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Energy transition: investment perspective

Key takeaways

- The renewable energy sector, especially solar PV and wind, is witnessing substantial growth. Global annual renewable capacity additions surged by almost 50% in 2023, driven largely by China. The IEA forecasts that wind and solar PV will become the leading sources of electricity by 2025 and 2026, respectively.
- Global and regional policies are crucial in driving the clean energy transition. Significant measures include the EU's "Fit for 55" package and the U.S. Infrastructure Investment and Jobs Act (IIJA). However, inconsistencies in policy implementation and the potential for regulatory changes pose risks to the sector's stability and growth.
- Different sectors within the clean energy transition face unique challenges. Despite these challenges, the long-term outlook for renewables remains positive due to technological advancements, decreasing costs, and strong government support. Traditional sectors like utilities and oil majors are also navigating the transition with a mix of traditional and renewable energy investments, facing both regulatory pressures and market opportunities.

01 Introduction

We published our previous report on the energy transition in early 2023. Since then, renewables capacity and output has continued to rise: the energy transition continues apace. However, firms in some renewables energy sectors have found the going tough, due to the macroeconomic environment and/or international competition, and this has influenced investors' perceptions of the energy transition. This report is therefore intended to take a closer look at investment angles around the transition, looking also at it from the perspective of earnings and valuations measures. As we discuss, we also think that a more holistic view of the energy transition continues to suggest opportunities in areas such as utilities and energy storage, particularly given rising demand for AI-related power. As has been much discussed in the past year, global oil demand now seems unlikely to peak before the end of this decade, but we would argue that risks remain around hydrocarbons investment. In short, expect continued transformation of the energy landscape.

02 The rise of renewables

According to the International Energy Agency (IEA), global CO_2 emissions rose by approximately 1.5% in 2023 as global economies recovered from the pandemic. However, this was lower than the economic growth rate, indicating some decoupling of emissions from economic activity.

Such decoupling will have been helped by a step change in **renewable capacity additions** in 2023, driven by China's solar PV market. Global annual renewable capacity additions increased by almost 50% to nearly 510 gigawatts (GW) in 2023, the fastest growth rate in the past two decades. In fact, China commissioned as much solar PV in 2023 as the entire world did in 2022, while its wind capacity also grew by 66% year-on-year.[1]

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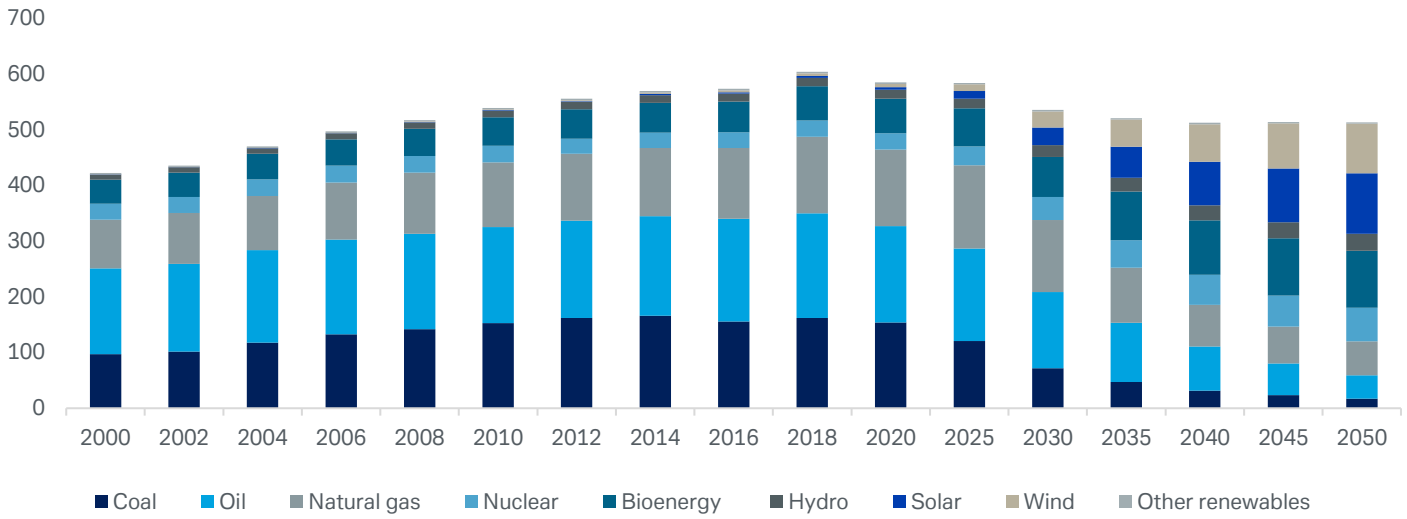
Figure 1: Global energy generation by technology according to IEA Net Zero Emission forecasts



Source: IEA NZE forecasts, Deutsche Bank AG. Data as of March 2024.

But trends are not all positive. In parallel to this growth in renewables, China also approved 106 GW of new coal plants in 2023 and growth in coal consumption in China and India that year offset declines in the U.S. and EU. As a result, global coal consumption rose 1.4% in 2023 to a new record level.[2] Why this dual strategy? Coal has long been a cornerstone of China's energy strategy due to its abundance and the existing infrastructure. For security reasons, China is not likely to abandon hydrocarbons, despite the growth in renewable energy, particularly due to the intermittent nature of solar and wind power.

There was a marginal increase in natural gas consumption while oil consumption remained relatively stable in 2023. Nuclear power also maintained its share in the global energy mix, providing about 10% of the world's electricity.[3] Figure 1 shows historical data on energy sources and IEA forecasts. The IEA expects wind and solar PV will in 2024 jointly generate more electricity than hydropower. A year later, renewables are expected dethrone coal as the top electricity source. Wind and solar PV will both overtake nuclear power in 2025 and 2026, respectively.

The world is on course to add more renewable capacity in the next five years than has been installed since the first commercial renewable energy power plant was built more than 100 years ago. In the main case forecast by IEA, almost 3,700 GW of new renewable capacity comes online over the 2023-2028 period, with solar PV and wind accounting for 95% of global renewable expansion.

From the energy consumption perspective, Asia, particularly China and India, accounted for the largest share of the increase in **electricity consumption** in 2023. Rapid economic growth and urbanization were key drivers. North America and Europe saw moderate increases in electricity consumption, with a strong emphasis on efficiency improvements and electrification of transport.[4] With renewables increasing their share of electricity supply, more attention may now be paid to greening "difficult-to-electrify" final energy consumers.

