

Private Bank



Citi Private Bank Office of Innovation

Unstoppable trends:
Examining the future
of energy

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Foreword: Shifting sands in the energy sphere



The world's energy mix is currently undergoing profound changes. Incremental electrification of the developing world, proliferation of electric vehicles (EVs) in major markets, rising climate change awareness and the general public mood in favor of reducing reliance on fossil fuels have been very visible for the past few years.

As this palpable drive was gaining traction, the outbreak of the COVID-19 global pandemic towards the end of the first quarter of 2020 also caused sudden shifts in crude oil demand on an unprecedented scale. Before the pandemic hit, global oil demand hovered around 100 million barrels per day (bpd) levels and annual demand growth forecasts were in the region of 1.1 to 1.3 million bpd.

However, when the COVID-19 outbreak was declared a global pandemic, negative oil and gas market sentiment went up several notches as restrictions to halt the spread of the virus brought curbs on human mobility.

With whole economies in lockdown at various points in 2020; people driving and flying a lot less; and human consumption patterns seeing abnormal shifts - oil prices

and demand projections took a knock. Market conjecture in the immediate aftermath of the declaration of the pandemic suggested around a fifth of global crude oil demand or 20 million bpd might be wiped out in 2020. Admittedly, this has not turned out to be the case.

The International Energy Agency (IEA) estimated the demand slump in 2020 to be around 8.8 million bpd, with global consumption of under 92 million bpd, largely underpinned by petrochemicals and a gradual recovery¹ of human mobility. But what has also clearly emerged is the unstoppable march towards a low carbon economy largely predicated on energy generated from renewable sources.

Core OECD (or 'Organisation for Economic Co-operation and Development') markets have made direct overtures towards reducing their reliance on fossil fuels, that too in a climate of near-term global oil demand destruction.

However, when it comes to a more holistic energy transition and peak demand for fossil fuels, there is no market unanimity on when we might get there.

¹ International Energy Agency, Oil Market Report, December 2020 <https://www.iea.org/reports/oil-market-report-december-2020>

In light of the ongoing transition, at Citi Private Bank's Office of Innovation, we believe the wider market and our clients have to confront some searching questions at this critical point in time:

- ✓ As world's energy consumption continues to grow in leaps and bounds, what source is going to power this ever-increasing consumption in the most sustainable way possible?
- ✓ What will be the role of the fossil fuels as the world goes through a big energy transition into renewables?
- ✓ How should we find sustainable investment opportunities in this new and complex alternative or 'clean' energy future?
- ✓ How should we balance the energy generation, usage and tackling climate change versus concerns over carbon emissions?
- ✓ What are the major upcoming changes in human transportation be it aviation, public or private transport?
- ✓ How is technology going to play a key role in the transformation, disruption, and innovation as we look to a greener future?

As we confront these searching questions, there is a tacit acknowledgement that we all live in a connected world with better health, opportunities and increasing standards of living. All of this requires energy sources that ought to be accessible, reliable and affordable whilst tackling climate change and lowering carbon emissions.

Policymakers and the investor community will confront these issues head on as the UK prepares to host the 26th UN Climate Change Conference of the Parties (or 'COP26') in Glasgow 1 - 12 November 2021², to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change.

Cognizant of the complex scenario, as well as the opportunities and challenges it presents, our team and OpenExO³ recently presented a series of virtual summits featuring thought leaders and innovators exploring 'Unstoppable Trends' through the prism of cutting-edge innovations. The future of energy⁴ was a pivotal session and major segment of our deliberations.

We feel that a change in the energy mix is not just on the horizon; it has indeed arrived. Oil majors such as BP and Total, and even the Organization of Petroleum Exporting Countries (OPEC) currently see crude oil demand plateauing⁵ sometime between 2030 and 2040. Of course, this view is by no means universal. Over the coming decades, we believe much of this would depend on consumption patterns seen in emerging markets deemed to be burgeoning centers of energy demand.

For example, China is the world's largest energy consumer as well as its biggest investor in renewable energy. But nearly 60% of its energy needs⁶ are still serviced by coal. China is also logging bumper crude oil imports⁷ in its post COVID-19

economic rejuvenation efforts. The Chinese government had previously said its CO2 emissions would peak around 2030, a target that sounded plausible. However, in September 2020, Beijing flagged an ambition of achieving "absolute carbon neutrality" before 2060⁸.

Such a move will require drastically reducing the use of fossil fuels in transportation and electricity generation, and offsetting any remaining emissions through carbon capture and storage (CCS) or planting forests. To achieve this objective, apart from being the world's largest spender in solar and wind power, China has 50 nuclear power reactors in operation with a capacity of 48.5GW and 18 under construction as of June 2021, according to the World Nuclear Association⁹. The government had aimed for 58GW of nuclear capacity but fell short of that target by the end of 2020.

On the other hand, China's coal-fired generating capacity grew by around 40GW in 2019¹⁰, to about 1050GW. Then in 2020, China's coal-fired capacity rose further by a net 29.8GW, even as the rest of the world made cuts of 17.2GW, according to research¹¹ published by Global Energy Monitor and the Centre for Research on Energy and Clean Air. Concurrently another 100GW is under construction.

It all correctly points to the tough nature of the task ahead. China's latest Five-Year Plan (for 2021-25) published on 5 March¹², aims to cut the amount of CO2 produced per unit of the country's GDP by 18% over the period. However, this target is broadly in line with previous trends. Having noted that, non-fossil fuel energy is targeted to make up 20% of China's energy mix and the scale of ambition is there for investors to see.

Furthermore, we see palpable overtures by Big Oil in general - at least the non-US hydrocarbon producers in the group - towards renewable energy that have also been the subject of many recent headlines. There was also a near-stalling of fresh oil and gas prospecting in 2020. And across the energy spectrum, we see an acceleration of process optimization and technology by International Oil Companies (IOCs) to extract maximum value from their portfolio and seek a lower breakeven. All of the world's top 20 IOCs have outlined their ambitions for a lower breakeven, with BP declaring its intentions for a \$30 per barrel breakeven as early as 2017¹³.

We believe the pandemic will serve to hasten this. The venture capital funding arms of energy companies and their partner vendors are going into overdrive to find both 'green' as well as 'processing and resource' maximization technology. There is ample room for private capital to fund this transition.

