WNA 2013 Fuel Market Report

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Fuel Market Report Drafting Group

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Methodology

- The report follows previous practice by using information provided by WNA members, representing all aspects of the fuel cycle globally

- Questionnaires were sent to utilities and suppliers (both members and non-members) to improve the knowledge base

  - The requested data included:

    - For utilities: nuclear generation forecast, key parameters for reactor operation and fuel inventories
    - For suppliers: Production forecast for existing facilities as well as the planned new facilities

WNA Scenario Approach

Three demand scenarios:

- Reference case
- Upper case
- Lower case

Generic assumptions underlie each scenario –

- nuclear economics
- public acceptance
- impact of climate change debate
- electricity market structure

Scenarios to 2030

- Country-level judgements.
- Existing reactors – consideration of operating lives (technical, licensing and policy issues) – also power up-rates.
- New reactors - a) under construction

  b) already within planning & licensing

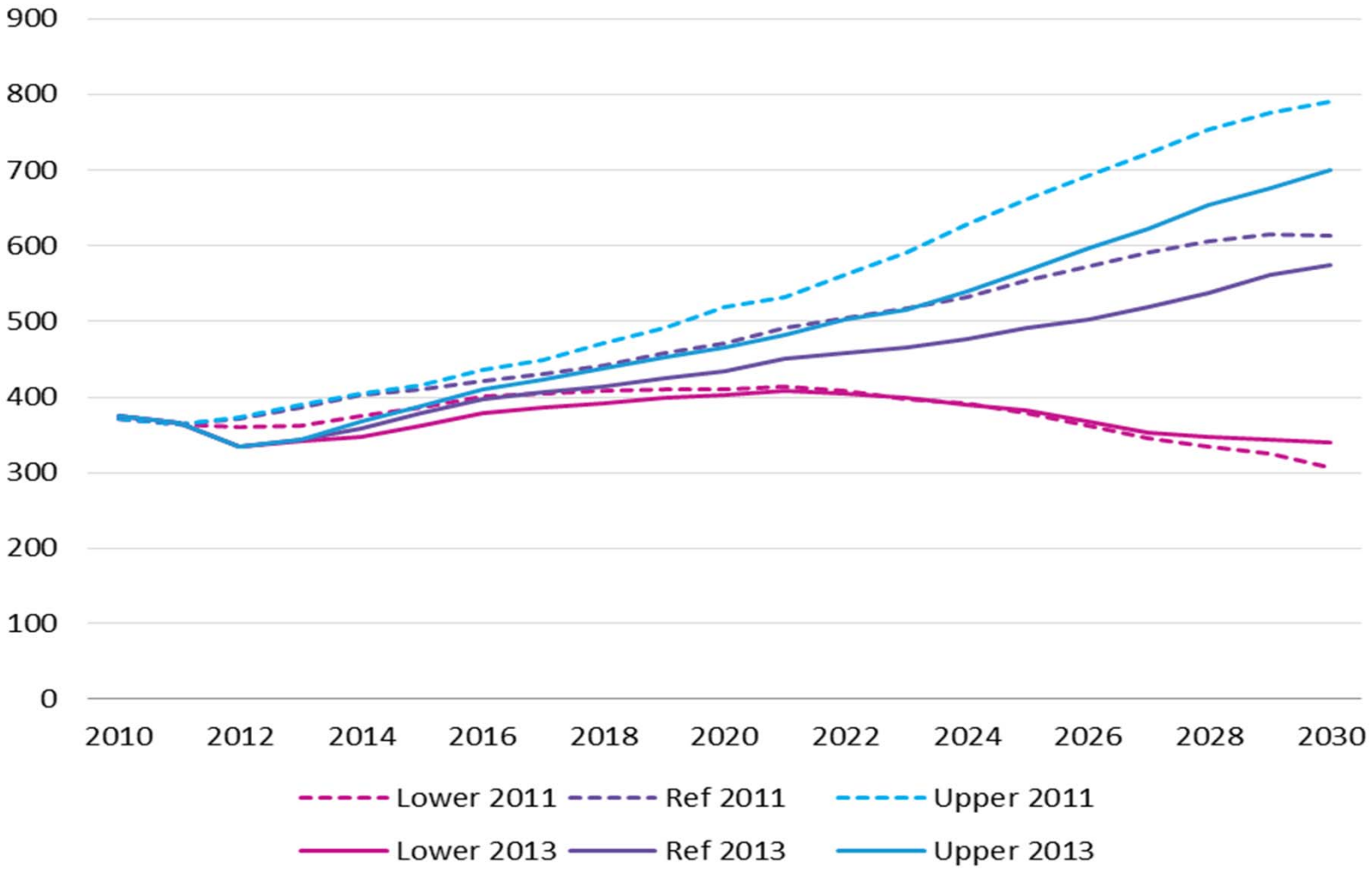
  c) proposed without firm commitment

Key Countries

- United States
- Japan
- United Kingdom, Eastern Europe
- China
- India
- Russia
- Korea
- Other developing countries (UAE, Turkey, Saudi Arabia)

