**A *Gold Newsletter* And *Mercenary Geologist* Joint Report on Uranium**

# The Path To Enrichment

## The next big boom in uranium, and how you can profit from it.

By Mickey Fulp and Brien Lundin

A *Gold Newsletter* And *Mercenary Geologist* Joint Report on Uranium

# THE PATH TO ENRICHMENT

The next big boom in uranium, and how you can profit from it.

**By Mickey Fulp and Brien Lundin**

A lot of money has been made by investing in junior uranium stocks. Unfortunately, not so much has been made recently.

But that's about to change, according to a mounting pile of evidence.

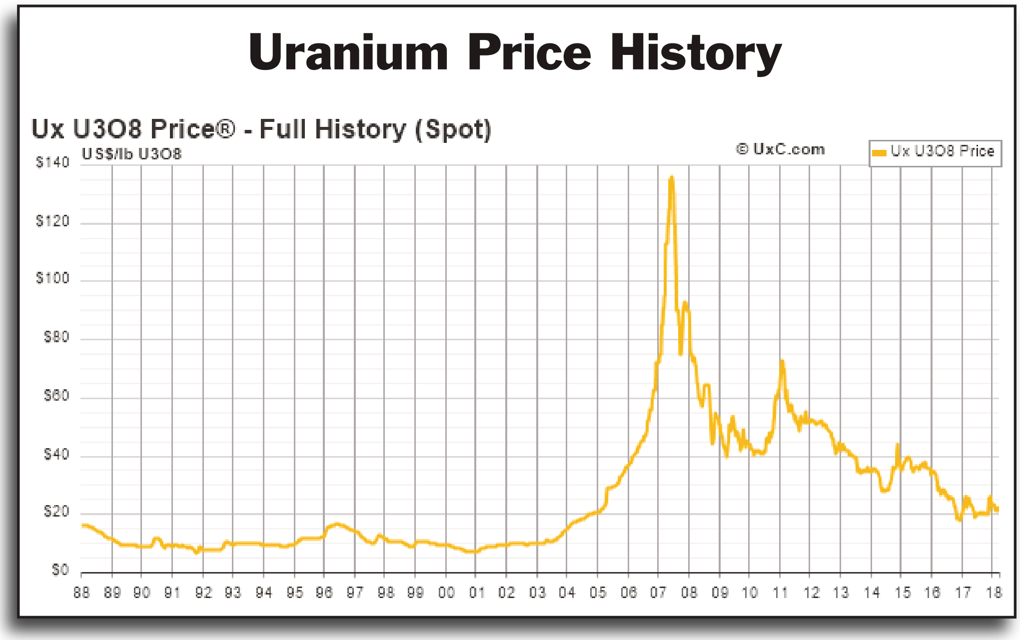
The uranium market has always had compelling fundamentals. In fact, the supply/demand argument for higher prices has been irrefutable for years — it's just the timing that has been in question.

But it's not like those powerful fundamentals haven't impacted the price before. In 2007, for example, the price briefly hit $140/pound, or nearly four times today's levels. But then came the global financial crisis to toss the prices of all commodities into the dumpster.

Once we got past that train wreck and the global monetary reflation kicked in, the fundamentals for uranium began to kick in once more. The price of uranium was steadily climbing back up...until the Fukushima accident sent the price reeling once again.

That's an unfortunate run of bad luck, to be sure. But the Fukushima accident was specific to the uranium market. And, as you are about to see in this report, the lesson from that event is that the benefits of nuclear power make it hard, if not impossible, to replace this crucial source of energy.

And today, against the backdrop of Covid-19, the powerful and irreversible supply/demand fundamentals are coming into play. The result, according to our latest research as well as that of a number of highly respected analysts, will be the return of a global uranium supply deficit. We can




Source: Ux Consulting, LLC

The mushroom cloud from the bomb dropped on Hiroshima, Japan.

already see uranium prices begin to reflect this with the price per pound recently surging over 35%..

And these developments promise to bring a re-enactment of the fortune-making run of a decade ago, when junior uranium mining companies began their big run, eventually multiplying in price.

Over the next few pages, we'll explain this extraordinary situation, and highlight some of the most aggressive and exciting junior uranium plays out there — companies with smart management, solid resources and important stories to tell.

But first, a little background...

## Uranium 101

Named after the planet Uranus, uranium is the heaviest of the naturally occurring elements. Once considered relatively rare, uranium is actually quite abundant. In fact, the Earth's crust contains as much uranium as it does tin, zinc or molybdenum. You can find traces of it almost everywhere, including granite (10-20 ppm U), sedimentary rock (2 ppm U) and even seawater (0.003 ppm U).

The key, of course, is finding concentrations of sufficient size and grade for economic extraction. And that is rare indeed.

"Natural uranium" is composed primarily of two isotopes, the more abundant U-238 (99.3%) and the more valuable U-235 (0.7%). U-235 is more valuable because its atomic structure makes it a prime candidate for the fission process that powers nuclear reactors and gives atomic weapons their awesome firepower.

## A Brief History of Uranium

As a commodity, the uranium story now and in the future revolves around the nuclear power industry, which consumes the vast majority of annual production. However, to understand the story completely, its seminal role in the development and proliferation of the nuclear weapons has to be taken into account.

Uranium's potential as a power source was not apparent when Martin Klaproth, a German chemist, discovered it in 1789. Up until the late 19th century, it was primarily used as a yellow dye. In fact, it's still possible to get your hands on Fiestaware plates glazed with 14% uranium on Ebay.

Towards the close of that century, however, a series of discoveries made in conjunction with the advance of modern atomic theory opened scientists' eyes to the theoretical possibilityof sub-atomic particles to generate massive amounts of energy in a chain reaction.