03 Policy and regulation

During the last years we have witnessed an unprecedented push at the international and regional level towards net zero commitments and the clean energy transition. The **Glasgow Climate Pact**, adopted at the United Nations Climate Change Conference (COP26) in November 2021, marked a pivotal moment in global climate policy, reflecting a significant shift towards cleaner energy sources and emphasising the importance of climate finance for developing economies. The subsequent COP28 agreement featured the first-ever "global stocktake" of climate action, a comprehensive assessment of how countries are progressing towards the goals set by the Paris Agreement.

The COP28 agreement called for a tripling of renewable energy capacity and a doubling of energy efficiency improvements by 2030 but has been criticised for its lack of specific mandates or timelines for phasing out fossil fuels. At COP29, which will take place in Baku, Azerbaijan, from November 11-22, 2024, several key developments are expected. The primary focus will be on establishing a new climate finance goal to replace the existing USD100bn annual commitment, addressing the financial needs of developing countries for their climate transition. There will also be significant emphasis on updating and enhancing Nationally Determined Contributions (NDCs) before the 2025 deadline to ensure they align with the goal of limiting global warming to 1.5°C.

At a regional level, governments have introduced a variety of regulations to foster the clean energy transitions in their respective countries on the back of international agreements. The European Union's "Fit for 55" package, also introduced in 2021, pledged to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Key components include the Carbon Border Adjustment Mechanism (CBAM), ensuring that imported products are subject to the same carbon

costs as those produced within the EU, and the Renewable Energy Directive (RED III), under which the EU must get at least 40% of its energy from renewable sources by 2030. Lastly, the EU's Energy Efficiency Directive (EED) has imposed energy efficiency gain targets for 2030.We do not anticipate any rollback of current EU regulations, despite fiscal and other pressures.

The **U.S.** Infrastructure Investment and Jobs Act (IIJA), enacted in 2021, includes substantial investments in clean energy infrastructure (e.g. for upgrading the electricity grid and electric vehicle (EV) charging infrastructure). The U.S. Inflation Reduction Act (IRA), signed into law in August 2022, allocates USD369bn to energy security and climate change programmes, including extended and expanded tax credits for renewable energy projects, incentives for EVs, and support for carbon capture and storage (CCS).

China has also made significant policy advances through its current Five-Year Plan, which sets ambitious goals for renewable energy and carbon reduction. Launched in 2021, China's national carbon market covers power generation and has expanded to other sectors, driving emission reductions through market-based mechanisms.

The **ASEAN** Plan of Action for Energy Cooperation (APAEC) 2021-2025 aims to enhance energy security and sustainability across member states. As part of this, the ASEAN Power Grid (APG) aims to integrate renewable energy sources across the region. The APAEC also sets targets for increasing the share of renewable energy in the ASEAN energy mix and improving energy efficiency.

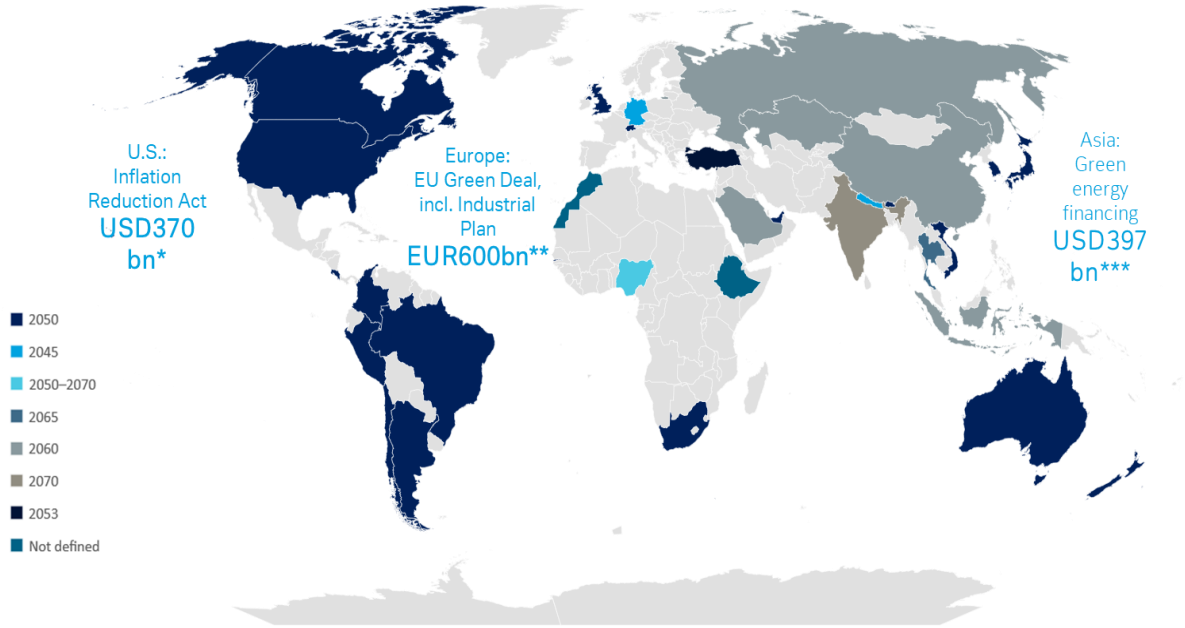
Similarly, the MENA region is advancing its energy transition with ambitious renewable energy targets, enhanced regulatory frameworks, and significant investments in green hydrogen. Key initiatives include Saudi Arabia's 58.7GW renewables target and the UAE's 50% clean energy goal by 2030. Regional cooperation, such as the Gulf Cooperation Council (GCC) Interconnection Authority, and international partnerships will be central to making this work.

Government policies and regulatory frameworks play a crucial role in supporting the renewable energy sector with, for example, the U.S. IRA making utility-scale solar and onshore wind projects more competitive on costs.

But policy support can be inconsistent and slow to adapt to new practical or economic realities. On the practical side, for example, getting permission for wind projects can take up to 10 years – something that EU's 2023 Wind Power Action Plan now hopes to address[5]. On the economic side, there is a legitimate question as to whether EU firms manufacturing some renewables technologies (e.g. solar PV and wind turbines) can be viable, given international competition. We discuss this in the next section.

What are the policy risks? The likelihood of a complete repeal of the IRA seems rather low, although some incentives could be abandoned in event of a Republican presidency and control of Congress. Given the EU's strong commitment to climate goals, extensive legislative framework, and substantial investments in renewable energy, it is unlikely that the bloc will reverse its clean transition regulations. On the other hand, a policy risk would be a deterioration in U.S. trade relations with China, which could disrupt supply chains and slow down the transition.

