Strategic Beta in Your Commodity Benchmark

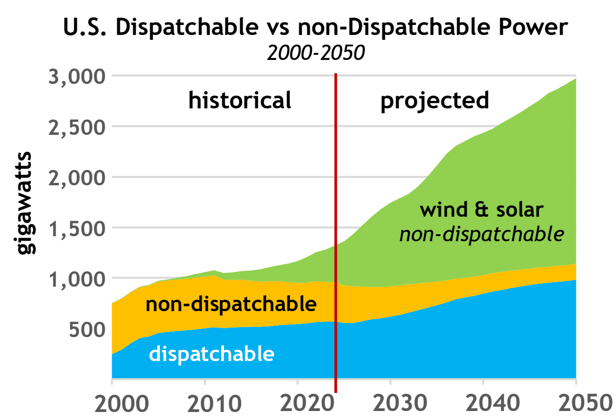
September 2023

Executive Summary

Since their launch in the late 1990's, the Bloomberg Commodity Index (BCOM) and the Standard & Poors GSCI have become recognized performance benchmarks for commodity investments with 24 futures contracts chosen to track a diverse range of commodities, including energy, metals, agriculture, and livestock. Neither index includes electricity (power), which is the one of the most consumed commodities in the U.S. after gasoline and the focus of climate change initiatives for renewable power.

The ICE U.S. Carbon Neutral Power Index ("ICECNPIT")[1] provides investors with a transparent, rules-based approach to investing in a diversified portfolio of electricity and carbon allowance futures contracts representing the U.S. domestic market for power in a carbon neutral format. A 90% allocation to a commodity index, such as the BCOM, and a 10% allocation to ICECNPIT (based on the 33% share of electricity in the energy CPI subindex) delivers important benefits to the benchmark.

- **Enhanced benchmark performance.** In a backtest[2] from January 1, 2014 through August 31, 2023, the BCOM with a 10% allocation to ICECNPIT ("BCOM90P10") delivered better returns at lower risk, as measured by Sharpe ratios, than the BCOM by itself. It provided more effective diversification with lower correlations to every major asset class and a better inflation hedge with a higher correlation to CPI.
- **Disruption in U.S. power markets.** Non-dispatchable renewable power generation is replacing dispatchable thermal plants, creating extreme pricing events and highly upward-biased pricing profiles. The cost of renewable generation together with the implicit cost to firm renewable output exceeds forward prices by a substantial margin, which means grid reliability will require much higher prices for power in the future.



- **Supply and demand imbalance.** Government policies, EVs, and industrial trends are accelerating demand for power beyond the capacity of the grid to reliably supply it. Broad-based commodity benchmarks increasingly must include power as demand for power displaces demand for fossil fuels.

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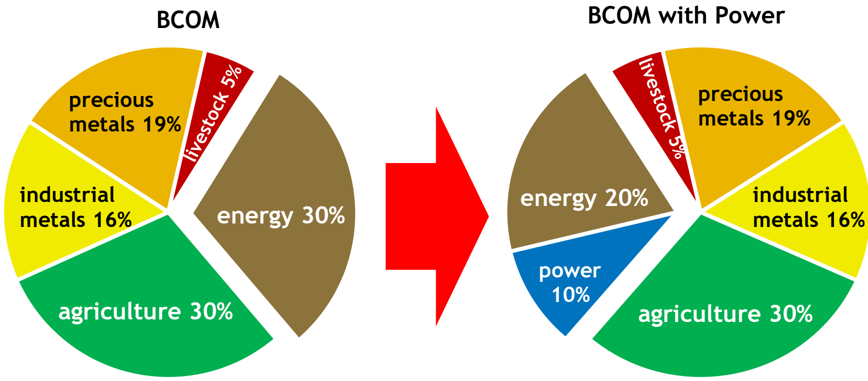
Enhanced Benchmark Performance

Returns, Risk, and Inflation Hedge

Beyond its conventional role as an essential commodity, electricity has emerged as a dynamic and tradable asset that offers investors enhanced returns, diversification, and robust inflation protection. A 10% allocation to ICECNPIT in the BCOM should replace a third of the allocation to energy in the benchmark.