World Nuclear Generating Capacity, GWe

2013 vs 2011 Fuel Market Report

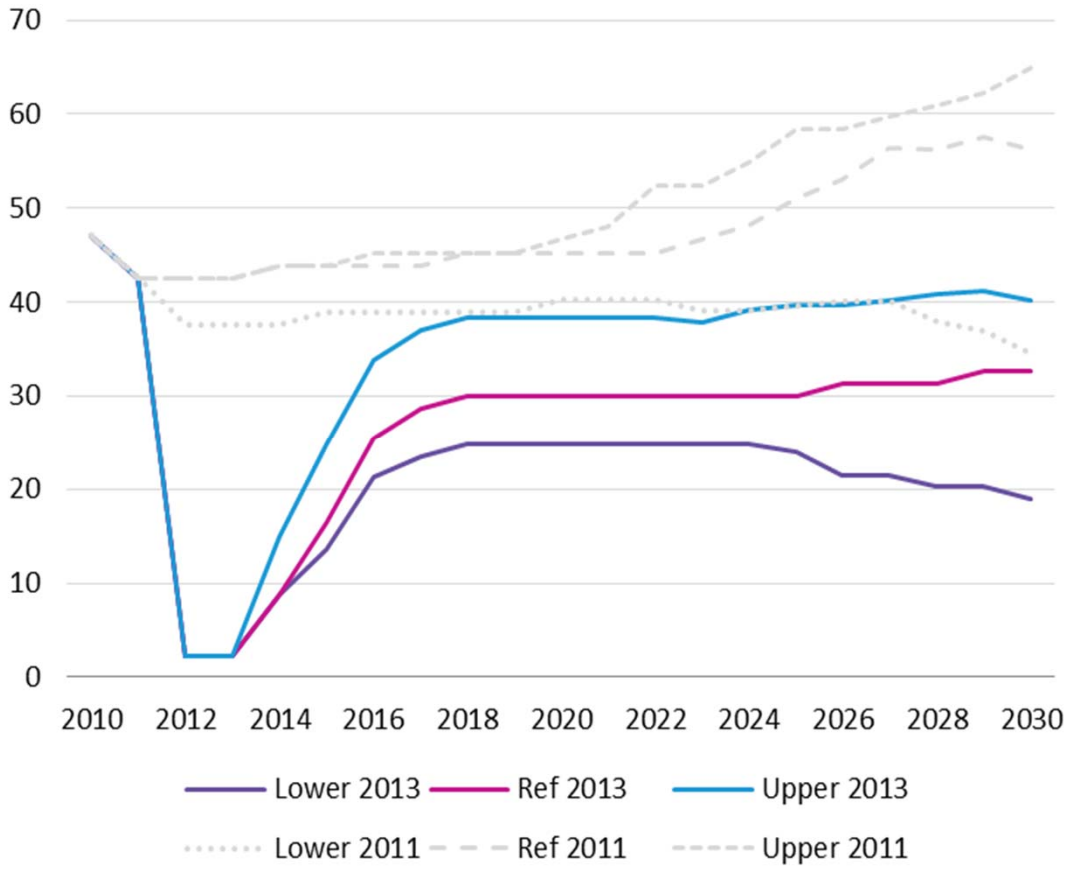


Assessment of Likely Japanese Reactor Restarts

2013 vs 2011 Report

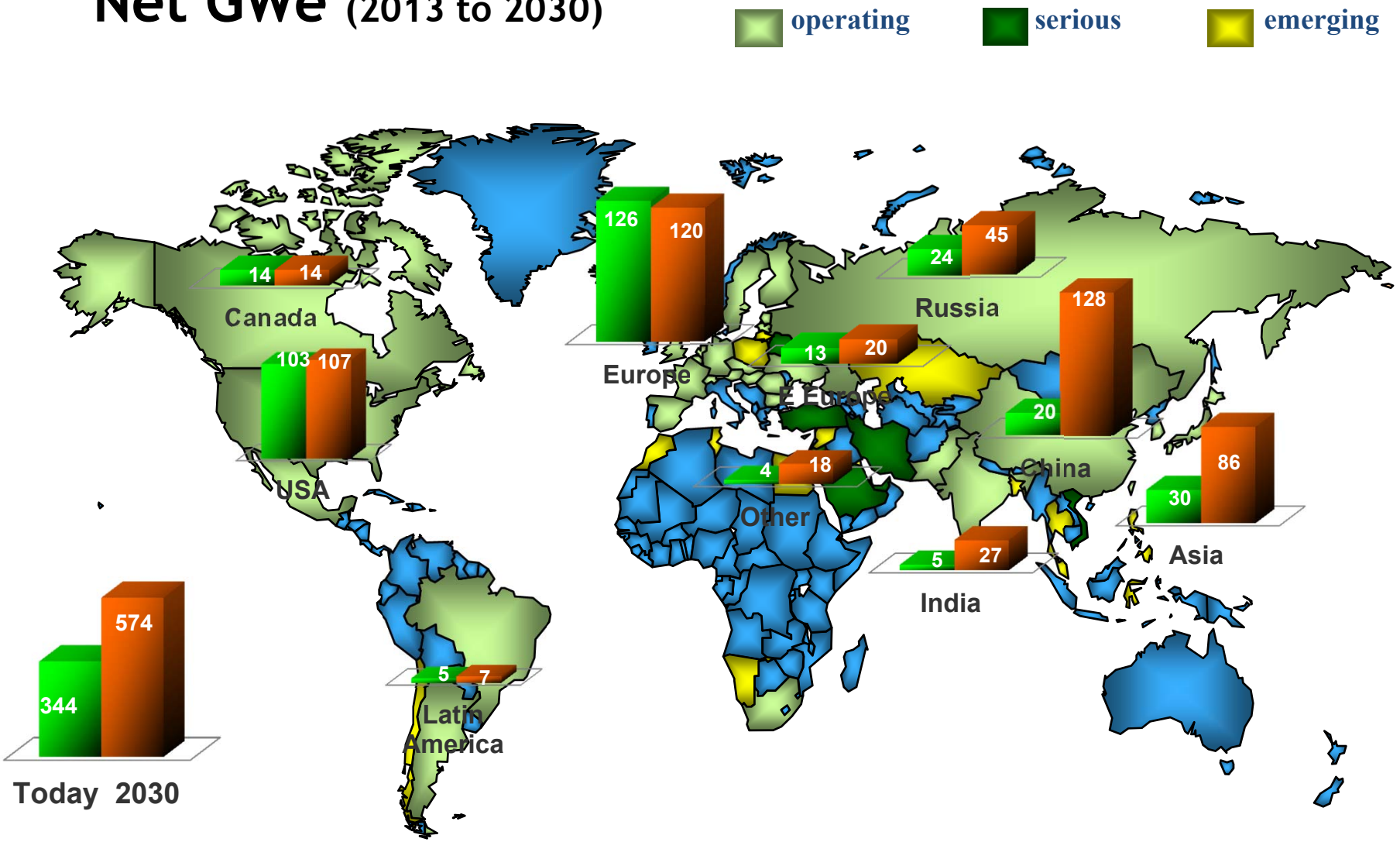
Reactor-by-reactor assessment:

- Age
- Size
- Type
- Location



Reference Case Capacity

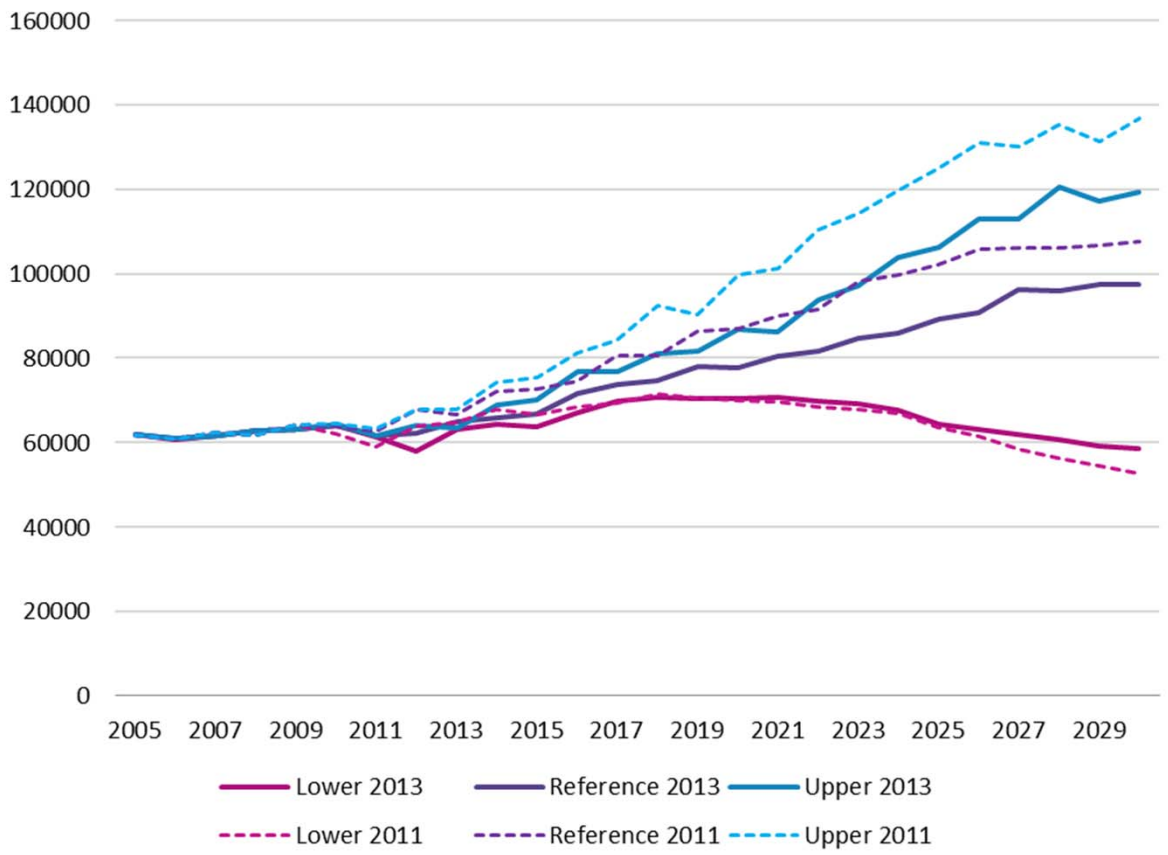
Net GWe (2013 to 2030)



Fuel Cycle & Reactor Operating Factors

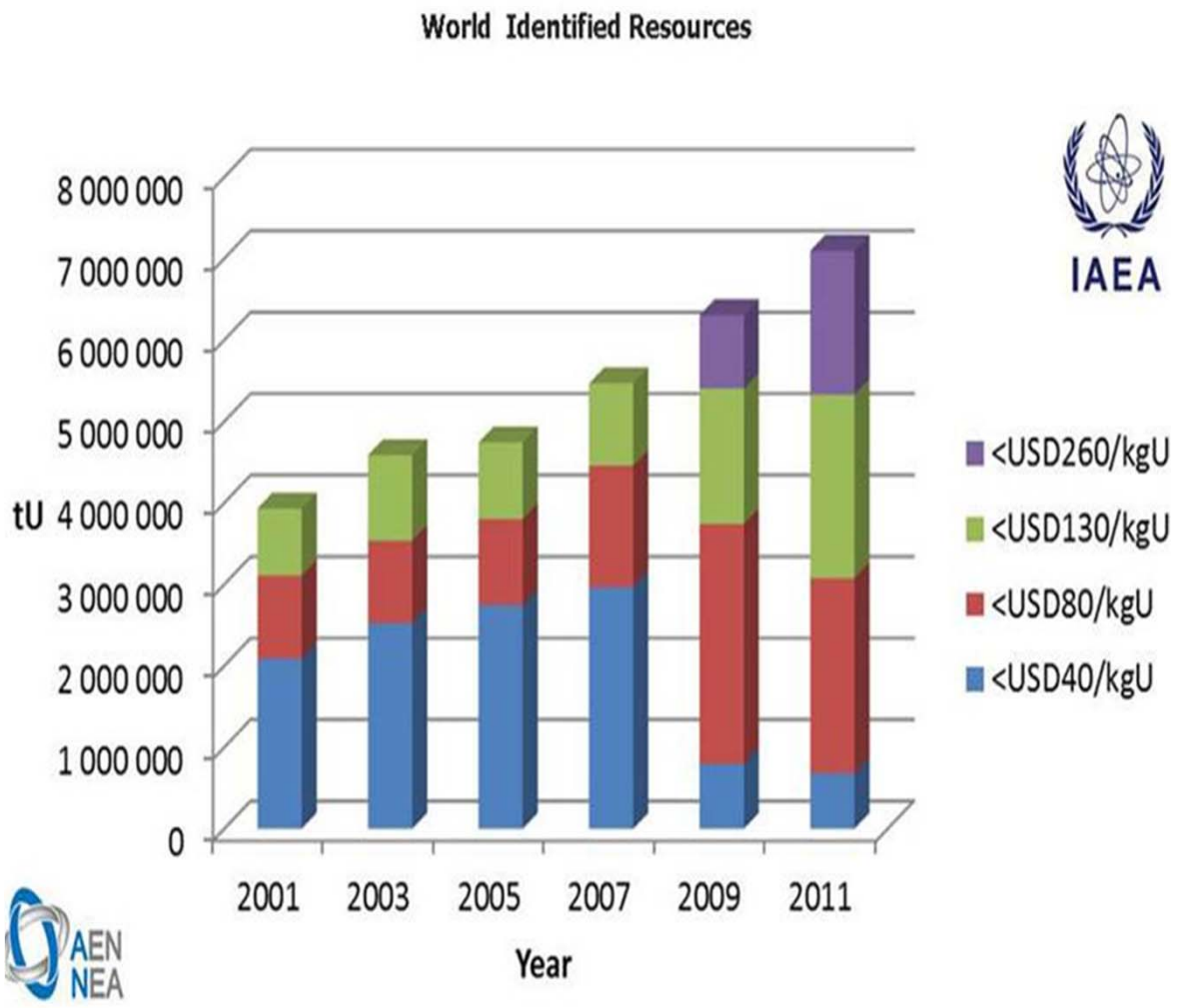
- Capacity factors – 10% worldwide increase in 1990s – still rising
- Enrichment level – rising slowly – up to 5% U-235
- Fuel burn-up – now rising above 50 GWd/tU
- Tails assay – 0.22% - possible substitution between uranium and enrichment depending on relative prices