Such a shift is likely to give heart to impact investors in emerging markets unencumbered by legacy issues. The global levelized cost of energy (LCOE) via renewable sources appears to be constantly in decline, according to the International Renewable Energy Agency (IRENA). In particular, the agency's research notes that LCOE of PV systems declined by 36% between 2010 and 2019¹⁴.

That helps developing markets - provided the capital and socio-political will is there - to jump the fossil fuel chain when it comes to electrification. Anecdotal and empirical evidence points to renewable energy, especially wind and solar, leading electrification of rural areas in developing economies as diverse as India and Vietnam. A case can already be made

here for sub-Saharan Africa following a similar trajectory in by-passing fossil fuels in favor of renewables-led electrification via mini, localized power grid infrastructure.

As the world moves past COVID-19, economic growth and the transition to EVs will drive major increases in energy demand even as major changes are happening in the industry with source replacement and displacement. In addition, big data and analytics are being used in major markets at consumer level to manage power plans. This in turn results in an availability of sophisticated analytics that enable renewable energy companies to better manage wind and solar power sources, and more accurately forecast the amount of energy that can be sent to the power grid or to storage.

The inexorable direction of travel towards a low-carbon future is becoming clearer. Our job is to help identify how you as an investor can get exposure to such unstoppable trends in the energy sphere, and make a considered case for seeking opportunities and investments down this route. In that endeavor, we hope this whitepaper would prove to be informative. As ever, we welcome your feedback.



Philip Watson,
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² UN Climate Change Conference, November 2021 <https://ukcop26.org/>

³ OpenExO is a global transformation ecosystem of nearly 8,000 coaches, investors, consultants and innovation specialists. Citi Private Bank partnered with the organization to present a series of virtual summits on unstoppable trends in the global investment landscape in July & August 2020 <https://www.privatebank.citibank.com/ivc/docs/UT-agenda.pdf>

⁴ The Future of Energy, Unstoppable Trends, Citi Private Bank <https://www.privatebank.citibank.com/unstoppable-trends/the-future-of-energy.html>

⁵ OPEC, in major shift, says oil demand to plateau in late 2030s, By Alex Lawler, Reuters, 8 October 2020 <https://www.reuters.com/article/us-oil-opec-outlook-idUSKBN26T24C>

⁶ Coal's share of China energy mix falls to 57.7% in 2019, Reuters, 28 February 2020 <https://www.reuters.com/article/china-energy-idAFB9N2A2084>

⁷ China's oil buying binge to run on in 2021 as tank operators, refiners stock up, By Chen Aizhu, Muyu Xu, Gavin Maguire, Reuters, 18 November 2020 <https://uk.reuters.com/article/china-oil-stockpiles-idUKL1N2I40B7>

⁸ China aims for 'carbon neutrality by 2060' By Matt McGrath, BBC, 22 September 2020 <https://www.bbc.co.uk/news/science-environment-54256826>

⁹ Nuclear power in China, World Nuclear Association, June 2021 <https://world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx>

¹⁰ Will China build hundreds of new coal plants in the 2020s?, Carbon Brief, 24 March 2020 <https://www.carbonbrief.org/analysis-will-china-build-hundreds-of-new-coal-plants-in-the-2020s>

¹¹ China's new coal power plant capacity in 2020 more than 3 times rest of world's, By David Stanway, 3 February 2021 <https://www.reuters.com/business/energy/chinas-new-coal-power-plant-capacity-2020-more-than-3-times-rest-worlds-study-2021-02-03/>

¹² What does China's 14th 'five year plan' mean for climate change?, Carbon Brief, 12 March 2021 <https://www.carbonbrief.org/qa-what-does-chinas-14th-five-year-plan-mean-for-climate-change>

¹³ Era of \$100 oil price was an aberration says BP's Bob Dudley, By Gaurav Sharma, International Business Times, 16 July 2017 <https://www.ibtimes.co.uk/era-100-oil-price-was-aberration-says-bps-bob-dudley-1629952>

¹⁴ Solar power at a glance - IRENA, December 2020 <https://www.irena.org/costs/Power-Generation-Costs/Solar-Power>

The new energy revolution



In Outlook 2021¹⁵, Citi Private Bank called the new energy revolution an unstoppable trend. Market forces - rather than government mandates alone - are now powering the switch from fossil fuels to renewables. The investment case for renewables has become even more compelling as the world attempts to shake-off the COVID-19 downturn.

As previously noted in this paper, a historic global pandemic with unprecedented economic lockdowns sweeping across the world has in fact aided in the reimagining and rebuilding of how the world powers itself. For nearly a hundred years, economic growth and fossil fuel consumption have been inextricably linked. But that bridge has been broken and we will attempt to demonstrate how the current wave of new energy solutions could soon swamp the fossil fuel sector.

The COVID-19 pandemic which no one could have dreamed up in late 2019 drastically cut US and global oil demand as well

as production in 2020 (see Figures 1 & 2). The OECD countries saw 7% aggregated drop in oil demand year-on-year for the first half of 2020 before a sluggish recovery began to take shape. The initial shock was so large that it briefly sent oil prices on to a negative turf (see Figure 3), driving a dramatic underperformance of the traditional energy sector in the US and Global markets.

And while we often see value in beaten down sectors, for those who are not looking at a very short run price bounce, we would note that in markets just like in physics not everything that goes down comes up (see Figure 4). The now decades-long underperformance of the coal sector offers a case in point. For every \$100 invested in the coal sector back in April 2005, would now be worth just \$8.40 even accounting for dividends, a shocking -92% total return (as derived from figure 4).

¹⁵ Citi Private Bank Outlook 2021 <https://www.privatebank.citibank.com/outlook.html>

