Guinness Sustainable Energy

Investment Commentary – December 2024

RISK

This is a marketing communication. Please refer to the prospectus, supplement and KID/KIID for the Funds, which contain detailed information on their characteristics and objectives, before making any final investment decisions.

The Funds are equity funds. Investors should be willing and able to assume the risks of equity investing. The value of an investment and the income from it can fall as well as rise as a result of market and currency movement, and you may not get back the amount originally invested. Further details on the risk factors are included in the Funds' documentation, available on our website.

Past performance does not predict future returns.

ABOUT THE STRATEGY

Launch	19.12.2007
Index	MSCI World
Sector	IA Commodity/Natural Resources
Managers	Will Riley Jonathan Waghorn
EU Domiciled	Guinness Sustainable Energy Fund Guinness Sustainable Energy UCITS ETF
UK Domiciled	WS Guinness Sustainable Energy Fund

INVESTMENT POLICY

The Guinness Sustainable Energy Funds are managed for capital growth and invest at least 80% in companies involved in the generation, storage, efficiency and consumption of sustainable energy sources (such as solar, wind, hydro, geothermal, biofuels and biomass). We believe that over the next twenty years the sustainable energy sector will benefit from demand growth, improving economics and both public and private support, offering attractive investment opportunities. The Funds are actively managed and use the MSCI World Index as a comparator benchmark only.

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COMMENTARY

ENERGY ISSUES FOR THE TRUMP ADMINISTRATION

Surging electricity demand, as a result of the growth of artificial intelligence and the wider trend of electrification, is the most critical energy issue as Donald Trump assumes office in January. For him to win the 'AI arms race', he will need to oversee significant grid upgrades and near-term growth in both renewable and natural gas-based power generation, because new nuclear is unlikely to play a part before the mid-2030s.

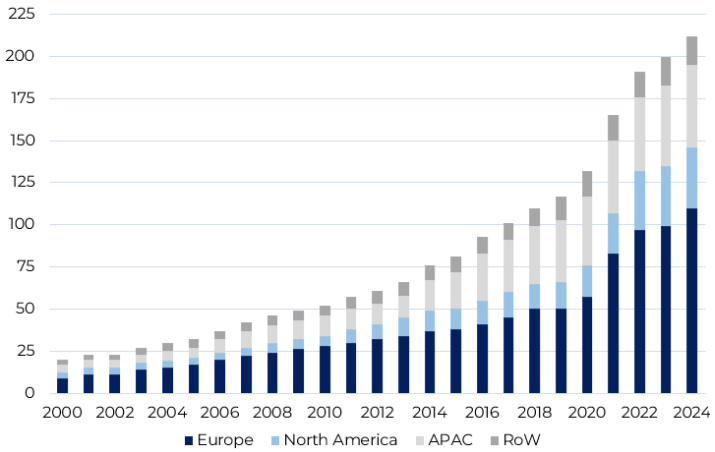
EQUITIES

The Guinness Sustainable Energy Fund (Class Y) delivered a return of -1.4% (in USD) in November, underperforming the MSCI World at +4.6%. Following the election of Donald Trump, we saw US industrials rally, with Owen's Corning, Eaton and Trane Technologies among the fund's top performers. Meanwhile, wind names Vestas and TPI Composites were among the fund's weakest performers as concerns around the future of the Inflation Reduction Act weighed on sentiment towards renewables and EVs.

CHART OF THE MONTH: EFFICIENCY REGULATIONS

Data from the International Energy Agency (IEA) suggests that global policy remains highly supportive for the energy efficiency sector. The number of national policies in force targeting building design, envelope technologies and insulation hit a new record in 2024, having increased by around 80% since 2019.

National building efficiency policies in force globally



Source: IEA, 2024

PRI Principles for Responsible Investment

NOVEMBER NEWS AND EVENTS IN REVIEW

In this section, we review the key news items and their impact on our various portfolio sub-sectors over the last month.

News	Sub-Sector	Impact
COP29 resulted in a series of important developments for the sustainable energy space. Mexico set a 2050 net zero target, an important milestone that means that 14 of the world's 15 largest emitters have now set such a target. Meanwhile, Indonesia announced that it would bring forward its target of retiring all coal-fired plants by 16 years to 2040. As Indonesia operates the world's fifth largest coal-fired power fleet, the announcement would have a material impact on global emissions if achieved. Progress was also made towards a global carbon credit platform, with steps being made to implement agreed guidelines and improve accounting methodologies.	COP 29	
Reports that Total is nearing a deal to acquire the German renewable developer VSB Group for c.€2bn continued a trend of M&A in the sustainable energy space. In the same month, EQT and GIC announced that they would acquire a joint stake in Calisen, a UK smart metering company, in a deal that values the company at approximately £4bn. These deals follow previously announced takeovers in the sustainable energy space this year, including KKR's bid for Encavis, Rio Tinto's acquisition of Arcadium Lithium, and Equinor's recent offer for a 10% stake in Orsted.	Sustainable energy M&A	
In November, the CEOs of both Orsted and Vestas commented that they expect demand for green energy in the US to continue to grow, regardless of Trump's re-election. The industry is set to benefit from falling interest rates and a normalisation of raw material prices following a period of significant inflation. Orsted's CEO commented that demand is being driven by both nations and corporations, highlighting the role of clean energy in meeting the growing power demands of data centres.	US renewables	
A recent Energy Information Administration (EIA) report outlined the extent to which US power demand is set to increase over 2024/25, having been effectively flat for the previous two decades. The EIA expects power demand to rise by around 2% per annum over the next two years driven by the adoption of artificial intelligence and data centers. In a similar report, S&P Global estimates that data centre growth will require around 50GW of new generation capacity to be added through 2030, requiring $60bn of investment across both generation and transmission.	US power demand	
In November, Chinese regulators affirmed the country's commitment to the energy transition with the signing of the new Energy Law. The development addresses a legislative gap by establishing a comprehensive regulatory framework for the energy sector and provides industry participants with clear direction and the confidence necessary to make long-term investments. The government also took action to address overcapacity in the solar PV manufacturing space by increasing guidelines for minimum capital ratios on PV manufacturing projects from 20% to 30%.	China's energy transition	

MANAGERS' COMMENTS

Surging electricity demand, as a result of the growth of AI searching and data centres as well as the wider trend of electrification, is the most critical energy issue in Donald Trump's in tray in January. For him to win the "AI arms race", he will need to oversee significant grid upgrades and near-term growth in both renewable and natural gas-based power generation, because new nuclear is unlikely to play a part before the mid-2030s.

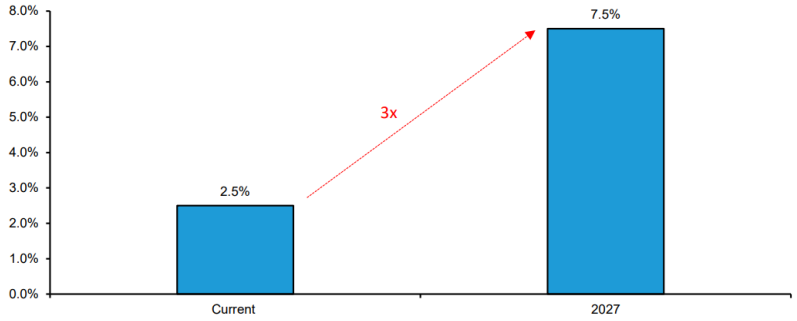
AI and data centre growth leading to higher electricity demand growth

The growth and increasing popularity of artificial intelligence (AI) is driving rapid growth in data centre demand and will cause a step change in electricity demand growth, since AI servers are 4-7 times more power-hungry than traditional servers.

The US data centre market has doubled in the last four years and existing units are practically fully utilised. Data centre rents are reaching new highs (up around 25% year-over-year), and construction of new units is booming, up sevenfold in the last two years. Looking forward, there are expectations of the data centre market growing between 10% annually between 2023 and 2026 (McKinsey) and an eye-watering 65% annually (SemiAnalysis).

According to Bernstein, power demand for these data centres is poised to grow at 10% a year from 2023-2030, increasing from 2.5% to 7.5% of total US electricity consumption.

Data centre electricity consumption as % of total US electricity consumption



Source: BCG, Grid Strategies, Bernstein, 2024

This means that overall US electricity demand growth is biased sharply higher. The Southern Company (a US utility) announced expectations for data centres to represent 80% of all future electricity demand growth while the Georgia Power utility (in Atlanta) is forecasting that the growth in power demand to 2031 will be 28 times greater than their prior forecast, predominantly as a result of power use by AI and data centres.

Looking across the US, a number of utilities are forecasting demand growth of 2% a year to 2028 (up from the 20-year historic rate of 0%) as a result of this data centre demand which will be compounded by the broader trend of electrification plus the reshoring of manufacturing, as well as growth in the electric vehicle fleet.

To satisfy this demand and to maintain competitiveness, it is clear that Trump needs to **extend and strengthen the power grid** while also **increasing the supply of low-carbon electricity**.

Issue #1: extending and strengthening the US power grid

Seventy percent of US electricity transmission lines are over 25 years old, and less than a quarter of them are underground (compared to Europe, where the majority of lines are underground). With 180 million power poles supporting these 5.5 million miles of overhead distribution lines, it is not surprising that worsening weather and wildfires are the greatest risk to the US grid. The American Society of Civil Engineers considered these factors critical in its rating of "C-" for the grid overall, in its most recent (2021) assessment.

Permitting grid extensions has become painfully slow in the United States. It currently takes around ten years to permit new high-voltage transmission lines and the current backlog of new electricity projects awaiting grid connection is double the size of the country's current electric generating capacity. With each new data centre requiring, on average, a grid connection equivalent in size to that of a typical airport it is not surprising that new data centre connections are being delayed. Transmission and power generation issues are key factors while local community concerns about noise, environmental impacts, and stress on existing power infrastructure also cause delays.

An expanded, digitised, modernised grid will be more reliable and cost competitive and will give greater chance to have lower-cost electricity, improving prosperity and energy security whether in the United States, Europe or globally.

Issue #2: increasing the supply of economic low-carbon electricity

Every new data centre needs to have access to incremental new power supply (rather than being reliant on existing supply) and the big tech companies developing these new facilities typically target low-carbon or carbon-free power sources. As an example, Amazon co-founded the "Climate Pledge 2019" (which now has 538 signatories from 60 industries across 45 countries committing to reach net zero by 2040) and the company matches all its electricity consumption with renewable supply, while Meta has committed to reaching net zero emissions across its value chain in 2030.

These targets will clearly drive supply choices but the economics of new supply sources and their speed to market will also be important in determining the successful supply sources for new AI-driven electricity demand. Thinking about the US, there are three potential sources of material size that could help to satisfy the new electricity demand:

1. **Natural gas**, currently 43% of US generation
2. **Nuclear**, currently 19% of US generation
3. **Renewables**, currently 21% of US generation

We do not believe that coal (currently representing 16% of US generation) will see a resurgence since coal generation is in decline and the last new US coal plant was built over a decade ago. Changes in sentiment, regulation and environmental protection make further new coal plants unlikely, in our opinion.

Natural gas

Natural gas is the dominant source of US electricity generation today. Although it is not necessarily the clean fuel that big tech may seek, any short to medium-term uplift in US electricity demand will be satisfied by greater levels of natural gas combustion. This can be achieved in the near term by higher utilisation of the existing fleet (in 2023, capacity utilisation was nearly 59%) rather than new builds (which are quick to build but generally face permitting issues).