World Uranium Requirements, tU 2011 vs 2009 Reports



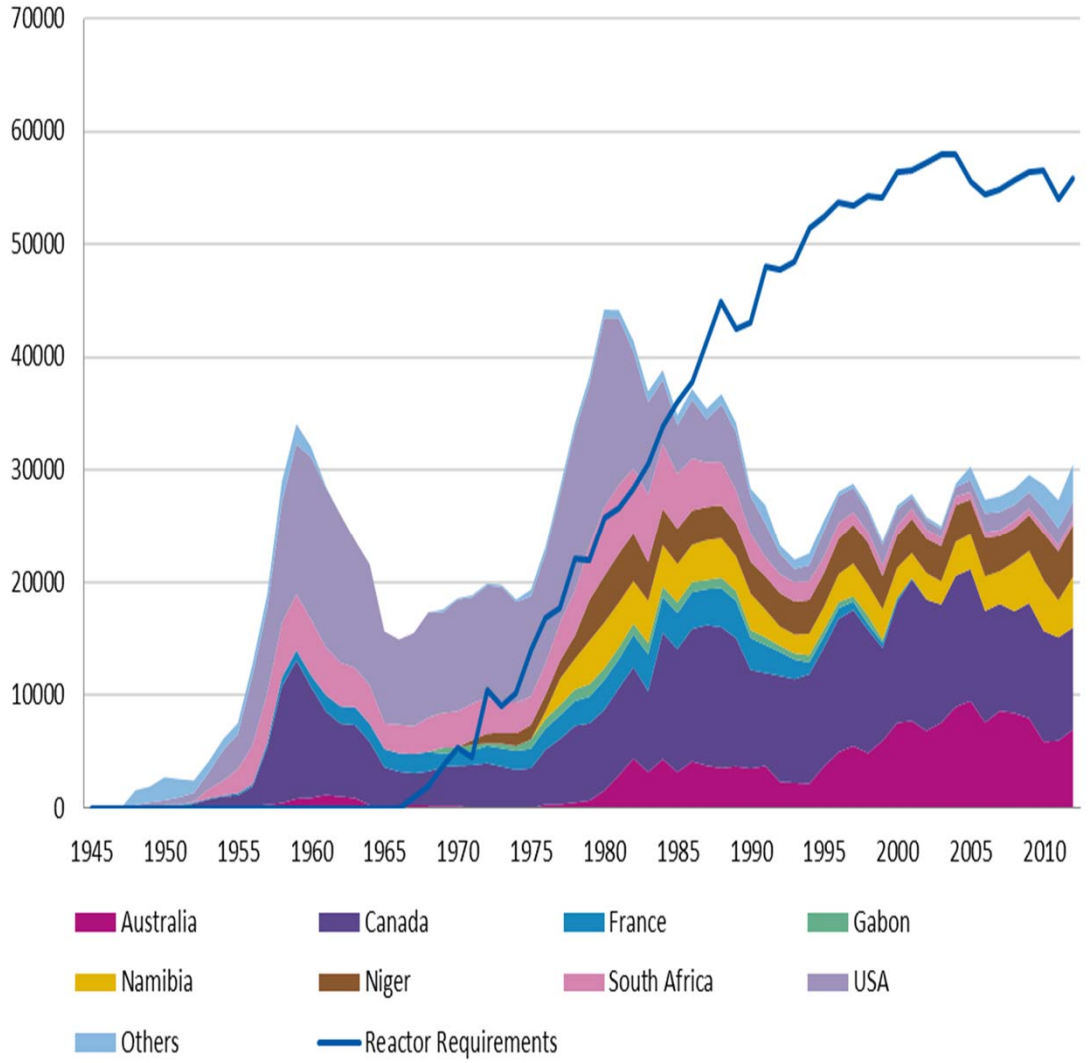
World Uranium Resources

- The amount of identified resources in the Red Book continues to increase rapidly
- The overall cost of mining these resources has increased
- Most of these resources are found in four countries (Australia, Kazakhstan, Russia, Canada)



Historical Uranium Production – Western World

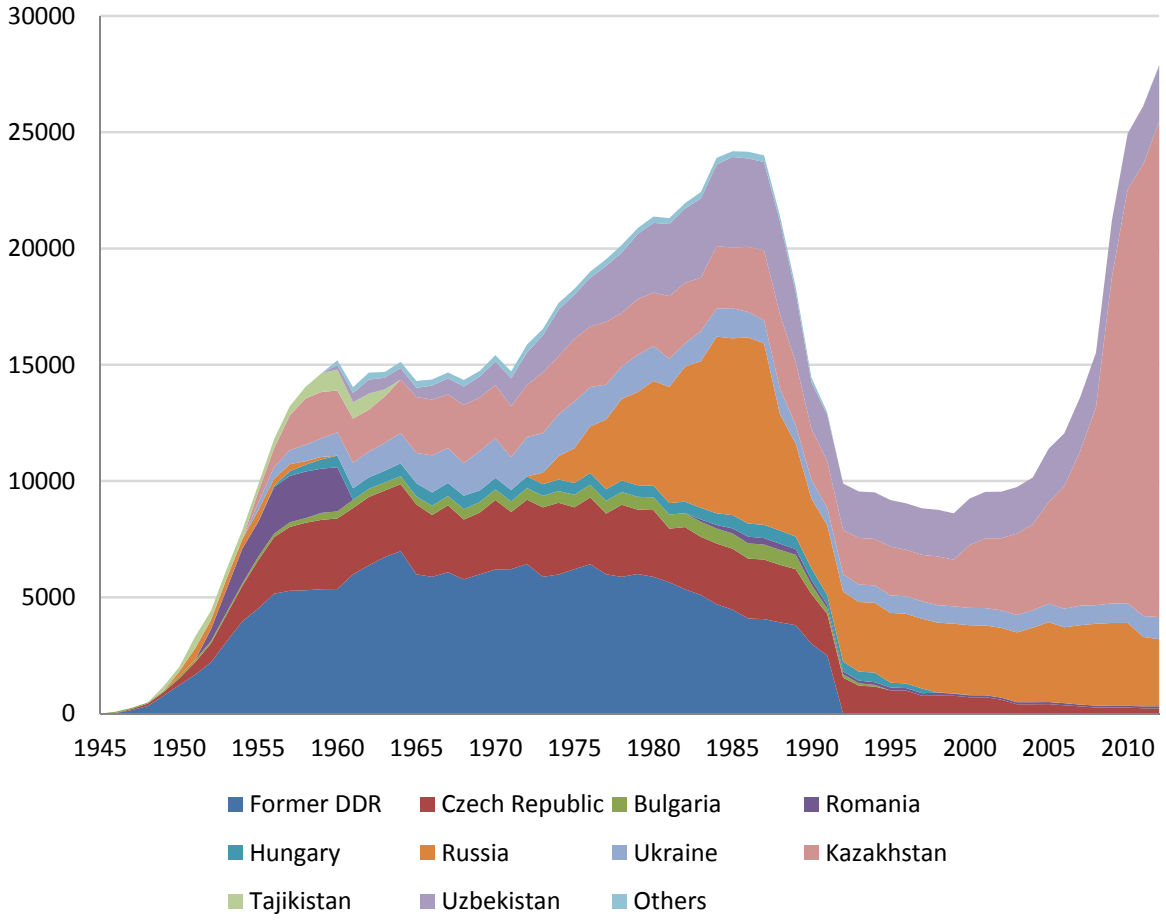
Production was substantially ahead of reactor requirements until 1985, but has since fallen below. Since 1985, requirements have exceeded production by over 450,000 tU. The difference was covered by inventories and other secondary sources



Historical Uranium Production – FSU and Eastern Europe

Reactor requirements for former Comecon are unreliable.