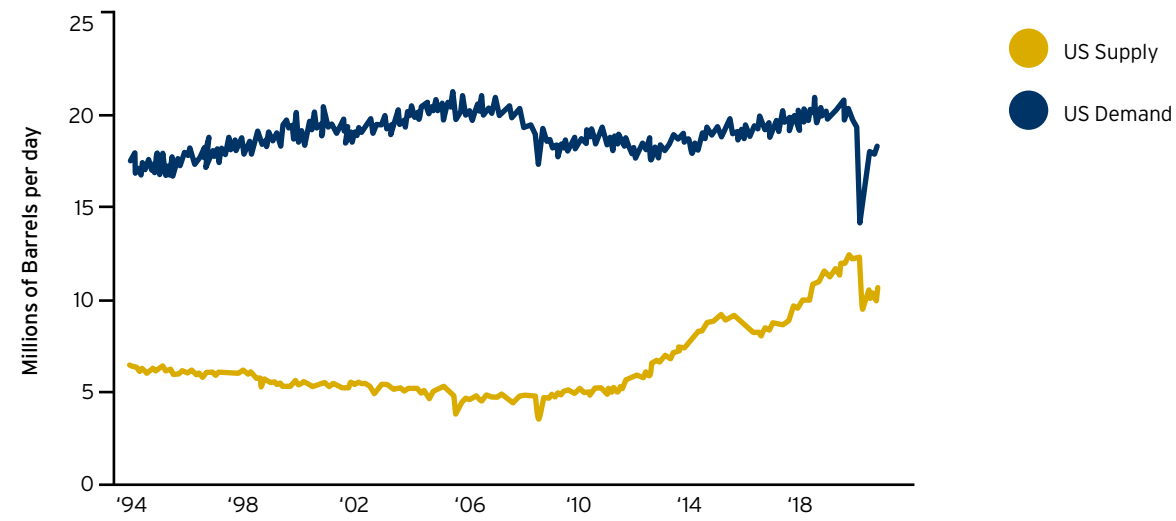


Figure 1. US oil demand fell much faster than supply in the pandemic (Source: Haver Analytics as of February 10, 2021)



Figure 3. Oil price and energy relative to broader S&P 500 (Source: Haver Analytics and Factset as of February 10, 2021)

Past performance is not indicative of future returns. Indices are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment. Index returns do not include any expenses, fees or sales charges, which would lower performance.

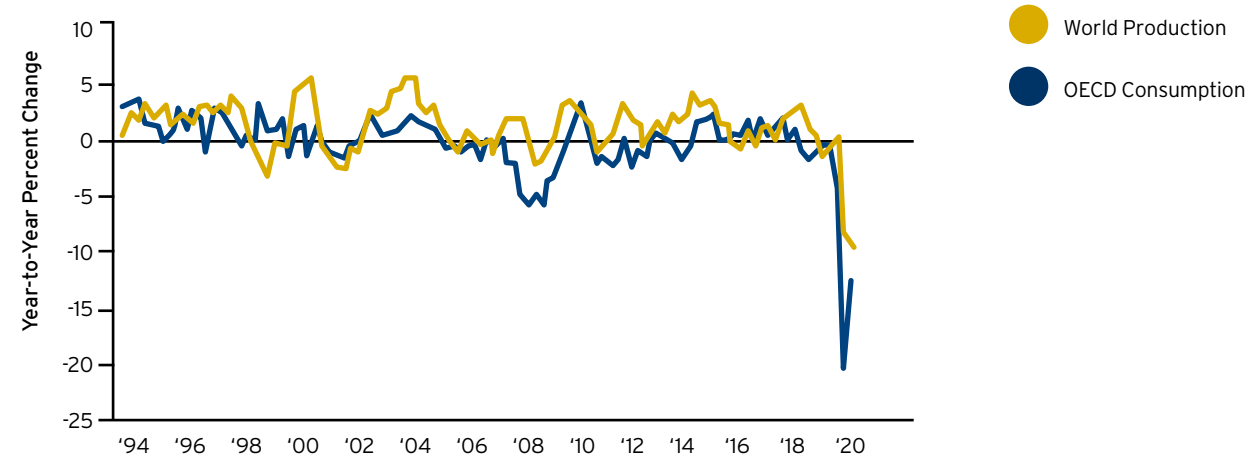


Figure 2. Developed market oil demand has plummeted as supply merely slowed (Source: Haver Analytics, October 2020)



Figure 4. S&P 1500 coal performance offers a future look at other endangered fuels. (Source: Haver Analytics, October 2020) Past performance is not indicative of future returns. Indices are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment. Index returns do not include any expenses, fees or sales charges, which would lower performance.

In the energy production space, we do not see a single winner but instead view price as the ultimate winner. Whatever means of production is the cheapest in a location is the medium that will prevail. As such, we see solar, wind, geothermal, biomass, hydro, tidal and other renewable mediums scrambling for pieces of the once mighty fossil fuel empire.

As the world watched the COVID-19 epidemic in 2020, something truly astonishing took place in the energy mix. For new electricity production, data suggests renewables are now the least expensive source without subsidies in most of the world's largest economies (see Figure 5).

Of course, which renewable source is the least expensive is not consistent across countries or even within countries. For instance, according to BloombergNEF, as of June 2021 in Germany and the UK, wind is now the least expensive new power generation medium, while in the US, China and India, the least expensive option is solar. Therefore, due diligence is necessary for project and investment avenue selection for those looking to capitalize on the march to renewables.

The market demands such avenues be carefully evaluated on their individual merits given their location, without assuming one technology will be victorious everywhere as the natural distribution of renewable power sources is not homogenous across the globe.

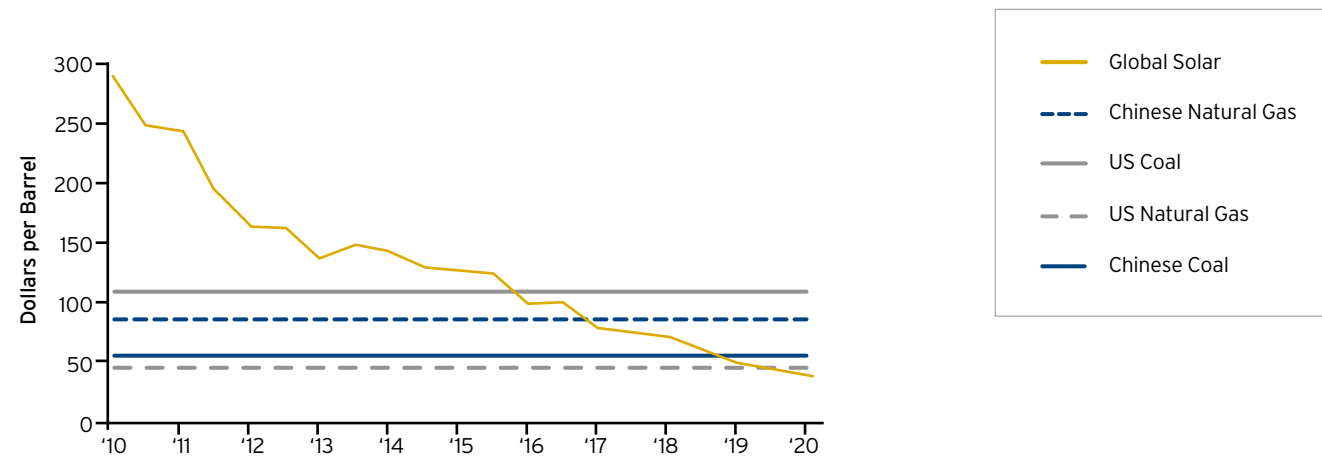


Figure 5. Solar is now the cheapest source of new energy in the world's largest economies (Source: BloombergNEF, February 2021)