Figure 2: Overview of net zero target year for G20 member countries (excluding France & Italy) and selected other countries



*Approximately USD 370 billion will be allocated for measures to enhance energy security and accelerate the transition to clean energy.**The European Green Deal is also a lifeline out of the COVID-19 pandemic. One-third of the €1.8 trillion investments from the NextGenerationEU recovery program and the EU's seven-year budget will finance the European Green Deal. ***In 2021, approximately $468 billion was invested in electricity supply in Asian developing countries, with $397 billion allocated specifically to renewable energy, power grids, and storage infrastructure. Source: Climate Action Tracker, IEA, European Commission, Asian Development Bank, Sustainable Fitch, Financial Times. Data as of March 2024.

04 Global competitive dynamics and renewables value chains

There has been an increasing focus on the geopolitical dimension to global renewables value chains. Largely because of the size of its manufacturing capacity (rather than, at least for now, inherent technological advantages), China's role in the manufacture of renewables technology has become pivotal. Chinese manufacturers already dominate the global supply chain for **solar photovoltaics** (PV), benefiting from economies of scale and lower production costs. A tripling of solar PV manufacturing capacity since 2021 has contributed to a price drop of almost 50% for solar PV modules in 2023. China now controls an estimated 80-95% of the global supply of solar panels.[6]

Manufacturing capacity under construction indicates that the global supply of solar PV will reach 1,100 GW-equivalent at the end of 2024 according to the IEA. While positive in the aggregate, as they can allow for a cheaper and faster transition, price falls have put pressure on domestic PV manufacturing outside of China: policymakers in the U.S., India and EU now have to decide how much they value the benefits of local production vs. the higher prices of its output. The solar PV glut is impacting the profitability of companies throughout the supply chain, often putting particular pressure on smaller manufacturers.

In the **wind energy** sector, the global market is split between around a dozen Chinese manufacturers (which primarily serve domestic Chinese demand) and a few western firms which cater to international markets.[7] The latter have faced a range of pressures, meaning that Chinese turbines have become increasingly financially attractive, being up to 70% cheaper[8]. The rising cost of raw materials has been particularly problematic for offshore wind projects, where investment costs surged by approximately 50% in Europe from 2021 to 2023 according to a 2023 report by WindEurope. Many developers have had to cancel or delay projects, with the withdrawal of more than 12 gigawatts of wind projects in the U.S. over the past year.[9] Global competition and its related dynamics has been one of the key factors influencing the financial performance of clean energy companies, as we explain in the next section.

05 Investment perspectives

a. Renewable energy

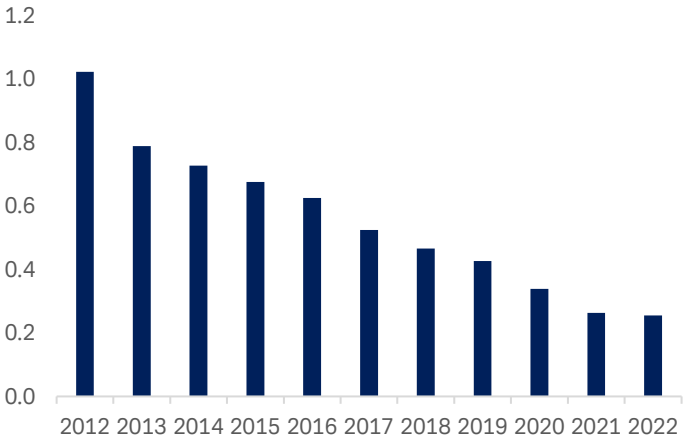
The financial and thus investment performance of renewable energy companies is and has been influenced by a wide range of factors, both macroeconomic (e.g. inflation and interest rate expectations) and sector-specific (supply gluts and global competition).

The first issue is related to the current macroeconomic environment and the related effect on clean energy companies due to their balance sheet characteristics. The problem is not just that renewable projects can be capital-intensive.

Clean energy companies also tend to be less well established than traditional energy counterparts, meaning that their **cost of capital** is usually higher and access to funds may not be as easy, especially in the context of rising interest rates. Their relatively high level of leverage means that they can be impacted more strongly by macroeconomic expectations, notably regarding future interest rate levels (higher rates imply a higher discounting of expected future revenue flows). Figure 4 below shows the negative correlation of the S&P Clean Energy Index with expectations for 10-year U.S. Treasury yields, clearly highlighting the negative effect higher rates have had on this sector.

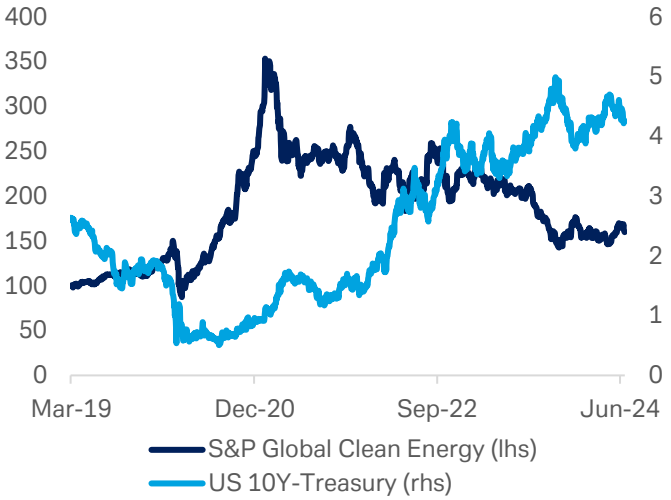
The financial performance of leading renewable energy companies is aggregated in several **clean energy indexes**, like the S&P Global Clean Energy Index or the MSCI Global Alternative Energy index. Over the past year, these indexes

Figure 3: Solar PV prices (data is expressed in USD per Watt, adjusted for inflation)



Source: Nemet (2009); Farmer and Lafond (2016), retrieved from Our World in Data. Data as of March 2023.

Figure 4: Clean energy and the negative correlations to interest rates



Source: Source: Bloomberg L.P., Datastream LSEG, Deutsche Bank AG. Data as of June 2024.

have underperformed the broader market, going down by 20% and 25.3% respectively, while the MSCI world index has recorded a positive performance of 22%. In contrast, indices for the traditional energy sector (e.g. the STOXX Europe 600 Oil & Gas and the iShares U.S. Oil & Gas Exploration & Production ETF), have shown positive returns, going up by 10.5% and 3.6% in 2023. Over three-year and five-year periods, renewable energy indexes have also generally underperformed broader market indexes, reflecting ongoing structural and economic challenges (Figure 5).