Kazakhstan accounts for most incremental primary supply globally since 2005.



Uranium production model assumptions

Five categories of production and potential production capacities:

Current capacities (mines already in operation)

Mines under development (mines for which development decisions have been made and development spending has commenced)

Planned Mines (mines for which a feasibility study has been completed, regulatory process and project financing are advanced, with a definite start-up date)

Prospective Mines (projects which have undergone preliminary feasibility study, regulatory approvals initiated and indicative start-up announced)

Supply Pipeline (uncategorised supply to meet future demand, eg, development of early stage projects, resurrection of cancelled or deferred projects, unexpected mine life extensions at existing operations)

Production model discount and delay factors

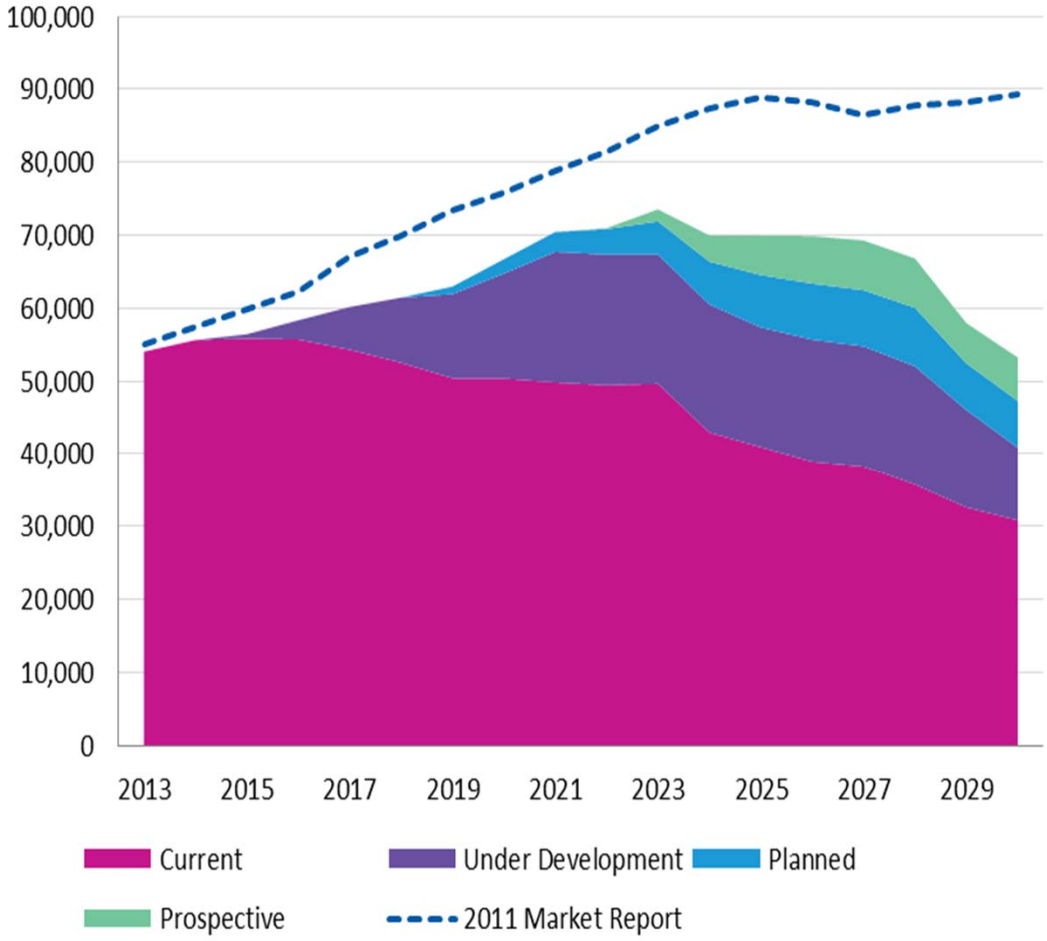
Three supply scenarios are developed and production capabilities are projected. Production capability for each mine assumes an expected percentage level of the production capacity as well as a 'delay' (in years) to start-up

	Reference		Upper		Lower	
	Delay	% Expected	Delay	% Expected	Delay	% Expected
Current Capacity*	0	90%	0	100%	0	85%
Mines Under Development	-2	90%	-1	90%	-2	70%
Planned Mines	-6	80%	-5	90%	-6	70%
Prospective Mines	-8	70%	-7	90%	-8	60%

Reference Scenario Primary Supply to 2030, tU

Existing capacity incorporates published statements of expected 2030 production (minus approx. 20ktU vs 2011 report)

Planned and prospective capacity changes reflect project cancellations/deferments (eg, Olympic Dam, Trekkopje) (minus approx. 15ktU in 2030 vs 2011 report)



Secondary Supply

Commercial inventories 2012 – 180,000 tU

- Utility inventories – 155,000 tU (pipeline material, strategic inventory for security of supply, non strategic – additional)
- Uranium producer inventories 10,000 tU
- Inventories of other fuel cycle participants 15,000 tU

Government inventories (US 46,000 -56,000 tU, Russia, other)

Fuel banks (US, France, UK, Russia)

Highly enriched uranium (US, Russia)

Recycling

- Reprocessed uranium (RepU)
- Plutonium – MOX fuel

Re-enrichment of depleted uranium (1,320,000 tU)

