Prospects for Nuclear Power worldwide & Learnings from past and on-going Project Implementation

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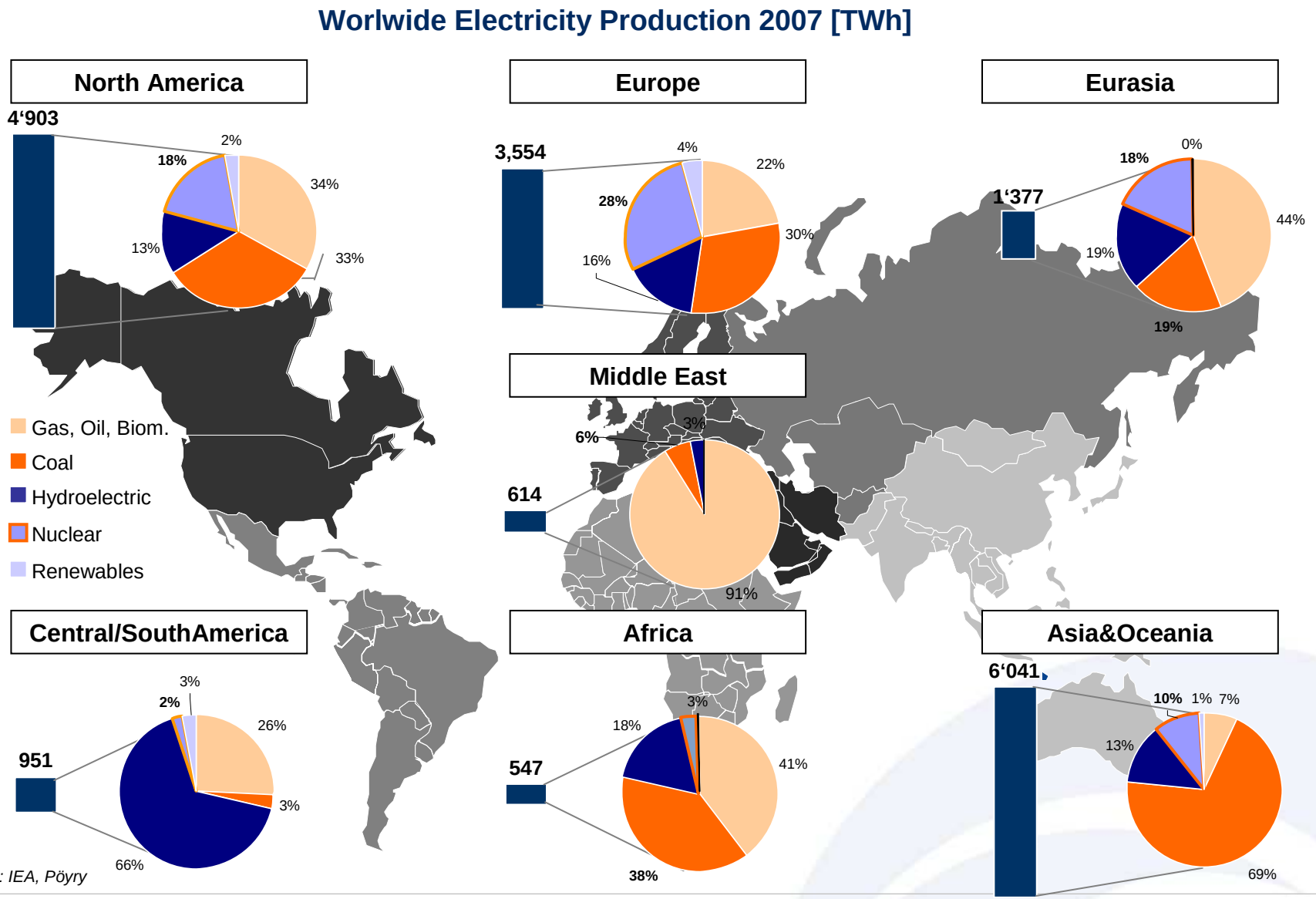