Shale gas resources are plentiful, and the supply curve of new gas resources is relatively flat, with new gas being produced at an all-in cost of around $3.50/mcf, close to current levels. At this cost, existing gas plants can provide electricity at maybe $50-60/MWh and new plants would need more like $80/MWh to be economic.

As an economic source, natural gas will therefore play a key role in supplying increasing electricity demand in the near-term. Trump supports development of US fossil fuels and, while he will make more federal lands available and reduce environmental and pollution controls on the industry, it will be the gas price that will drive future generation levels.

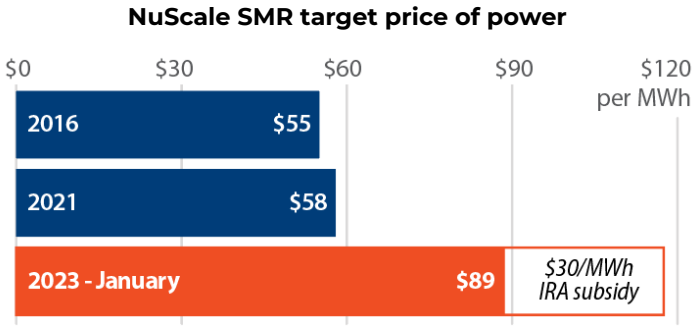
Nuclear

Several big tech companies have recently signed deals either to restart old reactors (Microsoft is paying around $130/MWh to do this at Three Mile Island, on our estimates), to pursue small modular reactors (SMRs) or to invest in start-up companies developing nuclear fusion technologies.

While the Three Mile Island deal will bring additional power from around 2028, first power from a new SMR facility is unlikely before 2032 and, even then, it is unlikely that SMRs have any meaningful impact until the late 2030s, in our opinion.

Developers of SMRs suggest that they offer the potential to deliver flexible power generation with enhanced safety performance and better up-front capital cost affordability than large-scale nuclear. In contrast, questions persist about the efficiency of SMRs, their safety claims and the level of radioactive waste that is created. All of this remains to be proved in a commercial setting as, as far as we are aware, only two SMRs are currently in operation globally, one in Russia (in a maritime setup) and the other in China. With limited information about either, the development schedule and the underlying economics of both are unclear.

The first new SMRs in the US are unlikely to be cheaper than gas or renewables-based power generation. In late 2023, NuScale cancelled its planned SMR Carbon Free Power Project (CFPP) in Utah as its costs escalated (requiring $90/MWh to be economic, after a $30/MWh IRA subsidy) and its start date slipped (back to 2029, from an original plan of 2026). We note that carbon-free base load power at $90/MWh could certainly be considered 'economic', but the history of nuclear development includes long project delays and cost overruns, implying that the subsidised $90/MWh would be very much a 'best case'. In reality, project economics could easily be 50-100% higher.



Source: UAMPS, January 2023

So, beyond restarting idled nuclear plants, nuclear does not provide a solution to sharply increasing near-term power demand. Longer-term, we would think of nuclear needing $100-150/MWh. A learning curve in developing SMRs will help to bring that down, but not to the extent that solar has deflated in recent years.

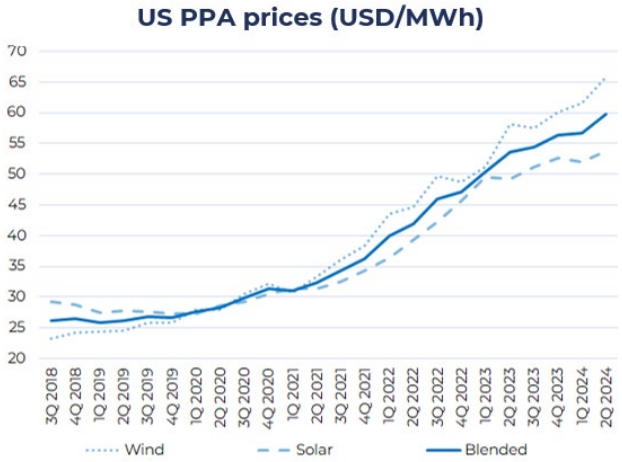
Donald Trump is a supporter of nuclear (as are the Democrats) and he has not proposed any changes to nuclear regulation, as far as we are aware. The role of grants and tax credits to incentivise R&D important for the nascent SMR industry will be critical in allowing the US to win a very important race, that Russia and China are currently leading.

Renewables

Renewable power, currently providing 21% of US power, provides a near-term solution to power demand that satisfies big tech's desire for carbon-free power.

Renewables are reasonably quick to permit and bring online, although greater penetration in the grid will ultimately require greater levels of grid-based storage, at extra cost. We think of solar needing a long-term electricity price of around $30-40/MWh for supply and maybe the same again for some storage, giving an overall project cost of around $70-80/MWh.

Amazon, Microsoft, Meta and Google are the four largest purchasers of corporate renewable energy power purchase agreements (PPAs), having contracted almost 50GW to date, equal to the generation capacity of Sweden. Recently, big tech have been paying 20% higher prices for wind-based power purchase agreements (PPAs), on the basis that a renewable power producer can provide quick access to long-term contracted electricity supply with clarity around pricing, since electricity represents 20% of the operating costs of a data centre.



Source: LevelTen, 2024

While President-elect Trump clearly needs renewables to satisfy growing electricity demand, it is interesting that investment and new projects have slowed because of uncertainty around how he will amend clean power manufacturing and investment tax credits in the Inflation Reduction Act. We see it as particularly important, therefore, that he clarify his position around manufacturing and tax credits quickly and allows the US clean energy industry to reset and support him in his desire to win "AI arms race".

PERFORMANCE

Past performance does not predict future returns.

The **Guinness Sustainable Energy Fund** (Class Y, 0.66% OCF) delivered a return of -1.4% in the month, while the MSCI World Index (net return) delivered +4.6% (all in USD terms).

Guinness Sustainable Energy Fund	Ytd	1 Yr	3 Yrs	5 Yrs	10 Yrs*
Fund (Class Y)	-3.6%	6.1%	-15.9%	85.2%	58.6%
MSCI World NR Index	21.9%	27.8%	28.7%	79.5%	160.8%
Out/Underperformance	*-25.4%*	*-21.7%*	*-44.6%*	*5.6%*	*-102.2%*

	2023	2022	2021	2020	2019
Fund (Class Y)	-0.4%	-12.5%	10.4%	84.1%	31.4%
MSCI World NR Index	23.8%	-18.1%	21.8%	15.9%	27.7%
Out/Underperformance	*-24.2%*	*5.6%*	*-11.4%*	*68.2%*	*3.7%*

	2018*	2017*	2016*	2015*	2014*
Fund (Class Y)	-15.2%	20.2%	-15.4%	-12.0%	-12.1%
MSCI World NR Index	-8.7%	22.4%	7.5%	-0.9%	4.9%
Out/Underperformance	*-6.5%*	*-2.2%*	*-23.0%*	*-11.2%*	*-17.0%*

*The Fund was launched on 19.12.2007. *Simulated past performance prior to the launch of the Y class on 16/02/2018. The Performance shown is a composite simulation for Y class performance being based on the actual performance of the Fund's E class, which has an OCF of 1.24%. On 31/12/2018, the benchmark became the MSCI World NR. Prior to this, the benchmark was the Wilderhill Clean Energy Index (ECO Index).*

The **WS Guinness Sustainable Energy Fund** (Class Y, 0.67% OCF) delivered a return of -0.8% in the month in GBP, while the MSCI World Index (net return) delivered 5.8%.

WS Guinness Sustainable Energy Fund	Ytd	1 Yr
Fund (Class Y)	-4.1%	6.0%
MSCI World NR Index	22.2%	27.3%
Out/Underperformance	*-26.3%*	*-21.3%*

	2023
Fund (Class Y)	-5.8%
MSCI World NR Index	16.8%
Out/Underperformance	*-22.6%*

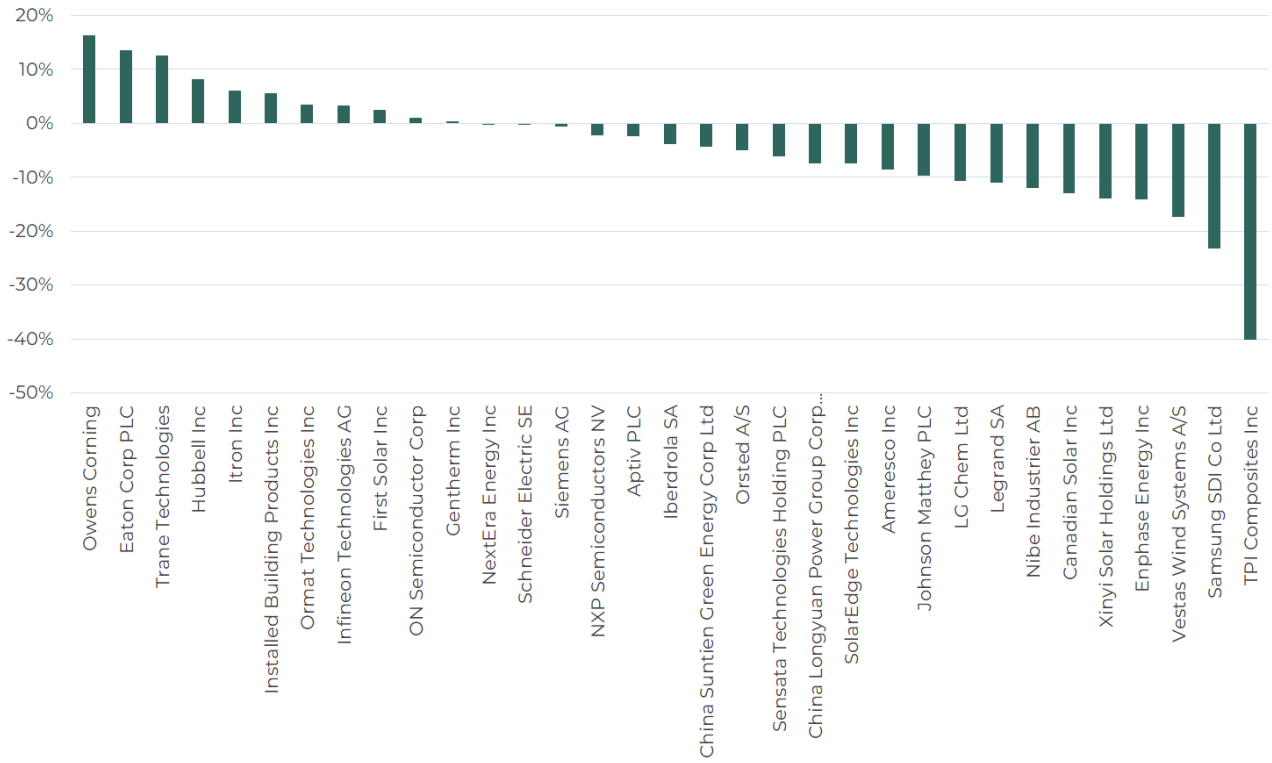
Data as of 31.10.2024. The Fund was launched on 30.12.2022.

Source: FE fundinfo, bid to bid, total return. Investors should note that fees and expenses are charged to the capital of the Funds. This reduces the return on your investment by an amount equivalent to the Ongoing Charges Figure (OCF). The performance shown has been reduced by the current OCF shown. Returns for share classes with different OCFs will vary accordingly. Transaction costs also apply and are incurred when a Fund buys or sells holdings. Performance returns do not reflect any initial charge; any such charge will also reduce the return.

