kinvestor

URANIUM

RESEARCH REPORT

presented by
kincommunications

NOVEMBER 2021

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Summary

Uranium, first discovered in 1789, has become an important source of energy on the global stage. With the renewed focus on clean energy and a changing legislative landscape to support the transition, uranium is poised to become more important than ever before.

The uranium market has quietly been transitioning from a bear market to a new bull cycle that commenced in early 2018. For the first time in the last five years, global requirements for uranium have outpaced production, putting uranium explorers, miners, and producers in a favorable position to meet future demand.

This report aims to help the reader understand the history of uranium, the factors that impact both supply and demand, the market outlook, the impact of COVID-19 on production, the cyclical nature of uranium, and ultimately offer insight on what appears to be an attractive risk-reward tradeoff for uranium assets.

Contents

Background Information

World Electricity Mix

The world's energy and electricity are provided by a myriad of sources, with the major sources being coal, gas, hydropower, nuclear, wind, oil, solar, and other renewables. As of 2020, nuclear and renewables sourced over one-third of global electricity. With the increased focus on decarbonization, renewables have become more important in the electricity mix. There are increasing trends of electricity production by renewable sources, decreasing trends for coal and oil, and an ever-evolving legislative landscape that favors the former.

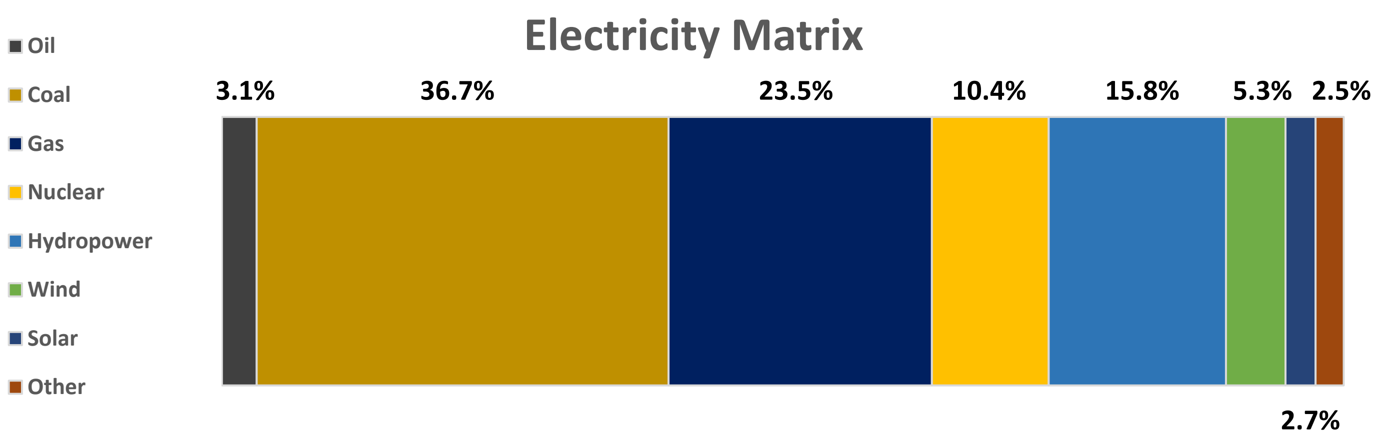
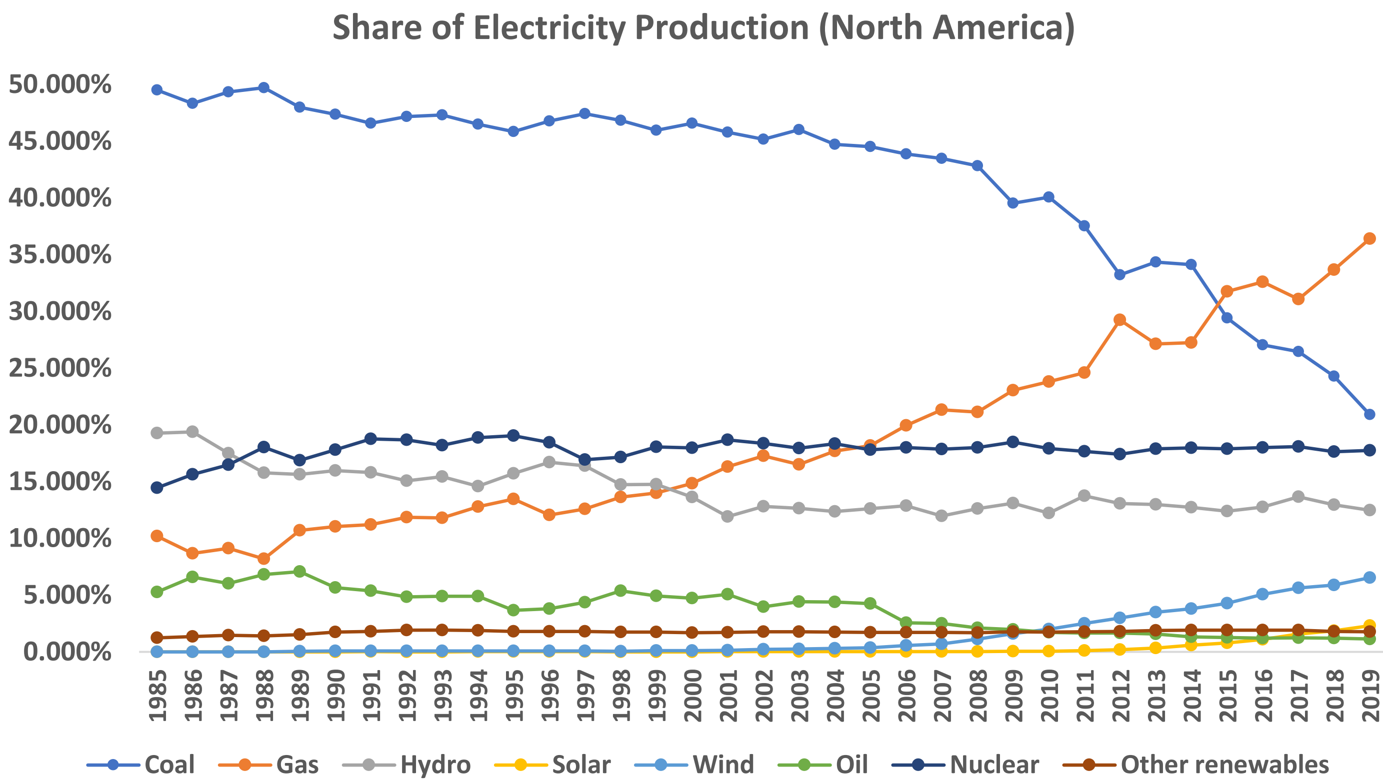


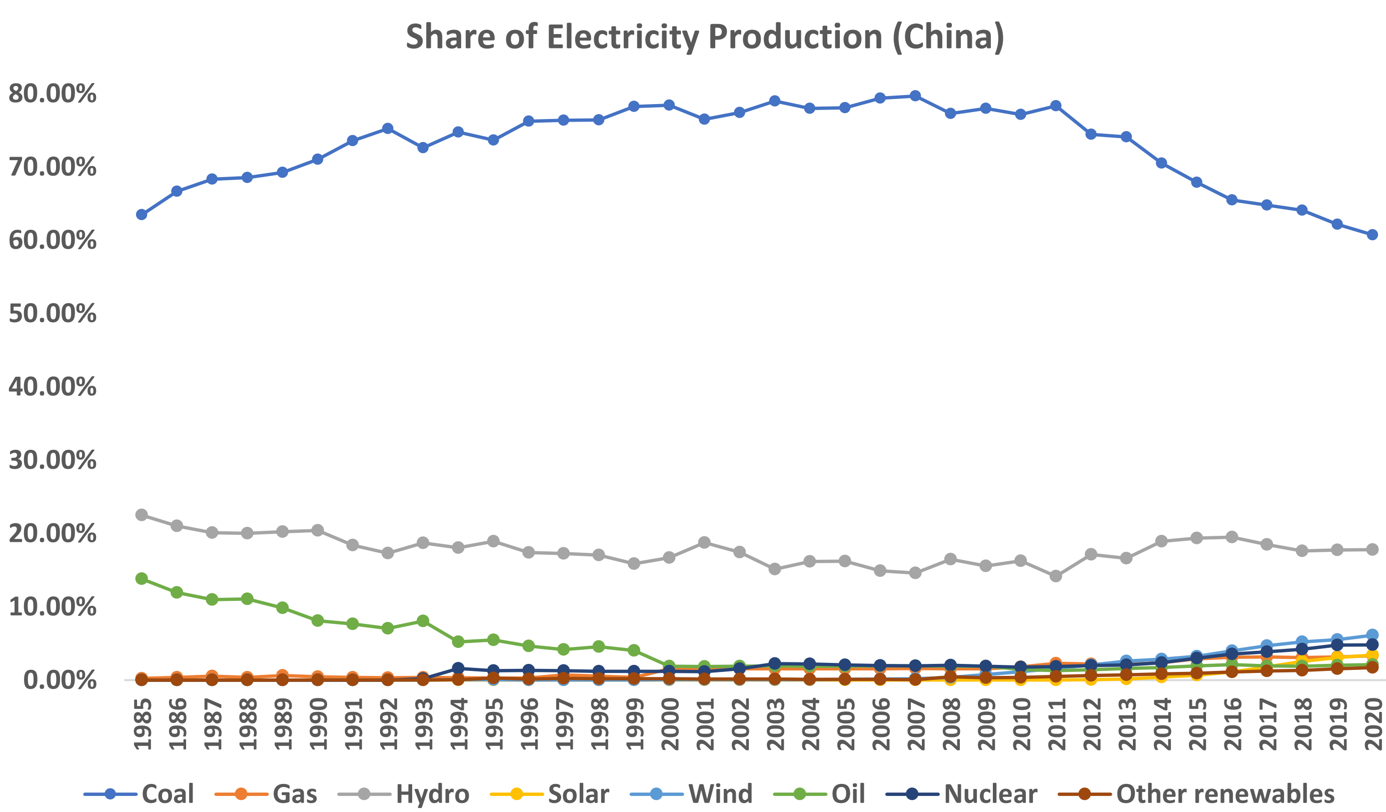
Fig 1. Electricity Mix

Source: OurWorldinData.org

The United States and China alone accounted for nearly 40% of worldwide electricity production in 2020. More renewable forms of energy have been introduced in the past decade, but they have not reached a point of statistical significance. China's primary source of energy remains to be coal; although they have no immediate plans for a massive shift from coal, they do plan on lowering carbon intensity by 65% in 2030, as compared to 2005 levels. North America currently has a more balanced approach but remains heavily dependent on Natural Gas. As leading nations begin to deviate from fossil fuels in the coming decade, a heavier reliance on sustainable forms of energy like hydropower, solar, and nuclear, will be required to meet these goals.

Fig 2. Share of Electricity Production by Source





Source: OurWorldinData.org

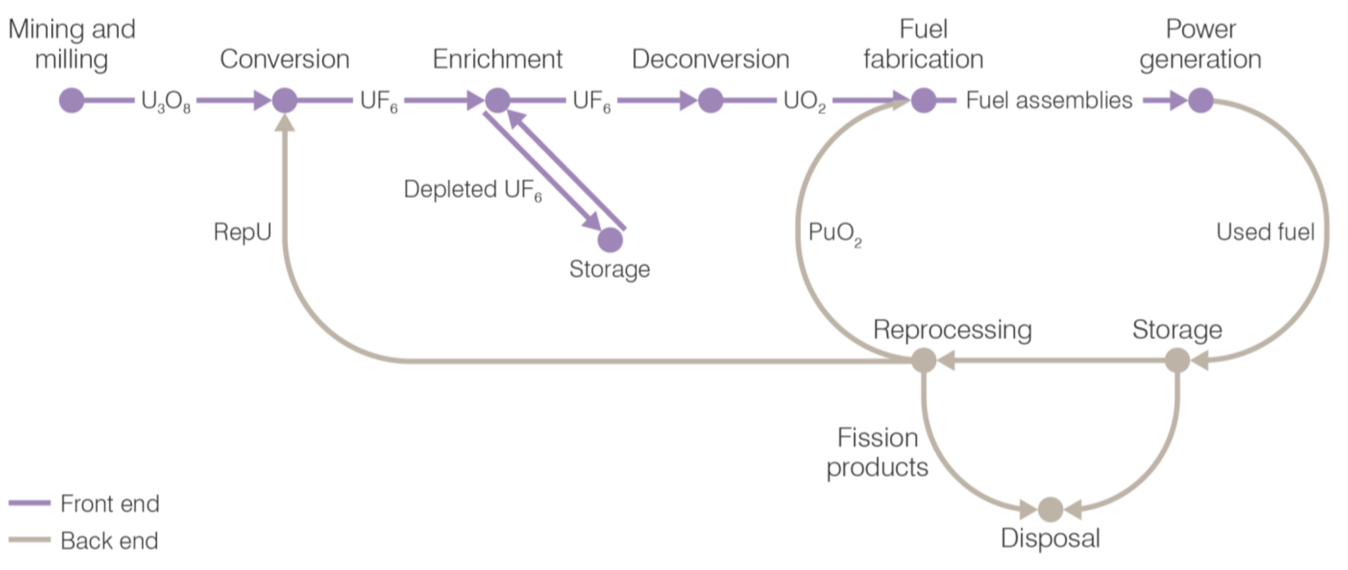
What is Uranium?

