# Nuclear Power and Climate Change

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International Atomic Energy Agency

# Overview

- Global response to Fukushima
- IAEA Action Plan
- Drivers behind recent nuclear renaissance still present:
  - Rising global energy demand
  - Climate change
  - Need for affordable base load electricity
  - Energy security
- IAEA post-Fukushima nuclear power projections

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# GLOBAL RESPONSE TO FUKUSHIMA

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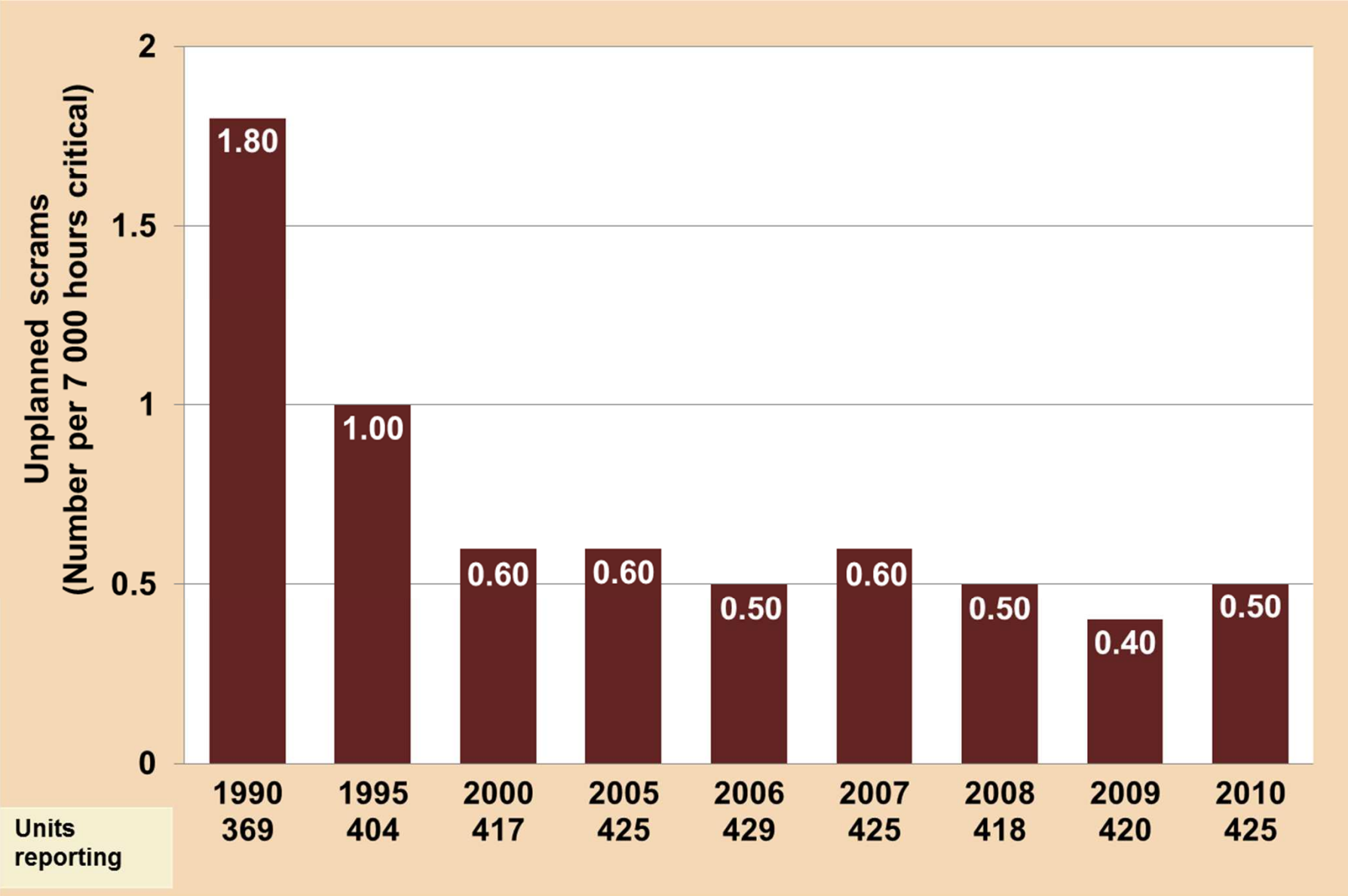
# Plant safety improving
# - but then Fukushima happened



# Global response to Fukushima

- Japan:
  - 4 out of 54 units are operating (these 4 will be idled by the end of April).
  - 29 GW are idle for inspection.
  - 16 GW have been shut down.
  - The future of nuclear power in Japan is uncertain
- Continued use of existing NPPs challenged in Germany, which voted to phase out nuclear power by 2022
- Referendum in Italy maintained 1987 ban on nuclear energy

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# Global response to Fukushima

- Switzerland stopped plans to construct a new plant and then the parliament voted to phase out existing nuclear plants 1 year early in 2034
- Continued use of NP in principle not opposed in other countries
- The US NRC issued its first new license in 30 years for 2 reactors in Georgia.
- A lot will depend on the
  - Transparency and effectiveness of dealing with the aftermath of Fukushima
  - Short- and long-term impacts on the local population
  - Full understanding of causal chain
  - Availability and economics of alternatives
- So far: no significant retraction of NP programmes globally

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# IAEA ACTION PLAN

# IAEA Action Plan

## Objectives of the Action Plan

- To define a programme of work to strengthen the global nuclear safety framework …
- … building on the Ministerial Declaration, the conclusions and recommendations of the Working Sessions including the INSAG letter report (GOVINF/2011/11), and facilitation of consultations among Member States.

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# Action Plan consists of 12 key actions

1. Safety assessments in the light of the accident;
2. IAEA peer reviews;
3. Emergency preparedness and response;
4. National regulatory bodies;
5. Operating organizations;
6. IAEA Safety Standards;
7. International legal framework;
8. Newcomers;
9. Capacity building;
10. Protection of people and the environment;
11. Communication and information dissemination;
12. Research and development.

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# Players in the Action Plan

- This is *not* an Action Plan only for the employees of the IAEA Secretariat.
- It *must involve* Member States, regulators, nuclear operators, vendors, international and intergovernmental organizations involved in nuclear matters.
- Successful implementation necessitates *full cooperation* and participation of all.
- Actions are explicitly addressed either to MS or to IAEA, or to other stakeholders

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# Transparency in the Action Plan

- Transparency of the evaluation by peers is a key element of the Action Plan.
- It is the necessary first step to rebuild trust in nuclear energy.
- Systematic use by Member States of peer review missions will play a decisive role towards harmonization and strengthening of safety practices.

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# DRIVERS IN FAVOUR OF NUCLEAR POWER REMAIN

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# Unchanged drivers behind the “renaissance” of nuclear power

- **Global energy demand is set to grow** ➡
  ***Nuclear power expands supply options***
- **Environmental pressures are rising** ➡
  ***Nuclear power has low life-cycle GHG emissions***
- **Reliable base load electricity at predictable and affordable costs for meeting MDGs** ➡
  ***Nuclear power offers stable and predictable generation costs based on low resource costs***
- **Energy supply security back on the political agenda** ➡
  ***Nuclear power contributes to energy security***