Overall, for new fixed location baseline energy production, we believe the race has been run and fossil fuels have lost. But the world still has a long way to go before existing fossil fuel plants are entirely phased out. It is worth not losing sight of the fact that the energy space has a precedent for an old technology to have a long drawn out span of losses. For instance, as petroleum replaced whale oil as the primary fuel source for lighting, the whaling industry gradually shrank for more than 40 years before becoming a footnote in the history of global commerce.

Today, the world is moving perceptively faster and there are additional non-market motivations for the transition from fossil fuels. It is therefore expected that the current energy transition is likely to be more rapid. We recently highlighted¹⁶ the energy source share in Citi Research theme baskets for Solar, Wind, Hydro, Energy Storage, Energy efficiency, Smart Grids, as noted in Citi GPS Energy 2030: Financing A Greener Future, and offered them as examples of likely outperformers. In 2020, not only did the basket outperform the traditional energy sector, but also outperformed the broader global index (see Figure 6).

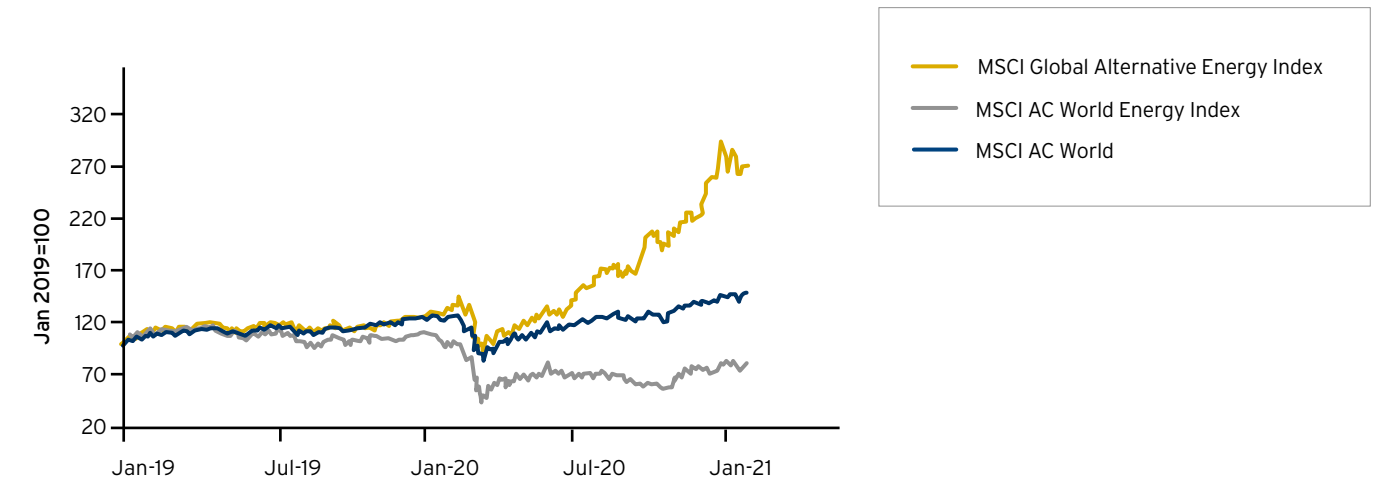



Figure 6. New energy not only outperformed traditional energy in 2020, but also the broader market. (Source: Bloomberg as of February 10, 2021) Past performance is not indicative of future returns. Indices are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment. Index returns do not include any expenses, fees or sales charges, which would lower performance.

For moments of peak production and grid stability, additional energy storage will be necessary. There are signs that the needed battery technology has arrived. For instance, battery powered 'peaker plants' are now providing better performance than natural gas plants in Australia where the large spread between the cheapest power (which the batteries are filled with) and the most expensive (which the batteries sell) has aided a rapid transition.

¹⁶ Realigning income portfolios, Outlook 2020, Citi Private Bank <https://www.privatebank.citibank.com/outlook/realigning-income-portfolios.html>



Energy generation
will be a patchwork,
storage will likely
be the winner

As discussed throughout this paper, renewables appear to be winning the race for new fixed electric power generation. But by far the largest use of crude oil products globally is in transportation not fixed power generation. Typically, the power needed to drive a personal car is now cheaper from the grid in many locations than the equivalent power from gasoline, but getting that power into the right location and storing it in the vehicle remain the primary challenges.

There are many potential solutions to this problem, but two of the furthest along that actually have vehicles for sale in this day and age, with accompanying infrastructural networks, are hydrogen and batteries. As such, it is important for investors to not just find assets with a green label but work with trusted partners to pick technologies

that will set the standard and not fall by the wayside. In our view the market has already spoken, and the battery solution is the clear winner.

When it comes to market assessment, numbers tell their own story. According to the US department of Energy, there are currently 54 hydrogen fueling stations in the US, with nearly all of them, bar a handful, in California. Concurrently, all of China - one of the most significant markets for vehicle sales - has less than 30. The only other markets with reasonably credible hydrogen fueling infrastructure are Japan and Germany, with 114 and 84 fuel points respectively, as of June 2020¹⁷. By contrast, there are more than 49,000 battery vehicle charging stations spread across the US alone (see *Figure 7*).