The big breakthrough came in 1905, when Einstein put forth his Theory of Special Relativity, which established an equivalency between mass and energy. Einstein's theory paved the way for the creation of the atomic bomb by planting the notion that mass could be converted to energy.

## Building the Bomb

Over the next three decades, scientists made steady progress toward harnessing the power of the atom. World War II accelerated these efforts, as Germans and the Allies engaged in a race to build the first super-weapon.

The Germans made the most progress at first. Their scientists built on the work of U.S.-based scientist Enrico Fermi, who in the mid- and late-1930s had successfully created both heavier, man-made elements (artificial radionuclides) and lighter, naturally-occurring elements by bombarding uranium with neutrons.

In 1939, Lise Meitner, Otto Hahn and Fritz Stassman demonstrated that the lighter elements produced in Fermi's experiments were, in fact, a mixture of barium and several other elements with atomic masses roughly half the mass of a U atom. Their findings proved definitively that atoms could be split.

A team led by Niels Bohr, one of chemistry's giants, advanced fission theory still further by accurately predicting and measuring the amount of energy released by splitting a single uranium atom. More importantly, his team hypothesized that stray neutrons emitted by this process could spark a self-perpetuating "chain reaction" that would multiply exponentially the energy released by fission.

The Allies, led by Rudolf Peierls' team in Great Britain, were perhaps a step behind the Germans during this period. But once World War II began in earnest, the defection of German scientists like Otto Frisch, who had a hand in many of the aforementioned discoveries, gave them a decided edge.

In 1940, Peierls and Frisch released a uranium memorandum, which posited that a bomb could be built by initiating a chain reaction within a concentrated, five-kilogram ball of U-235. Though it would be another five years before a bomb rolled off the assembly line, this memo provided the Allies with the road map to get there.

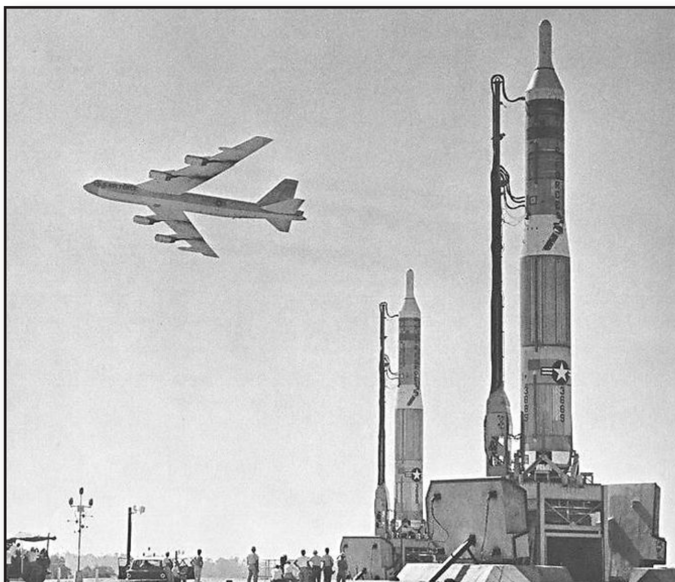
Over the course of the bomb's development, scientists made parallel discoveries about uranium's usefulness as a power source. Indeed, prior to its entry into the war in late 1941, America focused more on the commercial power applications of uranium than on its weapon-making potential. The bombing of Pearl Harbor changed this focus overnight, and by early 1942, America had initiated the Manhattan Project, an all-out, highly classified effort to build the first atomic bomb.

The Manhattan Project had one overriding goal: to produce enough fissile material to create a weapon. And while the British, with a big assist from German and French scientists, had constructed much of the theoretical framework for the bomb, only the Americans had the industrial and economic firepower to make it a reality. In the end, a war-ravaged Germany could not compete with the resources the U.S. could bring to this arms race.

Despite the advantages America afforded the allies, producing a bomb proved a daunting task. Using uranium drawn primarily from mines in the Belgian Congo, the Americans, British and Canadians used electromagnetic separation and gaseous diffusion processes to generate weapons-grade concentrations of the two most promising fissile elements — Uranium-235 and Plutonium-239. This latter element is an artificial radionuclitide created when U-238 absorbs two additional protons during the fission process.

The need for these fissile elements also had important implications for the eventual use of uranium as a power source. In order to enrich uranium, Enrico Fermi's team built the world's first nuclear reactor, Chicago Pile 1. This proved that a sustained nuclear chain reaction was both possible and controllable.

By the spring of 1945, the Manhattan Project had produced enough P-239 and highly-enriched U-235 for Robert Oppenheimer and his team in Los Alamos, New Mexico to build and test a bomb. On July 16, 1945, they successfully detonated a plutonium device at Trinity, New Mexico. The explosion ushered the world into the Atomic Age.



The Cold War fueled uranium exploration and production.

Soon thereafter, President Harry Truman, in an attempt to bring the war with Japan to an early close, ordered U.S. armed forces to drop atomic bombs on two Japanese cities. On August 6, 1945, the Enola Gay dropped the first bomb, made of U-235, on Hiroshima. Three days later, a second, plutonium-based bomb destroyed much of Nagasaki. The horrific destruction and loss of life the bombs inflicted had their intended effect. On August 10, 1945, the Japanese surrendered.

## The Cold War Weapons Race

Russia was working on its own nuclear weapons during World War II, but was still a couple of years away from completion when it received word of the bomb at Hiroshima. The news spurred Russia to redouble its efforts. In doing so, it leaned heavily on the expertise of German scientists acquired after the Russian occupation of Berlin.

## In The Wake Of A Tsunami

On March 11, 2011 a 9.0 earthquake — the fourth largest in recorded history — struck northeastern Japan. The effects were horrifying to watch in action and in retrospect, as the death toll of the earthquake and resulting tsunami rose to nearly 16,000 souls.

