Unearthing Opportunity: Uranium Miners and the Global Clean Energy Transition

An overview of the opportunity for uranium miners as the world moves to decarbonize electricity production

Sprott
What is the Clean Energy Transition?

The clean energy transition means shifting electricity production away from sources that release significant greenhouse gases, such as fossil fuels, to those that release minimal greenhouse gases. Nuclear power, hydro, wind and solar are the primary clean energy sources.

Around two-thirds of the world’s electricity still comes from burning fossil fuels. In order to progress toward climate goals, particularly those outlined in the Paris Agreement, at least 80% of energy production will need to shift to low-carbon sources.

Source: International Atomic Energy Agency.
Global Energy is at an Inflection Point

Climate change is driving the urgent need for carbon-free electricity. Energy infrastructure and commodity markets are coming into high focus. A new wave of technological changes geared toward higher energy efficiency is underway. We believe that nuclear energy and uranium miners are poised to benefit from this shift.

This white paper introduces the trends that are driving uranium markets and uranium miners, and explains our positive outlook for growth. The case for uranium mining equities comes down to three converging factors.

• First, the clean energy movement will have to embrace more nuclear power.
• Second, uranium supply is not sufficient to meet the future demand.
• Third, uranium miners represent a tiny share of the energy market today but may be poised to claim an increasing share going forward.

Nuclear power has a complicated political history. However, it represents a unique mix of attributes that renewables can’t match at scale. Countries and states will need to embrace these attributes to make significant progress toward future decarbonization goals.

The Three Trends Driving Uranium Miners

➊ New nuclear reactors are under construction or planned globally.
To meet global decarbonization goals, countries will need to embrace nuclear power more broadly, a sentiment that is gathering global support.

➋ Uranium mining supply shortfall may likely rise relative to growing demand.
Uranium mining has been lower than reactor demand since the Cold War ended in 1989. Now that de-weaponized stockpiles (secondary-source uranium) have been depleted, the projected supply gap is likely to be a more pressing issue.

➌ As nuclear power gains a greater share of global electricity generation (currently 10%),¹ uranium miners may be likely to follow.
To meet or even approach climate change mitigation, nuclear power needs to take “share” of the energy market from high-carbon-emitting fossil fuels; uranium miners may follow suit. Geopolitical upheavals, including the Russia-Ukraine war, have also magnified the need for secure energy sources.

¹ Source: BloombergNEF as of 12/31/2021.
The Global Commitment to Lower Emissions

The clean energy transition has a long way to go. Today, about two-thirds of the world’s energy comes from carbon-producing fossil fuel sources. As the world’s population has expanded and grown richer, carbon emissions have increased every year. Between 2010 and 2022, global carbon dioxide emissions climbed about 1% annually, even as developed economies began to embrace green energy sources and electric vehicles in higher numbers.

Green energy is not yet replacing fossil fuel sources at scale. Researchers estimate that renewable energy production is being deployed in addition to — not instead of — fossil fuel sources. Meanwhile, emissions from surface transportation account for the continued annual growth. The COVID-19 pandemic, like prior economic downturns, did drive emissions downward, but this was only a temporary effect. As the world recovers from the pandemic, carbon emissions are resuming their upward trajectory.

Figure 1. Yearly CO₂ Emissions Continue to Rise (1750-2022)

The Paris Agreement and the Net-Zero Movement

The drive to mitigate climate change has been gaining strong momentum. The Paris Agreement, an international treaty signed in 2015 and now ratified by 194 countries and the European Union (EU), established the global framework for cooperative efforts to address climate change. To date, only a handful of countries in the Middle East have not ratified the agreement. The Paris Agreement sets out shared goals, a framework of shared resources, and a monitoring system for parties to measure and report on their progress. However, the real work of implementing green technologies falls on each country individually.

