industry?
3. What are the conditions for a more efficient global nuclear supply chain?