¹⁷ Hydrogen mobility tracker <https://h2.live/en>

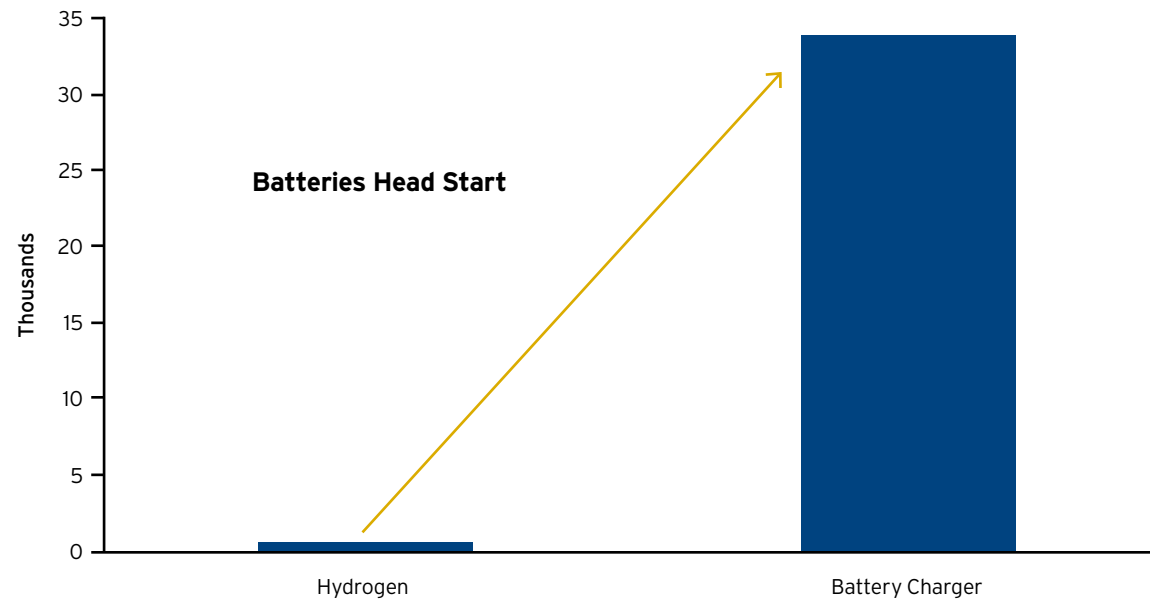


Figure 7. US hydrogen and electric vehicle charging stations (Source: Bloomberg, October 2020)

	Tesla Model 3	Toyota Mirai
Base Model Range	250	312
	<i>Average American drives 13,000 miles a year. Example Break Down 30 daily miles + two 1000 mile round trip vacations a year*</i>	
Miles Charged at Home	11,450	0
Miles Charged on Public Network	1,500	12,950
Visits to charging Stations	6-9	42-60

*Assuming no charging at vacation destination.

Figure 8. Comparing the charging requirements of the bestselling EV and hydrogen cars in 2019

(Source: Bloomberg, Bureau of Transportation Statistics, Tesla and Toyota and authors' calculations, October 2020)

For illustrative purposes only. This should not be construed as an offer of, or recommendation of companies discussed.

In terms of units moved by Original Equipment Manufacturers (OEMs), globally only around 8,000 hydrogen vehicles had been sold in total by the end of 2019. By contrast, there were more than 10.8 million EVs on the roads in 2020 and over 2 million units sold in just that year, as the International Energy Agency noted in June 2021.

There were just three models of hydrogen vehicles available for sale in the US in 2020. All of these happened to be small sedans, with Toyota's Mirai being the most recognizable brand. Having noted that, OEMs that have declared commitments to backing hydrogen vehicular units also include Honda, Toyota, Hyundai, Daimler, BMW, Volvo and GM.

By contrast, there are 56 consumer battery powered EVs on sale in the US alone¹⁸, covering the small and large sedan spaces as well as SUVs, with most mass market and marquee automotive OEMs having put forward at least one electric passenger car model. Additionally, starting later this year truck models from GM, Tesla, Rivian and Ford, as well as other smaller entrants are slated to go on sale.

If it was just a head-to-head comparison of charging/fueling networks, the head start of battery charging EVs would likely already be insurmountable. For battery EVs, most charging is typically done either at home or work for personal and fleet vehicles, with only infrequent long drives requiring use of the public charging network.

Hydrogen vehicles require fill ups roughly as frequently as their gasoline counterparts. So a full network to support a hydrogen vehicle fleet would likely run into the hundreds of thousands (see Figure 8). Each hydrogen vehicle would need more than six times as much charging station capacity compared to a typical EV in our base case scenario.

Additionally, because hydrogen charging stations connect to the grid and actually make hydrogen out of water and electricity, each station costs between \$1 million and \$2 million. On the other hand, EV charging stations currently cost between \$1,000 and \$10,000 to build with land cost being the largest variable¹⁹.

Large corporate fleets of commercial vehicles would likely rely even less on public grids, as early adopters of EV delivery vehicles such as Amazon, FedEx, UPS and Walmart have demonstrated in the US and beyond.

¹⁸ Source: evadoption.com as of June, 2021

¹⁹ Source: National Renewable Energy Laboratory. As of March 2021.

Competition for EVs comes from gasoline vehicles not hydrogen



We believe the main competitor of battery powered EVs is gasoline, and not rival alternative sources. However, the writing appears to be on the wall for gasoline vehicles, even if they take a long time to be phased out. Seventeen countries have set targets for the end of gasoline powered vehicle sales or their registration.

Most notably, Norway has a target of 2025; the UK and Germany have a 2030 phase-out, while China has a target of 2040. The US has not set a target date for a gasoline powered vehicle ban, but the state of California set itself a target year of 2035 in September 2020²⁰. Given that California is the fifth-largest economy in the world on its own standing, the US state's stance matters.

Additionally, global gasoline vehicle sales appear to have peaked in 2017, barring a complete reversal of consumer trends which does not appear to be on the horizon. As additional market segments are served by EV manufacturers, most notably small sedans and pickup trucks, the electric share of vehicle sales will likely only grow.

However, it must be noted that COVID-19 has made breakeven scenarios for ownership costs for EVs versus gasoline vehicles confusing. For instance, many observers such as Car and Driver magazine²¹ had previously assumed that a \$100/KWhr battery would be cost competitive with an internal combustion engine. Instead oil prices plummeted in 2020, thereby giving gasoline vehicles a reprieve.

Of course, many industry commentators do suggest that some of the technologies already announced will put battery prices substantially below \$100/KWhr sooner rather than later. If that is the case, either EV makers will be able to have very large margins or sell for less than gasoline vehicle makers can compete with.

For their part, most OEMs could continue the juggling act of marketing as well as manufacturing EVs and gasoline vehicles contingent upon the domestic dynamic of each market they operate in, before phasing in what is incrementally appearing to be a world where human mobility, especially ground transportation, will be powered by electricity.