Guinness Global Investors has been the investment manager of the **Guinness Sustainable Energy Fund UCITS ETF** since July 2024. We will include performance data for this vehicle in due course.

Within the Fund, the strongest performers were Owens Corning, Eaton Corp, Trane Technologies, Hubbell, and Itron while the weakest performers were TPI Composites, Samsung SDI, Vestas Wind Systems, Enphase, and Xinyi Solar

Stock by Stock performance over the month, in USD

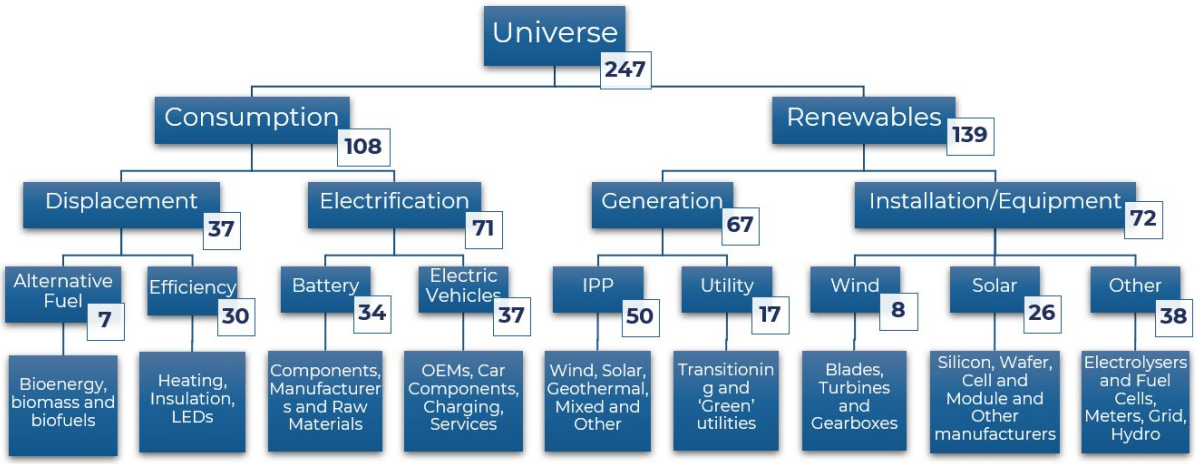


Source: Bloomberg. As of 30th November 2024

PORTFOLIO

The Guinness Sustainable Energy Fund is positioned to benefit from many of the long-term themes associated with the transition towards a lower-carbon economy and of sustainable energy generation via investment in companies with activities that are economic with limited or zero government subsidy and which are profitable. We do not limit ourselves to 'pure plays', opening our universe up to some companies with existing hydrocarbon-based fuel exposure, but this must be allied with a commitment to transitioning their business models towards sustainable energy sources. Our investment universe comprises around 250 companies which are classified into four key areas:

- **Generation** includes companies involved in the generation of sustainable energy, either pure-play companies or those transitioning from hydrocarbon-based fuels
- **Installation** includes companies involved in the manufacturing of equipment for the generation and consumption of sustainable energy
- **Displacement** includes companies involved in the displacement or improved efficient usage of existing hydrocarbon-based energy
- **Electrification** includes companies involved specifically in the switching of hydrocarbon-based fuel demand towards electricity, especially for electric vehicles



We monitor each of the industry areas very closely and hope that detailed top-down (macro) analysis of each (complemented with disciplined equity screening and stock valuation work) will allow us to deliver attractive fund performance via a broadly equally weighted portfolio of 30 stocks. The portfolio is designed to create a balance between maintaining fund concentration and managing stock-specific risk.

Guinness Global Investors is a signatory of the United Nations Principles for Responsible Investment. The Guinness Sustainable Energy Fund prioritises returns whilst delivering concentrated exposure to companies playing a key role in global decarbonisation. The Fund's holdings align most closely with four of the UN's sustainable development goals:

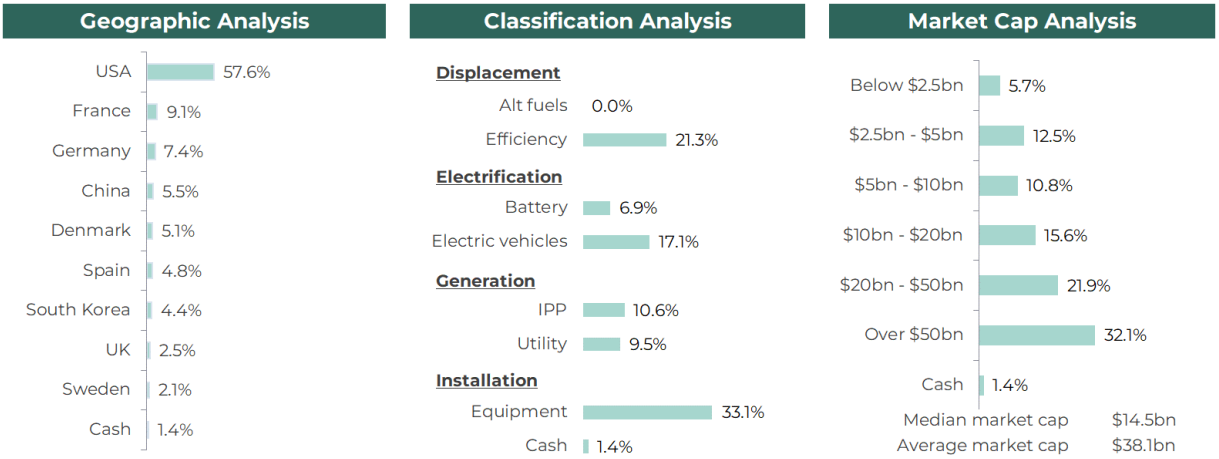
Signatory of:

PRI Principles for Responsible Investment

Buys/Sells

There were no stock switches during the month but the portfolio was actively rebalanced.

Portfolio structure analysis



Data as of month end. Source: Guinness Global Investors. Portfolio holdings are subject to change.

Portfolio sector breakdown

The following table shows the asset allocation of the Fund at month end and at previous year ends.

Asset allocation as %NAV	Current	*Change*	Year end	Previous year ends				
	Nov-24		Dec-23	Dec-22	Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**45.4%**	***1.5%***	**43.9%**	**44.9%**	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	21.3%	*6.0%*	15.3%	15.0%	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.9%*
Efficiency	*21.3%*	*6.0%*	*15.3%*	*15.0%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	24.1%	*-4.5%*	28.5%	29.9%	31.6%	26.8%	28.2%	10.1%
Batteries	*6.9%*	*-3.2%*	*10.2%*	*11.6%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*17.1%*	*-1.2%*	*18.4%*	*18.2%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**53.2%**	***1.3%***	**51.9%**	**49.3%**	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	20.2%	*0.7%*	19.5%	17.7%	23.1%	24.6%	22.2%	27.3%
IPP	*10.6%*	*-0.3%*	*10.9%*	*8.7%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*9.5%*	*1.0%*	*8.6%*	*9.0%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	33.1%	*0.6%*	32.4%	31.6%	28.2%	35.8%	32.0%	42.5%
Equipment	*33.1%*	*0.6%*	*32.4%*	*31.6%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	1.4%	*-2.9%*	4.2%	5.8%	5.3%	3.0%	4.2%	3.8%

Source: Guinness Global Investors

Valuation

At the month end, the Guinness Sustainable Energy portfolio traded on the following multiples:

As at 30 November 2024	PE			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI	
	2024E	2025E	2026E	2024E	2025E	2026E	2025E	2026E	2019-24	2024-27	2024E	2025E
Guinness Sustainable Energy Fund	18.9x	15.6x	13.2x	11.4x	9.6x	8.3x	1.7%	2.0%	6.4%	16.6%	6.4%	9.6%
MSCI World Index	21.5x	19.5x	17.6x	14.2x	12.8x	11.7x	1.8%	2.0%	6.7%	10.5%	9.2%	9.7%
Fund Premium/(Discount)	*-12%*	*-20%*	*-25%*	*-20%*	*-25%*	*-29%*						

*2023 P/E = Latest month-end price / 2023 earnings; Portfolio = median CFROI; Index data = HOLT MSCI World ETF median CFROI, EPS derived from consensus, adjusted for Canadian Solar

Source: Guinness Global Investors, Bloomberg

Portfolio holdings as at end November 2024

Our portfolio is typically allocated across 30 broadly equally weighted equities providing exposure across the value chain of sustainable energy.

We hold a 45% weight to companies associated with the consumption (or demand) of sustainable energy. Our largest exposure here is to companies involved in the electrification of demand, either via the creation of new batteries (c.7%) or the electrification of transportation (c.17% weight), while we have c.21% weight to those companies involved in either displacing existing energy sources or improving overall energy efficiency.

We hold two lithium-ion battery manufacturers. LG Chem is a Korean chemicals company and the largest lithium-ion battery manufacturer in the world, while Samsung SDI is a pure-play lithium-ion battery manufacturer currently in the top 10 in the world.

The portfolio holds six names in the electric vehicle sub-category, giving it exposure to companies that provide semiconductors, electronics, components and software/services to the growing EV and autonomous vehicle industry. Onsemi, Infineon and NXP Semi are providers of power semiconductors and microcontrollers that are a necessity for higher-voltage electric vehicles to become competitive with ICE (internal combustion engine) vehicles, while Gentherm, Aptiv and Sensata are component manufacturers and service providers that should benefit from the ever-increasing amount of electronics present in electric vehicles.

Our displacement holdings provide pure-play quality exposure to heating industries (Nibe Industrier), insulation (Installed Building Products, Owens Corning), energy efficient electrical equipment and services (Hubbell) and energy efficiency projects (Ameresco), and the group as whole will benefit from the increasing industry focus on energy efficiency that is expected to be a very long-term trend.

In terms of the supply of sustainable energy, we hold a c.20% weight to companies involved in the generation of sustainable energy and c.33% weight to those exposed to the installation of or equipment used in the process of sustainable energy generation.

China Suntien and China Longyuan are our two pure-play Chinese wind power producers and they represent two of our seven generation holdings. The remaining exposure comes in the form of geothermal (Ormat), plus offshore wind and broad-based wind/solar renewable energy generation through Orsted and NextEra Energy (the largest producer of renewable energy in the world). Iberdrola is our one utility.

We hold exposure to the solar and wind equipment and manufacturing value chains. Xinyi Solar is the world's largest supplier of the glass used in solar cell modules, and both Enphase and SolarEdge manufacture the inverters required to convert DC solar power into consumable AC electricity. Canadian Solar and First Solar give integrated exposure to the solar cell and module manufacturing process. Vestas provides broad exposure to the strong growth that we expect in the onshore and offshore wind markets, while TPI Composites offers niche exposure to the high-skilled business of manufacturing wind turbine blades.

Our remaining exposure to installation (Itron, Eaton, Legrand, Siemens and Schneider Electric) consists of companies that provide equipment and services to improve the efficiency and metering of electricity transmission and consumption.