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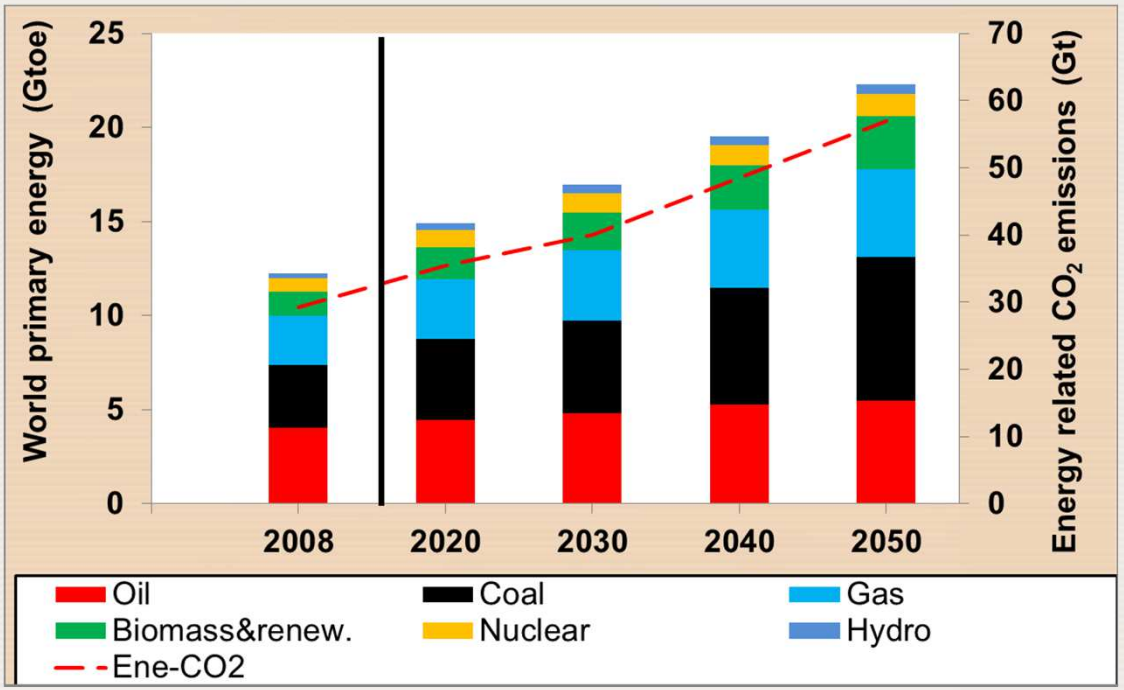
# Energy Demand

- Total primary energy demand (TPED)
  - 2030: ~17 Btoe
  - 2050: ~23 Btoe
- EneCO2 increases from 2008
  - 2030: 50+%
  - 2050: 100+%

## IEA Reference Scenario

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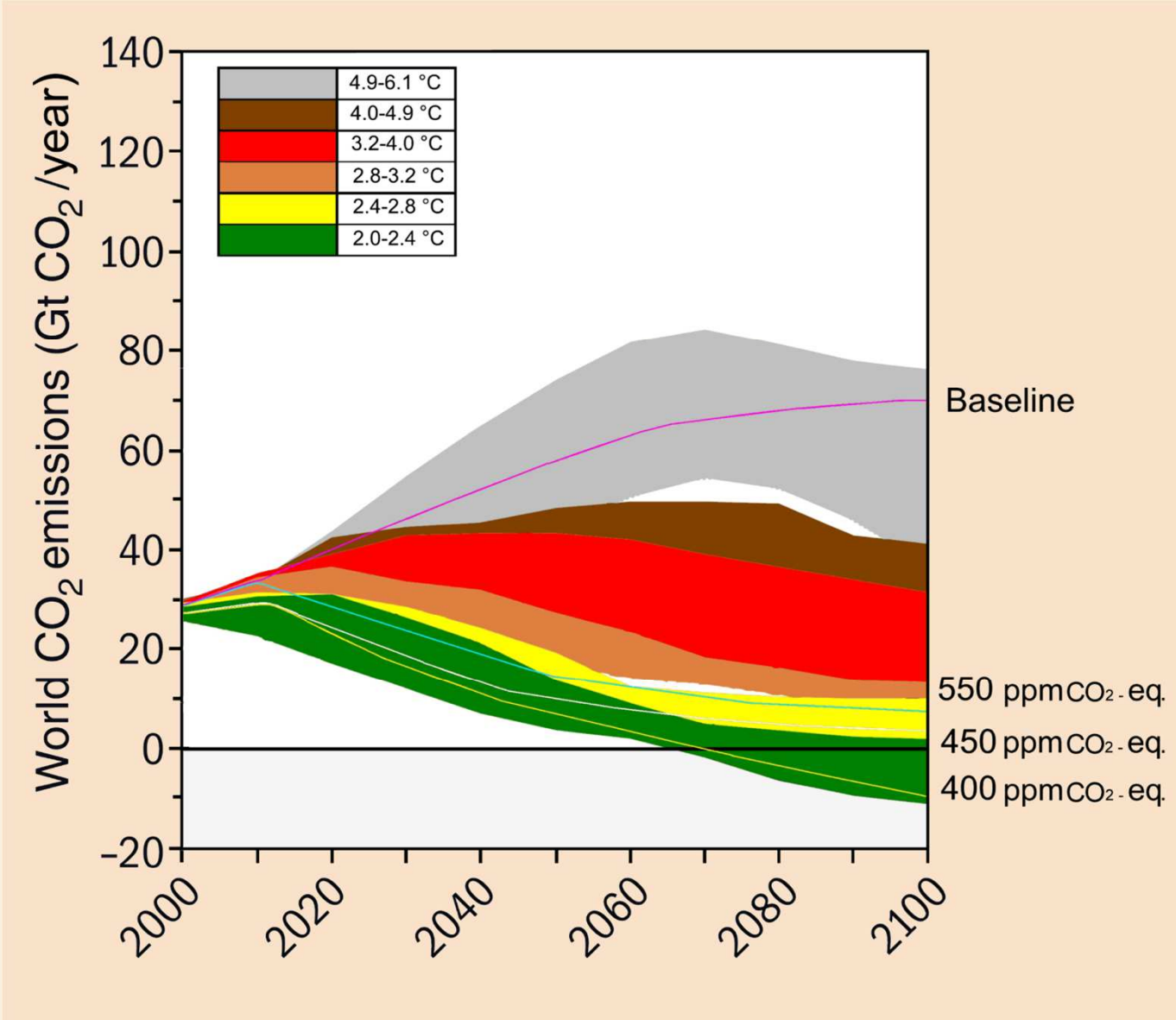
# Stabilization levels



# CO2 Mitigation Strategies

- Demand-side:
  - Reduced demand
  - Energy efficiency
- Supply-side:
  - Fossil – improved efficiency, fuel switching (coal-to-gas), carbon capture and storage
  - Nuclear
  - Renewables – hydro, wind, bioenergy, geothermal, solar, etc.

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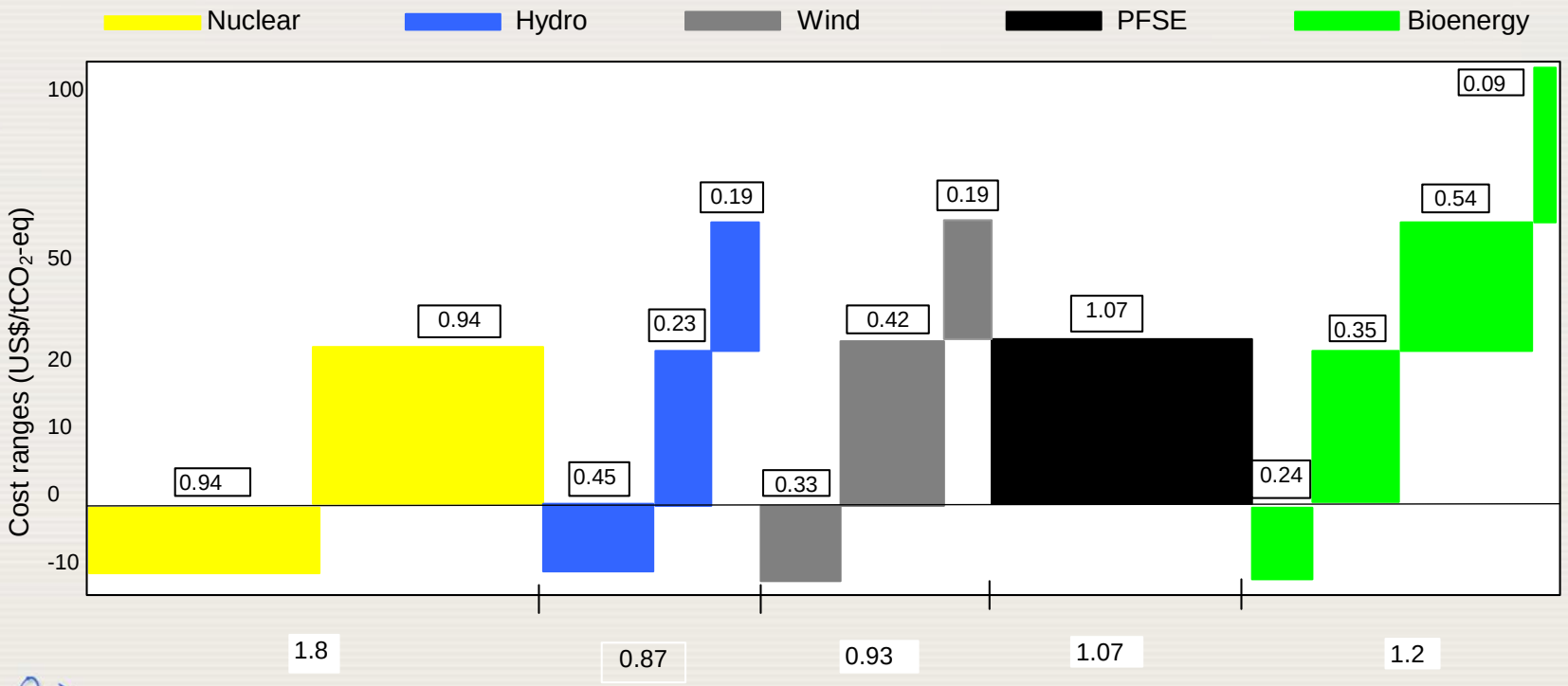
# CO2 mitigation potential

