Sabrient Systems

Sector Detector

August 20, 2025

The Future of Energy is Nuclear – Part 3 of 3

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Overview

In Part 3 of my 3-part commentary on Energy, I close the series by discussing these topics: 1) Solving the US grid fragility problem, 2) The future is nuclear, 3) Rare earth elements, 4) Superconductors, and 5) Investment opportunities. Then I close as usual with Sabrient's latest fundamental-based SectorCast quantitative rankings of the ten U.S. business sectors, and current positioning of our sector rotation model.

In Part 1 of my 3-part commentary, I discussed the following topics: 1) A brief history of energy, 2) Fossil fuels remain dominant today, and 3) The push for renewables. ***If you missed it, you can read it here at Sabrient.com.***

And in Part 2, I discussed: 1) Green legislation and subsidies encounter roadblocks, 2) Europe hitting a breaking point, and 3) Surging power demand from AI and other new technologies. ***If you missed it, you can read it here.***

To reiterate, I am writing this special 3-part series on Energy because: 1) it is the lifeblood of an economy, 2) it is a key component of inflation, 3) AI applications and datacenters are expected to surge global demand for electricity in the face of an already overburdened power grid, and 4) low energy costs benefit all aspects of the economy and raise our GDP growth rate, thus allowing us to more quickly grow our way out of debt rather than having to resort to austerity measures. In summary, it is essential that we have abundant, affordable, reliable, equitable, secure, and clean power generation, and the key energy sources to achieve that are natural gas today and nuclear in the longer term.

I began my professional career with Chevron Corporation, serving as a civil/structural design engineer and environmental compliance engineer for offshore oil & gas production, as well as senior analyst and operations manager in the oil shipping segment. I continue to follow the Energy sector to this day.

By the way, Sabrient's 13th annual ***Forward Looking Value 13*** portfolio launched on 8/15 with a value and small/mid-cap bias, as an alpha-seeking alternative to the S&P 500 Value Index (SPYV). This may be a timely investment in that Fed rate cuts this fall should be favorable for value stocks and small caps, which frequently are capital intensive and carry significant debt as part of their capital structure. Moreover, given the striking divergence in growth over value and large over small caps, the time may be ripe for mean reversion and market rotation into value and small/mid-caps.

Our other portfolios in primary market include ***Q3 2025 Baker's Dozen*** which launched on 7/18, ***Dividend 53*** which launched on 8/8 with a yield of 4.0%, and ***Small Cap Growth 47*** which launched on 7/16. All represent alpha-seeking alternatives to passive broad-market benchmarks.

As always, please email me your thoughts on this article, and feel free to contact me about speaking at your event!

Commentary – Part 3 of 3

Again, you can find Part 1 at this **link**, and you can find Part 2 at this **link**.

Solving the US grid fragility problem:

US grid fragility has been worsening for years, with diminishing spare capacity and increasing demand. As more intermittent energy sources are added to the grid (such as wind and solar), maintaining sufficient spare capacity is critical to balance out the variability of those sources and ensure grid stability. According to Emmet Penney, energy writer, historian, and Senior Fellow at the Foundation for American Innovation, *"We're short on spare capacity and long on increasing demand: a recipe for disaster."*

The US Department of Energy (DOE) just released an in-depth report entitled, *Evaluating the Reliability and Security of the United States Electric Grid,* warning that the US will experience a 100-fold increase in blackouts if coal and natural gas plants are retired amid rising demand from datacenters. After all, a single large datacenter could consume as much power as an average American city.

The report concludes: *"The status quo of more generation retirements and less dependable replacement generation is neither consistent with winning the AI race and ensuring affordable energy for all Americans, nor with continued grid reliability (ensuring 'resource adequacy'). Absent intervention, it is impossible for the nation's bulk power system to meet the AI growth requirements while maintaining a reliable power grid and keeping energy costs low for our citizens…. This report clearly demonstrates the need for rapid and robust reform to address resource adequacy issues across the Nation. Inadequate resource adequacy will hinder the development of new manufacturing in America, slow the re-industrialization of the U.S. economy, drive up the cost of living for all Americans, and eliminate the potential to sustain enough data centers to win the AI arms race."*

So, this new race for AI supremacy requires reliable, affordable, secure, and 24/7 continuous (as opposed to intermittent) electrical power supply. We must recognize that, rather than a climate crisis, we are facing an energy crisis—not unlike the Arab Oil Embargo of 1973, which laid bare the dependence of the West on Middle East oil (and OPEC) and prompted the US to boost domestic production, diversify our sources of energy supply, and pursue energy independence in the name of national security. Does that sound similar to today's push for strategic deglobalization, supply chain redundancy, and reshoring of critical manufacturing?

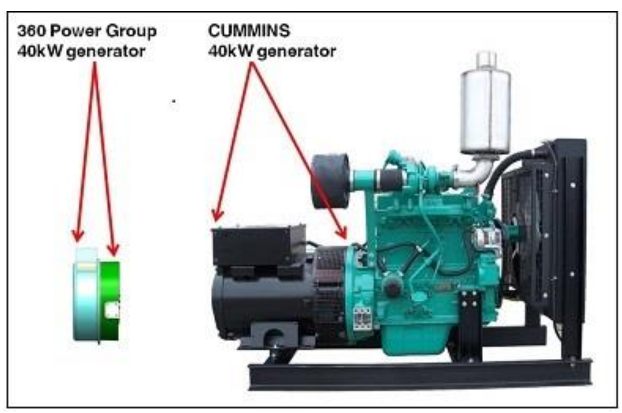
Let's compare costs. An onshore wind farm costs around $1.5 billion per GW to build, offshore wind costs closer to $2.5 billion/GW, a solar farm costs roughly $1.0 billion/GW, and a natural gas-fired power plant costs around $800 million/GW, Also, it takes about 1-2 years to build either a solar farm, wind farm, or a gas-fired power plant. But nuclear plant construction is much costlier, riskier, and not at all streamlined in the US. It can cost $5-10 billion per GW, largely because every nuclear plant is custom-made, and it takes more like 10 years to build one. Unfortunately, the surge in AI demand is happening now and over the next few years.