Portfolio themes as at end November 2024

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	Iberdrola, legrand	32.3%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, APTIV	9.7%
3	Power semiconductors	onsemi, Infineon	9.9%
4	Battery manufacturing	Samsung SDI	4.4%
5	Expansion of the wind industry	Vestas	9.0%
6	Expansion of the solar industry	First Solar	8.0%
7	Heating, lighting and power efficiency	NIBE Industrier, Trane Technologies	21.3%
8	Geothermal	ORMAT	3.9%
9	Other (inc cash)		1.4%

Portfolio at end October 2024 (one month in arrears for compliance reasons)

Guinness Sustainable Energy Fund (31 October 2024)			P/E			EV/EBITDA			Price/Book		
Stock	**ISIN**	**% of NAV**	**2023**	**2024E**	**2025E**	**2023**	**2024E**	**2025E**	**2023**	**2024E**	**2025E**
Displacement/Efficiency											
Hubbell Inc	US4435106079	4.5%	29.6x	25.9x	24.1x	19.5x	18.5x	17.3x	8.0x	7.0x	6.2x
Nibe Industrier AB	SE0015988019	2.4%	21.2x	69.7x	29.9x	14.5x	26.9x	17.7x	3.2x	3.4x	3.2x
Trane Technologies PLC	IE00BK9ZQ967	4.4%	41.0x	33.5x	29.4x	25.3x	23.1x	21.0x	12.0x	11.2x	9.7x
Installed Building Products Inc	US45780R1014	3.0%	25.2x	19.2x	18.2x	13.3x	12.8x	12.1x	9.2x	7.2x	0.8x
Owens Corning	US6907421019	3.6%	13.5x	11.5x	10.8x	7.0x	6.6x	6.3x	3.0x	2.6x	2.3x
Ameresco Inc	US02361E1082	2.1%	24.8x	27.1x	16.6x	20.2x	15.2x	12.0x	1.8x	1.7x	1.5x
		20.0%									
Electrification/Battery											
LG Chem Ltd	KR7051910008	2.6%	15.0x	42.4x	13.3x	7.6x	8.4x	5.6x	0.6x	0.7x	0.7x
Samsung SDI Co Ltd	KR7006400006	2.7%	10.3x	19.1x	13.2x	8.5x	10.5x	7.2x	1.1x	1.1x	1.0x
Johnson Matthey PLC	GB00BZ4BQC70	2.7%	9.3x	9.6x	8.3x	5.8x	6.0x	5.5x	1.1x	1.1x	1.1x
		8.0%									
Electrification/Electric Vehicles											
Aptiv PLC	JE00B783TY65	2.5%	13.1x	9.2x	7.9x	7.5x	7.0x	6.7x	1.4x	1.5x	1.3x
ON Semiconductor Corp	US6821891057	3.4%	13.8x	17.6x	16.3x	9.4x	12.0x	11.4x	3.9x	3.4x	2.9x
Infineon Technologies AG	DE0006231004	3.0%	11.1x	16.0x	15.5x	7.1x	8.7x	8.6x	2.5x	2.1x	1.9x
NXP Semiconductors NV	NL0009538784	3.3%	17.4x	17.3x	15.4x	11.9x	13.2x	12.2x	7.0x	6.3x	5.4x
Sensata Technologies Holding PLC	GB00BFMBMT84	2.9%	10.1x	9.7x	9.1x	7.5x	9.0x	8.6x	1.7x	1.6x	1.5x
Gentherm Inc	US37253A1034	1.9%	19.7x	15.5x	13.4x	8.4x	7.6x	6.8x	2.1x	n.m.	n.m.
		17.1%									
Generation/IPP											
China Longyuan Power Group Corp Ltd	CNE100000HD4	2.4%	6.8x	7.9x	7.1x	10.1x	10.4x	9.3x	0.8x	0.7x	0.7x
Ormat Technologies Inc	US6866881021	3.7%	38.2x	41.8x	33.7x	17.6x	13.2x	12.0x	2.1x	1.9x	1.8x
NextEra Energy Inc	US65339F1012	4.7%	25.4x	23.2x	21.5x	15.4x	15.9x	14.2x	3.4x	3.0x	2.8x
Orsted A/S	DK0060094928	3.0%	30.1x	21.8x	14.4x	8.5x	9.1x	8.0x	2.9x	2.3x	1.9x
China Suntien Green Energy Corp Ltd	CNE100000TW9	1.6%	5.9x	5.9x	4.9x	10.3x	9.6x	8.1x	0.6x	0.6x	0.5x
		15.5%									
Generation/Utility											
Iberdrola SA	ES0144580Y14	4.9%	18.0x	15.7x	15.5x	12.1x	10.3x	10.2x	1.9x	1.7x	1.7x
		4.9%									
Installation/Equipment											
Schneider Electric SE	FR0000121972	4.8%	33.4x	29.0x	25.3x	19.9x	19.2x	17.1x	5.0x	4.6x	4.2x
Legrand SA	FR0010307819	4.7%	22.6x	21.9x	20.4x	15.0x	15.4x	14.4x	4.0x	3.8x	3.5x
Eaton Corp PLC	IE00B8KQN827	4.7%	39.8x	30.9x	27.8x	27.2x	24.3x	21.8x	7.0x	6.8x	6.3x
Siemens AG	DE0007236101	4.2%	21.3x	17.0x	16.3x	13.6x	13.3x	12.5x	3.0x	2.8x	2.6x
Itron Inc	US4657411066	3.9%	62.9x	21.2x	22.7x	27.7x	18.0x	17.1x	3.9x	3.6x	3.3x
Xinyi Solar Holdings Ltd	KYG9829N1025	2.0%	8.5x	10.3x	8.1x	6.4x	7.0x	5.9x	1.1x	1.0x	1.0x
SolarEdge Technologies Inc	US83417M1045	0.2%	12.8x	n.m.	n.m.	5.6x	n.m.	n.m.	0.4x	0.5x	0.5x
Enphase Energy Inc	US29355A1079	1.4%	25.6x	39.0x	22.3x	19.3x	30.0x	18.1x	11.5x	11.2x	7.7x
First Solar Inc	US3364331070	3.1%	23.0x	14.7x	9.4x	16.8x	11.1x	7.2x	3.1x	2.6x	2.0x
Canadian Solar Inc	CA1366351098	1.8%	3.2x	13.6x	5.2x	6.1x	7.7x	5.4x	0.4x	0.3x	0.3x
Vestas Wind Systems A/S	DK0061539921	2.6%	531.0x	38.3x	15.9x	19.5x	12.0x	7.7x	5.6x	5.1x	4.0x
TPI Composites Inc	US87266J1043	0.2%	n.m.	n.m.	n.m.	n.m.	777.2x	7.4x	n.m.	n.m.	n.m.
		33.6%									
Cash	Cash	**1.0%**									

The Fund's portfolio may change significantly over a short period of time; no recommendation is made for the purchase or sale of any particular stock.

OUTLOOK - sustainable energy & the energy transition

Over the next thirty years, the world will continue its transition to a sustainable energy system. The key factors driving the transition are:

- **Population and GDP growth** putting a significant strain on today's energy supply
- **Economics** as sustainable sources of energy will be cheaper than the incumbents
- **Climate change** leading the world to reduce carbon emissions via cleaner energy
- **Pollution** forcing governments to drive air pollution out of cities via cleaner energy
- **Energy security** as sustainable energy sources, which are more evenly spread across all countries, facilitate lower reliance on energy imports.

The outcomes of the energy transition will of course be wide-ranging. On the **supply** side, we see a sustained shift towards renewable power generation, fulfilling global power generation needs which are set to double by 2050. On the **demand** side, we believe that improved energy efficiency will be key to limiting energy consumption growth to a manageable level so that it can be increasingly satisfied by renewable sources.

The long-term direction is clear and is driven by economics, in our opinion, while near-term geopolitical issues (such as the invasion of Ukraine in February 2022) could potentially have an effect on the speed of the transition and the relative importance of the factors stated above.

Policy support for decarbonisation

Policy commitment in recent years has been particularly supportive. However, the path has not always been smooth and it is unlikely to be a smooth ride from here. The most significant policy milestones in 2023 include:

- Further details were provided in **Europe** about how the EU will localise clean technology manufacturing and supply chains, in order to reduce its reliance on China, as part of its goal to achieve carbon neutrality by 2050. The EU plans include a 55% cut to emissions, 13% lower final energy consumption and 45% renewables in the energy mix by 2030.

- In the **United States** there was a meaningful surge in activity thanks to the Inflation Reduction Act (IRA), with $369bn of tax breaks morphing into $1.6 trillion of capital being mobilised towards achieving net zero aims. According to the World Economic Forum, this will create over 170,000 jobs and more than 9 million jobs over the next decade. Importantly, with 2024 being an election year, 80-90% of these new jobs are within Republican states.

- From a **global** perspective, around 130 countries have now signed up to the COP 28 Global Renewables and Energy Efficiency Pledge, committing to deep emissions reductions by 2030, requiring a tripling of global installed renewable energy capacity and a doubling of the rate of annual energy efficiency improvements.

Energy displacement

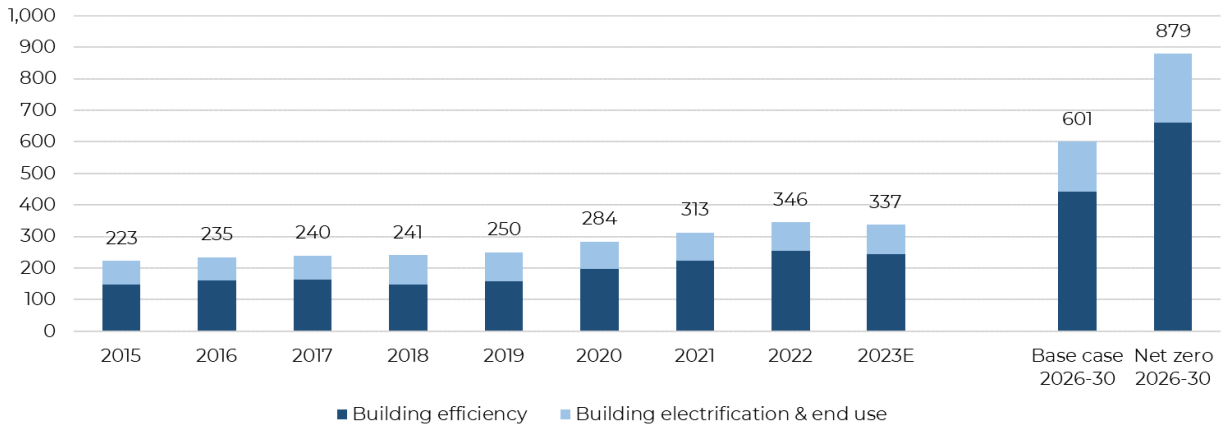
It is a common misconception that achieving rapid growth in renewable power generation will be enough to deliver government targets for pollution, energy security and decarbonisation. Renewable power generation is a key part of the solution, but we see the displacement and more efficient use of existing energy sources as just as critical, and arguably more urgent, in achieving these goals. The IEA refers to the theme of energy efficiency as being the 'first fuel' that should be considered in delivering the energy transition. It is the one energy source that every country can access in abundance today.

In our base case, we assume global energy demand growth over the next 30 years of around 1% pa. This assumes significant efficiency improvements relative to an historical energy demand growth rate of around 2% pa. Within the energy displacement sector, the key areas of focus are **efficiency** and **alternative fuels**.