## Result: Potential GHG emissions avoided by 2030 in power generation: potential and cost ranges (potential > 0.5 GtCO2-eq) (Based on IPCC AR4)

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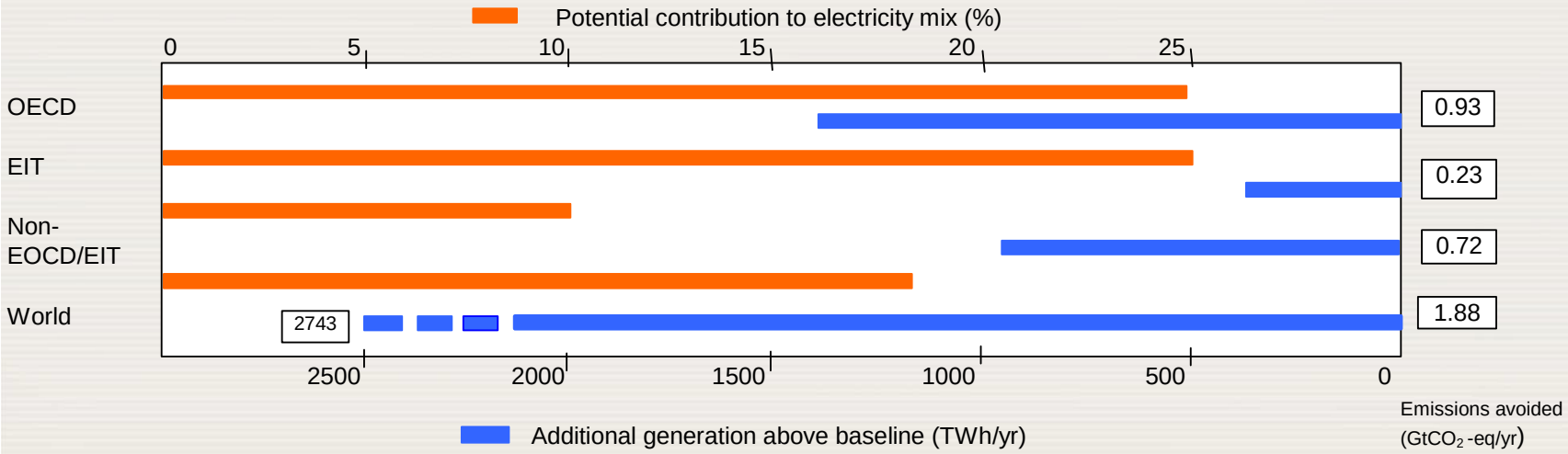
# Nuclear contribution to CO2 mitigation potential

## IPCC AR4:

### Nuclear contribution and emissions avoided by 2030



# Nuclear provides low CO2 energy

- Almost no GHG emissions during operation
- Some emissions in construction, fuel cycle, decommissioning

➔ *Very low* emissions on *life-cycle* basis:

15 studies; range: 2.8-24 gCO2-eq/kWh

Mean: below 10 gCO2-eq/kWh

Contributions: GHG emissions avoided in past

Low-carbon electricity sectors: countries with large shares of renewables and nuclear

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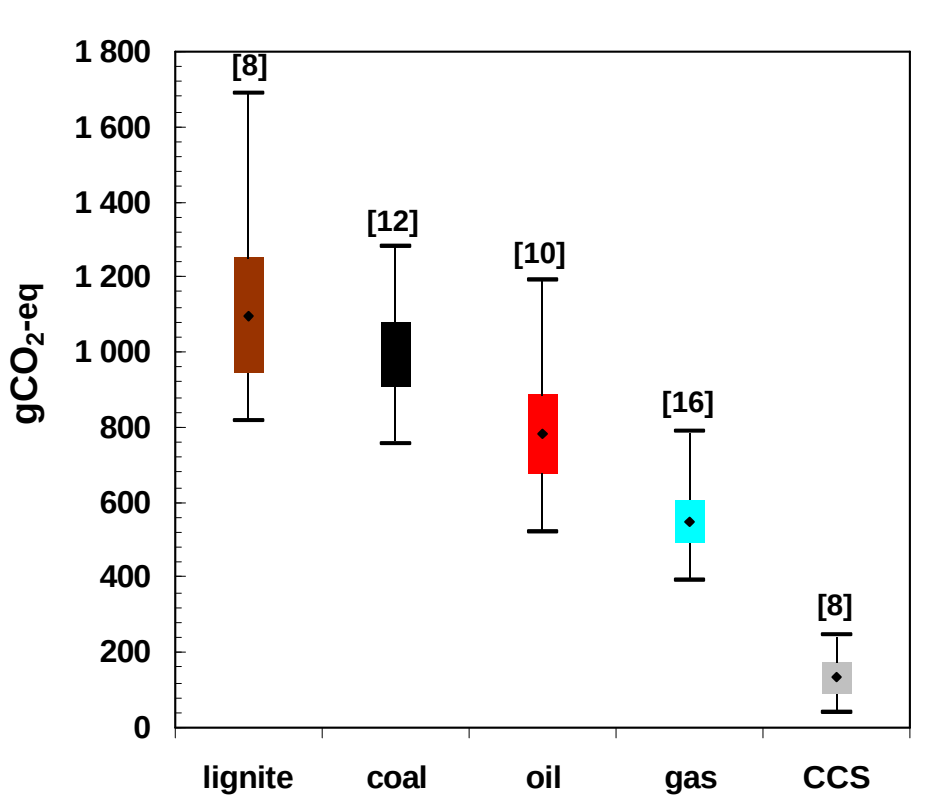
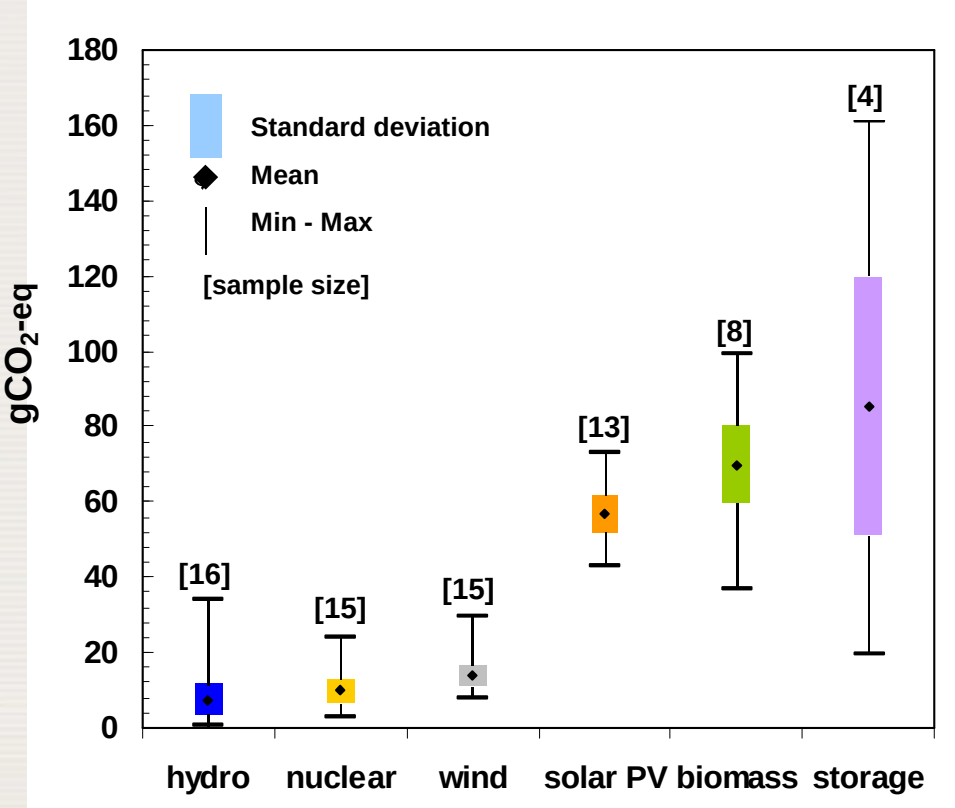
# Nuclear has low lifecycle GHG emissions

