

# Uraniumletter INTERNATIONAL

the international independent information and advice bulletin for uranium resource investments

May 2016

## Uranium Market Outlook



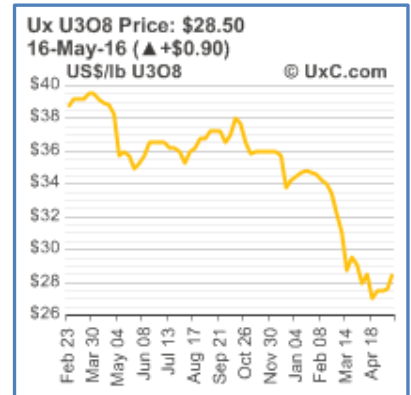
**Marino G. Pieterse, publisher and editor**

► **With Germany not on board, EU's updated nuclear policy to 2025 is doomed to fail**

Despite all positive comments by investment houses and management of major uranium companies in the prospective outlook for a recovery of the uranium price, in April 2016 the course of the U3O8 price showed a further decline to a 2-year low of US\$ 27.00/lb on April 18, 2016.

A stronger than expected negative impact on short-term uranium demand resulted from world-wide tightened security and environmental regulations since the March 2011 Fukushima disaster. The restart of the first two reactors in **Japan** took two years longer than originally anticipated

Also indicated by me earlier, despite the potentially strong future growth of uranium demand as a result of 65 reactors under construction and 173 planned reactors and a supply/demand-side balance expected from 2017, the fall of oil and gas prices has affected uranium prices.



OVERVIEW OF U3O8 PRICES					
	Spot	Long-term		Spot	Long-term
<b>2016</b>					
May 16	28.50	43.50	Year-end 2015	34.25	44.00
April 25	27.50	43.50	May 31, 2015 (year high)	39.50	50.00
April 18 (2-year Low)	27.00	43.50	Year-end 2014	35.50	49.00
March 28	29.15	43.50	May 14, 2014 (year low)	28.25	49.00
February 29	33.50	44.00	Year-end 2013	34.50	50.00
January 31	34.75	44.00	Year-end 2012	43.50	56.50
			Year-end 2011	61.75	64.00
			Pre-Fukushima accident		
			March 11, 2011	67.75	73.00

Before Fukushima, Japan's 50+ more reactors have provided some 30% of the country's electricity and this was expected to increase to at least 40% by 2017. The prospect now is for two-thirds of this, from a depleted fleet.

Currently 42 reactors are operable and potentially able to restart, and 24 of these are in the process of restart approvals. The first two restarted in August and October 2015.

Preliminary PEA figures indicate that in 2014 Japan generated 1,025 TWh gross, of which 337 TWh from coal, 413 TWh from gas (up from 300 TWh in 2010), nothing from nuclear versus 288 TWh in 2010, 114 TWh from oil (up from 94 TWh in 2010). and 87 TWh from hydro.

The Japanese government estimated generation costs per kWh: wind JPY 10.0, nuclear JPY 10.1, coal JPY 12.3, LNG JPY 13.7, solar (non-residual) JPY 24.3.

In April 2015, the Japanese government announced that it wanted base-load resources to return to provide 60% of the power by 2030, with about one-third of this being nuclear.

Analysis by the Nuclear Institute of Innovative Technology for the Earth estimated that energy costs would then be reduced by JPY 2.4 trillion (US\$ 20.0 billion) per year, compared with the present 40% base-load scenario (renewables being 30%).

According to a [strategic paper from the European Union released on May 18, 2016](#), which is reportedly the basis for the [European Commission's future nuclear policy](#), the EU's 28 member states should strengthen cooperation on researching, developing, financing and constructing innovative reactors.

However, because the plan contradicts the energy policy in [Germany](#) to phase out nuclear energy and in addition [France](#) to half its current 58 operating reactors to decrease its dependence on nuclear energy, [nuclear power faces an uncertain future in Europe](#).

Only 3 EU member states – [Finland](#), [France](#) and [Slovakia](#) – are currently constructing new nuclear plants, but all of these are facing cost overruns and delays.

In [England](#) the planned [Hinkley Point C](#) nuclear power station, spearhead by French utility EPF, is also facing cost overruns, financing difficulties and delays to scheduled construction begin.

The [2016 BP Energy Outlook](#) published in February, says that Japanese reactors were expected to restart over the next 5 years to reach 60% of their 2010 levels by 2020. Although the Outlook expecting that it will take up to 5 years to restart 60% of their 2010 level of up to 30 reactors by 2020, the fall-out over this period will be more than compensated for by the [current 52 reactors under construction](#), led by **China** (24), **India** (6) and **Russia** (8) and in addition [109 reactors](#) being planned, led by [China](#) (42), [India](#) (24) and [Russia](#) (25).

According to [WNA](#) in the 28 [European Union member countries](#) only 9 reactors, of which 6 in [Poland](#), are under construction and 13 are planned, against which [France](#) may half up to 50% of its current 58 operating reactors, which contribute to an excessive share of approximately 77% of its electricity generation, and in [Germany](#), all of the 8 remaining reactors to be shut down by 2025.

### No material impact from Fukushima disaster in March 2011 on future nuclear power demand

Country	Nuclear generating 2014 (billion kWh)	in % total consumption	Operable reactors	Under construction	Planned	Proposed	Uranium required 2015 (in tonnes U)
<i>March 1, 2016</i>							
China	123.8	2.4	30	24	42	136	6.072
India	33.2	3.5	21	6	24	36	1.077
Russia	169.1	18.6	35	8	25	23	6.416
USA	798.6	19.5	99	5	5	18	18.214
European Union	833.2	NA	128	9	13	16	20.090
<i>of which 71% applies to:</i>							
France	418.0	76.9	58	1	-	1	9.211
UK	57.9	17.2	15	-	4	9	1.734
Germany	91.8	15.8	8	-	-	-	1.689
<b>Subtotal</b>	<b>1.957.9</b>		<b>313</b>	<b>52</b>	<b>109</b>	<b>229</b>	<b>51.869</b>
<b>World total</b>	<b>2.411.0</b>	<b>11.5e</b>	<b>440</b>	<b>65</b>	<b>173</b>	<b>337</b>	<b>65.220</b>
<b>Top-5 regions in % world total</b>	<b>82</b>		<b>71</b>	<b>80</b>	<b>60</b>	<b>68</b>	<b>80</b>
<i>source: WNA</i>							

<b>Top 10 countries of world's uranium production</b>						
	<b>Production</b>	<b>in %</b>				<b>in %</b>
	<b>in tonnes U</b>	<b>world total</b>				<b>world total</b>
	<b>2015</b>		<b>2014</b>	<b>2013</b>	<b>2010</b>	
Kazakhstan	23.800	39	23.127	22.451	17.803	33
Canada	13.325	22	9.134	9.331	9.783	18
Australia	5.672	9	5.001	6.350	5.900	11
Niger	4.116	7	4.057	4.518	4.198	8
Russia	3.055	5	2.990	3.135	3.562	7
Namibia	2.993	5	3.255	4.323	4.496	8
Uzbekistan (est)	2.385	4	2.400	2.400	2.400	4
China (est)	1.616	3	1.500	1.500	827	2
USA	1.256	2	1.919	1.792	1.660	3
Ukraine (est)	<u>1.200</u>	<u>2</u>	<u>926</u>	<u>922</u>	<u>850</u>	<u>2</u>
<b>Top-10 total</b>	<b>59.418</b>	<b>98</b>	<b>54.309</b>	<b>56.722</b>	<b>51.479</b>	<b>96</b>
Others	<u>1.100</u>	<u>2</u>	<u>1.908</u>	<u>2.648</u>	<u>2.192</u>	<u>4</u>
<b>Total world production tU</b>	<b>60.518</b>	<b>100</b>	<b>56.217</b>	<b>59.370</b>	<b>53.671</b>	<b>100</b>
Total world production U3O8	71.369		66279	70015	63295	
<i>source: WNA</i>						

