November 11, 2020

RBCCM Uranium Outlook: Recovery in progress as balance set to turn into L-T deficit

Uranium market balanced through mid-2020s before entering significant deficit: We forecast a relatively balanced market through the mid-2020s as growing demand is met by increased supply. As we enter the late-2020s, we expect a growing deficit as supply decreases due to mine depletion and a reduction in secondary supply.

Near-term outlook, less spot activity, but more term activity: In the near-term, we expect spot market activity in 2021 to be lower than in 2020, which was spurred by COVID-19-related mine shut-downs that resulted in significant producer purchases, utilities working to secure near-term supply, and speculative activity. Term market activity may improve in 2021 as COVID-19-related concerns subside and the RSA (Russian Suspension Agreement) amendments have been completed.

Expect gradual improvement in prices and higher long-term price to incentivize new mine production: We expect prices to increase gradually through mid-2020s into the $35-40/lb range, from ~$30/lb currently, supported by the uranium cost curve. As the market moves into deficit, we expect prices to increase more significantly and forecast a long-term uranium price at $50/lb, which we view as the necessary incentive price for new mine supply. Our long-term price forecast is down from $65/lb previously due to updates to our incentive price curve.

Supply rising in medium-term before declining longer-term: We expect global uranium supply to recover in 2021 as COVID-19-related shut-downs are reversed, but global supply will likely start to decline post-2025. Through 2025, we forecast rising production as the re-start of Cameco's McArthur River, recovery of production in Kazakhstan, and ramp-up of Husab in Namibia offsets two mine closures (Cominak in Niger, Ranger in Australia) and declining secondary supply. Post-2025 we expect reduced supply due to potential mine closures (Cigar Lake, some Kazakh mines) and further reductions in secondary supply.

Inventory position has improved, but continues to weigh: We think global inventories may continue to weigh on the market, but the situation has improved in recent years. Western utility inventory coverage has declined and is less onerous, but remains above historical levels. China and Japan are two special cases that could be swing factors in terms of inventory impact on the uranium markets – China has built up a large strategic reserve and how this influences future purchasing decisions will impact future actual demand; Japan has seen inventories rise significantly following the Fukushima accident in 2011, and although we view inventories as relatively immobile, any dispositions could affect the global market.

Demand expected to grow moderately as new reactor builds offset phase out plans: We expect global uranium demand to grow by 1% (CAGR) to 190Mlbs U3O8e by 2030, from 171Mlbs in 2020. The majority of growth should come out of Asia, in particular China, and offset decreasing demand in North America and Europe, as older reactors age out without being replaced and some governments enact nuclear phase out policies. In terms of nuclear generating capacity, we forecast 417 GWe by 2030, up from 370 GWe in 2020. We believe nuclear will likely remain a key contributor to the global energy mix as countries work to balance efforts to lower carbon emissions with growing energy demands.

RBC Dominion Securities Inc.

Andrew D. Wong (Analyst)
(416) 842-7830
andrew.d.wong@rbccm.com

Stephen Morton (Associate)
(416) 842-8520
stephen.morton@rbccm.com

All values in USD unless otherwise noted.

Priced as of market close on November 10, 2020 ET (unless otherwise stated).

For Required Non-U.S. Analyst and Conflicts Disclosures, please see page 34.

Disseminated: November 11, 2020 00:40ET; Produced: November 10, 2020 23:50ET

RBC Global Mining Research Team

Toronto

RBC Dominion Securities Inc.

NORTH AMERICAN PRECIOUS METALS	**Josh Wolfson** **Mark Mihaljevic** **Wayne Lam** Cole Chessell
NORTH AMERICAN BASE METALS	**Sam Crittenden** **Alexander Jackson** Stephen Morton
FERTILIZERS/URANIUM	**Andrew Wong**

London

RBC Europe Limited

GLOBAL DIVERSIFIED METALS AND MINING	**Tyler Broda** **Srivathsan Manoharan** **Marina Calero**

Sydney

Royal Bank of Canada – Sydney Branch

AUSTRALIAN MINING	**Kaan Peker** **Alexander Hislop** **Paul Kaner**

New York

RBC Capital Markets, LLC

COMMODITY STRATEGY	**Helima Croft** **Chris Louney** **Michael Tran** Megan Schippmann

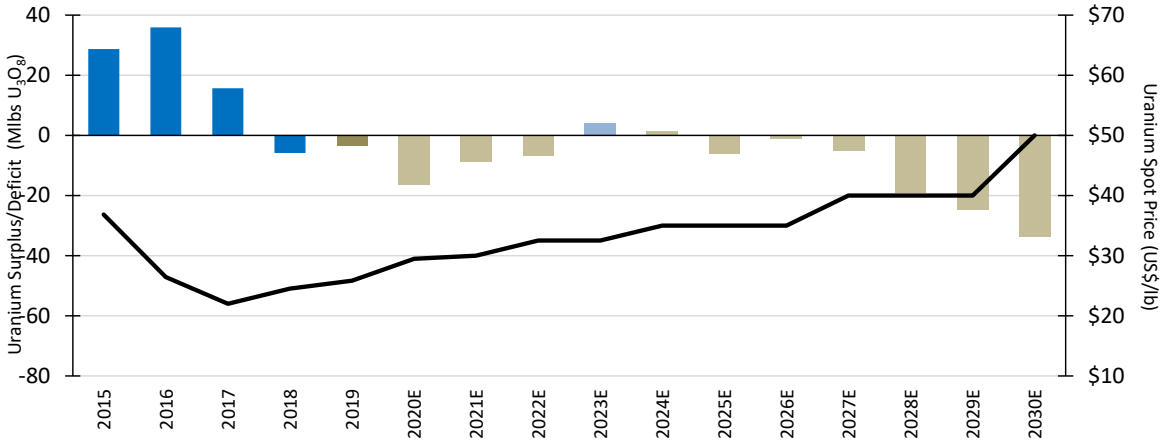
Uranium S&D Summary – Balanced through mid-2020s before moving into significant deficit

We forecast a relatively balanced market through the mid-2020s as growing demand is met by increased supply. As we enter the late-2020s, we expect a growing deficit as supply decreases due to mine depletion and a reduction in secondary supply.

We expect prices to increase gradually through mid-2020's into the $35-40/lb range, supported by the uranium cost curve. As the market moves into deficit, we expect prices to increase more significantly and forecast a long-term uranium price at $50/lb which we view as the necessary incentive price for new mine supply.

Uranium supply & demand estimates

S&D (Mlbs U3O8)	2015	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	CAGR 20-30E	CAGR 20-35E
Demand	**171**	**167**	**181**	**186**	**183**	**172**	**175**	**173**	**173**	**183**	**188**	**181**	**182**	**185**	**187**	**191**	**1%**	**0%**
Mine Supply	159	164	157	141	143	122	137	137	149	158	156	157	156	145	140	140	1%	0%
Secondary Supply	40	39	39	38	36	33	29	29	28	26	25	23	21	21	22	17	-6%	-5%
Total Supply	**199**	**203**	**196**	**180**	**180**	**156**	**166**	**166**	**177**	**184**	**181**	**180**	**177**	**166**	**162**	**157**	**0%**	**-1%**
Surplus/Deficit	**29**	**36**	**16**	**-6**	**-3**	**-16**	**-9**	**-7**	**4**	**2**	**-6**	**-1**	**-5**	**-19**	**-25**	**-34**		
Supply as % of demand	117%	121%	109%	97%	98%	90%	95%	96%	102%	101%	97%	99%	97%	90%	87%	82%		
Spot Price (US$/lb)	**$37**	**$26**	**$22**	**$25**	**$26**	**$29**	**$30**	**$33**	**$33**	**$35**	**$35**	**$35**	**$40**	**$40**	**$40**	**$50**	**5%**	**6%**
Term Price (US$/lb)	**$47**	**$40**	**$31**	**$31**	**$32**	**$32**	**$34**	**$35**	**$38**	**$40**	**$40**	**$40**	**$50**	**$50**	**$50**	**$50**	**5%**	**4%**



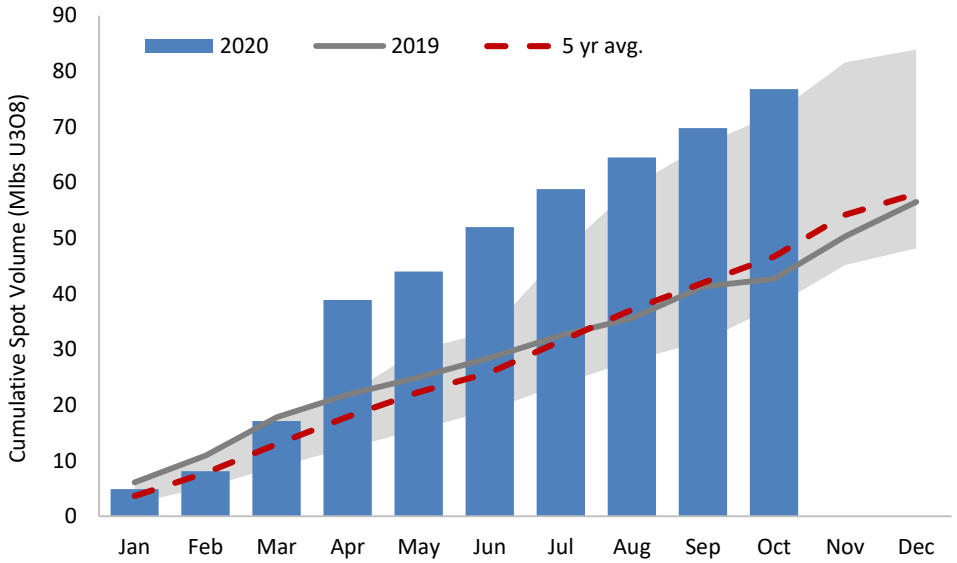
Source: UxC, WNA, Company reports, RBC Capital Markets estimates

Uranium Near-term – Expect more subdued spot activity, but better term activity in 2021

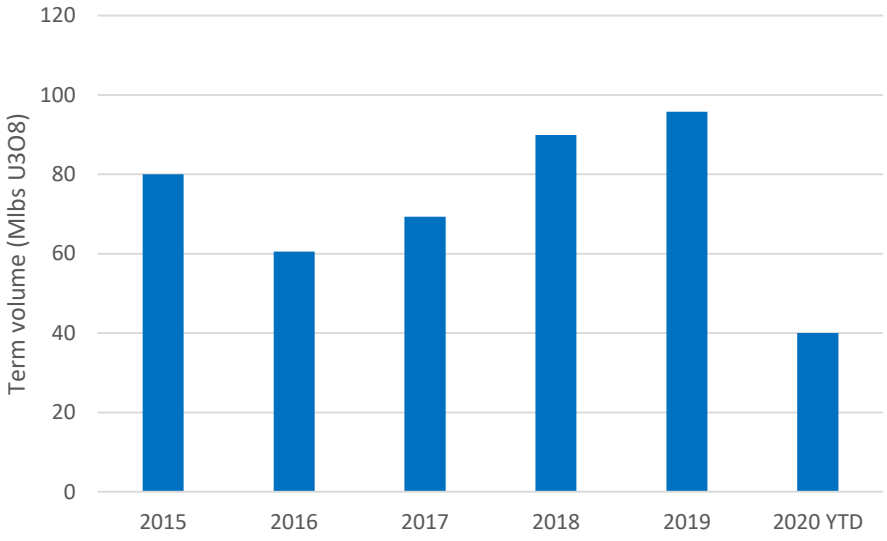
Uranium market activity in 2020 was skewed towards the spot market as COVID-19-related mine shut-downs resulted in significant producer purchases, utilities working to secure near-term supply, and speculative activity. As operations in Kazakhstan and at Cigar Lake were re-started in Q3, spot market activity slowed. Term market activity was very low as the market focused on near-term dynamics and awaited the outcome of the RSA (Russian Suspension Agreement) review.

We expect spot market activity in 2021 to be more moderate with prices relatively range-bound near $30/lb, while term market activity should improve as COVID-19-related concerns subside and RSA amendments have been completed, resulting in slightly higher term prices.

2020 spot volume well above average…



…but term market activity has been slow



Source: UxC, WNA, Company reports, RBC Capital Markets estimates

Key Questions

1) Will China continue significant uranium purchases as new reactors come on-line?	China is considered the primary uranium demand growth driver due to an ambitious reactor build program. However, China has also built up a very large inventory position and has invested in growing production in foreign countries. Chinese uranium imports were only 50Mlbs U3O8e in 2019 (vs. 62Mlbs average in 2010-2018) and down significantly in 2020 (although partially COVID-19-related). We view the large inventory position as a potential risk, but we believe China will continue significant market purchases, albeit at a slower pace, for several reasons – 1) desire to maintain diversity of supply; 2) a large portion of the domestic inventory is likely strategic; 3) ongoing opportunistic build up of strategic inventory with still relatively low uranium prices; 4) Chinese-controlled production is at high-end of cost curve and it makes more economic sense to take advantage of lower-cost options first.
2) What will be the supply response as prices rise and how will that impact the market?	We expect increased mine supply as prices rise gradually, in particular we expect Cameco's McArthur River to resume production in 2023 and Kazakhstan to return production to previous levels. However, we think this production increase will be in response to market demand and we continue to forecast a relatively balanced market through mid-2020s. We note Cameco's desire to only start McArthur River if the company is able to secure contracted volumes at acceptable prices (which we view at ~$40/lb) and Kazatomprom's stated focus on profitability (which we take to mean price over volume). Overall, we believe increased mine supply may slow, but not reverse, a gradual rise in uranium prices and a more significant long-term deficit will require higher prices at ~$50/lb to incentivize a supply response.
3) What will be the market impact from the recently amended Russian Suspension Agreement? Will there be a bi-furcated market?	We view the recently amended RSA (Russian Suspension Agreement) as moderately positive for non-Russian producers, but the transition period may create some uncertainty and take time for the market to adjust to the changes. The RSA amendments place a decreasing quota on enrichment to 15% by 2028, but more importantly only 5% on natural uranium by 2025, down from 20% previously for enriched product. US utilities that receive enriched product from Russia will need to purchase and return non-Russian natural uranium to remain in compliance with the 5% cap. The new quota may eventually result in a slightly bi-furcated market, with US utilities paying a moderate premium.
4) Will uncertainty around potential reactor closures and life extensions impact utility buying patterns?	Although Western utilities in particular have been grappling with the risk of potential early reactor closures and questions around reactor life extensions, which has limited term interest, we think the situation is slowly improving. Looking forward, we think the US market could receive more clarity as reactor life extensions are approved (we note four recent extensions to 80 years) and government support for reactor economics are clarified (like Zero Emission Credit programs). In Europe, the situation is slowly moving in a more constructive direction as earlier pronouncements for phase out programs immediately post-Fukushima have been met with the realities of carbon emission targets and economics of closing already built plants (France for example has pushed phase out plans by 10-years).

