

Uranium: Path To Enrichment



**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



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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 seven times today's levels. But then came the global financial crisis to toss the prices of all commodities into the dumpster.

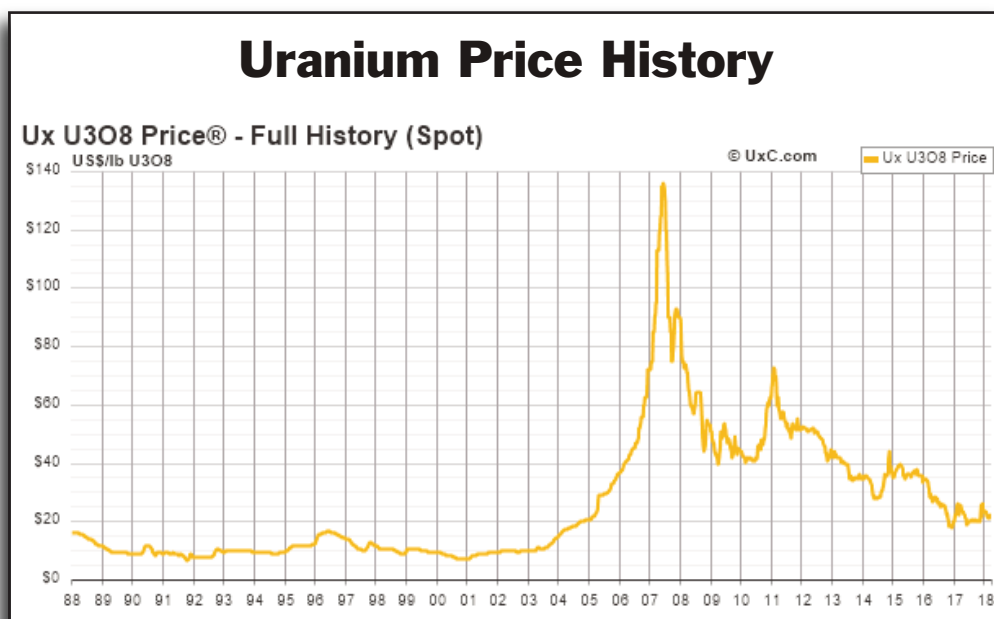
Once we got past that train wreck and the global monetary deflation kicked in, the fundamentals for uranium began to kick in once more. The price of uranium was steadily climbing back up...until the Fukushima accident sent the price reeling once again.

That's an unfortu-

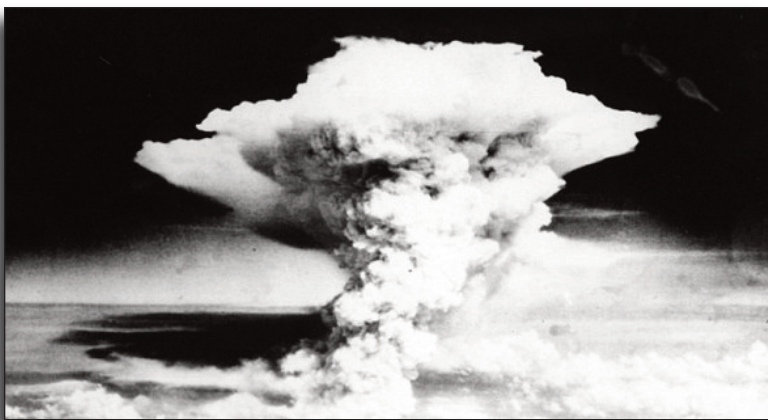
nate run of bad luck, to be sure. But the Fukushima accident was specific to the uranium market. And, as you are about to see in this report, the lesson from that event is that the benefits of nuclear power make it hard, if not impossible, to replace this crucial source of energy.

And today, once again, the powerful and irreversible supply/demand fundamentals are about to come 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 and substantially higher prices just ahead.