<b>Mining method 2015</b>	<b>Tonnes U</b>	<b>%</b>
In situ leach (ISL)	29.197	48
Underground & open-pit (except Olympic Dam)	29.795	46
By-product x	3.525	6
<i>x considering <u>Olympic Dam</u> as a by-product rather than in underground category</i>		

## Top-15 producing uranium mines by country

Country	Number of uranium mines	Production in tonnes 2015	in % Top-15
Kazakhstan	6	13.949	34.4
Canada	3	13.705	33.8
Australia	2	4.878	12.0
Niger	2	4.116	10.1
Russia	1	1.977	4.9
Namibia	<u>1</u>	<u>1.937</u>	<u>4.8</u>
<b>Total</b>	<b>15</b>	<b>40.562</b>	<b>100.0</b>
<b>Western countries</b> (Canada, Australia)		<b>18.353</b>	<b>45%</b>
<b>Emerging countries</b> (Kazakhstan, Niger, Russia, Namibia)		<b>21.929</b>	<b>55%</b>
			<b>100%</b>

## Top-15 producing uranium mines in 2015

Mine	Country	Main owner	Type	Production t/U	% of world
McArthur River	Canada	Cameco (69.8%)	underground	7.352	12.1
Cugar Lake	Canada	Cameco (50%)	underground	4.333	7.2
Tortkuduk & Myunkum	Kazakhstan	Katco JV / Areva	ISL	4.109	6.8
Olympic Dam	Australia	BHP Billiton	by-product/underground	3.178	5.3
SOMAIR	Niger	Areva (63.6%)	open pit	2.509	4.1
Inkai	Kazakhstan	Inkai JV / Cameco	ISL	2.234	3.7
Budenovskoye 2	Kazakhstan	Karatau JV/Kazatomprom - Uranium One	ISL	2.061	3.4
South Inkai	Kazakhstan	Betpak Dala JV / Uranium One	ISL	2.056	3.4
Priargunsky	Russia	ARMZ	underground	1.977	3.3
Langer Heinrich	Namibia	Paladin Energy	open pit	1.937	3.2
Central Mynkuduk	Kazakhstan	Ken Dala JSC / Kazatomprom	ISL	1.847	3.1
Ranger	Australia	Rio Tinto (63.39%)	open pit	1.700	2.8
Budenovskoye 1, 3	Kazakhstan	Akbastau JV / Kazatomprom -	ISL	1.642	2.7
Rabbit Lake	Canada	Cameco	underground	1.620	2.7
COMINAK	Niger	Areva (34%)	underground	1.607	2.7
<b>Total Top 15</b>				<b>40.162</b>	<b>66.4</b>
<b>World total</b>				<b>60.518</b>	

source: WNA

## EIA sees strong growth in nuclear generation to 2040

Releasing the latest edition of its International Energy Outlook on May 11, 2016, the US Department of Energy Administration (EIA) says that total world energy consumption will increase by almost 50% from 549 quadrillion British thermal units (BtU) in 2012 to 815 quadrillion BtU in 2040. This growth will be driven by industrialization in non-OECD countries, especially Asia.

Developing **Asia** accounts for more than half of the projected increase in global energy use through 2040, this increase will have a profound effect on the development of world energy markets.

By 2040, almost two-thirds of the world's primary energy will be consumed in the non-OECD economies, according to the EIA.

Although consumption of non-fossil fuels is expected to grow faster than consumption of fossil fuels, fossil fuels will still account for 78% of primary energy in use in 2040.

**Coal** will be the world's slowest growing energy source, rising by 0.6% annually from 153 quadrillion BtU in 2012 to 180 quadrillion BtU in 2040.

**China**, the **USA** and **India** will remain the top three coal-consuming countries, together accounting for more than 70% of world coal use.

**Natural gas** consumption will grow 1.9% annually over the same period.

According to the EIA, global electricity generation will increase by 69% between 2012 and 2040, from 21.6 trillion KWh in 2012 to 25.8 trillion KWh in 2020 and 36.5 trillion KWh in 2040.

While **renewable energy** sources are projected to be the world's fastest growing energy source for electricity production between 2012 and 2040, growing an average of 2.9% annually, nuclear energy will be the third fastest growing after natural gas.

Global nuclear generating capacity is expected to see 2.3% annual growth between 2012 and 2040 from 2.3 trillion kilowatt-hours to 4.5 trillion KWh. Its share of total primary energy over this period will increase from 4% to 6%.

Concerns about energy security and greenhouse gas emissions support the development of new nuclear generating capacity, the EIA said.

**China** alone plans to add 139 GWe of nuclear capacity by 2040, accounting for 61% of world nuclear capacity.

Among the 34 OECD countries, only **South Korea** has a sizeable increase in nuclear generating capacity (12 GWe), the EIA notes. However, earlier shutdowns in **Canada** and **Europe**, together with reduced capacity in **Japan**, will see an overall drop of 6 GWe in nuclear capacity in OECD nations by 2040.

Despite the move towards lower-carbon sources, energy-related CO2 emissions are projected to increase from 32 billion tonnes in 2012 to 36 billion tonnes in 2020 and to 43 billion tonnes in 2040, a 34% increase from 2012 to 2040.

Much of the growth in emissions is attributed to developing non-OECD nations, many of which continue to meet the fast-paced growth of energy demand, the EIA said.



<b>Australian Uranium Production</b> (in tonnes U)				
	<b>2015</b>	<b>2014</b>	<b>2013</b>	<b>2011</b>
Olympic Dam	3.749	3.952	4.009	3.984
Ranger	2.005	1.165	2.960	2.641
Four Mile	935	755	0	0
Beverley	0	25	407	416
Honeymoon	0	0	112	45
<b>Total</b>	<b>6.689</b>	<b>5.897</b>	<b>7.488</b>	<b>7.086</b>

**Olympic Dam** Located in the middle of South Australia owned by **BHP Minerals**, is a large underground mine which produces copper, with gold and uranium as major by-products. Annual production capacity for uranium oxide (U<sub>3</sub>O<sub>8</sub>) has been expanded from 1,800 to 4,600 tonnes U<sub>3</sub>O<sub>8</sub>.

In 2009 **BHP Billiton** undertook a major feasibility study based on plans to greatly increase the mine's size and output by accessing the ore body with a huge open-pit, about 4.1 x 3.5 kilometres and 1,000 metres deep, with associate infrastructure over 11 years and lift uranium production to 19,000 tonnes U<sub>3</sub>O<sub>8</sub> per year. The open-pit would mean that up to 98% of the ore is mined rather than 25% of it.

However, in November 2014, in a general announcement about productivity, **BHP Billiton** flagged a 27% increase in copper production at Olympic Dam from 2018, and a doubling from that level subsequently by a "low-risk underground expansion with significantly lower capital intensity than the previous open-pit design".

This has the potential to deliver over 450,000 tonnes of copper production a year at first quartile C1 costs by the middle of next decade.

The **uranium** implications were not mentioned, but assuming the same as today, it would mean about 5,000 tonnes U<sub>3</sub>O<sub>8</sub> per year from 2018 (4,200 tonnes U) and some 9,400 tonnes U<sub>3</sub>O<sub>8</sub> (8,000 tonnes U) per year in the mid-2020s

About 80% of the uranium is recovered in conventional acid leach of the flotation tailings from copper recovery.

The **Ranger Mine** owned by **Energy Resources of Australia (ERA)** a 68.39% subsidiary of Rio Tinto, is located about 230 kilometres east of Darwin, Northern Territory. The mine opened in 1981 at a production rate of approximately 3,300 tonnes U<sub>3</sub>O<sub>8</sub> per year. Treatment is conventional acid leach. Any further development will be underground and application was made for approval of this in 2013.

Substantial development was undertaken to mine the Ranger Deeps and in June 2015 **ERA** announced that it will defer proceeding further with development of the underground mine to access 27,6650 tonnes of uranium, after spending A\$ 172 million on the project.

This is due to challenging conditions of the uranium market and the requirement to cease operations under the present Ranger Authority, which expires in 2021.