Andrew Lees says, *"The only primary energy source to suffer [an aggregate global] production decline is nuclear, on which our future clearly depends. The question is whether [nuclear] can be developed and rolled out fast enough to offset the declining production growth of fossil fuels…. The longer we ignore nuclear energy, the more our current spending on renewable projects looks like nothing more than pure vanity projects from constructivist governments…. With all of GDP [essentially] an energy conversion, our future depends on either extending fossil fuel production further or developing nuclear."*

Yes, the noble desire—along with entrenched industry and political interests—for more renewable energy production must face the reality that the go-to fuel source today for reliable, affordable, equitable, and dispatchable (i.e., readily able to accommodate fluctuations in demand) baseload power that can be quickly placed into service to meet surging demand is cheap, clean, and domestically abundant natural gas. And in the longer term, the future of energy clearly is nuclear, in my view, as a reliable zero-carbon energy source, particularly given exponential growth expectations in power-hungry AI datacenters, quantum computing, cryptocurrency mining, robotics, automation, and electric vehicles, as well as the continued desire for decarbonization and broad electrification.

So, the proverbial "15 minutes of fame" for extreme climate activists like Greta Thunberg and Jennifer Granholm pushing for an immediate end to fossil fuel use seems to have come to a close. And the fantasy of entire nations being powered exclusively by vast wind and solar farms as far as the eye can see—blighting our mountain passes, open plains, and coastal terrain—is over. Am I suggesting there is no use for wind and solar? Absolutely not. They can certainly be employed in *localized* situations where they can be economically justified. And of course, electric vehicles, buses, trains and other modes of transportation still can be electrified to reduce emissions (and noise pollution).

Indeed, localized, distributed, onsite, or standalone power generation can play a critical role in alleviating the load on the power grid, as can high-performance electric motors. A compelling new design innovation for both generators and motors that I came across (and full disclosure, invested in) several years ago is the brainchild of ClearWater Holdings Ltd, and it has been gradually gaining traction. It employs a patented architecture comprising three magnets positioned on the rotor in a radial–axial–radial configuration that creates three magnetic fields and three precisely controlled air gaps that produce significant performance advantages—including smaller size and weight (as shown in the illustration), portability, scalability (from 3kW to 10MW), high power density, 98% efficiency, 33% lower fuel usage, variable speed, and high torque and power production (regardless of load)—throughout the full operating range, with a fully electronic transmission. And because its coils are programmable, no gear box or transmission is required. So, in a wind turbine for example, there is no need for a maintenance-intensive gearing system—which greatly reduces costs, friction, and downtime, thus improving efficiency and economic viability. The company's commercial generator introduction is underway, including a mixed-use datacenter in the US and a nationwide mobile distributed power project overseas.



<u>The future is nuclear</u>:

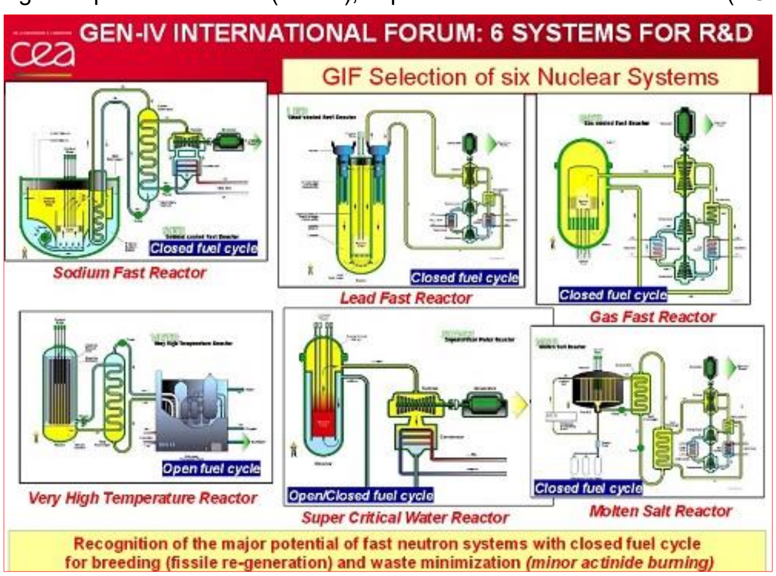
There are plenty of reasons to like nuclear energy. For instance, 1) it is highly energy dense, i.e., a small amount of fuel (e.g., uranium) produces a large amount of electricity, 2) it has a low carbon footprint (comparable to wind and lower than solar), zero greenhouse gas emissions during operation, and the volume of radioactive waste is quite low relative to the energy produced, 3) its fuel source (typically uranium) is abundant and easily stored and stockpiled, and 4) it is ideal for baseload supply given its high capacity factor (actual electricity output divided by maximum potential output) of over 90%.

Unfortunately, government's focus on subsidizing wind and solar effectively disadvantaged new nuclear development (whether intentional or unintentional), and now we are badly lagging China in new technologies and projects. According to this list from the International Atomic Energy Agency (IAEA), China has 58 operational nuclear reactors with a total capacity of around 57 GW and an *additional 29 reactors* currently under construction that will add another 31 GW of capacity—far more than any other country. However, while the US has 94 operational reactors having 97 GW total capacity, we have *none* under construction. As former Energy Secretary Rick Perry said, *"We're behind, and it's all hands on deck."*

To be sure, the Far East in general has limited fossil fuel reserves while North America is rich in fossil fuels. So, China in particular has a greater degree of desperation for energy security. Nearly 25% of China's total energy consumption in 2023 was supplied by imports. David Friedberg observes, *"The US is forecasted to increase its electricity production capacity from roughly 1 to 2 TW by 2040…. During that same period of time, China is going from 3 to 8 terawatts. And that China forecast excludes any of the Gen-IV nuclear reactors and the new hydroelectric facilities…. So, in the next 15 years, China is adding 5 Americas in electricity production capacity."* Meanwhile, our cost per kilowatt-hour in the US today is about 3x China's cost. So, we should do whatever we can to hasten the growth in our power generation capacity while also lowering unit energy costs.