Key Questions

5) What impact will Japanese inventories have on the market?	We expect Japanese inventory coverage levels to remain high through 2030 even with reactor re-starts, but we believe the actual risk to the market is lower than the perceived risk. Utilities may continue diverting some contract deliveries to the market and could eventually sell excess inventories, but we view Japanese inventories as relatively immobile– 1) all utilities except one expect to re-start reactor operations, albeit at significantly reduced levels; 2) much of the inventory is already in country at fuel fabricators or fuel bundles; 3) uranium inventories remain valued at much higher purchase prices and are used as collateral for loans.
6) What are demand expectations in the rest of the world aside from China?	Aside from China, there are many other countries that we expect will be growing nuclear generating capacity including – Belarus, Czech Republic, Finland, Hungary, India, Iran, Pakistan Poland, Romania, Saudi Arabia, Slovakia, South Korea, Turkey, UAE, and Uzbekistan. We also note that although many mature nuclear countries may experience a decrease in nuclear generation, new projects are being built or planned and nuclear remains a key part of the energy mix. We note only three countries that are expected to completely phase out nuclear within our forecast period through 2035 – Belgium, Germany, and Taiwan. Excluding the growth in China and the recovery in Japan, our forecast for nuclear generating capacity remains relatively flat at ~315 GWe over the next 15 years.
7) What will be the impact from new nuclear technologies?	In the near-term, new Generation III+ reactors with improved passive safety measures and standardized construction should become widely accepted and may improve new build economics. SMR (small modular reactor) technology is being heavily pursued, with over 70 different designs at various stages. SMRs may provide more flexibility for reactor construction and deployment at lower cost (especially the initial capex hurdle). SMRs could eventually add incremental demand and/or replace current nuclear reactor designs. However, we expect widespread SMR commerciality at least 10+ years away and we also note that SMRs use less uranium than current reactor designs due to much longer re-load times (7+ years SMR vs. ~3 years current). Generation IV reactor designs (high temperature, molten salt, fast breeder) are being developed as potential long-term solutions for nuclear generation with potential closed nuclear fuel cycles, but aside from demonstration projects likely remain decades away from commercial deployment.
8) How does nuclear fit into plans for decarbonization?	We believe nuclear, as a near zero carbon emission energy source, will continue to play a critical role in global efforts to decarbonize economies and meet emission targets. Although new nuclear generating capacity is relatively expensive in Western countries, we believe the operating lives of nuclear reactors that are already operating can be economically and safely extended (see recent US reactor life extensions to 80-years), providing clean baseload electricity that can complement growing renewable generation. Overall, we expect a combination of different low-carbon energy sources, including nuclear, will be required to tackle carbon emissions while providing the electricity necessary for growing economies.

Price forecast and cost analysis

Prices expected to rise gradually to L-T incentive price

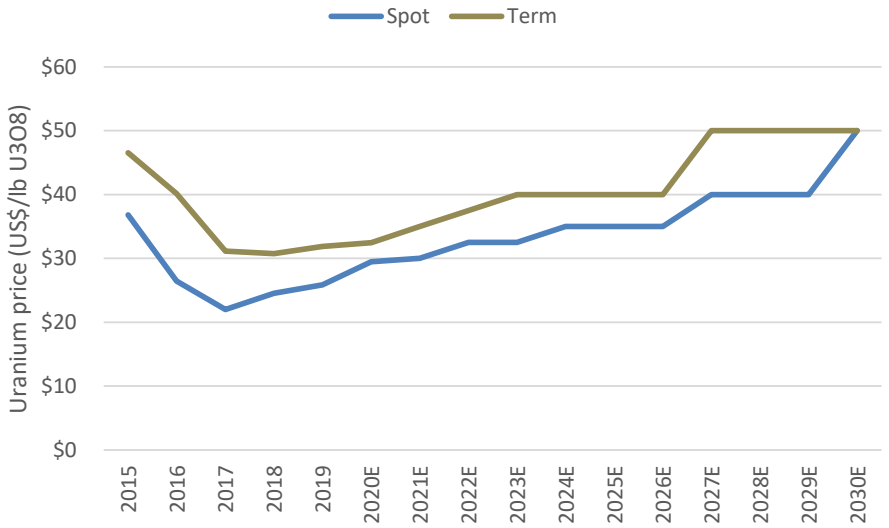
RBC Capital Markets

Prices forecast to rise gradually as market moves into balance and then long-term deficit

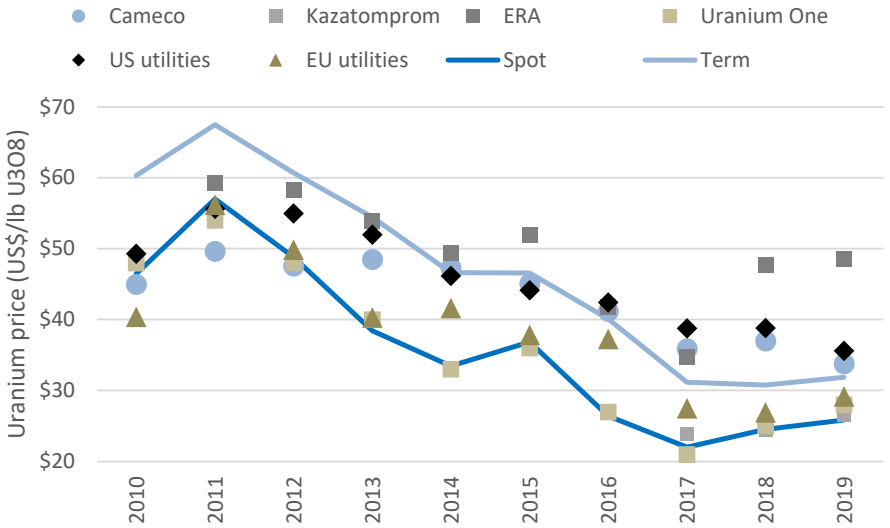
We expect uranium prices to rise gradually in the near and medium-term as the market remains in balance and reflects cost curve economics – we forecast prices at $30-35/lb in 2021-2022 and $33-40/lb in 2023-2026. Longer-term, we think uranium prices will need to rise to incentivize new supply as the market moves into significant deficit in late-2020s – we forecast prices at $40-50 in 2027-2029 and $50/lb starting 2030.

We note actual realized prices can differ drastically from market prices (higher or lower), depending on contract terms, and believe that understanding company and industry contract portfolios are important in understanding actual realized price dynamics.

RBC uranium price forecast



Actual realized prices can differ from market prices

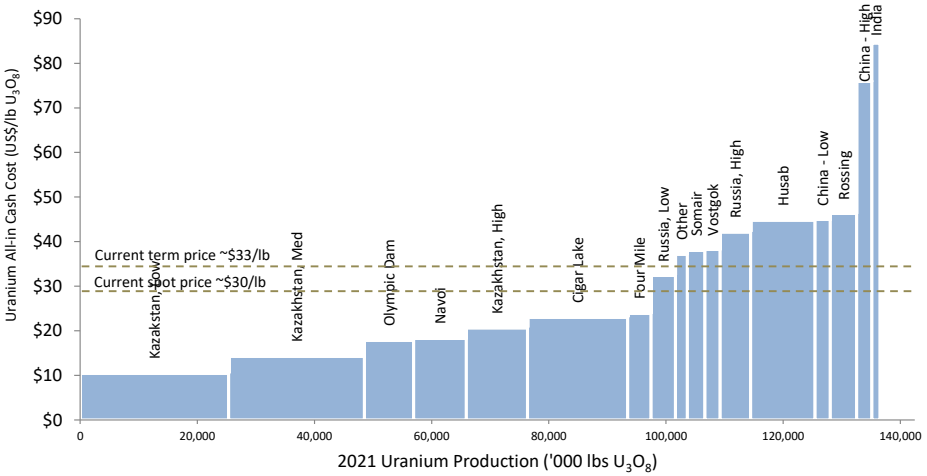


Source: UxC, Company reports, US EIA, Euratom, RBC Capital Markets estimates

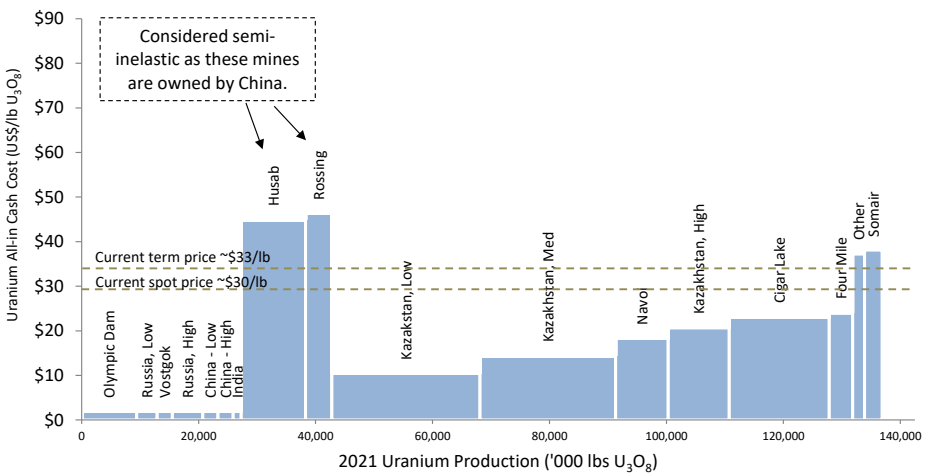
Cost curve points to uranium prices in the $30-40/lb range through 2027

We think the uranium cost curve supports market prices in the $30-40/lb range while the market is in a balanced to slight deficit position through 2027.
Although ~20% of the global cost curve is above $40/lb, we view the supply from many projects as inelastic or semi-inelastic. Adjusting for this inelastic supply points to cost support at $30-40/lb. While the adjusted cost curve could arguably indicate weak cost support and risk of prices dropping into the $20-30/lb range (spot prices from 2016-2020), we think many producers only continued production due to contracted volumes (i.e. higher actual realized prices) while relatively high concentration should limit periods when prices fall significantly below cost support.

Uranium mine supply cost curve



Cost curve after adjusting for inelastic supply



Olympic Dam produces uranium as a by-product. State controlled production (i.e. China, Russia, India) is mostly for domestic purposes. We considered these sources as relatively inelastic.

Husab and Rossing are located in Namibia, but owned by Chinese state companies – these high cost mines are run for strategic purposes and domestic imports, but material does get sold on the market. We considered these mines as semi-inelastic.

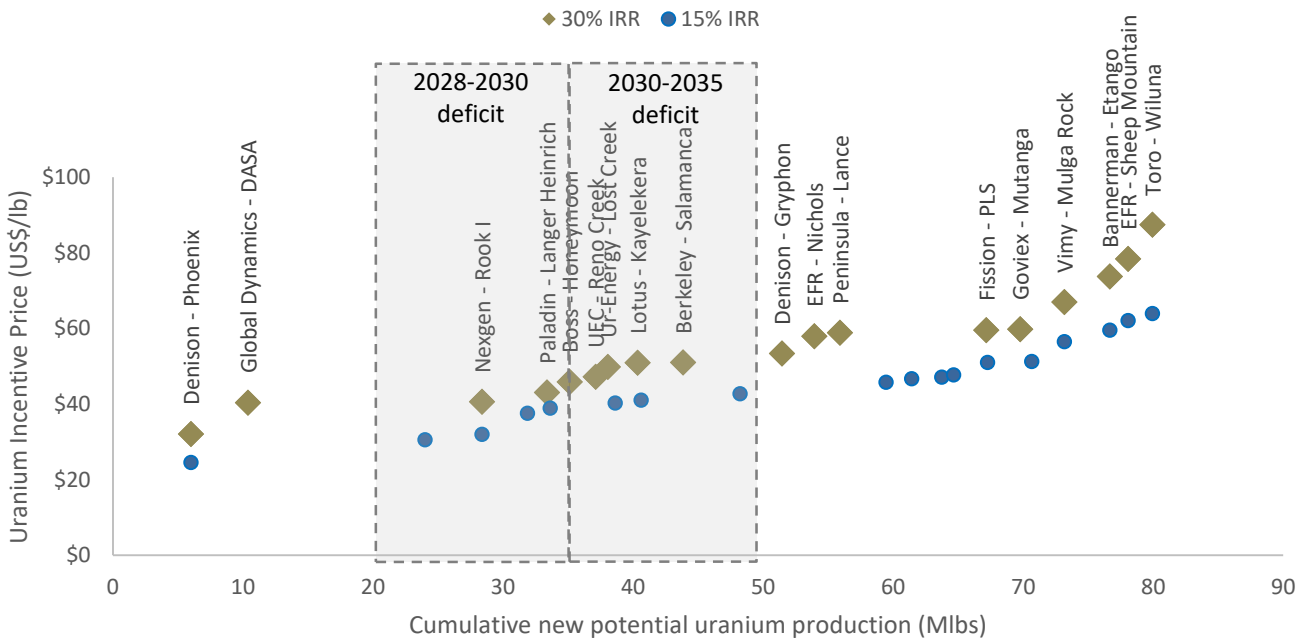
Source: UxC, Company reports, RBC Capital Markets estimates

New uranium projects require higher incentive prices longer-term

We believe higher uranium prices will be required long-term to incentivize new builds as the market moves into a significant deficit in the late-2020s – we estimate long-term incentive price at $50/lb.

We note several points regarding the incentive price curve – 1) we think a relatively high 30% IRR is appropriate as investors will likely want to be compensated for historically volatile uranium prices, permitting difficulties, and construction challenges; 2) all projects on our curve aside from re-starts, require permitting; 3) many projects are at early stages and unproven (PFS level); 4) many medium sized projects in the middle of the curve are re-starts of projects with history of cost and technical challenges.

Uranium incentive price curve points to long-term prices at ~$50/lb



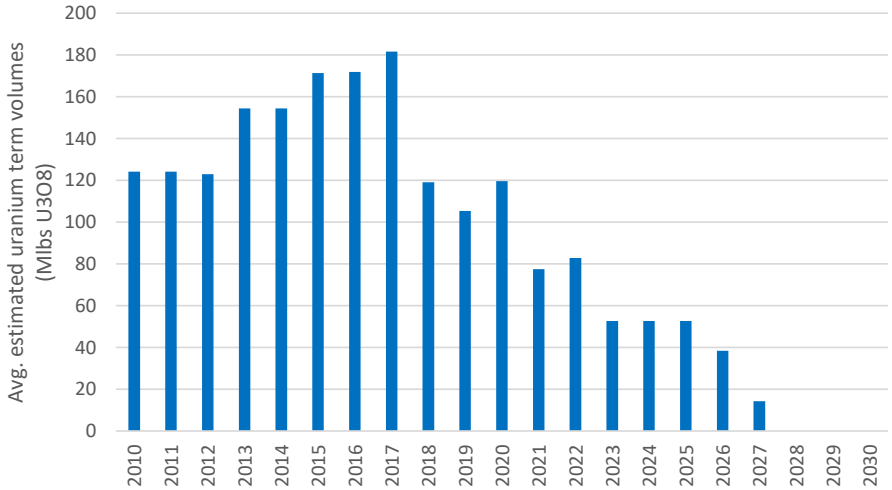
Source: UxC, Company reports, RBC Capital Markets estimates

Contract coverage points to contract cycle in early-2020s, but some hurdles remain

We believe the uranium market's contract coverage indicates term market activity should increase in early-2020s as contracts expire and coverage is limited past 2025. According to a recent UxC survey, the vast majority of utilities indicate a desire to have >60% of uranium requirements with long-term contracts.

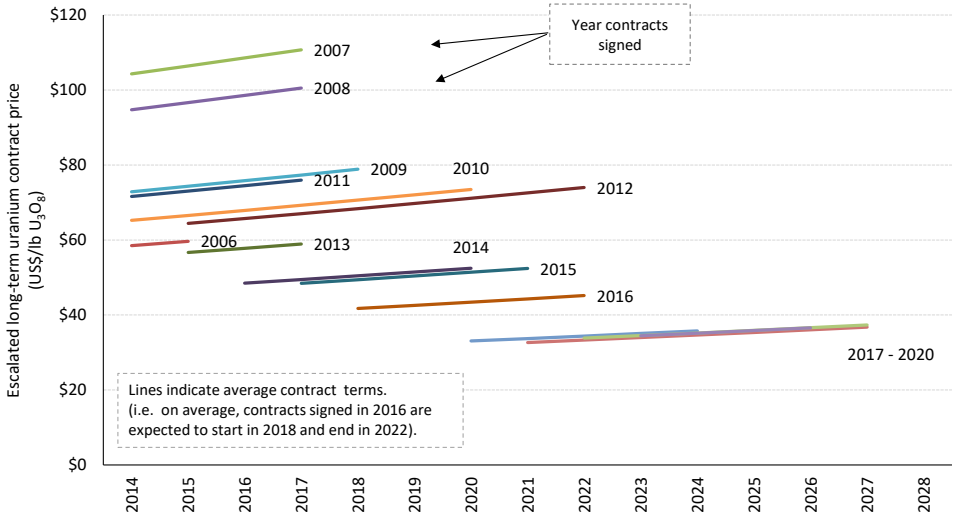
However, there may be some potential hurdles before term activity improves significantly – 1) uncertain reactor futures in the US could be addressed by reactor extension approvals; 2) European nuclear policies change frequently and utilities may need more government certainty; 3) market may need time to adjust to any potential impact from Russian Suspension Agreement amendments.

