Uranium

Resources and Energy Quarterly December 2017

Australia holds **31%** of the world's proven uranium reserves

Australia is the **3rd** largest producer of uranium in the world

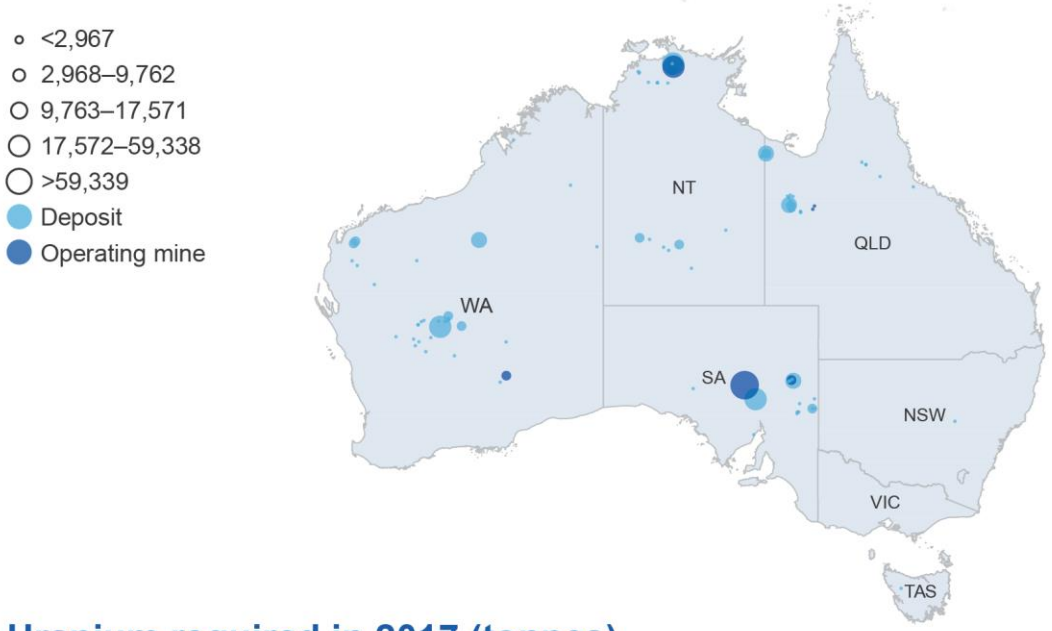
Australia produces and exports more than **7,000 tonnes** of uranium every year

Uranium makes up **11%** of global electricity generation

There are **447** nuclear power reactors across 31 countries, with 60 more being built

There are **245** civil research reactors operating across 55 countries

Major Australian uranium deposits (tonnes)



Uranium required in 2017 (tonnes)

USA	France	Russia	China	South Korea	Japan
17,847	**9,216**	**7,767**	**7,757**	**4,816**	**2,517**

9.1 Summary

- Uranium spot prices remained low in 2017, at just under $US22 a pound, but are expected to recover to around $US27 a pound in 2018 and $US29 a pound in 2019, as market conditions tighten slightly.
- Upgrades at the Olympic Dam facility are expected to impose a temporary disruption on mine output, which will reduce Australian uranium production to 6,990 tonnes in 2017–18.
- Rising demand in Asia and an increase in output at Olympic Dam should support a rebound to 7,100 tonnes in 2018–19.
- Australia's uranium export earnings are expected to increase from just under $600 million in 2016–17 to around $635 million in 2017–18 and 2018–19, with an easing in export contract prices offsetting the impact of higher spot prices.

9.2 Prices

Prices are expected to begin rising from their current historical low

Spot prices appear to have bottomed out, remaining largely unchanged over several successive quarters. Prices averaged $US20.79 a pound in the June quarter, $US20.22 in the September quarter and around $US21.00 in the December quarter. This suggests the long price fall of recent years has finally come to a halt, though at levels well below those needed to support profitable production.