Regarding its new hydroelectric facilities, China has begun construction on what would be the world's largest hydroelectric project in southeast Tibet, in the foothills of the Himalayas, called the Medog Power Station. It comprises five cascading mega-dams creating 60,000 MW total design capacity (i.e., peak demand) and 300 TWh annual generation capacity, at a cost estimated to reach $167 billion. As a former registered civil engineer, I can't help but marvel at the size, scope, and ingenuity of this project. To the right is a picture of the existing Three Gorges Dam in China, which is currently the world's largest power station with 22,500 MW design capacity and 88.2 TWh annual generation. So, the new Medog project *is 3x its size*—enough to power approximately 40 million homes.

Regarding its nuclear expansion, China's focus is on massive 1,200–1,700 MW Generation IV (Gen-IV) reactors. The Generation IV International Forum (GIF) is an intergovernmental collaboration founded in 2001 to coordinate R&D on next-generation nuclear technology that emphasizes enhanced safety (i.e., low meltdown risk), sustainability, cost-effectiveness, and resistance to nuclear proliferation (e.g., weaponization). Their chart below from GIF illustrates the six officially recognized designs: sodium-cooled fast reactor (SFR), lead-cooled fast reactor (LFR), gas-cooled fast reactor (GFR), very high-temperature reactor (VHTR), supercritical-water-cooled reactor (SCWR), and molten salt reactor (MSR).



Interestingly, the molten salt reactor is actually not so new. This article in Popular Mechanics describes how China has resurrected the technology that was first developed by the US in the 1960s during the Cold War with Russia. Instead of the typical uranium-235 isotope (U-235), it uses thorium-232 (Th-232), which itself is fertile rather than fissile, but when bombarded with radiation captures an extra neutron and morphs into protactinium which decays into uranium-233 (U-233), which is fissile. Thorium is much more abundant than uranium, produces less long-lived radioactive waste, and is not nearly as explosive as U-235 and thus very difficult to weaponize. The system also uses molten salt instead of water to cool the fission reactor, which is considered much safer in the event of a meltdown since it is prone to freeze when breached.

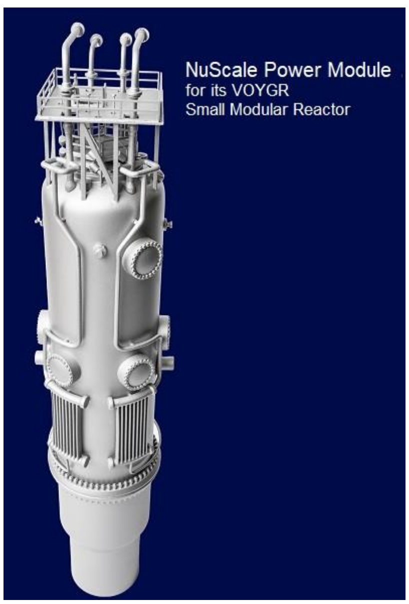
According to Wikipedia, *"Thorium is three times as abundant as uranium [and safer to mine]…. The Thorium Energy Alliance estimates 'there is enough thorium in the United States alone to power the country at its current energy level for over 1,000 years.' America has buried tons as a by-product of rare earth metals mining. Almost all thorium is fertile Th-232, compared to uranium that is composed of 99.3% fertile U-238 and 0.7% more valuable fissile U-235."* In other words, thorium does not need to be refined and enriched like uranium. It also allows for small, distributed units on site (like a small modular reactor, described below) rather than massive, centralized power plants with widespread transmission systems, which can be fragile and hackable. US nuclear technology company Core Power is planning a floating network of thorium power plants using molten salt reactors within the next decade.

To encourage domestic nuclear energy, President Trump signed an executive order in May directing the US Secretary of Energy to: 1) designate AI data centers as critical defense facilities (to be located in coordination with DOE facilities, including potential access to federal land) and the nuclear reactors powering them as defense-critical electric infrastructure; and 2) work with the private sector to deploy advanced nuclear technology for powering AI infrastructure and other national security objectives within the next three years. He also signed an executive order to streamline the regulatory process for approving new reactors and enhancing supply chains. According to Bloomberg Intelligence, US nuclear energy capacity is expected to surge 63% by 2050, primarily due to a projected $350 billion buildout of power-hungry datacenters.

I suppose Trump's ardent support of nuclear energy should come as no surprise given that his uncle John George Trump was a pioneer in nuclear technology, led the High Voltage Research Laboratory at MIT, and earned the National Medal of Science in Engineering from President Reagan. To catch up with China on technology and implementation while addressing a near future of surging demand for affordable and reliable electricity, we might need to go so far as to initiate a new Manhattan Project—this time geared toward nuclear power rather than the atomic bomb.

For now, the industry is relying on private investment dollars. For example, Constellation Energy signed a 20-year deal with Microsoft back in September 2024 to power datacenters with nuclear energy by restarting the Three Mile Island nuclear plant (Pennsylvania), and then on 6/3 Constellation announced a similar 20-year deal with Meta Platforms, which entails relicensing of the Clinton (Illinois) Clean Energy Center starting in 2027 and expanding output by 30 MW. Amazon announced a $20 billion project for two datacenter complexes in northeast Pennsylvania alongside Talen Energy's Susquehanna nuclear plant and plans to build another plant just north of Philadelphia on the site of shuttered steel mill. Governor Josh Shapiro said it is the largest capital investment in state history. Westinghouse announced plans to build 10 new nuclear reactors in the US starting in 2030. And Alphabet just signed a deal to power its data centers in Tennessee and Alabama with privately held Kairos Power in which the Tennessee Valley Authority (TVA) will buy power from a small Kairos reactor (Hermes 2) cooled by molten fluoride salt, to be built and operational by 2030—making TVA the first American utility to buy electricity from this type of reactor, according to Barron's.

I spoke earlier about the importance of on-site or stand-alone power generation, such as ClearWater's innovative generator design. Another exciting development in this regard is the commercialization of small modular nuclear reactors (SMRs). Abilene, Texas—at the edge of the Permian Basin—is the location for the nation's first permitted SMRs, to be built by a consortium that includes NuScale Power (stock ticker SMR), local developer Natura Resources, Abilene Christian University, and the DOE. As energy analyst Ed Ireland explains, *"Unlike traditional large-scale nuclear reactors, SMRs are compact, factory-built systems designed to produce between 50 and 300 MW of electricity—enough to power tens of thousands of homes. Their modular design allows for faster construction, lower upfront costs, and enhanced safety features, making them an attractive option for regions or industrial applications seeking reliable, clean power."* NuScale's VOYGR™ SMR plant will employ the NuScale Power Module (NPM) pressurized water reactor technology (illustrated below) that uses conventional low-enriched uranium (LEU) fuel and light water as a coolant, with the initial phase comprising multiple units providing a combined total capacity (peak demand) of 462 MW. It is scalable, resilient to extreme weather, and "walk-away safe" (i.e., shut down and self-cool without operator action).