Bloomberg Commodity Index with ICECNPIT



In a backtest from January 1, 2014 through August 31, 2023, ICECNPIT delivered better returns at lower risk, as measured by Sharpe ratios, than the BCOM, the S&P GSCI, and the largest energy components of both indexes, which include Brent crude oil, WTI crude oil, gasoline, and natural gas. Combining ICECNPIT with the BCOM in the BCOM90P10 delivers materially better returns than the BCOM alone with less risk (higher Sharpe ratios) over 3 years, 5 years, and the entire period since 2014.

Comparative Annualized Performance Metrics

January 1, 2014 – August 31, 2023

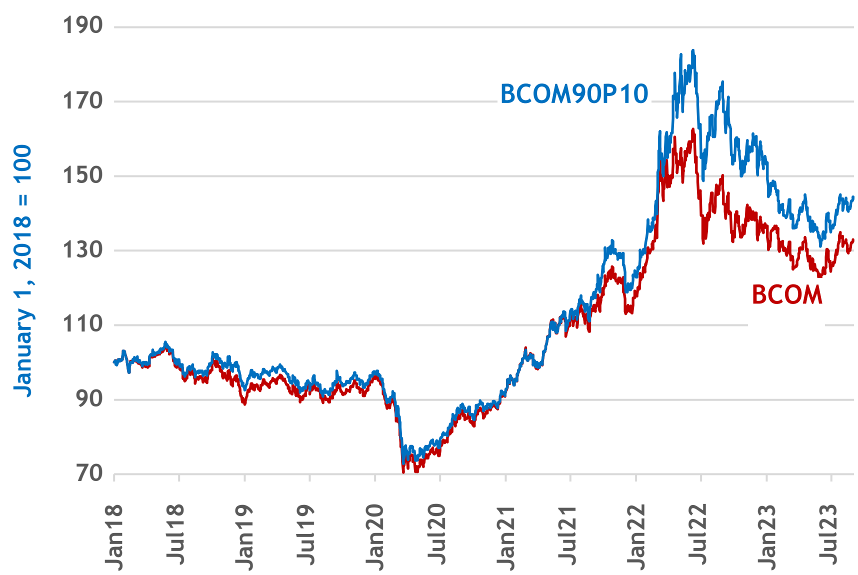
Metric	Period	ICECNPIT	BCOM	GSCI	Brent Crude	WTI Crude	Gasoline	Nat Gas	BCOM90 P10
Returns	3 years	31.7%	15.2%	26.2%	40.3%	34.2%	55.2%	-19.1%	17.6%
	5 years	16.1%	6.7%	5.5%	10.4%	-0.9%	15.4%	-22.4%	8.1%
	2014	6.8%	-0.6%	-3.0%	-2.1%	-8.6%	1.9%	-23.0%	0.4%
Risk *Sharpe ratio*	3 years	1.05	0.86	1.09	1.11	0.87	1.50	-0.30	0.98
	5 years	0.66	0.41	0.22	0.25	-0.02	0.34	-0.38	0.50
	2014	0.34	-0.04	-0.13	-0.06	-0.20	0.05	-0.46	0.03
Inflation Hedge *Correlation CPI*	2014	81%	59%	32%	48%	-7%	56%	-34%	68%

Strategic Beta in Your Commodity Benchmark

ICECNPIT in the BCOM also improves the effectiveness of the benchmark as an inflation hedge. Since 2014, the CPI All Consumers Electricity Index has tracked the CPI with a correlation of over 85%, which explains the 81% correlation of the ICECNPIT with the CPI over the same period. In the BCOM, ICECNPIT increases the correlation of the benchmark with the CPI from 59% to 68% in the BCOM90P10 from 2014 through the end of July 2023.

Bloomberg Commodity Index with ICECNPIT

January 1, 2018 – August 31, 2023



Diversification

The primary drivers of power market prices are not the overall U.S. economy, but regional weather, supply and demand, transmission outages, unit availability, the cost of the marginal fuel molecule, and other factors unique to power markets. The significance of these distinct factors means power markets exhibit the weakest correlations with every major asset class—equities, fixed income, and other commodities.