Currently, 89 parties representing 93 countries and 78.7% of global greenhouse gas emissions have communicated a net-zero target. Parties have net-zero targets outlined in laws, including Canada, the EU, Japan, South Korea and New Zealand. Other major nations, such as the United States, China, India and Brazil have included net-zero targets in policy documents. Countries that have not submitted net-zero documentation are generally developing nations.¹

³ Source: climatewatchdata.org as of 12/31/2022.
Decarbonization Will Require More Nuclear Power

The climate goals set in the Paris Agreement aim to limit global warming to a rise of 1.5 to 2 degrees Celsius. Scientists estimate that the world needs to cut annual fossil fuel production by 6% each year to meet the stated targets. However, the reality is that fossil fuel production is on track to rise 2%.5

To make significant progress, countries need to invest in infrastructure that can replace carbon-producing energy sources with carbon-free energy sources. Changes on the margin will not suffice. Small increases in renewable energy sources and incremental moves toward electric vehicles are considered low-impact tweaks that will barely move the needle.

By contrast, nuclear power has the potential to provide high-impact change that can significantly move the needle. Given that nuclear power can provide an appealing solution, sentiment has turned much more positive in recent years. Environmental advocates face the tough choices required to decarbonize economies. While there are still holdouts — particularly Germany — the political tone toward nuclear power is on the upswing.

The recent invasion of Ukraine by Russia has forced countries like Germany and Belgium to reexamine past policy decisions to phase out nuclear energy. The Russia-Ukraine war has highlighted the dual objectives that nuclear energy can support the clean energy transition and the need for energy security.

---

Figure 3. Sentiment and Government Policy Have Turned in Favor of Nuclear Power

Korea Curbs Plans for Renewables in Push For More Nuclear

Gas crisis spurs Germany to mull extending life of nuclear plants

Japan Adopts Plan to Make Maximum Use of Nuclear Power

EU Commissioner outlines ‘new conversation’ on nuclear

Five ways the Biden DOE is spending big on nuclear energy

China’s Nuclear Industry Says It Can Accelerate Expansion Plans

U.S. developing domestic uranium strategy — energy secretary

Sources: WNN: 11/14/2022; Bloomberg: 1/11/2023; The Hill: 12/8/2022; Reuters: 7/18/2022; Bloomberg: 9/6/2022; The Japan News: 2/10/2023; and Reuters: 10/26/2022. Included for illustrative purposes only.

The Broad Appeal of Nuclear Power

Nuclear power has faced waves of negative sentiment since the technology’s early roots in weaponization. This history dates back to the 1930s-1940s and was exemplified with the U.S. atomic bombing of Japan in 1945, during World War II. Despite this dark history, nuclear power offers a mix of attributes that add up to broad appeal.

We see five main characteristics supporting the case for nuclear energy:

1. **Nuclear power is reliable.**

For a national, state or local utility, the appeal of nuclear power starts with its reliability. Regions with nuclear power plants deploy reactors around the clock, using nuclear as the baseload power source for electric grids. All other power sources depend on less-reliable inputs — whether that’s fuels with volatile prices or natural conditions that are unpredictable and intermittent, like wind, solar and hydroelectric.

Building a nuclear power plant requires a major capital investment, but the cost of fuel is a minuscule share of the overall operating expense. For utilities, that means it’s economically appealing to maximize their return on investment by running reactors at the highest possible capacity.
Figure 4. Nuclear Energy Provides the Most Reliable Baseload

Note: Capacity factor measures the total amount of energy produced during a period of time divided by the amount of energy the plant would have produced at full capacity.

Nuclear power plants have advanced in recent decades and the technology has evolved so that plants operate and maintain reactors more efficiently. This translates to fewer, shorter disruptions in the reactors’ consistent production of electrical power.

These reliability dynamics mean that nuclear energy has an incredibly high capacity factor of more than 90%. The next-most reliable source is biomass (plant-based material used as fuel such as wood, soy and corn), which produces 61% of its potential energy capacity. Renewables such as wind and solar rank relatively low given that they are intermittent and subject to fluctuating wind and solar conditions. They are among the least reliable sources for meeting electricity demand. Hydroelectric power is greatly dependent on water flow and has been negatively impacted by increased drought conditions due to climate change. For these three renewable sources, variable weather patterns can greatly impact electricity production, leading to potential shortfalls.