In the wake of such a human disaster, it seems distasteful to focus on how the tragedy affected the uranium market. But there is no denying that, from the standpoint of the nuclear industry, the effects were also devastating.

As we all know, the tsunami knocked out power to nuclear power plants at Fukushima-Daiichi, and also crippled back-up generators, resulting in the failure of cooling systems. Over the following months, all of Japan's nuclear reactors were taken offline.

But it didn't take long for the repercussions to be felt in the investment markets. Uranium stocks crashed en masse in the market sessions following the disaster. And for good reason: Over the next three years, the spot prices of uranium fell from a high of $73 to a low of $20, a loss of over 70%.

The uranium price crash was directly related to the decrease in demand from Japan. Before the incident, Japan used about 12% of the world's uranium in its 55 reactors and was the third largest consumer in the world behind the USA and France.

Right now there are 42 operable reactors that have the potential to restart. Out of those, two were restarted by November of 2015 and another two in February 2016. A further 21 are already in the process of seeking restart permits.

The effect of the Japanese shutdowns was striking:

- In 2010, worldwide nuclear power plant demand was 167 million pounds $U_3O_8$. There were 142 million pounds mined and 23 million pounds of secondary supply from conversion, enrichment and government stockpile sales, resulting in a 2-million-pound deficit.
- In 2014, demand was 175 million pounds. There were 148 million pounds mined and 43 million pounds of secondary supply to the market, resulting in a 16-million-pound surplus.

According to the World Nuclear Association, Japan consumed on average nearly 22 million pounds per year from 2007 to 2010. Germany also shut down eight of its 17 reactors in the wake of Fukushima, and that cut its annual demand by half.

The removal of demand from Japan and, to a lesser extent, Germany from 2012-2015 has been devastating to the uranium market. It has also been devastating to the Japanese economy. with an additional $40 billion per year in imported fossil fuel costs.

By 1947, it successfully tested its own weapon. The nuclear build-up that defined the Cold War between the United States and Russia had officially begun.

The weapons race drove uranium demand between 1945 and 1969, a period during which the U.S. government was by far its biggest customer. In order to prime the supply pump, the Atomic Energy Commission kept prices artificially high so producers could earn an adequate return on their investment.

Beginning in 1948, miners delivered their uranium to various buying stations across the country, at prices that averaged around $45/lb. in current dollars. By 1969, the industry had produced 337,000 tonnes of uranium, only 4% of which had been sold to commercial power plants.

## Nuclear Power Comes Into its Own

Although nuclear power plants had been generating electricity since the 1950s, it wasn't until the early 1970s that commercial nuclear power surpassed weapons in uranium consumption. The oil crises during that decade greatly accelerated interest in nuclear power as a clean, affordable energy source. At one point, the United States planned to build 250 nuclear power plants. (By way of comparison, it only has 100 currently in operation.)

Then the accident at Three Mile Island, though largely contained, put the brakes on domestic interest in nuclear energy. Subsequently, a new power plant was not built and commissioned in the U.S. for three decades.

Today, the world has 440 nuclear plants operating in 30 countries, with an aggregate production capacity of 400 GWe (400,000 MWe). Nuclear power plants provide over 10% of the world's electricity, and 16 countries rely on nuclear energy for at least one-quarter of their electricity.

Today, commercial nuclear power is the overwhelming consumer of the world's uranium supply with the United States using nearly 25% annually.

## The Fuel Cycle

The opportunities that define uranium's current supply-demand dynamics emanate from the way it moves through the fuel cycle, a path that takes uranium from ore in the ground to power-generating fuel to depleted radioactive waste. Because a basic knowledge of this process is critical to understanding the investment case for uranium, a brief overview is in order.

Let's take the case of a large, 1,000 Mwe light-water reactor (LWR), which can generate enough electricity to power a city of one million. The fuel needed to generate all that electricity can come from a variety of sources (more on these later), but for the sake of this example, we will assume that the power company that owns the LWR fills its annual fuel requirements entirely by purchasing $U_3O_8$ from miners.

## Mining and Milling

Our 1,000 MWe LWR needs around 200 tonnes of $U_3O_8$ annually. Producers receiving an order for this amount of uranium oxide will extract it from either an open-pit or an underground mine. In most cases, this ore is shipped to a mill, which crushes it and then leaches out the $U_3O_8$ using sulfuric acid. When the resulting concentrate dries, it forms a khaki-colored powder known as yellowcake.

In-situ-covered (ISR) uranium, where uranium is extracted from a solution, has risen in popularity and now constitutes around 40% of the annual world mining supply and nearly all that is produced in the US.

Even in concentrated form, yellowcake retains its naturally occurring levels of isotope composition — 99.3% U-238 and 0.7% U-235. Since the fuel assemblies that power LWRs require U-235 levels between 3.5% and 5.0%, the yellowcake leaving the mill must undergo a series of industrial processes to become suitable for power generation.

## Conversion

The first of these is conversion, which turns yellowcake powder into a gaseous form known as uranium hexafluoride (UF6) or "hex." Conversion takes place at a relative handful of plants

The powerful growth of nuclear power worldwide has continued despite the Fukushima disaster.

scattered across the globe. This set-up is the same for the enrichment and fuel fabrication steps discussed below, allowing the world's nuclear powers to keep close tabs on inventory and making it more difficult for terrorists and rogue states to get their hands on nuclear fuel and technologies.

## Enrichment

Because "hex" exists in liquid form at room temperature and pressure, it can be transported in steel cylinders to one of the world's enrichment plants. There, it is converted back into a gas and run through a long series of gaseous centrifuges or diffusion units, which gradually separate the U-235 from the more-prevalent U-238.