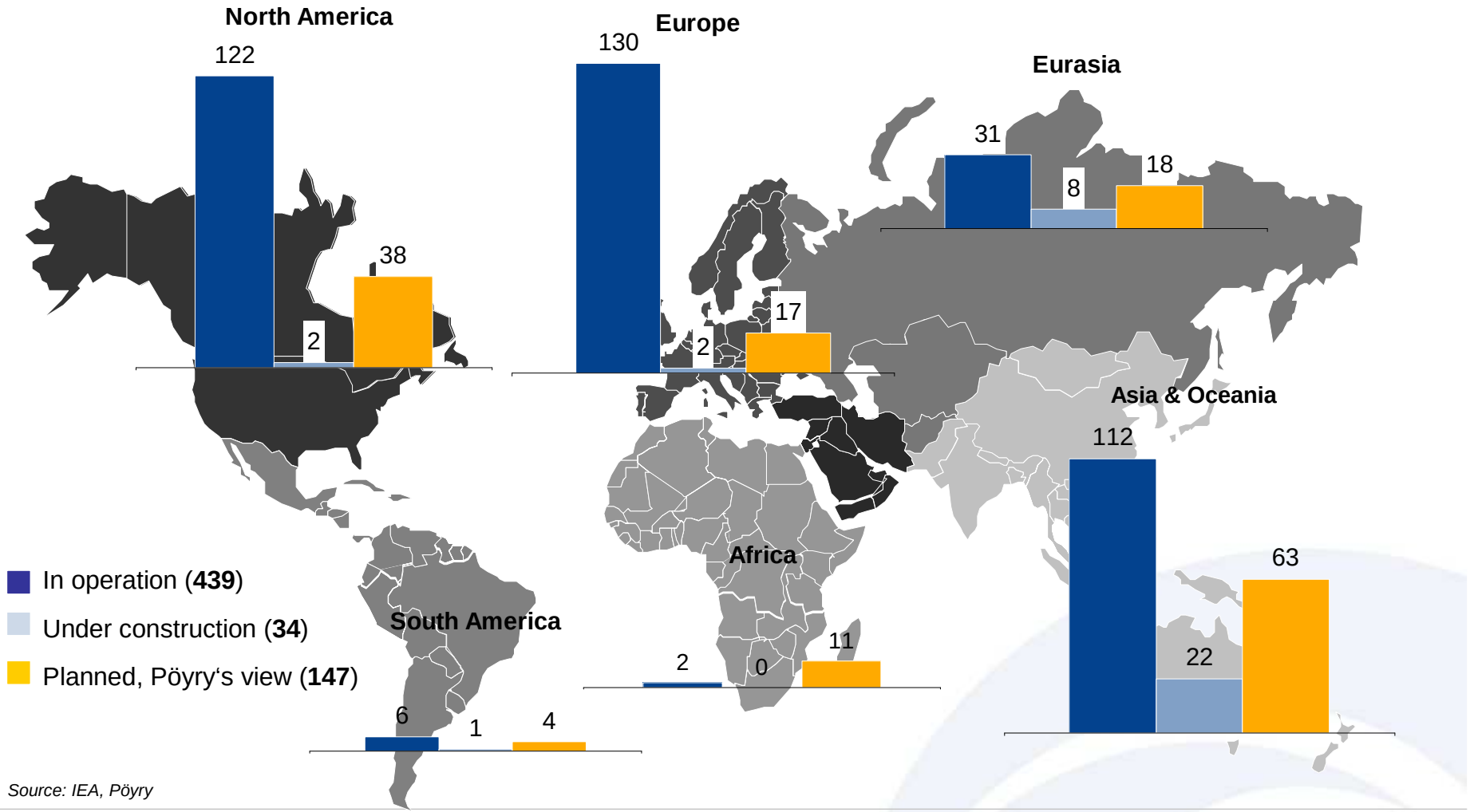
Nuclear power production is currently making up app. 15% of the worldwide electricity production.