Uranium is a heavy metal which has been used as an abundant source of concentrated energy for over 60 years. It was discovered in 1789 by Martin Klaproth in a mineral called pitchblende. Like other elements, uranium occurs in differing forms known as isotopes. Natural uranium, as found in the Earth's crust, is a mixture of two isotopes: U-238 and U-235, accounting for 99.3% and 0.7% of natural supply, respectively. The isotope U-235 is important because it is ready for nuclear fission under certain conditions, while U-238 is less radioactive and decays very slowly making it non-fissile (energy required for fission is greater than energy output from fission).

Uranium Fuel Cycle

The nuclear fuel cycle refers to the various activities associated with the production of electricity from nuclear reactions. The front-end of the fuel cycle includes mining and milling, conversion, enrichment, and fuel fabrication; while the back end includes temporary storage, reprocessing, recycling, and disposal.

Fig 3. Uranium Fuel Cycle Diagram



Source: World Nuclear Association

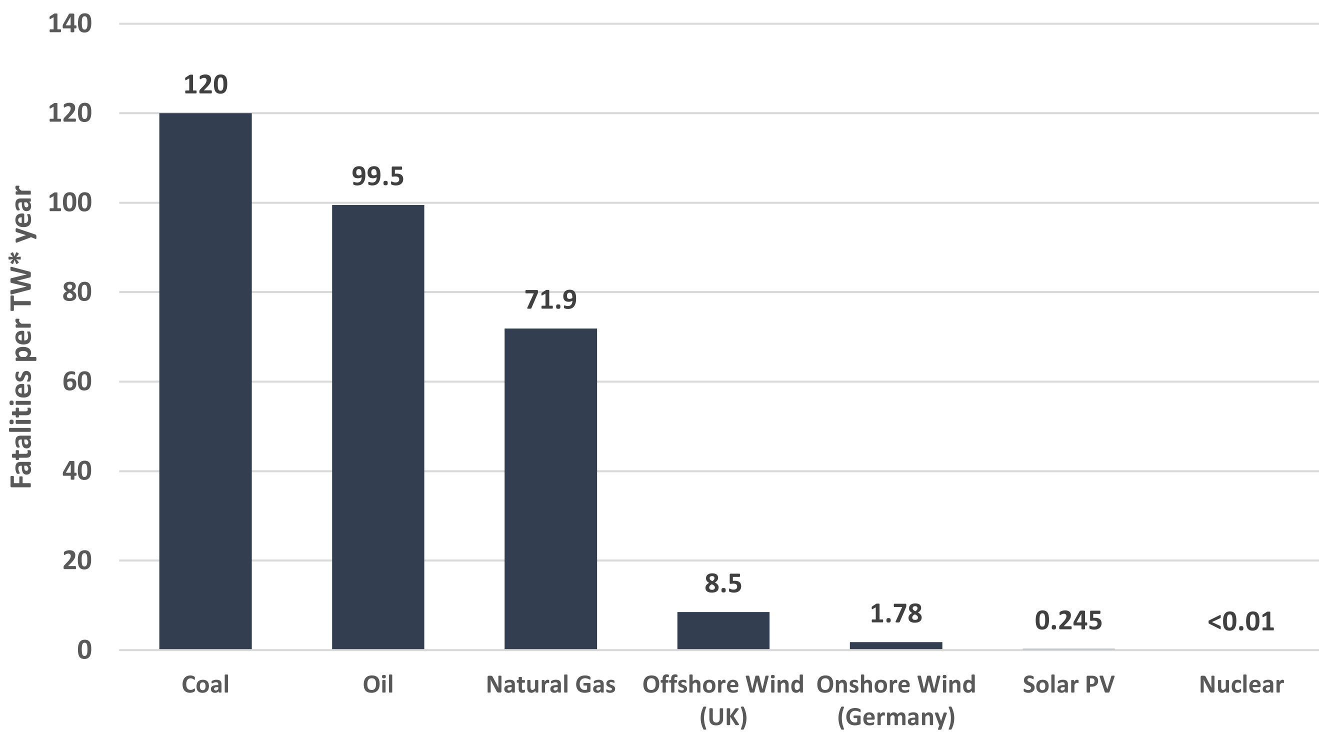
Nuclear Power Generation

Similar to fossil-fuel burning electrical plants, heat generated from nuclear fission and chain reaction is used to produce steam to drive a turbine and an electric generator. In order to maintain efficient reactor performance, about one-third of the spent fuel is removed and replaced with fresh fuel every 12 to 18 months. Typically, one tonne of natural uranium can produce approximately 44 million kilowatt-hours of electricity, the same electrical output as 20,000 tonnes of coal or 8.5 million cubic meters of gas.

Safety & Benefits of Nuclear Energy

Many people continue to associate the safety of nuclear energy with devastating occurrences such as the Chernobyl and Fukushima nuclear disasters, but this is not an accurate representation. Chernobyl (Ukraine 1986), in addition to using RBMK Soviet reactors with an extremely flawed design, was also a nuclear weapons manufacturing facility, a key reason for the explosions that caused the disaster. As for Fukushima Daiichi (Japan 2011), the only fatalities were elderly hospital patients who passed away from the stress of being suddenly transported out of the radiation zone. Like any industrial design, nuclear power plants are built to minimize the risk and impact of accidents. To put the Chernobyl and Fukushima disasters into perspective - they are the only major accidents that occurred in over 18,500 cumulative reactor-years of commercial nuclear power operation in 36 countries, according to the World Nuclear Association. As show in *Fig 4*, on a per unit of electricity basis, nuclear appears to be the safest method of generating electricity.

Fig 4. Deaths from Energy-Related Accidents Per Unit of Electricity



Source: Paul Scherrer Institute

Nuclear power is the only proven technology for large-scale and centralized power production that is carbon-free as of 2021. A quarter-ounce uranium fuel pellet has the energy-to-electricity equivalence of 3.5 barrels of oil, 17,000 cubic feet of natural gas, and nearly a tonne of coal. In addition, nuclear power plants usually operate 24/7 at more than a 93 percent average capacity factor, which is much more efficient compared to traditional energy sources. Ultimately, weather conditions will not affect nuclear power generation as compared to renewable energy such as solar and wind, making it a reliable energy source under any condition.

Supply

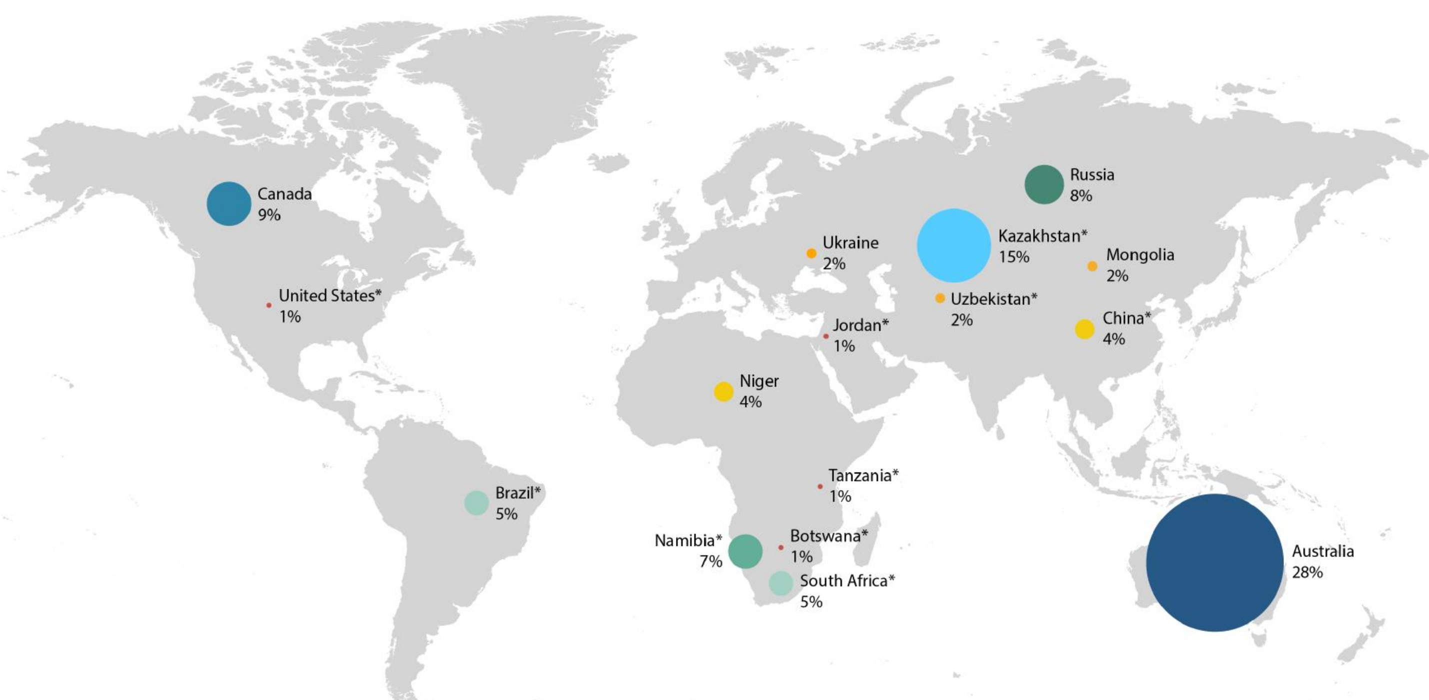
Uranium is a relatively common metal that can be found in rocks and seawater. Similar to other minerals and metals, the exact quantity of world resources are difficult to calculate with any degree of certainty. The only meaningful measure of long-term security of supply is the known reserves in the ground that are capable of being economically mined.

Generally, the supply of uranium is grouped into three categories, namely **uranium resources**, **exploration**, and **production**.

Uranium Resources

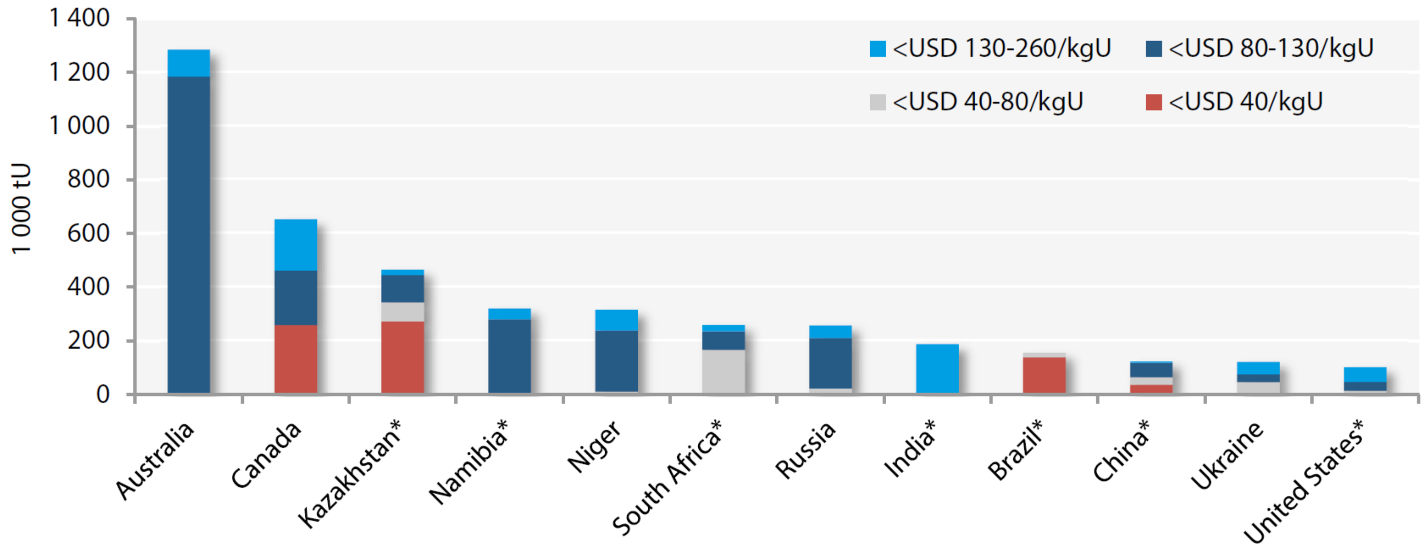
As of 2020, the top three countries with the greatest uranium resources account for more than half of the total supply. Australia contributed the most, with approximately 1.7 million tU (28%), followed by Kazakhstan and Canada, which accounted for 0.9 million tU (15%) and 0.5 million tU (9%), respectively. The global distribution of identified conventional resources is shown in *Fig 5* and the current estimates of reasonably assured resources (RAR) and inferred resources (IR) are presented in *Fig 6* and *Fig 7*.