Energy efficiency

Buildings account for around 30% of global emissions, with space heating, water heating, and space cooling accounting for 60% of their energy use. Decarbonising buildings will require investment in heat pumps to electrify space and water heating, insulation to improve thermal efficiency, and efficient cooling to help inhabitants cope with rising outdoor temperatures. We see spending on building efficiency and electrification increasing from $340bn in 2022 to $600bn pa from 2026-30 (a forecast rate of around 10% pa versus a historic rate of around 5% pa) driven by energy security, economics and tightening building standards.

Global building efficiency-related investment by scenario ($bn)



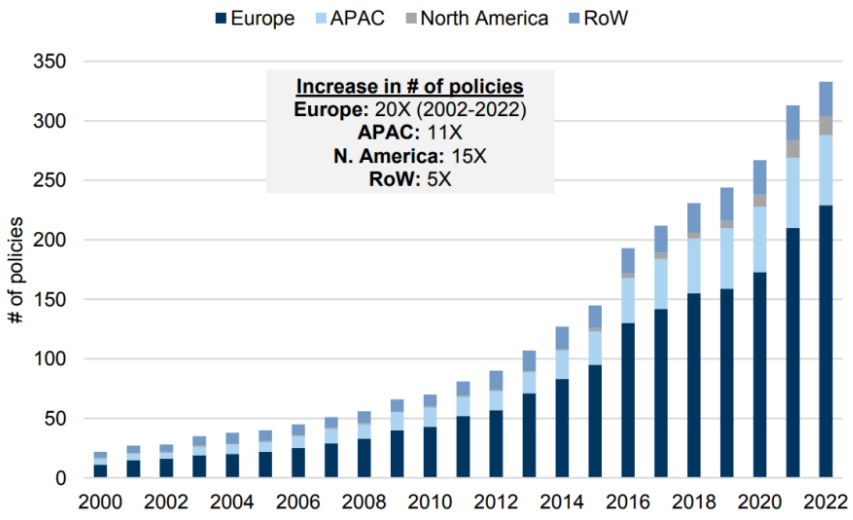
Source: IEA, Guinness Global Investors; December 2023

Heat pumps are a vital tool for electrifying and decarbonising heat and reducing reliance on natural gas imports, especially in the EU, where over one-third of natural gas is used for heating in buildings. European heat pump sales have grown strongly in recent years, increasing by 35% and 39% in 2021 and 2022 respectively, bringing annual sales to over 3 million units. This expansion was primarily driven by high gas prices and increased policy support as a result of Russia's invasion of Ukraine, since heat pumps remain a vital tool to secure Europe's energy independence from Russia. The EU's target to install 60 million additional heat pumps between 2023-30 is expected to reduce the bloc's household gas demand by 40% and would require installations to grow at around 20% pa.

Insulation can improve the thermal efficiency of a building's exterior walls and roof. As a result, insulation can help reduce energy consumption from heating and cooling by up to 40%, offering payback periods as short as 1-3 years.

Over the past 20 years, most regions have seen a 10x increase in government policies targeting building energy efficiency (including insulation). Government incentives, stricter energy efficiency requirements and higher energy costs have helped the global insulation market to grow at 6.5% pa from 2012-22 and we see economics and ratcheting regulation continuing to drive strong growth out to 2030.

Global policies targeting building insulation, envelope technologies and eco-design



Source: IEA, Goldman Sachs, December 2023

Space cooling is the largest driver of building electricity demand, with energy consumption more than tripling since 1990. Ensuring access to energy efficient cooling is of primary importance to minimise the number of heat-related deaths, especially among the elderly. The number of air conditioning units in operation globally has increased by 2.5x in the past 20 years and is set to grow by a further 50% by 2030. Thanks to a consolidated industry and a fragmented customer base, air conditioning manufacturers enjoy strong pricing power and we expect this to continue out to 2030.

Alternative fuels

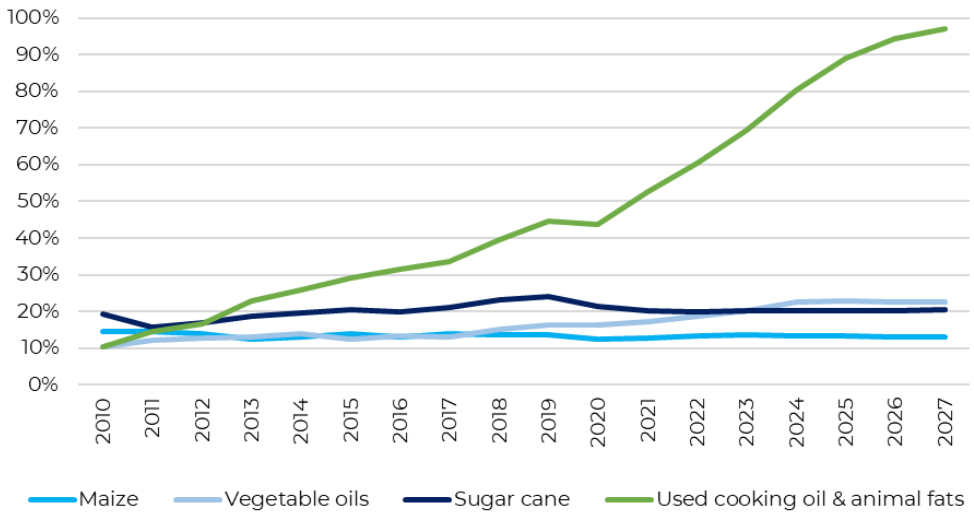
Global biofuel consumption is expected to be just under 180bn litres in 2023, displacing around 2 million barrels of oil per day, equating to 4% of oil demand from transportation. The market continues to be dominated by the USA, Brazil, Europe and Indonesia, which make up 85% of global consumption.

Biofuel demand is expected to have grown by 6% in 2023 versus 2022, with growth continuing to be underpinned by policy and regulation. Demand benefited from prices falling from 2022 highs thanks to lower vegetable oil prices and increasing supply, while new Clean Fuel Regulations from Canada helped to provide visibility to future growth.

From 2023-2027, biofuel demand is expected to expand at 3-4% pa. Nearly two-thirds of growth will be driven by emerging economies, skewing heavily towards first-generation biofuels such as bioethanol and biodiesel. These fuels are derived from edible crops such as sugarcane and corn, and despite their sizeable role in reducing transportation related emissions, they have attracted criticism for diverting farmland away from food production.

The remaining third of demand growth will come from developed markets seeking higher volumes of second-generation biofuels such as renewable diesel and Sustainable Aviation Fuel (SAF). These fuels are derived from waste products such as animal fats and used cooking oil. They garner higher subsidy support in the United States and also meet strict EU requirements. Demand for these feedstocks is set to increase by 35% over the next four years, taking biofuels to 95% of total demand in 2027 (up from 70% in 2023).

Biofuel demand as a percentage of total feedstock supply



Source: IEA, Guinness Global Investors estimates; December 2023

Despite generous incentives and strict standards creating an industry where production costs are still 2-3x that of fossil fuel equivalents, further government intervention may be required to avoid a supply crunch in the near future.

Implications of a net zero scenario on our displacement outlook

Our base case for the energy transition assumes global energy demand growth of 1% pa, which compares to historic long-run average demand growth of 2% pa. Reducing energy demand growth to 1% pa requires significant investment in energy efficiency across buildings, heating, transportation and industry.

To be clear, however, reducing energy demand growth to 1% pa does not align with net zero. A net zero scenario would require world energy demand to be broadly flat over the next two decades and we do not yet see the investment, industry scale or technologies in place to achieve this. Examples of changes to energy efficiency or alternative fuel production that would be needed to align with net zero include the following:

- Within **efficiency**, annual improvements in energy intensity would need to double from 2% in 2022 to average 4% pa out to 2030 globally. This translates into building efficiency, electrification and end-use investment increasing to over $800bn pa this decade (from $350bn today). Installation of heat pumps would need to increase globally by 20% pa out to 2030 while air conditioner efficiency must improve by more than 50% by the end of this decade.

- **Alternative fuel** production growth would need to more than double, averaging over 11% pa out to 2030 to help reduce emissions from new and existing trucks, planes, ships and passenger vehicles. SAF would face the biggest challenge of growing from less than 0.1% of aviation fuel demand today to around 10% in 2030.

Electrification

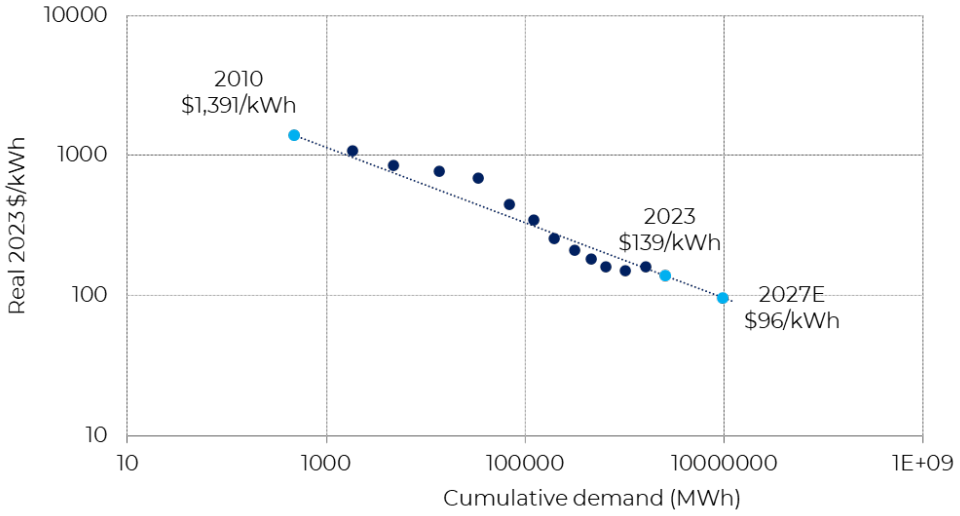
The steps required to transition to a low-carbon economy can broadly be summarised into three actions: i) reduce demand, ii) clean up electricity supply and iii) electrify the remaining demand. Our electrification sector includes enablers across lithium-ion battery and electric vehicle supply chains which do all three of these. **Batteries** serve a key role in cleaning up electricity, capturing excess clean energy during the day and releasing it when supply is low. They contribute towards electrification, acting as the power source for **electric vehicle** (EV) drivetrains. On top of this, EVs contribute towards greater

energy efficiency, converting over 85% of energy stored into motion, compared to less than 40% for internal combustion engines. We consider each of these areas in turn below.

Batteries

In last year's outlook, we reported that 2022 was the first year on record that **lithium-ion battery** pack costs had increased, driven by soaring metal prices. In 2023, this trend reversed, with lithium and nickel prices cooling by 80% and 40% respectively due to slower electric vehicle demand growth. Shrinking commodity costs helped to drive a 14% decline in average battery pack prices to $139/kWh. According to Bloomberg New Energy Finance (BNEF), this meant that real battery prices have fallen by 90% since 2010 and are forecast to fall below the EV/ICE parity benchmark of $100/kWh in 2027.