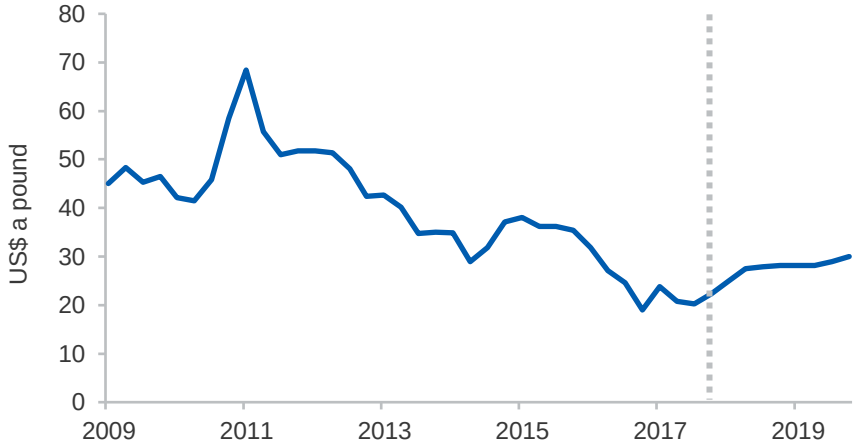
Producers have remained cushioned to some extent by contract prices, but there is downward pressure evident here as well. A number of legacy contracts are expiring, with many more set to do so in coming years. This will likely force some high-cost producers out, curtailing supply at the margins. This will, in turn, place upward pressure on spot prices and gradually close the gap between contract and spot prices.

Prices lifted briefly following an announced production cutback in Kazakhstan, but the rise was not sustained. A similar outcome is expected following a second cut-back in Kazakhstan and an announcement by Cameco of a production cut at its huge MacArthur River mine in Canada.

Substantial secondary markets and inventories will likely dull the effect of these curtailments. However, price pressure is also expected to increase on the demand side. A wave of new reactors is expected to come online in China over the next 12 months. This will likely lead to a spike in demand in the second half of 2018, and a modest reduction in inventories over the outlook period.

As a result, uranium spot prices are forecast to lift from the present low to average $US27.15 a pound in 2018 and $US28.85 a pound in 2019.

Figure 9.1: Outlook, quarterly uranium prices



Source: Cameco Corporation (2017) Uranium Spot Price; Ux Consulting (2017) Uranium Market Outlook

9.3 Consumption

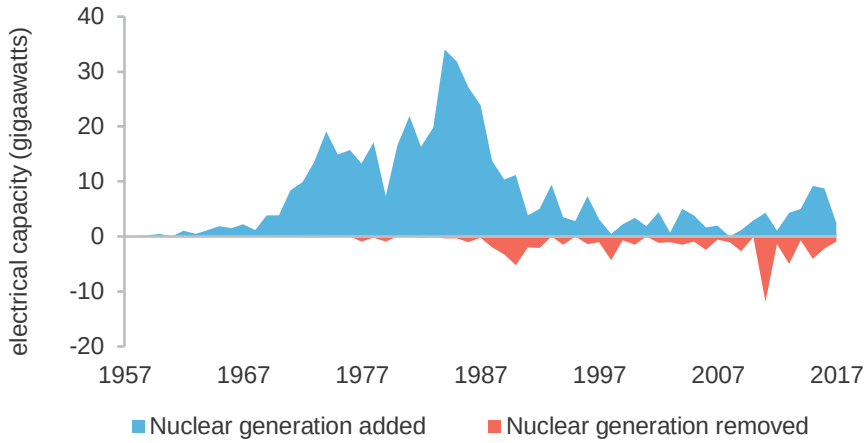
Growth in nuclear energy is concentrated in China, India and Russia

Global uranium consumption is forecast to rise from 82,000 tonnes in 2017 to 86,400 tonnes in 2018 and 89,600 tonnes in 2019. Growth will be largely driven by reactor construction in China, where 16 new reactors are scheduled to commence operation over the end of 2019. These include the Taishan 1 and 2 reactors, which are expected to be two of the largest ever built. New reactors are also expected to be completed in Russia, South Korea, Finland and the United Arab Emirates. Partly offsetting this, reactor closures are expected in Germany, Switzerland, Sweden and France.A wave of new Chinese reactors may create a "spike" in uranium demand in 2018, since new reactors require a full fuel load on commencement (where existing reactors replace only part of their fuel loads each year).