²⁰ Theclimatecenter.org, June 2021

²¹ Car and Driver Magazine: Focus on EVs <https://www.caranddriver.com/ev/>

Conclusion: Approaching horizon favors investing in unstoppable trends



Given the ongoing innovation and technological changes, we are now at a 'point of no return' with a clear emphasis on clean energy. However, we have to be pragmatic enough to acknowledge that the trends tracked in this paper are long-term trends, albeit ones that investors with faith in the spirit of human ingenuity would want to back.

As fuel cell powered mobility thrives, fossil fuels face a precarious near-term as well as long-term future. Focusing on the here and now, the world is likely to have lost over two years' worth of net crude demand growth as the COVID-19 pandemic recedes. And near-term demand growth trends remain weak, given that the pandemic hit human mobility with the rise of the remote working, lower vehicular traffic and stunted appetite for commercial flying.

While multiple factors are accelerating energy transition, the fossil fuels business is being reshaped as well to

cope with medium-term challenges to begin with. As bankruptcies mount, the oil and gas industry is being restructured. That includes the US, the world's largest oil liquids producer, catapulted to that position by shale exploration and production.

Yet, no one should write off either the US, as it should remain a critical global marginal hydrocarbon supplier, or the oil and gas industry which would re-gear itself more towards petrochemicals and aviation where there appear to be no near-term viable substitutes.

From the Office of Innovation's perspective, the future of clean energy looks positive given the substantial focus on addressing climate change that we continue to witness, alongside the drive towards investments focused on technology and data. It is generally inescapable that the costs of renewable energy are coming down in key

markets, as variously noted earlier in this paper. A recent study by BloombergNEF²² noted that, it is now cheaper to build and operate new large scale wind or solar plants in nearly half the world, than it would be to run an existing coal or gas-fired power plant.

Furthermore, it is not just the adoption of the new, but the steady, if not rapid, phase out of the old that suggests both energy transition and efficiency would be the hallmarks of a low carbon global economy. Of course, policy regulations, socioeconomic and geopolitical challenges will continue to play a major role in setting energy policies as more and more countries embrace these exponential changes. To offer a few cases in point:

- **Policy Initiatives:** The European Union has an explicit policy target through its Renewable Energy Directive II (RED II) setting a new binding renewable energy target of at least 32% across the 27-nation economic bloc²³.
- **Low carbon overtures:** Clothing supply chain and transportation companies are looking to lower their energy costs and transfer savings down the value chain with online sales outgrowing in-store sales in many developed e-commerce markets.
- **Fuel efficiencies:** Major airline companies around the world have retired their Boeing 747 four-engine jet planes with British Airways, the largest transatlantic operator of the model, announcing an immediate end to its fleet's usage in the wake of the pandemic. These aircrafts are being replaced by new fuel efficient two-engine models.
- **Oil demand recovery will remain challenging:** The International Energy Agency expects global oil demand to recover by 5.5 million bpd to 96.6 million bpd in 2021, following an unprecedented collapse of 8.8 million bpd in 2020²⁴. That is still well short of global demand recorded in 2019, with the pandemic reversing nearly a decade's worth of demand growth.

In many ways, the energy sector offers an opportunity for investors seeking to add growth potential to their investment portfolios by harnessing the power of unstoppable trends. Many investors have little to no renewable energy exposure in their portfolios. Hence, this sector presents an opportunity, more particularly so given how we perceive the global growth outlook to be in step with the technology revolution in major economies that lean towards clean energy and sustainability.

Environmental, social and governance (ESG) based strategies are growing significantly along with the assets under management (AUMs) managed by professional managers who place emphasis on it. We are strategically placed to assist you in tapping emerging opportunities arising out of unstoppable trends like the ongoing energy transition. Both Citi Private Bank and the wider Citi

family are committed to the highest ESG principles and opportunities that the ongoing energy transition brings for investors and consumers alike.

In August 2020, we announced our 2025 Sustainable Progress Strategy; a new five-year effort to accelerate the transition to a sustainable future which will focus on climate risk, low carbon transition and sustainable operations. Going a step further on 1 March 2021, our group CEO Jane Fraser committed Citi to net-zero emissions by 2050²⁵. It reaffirms our commitment to reducing our greenhouse gas emissions to as close to zero as possible and removing the rest from our atmosphere. For us, such a transition to more sustainable business practices can mitigate risk, unlock value over the long-term and can be another competitive advantage.

Carefully considered investment spectrum and clean energy options are mapped based on risk and return in *Figure 9*. Selective sectors where these trends prevail continue to grow rapidly and there are other sectors on the cusp of embracing these trends. The same goes for regions around the world where some are adopting these exponential changes faster than others.

So how can clients take the right steps in incorporating these trends as part of their portfolios? Getting appropriate investment exposure to these wide-ranging trends presents more of a challenge to investors than identifying the trends themselves.

A number of our clients have no or minimal exposure to unstoppable trends. For those who have exposure to the unstoppable trends, these are generally in line with the benchmark. The best pathway forward is to consult your private banker who can help you:

1. Perform a portfolio health check-up with the help of Global Investment Lab's proprietary tools to identify exposures to these trends based on your customized objectives and current holdings. But before doing this, investor suitability needs to be addressed including professional, accredited or institutional investor status. The analytics results are available for investors who meet these criteria.
2. Provide a detailed report titled, 'Outlook watchlist,' which compares your exposure to these favored trends from Citi Private Bank's investment outlook.
3. Get access to Citi Research's Global Theme Machine which combines the insights from our fundamental analysts around the globe with a rigorous quantitative analytical framework to evaluate the relative attractiveness of themes on a number of different financial metrics.
4. Share our insights through advice on your Investment Policy Statement, adding these trends into your portfolios to fill the gaps.