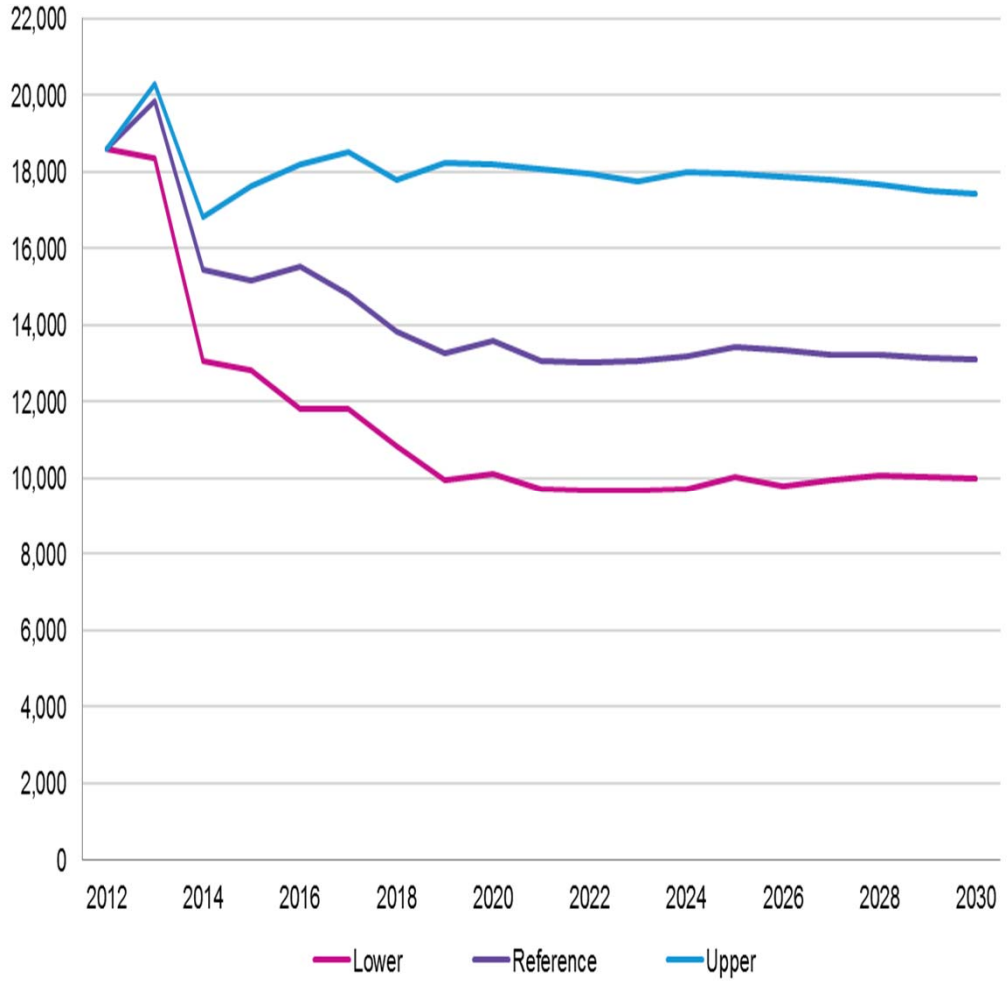
Secondary Supply

Secondary supply projections do not include commercial inventory changes.

The 2013 end of the US-Russia HEU Agreement results in nearly 8ktU/yr less supply.

Reference Scenario supply in 2030 is about 2ktU less than in the 2011 report.

Lower expected US DOE, ERU&MOX, Russian supply is largely offset by greater underfeeding.