Estimated contracted term volumes



Estimated contract term volumes based on layering in UxC reported annual term contract settlements and projecting the volumes over average contract terms (i.e. 83Mlbs contracted in 2019, with average 3 year start and 9 year duration). Contract terms and deliveries may change over time, and volumes have likely shifted into later years, but the key takeaway remains that limited volumes are contracted starting in early-2020s.

Many contracts set to expire early-2020s



Each line indicates average contract terms for a certain year. For example, the 2016 line indicates that the average contract signed that year started in 2018 and ended in 2022, with prices likely in the $40-45/lb range after taking into account escalators. The key point is that many contracts are likely expiring in early-2020s and there is limited coverage past 2025.

Source: UxC, RBC Capital Markets estimates

Uranium Supply and Inventory

Supply expected to end the decade relatively flat

RBC Capital Markets

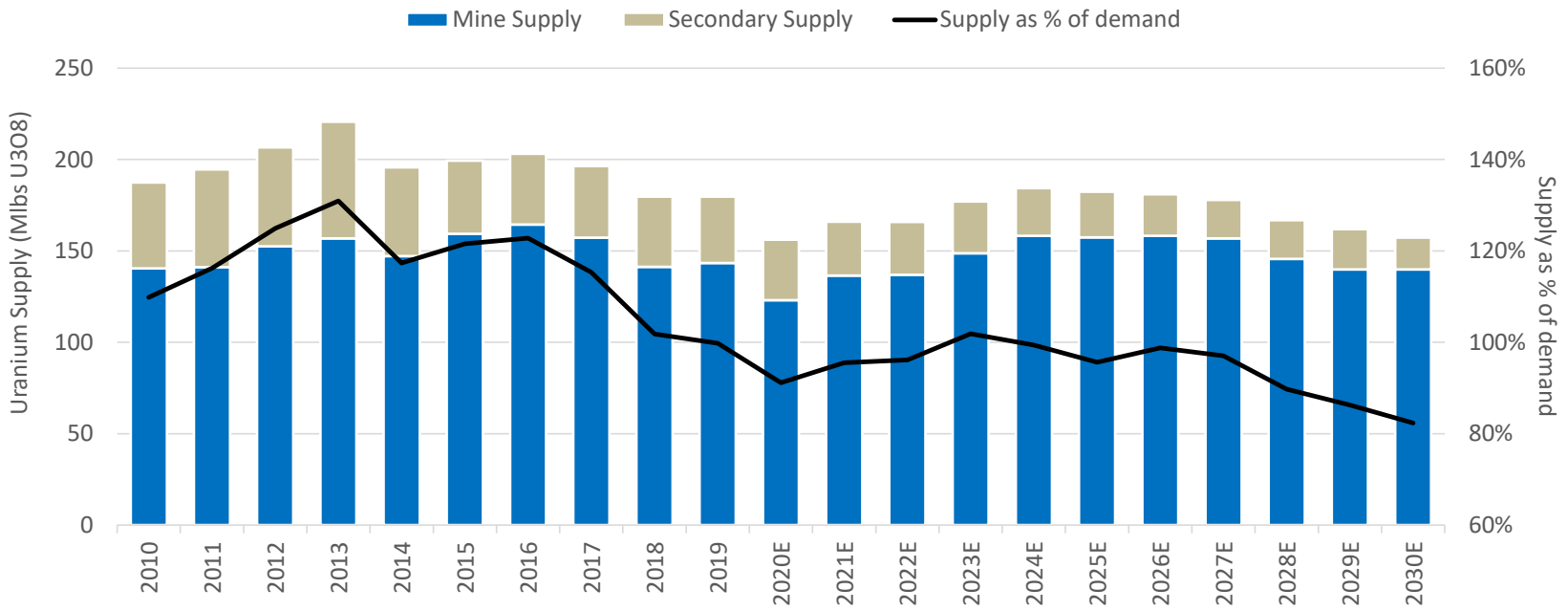
Global uranium supply expected to end the decade relatively flat

We expect global uranium supply to recover in 2021 as COVID-19-related shut-downs are reversed, but global supply will likely start to decline post-2025 and end the decade relatively flat to 2020 levels.

Through 2025, we forecast rising production as the re-start of Cameco's McArthur River, recovery of production in Kazakhstan, and ramp-up of Husab in Namibia offsets two mine closures (Cominak in Niger, Ranger in Australia) and declining secondary supply.

Post-2025 we expect reduced supply due to mine closures (Cigar Lake, some Kazakh mines) and further reductions in secondary supply.

Global uranium supply forecast



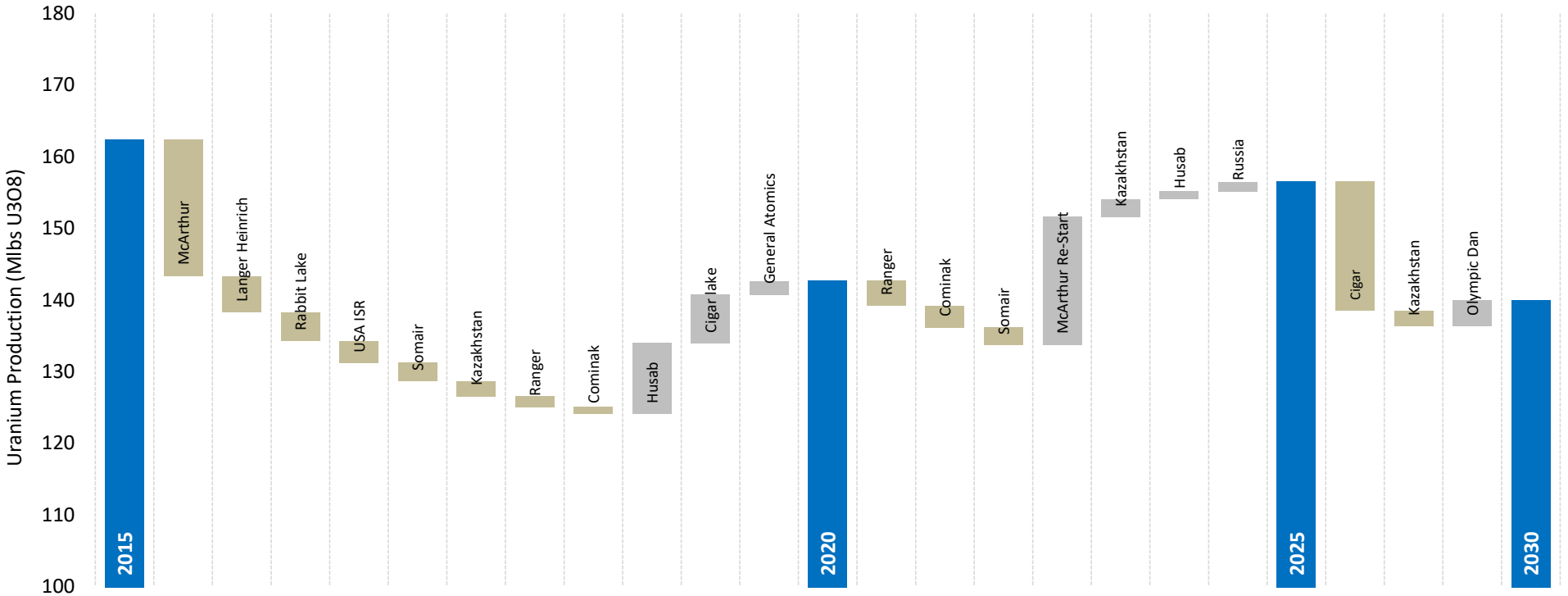
Source: UxC, Company reports, RBC Capital Markets estimates

Mine supply expected to increase in medium-term, but down long-term without new investment

Between 2020-2025, we expect uranium mine production to increase, primarily due to the re-start of Cameco's McArthur River (RBC forecast assumes 2023 re-start). Several mine closures or reductions (Ranger, Cominak, Somair) are expected, but likely offset by increased production from several sources (Kazakhstan, Husab, Russia).

Post-2025, we forecast a significant reduction in mine supply due to the depletion of Cameco's Cigar Lake Phase 1 (assuming no expansion built by then) and slight reductions in Kazakhstan, offsetting increased production at Olympic Dam.

Global uranium mine supply forecast



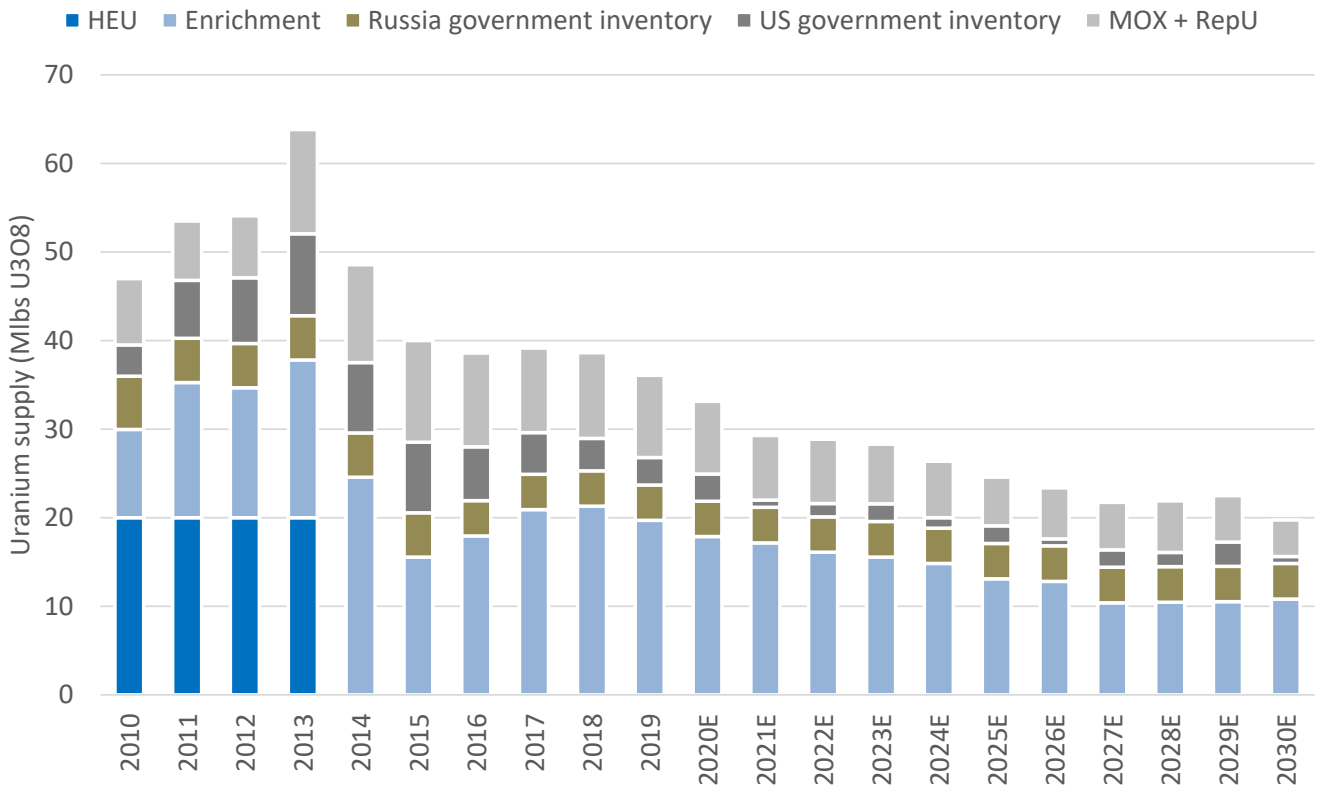
Note: 2020 production figures adjusted higher to normalize impact from COVID-19-related closures for comparative purposes.
Source: UxC, Company reports, RBC Capital Markets estimates

Secondary uranium supply declining through the decade

We expect a continued decline in secondary uranium supply as the impact from excess enrichment capacity is reduced over time – higher enrichment prices reduce incentive for underfeeding and tails re-enrichment; attrition of enrichment capacity over time without matching replacements due to still relatively low enrichment prices; new enrichment contracts with higher tails assays limit underfeeding.

Additionally, US government inventory supply will likely remain significantly reduced due to government directives and reduced inventory for sale, and the closure of nuclear reactors using MOX/RepU fuel will reduce the supply from these sources.

Global uranium secondary supply forecast



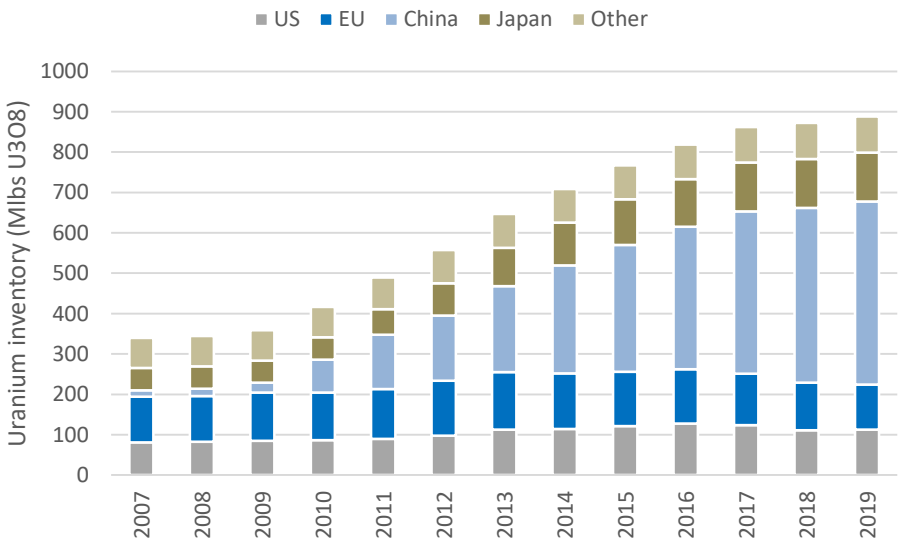
Source: UxC, US DOE, RBC Capital Markets estimates

Inventory has improved, but still large…China and Japan key players to watch

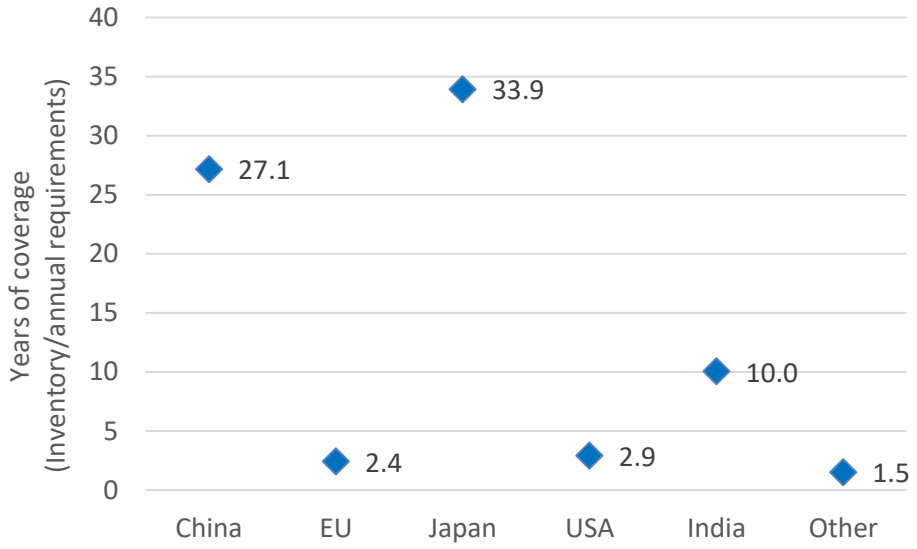
We think large global inventories may continue to weigh on the market, but the situation has improved in recent years. Western utility inventory coverage remains above historical levels, but has declined and is less onerous. India has high coverage, but has ambitious nuclear growth plans and limited domestic uranium production.