## Nuclear power: Very low lifetime GHG emissions make the technology an effective climate change mitigation option

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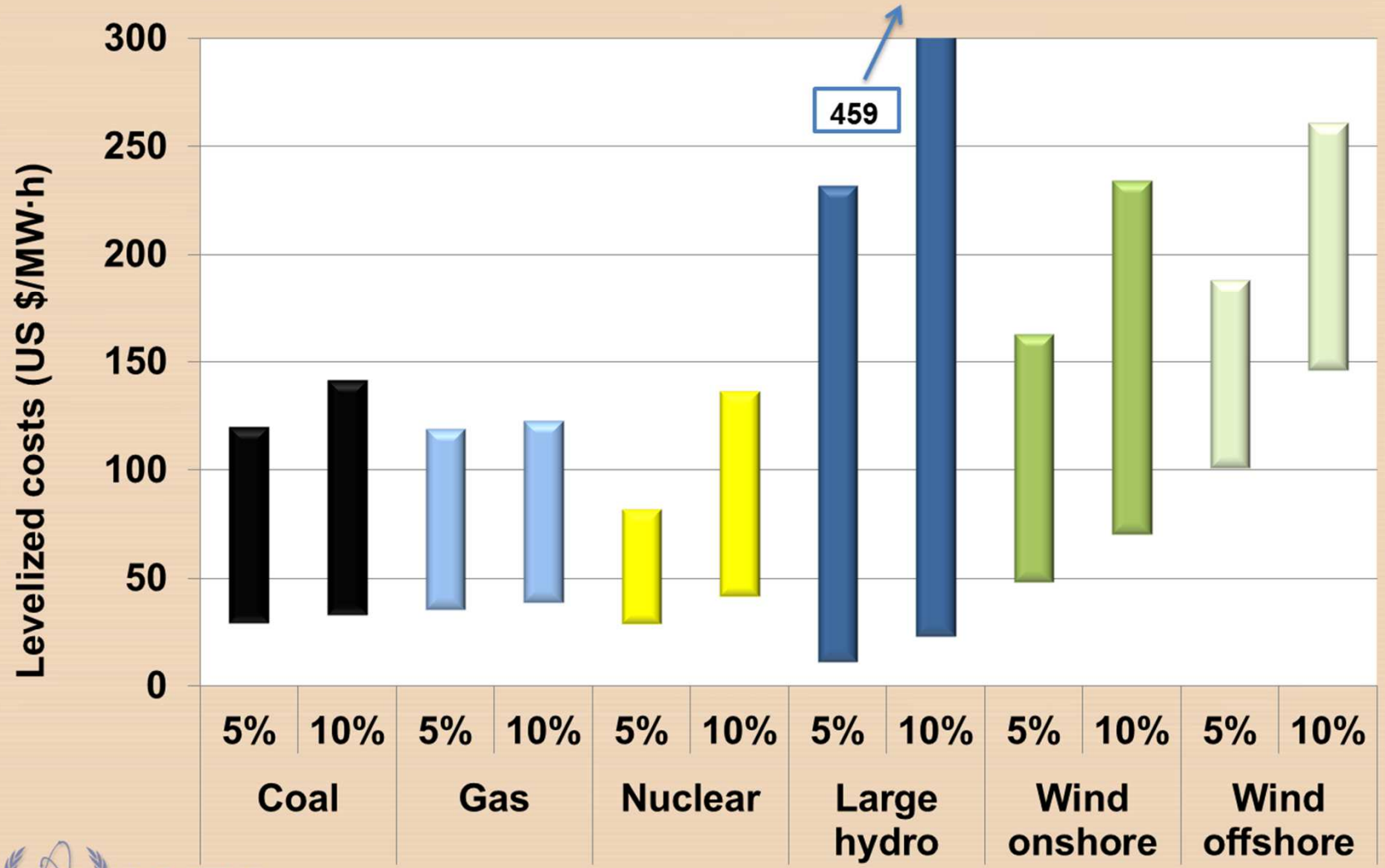
Source: Weisser, 2007

# Competitive costs

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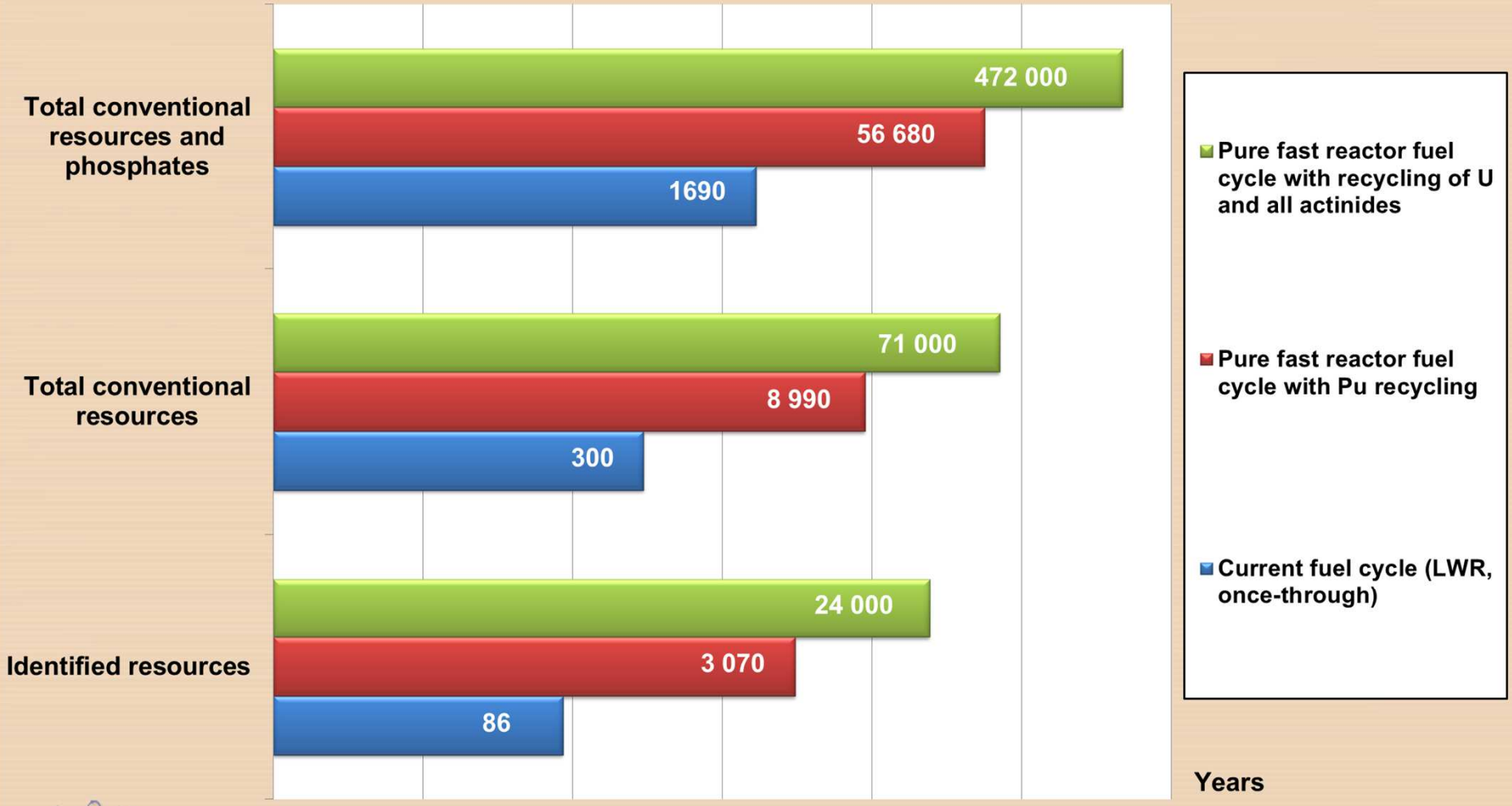
# Energy security: sufficient uranium available