2. Nuclear power is efficient.

One uranium fuel pellet — about the size of a gummy bear — is the energy equivalent of three barrels of oil, one ton of coal or 17,000 cubic feet of natural gas, according to the American Nuclear Association, as shown in Figure 5. The size and weight advantage of nuclear fuel adds up when considering the full life cycle of energy production — extraction, refining, transport, production and especially waste disposal.

At each step, the energy density of uranium translates to large efficiencies. Efforts to reprocess or recycle spent fuel in nuclear power plants extend uranium’s efficiency further. Enriched uranium only uses about 4% of the potential energy in the first cycle through a reactor. As the technology advances to make it more economically viable to recycle fuel, the efficiency of nuclear is likely to rise even higher.
Figure 5. Nuclear Fuel is Efficient

1 Uranium Fuel Pellet is About the Size of a Gummy Bear
and without being reprocessed and recycled, has about as much
energy available in today’s light water reactor as…

Uranium Fuel Pellet = 3 Barrels of Oil = 1 Ton of Coal = 17,000 Cubic Feet of Natural Gas

Source: American Nuclear Association. Included for illustrative purposes only.

Spent nuclear fuel even has arguable appeal. Compared to the waste byproducts of other
energy production processes, nuclear fuel has two significant advantages. First, the waste
is physically compact. The waste from a reactor supplying one person’s electricity needs
for a year is about the size of a brick. Only five grams of this is high-level waste (the type
requiring the most shielding from radiation). The small scale of waste allows utilities to
store spent fuel on-site or in interim storage locations as policymakers sort out permanent
storage plans.

Second, and even more important, the waste from nuclear power is completely accounted
for in the cycle. Fossil fuel energy creates expensive and destructive externalities for
societies, most of which are invisible to the human eye. Fossil fuel plants are regulated for
emissions, but they are not forced to bear the true costs of their wastes.

3. Nuclear power is clean.

Nuclear energy generates the lowest greenhouse gases of any power source, period. Over
the full life cycle of nuclear power production, each gigawatt-hour of electricity contributes
about three CO₂-equivalent emissions per gigawatt-hour of electricity, which is in line
with wind and solar. Hydroelectric power sources generate 11 times more CO₂-equivalent
emissions; oil and coal generate 240 and 273 times more, respectively.²

---

² Source: Ourworldindata.org; measured in emissions of CO₂-equivalent per gigawatt-hour of electricity over the life cycle of the power plant. Data as of 12/31/2020.

---
Figure 6. Nuclear has the Lowest Full-Cycle Carbon Footprint

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>CO\textsubscript{2} Equivalent Emissions per Gigawatt-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>3</td>
</tr>
<tr>
<td>Wind</td>
<td>4</td>
</tr>
<tr>
<td>Solar</td>
<td>5</td>
</tr>
<tr>
<td>Hydro</td>
<td>34</td>
</tr>
<tr>
<td>Biomass</td>
<td>154</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>490</td>
</tr>
<tr>
<td>Oil</td>
<td>720</td>
</tr>
<tr>
<td>Coal</td>
<td>820</td>
</tr>
</tbody>
</table>

Source: https://ourworldindata.org/nuclear-energy as of 2021; measured in emissions of CO\textsubscript{2}-equivalent per gigawatt-hour of electricity over the life cycle of the power plant. Included for illustrative purposes only. Past performance is no guarantee of future results.

4. Nuclear power is safe.

A common perception of nuclear energy is that it’s unsafe because of the risk of leaking radiation from reactors or spent fuel — but it is scientifically a far safer energy production method than fossil fuel sources. The mortality rate for the nuclear energy cycle is 0.03 per TWh (terawatt-hour), which includes Chernobyl and Fukushima, which is in line with renewables and about 821x safer than coal.

Nuclear Power’s Low Mortality Rate

Nuclear power technology has not changed since it was first implemented in the mid-20\textsuperscript{th} century, but the safety protocols have advanced significantly. The 1986 disaster at Chernobyl was driven by an insufficient reactor containment blamed on a flawed Soviet-era design and by avoidable operator mistakes. The international community upgraded design standards and safety protocols after the tragedy.