Source: IEA, Pöyry

Utilities and governments are planning on investing in new nuclear power plants all over the world.

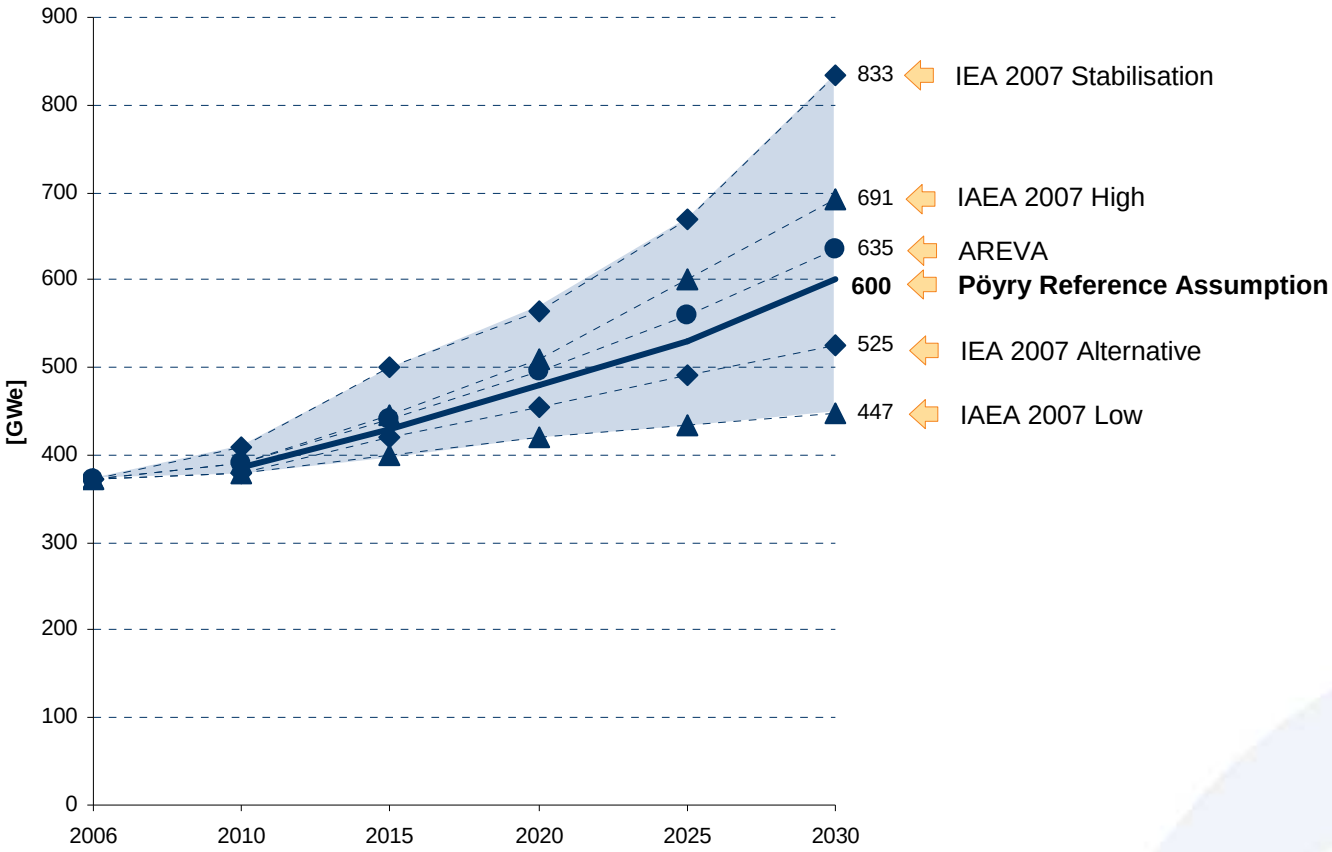
Nuclear power plants worldwide – existing, under construction and under development.



Source: IEA, Pöyry

Pöyry assumes the total installed nuclear capacity to reach 600 GW by 2030.

