

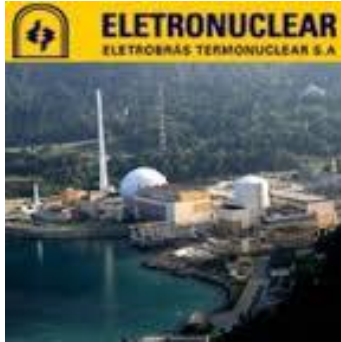


Uranium International Market – ENIN, Recife, Brazil

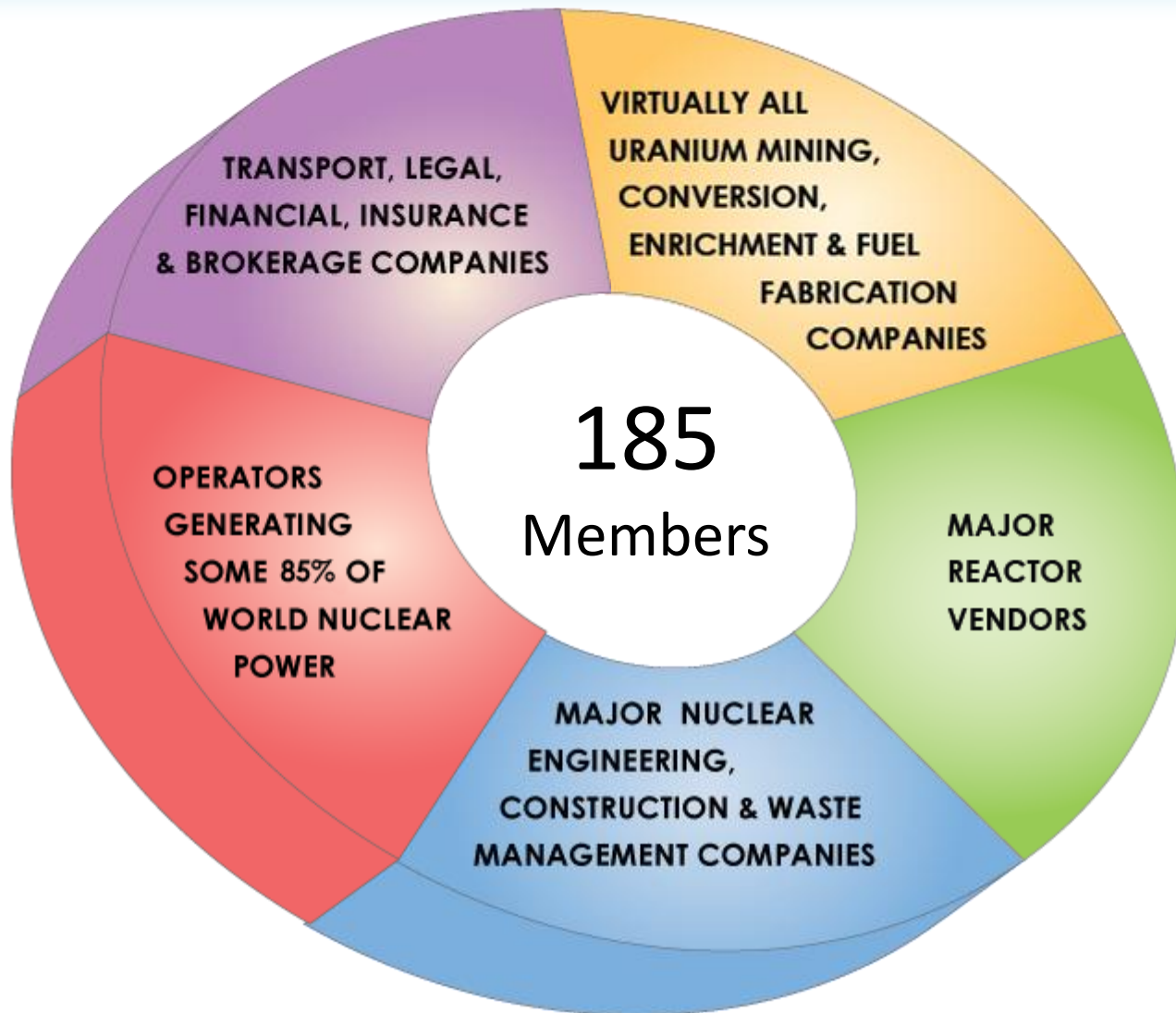
Serge Gorlin, Head of Industry Cooperation, WNA
gorlin@world-nuclear.org