This process removes around 85% of the U-238 from the final "product," a quantity of UF6 enriched to 3.5% U-235. By contrast, the "by-product" or "tails" contain less than 0.25% U-235.

## Fuel Fabrication

The enrichment plant will then ship its finished product to a fuel fabrication plant. There, the enriched UF6 is baked into small, ceramic pellets of uranium dioxide (U02). These pellets are then packed into four-meter-long zirconium alloy tubes, which are then bundled into the fuel assemblies that power the reactor.

## At the Reactor

A light-water reactor contains several hundred such fuel assemblies. Once loaded in, these assemblies undergo a fission process that is a less-intense, more-controlled version of the process that causes a nuclear explosion.

Once the U-235 atoms within the fuel rods begin to split, they emit neutrons, other radioactive elements, rays and enormous amounts of heat. The particles not only split other U-235 atoms, they also convert a portion of the U-238 into plutonium. Half of this plutonium also fissions and, in doing so, provides about one-third of the reactor's energy output.

As it would in a coal-fired plant, the heat generated in a nuclear plant produces steam, which turns the turbines that generate electricity — about seven billion kilowatt hours worth annually. In the process, a reactor of this size will consume about one-third of the roughly 75 tonnes of fuel in its core.

Once removed, the spent fuel rods continue to emit a great deal of heat and radioactivity. To dissipate that heat and to facilitate future handling, the assemblies are temporarily stored in on-site storage tanks, where they await either reprocessing or final disposal.

## Irreversible Demand Growth

Drawing back from the fuel cycle, we see a demand environment for uranium driven almost exclusively by the demand for nuclear power. The end of the Cold War 30 years ago sent the demand for nuclear weaponry (except for a few well-known rogue states) into steep decline. That said, Cold War weapon stockpiles continue to play a critical role on the supply-side of the equation.

As we noted, nuclear power plants currently provide over 10% of the world's electricity. Coal (38.3%), natural gas (22.9%) and hydro (16.3%) are responsible for most of the balance of global baseload electricity, with renewable energy sources like solar and wind power making token contributions.

Because nuclear plants take a long time to get permitted and built (between five to 10 years, depending on the country) and because they produce power and consume fuel at relatively predictable rates, the growth of the nuclear industry is both methodical and relatively easy to predict.

And for the same reasons, once the market gets headed in one direction it is — like a massive oil tanker — hard to change course.

That is why, despite the setback of the Fukushima disaster, the upward slope of global uranium demand remains largely unchanged. According to the World Nuclear Association, over 57 nuclear reactors are now under construction in 15 countries. And that's just the start: Another 460 are in planning or being proposed.

While many naysayers focus on Germany and Japan moving away from nuclear energy, China is leading the world in the other direction. It currently has 11 reactors under construction, 43 planned and 170 proposed. The country boasted 45.7 GWe of combined net capacity at the beginning of 2019 and plans to have about 58 GWe in by the end of 2020. It has another 30 GWe under construction.

The country plans on having 150 GWe in capacity by 2030, so this is not a short-term trend.

The biggest issue to weigh on the uranium market recently was the Fukushima disaster, and Japan's supposed abandonment of nuclear power in its wake.

But the reality is different from the public perception: Today, there are eight more operable nuclear power plants worldwide than before Fukushima, and more reactors under construction or planned as well.

Just since the Fukushima event, the UK has announced it will build five new reactors, Saudi Arabia has announced 16 reactors, Brazil has begun construction on one reactor and plans for an additional eight, and Russia, China and India have all pronounced their support for nuclear energy, with their plans contributing half of the projected new construction.

The ongoing nuclear build-out will result in increasing demand for yellowcake, with annualized growth projected at 3%-4%.

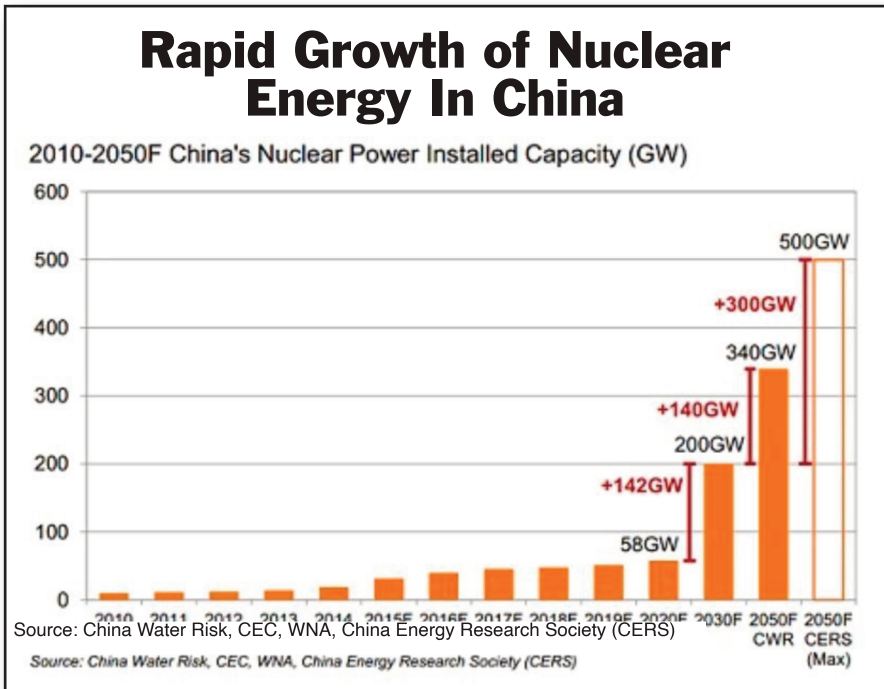
Add it all up, and worldwide uranium demand is projected to grow from around 67,600 tonnes in 2019 to 84,850 tonnes by 2030 and 100,000 tonnes by 2040.