China and Japan are two special cases that could be swing factors in terms of inventory impact on the uranium markets – China has built up a large strategic reserve and how this influences future purchasing decisions will impact future actual demand; Japan has seen inventories rise significantly following the Fukushima accident in 2011 and any dispositions could affect the global market.

Global inventories plateauing, but still large



China and Japan key players to watch for inventory impact



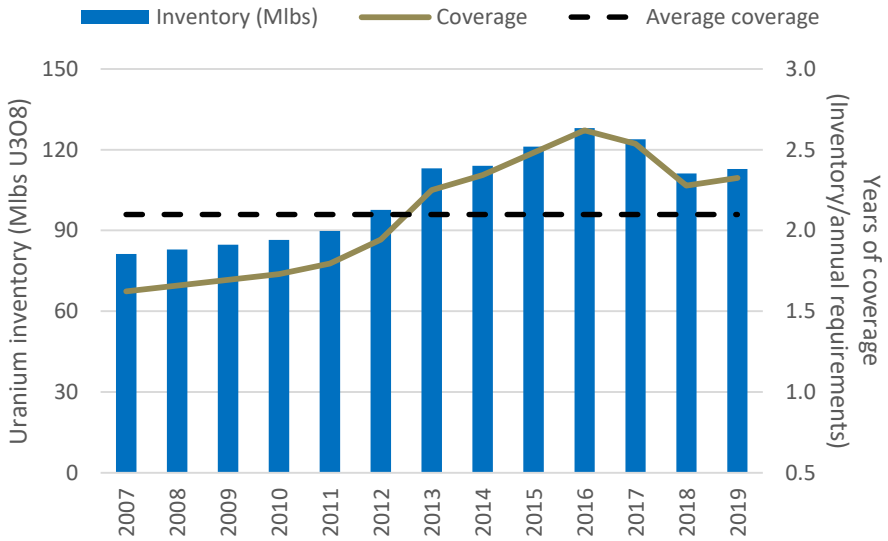
Source: UxC, US EIA, Euratom, WNA, RBC Capital Markets estimates

Western utility inventories being slowly drawn down

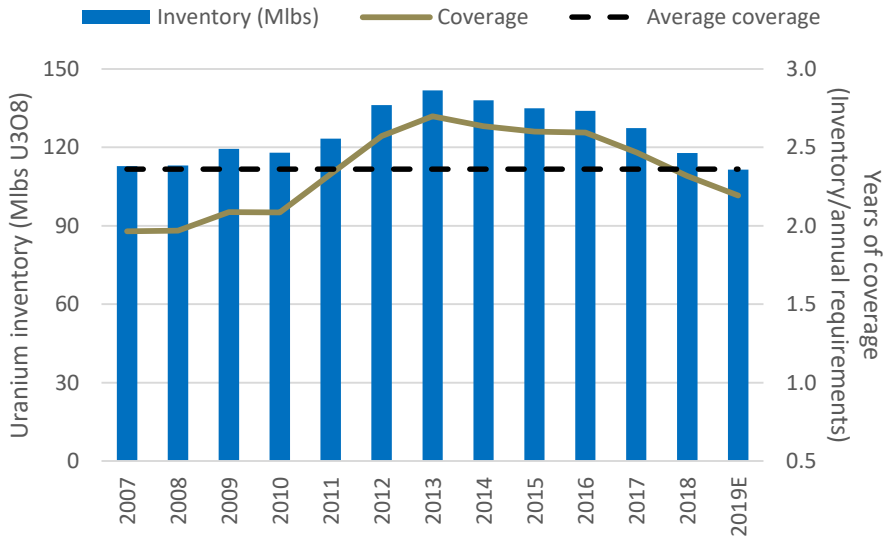
We believe the gradual decline in Western utility levels over the past several years is considered a positive development and we expect inventory draw downs to slow. Current coverage levels are near the 10-year average and indicates a lower level of excess inventories than in prior years.

However, coverage remains above pre-Fukushima levels when uranium markets were in a bullish environment. Also, upcoming reactor closures in both the US and Europe mean uranium requirements will likely decline in coming years, resulting in little change in coverage levels even as total inventories are drawn down.

US coverage is slightly above average



European coverage is slightly below average



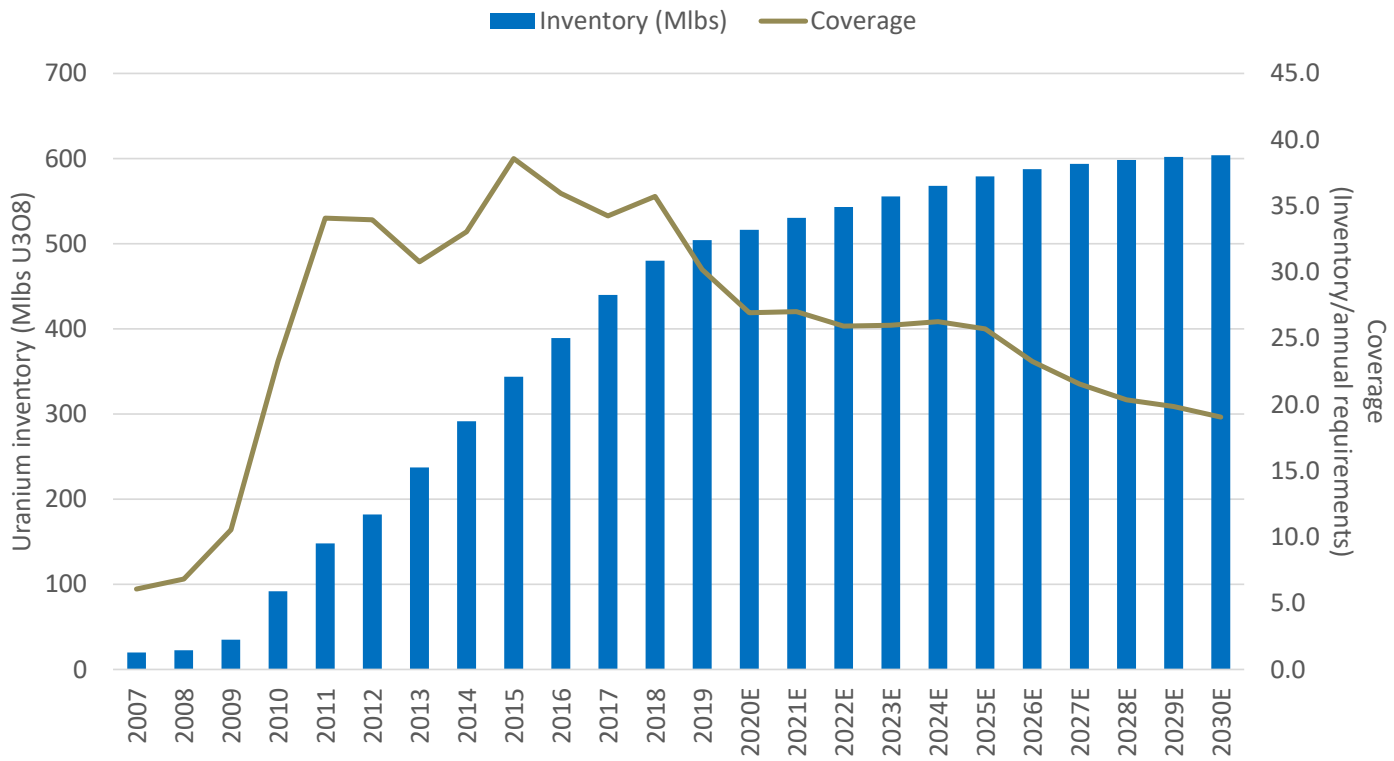
Source: UxC, US EIA, Euratom, WNA, RBC Capital Markets estimates

China’s strategic inventory build up supports reactor growth

We view China’s large inventory build as primarily a strategic reserve – the country has ambitious reactor build targets and limited domestic uranium production. We do not expect to see any significant inventory dispositions from China and we would not be surprised to see a continued rise in inventories with opportunistic purchases if uranium prices remain low.

However, the coverage level remains high even as new reactors come online (we estimate 20x annual requirements even in 2030) and could be a headwind for China’s future market purchases if uranium prices rise too quickly.

China’s high coverage levels could present a headwind to future market purchases



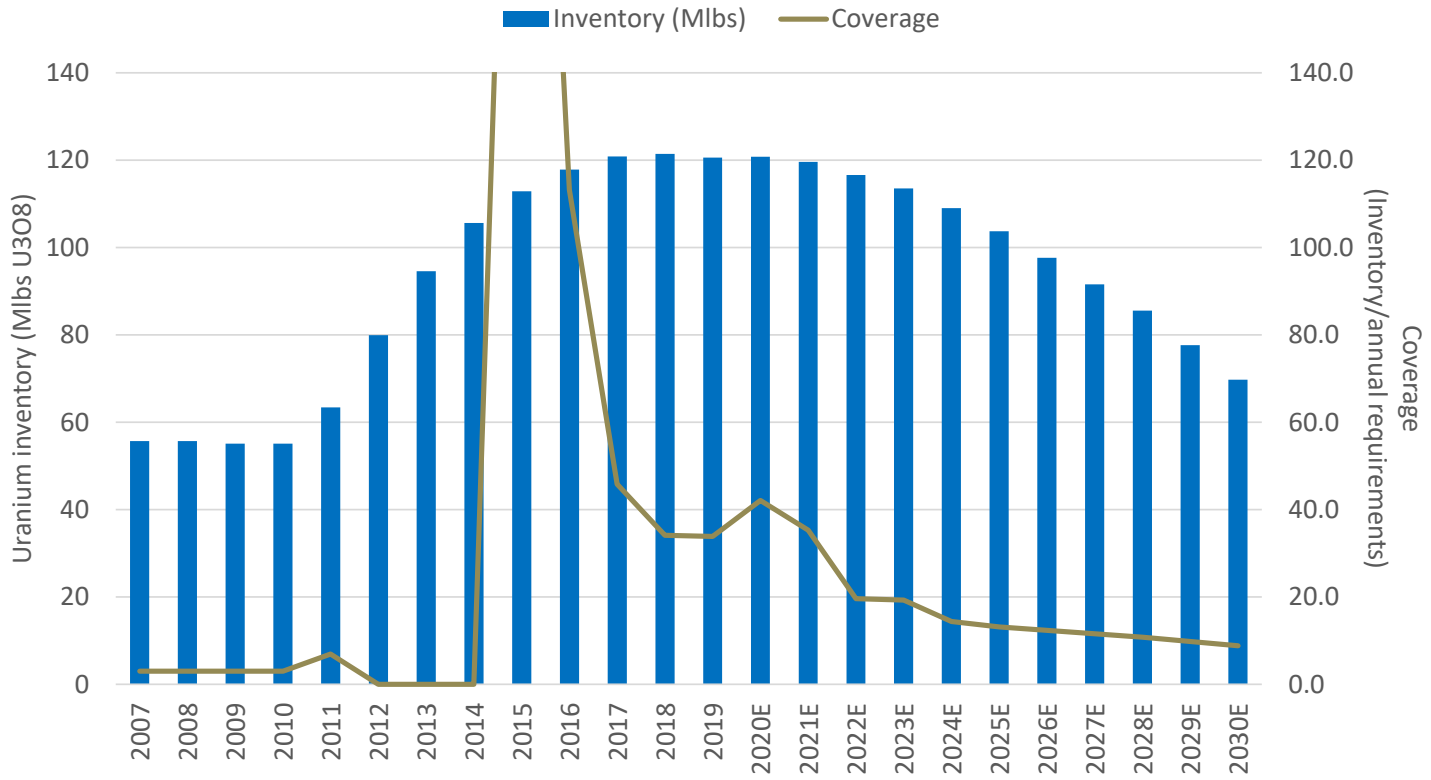
Source: UxC, WNA, RBC Capital Markets estimates

Japanese inventories still an overhang, but remain relatively immobile for now

We expect Japanese inventory coverage levels to remain high through 2030 even with reactor re-starts, but we believe the actual risk to the market is lower than the perceived risk.

Utilities may continue diverting some contract deliveries to the market and could eventually sell excess inventories, but we view Japanese inventories as relatively immobile– 1) all utilities except one expect to re-start reactor operations, albeit at significantly reduced levels; 2) much of the inventory is already in country at fuel fabricators or fuel bundles; 3) uranium inventories remain valued at much higher purchased prices and are used as collateral for loans.

Japanese inventories remain a market overhang and coverage will likely remain significant even with reactor re-starts



Source: UxC, WNA, RBC Capital Markets estimates

Uranium Demand

Growing as new reactors offset closures

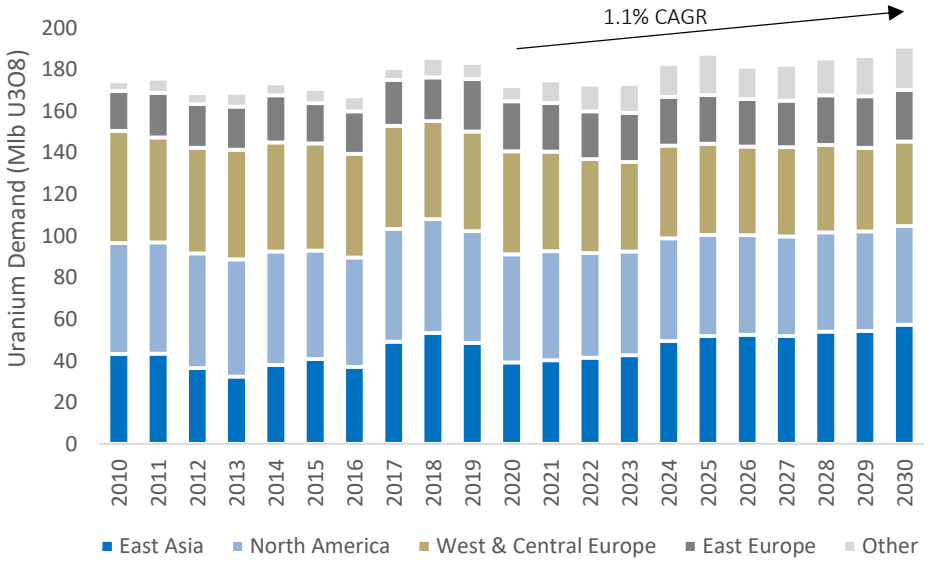
RBC Capital Markets

Global uranium demand expected to grow modestly

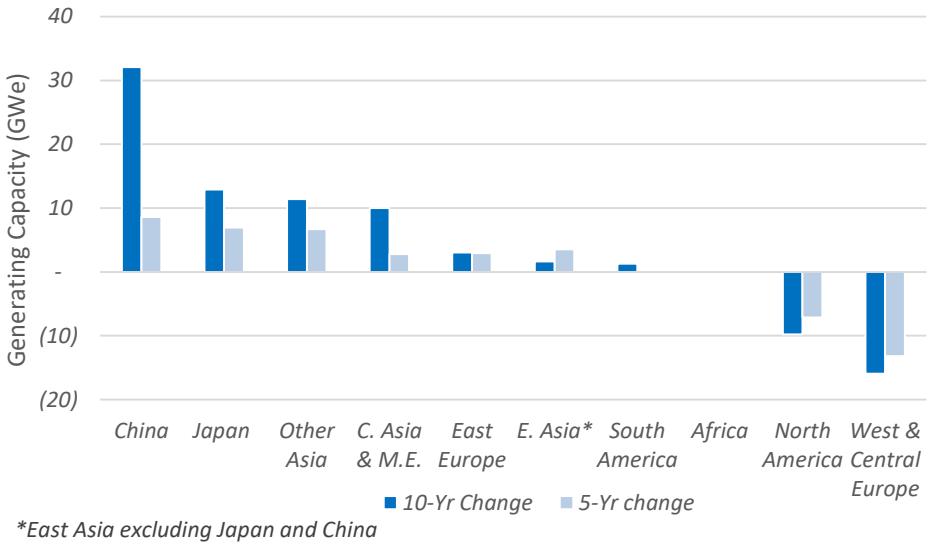
We expect global uranium demand to grow by 1% (CAGR) to 190Mlbs U3O8e by 2030, from 171Mlbs in 2020. In terms of nuclear generating capacity, we forecast 417 GWe by 2030, up from 370 GWe in 2020.