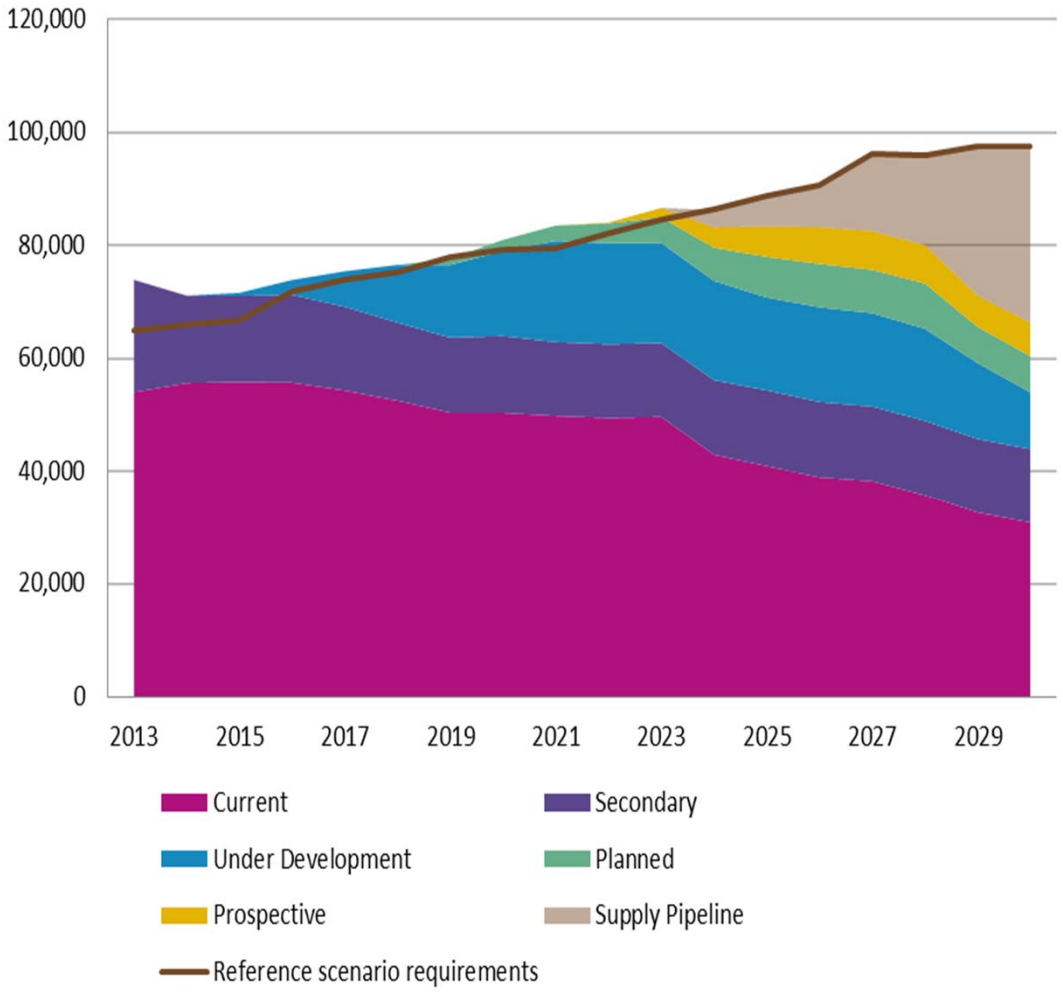


Reference Scenario Supply Demand Balance

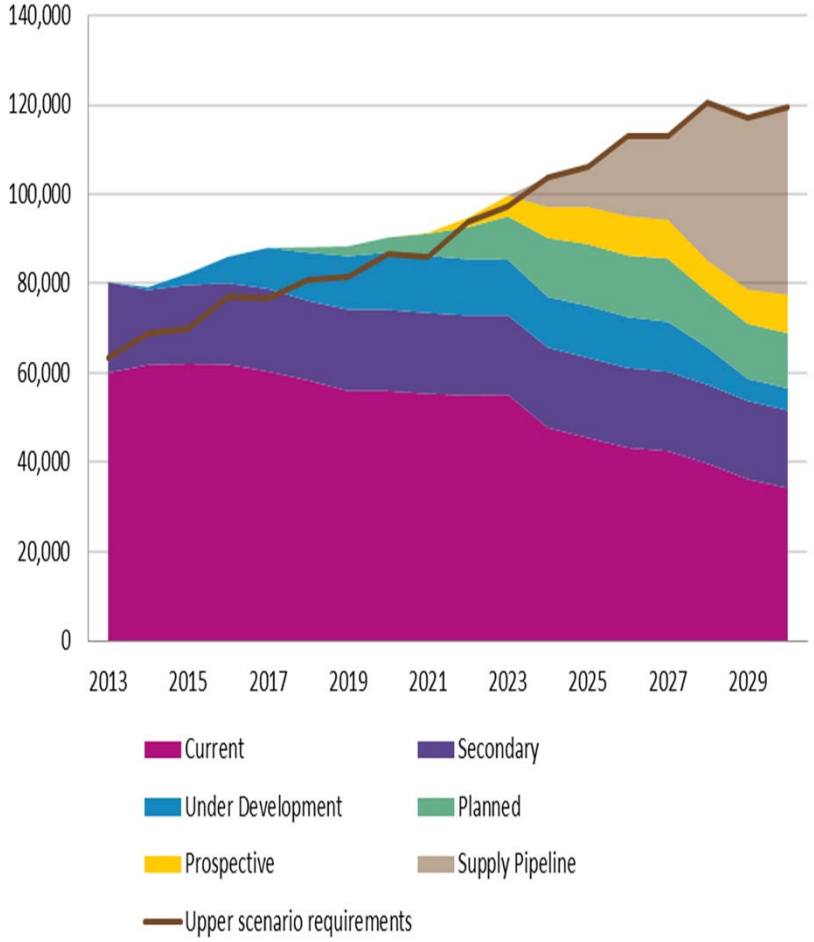
The greater uncertainty in the prospects for nuclear power have greatly impacted expectations of future mine development.

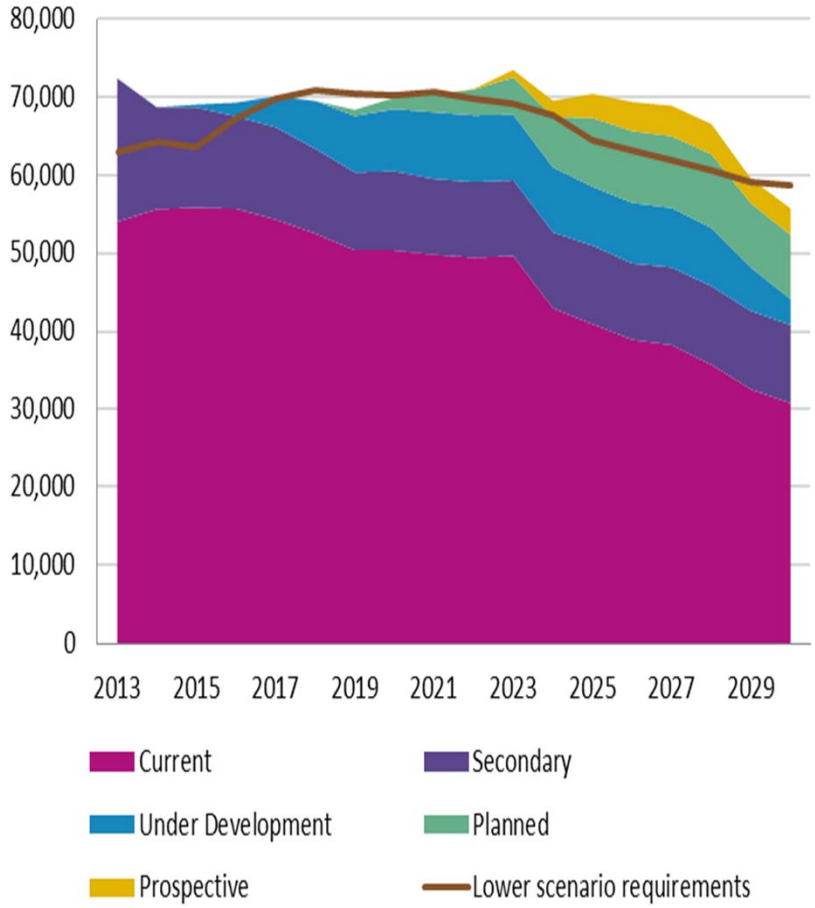
On current expectations for existing and future capacity, the market should remain balanced to about 2023.

After 2023, the depletion of existing mines and the reduced numbers of expected new mines results in the need for the 'Supply Pipeline'.