Negotiations are exploring the potential to bear the deadline.

The small **Beverley Mine**, owned and operated by **Heathgate Resources**, an associate of General Atomics in the USA, 520 kilometres north of Adelaide on the planes north-west of Lake Frome in South Australia, started operations late in 2000.

Mining of Beverley ceased at the end of 2013, and of Beverley North early in 2014.

The Mine was licenced to produce 1,180 tonnes U<sub>3</sub>O<sub>8</sub> per year and reached this level in 2004, though production has declined since.

The **Four Mile Mine** leases held by **Heathgate Resources** are contiguous with Beverley and mining the east ore body by ISL commence in April 2014.

In July 2015 **Heathgate** purchased the 25% free carried interest of Alliance Resources in the mine.

The **Honeymoon ISL mine** in South Australia, owned by **Uranium One** (51%) and **Mitsui** (49%), commenced operations in 2011. Operations were ramping up to 400 tonnes U3O8 per year. Mitsui largely funded the development and commissioning, but then withdrew from the project in 2012.

In November 2013 **Uranium One**, by the owned by Russia's **ARMZ**, closed the mine and put it on care and maintenance until uranium prices improved.

In September 2015, Boss Resources agreed to buy Uranium One Australia which owned the mine.

### **Advanced development projects**



**Toro Energy (TOR – ASX)** is focused on the development of its advanced-stage 100%-owned **Wiluna Uranium Project** located in Western Australia to production estimated by 2020. The Company has previously secured government approval for mining of the Centipede and Lake Way deposits, as well as a processing facility based at Centipede.

Wiluna's four deposits re being integrated into the Project to provide an operating life of at least 16 years.

In March 2016, **Toro** received highly encouraging results from the geological modelling and mine planning studies currently underway at the Wiluna Project. Pit design and inventory improvements have been driven by the 20% increase in mineral resources reported in October 2015 for Centipede and Millipede, the first two deposits to be mined at Wiluna.

The results if the optimisation include a 12% increase in the grade of mining inventory material above 1,000 pm; a 31% decrease in the waste-to-ore strip ratio; and a reduction in waste tonnes mined.

Centipede and Millipede have a current mineral inventory of 23.7 million tonnes grading 1,005 ppm containing 12.1 million pounds of U3O8 at a 500 pm cut-off.

**Lake Maitland**, acquired from Mega Uranium in November 2013 for consideration of a 27% interest in **Toro** (currently 20.7%), has high-grade mineral resources of 16.9 million pounds U3O8 grading 929 ppm at a 500 ppm cut-off.

Including expanded high-grade resources at Wiluna (500 ppm cut-off) following completion of geological analysis, resource estimation and 3D geological modelling, Wiluna now has a total resource of 84 million pounds (200 pm cut-off).

The total Mineral resource estimate for Wiluna's four core deposits Centipede and Millipede, Lake Maitland and Lake Way now stands at 40.4 million pounds contained U3O8 with an average grade of 951 ppm at a 500 pm cut-off. **Toro** is completing the necessary preparations to be able to consider the commencement of the final feasibility study for **Wiluna** in 2016.

Net cash flow from operating activities and investment activities in the first 9 months of Fiscal year 2015, as of March 31, 2016 amounted to A\$ 4.4 million and A\$ 0.42 million, respectively. Net cash flow related to financial activities amounted to A\$ 6.2 million negative.

At March 31, 2016, **Toro** has a cash balance of A\$ 12.2 million.

Estimated cash outflow for Q4 of fiscal 2016 amounts to A\$ 2.05 million, of which A\$ 1.77 million for exploration and evaluation and A\$ 0.28 million for administration. At March 31, 2016, **Toro** had A\$ 6 million loan facilities available from Sentient Group.



**Vimy Resources (VMY – ASX)** is developing its 100%-owned **Mulga Rock Project** in Western Australia. On March 30, 2016 the Company announced a maiden ore reserve comprising 15.2 million tonnes at 660 ppm U<sub>3</sub>O<sub>8</sub> or a total metal content of 22.1 million pounds (10,000 tonnes) of U<sub>3</sub>O<sub>8</sub>. The total resource estimate is 66.5 million tons at 520 ppm U<sub>3</sub>O<sub>8</sub> for 75 million pounds U<sub>3</sub>O<sub>8</sub>.

During Q1, 2016, **Vimy** made progress towards the completion of a Definitive Feasibility Study (DFS) with the continuing support of Reserve Capital Funds by Q1, 2017.

The PFS indicated that the **Mulga Rock Project** is a 17-year operation with the maiden ore reserve underpinning the initial 6 years of production targeted at 3 million pounds U<sub>3</sub>O<sub>8</sub> per annum.

On-going resource estimates and DFS are expected to increase reserve and resource base.

In the first 9 months of Fiscal year 2016 to March 31, 2016, net cash flow from operating activities and investing activities was A\$ 1.45 million and A\$ 4.8 million, respectively. There was no cash flow. As at March 31, 2016, cash was A\$ 1.6 million.

**Vimy** has an available and undrawn A\$ 15 million bridge facility agreement from Resource Capital Fund.

The estimated cash outflow of Q4, 2015 of Fiscal year 2016 is A\$ 6.9 million, of which A\$ 6 million applies to exploration and evaluation and A\$ 0.9 million to administration.



## Uranium mining in Namibia

Uranium was discovered in the Namibia Desert in 1928, but not until intensive exploration got underway in the late 1950s and **Rio Tinto** discovered numerous uranium occurrences in Rössing, which in 1966 resulted in Rio Tinto taking over the rights over the low-grade Rössing deposit, 65 kilometres inland from Swakopmund.

**Rössing Uranium** was formed in 1970 and is now owned by **Rio Tinto** (68.6%), **Iranian Foreign Investments** (15%), **International Development Corporation of South Africa** (10%) and **Namibian government** (3%).

Two other significant deposits found in early exploration were Trekopje, a calcrete deposit near Rössing and Langer Heinrich, a calcrete deposit discovered in 1973 by **Gencor**, 50 kilometres southeast of Rössing.

**Rio Tinto** has mined the Rössing deposit from 1975 as a large-scale open-pit in very hard rock. The mine has a nominal capacity of 4,000 tonnes U per year. Rössing's reserves at the end of 2015 were 6,270 tonnes proven at 0.027% uranium and 32,200 tonnes probable at 0.030% uranium in ore (not allowed for 85% mill recovery).

Rio Tinto reported losses in 2010, 2011, 2012 and 2014, but was profitable in 2013 after cuts on expenditures and layoffs. In 2015, the Company announced that it expected to continue production to 2032, with current reserves taking it to 2025.

Over 2011-2012 a Strategic Environmental Assessment was undertaken over the whole uranium province inland from Swakopmund and Walvis Bay. This addressed the whole region and projects and is to result in a Strategic Environmental Management Plan to be implemented by the government of Namibia and individual project companies.

The major aspect in the Plan is water supply as the coastal town of Swakopmund and Walvis Bay are short of water. In 2013, Namibia was hit by the worst drought for 30 years. Since 2010, water has been supplied to Trekopje from a coastal desalination plant in the Erongo region, with about 20 million m<sup>3</sup> per year output and requiring 16 MWe from the grid.

Some of this water, up to 10 million m<sup>3</sup> per year, is available to other mines and agreements have been signed with Namibian Water Corp for Rössing, Langer Heinrich and Hussab (reported to be taken 2 million m<sup>3</sup> per year).



Rössing requires about 3 million m<sup>3</sup> water per year, but in July 2014 said that it had been unable to reach agreement on purchasing long-term from Erongo at a satisfactory price, so would like to set up its own 3 million m<sup>3</sup> per year RO plant near Swakopmund. However, the Ministry of Environment & Tourism has rejected this proposal.



**Paladin Energy (PDN – ASX)** bought the **Langer Heinrich Project** in 2012. The project is located 50 kilometres south-southeast of Rössing in the Namib Park, and 80 kilometres from the coast. The open-pit mine commenced operation in 2006 with 1,000 tonnes U a year capacity. The ore occurs over 15 kilometres in a palaeochannel system, some 50 metres deep. Some vanadium is present in the carnotite mineral. There is a conventional hard rock mill with an alkaline leaching circuit.