And these developments promise to bring a re-



Source: The Ux Consulting, LLC



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

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 (4 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. 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 ability of sub-atomic particles to generate massive amounts of energy.

The big breakthrough came in 1905, when Einstein put forth his Theory of 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, Otto Hahn and Fritz Strassman 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 radionuclide created when U-238 absorbs two additional protons during the fission process.

By the spring of 1945, the Manhattan Project

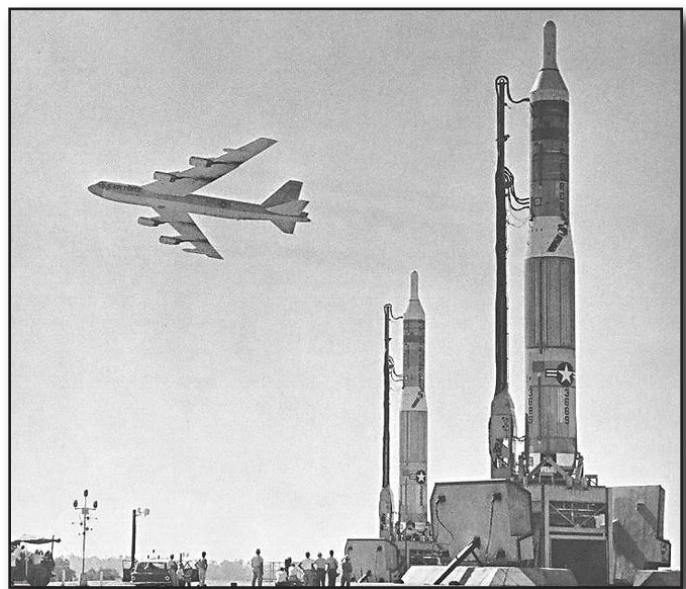
had produced enough P-239 and highly-enriched U-235 for Robert Oppenheimer and his team in Los Alamos, New Mexico to build and test a bomb. On July 16, 1945, they successfully detonated a plutonium device at Trinity, New Mexico. The explosion ushered the world into the Atomic Age.

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.

By 1947, it successfully tested its own weapon. The nuclear build-up that defined the Cold War be-



The Cold War fueled uranium exploration and production.

tween 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 in-

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-Daichi, 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.

terest 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 443 nuclear plants operating in 31 countries, with an aggregate production capacity of 392 GWe (392,000 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 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 (UO₂). These pellets are then packed into four-meter-long zirconium alloy tubes, which are then bundled into the fuel assemblies that power the reactor.



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

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 de-

mand 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 bal-

ance 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. At the beginning of 2019, it had 19 reactors under construction, with more to come. 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 mar-

ket 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 security of future Western World supplies of U_3O_8 :

- 60% of the world's uranium supply came from these six countries: Kazakhstan, Niger,

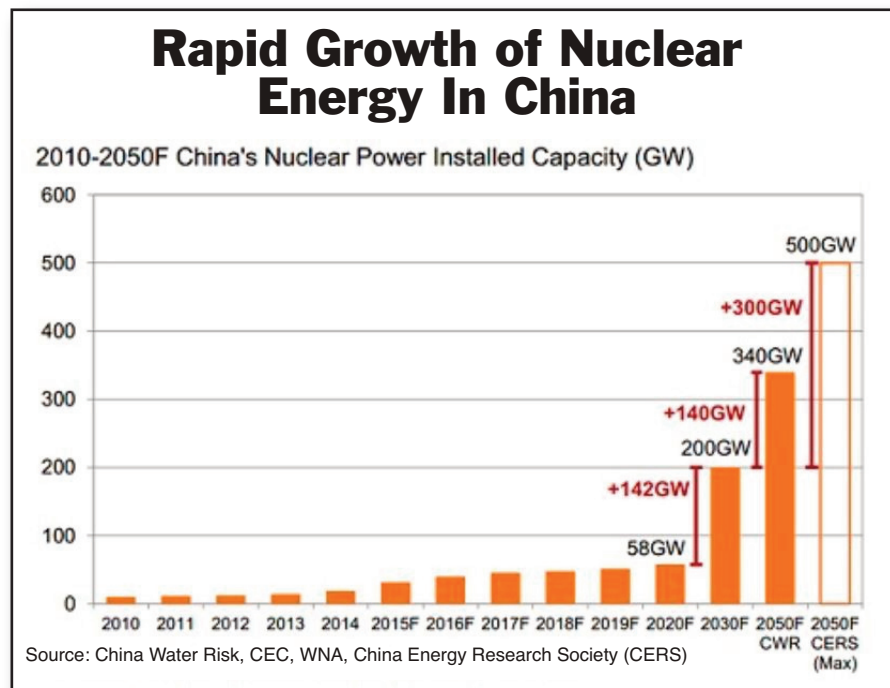
Russia, Uzbekistan, China, and Ukraine.

