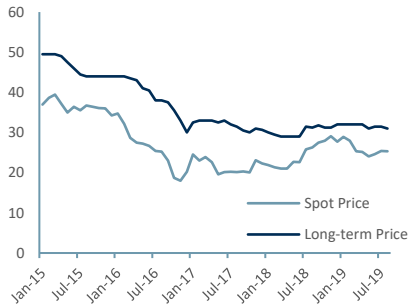
BRIEFING NOTE

Extractives



Sources: TradeTech; UxC

Wednesday, 25 September 2019

Commodity Prices	**USD**
Uranium	
Current Price	25.25/kg
Brent Crude Oil	
Current Price	64.55/bbl.
WTI Crude Oil	
Current Oil	58.44/bbl.
Metal Prices	
Copper	
Current Price	2.59/ton
Gold 100oz	
Current Price	1,499.30 t/oz

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Uranium Market

Market Mechanism and Drivers U_3O_8

Uranium's (U_3O_8) main use is as a fuel in the production of electricity by nuclear power stations. The uranium market is complex, illiquid (thinly traded) and opaque. Directly or indirectly State-controlled producers account for up to 70% of global production and these players do not have to follow economic logic unlike the companies without State subsidy. The majority of consumption (power stations) are geographically and often politically far from the majority of production (mines). Consumption growth requires decades-long investment cycles whereas supply (uranium) is relatively volatile. These characteristics make the market susceptible to marginal pricing, dumping and panic selling, pushing the spot.

- No traditional spot or forward market;
- Conversion market is a leading indicator for the production market;
- The top 10 uranium mines account for 51% of total production;
- Majority of the world's 438 nuclear reactors are from 5 countries;
- 70% of supply companies state-owned and in different countries with radically different politics to the majority of reactors
- Utility companies hold unknown or unknowable uranium reserves.

How the Uranium Market Functions

Pricing behavior describes an amplified cobweb model.

Unlike most commodities, uranium (U) is not traded on the open market nor is it governed by the typical supply and demand pricing mechanism. The uranium market is comprised of a few key players, and there's no real single market price as one would find in the oil & gas market.

Illiquid market

Uranium trades once or twice per day, which is in direct contrast to commodities like oil and gold, which trade several million times a day.

The uranium market is highly illiquid since trades are few and often carried out in secrecy. Trade reporting is late and may in fact be largely inaccurate. Trades in the market are commonly of three types - spot prices (buying on the day) mid-term contacts and long-term contracts that determine price, volume and production levels for a buyer and seller. The market is cyclical over the long run. Lead times for demand for uranium run into decades with high barriers to entry (approving, planning and building nuclear power stations, compared with supply (mining and milling uranium ores), which is much more volatile.

Market is not transparent

Spot price is the price for the immediate purchase of a kilogram of uranium.

Because of its close ties to politics, buyers and sellers negotiate deals privately. This lack of transparency means that there is no global market price, instead prices are published by independent market consultants; UxC LLC (UxC) and TradeTech. Prices in the uranium industry are not set in the same way as other commodities, instead, these firms infer a spot price by analysing various uranium transactions from around the world and the general state of the global market. As such the spot price is very unlikely to be the price paid. The same is true to a lesser degree of mid and long-term contract rates.

UxC and TradeTech publish longer-term prices also.

Price trends decoupled

Spot market is not a real market

In general, basic materials follow the pricing patterns of energy, the exception being precious metals such as Gold (Au), which have more complex demand drivers. Mined commodities broadly follow the price of energy because energy is required as the key system input to change something dug out of the ground into something we want.

First nuclear power station was turned on in 1960

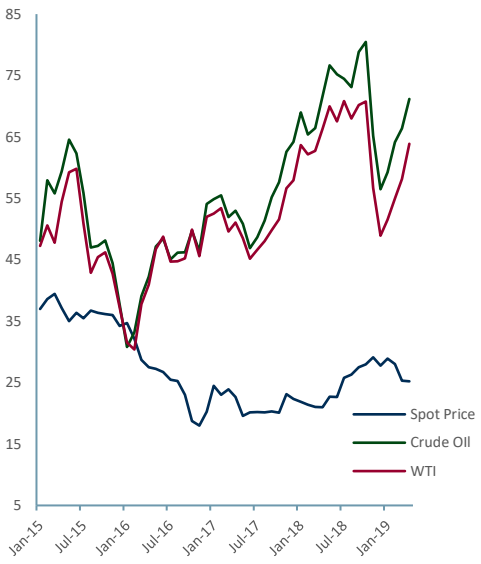
11% or 2,500 TWh p.a. of the world's electricity is produced from "burning" U_{235} and U_{238}

The dominant use of uranium is as an energy source in the production of heat to create steam to drive turbines to generate 11% of global electricity. Uranium's pricing should also therefore be reflected in the price of other hard commodities, but it is not.