Reactor construction in China continues a long-term trend in nuclear power away from the EU and US and towards Asia. The bulk of currently operating reactors were constructed in the US, UK, Japan, Germany and France in the 1970s and 1980s. Reactor construction in most Western countries subsequently ground to a halt, although there remain long-term plans to expand the reactor fleet in the UK and Canada. The aging of the world's reactor fleet (with a global average reactor age of 29 years) makes it unlikely that nuclear energy will grow substantially as a share of global energy generation over time. Long term prospects for nuclear generation remain highly influenced by the pace of reactor construction in Asia.

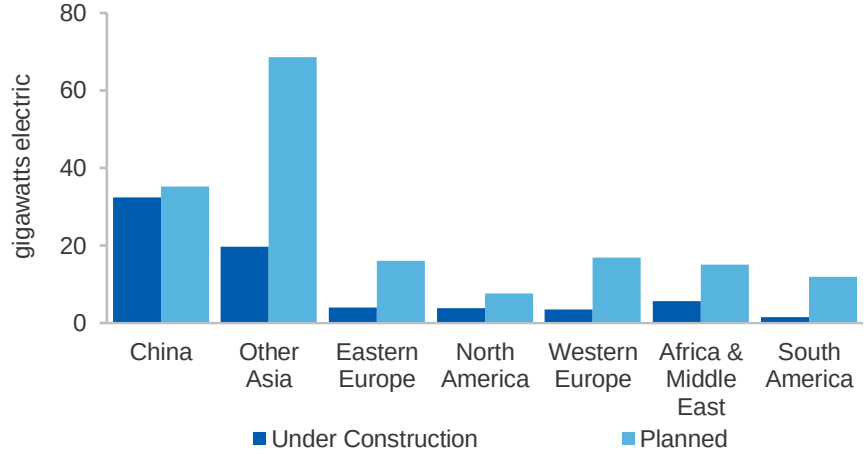
Importantly however, the December quarter showed some improvement in the outlook for nuclear generation across the OECD. In October, the Japanese Government reaffirmed its commitment to reconnecting its reactor fleet. The US Government agreed to $3.7 billion in loan guarantees to progress the stalled Vogtle project, which now appears likely to proceed. The US Government also instructed the Federal Energy Regulatory Commission to adopt new regulations ensuring that nuclear (and coal) plants which support "grid reliability" can recover "fully allocated costs" in order to protect energy security.

Figure 9.2: Annual change to world nuclear power generation



Source: World Nuclear Association (2017)

Figure 9.3: New nuclear capacity



Source: International Energy Agency (2017); World Nuclear Association (2017); DIIS estimates

In South Korea, a citizens' jury rejected previously announced plans to cancel construction of units 5 and 6 of the Shin Kori plant, and the Government has committed to their completion. Ontario has released a plan to refurbish ten reactors and extend the life of six others, ensuring significant nuclear power generation in Canada until 2064. The French government has announced that earlier plans for rapid phase-down of nuclear power will be replaced with a more "realistic" target.

However, although the environment for existing nuclear energy production has stabilised, there remains no significant pipeline of nuclear power plant construction across the OECD, and isolated projects underway face a high risk of cost blow-outs and delays.

9.4 Production

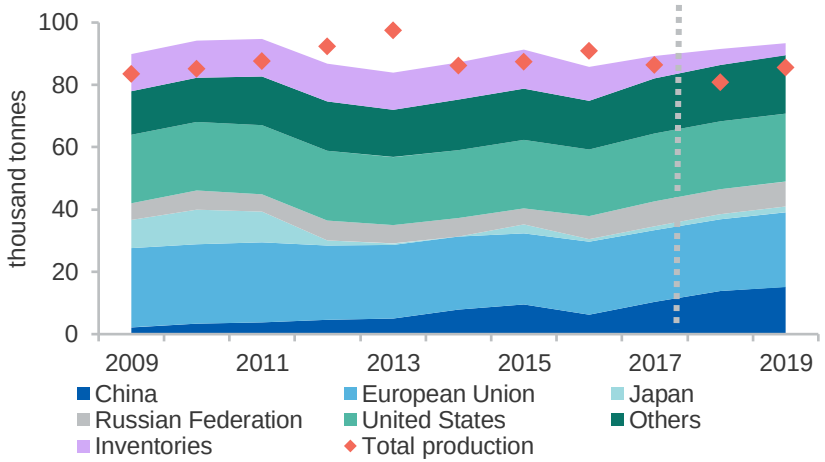
Mine production is falling, but inventories and secondary markets should constrain price growth