- 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.

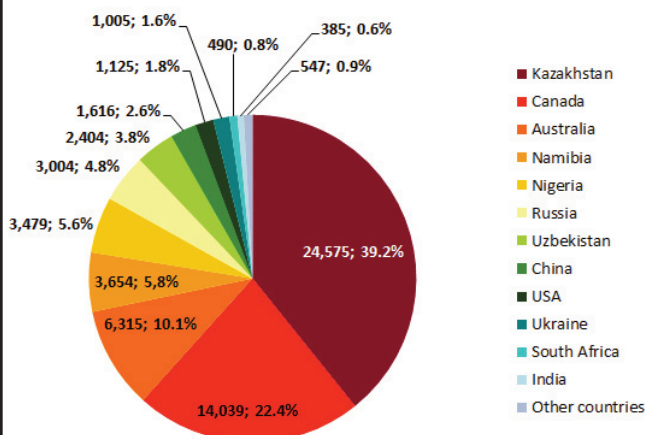
The sources of new supply are problematic because conventional underground uranium mining and milling requires significantly higher prices to be economic, generally estimated at \$65-\$80/lb. Even the lower-cost in-situ recovery (ISR) and open-pit heap leach mines are below break-even at current prices.

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



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

Data in tonnes and in percentage



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.

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

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% U_3O_8 , unconformity-related ore grades can be exceedingly rich — the deposit at the proposed Cigar Lake mine in northern Saskatchewan averages 20% U_3O_8 , 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% U_3O_8 , 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% U_3O_8) and small- to medium-size (up to 50,000t U_3O_8 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.

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 opposition 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

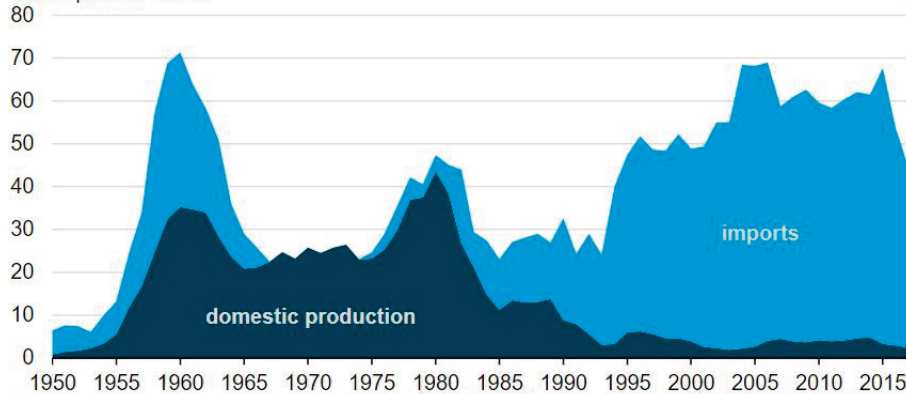
Could the nuclear power industry withstand a steep escalation in fuel costs? By all accounts, it can do so easily. The high capital costs associated with building a nuclear plant comprise the vast majority of its Levelized Cost of Electricity (LCOE).