ICECNPIT Correlation Matrix

January 1, 2018 - August 31, 2023

	ICECNPIT	BCOM	BCOMEN	BC90P10	S&P	IG Bonds	5 yr TIPS	Gold
ICECNPIT	1.00	0.41	0.55	0.66	0.17	(0.07)	(0.05)	(0.08)
BCOM	0.41	1.00	0.83	0.95	0.33	(0.02)	0.12	0.23
BCOM Energy	0.55	0.83	1.00	0.86	0.30	(0.16)	(0.02)	(0.06)
BCOM90P10	0.66	0.95	0.86	1.00	0.33	(0.04)	0.08	0.16
S&P	0.17	0.33	0.30	0.33	1.00	(0.03)	(0.03)	(0.04)
IG Bonds	(0.07)	(0.02)	(0.16)	(0.04)	(0.03)	1.00	0.81	0.53
5 yr TIPS	(0.05)	0.12	(0.02)	0.08	(0.03)	0.81	1.00	0.55
Gold	(0.08)	0.23	(0.06)	0.16	(0.04)	0.53	0.55	1.00

Strategic Beta in Your Commodity Benchmark

ICECNPIT provides better diversification than energy or any other commodity, exhibiting lower correlations with every major asset class and higher Sharpe ratios. The BCOM with power, the BCOM90P10, delivers better overall returns with less risk and better risk adjusted results than the BCOM by itself.

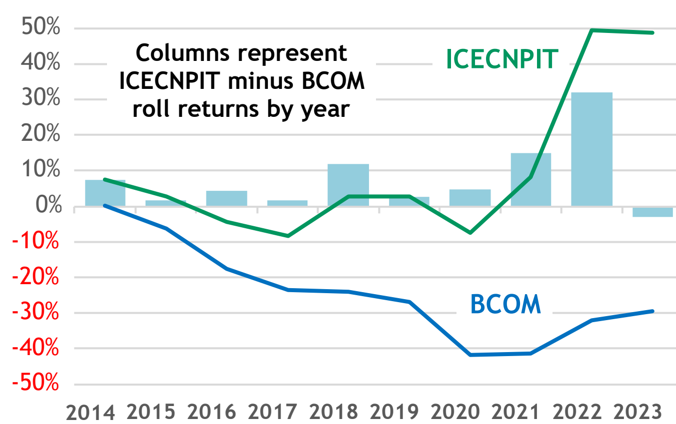
Roll Yield Returns

There are four sources of yield in a commodity index. They are (i) spot yield, which is the change in the current price of the underlying commodity futures; (ii) roll yield, which is the difference between the prompt, expiring future in the index and the cost of rolling into the longer dated futures—backwardated if lower and cheaper, contango if higher and more expensive; (iii) collateral yield, which is the interest earned on the collateral supporting the futures position, usually 3-month U.S. Treasuries, and (iv) rebalancing yield, which is the return attributed to rebalancing the index on an annual basis and typically involves a formula-based change of weights of the individual futures contracts in the index as described in published index rules.

Unlike other commodity indexes that use a prompt-month-to-prompt-month roll structure, the ICECNPIT uses a 12-month calendar strip of electricity and carbon allowance futures that rolls the electricity prompt month to month 13 instead of rolling into the next available month as is the widespread practice with traditional commodity indexes.

Dislocation between physical power market fundamentals and long-term financial markets has created persistent backwardation in power prices that is expected to continue for the foreseeable future. Electricity cannot be stored, which creates a structural arbitrage between purchasers of physical power, who bid up the front months of the power futures curve to ensure pricing and security of supply, and financial intermediaries, who sell longer-term futures to provide the hedges required for funding the construction of renewable generation facilities.

ICECNPIT & BCOM Cumulative Roll Returns
January 1, 2014 - August 31, 2023



From 2014 through August 2023, the arbitrage between shorter-dated contracts subject to constraints of physical supply and demand and the longer-dated financial contracts required for hedges has generated an average annual roll yield of 4.0% and a cumulative roll return of 49% for the ICECNPIT versus an annual roll yield of **-3.2%** and cumulative roll return of **-29%** for the BCOM. The structural positive roll yield in the ICECNPIT represents another source of return for the commodity benchmark. Positive roll yield is expected to persist for the foreseeable future as another source of structural returns.