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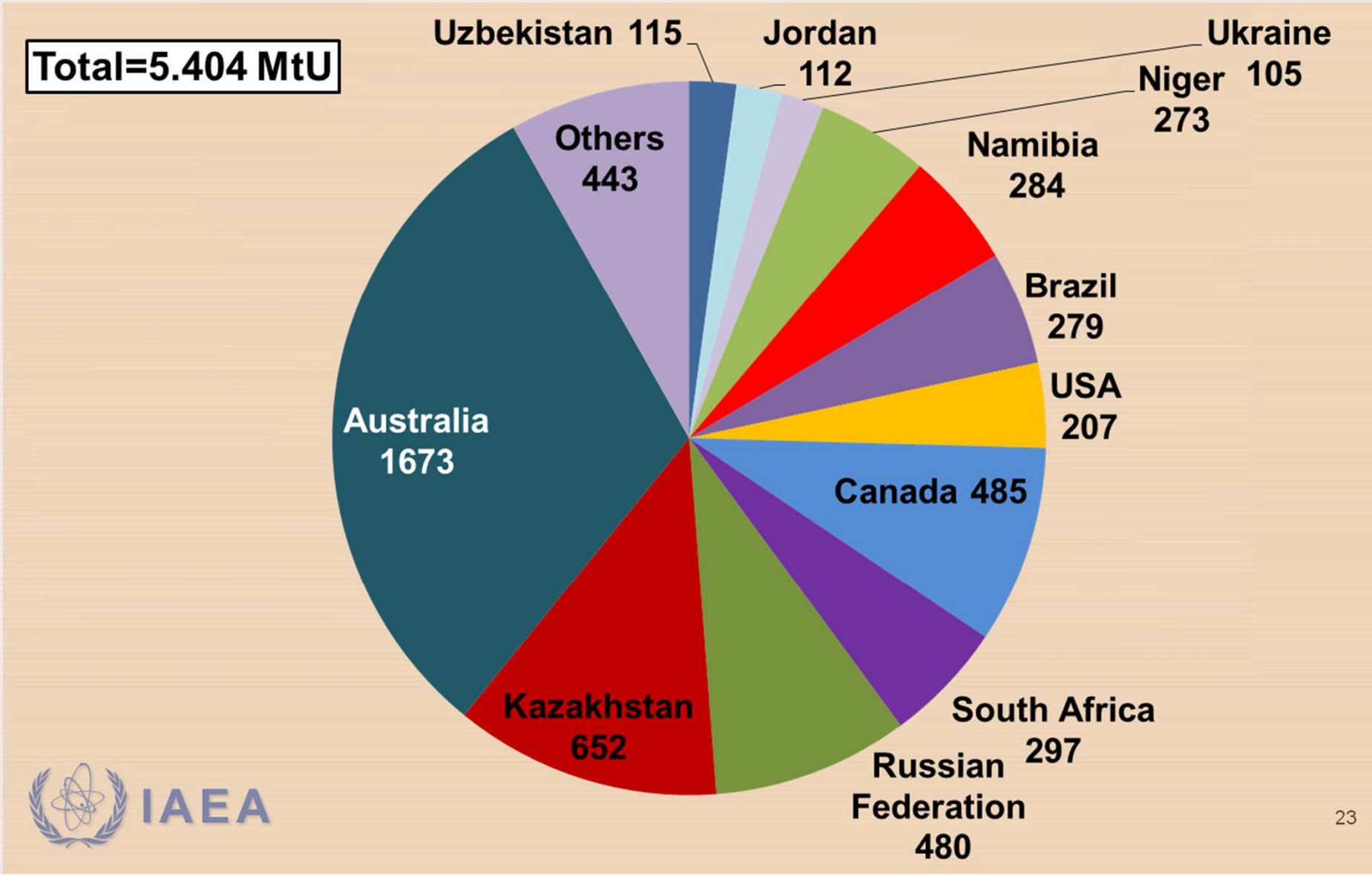
# Resources spread, fuel market competitive

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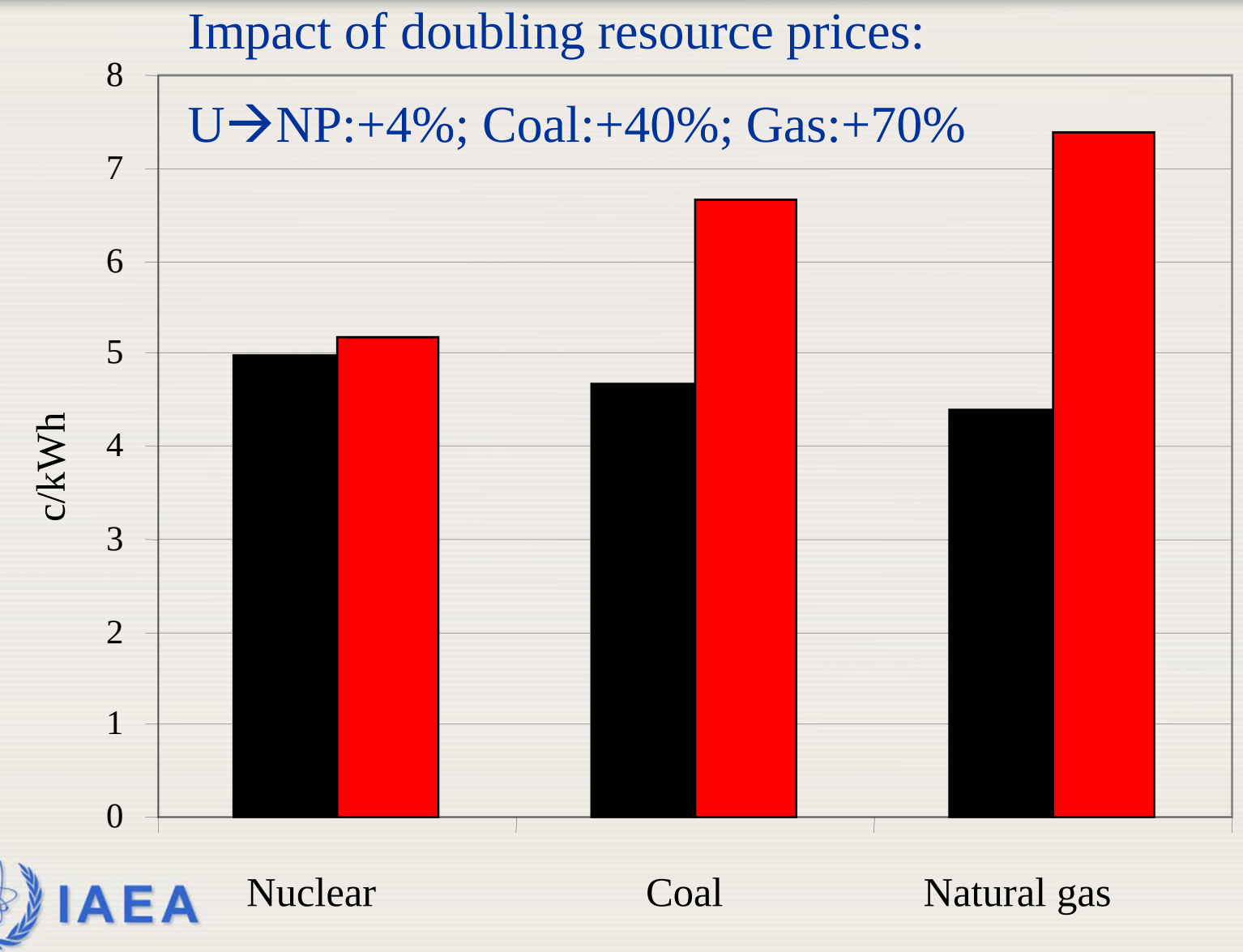
# Fuel cost a small fraction of electricity cost



# IAEA NUCLEAR POWER PROJECTIONS

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# IAEA nuclear power projections (RDS-1)

- Projections of future role of nuclear power are presented as LOW and HIGH estimates
- Projections are NOT predictions
- The RDS-1 estimates should be viewed as very general growth trends whose validity must be constantly subjected to critical review
  - Economic growth and structural economic change
  - Energy intensity
  - Technology performance and costs
  - Energy resource availability and future fuel prices
  - Energy policy and physical, environmental and economic constraints.