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.

Global Uranium Market

U.S. uranium supply to commercial nuclear reactors (1950-2017)
million pounds U3O8



Source: U.S. Energy Information Administration, *Monthly Energy Review* and *Uranium Marketing Annual Report*

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.

A SPECIAL SITUATION DEVELOPS IN THE U.S.

A special situation on the demand side of the 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.

While the recommendations of that working group are still being finalized, word slipped out in late 2019 that the group would recommend that the Department of Defense fill all of its uranium

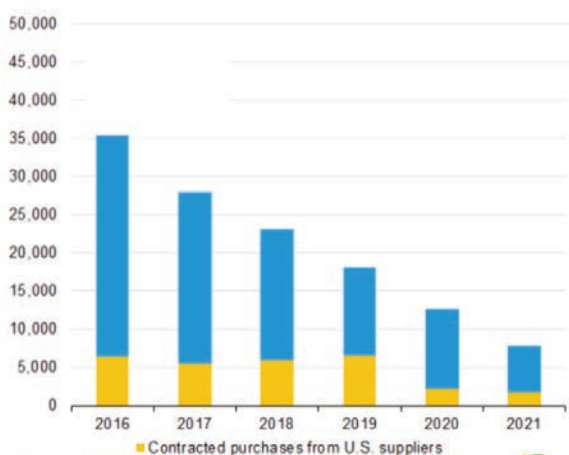
MINING TECHNIQUES

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.

Forward Uranium Supply Contracts

thousand pounds U₃O₈ equivalent



Source: U.S. Energy Information Administration, Form EIA-858 "Uranium Marketing Annual Survey" (2013).



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

requirements with domestically produced uranium. It would also recommend boosting the national uranium stockpile. These recommendations could create as much as 10 million pounds per year of demand for domestically produced U₃O₈.

Reports have also circulated that the Trump administration has allocated \$150 million in its upcoming budget toward buying U.S.-produced uranium for use by the U.S. military.

In short, while there will not be full-fledged tariff protection for U.S. producers, a positive decision should come in 2020 to give domestic producers the DoD's business. If the Trump administration accedes to that recommendation, it should provide a boost to domestic producers' share prices. As you'll see in a moment, this report includes two company 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 should begin to see gains in the uranium price.

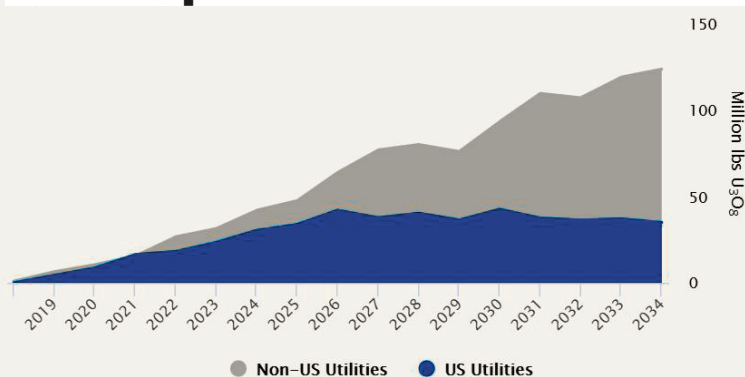
That's because recent low uranium prices have motivated the largest uranium producing country (Kazakhstan) and the largest uranium company (Cameco) to drastically cut production. Kazakhstan announced its intention in 2018 to cut production by 20 percent over the three years between 2018 and 2020. In addition, Cameco has suspended production indefinitely on its massive McArthur River complex in the Athabasca Basin. It has also curtailed production at its Cigar Lake and Rabbit Lake projects.

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.

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

Uncovered Uranium Requirements Estimate



Source: UxC estimates - September 30, 2019

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

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

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.