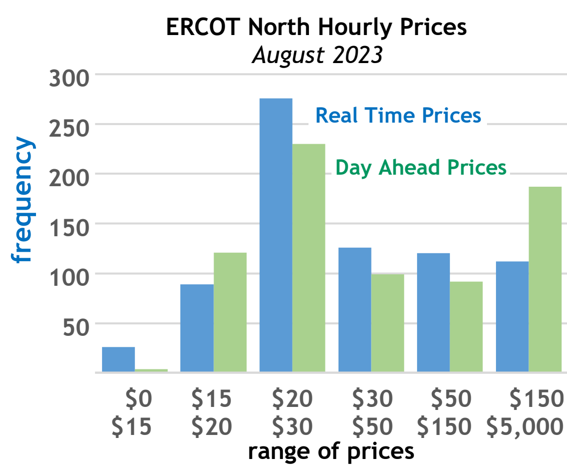
Disruption in U.S. Power Markets

Dynamics of non-Dispatchable Renewable Power

Rapid changes in power demand due to weather or unexpected interruptions in supply from equipment failure require a secure source of generation capacity that can be placed online rapidly to meet demand and avoid blackouts. Power plants that can be placed online quickly in response to changes in demand and that can vary their output quickly are called dispatchable and include primarily gas and oil-fired facilities.

Wind and solar are intermittent sources of power and are not dispatchable. Their output cannot be controlled or varied to meet constant changes in demand. The energy transition in the U.S. is forcing a greater reliance on non-dispatchable renewable power in the face of accelerating growth in demand, which increases the exposure of the grid to the inherent variability in renewable generation. When weather conditions are favorable, renewable output provides the grid with excess electricity that results in a significant drop in power prices. When weather conditions unexpectedly change and renewable output performs below forecasts, dispatchable plants must be engaged at higher cost to meet an inelastic demand, causing power prices to surge.

The unpredictability of power supply from renewables to the grid amplifies the variability of prices and is one source of dramatic price spikes. In August 2023 more than half of Real Time peak hourly prices in ERCOT, the Texas ISO, were between $20 and $50 while a third exceeded $50 and ran as high as $5,000. The Real Time price is the actual hourly price of physically delivered power. In the Day Ahead market, which forecasts the expected price for power in the Real Time market, more than 40% of hourly prices exceeded $50 but did not touch the top price of the following day.

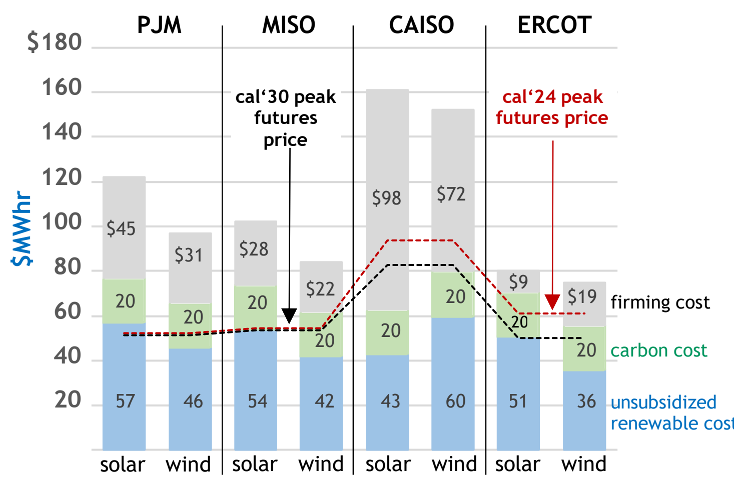


This instability has costs. They include capital costs as well as the operating cost to keep dispatchable thermal generation available to meet demand when renewable generation fails, which is known as the cost to firm renewables.

The cost of firming intermittency of renewables ranges from an estimated $40 to $100 per MWhr with an incremental $20 per MWhr added for carbon allowances[3]. The cost of renewable generation together with the implicit cost to firm renewable output exceeds current forward prices by a substantial margin, which means grid reliability will require much higher prices for power in the future.

A commodity benchmark with power provides direct exposure to the coming disruption in U.S. power markets from renewables and the inevitable growth in the relevance of power as a commodity. The increasing importance of weather-dependent power sources in the grid will have a profound impact on power prices and the reliability of power supply. Power pricing will become more unpredictable[4], rolling blackouts more likely, and the cost of power more expensive as operators seek to recover higher capital and operating costs.

Cost To Firm Renewables[3.]



Supply and Demand Imbalance

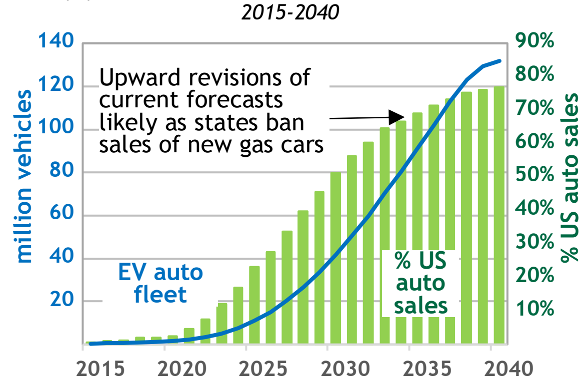
Importance of Power to the Commodity Benchmark

The importance of power in the evolution of the U.S. economy will continue to grow at the expense of other energy sources as renewables take an increasing share of the U.S. power grid and electric vehicles (EVs) a meaningful share of the U.S. auto market. A commodity index without power will become less relevant when power becomes the most consumed commodity and the most important source of growth and value in the energy sector.