Fig 5. Global Distribution of Identified Resources



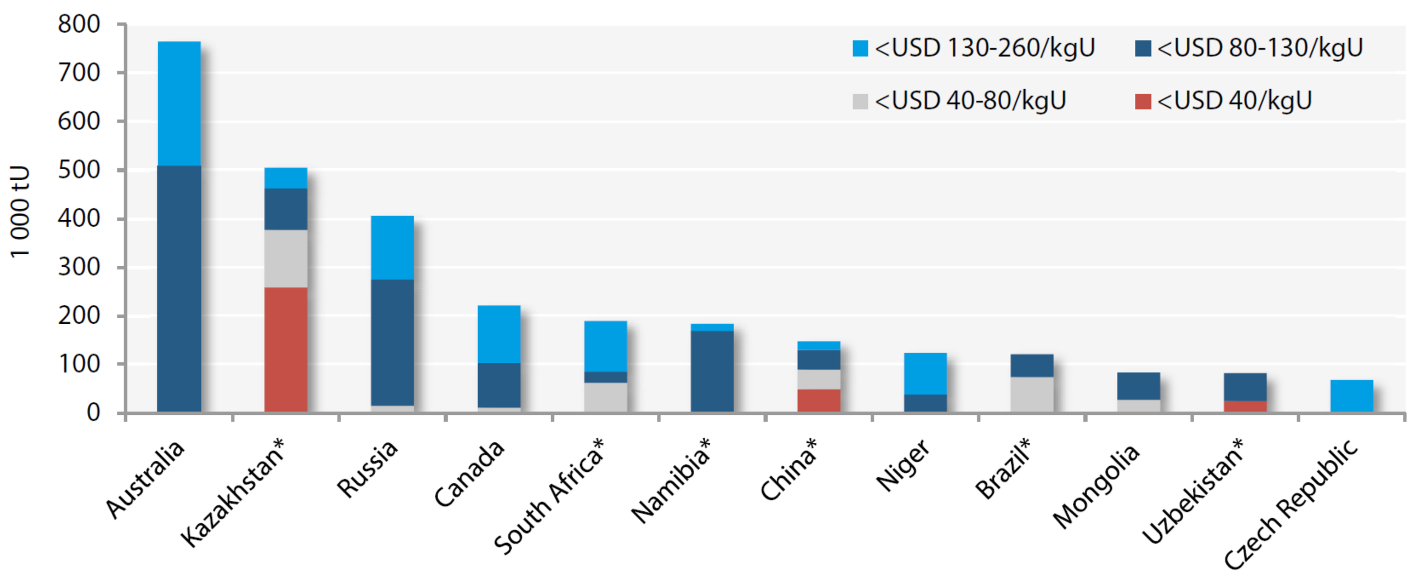
Source: World Nuclear Association, Nuclear Energy Agency & International Atomic Energy Agency

Fig 6. Distribution of RAR Among Countries with a Significant Share of Resources



Source: Nuclear Energy Agency & International Atomic Energy Agency

Fig 7. Distribution of IR Among Countries with a Significant Share of Resources



Source: Nuclear Energy Agency & International Atomic Energy Agency

Even though Australia dominates the world uranium resources, 64% of its resources are attributed to the Olympic Dam deposit, where uranium is mined as a co-product of a core copper mining operation.

Undiscovered Resources

Undiscovered resources are mainly located through geological knowledge of previously discovered deposits, along with regional geological mapping. A total of 25 countries reported undiscovered resources as of 2020, led by Mongolia, Canada, and South Africa.

Exploration

Exploration involves the search for materials in the earth's crust, which could potentially identify new resources for future mining.

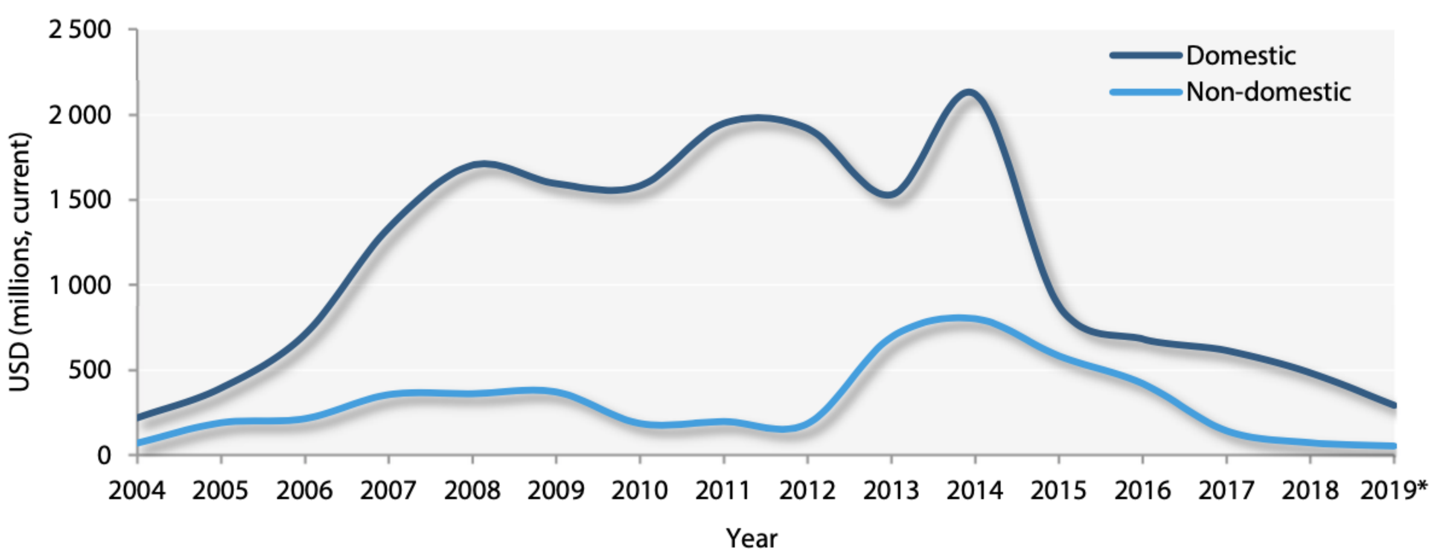
Non-Domestic Exploration

There are only four countries, namely China, France, Japan, and Russia, that have reported non-domestic exploration and development expenditures since 2008. Data suggested that non-domestic exploration expenditures declined since 2014, to a low of USD 54 million in 2019.

Domestic Exploration

Twenty-five countries reported domestic exploration and mine development expenditures as of 2020. Like non-domestic exploration, there was a notable decline in total expenditures since 2014, with only USD 292 million in 2019. The decrease is primarily due to the persistently low uranium prices that arose since the Fukushima disaster. This slowed down, and in many cases, eradicated uranium exploration and development projects for several years. Currently, we have reached a point where exploration projects have become more economically viable. This is mainly due to the increasing spot price of the metal, along with positive sentiment towards uranium's role in a more sustainable future.

Fig 8. Trends in Exploration and Development Expenditures



Source: Nuclear Energy Agency & International Atomic Energy Agency

Recent Exploration and Developments in Major Countries

Australia: Domestic exploration expenditures have been declining since 2015. Uranium exploration was most active around Western and South Australia, but low uranium prices limited greenfield activity. Future development awaits improved market conditions.

Canada: Canada has maintained higher than average expenditures as of 2018. Even so, its expenditures have declined over the years, partially due to the slowdown in development activities at the Cigar Lake mine. Despite poor market conditions, Canada's high-grade uranium deposits remain the prime target for uranium exploration. Recently discovered high-grade uranium deposits include Phoenix/Gryphon (Denison Mines Inc.), Triple R (Fission Uranium Corp.), and Arrow (NexGen Energy Ltd.).

Kazakhstan: Exploration and development expenditures increased in 2017 and 2018, but declined in 2019. Exploration during 2017 and 2018 resulted in a significant increase in identified resources spread among the Budenovskoye, Inkai, the Tortkuduk block at Moinkum, and Northern Kharasan deposits.

Namibia: Namibia has limited exploration activity at known uranium projects in recent years due to continued low uranium prices.

Russia: The Dalur company, in 2018, completed exploration of the Khokhlovskoye deposit in the Kurgan Region and has begun intensive exploration of the Dobrovolnoye deposit.

Production

As of 2020, 15 countries reported uranium production, with global production of uranium from mines totaling 47,731 tU, which met 74% of the world demand. The complete data is shown in *Fig 9*.

Kazakhstan dominated production in 2020 with 19,477 tU. It alone totaled more than the combined production in that year from Canada, Australia, and Namibia, the second, third, and fourth largest producers of uranium, respectively. Nevertheless, the data indicated that global production peaked in 2016 with 63,207 tU, primarily due to production cuts to reduce supply in a saturated market in those years.

Present Status of Uranium Production

Australia: The only producing country in the Pacific region. The decline in production in 2017 is due to the Beverley North ISL mine being placed on care and maintenance, and the increase in production afterwards is mainly due to the increased production from the Four Mile ISL facility. Mining and processing activities at the Ranger mine were closed in January 2021.

Canada: Remains the dominant North American producer and the world's second-largest producer. Production at the McArthur River mine, Key Lake mill, and Rabbit Lake have been suspended due to poor market conditions. COVID-19 has caused production halts in a myriad of locations, but in July 2021, Cameco announced it will restart production at Cigar Lake.

Kazakhstan: Although production has decreased since 2016, Kazakhstan still accounted for 41% of global production in 2020. Uranium was mined at the Kanzhugan, Moinkum, Akdala, Uvanas, Mynkuduk, Inkai, Budenovskoye, North and South Karamurun, Irkol, Zarechnoye, Semizbay, and Northern Kharasan deposits. In 2020, production was reduced due to COVID-19 and is expected to maintain a 20% reduction throughout 2021.

Namibia: The Husab mine ramped up to full production capacity as of 2018, which offset the impact of the closures of the Langer Heinrich mine in 2018.

Fig 9. Production from Mines (tonnes U)

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Kazakhstan	19,451	21,317	22,451	23,127	23,607	24,689	23,321	21,705	22,808	19,477
Canada	9,145	8,999	9,331	9,134	13,325	14,039	13,116	7,001	6,938	3,885
Australia	5,983	6,991	6,350	5,001	5,654	6,315	5,882	6,517	6,613	6,203
Namibia	3,258	4,495	4,323	3,255	2,993	3,654	4,224	5,525	5,476	5,413
Uzbekistan (est.)	2,500	2,400	2,400	2,400	2,385	3,325	3,400	3,450	3,500	3,500
Niger	4,351	4,667	4,518	4,057	4,116	3,479	3,449	2,911	2,983	2,991
Russia	2,993	2,872	3,135	2,990	3,055	3,004	2,917	2,904	2,911	2,846
China (est.)	885	1,500	1,500	1,500	1,616	1,616	1,692	1,885	1,885	1,885
Ukraine	890	960	922	926	1,200	808	707	790	800	400
USA	1,537	1,596	1,792	1,919	1,256	1,125	940	582	58	6
India (est.)	400	385	385	385	385	385	421	423	308	400
South Africa (est.)	582	465	531	573	393	490	308	346	346	250
Iran (est.)	0	0	0	0	38	0	40	71	71	71
Pakistan (est.)	45	45	45	45	45	45	45	45	45	45
Brazil	265	326	192	55	40	44	0	0	0	15
Czech Republic	229	228	215	193	155	138	0	0	0	0
Romania	77	90	77	77	77	50	0	0	0	0
France	6	3	5	3	2	0	0	0	0	0
Germany	51	50	27	33	0	0	0	0	0	0
Malawi	846	1,101	1,132	369	0	0	0	0	0	0
Total world	**53,493**	**58,493**	**59,331**	**56,041**	**60,304**	**63,207**	**60,514**	**54,154**	**54,742**	**47,731**
tonnes U3O8	**63,082**	**68,974**	**69,966**	**66,087**	**71,113**	**74,357**	**71,361**	**63,861**	**64,554**	**56,287**
% of world demand	**87.00%**	**94.00%**	**91.00%**	**85.00%**	**98.00%**	**96.00%**	**93.00%**	**80.00%**	**81.00%**	**74.00%**

Source: World Nuclear Association

Fig 10 and *Fig 11* outline the major companies competing in global uranium production as of 2020. The largest producer, Kazatomprom, is the national operator of the Republic of Kazakhstan and the owner of multiple large-producing uranium mines in Kazakhstan. The second, third, and forth largest uranium producing companies operate mainly in Canada, with Cameco and Orano being the major owner of the largest-producing uranium mines of Cigar Lake (The largest non-producing mine is McArthur River mine owned by Cameco).

