



Market Commentary
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English Version

Economy in Motion: The Kinetic Art of Turning Energy into Wealth

Quarterly Call Q2 | 2024

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Economy in Motion: The Kinetic Art of Turning Energy into Wealth

The concept of combinatorial growth is central to economic growth and technological advancement with new technologies often emerging from the novel combination of existing ones.

The theory of the adjacent possible explains the strong performance of stocks since the Industrial Revolution and predicts that they should continue to outperform over the long-term.

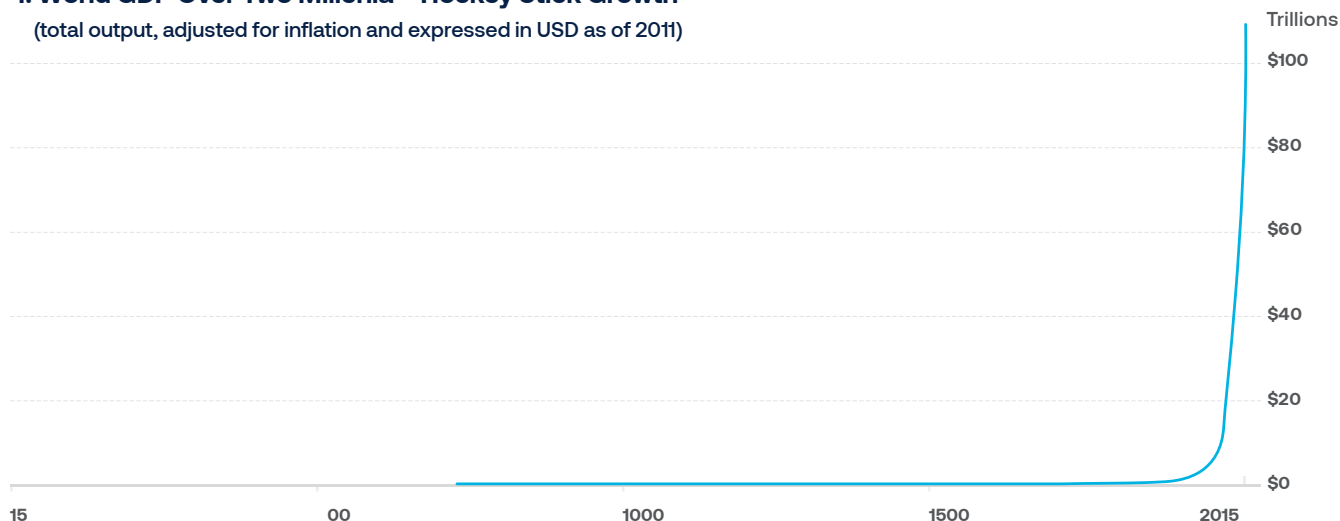
This first graph demonstrates global GDP going back over 2000 years by tracking total output adjusted for inflation in US Dollar terms using prices in 2011. Basically,

this is most of human economic history in one chart. One does not need to be particularly perceptive to notice that during much of this observation period, economic production grew with a gentle slope largely mirroring population growth. Then, it exploded upward, growing exponentially during the Industrial Revolution. The simple answer is that new technologies during the Industrial Revolution drove this rapid growth. But that explanation is incomplete because humans have been developing new technologies as far back as the physical anthropological record goes. In fact, chimpanzees and orangutans, two of our closest genetic relatives, have been observed to use simple tools by repurposing objects in their natural habitats. Naturally, there is a better explanation. The theory of the adjacent possible (TAP) offers a compelling description for the progression from the earliest tools used by our human ancestors, such as stones, sticks, and bones, to the vast array of sophisticated technologies available today, like computers, nuclear power, and artificial intelligence. This phenomenon is driven by autocatalytic processes that fuel increasing diversity within these systems. Essentially, the introduction of novelty initiates a positive feedback loop, where a set of transactions that enable each other in a self-sustaining manner contribute to a combinatorial increase in diversity. This process, inherently unpredictable in its specific outcomes, underlies the observable hockey stick growth pattern characterized by a long period of relative stability and slow growth, abruptly transitioning to rapid expansion and diversification.

This concept of combinatorial growth is central to economic growth and technological advancement. It posits that new technologies often emerge from the novel combination of existing ones. From the creation of the stone axe millions of years ago, which combined a hand axe, a stick, and string, to the development of the early trains, which merged steam locomotives with horse-drawn carriages, the pattern of innovation has been largely combinatorial. The essence of TAP lies

1. World GDP Over Two Millenia – Hockey Stick Growth

(total output, adjusted for inflation and expressed in USD as of 2011)



Source: World GDP – Our World in Data on World Bank & Maddison (2017)

in the exponential increase in possible new technologies or inventions as the number of existing technologies grows. At any given moment, the adjacent possible encompasses all potential new combinations of existing technologies, expanding with each innovation to allow for an ever-increasing array of future inventions. For instance, while trains were beyond the realm of possibility millions of years ago, the invention of the steam engine dramatically expanded the adjacent possible, making locomotives and subsequently trains feasible.

Naturally, we can describe this process mathematically in the TAP equation seen here. M_t represents the number of existing technologies at any time t , and the parameters α_i denote the decreasing probabilities of successful new inventions as the number of combined items increases. This equation accurately models the exponential growth rate observed in the economy, illustrating the predictive power of combinatorial innovation for technological evolution and economic expansion. This theory not only explains past trends in technological advancement and economic growth, but it also suggests a predictable pattern for future developments. Since the Industrial Revolution, real global GDP has

grown by nearly a hundred times, and labor productivity is up 13-fold over that period. US equities have delivered a healthy annualized total real return of 7.1% since 1871. **The theory of the adjacent possible explains the strong performance of stocks since the Industrial Revolution and predicts that they should continue to outperform over the long-term.** Indeed, the formulations underpinning TAP demonstrate that only the permanent loss of a substantial portion of our cumulative technological knowledge could disrupt this power-law distribution once it gets started.

2. The TAP (Theory of the Adjacent Possible) Equation

M_t = number of technologies existing at a given time t

$$M_{t+1} = M_t + \sum_{i=1}^{M_t} \alpha_i \binom{M_t}{i}$$

α_i = series indicating the probability that a given combination of i existing items forms a new technology

At Insigneo, we strive to be mindful of the difference between “forecast” and “strategy.” When we are forecasting, we are simply using statistical models to inform you of what we think is most likely to happen. For example, “the economy will slip into a recession in 12 months”, “US rates should fall”, “At least one of Joe Biden or Doanld Trump will not be a candidate by the November election” are a few that you will read about here. The following sections will contain a plethora of economic and market forecasts just like the preceding. But “strategy” is more holistic, balancing the risks to any forecast while also factoring in how parts of an investor’s portfolio may affect the rest. **Investment strategy needs to incorporate all possible outcomes, not just the most likely ones.** After the section detailing macroeconomic and market forecasts, the remaining sections will be filled with strategy pieces on a nascent energy revolution, occurring concurrently and synergistically with the artificial intelligence revolution. They are both influencing and enhancing one another. Powerful feedback loops exist between the two and combinatorial math is hard at work. The adjacent possible in action, turning potential energy into kinetic energy, fueling exponential economic growth.

The Fed May Pull Off a Soft Landing, But Can They Stick It?

In our view, contrary to the consensus on Wall Street, the probability of a US recession is rising rather than falling.

As we noted to start the year, the first half looks benign, and the US will avoid recessionary conditions; but, as we move into the second half of the year, the picture becomes murkier as recessionary risks increase, requiring more defensive portfolio positioning especially given the market’s recent, momentum-driven run and high valuations.

Counterintuitively, low rates of unemployment in the US are usually followed by lower equity returns; the S&P 500 has historically delivered stronger returns during periods of high unemployment.

Like our macroeconomic forecasts, our market views are only moderately altered from the start of the year.

The subjective distribution implies a weighted average level of 4800 for the S&P 500 and 3.7% for the US 10-year Treasury by year-end, implying a return of -8.5% and +12%, respectively, as of closing levels of March 27, 2024.

While Trump is currently the odds favorite, it is too early to start trading around this outcome.

There is a higher-than-usual chance that one or both men are not the candidates come the election; not likely, but around 10 to 20% odds.

As we near the election, investors should keep their eye on the betting markets and not the polls.

Against all odds (and history), the Fed might be able to softly land the US economy. That is, they may be able to calibrate monetary policy just finely enough to keep a disinflationary trend in place while simultaneously avoiding a recession. The macroeconomic data are mostly signaling this outcome...for now. But the better question might be, “for how long can they stick that landing?” Here, we are less convinced. **Chart 3** demonstrates that the unemployment rate is a highly mean reverting series, and there are two major takeaways. First, it does not tend to stay down for exceedingly long. Second, once it starts to creep higher, it usually explodes higher – there is no gradual ascent. In *The Sun Also Rises*, one of Hemingway’s characters asked, “How did you go bankrupt?” The reply: “Two ways. Gradually, and then suddenly.” Interestingly, this quote is even more applicable in the case of the unemployment rate than

3. The Unemployment Rate is Mean Reverting

Source: BCA Research

There has never been a case in the post-war era where the three-month moving average of the unemployment rate has risen by more than one-third of a percentage point without a recession taking place.