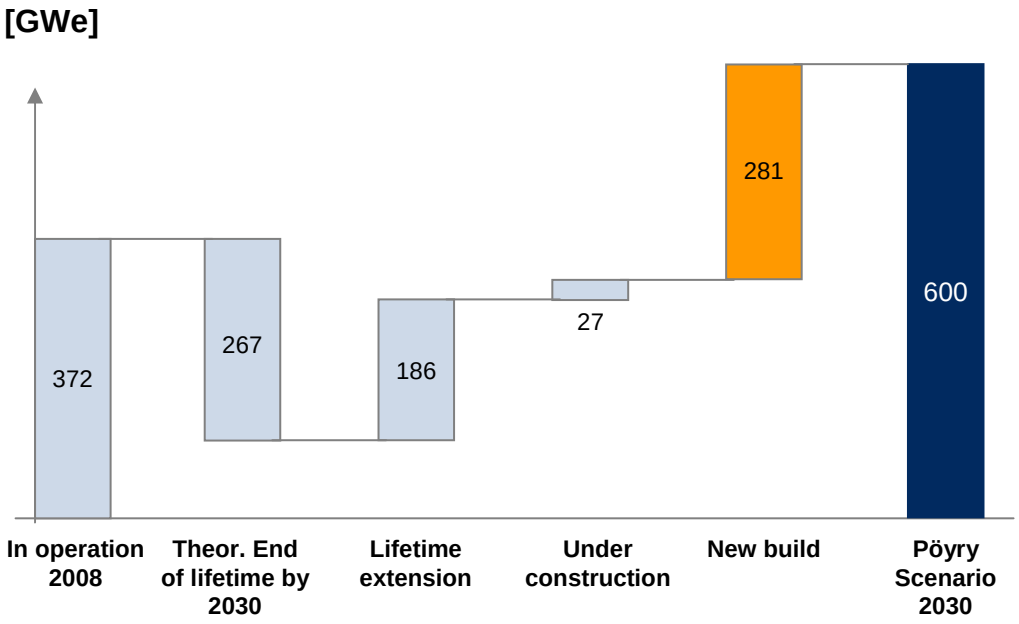
Scenarios of demand for nuclear power capacity worldwide



- Several sources are providing forecast scenarios regarding the development of nuclear energy.
- Pöyry has developed its nuclear scenario based on its unique market intelligence and experience-based understanding of worldwide trends of energy supply and consumption.
- Pöyry's reference assumption for nuclear power generation in 2030 ties in with the average of other relevant forecasts.

Based on lifetime extensions of 186 GW for existing nuclear capacity, new-build‘s of 280 GW are assumed by 2030.

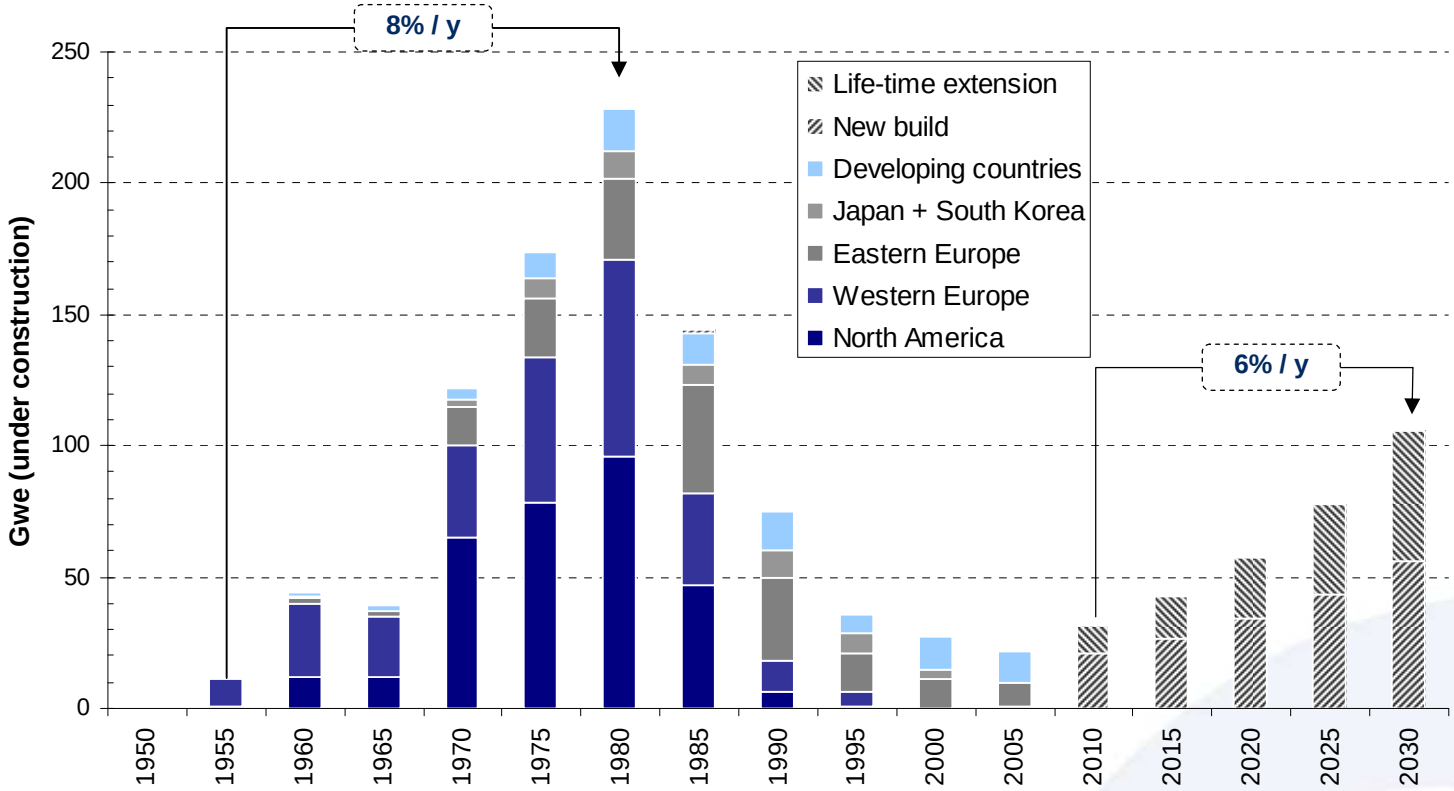
Estimated demand for new-build nuclear power plants