As shown in Figure 7, mortality rates reflect the damage to human life from both the extraction cycle and environmental effects. Energy from coal releases so much toxic pollution that it is estimated to account for 4,400 deaths per day in China, where coal plant usage is the highest.\(^8\)

The secure storage of spent nuclear fuel (SNF) is the other key issue for nuclear power’s safety ratings. SNF must be stored indefinitely because it is radioactive for hundreds of thousands of years — but importantly, the portion of the SNF that generates most of the penetrating heat and radiation has a short half-life. As a result, the radioactivity level of SNF decays exponentially.

### The Two Types of Radioactivity in Spent Nuclear Fuel

Spent fuel contains two different kinds of radioactive materials: certain lighter isotopes like cesium-137 and plutonium. The lighter isotopes account for most of the heat and penetrating radiation, but they decay relatively quickly, with a half-life of 30 years. Plutonium has a much longer half-life of 24,000 years, but it generates very little penetrating radiation.

### Figure 7. Nuclear Operations and Waste are Safe

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Mortality Rate (per TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>0.02</td>
</tr>
<tr>
<td>Nuclear*</td>
<td>0.03</td>
</tr>
<tr>
<td>Wind</td>
<td>0.04</td>
</tr>
<tr>
<td>Hydro</td>
<td>1.3</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>2.8</td>
</tr>
<tr>
<td>Biomass</td>
<td>4.6</td>
</tr>
<tr>
<td>Oil</td>
<td>18.4</td>
</tr>
<tr>
<td>Coal</td>
<td>24.6</td>
</tr>
</tbody>
</table>

Source: https://ourworldindata.org/nuclear-energy as of 2021. Included for illustrative purposes only.

* Death rate for nuclear energy includes deaths from Fukushima and Chernobyl disasters and the deaths from occupational accidents (largely mining and milling). Death rates from fossil fuels and biomass are based on state-of-the-art plants with pollution controls in Europe and are based on older models of the impacts of air pollution on health. This means these death rates are likely to be very conservative.


†† Radioactivity.eu.

### 5. Nuclear power may offer greater energy security.

The Russia-Ukraine war has created a sense of urgency among Western nations to securitize energy sources. According to the International Energy Agency (IEA), natural gas imported from Russia accounted for around 45% of the EU’s gas imports in 2021. Natural gas prices in Europe have soared compared to the U.S., putting significant pressure on policymakers to find more secure alternatives.

On March 3, 2022, the IEA released A 10-Point Plan to Reduce the European Union’s Reliance on Natural Gas; one of its points recommends maximizing dispatchable low-emissions sources, including nuclear:

> “Nuclear power is the largest source of low emissions electricity in the EU, but several reactors were taken offline for maintenance and safety checks in 2021. Returning these reactors to safe operations in 2022, alongside the start of commercial operations for the completed reactor in Finland, can lead to EU nuclear power generation increasing by up to 20 TWh in 2022. A new round of reactor closures, however, would dent this recovery in output: four nuclear reactors are scheduled to shut down by the end of 2022, and another one in 2023. A temporary delay of these closures, conducted in a way that assures the plants’ safe operation, could cut EU gas demand by almost 1 billion cubic meters per month.”
A New Uranium Bull Market⁹ Underway?

The changing sentiment toward nuclear power is one element driving the first signs of a new uranium bull market. Uranium has had two previous bull markets in the past seven decades. The first was during the energy crisis of the 1970s, a phase of history that prompted a major wave of investment in nuclear power plants. The dynamics of the era were complex. The raging Cold War prompted countries to stockpile uranium just as hundreds of new nuclear power plants were under construction. The resulting bull market for uranium ran from 1973 to about 1978.

Supply and demand stabilized in the 1980s. Despite a movement for nuclear disarmament, the continued Cold War drove countries to keep building reserves of uranium. But higher uranium prices had prompted mining activity. Uranium traded in a range until around 2003, when an inflationary supercycle drove many commodities sharply higher through 2007. Markets also traded higher on a trending view that nuclear energy was soon facing a renaissance just as secondary supplies (i.e., defense stockpiles) were tapping out.¹⁰

The 2000-2007 bull market ended with the Global Financial Crisis (2008-2010) and was further reinforced by negative sentiment after the 2011 tsunami-driven accident at Fukushima.