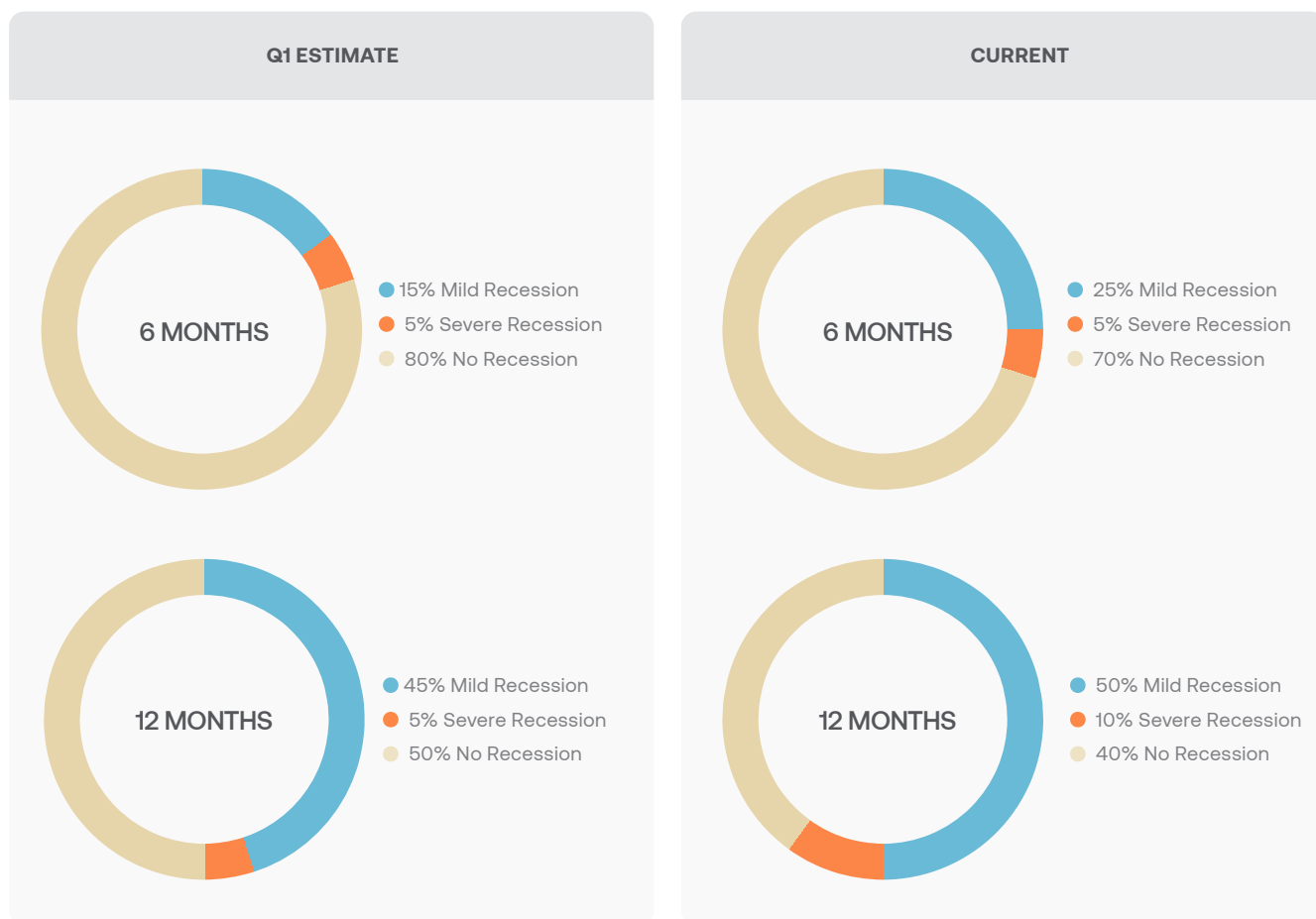
it first appears because nothing must happen for the unemployment rate to start ticking higher. By virtue of it being so low, it creates the necessary conditions for it to go higher. During the [Q1 2024 quarterly call](#), we discussed how the kinked (or L-slanted) Phillips Curve framework has served as a useful model for the post-pandemic recovery. It predicts that the relationship between inflation and unemployment becomes more volatile as the economy nears full employment. In times of high unemployment, companies can easily expand their workforce without significantly increasing wages. However, when the economy is at full employment, firms must attract employees from competitors by offering higher wages. In turn, this leads to inflationary pressures, illustrating why maintaining a low unemployment rate without triggering inflation is challenging, and central banks must respond with restrictive monetary policy. In other words, the kinked Phillips Curve explains the inability of the unemployment rate to decrease permanently and stay there.

Once the unemployment rate starts rising, aggregate demand falters, more people lose their jobs, spending

falls further, and the loop feeds upon itself – it is autocatalytic. In fact, since World War II, there has never been an instance where the 3-month moving average of the unemployment rate has risen by more than 50 bps without a recession ensuing. Perhaps, this time around, labor force participation is being underrepresented. Maybe, there are 2 or 3 million extra workers in the US due to heightened immigration that are skewing the Labor Department’s figures. Perhaps, the pandemic has changed how willing companies are to dismiss employees after the difficulty of hiring workers after the Covid pandemic. Maybe, as they say, this time will indeed be different. We would not bet on it. **In our view, contrary to the consensus on Wall Street, the probability of a US recession is rising rather than falling.** Chart 4 reflects our updated subjective recessionary probabilities over the next 6- and 12-months. As we noted to start the year, the first half looks benign, and the US will avoid recessionary conditions. We are increasingly confident in that view and agree with current market pricing. **But as we move into the second half of the year, the picture becomes murkier as recessionary risks increase, requiring more defensive**

4. Subjective Recessionary Probabilities Over 2- & 4-Quarters Incorporating All Factors

In our Decision Tree, a “Mild Recession” is defined as U-3 Unemployment Rate of $4\% \leq U3 \leq 6\%$



Source: Insigneo-Forefront Recessionary Indicator

portfolio positioning especially given the market’s recent, Momentum-driven run and high valuations. Forget the Magnificent-7 and the market-cap weighted indices, even the equal-weight S&P 500 is now expensive. Its P/E has expanded to 17x, which ranks in the 92nd percentile since 1985. If the fair value is 15x, then it is about 13% overvalued. Now, it is not time to run for the hills or hide in a bunker either. Following past periods when the equal-weight index has been similarly overvalued, it has typically continued to rise over the subsequent year. However, returns were below

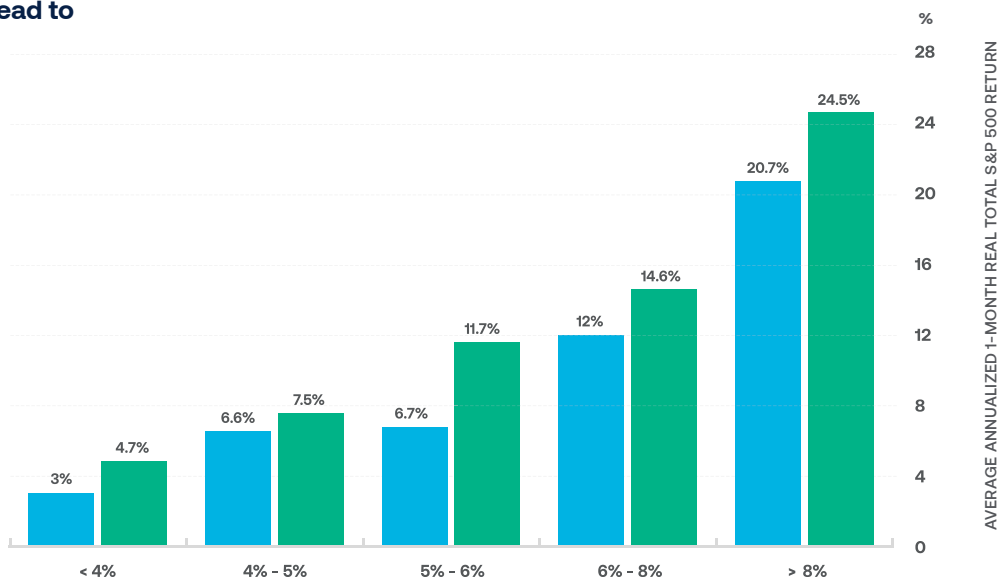
average. In this instance, the market valuation analysis matches the macroeconomic forecast we just alluded to. As Chart 5 demonstrates, low rates of unemployment in the US are usually followed by lower equity returns. The S&P 500 has historically delivered stronger returns during periods of high unemployment. The explanation for this counterintuitive trend is a two-sided coin. When the unemployment rate is low, the economy is doing well, and stocks become expensive. Conversely, since unemployment is mean reverting, once it reaches a nadir, it eventually starts

5. Counterintuitively, Low Rates of Unemployment in the US Lead to Diminished Equity Returns

Observed Unemployment Rate
January 1950 to January 2024

REAL TOTAL S&P 500 RETURN

— MEAN RETURN
— MEDIAN RETURN



Source: BCA

rising, people cut spending, increase savings, and the positive feedback loop of a recession ensues.