New Sources of Demand for Power

In addition to underlying growth in power consumption, the grid must be prepared to meet new sources of demand. State and federal regulations are accelerating the timelines of Energy Transition Scenarios that target 2035 as the year when EVs will achieve a 50% share of U.S. new auto sales. The actual share is likely to be much higher and could approach 100% in many states that have or will pass laws, like New Jersey, banning new gas cars by 2035. A fully EV fleet by 2040 would require twice the generating capacity in a full Net Zero Scenario than under a more realistic Energy Transition Scenario[5].

U.S. EV Auto Fleet vs EV % Total Auto Sales
2015-2040



Strategic Beta in Your Commodity Benchmark

New demand will come from data centers as the scale and economics of data management force corporations to accelerate the migration of their data to cloud infrastructure. According to a McKinsey study on the data center economy, U.S data center demand is projected to grow over 9% per year from 2022 to 2030. That growth will put another 17 GW of demand on the grid for a total of 35 GW by 2030[6].

With the evolution of AI and large language models (LMMs), these estimates are probably low. A recent study[7] estimated that the computing costs to train GPT-3, the forerunner of ChatGPT, consumed 1,287 MWhr of electricity, more than 120 times the average annual household consumption of electricity in the U.S.[8] Integrating ChatGPT into Microsoft's Bing search engine, which handles a half billion searches daily[9], would consume between 1,500 to 1,980 MWhr of electricity every day based on estimates of power consumption per query.[10]

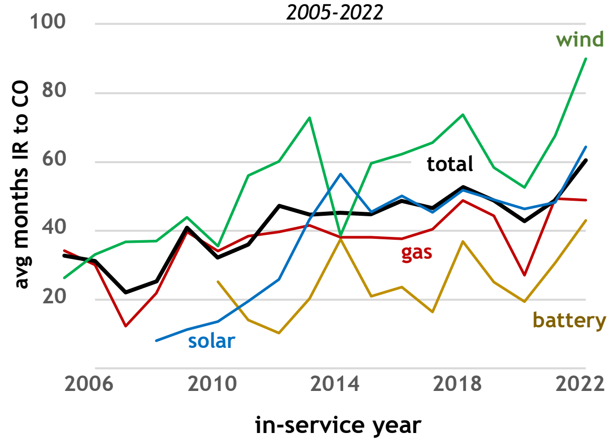
Other sources of new demand are emerging from state regulations targeting specific carbon-emitting products. New York recently became the first state to ban gas stoves, gas furnaces, and propane heating in new construction by 2026. California banned all gas-powered lawn equipment by 2024[11].

Increasing Obstacles to Expanding Capacity

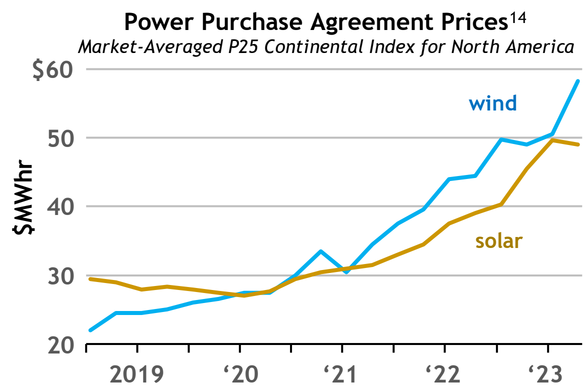
Over the next 7 years retirements of thermal facilities are expected to more than quadruple and reduce thermal generating capacity by 12%, an e estimate that continues to increase with new announcements of early retirements. Wind and solar additions over the same period are projected to more than double[12], but that forecast may appear optimistic with renewables construction facing increasing delays in development queues.

At the end of 2022 more than 10,100 projects were waiting for approval to connect to the grid, up from over 7,000 in 2021[13]. On average, only 21% of projects that filed Interconnection Requests from 2000 through 2017 began commercial operations before the end of 2022 after an average of 5 years in the development queue, up from 3 years in 2015 and under 2 years in 2008.