Ireland notes, *"The whiff of irony is that the first SMR in the US is being developed in the backyard of the largest oil and gas field in the US."* But as Texas Governor Greg Abbott declared, *"Texas is the energy [not just oil] capital of the world, and we are ready to be No. 1 in advanced nuclear power."*

Also, Oklo (OKLO) is a young company developing advanced fission nuclear power plants and SMRs. It recently announced the selection of Kiewit Nuclear Solutions as the lead constructor for its first commercial Oklo Aurora Powerhouse reactor at the Idaho National Laboratory (INL), with a capacity of 75 MW primarily to power datacenters. Its sodium-cooled "fast reactor" design is able to use both fresh high-assay low-enriched uranium (HALEU) and recycled nuclear waste as fuel. The firm says it is self-stabilizing, self-controlling, cooled by natural forces, and "walk-away safe," creating passive safety suitable for datacenters, remote communities, and industrial sites. Commercial operations are targeted for late 2027 or early 2028. In addition, the Defense Logistics Agency Energy intends to enter into a long-term power-purchase agreement for one of Oklo's 75-megawatt microreactors to power Eielson Air Force Base in Alaska to offset its heavy usage of diesel and coal. By the way, Energy Secretary Wright previously served as an investor and board member of Oklo.

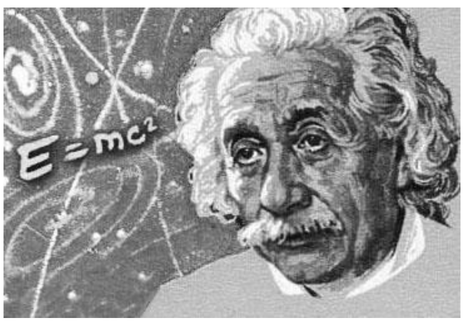
A more established company in the SMR space is BWX Technologies (BWXT), which specializes not only in small modular reactors but also a broader range of nuclear reactors and components for both commercial and military (mostly naval) applications. The firm recently signed manufacturing contracts for two major nuclear projects in Ontario, Canada, including life extension of the Pickering Nuclear Generating Station and for a new small modular reactor at the Darlington Nuclear Generating Station. By the way, the firm is also expanding into medical markets (e.g., isotopes for radiopharmaceuticals).

Another interesting private company is Standard Nuclear, whose mission is to address the dearth of domestic uranium conversion and enrichment for nuclear fuel and secure the supply chain by developing and manufacturing an advanced fuel called TRISO (TRIstructural-ISOtropic). TRISO is made from uranium particles wrapped in protective ceramic and carbon layers, and is favored for its safety, durability, and performance at extreme temperatures in advanced nuclear reactors like SMRs and microreactors. The firm owns the former Oak Ridge (Tennessee) K-25 gaseous diffusion plant, which has fully permitted radiological facilities (from the Manhattan Project days). By establishing large-scale production, it aims to provide a reliable and independent fuel source to reduce reliance on foreign sources, prevent supply chain bottlenecks, and facilitate the broad deployment of advanced reactors. Moreover, in partnership with SHINE Technologies, Standard Nuclear will use recycled nuclear materials in its fuel production process.

Today's commercially available nuclear technology employs nuclear fission. But ultimately, the goal is to perfect and commercialize nuclear fusion technologies, aka the "holy grail" of energy production. It is the zero-emissions, low-hazardous waste, perpetual-energy reaction of the Sun and stars. It *fuses* atoms rather than *splitting* them, using a common element like hydrogen as its fuel source. In theory, it takes a mere 10-meter cube of ocean water (i.e., H_2O) to provide hydrogen to convert to inert helium through a fusion reaction that releases enough energy *to power the entire planet for a year*—again, with no atmospheric emissions and minimal (short half-life) radioactive waste.

Just to geek out for a moment, here is even more detail (sorry, but I'm still an engineer at heart). Conventional nuclear fission involves splitting a heavy, unstable atomic nucleus—typically uranium-235 or plutonium-239—into two lighter nuclei by bombarding it with a high-energy neutron. This process releases a large amount of energy, as the total mass of the resulting fragments is slightly less than that of the original nucleus. In contrast, nuclear fusion involves combining two light atomic nuclei—usually isotopes of hydrogen such as deuterium and tritium—into a single, heavier nucleus. This requires extremely high temperatures and pressures to overcome the natural electrostatic repulsion between the positively charged nuclei. Fusion also releases energy, again due to a small loss in mass during the reaction.

In both cases, this "missing" mass—known as the "mass defect"—is converted into energy according to Einstein's mass-energy equivalence principle ($E=mc^2$), a cornerstone of modern physics. By the way, the original atomic bomb employed a fission reaction, while the thermonuclear (aka hydrogen) bombs today employ a fusion reaction. Unfortunately, using the fusion reaction in a controlled manner for nuclear power generation is not trivial.



Ocean water is considered the primary long-term fuel source for nuclear fusion, as it contains large amounts of deuterium and trace amounts of lithium. In fact, a single spoonful of seawater has enough deuterium to provide the same amount of energy as a barrel of oil, and tritium can be bred from a tiny amount of lithium inside a fusion reactor, making the fuel cycle potentially self-sustaining and virtually limitless—one of the greatest appeals of fusion energy. Fun fact: according to Scientific American magazine, the Sun uses fusion to transform about 700 million tons of hydrogen into 695 million tons of helium every second, with the 5 million tons of "lost" mass converted into enough energy to *"satisfy humanity's total consumption for about 650,000 years."* Again, that occurs every second of every day. In effect, the Sun is a God-created power generation station rated at 400 septillion (i.e., a trillion trillion) watts, or 4×10^{20} MW.