As we can see in chart 6 from our macroeconomic forecasts, our market views are only moderately altered from the start of the year when we first published them. This table displays our current expectations for the S&P 500 and the US 10-year Treasury under the 3 scenarios previously mentioned. The subjective distribution implies a weighted average level of 4800 for the S&P 500 and 3.7% for the US 10-year Treasury by year-end, implying a return of -8.5% and +12%, respectively, as of closing levels of March 27, 2024. For credit, we simply do not think investors are being adequately compensated for potential defaults. In fact, credit spreads are pricing in a substantial decline in default risk over the next few quarters which is unlikely, even with a non-recessionary outcome. The US Dollar should weaken over the next few months, but then restrengthen when the next recession arrives. Over the longer-term though, the Greenback remains expensive on a trade-weighted basis, so we expect it to depreciate over the long-haul. The Japanese Yen, on the other

hand, is quite possibly the cheapest major global currency and should strengthen over the long-term, especially if there is a short-covering rally later this year. In the commodity complex, over the long term, the outlook for industrial metals is better than for oil, but in the near-term, both should end the year higher than current levels. Lastly, while gold is expensive, lower real rates and persistent central bank purchases should keep the shiny metal well bid.

6. Key US Market 2024 Forecasts

Can the Fed Stick a Soft Landing?

	WITHOUT RECESSION	WITH MILD RECESSION	WITH SEVERE RECESSION
S&P 500	5000 to 5200	4100 to 4300	3600 to 3800
US 10-Year Treasury	3.7% to 4.0%	3.2% to 3.5%	2.9% to 3.2%

Source: Insigneo

Finally, we will publish extensively on this topic over the next few months, but a few brief comments on the November US presidential election seem appropriate. First, there is a narrative forming that former President Donald Trump should be seen as the overwhelming favorite to win the election. **While he is currently the odds favorite, it is too early to start trading around this outcome.** This graph shows us that Trump’s odds are sitting at around 47%, while Biden’s chances hover at approximately 41%. But the gap has been narrowing in recent weeks. The other takeaway is that there is a higher-than-usual chance that one or both men are not the candidates come the election. I would not say likely, but it also cannot be summarily dismissed. Peg it at 10 to 20%. The fact that so many other candidates who have dropped out of the race or have not even entered the race are still being priced in betting markets reflects the abnormality of this cycle given the presumptive candidates’ ages, high unfavourability ratings, mental competency (or lack thereof), and possible felony judgments. As an aside, there is now ample academic evidence that aggregating betting markets like we see in this chart are a better predictor of election

results than polling. So, as we near the election, keep your eye on the betting markets and not the polls.

A Chain Reaction

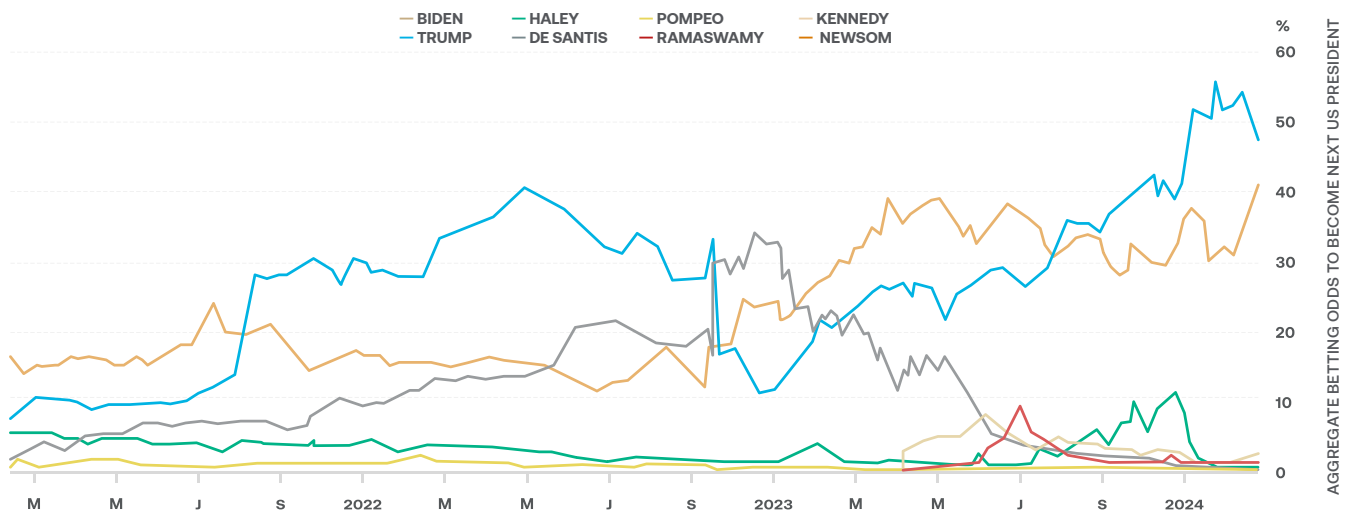
For the first time in many decades, the nuclear industry is once again becoming a growth industry, with renewed willingness and ability to play a central role in the energy transition away from fossil fuels; by most measures, nuclear energy is superior to the other main renewable energy contenders, like wind and solar.

The nuclear renaissance presents a multifaceted investment landscape, with opportunities ranging from direct exposure to uranium and mining operations to broader engagements with nuclear reactor development and utility companies.

Nuclear energy in the context of power generation refers to the use of nuclear reactions to produce electricity. The most common method involves nuclear fission, where the nucleus of a heavier atom splits into

7. US Election Race is Only Beginning to Heat Up

Source: electionbettingodds.com as of 03/27/24



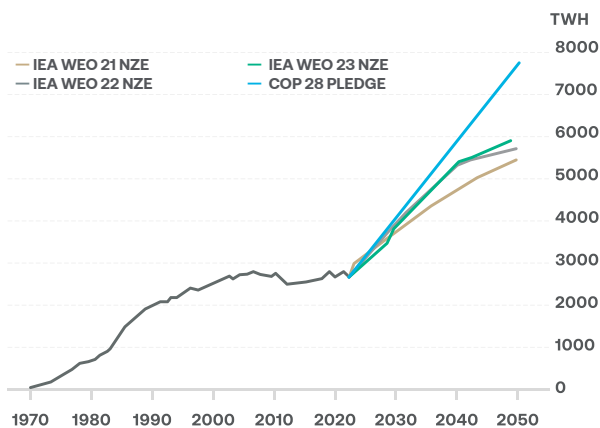
lighter nuclei, releasing a significant amount of energy in the form of heat and radiation. This heat is then used to produce steam, which drives turbines connected to generators, eventually converting kinetic energy into electrical energy. The process begins with the mining and processing of uranium, a radioactive element used as fuel in nuclear reactors. Inside the reactor, uranium atoms are bombarded with neutrons, triggering fission reactions. These reactions are carefully controlled to ensure a steady release of energy, maintaining the reactor’s temperature within safe limits. Although nuclear fission reactions drive all current commercial applications, there are hopes that nuclear fusion may one day take the baton as a leading source of energy on the planet as we scale up to the 10^{16} Watts needed to evolve into a type 1 civilization on Kardashev’s scale (we wrote extensively on this subject in our [Q2 2023 quarterly call](#)). Back to the present, nuclear power plants can produce copious amounts of electricity without emitting greenhouse gases during operation, making them a low-carbon option for meeting the world’s energy demands.

Despite the benefits, challenges remain, and these include safety concerns, nuclear waste management and storage, and high initial construction costs. The most significant impediment centers around public opinion where misconceptions surrounding nuclear energy safety abound. The public significantly exaggerates the risks of nuclear accidents, and it tends to overstate concerns regarding waste management and proliferation risks, as well. Even in many developed countries, nuclear energy is perceived by many as unsafe as burning coal, which is incongruous. Nuclear accidents are highly improbable, left tail risk events. Only the Chernobyl accident resulted in human fatalities, and that plant was operated for fourteen years after the incident and only closed in 2000 after pressure from the EU. In sum, misinformation and poor communication about the true costs and benefits of nuclear power have all conspired to engender this public misconception. Mercifully, Homer Simpson does not manage nuclear safety these days and the risks of a calamitous accident are even lower today as these past few failures allowed modern nuclear power plants to

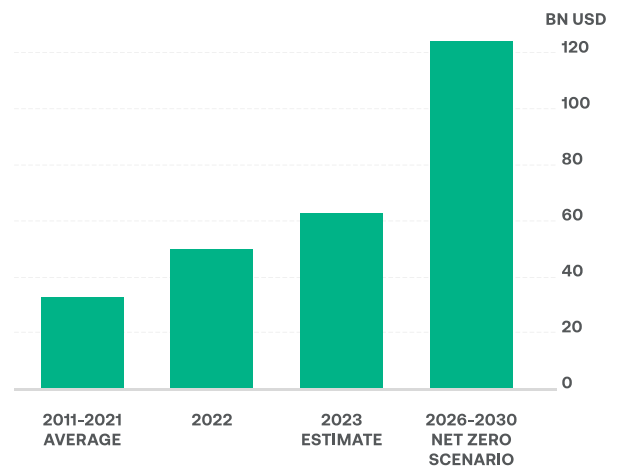
8. The Global Nuclear Power Reawakening

Source: International Energy Agency World Economic Outlook 2023

GLOBAL ELECTRICITY GENERATION FROM NUCLEAR POWER



GLOBAL ANNUAL INVESTMENT IN NUCLEAR POWER



deploy multiple safety protocols. The conditions were set for a resurgence. All that was needed was a spark.

— “...**misinformation and poor communication** about the true costs and benefits of nuclear power have all conspired...”