25 November 2013

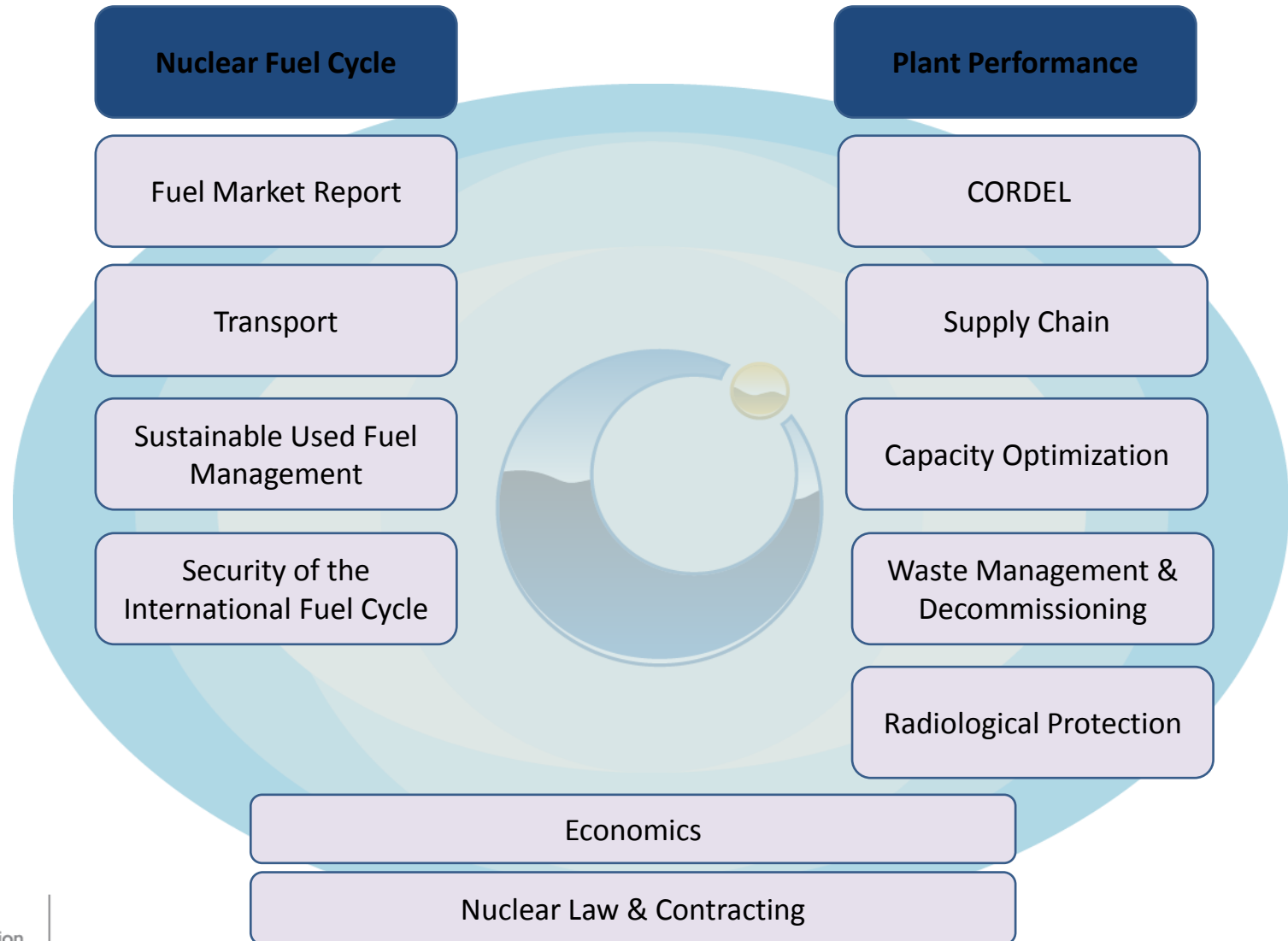
WNA links with Brazil



About the WNA



WNA Working Groups



Representation in Key International Forums



International Atomic Energy Agency



Nuclear Energy Agency of the OECD

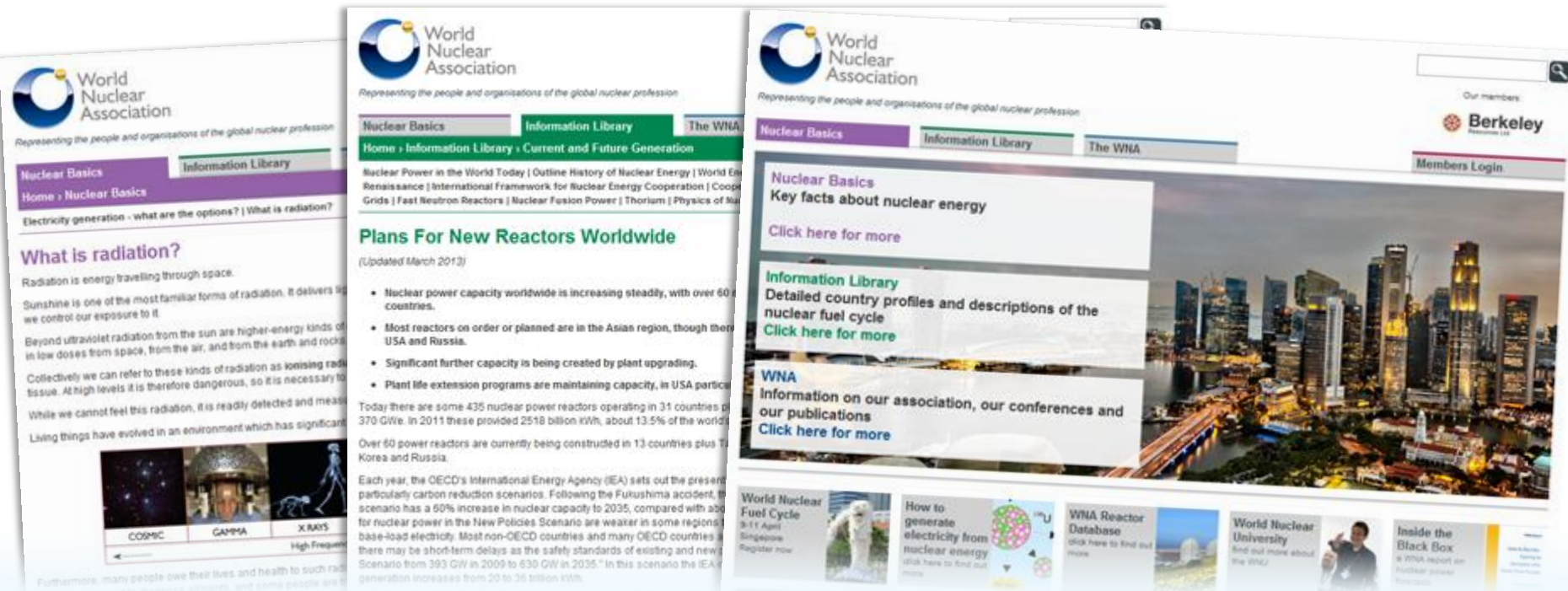


UN Framework Convention on Climate Change



International Commission on Radiological Protection

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Energy & Environment | New Nuclear | Regulation & Safety | Nuclear Policies

IAEA reviews Japan's nuclear restart

31 January 2012

A team of international nuclear safety experts has reviewed procedure to confirm the safety of its nuclear plants as dire conditions grip the country's power industry.

A mission to Japan lasting from 23 to 31 January saw a team of experts from the International Atomic Energy Agency (IAEA) and member states spend time with Japan's nuclear safety regulator which is conducting a two-stage assessment process to ensure plants have adequate protection against extreme external events.

While NISA continues its work to review the preliminary assessment supported by the Nuclear Safety Commission and the Japanese Energy Safety Organization, reactors are still closing one by one by mandatory safety inspections. Currently only three are in operation a potential operating fleet of 44, not counting the ten Fukushima and Daiichi units.

The preliminary report from the IAEA team to the Japanese government said NISA and nuclear operators had "promptly addressed" safety measures after the accident at Fukushima Daiichi. It contains a range of recommendations to NISA to ensure thorough and improvements in safety are made.



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Privatisation of Russian state nuclear giant

02 February 2012

Having spent five years combining its nuclear power, engineering and research enterprises into the single entity of Rosatom, the Russian government now sees privatisation of the firm as part of a plan for industrial modernisation.

Rosatom is just one of several vertically integrated state holding companies Russia established to "discourage the decline of the more intellectual sectors of national industry" in the post-Soviet era, wrote Vladimir Putin in the *Vedomosti* newspaper on 30 January.

Currently in the role of prime minister, Putin served the maximum two terms as president from 2000 to 2008, and is now campaigning to return to that position in March 2012. He used the lengthy article to set out a range of government targets for Russia to develop its infrastructure, innovation and private enterprise while curbing corruption and improving the legal and investment environment for business.



Vladimir Putin

Speaking of sectors such as aerospace, shipbuilding and nuclear energy Putin wrote: "We had to consolidate those assets which were officially government-owned but managed disjointedly, and which had lost all links with their respective research and design centres."

Government efforts "were focused on restoring Russia's ability to compete in those sectors which involved only a few players on the global market," Putin wrote, emphasising that the "expansion of state capitalism" only occurred because there was no private initiative in those sectors. He stressed the scale of state action had no bearing on "our work to accumulate and restructure assets and get them ready for sale."



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Approval for first nuclear new build in America

09 February 2012

American safety regulators gave the go-ahead today for the construction of two new nuclear power reactors.

The vote by the five-member commission brought to an end a regulatory process lasting almost four years that confirmed the safety of building two Westinghouse AP1000 reactors at the Vogtle site in Georgia. It is the first combined construction and operating licence issued by the US Nuclear Regulatory Commission (NRC).



Workers stand in the excavated and waterproofed space for Vogtle 3's reactor building (Image: Southern)

The review work of the NRC staff was celebrated by the commissioners in a confirmatory hearing today. Four commissioners voted to grant the licence, while chairman Gregory Jazcko abstained. He had wanted the recommendations developed in response to the Fukushima accident in Japan last year and said he "could not support issuing this licence as if Fukushima had not happened." The other commissioners spoke to Fukushima individually or collectively regarding the events of 11 March 2011 and the ensuing accident at Fukushima. She added that NRC staff did not recommend and did not support Jazcko's idea of a condition being attached to the licence. "In 2011, we found a condition that was not supported by the staff."

Related Stories

- Westinghouse secures AP1000 approval
- Toshiba ships Vogtle 3 condenser
- NRC gives planned Vogtle units environmental OK
- Georgia Power accepts Vogtle loan guarantee
- First piece of Vogtle financing
- Loan guarantees offered for new Vogtle units
- Southern receives ESP for Vogtle site
- Georgia PSC approves new Vogtle units

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Nuclear Fuel Market & Supply Chain

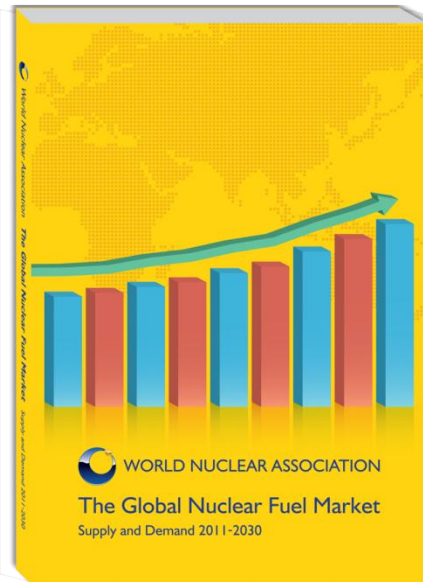


Table 5.12: Prospective world uranium supply

Region	2010	2015	2020	2030
Australia	7,824	7,824	7,824	7,824
Current Capacity	-	-	-	-
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
Canada	8,890	8,844	8,890	8,844
Current Capacity	-	-	-	-
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
Africa	7,302	8,065	7,302	8,065
Current Capacity	7,302	7,741	7,302	7,741
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
US	1,862	1,971	1,862	1,971
Current Capacity	1,875	1,871	1,875	1,871
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
South America	12,513	16,361	12,513	16,361
Current Capacity	11,252	14,051	11,252	14,051
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
Russia	3,250	3,171	3,250	3,171
Current Capacity	-	-	-	-
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
Uzbekistan	2,378	2,611	2,378	2,611
Current Capacity	2,042	2,042	2,042	2,042
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
All Other	2,567	2,721	2,567	2,721
Current Capacity	-	-	-	-
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-
Total	46,976	56,000	46,976	56,000
Current Capacity	44,952	47,000	44,952	47,000
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-

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Current Capacity	44,952	47,000	44,952	47,000
Under Development	-	-	-	-
Planned Mines	-	-	-	-
Prospective Mines	-	-	-	-

Table 2.1: Nuclear reactors and generating capacity (MW) under construction as of August 2010

Country	Number	Capacity (MW)
United States	104	100,562
France	59	63,473
Japan	54	47,122
Russia	31	22,133
Germany	17	20,339
Korea	20	18,926
Canada	15	13,168
Ukraine	18	12,595
United Kingdom	19	10,982
Sweden	10	8,512
Spain	11	8,587
Belgium	8	7,442
Others	7	5,755
World total	436	312,600

Figure 1.1: Age structure of operating reactors

Figure 1.2: World primary energy demand in the IEA reference scenario

Figure 1.3: Energy related CO2 emissions in the IEA reference scenario

Figure 2.1: Age structure of operating reactors

Figure 2.2: Nuclear reactors and generating capacity (MW) under construction as of August 2010