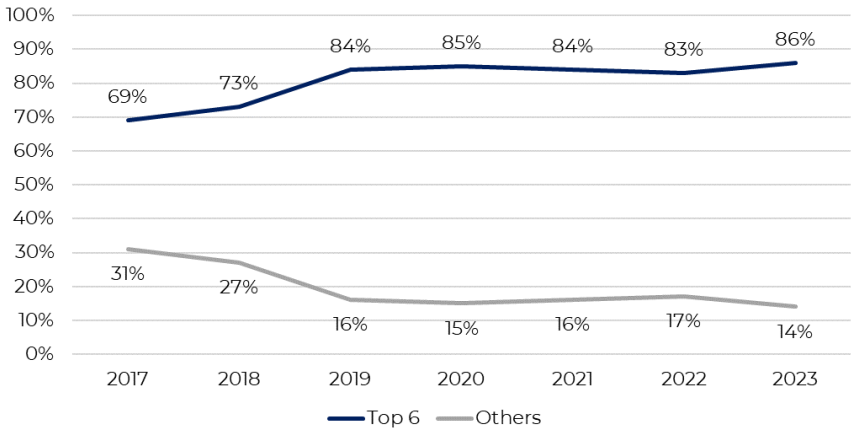
Cumulative demand for LiB packs (MWh) vs battery pack price ($/kWh)



Source: BNEF, Guinness Global Investors, December 2023

In the year, the industry faced **oversupply concerns**, with CRU Group suggesting that planned Chinese capacity would be 2.5-3x higher than global demand from 2025-2030. While we do see overcapacity in the sector, we believe this is likely overstated. The top six battery manufacturers (CATL, BYD, LGES, Samsung SDI, SK On, and Panasonic) are responsible for 85% of electric vehicle battery volumes. These companies are behind just 50% of planned capacity additions out to 2025, with capital expenditure plans typically underpinned by supply arrangements with EV manufacturers. The remaining 50% of additions are expected to be brought online by more indebted and less profitable tier-2 suppliers. A lot of this tier-2 capacity ultimately may not come online, as declining share and poor cashflows lead to funding constraints and sector consolidation.

Top 6 battery manufacturer volume-based market share



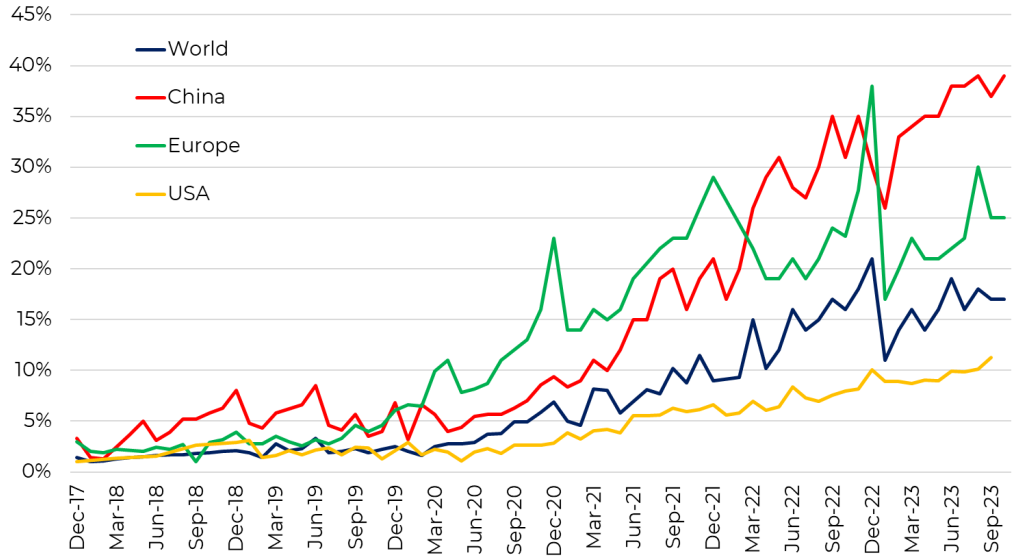
Source: EV-Volumes, HSBC, Guinness Global Investors, December 2023

The last 12 months have also seen legislators wrestle for control over **battery supply chains** to reduce their dependence on Chinese imports. The EU announced its Critical Raw Materials Act and the US released guidance that EVs with Chinese battery components would not be eligible for full IRA tax benefits. With China processing around 75% of the world's lithium and supplying over 50% of battery components globally, we believe it will be extremely challenging to extricate Chinese companies from Western supply chains.

Electric vehicles

Electric vehicles saw continued adoption in 2023, albeit at a slower pace than seen in recent years. After growing at over 100% and over 50% in 2021 and 2022, sales of plug-in vehicles are expected to have grown by around 35% in 2023 to around 14 million units, representing an 18% penetration rate. China will retain its crown as the largest market for EVs, representing 60% of global plug-in vehicle sales, with monthly penetration rates approaching 40%. Europe will come in second, at 25% of global sales and penetration rates of around 25%, with the USA in third at around 10% of global sales, breaching 1 million units and seeing EVs making up over 10% of monthly sales for the very first time.

Monthly plug-in vehicle penetration rates by region



Source: Cleantechnica, AtlasEVhub, Guinness Global Investors, December 2023

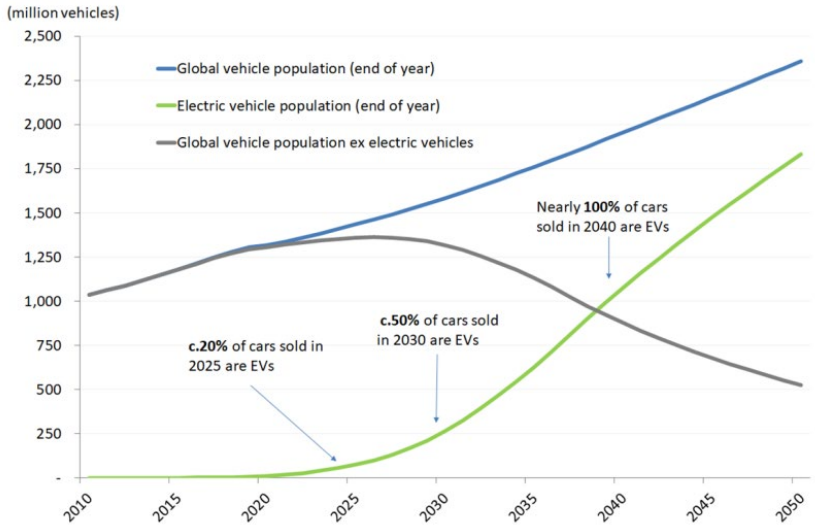
These regional differences largely reflect the main driver of adoption: affordability.

- **China** saw the withdrawal of government EV subsidies at the end of 2022, resulting in a slowing of sales at the start of 2023, sparking a year-long price war among manufacturers. This, combined with a bias for cheaper lithium iron phosphate (LFP) chemistries and smaller average battery sizes, resulted in sales prices for electric vehicles across multiple segments reaching price parity with internal combustion engine vehicles.

- **Europe** has a more nuanced picture, where moderate subsidies and higher gasoline prices led to certain models being cheaper to own than petrol or diesel counterparts. However, the threat of cheap Chinese imports in 2023 has impelled local manufacturers to cut costs to avoid losing out to imports.

- The market for electric vehicles in the **United States** is generally less competitive. Import tariffs and subsidies for local producers have led to higher prices, allowing cost-advantaged Tesla to take a 50% market share. A preference for larger vehicles (SUVs, trucks) with larger batteries (100kWh+) alongside lower average pump prices mean that the relative economics of owning an EV are not as attractive as in other regions. Despite record EV sales and penetration rates in 2023, further battery price declines are needed to see continued adoption.

Global auto, ICE and EV population to 2050



Source: US DOE, Guinness Global Investors estimates; December 2023

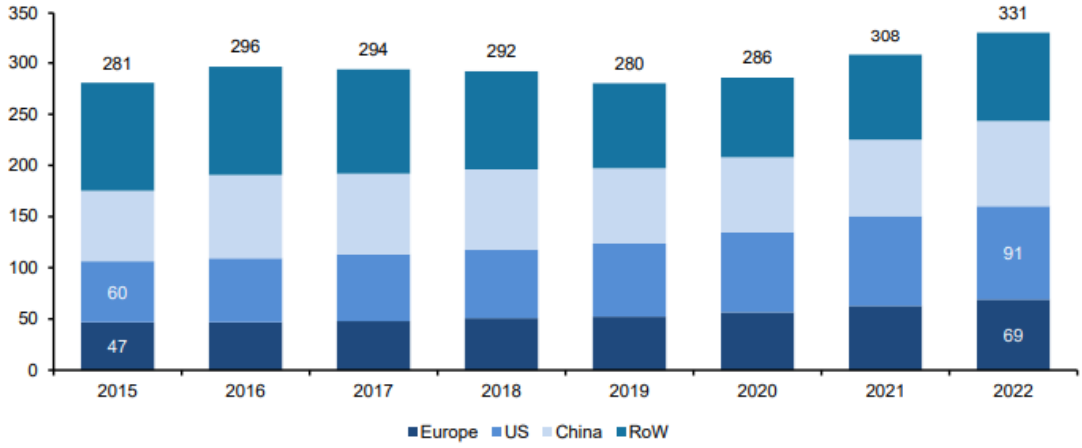
The decline in battery prices (and commensurate improvement in EV affordability) observed over recent years has coincided with climbing expectations of EV sales (Bloomberg New Energy Finance has upgraded its electric vehicle sales estimates by 100% and 50% for 2025 and 2030 in the past five years alone). We estimate that EV sales should exceed 16 million in 2024, representing around 20% of total passenger vehicle sales and coming in one year earlier than our long-held target of 20% EV penetration by 2025. Beyond that, we maintain our long-held view that electric vehicles continue to take share, reaching 50% of global light vehicle sales by 2030 and nearly all new vehicle sales by 2040. At that point, it implies an overall population of one billion EVs, over 35 times greater than the global stock in 2022 of 27 million.

Power grids

The global power grid consists of over 2.6 million miles of transmission lines, over 43 million miles of distribution lines and over 700,000 substations. A significant proportion of this infrastructure in the US and Europe is ageing, analogue (rather than digital) and increasingly capacity constrained.

According to the IEA, global grid investment averaged c.$300bn from 2018-22 and has been growing slowly (2% pa) over the past eight years. Growth has predominantly been driven by Europe and the US (c.6% pa) due to decarbonisation and replacement spending. Distribution (low and medium-voltage) accounted for roughly two-thirds of the spend with transmission (high-voltage) making up the rest.

Annual transmission and distribution investments ($bn)



Source: Bernstein, IEA, December 2023

Our base case assumes that annual grid investment grows by around 4% pa, twice the historic rate, rising from $300bn in 2022 to over $800bn pa in the 2040s. Around two-thirds of this will be spent on distribution and one-third on transmission, with a rising share of this being digital. Around c.40% will be spent on replacing ageing assets, c.40% reinforcing the network to improve reliability and efficiency and c.20% extending the existing grid to new generation facilities.

Greater residential adoption of heat pumps and electric vehicles leads us to expect that **distribution** will attract a higher proportion of the investment than transmission. Heat pumps and EVs increase residential electricity demand by c.90% and c.50% respectively. Moreover, the addition of EVs requires modernisation and digitisation of the distribution grid to facilitate bidirectional charging and allow EV batteries to help balance the grid. Bernstein estimate that to ensure grid reliability, US utilities will need to spend nearly $1,600 on transmission and distribution infrastructure for each electric vehicle on the road.