Geopolitics provided it. The Russian invasion of Ukraine catapulted energy security to the forefront of concerns when formulating national energy policy across many parts of the world, particularly in Europe and the United States. Indeed, both the EU’s inclusion of nuclear energy in its Sustainable Finance Taxonomy and the Inflation Reduction Act in the US incentivize the proliferation of domestic nuclear industries. This shift in global attitudes towards nuclear power is also mirrored in countries like South Korea, Belgium, Finland, and Japan. Japan’s pivot is extraordinary given that is the only country in history to have suffered from both nuclear attacks in Hiroshima and Nagasaki during World War II, and a nuclear plant failure at Fukushima over thirteen years ago. As the lefthand side of **Chart 8** demonstrates, during last year’s historic UN COP28 in Dubai, twenty countries pledged to triple nuclear energy by 2050, indicating significant momentum and investment interest in nuclear energy, highlighting its role in decarbonization efforts. Policy support that incorporates CO₂ emissions costs into electricity pricing will benefit nuclear energy significantly and level the playing field with other low-carbon technologies. The main objective of the declaration emphasizes the need for a significant shift away from the global nuclear

investment’s yearly average over the last ten years. We have already observed a notable increase in global nuclear investment in 2023, rising to USD 63 billion from USD 50 billion in 2022, and up from an average of USD 32 billion from 2011 to 2021 as you can see from the righthand side of the chart. According to COP28’s Net Zero Scenario, global nuclear investment will average USD 125 billion annually from 2026 to 2030. Moreover, recent advancements in technology and safety measures have ignited chain reactions in the field leading to greater government attention and investor interest. Overall, one can say that a nuclear renaissance may be afoot, and the market has begun to price it in. Uranium prices, for example, are up almost 80% over the past twelve months.

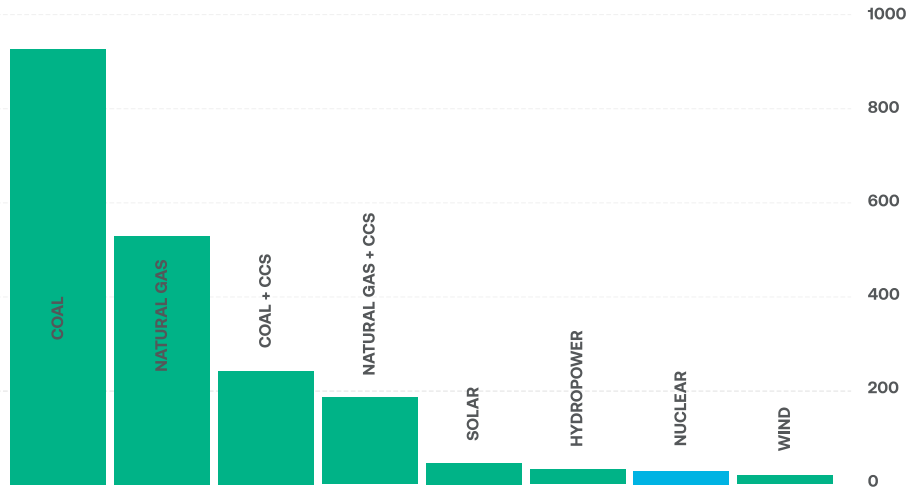
In this presentation, our aim is to clarify misunderstandings surrounding nuclear energy and highlight its potential as a significant investment opportunity amidst the global pivot towards decarbonizing economies. For the first time in many decades, the nuclear industry is once again becoming a growth industry, with renewed willingness and ability to play a significant role in the energy transition away from fossil fuels. Today, nuclear energy is responsible for around 9% of total global electricity. We expect nuclear power generation to more than double by 2040. Much of that will be contingent upon overcoming challenges related to construction costs and leveraging existing supply chains and standardized designs. Nonetheless, with its high-capacity factor and low greenhouse gas emissions, nuclear energy should play a pivotal role in the global energy demand mix of the future.

Earlier, we discussed how accident and safety assessments from the public did not match the reality when it comes to nuclear energy. Even more relevant today given the risks associated with climate change, is the nuclear industry’s safety record once you factor in total greenhouse gas emissions and related deaths. A recent study from MIT estimated that an additional 5,200 pollution-related deaths in the US would be realized,

9. Nuclear Energy is Green Energy

Apart from Wind, There is No Cleaner Source Than Nuclear
 Lifecycle greenhouse emissions in grams CO2 equivalent per kWh delivered to the grid

Source: IPCC, NREL, BFE & UN Economic Commission for Europe Lifecycle Assessment; BCA



if all domestic nuclear power production would be supplanted by oil, natural gas, and coal. As Chart 9 demonstrates, only wind energy can claim to emit fewer greenhouse gases per kilowatt hour than nuclear. As an aside, wind only tops nuclear because we are not considering the emissions necessary to

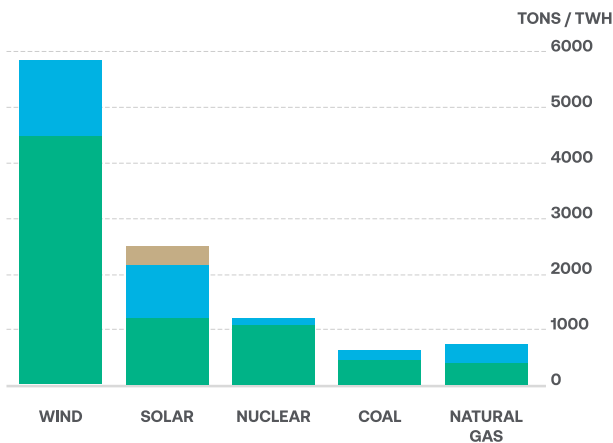
mine all the materials that are needed to build wind farms. The most potent argument against nuclear energy is that spent fuel from the reactors remains radioactive for a million years. This is true. But it is also true that 99% of the radioactive decay takes place during the first ten years. The amount of radiation one