Renewable energy companies were initially seen as growth stocks with high potential but have struggled recently with lower operating margins compared to other growth sectors and traditional oil and gas industries. **Valuation measures** here need to be treated with some care: Figure 6 below, showing current next-twelve-months PE ratios across different sub-indexes vs. their 10-year median, highlights the current depressed valuations for the sector due mostly to the erosion in earnings of the past few years, often for reasons explained elsewhere in this report (e.g. inflation's impact on costs, and falling global prices for some renewables technology).

Except for the MSCI Electrical Equipment and Multi-Utilities Indexes, all the other industries are trading below their 10-year median price earnings ratio. In particular, the discount for S&P Global Clean Energy and the MSCI Renewable Electricity Producers is equal to 12% and 25% respectively, reflecting more rational values after the excessive hype witnessed in 2020-2021. Despite current discounted valuations, earnings are expected to grow in 2024 for all the above-mentioned indices except for the MSCI Oil, Gas & and Consumable Fuels and S&P Global Clean Energy. For the latter, earnings are expected to decline slightly this year, before picking up again in 2025 and onwards. On the contrary, analysts are expecting earnings for Utilities to grow at double digit levels, in combination with improving EBIT margins.

Several factors are likely to continue to have a strong impact on the performance and expansion of renewable energy companies. These include **technological and infrastructural deficiencies** (e.g. around electricity grids and the integration of variable generation), **the macroeconomic environment** (e.g. the impact of inflation and still-high interest rates on project finance and viability) and **market structure** (diverse renewables players, each with unique technological, regulatory and other challenges).

Despite these challenges, the long-term prospects for renewable energy remain positive. The sector is poised for significant growth, driven by technological advancements, decreasing costs, and strong government support. For example, 96% of newly installed wind and solar PV capacity in 2023 had lower generation costs than new coal and gas plants, highlighting the economic viability of renewables.[10]

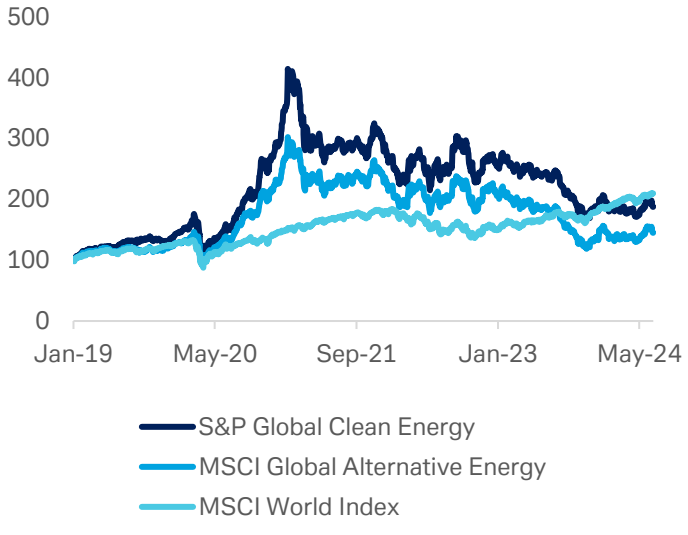
In the short term, the performance of clean energy companies will be closely tied to macroeconomic conditions, particularly interest rates and inflation, and global competition dynamics. Companies with strong balance sheets, consistent execution, and visible profitable growth are more likely to outperform.

Large-scale renewable developers with stable earnings outlooks and strong customer ties will be better positioned to navigate market pressures. Investors need to balance optimism with caution, closely monitoring market expectations and sub-sector distinctions. While the sector faces short-term uncertainties, the long-term outlook remains robust, fuelled by positive capacity growth and continued government support.

b. Utilities

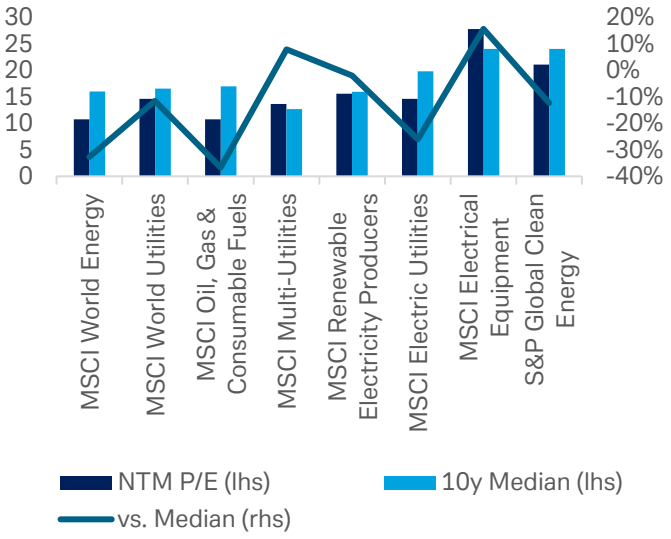
Utilities play an important role in the clean energy space. Half of the S&P Global Clean Energy Index, for example, is made up of utilities that generate significant revenues from renewable energy sources. As a key driver of demand for wind turbines and solar panels, they play a critical role in the stock performance of these and other "upstream" sectors. Increased renewables however pose some challenges to electricity grids, as we discussed in detail in last year's report, Energy transition: the quest for emissions free energy.

Figure 5: Performance of clean energy indices versus the broader market



Source: Bloomberg L.P. Data as of June 2024.

Figure 6: Price earnings ratios across different energy sub industries



Source: Datastream LSEG, Bloomberg L.P., Deutsche Bank AG. Data as of June 2024.

Utilities themselves are considered a **defensive investment** due to their often regulated, stable and slow-growing earnings. They therefore may be seen as a partial substitute for bonds, with their dividends compared against bond yields. Following the rise in bond yields last year, the gap between the dividend yield of utilities and 10-year government bonds has narrowed.

However, utilities are not immune to the economic pressures impacting renewables energy generally. Around 80% of global wind and solar energy production capacity was deployed in an interest rate environment where 10-year government bond yields were well below 3%. There are worries that higher interest rates, when debt needs to be refinanced, will affect the economic viability of some projects. As a result, some energy assets have been significantly devalued, in turn impacting the value of utilities. The broader STOXX 600 Utilities sector index is at its lowest level since 2021, while the corresponding sector index in the S&P 500 has turned negative.