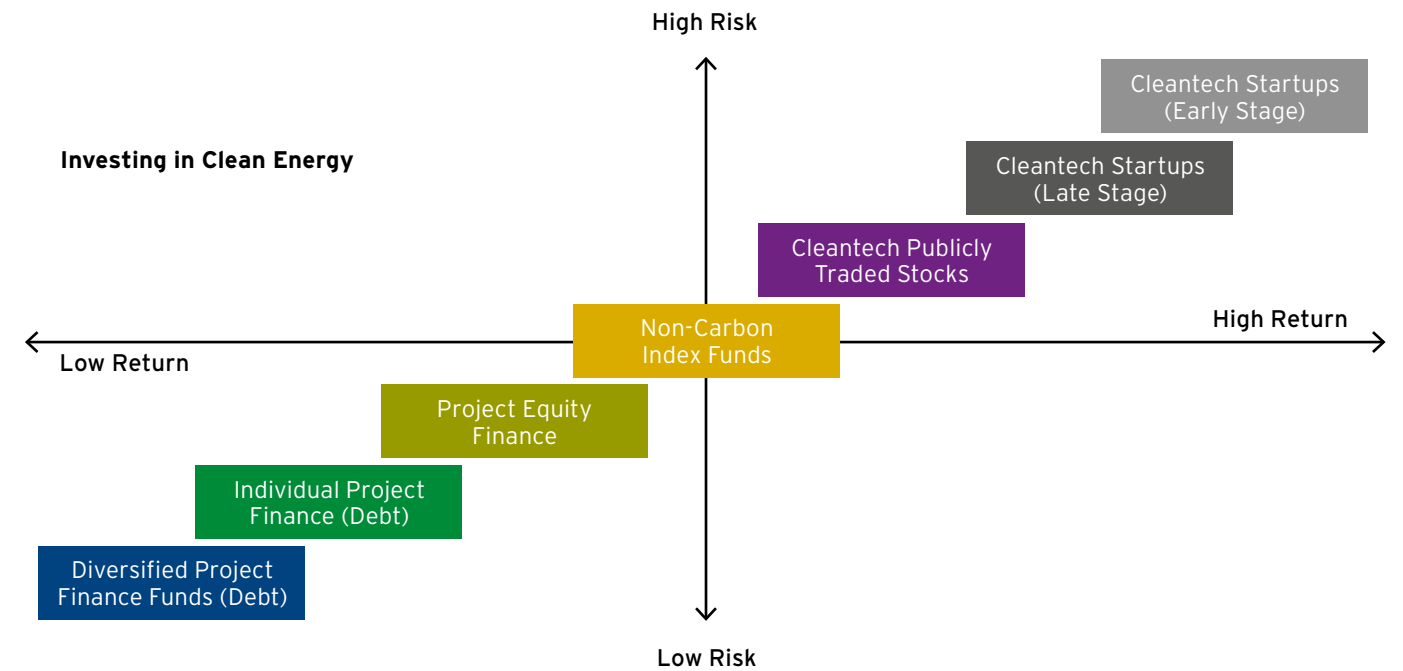


Figure 9. Clean Energy Investment Opportunities and Risk Spectrum, Jun 2020

5. Keep you informed on upcoming marketing events focused on these trends.
6. Finally, connect you with our Global Innovation team which can provide latest insights and trends impacting the world - disruption in demand and supply side and shifting dynamics in various industries, including energy, on account of innovation.

Summing it all up, if you are a family office wealth manager or high net worth individual, then you may need to look at your overall portfolio including exposure to direct investing which may correlate with these unstoppable trends.

It is important to do a holistic portfolio review as more and more family offices and investors focus on early-stage startups and plan to keep that trend going during the pandemic, and long after it has receded. We believe that diversifying across sectors should be a key component of your overall planning, and perhaps even an imperative.

For more on this subject, please consult your private banker or investment counselor. We hope that Citi Private Bank can help you navigate these changed times and explore the myriad investment opportunities that have arisen.

Viswanathan Venugopala
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²²Source: Energy and Science, Building New Renewables, Bloomberg Green, 23 June 2021.

²³Source: EU Science Hub, December 2018, <https://ec.europa.eu/jrc/en/jec/renewable-energy-recast-2030-red-ii>

²⁴IEA cuts 2021 oil demand outlook as new Covid lockdowns weigh on fuel sales, By Sam Meredith, CNBC, 19 January 2021 <https://www.cnbc.com/2021/01/19/oil-ia-cuts-2021-demand-outlook-on-renewed-covid-lockdown-measures.html>

²⁵Citi CEO Jane Fraser Day One Message: <https://www.citi.net/EN/Pages/Global/News/day-one-jane-fraser-ceo.aspx>

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About Citi Private Bank's Office of Innovation



Citi Private Bank's Office of Innovation was established specifically to help clients meet the challenges and opportunities which our rapidly changing world presents us with. Technological advancements are constantly transforming the way that we live and do business. Citi Private Bank clients are typically innovators by their very nature. They and their families have often generated their wealth via innovative businesses or business practices.

The challenge they now face is trying to preserve and grow that wealth by ensuring that their investment portfolios reflect and anticipate innovation's effects upon the economy and their assets. A key part of this exercise is keeping up with and understanding the rapid developments that are occurring.

Our purpose

The Office of Innovation not only better prepares our clients, but also the Private Bank for the future. Embedded within the innovation network of the wider Citi family, the Office of Innovation is both a sense maker and a connector – sharing insight by bringing the outside in and the inside out.

How we serve that purpose

- Events and forums – bringing clients and distinguished thought leaders together to make connections
- White papers and thought pieces – illustrating how innovation topics are relevant to private banking clients and their offices
- Global insights - sharing global themes, industry insights, and investment methodology from research and investment professionals
- Connecting clients to our internal network – bringing the best of Citi's innovation from Treasury and Trade strategies, to Citi Innovation Labs, Citi Ventures, and different research areas to clients
- Investor community – participating in wider forums across the private wealth and asset management industry
- Collaboration and partnership – collaborating with academic and technology partners such as Imperial College London.

Glossary

Asset class definitions:

Cash is represented by US 3-month Government Bond TR, measuring the US dollar-denominated active 3-Month, fixed-rate, nominal debt issues by the US Treasury.

Commodities asset class contains the index composites – GSCI Precious Metals Index, GSCI Energy Index, GSCI Industrial Metals Index, and GSCI Agricultural Index – measuring investment performance in different markets, namely precious metals (e.g., gold, silver), energy commodity (e.g., oil, coal), industrial metals (e.g., copper, iron ore), and agricultural commodity (i.e., soy, coffee) respectively. Reuters/Jeffries CRB Spot Price Index, the TR/CC CRB Excess Return Index, an arithmetic average of commodity futures prices with monthly rebalancing, is used for supplemental historical data.

Emerging Markets (EM) Hard Currency Fixed Income is represented by the FTSE Emerging Market Sovereign Bond Index (ESBI), covering hard currency emerging market sovereign debt.

Global Developed Market Corporate Fixed Income is composed of Bloomberg Barclays indices capturing investment debt from seven different local currency markets. The composite includes investment grade rated corporate bonds from the developed-market issuers.