10. Nuclear Energy is Not as Resource-Intensive as Wind or Solar

Source: BP Statistical Energy Outlook

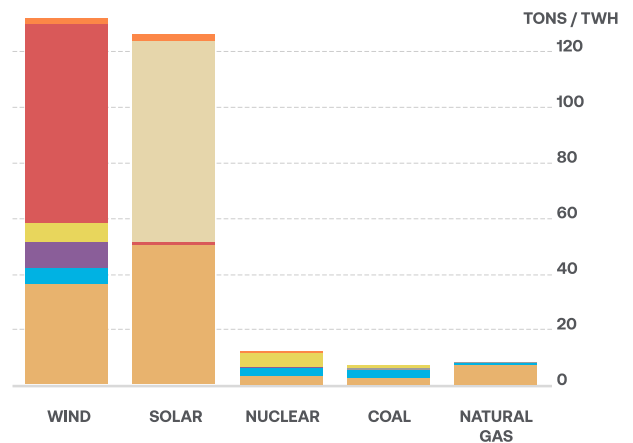
KEY BULK MATERIALS USED

CONCRETE STEEL ALUMINIUM



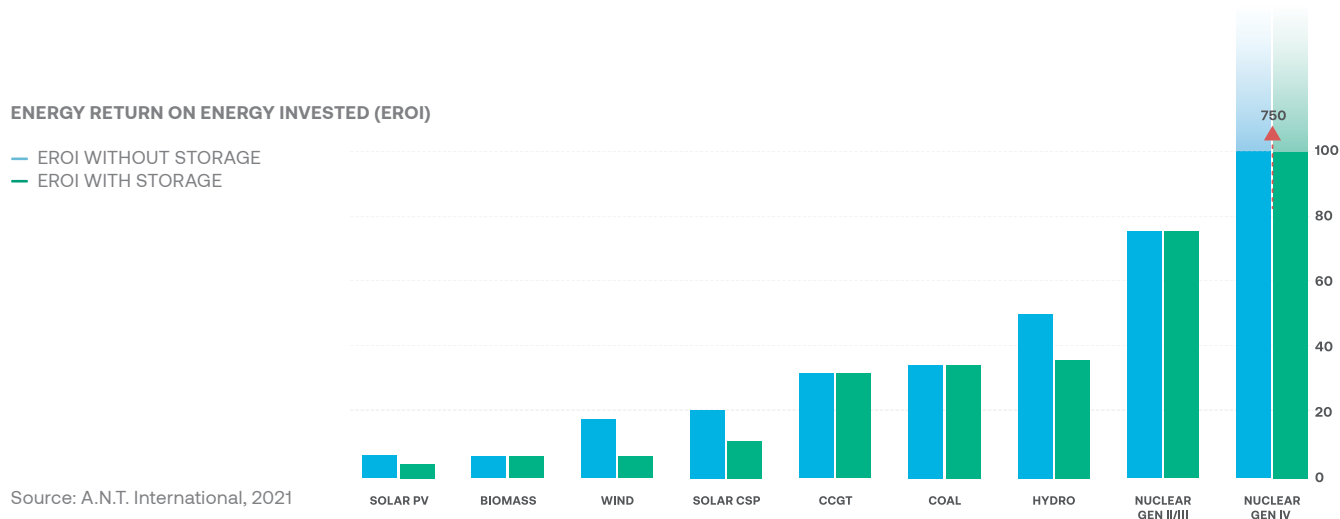
CRITICAL MATERIALS USED

COPPER MANGANESE CHROMIUM SILICON
 NICKEL COBALT ZINC OTHERS



11. Nuclear Gen IV Reactor’s EROI is Literally Off the Charts

Modern civilized society requires a MINIMUM of an EROI of 7 to 10

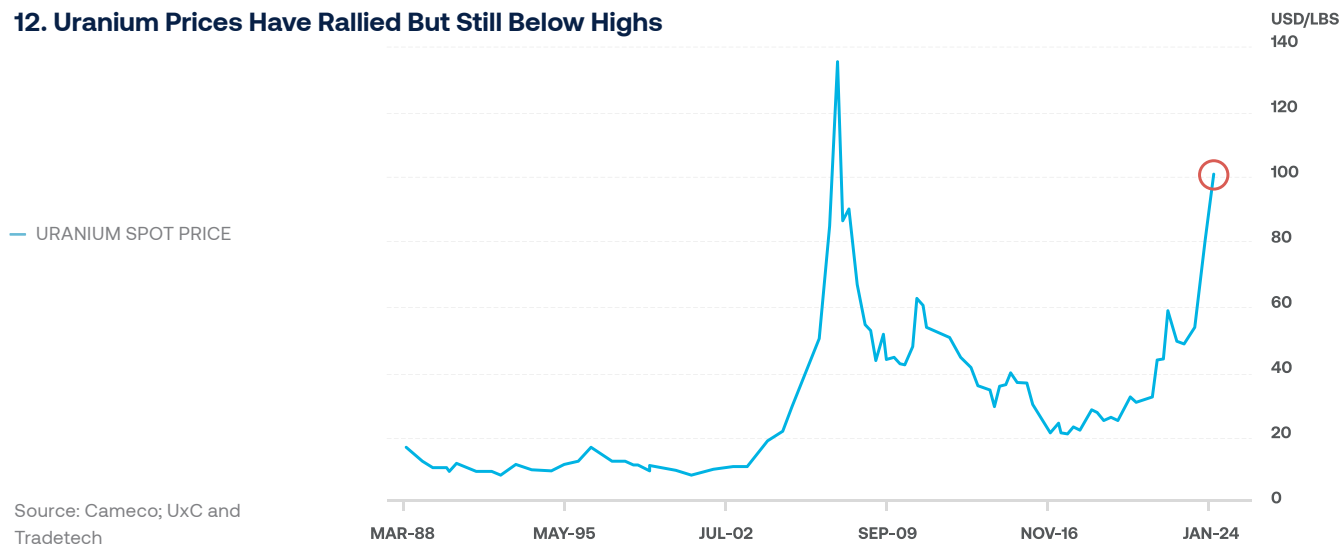


would receive standing next to one of these concrete containers after ten years is negligible and would barely register in a radiation dosimeter.

By most measures, nuclear energy is superior to the other main renewable energy contenders, like wind and solar. One such measure is operating capacity, which factors in reliability and reflects the frequency running at maximum power generation. According to the US Energy Information Administration, nuclear energy’s operating capacity is 92% without battery storage capacity, compared to about 30% for both wind and solar. In other words, for each Watt of electricity generated, three wind and solar farms would be required to match the capacity of a single nuclear plant. A further significant distinction lies in the construction materials required to get these projects built. Chart 10 reflects the various key bulk and critical metal materials used across various energy technologies per unit of generated electricity adjusted for operating capacity. Unequivocally, wind and solar energy utilize far greater resources. Obtaining those resources requires high energy input costs and, therefore, economic externalities such as air pollution.

Lastly, and perhaps the most important metric when considering which energy investment is the most efficient, is the Energy Return on Investment (EROI). Like Return on Investment (ROI) in the financial world, this measure captures the amount of energy delivered versus the energy expended to produce it. Chart 11 demonstrates that, again, nuclear power proves to be much more efficient than other renewable sources. Third-generation reactors, which began to be deployed in the 1990s and 2000s, incorporate passive safety features and other design improvements, but still use water as a coolant. Nevertheless, these have an EROI of 75, both with and without storage, far outpacing their next closest competitor hydroelectric power at about 50 EROI without storage and 35 with storage. This alone would make the case for nuclear energy a powerful one. However, the EROI on the new fourth-generation reactors is literally off the chart. These new reactors are designed to be safer, more efficient, and more sustainable than previous generations of nuclear power plants. As the graph shows, their estimated EROI value could be an extraordinary 750. They are more efficient, with higher conversion rates of nuclear fuel to electricity, but they are also more

12. Uranium Prices Have Rallied But Still Below Highs



sustainable, with lower waste production and the ability to use nuclear waste as fuel.

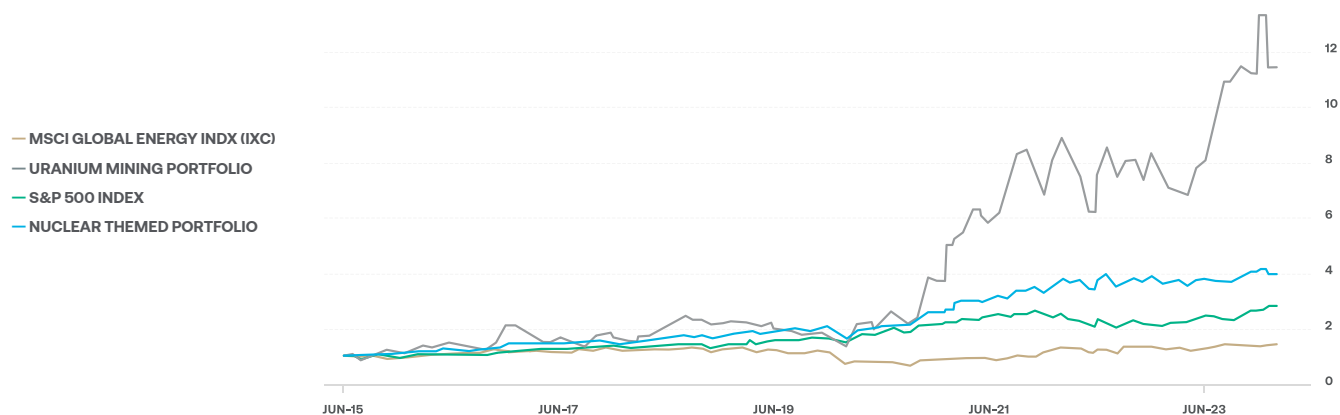
Looking ahead, it seems that, given recent developments in the political sphere and advances within the industry, policies aimed at decarbonization will ensure a fair competition among all low-carbon energy technologies based on their own merits. If so, then nuclear energy stands to gain the most from this shift. For the first time in many years, there is both the desire and the capability to invest in the nuclear sector, signaling its resurgence as an area of growth. **The ongoing momentum in the nuclear industry further strengthens the positive outlook for uranium and the companies involved in the nuclear fuel cycle.** We will now delve deeper into some of the investment opportunities born of this nuclear renaissance.

One of the most straightforward investment opportunities within this space is through physical uranium, which is witnessing a surge in demand against limited supply capacity. The World Nuclear Association forecasts a 30% increase in uranium demand by 2030 as nations strive to meet zero-carbon targets. Moreover, expectations are that uranium demand may subsequently double by 2040. Of course, the market has taken notice

of this burgeoning renaissance in nuclear power. As mentioned previously, spot uranium prices are up almost 80% over the past twelve months and 110% since the start of 2023. However, as Chart 12 shows, **they are still well below their historical highs during the late 2000s when the bull case was much weaker, and the industry was languishing.** Unlike other commodities, like gold or copper, uranium does not trade on an open market, which means you can only gain exposure to it through futures, ETFs (e.g., the Sprott Physical Uranium Trust SPUT), and public companies that invest in the physical metal (e.g., Yellow Cake YCA and Uranium Royalty Corp. UROY). Yellow Cake, for instance, purchases and stores uranium oxide so an investor could mitigate risks associated with exploration and mining. However, Uranium Royalty Corporation represents a diversified portfolio of uranium interests including royalties. The benefit to owning the metal as opposed to owning uranium miners is that physical uranium is less volatile due to the benign mix of rising demand and the current supply deficit. **Moreover, uranium will also function as a portfolio diversifier to hedge both inflation and recession risks this year.**

Of course, exposure to uranium miners represents the highest beta trade on this nuclear renaissance

13. This Rally Has Room to Run



Source: MSCI, BCA (Series rebased to 06/01/2015)

theme and should provide the steepest returns during upswings. However, beta works both ways and they should underperform during periods of market downturns. There are approximately 65 public uranium miners in this universe. Some of the most well-known and established names in the sector include Cameco (CCJ), BHP Group Limited (BHP), NexGen Energy (NXE), Denison Mines (DNN), Uranium Energy (UEC), and Ur-Energy (URE). This list is not exhaustive and only represents a handful of names, each with unique strengths, weaknesses, and prospects in the evolving nuclear landscape. Additionally, there are a few ETFs that grant investors exposure to uranium miners, such as Sprott Uranium Miners ETF and Global X Uranium ETF. Ultimately, investors should consult with their financial advisors to find the most suitable investment vehicle for their own risk tolerance.

Finally, there are several well-known private companies operating in this space, with many working on fourth

generation and small modular reactors. TerraPower, backed by Bill Gates and others, should be on the cusp of going public once their first reactor is fully built in Wyoming.