In short, the steep trajectory of global uranium demand has, if anything, only grown steeper after Fukushima. But while demand is growing relentlessly, the story is much different on the supply side of the equation.

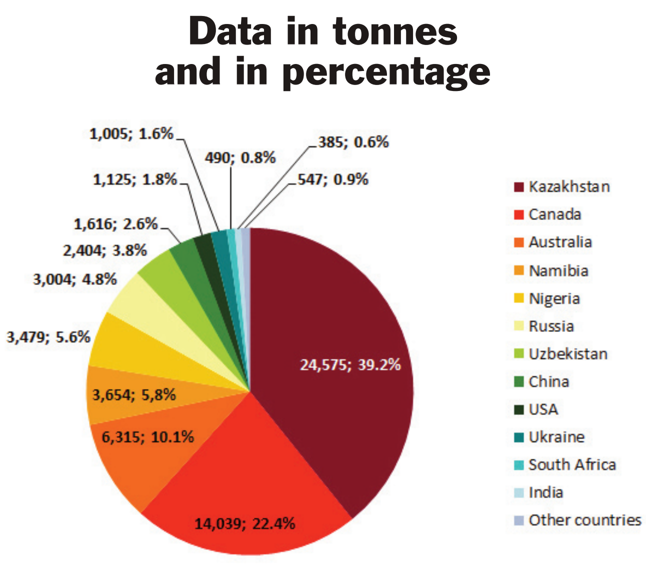
## Constrained Supply Growth

The argument for uranium investing encompasses more than the demand-side case — the supply case is also quite compelling.

Consider the accompanying chart of global uranium production by country. A quick perusal gives one pause with respect to the certainty and




China's installed nuclear capacity is expected to top 200 GWe by 2030.



Source: UxC, Raymond James Ltd., Peninsula Energy Ltd.

Much of the world's uranium production comes from the countries where the security of future production is questionable.

security of future Western World supplies of $U_3O_8$:

- 60% of the world's uranium supply came from these six countries: Kazakhstan, Niger, Russia, Uzbekistan, China, and Ukraine.
- These six of the top ten producing countries have corrupt and/or unstable governments and must be considered unfriendly to the USA.
- Kazakhstan alone produced 41% of the world's uranium in 2018.
- In 2017 the United States consumed 19,000 tonnes of yellowcake yet produced only 940 tonnes, less than 5% of its annual demand.

Analyst consensus projects a significant deficit for mined uranium and secondary supplies in the mid- to long-term. Opinions differ as to when the deficit will commence but are generally in the range of 2020-2024.

## Uranium Deposit Types

Mineable uranium occurs in a number of geologic settings, including igneous, hydrothermal and sedimentary structures. Of these, unconformity-related deposits host many of the world's most prolific deposits. An unconformity is a boundary separating two or more rocks of markedly different ages. Uranium mineralization usually lies below the unconformity in faulted and brecciated metasedimentary host rock.

These deposit types generate all of Canada's production and account for 20% of Australia's known resources. And while most uranium deposits average between 0.1% and 2.0% U3O8, unconformity-related ore grades can be exceedingly rich — the deposit at the proposed Cigar Lake mine in northern Saskatchewan averages 20% U3O8, including some areas with grades in excess of 50%.

Iron Oxide Copper Gold deposits lie on the other end of the scale. Though capable of hosting massive resources, their ore grades are typically quite low. The uranium remains economic to mine because it is viewed as a by-product of the vast quantities of copper and gold these deposits can produce.

Australia's Olympic Dam is the prototypical IOCG. Even with uranium grades that range between 0.04% to 0.08% U3O8, it still contains one of the world's largest uranium deposits and accounts for two-thirds of Australia's known reserves.

Sandstone deposits host 18% of all known uranium reserves. Though typically higher in grade than IOCG deposits, most sandstone-hosted deposits contain ore bodies of low- to medium-grade (0.05% to 0.4% U3O8) and small- to medium-size (up to 50,000t U3O8 at a maximum). Producers initially mined and milled these deposit types using the conventional methods described in our discussion of the fuel cycle, but are now more likely to use cheaper in situ recovery methods.

Geologists have also encountered uranium in surficial, volcanic, intrusive, metamorphic and quartz-pebble conglomerate deposits. Though less common than the above-mentioned structures, all are capable of hosting ore-grade mineralization.

The sources of new supply are problematic because conventional underground uranium mining and milling requires significantly higher prices to be economic, generally estimated at $65-$80/lb. Even the lower-cost in-situ recovery (ISR) and open-pit heap leach mines are below break-even at current prices.

The logical conclusion is that uranium prices must nearly quadruple to meet projected demand by the latter part of this decade.

Meanwhile, sovereign stockpiles are dwindling…higher cost mines continue to cut production or are being shuttered…major new projects have been and will continue to be delayed or shelved…and the Russia-USA supply deal thru 2023 is just half of the amount supplied by downgrading of weapons-grade to reactor-grade $U_3O_8$ from 1993-2013.

So where will new uranium supply come from to meet the growing demand?