Fig 10. Companies by Production in 2020

Company	Tonnes U	% of World Total
Kazatomprom	10,736	22
Orano	4,453	9
Uranium One	4,276	9
CGN	3,671	8
Navoi Mining	3,500	7
CNNC	3,333	7
BHP	3,062	6
ARMZ	2,846	6
General Atomics/Quasar	1,806	4
Rio Tinto	1,016	2
Sopamin	1,032	2
Energy Asia	852	2
VostGok	744	2
Other	3,295	7
Total	**47,731**	**100**

Source: World Nuclear Association

Fig 11. Largest Producing Uranium Mines in 2020

Mine	Country	Main owner	Type	Production (tonnes U)	% of world
Cigar Lake	Canada	Cameco/Orano	underground	3,885	8
Husab	Namibia	Swakop Uranium (CGN)	open pit	3,302	7
Olympic Dam	Australia	BHP Billiton	by-product/underground	3,062	6
Inkai, sites 1-3	Kazakhstan	Kazaktomprom/Cameco	ISL	2,693	6
Karatau (Budenovskoye 2)	Kazakhstan	Uranium One/Kazatomprom	ISL	2,460	5
Rössing	Namibia	Rio Tinto	open pit	2,111	4
SOMAIR	Niger	Orano	open pit	1,879	4
Four Mile	Australia	Quasar	ISL	1,806	4
South Inkai (Block 4)	Kazakhstan	Uranium One/Kazatomprom	ISL	1,601	3
Kharasan 1	Kazakhstan	Kazatomprom / Uranium One	ISL	1,455	3
Top 10 total				**24,162**	**51%**

Source: World Nuclear Association

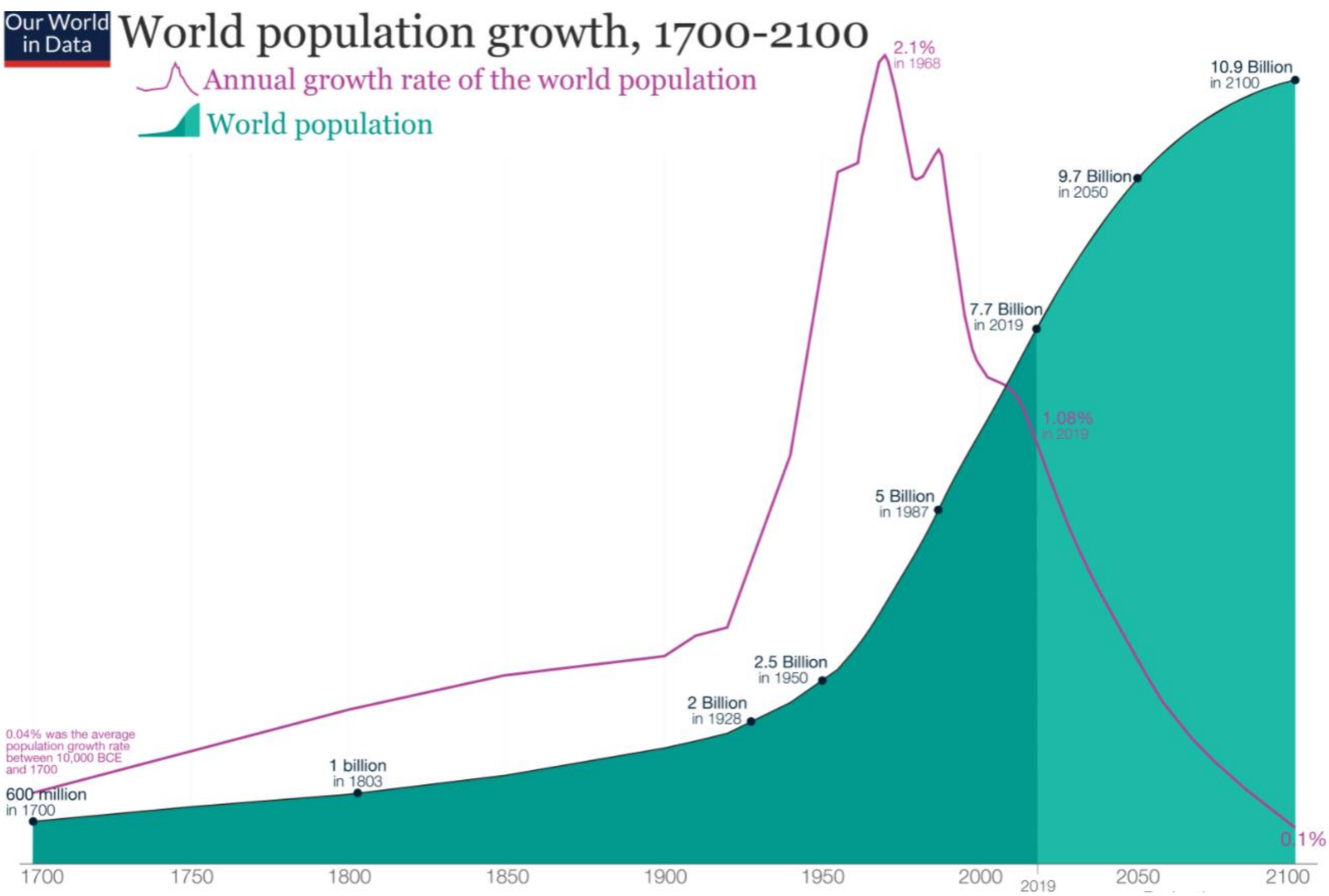
Demand

The core demand for uranium can be broken down into two main drivers: **world population** and the **number of nuclear power reactors**.

World Population

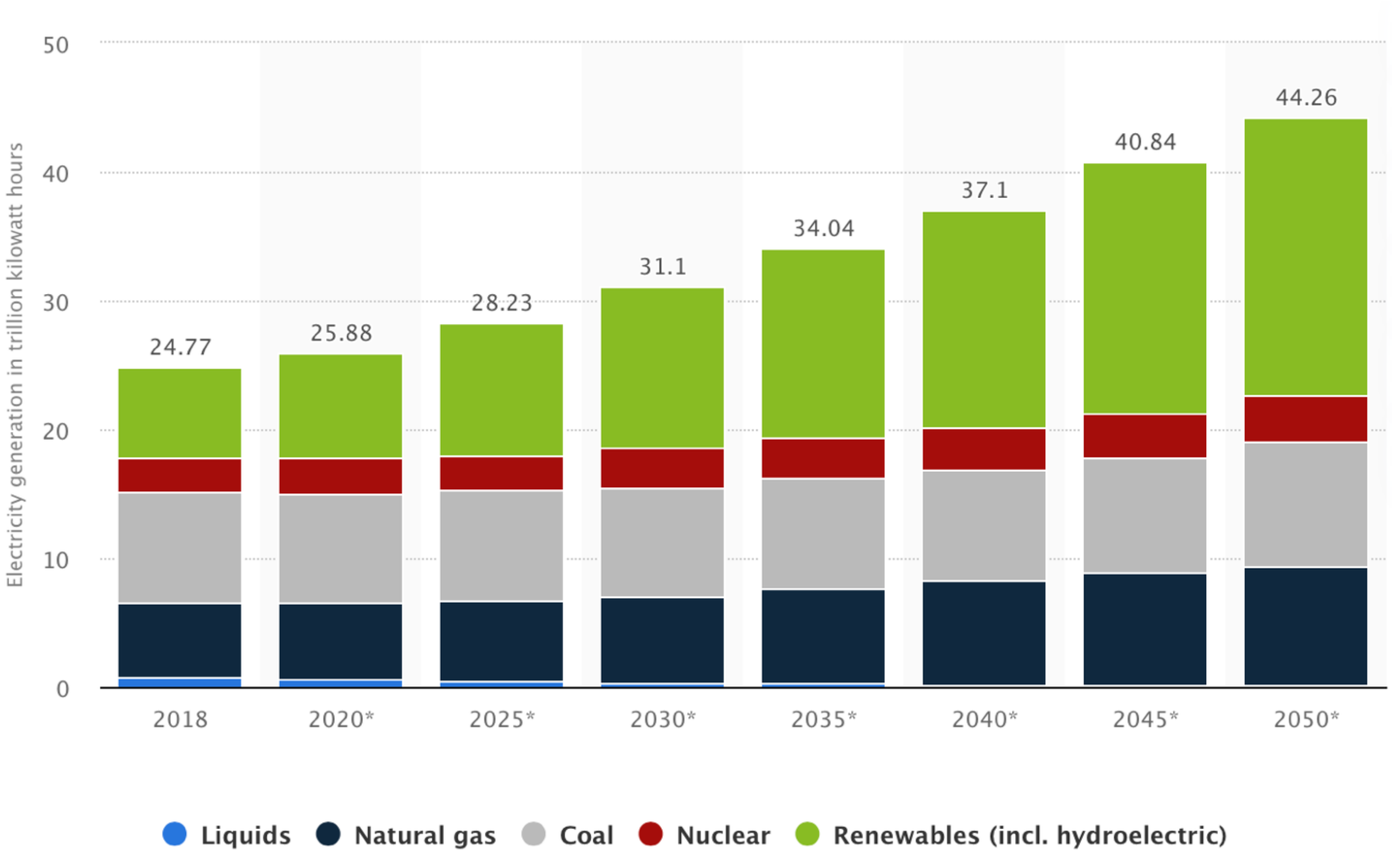
As the end users of electricity, the number of people on this planet has a direct effect on the demand for uranium. Projections for global population show an increase from 7.7 billion in 2019 to 11.2 billion by the end of the century, and expected electricity generated would increase at a CAGR of 1.0%. As noted earlier, nuclear energy contributed to approximately 10% of the electricity mix and assuming the proportion is maintained in the future, the demand for uranium is expected to grow at a steady rate. If the proportion of uranium in the electricity mix increases in the future, which is likely with the global awareness of renewable energy and changing legislative landscape, the demand for uranium will further increase.

Fig 12. World Population Growth and Projection



Source: OurWorldinData.org

Fig 13. Projected Electricity Generation Worldwide



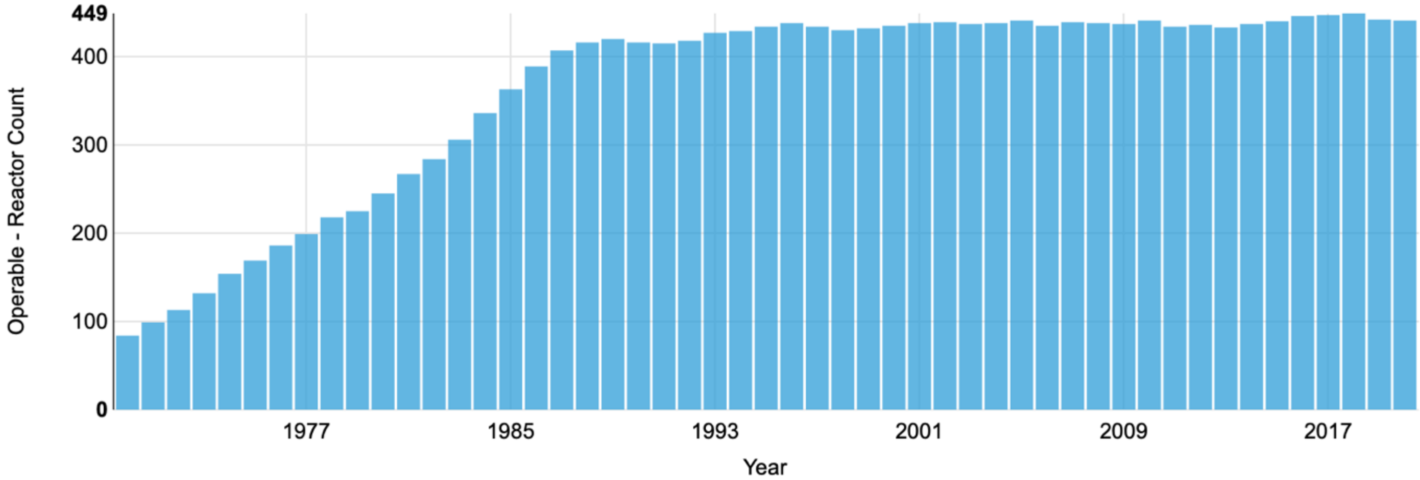
Source: Statista

Number of Nuclear Power Reactors

With uranium being the main input for nuclear power reactors, demand forecasts for uranium depend largely on the number of existing and planned reactors.