In conclusion as Chart 13 shows, the nuclear renaissance presents a multifaceted investment landscape, with opportunities ranging from direct exposure to uranium and mining operations to broader engagements with nuclear reactor development and utility companies. As the sector continues to evolve, propelled by favorable policies and increasing recognition of nuclear energy’s role in decarbonization, investors are likely to find an expanding array of vehicles to participate in this growth. The momentum behind nuclear energy’s resurgence underscores its potential not only as a cornerstone of global energy transition but also as a compelling domain for investment, promising diversification, and resilience in the face of changing energy paradigms. ■



Andres Salmanca
Data Analyst



Mauricio Viaud
Senior Investment Strategist
and PM



Energy storage and Investment Opportunities

By 2027, AI-related energy consumption could rival the annual electricity consumption of countries such as the Netherlands or Argentina.

Data centers and energy storage are poised to serve as the backbone of global technology development in the next decade.

If we focus on data centers' growth expectations and energy consumption estimates for the near future, recent market price adjustments could prove beneficial to portfolios with medium to long term investment strategies looking for exposure to the electric supply chain of technology.

In our quest to identify promising investment opportunities, we are focusing on sectors poised to benefit from the rise of disruptive industries and technologies. As discussed in our [January 26th Market Musings](#), industries such as Artificial Intelligence (AI) extend beyond chipmakers like Nvidia (NVDA) or Arm Holdings (ARM). They encompass “end-users” such as cloud computing entities like Salesforce (CRM) or Snowflake (SNOW), as well as “suppliers” like ASML Holdings (ASML). Upon deeper investigation into the “supply chain” of these industries, the energy sector has been emerging as a hot topic over the last couple of years.

But why energy? We have all encountered discussions surrounding the substantial energy consumption attributed to cryptocurrencies, particularly concerning their blockchain operation, with Bitcoin mining being a focal point of such discussions. Estimates from the Cambridge Centre for Alternative Finance suggest that

electricity usage associated with this activity ranges from 0.2% to 0.9% of the total global electricity demand. Although precise data regarding the energy consumption of Artificial Intelligence remains scarce, preliminary research indicates a trend like that of Bitcoin. In an article posted by Melissa Heikkilä in the MIT Technology Review magazine, the author states that the energy expended in generating an image using AI is comparable to fully charging a smartphone. **Further research projections indicate that by 2027, AI-related energy consumption could rival the annual electricity consumption of countries such as the Netherlands or Argentina.** Despite increasing recognition of this issue, the lack of transparency from companies like OpenAI regarding their energy usage contributes to the opacity surrounding this industry. Nevertheless, the significance of this matter is steadily gaining traction. In January 2024, Senator Ed Markey, alongside other representatives, introduced a bill to require the US federal government to assess the AI environmental footprint, alongside the development of a standardized system to monitor energy usage and emissions.

— “According to Google and UC Berkeley researchers, it was estimated that training **ChatGPT-3 consumed, in just one hour, as much power as the annual energy consumption of 121 US houses.**”

How does Artificial Intelligence energy consumption work and why are people worried about it? There are two parts to the process of creating an Artificial Intelligence model: training and interference. To give

an example, if we were learning to play golf, we would have to go several times to the course, learn about the equipment, the rules, and most importantly, practice thousands of times to become competent. It is the same for an AI model. With generative AI, models must run millions of tests and iterations to “learn” to do the tasks that they were created for. This part is called training. For a generative AI model to run, it must learn how to search, understand, summarize, and execute tasks in milliseconds, which takes millions of tests to achieve it. In 2018, OpenAI reported that since 2012 computing capacity requirements for training were doubling every 3.4 months. According to Google and UC Berkeley researchers, it was estimated that training ChatGPT-3 consumed, in just one hour, as much power as the annual energy consumption of 121 US houses. However, as mentioned before, training is just the first part of the equation. A large generative AI model can be trained just once, but it can be used millions of times in one day. It is estimated that ChatGPT has up to 10 million users per day running multiple prompts (requests) in its systems. This user-interaction process is called interference, where a model solves requests using what it learned from the training stage. Interference has a larger energy consumption than training due to the number of interactions that can happen in a single day. UC Riverside and UT Arlington researchers estimated that ChatGPT interference could consume as much as a 500 ml bottle of water for a short conversation of 20 to 50 questions and answers. All this energy consumption is happening within a relatively new form of real estate called data centers.

As the use of computing continues to surge in the development of modern technologies, data centers are evolving into larger and more sophisticated facilities. But what exactly is a data center? Simply put, it’s a specialized building filled with computers equipped with Graphical Processing Units (GPUs). These GPUs, designed by companies like Nvidia, are specialized chips that excel at rapid mathematical calculations

needed for rendering images and graphs. Nvidia holds a dominant position in the GPU market, having over 80% of the global market share. However, the role of data centers extends beyond just Artificial Intelligence applications; they serve as the backbone of every technological process we encounter today. Fueled by the escalating demand for digital services and technological resources, data centers have transitioned from modest hundred-thousand-square-foot installations to massive hyperscale buildings spanning one or two million square feet. Two of the biggest, publicly traded data center real estate investment trusts (REITs), Digital Realty Trust (DLR) and Equinix (EQIX), together generated close to \$14 billion in revenues last year, \$4 billion higher than their combined revenue just three years earlier. A 40% jump in revenue generation in three years is significant, encapsulating the scale of the demand for this type of service. With data centers emerging as a critical component of the tech sector, **projections by the International Energy Agency forecasts that these facilities will consume the same amount of energy as Japan by 2026.** This rapid growth is expected to be fueled by the adoption of innovative technologies and the proliferation of companies establishing proprietary data centers to bolster privacy and security measures.

As the technology sector continues its rapid growth and becomes increasingly reliant on energy consumption, investors may find themselves pondering how to incorporate this industry into their investment strategies. Fortunately, there are several avenues to explore within this market. One approach is to consider investments in traditional utility companies. In the United States, **Northern Virginia stands out as the global epicenter of data centers, boasting nearly 300 facilities, including numerous AWS servers (Amazon servers). This state alone accounts for over one-third of the global online traffic.** Additionally, states like Texas and North Carolina are emerging as attractive destinations for companies seeking new markets for expansion. Companies like Sempra (SRE) recently bolstered its

transmission budget in Dallas by USD 5 billion through its subsidiary Oncor, betting on the competitive advantages of the fastest-growing market for data centers within the US. **John Ketchum, CEO of NextEra Energy (NEE), another beneficiary of this trend, recently stated that AI could increase electricity growth in the US by more than 80% over the next five years.** In addition, Mr. Ketchum expects renewable energy generation to increase by three-fold over the same period. These are staggering figures.

— “...projections by the **International Energy Agency forecasts** that these facilities will consume the same amount of energy as Japan by 2026.”

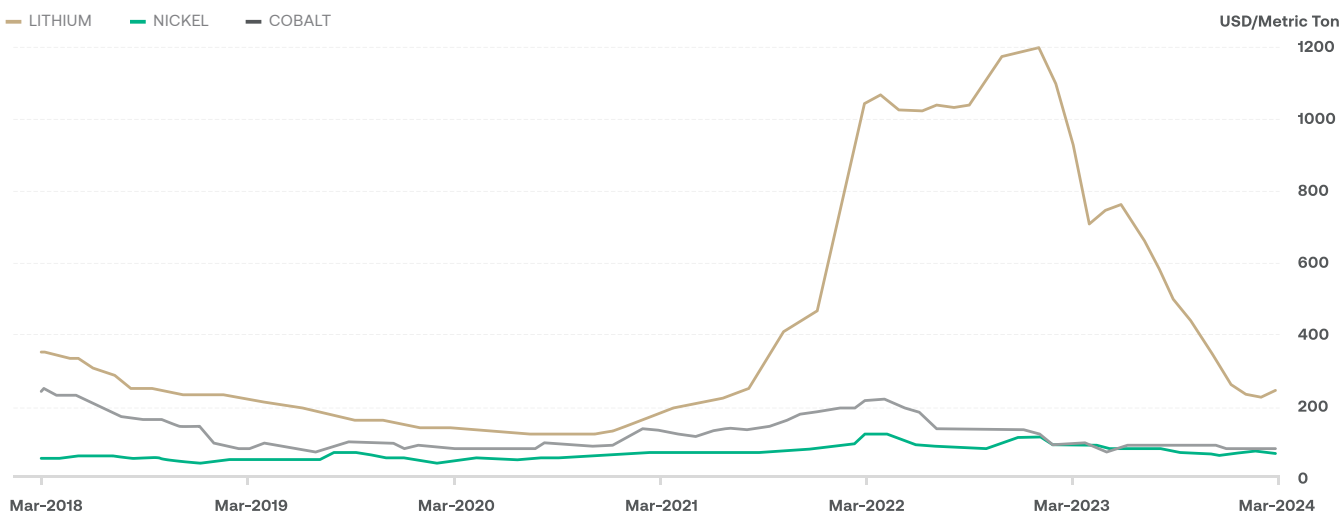
Utility companies are certainly cashing in on the surging demand for electricity driven by data centers, but energy consumption is anything but steady. In fact, it is more like a rollercoaster ride, with data centers, and pretty much every other business, riding the ups and downs of supply and demand. Currently, demand is outstripping supply by a mile, which explains why tech giants are pushing to build bigger and more sophisticated data centers. Nevertheless, regardless of the quantity of data centers, the availability of electricity remains essential for their operation. In this context,

energy storage emerges as a crucial factor in the technology sector’s future, as these facilities need a constant, uninterrupted, supply of energy. Among the various forms of energy storage, lithium-ion batteries and hydroelectric dams stand out as the most prevalent options. In recent years, lithium-ion batteries have surged in popularity, particularly within the industry of renewable energy, as they offer a solution to the intermittent nature of wind and solar power. For years, companies have been making investments in this area of the energy storage industry, recognizing the cost-effectiveness of this type of battery. Tesla (TSLA) is a clear example of this trend. Back in 2017, the company changed its name from Tesla Motors to Tesla Inc. While this looks like a minor change, it reflected Elon Musk’s vision of the company. Back then, the purpose of this rebranding was to show that Tesla was no longer just an Electric Vehicles (EVs) producer, but that it was expanding into an integrated EVs, solar power, and energy storage company. Recently, during a conference held in January of 2024, Musk said that this year the energy storage operation will surpass the car business

side, as EVs volume expansion is set to stall in 2024.