- Various reactor types will be applied for “new build’s” worldwide, unit sizes of 600-1600 MW are under consideration.
- Lifetime-extensions are expected to contribute almost one third of the nuclear capacity foreseen for 2030
- It is assumed that the on-going financial crisis will have only slight impacts in the short run by creating additional uncertainty for investment.

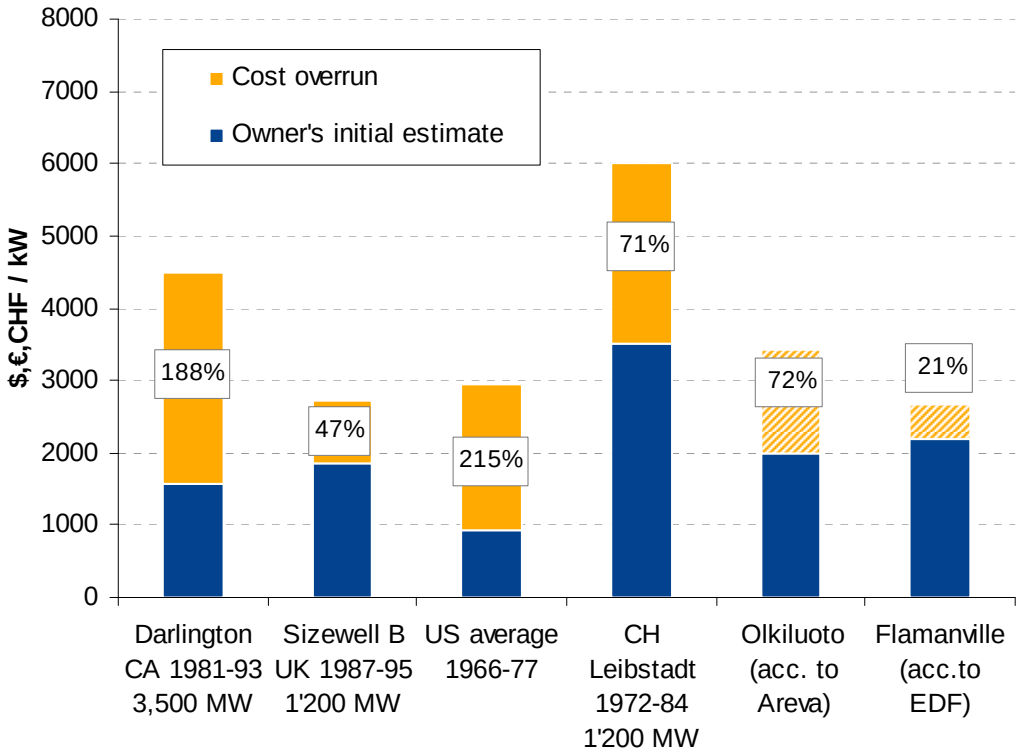
In order to cope with expected demand, the nuclear power industry has to cope with similar growth rates as for the last investment cycle

Historical and projected rate of capacity additions for NPPs worldwide



It is estimated that more than half of the nuclear power plants worldwide have been implemented with a cost overrun and/or delay.