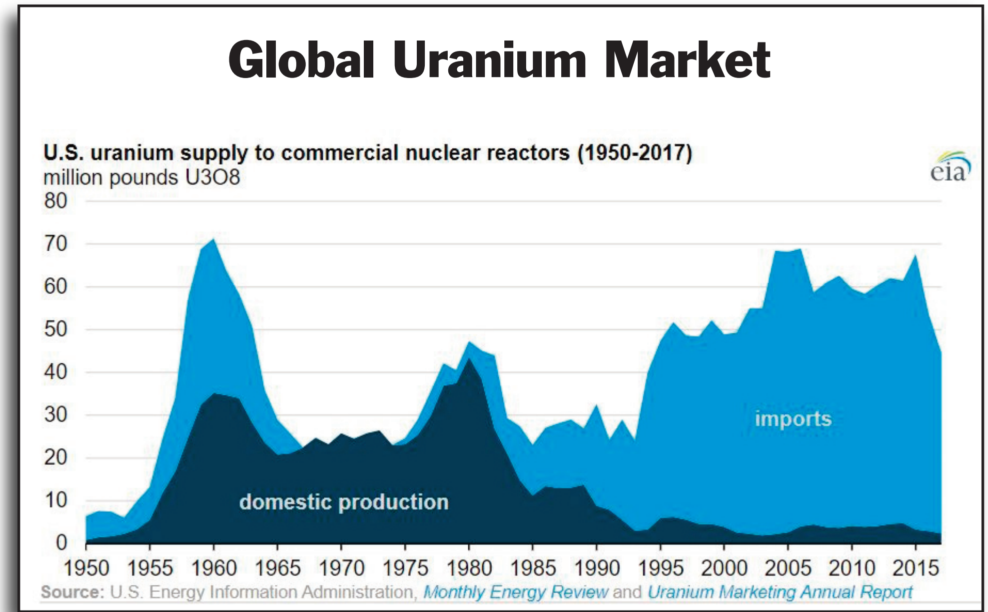
Mined uranium and secondary supplies will both be parts of the solution. Recycling and reprocessing are increasing every year but they still produce only a minor amount of the world's total uranium supply. Enrichment underfeeding continues to contribute to supplies but to a lesser extent. Mining will remain the major contributor to future supply and prices must increase for new mines to be developed and come on stream.

That said, every major established uranium district in the world faces unique challenges that make new developments problematic in terms of economics, sustainability, and/or timing to production:

- Since the uranium renaissance of the mid-2000s, increased demand has been mostly met by Kazakhstan, which has gone from 11.5 million to 43.4 million pounds of $U_3O_8$ production over the past decade. However, its shallow and high-grade ISR mines in the north are being depleted and production is increasingly moving to southern districts that are deeper, lower-grade and more difficult to recover. Therefore, there are doubts if Kazakhstan's current production level is sustainable.
- Canada's Athabasca Basin boasts the world's largest and highest grade uranium mines even with the recent closure of McArthur River and the Key Lake mill in 2018. Exploration success continues in the Basin, but these deposits require high capital expenditures and very long lead times through discovery, development and mining (now estimated at 15-20 years).
- There are world-class sandstone uranium mines and development projects in Niger, but the country is plagued by a corrupt bureaucracy and unstable government. In addition, its mines have been repeatedly targeted in civil wars and Islamic terror attacks over the past decade.
- The western United States is the world's second-most endowed uranium province.

  Smaller, moderate-grade sandstone-hosted deposits occur in Utah, Colorado and Wyoming, but again are relatively high-cost underground mines. High-grade resources occur in breccia pipes of the Northern Arizona Strip, but most of this prospective ground has been removed from mineral entry by the U.S. government.

  A huge, high-grade sandstone deposit in Virginia is subject to a state government moratorium on development. A state's rights issue regarding this was challenged in the Supreme Court and lost, but another lawsuit on the Constitutional takings clause is pending.
- ISR mines in established districts in Wyoming and South Texas are low capex and low cost, with relatively fast timelines to permitting, development and production. However, these are small sandstone uranium deposits, generally in the range of 1-10 million pounds, and require sequential well-field development and ongoing sustaining capital to maintain production. Larger (20 to 100 million pound) ISR-amenable deposits in New Mexico are burdened by long lead times to permitting.
- Unconformity deposits in the Northern Territory of Australia are high-grade giants, but face geopolitical hurdles stemming from ongoing governmental and aboriginal opposi-




A large and growing uranium supply deficit will emerge over the next few years. Well in advance, utilities will fight to secure long-term supplies.

tion to the mining of uranium, and have no current timeframe for development.

As you can see, the discovery, development and operation of new uranium mines is a difficult proposition. It has always been problematical for uranium production to react to spikes in the price and, given the lack of exploration over the past few years as prices have fallen, the mining industry is getting even further behind the curve.

And unlike many commodities, higher prices are likely to have little impact on demand, for one very important reason…

## Inelastic Fuel Prices

Could the nuclear power industry withstand a steep escalation in fuel costs? By all accounts, it can do so easily. The high capital costs associated with building a nuclear plant comprise the vast majority of its Levelized Cost of Electricity (LCOE).

Delivered fuel assemblies, on the other hand, contribute only 10% to the LCOE. And almost half of that fuel cost stems from the energy expended during the enrichment process. $U_3O_8$ counts for, at most, a third of total fuel costs. As a result, the nuclear power industry is largely indifferent to price increases in yellowcake.

That kind of price elasticity could pay off enormously, because a price three or four times today's levels may be necessary to address the production shortfall going forward. And that doesn't even factor in the dynamics specific to the U.S. market.

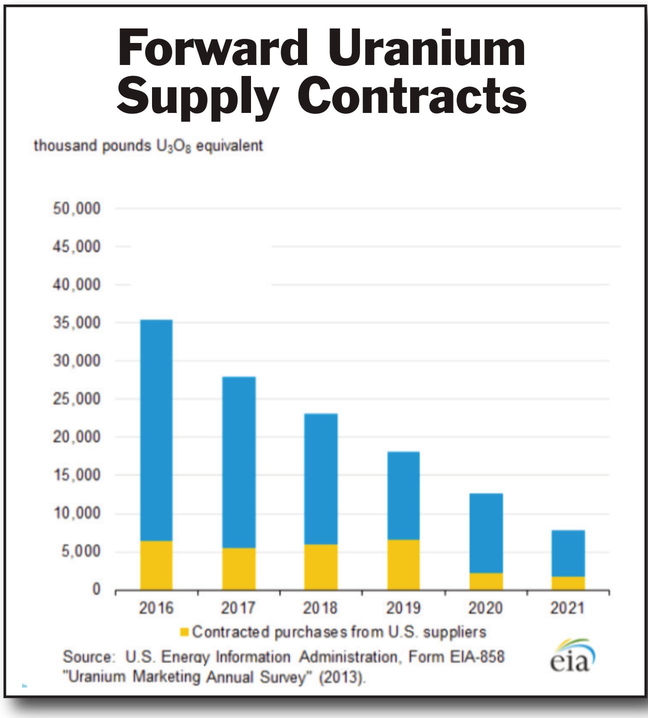
## A Special Situation Develops In The U.S.