Stage 3 development boosted production capacity to 2,000 tonnes U per year late 2011 at a cost of US\$ 100 million.

In late 2015, C1 cash costs were US\$ 25.38/lb. Recovery in late 2014 was 84.5%.

A heap leach to produce about 400 tonnes U per year from low-grade pre by mid-2016 was proposed for stage 4, in moving towards 3,850 tonnes U per year production level.

AMEC Minproc is undertaking a Definitive Feasibility Study on this. However, in April 2014 new plant investment was put on hold for at least two years. JRC and NI 43-101 compliant reserves are 46,500 tonnes U at 100 ppm cut-off plus 5,100 tonnes U in stock pile.

In January 2014, China National Nuclear Corporation's subsidiary CNNC Overseas Uranium Holding bought a 25% joint venture equity stake in the Langer Heinrich mine for \$ 190 million, entitling it to that share of output.

In Q1, 2016, the Langer Heinrich mine (75%) produced 1.3 million pounds U<sub>3</sub>O<sub>8</sub> at a cost of production of US\$ 24.13 per pound U<sub>3</sub>O<sub>8</sub> versus 1,123 million pounds U<sub>3</sub>O<sub>8</sub> in Q1, 2015 to a C1 cash cost of production of US\$ 29.42. Ore mined was 673.52 tonnes (in Q1, 2015: 598.34 tonnes) at a grade of 789 ppm (868 ppm). Additional low-grade ore mined was 304.27 tonnes grading 323 ppm versus 353.66 tonnes grading 316 ppm in Q1, 2015.

Total sales for the quarter was 595,287 pounds U<sub>3</sub>O<sub>8</sub> at an average selling price of US\$ 34.67/lb. General gross sales revenue amounted to US\$ 20.6 million, which was a 68% decrease over the previous quarter's revenue. Sales volume for the quarter was lower due to inventory accumulation for a fixed price contract delivery and a major CNNC delivery in April.

Higher uranium sales in the range of 1.75 million pounds U<sub>3</sub>O<sub>8</sub> to 2.10 million pounds are anticipated for the June-quarter, the majority of which has already been priced at a substantial premium to current spot uranium prices.

In February 2016, **Paladin** repurchased another US\$ 25 million of the convertible bonds due April 2017. The bought back at an average price of 92% together with earlier repurchases of US\$ 37.9 million has reduced the principal amount of the convertible bonds due April 30, 2017 from S\$ 274 million to US\$ 212 million.

In March 2016, **Paladin** repaid the entire US\$ 56.4 million remaining drawn under the LHN Syndicated facility and terminated it. The Company intends to put a US\$ 25.0 million 24-months revolving working capital facility in place at LHM.

At March 31, 2016, **Paladin's** cash and cash equivalents were US\$ 21.4 million, which is not including any drawing under the 24-month revolving working capital facility being put in place at LHM.

## ► Q2, 2016 guidance update

Uranium sales are anticipated to be in the range of 1.75 million pounds to 2.10 million pounds, of which approximately 1.2 million pounds has already been priced and stripped at the date of April 18, 2016.

C1 cash costs are to be expected within the range of US\$ 23/lb to US\$ 25/lb. Cash and cash equivalents balance as at June 30, 2016 are forecasted to be in the range of US\$ 45 million to US\$ 65 million and then to continue it build further into July as the Company anticipates receiving more than one-third of its fiscal year sales receipts within three months due to the timing of deliveries and payments from customers.

Annual U3O8 production guidance for fiscal year 2016 is expected to be approximately 5.0 million pounds.



**Deep Yellow (DYL – ASX)** of Australia, through wholly-owned subsidiary Reptile Uranium Namibia, is focused on the **Omahola Project**. It includes the high-grade Inca primary uraniumiferous magnetite deposit at about 200 metres depth, the Ongolo Alaskite 10 kilometres away, and MS7 Alaskite in between and possibly connected to it.

An acid leach mill near the Ongolo Alaskite deposit was envisaged treating ore from Ongolo and MS7 Alaskite deposits and the Inca deposit, all mined by shallow pen-pit to 200 metres.

Inca, located about 10 kilometres south of Etango and 95 kilometres from the coast, has 2,800 tonnes U Indicated and 2,400 tonnes U Inferred resources grading about 0.04% U.

Some 12 kilometres northeast of Inca, the Ongolo Alaskite deposit was discovered in 2010, and has 2,50 tonnes U measured, 3,000 tonnes U Indicated and 4,000 tonnes U Inferred resources grading 0.032% U and a strike length of up to 2 kilometres (contiguous with Extract's Ida Dome).

In between is MS7 with 1,660 tonnes U Measured, 370 tonnes U Indicated and 500 tonnes U Inferred resources. It is 600 metres along strike and 400 metres wide.

In November 2011, **Deep Yellow** submitted an environmental assessment report for Inca envisaging an open-pit mine producing up to 2.5 million tonnes per year of uranium and iron-bearing ore, which could result in production of up to 960 tonnes U per year, depending on project economics at 50 ppm cut-off for the whole greater Omahola Project.

In January 2013, **Deep Yellow** reported JORC compliant resources of 17,400 tonnes U grading 0.036% U at 250ppm cut-off for the whole greater **Omahola Project** comprising Inca, Ongolo and MS7.

Areva Resources Namibia's (Areva 100%) **Trekkopje Project**, located about 80 kilometres northeast of Swakopmund, and 35 kilometres north of Rössing, taken over from UraMin, comprises two palaeochannel deposits, with Klein Trekkopje the main one.

The US\$ 1 billion project has shallow open-pit mine and plans a sodium carbonate/bicarbonate heap leach process. About 80% of the ore is less than 15 metres deep, but is very low-grade – 0.012-0.015%.

A substantial conversion of Inferred resources to reserves occurred as a result of drilling in 2006 and 2007, taking the Measured and Indicated resource category up 42,000 tonnes in the main deposit, with in addition 9,000 tonnes of vanadium pentoxide by-product envisaged.

Having quoted 45,600 tonnes U resources in 2008, this was revised to 26,000 tonnes in 2011 at lower grades. This resulted in a massive EUR 1.8 billion write-down of Areva's investment.

The Trekkopje mine was intended to produce 3,200 tonnes U per year from 2013. First concentrate from the pilot phase was produced in January 2011 but development stalled in October 2014 due to low uranium prices. Production in 2012 was 437 tonnes U, followed by the Project into a care and maintenance basis in October 2012 due to the continued decrease of uranium prices with the investments yet to be made on site.



**Taurus Minerals**, a subsidiary of **China's CGNB Uranium Resources**, owner of the **Husab Project** started development of the mine in February 2013, and production is expected to commence late in 2016, ramping up 5,700 tonnes U per year. Swakop Uranium is the developer, now 90% owned by Taurus and 10% by Epangelo Mining.

Taurus is 60% owned by CGNB-URC and 40% by China Africa Development Fund, set up by China Development Bank in 2007.

In July 2014, CGB Global Uranium was incorporated in the UK to sell Husab uranium on the world market.

The main ore body at of the Husab Project is the **Rössing South**, about 5 kilometres south of the Rössing mine and 45 kilometres northeast of Walvis Bay port.

A Definitive Feasibility Study demonstrating the technical and economic viability of mining zones 1 and 2 was collected by Perth-based Extract Resources on the basis of a Measured resource of 32,000 tonnes averaging 0.043% U, and an Indicated resource of 108,000 tU at 0.037% U (JORC and NI43-101 compliant). Inferred resources in Zone 1 to 5 are 50,000 tonnes U averaging 0.029% U.

This comes to 188,000 tU averaging about 0.035% U proven to June 2011, all with a 100 ppm cut-off and still open along strike and dip.

This makes Rössing South the highest grade granite-hosted uranium deposit in Namibia and it is an extension of the Rössing stratigraphy.