"Dr. Realist" (nee "Dr. Doom") Nouriel Roubini expects the elusive nuclear fusion to gain momentum as investments pour into its development. Making nuclear fusion commercially viable would be transformative in turbocharging the global economy. In 2023, Microsoft signed a deal with Helion Energy for 50 MW of fusion energy, to be provided through Constellation Energy as the power marketer (restarting the notorious Three Mile Island), with a goal to start producing by 2028. Corporate titans like Chevron and Alphabet (Google's parent company) recently invested over $150 million into TAE Technologies and Type One Energy. Most recently, Alphabet signed an agreement with nuclear startup Commonwealth Fusion Systems (CFS), backed by Bill Gates's Breakthrough Energy Ventures fund, with the goal of commercial fusion energy production in the 2030s.

So, this is truly exciting stuff. Nuclear fusion could become one of the game-changing applications of the 2030's. Perhaps its development will be facilitated by the astonishing promise of Artificial Super Intelligence (ASI) coupled with quantum computing. As Energy Secretary Wright said, *"We are unabashedly pursuing a policy of more American energy production and infrastructure, not less. Our goal is to re-industrialize America, not de-industrialize America…. We are working to launch the long-awaited American nuclear renaissance—fission and fusion. We want more reliable, affordable, secure energy."*

Notably, in the view of Thomas Hochman of the Foundation for American Innovation, both political parties are learning to embrace nuclear energy in what he calls an "ideological convergence." Democrats who traditionally are skeptical of nuclear power are increasingly embracing its zero-carbon footprint, and Republicans who traditionally are uneasy with government dictates are increasingly embracing the strategic importance of nuclear power.

Rare earth elements:

By now, we are all aware of rare earth elements (REEs) as essential to US national security and energy independence, so allow me to discuss them here. The federal government has identified 17 elements considered critical for infrastructure and technologies ranging from missile guidance systems to energy infrastructure. They include obscure and hard-to-pronounce names like neodymium, praseodymium, dysprosium, and terbium, which are used in making photo voltaic cells for solar panels and permanent magnets for wind turbines and EVs; lanthanum and cerium, which are used in making catalytic converters, catalytic cracking in refineries; samarium and europium used in batteries and TV/computer display screens; and ruthenium, which enhances high-density storage in hard disk drives (HDDs) for cloud computing and AI applications, with lower cost per gigabyte versus solid-state drives (SSDs).

Unfortunately, China controls 69% of global REE mining, 90% of REE processing, and 90% of high-strength magnet production, while the US produces less than 12% of total global output. Such dependency on China is no longer acceptable, particularly since the CCP has demonstrated a willingness to leverage its REE dominance as a bargaining chip or economic weapon—even temporarily halting exports of six key metals to the US in response to Trump's onerous tariffs. A statement from the White House said, *"Critical minerals, including rare earth elements, are essential for national security and economic resilience... The United States remains heavily dependent on foreign sources, particularly adversarial nations, for these essential materials, exposing the economy and defense sector to supply chain disruptions and economic coercion."*

The New York Times recently opined, "*Chinese mines and refineries produce most of the world's rare earth metals and practically all of a few crucial kinds of rare earths. This has given China's government near complete control over a critical choke point in global trade…. Achieving dominance in rare earths came with a heavy cost for China, which largely tolerated severe environmental damage for many years. The industrialized world, by contrast, had tighter regulations and stopped accepting even limited environmental harm from the industry as far back as the 1990s, when rare earth mines and processing centers closed elsewhere.*"

So, as described by *Doomberg* on Substack two years ago, China cornered the market by ignoring "wholesale environmental degradation" from the mining process that other developed countries were not willing to allow. *Doomberg* wrote, *"Taken to the extreme, allowing domestic producers to recklessly pollute amounts to a hidden but decisive subsidy that can allow a nation to monopolize strategic industries. No country has perfected this art more than China…. The US, by way of example, is overdue for a straightforward admission: it is in an economic war with China, a country that monopolizes a staggering number of the important materials the US needs and engages in unfair practices that undermine national security in the process.*"

This is why the US Department of Defense recently acquired a significant share of MP Materials (MP), which owns and operates the Mountain Pass Rare Earth Mine and Processing facility located in San Bernardino County, California. The DoD also entered into a 10-year agreement to construct additional rare earth processing facilities and put a floor under the market price, essentially subsidizing the production of high-powered magnets critical to US weapons systems. Furthermore, MP Materials will soon begin supplying Apple with rare earth magnets and eventually support "hundreds of millions of Apple devices."

<u>Superconductors</u>:

In the US alone, datacenter square footage either under construction or in planning stage for the next few years is greater than the entire existing inventory. The surge in power demand will also surge the demand for materials like copper, aluminum, tin, steel, silver, lithium, platinum, palladium, lithium, cobalt, nickel, and various rare earth minerals. A single datacenter requires around 5,000-10,000 metric tons of copper for cabling and equipment. An AI-controlled robot might require 50-100 lbs of copper, and some experts foresee 1 million operational robots by 2030. Indeed, by some estimates, AI could increase copper demand by 15%-20% annually through 2030.

So, any cost savings in power consumption will become increasingly important. The EIA estimates that around 5% of power is lost in the transmission process due to inherent resistance within the conductors (like copper wire), which caused energy to be dissipated as heat—and the further the distance of transmission, the more energy is lost. This is why you have likely heard of "superconductors," which exhibit zero energy loss at extremely low temperatures. Other applications of superconductors include high-speed magnetic levitation trains, magnetic particle accelerators, and magnetic resonance imaging (MRI) machines.

But because most superconductors are expensive and experience instability during fluctuations in electrical frequency, voltage, temperature, and pressure, implementation in power transmission lines has been an engineering challenge. However, a promising new material that has arrived on the scene is superconductive *graphene*, which is extracted from graphite and composed of pure carbon. Its electrical resistance is among the lowest of any known material at room temperature.

Graphene has shown immense potential as a replacement for heavy copper wire in power cables and "smart grids" given its exceptional electrical and thermal conductivity (at room temperature rather than requiring deep-freeze), its ultra-light weight, superb strength (200x stronger than steel), high current carrying capacity (100x the current density of copper), and resistance to corrosion. But because of the difficulty in producing large, defect-free graphene sheets or fibers long enough for power lines, there is ongoing research into graphene-copper composites. Ultimately, graphene or graphene-coated copper could revolutionize power grids by reducing transmission losses and enabling lighter, more efficient power lines.