Today, we believe that we are in the midst of a third bull market that has been building since 2016. The climate change movement set in action by the Paris Agreement has helped drive the uranium spot price¹¹ up from its price lows in 2016.

---

⁹ A “bull market” is the condition of a financial market in which prices are rising or are expected to rise. The term “bull market” is most often used to refer to the stock market but can be applied to anything that is traded, such as bonds, real estate, currencies and commodities. (Source: Investopedia)


¹¹ The spot price is the current price in the marketplace at which a given asset — such as a security, commodity or currency — can be bought or sold for immediate delivery.
Uranium Demand Dynamics are Boosting Spot Prices

Global demand for electricity is expected to climb 76% between 2020 and 2050, according to the IEA. In the developed world, much of this demand stems from technological innovation, such as a preference for electric vehicles and greater usage of electronics. In the developing world, tectonic demographic shifts are underway, driving higher incomes, population growth and the rise of middle classes, which translates into increased demand and consumption of new technologies.

To meet these expectations, many nuclear power plants are currently under construction — but an even larger number are in the planning stage. Today, there are 435 nuclear power reactors in operation; 58 are currently in construction, primarily in China and across Europe and the Middle East, while another 104 reactors are planned for construction.

In terms of capacity and uranium usage, it’s also important to remember that many first- and second-generation reactors from the 1950s through the 1980s are smaller units producing around 400 to 500 megawatts of electricity (MWe). New reactors tend to be 1,000 or more MWe in capacity.
Figure 11. Worldwide Nuclear Power Plant Count: 435 in Operation and 162 Under Construction/Planned

<table>
<thead>
<tr>
<th>Region</th>
<th>Operational</th>
<th>Under Construction</th>
<th>Planned</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>113</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Latin America</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Europe</td>
<td>169</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Africa</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Middle East</td>
<td>5</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Asia &amp; Pacific</td>
<td>141</td>
<td>36</td>
<td>63</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>435</strong></td>
<td><strong>58</strong></td>
<td><strong>104</strong></td>
</tr>
</tbody>
</table>

Source: World Nuclear Association as of 2/15/2023. Included for illustrative purposes only.

Understanding Nuclear Radiation

Nuclear radiation exposure is minimal compared to the many sources of radiation we could come across in our daily lives. ~80% of an average person’s annual radiation exposure comes from natural sources, such as sunlight, soil and water, while ~18% comes from man-made sources such as computers, cell phones and x-rays. Less than 1% comes from the nuclear industry, including uranium exploration and mining.

Measuring Radiation Exposure

Far less radiation stems from nuclear energy than from activities not commonly associated with nuclear activities, such as flying on an airplane or interacting with more traditional energy sources.

Millirems of Radiation (mrem)

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000</td>
<td>Annual U.S. regulatory radiation limit for an adult</td>
</tr>
<tr>
<td>500</td>
<td>One transcontinental round trip flight</td>
</tr>
<tr>
<td>360</td>
<td>Average person’s annual exposure from all sources</td>
</tr>
<tr>
<td>20</td>
<td>Living one year outside a coal plant</td>
</tr>
<tr>
<td>2</td>
<td>Living one year outside a nuclear power plant</td>
</tr>
</tbody>
</table>

Source: U3O8 Corporation.

Uranium Supply Dynamics Stand Supportive of a Continued Bull Market

Global production of uranium has not kept pace with reactor requirements. Until recently, the production gap has had little effect on spot prices. In the Cold War era, countries were actively accumulating uranium for defense readiness. However, since the end of the Cold War in 1989, uranium demand has been limited to nuclear power production.