A special situation on the demand side of the

## Mining Techniques

Depending on the depth and grade of the deposit, uranium can be extracted by using either underground or open-cut techniques. Underground methods are usually reserved for higher-grade deposits at depths below 120 meters. In general, open-cut methods are usually low-grade, bulk-tonnage deposits and employ traditional mining and milling methods.

Some lower-grade and deeper deposits are increasingly being mined via the low-cost in situ recovery (ISR) method. Instead of mining the deposit and hauling rock to the surface, in situ recovery essentially "mines in place." Oxygenated water is pumped down boreholes to the deposit, where it dissolves the uranium-bearing mineralization. The resulting solution is then pumped to the surface, where the recovery process extracts the native U3O8 as it would be using conventional methods. This method works best with porous rock, which explains why sedimentary deposits are good candidates for ISR.




Uranium supply contracts by utilities will roll off rapidly over the next few years, forcing them to come back into the market in a big way

uranium equation has developed in the U.S. market. In early 2018, two domestic U.S. producers — Ur-Energy and Energy Fuels — filed a Section 232 petition with the U.S Department of Commerce to boost U.S. uranium mine production.

As you can see from the chart above, U.S. uranium production as a percentage of uranium consumption has dramatically decreased since 1980. Armed with the argument that this gap creates a dangerous U.S. dependency on foreign sources of uranium, Ur-Energy and Energy Fuels asked the Department of Commerce to consider a remedy to the situation, with a preference toward creating a tariff-protected market for domestic production.

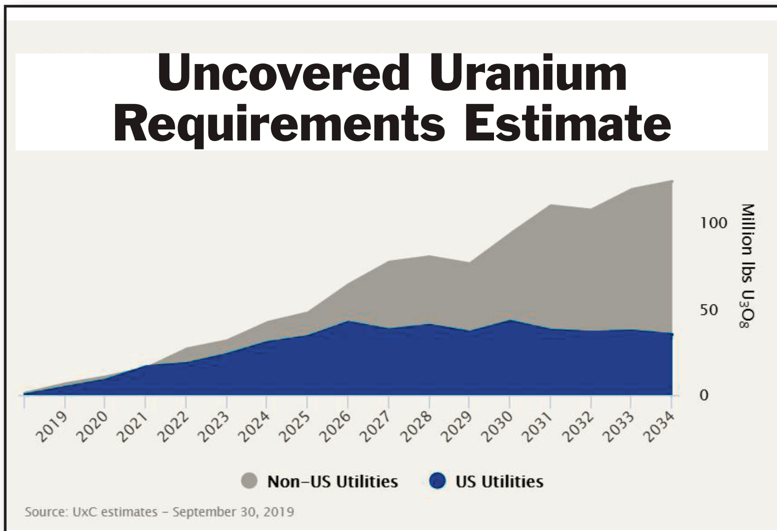
The stock prices of uranium companies with U.S. operations experienced an initial lift when the DoC elected, in July 2018, to consider the issue and provide a recommendation to the Trump administration. The DoC submitted its recommendation to the administration in April 2019 and urged the administration to make an accommodation for U.S. producers.

When the administration responded to the DoC's initial recommendation in July 2019, it elected to form the U.S. Nuclear Fuel Working Group to consider the issue further. In the end, the administration was unwilling to create an entirely separate market for U.S.-based uranium production, but it was willing to consider alternatives to help provide a boost to domestic producers.

The NFWG has just released its highly anticipated report on The Strategy to Restore American Nuclear Energy Leadership and based on what's inside this should be a major boon to the uranium market. A few key points are summarized below:

- Making direct U.S. government purchases of 17 – 19 million pounds of uranium beginning in 2020 for a strategic uranium reserve (which is already reflected in the President's fiscal 2021 budget).
- Ending the Department of Energy uranium bartering program that has directly competed against domestic uranium miners in the past.
- Supporting the Department of Commerce's efforts to prevent dumping of Russian uranium in the U.S., and "the consideration of further lowering the cap on Russian imports under future RSA terms."
- Enabling the U.S. Nuclear Regulatory Commission to deny imports of fabricated nuclear fuel from Russia.
- Streamlining regulatory reform and land access for uranium.

In short, while there will not be full-fledged




The uranium requirements of nuclear power plants that are not covered by supply contracts with producers are about to soar.

tariff protection for U.S. producers, a positive decision to give domestic producers the DoD's business has arrived and should boost domestic producers' share prices. As you'll see in a moment, this report includes threecompany recommendations specifically tailored to this part of the uranium story.

## An Historic Opportunity In the Making

As we indicated earlier, analysts are forecasting that a significant supply deficit will eventually emerge in the uranium market, and then grow rapidly from there.

But far in advance of this supply deficit, we are already seeing gains in the uranium price.

That's because, among other things, recent low uranium prices have motivated the largest uranium producing country (Kazakhstan) and the largest uranium company (Cameco) to drastically cut production. Kazakhstan cut production by 20 percent over the three years between 2018 and 2020. In addition, Cameco suspended production indefinitely on its massive McArthur River complex in the Athabasca Basin starting in 2018. It has also just suspended production at its Cigar Lake project due to Covid-19 for a four-week period and will then reevaluate.