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# Key assumptions

- LOW reflects a continuation current trends and few changes in policies affecting nuclear power other than those already in the pipeline
- HIGH is much more optimistic, but still plausible and technically feasible and assumes that
  - the current financial and economic crises will be overcome in the not so distant future
  - past rates of economic growth and electricity demand, especially in the Far East, would essentially resume
  - the implementation of stringent policies globally targeted at mitigating climate change

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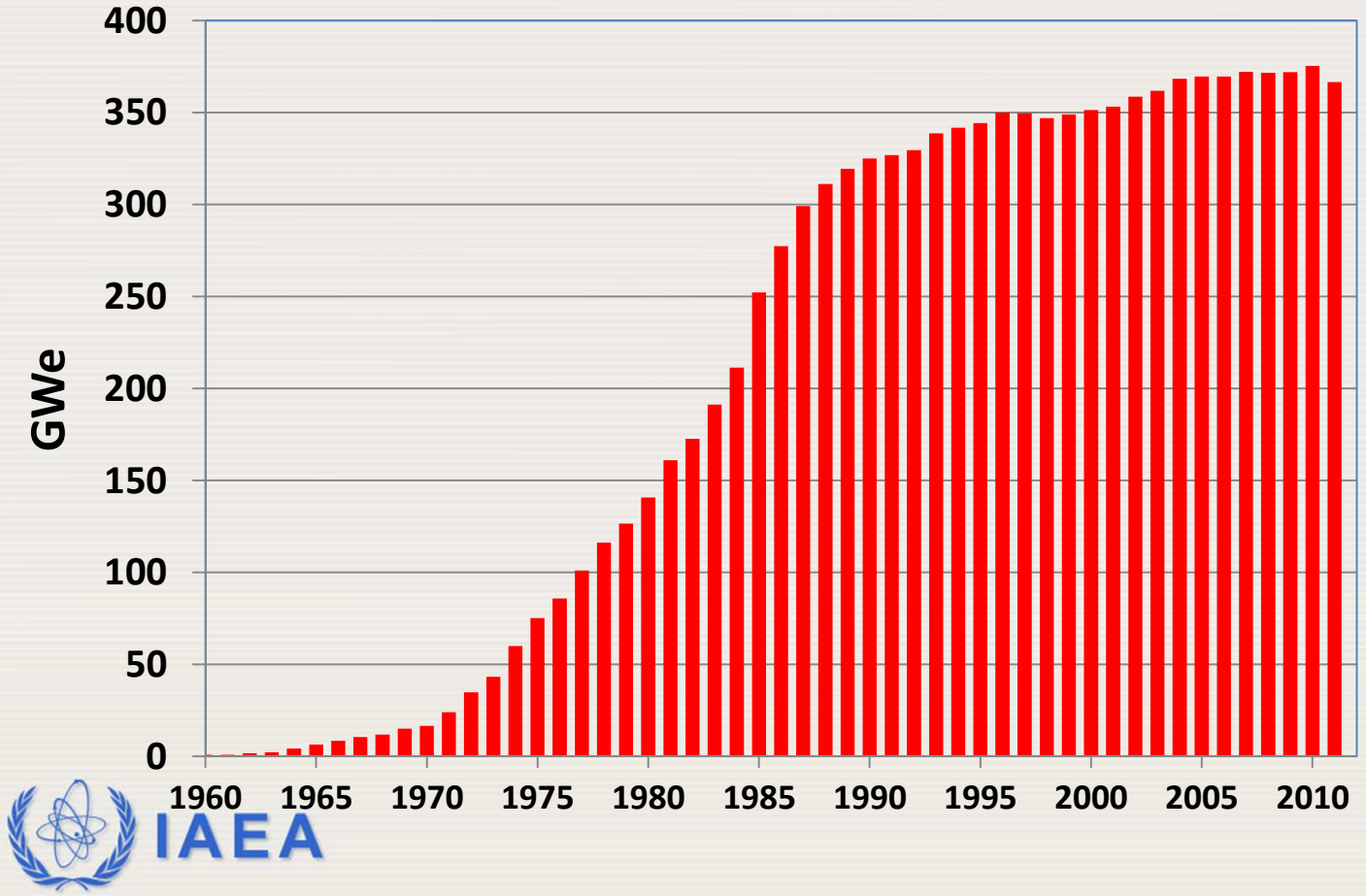
# Nuclear power today

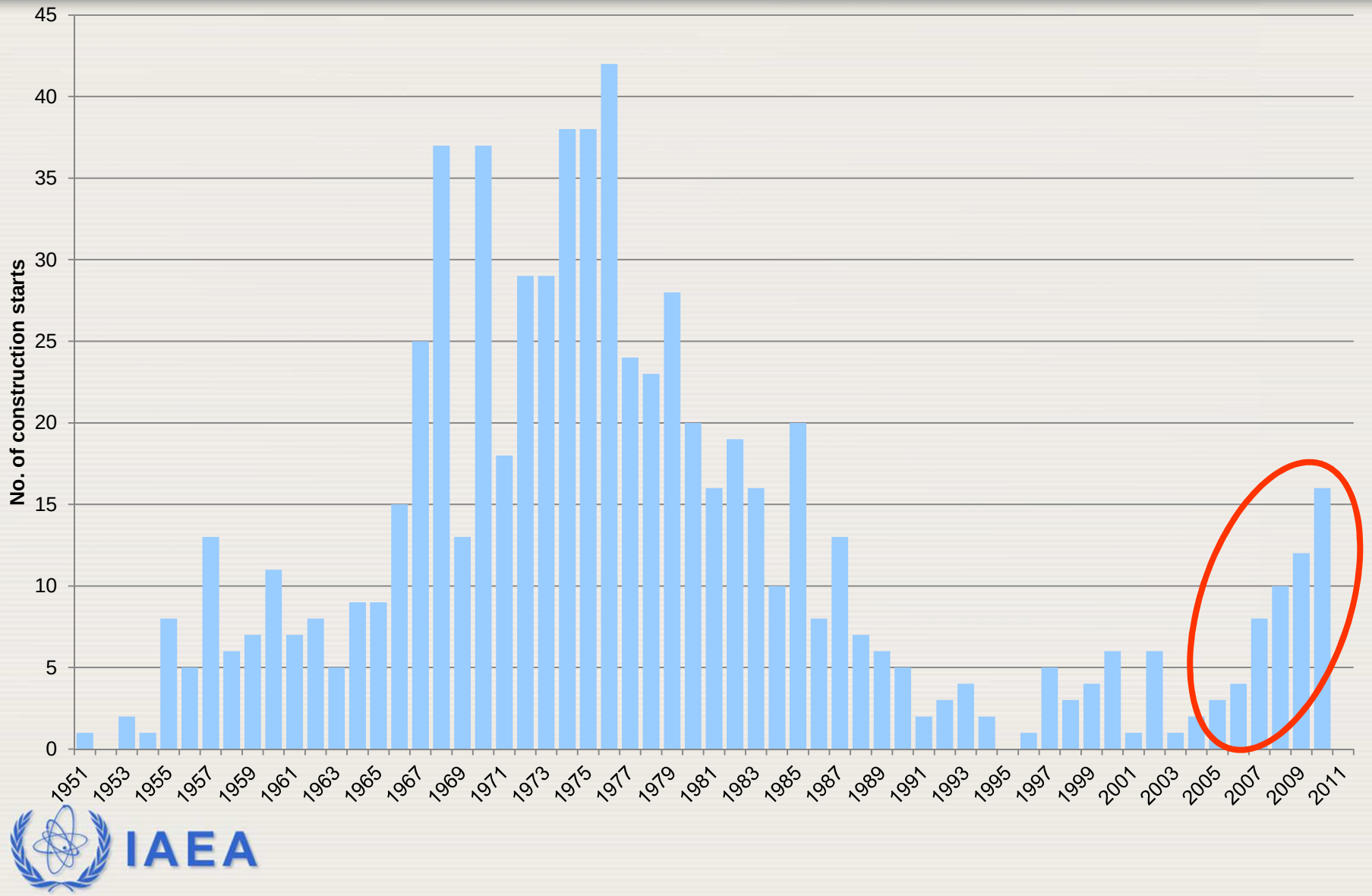
**On 21 November 2011, 443 nuclear power plants (NPPs) operated in 30 countries worldwide, with a total installed capacity of 366.6 GWe.**