In the de-escalation era that followed the end of the Cold War, enriched uranium supplies reserved for weapons were released for use in power plants. This supplied nuclear power plants for many years. In 2002, only 54% of power plant uranium came from mining activity, with the remainder coming from secondary supply. Utilities worked through the excess supply. By 2012, 95% of power plant uranium was supplied by mining.12

Source: https://www.oecd-nea.org/jcms/pl_13870.
Uranium mining did pick up in the 2010s, but it remains below the level of current reactor demand by millions of pounds annually, and is likely to persist. The International Atomic Energy Agency forecasts that uranium mining will not meet reactor demand in the next 13 years.

**Figure 13. Uranium Production/Demand Imbalance Could Grow (2021-2035e)**


**Uranium Miners Stand Poised for Growth**

In our view, the prevailing backdrop bodes well for uranium miners. We see three trends driving upside for miners in the years to come:

1. **As nuclear power takes share, uranium miners may grow.**

We expect to see an even more dramatic shift in energy policies of both developed and developing economies, expanding the outlook for nuclear power beyond what the present trajectory suggests.
Globally, nuclear power only represents about 10% of electricity production today and more than 50% of zero-carbon emissions electricity. As we noted earlier, renewable energy sources have added to electricity production to date; they have not replaced carbon-emitting production. Nuclear power is a clear frontrunner for replacing fossil fuel sources over time. Renewables have become much more competitive in cost, but they do not have the dependable capacity to take a significant share of the broader energy market.

Figure 14. Miners Represent a Small Share of Energy Players Today
Nuclear energy generates 10% of the world’s electricity and more than 50% of zero-carbon emissions electricity.

As nuclear power gains a greater share of the worldwide energy market, the balance of capital across energy market names may also shift. Today, uranium miners represent just a tiny fraction of the market capitalization of all energy companies. Single company oil and gas conglomerates remain vastly larger than the entire uranium equity sector, in keeping with the relative share of their products in the electricity market.

2. Higher spot prices prompt mining activity.

Another way to consider the equity value of miners is in the outlook for mining activity. According to Sprott and WMC Energy, spot prices above ~$50-$60 per pound begin to present an incentive for certain miners to expand their uranium production. Many other miners may likely require spot prices far north of that to economically ramp production or develop greenfield projects (new exploration on unmined terrain). In the emerging bull market, spot prices are beginning to approach these incentive ranges. Uranium miners may be poised to generate higher revenues and potential profits if and when mining production ramps.

13 Source: Bloomberg NEF as of 2021.
14 Source: NEI.org as of 12/31/2021, represents the most up-to-date information available; see https://www.eia.gov/energyexplained/nuclear/data-and-statistics.php.
3. **Uranium miners may have investment torque to underlying spot prices.**

Historically, the value of uranium miners is leveraged to the underlying price of uranium. Put another way, miners tend to outperform during physical uranium bull markets. Our outlook for uranium spot prices remains bullish for several reasons, both demand- and supply-driven, as we have discussed throughout this white paper.

**Figure 15. Mining Equities Historically Outperform During Uranium Bull Markets (2004-2022)**

Source: Bloomberg and TradeTech LLC. Data from 1/1/2004 to 12/31/2022 reflecting longest available data. World Uranium Equities measured by the URAX Index, which tracks the performance of stocks globally that conduct business with uranium. URAX and Uranium Spot denominated in U.S. dollars. You cannot invest directly in an index. Included for illustrative purposes only. Past performance is no guarantee of future results.

---

**IMPORTANT DEFINITIONS**

- **Bull Market:** A condition of financial markets where prices are generally rising.
- **Spot Market:** Where financial instruments, such as commodities, are traded for immediate delivery.
- **Spot Price:** The price where a financial instrument, such as commodities, would be traded for immediate delivery.
Appendices

Appendix A

The Uranium Life Cycle

Source: World Nuclear Association. Included for illustrative purposes only.

Appendix B

Global Policy Initiatives Support Nuclear Energy

The U.S., Europe, China and Japan are recognizing nuclear’s vital role as a carbon-free energy source.