World primary production of uranium is estimated to have declined from 73,500 tonnes in 2016 to 69,400 tonnes in 2017, largely as a result of production cut-backs in Kazakhstan. A further large fall (to around 60,000 tonnes) is forecast for 2018. This follows announcements of an additional cut in Kazakhstan (where KazAtomProm will impose a 20 per cent output reduction for three years), and a freeze at the MacArthur River mine in Canada, where production will cease for 10 months from January 2018. MacArthur River accounts for more than 10 per cent of global mine output.

Several other production cuts also occurred in the December quarter. Areva announced plans to reduce uranium output from its Somair mine in Niger by 400 tonnes in 2018, with production at the nearby Cominak mine also under review. Both mines have production costs above $US30 a pound, making them uneconomic. A succession of other cuts and investment deferrals have also taken place in the US, Ukraine and Africa.

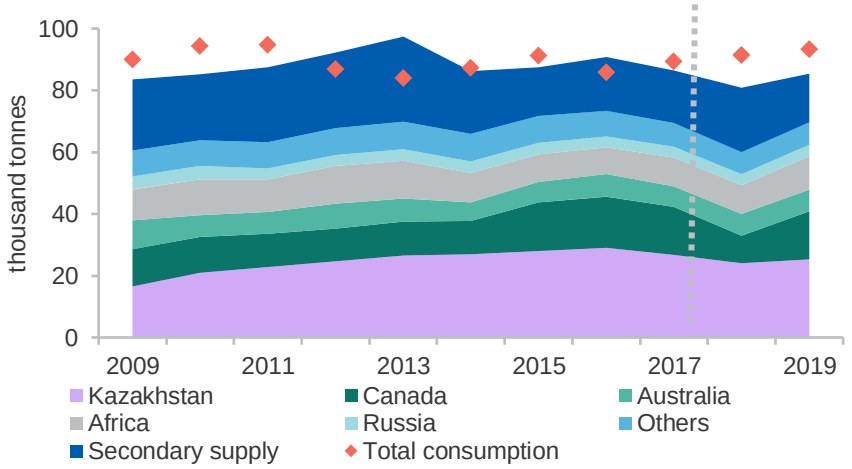
The effect of this tightening on prices and markets is likely to be somewhat muted. Production is expected to resume at MacArthur River in late 2018, leading to a rebound in mined supply to 69,600 tonnes in 2019.

Figure 9.4: World uranium consumption



Source: International Energy Agency (2017); World Nuclear Association (2017); Ux Consulting (2017)

Figure 9.5: World uranium production



Source: UX Consulting (2017) Uranium Market Outlook; World Nuclear Association (2017).

In the interim, any supply shortfall could be made up, in part, through increased supply from uranium enrichers in secondary markets. Cameco also plans to meet its sales commitments (which sum to around 13,000 tonnes per year) using inventories and output from its mine at Cigar Lake.

Although further cuts in production are still a strong prospect, the scale of uranium inventories (almost 1.5 billion pounds of inventories have been run up globally over the past 25 years) will help to cover the gap.