Figure 2.3: Energy related CO2 emissions in the IEA reference scenario

Figure 2.4: World primary energy demand in the IEA reference scenario

Figure 2.5: Uranium production in the former Soviet Union 1946-2008, EJ

Figure 2.6: Uranium production in the former Soviet Union 1946-2008, EJ

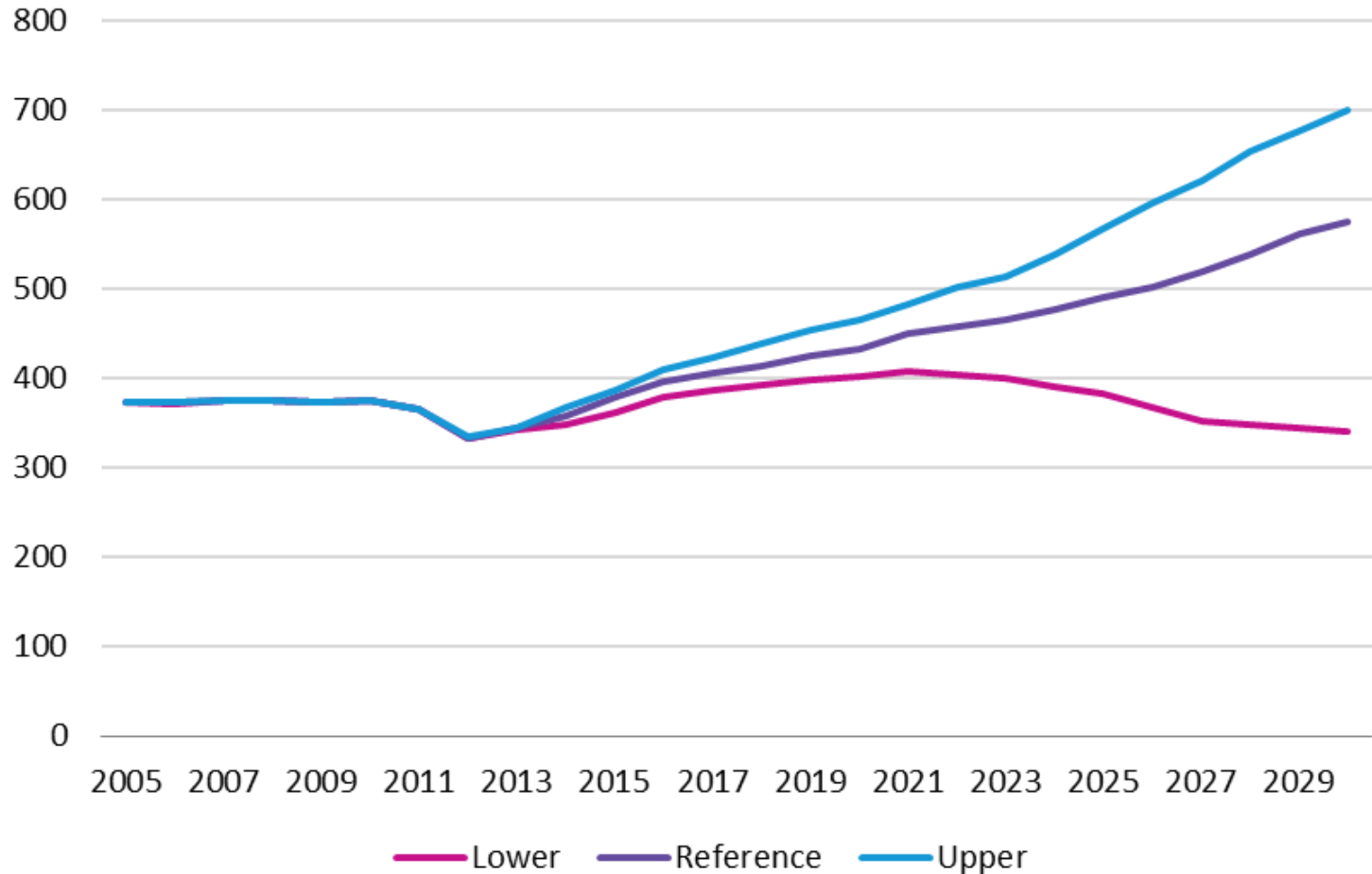
Figure 2.7: Uranium production in the former Soviet Union 1946-2008, EJ

Figure 2.8: First core fabrication demand for the reference scenario, #M\$/year

Figure 2.9: Primary fuel fabrication supply

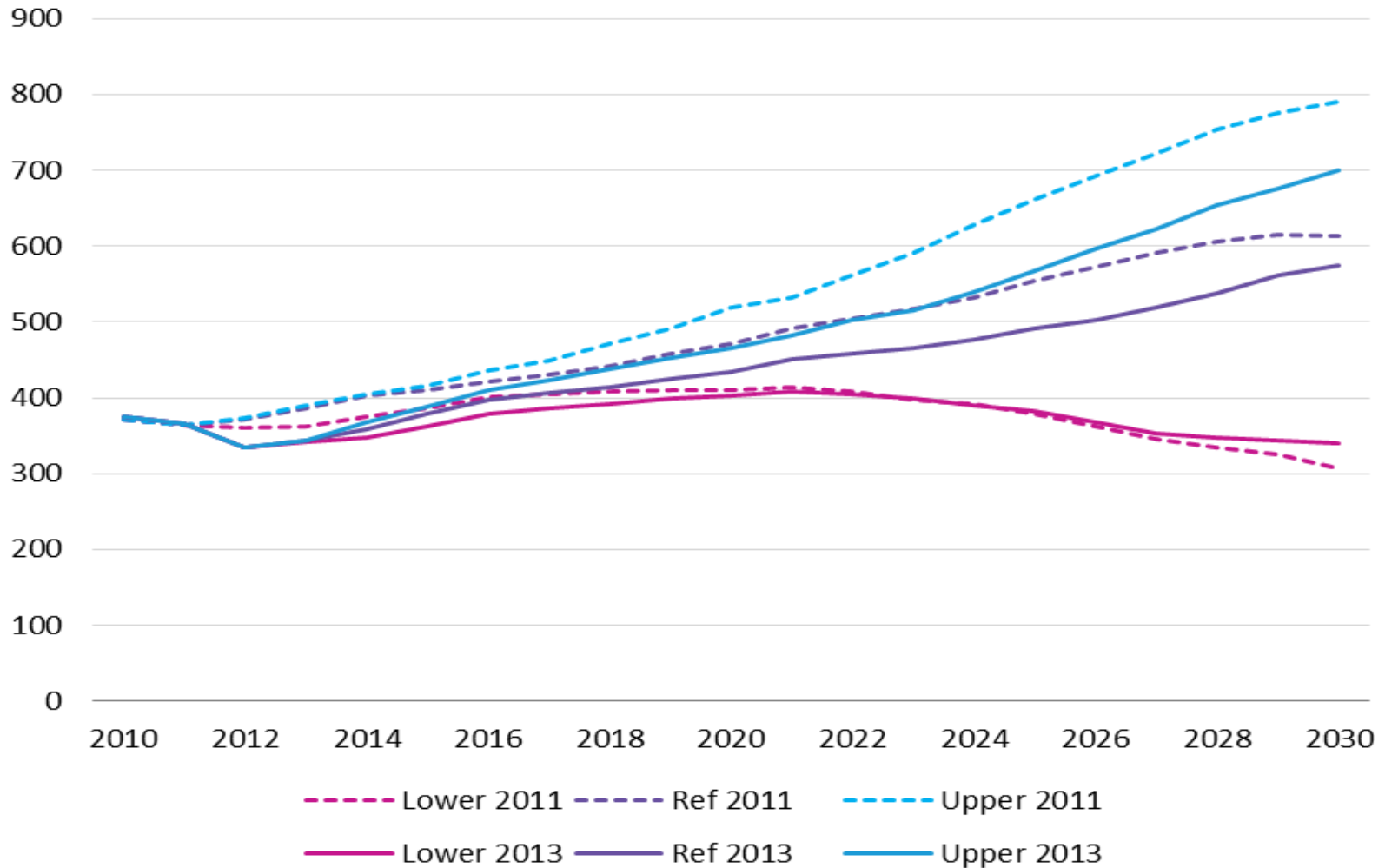
- Biennial market reports on global fuel market and supply chain

World Nuclear Generating Capacity, GWe (2013 WNA Global Fuel Market Report)



World Nuclear Generating Capacity, GWe

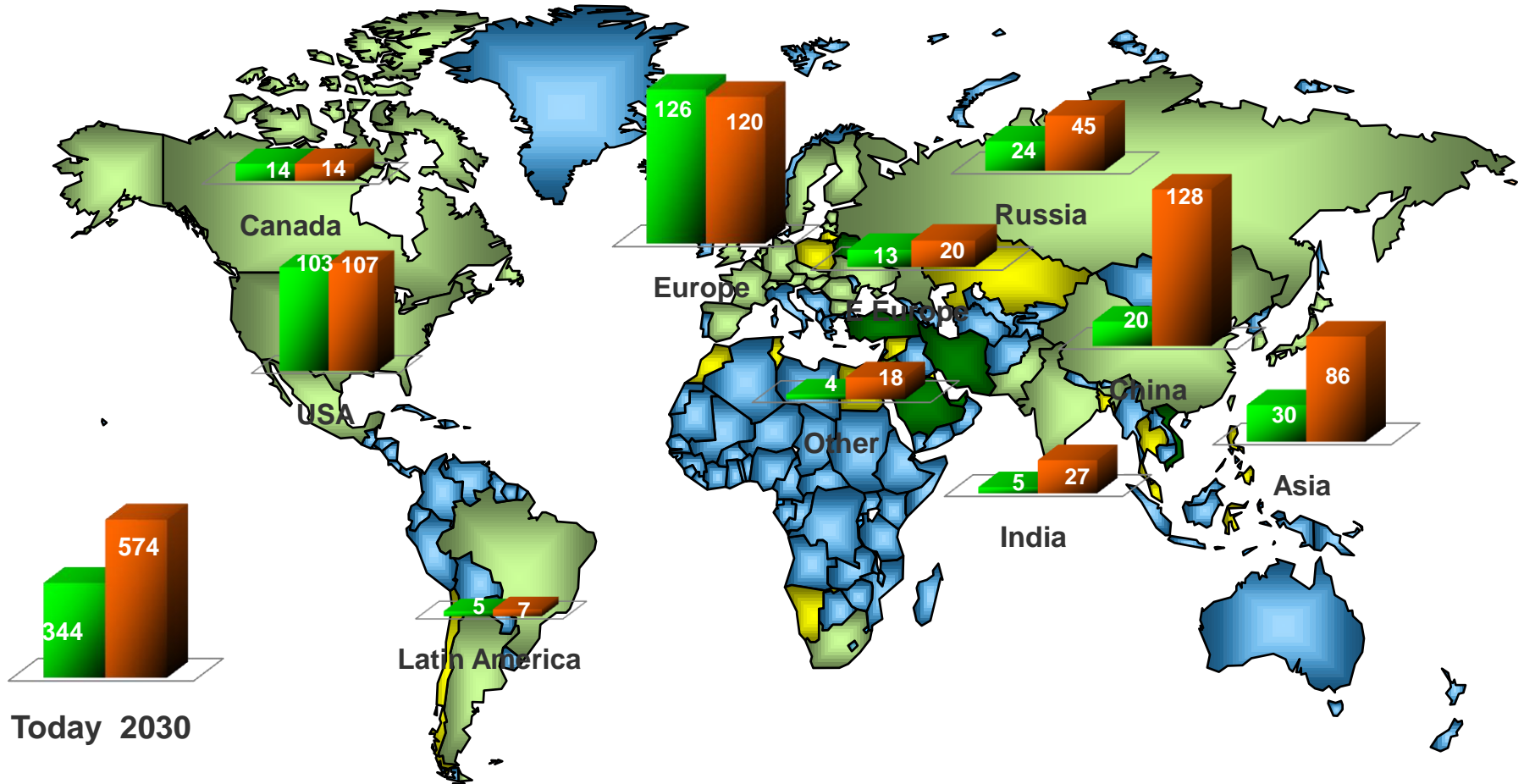
2013 vs 2011 Fuel Market Report



Reference Case Capacity

Net GWe (2013 to 2030)