However, the current state of the batteries market paints a contrasting picture. Despite a surge in the industry prompted by the rise of electric vehicles in 2021, prices have recently undergone corrections due to oversupply and a lack of sustained growth guidance. Notably, nickel, lithium, and cobalt prices—the primary components of batteries—have plummeted 60%, 85% and 65% from their peak, respectively. Declining expectations regarding electric vehicle growth, coupled with shifts in adoption trends, have further dampened market sentiment. Highlighting this trend, Tesla only sold one vehicle in South Korea during January 2024. While battery-related commodity prices have been falling, Goldman Sachs’ analysts anticipate further decreases of at least 10% throughout the year. This downward trajectory has also impacted battery manufacturers, with oversupply and reduced commodity prices adversely affecting their financial performance. In their earnings reports throughout 2023, Korean battery makers, one of the main players in this

14. Normalized Lithium, Nickel & Cobalt Price Evolution Since 2018



Source: Insigneo, Bloomberg

industry, reported diminished shipments to the US in line with the broader decline in electric vehicle sales, exacerbating the downward pressure on margins due to inventory revaluations related to commodities prices.

While industry participants have experienced meaningful corrections in the last few months, **this dynamic could be creating an attractive entry point for investors interested in gaining exposure to the sector.** If we focus on data centers' growth expectations and energy consumption estimates for the near future, these market price adjustments could prove beneficial to portfolios with medium to long term investment strategies looking for exposure to the electric supply chain of technology. Investors could potentially access this industry by investing in ETFs like the First Trust NASDAQ Clean Edge Smart Grid Infrastructure Index Fund (GRID), which invests in companies directly involved in electric grid products and services, as well as energy storage and management. Many of the companies in this ETF are established industrial companies, that make components for the electric grid market, adding a degree of diversification to this investment theme, by gaining access to it in an albeit indirect manner. Additionally, an ETF such as the Global X Lithium & Battery Tech ETF (LIT), could provide investors

looking for exposure to this theme with access to both the technology and natural resources needed to harness the battery and energy storage industry.

Data centers and energy storage are poised to serve as the backbone of global technology development in the next decade. However, it is crucial to acknowledge that certain areas lack comprehensive information, making this strategy particularly attractive for risk-tolerant profiles. Additionally, it is important to note that some segments of the industry mentioned were previously in bubble territory, and although recent market corrections have occurred, prices may continue to decline further before stabilization.

There is no question that demand for energy generation and storage is rising, driven in large part by the ever-increasing need for power consumed by the very technology that powers our lives. Ranging from consumers such as data centers, to producers like utility companies, to storage and transmission manufacturers, there is little doubt that increased power consumption, generation, and storage will be important investment themes for years to come. Approached the right way, they could come to form important components of successful, well diversified portfolios over the long-term. ■



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The Shifting Sands of the Energy Landscape in Latin America

Latin America is a region well known for its large oil and gas resources; however, it is showing progress in areas that will enhance its role in the clean energy industry.

The IEA is currently projecting that by 2030, oil production in Latam will outpace demand growth, with new projects facing major risks from waning global oil demand.

Argentina has long been an important player in the region’s energy industry. However, political instability has been a factor limiting the industry’s full potential and progress. If the new administration succeeds in deregulating the energy sector, this change alone could allow YPF to achieve its production growth targets.

Due to this shift in focus, Petrobras’ cash flow is likely to decline, a dynamic that has added uncertainty to the stock’s dividend yield.

In addition to the production shortfalls, Pemex also faces financial risks, against a backdrop of increased reliance on government support for day-to-day operations.

The Petro administration and Ecopetrol have clashed continuously, as the current administration’s efforts to turn Colombia’s economy away from fossil fuels clashed with Ecopetrol’s exploration projects, amid a challenging environment with an increased government influence and intervention.

Latin America has always been considered a land of opportunities – even if those sometimes come in the form of hidden gems. The energy sector in the region is no stranger to this reality. Hence, we deemed it fit to review the current landscape, focusing on attractive opportunities, and the region’s energy giants.

According to the International Energy Agency’s (IEA) latest Latin America Energy Outlook, “Latin America and the Caribbean are well placed to thrive as the world moves into a clean energy age.” Even if the region’s energy mix is tilted toward fossil fuels, the Agency

believes that Latin America can still play a meaningful role in the “new energy economy.” **The region is well known for its large oil and gas resources; however, the observed progress in developing and exporting advanced biofuels and low-emissions hydrogen, as well as its production ramp-up of critical minerals that are essential to clean energy technologies will enhance its role in the clean energy industry.** Hence, it is no surprise that renewable energy is presenting itself as an opportunity to transform the electricity sector in the region into an even cleaner one.

— “...by 2030, **oil production in Latam will outpace demand growth, with new projects facing major risks from waning global oil demand.**”

If we take a deeper look into the energy sector in Latin America, we find that hydropower provides the bulk of the electricity production in several countries, such as Brazil and Colombia. Moreover, the IEA also highlights that in terms of solar, photovoltaic – PV –, and wind, Brazil, Mexico, Chile, and Argentina are leading the way. Meanwhile, natural gas is still a relevant energy source in the region, expected to generate about a quarter of its electricity by 2030. On the other hand, the agency expects coal and oil to decline rapidly. Here, it is worth highlighting that Argentina could position itself as one of the main players in Latin America, considering its capacity to exploit unconventional resources, thus expanding gas production in the region. Another relevant point stressed by the IEA is that, aside from Argentina, several other countries like Brazil, Mexico, Colombia, and Venezuela also have additional

gas resources that could be accessed, given the right combination of higher demand, attractive market prices, and lower-than-expected production costs.

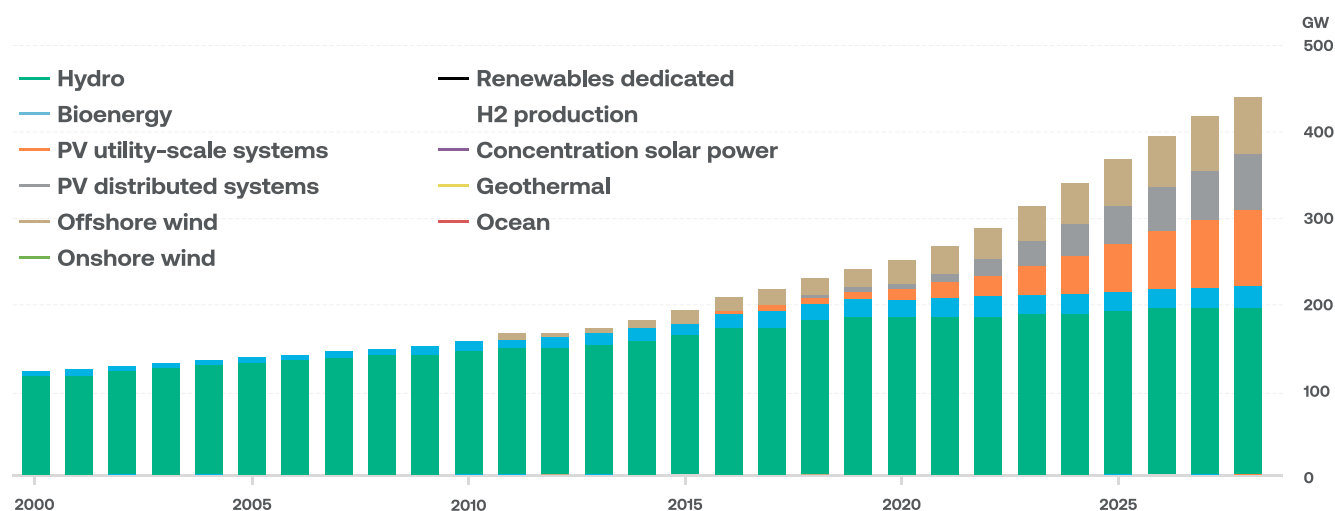
Furthermore, this report states that Latin America’s current policy environment sets a course for modest growth for fossil fuels in the region over the long term, complemented by renewable energy. According to the IEA, fossil fuels are expected to fall from their current 67% share of energy production today, to 63% in 2030 and 54% in 2050. At the same time, renewables are expected to increase their share from the 28% observed in 2022 to over 40% in 2050. This is relevant because the IEA considers that Latin America has the potential to become a major producer of low-cost and low-emissions hydrogen and related fuels, particularly in Argentina, Brazil, Colombia, and Chile.