**"Where does nuclear power go from here?"**

**65 NPPs under construction**

# Construction starts (1 Dec 2011)

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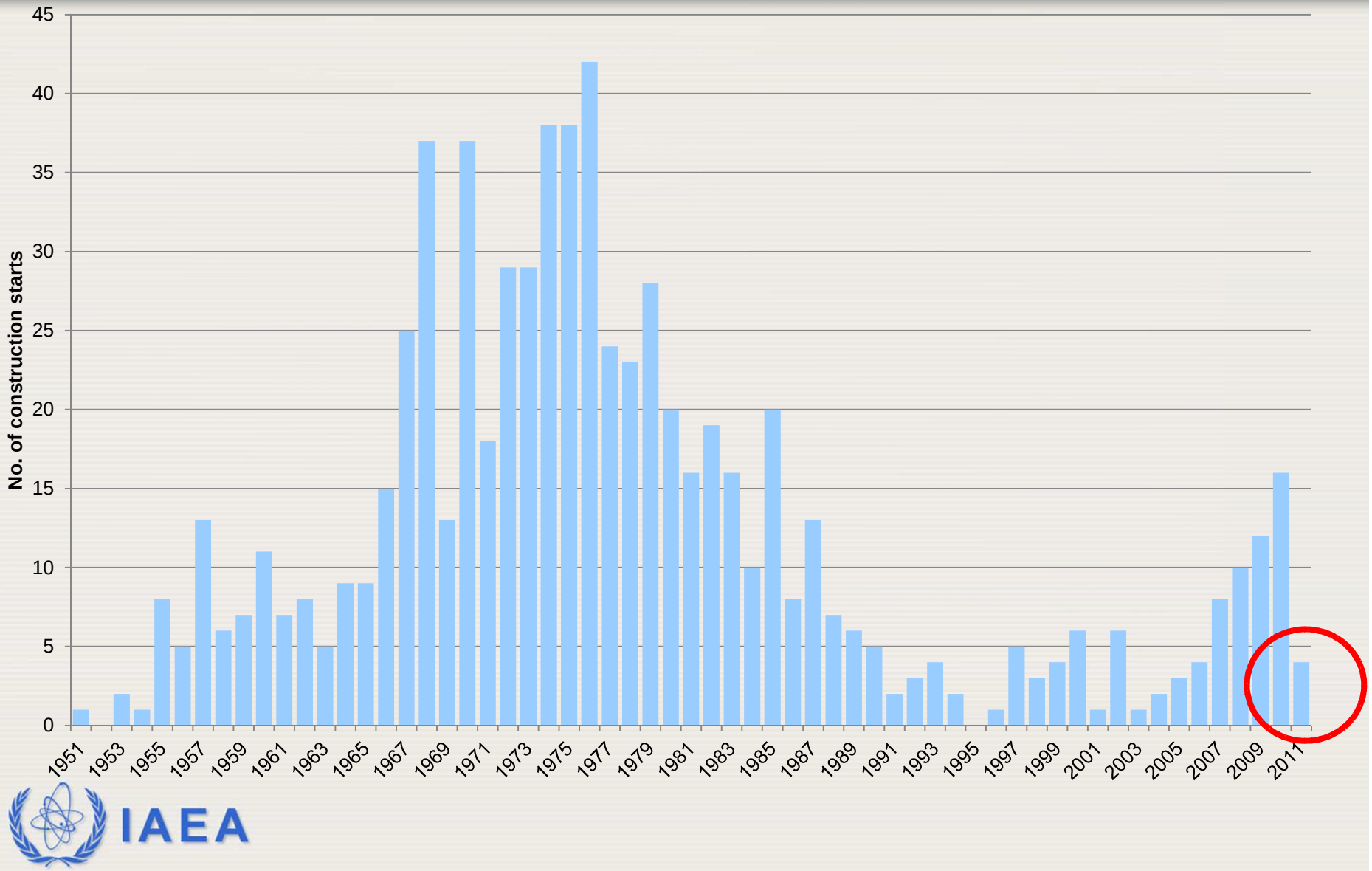
# Construction starts (1 Dec 2011)