Average Months from Interconnection Request to Commercial Operations[13]
2005-2022



Escalating costs are challenging the economic viability of renewable energy projects. The review process for a new facility is complex with detailed technical analysis, environmental assessments, and community engagement. Obstacles developers face include extensive technical requirements that can change before a permit to build can be issued, inadequate transmission infrastructure, intricate siting conditions, and opposition from the public to local siting of power facilities. At the same time, developers must contend with rising interest rates, labor shortages, land costs, interconnection costs, mandated system upgrades, and supply chain shortages. These costs are beginning to appear in the prices the developers are charging for electricity in power purchase agreements. Prices for wind and solar in the Market-Averaged P25 Continental Index for North America have almost tripled since 2019.[14]

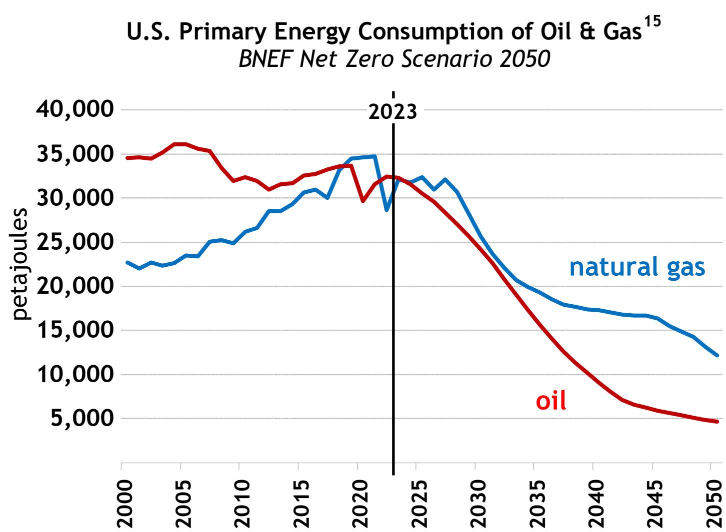


The most significant issue, however, is the sheer volume of new projects, which exceed the capacity of the agencies and engineers to review and approve them. This is the natural outcome of the smaller size of renewable projects, which means more are required to replace the larger coal and gas-fired plants that are taken out of service. Delays and technical constraints of the grid often force developers to cancel their projects before construction begins. Between 2012 and 2022 over 8,700 interconnection requests were withdrawn or suspended from over 20,000 that were filed over that period.[13]

Accelerating growth in demand with these constraints on development of new capacity will contribute increasing value to any commodity index that includes power.

Declining Demand for Fossil Fuels

Energy consumption is pivoting away from oil and natural gas, led by the goal of carbon-free alternatives, concerns over climate change, and economics. At the same time, the initiatives that promote demand for power are accelerating the decline of fossil fuels. Under the BloombergNEF Net Zero Scenario[15] the consumption of oil is projected to decline by 6.1% annually for a total drop of over 80% by 2050. Natural gas consumption is projected to decline by 6.1% per year over the same period for a total loss of 83% by 2050.



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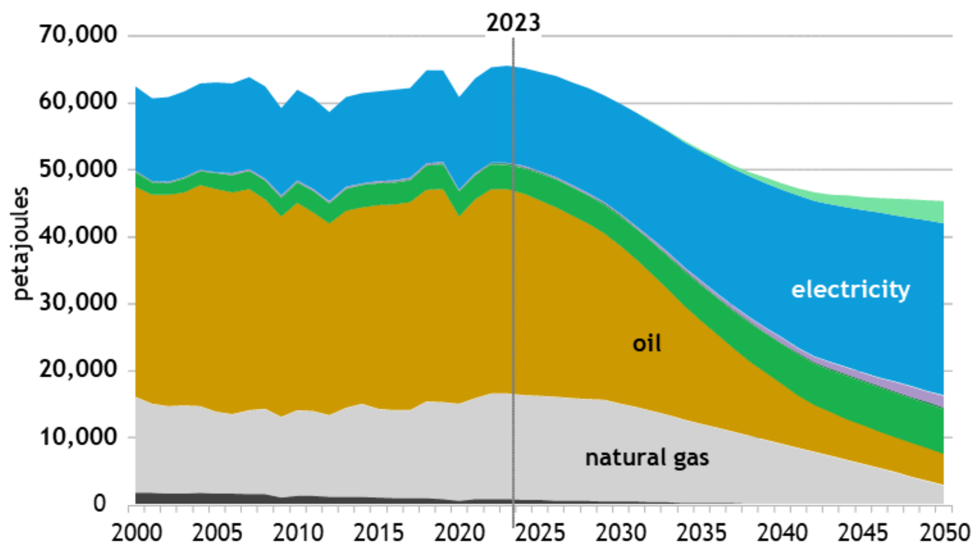
The importance of power in the evolution of the U.S. economy will continue to grow at the expense of other energy sources. Climate change initiatives are increasing the imbalance between supply and demand in U.S. electricity markets with new sources of demand from EVs, data centers, AI, and cloud computing and growing constraints on new sources of power generation. Renewables are displacing fossil fuels as a primary source of energy and disrupting the reliability of power supply and markets for power prices.

