

## Uranium

This mostly comes from a conversation with someone who was asking me about uranium, so it is fairly informal and most of the content is in response to questions that were asked. I went fairly in depth with my thoughts, so I thought I would consolidate them into a PDF file. I've done a fair bit of research, but I am not an expert. If there is something I've got wrong or overlooked, feel free to let me know at [sdinicol@hotmail.com](mailto:sdinicol@hotmail.com)

If you only follow news in the US or Europe, you'd think that nuclear power is dying. And it is in decline in those parts of the world, but China is expanding its fleet of nuclear power plants in a big way. Same with India. Both these countries have increasing electricity demand and terrible problems with air pollution. Coal is just not an acceptable solution for them anymore. There are also plants being built mainly in EM countries. Overall, the number of reactors is increasing. China and Russia are also becoming leaders in the construction of new plants. The US has for the most part let their technology die (although there are some interesting projects like small modular reactors and Bill Gates's company). China and Russia are becoming much more efficient at this, and it should make building new reactors more affordable. Construction is by far the most expensive part about nuclear power. The uranium itself makes up less than 10% of the cost.

Now onto supply. The spot price has been in decline since Fukushima, but the industry works on long term contracts. That is why miners continued to produce despite the spot price becoming economical. They were still at least breaking even on their long-term contracts. Now those contracts are running out, and supply is shutting down. Cameco, the second largest producer, has shut down all but one of their mines. Paladin shut theirs recently. Many of the rest that are still operating are operating at below capacity. Kazatomprom is the elephant in the room. They are responsible for 40% of supply. They have recently IPO'd and are showing signs that they are going to start acting like a capitalist business rather than the soviet production-driven entity that they've been in the past. They have reduced production 20%. All this supply discipline has meant that the market is finally in a supply deficit.

Looking forward, there are really no new mines being built. There is no incentive to do so, and there won't be for some time. The uranium market still has excess inventory to work through, so patience will be required. But I don't think it will take as long as a lot of people think. New contracts are signed 2 years in advance of when the uranium is actually delivered, and for the shuttered mines to resume production or for producing mines to scale up, it will take at least that long to do so. After the uranium is delivered, the uranium needs to be enriched and fabricated into fuel rods. This is another 2 years. So this is a fairly long lead time between when a contract is signed and when the uranium is actually loaded into a reactor.

Few long term contracts are being signed right now, it's kind of a stalemate. Miners aren't going to sign a contract that ensures they lose money and utilities aren't going to sign a contract for lbs that are significantly above the spot price. Once things do get going, they could escalate quickly.

Section 232 has actually put the US utilities on the sidelines for now. It is unclear what the remedy will be, if any. Personally, I am skeptical that the Trump administration will do anything

to hurt the utilities. It is a tough business in the US and they face stiff competition from cheap natural gas. If they cause more reactors to decommission early, it helps no one. A lot of people seem pretty sure that 232 will go through, but I give it no more than a 50% chance. And if it does, it will have to be implemented slowly. Barely any uranium is actually produced in the US. The petitioners have asked for 25% of supply to be required to be American. This would be roughly 12 million lbs. It's possible but it would take 3-5 years. The US would end up with a different price than the rest of the world, and it would have to be at least \$60/lb. If section 232 does not go ahead, it is bullish for the sector anyways (maybe less so for American producers that are higher cost and likely have some likelihood of 232 priced in) because utilities will finally enter the market again.

To be a little more specific on 232, according to Jeffrey Klenda of Ur-Energy it was actually Rick Perry that asked them to come forward with the 232 petition. So there is definitely support within the government.

But Trump has been so supportive of coal and nuclear power plants that the only way I can see it happening is if he also came up with a subsidy to keep plants open. In unregulated markets they are struggling to compete with natural gas.

I think the military is also in favour of protecting the supply chain.

Another thing you might see is something that excludes Russia and ex-Soviet countries but still allows the import of U from allies like Canada and Australia.

Now if 232 fails completely, the bull case is that the uncertainty that has kept utilities on the sidelines is removed and the US utilities can start contracting again. Security of supply is extremely important and one of the ways they maintain that is through diversity of supply. So even if Kazakhstan offers them a sweet deal, there is no way they're going to contract 100% from them.

The bull case for US producers I guess is they are so small that it wouldn't take a huge contract to make a big difference to their bottom line.

*"I'm trying to understand how these contracts work. Like, how long did those contracts last for, and what was the amount of money the mines were selling Uranium for despite the low spot price?"*

*Now that the contracts have run out, what are the new 'set' of contracts that are coming in?"*

They vary in length but often they are up to 10-years. Many of the contracts that are near-expiring today were signed in the years before Fukushima. Take Ur-Energy for example, they are still selling uranium into their long-term contract at \$49/lb (current spot price is just shy of \$29/lb). So they could continue to produce from their mine as the spot market collapsed.

There are also different ways the contracts are written. If they're not for a fixed price they will often have a base price, sometimes a ceiling price, and sometimes they will be a combination of

fixed and spot. For example, Cameco prefers to sign contracts that are 40% fixed and 60% market. That gives them exposure to the upside while protecting themselves on the downside. Since right now they are buying most of their lbs to resell into their contracts, this arrangement means their realized price goes up as the spot price goes up so they are protected there too.

Kazatomprom has been responsible for much of the downward pressure in the spot price since Fukushima. By Kazakh law, they were required to sell into the spot market. I guess to prevent corruption. They have recently set up a trading arm in Europe, so now they sell to that subsidiary and then the trading arm markets the uranium to customers. This should be supportive of prices.