9.5 Australia's exploration, production and exports

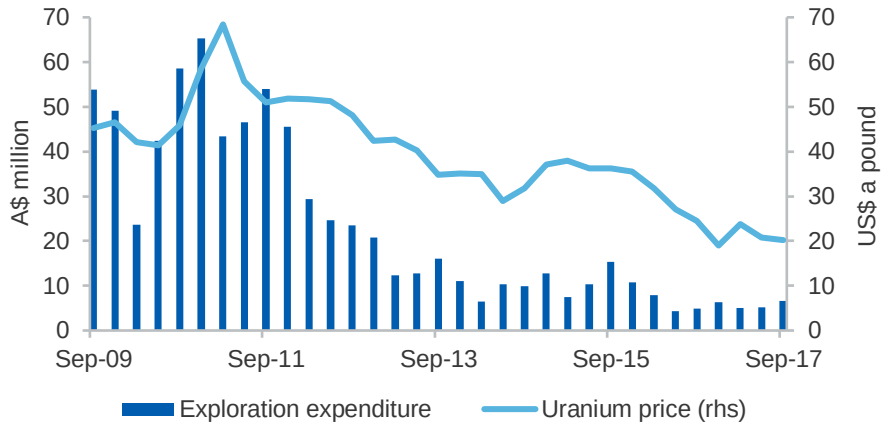
Australia's uranium exploration expenditure remains low

Australia's uranium exploration expenditure remains minimal, with $6.6 million invested during the September quarter. Exploration has risen marginally in quarterly and through-the-year terms, but remains well below the 2010-11 peak, when quarterly expenditure averaged over $50 million.

Production remains solid, as upgrades conclude at Olympic Dam

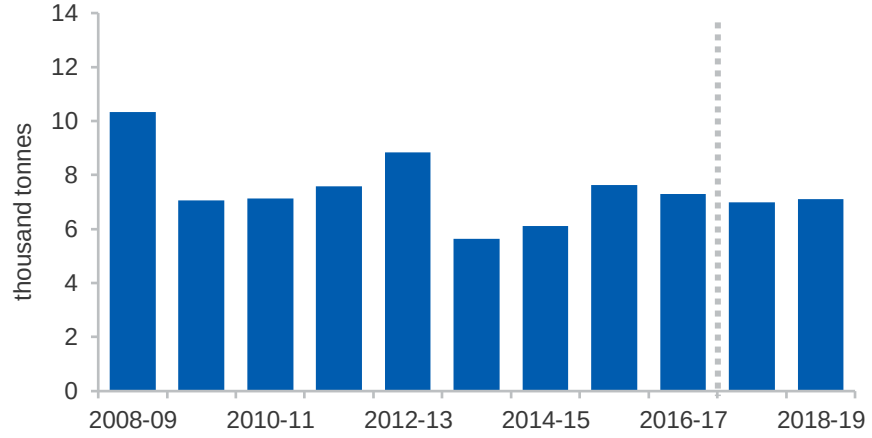
Australia's uranium production is forecast to decrease from 7,295 tonnes in 2016–17 to 6,990 tonnes in 2017–18, affected by the production pause at Olympic Dam. This production pause was timed to run until late November, with BHP seeking to expand capacity through major overhauls, including a rebuild of the slag and flash furnaces and the electro static precipitator. In 2018–19, a recommencement of production at Olympic Dam (and expansion of its capacity) is expected to support a rebound in Australian production to around 7,100 tonnes. Various uranium mine developments moved closer to completion in Australia during the December quarter. Boss Resources' Honeymoon project in South Australia is on a stronger footing following recent field leach trials, which demonstrated "historic high" uranium recovery levels of over 370 mg U3O8 per litre. This significantly reduces the costs and risks of the project. The ion exchange plant attached to the project also performed well during initial start-up. Boss has recently filed a Preliminary Feasibility Study for the project, bringing it closer to final approval.

Figure 9.6: Australia's uranium exploration



Source: ABS (2017) Mineral and Petroleum Exploration, cat. No. 8412.0; Cameco Corporation (2017) Uranium Spot Price

Figure 9.7: Australia's uranium production



Source: BHP (2017); Operational Review, DIIS (2017); Energy Resources of Australia (2017); ASX Announcements – Operations Review; company media announcements (2017)

Vimy Resources' Mulga Rock project also appears to have a higher resource deposit than previously thought, with ore reserves now estimated at more than 42 million pounds of U3O8. This is 36 per cent higher than the previous estimate, which was published in late 2016. Vimy's Definitive Feasibility Study is ongoing.