Global Developed Market Equity is composed of MSCI indices capturing large-, mid- and small-cap representation across 23 individual developed-market countries, as weighted by the market capitalization of these countries. The composite covers approximately 95% of the free float-adjusted market capitalization in each country.

Global Developed Investment Grade Fixed Income is composed of Bloomberg Barclays indices capturing investment-grade debt from twenty different local currency markets. The composite includes fixed-rate treasury, government-related, and investment grade rated corporate and securitized bonds from the developed market issuers. Local market indices for US, UK and Japan are used for supplemental historical data.

Global Emerging Market Fixed Income is composed of Bloomberg Barclays indices measuring performance of fixed-rate local currency emerging markets government debt for 19 different markets across Latin America, EMEA and Asia regions. iBoxx ABF China Govt. Bond, the Markit iBoxx ABF Index comprising local currency debt from China, is used for supplemental historical data.

Global High Yield Fixed Income is composed of Bloomberg Barclays indices measuring the non-investment grade, fixed-rate corporate

bonds denominated in US dollars, British pounds and euros. Securities are classified as high yield if the middle rating of Moody's, Fitch, and S&P is Ba1/BB+/BB+ or below, excluding emerging market debt.

Ibbotson High Yield Index, a broad high yield index including bonds across the maturity spectrum, within the BB-B rated credit quality spectrum, included in the below-investment-grade universe, is used for supplemental historical data.

Hedge Funds are composed of investment managers employing different investment styles as characterized by different sub categories – HFRI Equity Long/Short: Positions both long and short in primarily equity and equity derivative securities; HFRI Credit: Positions in corporate fixed income securities; HFRI Event Driven: Positions in companies currently or prospectively involved in wide variety of corporate transactions; HFRI Relative Value: Positions based on a valuation discrepancy between multiple securities; HFRI Multi Strategy: Positions based on realization of a spread between related yield instruments; HFRI Macro: Positions based on movements in underlying economic variables and their impact on different markets; Barclays Trader CTA Index: The composite performance of established programs (Commodity Trading Advisors) with more than four years of performance history.

High Yield Bank Loans are debt financing obligations issued by a bank or other financial institution to a company or individual that holds legal claim to the borrower's assets in the event of a corporate bankruptcy. These loans are usually secured by a company's assets, and often pay a high coupon due to a company's poor (noninvestment grade) credit worthiness.

Private Equity characteristics are driven by those for Developed Market Small Cap Equities, adjusted for illiquidity, sector concentration, and greater leverage.

Index definitions:

Bloomberg Barclays US Corporate Bond Index measures the investment grade, fixed-rate, taxable corporate bond market. It includes US dollar denominated securities publicly issued by US and non-US industrial, utility and financial issuers.

Bloomberg Barclays US Treasury Index measures US dollar-denominated, fixed-rate, nominal debt issued by the US Treasury.

FTSE All-World Index is a stock market index representing global equity performance that covers over 3,100 companies in 47 countries starting in 1986.

MSCI AC Asia ex-Japan Index captures large and mid-cap representation across two of three Developed Markets (DM) countries* (excluding Japan) and 9 Emerging Markets (EM) countries* in Asia. With 1,187 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

MSCI China Index captures large and mid-cap representation across China A shares, H shares, B shares, Red chips, P chips and foreign listings (e.g. ADRs). With 704 constituents, the index covers about 85% of this China equity universe.

MSCI Emerging Markets Index captures large and mid-cap representation across twenty-four Emerging Markets (EM) countries. With 837 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

MSCI Emerging Markets EMEA Index captures large and midcap representation across 11 Emerging Markets (EM) countries* in Europe, the Middle East and Africa (EMEA). With 173 constituents, the index covers approximately 85% of the free float adjusted market capitalization in each country.

MSCI Emerging Markets (EM) Latin America Index captures large and mid-cap representation across five Emerging Markets (EM) countries in Latin America. With 113 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

MSCI Europe Index captures large- and mid- cap representation across 15 Developed Markets (DM) countries in Europe*. With 437 constituents, the index covers approximately 85% of the free float-adjusted market capitalization across the European Developed Markets equity universe.

MSCI Global Alternative Energy Index includes developed and emerging market large, mid and small cap companies that derive 50% or more of their revenues from products and services in Alternative energy.

MSCI ACWI Energy Index includes large and midcap securities across 23 Developed Markets (DM) and 27 Emerging Markets (EM) countries. All securities in the index are classified in the Energy as per the Global Industry Classification Standard (GICS).

MSCI ACWI Index is MSCI's flagship global equity index, is designed to represent performance of the full opportunity set of large and midcap stocks across 23 developed and 27 emerging markets. As of November 2020, it covers more than 3,000 constituents across 11 sectors and approximately 85% of the free float-adjusted market capitalization in each market.

The VIX or the Chicago Board Options Exchange (CBOE) Volatility Index, is a real-time index representing the market's expectation of 30-day forward looking volatility, derived from the price inputs of the S&P 500 index options.

Other terminology:

Adaptive Valuations Strategies is Citi Private Bank's own strategic asset allocation methodology. It determines the suitable long-term mix of assets for each client's investment portfolio.

Correlation is a statistical measure of how two assets or asset classes move in relation to one another. Correlation is measured on a scale of 1 to -1. A correlation of 1 implies perfect positive correlation, meaning that two assets or asset classes move in the same direction all of the time. A correlation of -1 implies perfect negative correlation, such that two assets or asset classes move in the opposite direction to each other all the time. A correlation of 0 implies zero correlation, such that there is no relationship between the movements in the two over time.

EU or the European Union is a political and economic union of 27 member states in Europe.

IEA or the International Energy Agency is an autonomous intergovernmental organization established in the framework of the OECD in the wake of the 1973 oil crisis to further energy consumers' interests.

IRENA or the International Renewable Energy Agency is an intergovernmental organization supporting countries in their transition to a sustainable energy future.

LIBOR or London interbank offered rate is the rate of interest at which banks offer to lend funds to each other. It is used as a reference rate for large amounts of financial contracts.

OECD or the Organisation for Economic Co-operation and Development is an intergovernmental economic organization with 38 member countries, aimed at stimulating economic progress and world trade.

OPEC or the Organization of the Petroleum Exporting Countries is an intergovernmental organization of 13 oil producing countries.

Sharpe ratio is a measure of risk-adjusted return, expressed as excess return per unit of deviation, typically referred to as risk.

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