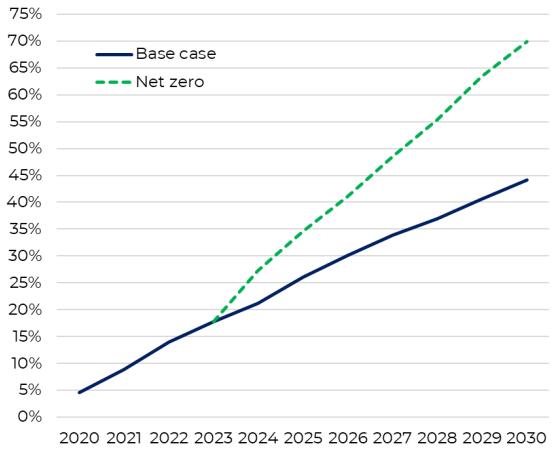
- The continued adoption of renewables, characterised by smaller and more distributed power plants, will drive demand for more **transmission** lines. We see transmission investment enjoying a further tailwind from the building of more interconnectors to facilitate the international trade of electricity. We think these will be vital for ensuring energy security by allowing regional renewable energy surpluses and deficits to be equalised.

- We see investments in **digitalisation** of the grid increasing from c.19% in 2020 to 42% in 2050. Integrating the physical grid into computer-based systems through the use of smart meters and sensors, communication networks and data analytics can help identify outages faster, automate grid performance, and improve uptime and efficiency. For network operators, data insights allow them to reduce maintenance costs through predictive maintenance. For consumers, smart meters can help reduce energy bills by enabling smart charging of electric vehicles at off-peak tariffs.

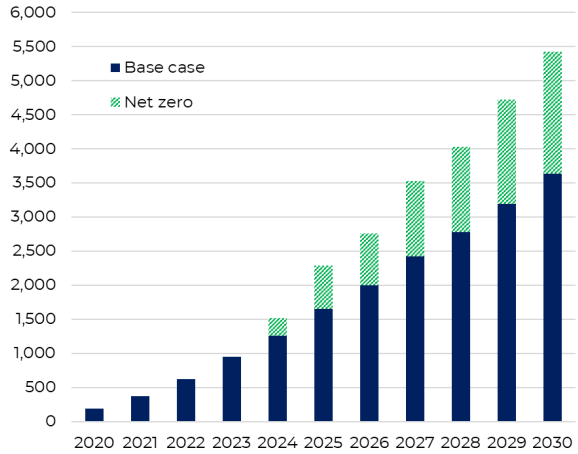
Implications of a net zero scenario on our electrification and grid outlook

For **electric vehicles**, BNEF estimate that in a net zero scenario, global EV penetration rates must hit 35% by 2025 and 70% by 2030 (versus their current base case estimates of 26% and 44% respectively). This translates into global battery demand of 2.3 TWh in 2025 and 5.5 TWh in 2030 compared to 0.95 TWh today. This is 40-50% higher than their 'base case' economic transition assumptions for each year, which themselves still imply annual growth rates of 20-30% pa from current levels.

EV sales penetration



Lithium-ion battery demand (GWh)



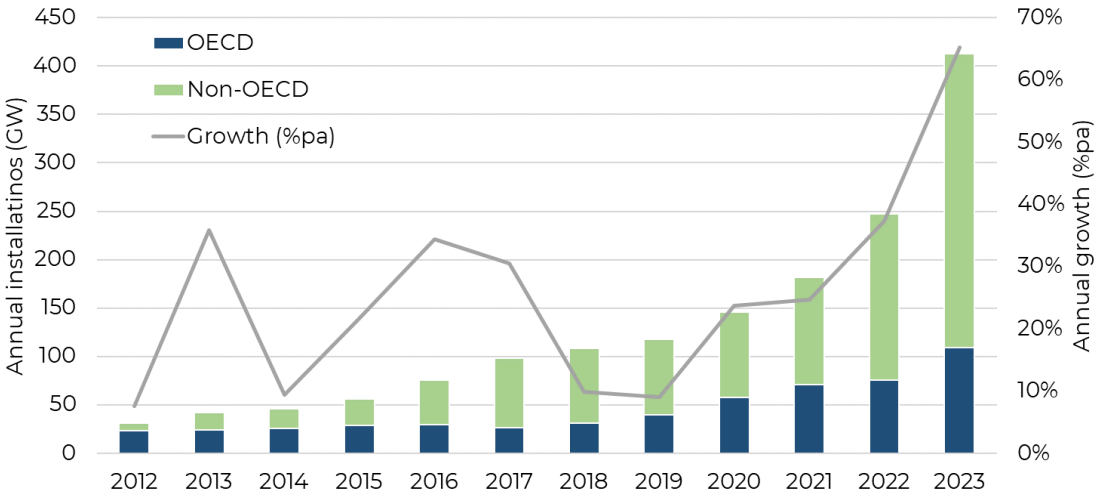
Source: BNEF, Guinness Global Investors, December 2023

For **grids**, the IEA net zero scenario requires investment to nearly double from the current $300bn to around $580bn pa for the remainder of this decade and to more than double again to around $1.4tn per annum in the 2040s (nearly double the investment levels implied by their base case).

The solar sector

The solar industry has grown rapidly in 2023, with installations likely to have exceeded 415GW for the full year (up tenfold over the last decade and 65% higher than 2022). This is materially ahead of our prior 2023 expectation of 310GW and will represent the fastest annual growth rate since 2010 (following several years of robust (20%+) growth). The non-OECD continues to dominate the global market.

Annual solar installations split by OECD and non-OECD



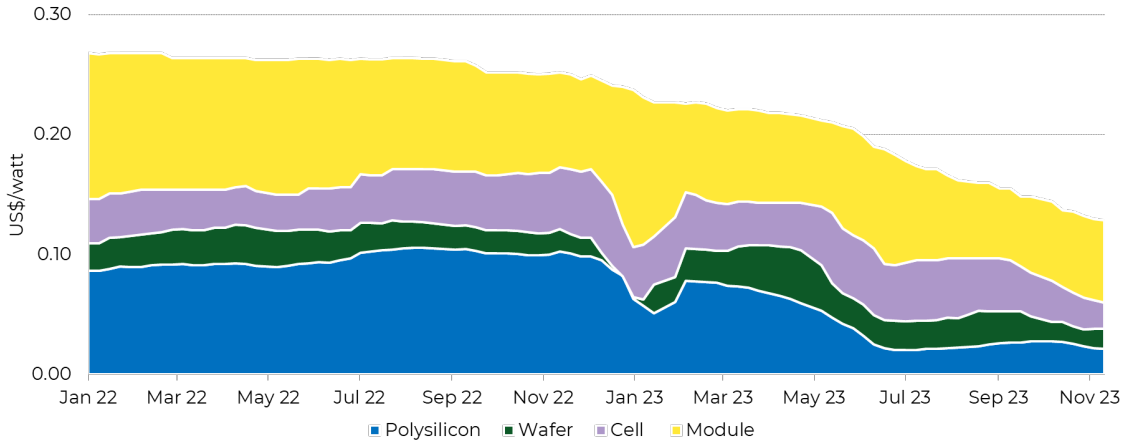
Source: BP, BNEF, PV InfoLink, IEA and Guinness Global Investors estimates, December 2023

On a regional basis, the key driver of the industry continues to be China – accounting for nearly 60% of all installations and 80% of the year-on-year growth. This has been largely driven by utility-scale "megabase" projects, where the government allocates huge areas of land for multi-gigawatt projects, thereby avoiding many of the permitting pitfalls seen in the US and Europe.

Outside China, there has a more mixed picture. Commercial and Utility solar (which account for c.80% of the market) continue to grow apace, with installations hitting record highs. Offsetting this, however, is the residential market, which has seen pockets of weakness in both the US and Europe as a function of higher interest rates, changing regulation and the waning impact of the war in Ukraine. Taken in aggregate, however, both geographies are expected to grow well in excess of 30% in 2023 and account for 8% and 13% of global installations respectively.

Underpinning much of this growth has been the ever-improving economics of solar relative to fossil fuel-based options and current wholesale electricity prices. Over the year, the cost of solar modules declined by more than 50%, driven by a normalisation of global supply chains and material growth in polysilicon supply. According to BNEF, the global capacity for solar-grade polysilicon increased to 2.4m tons during the year, more than double what is required for current PV installation levels. The consequent deflationary impact on the polysilicon price has reverberated throughout the solar supply chain meaning that solar module prices now sit at a **record low level** of $0.13/watt.

Solar module price (US$/watt)



Source: BNEF, Guinness Global Investors estimates, December 2023

Looking to 2024, we expect these improved economics to continue to spur growth in all major geographies with full-year global installations likely topping 500GW. In China, we see a continued tailwind from a second and third round of "megabase" auctions as the government seek to achieve 1,200GW of installed capacity by 2030. In Europe and the US, the lagged benefits (and increased clarity) of policy support coupled with robust utility capital expenditure should serve to drive utility installations to new highs. This will be somewhat tempered by continuing sluggishness in the residential market, but this should begin to clear in the second half. All in, we expect European and US solar demand to rise to 70GW and 39GW respectively.

Global solar module installations, 2010-2024E (GW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024E
OECD solar installations (annual)															
North America	1	2	4	6	7	8	14	11	10	11	19	25	24	34	39
Germany	7	7	8	3	2	1	2	2	4	4	5	6	7	13	15
Spain	0	0	0	0	0	0	0	0	0	5	3	5	7	8	9
Rest of Europe	3	4	5	5	5	6	4	3	4	6	12	19	21	36	42
Australia	0	1	1	1	1	1	1	2	4	4	4	5	4	5	5
South Korea	0	0	0	1	1	1	1	1	2	3	6	4	3	3	3
Japan	1	1	2	7	10	11	8	8	7	7	9	6	6	6	5
Total OECD	**17**	**23**	**24**	**24**	**25**	**29**	**29**	**26**	**31**	**40**	**58**	**71**	**76**	**109**	**122**
Change	*10*	*7*	*0*	*0*	*2*	*4*	*0*	*-3*	*5*	*9*	*18*	*13*	*18*	*33*	*13*
Non-OECD solar installations (annual)															
China	0	3	3	14	13	19	30	53	44	33	52	69	107	240	256
India	0	0	1	1	1	2	5	10	11	12	4	12	18	15	18
Rest of non-OECD	1	3	3	4	6	6	11	9	22	34	32	30	47	49	105
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**77**	**78**	**88**	**111**	**172**	**304**	**379**
Change	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*5*	*1*	*10*	*23*	*58*	*132*	*75*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**98**	**108**	**118**	**146**	**182**	**250**	**413**	**501**
Change	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*23*	*10*	*10*	*28*	*36*	*76*	*163*	*88*

Source: BP, BNEF, PV InfoLink, IEA and Guinness Global Investors estimates, December 2023

The wind sector

Despite a return to growth in 2023, the wind industry continues to experience a bumpy recovery. On the one hand, it is having to navigate the near-term impact of supply chain disruptions and increased financing costs, while on the other hand it has a very favourable long-term outlook driven by relative economics and supportive policy. Despite the cross-currents, the industry globally is likely to have installed **a new record of around 103 GW of new capacity**, up 15 GW on 2022 levels.

In 2022 the key issue for the sector was high raw material prices which adversely impacted the economics of the supply chain and pushed margins for all the major turbine producers into negligible or negative territory. In 2023 the issue passed to the developers as turbine manufacturers looked to pass on cost increases, while at the same time financing costs increased in line with global interest rates. This issue was particularly acute within the offshore wind sector, where the lag between securing projects and locking in costs is far longer, prompting high-profile project cancellations from the likes of Orsted, Shell and Vattenfall.