Expectations of an eventual fall in interest rates suggest medium to long-term upside potential for utilities. This should be supported by the degree of inflation protection embedded in many **power purchase agreements** (PPAs). When these PPAs are renegotiated, prices received for energy can also rise sharply – in the U.S., for example, they rose by 85% for solar and wind energy between the third quarter of 2020 and the third quarter of 2023.[11] The renewal of expiring PPAs can therefore lead to significant revenue gains. There are also indications, based on recently underwritten projects, that renewables have become more financially disciplined, requiring internal rates of return well above the cost of capital.

Valuations do not appear to completely discount growth prospects. In general, U.S. and European utilities are trading well below previous next-twelve months (NTM) price-to-earnings ratios, and renewables are roughly in line with these levels. The respective multiples of 15x and 12x are about 15% below the median of the last 10 years. While analysts expect above-average earnings growth for utilities of 7% for the U.S. in 2025, only 2% is expected for Europe.

Utilities face hurdles in both **transmission and distribution** ("last mile" to consumers) of electricity. Electricity grids are often old (approximately one third of the EU's grids are already over 40 years old with this share likely to surpass 50% by 2030[12]) and the increase in electromobility and electric heating will require them to be larger, better and more regionally interconnected grids. This will require very substantial investment in the U.S., Europe and elsewhere.

Within the context of rapid renewables expansion, burgeoning demand for electricity to support artificial intelligence (AI) applications (and associated needs, for example server stack cooling) is forcing a recalibration of utility company strategies and investment plans, with some companies already highlighting AI as a crucial driver for future energy demand, encouraging some firms to increasingly invest in renewable energy sources. One study (by the Boston Consulting Group) suggests that **data centres** could account for as much as 7.5% of the total U.S. electricity consumption by 2030, up from around 2% today.

Concerns around energy supply are already driving a significant shift in AI locations. Traditionally concentrated in tech hubs like Northern Virginia and Silicon Valley, new data centres are increasingly being constructed in regions with better power availability and access to renewable energy.

For financial markets and investors, the intersection of AI and energy demand, together with the complexities related to clean energy transition, presents a complex array of opportunities and risks, with potential sectoral growth but also risks related to grid capacity and regulatory changes, with implications for distribution and pricing.

c. Oil majors

Market sentiment on fossil fuel producers has fluctuated in recent years. The slump in travel and industrial activity during the pandemic hit oil prices – at a time when low interest rates were assisting a sharp acceleration in the deployment of renewables. But with the end of pandemic-related restrictions, the outlook for fossil fuel producers picked up with European and U.S. oil majors making sharp stock market gains in 2022. Then the Russia/Ukraine war and resulting energy security concerns pushed up hydrocarbon prices and sent sector earnings to record highs.

Despite some easing of oil prices in 2023, oil and gas companies have since managed to make further gains, benefiting from improved capital discipline, the dialing back of exploration activities and focusing on projects with high expected returns on investment.

From a medium-term perspective, the IEA does not expect **global oil demand** to peak until the end of this decade, given the expected further rise in global prosperity and its non-linear relationship with demand for oil. Household incomes in more emerging markets, particularly in Asia, will soon reach and exceed thresholds at which broad sections of the population can afford cars or more travel, boosting fossil fuel demand. Growing demand should keep oil and gas companies in a relatively comfortable position in the next few years, despite expectations of further increases in supply, including from new producers.

Oil and gas stocks in the U.S. and Europe nevertheless currently trade at 8.3 and 12.0 times expected NTM earnings, 30% below their respective 10-year medians. This is perhaps due in part to concerns that implementing changes to achieve **global climate goals** could result in a much faster fading of the fossil fuel era than currently anticipated.

To keep on target for the IEA's Net Zero Emission by 2050 scenario (keeping the rise in global warming to 1.5°C), oil and gas production would need to decline by 21% and 18% respectively from their 2022 levels by 2030. Achieving "net zero" would also require a halt to the development of new oil and gas fields as well as a more than doubling of annual investment in the energy transition.

If governments are determined to limit global temperature rise, the U.N. climate panel estimates that this could cost fossil fuel investors USD 1-4 trillion, with significant stranded assets. Even in the looser scenario of limiting global temperature rises to 2°C, the IPCC reckons that roughly 80% of coal, 50% of gas, and 30% of oil reserves would need to be left in the ground.

The outlook for energy companies therefore appears trapped between two extreme scenarios: either the hydrocarbon reserves are extracted, exceeding the global carbon budget,

or governments impose and enforce the rules required to limit global warming, which would likely disrupt oil majors' business and trigger substantial asset write downs.

As of now, energy majors do not seem aligned with efforts to limit global warming and their efforts to deploy renewables may be flatlining. European majors' **energy capex plans** suggest 15-33% of investments being dedicated to renewables throughout the next few years, implying that renewable energy is set to account for 2-19% of their production mix. However, the introduction of the EU's Green Taxonomy (a detailed framework for tracking companies' activities in terms of sustainability) could provide some extra impetus for investment, e.g. via creating incentives for companies with high CO_2 emissions to invest in sustainable projects.

On the other hand, U.S. oil majors do not disclose renewable capex plans and development objectives. One estimate from S&P Global suggests that while climate-friendly businesses currently account for more than 10% of the enterprise value of European oil companies on average, they have a share of only around 3% at large integrated U.S. oil companies.

The U.S. energy sector relies heavily on the expected ramp-up of **carbon capture, utilisation and storage (CCUS)** facilities, aiming to capture approximately the equivalent of 45% of its scope 1 and 2 emissions in this way by 2030 (Scope 1 refers to a company's direct emissions, Scope 2 to indirect emissions and Scope 3 to upstream and downside emissions in value chains associated with the company's products).

d. Storage

With hydrocarbon prices likely to be supported by supply and demand dynamics, at least in the short term, there is an arguable case for favouring European energy companies which have tilt, though limited, towards higher sustainable energy investments. European oil and gas companies are valued around a third cheaper than their U.S. counterparts, as measured by the NTM P/E ratio. This can make these companies potentially better positioned for the strategic shift in their business model towards clean energy generation, taking advantage of the currently profitable fossil fuels business to further increase renewable energy capex versus their U.S. counterparts. However, they could be more exposed to risks from the regulatory enforcement of a rigorous EU green transition.

The intermittent nature of much renewable energy output (due to weather fluctuations) necessitates storage solutions. **Batteries** have emerged as a frontrunner, but storage may also be in a thermal, mechanical, or chemical (e.g. hydrogen) form.