While these cuts obviously reflect a weak market, they also have the potential to shore up the uranium market in the next few years and to force uranium prices back up beyond the costs of production for many of these operations.

Simply put, utilities cannot allow themselves to run out of uranium fuel, or get anywhere close to such a situation. So they look far ahead to secure their uranium supplies, and buy most of their fuel via long-term contracts.

## Conversion Factors, Etc.

To understand the nitty-gritty of uranium mining and investing, you need to familiarize yourself with a few technical nuances. Chief among these is the difference between uranium oxide (U3O8) and what the industry refers to as "natural uranium." Also, because the literature on uranium tends to bounce around between metric and avoirdupois units of measure, a brief review of the relevant conversion factors used to describe deposits is also needed.

When producers send U3O8 to the conversion facility, it contains a little more than 80% uranium by weight. The term "natural uranium" allows the industry to equate the amount of uranium contributed by secondary sources (i.e. weapons-grade, enrichment tails, etc.) with the amount contributed by yellowcake, the concentrated ore.

To convert "natural U" to its U3O8 equivalent, simply multiply the "natural U" figure by 1.18. As an example, let's take the United States' demand for "natural U' in 2003. That year, its nuclear power industry consumed 22,379 "tonnes U." If it had met that demand entirely from primary sources, it would have needed to purchase 26,428 tonnes of U3O8.

Producers concern themselves primarily with the quantity and grade of U3O8 in their reserve and resource bases. Power companies and intermediaries purchase almost 90% of all U3O8 through long-term contracts, but the financial and trade press usually quote the spot price, expressed in terms of U.S. dollars per pound.

To be able to conduct a back-of-the-envelope valuation on junior, you will need to move deftly from tonnes to tons and from kilograms to pounds. The relevant metric-to- avoirdupois conversions are as follows:

1 metric tonne = 1,000 kilograms = 0.9071 short tons = 2,204.6 pounds

Let's apply these numbers to a hypothetical company with a defined resource of 15.0 million tonnes grading 0.30% U3O8. The total resource in pounds would be 100 million pounds (15,000,000 x 0.003 x 2,204.6). At a U3O8 spot price of US$40, it would be worth $4 billion, or $268/tonne of ore in the ground.

Given the persistent malaise in uranium prices in recent years, however, the utilities have shown uncharacteristic patience in coming back to market to renew their long-term contracts. They've been content to merely top off their supplies here and there via the spot market.

In the near future, however, these industry-wide production cuts will force utilities to return to market as their reserves run down. As you can see from the accompanying chart, the uranium requirements of both U.S. and non-U.S. utilities that are "uncovered" by existing supply contracts are set to grow dramatically over the next few years.

Today, they may not be shopping for uranium in size. But analysts agree that, at some point over the next two years, they will have to. And the price of uranium will simply have to rise significantly in response.

Cantor Fitzgerald senior analyst Rob Chang is one of the most respected experts in the uranium sector, and he predicts that the upcoming price shock will rival anything seen in the "uranimania" of the mid-2000s.

"We are going to see it jump $5 to $10 every week, like we saw before, because it just has to happen that way," notes Chang. "I'm not sure exactly when this will happen, but there frankly is just not enough supply. It's a very thin market, and once you get two, three, four utilities trying to buy at the same time, you are going to see large jumps."

All by themselves, the supply-side fundamentals for uranium make for a compelling investment thesis. Combine them with the upside that nuclear power contributes to the demand-side, and it becomes a slam dunk.

If you believe, as we do, that the future for uranium is exceedingly bright, then the question of how to cash in on that future should now be top-of-mind. In the pages ahead, we intend to answer that question in a way that maximizes your leverage on what has all the makings of a secular bull market for uranium.

Since it does not trade on a futures exchange, the only viable way to play uranium is to invest in companies that mine and explore for it. Simply put, if you want to hitch your wagon to uranium's star, you'll need to familiarize yourself with the inner-workings of this relatively small corner of the mining universe.

And here's where it gets truly exciting. You see, the current opportunity for uranium investors is magnified by the fact that there are relatively few well-positioned companies remaining in the sector.

During the 2004-2007 surge in the uranium price and the resulting mania in junior uranium companies, over 500 new uranium ventures suddenly emerged like mushrooms after a rainstorm.

In the early stages of the uranium land rush, resource accumulation provided the clearest path to share price appreciation. Indeed many companies enjoyed multi-bag gains based solely on their ability to amass sizable chunks of property with historic resources.

But as the price of uranium came back to earth over the following years, the rules of the game changed. In short, the sector went through a Darwin-esque experience, with only the fittest companies surviving.

Now, only about a dozen junior companies remain. The good news is that these survivors are the companies run by very capable and resourceful management teams. These are the talented groups that consistently grew their resources by absorbing other companies and high-quality projects, and advancing them along the development curve.

The result is that some of the survivors are either in production or very close to it, and can therefore provide investors almost immediate leverage to rising uranium prices. Of those companies that are still in the exploration phase, a few have uncovered truly exceptional, world-class deposits.

Let's review some of the best of the lot.

## Putting It All Together: Five Ways To Play Uranium

There are not only far fewer companies involved in the uranium sector today, but the survivors generally boast market capitalizations significantly lower than before the last big run in uranium stocks.

With the global uranium market running headlong into its first major supply deficit, there has never been a better time to speculate in high-quality uranium stocks.

So what are the best opportunities in the sector? A number of top companies are or have been covered and recommended in our publications, *Gold Newsletter* and *Mercenary Geologist.*




**Gold Newsletter In Our 50th Year**