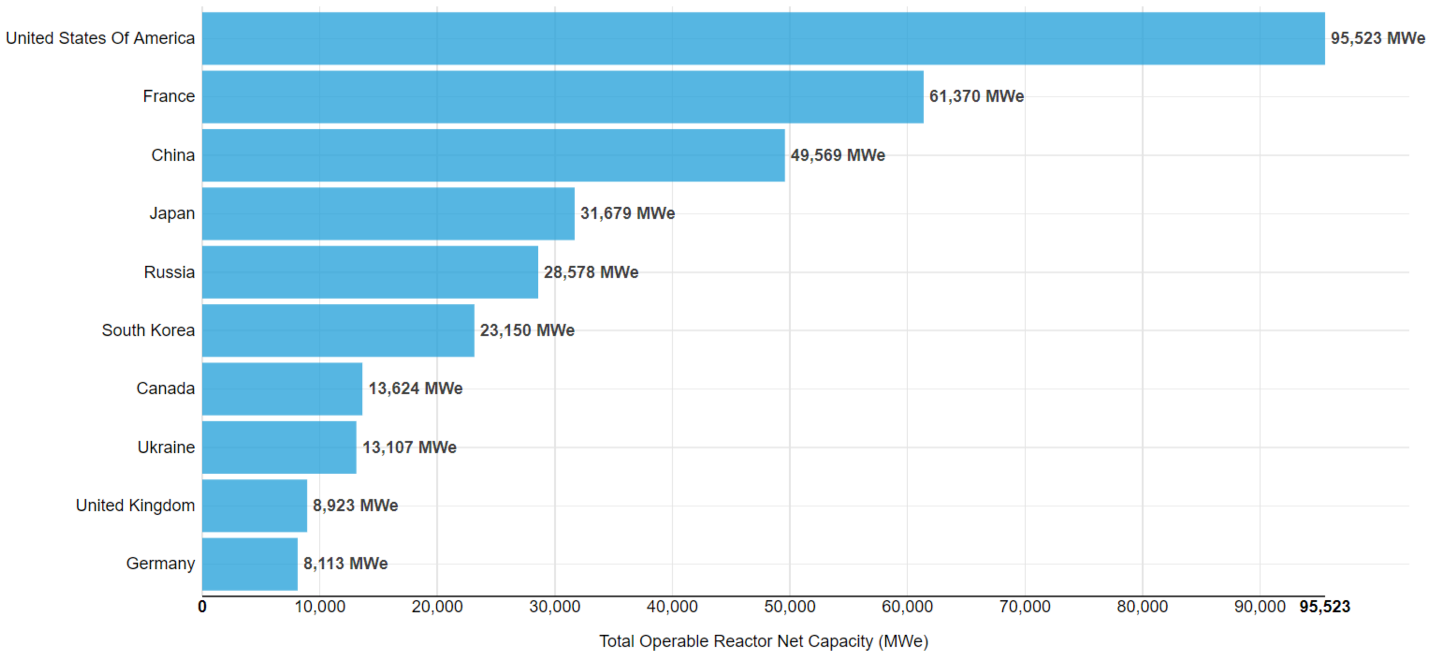
As of 2021, there are a total of 445 operable reactors, 50 reactors under construction, 97 planned reactors, and over 300 proposed reactors globally, with a total of 73,698 tonnes of U_3O_8 required each year. As shown in *Fig 14*, the number of operable reactors worldwide has stalled at approximately 420 reactors since the late 1990s. The historic addition of reactors is more or less offset by permanent closure of reactors in certain locations. In the future, the increase in reactors under construction will be led by East-Asian regions, namely China, South Korea, and India, with China outpacing other countries with 17,270 MWe net capacity in its reactors under construction, three times greater than the net capacity of South Korea.

Fig 14. Number of Operable Reactors Worldwide



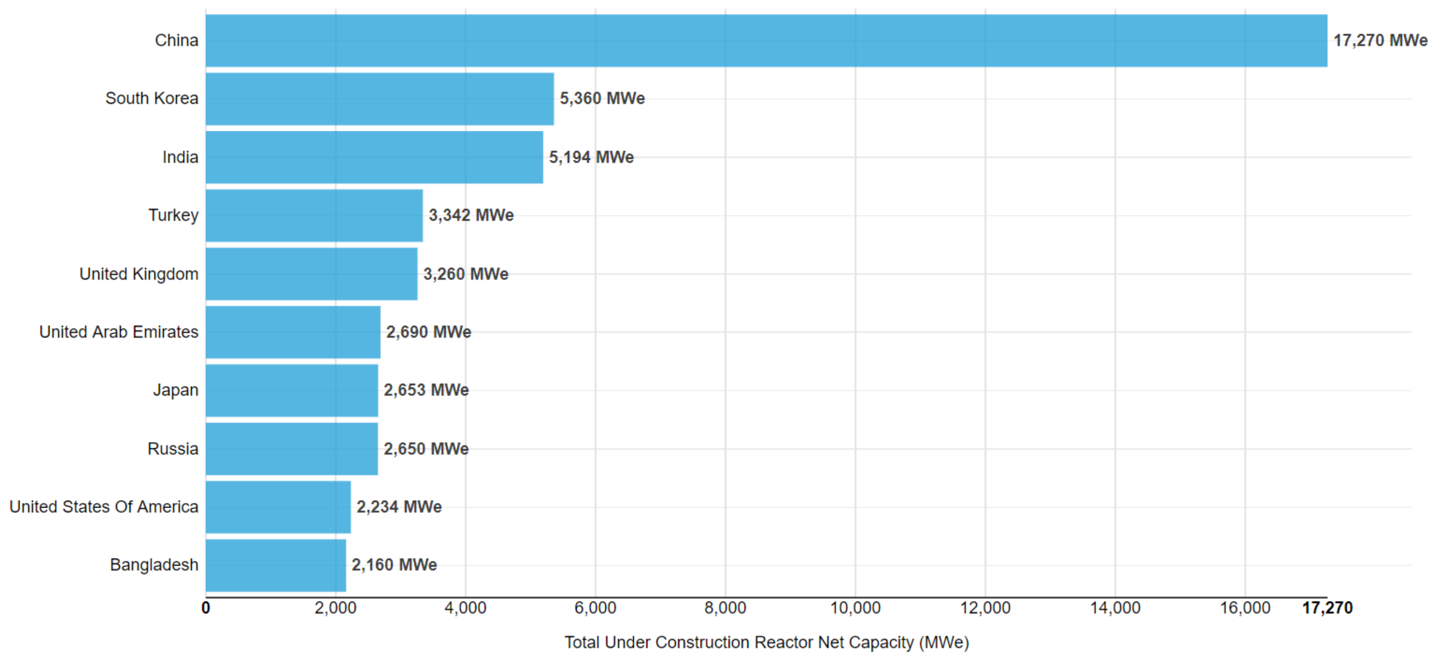
Source: World Nuclear Association

Fig 15. Total Operable Reactor Net Capacity



Source: World Nuclear Association

Fig 16. Reactors Under Construction Net Capacity (Top 10)



Source: World Nuclear Association

Other Factors Affecting Uranium Demand

Uranium demand is also influenced by the performance of installed nuclear power plants, capacity (or load) factors, fuel cycle length, enrichment level, burn-up, improved fuel designs, as well as strategies employed to optimize the relationship between the price of natural uranium and enrichment services. *Fig 17* shows the uranium sensitivity to various parameters. In general, increased uranium prices have provided an incentive for utilities to reduce uranium requirements by specifying lower tails assays (concentration of U-235) at enrichment facilities, to the extent possible, in contracts and the ability of the enrichment facilities.

Fig 17. Uranium Sensitivity to Various Parameters

Factor	Base Value	Change	Impact on Uranium Requirements
Capacity (or load factor)	80%	5%	6%
		-5%	-6%
Tails assays	0.25%	0.03%	6%
		-0.03%	-6%
Burn-up	40 GWd/tU	+5 GWd/tU	-3%
		+10 GWd/tU	-4- 5%
Cycle length	12 months	+6 months	7%
		+12 months	18%

Source: World Nuclear Association, Nuclear Energy Agency & International Atomic Energy Agency

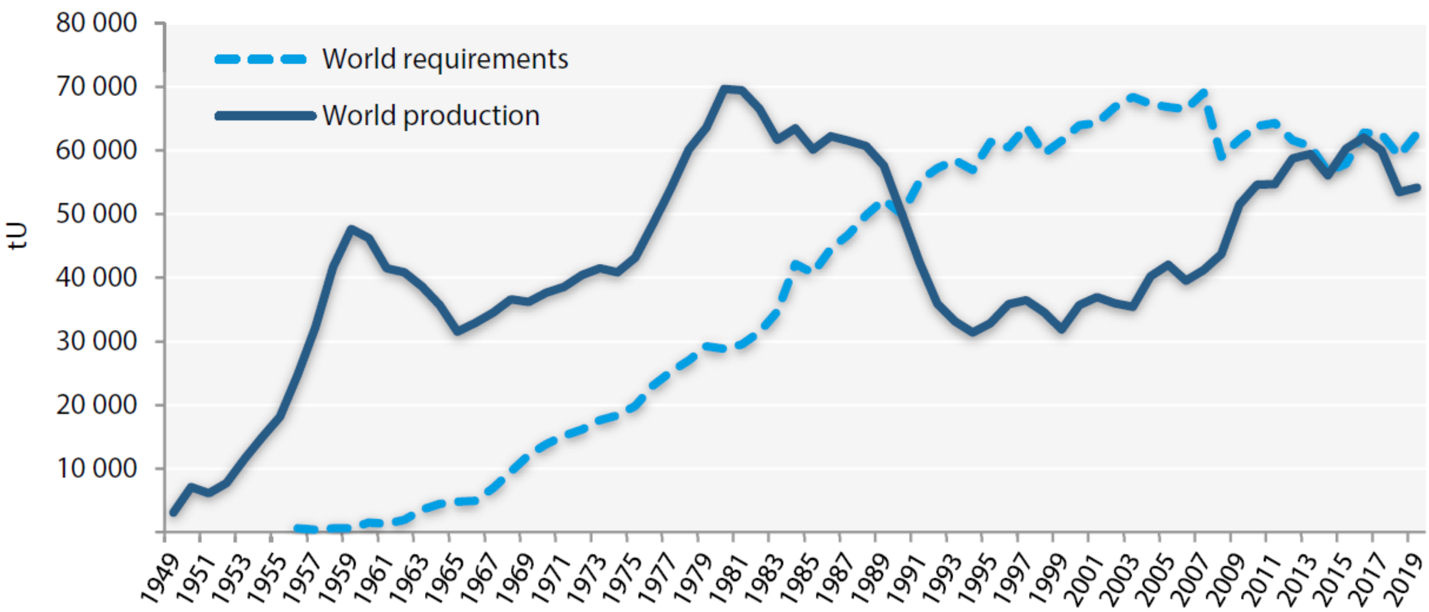
Supply vs. Demand

With the factors driving supply and demand mentioned in previous sections, this section combines both perspectives to form an overall picture of the uranium market.

A Brief History of the Supply and Demand Dynamic

The commercial exploitation of nuclear power began in the late 1950s to 1990, where uranium production consistently exceeded commercial requirements as demonstrated in *Fig 18*. This was primarily driven by a lower than projected growth rate of nuclear generating capacity with high levels of production during that period. The overproduction created a stockpile of uranium for future usage. The surplus did not persist, and production fell below demand after 1990. Since 2008, requirements increased slightly before declining again after reactor closures in Germany and Japan due to the Fukushima accident. With the increased production since 2007, the deficit was once again minimized. However, more recently, the deficit gap appeared again due to ongoing low uranium prices that led to suspensions and closures of various uranium mines.