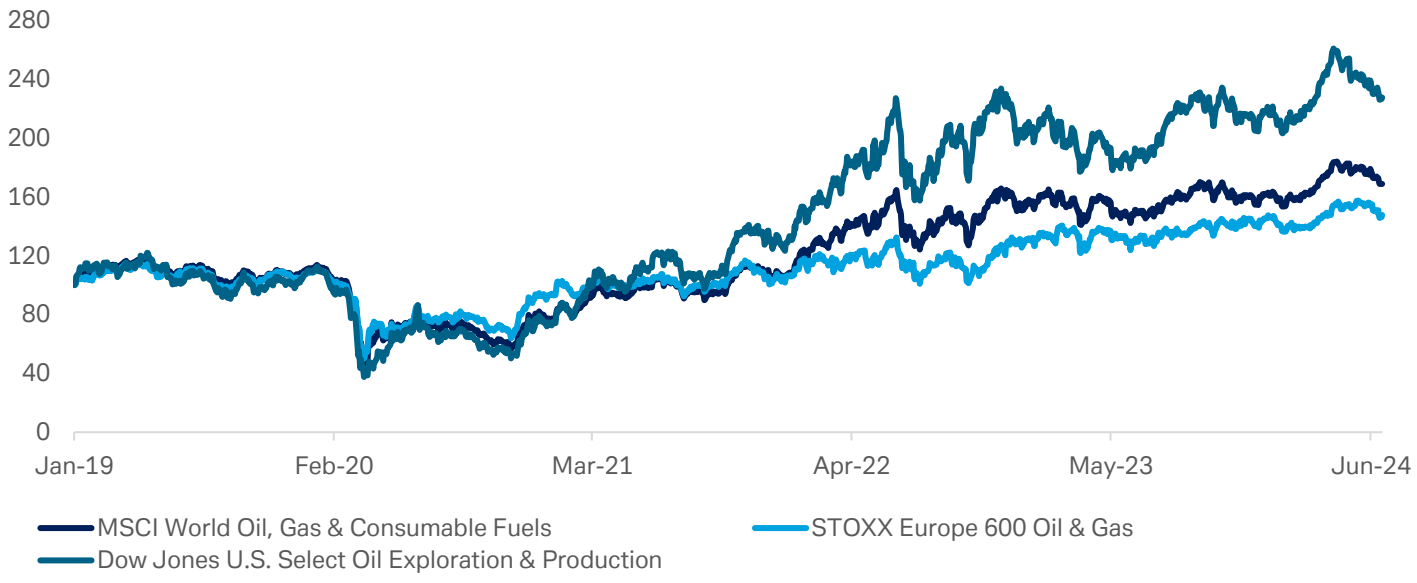
There was a fourfold increase in total battery volume between 2020 and 2023, to 2,400 GWh[13], driven largely by growth in the number of electric vehicles, but the power sector is also witnessing rapid growth in battery storage capacity, helping integrate renewables and maintaining grid stability.

Continued innovation in battery technology, coupled with cost reductions, is expected to make battery storage solutions, when paired with solar or wind, an increasingly competitive electricity source. However, there are concerns around the dominance of China's battery cell production and related critical mineral processing.

China accounted for roughly 75% of global lithium-ion battery production capacity in 2022 and processes more than half of global lithium and cobalt[14]. This has potential supply chain and geopolitical ramifications. However, diversification efforts are underway, and new **battery chemistries** (e.g. vanadium-redox or sodium-sulfur) could potentially challenge the dominance of lithium-ion in the coming years, helping ramp up utility-scale long-duration energy storage.

Despite this growth backdrop, the global battery value chain (Stoxx Global Lithium and Battery Producers Index) has returned a negative -30% over the past 12 months and is now underperforming the S&P Global Clean Energy Index by

Figure 7: Performance of selected energy sector indexes



Source: Datastream LSEG, Deutsche Bank AG. Data as of June 2024.

20 ppts. The NTM P/E valuation of this index does not appear stretched at 22x, given high double-digit earnings growth expected in 2025. However, earnings downward revisions have weighed heavily: growing Chinese battery output capacity has increased battery inventories and average battery cell prices in China fell by an estimated -50% in 2023 according to BloombergNEF– at the same time as Chinese power battery exports (excluding storage batteries) rose by 87% YoY. Globally the average battery cell price declined by more than -16% in 2023.

But with the market expected to more than double within the next 3 years, there appear to be significant growth opportunities for the big players. Korean manufacturers may also be able to increase their share of the U.S. market, from 12% in 2021 to close to 70% by 2025 according to one prediction by Goldman Sachs, at the expense of Chinese companies.

Hydrogen storage presents an alternative for certain applications if sustainably sourced, for example from water through electrolysis using renewable energy. Hydrogen can then be stored and used in fuel cells to generate electricity when needed or utilized (burned) in industrial processes or transportation. Advantages include a much higher energy density by weight than natural gas or batteries. However, electrolysis is energy-intensive, and infrastructure for hydrogen storage and transportation is still in its early stages of development.

Additionally, the efficiency of converting hydrogen back to electricity through fuel cells remains low compared to batteries. High production costs are making it difficult to conclude long-term purchase agreements and price projections mean that most startups in the industry are likely to operate unprofitably for the foreseeable future. Potential competition from China is also increasing. Accordingly, hydrogen stocks (Solactive Global Hydrogen Index) have lost almost -30% over the last 12 months and -75% over the last 3 years. Although hydrogen is likely to play a significant role in the green transformation of transport and heavy industries, investors should be cautious about hydrogen pure plays and look instead to large industrials with exposure to this area.

Carbon markets

Putting a price on carbon emissions is crucial for fighting climate change. While we are seeing developments in many parts of the world (with China being a case in point), the EU continues to have by far the largest carbon market in the world (Figure 8). However, recent price swings in the EU's Emissions Trading System (EU ETS) raise concerns about the stability of compliance carbon markets both as a policy tool and an investment.

Carbon prices in the EU ETS have fallen from a record EUR100/t in February 2023 to EUR50/t in March 2024, before climbing back again to EUR74/t recently. This has probably been due to a mix of structural (e.g. a secular fall in EU CO_2 emissions due to decarbonization) and cyclical factors. As highlighted by the European Environment Agency, half of ETS emissions come from the European industrial sector, which has been hobbled by high energy prices, recession concerns and cost inflation – taking a toll on the sector's activity levels, emissions and thus demand for carbon allowances.

Most of the rest of the ETS emissions come from the power sector, which is on a clearer decarbonization trajectory, with falls in gas prices triggering coal-to-gas switching, which in turn has decreased demand for carbon allowances given the lower emissions intensity of gas-fired vs. coal-fired power plants. There is however a cyclical element here too. Lower European demand for electricity – down almost -7% between 2021 and 2023[15] – is a consequence of price spikes in 2022 and can be expected to reverse.