The definitive feasibility study involved the project's Zones 1 and 2, and showed a production cost of US\$ 32/lb U3O8 including royalties, marketing and transport and capital cost of US\$ 1.66 billion.  
The study envisages mining of 15 million tonnes of ore per year from two separate open pits to feed a processing plant producing 5,770 tonnes U per year.

The Ministry of Mines and Energy approved the mining licence in November 2011, and in January and July 2011 the Ministry of Environment and Tourism gave environmental approval for the mine and related works to subsidize Swakop Uranium, which holds some of the tenements.

Water supply and labour arrangements were signed in April 2014.

Mining commenced in May 2014. A 1,500 tonnes per day sulphuric acid plant is on line.



**Bannerman Resources (BMN – ASX)** originally held 80% of the exclusively prospecting licence 3345 of the **Etango Project** located 30 kilometres southwest of Rössing and 35 kilometres east of Swakopmund. On January 4, 2016 Bannerman completed the acquisition of the balance of 20%, extinguishment of the A\$ 12 million convertible note and completion of an A\$ 3 million capital raising at a share price of A\$ 0.075.

Funding was formerly from a major shareholder Resource Capital Funds, but at the end of 2015 Bannerman was debt free.

In July 2011, China's Sichuan Hanlong Group made a conditional A\$ 144 million takeover offer for Bannerman, but this did not proceed.

In April 2012, state-owned Epangelo Mining agreed to buy a 5% stake in the Etango Project for about US\$ 3.9 million, with an option to buy a further 5% upon commitment to mine development, but was called off when the companies could not agree on terms.

A Definitive Feasibility Study (DFS) was completed by AME Minproc in March 2012, confirming the viability of the project on the basis of measured and Indicated resources only, and putting its cost estimate at US\$ 870 million.  
Some 80% of the Measured and Indicated resources were converted to proven and probable reserves of 46,000 tonnes U grading 0.0165% U, supporting minimum open-pit life of 16 years.

Production at 2,700 tonnes U to 3,500 tonnes U is envisaged over the first 5 years, then 2,300 – 3,100 tonnes U per year, with production costs of US\$ 41/lb U3O8 over the first 5 years and US\$ 6/lb longer term.

In September 2014, **Bannerman** awarded contracts to construct and operate a heap leach demonstration plant, which was commissioned in March 2015.

In July and then November 2015, the Company said that tis supported the assumptions in the DFS, with over 90% U recovery and only 15 kg/t acid consumption.

A further three phases of leach and SX testing will run to mid-2016.

A project schedule drawn up as part of the DFS envisages an engineering and construction period of about 30 months from project approval to plant commissioning.

During Q1, 2016 or the period ended March 31, the Namibian Ministry of Mines and Energy provided a notice of intention to grant the renewal of the licence. The notice included additional terms and conditions requiring **Bannerman** to submit a proposal on how it can achieve local Namibian 5% equity ownership and participation in management of the Etango Project, together with a broad corporate social responsibility program.

**Bannerman** submitted its proposal on April 22, 2016 with the Management having 30 days to confirm it is satisfied with the proposal, otherwise a 3-month process follows to each agreement on meeting these additional conditions.

On April 7, 2016, **Bannerman** announced further positive results from Phase 3 of the Etango heap leach demonstration plant program, which are similar to or better than the assumptions used in the Definitive Feasibility Study (DFS) and have delivered the clear potential to further reduce operating cost estimates.



**Forsys Metals' (FSY-TSX)** principal focus is on bringing the **Norasa Uranium Project**, which includes the fully licenced Valencia Uranium and exploration-stage Namibplaas Uranium projects into production.

The Company owns a 70% interest in the **Odundo Gold Project**.

The financial model incorporates the mineral reserve mining schedule and capital expenditures over a 15-year life of mine.

In March 2015, **Forsys** files an NI 43-101 compliant Definitive Feasibility Study on the **Norasa Project** prepared by Ameer Foster Wheeler.

The total proven and probable Norasa mineral resere is estimated at 206 million tonnes at a cut-off grade of 200 ppm which equals to 90.7 million pounds U3O8.

The project economics calculated a Net Present Value (NPV) of US\$ 383.4 million including tax at a discount rate of 8% and an internal rate of Return (IRR) of 26% including tax, resulting in a pay-back period from start of production of 4.4 years.

Capital costs are estimated at US\$ 432.8 million.

Quantitatives are treated during the life of mining at a recovery grade of 92.4%, is estimated at 206.1 million tonnes of which 66.7 million tonnes in the first 5 years, containing 77.8 million pounds U3O8 and 25.8 million pounds U3O8, respectively.

Based on US\$ 65/lb average base price, Net Revenue is estimated at US\$ 5.05 billion, of which US\$ 1.68 billion in the first 5 years; Operating cash flow at US\$ 1.75 billion and US\$ 440.3 billion, respectively; and net cash flow after tax US\$ 1.0 billion and US\$ 1.65 billion, respectively.

Total operating costs over the life of mine are US\$ 34.72 and in the first 5 years US\$ 32.96.

In January 2016, **Forsys** executes a Heads of Agreement with respect to the **Odundo Gold Project** with B2Gold Mining Investments and B2Gold Namibia. The earn-in with B2Gold gives them the right to earn up to a 100% interest in Odundo for a total investment of Cdn\$ 11.8 million over 3 years, of which Cdn\$ 2.0 million in the first two years to acquire a 49% interest.

## Niger Uranium Mining

Uranium was discovered at **Azelik** in **Niger** in 1957 by the French Bureau de Recherches Géologiques et Minières (BRGM) looking for copper. The French Atomic Energy Commission (CEA) initiated further studies.

Further discoveries in sandstone followed including at Abokurum (1959), Madaouela (1963), Arlette, Ariege, Artois and Tassa/Taza (1965), Imouraren (1968) and Akouta (1967).

In the midst of these discoveries, **Niger** became independent of France in 1960.

Historically, uranium mining in Gabon has been closely linked with **Niger** due to the role of the French Atomic Energy Commission and Cogema (now **Areva**).

**Niger** is the world's fourth-ranking producer of uranium, with production from its two mines ranging from 3,243 tonnes U in 2009 to 4,116 tonnes in 2015.

### ► **Areva's SOMAIR and COMINAK mines**

The highest production was in 2013 and amounted to 4,528 tonnes including an estimated production of 290 tonnes from SOMINA. There was no production from SOMINA in 2015.

Uranium is mined close to the twin towns of Arlit and Akokan, 900 kilometres north-east of the capital Niamey on the southern border of the Sahara desert and on the western range of the Air mountains.

The concentrates are trucked 1,600 kilometres to Parakou in Benin, then railed 450 kilometres to Cotonou port and exported for conversion mostly to Comurhex in France.

The Somair and Cominak mines were licenced to the end of 2013, and in mid-December both were shut down for maintenance, ending resolution of negotiations on licence renewal. The **Niger** government has been seeking a new deal to be based on the 2006 mining law, which raised royal taxes from 5.5% as set in the 10-year licence to between 12% and 15%, depending on profits. However, low uranium prices limited the economic scope for higher taxes and negotiations were protracted.

The Somair and Cominak mines resumed operations by the end of January 2014 under the terms of government decree. In May 2014, the Niger government and Areva signed a new 5-year agreement for the two mines based on the 2006 mining law and expressing what both sides said was a balanced partnership. The royalty rate will increase potentially to 12% of market value, but depending on profitability.

The deal includes for the first time that the firm's boards will include Nigerian managing directors – appointed in 2015 for Somair and in 2016 for Cominak.

Also Areva will provide 90 million Euros (US\$ 103 million) to support constructing a road from Tahoua to Arlit, near the uranium developments, as well as a further 17 million Euros (US\$ 19 million) for development in the surrounding Inhazer valley. Areva will also build a new headquarter for the two operations in the capital Niamey at a cost of 10 million Euros (US\$ 14 million).

The Niger government expects more than US\$ 39 million in additional tax revenues annually from the new agreement. In October 2014, the government formally approved the agreement.