Fig 18. Annual Uranium Production and Requirements

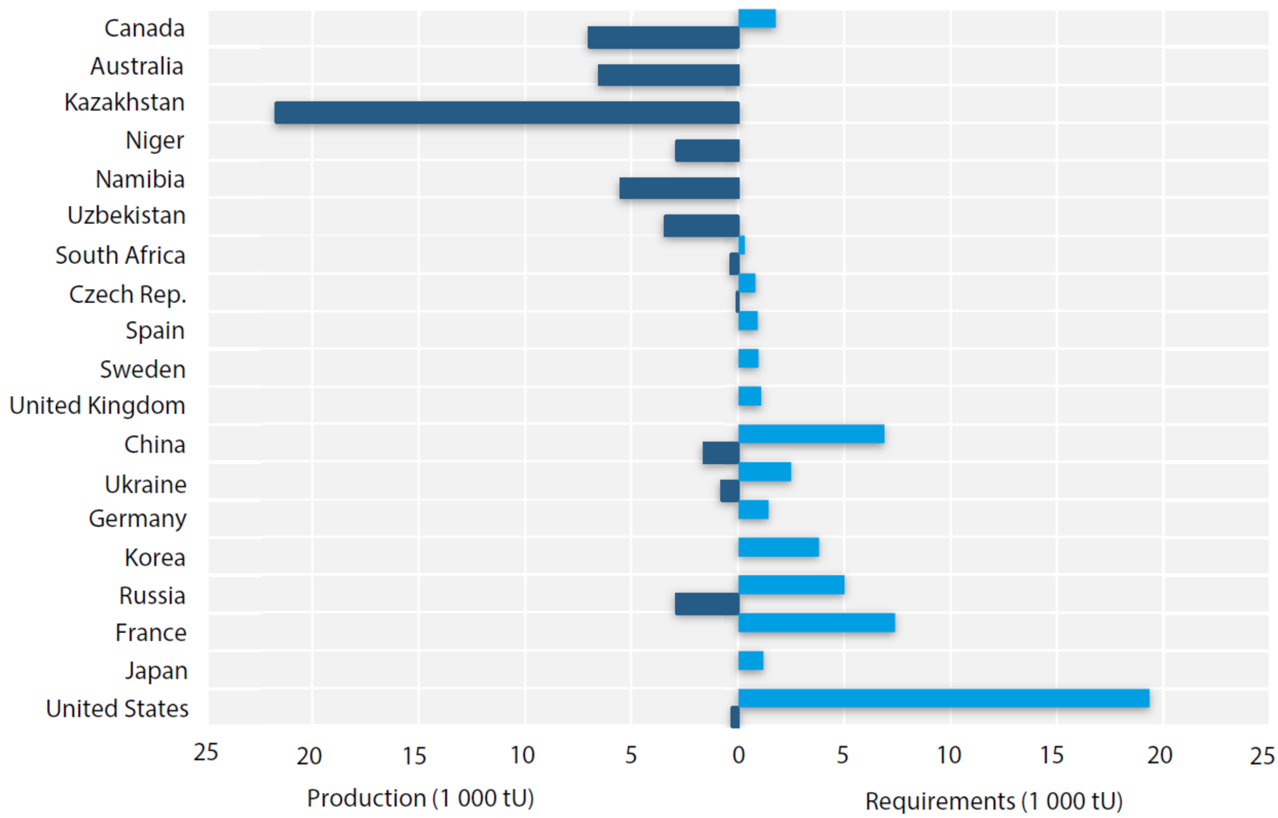


Source: Nuclear Energy Agency & International Atomic Energy Agency

International Trade

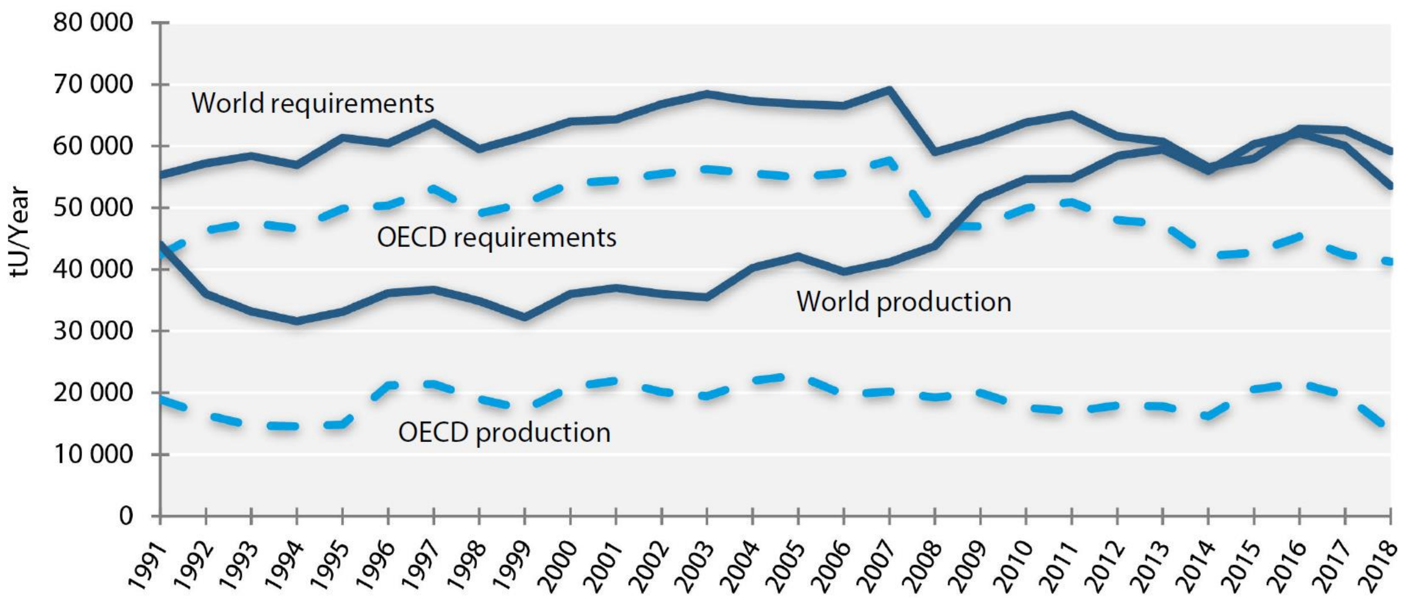
As indicated in *Fig 19*, of the countries currently using uranium in commercial nuclear power plants, only Canada and South Africa produced enough uranium to meet domestic requirements in 2018. All other countries with nuclear power must import the uranium or use secondary sources to meet their production requirements. Historical data suggests that primary uranium production volumes have been significantly below world uranium requirements for some time, and only in recent years has the market become more balanced as production has increased and requirements have declined.

Fig 19. Uranium Production and Reactor-Related Requirements



Source: Nuclear Energy Agency & International Atomic Energy Agency

Fig 20. OECD and World Uranium Production and Requirements



Source: Nuclear Energy Agency & International Atomic Energy Agency

Secondary Sources of Uranium Supply

A significant portion of uranium demand has been supplied by secondary sources. These sources include stocks and inventories, nuclear fuel from reprocessing of spent reactor fuels and from surplus military plutonium (MOX and RepU), underfeeding, and uranium produced by the re-enrichment of depleted uranium tails.

Market Outlook

Even though the total number of reactors has plateaued since 1990 as shown in *Fig 14*, forecasts of installed capacity and uranium requirements continue to point to long-term growth, with governments around the world embracing zero-emission targets. For instance, USA and Canada are aiming for net zero emissions by 2050, and China by 2060. With the effort from different governments to promote low-carbon energy and electricity, nuclear energy will likely be one of the focus points, along with other renewables, due to its space-efficient nature and its ability to perform under any weather condition.

With the global outlook, world reactor-related uranium requirements by the year 2040 are projected to increase to a total of between 56,640 tU/year in the low case and up to 100,224 tU/year in the high case. The details are outlined in *Fig 21* and *Fig 22*.

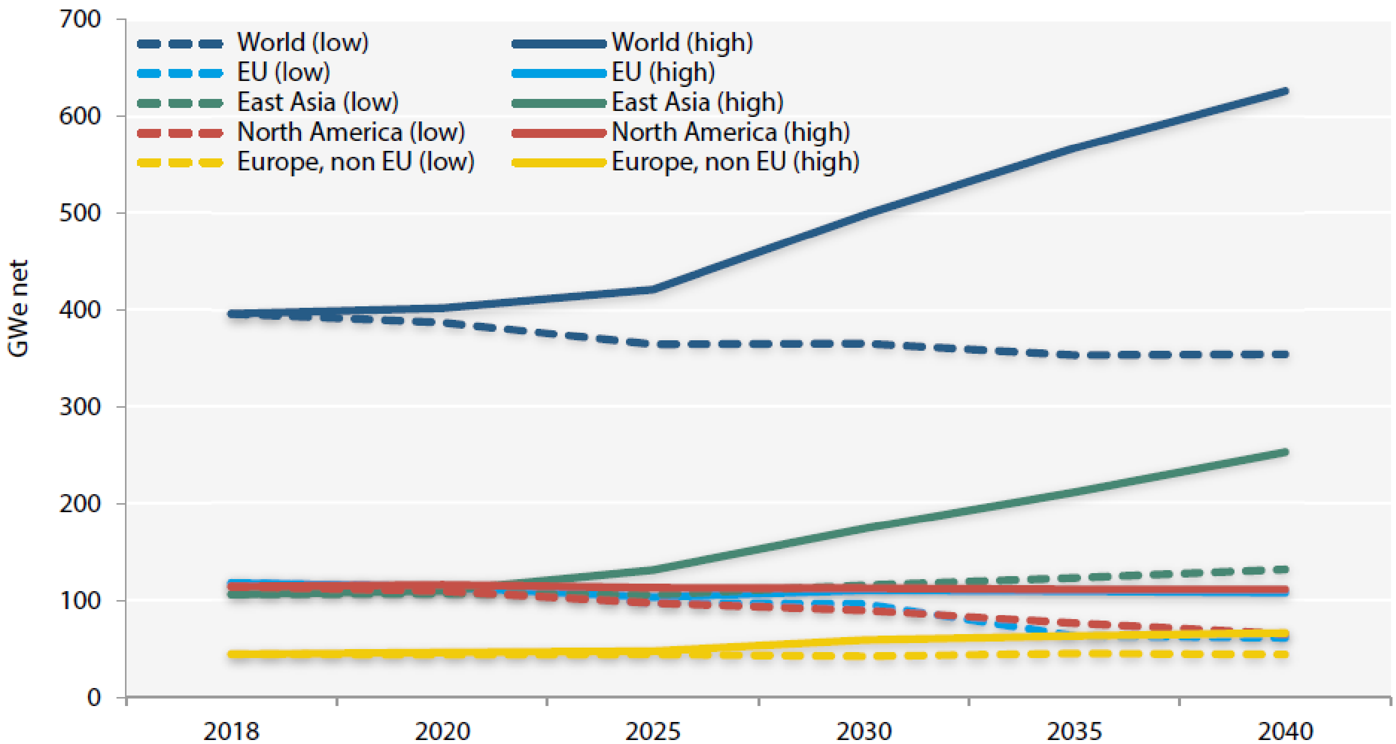
Annual uranium requirements are projected to be largest in the East Asia region, particularly in China, where increased installed nuclear generating capacity drives significant growth in uranium demand.

Fig 21. Annual Reactor-Related Uranium Requirements to 2040

	2018	2020	2020	2025	2025	2030	2030	2035	2035	2040	2040
		Low	High	Low	High	Low	High	Low	High	Low	High
European Union	117.9	113.4	113.9	97.1	103.4	86.6	110.3	62.8	109.5	61.1	**108.0**
North America	114.1	109.5	116.0	97.2	112.8	89.8	112.5	76.2	111.4	65.0	**111.3**
East Asia	106.1	106.8	110.1	105.8	131.2	115.3	173.8	123.3	211.8	131.8	**252.9**
Europe (non-EU)	44.1	43.3	46.2	43.8	47.2	42.0	58.8	44.9	63.1	43.7	**66.0**
Central and South America	3.5	3.5	3.5	3.2	3.5	4.5	5.6	7.0	9.7	6.4	**10.7**
Middle East, Central, and South Asia	8.4	8.4	10.1	15.2	21.3	24.0	33.2	36.7	53.1	41.6	**63.8**
South-eastern Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	**3.0**
Africa	1.8	1.8	1.8	1.8	1.8	3.0	4.2	2.4	8.7	3.4	**10.7**
Pacific	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
World Total	396	387	402	364	421	365	498	353	567	354	**626**