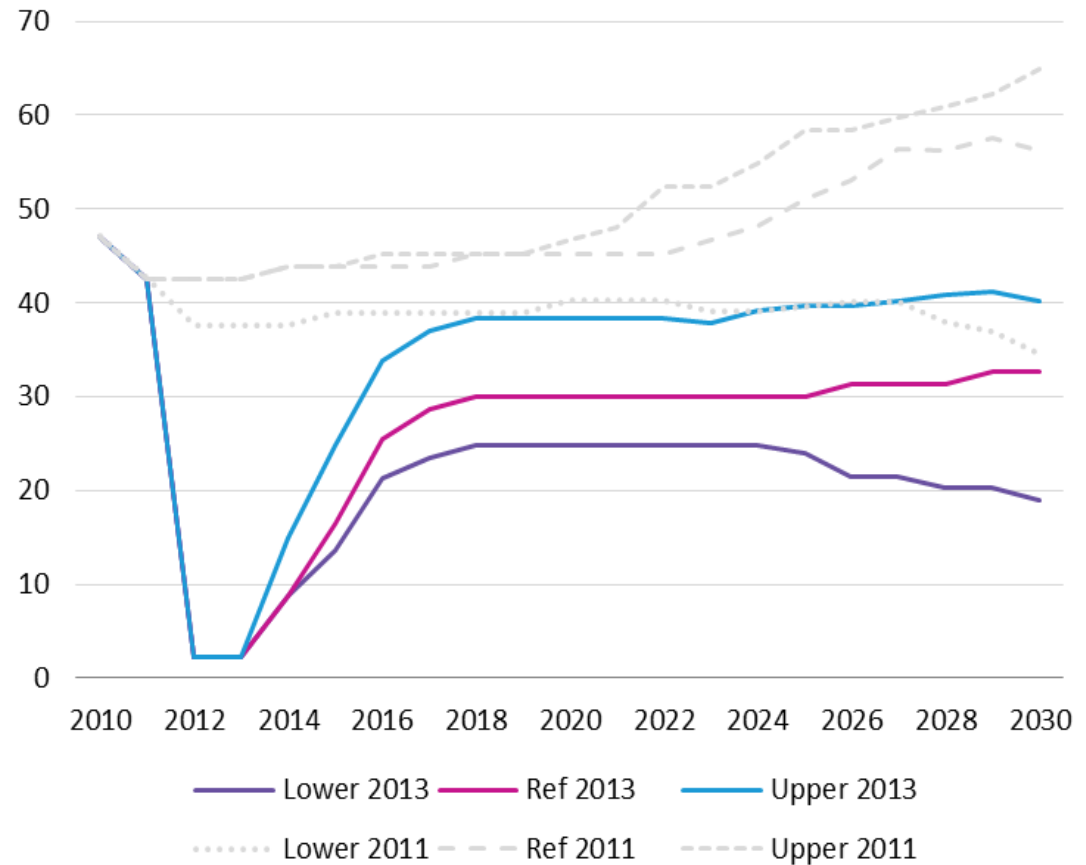
operating serious emerging



Assessment of Likely Japanese Reactor Restarts 2013 vs 2011 Report

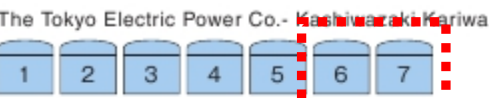
Reactor-by-reactor assessment:

- Age
- Size
- Type
- Location

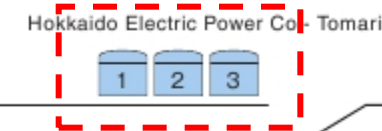


Nuclear Power Plants in Japan

Kashiwazaki Kariwa



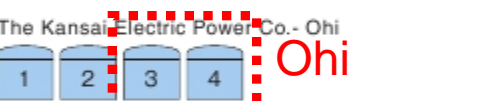
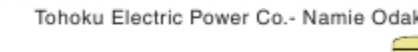
Tomari



(Commercial Plants, as of the end of April 2012)



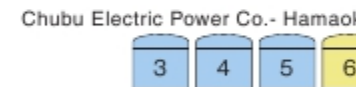
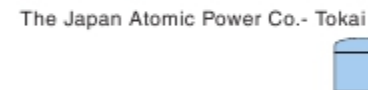
Electric Power Development Co.- Ohma



Ohi



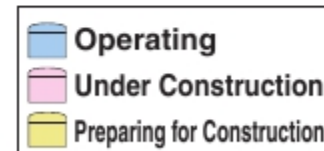
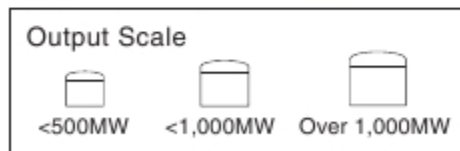
Takahama



Genkai



Sendai



	units	Total Output (MW)
Operating	50	46,148
Under Construction	3	4,141
Preparing for Construction	9	12,407
Total	62	62,696

The Tokyo Electric Power Company abolished the unit 1-4 of Fukushima Daiichi Nuclear Power Station on April 19, 2012.

Chubu Electric Power Company abolished the unit 1 and 2 of Hamaoka Nuclear Power Station on January 30, 2009 and is currently decommissioning them.

The Japan Atomic Power Company abolished Tokai Power Station on March 31, 1998 and is currently decommissioning it.

Process toward restart

July 8 Introduction of New Regulatory Standard

July 8&12: Submission of Licensing Application (12 PWRs)

Tomari-1,2,3 Takahama-3,4 Ohi-3,4

Ikata-3 Genkai-3,4 Sendai-1,2

September 27: Kashiwazaki-Kariwa-6,7 (2 BWRs)

Ongoing

Delayed but ongoing

Stuck

Tomari-3 Ikata-3,
Genkai-3,4 Sendai-1,2

Ohi-3,4
Takahama-3,4

Tomari-1,2
KK-6,7

Regulatory Permission

Consent of Local Government??

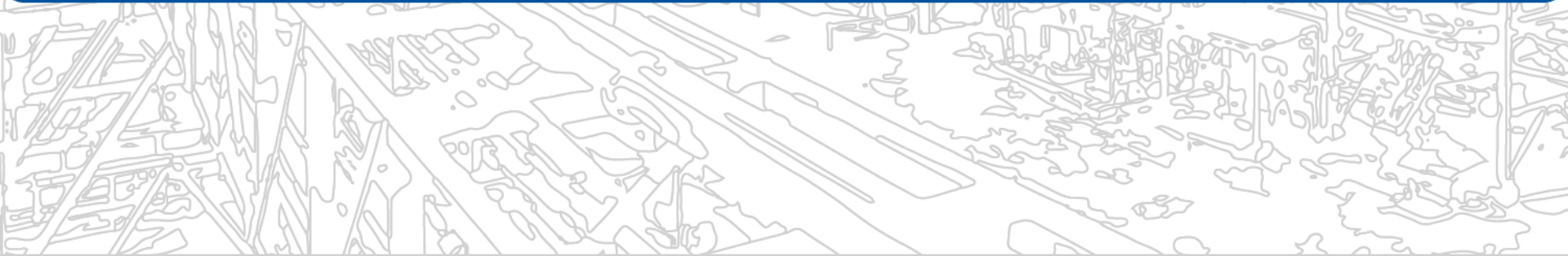
Final Judgment of Japanese Government??