The majority of growth should come out of Asia, with China building new reactors and Japan re-starting almost half the nuclear fleet. As an offset, we expect demand in North America and Europe to decline, as Germany and Belgium enact nuclear phase out policies and some older reactors age out without being replaced.

Global uranium demand forecast to grow at 1% CAGR



Demand shifting from Western economies to Asia



*East Asia excluding Japan and China

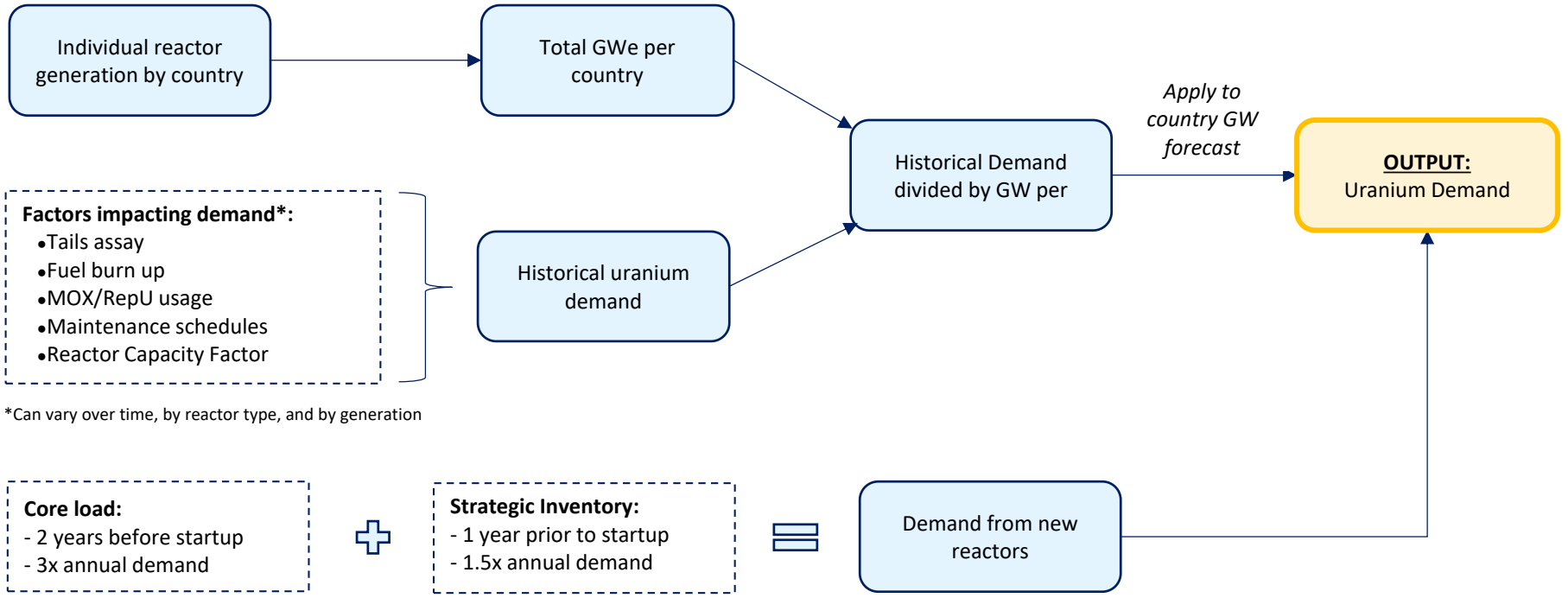
Source: UxC, WNA, RBC Capital Markets estimates

Demand forecast explained

Our uranium demand forecast is based on estimated reactor demand and is indicative of broad demand trends and longer-term market dynamics, but does not represent actual market purchases.

We take a bottoms-up approach based on individual reactor forecasts, including first core loads and strategic inventory build. However, we do not account for inventory changes (we think the uranium market is too opaque for us to accurately forecast actual market purchases) and there are many unknowable variables that affect actual uranium usage in a nuclear reactor (tails assay, burn up, capacity factor, maintenance schedules, different technologies, etc.)

Uranium demand forecast methodology chart



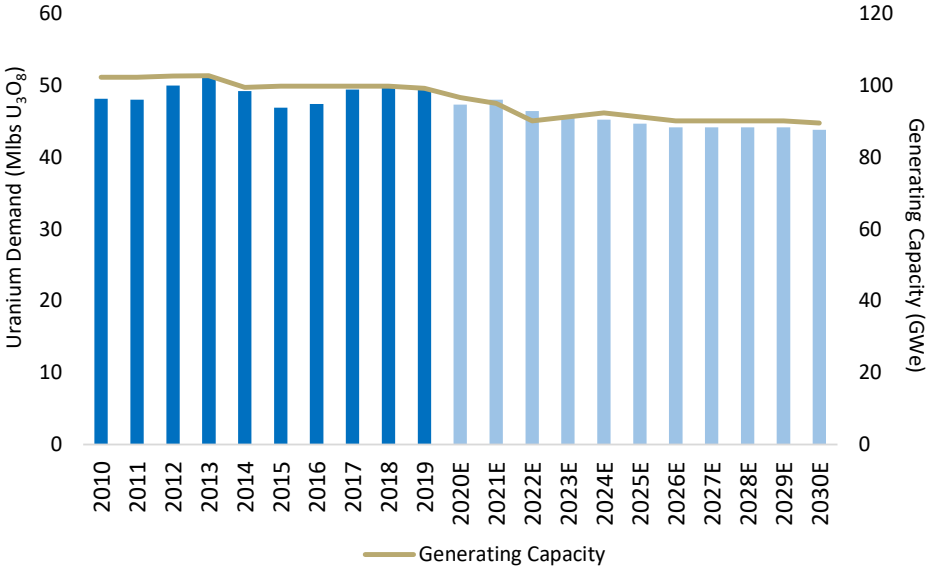
Source: RBC Capital Markets

United States nuclear generating capacity expected to decline, but remain a key energy contributor

We expect US nuclear generating capacity to decline by 7% to 89 GWe in 2030, from 97 GWe in 2020. The decrease is driven by an aging reactor fleet with minimal replacement capacity expected to come on line. Over the next decade we see ten reactors shutting down and two reactors starting operations (Votgle 3&4).

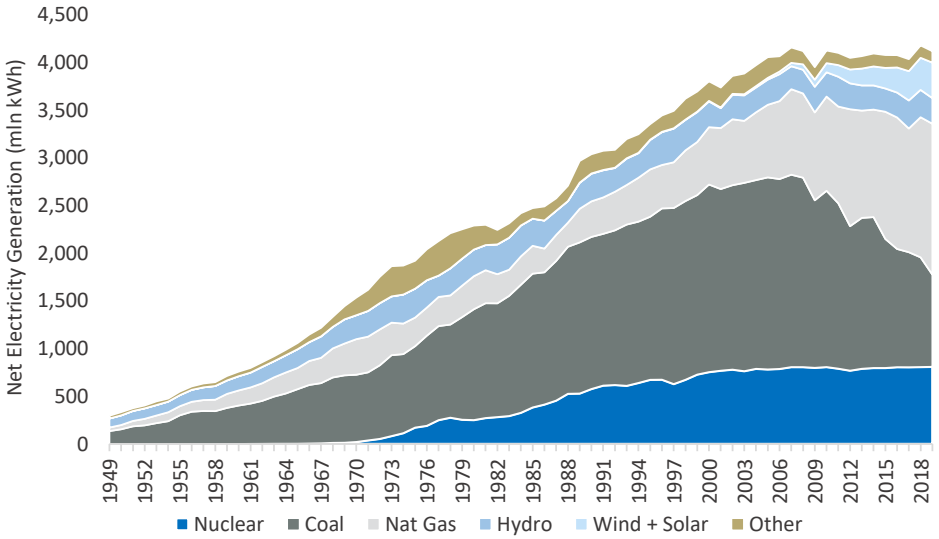
Longer term, based on current operating licenses, 50% of US generating capacity is scheduled to be shut down by 2040. However, we view this as unlikely given the importance of nuclear energy to US electricity generation (~20% of total) and the relative cost of plant modernization vs. new builds. We see most existing reactors getting supplemental 20-yr extensions and operating to 2050+.

Nuclear capacity falling slightly as reactors age out



The US currently has 94 operable reactors for 97 GWe of generating capacity, making it the worlds largest producer of nuclear electricity. While, we expect generating capacity to decrease slightly over the next decade, at 90 GWe of generating capacity, the US should still be the top producer of electricity worldwide in 2030.

Nuclear generation critical to US electricity generation



Nuclear accounts for 20% of total electricity generation but an aging reactor fleet risks future generating capacity. We estimate that if reactors were to age out at the current rate, net electricity generation from solar and wind sources needs to grow by 2.2x to offset the decline in Nuclear and maintain carbon free electricity production (excluding changes in other sources).

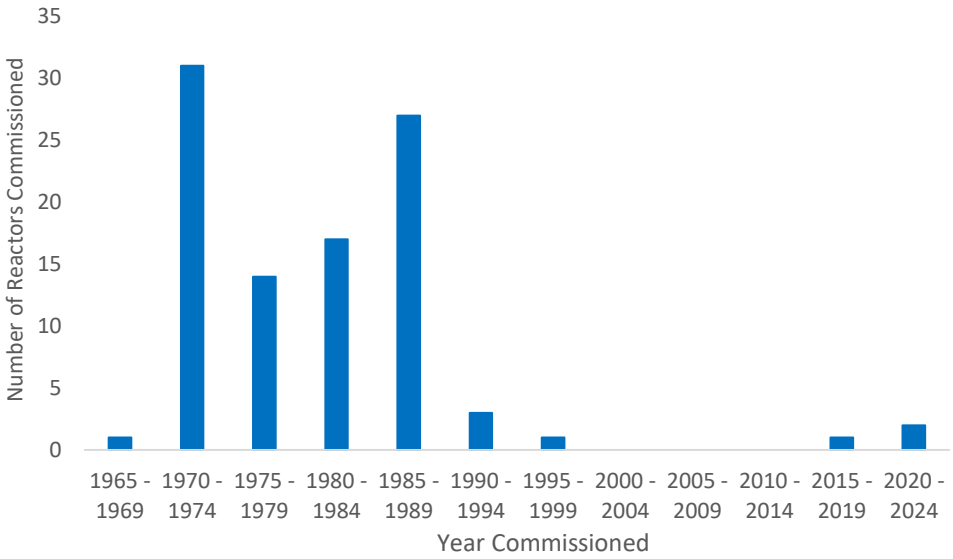
Source: UxC, WNA, US NRC, RBC Capital Markets estimates

United States nuclear fleet should see reactor life extensions that stabilizes future uranium demand

New builds have generally been uncompetitive in the US with recent projects facing costly budget overruns and delays. Strict licensing and design regulations mean that capital cost is high and lead times are long. We see plant modernization and supplemental operating life extensions as the likely path forward for nuclear electricity in the US. Plant modernization cost estimates range from $500M to $1B, and can result in operating costs falling by 25 – 50% (per EPRI), much less than the current $25 billion estimate for Vogtle 3 & 4.

The US NRC is accepting applications for supplemental life 20-yr extensions, above the initial 60 year extended operating life. To date, four reactors have been approved, another nine are under review, and 20 reactors are assessing potential applications.

New reactor builds slowed down post-1990



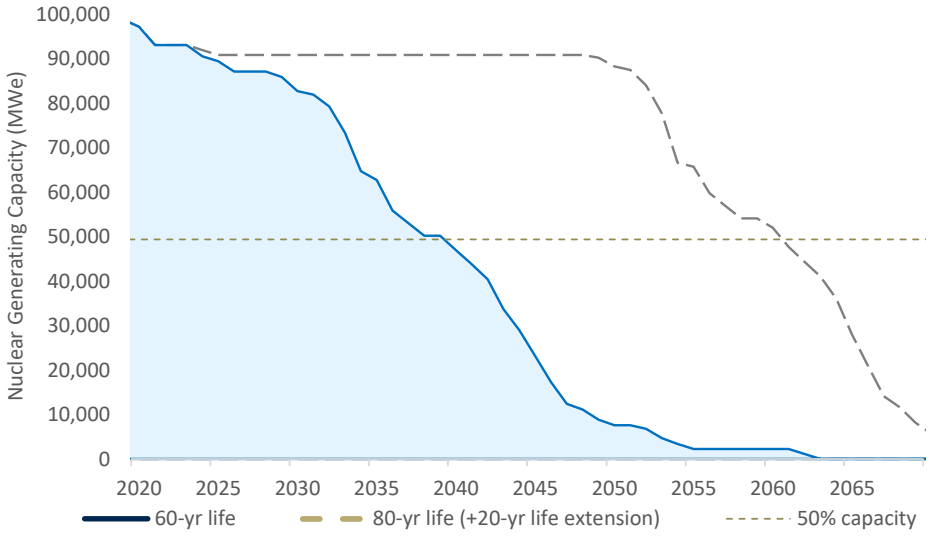
Construction of new reactors has slowed since 1990 with a preference towards uprating existing reactors and extending operating lives. There have been just two attempts at new builds in the US with current nuclear power technology:

- **Virgil C. Summer units 2 & 3** – Abandoned following delays and cost overruns; lead to the bankruptcy of Westinghouse
- **Votgle units 3 & 4** – Expected start up 2021/2022; current estimates at $25B vs. initial estimates of $14B.

There have been over 164 uprates in the US, adding an additional 7.9 GWe to generating capacity (equivalent to ~7 - 8 new reactors)

Source: WNA, US NRC, EPRI, RBC Capital Markets estimates

Potential for reactor life to be extended to 80 years



Initial reactor designs were for a 40 year operating life, which was based on economic life rather than safety. 88 reactors have since been extended to a 60 year operating life. The US NRC is now taking applications to extend reactor operating life by a supplemental 20 years to 80. They indicated 20 reactors are looking into the application, while the following have submitted an application:

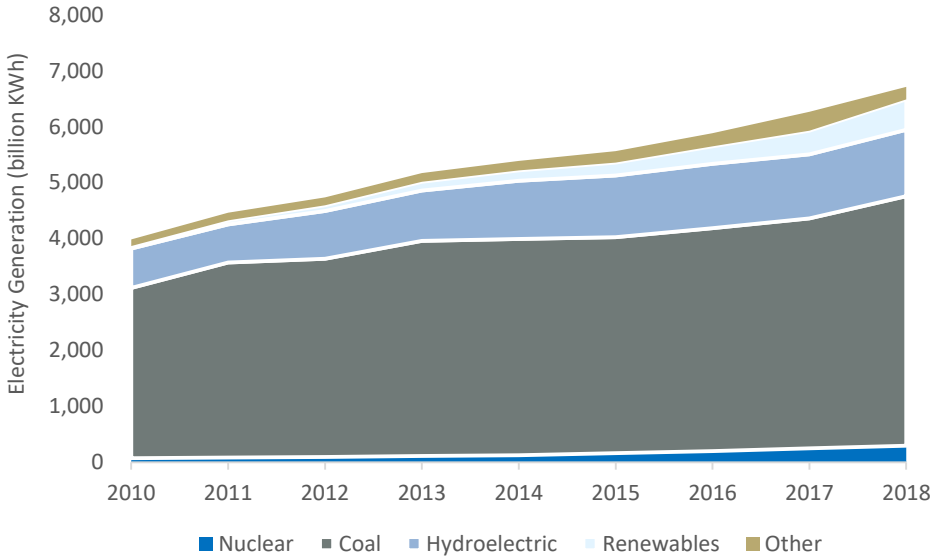
- Turkey Point units 3 & 4 (December 2019) – APPROVED
- Peach Bottom units 2 & 3 (March 2020) – APPROVED
- Surry units 1 & 2 – UNDER REVIEW
- North Anna units 1 & 2 – UNDER REVIEW
- Oconee units 1, 2, & 3 – UNDER REVIEW
- Two undisclosed reactors – UNDER REVIEW

China forecast to grow nuclear capacity significantly as part of clean energy goals

We forecast China's nuclear generating capacity to grow at a 5% CAGR and increase to 81 GWe by 2030, up from 49 GWe in 2020. We expect China to have 79 and 88 operable reactors by 2030 and 2035, up from 48 in 2020, as nuclear remains important to China's goal to reduce emissions while meeting the country's growing electricity demand.