Graphene also holds promise for many other technologies—including electronics, energy storage, sensors, coatings, composites, and biomedical devices—given its vastly superior switching speed compared to either traditional silicon or the newest silicon carbide. Despite its light weight, it is incredibly strong and stiff but not brittle, i.e., it is flexible enough to be bent or folded without breaking. It has large surface area, optical transparency, and gas impermeability.

Futurist and technology prophet George Gilder has been a big cheerleader for graphene, which he calls, *"a single layer of carbon atoms 200 times stronger than steel, more flexible than rubber, a thousand times more conductive than copper, and the best heat transmitter ever studied…. This promises cool, terahertz-speed, wafer-scale electronics within the next decade."* Rather than the traditional method of cutting individual chips from a wafer and then packaging them together, wafer-scale integration (WSI) is an emerging technology that aims to transform electronics by, in Gilder's words, *"putting hyperscale AI computers not on millions of chips linked with complex wiring, but on a single [12-inch] wafer."*

Yes, he foresees a future in which an entire datacenter is collapsed into a single 12-inch graphene wafer, thus eliminating the need for the hyperscale cloud—not by duplicating its every physical component and architecture, but by rendering much of the compute, memory, storage, and networking obsolete through integration and new materials.

Investment opportunities:

The surge in electricity demand amid an evolving global political landscape presents a host of investment opportunities ranging from conservative to speculative.

For oil & gas and LNG investments, key companies include the large vertically integrateds like Exxon Mobil (XOM), Chevron (CVX), Shell (SHEL), ConocoPhillips (COP), and TotalEnergies SE (TTE), as well as smaller names like EQT Corp (EQT), Range Resources (RRC), CNX Resources (CNX), and Expand Energy (EXE). Midstream pipeline transportation and processing companies ("toll takers" on throughput) include Kinder Morgan (KMI), ONEOK (OKE), Enbridge (ENB), Plains All-American Pipeline (PAA), Energy Transfer (ET), The Williams Companies (WMB), Cheniere Energy (LNG), and Dorian LPG (LPG). Some ETFs include First Trust Natural Gas (FCG), SPDR Oil & Gas Exploration & Production (XOP), iShares US Energy (IYE), and commodity pure play United States Natural Gas Fund (UNG).

Notably, Vincent Deluard, global macro strategist for StoneX Group, believes the oil & gas sector today is a low-risk value play given its impressive shareholder yield (buybacks plus dividends) of around 7.2%, which is about 3x the broad S&P 500's shareholder yield. He points out that the $1.5 trillion market value of the Energy sector within the S&P 500 has fallen to roughly 3% of the index (versus its long-term average of 8%). Moreover, the "wild west" of aggressive capex, leverage, and M&A of the shale boom has given way to a focus on profitability and shareholder-friendly policies, with a mandate to return as much capital to shareholders as possible, even at the expense of future growth—which is why Energy doesn't score particularly well in Sabrient's growth-biased SectorCast model.

Because of the capital spending going into building out the power grid and infrastructure, Utilities and Industrials have been the best performing sectors this year. However, the Utilities sector as a whole suffers from relatively high valuations for only modest projected earnings growth over the next 12 months (8.2%). But this should change as datacenters get built and power demand ramps up. As discussed earlier, although US electricity consumption has been increasing only gradually over the past few years, ICF International forecasts a 25% increase in by 2030 and 78% by 2050, driven largely by AI-related initiatives.

Those wishing to invest accordingly might look to Constellation Energy (CEG), Talen Energy (TLN), Vistra Energy (VST), NRG Energy (NRG), The Southern Company (SO), Entergy (ETR), Dominion (D), DTE Energy (DTE), and GE Vernova (GEV). Some ETFs include iShares US Utilities (IDU) and First Trust Utilities AlphaDEX (FXU).

Those seeking commodity upside might consider uranium plays like Cameco (CCJ), Uranium Energy Corp (UEC), Global X Uranium ETF (URA), and Sprott Uranium Miners ETF (URNM), and copper plays like Freeport-McMoRan (FCX), Southern Copper (SCCO), Compañía de Minas Buenaventura S.A.A. (BVN), Rio Tinto (RIO), BHP Group (BHP), and commodity pure play US Copper Index Fund (CPER).

To invest in engineering, construction, technology, and the emerging "smart grid," companies include Eaton (ETN), Johnson Controls (JCI), Quanta Services (PWR), MasTec (MTZ), AECOM (ACM), Fluor (FLR), and Sterling Infrastructure (STRL, which is in Sabrient's *Q3 2025 Baker's Dozen* portfolio), as well as the First Trust Nasdaq Clean Edge Smart Grid Infrastructure Fund (GRID).

For higher-risk higher-reward nuclear plays, established nuclear reactor maker BWX Technologies (BWXT) and innovators like NuScale (SMR), Oklo (OKLO), Centrous Energy (LEU), ASP Isotopes (ASPI), and NANO Nuclear Energy (NNE) offer unique exposure to the next frontier of nuclear power.

For those interested in investing in companies involved in sustainability, wind, solar, battery storage, and lithium, players include General Electric (GE), First Solar (FSLR), Enphase Energy (ENPH), HA Sustainable Infrastructure Capital (HASI), Clearway Energy (CWEN), NextEra Energy (NEE), Enovix (ENVX), Tesla (TSLA), QuantumScape (QS), ESS Tech (GWH), Fluence Energy (FLNC), Albemarle (ALB), Lithium Americas (LAC), First Trust Nasdaq Clean Edge Green Energy (QCLN), iShares Global Clean Energy (ICLN), Invesco WilderHill Clean Energy (PBW), Global X Wind Energy (WNDY), First Trust Global Wind Energy (FAN), and SPDR S&P Kensho Clean Power (CNRG).

For rare earth elements, investment opportunities include MP Materials (MP), Lynas Rare Earths (LYSDY), and VanEck Rare Earth and Strategic Metals ETF (REMX). And regarding graphene, related companies include NanoXplore (NNXPF), First Graphene (FGPHF), Talga Group (TLGRF), Archer Materials (ARRXF), Cabot Corp (CBT), and Global X Disruptive Materials ETF (DMAT).