Restart of Plant

At least
6 months

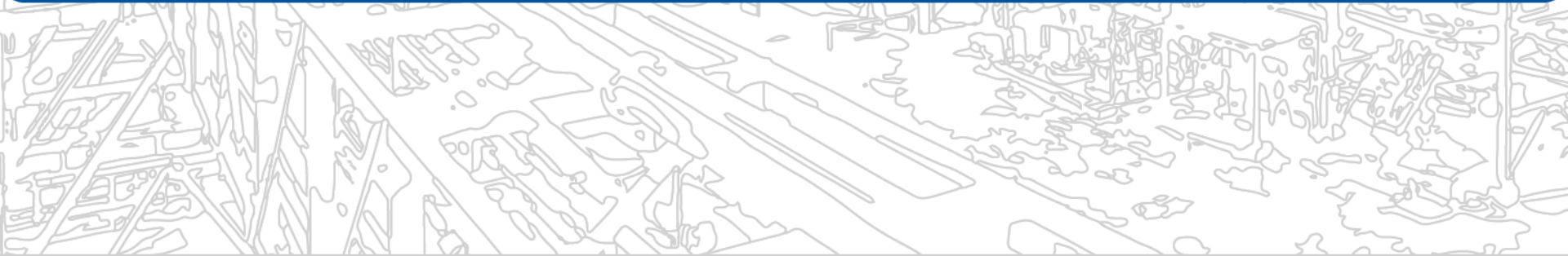


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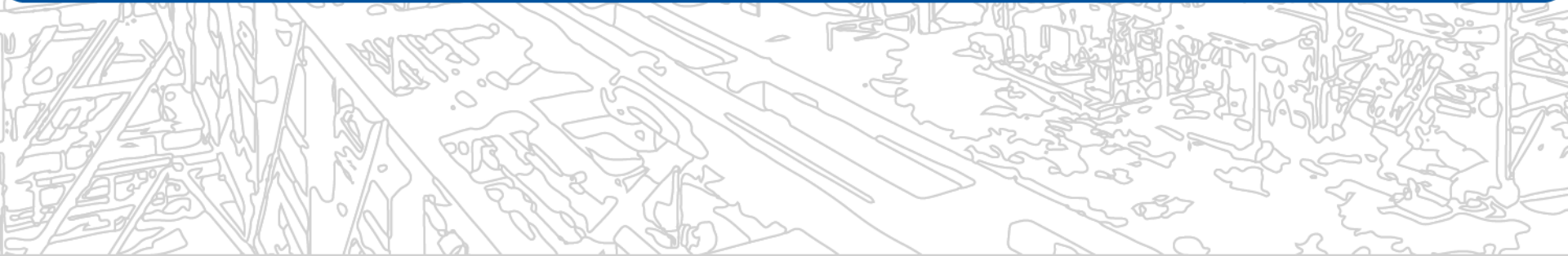


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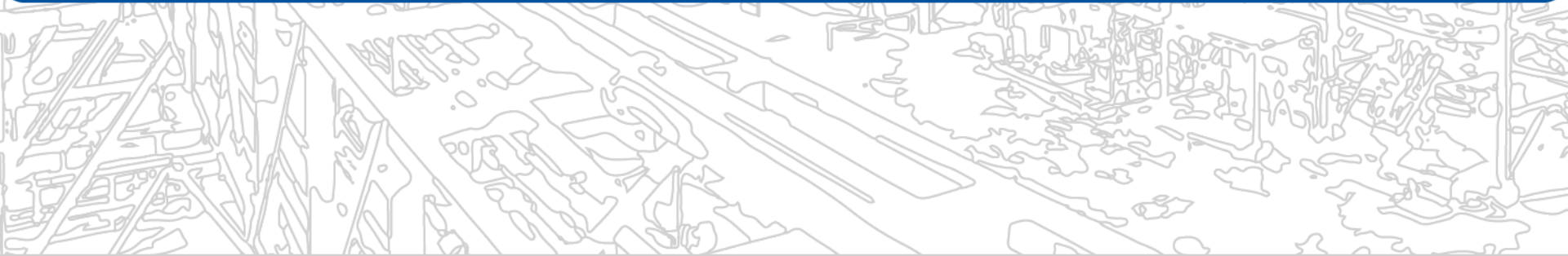


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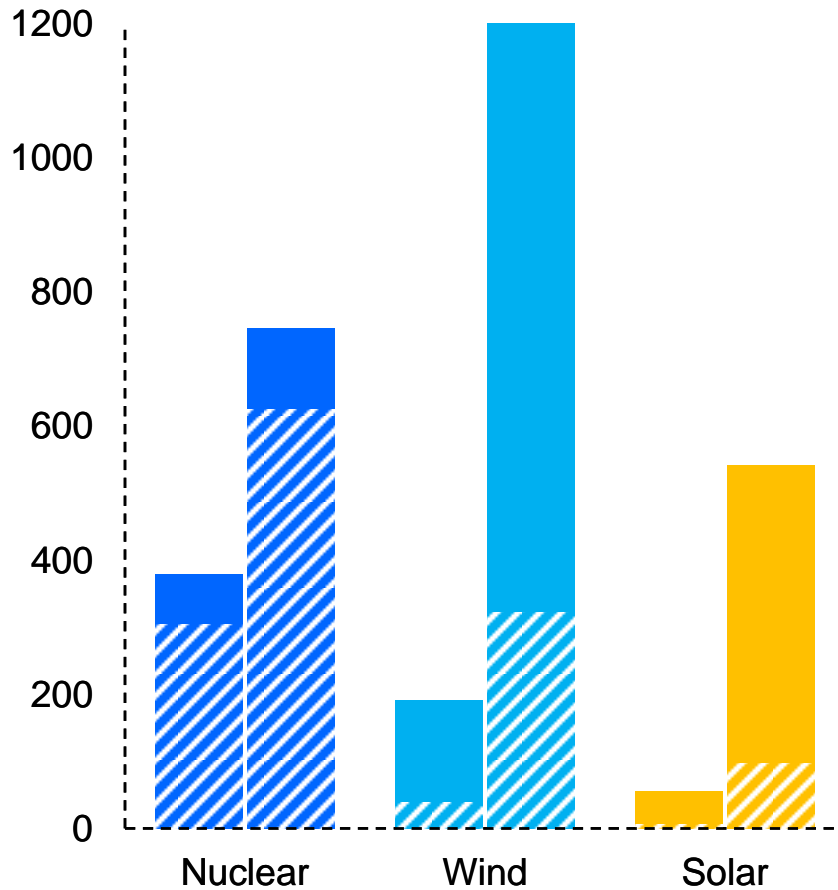


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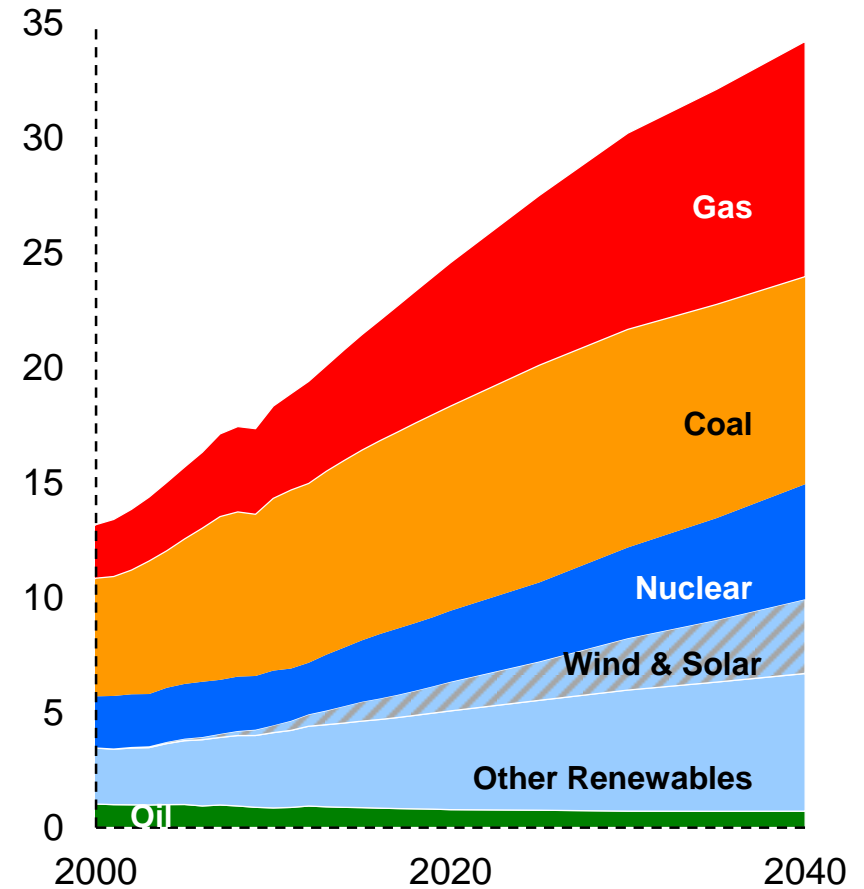