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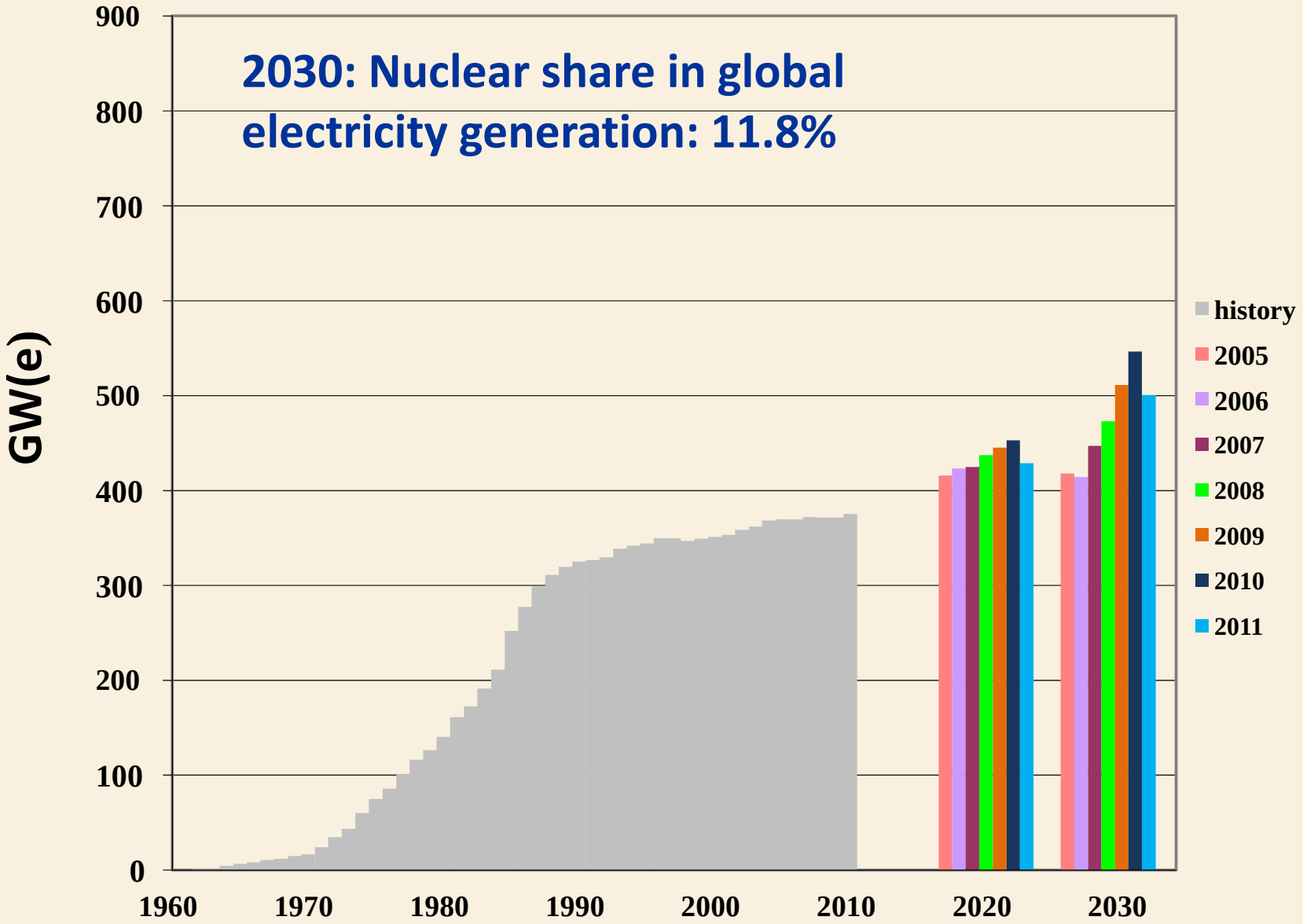
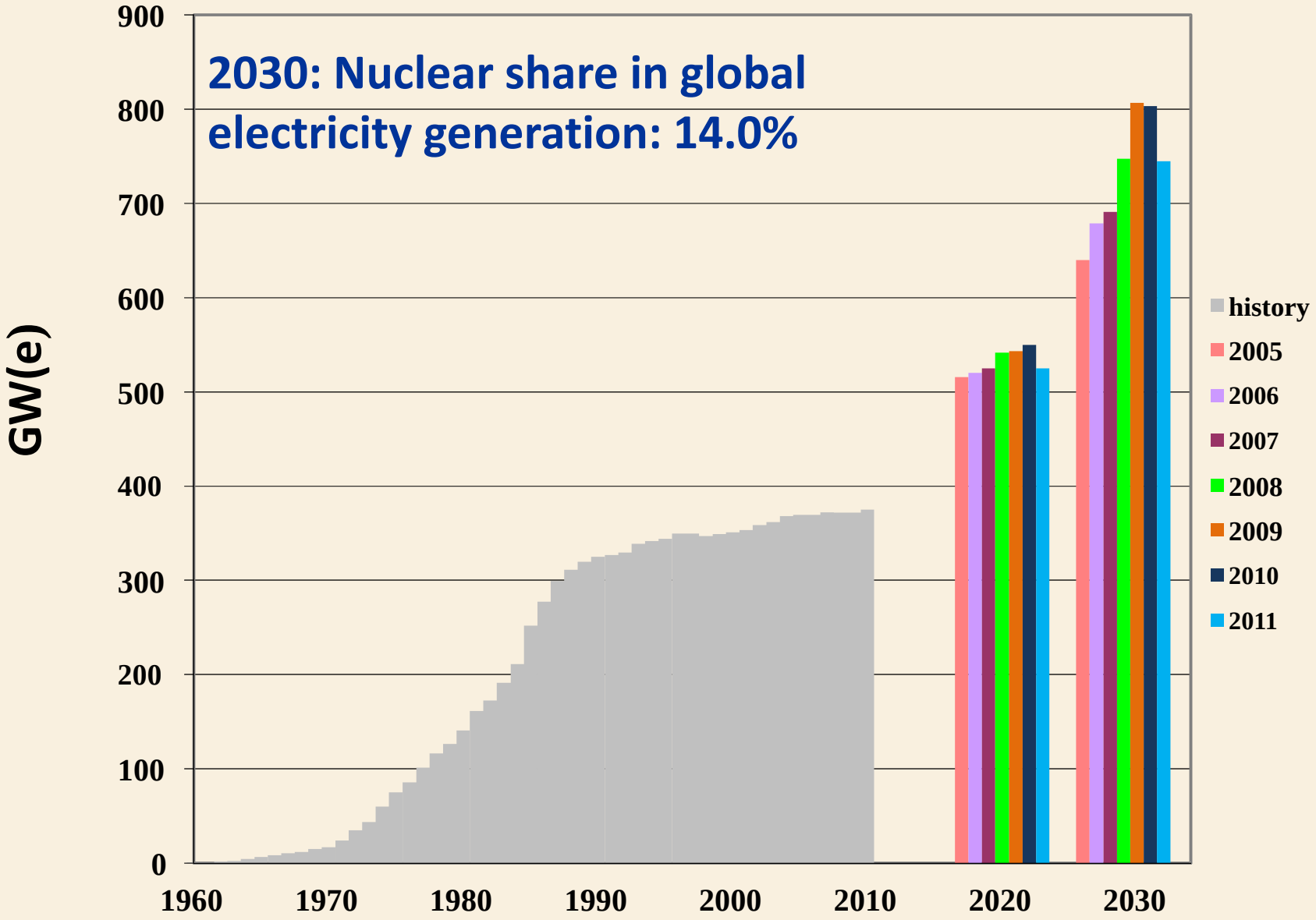
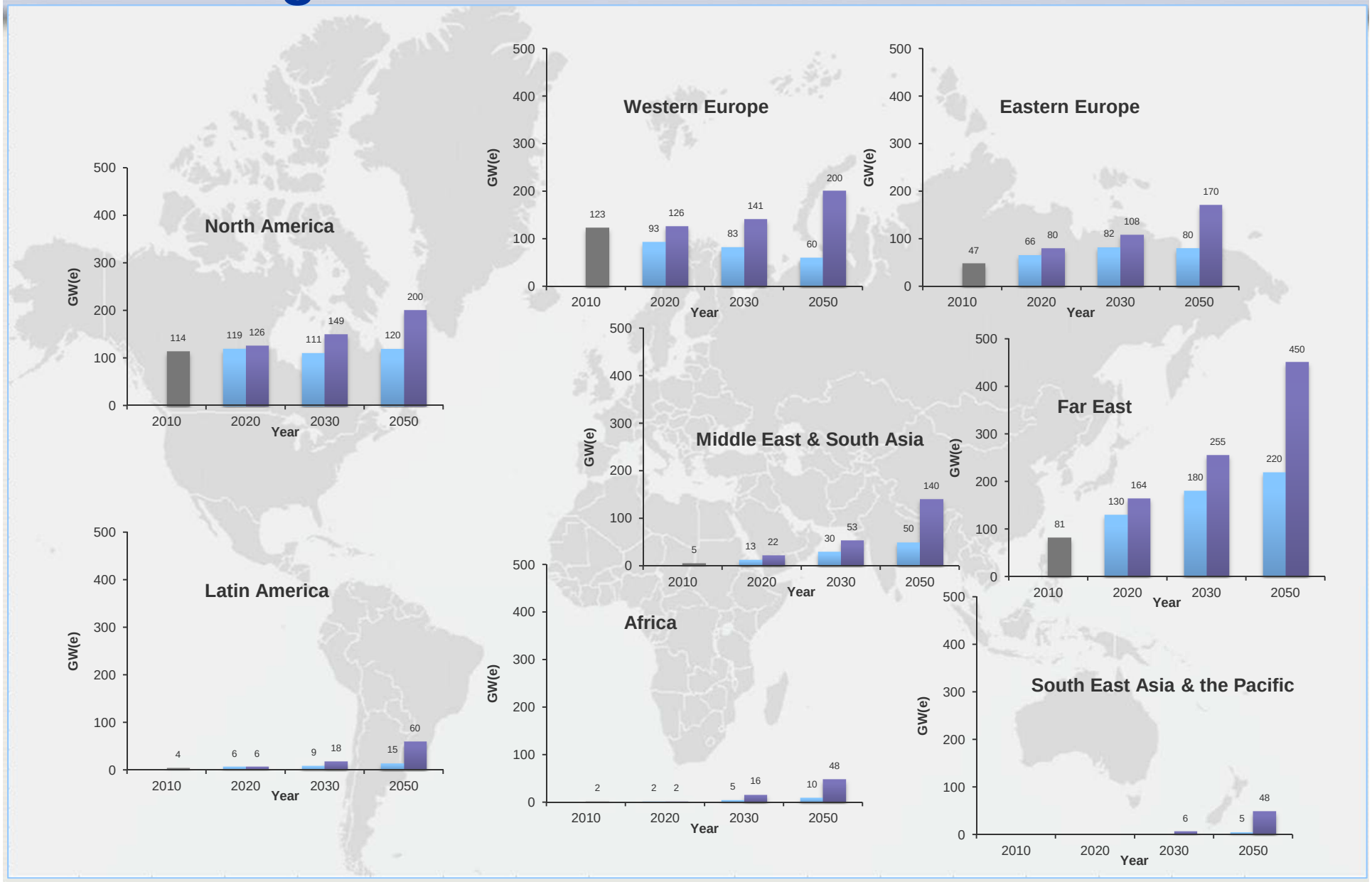
# IAEA – LOW projection



# IAEA – HIGH projection



# Nuclear power development in different world regions



# Conclusions

- With a few exceptions, the global future of nuclear power remains largely unchanged after Fukushima.
- The drivers in place that gave rise to the recent renaissance of nuclear power are still there: energy demand, climate, low-cost power, and energy security
- The latest projections (after Fukushima) of global nuclear generation are slightly lower than the projections from the previous few years, but still indicate increasing nuclear capacities for 2020 and 2030 relative to the present level

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