However, even if renewable energies have gained participation and importance across the region, it would be foolish to deny the importance of oil in the current stage of the energy cycle. Latin America’s largest oil producers are Brazil, Mexico, Colombia, Venezuela, and Argentina; however, these countries are all in various stages of the resource development cycle. **The IEA is currently projecting that by 2030, oil production in Latam will outpace demand growth, with new projects facing major risks from waning global oil demand.**

Against this backdrop, clean energy would need a major push to reach the established emission reduction targets – even those from the IEA. The private sector could play a crucial role in this realm; however, regulatory stability is necessary for these projects to thrive long-term. According to the IEA’s Renewable Energy Progress Tracker, Latam is expected to add over 165GW of renewable energy capacity between 2023 and 2028. This increase will stem from four markets: Brazil, Chile, Mexico, and Argentina, against a backdrop where PV energy will lead capacity growth, closely followed by wind power.

15. Renewable electricity in Latam will continue to play a crucial role in the future

Source: IEA Renewable Energy Progress Tracker



If we delve into the major countries operating in the Latin American energy realm, it is no surprise to find that Argentina has long been an important player in the region’s energy industry. However, political instability has been a factor limiting the industry’s full potential, which has impeded its progress. However, over the past few years, the country embraced the resource potential within its borders, albeit in fits and starts. Enter the Milei administration. The advent of this new government and its energy-friendly policies could be what the country needed to fully develop its enormous resource potential. Estimates show that the Argentina’s largest resource basin, Vaca Muerta, could hold an estimated cumulative production potential of as much as 6 billion barrels of oil through 2040. In terms of natural gas, Vaca Muerta could hold as much as 300 trillion cubic feet, making it one of the largest natural gas shale reserves in the world. In fact, the Neuquén region, where Vaca Muerta is located, saw record oil production levels last month rise close to 18% on a year-on-year basis. It was no surprise that Vaca Muerta itself accounted for more than 90% of the region’s production growth over that period. If correctly embraced by the government, these

numbers could be just the beginning of what could be a major revolution in the country’s energy industry. Argentina could be a true diamond in the rough when it comes to potential oil and gas production in Latin America.

Leading the charge in the country’s energy revolution is YPF. As a leader in the exploration, production, and distribution of oil and natural gas in the region, YPF is well positioned with prolific acreage in the Vaca Muerta basin, making it highly likely to increase production of these products over the long term. Equally important, the board is truly focused on increasing production to boost profits. To this point, the company recently announced that it would shift its strategy to focus primarily on increasing its production from the shale formation. This feat could be more easily achieved under Milei’s administration, as one of the major policy changes being touted by the new administration is the liberalization of the country’s energy industry. If passed, this measure would ease restrictions on oil and gas exports, as well as allow producers and refiners to set market prices with less government intervention. This

would allow companies like YPF to sell their products at prices more in line with global benchmarks, not the deep discounts previously imposed by the government to subsidize artificially low fuel prices. **If the new administration succeeds in deregulating the energy sector, this change alone could allow the company to achieve its production growth targets. YPF, along with other players like Vista Energy, are poised to be major beneficiaries of the proliferation of the energy industry in Argentina.**

Shifting our focus to another major energy player in the region, Brazil, we see a different picture. As the major player in the offshore Pre-Salt formation, Brazil boasts access to one of the largest oil reserves in the world. Some estimates indicate the possibility of as much as 50 billion barrels of high-quality oil in this basin.

Not surprisingly, as a dominant player in the Pre-Salt, state-run Petrobras has some of the strongest exploration and production operations in Latin America. In recent years, the company had focused on the development of these operations, which resulted in strong cash flows and a high dividend payout. The Bolsonaro administration left the company to run itself, allowing it to focus more on profitability and shareholder returns. However, when Lula came to power, the emphasis shifted from profitability to using the company's diesel and gasoline refining operations to subsidize the prices of these end products in local markets. However, refining operations tend to consume, not produce, cash, as they have higher operating costs. **Due to this shift in focus, Petrobras' cash flow is likely to decline, a dynamic that has added uncertainty to the stock's dividend yield.** That said, although we did not expect the abrupt manner through which it was implemented, we were not surprised when the company recently announced the suspension of the payment of extraordinary dividends to focus more on the transition to sustainable energy. To be fair, the board of directors is looking to increase cash flow yields through more

efficient operations at its Tupi and Buzios oil fields. At the same time, a focus on capital discipline aimed at maintaining cash flow generation, as well as a commitment to increasing exposure to low-carbon projects, could help sustain cash flow generation in the future. However, Lula's recent proclamation as the de facto head of Petrobras serves as a reminder that the government remains very much entrenched in the company's operations.

— “this change alone could allow the company to achieve its production growth targets. **YPF, along with other players like Vista Energy, are poised to be major beneficiaries of the proliferation of the energy industry in Argentina.**”

In the case of Mexico, our attention is immediately turned to Pemex. When current president Andrés Manuel López Obrador – AMLO – started his time in office, he had an ambitious plan for Mexico to achieve energy self-sufficiency, which he hoped to achieve through Pemex. However, as we reach the end of AMLO's term, Pemex has not reached that goal, with the company's main refinery, Dos Bocas, still not being fully operational at the time of this writing. According to the latest statement from Pemex's CEO, Octavio Romero, Dos Bocas is expected to be fully operational in September of this year. However, even with the

addition of Dos Bocas and the additional refineries from the Deer Park plant in Texas, Pemex's crude oil production volume would stand at 1,549 million barrels per day - still short of its self-sufficiency goal by about 100,000-200,000 barrels per day, according to the latest statements by AMLO.

In addition to the production shortfalls, Pemex also faces financial risks. Even if the current administration is hopeful that Pemex should be able to continue decreasing its debt in 2024, while remaining committed to honoring upcoming amortizations, the projected debt balance of USD 94.5bn looks daunting if one takes into consideration the increased reliance of the company on government support for day-to-day operations. This is even more visible in one of the latest decrees approved by the AMLO administration, which exempted the company from tax payments after the rating agency Moody's performed a double-credit downgrade.

The importance of government support in the Pemex situation is such that it has become a relevant topic now that presidential elections are looming. Claudia Sheinbaum, the frontrunner candidate, recently presented her energy policy, which maintained support for Pemex, even if her policy plan has a push toward renewable energy not seen in AMLO's administration. Moreover, Sheinbaum stated that she would aim to keep Pemex's oil production around 1.8 million barrels per day, with the remaining energy demand being supplied by renewable energy sources. In the case of the opposition candidate, Xóchitl Gálvez, she recently reaffirmed her commitment to finishing the Dos Bocas Refinery while maintaining her stance on allowing more private participation in the oil and gas industry. Regarding Colombia, the country's main company within the oil and gas sector is the state-owned Ecopetrol. Ever since the Petro administration took office, Ecopetrol has constantly been in the eye of the storm, as the current administration's efforts to turn

Colombia's economy away from fossil fuels clashed with Ecopetrol's exploration projects. As such, and even before the Petro administration took office, Ecopetrol unveiled its 2040 strategy, aimed at positioning the company as an integrated energy group that will maintain its hydrocarbon presence, while diversifying its exposure to other business lines such as energy transmission and road concessions. Even if the 2040 strategy highlights the importance of developing unconventional reservoirs by exploiting partnerships with Brazil and the United States, it also expects to bring additional growth through what the company has deemed "TESG" - adding technology to the ESG acronym. The latter is to be accomplished by including an investment of USD 1,400mn in projects for, among other initiatives, decarbonization, energy efficiency, and studies and pilot programs in green and blue hydrogen for applications in refineries and mobility.

Even if the company has maintained sound oil production over the last couple of quarters, while maintaining healthy leverage ratios, another challenge that Ecopetrol faces stems from government influence and intervention. Ecopetrol's CEO, Ricardo Roa, was ratified during the last shareholders' meeting; nonetheless, his tenure should remain steeped with criticism. Furthermore, the new board members appointed at the general shareholders' meeting include several government members, such as two vice-ministers, and other characters without relevant experience in the oil and gas sector.

As we can see, the energy industry is no stranger to Latam, with the region continuing to profit from its abundant resources for generation and export. However, the sector is undergoing a relevant shift in its paradigm, which is already forcing the hand of the oil giants in the region, having to address energy supply from a different angle. If they want to stay relevant, they will have to incorporate renewables, regardless of what shape this change might take. ■

House Views Matrix

	TACTICAL (UP TO 3 MONTHS)	CYCLICAL (UP TO 12 MONTHS)
Global Asset Allocation		
Equities	NEUTRAL	NEUTRAL
Fixed Income	OVERWEIGHT	OVERWEIGHT
Cash	UNDERWEIGHT	NEUTRAL
Regional Breakdown		
US Equities ¹	OVERWEIGHT	OVERWEIGHT
European Equities	NEUTRAL	NEUTRAL
Japanese Equities	OVERWEIGHT	OVERWEIGHT
Emerging Market Equities	NEUTRAL	UNDERWEIGHT
Chinese Equities	NEUTRAL	UNDERWEIGHT
US Treasuries ²	OVERWEIGHT	OVERWEIGHT
Investment Grade Fixed Income	NEUTRAL	NEUTRAL
High Yield Fixed Income	NEUTRAL	UNDERWEIGHT
Emerging Market Sovereign	OVERWEIGHT	NEUTRAL
US Dollar	NEUTRAL	OVERWEIGHT
Energy ³	OVERWEIGHT	NEUTRAL
Precious Metals	UNDERWEIGHT	OVERWEIGHT

¹Relative to global equities in USD

²Relative to aggregate fixed income markets in USD

³Relative to an overall commodity allocation

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