Global Electricity Generation Mix Evolves

Global Capacity Utilized
GW



By Generation
k TWh



Projecting Nuclear Reactor Requirements

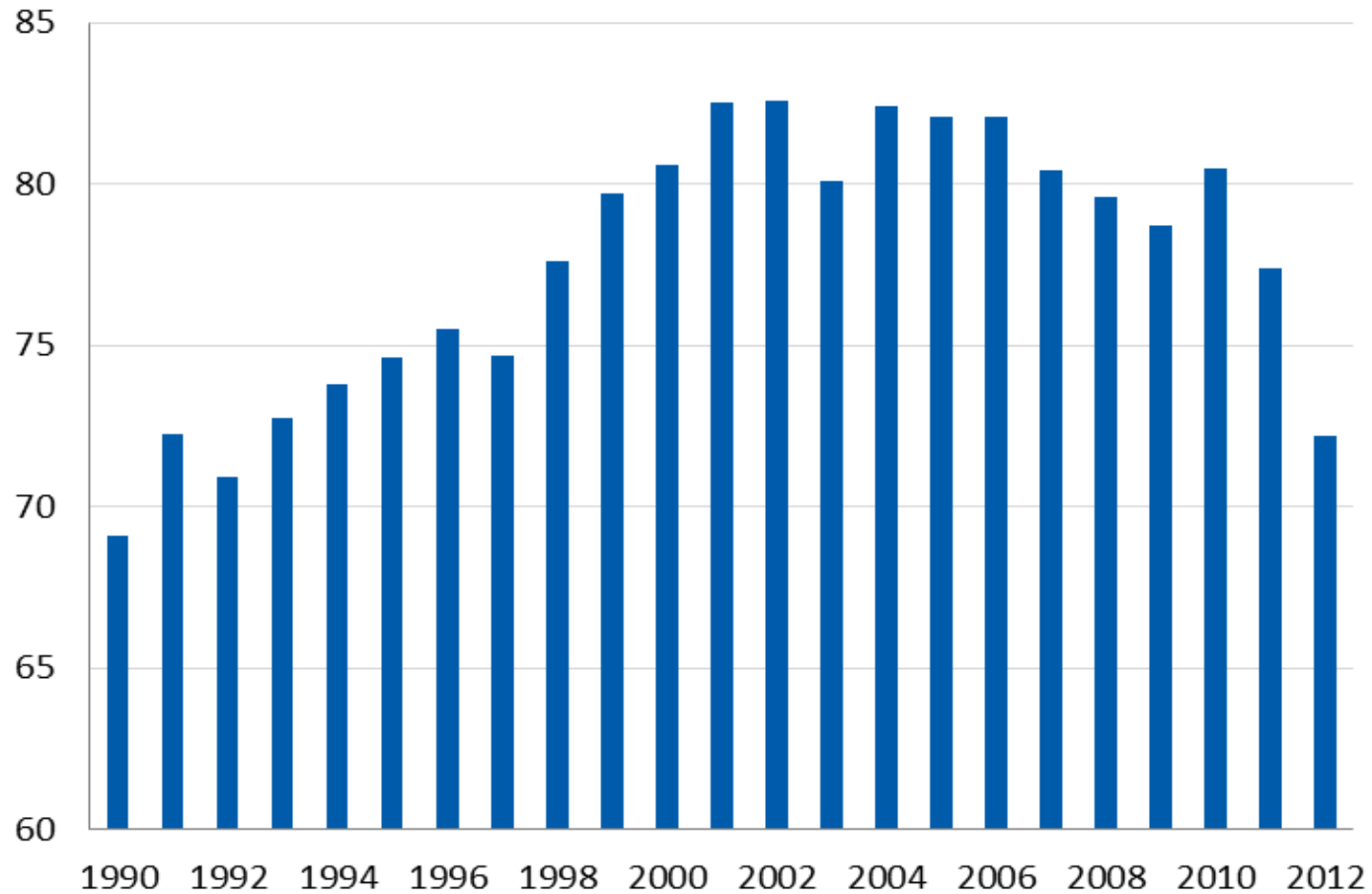
- Nuclear generating capacity
- Fuel cycle and reactor operating factors – load/capacity factors, tails assay, fuel burn-up
- MS Excel-based spreadsheet model computes uranium, conversion and enrichment requirements by year to 2030

Sensitivity of Factors

Table 3.2: Impact on uranium and SWU demand from parameter changes

Parameter	Base value	Change	Impact on U	Impact on SWU
Capacity factor	80%	5%	6%	6%
		-5%	-6%	-6%
Tails assay	0.25%	0.03%	6%	-6%
		-0.03%	-6%	6%
		0.15%	8%	-13%
0.22% 2013 Market Report	0.15%	-0.05%	-7%	18%
		5	-3%	1%
Burn up	40 GWd/tU			
Reactor power level increase	present	10%	12%	12%
		-10%	-15%	-15%

Global Load Factors (using IAEA capacities)



Recent Uranium Production, tU

Global production increased by a third 2008-2012

Mines that have opened since 2011 include:

- Honeymoon (Australia)
- Langer Heinrich Stage 3 (Namibia)
- Novokonstantinovskoe (Ukraine)
- Willow Creek (US)

Ramp-up of existing mines continues, led by Kazakhstan (nearly 2ktU increased production 2011-2012)

Country	2010	2011	2012	% change 2010-2012
Australia	5,900	5,983	6,991	18%
Brazil	148	265	231	56%
Canada	9,783	9,145	8,998	-8%
China	827	885	1,500	81%
India	400	400	385	-4%
Kazakhstan	17,803	19,451	21,317	20%
Malawi	846	1,077	1,101	30%
Namibia	4,496	3,258	4,495	0%
Niger	4,198	4,351	4,667	11%
Russia	3,562	2,993	2,872	-19%
South Africa	583	582	465	-20%
Ukraine	850	890	960	13%
United States	1,660	1,537	1,596	-4%
Uzbekistan	2,400	2,500	2,400	0%
Others	207	178	366	77%
Total	53,663	53,494	58,344	9%

Potential production capacities

Four categories of potential production capacities:

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)

More based on publically available statements

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%

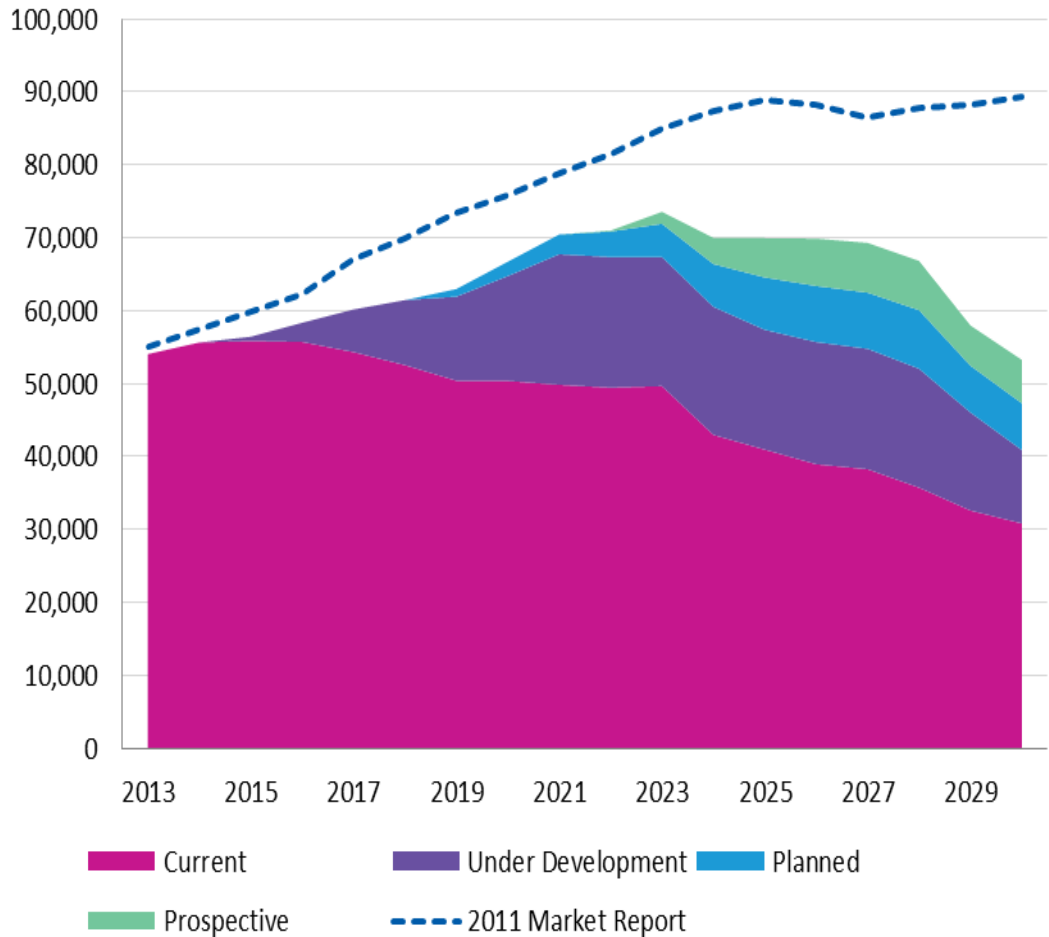
Reference Scenario Primary Supply to 2030, tU

Compared with the 2011 report, expected primary supply has been significantly revised.

Capacity definitions are now more based on public statements. Many projects have been transferred to the Supply Pipeline category.