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: FOUR WAYS TO PLAY URANIUM

There are not only far fewer companies in-

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*.

Here, then, are four companies that fit the bill in all respects. Enjoy their intriguing stories, visit their websites, give them a call, and seriously consider the opportunities they now present.

ENERGY FUELS

UUUU.NYSE-A

energyfuels.com

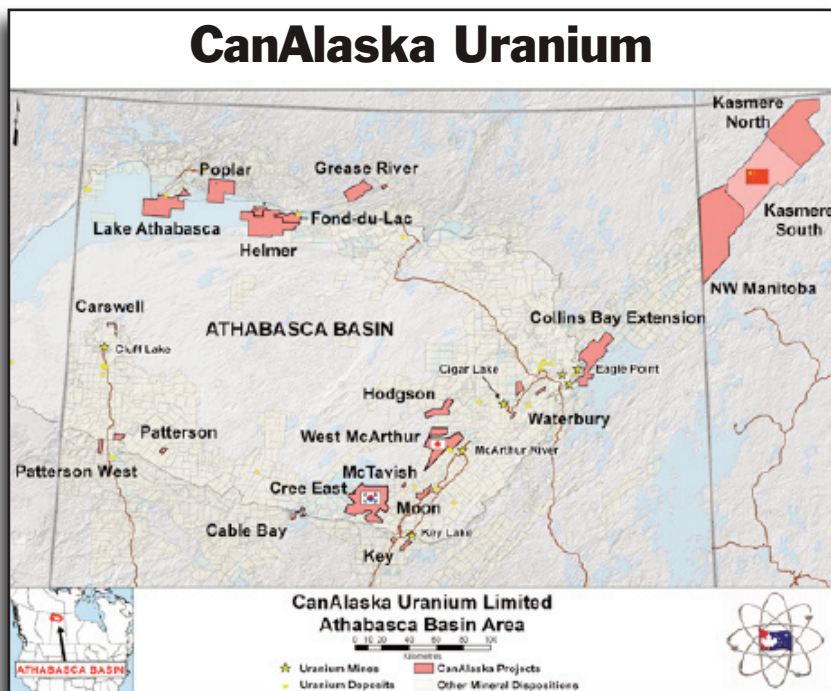
As one of the co-petitioners for the U.S. Section 232 review of domestic uranium production, Energy Fuels obviously stands to benefit from preferential action by the Trump Administration.

The U.S. Nuclear Fuel Working Group reportedly recommended that the U.S. government increase its uranium stockpile and the Department of Defense fulfill its annual uranium demand with domestic supplies. If the Trump administration elects to act on those recommendations, that decision could create demand for up to 10 million pounds of domestically produced uranium.

It would be an environment tailor-made for Energy Fuels, which has an outstanding portfolio of U.S.-based uranium assets and the ability to flip the switch quickly on production at those assets. Even at current limited domestic production levels, Energy Fuels stands as the largest uranium producer in the U.S.

The company's portfolio includes the White Mesa mill. Located in southeast Utah, White Mesa is the only conventional uranium milling operation in the U.S. Moreover, it sits within a constellation of uranium projects in Utah, New Mexico and Arizona with the potential to feed ore to the complex.

In addition, Energy Fuels operates the Nichols



Ranch in-situ recovery (“ISR”) in Wyoming. That facility is fully permitted and capable of producing at a 2 million pound per year level. Combined with the mill operation at White Mesa, Nichols Ranch brings the company’s nameplate annual capacity to 11.5 million pounds U_3O_8 . It also has the Alta Mesa ISR facility in Texas available on standby.

Energy Fuels’ ability to quickly bring all that production online makes it a smart-money play on a favorable decision by the Trump administration on the working group’s recommendations. Given the notoriously slow permitting process for uranium operations, the fact that this company already has a fully-permitted conventional mill and two permitted ISR operations puts it in the proverbial cat bird’s seat.