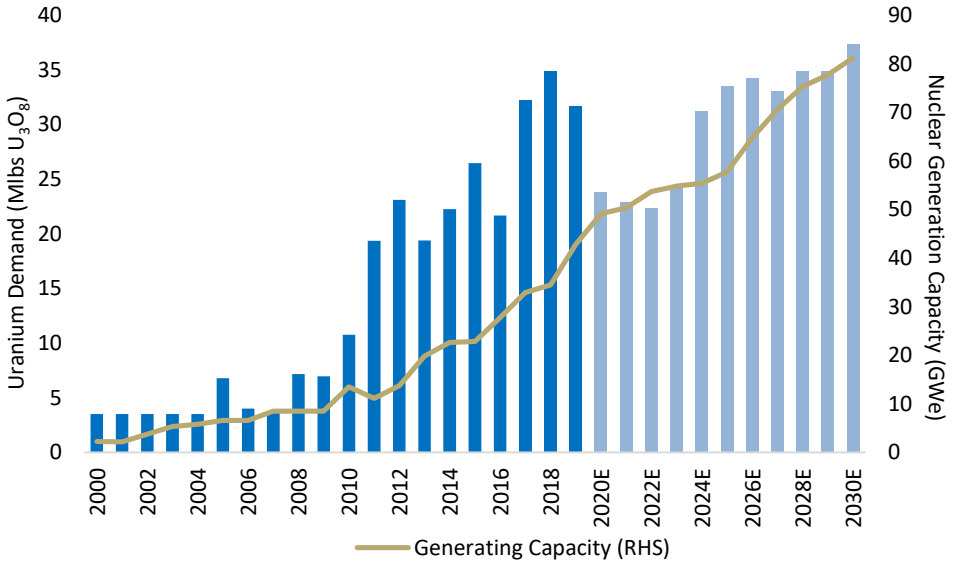
However, we also note that China has taken action to become more self sufficient within the nuclear cycle, including building and purchasing foreign mine production and stockpiling uranium. We believe China will continue significant market purchases, albeit at a slower pace and potentially below historical levels.

Nuclear important for clean air goals



Nuclear accounts for only a fraction (~4.9% in 2019) of China's electricity generation but is important to China's goal of carbon neutrality by 2060. China's NDRC's Energy Research Institute stated that if China is to meet its goal in limiting the global temperature rise to below 1.5 °C, nuclear would need to account for 28% of total energy by 2050. This equates to ~554 GWe, compared to current at 49 GWe.

Uranium demand to pick up by mid-2025E with new capacity



In the near term, we see uranium demand flat as a lull in reactor licenses being granted in 2016-2019 results in minimal new reactors coming on-line in the near-term. Looking to 2024+, we expect a significant uptick in uranium demand as reactors that are under construction begin to load initial cores and build pipeline inventory.

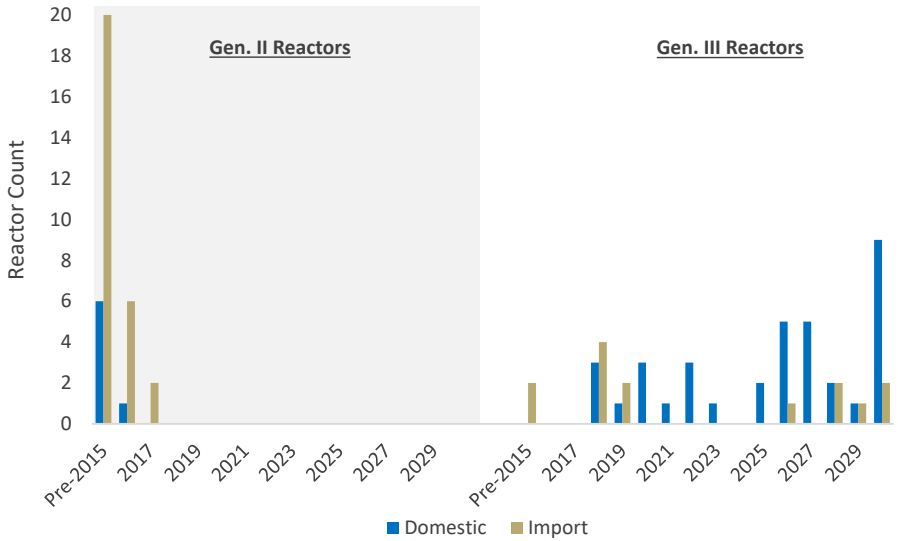
Source: UxC, WNA, US EIA, RBC Capital Markets estimates

China nuclear reactor construction back on track after a brief pause

Between 2016 and late 2019, China took a pause on granting new reactor construction licenses as it focused on ensuring safety and the development of domestic reactor technology. We think the shift to domestic reactor designs is a result of delays and cost overruns from imported reactor designs, as well as a general preference for China's government for domestically controlled technology. Going forward, China announced that it will be granting six to eight new reactor licenses a year.

We expect new builds will primarily be based on the Hualong One (HPR-1000) and CAP-1000/1400 domestic designs, moving away from the foreign-controlled AP-1000 and EPR. A focus on just a few reactor designs should help with construction cost and times.

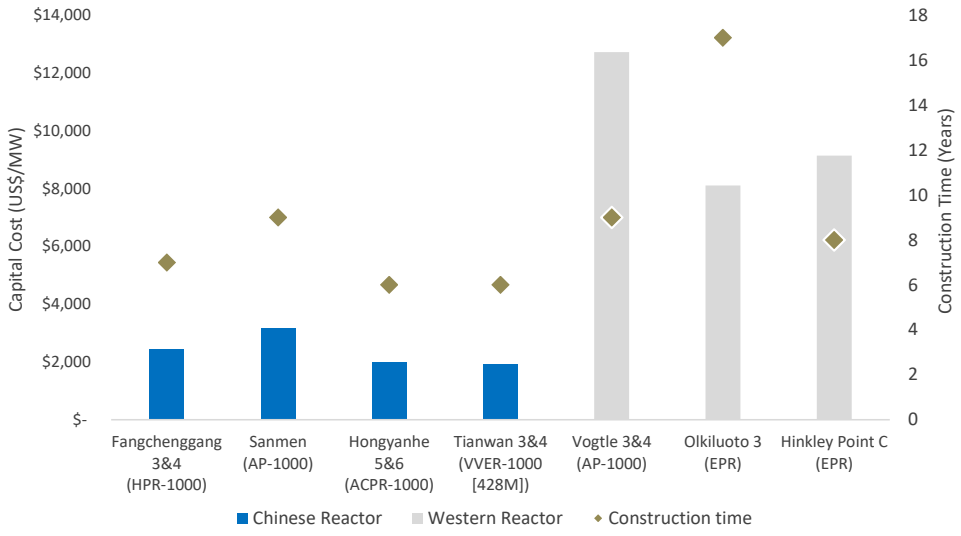
New builds took a pause, but are likely back on track



New builds going forward are primarily focused on domestic Chinese designs rather than imported foreign designs. Looking at 2020+ we see the following number of reactors commissioned:

- HPR-1000 (China) = 18
- CAP-1000/1400 (China/US) = 12
- VVER-1200 (Russia) = 4
- EPR (France) = 2
- Other (mixed) = 6

Reactors built in China lower cost than Western countries



Costs of new reactor builds in China are significantly less than in Western countries. This can be attributed to more recent construction experience, more friendly licensing regulations, and lower labour costs. Going forward, as the country focuses on just a few reactor types, namely the HPR-1000 and CAP-1000/1400 designs, China should be able to keep costs and construction time down by standardizing manufacturing and processes.

Source: WNA, Bloomberg, Company Websites, Reuters, BBC, RBC Capital Markets estimates

Europe to remain reliant on nuclear despite phase out policies

We expect nuclear power to remain an important contributor to electricity generation in Europe as the region works to achieve carbon emission reduction targets while maintaining electricity capacity. Excluding the complete phase-outs planned in Belgium and Germany, nuclear generating capacity is expected to remain little changed in Europe through 2030 as some countries with nuclear phase-out policies (France, Switzerland) are offset by countries with aims to increase nuclear generation (Czech Republic, Hungary, Slovakia).

Looking through to 2035, there is risk of more significant reductions in nuclear generating capacity as reactors in France and the UK reach official end of life dates, but reactor extensions in France and new builds in the UK are likely to keep nuclear capacity stable.

Nuclear policy overview by country

	Nuclear Power				Reactors		Generating Capacity (MWe)		
Country	% of Electr.	Growth	Importance	Current Policy	Operating	Construction	2010	2020	2030
Belgium	50%	↓	Phase out	●Policy to phase out nuclear power generation by 2025; ●Expected electricity shortage could extend nuclear generation	7	0	5,943	5,943	0
Czech Republic	33%	↗	High	●Extend reactor lives to 60 yrs + new reactor online mid-2030s; ●Nuclear to account for 40-58% of total electricity by 2040	6	0 (1 planned)	3,932	3,932	3,932
Finland	30%	↑	High	●Extend life and uprate existing reactors + expand fleet; ●Nuclear to replace coal & account for 60% of electricity	4	1 (1 planned)	2,769	2,769	5,062
France	70%	↘	High	●12 reactors to be shutdown by 2035 + one under construction; ●Reduce nuclear electricty to 50% of total by 2035	56	1	63,130	63,130	61,180
Germany	12%	↓	Phase out	●On track to phase out all nuclear power generation by 2022; ●Public opinion broadly opposed to nuclear power	6	0	20,490	9,444	0
Hungary	49%	↑	High	●Extend life and uprate existing reactors + expand fleet; ●Nuclear to help offset coal electricity generation	4	0 (2 planned)	1,889	1,889	4,289
Netherlands	3%	→	Low	●Reversed a decision to phase out nuclear electricity; ●Cancelled a planned reactor, no other plans for expansion	1	0	485	485	485
Poland	0%	→	Low	●Nuclear part of plan to diversify energy supply away from coal; ●Government plans to have 6-9 GWe of capacity by 2043	0	0 (1 planned)	0	0	0
Slovakia	54%	↑	High	●Policy to actively expand generating capacity as % of total; ●Potential to extend life or replace two existing reactors in 2025	4	2	1,816	1,816	2,758
Slovenia	39%	→	High	●Shared reactor with neighbouring Croatia; ●Considering adding a second reactor, decision by 2027	1	0	696	696	696
Spain	20%	↘	Medium	●No active policy to expand or phase out nuclear; ●Phasing out reactors with age (40 yr + can apply for 10 more)	7	0	7,567	7,121	5,104
Sweden	40%	↘	High	●Overturned old policy to phase out nuclear by 2010; ●No active policy to expand or phase out nuclear	7	0	8,849	8,376	6,691
Switzerland	36%	↘	High/gradual phase out	●Plans to gradually phase out nuclear reactors with age; ●No new construction licenses or life extensions to be granted	4	0	3,315	3,315	2,230
UK	20%	↘	Mediuum	●~50% of existing capacity offline by 2025, two new builds; ●Electricity market makes capital intensive projects difficult	15	2	10,155	8,883	6,903

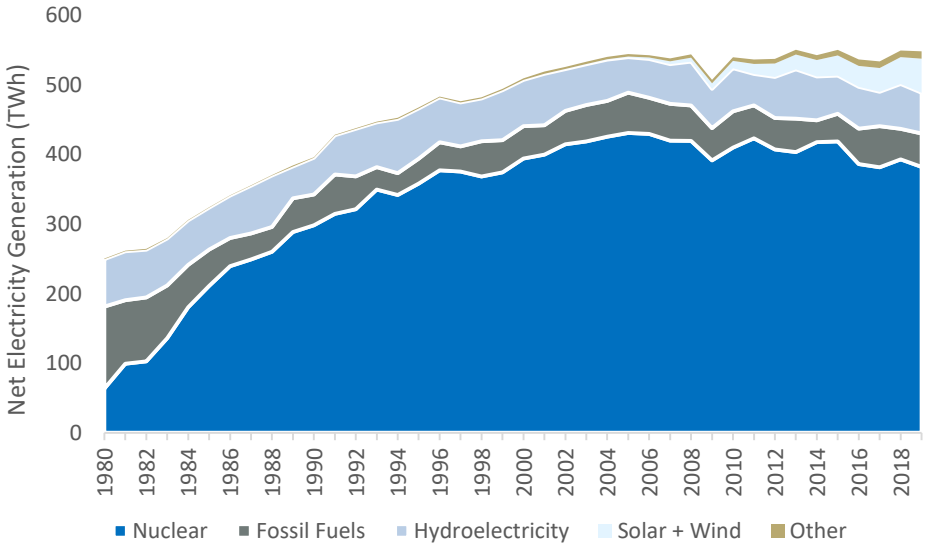
Source: WNA, US EIA, IEA, IAEA, BBC, RBC Capital Markets estimates

France nuclear generating capacity likely to remain unchanged over next decade

We expect nuclear generating capacity in France to decrease by 3% to 61 GWe in 2030, from 63 GWe in 2020. The reduction is driven by France's policy to close up to six reactors by 2030 and reduce nuclear as a share of total electricity generation to 50% by 2035.

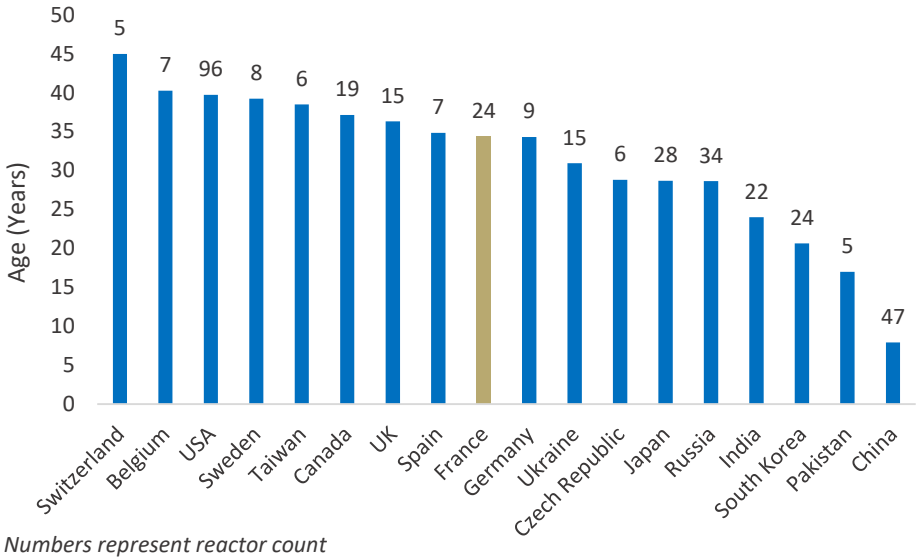
While we expect the oldest reactors to shut down, we also view the phase-down policy as generally unrealistic. Given the importance of nuclear to France's electricity market, the country's relatively young reactor fleet, and plans for potential new builds and reactor life extensions, we could see the target reductions lowered or the policy delayed, or even reversed. We have seen phase-out policies altered in Europe many times, including this same policy in France which was deferred by 10 years from its original target of 2025.