The intersection of declining demand for fossil fuels and increasing demand for power underscores the strategic beta that the ICE Carbon Neutral Power Index brings to any commodity benchmark. A benchmark with ICECNPIT will deliver better returns than a benchmark without it and will perform with less risk (higher Sharpe ratios), offer better diversification, and provide a better hedge for inflation.

ICECNPIT provides direct exposure to the coming disruption in U.S. power markets from renewables and to the inevitable growth in the relevance of power as a commodity. At the same time accelerating growth in demand and constraints on new capacity will contribute increasing value to any commodity benchmark that includes power. A commodity benchmark without power will become less relevant when power becomes the most consumed commodity and the most important source of growth and value in the energy sector.

Final Energy Consumption by Fuel[15]

BNEF Net Zero Scenario 2050



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[2] Hypothetical performance results have many inherent limitations, some of which are described below. No representation is being made that any account will or is likely to achieve profits or losses similar to those shown. In fact, there are frequently sharp differences between hypothetical performance results and the actual results subsequently achieved by any particular trading program. One of the limitations of hypothetical performance results is that they are generally prepared with the benefit of hindsight. In addition, hypothetical trading does not involve financial risk, and no hypothetical trading record can completely account for the impact of financial risk in actual trading. For example, the ability to withstand losses or adhere to a particular trading program in spite of trading losses are material points which can also adversely affect actual trading results. There are numerous other factors related to the markets in general or to the implementation of any specific trading program which cannot be fully accounted for in the preparation of hypothetical performance results and all of which can adversely affect actual trading results.

[3] Lazard, LCOE, 2023.

[4]thehill.com/opinion/energy-environment/589235-a-wind-and-solar-electric-grid-thats-a-terrible-idea/#:~:text=Both%20solar%20and%20wind%20are,clouds%20for%20many%20days%20consecutively.

[5] Source: BNEF, CNIC Research. Generating capacity required per vehicle based on industry estimates of 4 kWh per mile and an average of 12,000 miles per year per car. Fleet size based on 18-year average life per car.

[6] www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/investing-in-the-rising-data-center-economy

[7] Patterson, David, et all, "Carbon Emissions and Large Neural Network Training", chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/ftp/arxiv/papers/2104/2104.10350.pdf.

[8] U.S. Energy information Administration, "How much electricity does an American home use?", https://www.eia.gov/tools/faqs/faq.php?id=97&t=3.

[9] Stokel-Walker, Chris, "The Generative AI Race Has a Dirty Secret", Wired, February 18, 2023, https://www.wired.com/story/the-generative-ai-search-race-has-a-dirty-secret/

[10] Ludvigsen, Kasper Groes Albin, "ChatGPT's Electricity Consumption", Medium, March 1, 2023. https://medium.com/towards-data-science/chatgpts-electricity-consumption-7873483feac4

[11] www.turnto23.com/news/state/california-to-ban-sale-of-gas-leaf-blowers-lawn-mowers-in-small-engine-ban

[12] Bloomberg NEF, "Comparing Long-term Energy Outlooks", 2022.

[13] Lawrence Berkeley National Laboratory, "Queued Up: Seeking Transmission Interconnection as of the End of 2022", April 2023.

[14] Dvorak, Phred, "Green Power Get Pricier After Years of Declines", Wall Street Journal, August 13, 2023. LevelTen Energy, Market-Averaged P25 Continental Index for North America.

[15] BloombergNEF, New Energy Outlook 2022, November 20, 2022.