Resources Minières du Niger (ONAREM), through Sapamin, the Niger mining assets company **SOMAIR** was formed in 1968 and started production from the Arlette/Arlit deposit in 1971, by open cut mining of 0.30-0.35% ore down to 70 metres depth. The mine is located 250 kilometres north of Agadez and 7 kilometres northeast of Arlit town.

Capacity was subsequently expanded to about 2,100 tonnes uranium per year in 1981 (though half was then laid up). Since 2003, production ramp up again, with the Tamou deposit producing 1,565 tonnes U in 2006.

The Artois deposit is deeper (90 metres) and at a lower grade (0.20-0.25%). Mill grade capacity was increased to 3,000 tonnes U per year in 2012 and product is sodium uranite. The average head grade in 2015 was 0.25% U.

**COMINAK** was set up in 1974 and started production from the Akoula deposit in 1978, a few kilometres southwest of Akokan, and then from Akola and Afosta ore bodies.

This is an underground operation at a depth about 250 metres, with 25 kilometres of tunnels.

Mill capacity is 2,000 tonnes per year of magnesium urinate (75% U) or 1,800 tonnes U per year.

Cominak has been engaged in a process to improve its competitiveness. Product is switching to the new deposit of Ebba/Afsto, south of Akoula and Akola. Areva is the operator.

**SOMINA** was established in 2007 to mine Azelik/Teguidda, 160 kilometres southwest of Arlit and 150 kilometres northwest of Agadez, in the Agadez region.

Azalik is being developed with major Chinese (**CNNC**) equity and came into production at the end of 2010, with the aim to ramp up 700 tonnes U per year. It is an open-pit and underground operation using alkaline leach, and with resources of 15,600 tonnes U grading 0.2%.

CNNC said in August 2014 that Azelik has experienced prolonged project delays overrun in its construction budget and low production, which led to heavy losses and causing default on the repayment of bank loans.

In February 2015, CNNC International announced that the mine would be closed and put on care and maintenance due to tight cash flow.

It had earlier hoped to raise production to 2,500 tonnes U per year by 2005 and double that by 2010.

#### ► **Imouraren deposit**

Development of the large **Imouraren Deposit** located about 80 kilometres south of Arlit and 16 kilometres north of Agadez was confirmed in January 2007 after **Areva** agreed to increase royalty payment to the government by 15%, following a 2006 agreement.

In January 2009, Areva was awarded a mining licence.

The project company is Imouraren Inc, 57.6%-owned by Areva, 9% by Kepco and 33.35% by Sopamin and Niger government. Kepco paid 170 million Euros for its share and the right to take 10% of production.

In February 2012, in connection with a 20,000 tonnes U purchase agreement over 10 years, EdF (Electricité de France) agreed with Areva to take a 12.7% stake in the mine, but this did not proceed.

The Imouraren Project is a 1.9 billion Euros investment and Areva had also agreed to spend 6 million Euros per year on health, education, training, transport and access to water and energy for local people.

Areva was aiming for initial production in 2014, ramping up to 5,000 tonnes U for 35 years.

Imouraren will be the largest mining project ever undertaken in Niger, the largest open-pit uranium mine in Africa and the largest anywhere to use heap leaching – on a 42 hectare pad.

The deposit covers 8 kilometres by 2.5 kilometres and Areva lists 213,700 tonnes of uranium resources at 0.07% U, plus 62,000 tonnes U Indicated resources. Ore body depth is between 100 and 150 metres and maximum thickness is 60 metres.

At full production, the project's acid heap leaching facility will process 20,000 tonnes of ore per day with an expected 85% rate of recovery.

In May 2014, with uranium prices not sufficient to allow profitable mining of the deposit, the government and Areva agreed to set up a joint strategic committee which will determine when mining should start – possibly not until about 2020 or when COMINAC resources are depleted.

Almost 1 billion Euros in capital expenditures is still required.

## ► Madaouela deposit

**GoviEx' Madaouela Deposit** is located 15 kilometres from the Arllette and Akoula mines (SOMAIR and COMINAK) in the Arlit region of the Air Massif and was discovered by the CEA in the early 1960s.

**Trendfield** (25%) and **GoviEx Uranium**, at that time a private company, formed the GoviEx Niger Joint Venture in 2007 to explore the Madaouela and Anou Melle deposits, but Trendfield then exchanged this equity for a 10% share of GoviEx. In 2008, Camenco bought an 11% share in the Company for US\$ 28 million with the option to increase to 48%.

Niger Uranium Reserves and Resources					
in tonnes U	Reserves		Resources		
	Proven	Probable	Measured	Indicated	Inferred
SOMAIR	40	5,192	1,184	37,027	20.82
	@ 0.127%	@ 0.259%	@ 0.093%	@ 0.132%	@ 0.167%
Arlit concession					20,403
					@ 0.159%
COMINAK	3,000	11,090			2,239
	@ 0.321%	@ 0.361%			@ 0.305%
Imouraren		213,722		62,584	2,879
		@ 0.07%		@ 0.058%	@ 0.066%
SOMINA			15,600		
Azelik			@ 0.2%		
Madaouela				42,700	10,660
				@ 0.114%	@ 0.113%
Dasa			44,500		
			@ 0.155%		

The Niger government holds a 10% carried interest in the Madaouela Project and has the option to purchase a further 30% share when the mining licence is issued.

The Madaouela Project is based on the mineral resources associated with the Madaouela I mining permit. The NI 43-101 Integrated Development Plan (IDP) for the project defined a large, low operating cost commercially viable uranium project in the prolific Arlit uranium-mining district of northern Niger.

On February 1, 2016, **GoviEx** confirmed that the government if Niger has advised the Company that its mining permit application for the Madaouela I tenement area has been approved by the Council of Ministers.

This positive decision is the result of a decade of considerable effort by **GoviEx** and local stakeholders engaged on exploration, discovery, engineering and the critical environment and social aspect of this large and high-grade project, since the exploration permits were awarded in June 006.

The confirmed Mine permit and approved Environmental and Social Impact Assessment (ESIA) means that the Madaouela project is fully permitted for construction and production.

The IDP was prepared for **GoviEx** by SRK Consulting dated effective August 11, 2015 and is available on SEDAR at [www.sedar.com](http://www.sedar.com)

### Highlights of the IDP are:

- The project development plan envisions an average 2.69 million pounds per year U3O8 production rate over a 21-year mine life, with a 93.7% ultimate recovery of uranium.
- The IDP is based on 61 million pounds of Probable reserves and a Measured and Indicated Mineral resource of 110 million pounds U3O8.
- The base-case project economics at a long-term uranium price of US\$ 70/lb U3O8 are positive and indicate an after-tax net present value of US\$ 340 million (at an 8% discount rate) with an internal rate of return (IRR) of 23.5% and a total life of mine net free cash of US\$ 1,126 million.
- Initial capital costs are estimated at US\$ 359 million and cash operating costs at US\$ 24.49/lb U3O8 including by-product credits and excluding royalties.

In addition, **GoviEx** has been advised by the Niger Government that its application for the Eralrar exploration tenement has been approved as well as the renewal applications for the Madaouela I, II, III, IV and Anou Melle tenements. However, GoviEx's renewal application for Agaliouk exploration tenement was not approved and the Company remains focused assessing the various options available.



**Global Atomic Fuels** is a private Ontario, Canada corporation founded in January 2015. The Company has exploration agreements covering 6 uranium permits in **Niger**, as well as owning a database consisting of numerous uranium exploration targets around the world collected over a 30-year period by a major Canadian uranium producer.

**Global Atomic Fuels** is currently developing 4 uranium deposits with the flagship **DASA**, located on the main highway, 80 kilometres south of Areva's two operating uranium mines in Arlit, has resources of 95.7 million

pounds U<sub>3</sub>O<sub>8</sub> grading 2,554 ppm at a 600 ppm cut-off grade. As the preliminary Economic Assessment (PEA) continues, the Company will continue to conduct exploration activities with the intention to significantly expand the current resource. The other 3 deposits, Isakanam, Dajiy and Tin Negouran are currently less developed.