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

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

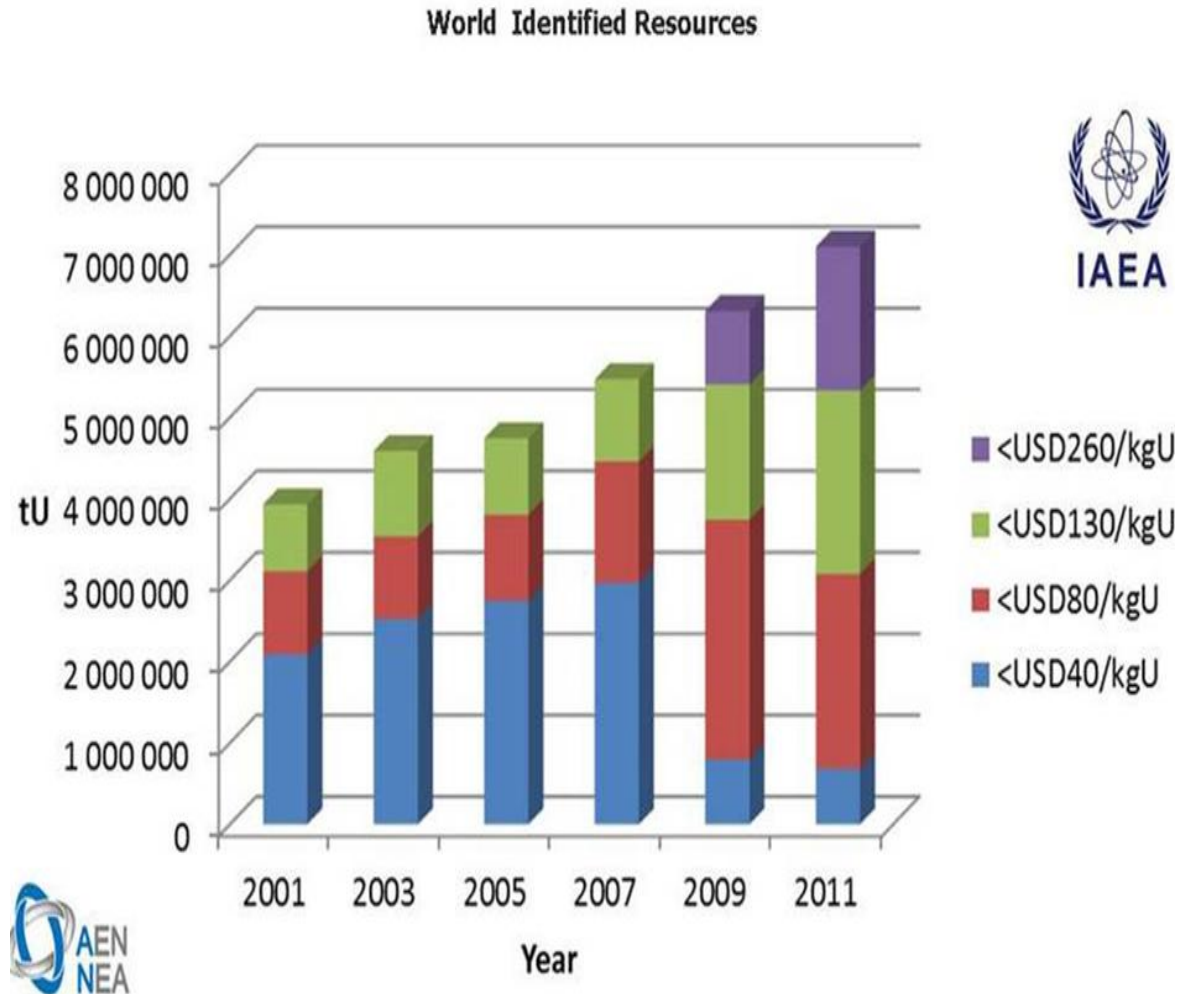


Conclusions

- 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. As a result, existing and expected capacity plus secondary supply will be insufficient on current plans to meet reference scenario requirements by about 2023.

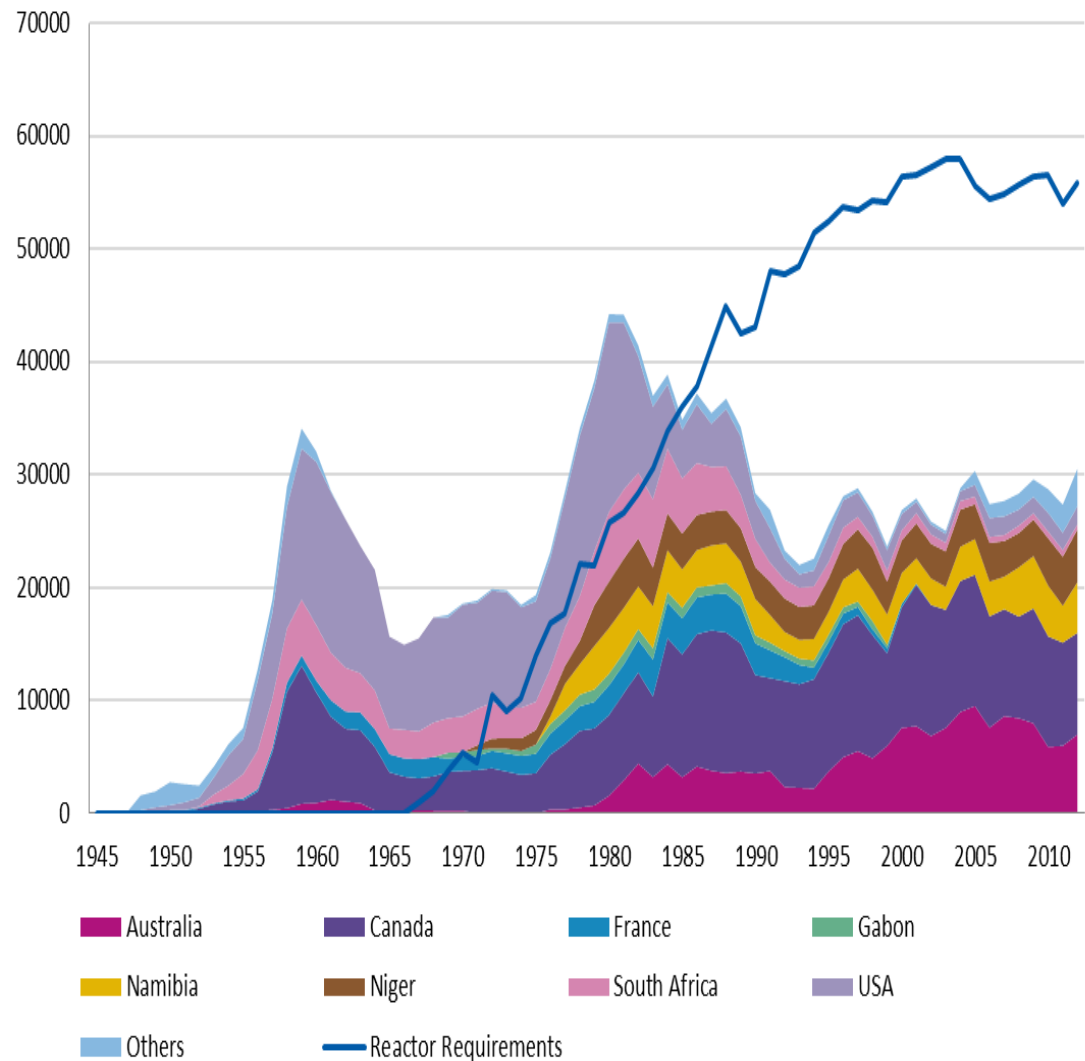
World Uranium Resources

- 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



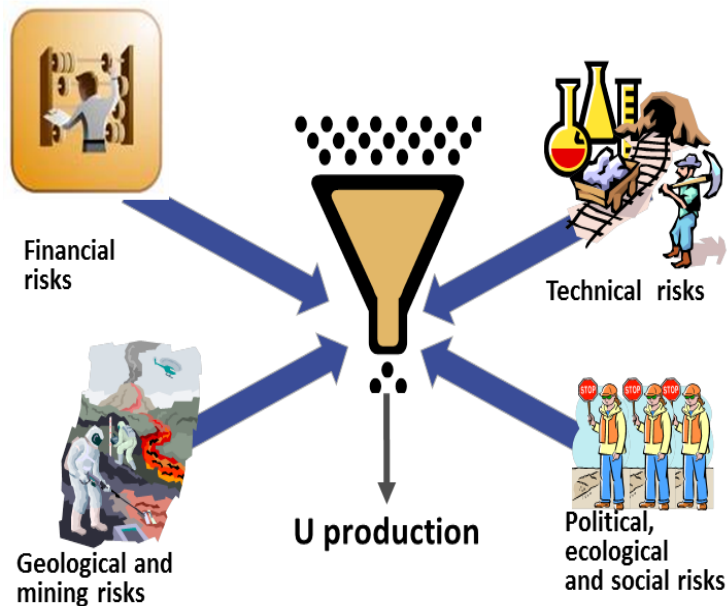


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Mining is a risky business!

Resources



Main risks hampering the development of the biggest U mining projects

Deposit	Financial risks	Technical risks	Political social and environmental risks
Olympic Dam (expansion),	V		V
Cigar Lake	V	V	
Imouraren	V		V
Midwest	V		V
Jabiluka			V
Elkon	V		

Fuel Cycle & Reactor Operating Factors

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

Reactor Construction Performance

Annex 2: Reactor Construction Times 2003-2013

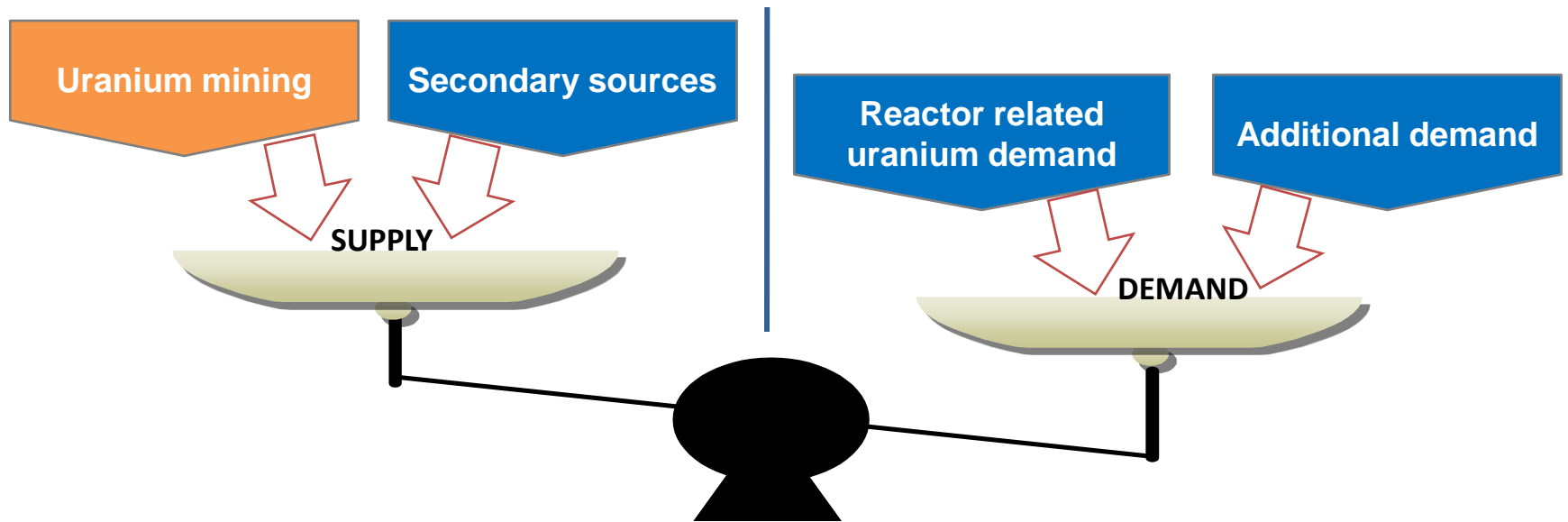
Construction Times (in years) <i>Startups between 2003 and July 2013</i>				
Country	Units	Mean Time	Min	Max
China	11	5.9	4.4	11.2
India	6	6.7	5.1	8.8
S. Korea	5	4.4	4.0	5.3
Japan	4	4.4	3.8	5.1
Russia	3	23.8	19.2	26.8
Ukraine	2	18.8	18.2	19.5
Iran	1	36.3	36.3	36.3
Pakistan	1	5.3	5.3	5.3
Romania	1	24.1	24.1	24.1
Total	34	9.4	3.8	26.8