Another contributory factor to the fall in carbon prices is the EU auctioning additional allowances to finance the energy transition investments required for the REPowerEU policy. This has brought forward the distribution of permits that would otherwise have been issued in the three years from 2027, essentially borrowing from future supply.

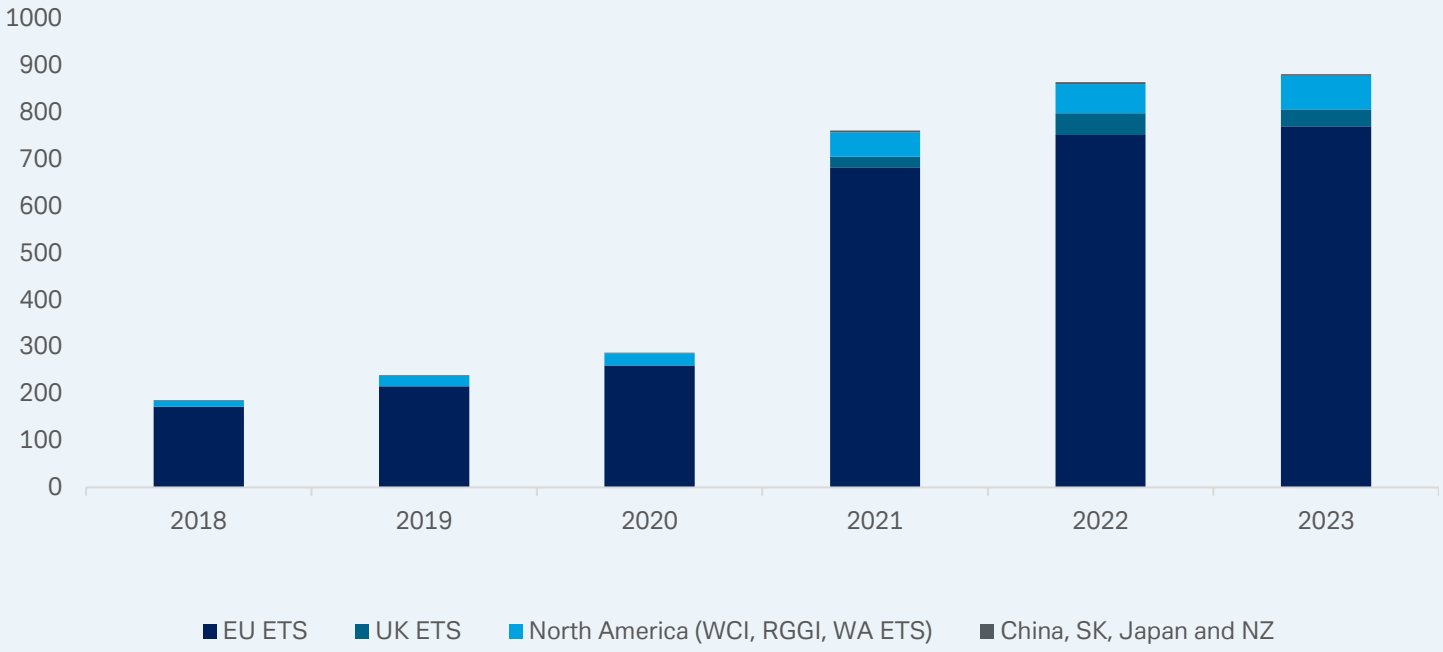
So, while the current confluence of factors – lower emissions, cheaper gas, high interest rates, and muted industrial activity – has recently kept EU carbon prices subdued, this might be a temporary lull. Low gas prices may not persist indefinitely. As the European economy recovers, industrial activity and emissions are expected to rebound. There are also concerns that current low carbon prices could discourage investment in new emission reduction technologies. Failure to invest in such technologies could further limit our ability to reduce emissions in the future, leading (at some point) to a sharper rise in permit prices as demand outpaces supply.

The EU's commitment to a sharp reduction in ETS permits by 2030 is also likely to cause a squeeze on supply. From an investor perspective, given this mandated drop in the availability of permits, even stable demand would be expected to drive prices upwards in the coming years.

Lastly, to prevent companies from simply moving production outside the EU to avoid these costs (carbon leakage), the EU is introducing a **Carbon Border Adjustment Mechanism (CBAM)**. This will put a levy on imports from countries without equivalent carbon pricing schemes, attempting to create a level playing field. The CBAM's phased rollout will see the scope of covered products and emissions gradually expand, creating a larger carbon market. Furthermore, the EU is legitimizing carbon removal technologies by establishing a certification framework. These certified carbon removal credits could potentially be included in the EU ETS, further boosting the market.

These developments in Europe, coupled with the expansion of carbon pricing initiatives worldwide, suggest a future where carbon becomes a major commodity market. While some short-term volatility is likely, investors who can weather these initial fluctuations could be well-positioned to benefit from the long-term growth of this market.

Figure 8: Carbon markets around the world



Source: LSEG, World Bank, Deutsche Bank AG. Data as of April 2024.

06 Conclusion

The ongoing clean energy transition is characterized by rapid growth in renewable energy sectors, evolving policy landscapes, and sector-specific challenges and opportunities. Renewable energy, particularly solar PV and wind, is experiencing unprecedented expansion. According to the IEA, global renewable capacity additions increased by nearly 50% in 2023, with China leading the charge. This growth is expected to continue, positioning renewables to surpass hydropower, coal, and nuclear power as the dominant sources of electricity within the next few years.

However, this rapid expansion is not without its challenges. The solar PV industry faces significant price pressures due to oversupply, particularly from Chinese manufacturers who dominate the global market. This has led to reduced profitability and increased competition for manufacturers outside China. Similarly, the wind energy sector grapples with rising raw material costs and logistical challenges, particularly for offshore projects. Despite these hurdles, the long-term prospects for renewables remain positive, driven by technological advancements, cost reductions, and strong government support. Utilities will play an essential role in this context, but their valuations do not seem to correctly discount the growth prospects at the moment.

Energy storage, crucial for managing the intermittent nature of renewable energy, is also witnessing rapid growth. Battery storage capacity quadrupled between 2020 and 2023, driven by advancements in battery technology and cost reductions.

However, the dominance of Chinese manufacturers in lithium-ion battery production raises supply chain and geopolitical concerns. Diversification into alternative battery chemistries and continued innovation are vital for sustaining growth. The sector's performance has been mixed, with the global battery value chain underperforming recently despite expected high growth rates.