Upper and Lower Scenario Supply Demand Balances



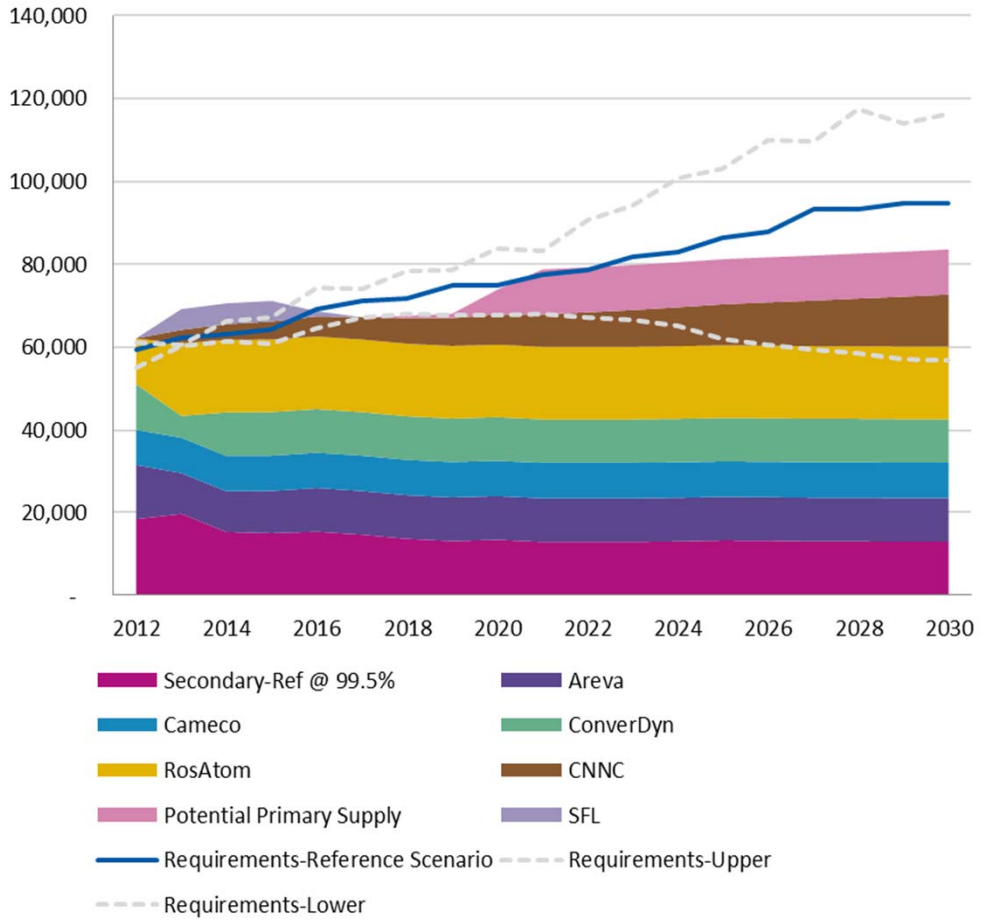


Reference Scenario Conversion Supply Demand Balance

Capacity is sufficient to meet conversion requirements till 2017.

Capacity is assumed in the projection to operate at 70% utilisation. The prospect of capacity shortfalls should incentivise converters to increase utilisation %.

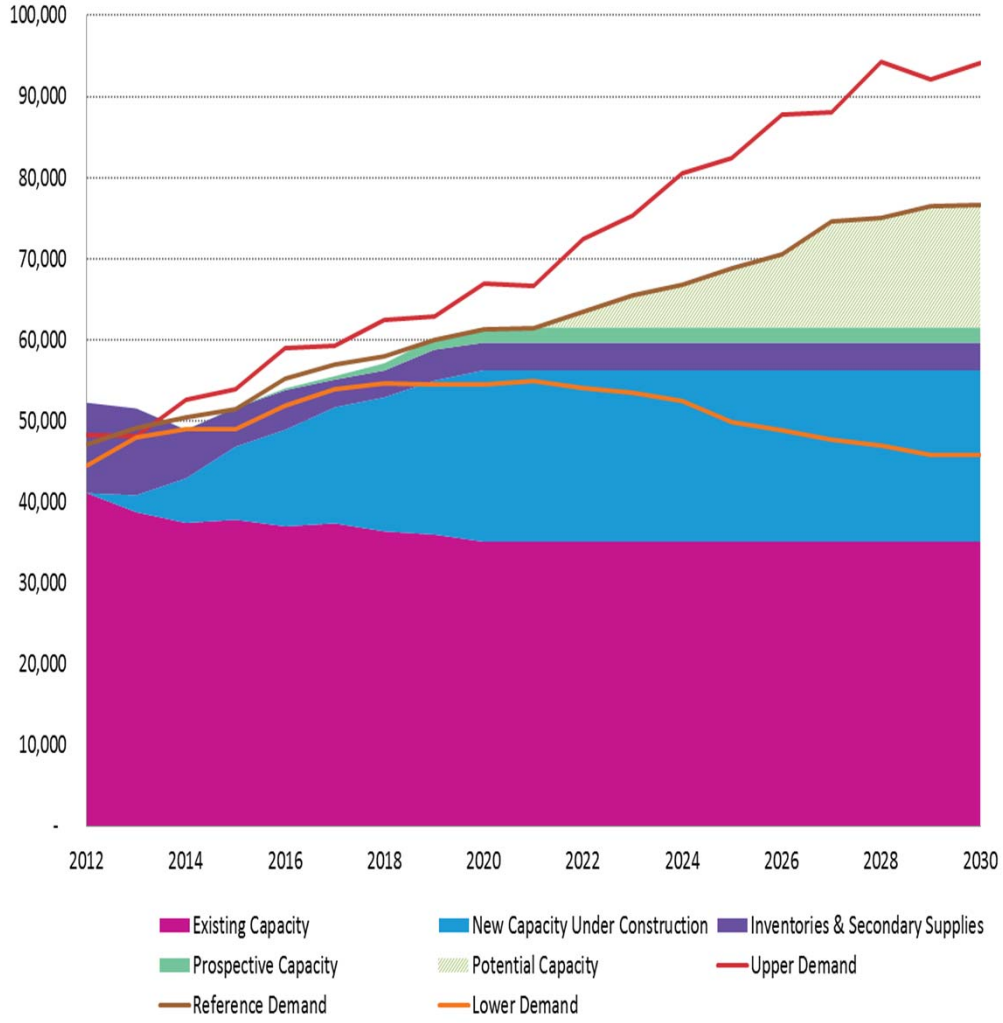
In the longer term, new capacity will be required.



Reference Scenario Enrichment Supply Demand Balance

In the light of capacity surplus, adjustment may be achieved by:

- Current centrifuge construction plans could be scaled back if desired.
- Surplus Russian capacity no longer required for HEU downblending faces trade restrictions and may be used for underfeeding.
- Potential exists too for underfeeding by Western enrichers.



Fuel Fabrication Supply Demand Balance

In the Western world fabrication capacity currently outweighs requirements by approximately 40%. Existing fuel fabrication capacity is more than sufficient to meet requirements throughout 2020 even for the high case.

Additional capacity can be brought on line faster than additional reactor capacity so the fabrication industry should be able to adjust in a timely fashion.

Conclusions

- WNA nuclear capacity projections have been revised downwards since the 2011 report. Nuclear capacity is still projected to increase at a faster rate than anytime since the 1980s to 574GW by 2030 in the reference scenario leading to projected uranium requirements of 97,000tU.
- Increased uranium market uncertainty has resulted in the cancellation and deferment of a number of mining projects. Our uranium production methodology has also become more objective. As a result, existing and expected capacity plus secondary supply will be insufficient on current plans to meet reference scenario requirements by about 2024.
- Conversion capacity will need to increase utilisation rates after 2017 in the reference scenario in order to meet requirements.
- Enrichment capacity will adjust to current surpluses; underfeeding is expected to increase.
- Fabrication capacity is expected to be sufficient to meet expected reactor requirements.
- Beyond 2030 Generation IV reactors could change future uranium requirements but not to a significant degree before 2050.