Utilities tend to want to lock down supply when it is scarce, this means they do the most contracting at market peaks. Uranium makes up ~5-10% of the electricity they generate, so to pay double for their fuel is not the end of the world. Running out of fuel is their biggest fear. Right now, there is excess uranium inventories and the sentiment is that it is plentiful. So utilities are complacent. Spot market volumes are at record levels while term contract volumes are low.

US utilities are in a more complicated position. Those power plants in unregulated jurisdictions are struggling to compete with cheap natural gas. For some of them, their future is uncertain, and this prevents them from thinking long term. On top of that, there is section 232. The petitioners have recommended that the remedy be that 25% of uranium be required to come from American sources, but that is just their recommendation. The government could decide to do anything, they could go the route of imposing tariffs if they wanted to. This uncertainty has made the utilities even less willing to enter into contracts. A decision either way will free them up to plan longer term.

Now back to the contracts running out, once they do, the mines they support become uneconomical and it leads to them being put on care and maintenance. This is what happened with Paladin's Langer Henrich mine in Namibia. Once their contract ran out, they shut it down rather than produce at a loss.

Some producers that still have contracts are even closing their mines. Cameco is the best example of this. They shut their McArthur River mine, the biggest in the world, even though it was still producing uranium economically. They did this to preserve their asset for better times and to try to bring the market back into balance.

I believe UxC (the analysts that make reports on the market mostly for utilities) is and has been far too optimistic about its reopening. They assume a price around \$40 would be enough to get them to restart the mine, but this is unlikely. They also assumed in their model that it would restart when the 10-month temporary closure was up. It was clear to anyone paying attention that they announced the 10-month closure to comply with labour laws and not because they actually planned to restart the mine after that. I wish I would've bought some calls because it was so obvious. The spot price spiked \$5/lb the day they announced the indefinite suspension.

So now Cameco is producing around 9m lbs from Cigar Lake and is committed to deliver 20m lbs annually. This means they are buying around 11m lbs/year. They also whittled down their

inventory in 2018, and that is why their recent earnings looked so good. Some of the smaller producers like Ur-Energy and Peninsula are also buying to sell into their contracts.

If the past is any guide, once the market begins to tighten, and utilities begin to worry about security of supply, there's going to be a rush to sign new contracts.

Financial players have also been acting to mop up excess inventory while it is still cheap. Yellowcake (YCA on the LSE) IPO'd in 2018 and bought over 8m lbs from Kazatomprom. Uranium Participation Corp (U on the TSX) is another such entity, and a couple more have been proposed, one in Australia and one in the US. This is the safest way to play uranium but with the least upside.

In the past, these entities and hedge funds were buying as supply was drying up and the price was rising, and accelerated the move.

YCA has an agreement (not obliged to though) to buy U from Kazatomprom over the next 9 years or so.

I think it will be a gradual rise over the next year or two and then things will go parabolic.

### *Secondary Supply*

I haven't mentioned secondary supply either but that was also a major factor in the bear market, underfeeding in particular.

So a utility buys U from a miner, and then signs a contract with an enricher to increase the concentration of U-235. U-235 is the isotope that can undergo the chain reaction that nuclear power depends on. The enricher is required to enrich it to a certain amount of lbs at a specified concentration and the waste is discarded as tailings. However, these tailings still contain U-235. If an enricher has nothing else to do, they can stick the tailings back into their centrifuges. Whatever enriched uranium they get out, they can sell into the market. This has been another source of low-cost uranium and since the main cost of the centrifuges is the sunk cost of their construction, it makes sense to keep them working as much as possible.

Because so many reactors were idled after Fukushima, there was less work for these centrifuges to do. It's a little more complicated than that but let's keep it basic.

This meant they had free time to re-enrich their tailings. And if you look at the cost of SWU (separative work units), you can see it has also been in a huge price decline, implying excess supply and not enough demand.

But as demand for enrichment increases as the global fleet of reactors grows, these centrifuges will have less time to spend re-enriching their tailings. And as their tailings are re-enriched the U-235 content in them is going to fall to uneconomic levels anyways.

So this is another source of uranium supply that should decline. And if you look at SWU prices, they are in the beginning of an uptrend so it looks like this has already begun.

*“Aren't some scientists in WA state developing (or developed) a cheap scalable mesh fiber product to extract uranium from seawater? I've looked into uranium investing a lot and have never heard a good argument for why this won't kill the price of uranium and wreck the miners. It's not capital intensive at all. And mining very much is. Source: been a mining investor for a few years now.”*

<https://www.newsdeeply.com/oceans/articles/2018/06/28/the-nuclear-option-technology-to-extract-uranium-from-the-sea-advances>

This article says \$200/lb. I'm sure the cost will come down with scale but doesn't seem like a big threat to miners.

They got 5 grams of uranium in a lab, so the next step will be to test it in the ocean. I imagine they will need to do studies to ensure that it does not harm marine life significantly, and then obtain permitting from the Department of Fisheries.

The article says it is “decades or more away” and may not be viable until the cheaper uranium to mine is used up.

I pretty much wrote this while I've been sidelined on the couch after surgery. It has been a good exercise to get my thoughts out and organized. I'm just an amateur, so take my writing with a grain of salt. If you want to take a deeper dive, Mike Alkin and SmithWeekly have been excellent sources of information for me.