Finally, oil majors are also navigating a transition with a mix of traditional and renewable energy investments. Despite regulatory pressures, they have benefitted over the past years from high hydrocarbon prices and disciplined capital investment strategies. While their recent market performance has been positive, it is easy to see how they will be penalized in the future unless they adapt their business models.

In conclusion, while the renewable energy sector faces significant challenges, the overall trajectory remains positive. Continued technological innovation, supportive policies, and strategic investments are essential for overcoming current obstacles and ensuring a sustainable energy future. As the world moves towards cleaner energy sources, the potential for growth and transformation in the energy landscape remains substantial.

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Historical performance

Performance	02.07.2023 - 02.07.2024	02.07.2022 - 02.07.2023	02.07.2021 - 02.07.2022	02.07.2020 - 02.07.2021	02.07.2019 - 02.07.2020
MSCI ACWI IMI	18.70	16.00	-16.34	40.59	2.16
MSCI World Oil, Gas & Consumable Fuels Net Total Return USD Index	15.87	10.80	30.28	41.30	-34.86
STOXX Europe 600 Oil & Gas Price EUR	15.73	13.15	7.12	33.92	-30.49
iShares U.S. Oil & Gas Exploration & Production ETF	20.25	12.72	39.76	79.85	-37.01
S&P Global Clean Energy Index	-26.21	-3.19	-16.49	85.08	21.57
MSCI GLOBAL ALTERNATIVE ENERGY INDEX	-27.01	-8.71	-15.38	69.88	14.49
MSCI World Index	20.84	18.15	-14.28	39.40	3.71
MSCI World Energy Sector Index	16.18	12.68	31.26	44.63	-34.81
MSCI World Utilities Sector Index	5.15	0.50	5.28	14.02	1.76
MSCI World Multi-Utilities GICS Level 3 Index	1.07	-1.58	9.60	9.88	-1.59
MSCI ACWI Indp. Pwr. Producers & Renewable Electricity Producers Index	28.73	-3.71	6.73	19.82	-9.72
MSCI ACWI Electric Utilities Index	7.28	2.52	5.06	15.68	3.05
MSCI World Electrical Equipment Index	27.46	36.32	-29.33	52.96	7.35
Bloomberg Goldman Sachs Global Clean Energy Index Net Return	-11.65	1.96	-10.03	73.16	27.00
U.S. Generic Govt 10 Year	-0.40	-3.90	9.90	-4.00	12.40
Natural Gas*	-13.01	-51.17	54.86	113.38	-22.59
Crude Oil WTI*	18.11	-34.85	44.27	84.90	-27.73
Crude Oil Brent*	15.87	-32.90	46.55	76.56	-30.87

Total return in USD. *Percentage change in price over stated time horizon (USD).
Source: Bloomberg L.P., Deutsche Bank AG. Data as of July 02, 2024.

Glossary

The iShares U.S. Oil & Gas Exploration & Production ETF tracks the investment results of an index composed of U.S. equities in the oil and gas exploration and production sector.

The MSCI Electrical Equipment Index represents the performance of companies in the electrical equipment industry. It includes manufacturers of electrical components, machinery, and related products.

IEA (International Energy Agency) is an intergovernmental organization that focuses on energy policy, security, and sustainability. It provides research, analysis, and recommendations to member countries.

PV (Photovoltaic) refers to solar panels that convert sunlight into electricity. Photovoltaic technology is commonly used for solar power generation.

COP stands for Conference of the Parties. It refers to the annual meetings where countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC) come together to discuss and negotiate climate-related agreements and actions. These meetings play a crucial role in addressing global climate change and setting international climate policy.

Treasuries refers to U.S. Treasury securities, which are debt instruments issued by the U.S. government. They include Treasury bills, notes, and bonds.

MSCI World Index is a global equity index that tracks the performance of large and mid-cap stocks from developed countries worldwide.

P/E ratio (Price-to-Earnings ratio) is a financial metric that compares a company's stock price to its earnings per share. It helps investors assess valuation.

EBIT (Earnings Before Interest and Taxes) is a measure of a company's operating profit, excluding interest and tax expenses.

Exchange-traded funds (ETFs) are a type of investment fund and exchange-traded product, i.e. they are traded on stock exchanges.

Liquified Natural Gas (LNG) refers to natural gas in its transparent, non-toxic liquid state at temperatures below -162°C is referred to as LNG. It allows for the pressurised transport and storage of natural gas, notably over extended distances via ships.

The term "Net-zero-carbon-emissions" or "Net-zero" refers to a situation in which the economy, society, or a particular economic sector emits no carbon dioxide (CO2), either because it does not produce any or because it collects the CO2 it does produce for use or storage.

The MSCI Renewable Electricity Producers Index represents companies in the renewable energy sector that are involved in generating electricity from sources like solar, wind, hydro, and geothermal.

The 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.

The MSCI World Energy Index captures the large and mid cap segments across 23 developed markets countries.

MSCI World Utilities Index is an equity index that tracks utility companies globally. It includes companies that provide essential services such as electricity, water, and natural gas.

MSCI Multi-Utilities Index covers diversified utility companies that operate across various segments, including electricity, gas, and water distribution.

MSCI Electric Utilities Index specifically focuses on electric utility companies that are involved in power generation, transmission, and distribution.

STOXX 600 Utilities Index is a European index that includes utility companies from various European countries.

S&P 500 Utilities Index is part of the S&P 500, tracking utility companies in the United States.

Power Purchase Agreements (PPAs) are contracts between electricity buyers (often large consumers or renewable energy developers) and electricity generators. PPAs define terms for purchasing electricity, including pricing, duration, and delivery.

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks typically requiring human intelligence. AI encompasses machine learning, natural language processing, and other advanced techniques.USD

Stoxx Global Lithium and Battery Producers Index represents companies in lithium and battery production.

Stranded assets are those assets experiencing redundancy or loss of value due to environmental challenges, changing resource landscapes, new government regulations and evolving social norms.

Solactive Global Hydrogen Index focuses on companies related to hydrogen energy.

EU's Emissions Trading System aims to reduce greenhouse gas emissions by creating a market for trading emission allowances.

REPowerEU planaims to reduce the EU's dependence on fossil fuels and accelerate the transition to clean energy.

S&P Global Clean Energy includes companies in the clean energy sector, such as renewable energy producers.

MSCI Oil, Gas & and Consumable Fuels Index covers companies in the oil, gas, and fuel industries.

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