On February 1, 2016, **Global Atomic Fuels** announced the Ministry of Mines of Niger had signed a 3-year renewal of the uranium exploration permits.

As part of the **DASA** PEA program, the company has completed 110,000 metres of drilling including 22,000 metres of core drilling, as well as advanced metallurgical, hydrogeological, environmental and geophysical studies.

With the current resource of 95.7 million pounds U<sub>3</sub>O<sub>8</sub> having been designed over a 1 kilometre strike length, **Global Atomic's** exploration programs have defined a potential strike length of over 4 kilometres. All infrastructure including roads, power and water are available at the DASA site.

Current studies are focused on a ramp access underground operation based on a 1,500 ppm cut-off grade, which produces a blended head grade of > 3,420 ppm.

Drilling to date indicated in excess of a 10-year mine life at this grade, which would be economic even at current uranium prices. Should prices improve, a lower cut-off grade would increase the mineable tonnes and extend the mine life to over 20 years based on a 5 million pound U<sub>3</sub>O<sub>8</sub> per year production rate.

**Global Atomic** has spent approximately Cdn\$ 550 million on exploration and development to date on its Niger projects and expects to apply for its mining licence for the DASA during the 3-year renewal of its exploration permits.



## **Kazakhstan uranium mining**

In 2009 **Kazakhstan** became the world's leading uranium producer, with almost 28% of world production, rising to 41% in 2014. In 2015 the share of world production declined to 39%. The country produced 23,800 tonnes in 2015 and is planning for further increase to 2018.

Capacity is around 25,000 tonnes U per year, but in October 2011 **Kazatomprom** announced a cap on production of 20,000 tonnes U per year, which was evidently disregarded.

**Kazakhstan** has a major plant making nuclear fuel pellets and aims eventually to sell value-added fuel rather than just uranium.

The country is committed to a high level of uranium exports, and is planning to build a Russian nuclear power reactor probably at Kurchatov by 2025.

Of its 17 mine projects, 5 are wholly-owned by **Kazatomprom**, the national atomic company set up in 1997 and owned by the government, and 12 are joint ventures with foreign equity holders and some of these are producing under normal capacity.

**Kazakhstan** has northern and southern electricity grids with some connection and links to Russia and Kyrgyzstan and Uzbekistan, respectively. Electricity produced was 91 TWh in 2015, of which 81% from coal and gas thermal, 10% from hydro and 8% from gas, turbine.

Net imports from Russia were 471 GWh, net exports to Kyrgyzstan were 421 GWh.



In 2012, the **Kazakhstan** government's energy development plan had 150 TWh per year production in 2030, with 10% of this from renewables and 4.5% from nuclear.

The government planned investment in electricity production and grid of US\$ 7.8 billion by 2015 and foresees US\$ 68 billion by 2030.

**Kazatomprom** has forged major strategic links with **Russia, Japan** and **China**, as well as taken a significant share in the international nuclear company **Westinghouse**.  
**Canadian** and **French companies** are involved with uranium mining and other aspects of the fuel cycle.

The uranium exploration and mining Joint Ventures Akbastau and Karabau with **Tenex** started with Budenovskoye in the Stepnoye area of south Kazakhstan, which commenced production in 2008. These complemented the Zavechnoye Joint Venture 250 kilometres to the south, which was set up in June 2006.

However, in 2009 and 2010 the 50% ARMZ equity in these three joint ventures was traded for an eventual 51% share of Canada-based **Uranium One**, which subsequently became wholly-owned by **ARMZ of Russia**.

Uranium One Holdings is now the holding company for all Russian uranium mining interests in Kazakhstan and its equity in an acid plant.

In mid-2014, **Kazatomprom** said that 55% of Kazakh uranium was exported to China.

In December 2015, the governments of **China** and **Kazakhstan** announced establishment of a US\$ 2 billion fund for bilateral projects within the framework of the "New Silk Road", the new Chinese program.

At the end of August 2015, among US\$ 23 billion of China-Russia deals, **JSC Samruk Kazyna**, the national holding company owning **Kazatomprom**, signed deal worth US\$ 5 billion with Chinese companies and Kazatomprom agreed on transit of its products via China to North America.



**China** is making strides to become self-sufficient in most aspects of the nuclear fuel cycle. Domestic uranium mining currently supplies less than 25% of the country's nuclear fuel needs.

China aims to produce one-third of its uranium domestically, obtain one-third through foreign equity in mines and joint ventures overseas and to purchase one-third in the open market.

Uranium demand in 2020 is expected to be over 11,000 tonnes U, with 58 reactors operating, in 2025 about 18,500 tonnes U for 100 reactors operating, and in 2030 about 24,000 tonnes U for 130 reactors operating.

UxC reports that China imported over 115,000 tonnes U over 2009 – 2014, notably 21,294 tonnes U in 2014 and 19,200 tonnes U in 2015. With annual consumption currently about 8,000 tonnes U, much of this will be stock-piled. It is estimated that the country's strategic inventories are at least 100,000 tonnes U.

China still relies to some extent on foreign supplies for all stages of the nuclear fuel cycle, from uranium mining through fabrication and reprocessing, but mostly for uranium supply.

## ► **China** Nation Nuclear Corporation

**CNNC** maintains a strong monopoly on the nuclear fuel cycle in China, notably the front end forcing China General Nuclear Plant (CGN) to work around this, principally with international ventures, some involving large capital outlays. With the merger of SNPTC and CPI to form **SPI** in 2015 so that SNPTC look over all the nuclear-related business of CPI to function as an active subsidiary of SPI, SNPTC intends to get into both uranium mining and fuel fabrication.

## ► Domestic uranium resources and mining

CNNC is the only current supplier of domestic uranium. CGN has responded energetically to this situation through its subsidiary China Guangdong Nuclear Uranium Resources (CGN – URC).

China now claims to be a uranium-rich country on the basis of “some 2 million tonnes U”. The Red Book total given is 265,000 tonnes U Inferred resources in 11 provinces, 46% of this in Inner Mongolia and 36% in Jiangxi and Guangdong.

China’s seven operating mines have a nominal capacity of 1,450 tonnes U per year. Plans for expansion are up to 2,000 tonnes U per year.

China Nuclear Uranium Corporation, subsidiary of CNNC, operates these mines.

The Ordas basin, covering over 250,000 sq. kilometres of Shaanxi, Shanxi, Gansu and Inner Mongolia, which starts just north of Xian in Shaanxi province and extends nearly to Baotou near the Mongolian border, has become the premier uranium region of China.

Daying is expected to become China’s largest uranium resource and in late 2014 was described by the Geological Survey Bureau as “world-class”. Also in the Erlan basin the Bayonwula deposit, and the Qianjiadian deposit in the Songliao basin in the east of Inner Mongolia were identified.

**CNNC Inner Mongolia Mining Industry** based in Baotou, is responsible for overseeing natural prospecting, scientific research and project management in the middle and western parts of Inner Mongolia. Its Mining Business Division is focused on mainly evaluating the Nalinggou and Bayanwula projects. The Division is also setting up regional headquarters in Inner Mongolia, Jiangxi, Guandong and Xinjiang.

The Dongsheng group of uranium deposits is located south-central Inner Mongolia about 100 kilometres south of Baotou.

## ► International uranium resources

Increasingly, uranium is imported from Kazakhstan, Uzbekistan, Canada, Namibia, Australia and Niger. In 2013, China imported 18,968 tonnes of uranium for US\$ 2.37 billion from these five countries according to China’s General Administration of Customs. In 2014 and 2015, 21,294 and 19,200 tonnes U were imported, respectively.

With the prospective need to import much more uranium China Nuclear International Uranium Corporation (Sino U) was set up by CNNC to acquire equity in uranium resources internationally. It set up the Azelik mine in Niger and have agreed to buy a 10% share of **Areva’s Imouraren project** there for 200 million Euros.