Nuclear energy a big contributor to electricity generation



Historically, nuclear accounts for ~70% of France's electricity generation and is an important aspect of the country's energy independence policy. As well, France is the largest exporter of electricity, generating €3 Bln annually from these exports (per World Nuclear Association).

Reactor fleet relatively young



Numbers represent reactor count

France has a relatively young nuclear reactor fleet compared to other Western countries. With some investment, these reactors can run for 50+ years. Phase-out policies have a history of being deferred or even overturned in Europe:

- France delayed this phase-down policy by 10 years to 2035
- The Netherlands reversed its phase-out policy
- Belgium is reviewing its phase-out policy timeline
- Germany reversed its original phase-out policy in 2011, before re-instating it post-Fukushima

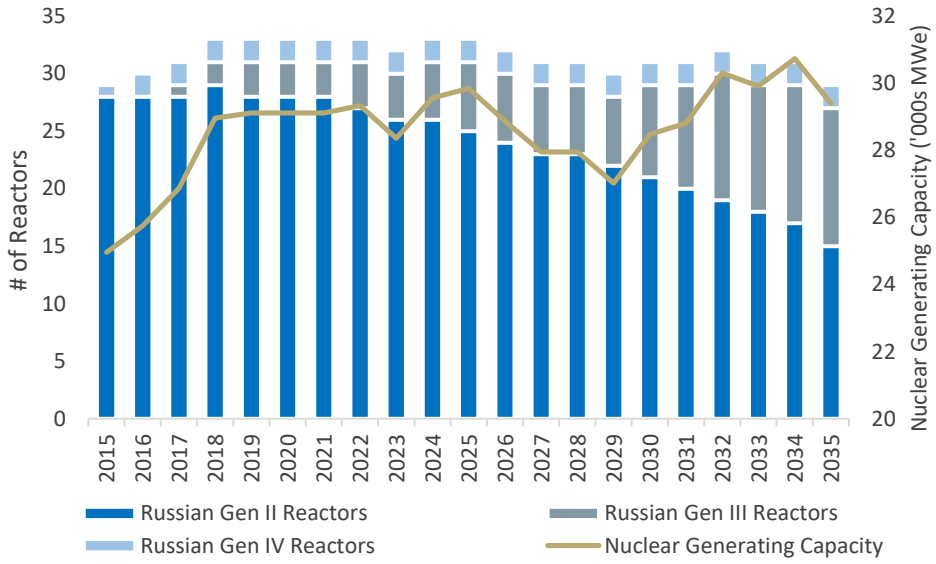
Source: WNA, US EIA, RBC Capital Markets estimates

Russia maintaining nuclear capacity by replacing old reactors with new designs

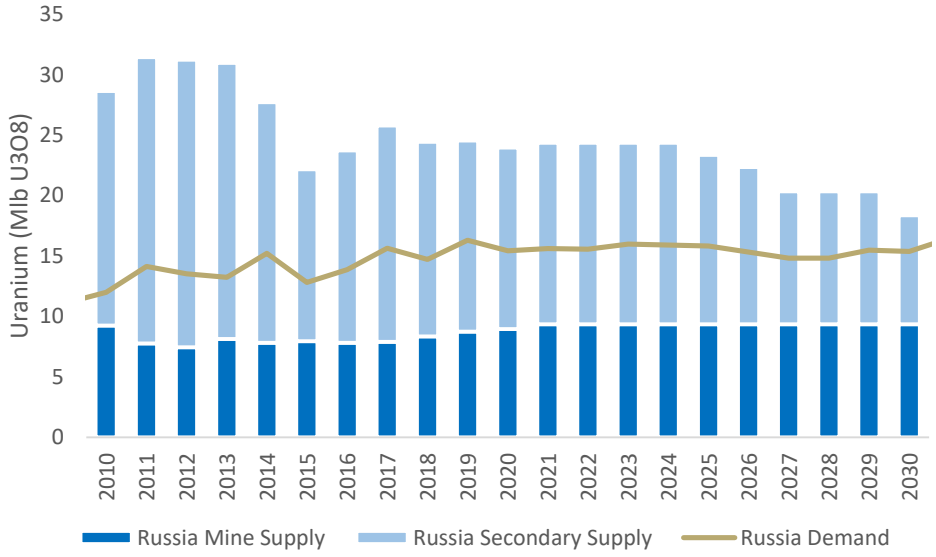
We expect nuclear generating capacity in Russia to remain relatively unchanged at 29 GWe in 2030, although there may be some variability as Russia replaces existing reactors with new technology to modernize its fleet. Over the next decade, we expect Russia to start-up five new reactors, mainly new VVER designs, to replace seven older reactors, primarily RMBK designs with safety concerns. As the fleet is modernized, we expect Russia to continue to draw on its domestic uranium supply and limit excess uranium supply to market.

We see long term generating capacity as stable, as it accounts for 19% of total electricity generation and is viewed as an important source by the country.

Russia is working to modernize its reactor fleet



Russia is relatively self-sufficient for uranium demand



Russia has developed and built significant uranium enrichment capacity to meet domestic requirements and for export along with new reactor exports to foreign countries. The enrichment capacity is primarily used to produce nuclear fuel, but can also be used to produce natural uranium by re-enriching low-assay tails or underfeeding the enrichment process. Additionally, Russia controls several mines in Kazakhstan that can be used to meet domestic needs or packaged with the export of Russian reactors.

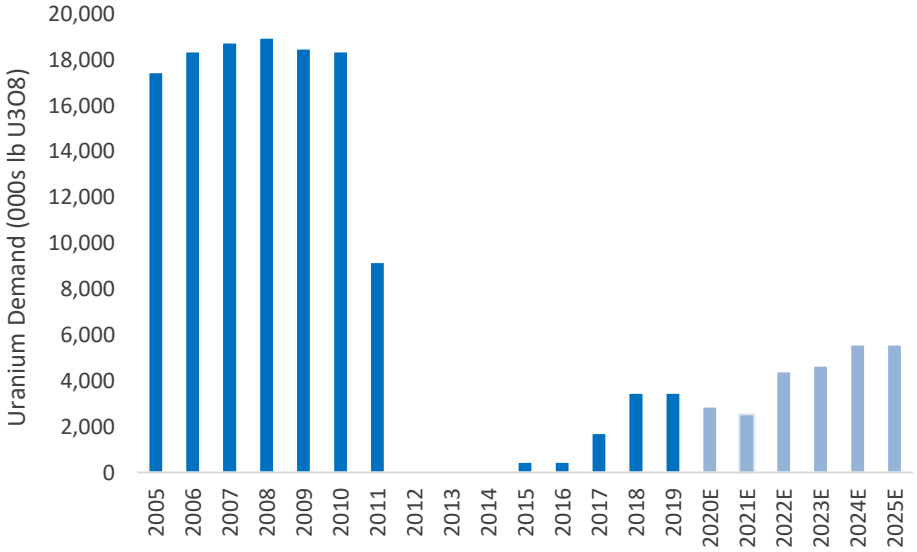
Source: UxC, WNA, RBC Capital Markets estimates

Japan nuclear reactor re-starts expected to pick up over coming decade

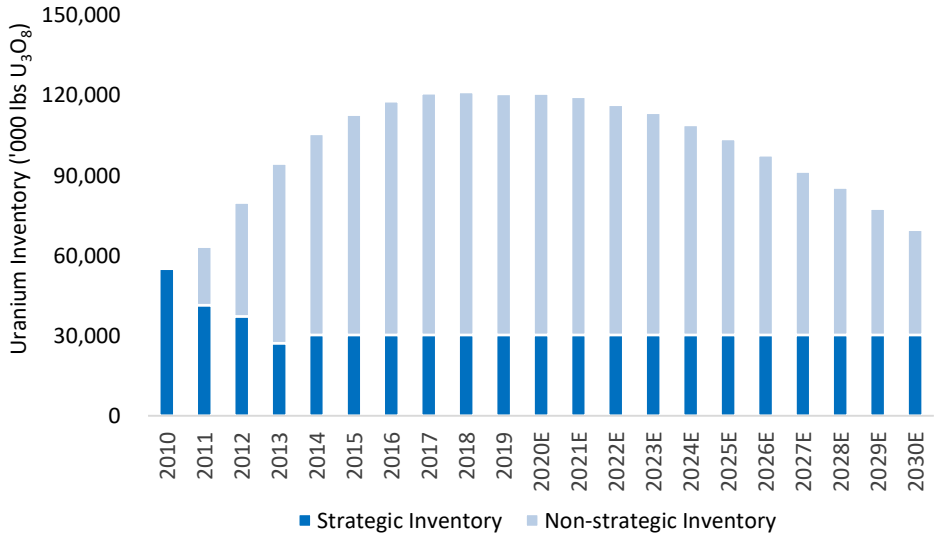
We expect nuclear generating capacity in Japan to recover to 20 GWe in 2030, from 7 GWe in 2020. The majority of this increase comes from re-starts of reactors that were suspended post-Fukushima for safety upgrades.

We assume that the country will have 14 reactors operating by 2025, but note the approvals and re-start process is highly unpredictable and there are some temporary reactor closures from already re-started reactors in the near-term for the construction of anti-terrorist measures. We think the key point is that as long as Japan's re-start process remains on-going, the significant in-country uranium stockpile should remain relatively immobile.

Demand picking up with re-starts but below historical levels



Inventories highlight no need for fresh demand buying



Japan has built up a significant inventory of uranium in various forms, which should meet domestic requirements through 2030 and limit the country's participation in the market. However, we think the most important point is that Japan's re-start process continues, which limits the risk that Japanese inventories enter the broader uranium market.

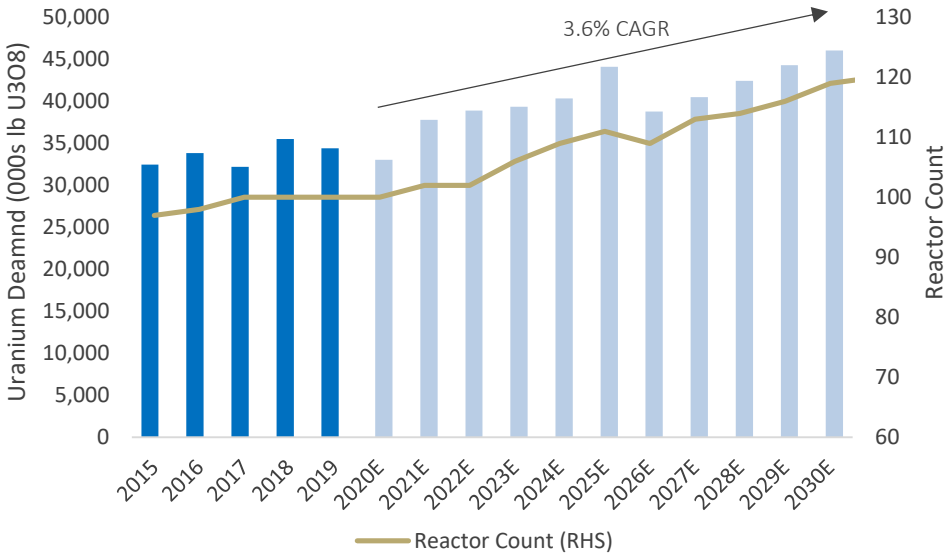
Source: UxC, WNA, RBC Capital Markets estimates

Rest of World (excludes US, China, Western Europe, Russia, and Japan)

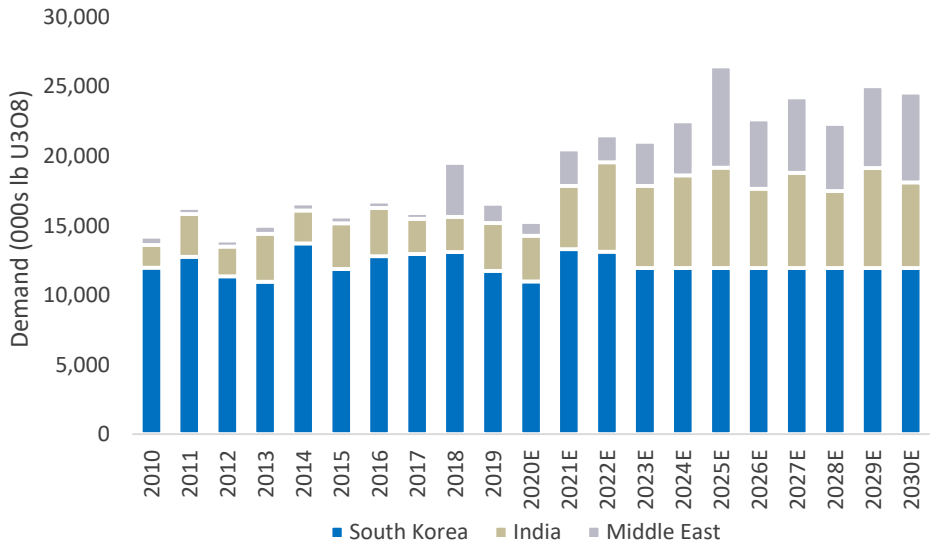
We expect RoW nuclear generating capacity to grow by 35% to 98 GWe in 2030, from 73 GWe in 2020. This growth is driven by new reactor builds in developing economies, but is partially offset by reactor shut downs in developed economies.

Growth is primarily concentrated in India and the Middle East (incl. Turkey), where we expect generating capacity to rise by 170% to 23 GWe in 2030, on the back on 13 new reactors. Offsetting some of this growth, we see reactor shutdowns in Taiwan (nuclear phase out policy) and Canada (reactors aging out) partially offsetting this growth.

New builds driving demand growth in RoW



India and the Middle East fueling RoW demand growth



Source: UxC, WNA, RBC Capital Markets estimates

Small Modular Reactors (SMRs)

We view small modular reactors as incremental uranium demand above our forecast as we see commerciality being 10+ years away. Most SMRs remain in the design and licensing phase, and are being developed for specialized applications (ex. power generation in remote areas where electricity demand is small and variable), so near-term demand should be minimal.

Longer term, SMRs could eventually add incremental demand and/or replace current nuclear reactor designs. However, SMRs require less fuel than conventional nuclear power plants due to longer fuel cycles (some have 20-yr refuel times), higher burn-up rates, and higher enrichment requirements for its fuel.