While a positive decision would send uranium companies with less advanced assets scrambling to get those assets permitted, Energy Fuels will be able to simply flip the switch on its operations and begin monetizing this special situation within the uranium market.

As an added bonus, the property around White Mesa has a vanadium resource. Vanadium has received attention lately as a battery metal, and White Mesa is capable of producing 160,000 to 200,000 pounds of vanadium oxide per month at its facility.

That operation has the potential to generate cash flow that can help Energy Fuels offset the costs of care-and-maintenance while it awaits a final decision from Trump. Well-managed and well-positioned for whatever comes next in the U.S. uranium market, Energy Fuels is a compelling play on U.S. uranium production. It’s a buy.

Energy Fuels

Recent Share Price: US\$1.73

Shares Outstanding: 93.5 million

Market Cap: US\$161.8 million

Shares Outstanding

Fully Diluted: 106.2 million

Market Cap

Fully Diluted: US\$183.7 million

FISSION URANIUM CORP.

FCU.TO

fissionuranium.com

There’s room in any portfolio of uranium stocks for companies with large, developable resources.

And that description fits Fission Uranium to a tee. The company has a 100% interest in the Patterson Lake South (“PLS”) project in the Athabasca Basin, and it has managed to outline one of the largest, highest-grade, near-surface uranium deposits in recent memory.

The deposit in question is PLS’s Triple R deposit, which the most recent resource estimate pegs at 102.4 million pounds of indicated U_3O_8 and 32.8 million pounds of inferred U_3O_8 . That’s a world-class resource by any measure.

Better still, management is leaning toward an underground-only mining scenario for Triple R that would allow the company to mine U_3O_8 for just \$7.18 a pound. Its 3.18 kilometers of east-west strike length is well beyond that of either Cameco’s Cigar Lake or its McArthur River project.

Moreover, the pounds in the ground at Triple R lie at relatively shallow depths for the Athabasca Basin. McArthur River’s deposit lies at 500 meters

depth. Cigar Lakes lies between 400 and 500 meters depth. By comparison, high-grade mineralization at Triple R begins near 50 meters from surface and extends to depths of just over 300 meters.

It's that shallow depth, combined with management's underground mining plan, that explains that low opex number for the mine. It also explains Triple R's compelling economics.

Applying the underground-only case outlined in a recent prefeasibility study, Triple R would have an after-tax NPV, discounted at 8%, of C\$702 million and an IRR of 25%. In other words, the underground scenario posits an operation that would be worth more than *five times* Fission's current market cap.

Plus, as big as Triple R already is, it has the potential to grow larger still through exploration. Not only does the deposit remain open in all directions,

but Fission has identified over 100 geophysical anomalies on the 31,039-hectare PLS property boundary. It's a target area that's fully five times the size of Manhattan Island.

As a development-stage play, Fission is more of a buy-and-hold story. While the Trump administration's decision on domestic U.S. production will likely impact players in that space first, the longer-term prospect of higher contracted uranium prices makes this company and its world-class uranium resources a key holding to have in your portfolio in advance of uranium's next run.

Fission Uranium Corp.