Despite these headwinds we continue to expect a positive outlook for the global wind sector – both on and offshore – with the industry likely to deliver record installations again in 2024. In the medium term, we take confidence from the book-to-bill ratio for turbine manufacturers – a key leading indicator for growth in the sector – continuing to inflect positively.

Beyond 2025 we see many of the current bottlenecks dissipating and supportive policy from all key regions in the world prompting a near 70% increase in installations by the end of the decade, reaching around 170GW. We detail some of these drivers, both positive and negative, individually for the onshore and offshore industries below.

Global onshore and offshore wind installations (GW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024E
Onshore wind installations (annual)															
North America	6	8	15	2	7	10	9	8	8	10	17	14	10	8	10
Latin America	0	0	0	0	5	3	3	3	4	3	3	6	4	6	5
Europe	9	10	12	11	11	11	12	13	8	9	14	14	15	16	13
China	17	18	14	15	21	29	22	17	19	26	54	42	44	54	57
India	1	1	2	2	2	3	4	4	2	2	1	2	2	3	4
RoW	3	4	4	3	4	5	5	5	4	4	4	8	5	4	6
Total onshore	**35**	**40**	**46**	**33**	**49**	**61**	**55**	**49**	**46**	**55**	**93**	**84**	**79**	**91**	**95**
Change	*-3*	*5*	*6*	*-14*	*17*	*11*	*-6*	*-6*	*-3*	*9*	*38*	*-9*	*-5*	*12*	*3*
World ex China	*18*	*22*	*32*	*18*	*29*	*32*	*33*	*32*	*27*	*29*	*40*	*43*	*36*	*38*	*38*
Offshore wind installations (annual)															
China	0	0	0	0	0	1	1	1	2	3	4	14	5	8	12
UK	1	0	1	1	0	1	0	1	2	2	1	1	3	1	2
Germany	0	0	0	0	0	2	0	2	0	2	0	1	0	1	1
RoW	0	0	0	1	0	0	0	1	0	1	2	1	1	2	6
Total offshore	**1**	**0**	**2**	**2**	**1**	**4**	**1**	**4**	**4**	**8**	**7**	**17**	**9**	**12**	**21**
Change	*1*	*-1*	*1*	*1*	*-1*	*4*	*-4*	*3*	*0*	*3*	*-1*	*10*	*-8*	*3*	*9*
World ex China	1	0	1	2	1	3	0	4	3	5	3	3	4	4	9
Total wind installations	**36**	**40**	**48**	**35**	**50**	**65**	**56**	**53**	**50**	**63**	**100**	**101**	**88**	**103**	**115**
Change	*-2*	*4*	*8*	*-13*	*16*	*15*	*-9*	*-3*	*-2*	*12*	*38*	*1*	*-13*	*15*	*12*

Source: BP, IEA, BNEF, Guinness Global Investors estimates, December 2023

Onshore wind

The onshore wind sector is likely to have delivered 91GW of new installations in 2023, with China accounting for 60% of the total and nearly 90% of the year-on-year growth. As with solar, the key driver here is the latest set of centrally-planned megaprojects – generally located in windy parts of northern China. The first set of such projects (40GW) was announced in 2021, with commissioning set for end 2023. This is to be followed by both a second and third wave of projects spanning 2024 and 2025. The combination of this, coupled with new state directives on repowering (the process of swapping older turbines with new, more efficient ones) should see installations average more than 55GW out to the end of the decade.

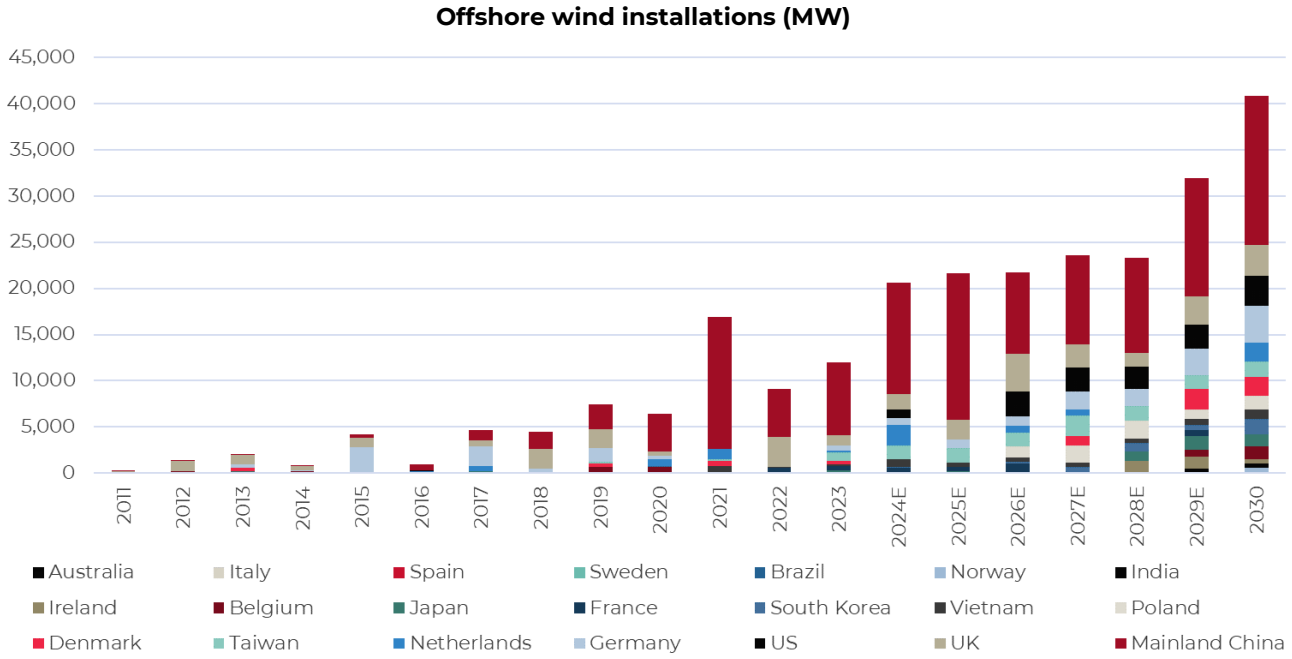
In Europe, the 16GW of installations we expect this year represents a record. However, installations may flatline in the near term as the impact of permitting and grid constraints coupled with poorly designed auction processes temporarily stalls progress. For example, the latest 1,500MW onshore auction in Spain saw just 45MW of capacity awarded as developers shied away from a price cap which failed to reflect the current cost environment. Ultimately, such auctions are highly likely to be redesigned and will be offset by other factors (such as more countries implementing the EU's new permitting recommendations which, in the case of Germany, have seen close to a 40% jump in permitting year-over-year).

In the US, the combination of cost pressures and the lack of clarity on the IRA tax credits has caused a temporary lull in activity meaning installations are likely to be down in 2023. That said, the US Treasury has now provided finalised guidance for the wind industry, and we are beginning to see rising project pipelines as a consequence. This will lead to increased activity in 2024, but will really begin to impact from 2025 onwards, when, coupled with large new transmission lines being commissioned in the Midcontinent and the Southwest, we expect to see installation activity grow at over 10% a year.

Offshore wind

The offshore industry remains a small and presently troubled segment of the market but it is critical to the overall growth of the wind market out to 2030. Installations in 2023 are likely to have reached 12GW, led heavily by China, but this figure is set to grow to 40GW by 2030 – a 20% pa growth rate. This means that despite accounting for just 12% of the overall market in 2023, offshore wind will account for over 40% of the expected growth in total global wind installations to 2030.

Despite negative recent headlines, the fundamental attractions of the offshore wind industry remain the same: in addition to generally experiencing higher wind speeds, offshore wind installations tend to be easier to permit, allowing for bigger turbines close to large urban centres. Recent project cancellations, particularly in the US, have raised concerns about the viability of offshore wind in general, but we view these issues to be largely transitory and US-specific. Unlike the key offshore wind centres, the US has not yet built out its supply chain, making it more vulnerable to disruption. Furthermore, unlike the rest of the world, most legacy US contracts did not include mechanisms to account for inflation. While this has wreaked havoc on a certain era of offshore projects, we don't expect it to repeat in the future and thus don't think it appropriate to extrapolate to the whole industry or indeed future US projects. Instead, we see robust state level commitment to offshore wind targets, project economics underpinned by structurally higher global electricity prices (ex-US) and the proliferation of offshore wind technology beyond the handful of existing core geographies.



Source: BNEF, Guinness Global Investors estimates, December 2023

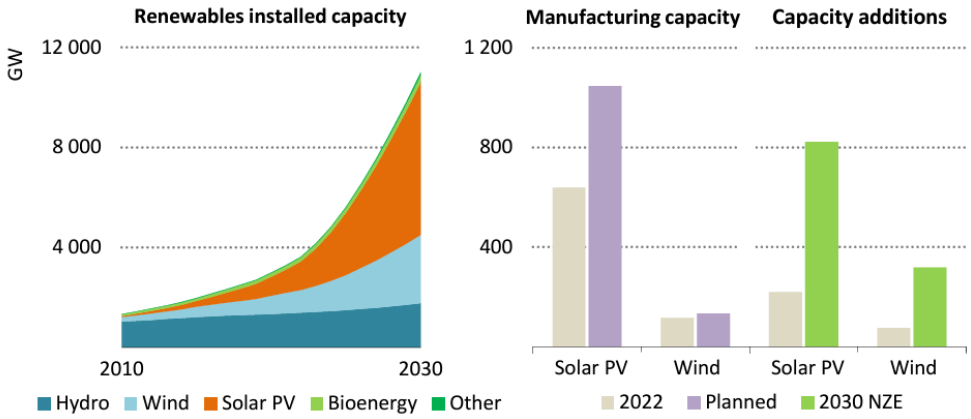
Implications of a net zero scenario on our solar and wind outlook

The IEA net zero scenario envisages that renewables have a 60% share of global electricity generation in 2030, up from 30% in 2022. Solar and wind generation dominate, with their combined shares increasing from 12% in 2022 to 40% in 2030 thereby accounting for over 90% of the overall increase in renewables capacity to 2030 and 85% of the increase in renewable electricity generation.

In terms of new installations, global **solar** capacity additions increase from 220GW in 2022 to 820GW in 2030 while **wind** installations rise from 75GW in 2022 to 320GW in 2030. Offshore wind accounts for around one-third of the total installations in 2030.

The solar industry is clearly targeting very high levels of growth and is arguably positioned to deliver sufficient manufacturing capacity to satisfy the net zero scenario. However, the wind industry appears to be lagging substantially and therefore much more in need of policy support to achieve the required manufacturing capacity.

Global renewables installed capacity and solar/ wind manufacturing capacity in a net zero scenario, 2022 and 2030



Source: IEA, December 2023

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GUINNESS SUSTAINABLE ENERGY FUND

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The documentation needed to make an investment, including the Prospectus, the Key Investor Information Document (KIID), Key Information Document (KID) and the Application Form, is available in English from www.guinnessgi.com or free of charge from the Manager: Waystone Management Company (IE) Limited 2nd Floor 35 Shelbourne Road, Ballsbridge, Dublin DO4 A4E0, Ireland; or the Promoter and Investment Manager: Guinness Asset Management Ltd, 18 Smith Square, London SW1P 3HZ.

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