Below are some reactor technologies that are far advanced in their development

Reactor	Developer	Country of Origin	Stage	Power (MWe)	First Operation	Cost ($US Mln)
ACP100	NPIC, CNPE, CNNC	China	Construction	125	2025	$400 - $800 ($260 - $520)
ARC-100	ARC, GE Hitachi	USA	Design	100	*n/a*	*n/a*
BWRX-300	GE Hitachi	USA	Licensing	300	2027	$675 + initials
CAREM-25	CNEA, INVAP	Argentina	Construction	27 - 100	n/a	$446 - $700
HTR-PM	INET, CNEC & Huaneng	China	Construction	210	2020/2021	$430
Integral MSR	Terrestrial Energy	Canada	Licensing	192	n/a	*n/a*
NuScale	NuScale Power, Fluor	USA	Licensing	60	2026	$3,000
RITM-200	OKBM	Russia	Operating	50	2019 (A)	*n/a*
SMART	KAERI	South Korea	Licensed Design	107	*n/a*	$1,000
SMR-160	Holtec, SNC Lavalin	USA, Canada	Pre-licensing	160	*n/a*	$600
U-Battery	Urenco	UK, Canada	Design	4	*2025*	$49M - $86M (post-dev.)
UK SMR	Rolls Royce	UK	Design	440	*n/a*	$2,300
VBER-300	OKBM	Russia	Licensing	325	*n/a*	*n/a*
Xe-100	X-energy	USA	Conceptual Design	75	~2030	*n/a*

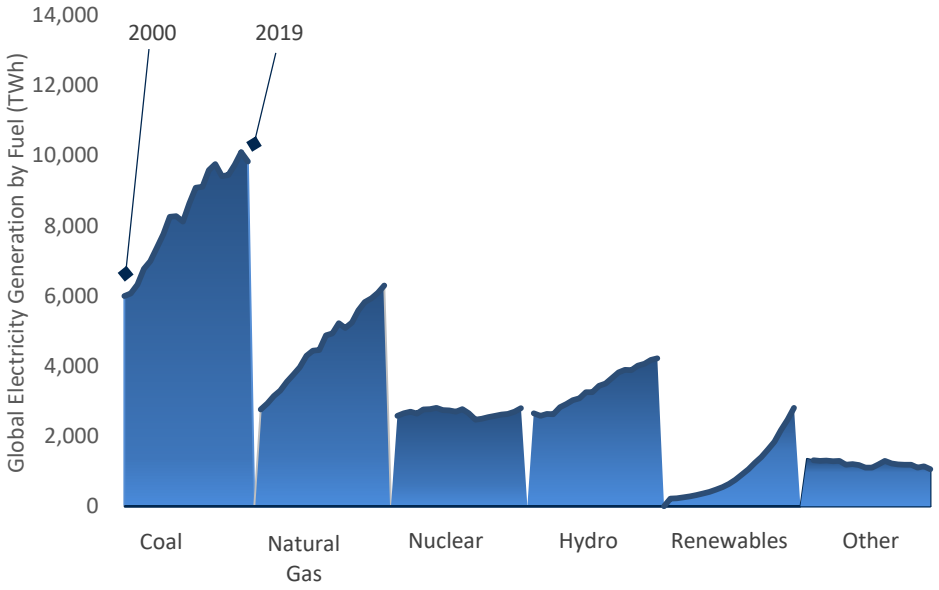
SMRs are small nuclear reactors that are manufactured at a plant and then assembled at a site, allowing for less on-site construction, faster construction times, lower costs, additional passive safety features, and more flexible, load-following, power generation. There over 70 SMR technologies currently under development with the vast majority in an early-design or pre-licensing stage. SMRs are being developed for a wide range of potential applications including general electricity and heating, remote power generation, industrial and production facilities, cogeneration, and vessel power. Currently, a disconnect between policy and regulations, which are geared towards large, conventional nuclear power plants, is impacting licensing and design times.

Source: WNA, IAEA, Company websites and reports, US DOE, RBC Capital Markets estimates

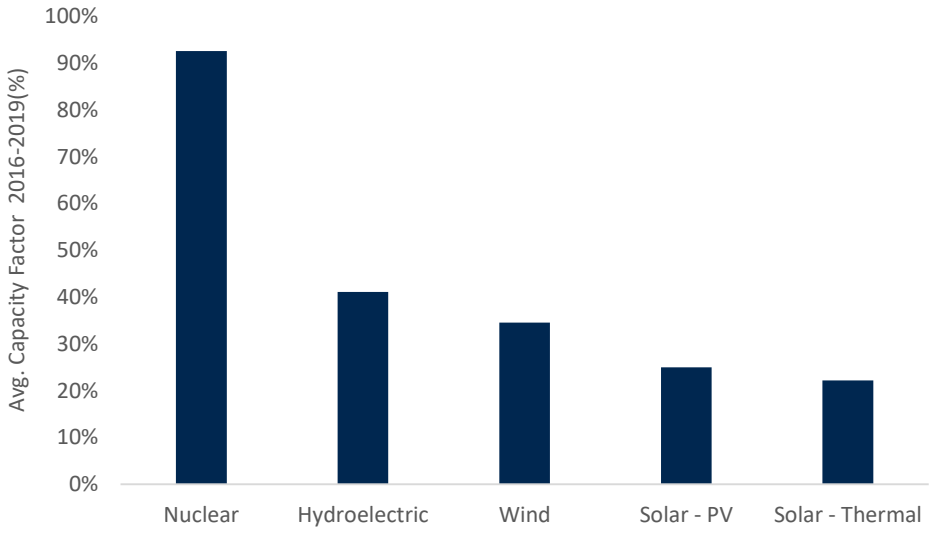
Nuclear's role in decarbonization

We believe nuclear plays an important role in the move to decarbonize electricity generation. Given the large proportion of electricity generated by fossil fuels and the still rising generation of carbon, we see nuclear as needing to grow, or at least hold steady, in order to realistically phase out fossil fuels and phase down carbon generation globally. We think nuclear has many advantages over renewables, including a high capacity factor, low land usage, and no energy storage requirements that makes it suitable as a carbon-free source of electricity. However, nuclear suffers from high upfront costs and strict regulatory requirements relative to other electricity sources. Still, this varies by region – for example, new builds in China are less expensive than in the US - so we would expect to see nuclear electricity growth to play a much larger role in decarbonization in more nuclear friendly regions (China, Japan, Russia, the Middle east, India, etc.).

Renewables rising but fossil fuels still dominate generation



Capacity factor across low carbon electricity sources



Source: WNA, US EIA, BP 2020 Statistical Review of World Energy, Global RBC Capital Markets estimates

Required Disclosures

Non-U.S. Analyst Disclosure
Andrew D. Wong and Stephen Morton (i) are not registered/qualified as research analysts with the NYSE and/or FINRA and (ii) may not be associated persons of the RBC Capital Markets, LLC and therefore may not be subject to FINRA Rule 2241 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account.

Conflicts Disclosures
The analyst(s) responsible for preparing this research report received compensation that is based upon various factors, including total revenues of the member companies of RBC Capital Markets and its affiliates, a portion of which are or have been generated by investment banking activities of the member companies of RBC Capital Markets and its affiliates.

Distribution of Ratings
For the purpose of ratings distributions, regulatory rules require member firms to assign ratings to one of three rating categories - Buy, Hold/Neutral, or Sell - regardless of a firm's own rating categories. Although RBC Capital Markets' ratings of Outperform (O), Sector Perform (SP), and Underperform (U) most closely correspond to Buy, Hold/Neutral and Sell, respectively, the meanings are not the same because our ratings are determined on a relative basis.

Distribution of ratings
RBC Capital Markets, Equity Research
As of 30-Sep-2020

			Investment Banking Serv./Past 12 Mos.	
Rating	Count	Percent	Count	Percent
BUY [Outperform]	788	52.96	248	31.47
HOLD [Sector Perform]	619	41.60	135	21.81
SELL [Underperform]	81	5.44	11	13.58

Required Disclosures

Conflicts Policy
RBC Capital Markets Policy for Managing Conflicts of Interest in Relation to Investment Research is available from us on request. To access our current policy, clients should refer to https://www.rbccm.com/global/file-414164.pdf or send a request to RBC CM Research Publishing, P.O. Box 50, 200 Bay Street, Royal Bank Plaza, 29th Floor, South Tower, Toronto, Ontario M5J 2W7. We reserve the right to amend or supplement this policy at any time.

Dissemination of research and short-term trade ideas
RBC Capital Markets endeavors to make all reasonable efforts to provide research simultaneously to all eligible clients, having regard to local time zones in overseas jurisdictions. RBC Capital Markets' equity research is posted to our proprietary website to ensure eligible clients receive coverage initiations and changes in ratings, targets and opinions in a timely manner. Additional distribution may be done by the sales personnel via email, fax, or other electronic means, or regular mail. Clients may also receive our research via third party vendors. RBC Capital Markets also provides eligible clients with access to SPARC on the Firm's proprietary INSIGHT website, via email and via third-party vendors. SPARC contains market color and commentary regarding subject companies on which the Firm currently provides equity research coverage. Research Analysts may, from time to time, include short-term trade ideas in research reports and / or in SPARC. A short-term trade idea offers a short-term view on how a security may trade, based on market and trading events, and the resulting trading opportunity that may be available. A short-term trade idea may differ from the price targets and recommendations in our published research reports reflecting the research analyst's views of the longer-term (one year) prospects of the subject company, as a result of the differing time horizons, methodologies and/or other factors. Thus, it is possible that a subject company's common equity that is considered a long-term 'Sector Perform' or even an 'Underperform' might present a short-term buying opportunity as a result of temporary selling pressure in the market; conversely, a subject company's common equity rated a long-term 'Outperform' could be considered susceptible to a short-term downward price correction. Short-term trade ideas are not ratings, nor are they part of any ratings system, and the firm generally does not intend, nor undertakes any obligation, to maintain or update short-term trade ideas. Short-term trade ideas may not be suitable for all investors and have not been tailored to individual investor circumstances and objectives, and investors should make their own independent decisions regarding any securities or strategies discussed herein. Please contact your investment advisor or institutional salesperson for more information regarding RBC Capital Markets' research.
For a list of all recommendations on the company that were disseminated during the prior 12-month period, please click on the following link: https://rbcnew.bluematrix.com/sellside/MAR.action
The 12 month history of SPARCs can be viewed at https://www.rbcinsightresearch.com/.

Analyst Certification
All of the views expressed in this report accurately reflect the personal views of the responsible analyst(s) about any and all of the subject securities or issuers. No part of the compensation of the responsible analyst(s) named herein is, or will be, directly or indirectly, related to the specific recommendations or views expressed by the responsible analyst(s) in this report.

Third-party-disclaimers

The Global Industry Classification Standard ("GICS") was developed by and is the exclusive property and a service mark of MSCI Inc. ("MSCI") and Standard & Poor's Financial Services LLC ("S&P") and is licensed for use by RBC. Neither MSCI, S&P, nor any other party involved in making or compiling the GICS or any GICS classifications makes any express or implied warranties or representations with respect to such standard or classification (or the results to be obtained by the use thereof), and all such parties hereby expressly disclaim all warranties of originality, accuracy, completeness, merchantability and fitness for a particular purpose with respect to any of such standard or classification. Without limiting any of the foregoing, in no event shall MSCI, S&P, any of their affiliates or any third party involved in making or compiling the GICS or any GICS classifications have any liability for any direct, indirect, special, punitive, consequential or any other damages (including lost profits) even if notified of the possibility of such damages.

RBC Capital Markets disclaims all warranties of originality, accuracy, completeness, merchantability or fitness for a particular purpose with respect to any statements made to the media or via social media that are in turn quoted in this report, or otherwise reproduced graphically for informational purposes.

References herein to "LIBOR", "LIBO Rate", "L" or other LIBOR abbreviations means the London interbank offered rate as administered by ICE Benchmark Administration (or any other person that takes over the administration of such rate).

Disclaimer

RBC Capital Markets is the business name used by certain branches and subsidiaries of the Royal Bank of Canada, including RBC Dominion Securities Inc., RBC Capital Markets, LLC, RBC Europe Limited, Royal Bank of Canada, Hong Kong Branch and Royal Bank of Canada, Sydney Branch. The information contained in this report has been compiled by RBC Capital Markets from sources believed to be reliable, but no representation or warranty, express or implied, is made by Royal Bank of Canada, RBC Capital Markets, its affiliates or any other person as to its accuracy, completeness or correctness. All opinions and estimates contained in this report constitute RBC Capital Markets' judgement as of the date of this report, are subject to change without notice and are provided in good faith but without legal responsibility. Nothing in this report constitutes legal, accounting or tax advice or individually tailored investment advice. This material is prepared for general circulation to clients and has been prepared without regard to the individual financial circumstances and objectives of persons who receive it. The investments or services contained in this report may not be suitable for you and it is recommended that you consult an independent investment advisor if you are in doubt about the suitability of such investments or services. This report is not an offer to sell or a solicitation of an offer to buy any securities. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. RBC Capital Markets research analyst compensation is based in part on the overall profitability of RBC Capital Markets, which includes profits attributable to investment banking revenues. Every province in Canada, state in the U.S., and most countries throughout the world have their own laws regulating the types of securities and other investment products which may be offered to their residents, as well as the process for doing so. As a result, the securities discussed in this report may not be eligible for sale in some jurisdictions. RBC Capital Markets may be restricted from publishing research reports, from time to time, due to regulatory restrictions and/ or internal compliance policies. If this is the case, the latest published research reports available to clients may not reflect recent material changes in the applicable industry and/or applicable subject companies. RBC Capital Markets research reports are current only as of the date set forth on the research reports. This report is not, and under no circumstances should be construed as, a solicitation to act as securities broker or dealer in any jurisdiction by any person or company that is not legally permitted to carry on the business of a securities broker or dealer in that jurisdiction. To the full extent permitted by law neither RBC Capital Markets nor any of its affiliates, nor any other person, accepts any liability whatsoever for any direct, indirect or consequential loss arising from, or in connection with, any use of this report or the information contained herein. No matter contained in this document may be reproduced or copied by any means without the prior written consent of RBC Capital Markets in each instance.

Additional information is available on request.

To U.S. Residents: This publication has been approved by RBC Capital Markets, LLC (member FINRA, NYSE, SIPC), which is a U.S. registered broker-dealer and which accepts responsibility for this report and its dissemination in the United States. Any U.S. recipient of this report that is not a registered broker-dealer or a bank acting in a broker or dealer capacity and that wishes further information regarding, or to effect any transaction in, any of the securities discussed in this report, should contact and place orders with RBC Capital Markets, LLC.

To Canadian Residents: This publication has been approved by RBC Dominion Securities Inc. (member IIROC). Any Canadian recipient of this report that is not a Designated Institution in Ontario, an Accredited Investor in British Columbia or Alberta or a Sophisticated Purchaser in Quebec (or similar permitted purchaser in any other province) and that wishes further information regarding, or to effect any transaction in, any of the securities discussed in this report should contact and place orders with RBC Dominion Securities Inc., which, without in any way limiting the foregoing, accepts responsibility for this report and its dissemination in Canada.

To U.K. Residents: This publication has been approved by RBC Europe Limited ('RBCEL') which is authorized by the Prudential Regulation Authority and regulated by the Financial Conduct Authority ('FCA') and the Prudential Regulation Authority, in connection with its distribution in the United Kingdom. This material is not for general distribution in the United Kingdom to retail clients, as defined under the rules of the FCA. RBCEL accepts responsibility for this report and its dissemination in the United Kingdom.

To German Residents: This material is distributed in Germany by RBC Europe Limited, Frankfurt Branch which is regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin).

To Persons Receiving This Advice in Australia: This material has been distributed in Australia by Royal Bank of Canada, Sydney Branch (ABN 86 076 940 880, AFSL No. 246521). This material has been prepared for general circulation and does not take into account the objectives, financial situation or needs of any recipient. Accordingly, any recipient should, before acting on this material, consider the appropriateness of this material having regard to their objectives, financial situation and needs. If this material relates to the acquisition or possible acquisition of a particular financial product, a recipient in Australia should obtain any relevant disclosure document prepared in respect of that product and consider that document before making any decision about whether to acquire the product. This research report is not for retail investors as defined in section 761G of the Corporations Act.

To Hong Kong Residents: To Hong Kong Residents: This publication is distributed in Hong Kong by Royal Bank of Canada, Hong Kong Branch, which is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission (SFC) in Hong Kong, RBC Investment Services (Asia) Limited and RBC Global Asset Management (Asia) Limited, both entities are regulated by the SFC. This material is not for general distribution in Hong Kong to persons who are not professional investors (as defined in the Securities and Futures Ordinance of Hong Kong (Cap. 571) and any rules made thereunder.

To Singapore Residents: This publication is distributed in Singapore by the Royal Bank of Canada, Singapore Branch, a registered entity licensed by the Monetary Authority of Singapore. This material has been prepared for general circulation and does not take into account the objectives, financial situation, or needs of any recipient. You are advised to seek independent advice from a financial adviser before purchasing any product. If you do not obtain independent advice, you should consider whether the product is suitable for you. Past performance is not indicative of future performance. If you have any questions related to this publication, please contact the Royal Bank of Canada, Singapore Branch. Royal Bank of Canada, Singapore Branch accepts responsibility for this report and its dissemination in Singapore.

To Japanese Residents: Unless otherwise exempted by Japanese law, this publication is distributed in Japan by or through RBC Capital Markets (Japan) Ltd. which is a Financial Instruments Firm registered with the Kanto Local Financial Bureau (Registered number 203) and a member of the Japan Securities Dealers Association (“JSDA”) and the Financial Futures Association of Japan (“FFAJ”).