In 1960 the total global electricity generation from all sources was 2,500 TWh p.a., the same as today's contribution from Nuclear power.

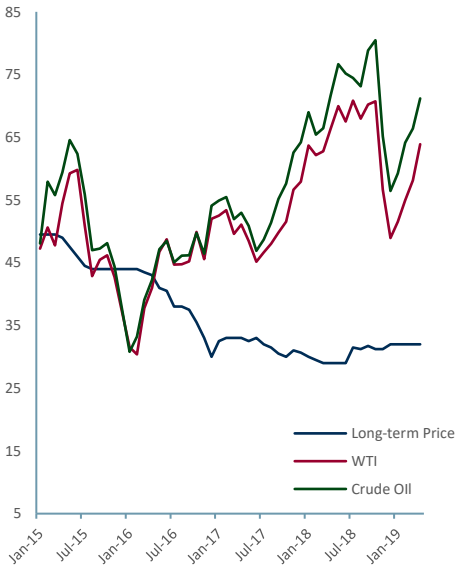
The spot, mid and long-term uranium (U_3O_8) prices are decoupled from other markets. In our view, the UF_6 (conversion market) is a forward indicator for the milled and leached U3O8 market, which is further evidence of an extreme asymmetrical information flow and so a distorted or even dysfunctional pricing market.

Exhibit 1: Uranium spot prices vs crude



Sources: TradeTech; UxC; The World Bank.

Exhibit 2: Uranium long-term vs crude



Sources: TradeTech; UxC; The World Bank.

UxC and TradeTech also publish longer-term prices.

Exhibit 3: Top 10 uranium producers YE18

Company	T/U	%	Exchange	Ticker	MCAP
Kazatomprom	11,074	22	LSE	KAP	3,064
Orano Group	5,809	11	Private	-	-
Cameco	4,613	9	TOR	CCO	5,050
Uranium One	4,385	8	Private	-	-
CGN	3,185	6	Private	-	-
BHP	3,159	6	LSE	BHP	37,924
ARMZ	2,904	5	Private	-	-
Rio Tinto	2,602	5	LSE	RIO.L	53,537
Navoi Mining	2,404	4	Private	-	-
Energy Asia	2,204	4	Private	-	-
CNNC	1,983	4	Private	-	-
*General AQ	1,663	3	Private	-	-
VostGok	1,180	2	Private	-	-
Sopamin	1,002	2	Private	-	-
Other	4,701	9	-	-	-
Total	**53,498**	**100%**			

Source: World Nuclear Association
*General Atomics/Quasar

80% of global uranium production was accounted for by the top 10 producers YE18A.

Producing Countries and Mines

Over half of the uranium mine production is from state-owned mining companies. Kazakhstan is the largest uranium mine producer delivering 41% of global supply from its mines in YE18, followed by Canada at 13% and Australia at 12%.

Kazakhstan produces 41% of global supply but has 14% of global extractable reserves, putting it in second place to Australia with 30% of global reserves (and 12% of production)

Exhibit 4: Top 10 uranium producers by country (tonnes U)

Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Kazakhstan	14,020	17,803	19,451	21,317	22,451	23,127	23,607	24,586	23,321	21,705
Canada	10,173	9,783	9,145	8,999	9,331	9,134	13,325	14,039	13,116	7,001
Australia	7,982	5,900	5,983	6,991	6,350	5,001	5,654	6,315	5,882	6,517
Namibia	4,626	4,496	3,258	4,495	4,323	3,255	2,993	3,654	4,224	5,525
Niger	3,243	4,198	4,351	4,667	4,518	4,057	4,116	3,479	3,449	2,911
Russia	3,564	3,562	2,993	2,872	3,135	2,990	3,055	3,004	2,917	2,904
Uzbekistan (est.)	2,429	2,400	2,500	2,400	2,400	2,400	2,385	2,404	2,404	2,404
China (est.)	750	827	885	1,500	1,500	1,500	1,616	1,616	1,885	1,885
Ukraine (est.)	840	850	890	960	922	926	1,200	1,005	550	1,180
USA	1,453	1,660	1,537	1,596	1,792	1,919	1,256	1,125	940	582

Source: World Nuclear Association

Exhibit 5: The largest producing uranium mines in YE18.