None of these names are intended as recommendations, and many of them don't score particularly well in Sabrient's quality-oriented models. **Below is a table** with many of their Sabrient Scores (1-100 scale, higher scores are better), ranked in order of their GARP (growth a reasonable price) scores (as of 8/15/2025). Some of the stocks (such as those traded OTC, like NNXPF) are not scored in our system. Other scores shown include our Earnings Quality Rank (EQR), Growth Quality Rank (GQR), Strategic Valuation Rank (SVR), Strategic Growth Rank (SGR), Aggregate Price Momentum Rank (AMR), and Dividend Rank (DIV).

You can learn more about our Scorecards at **http://HighPerformanceStockPortfolios.com**.

Sabrient Scorecard

Future of Energy stocks

Data as of: 8/15/2025

TICKER	COMPANY NAME	MARKET CAP ($M)	GARP	EQR	GQR	SVR	SGR	DIV
			Primary Factors					
		Weightings:	0.0	0.0	0.0	0.0	0.0	0.0
ACM	AECOM	15,836	90	72	85	81	34	
STRL	STERLING INFRASTRUCTURE INC	8,376	87	53	100	58	80	
BWXT	BWX TECHNOLOGIES INC	15,857	86	95	81	71	83	
CCJ	CAMECO CORP	32,939	85	83	58	78	70	
EXE	EXPAND ENERGY CORP	22,654	77	59	63	54	54	41
PAA	PLAINS ALL AMER PIPELNE -LP	12,321	76	85	50	82	7	97
ET	ENERGY TRANSFER LP	59,179	76	80	51	80	61	88
GE	GE AEROSPACE	284,038	73	74	65	70	97	
RRC	RANGE RESOURCES CORP	8,189	72	70	54	64	63	
SCCO	SOUTHERN COPPER CORP	77,864	70	73	71	69		62
MP	MP MATERIALS CORP	13,287	68	48	63	68	88	
ETN	EATON CORP PLC	136,655	67	38	80	61	82	28
LPG	DORIAN LPG LTD	1,281	64	59	32	76	74	42
EQT	EQT CORP	32,981	63	46	54	56	89	45
GEV	GE VERNOVA INC	169,298	62	24	59	87	47	
NEE	NEXTERA ENERGY INC	155,291	62		79		45	51
RIO	RIO TINTO GROUP	104,660	61	63	55	95	34	
SO	SOUTHERN CO	103,481	60		73		50	46
CNX	CNX RESOURCES CORP	4,071	59	58	57	69	84	
OKE	ONEOK INC	46,557	58	55	44	71	45	61
LNG	CHENIERE ENERGY INC	50,577	57	59	45	72	45	
PWR	QUANTA SERVICES INC	56,742	56	51	71	23	32	
LEU	CENTRUS ENERGY CORP	3,339	55	72	56	88	15	
MTZ	MASTEC INC	14,029	53	49	52	43	37	
FCX	FREEPORT-MCMORAN INC	60,819	51	42	47	45		37
ENPH	ENPHASE ENERGY INC	4,555	51	59	44	78	36	
SHEL	SHELL PLC	209,829	50	64	53	61	27	65
XOM	EXXON MOBIL CORP	453,993	49	53	57	58	71	50
CVX	CHEVRON CORP	320,519	49	91	40	34	51	89
JCI	JOHNSON CONTROLS INTL PLC	67,741	49	49	65	22	51	
COP	CONOCOPHILLIPS	119,061	47	68	40	73	53	63
HASI	HA SUSTAINABLE INFRA CAP INC	3,424	47		59	7	30	56
D	DOMINION ENERGY INC	52,178	46		50	61	58	
DTE	DTE ENERGY CO	28,838	45		53	39	92	51
TSLA	TESLA INC	1,065,725	44	62	39	69	39	
ETR	ENTERGY CORP	39,783	43		49		92	49
CEG	CONSTELLATION ENE CORP	100,666	42		36		75	
TLN	TALEN ENERGY CORP	17,260	42		18	30	26	
BVN	COMPANIA DE MINAS BUENAVENTU	4,632	40	14	51	89		
CBT	CABOT CORP	4,157	39	9	63	51	88	13
ALB	ALBEMARLE CORP	9,672	38	19	67	34	84	4
TTE	TOTALENERGIES SE	142,830	36	31	38	76	82	43
FSLR	FIRST SOLAR INC	21,444	36	16	28	58	76	
WMB	WILLIAMS COS INC	70,168	35	15	57	24	74	16
BHP	BHP GROUP LTD	138,880	35		58	6	2	
KMI	KINDER MORGAN INC	59,262	34	35	42	36	98	32
ENB	ENBRIDGE INC	102,687	31	28	45	36	99	38
FLR	FLUOR CORP	6,770	31	23	32	82	51	
VST	VISTRA CORP	66,859	30		12	64	92	
NRG	NRG ENERGY INC	28,747	28		16		99	39
QS	QUANTUMSCAPE CORP	5,112	20		19	22	29	
FLNC	FLUENCE ENERGY INC	1,041	19	39		27	7	
UEC	URANIUM ENERGY CORP	4,767	17	21	28	42	29	
OKLO	OKLO INC	10,489	17		8		19	
LAC	LITHIUM AMERICAS CORP	700	17		48	22		
SMR	NUSCALE POWER CORP	4,749	9	8	22	11	28	
ENVX	ENOVIX CORP	2,007	6	8	34	22	38	

Latest Sector Rankings

Relative sector rankings are based on Sabrient's proprietary SectorCast model, which builds a composite profile of each of over 1,400 equity ETFs based on bottom-up aggregate scoring of the constituent stocks. The *Outlook Score* is a Growth at a Reasonable Price (GARP) model that employs a forward-looking, fundamentals-based multifactor algorithm considering forward valuation, historical and projected earnings growth, the dynamics of Wall Street analysts' consensus earnings estimates and recent revisions (up or down), quality and sustainability of reported earnings, and various return ratios. It helps us predict relative performance over the next 3-6 months.

In addition, SectorCast computes a *Bull Score* and *Bear Score* for each ETF based on recent price behavior of the constituent stocks on particularly strong and weak market days. A high Bull score indicates that stocks held by the ETF recently have tended toward relative outperformance when the market is strong, while a high Bear score indicates that stocks within the ETF have tended to hold up relatively well (i.e., safe havens) when the market is weak. Outlook score is forward-looking while Bull and Bear are backward-looking.