United States

Biden’s infrastructure bill now in place:

- Production tax credit to support at-risk power plants ($6B through 2026)
- Funding secured for $3.5B of advanced nuclear power
- $8B to support hydrogen, which may include nuclear power
- Extended the Life of Diablo Canyon
- Passed the Inflation Reduction Act which will subsidize nuclear power plants’ revenue if power prices were to fall
- Announced a plan to buy $4.3B in enriched uranium from domestic producers

European Union (EU)

- Nuclear energy was included in the EU taxonomy
- Netherlands earmarks EUR5B for new nuclear support by 2030
- Reactor life extensions in the Czech Republic, Sweden and Finland announced
- France announces six new reactors and potentially eight more large-scale capacity reactors
- Germany rethinking plant closures
**South Korea**
- Planning to increase its percentage of total energy creation from nuclear to nearly 33% from a previous midterm plan of 25%

**China**
- Planning to produce 20% of electricity from non-fossil sources by 2030
- Intends to build 150 new nuclear reactors over the next 15 years

**Japan**
- Eight years after the Fukushima disaster, gave initial approval to restart the Onagawa reactor
- Plans to generate 20% of its energy from reactors by 2030
- Wants to restart seven more nuclear reactors by next summer
- Will explore the development and construction of innovative next-generation reactors
- Will consider extending the life of existing nuclear reactors


**Appendix C**

**Largest Uranium-Producing Countries**
Roughly half of the total uranium production in 2021 came from Kazakhstan.

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>45.7%</td>
</tr>
<tr>
<td>Namibia</td>
<td>12.4%</td>
</tr>
<tr>
<td>Canada</td>
<td>9.8%</td>
</tr>
<tr>
<td>Australia</td>
<td>7.8%</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>7.1%</td>
</tr>
<tr>
<td>Russia</td>
<td>5.9%</td>
</tr>
<tr>
<td>Niger</td>
<td>4.7%</td>
</tr>
<tr>
<td>China</td>
<td>3.4%</td>
</tr>
<tr>
<td>Other</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

Source: UxC LLC as of 12/31/2021. Included for illustrative purposes only. Past performance is no guarantee of future results.
Appendix D

Total Spent Nuclear Waste

- If all the nuclear waste from commercial reactors, a 63-year operating history, was stored in a cube, it would measure just 96 feet per side
- Nuclear waste produces the smallest amount generated by any source of energy when considered on an “all-in” basis


Appendix E

Uranium Miners Have Offered Diversification

Uranium miners have exhibited a low/moderate correlation to major asset classes, posing potential diversification benefits.

Diversification does not eliminate the risk of experiencing investment losses. You cannot invest directly in an index. Included for illustrative purposes only. Past performance is no guarantee of future results. Uranium Equity Index reflects The World Uranium Total Return Index (URAX Index); S&P GSCI reflects the S&P GSCI Index (SPGSCI Index); S&P 500 reflects the S&P 500 Index (SPX Index); Bbg U.S. Agg Bond reflects the Bloomberg Barclays U.S. Aggregate Bond Index (LBUSTRUU Index); FTSE Equity REITs reflects the FTSE NAREIT Equity Index (FNRE Index); Gold reflects the Gold Spot Price (GOLDS Comdty); U.S. TIPS reflects the Bloomberg Barclays U.S. Treasury Inflation-Notes Index (LBUTTRUU Index); U.S. Dollar reflects the U.S. Dollar Spot Index (DXY Curncy).


“Why Do We Fear Nuclear Power? Fear of power in any form, and those who wield it, is quite deep in the human psyche....with the dropping of the first atomic bomb on Japan, nuclear power came to be associated with the dark side of power technology.”

This document is intended solely for the use of Sprott, Inc. and its affiliates (collectively referred to as "Sprott") for use with investors and interested parties. Investments, commentary and statements are unique and may not be reflective of investments and commentary in other strategies managed by Sprott Asset Management USA, Inc., Sprott Asset Management LP, Sprott Inc., Resource Capital Investment Corporation, or any other Sprott entity or affiliate. Sprott Global Resource Investments Ltd. may distribute certain Sprott products. Opinions expressed in this presentation are those of the presenter and may vary widely from opinions of other Sprott affiliated Portfolio Managers or investment professionals. Opinions are subject to change without notice.

This document is for information purposes only and should not be relied upon as investment advice. We strongly recommend that you consult your investment professional for a comprehensive review of your personal financial situation before undertaking any investment strategy.