Recent Share Price: C\$0.29

Shares Outstanding: 486.6 million

Market Cap: C\$141.1 million

Shares Outstanding

Fully Diluted: 505.5 million

Market Cap

Fully Diluted: C\$146.6 million

GoviEx URANIUM

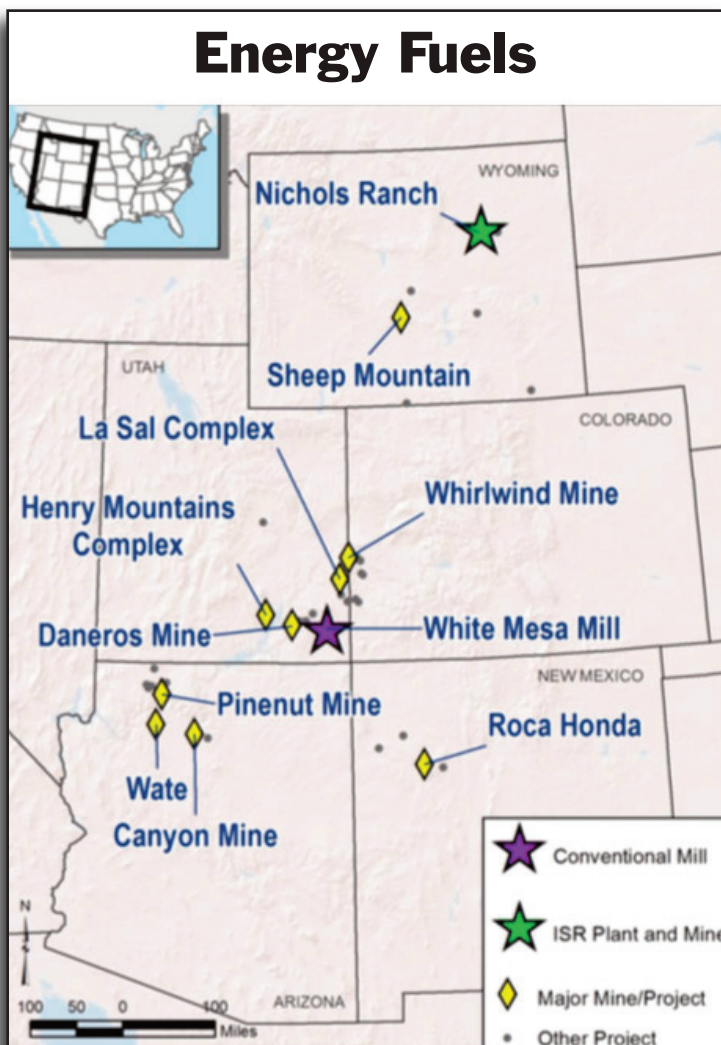
GXU.V
604-681-5529
govix.com

Another company with an impressive uranium resource base is GoviEx resources.

The company's portfolio is located in Africa, with its flagship project (Madaouela) in Niger and projects in Zambia (Mutanga) and Falea (Mali) as well. Madaouela and Mutanga contain a combined resource totaling 36.2 million pounds of measured U_3O_8 , 107.3 million pounds of indicated U_3O_8 , and 86.0 million pounds of inferred U_3O_8 .

GoviEx has a well-defined plan for these projects that will see Madaouela developed first. The company has already produced a PEA and prefeasibility study on the project, and also has a mining permit for it in hand.

The next step is to produce a definitive feasibility study for the project and to secure financing and offtake agreements for the mine's ore. In a sign that the broader sector likes this project and this company, GoviEx's shareholder base includes Cameco, Denison Mines and Ivanhoe Industries.



And it makes sense. Madaouela lies within 10 kilometers of Orano’s mining operations at Cominak and Somair and has access to good roads, skilled mine labor, ground water and grid power. Its probable mineral reserves stand at 60.5 million pounds U_3O_8 , putting it among the larger developable uranium deposits out there.

Like most uranium plays these days, an investment in GoviEx is a bet that the contract market will eventually settle at much higher prices to justify mining of deposits like Madaouela. The mine has a modest initial capex of just \$359 million, a mine life of 21 years and total, life-of-mine costs of \$36.40/lb.

Management pegs the breakeven price for U_3O_8 for an NPV discounted at 8% of \$48/lb. The company is both advancing offtake discussions on the project and has appointed Medea Capital Partners to help it secure financing. Efforts to optimize operating and capital costs during the development of the feasibility study would no doubt help nail down that financing, assuming they bear fruit.