Prices are weighing heavily on exports, but there are "green shoots"

Export values fell to $A596 million in 2016–17, as a result of falls in the uranium price. Contract prices are expected to decline slightly in 2017–18, as some contracts expire. As a result, export revenue is expected to increase only marginally to $A636 million, despite the resumption of production at Olympic Dam.

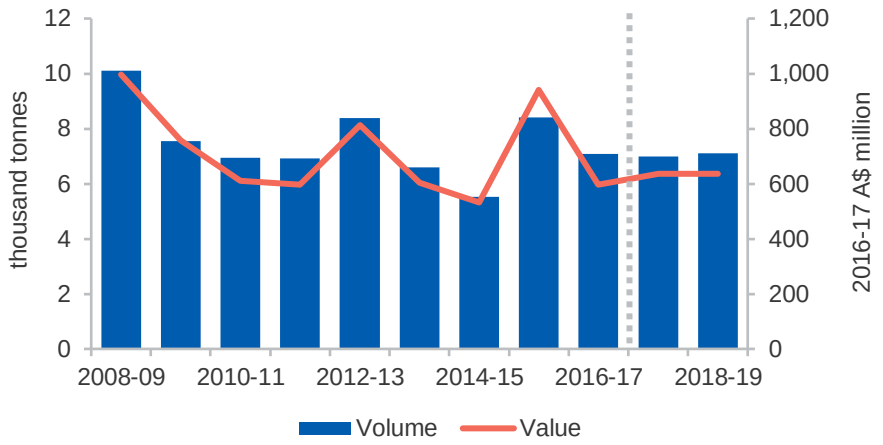
Export values are expected to be roughly stable in 2018–19, with some benefit from higher spot prices offset by the impact of an expected easing in production at ERA's Ranger mine (as it prepares to cease production by early 2021.)

Export earnings have been revised down from the previous *Resources and Energy Quarterly* forecast, reflecting a likely softening in the outlook for price growth.

As previously noted, the price outlook remains mixed, with spot prices expected to rise modestly while contract prices come under pressure. However, conditions for Australian exporters are likely to remain structurally difficult over the outlook period.

On the upside, competitors such as Canada and Kazakhstan have cut their production significantly, creating a chance to increase market share. However, global inventories remain high, and the expiration of supply contracts during 2017 and 2018 will see a larger share of global demand being met from the spot market. The current outlook for spot prices suggests marginal losses from uranium production in the Olympic Dam mine, and larger losses for other deposits.

Figure 9.8: Australia's uranium exports



Source: Department of Industry, Innovation and Science (2017)

Box 9.1: Nuclear power in the World Energy Outlook 2017

The International Energy Agency's World Energy Outlook (WEO) 2017 provides analysis and forecasting based on possible future pathways for energy markets. The 2017 edition includes several alternative scenarios:

- A Current Policies Scenario (CPS), in which energy policies already in effect remain intact, but no new policies are legislated.
- A New Policies Scenario (NPS), in which existing policies remain in effect, and announced policy intentions released following the Paris Agreement also proceed to implementation.
- A Sustainable Development Scenario (SDS), in which governments enact new policies not yet announced, in order to fully meet Paris targets and achieve the energy goals of the UN Sustainable Development Agenda.

Nuclear power will play an important role as a low-carbon energy source

Nuclear energy is a policy-sensitive industry, and figures from the WEO 2017 suggest different policy scenarios produce significantly varying outlooks.

Nuclear energy generation under alternative scenarios

	Historical		CPS		NPS		SDS	
	2000	2016	2025	2040	2025	2040	2025	2040
Generation (twh)	2,591	2,611	3,218	3,825	3,217	3,844	3,531	5,345
Share of total (per cent)	17	11	10	9	11	10	13	15

All scenarios predict a significant rise in output of nuclear energy as a result of rollouts announced by China and India. Although there is divergence between scenarios, all show an expansion in reactor constructions, with 60 new reactors expected by the mid-2020s.