The information contained herein does not constitute an offer or solicitation to anyone in the United States or in any other jurisdiction in which such an offer or solicitation is not authorized or to any person to whom it is unlawful to make such an offer or solicitation. Prospective investors who are not resident in Canada or the United States should contact their financial advisor to determine whether securities of the Funds may be lawfully sold in their jurisdiction.

Sprott assumes no responsibility for any losses or damages, whether direct or indirect, which arise out of the use of this information. Sprott is not under any obligation to update or keep current the information contained herein. The information should not be regarded by recipients as a substitute for the exercise of their own judgment.

Investment Risks

Generally, natural resources investments are more volatile on a daily basis and have higher headline risk than other sectors as they tend to be more sensitive to economic data, political and regulatory events as well as underlying commodity prices. Natural resource investments are influenced by the price of underlying commodities like oil, gas, metals, coal, etc.; several of which trade on various exchanges and have price fluctuations based on short-term dynamics partly driven by demand/supply and also by investment flows. Natural resource investments tend to react more sensitively to global events and economic data than other sectors, whether it is a natural disaster like an earthquake, political upheaval in the Middle East or release of employment data in the U.S. Low priced securities can be very risky and may result in the loss of part or all of your investment. Past performance is no guarantee of future returns.

Micro-cap stocks involve substantially greater risks of loss and price fluctuations because their earnings and revenues tend to be less predictable. These companies may be newly formed or in the early stages of development, with limited product lines, markets or financial resources and may lack management depth.

The Funds will be concentrated in the gold and silver mining industry. As a result, the Funds will be sensitive to changes in, and its performance will depend to a greater extent on, the overall condition of the gold and silver mining industry. Also, gold and silver mining companies are highly dependent on the price of gold and silver bullion. These prices may fluctuate substantially over short periods of time so the Fund’s Share price may be more volatile than other types of investments.

Funds that emphasize investments in small/mid-cap companies will generally experience greater price volatility.

Funds investing in foreign and emerging markets will also generally experience greater price volatility.

There are risks involved with investing in ETFs, including the loss of money.

Diversification does not eliminate the risk of experiencing investment losses.

The market for gold/precious metals is relatively limited; the sources of gold/precious metals are concentrated in countries that have the potential for instability; and the market for gold/precious metals is unregulated. The Fund may also invest in foreign securities, which are subject to special risks including: differences in accounting methods; the value of foreign currencies may decline relative to the U.S. dollar; a foreign government may expropriate the Fund’s assets; and political, social or economic instability in a foreign country in which the Fund invests may cause the value of the Fund’s investments to decline. The Fund is non-diversified, meaning it may concentrate its assets in fewer individual holdings than a diversified fund. Therefore, the Fund is more exposed to individual stock volatility than a diversified fund.

Product Risks

Sprott manages a variety of investment products. Important information about such products, including investment objectives and strategies, purchase options, management fees and expenses are contained in the offering documents. Please read the offering documents carefully before investing in any of the products.

An investor should consider the investment objectives, risks, charges and expenses carefully before investing. Investments in any of the Sprott products are not guaranteed, their values change frequently and past performance is no indication of future results. Furthermore, there is no assurance that any of the Sprott products will meet their investment objectives and their net asset value, yield and investment return will fluctuate from time to time with market conditions. There is no guarantee that the full amount of your original investment will be returned to you.

The Sprott products are NOT FDIC OR GOVERNMENT INSURED • MAY LOSE VALUE • NOT BANK GUARANTEED.

This document may not be reproduced in any form, or referred to in any other publication, without acknowledgment that it was produced by Sprott and a reference to sprott.com.

Resource Capital Investment Corporation is an SEC registered investment adviser.

Sprott Global Resource Investments Ltd. Member SIPC/FINRA.

Sprott Asset Management LP is registered with the Ontario Securities Commission and the SEC.

Sprott Asset Management USA, Inc. is registered with the SEC.

ALPS Distributors, Inc. is not affiliated with any of the other entities listed in this document.

© 2023 Sprott Inc. All rights reserved.