As a group, these three scores can be helpful for positioning a portfolio for a given set of anticipated market conditions. Of course, each ETF holds a unique portfolio of stocks and position weights, so the sectors represented will score differently depending upon which set of ETFs is used. We use the iShares that represent the ten major U.S. business sectors: Financials (IYF), Technology (IYW), Industrials (IYJ), Healthcare (IYH), Consumer Staples (IYK), Consumer Discretionary (IYC), Energy (IYE), Basic Materials (IYM), Telecommunications (IYZ), and Utilities (IDU). Whereas the Select Sector SPDRs only contain stocks from the S&P 500 large cap index, I prefer the iShares for their larger universe and broader diversity.

The table below shows the latest fundamentals-based Outlook rankings and our full sector rotation model:

Sabrient SectorCast Sector Rotation Strategy - As of 8/18/2025
Suggested Top 3 Sector ETFs for Bullish, Neutral, or Defensive Outlooks
Bullish/Neutral/Defensive bias based on SPY vs. 50/200 day moving averages; 30-90-day forward look

Sector	ETF	Outlook Score	Bull Score	Bear Score	Net Score: Neutral Bias	Net Score: Bullish Bias	Net Score: Defensive Bias
TECHNOLOGY	IYW	95	55	52	95	90.0	56.0
HEALTHCARE	IYH	59	42	54	59	43.8	50.7
FINANCIALS	IYF	54	55	52	54	76.2	39.0
INDUSTRIALS	IYJ	46	51	53	46	63.0	40.5
BASIC MATERIALS	IYM	42	46	56	42	48.6	53.4
TELECOMMUNICATIONS	IYZ	41	56	59	41	74.4	67.5
CONSUMER STAPLES	IYK	37	40	64	37	31.2	90.0
CONSUMER DISCRETIONARY	IYC	26	49	53	26	51.0	32.2
UTILITIES	IDU	19	42	64	19	30.3	82.5
ENERGY	IYE	16	38	61	16	18.9	66.8

Sabrient's ***Outlook Score*** employs a forward-looking fundamentals-based scoring algorithm to create a composite profile of the constituent stocks. ***Bull Score*** and ***Bear Score*** are based on price behavior of the underlying stocks on particularly strong and weak days over the prior 40 market days. High Bull indicates a tendency for relative strength in a strong market, and high Bear indicates a tendency for relative strength in a weak market (i.e., safe havens). High for all scores is 100, and higher is better.

The rankings display a bullish bias given that: 1) cyclicals and secular growth sectors dominate the top of the rankings, 2) the Outlook scores have generally risen with 3 sectors above 50, and 3) defensive sectors are in the lower half.

Technology (dominated by the mega-cap Big Tech titans and AI-driven highflyers) remains at the top with a robust Outlook score of 95, despite having by far the highest forward P/E—a lofty 29.6x (although lower than the 31x it hit last month). However, because of its rising EPS growth estimate of 19.5%, the forward PEG (ratio of P/E to EPS growth) of 1.52 remains relatively modest. Keep in mind that investors will always “pay up” for strong growth. Tech also displays by far the highest return ratios, favorable insider sentiment (open market buying), as well as strongly positive analyst revisions to earnings estimates (second only to Financials). Because many Tech stocks are riding secular growth trends (i.e., little cyclicality), no other sector comes close to the consistent sales growth, margins, operating leverage, and return on capital. And Tech not only benefits from its own product development and productivity gains, but those products help other companies with their product development, product delivery, and productivity—so Tech benefits by helping all sectors grow and prosper.

Rounding out the top 5 are Healthcare, Financials, Industrials, and Basic Materials (which is boosted by rising commodity prices). At the bottom of the rankings remain Energy and Utilities. Because of the capital spending going into building out the power grid and infrastructure, Utilities and Industrials have been the best performing sectors this year. However, the Utilities sector as a whole suffers from relatively high valuations for only modest projected earnings growth over the next 12 months (8.1%) and a high forward PEG of 2.43. But this should change as datacenters get built and power demand ramps up. Although US electricity consumption has been increasing only gradually over the past few years, ICF International forecasts a 25% increase in by 2030 and 78% by 2050, driven largely by AI-related initiatives.

Keep in mind, the Outlook Rank does not include timing, momentum, or relative strength factors, but rather reflects the consensus fundamental expectations at a given point in time for individual stocks, aggregated by sector.

Notably, our ETF rankings continue to display much stronger Outlook scores for the cap-weight indexes, like SPY (49) and QQQ (72), over the equal-weight indexes, like RSP (34) and QQQE (48), which reflects the higher quality of the mega cap companies that dominate the cap-weight indexes. You can learn more about gaining access to Sabrient’s ETF Scorecards, which rank roughly 1500 ETFs, by visiting: **http://highperformancestockportfolios.com**.

Sector Rotation Model

Our rules-based Sector Rotation model, which appropriately weights Outlook, Bull, and Bear scores in accordance with the overall market’s prevailing trend (bullish, neutral, or defensive), returned to a bullish bias in May when the SPY closed solidly above its 200-day moving average several days after previously eclipsing its 50-day. *(Note: In this model, we consider the bias to be bullish from a rules-based trend-following standpoint when SPY is above both its 50-day and 200-day simple moving averages, but neutral if it is between those SMAs while searching for direction, and defensive if below both SMAs.)* The SPY had suffered a dreaded “death cross” during the April selloff when the 50-day average crossed down through the 200-day, but it recovered in late-June when the 50 crossing back above the 200.

As highlighted in the table above, the Sector Rotation model suggests holding **Technology (IYW), Financials (IYF), and Telecom (IYZ).** However, if you prefer a neutral stance, it suggests holding Technology, Healthcare (IYH), and Financials. Or, if you prefer to take a defensive stance due to overbought technicals and lofty valuations, it suggests holding Consumer Staples (IYK), Utilities (IDU), and Telecom.

Disclosure: *At the time of this writing, of the securities mentioned, the author held positions in OKE, LNG, LPG, SMR, BWXT, UEC, NNXPF, ENVX, QS, and MP.*

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