In January 2014, CNNC bought a stake in **Paladin Energy’s Langer Heinrich mine** for US\$ 190 million, entitling it to that share of output.

CNNC has signed a framework agreement with **Kazatomprom** to become a major uranium and nuclear fuel supplier to CGN. Its subsidiary, Sino-Kazakhstan Uranium Resources Investment has invested in two Kazakhstan uranium mines in Irkol and Semizbal, while CNNC is investing in another: Zhalpak.

In April 2015, CNG Mining Co. purchased Sino-Kazakh shares, so it now holds 49% of Semizbai-U Joint Venture.

In November 2010, CGN signed a long-term contract with **Kazatomprom** for 24,200 tonnes of uranium through to 2020.

In May 2014, CGN contracted with **Uzbekistan’s Navoi Mining & Metallurgy** for US\$ 800 million worth of uranium to 2021. In 2013, Uzbekistan exported 1,63 tonnes of U3O8 to China.

In 2012, CGN – URC, through Hong Kong subsidiary **Taurus Minerals** (60% CGN, 40% China-Africa Development Fund) took over Kalahari Minerals and then Extract Resources, giving it ownership of the massive Husab project in Namibia, with 137,700 tU Measured and Indicated resources and a further 50,000 tU Inferred resources at Rössing South. The cost was about US\$ 2.2 billion.

Swakop Uranium is the development company owned by Taurus, except for a 10% share held by the Namibian government's Epangelo Minerals. Mine development commenced in April 2013; production is expected to commence in late 2016 ramping up 5,700 tonnes U per year.

In mid-2010, CGN signed a framework agreement with Cameco of Canada under which the two companies would negotiate long-term uranium purchase agreements and potential joint venture development of uranium resources. In November 2010 the companies signed a long-term supply agreement under which Cameco will supply CGN with 13,150 tonnes U by 2015. The value of the contract was not disclosed.

On May 9, 2016, **Cameco** and **China Nuclear (CGN)** signed an agreement to further expand and deepen their cooperation in the joint venture development of green field uranium exploration projects.

In November 2010, CNGPC signed a US\$ 3.5 billion 10-year contract with **Areva** for supply of 20,000 tonnes of uranium.

On January 26, 2016, **CGN Mining** and **Fission Uranium**, which in November 2012 discovered the world-class PLS Property (Triple R deposit) in the Athabasca Basin, Canada, the world's largest and richest uranium region, entered into a Cdn\$ 82.22 million private placement pursuant to which CGN Mining acquired approximately an 19.9% equity interest in Fission Uranium as a strategic investment at a price of Cdn\$ 0.85 per share.

**CGN Mining** and **Fission Uranium** entered into an off-take agreement pursuant to which CGN Mining will agree to purchase 20% of annual uranium production from the PLS Property and will have an option to purchase an additional 15% at industry standard pricing.



## Russia

In May 2015, Russia's Federal Council approved key support measures including the introduction of a zero rate for mining tax and property tax simplification of the system of granting subsoil use rights, including of the economic development of the Far East and Trans-Baikal up to 2018 policy in the Federal Target Program and the development of infrastructure in Kraznokamsk.

The Russian Federations main uranium deposits are in four districts: The **Trans-Ural district** in the Kurgan region, with the Dalur ISL mine; **Streltsovskli** in the Transbaikal of Chita region of southeast Siberia near the Chinese and Mongolian borders, served by **Krasnokamenks** and with major underground mines; the **Litimsky district** in Buryalia with the Khiagda ISL mine, the more recently discovered remote **Elkan district** in the Sakha Republic (Yakulia).

Russia has a high level concern about the development of new uranium deposits and the Federal Council meeting in 2015 agreed to continue the federal financing of exploration and estimation works in the Vitimsky Uranium Region in Buryalia. Is also agreed to financing construction of the engineering infrastructure of Mine No.6 of Priargunsky Industrial Mining and Chemicals Union (PIMCU).

In June 2015, Rosgeologica signed a number of agreements to expedite exploration in Russia, including one with **Rosatom**. It was established in July 2011 by presidential decree and consists of 38 enterprises located in 30 regions across Russia, but uranium is a minor part of the interests.

Russia has substantial economic resources of uranium with about 9% world reasonably assured resources plus Inferred resources up to US\$ 130/kg – 505,900 tonnes U (2014 Red Book).

**Rosatom** reported **ARMZ** resources as 517,000 tonnes U in September 2015, mostly underground mining. Historic uranium exploration expenditures are reported to have been US\$ 4 billion.

Supplemented by uranium production from **Uranium One** Kazakhstan operations, Russian uranium production more than doubled since 2004 to 7,629 tonnes U in 2012. In 2006, there were three uranium mining projects in Russia, since then others have been under construction and more projected.

Spending in new ARMZ domestic projects in 2013 was Rubel 253.5 million, though in November 2013 all Rosatom investments in mining expansion was put on hold due to low uranium prices.

**JSC ARMZ Uranium Holding Company** became the mining division of **Rosatom** in 2008, responsible for all Russian uranium mine asset and also Russian shares in foreign joint ventures.

In 2008, 78% of **JSC Priargunsky**, all of **JSC Khiagda** and 97.85% of **JSC Dalur** was transferred to ARMZ.

In March 2009, the Federal Financial Markets Service of Russia registered Rubel 16.4 billion of additional in ARMZ placed through a closed subscription to pay for uranium mining assets, on top of Rubel 4.0 billion issued in mid-2008 to pay for the acquisition of Priargunsky, Khiagda and Dalur.

In November 2009, SC Rosatom paid a further Rubel 33 billion for ARMZ shares, increasing its equity to 76.1%.

In 2009 and 2010, **ARMZ** took a 51% share in Canada-based **Uranium One**, pay for this with \$ 610 million in cash and by exchange of assets in Kazakhstan; 50% of JVS Akbastau, Karatou and Zarechnoye, mining the Budenovskoje and Zarechnoye deposits. An independent financial advisor put the value of ARMZ's stakes in the Akbastau and Zarechnoye JV's at \$ 907.5 million, with Karatou, Akdale, South Inkai and Kharasan, as well as small prospects in the USA and Australia (sold in 2015).

In 2013, **ARMZ** completed the purchase of remained outstanding shares in Uranium One and it became a full subsidiary of ARMZ.

Following that, late 2013, **Rosatom** established **Uranium One Holding** as its growth platform for all international uranium mining assets belonging to Russia and assets in Kazakhstan, USA and Tanzania, as well as owning and managing Rosatom's stake in Uranium One Inc.

In 2014, Rosatom accounted for 4,857 tonnes U production at average cost of US\$ 16/lb and listed 177,000 tonnes U of attributable Measured, Indicated and Inferred resources.

In December 2010, **ARMZ** made a US\$ 1.1 billion takeover bid for Australia's Mantra Resources owning the prospective open-pit Mkuju River project in southern **Tanzania**, which was expected in production by 2013 at 1,400 tonnes U per year, but deferred.

Having brought up the amount of prospective uranium deposits by 70% over the last four years from the initial 35,000 tonnes to 59,000 tonnes uranium ore, **Rosatom** hopes to come to a transaction with the Tanzanian government to start extracting uranium from Mikuju on an industrial scale in 2 years.

<b>Russian uranium production (tonnes U)</b>				
<b>Production centre</b>	<b>2015</b>	<b>2014</b>	<b>2013</b>	<b>2012</b>
Priargunsky	1.977	1.970	2.133	2.011
Dalur	590	578	562	529
Khiagda	488	442	440	332
<b>Total</b>	<b>3.055</b>	<b>2.990</b>	<b>3.135</b>	<b>2.872</b>

**ARMZ** planned to invest Rubel 203 billion (US\$ 6 billion) in the development of uranium mining in Russia in 2008-2015. It aimed for 20,000 tonnes per year by 2024.

Total cost was projected at Rubel 67 billion (US\$ 2 billion), mostly at Priargunsky, with Rubel 4.8 billion (US\$ 144 million).

Dalur and Khiagda have planned production of 600 and 488 tonnes U in 2016.