Under the NPS, nuclear capacity increases significantly, but remains confined to a limited number of countries. China is expected to more than triple its capacity and become the leading nuclear power, while India becomes one of the top five generating countries. However, nuclear generation in the EU falls by around one-third by 2040, as a result of planned phase-downs in France, Germany and Belgium.

Under the SDS, pressure to build clean energy leads to much more substantial investment in nuclear generation. Modern nuclear reactors are highly dispatchable, meaning they can support renewable energy deployment by balancing volatile renewable energy generation. Nuclear power projections have been revised down in the WEO 2017. This is due to recent announcements by Korea and France of plans to scale back nuclear power, as well as financial difficulties among US nuclear providers, which will make it harder to replace aging reactors.

China is expected to be the main engine of growth nuclear power

China's Energy Revolution policy contains significant targets for expansion of nuclear power. This expansion builds on rapid recent progress in Chinese nuclear technology. A total of 58 reactors are planned or under construction, but the WEO 2017 notes that approvals for reactors further out have slowed, suggesting a peak to reactor growth within the next few years.

China has improved its technology, developing its own second- and third-generation pressurised water reactors. Nuclear technology has also become an important part of China's export policy. The China General Nuclear Power Corporation has built five reactors in Pakistan, with two more under construction. It has also recently signed a contract with Argentina to build two reactors, and is collaborating on projects in the UK. Discussions are also underway with Romania, South Africa, and Turkey.

China's imports of uranium will likely be crucial for miners and exporters. Currently, China imports around 7,000 tonnes of uranium per year from Australia, Canada, Kazakhstan, Namibia, Niger and Russia. This is expected to rise to between 12,000 tonnes and 16,000 tonnes by 2030.

Table 9.1: Uranium outlook

						Annual percentage change		
World	**Unit**	**2016**	**2017 f**	**2018 f**	**2019 f**	**2017 f**	**2018 f**	**2019 f**
Mine production	kt	73.5	69.4	60.0	69.6	-5.5	-13.6	16.0
Africa b	kt	8.6	9.1	9.2	10.9	5.7	0.9	17.7
Canada	kt	16.6	15.6	8.8	15.4	-5.8	-43.3	74.4
Kazakhstan	kt	29.0	26.7	24.0	25.4	-8.0	-10.0	5.6
Russia	kt	3.5	3.6	3.7	3.7	0.9	2.3	0.0
Consumption	kt	74.9	82.0	86.4	89.6	9.5	5.4	3.7
China	kt	6.3	10.4	13.9	15.2	65.6	33.0	9.5
European Union 28	kt	23.3	22.9	23.1	23.9	-1.7	0.7	3.5
Japan	kt	0.8	1.3	1.6	1.9	58.0	25.0	18.8
Russia	kt	7.4	8.0	8.0	8.0	7.8	0.6	-0.3
United States	kt	21.4	21.8	21.8	21.8	1.8	0.0	0.0
Price								
– nominal	US$/lb	25.6	21.8	27.2	28.9	-15.0	24.5	6.3
– real c	US$/lb	26.2	21.8	26.6	27.6	-16.7	21.9	4.0
Australia	**Unit**	**2015–16**	**2016–17 s**	**2017–18 f**	**2018–19 f**	**2016–17 s**	**2017–18 f**	**2018–19 f**
Mine production	t	7,623	7,295	6,990	7,100	-4.3	-4.2	1.6
Export volume	t	8,417	7,081	6,990	7,100	-15.9	-1.3	1.6
– nominal value	A$m	940	596	636	635	-36.6	6.7	-0.2
– real value d	A$m	976	608	636	620	-37.7	4.6	-2.5
Average price	A$/kg	111.7	84.2	91.0	89.5	-24.6	8.1	-1.7
– real d	A$/kg	115.9	85.9	91.0	87.4	-25.9	6.0	-4.0

Notes: **b** Includes Niger, Namibia, South Africa, Malawi and Zambia; **c** in 2017 US dollars; **d** in 2017–18 Australian dollars; **f** forecast.

Source: Department of Industry, Innovation and Science (2017); Cameco Corporation (2017); UX Consulting (2017) Uranium Market Outlook