Meanwhile, the Mutanga project provides some longer-term blue sky. GoviEx conducted a PEA on Mutanga in 2017 and estimated the project’s deposit could support a mine with 2.6 million pounds of annual U_3O_8 production over 11 years. Like Madaouela, it would have modest capex costs of just \$121 million. It would break even on an 8%-discounted NPV at \$46/lb U_3O_8 .

The project remains open for expansion with further exploration, based on the limited work undertaken on two of the three mining permits that comprise Mutanga. Nearby infrastructure for the project includes gravel road access, available ground water and grid power located 60 kilometers away.

Led by Govind Friedland, GoviEx has a strong management pedigree and a Rolodex tailor-made for securing financing in the current market. Given the prospect that the company could have both Madaouela and Mutanga in production by 2023, the timing with the broader market via contract price negotiations could work out perfectly. Thus, GoviEx is another buy-and-hold bet on an eventual rebound in the uranium market.

***Note:** GoviEx is listed on the Canadian Secu-

rities Exchange, an exchange launched essentially to compete with the Toronto Venture Exchange. The CSE has a FAQ page here that should answer most of your questions regarding stocks listed there.

GoviEx Uranium Inc.

Recent Share Price: C\$0.15
 Shares Outstanding: 423.2 million
 Market Cap: C\$63.5 million
 Shares Outstanding
 Fully Diluted: 596.6 million
 Market Cap
 Fully Diluted: C\$89.5 million

Uranium Energy Corporation

UEC.NYSE
 604-682-3591
 uraniumenergy.com

We round our list of uranium picks with Uranium Energy Corporation, another U.S.-focused uranium company with assets that it can quickly put into production, under the right set of circumstances.

As a company with U.S. assets, a critical component of those circumstances is whether the Trump administration elects to implement some of the U.S. Nuclear Fuel Working Group’s recommendations.

If the administration does, indeed, carve out some domestic demand for uranium, UEC’s “hub-and-spoke” configuration of uranium assets in south Texas promises ramp up quickly. The “hub” that is the Hobson plant is already permitted, as are the Palangana, Goliad and Burke Hollow ISR projects that sit nearby.

Combined with the 2.8-million-pound inferred resource at the Salvo project, these projects contain 6.6 million pounds of indicated U_3O_8 and 9.9 million pounds of inferred U_3O_8 . The Hobson plant is capable of processing up to 2 million pounds of U_3O_8 per year. And since three of those nearby projects are already permitted, the right uranium price should allow UEC to rapidly churn out cash flow from these assets.

Management has also taken advantage of the down market for uranium to amass an enviable col-

lection of assets elsewhere in the U.S. and in Paraguay and Canada. Combined, the company's portfolio boasts 58 million pounds of measured and indicated U₃O₈ and 45 million pounds of inferred U₃O₈.

Those assets include the fully permitted Reno Creek ISR project in Wyoming (26 million pounds of measured and indicated U₃O₈ and 1.5 million pounds of inferred U₃O₈), a pipeline of conventional uranium and vanadium assets in the western U.S., and an ISR portfolio in Paraguay (8.9 million measured and indicated pounds and 2.2 million inferred pounds).

The company has a stellar management team that includes President, CEO and Director Amir Adnani and Chairman (and former U.S. Secretary of Energy) Spencer Abraham. Amir's team has set UEC up for success, once the uranium market turns the corner.

Between its Texas assets and Reno Creek (the largest pre-construction ISR uranium project in the U.S.), UEC is primed to jump into U.S. production with both feet, pending a positive decision from the Trump administration.

Throw in some metal optionality in the form of potential vanadium and titanium production, and you have the recipe for an excellent speculation on both uranium's near term and its long term. UEC is a strong buy at current levels.

Uranium Energy Corp.

Recent Share Price: US\$0.87

Shares Outstanding: 183.3 million

Market Cap: US\$159.5 million

Shares Outstanding

Fully Diluted: 214.0 million

Market Cap

Fully Diluted: US\$186.2 million

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