Cost overruns for NPP in the past (in the respective currencies)



- Massive cost overruns have been experienced in the past, which create a major risk for the future development of nuclear power
- The most cited reasons for cost overruns are
  - Changing requirements from the licensing side
  - Lack of standardization and front end engineering
  - Overly ambitious targets of the owner
- Although AECL of Canada (Candu reactors) experienced a record cost overrun in their Darlington project, all of their seven overseas projects between 1997 and 2007 were built in budget and on time.
  As reasons for this, CANDU mentions
  - High standardization
  - Local Canadian supply chain for critical items
  - Favorable regulatory environment
- Also the French nuclear power plant fleet was implemented without major delays or cost overruns, mostly due to a highly standardized design

Problem areas for nuclear power plant implementation are general for large and complex infrastructure projects.

Key problems in implementation of new nuclear power plants

Build before design completion	• „design as you go“ • Bid to win mentality • Misalignment of civil construction and mechanical erection
Inadequately defined scope	• Due to incomplete design • inadequate contract provisions • No benchmark to manage the project.
Custom design	• Contractor supply-chain-management not in line with engineering • No availability of standard designs
Poor schedule integration	• Construction builds by “Area” - Big stuff in first • Construction dominance in the scheduling process • Limited detailed coordination interfaces
Unstructured problem identification, resolution and documentation	• Lack of well-defined processes • Silo protectionism (often many silos even w/in groups) No “one project one team” mentality. • Cultural barriers within the team
Marginal owner involvement	• Rely on Contractor (deemed expert) • Good engineers presumed to be good managers • Weak executive involvement
Ineffective contract administration	• Vague contract terms, difficult to track and oversee • Marginal dedicated oversight of contract performance (Contrast
Lack of risk identification and management	• Risk management procedures not existing or not adequate • No risk mitigation measures defined ex-ante • Reactive vs. Proactive approach to failures

Four areas are identified to address the problems experienced in implementing nuclear power plants.

Optimized Front-End Engineering	• Increased level of engineering before implementation in order minimise misalignments between civil construction and mechanical design • Optimize balance between functional and detailed specifications for the respective packages
Efficient Contract Strategy	• Define optimize division of the power plants in lots, taking into account project specific issues and the internal organisation of the owner • Verify degree of standardization and supply chain of critical packages, especially Nuclear Island
Management of Licensing	• Early involvement of the licensing and regulatory bodies • Active management of the regulatory process in order to address design implications in an efficient manner • Leverage on international experience of licensing procedures
Consistent Project Management	• Integrated project management by the owner and outsourced project management company • Engineering Management and Contract Management out of „one hand“ • Establish state-of-the-art project controlling and risk management mechanisms

Improvement of project performance:

→ Increase overall acceptance of the project by respective stakeholders

→ Mitigate risks of cost overruns and delays

→ Optimise employment of owner's own resources

→ Leverage on the potential of local project management companies

Three basic types of implementation methods are distinguished according to the number of contracts and the division of risk between owner and contractors.

Three general approaches for project implementation

- **EPC-turnkey** – single contractor/point of responsibility
  Implementation risks included in contract and covered by liquidated damages.
  Open book procedure optional for transparent pricing between owner and contractor.

- **Split-package – EPCM** – Split of scope into 5-10 EPC lots, with respective responsibility for the supplier of the lots.
  If not covered by one of the package suppliers, the Owner or an EPCM contractor manages technical system integration and overall project management.

- **Multiple package – Architect Engineer** – Main packages like nuclear or turbine island are procured using EPC contracts, whereas the rest of the plant is engineered and procured in multiple (>10) packages. The Architect engineer entirely manages engineering and project implementation on behalf of the owner.