Sources: LAEA-PRIS, MSC, 2013

Percentage Variation in U & SWU Requirements with Tails Assay



Uranium supply – demand sources



Main factors of demand/supply relationship

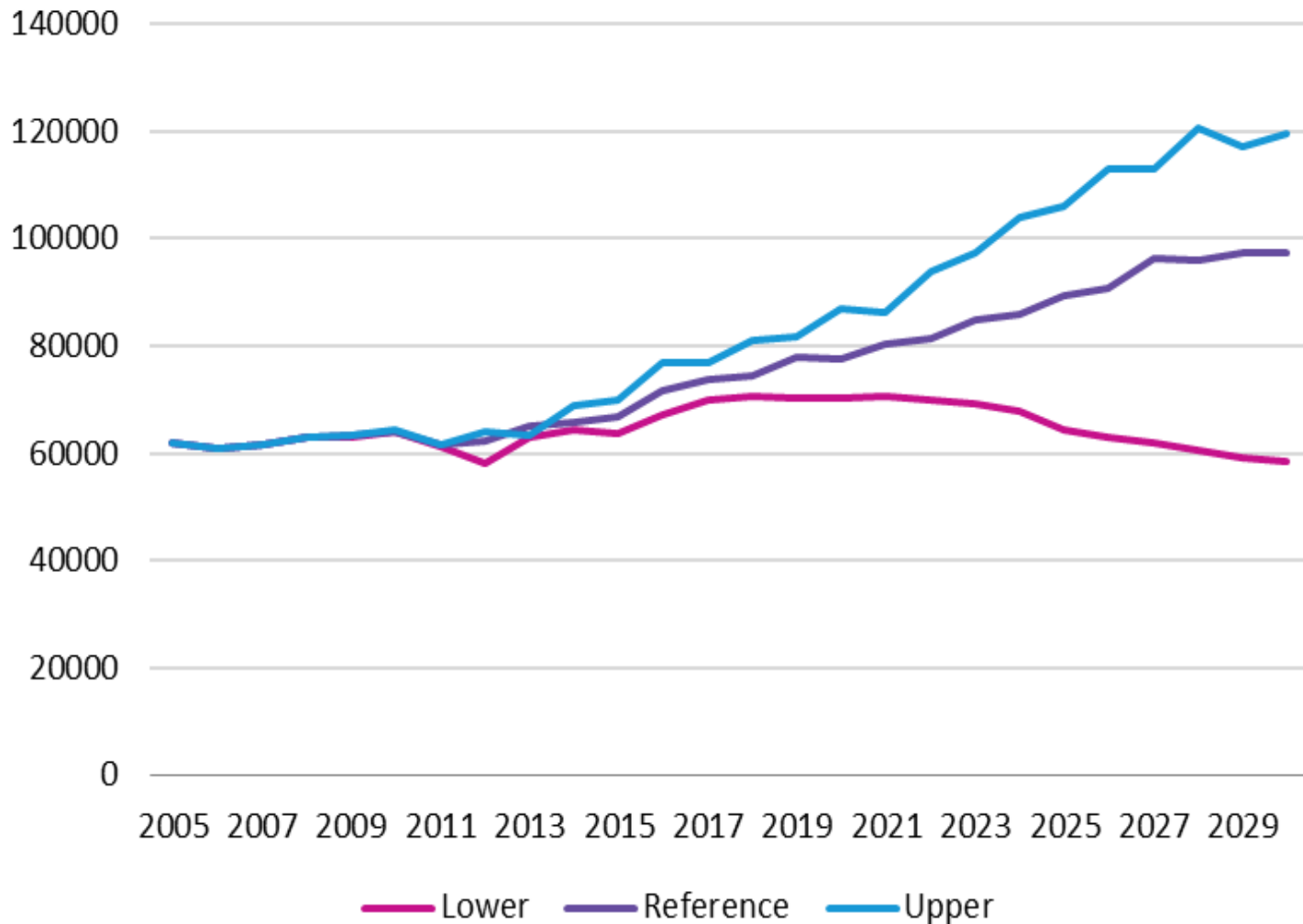
- Favorable uranium prices
- Sufficient and qualitative uranium resources
- Uranium production capacities

- HEU-LEU Program
- US policy in the uranium inventory reduction and stock balance selling
- Policy in depleted U, spent fuel and HEU reprocessing

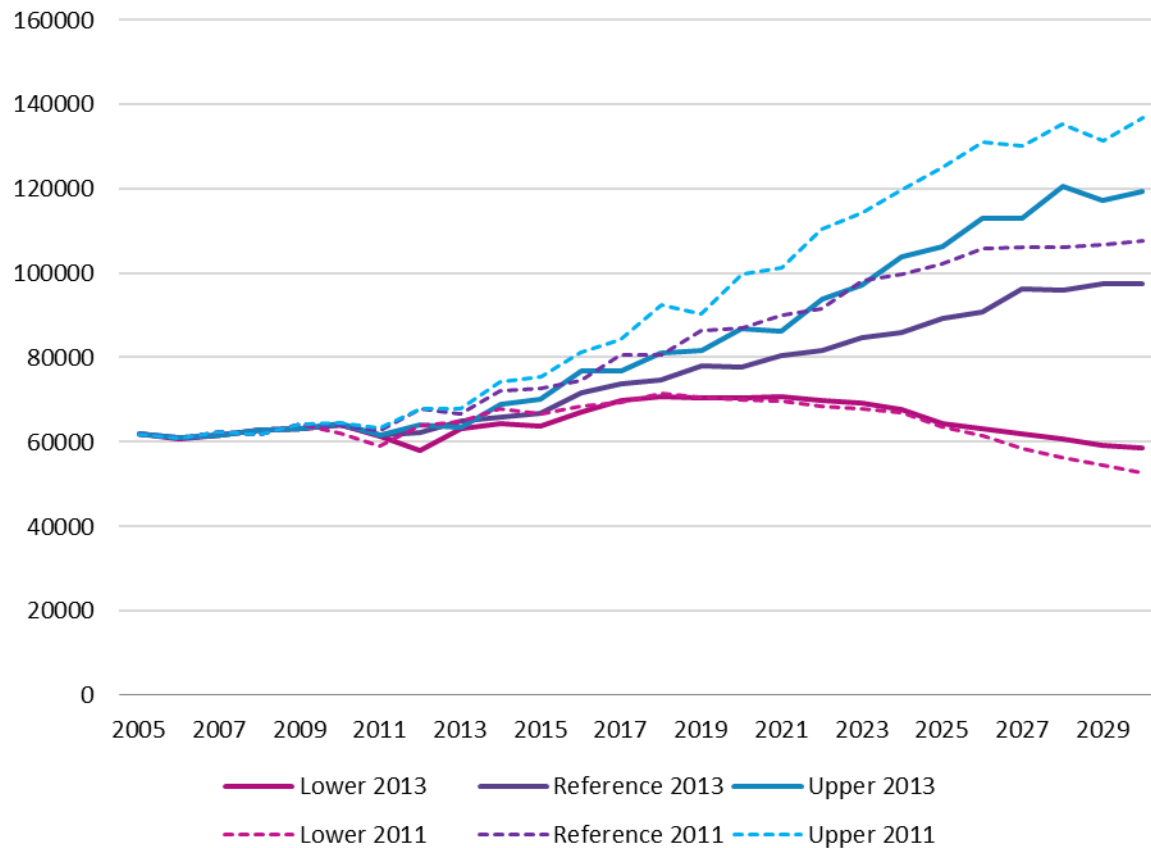
- Capacities
- Selection of tails assay
- Load factors
- Extending cycle length and enrichment levels
- Increased burn up

- Uranium as a trading commodity (stocks trading)
- Inventory change

World Uranium Requirements, tU (2013)



World Uranium Requirements, tU 2013 vs 2011 Reports



Tails Assay

Essentially an economic decision – relative price of U and SWU

- 0.30%-0.35% until 2003-4, now below 0.25%
- 2013 Market Report - 0.22% for all reactors

China's resourcing of uranium

Background

- Demand for uranium will increase sharply after 2020.
- Domestic production capability is limited. (~1500tU per year)

Government's Guideline- Three "1/3"s

- 1/3 of demand to be satisfied by domestic production;
- 1/3 of demand to be satisfied by purchasing natural uranium globally;
- 1/3 of demand to be satisfied by acquiring overseas resource asset.

Source: CGNPC