Source: Nuclear Energy Agency & International Atomic Energy Agency

Fig 22. Annual Reactor Uranium Requirements to 2040

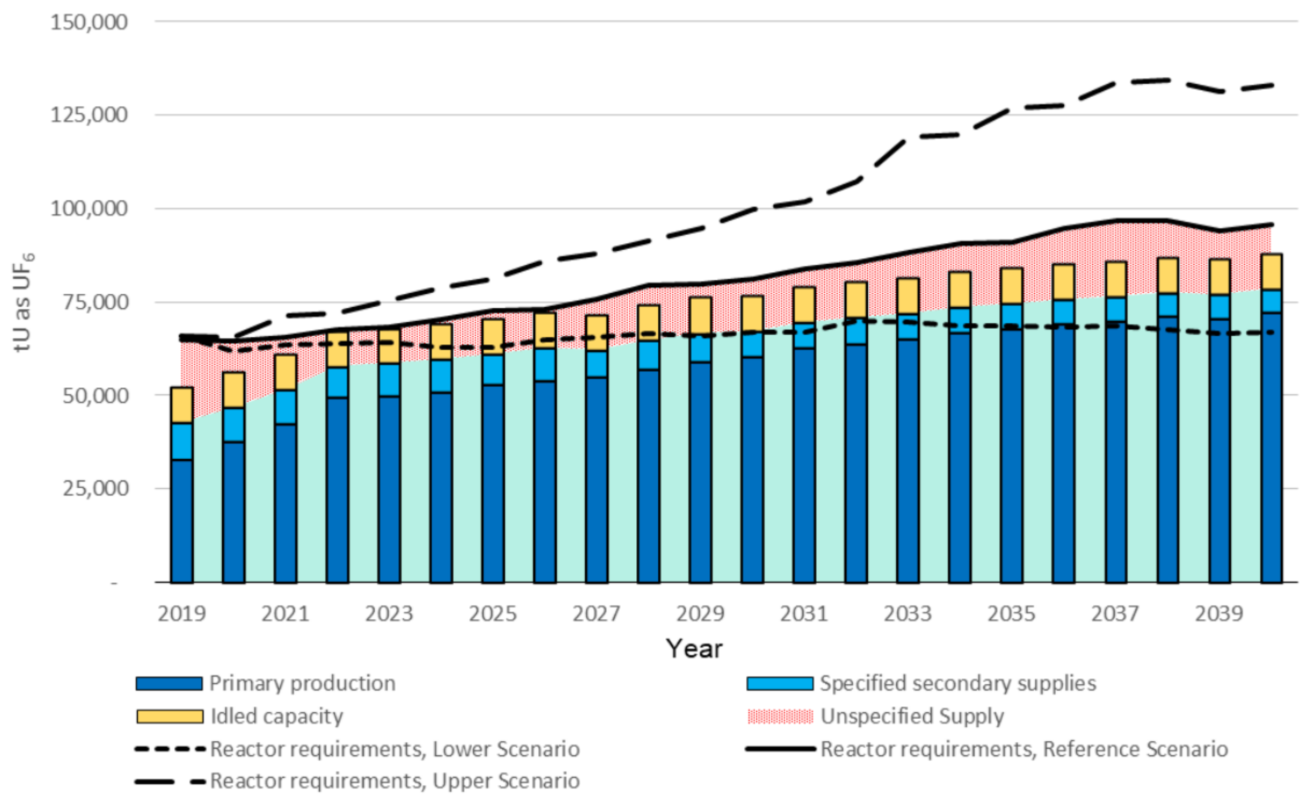


Source: Nuclear Energy Agency & International Atomic Energy Agency

In terms of future supply, *Fig 23* outlines the production capacity from 2019 to 2040. Data suggests that the market expects a steady gain in overall production capacity, from current mining facilities to approximately 77,000 tU/year by 2030. These forecasts are heavily dependent on prominent nations using their facilities to meet domestic enrichment capacity requirements in the years ahead.

Ultimately, the market has a growing force in supporting the development of nuclear energy with opinion leaders driving positive sentiment in nuclear usage. For instance, tech-giants' founders, Bill Gates and Elon Musk have suggested the potential future demand in renewable energy and placed emphasis on the importance of nuclear energy as a safe and sustainable energy source. In addition, political sentiment has shifted after nuclear energy innovation became a part of Biden's campaign pledge to address climate change, which acted as a catalyst in future development of the nuclear industry.

Fig 23. Reference Scenario Global UF_6 Conversion Supply and Demand, tU



Source: World Nuclear Association

Impact of COVID-19 and Recent Updates

With the pandemic causing a devastating impact to the global economy, production at various uranium mines has been halted. For instance, in April 2020, Kazatomprom announced that it would halt new wellfield development, reduce the number of staff onsite, and reduce production volumes by up to 4,000 tU. Later on, in August of the same year, the company began returning staff to the mine sites and has continued with remote work where possible.

At the Cigar Lake mine and the McClean Lake uranium mill in northern Saskatchewan, Canada, production was temporarily suspended in early 2020, and operations resumed shortly after in September. Nevertheless, a reduction of about 40% of production output is expected for the year. In Namibia and South Africa, mining activities were also suspended. However, since the end of April, mines were allowed to open but could only operate at 50% capacity. The Rössing mine has also discontinued mining operations.

Nevertheless, the suspension of uranium mining activity is not expected to create performance disruptions of nuclear power reactors in the near term, due to significant stockpiles held by utilities and fuel cycle producers.

Despite large uranium mines, such as McArthur River and Rabbit Lake in Canada, remaining suspended in early 2021, demand for uranium inventories has recently picked up, with several companies acquiring physical uranium. For instance, Denison, Yellow Cake, and Uranium Royalty Corp. have announced their plans to acquire physical uranium. Although these companies purchased physical uranium for their corporate strategies, management from these companies agreed upon the pending rebalances of the uranium market and acquiring uranium inventory now provides them with strategic benefits going forward. Most recently, Eric Sprott, one of the most prominent figures in the commodity space, began purchasing large amounts of physical uranium in the spot market through the Sprott Physical Uranium Trust (SPUT). SPUT has acquired over 24 million pounds of uranium since August 2021 and has become a strong catalyst that has helped to propel the uranium spot price to 6-year highs.

Cyclicality of Uranium Prices

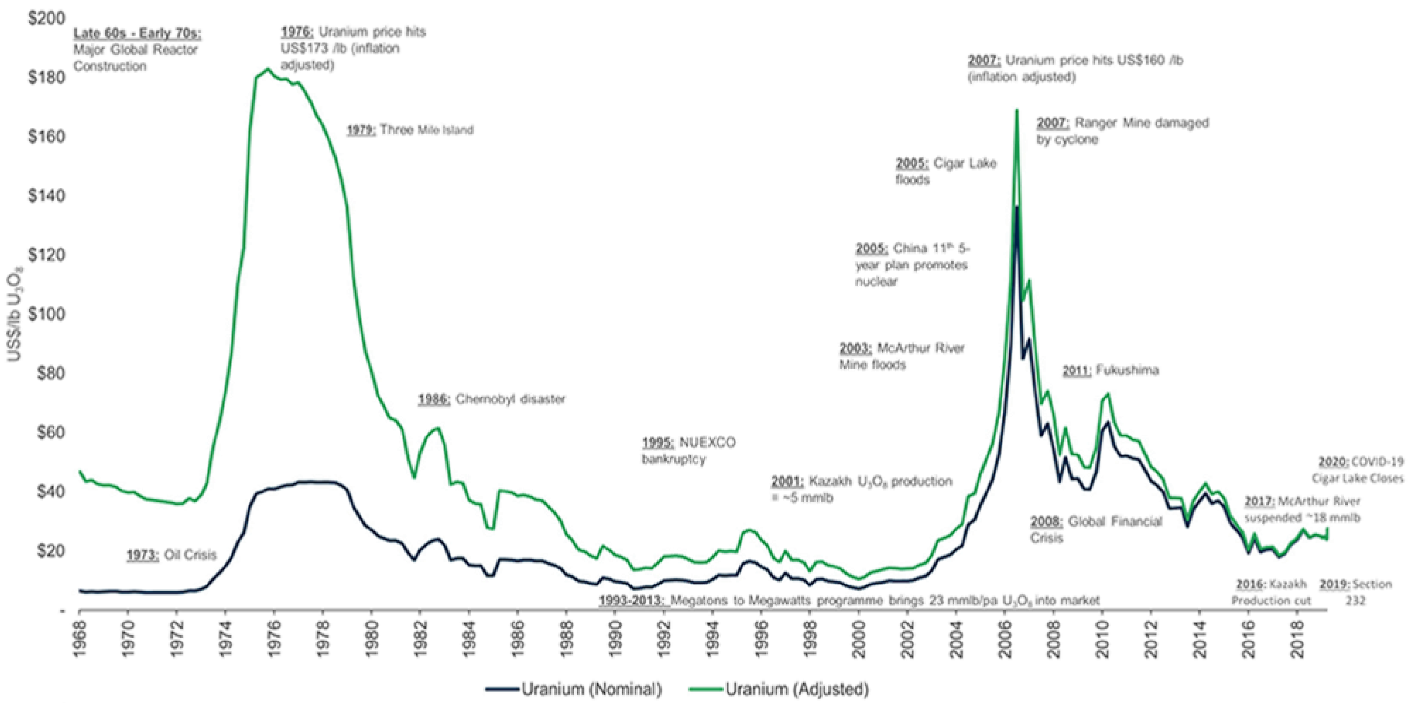
Like all other mineral commodity markets, the uranium market tends to be cyclical. A major difference is that uranium does not trade on an open market like other commodities, nor is there are any standardized futures or options contracts actively available with sufficient liquidity[1]. Buyers and sellers mostly negotiate contracts privately with their own terms and conditions. Nuclear utilities purchase uranium primarily through long-term contracts, usually for deliveries to begin two to four years after they are signed and provide for delivery from four to ten years thereafter.

Fig 24 depicts the historical price of uranium. There were historically two major cycles since 1970. After the burst in the 1990s, uranium prices reached an all-time low in 2001, reaching US$7/lb, and gradually rising in mid-2007, peaking at around US$137/lb. The high price spurred new prospecting and the reopening of old mines, but demand declined after the Fukushima disaster, which weighed down the price once again. The spot price is approximately US$45.05/lb as of November 2021, which recovered from the bear market low of US$18/lb.

Nevertheless, when comparing historical prices with supply and demand, there is no clear relationship between the two as only the parabolic move in 2004 was caused by the supply deficit, while the previous bull market in the 1970s did not experience a supply-demand imbalance.

[1] UxC Uranium U3O8 futures contract is available on the CME, but they are rarely traded

Fig 24. Historical Inflation Adjusted Uranium Price



Source: Yellow Cake Plc

Investment Thesis

With the information discussed in previous sections, it is becoming apparent that the uranium market is transitioning from a bear market to a new bull cycle.

The spot price of uranium has demonstrated its strength. Despite the impact from COVID-19, the spot price has only experienced mild pullbacks and recovered thereafter. This has not only reflected the short-term supply shortage due to production halts in a myriad of mines, but also signaled the strength in core demand in uranium with the current low price that is below production costs.

Moreover, major players in the industry have started to acquire physical uranium assets as of early 2021, which could act as a catalyst for other players to join the market and improve sentiment in the macro-environment. The acquisition activities, together with an increasing spot price, have also fueled exploration activities, which is beneficial to the explorers. Mining activities are expected to increase when uranium prices start to catch up with ~~the~~ production costs.

As suggested, the fundamental supply and demand factors are positive for the uranium market and uranium is currently trading below its average production cost. Investors should understand that the price cannot indefinitely stay below the cost of production, nor will it remain at very high levels for longer than it takes for new producers to enter the market. Therefore, with the current market being close to the cyclical bottom, investors holding uranium-related assets could benefit from a great risk to reward tradeoff.