Mine	Country	Main owner	Type	Production (tonnes U)	% of world
Cigar Lake	Canada	Cameco/Orano	underground	6,924	13
Olympic Dam	Australia	BHP Billiton	*by-pro/Undg	3,159	6
Husab	Namibia	Swakop Uranium (CGN)	open pit	3,028	6
Inkai, sites 1-3	Kazakhstan	Kazaktomprom/Cameco	ISL	2,643	5
Rössing	Namibia	Rio Tinto	open pit	2,102	4
Budenovskoye 2	Kazakhstan	Uranium 1/Kazatomprom	ISL	2,081	4
Tortkuduk	Kazakhstan	Orano/Kazatomprom	ISL	1,900	4
SOMAIR	Niger	Orano	open pit	1,783	3
Ranger	Australia	Rio Tinto/ERA	open pit	1,695	3
Kharasan 2	Kazakhstan	Kazatomprom	ISL	1,631	3
Top 10 total				**26,946**	**51%**

Source: World Nuclear Association
**by-product / underground*

Demand Drivers

Market dependency upon finite non-productive capacity

Nuclear power demand

Market demand is dominated by nuclear power stations requiring uranium rod bundles. and means there are in fact two markets – the U_3O_8 production market and the UF6 (gaseous phase for enrichment) conversion market.

Demand for nuclear power in electricity generation is the biggest driver of global uranium demand. As countries around the world seek cleaner alternative to fossil fuels, nuclear power use in electricity generation has gained greater traction.

We assume 443 nuclear power stations operate globally,

We assume 50 more are in construction,

We assume 100 more are in the planning phase.

Nuclear power stations currently account for 11% of global electricity generation. 11% of global electricity generation today is equivalent to the entire global electricity production in 1960. We have assumed that there are 443 nuclear power reactors in operation, a further 50 in the build phase and another 100 in the planning phase.

We have also assumed that electricity demand growth is underpinned population growth, emission free electricity, green and strategic energy government policy has brought nuclear power back into vogue after Three Mile Island, Chernobyl and Fukushima each halted its progression for long periods.

Environmental factors

Zero emissions electricity

Climate change policy makers support nuclear energy as an alternative to fossil fuels.

As more countries are implementing emission reducing policies, companies are turning to nuclear power as a greener or zero emissions electricity alternative to burning fossil fuels. We expect nuclear energy to provide a 40-year role in cutting emissions.

Macroeconomic factors

Underlying demand is rising – completion pricing is above production costs for the first time in 10-11 years

The demand for uranium grows in direct proportion with global economic growth. As economies become more reliant on nuclear electricity to power their growth, the demand for uranium will continue to rise.

Supply Drivers

Uranium prices are under pressure due to over-supply in the short run

Global supply sources

Relative to demand (building new nuclear power stations), supply (uranium mining is highly volatile and is subject to non-commercial decisions from panic sellers and state-controlled enterprises.

Lack of discipline in production from state backed entities, distressed selling and opaque inventories held by utility companies

Marginal pricing (the ability to price to every customer individually) is possible due to the illiquidity and opaqueness of the market and because a small or small number of producers in the industry can exert a significant influence on global supply and thus prices.

Complacency about long-run future supply driven by untested, unproven, unlicensed and unpermitted new production claims

In addition, the top three producing countries - Kazakhstan, Canada and Australia – provide about two-thirds of global annual supply of uranium. Therefore, events in these countries can have market moving effect. Kazakhstan dominates supply from a country perspective and the US dominates consumption – they are geographically and politically far apart. Note that we expect China and India to dominate consumption in the long term.

Global inventories

Production has reduced though the closing of mines and processing mills

Capital investment has been cut and new projects have come offline.

Many utilities hold unknown or unknowable inventories creating an unknown level of supply overhang in the market, leading to pricing uncertainty due to asymmetric information – i.e. the utilities (buyers) know far more about the total global supply than the producers (sellers)

However underlying demand cycle is in an upturn as evidence by conversion pricing, which has risen above the production cost in the last 6 months for the first time in 10 years.

Many producers hold inventories of uranium to buffer against the effect of lower prices, but this has the opposite effect of that which is intended. Holding a buffer signals that uranium supply is ubiquitous and causes prices to fall, much like the effect warrants issued by a company, which create a stock overhand causing a fall in the company share price because of the anticipated dilution when the warrants are converted to new shares. Similarly, once dug out of the ground the market expects the uranium to come into play at some point.

Closing mines and milling facilities does act as a signal to the market that supply is dropping. However, due to illiquidity, lack of transparency, panic sales and uncommercial selling by state-controlled entities below the cost of production, closing mines and facilities does not guarantee that prices in the uranium market will rise.

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