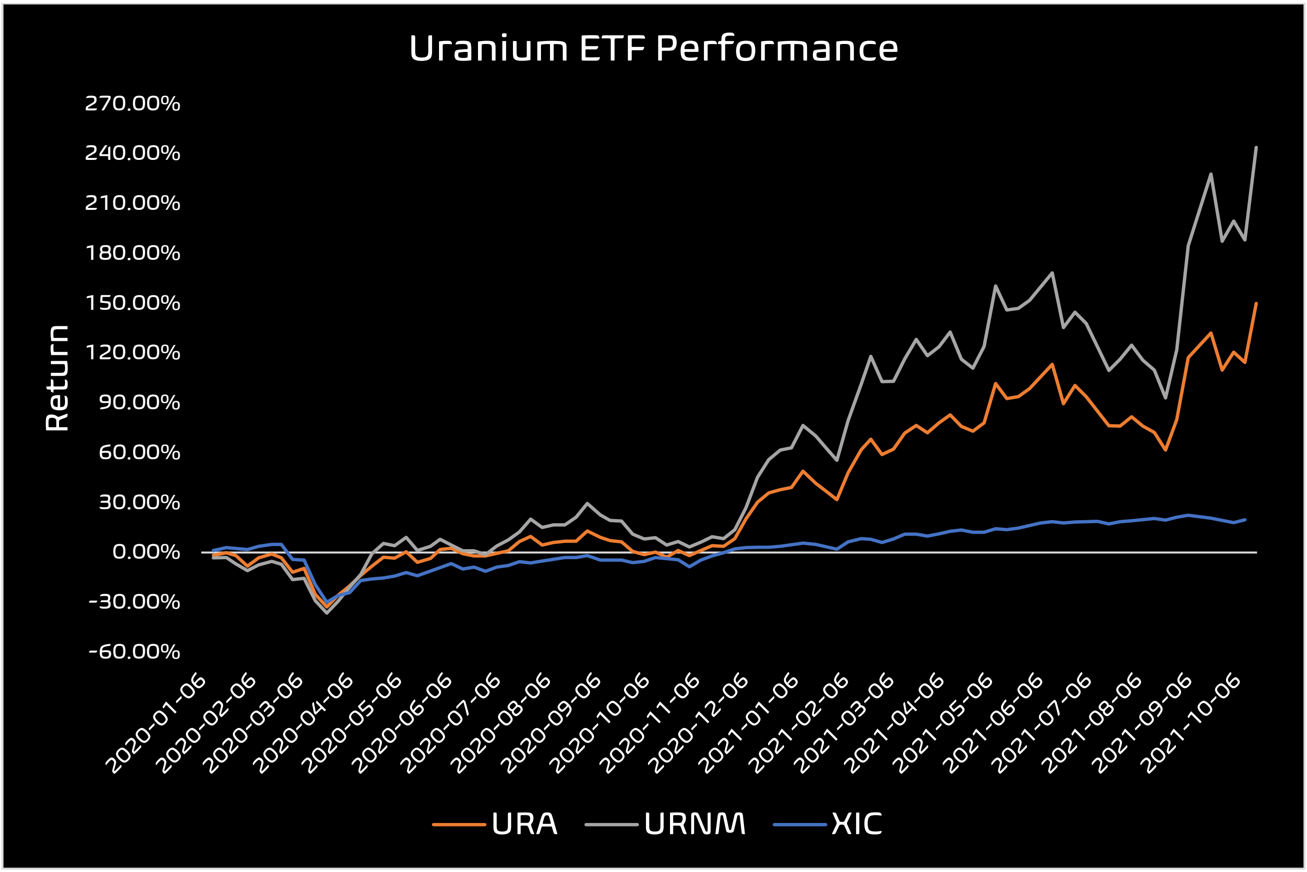
Competitive Landscape and Price Performance

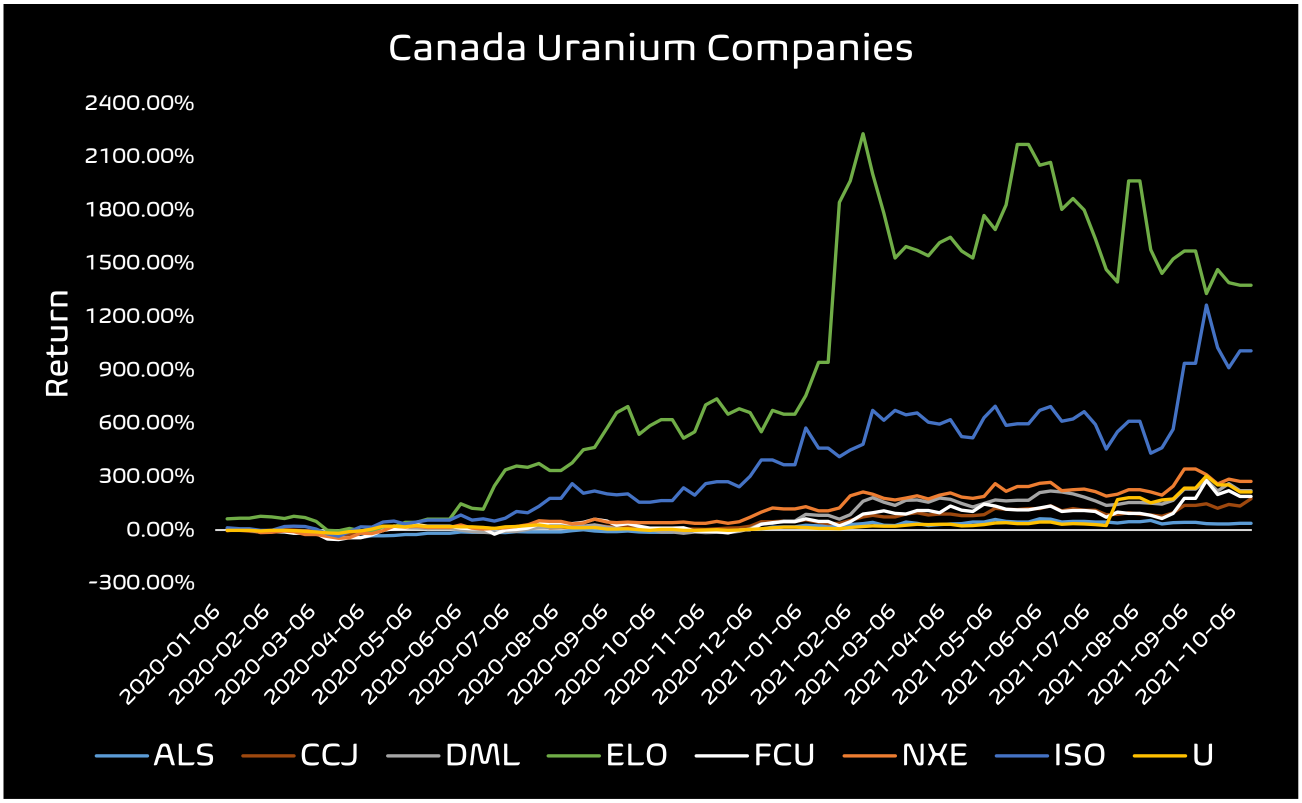
The following table provides a financial comparison of the major producers and miners in the uranium market with data as of November 2021.

	Market Cap	Enterprise Value	Capital Expenditures	Total Debt	Price / Book	Current Ratio	Debt / Equity	Return (YTD)
BHP Group	134.4 B	139.0 B	7.1 B	21.6 B	2.6	1.6	42.1%	-10.7%
Rio Tinto Group	99.4 B	95.5 B	6.8 B	13.5 B	1.9	2.1	25.5%	-9.8%
Cameco Corp.	13.4 B	12.7 B	89.3 M	1.0 B	2.7	6.3	20.6%	97.2%
NexGen Energy Ltd.	3.5 B	3.4 B	24.8 M	77.0 M	9.5	16.0	14.9%	109.4%
Denison Mines Corp.	1.6 B	1.4 B	450.8 K	-	5.4	5.8	-	198.3%
Energy Fuels Inc.	2.0 B	1.8 B	1.3 M	689.1 K	6.2	38.1	0.2%	136.7%
Uranium Energy Corp.	1.2 B	1.1 B	227.7 K	10.8 M	7.7	5.7	6.8%	160.2%
Altius Minerals Corp.	631.1 M	198.5 M	1.3 M	123.7 M	1.6	4.9	31.2%	12.6%
Fission Uranium Corp.	746.5 M	684.7 M	8.7 M	7.2 M	2.0	20.4	1.9%	193.5%
Global Atomic Corp.	739.4 M	711.5 M	6.8 M	-	11.7	10.3	-	180.5%
IsoEnergy Ltd.	579.6 M	499.7 M	4.7 M	22.4 M	5.7	9.6	36.1%	204.3%
Uranium Royalty Corp.	546.1 M	455.4 M	-	6.3 M	5.1	131.9	5.8%	349.3%
Ur-Energy Inc.	499.6 M	478.2 M	86.1 K	15.6 M	7.7	5.6	23.8%	127.9%
UEX Corp.	275.6 M	271.1 M	213.2 K	125.7 M	10.3	5.7	0.8%	100.0%
Eloro Resources Ltd.	235.2 M	198.1 M	6.9 M	22.8 K	6.1	18.8	0.1%	83.6%
Azimut Exploration Inc.	134.9 M	139.0 M	9.1 M	131.2 K	7.0	2.2	0.6%	55.7%
Arafura Resources Ltd.	282.0 M	241.9 M	5.7 M	143.1 K	2.7	3.1	0.2%	73.3%
Wealth Minerals Ltd.	141.7 M	148.5 M	2.1 M	1.7 M	3.6	2.0	6.3%	558.8%
Standard Uranium Ltd.	45.1 M	44.8 M	6.5 M	-	6.4	0.8	-	123.1%
				Average	5.6	15.31	13.6%	144.4%

Source: S&P Global Market Intelligence

The following charts visualize the price performance of several uranium ETFs, producers, and explorers since the beginning of 2020. Nearly every public uranium company has shown a positive price return in this time period, with several exhibiting massive upward shifts due to movements in spot price and demand, along with an increasingly positive sentiment towards nuclear energy.




Canada Uranium Companies
Return
2400.00%
2100.00%
1800.00%
1500.00%
1200.00%
900.00%
600.00%
300.00%
0.00%
-300.00%
2020-01-06
2020-02-06
2020-03-06
2020-04-06
2020-05-06
2020-06-06
2020-07-06
2020-08-06
2020-09-06
2020-10-06
2020-11-06
2020-12-06
2021-01-06
2021-02-06
2021-03-06
2021-04-06
2021-05-06
2021-06-06
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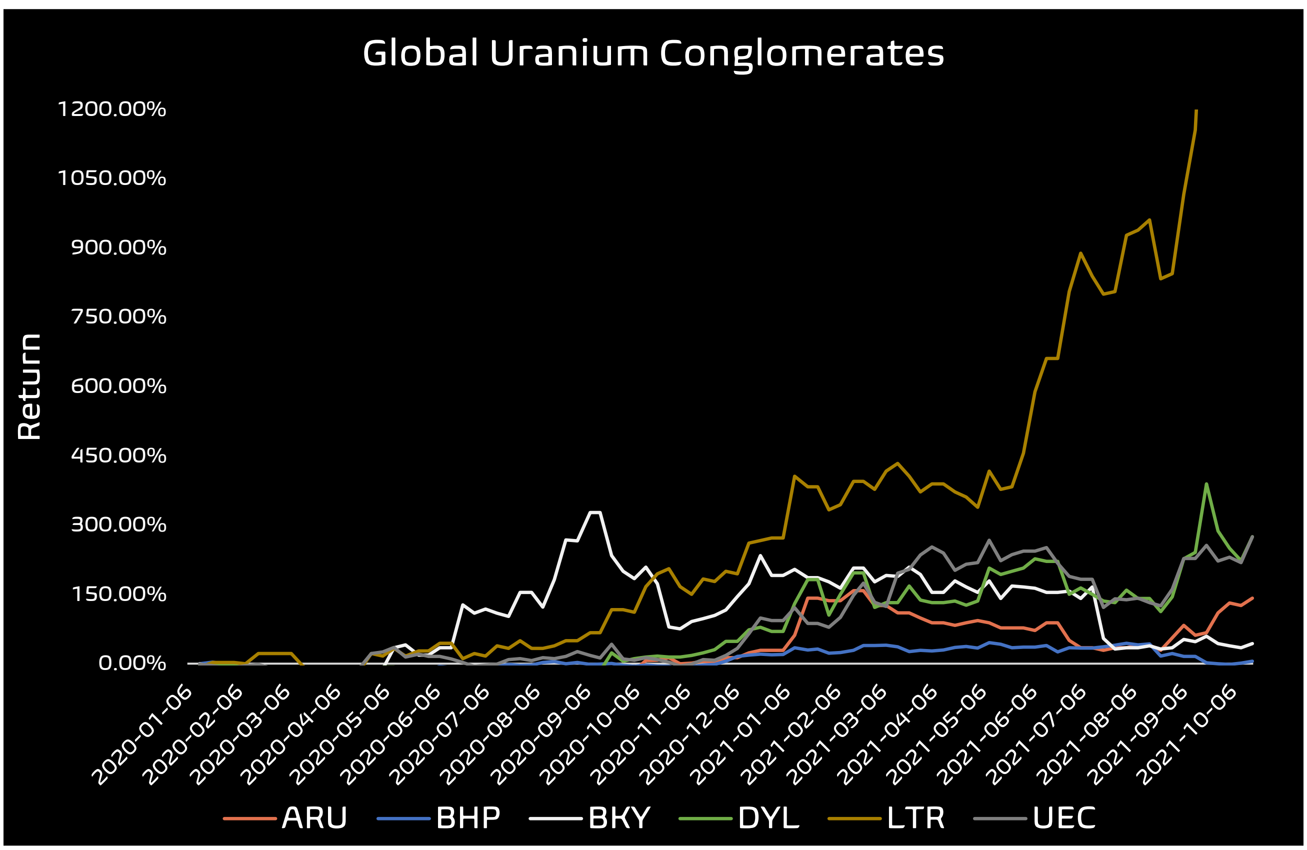
FCU
NXE
ISO
U


Global Uranium Conglomerates
Return
1200.00%
1050.00%
900.00%
750.00%
600.00%
450.00%
300.00%
150.00%
0.00%
2020-01-06
2020-02-06
2020-03-06
2020-04-06
2020-05-06
2020-06-06
2020-07-06
2020-08-06
2020-09-06
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2021-09-06
2021-10-06
ARU
BHP
BKY
DYL
LTR
UEC

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